FINAL PHASE I RCRA FACILITY INVESTIGATION WORK PLAN SWMU 60 – FORMER LANDFILL AT THE MARINA

For NAVAL ACTIVITY PUERTO RICO
EPA I.D. No. PR2170027203
CEIBA, PUERTO RICO

Prepared for:

Department of the Navy
NAVFAC SOUTHEAST
North Charleston, South Carolina

Prepared by:

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Michael Baker Jr., Inc.
Moon Township, PA

Contract No. N62470-07-D-0502
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IQC for A/E Services for Multi-Media Environmental Compliance Engineering Support

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Under:

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DELIVERY ORDER 0002

Prepared by:

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

I certify under penalty of law that I have examined and am familiar with the information submitted in this document and all attachments and that this document and its attachments were prepared either by me personally or under my direction or supervision in a manner designed to ensure that qualified and knowledgeable personnel properly gather and present the information contained therein. I further certify, based on my personal knowledge or on my inquiry of those individuals immediately responsible for obtaining the information, that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowingly and willfully submitting a materially false statement.

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Date: December 20, 2007________

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LIST OF ACRONYMS AND ABBREVIATIONS

APA	Aerial Photo Analysis
AST	Aboveground Storage Tank
Baker	Michael Baker Jr., Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene and Total Xylenes)
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERFA	Community Environmental Response Facilities Act
COPCs	Chemicals of Potential Concern
CRQL	Contract Required Quantitation Limit
DI	Deionized
DO	Delivery Order
DDE	Dichlorodiphenyldichloroethylene
DRO	Diesel Range Organics
Eco-SSL	Ecological Soil Screening Level
ECP	Environmental Condition of Property
ERA	Ecological Risk Assessment
FID	flame ionization detector
FMTUD	Facility Management Transportation and Utility Division
GIS	Geographic Information System
GPS	Global Positioning System
GRO	Gasoline Range Organcis
HSA	Hollow Stem Auger
ID	Internal diameter
IDW	Investigation Derived Waste
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
MCL	Maximum Contaminant Level
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
Mg/kg	milligrams per kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPR	Naval Activity Puerto Rico
NAVFAC	Navy Facilities Engineering Command
NFESC	Naval Facilities Engineering Service Center
NSSR	Naval Station Roosevelt Roads
NTU	Nephelometric Turbidity Units

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

OP	Organophosphorus (pesticides)
OVA	Organic Vapor Analyzer
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PI	Photo Identified
PID	Photoionization Detector
PMO	Program Management Office
PVC	Polyvinyl chloride
PREQB	Puerto Rico Environmental Quality Board
PRG	Preliminary Remediation Goal
PR LRA	Puerto Rico Local Reuse Authority
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SC	Site Characterization
SE	Southeast
SOP	Standard Operating Procedure
SVOC	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit of the mean
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This document describes the activities required for the implementation of a Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 60 – Former Landfill at the Marina located at Naval Activity Puerto Rico (NAPR), formerly Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico (Figure 1-1).

This document was prepared by Michael Baker Jr., Inc. (Baker), for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast (SE) office under contract with the Naval Facilities Engineering Command (NAVFAC) SE (Contract No. N62470-07-D-0502, Delivery Order [DO] 0002).

1.1 NAPR Description and History

NAPR occupies over 8,800 acres on the northern side of the east coast of Puerto Rico (see Figure 1-1), along Vieques Passage with Vieques Island lying to the east about 10 miles off the harbor entrance. NAPR also occupies the immediately adjacent islands of Piñeros and Cabeza de Perro, as presented on Figure 1-2. The northern entrance to NAPR is about 35 miles east along the coast road (Route 3) from San Juan. The property consists of 3,938 acres of upland (developable) property and 4,955 acres of environmentally sensitive areas including wetlands, mangrove, and wildlife habitat. The closest large town is Fajardo (population approximately 37,000), which is about 5 miles north of NAPR off Route 3. Ceiba (population approximately 17,000) adjoins the west boundary of NAPR (see Figure 1-1).

The facility was commissioned in 1943 as a Naval Operations Base, and finally re-designated a Naval Station in 1957. NSRR operated as a Naval Station from 1957 until March 31, 2004. NSRR has undergone operational closure as of March 31, 2004 and has been designated as Naval Activity Puerto Rico. NAPR will continue until the real estate disposal/transfer is completed. The mission of NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until final disposal of the property.

In anticipation of operational closure of NSRR the Naval Facilities Engineering Command, Atlantic Division (LANTDIV) prepared Phase I/Phase II Environmental Condition of Property (ECP) Reports to document the environmental condition of NSRR. Section 8132 of fiscal year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directed that NSRR be disestablished within 6 months, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the BRAC Act of 1990. This legislation requires that the base closure be conducted in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), as amended by the Community Environmental Response Facilitation Act (CERFA).

The Draft Phase I ECP Report dated March 31, 2004 (LANTDIV, 2004) identified new sites at NAPR based on the results of a review of records, an analysis of historic aerial photographs, physical site inspections, and interviews with persons familiar with past and current operations and activities. The new ECP sites had not been previously identified or investigated under existing environmental program areas. A Phase II ECP field investigation was conducted in April 2004 to conduct environmental sampling to determine if a release/disposal actually occurred at any of the Phase I ECP sites recommended for further evaluation in the Phase I ECP and, if so, whether any potential risk to human health was present. The Final Phase II ECP Report recommended additional sampling (to be undertaken as part of the RCRA Program) at several sites to permit a more detailed assessment (NAVFAC Atlantic, 2005).

The United States Environmental Protection Agency (USEPA) issued a RCRA 7003 Administrative Order on Consent (USEPA Docket No. RCRA-02-2007-7301), identifying SWMU 60 (formerly referred to as ECP 6) as having documented releases of solid and/or hazardous waste and hazardous constituents, and requires the submittal to USEPA for their approval, an acceptable work plan to complete the equivalent of a Phase I RFI investigation. Following a public comment period the Consent Order became effective on January 29, 2007. This document meets the requirement for a Phase I RFI Work plan.

1.2 Site Location and History

The Draft Phase II ECP Report concluded that SWMU 60 has been impacted by past and present operations at NAPR. T Arsenic was identified as a Chemical of Potential Concern (COPC) in the subsurface soil, but was believed to be representative of background concentrations used in the ECP report. Barium and vanadium were identified as COPCs in the groundwater, but an unlikely exposure scenario was used for the qualitative risk assessment in groundwater. Polynuclear Aromatic Hydrocarbons (PAHs), pesticides and inorganics were identified as COPCs in the sediment. These do not present any human health risk, but may present an ecological risk. Figure 1-2 presents the location of SWMU 60 within NAPR. SWMU 60 is located in the immediate area of the base marina. The Aerial Photography Analysis (APA) conducted during the Phase I ECP identified this area as Photo Identified (PI) Site 9, due to the observation of solid waste and scrap metal piles in 1958 (see Figure 1-3). The records review (historic maps) and interviews conducted during the Phase I ECP confirmed the former use of this area as a landfill from approximately the 1940s to the 1960s. The Phase I ECP physical site inspection observed only small quantities of scrap metal in the area, the majority of which is now covered by the marina, as shown in Photographs A-1, A-2 and A-3 in Appendix A. The portion of the site not covered by the marina consists of a level area described as estuarine intertidal scrub-shrub broad-leaved evergreen. There were no signs of any stains or stressed vegetation observed during the Phase II ECP investigation.

A piping system connecting two aboveground storage tanks (ASTs) at the Marina is reported to have been used to supply gasoline and diesel to a pump island located next to the refueling dock (CH2MHill, 1999). An underground piping system was associated with the refueling system and its use was discontinued, also as reported in CH2MHill, 1999. The underground piping system is no longer present at the SWMU, it was removed after the 1999 Site Characterization Report, according to Base personnel.

1.3 Objectives

The purpose of this work plan is to describe the activities necessary to obtain the data to further characterize impacts to the environment due to past operations at SWMU 60, including both a landfill disposal area and activities relating to the Marina that is within the boundary of this SWMU. The former landfill at the marina is currently not utilized, records review and historic maps indicate that the area was used as a landfill from the 1940s to the 1960s. Solid waste and scrap metal was reportedly disposed of in the disturbed areas shown on the 1958 polygon (see Figure 1-3). The operational closure of NSRR occurred on March 31, 2004. A Phase I RFI is required as outlined in the NAPR RCRA 7003 Order issued by USEPA Region II. This RCRA Order provides for further investigation at this SWMU including the development of a work plan, field investigation, and reporting on the findings of the investigation with recommendations of future actions necessary to ensure protection of human health and the environment.

The investigation area at SWMU 60 is shown on Figure 1-4. The 1958 polygon features have also been overlaid onto this figure for reference. This figure also shows the location of the ASTs and former underground piping system associated with the marina fueling system. A surface and subsurface soil sampling program is proposed to further characterize and delineate Volatile Organic Compounds

(VOCs), Semivolatile Organic Compounds (SVOCs), pesticides and metals detected during the ECP Phase II Investigation. Arsenic was detected in surface and subsurface soil above the USEPA Region III Industrial and Residential Risk Based Concentrations (RBCs), and above the background values established for NAPR soils in the ECP Phase II Investigation utilized at that time. The surface and subsurface soil sampling program will also address elevated levels of Total Petroleum Hydrocarbons (TPH) Gasoline Range Organics (GRO) detected above the Puerto Rico Environmental Quality Board (PREQB)Underground Storage Tank (UST) target levels of 100 mg/kg during a Site Characterization (SC) Report prepared in 1999 by CH2MHill (CH2MHill, 1999). Results for TPH GRO in four of the twelve soil samples ranged from 610 mg/kg to 3,200 mg/kg, as discussed in more detail in Section 2.2.1.

A sediment sampling program is proposed to further delineate semivolatile (primarily Polynuclear Aromatic Hydrocarbons [PAHs]), pesticides (4,4-dichlorodiphenyldichloro-ethylene [DDE]) and metal detections that were above marine sediment screening values in one sediment sample collected near a pier at the marina during the ECP Phase II Investigation.

A groundwater sampling program is proposed to further characterize and delineate metals (total and dissolved lead) detected during the groundwater sampling as part of the 1999 SC Investigation. Total lead ranged from 250 ug/L to 1,400 ug/L, and dissolved lead ranged from 270 ug/L to 1,300 ug/L. These results are above the USEPA Maximum Contaminant Level (MCL) and PREQB screening level for lead (15 ug/L). The groundwater and sediment sample analytical results will be used to determine if past releases from the disposal area as well as activities relating to the Marina (primarily the noted release in the past of products at the Marina from piping associated with formerly active Gasoline/Diesel ASTs) have migrated to the Ensenada Honda. The sampling to be performed as part of the Phase I RFI, as well as previous Investigations at SWMU 60 is discussed below.

1.4 Organization of the Work Plan

This work plan is organized into seven sections. Section 1.0 of this document includes the site history and objectives of this RFI. Section 2.0 provides a description of the current conditions and usage of the site, as well as a summary of previous investigations. Section 3.0 provides a description of the scope of investigations for the upcoming fieldwork. The proposed scope of investigations include soil sampling and analysis program, sediment sampling and analysis program, groundwater sampling and analysis program, and quality assurance/quality control (QA/QC) samples, as well as other investigation considerations. The reporting activities that will be conducted following the completion of the field investigation are described in Section 4.0. Section 5.0 discusses the proposed project schedule that will be followed for this Phase I RFI. The site management structure that will be utilized during this investigation, including project team responsibilities and field reporting requirements, is presented in Section 6.0, while Section 7.0 presents the report references.

2.0 SITE BACKGROUND AND CURRENT CONDITIONS

The following sections provide a discussion of the current conditions that exist at SWMU 60 along with findings from previous investigations at SWMU 60.

2.1 Current Site Conditions/Usage

This current site is broken into two distinct portions. The majority of the historical site consists of an active marina (built approximately in the 1970s). This marina covers approximately two thirds of the site. This portion of the site consists of the marina building, docks, concrete walkways, manicured lawn, tennis courts, and asphalt roads and parking. Two of the polygons identified during the APA fall within this area as well as the northern portion of the third polygon. The southern portion of the third polygon falls within the remaining third of the site. This portion of the site consists of a level area extending to the Ensenada Honda and is covered with secondary growth vegetation. This area is described as estuarine intertidal scrub-shrub broad-leaved evergreen (E2SS3) as shown on Figure 1-4. A small beach classified as marine intertidal unconsolidated shore sand (M2US2) is located on the southern edge of the site also shown on Figure 1-4.

2.2 Previous Investigations

Two investigations have been conducted at SWMU 60 as follows: The Phase I/II ECP (NAVFAC, 2005) and a Site Characterization Report (CH2MHill, 1999) as discussed in the subsections that follow.

2.2.1 Site Characterization

An SC investigation was conducted in 1999 at the Marina to evaluate the degree and extent of potential impacts from petroleum products to soil and groundwater at the Marina from the Marina's former underground petroleum piping system (CH2MHill, 1999). The piping system was connected to two aboveground storage tanks (AST) at the Marina and was used to supply gasoline and diesel to a pump island located next to the refueling dock. The original gasoline/diesel ASTs were removed during construction at the Marina (after the 1999 Site Characterization Report); however, there are currently three ASTs containing Diesel and Mogas at the same location as the previous ASTs. Records indicate that there was a release of petroleum products at the marina from the piping system associated with the ASTs. The piping system associated with the ASTs is no longer in service, and was removed at some point of time after the 1999 Site Characterization Report. The location of the ASTs and the former piping system are shown on Figure 1-4.

The objective of the SC was to access the horizontal and vertical extent of soil and groundwater impacted by the underground piping system. The exact location of the underground piping system is not known, however Base personnel stated that it was located in the area between ASTs and the refueling dock on the western shoreline of the SWMU. The SC investigation consisted of the advancement of 12 soil borings and four monitoring wells. Twelve soil borings (Marina-SB1 through Marina-SB12) were advanced at the site in an effort to delineate the extent of soils potentially impacted by petroleum hydrocarbons. Soil borings were advanced 2 to 4 feet below ground surface (bgs) with a post-hole digger. Soil samples were collected continuously in 2-foot intervals to depths between 3 and 4 feet bgs and terminated when water was encountered at approximately 3 to 4 feet.

Twenty-one soil samples screened with an Organic Vapor Analyzer (OVA) produced detectable vapors, and these samples were sent for laboratory analysis. These samples were analyzed for BTEX

(Benzene, Toluene, Ethylbenzene, and Total Xylenes), and TPH GRO and Diesel Range Organics (DRO).

At the time of the soil boring installations, the water table across the Marina was encountered at approximately 3 feet bgs. At select boreholes, Teflon® tubing was placed in the boring after the water table was encountered and a groundwater sample was collected with a peristaltic pump.

Based on the laboratory analytical data and field observations, four soil borings (Marina-SB1, SB5, SB9, and SB12) were determined to be in areas of petroleum contamination and were converted to permanent monitoring wells (Marina-MW1, MW2, MW3, and MW4, respectively). Marina-MW1 was noted by Base personnel as still being present at the SWMU. However, since that time, more construction has occurred at the Marina and it is unlikely that the other wells are still present and/or in good condition. On May 13 and June 9, 1999, the groundwater samples were collected and sent for analysis for BTEX, TPH (GRO and DRO), PAH, and filtered and unfiltered lead.

TPH GRO concentrations in soil samples were above the PREQB target level of 100 mg/kg at four soil boring locations with concentrations ranging from 600 mg/kg to 3,200 mg/kg, as shown on Table B-1 in Appendix B. These borings are all located in the area where the piping associated with the ASTs and refueling operations occurred. Laboratory results from all remaining soil samples collected were below the laboratory method detection limit for TPH GRO.

Groundwater laboratory analytical data results indicated benzene was detected in monitoring well MW3 at a concentration of 190 micrograms per liter (µg/L), which is well above the PREQB limit of 5 µg/L. TPH GRO was detected at this location at a concentration of 12 mg/L, below the PREQB limit of 50 mg/L. The detection limits for non-detected TPH GRO were high (10,000 µg/L and 25,000 µg/L) for TPH DRO in the groundwater samples. Lead was detected at all four monitoring wells in unfiltered and filtered groundwater samples. Both filtered and unfiltered samples for all monitoring wells exceeded the PREQB target level of 15 µg/L. Unfiltered lead ranged from 250 µg/L in MW-3 to 1,400 µg/L in MW-1 and MW-4; filtered lead sample results ranged from 270 µg/L at MW3 to 1,300 µg/L at MW4, as shown on Table B-2 in Appendix B.

In summary, based on field and laboratory data obtained from soil and groundwater sampling activities during the SC investigation, CH2MHill concluded that petroleum hydrocarbons were detected in the soil; and benzene and lead were detected in the groundwater above PREQB target levels at the Marina. Since the elevated concentrations of petroleum hydrocarbons were in the GRO class of hydrocarbons, it is likely that subsurface impacts are related to leaks from the underground piping system. The area of soil contamination appears to be limited to the area between the ASTs, and the Ensenada Honda.

2.2.2 Phase I/II ECP Report

The Phase I/II ECP investigation included the sampling of one surface soil, three subsurface soil samples, two groundwater, and two surface water/sediment samples that were analyzed for Appendix IX Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs), Pesticides/Polychlorinated biphenyls (PCBs), Organophosphorus (OP) pesticides, chlorinated herbicides, and metals (dissolved only for groundwater samples). Analytical data from the Phase I/II ECP are presented in Appendix C, including comparisons to human health and ecological screening criteria used at that time. The tables also include comparison to the applicable facility background levels for metals utilized at that time.

In the surface and subsurface soil VOCs, SVOCs, and pesticides were detected below the USEPA Region III Industrial and Residential screening values. Tables C-1 through C-4 in Appendix C present the positive detections of organics and inorganics in surface and subsurface soil. The constituents detected are primarily related to fuel and routine pesticide applications, with the exception of tetrachloroethene detected in the surface soil. None of the other organic compounds were detected.

Arsenic was detected in surface and subsurface soil above the USEPA Region III Industrial and Residential RBCs, and above background values for subsurface soil used in the ECP Phase II Investigation. Vanadium was detected above USEPA Region III Residential RBCs, but below the detected background values.

Groundwater samples collected at depths ranging from less than 4 feet to 9 feet below ground surface (bgs) indicated that a few VOCs, SVOC, and inorganic compounds were present in the groundwater; all organic concentrations were low and estimated, as summarized in Tables C-5 and C-6 in Appendix C. Only barium marginally exceeded its EPA Region III Tap Water RBC at 6E-02. Barium and vanadium were detected in surface water that below the Puerto Rico Water Quality Standards and Surface Water Screening Values, as summarized in Table C-9 in Appendix C.

A summary of the sediment and surface water analytical results from the Phase II ECP are provided in Tables C-7 through C-9 in Appendix C. The ECP Phase II Investigation determined that one sediment location (6E-SW01, see Figure 1-4 for previous sample locations) had concentrations of SVOCs that were higher than the Marine Sediment Screening Values. Location 6E-SW/SD01 is present among several docks that have been used for boat parking/refueling. Furthermore, a sail boat was noted to have burned near this location while it was docked. The other sediment location (6E-SD02), which was not located in the marina, did not detect any of the PAHs from 6E-SW/SD01, and the inorganic detections were also much lower. Sample 6E-SW01 was collected near the marina that was built in the 1970s, after the landfill ceased operations.

The soil and groundwater samples collected during the ECP were primarily collected within areas observed to have been disturbed by landfill activities within the 1958 polygons (see Figure 1-4). One or more of these locations were adjacent to the Marina, but not within the area impacted by the AST leakage that was described in Section 2.2.1.

3.0 SCOPE OF INVESTIGATION

Surface, subsurface soil, sediment, and groundwater samples will be collected from SWMU 60 during the Phase I RFI. Surface water will not be sampled, as this media did not show any evidence of contamination during the ECP investigation (see Section 2.2.2 and Appendix C). In addition, the proposed groundwater sample results will be evaluated to determine the impact of any potential discharge to the Ensenada Honda. Sampling locations presented in this section were identified from the historical aerial photograph (1958) and the Phase I/II ECP findings. Consideration was given to site topography, site features, historical operational features of the facility, and the results of the SC investigation. The subsections that follow outline the specific sampling protocol.

A summary of the sampling and analytical program for this investigation are provided as Table 3-1. The proposed sampling locations for SWMU 60 are shown on Figure 3-1. The following is a summary of the proposed sampling program:

- Five surface soil samples will be collected from five boring locations as shown on Figure 3-1.
- A maximum of ten subsurface soil samples will be collected from the five boring locations. The number and depth of subsurface soil samples from each boring will vary depending on the depth of the water table at each location. The depth to the water table in previous locations has been noted to vary from 3 feet to 9 feet. If suspected contamination is noted in multiple samples then, additional samples will be obtained from the boring location.
- Three sediment samples will be collected from locations as shown on Figure 3-1.
- Three groundwater samples are proposed to be collected from boring locations shown on Figure 3-1.

3.1 <u>Soil Sampling and Analysis Program</u>

Surface soil and subsurface soil samples will be collected from SWMU 60. The following outlines the specific sampling protocol.

Figure 3-1 identifies the locations of three soil borings (60SB01-60SB03) that will be advanced at various locations in the 1958 polygons south of the locations (6E-01 and 6E-02) sampled in the Phase I/II ECP in the areas that may have been impacted by past use of the site as a landfill. Two soil borings (60SB04 and 60SB05) are proposed in the northwestern part of the SWMU, aligned with the location of the former pipeline, as shown on Figure 3-1.

All soil borings for this RFI will be advanced using a 66DT Geoprobe rig capable of direct push and augering (see SOP F102 in Baker, 1995). Care will be taken to achieve maximum recovery so that a good stratigraphic profile can be developed. A boring log will be prepared (see SOP F101 in Baker, 1995) indicating, blow counts, lithology, water occurrence, flame ionization detector (FID)/photo ionization detector (PID readings, and miscellaneous (visual and olfactory).. One surface soil sample (0 to 1 foot bgs) and a –maximum of two subsurface soil samples [based on FID/PID, olfactory and visual screening and just above the water table interface] will be collected from each boring location. The depth to the water table is estimated to be variable at this SWMU (estimated to be from 3 to 9 feet based on previous investigations). Therefore, the number of subsurface samples collected at each proposed location will vary depending on the depth to water at each sample location and will be determined in the field. The surface and subsurface soil samples will be analyzed for Appendix IX VOCs, SVOCs, low-level PAHs, pesticides, and metals as presented in Table 3-1. In addition, samples collected from 60SB04 and 60SB05 will be analyzed for TPH DRO and GRO because they are located along the former pipeline associated with the ASTs. Samples 60SB01through 60SB03 will not be analyzed for TPH DRO/GRO since it is not suspected that these proposed sample locations were impacted by the release of petroleum products from Marina operations.

The soil boring samples will be labeled consecutively (beginning with 60SB01) in a matter consistent with previous sample designations at NAPR. Extensions to the sample identification will reflect the depth at which the sample was obtained. For the purposes of this work plan, two-foot discrete depths will be used. Sample identification extensions will follow the pattern shown below.

60SB01-00 - SWMU 60 Sample
60SB01-00 - Soil Boring Sample
60SB01-00 - Soil boring location identifier
60SB01-00 - 0 to 1 foot bgs (surface soil) sampling interval

Subsurface soil samples will be identified as follows:

60SB01-01 - First subsurface sampling interval, 1 to 3 feet bgs
60SB01-02 - Second subsurface sampling interval, 3 to 5 feet bgs, and so on.

Sample identification extensions will follow the pattern shown above. However, the actual sample depth will be determined in the field.

Following sample collection, each borehole not being converted into a permanent well will be backfilled with the remaining soil to the extent practicable, in order to minimize the burden of waste disposal. In the event of relocating a monitoring well location, the borehole will be abandoned by backfilling with the drill cuttings to the extent practicable, in order to minimize the burden of waste disposal. The surface of the borehole will then be patched with bentonite grout.

Samples will be packed in ice and shipped next day air to the "fixed base" laboratory. Because of previously encountered delays associated with sample shipments from Puerto Rico to the United States, additional insurance to cover re-sampling costs should be claimed on the bill of laden. At least one member of the field team will remain on the island until verification by the laboratory of receipt of all shipments. This will minimize any potential re-sampling costs associated with mobilization. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt.

All analysis at the laboratory will be performed using current methodologies as presented in Table 3-2. All analytical work conducted on the mainland of the United States of America must be certified by a Puerto Rico licensed chemist. The specific laboratory and third party validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date. Standard Operating Procedures (SOPs) used by the analytical laboratory will be requested from the laboratory after selection.

3.2 Sediment Sampling and Analysis Program

Three sediment samples will be collected at SWMU 60. Samples SD02 is located on the southern border of the ECP site boundary and samples 60SD02 and 60SD03 are proposed outside of the western ECP site boundary (outside of the marina area) as shown on Figure 3-1.

Sediment samples will be analyzed for Appendix IX SVOCs, pesticides and metals, and low-level PAHs as presented in Table 3-1. The samples will be obtained using disposable, stainless steel spoons and/or petite ponar dredge, or acetate sediment liner, (see SOP F105 in Baker, 1995) depending on accessibility and it physical characteristics. Following the removal of any debris, each sample will be placed in an aluminum pan and homogenized with a stainless steel spoon providing one discrete sample for each proposed sample location. Each sample will then be placed in the sample container. All pertinent sampling information such as sediment description (e.g., color and texture), sample number and location, presence or absence of aquatic invertebrates, and the time of sample collection will be recorded in the field logbook.

Samples will be packed in ice and shipped next day air to the “fixed base” laboratory. Because of previously encountered delays associated with sample shipments from Puerto Rico to the United States, additional insurance to cover re-sampling costs should be claimed on the bill of laden. At least one member of the field team will remain on the island until verification by the laboratory of receipt of all shipments. This will minimize any potential re-sampling costs associated with mobilization. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt.

All analysis at the laboratory will be performed using current methodologies as presented in Table 3-2. All analytical work conducted on the mainland of the United States of America must be certified by a Puerto Rico licensed chemist. The specific laboratory and third party validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date. SOPs used by the analytical laboratory will be requested from the laboratory after selection.

3.3 Monitoring Well Installation Program

Twopermanent monitoring wells will be installed within soil borings (60SB04-60SB05) advanced at SWMU 60. As shown on Figure 3-1, Base personnel indicated that one of the wells (MW1/SB1) that was developed during the 1999 Site Characterization Report is still present at SWMU 60. If the well is in good condition, the well will be developed and a sample will be colleted and analyzed for the constituents listed on Table 3-1. The approximate locations of these monitoring wells are presented on Figure 3-1.

The monitoring well location designation will correspond to the soil boring location. For example, the permanent well installed at soil boring location 60SB04 will have the sample identification of 60GW04. The wells (60GW04 and 60GW05) will be installed in the northwestern side of the SWMU along the location of the former pipeline associated with the ASTs that stored gasoline and diesel.

Monitoring wells will be installed using hollow-stem augers (HSAs) or air rotary techniques (see SOP F103 in Baker 1995), depending on the underlying stratigraphy. The wells will be constructed of 2-inch inner diameter (ID), Schedule 40 Polyvinyl chloride (PVC), with flush joint threads. Well screens will be 10-feet long and installed to straddle the water table.

- Soil sampling will be conducted in order to classify the soil during well installation. Upon completion of soil sampling, the borehole will be reamed as necessary to the desired depth using the prescribed drilling method. The well construction materials will be installed through the HSAs, casing, or in an open borehole.

- The well screen and bottom cap will be set at the bottom of the borehole. The screen will be connected to threaded, flush-joint, riser. An expandable, water tight locking cap or slip-cap with a vent hole will be placed at the top of the casing.

- The annular space around the well screen will be backfilled with a well-graded, fine to medium sand as the HSAs or casing are being withdrawn from the borehole. The sand will extend to approximately 2 feet above the top of the screened interval. The thickness of the sand above the screened interval may be reduced if the well is too shallow to allow for placement of adequate sealing material.

- An approximately 2-foot thick sodium bentonite seal (minimum of 6 inches for very shallow wells) will be placed above the sand pack. If bentonite pellets or chips are used, they will be sized appropriately given the well and borehole diameter and placed in a careful manner that will prevent bridging. The bentonite will be hydrated with potable water, as necessary.

- The annular space above the bentonite seal will be backfilled with cement/bentonite grout to prevent surface and near subsurface water from infiltrating into the screened groundwater monitoring zone. The grout will consist of five to ten percent (by dry weight) of bentonite powder and seven gallons of potable water per 94-pound bag of portland cement. For very shallow wells, the cement/bentonite grout may be omitted.

- The depth intervals of all backfilled materials will be measured with a weighted measuring tape to the nearest 0.1-foot and recorded in the field logbook.

- Wells in high traffic areas will be completed at the surface using a "flush" manhole type cover. The flush-mounted cover will be surrounded by a concrete pad and slightly elevated above the ground surface with the concrete sloping away from the cover to the existing ground surface. However, if any of the wells are relocated into areas that are heavily vegetated; these will be provided with 2 to 3 feet of "stickup" above ground surface. Steel protective casing will be placed over the riser and surrounded by a concrete pad. The pad will be a minimum of 2 feet by 2 feet (length x width) and 6 inches in thickness (with 2 inches set into the ground outside the casing), and extending 2 feet bgs inside the annular space around the well. If water table conditions prevent having a 24-inch thick bentonite seal, the concrete pad depth in the annular space around the well may be decreased. Steel bollards will be installed around the concrete pad as additional protection and painted a bright color to aid in visibility.

- All wells will have a locking cap installed on the PVC riser or protective steel casing.

Each new permanent monitor well will be developed using pumping and surging methods (see SOP F103 in Baker, 1995) after allowing suitable time for the cement/bentonite grout to cure (typically a minimum of 24 hours). The purpose of well development is to restore the permeability of the formation which may have been reduced by the drilling operations and to remove fine-grained materials that may have entered/accumulated in the well or filter pack. The wells will be developed until the discharged water runs relatively clear of fine-grained materials. It should be noted that the water in some wells does not clear with continued development. Typical limits placed on well development may include any one or a combination of the following:

- Clarity of water based on visual determination

- A maximum time period (typically two hours for shallow wells)

- A maximum borehole volume (typically three to five borehole volumes plus the amount of any water added during the drilling or installation process)

- Stability of pH, specific conductance, and temperature measurements (typically less than 10 percent change between three successive measurements)

- Clarity based on turbidity measurements [typically less than 20 Nephelometric Turbidity Units (NTU)]
- A record of the well development will be completed to document the development process.

3.4 Groundwater Sampling and Analysis Program

The groundwater sampling will be used to aid in characterization of the current conditions of groundwater that were impacted by prior activities at SWMU 60 and to obtain data for evaluating if continued migration of contamination to Ensenada Honda will occur. All groundwater samples collected will be analyzed for Appendix IX VOCs, SVOCs, low-level PAHs, metals (total and dissolved) and TPH DRO/GRO for the samples indicated on Table 3-1.

Wells that can be pumped or bailed to dryness with the sampling equipment being used shall be purged dry and allowed to recover prior to sample collection. If the recovery rate is fairly rapid and time allows, evacuation of at least three well volumes of water is preferred; otherwise, a sample will be collected when enough water is available to fill the sample containers.

The groundwater will be sampled using a low flow sampling technique. Appendix D includes a detailed description of low-flow sampling technique. Field parameters of pH, temperature, turbidity, conductivity, and oxidation-reduction potential will be obtained with appropriate instrumentation during sampling if adequate volume of groundwater is present. The groundwater samples will be placed into the appropriate laboratory supplied containers. The groundwater samples will be filtered in the field for dissolved metals analysis. The net groundwater flow direction is expected to be towards the surface water in Ensenada Honda. Prior to sampling, a synoptic set of static water levels will also be recorded in order to obtain data to more accurately interpret the groundwater flow direction at the SWMU.

Samples will be packed in ice and shipped next day air to the “fixed base” laboratory. Because of previously encountered delays associated with sample shipments from Puerto Rico to the United States, additional insurance to cover re-sampling costs should be claimed on the bill of laden. At least one member of the field team will remain on the island until verification by the laboratory of receipt of all shipments. This will minimize any potential re-sampling costs associated with mobilization. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt.

All analyses at the laboratory will be performed using current methodologies as presented in Table 3-2. All analytical work performed on the mainland of the United States of America must be certified by a licensed Puerto Rico chemist. The specific laboratory and validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date.

3.5 Quality Assurance/Quality Control Samples

Field specific QA/QC procedures are given below. QA/QC samples will be analyzed for parameters as shown in Table 3-3 by methods presented in Table 3-2.

QA/QC samples will be obtained during these investigations. These will include the collection of equipment rinsate samples, field blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD).

Equipment rinsate blanks will be collected daily from reusable (non-dedicated and non-disposable) sampling equipment during the sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are detected in any equipment rinsate blank, the remaining rinsate blanks will be analyzed. As an added level of QA/QC, a rinsate blank will also be collected from each batch of disposable sampling tools such as stainless steel spoons, acetate sediment liner, groundwater sample tubing, etc. The results from the blanks will be used to verify that the decontamination of reusable equipment had rendered them free of cross-contaminating chemicals at levels of concern for the site; and to verify that disposable sampling tools were free of contaminants at levels of concern for the site. This comparison is made during data validation, and the equipment rinsate blank is analyzed for the same parameters as the related samples.

Field blank samples consist of the source water used in equipment decontamination procedures. At a minimum, one field blank for each source of water must be collected and analyzed for the same parameters as the related samples. It is anticipated that three different sources of water (i.e., NAPR potable water source, store-bought distilled water, and laboratory-grade de-ionized water) will be utilized for this investigation as shown in Table 3-3 if they are used during this investigation.

Trip blank samples will be required to accompany the samples to the laboratory for volatile organic constituent samples and TPH GRO scheduled for collection. One trip blank sample will accompany each cooler containing samples of the afore-mentioned analyses.

Soil sample field duplicates will be homogenized and split and collected at a frequency of ten percent. Groundwater duplicates will be collected at a frequency of ten percent, and it will include at least one total and one filtered groundwater sample.

Analysis of duplicate and blanks associated with soil and groundwater sampling will include Appendix IX VOCs, SVOCs, Pesticides, low-level PAHs, and Metals and TPH DRO and GRO.

MS/MSD samples are collected to evaluate the matrix effect of the sample upon the analytical methodology. An MS and MSD must be performed for each group of samples of a similar matrix (e.g., surface soil). MS/MSD samples will be collected at a frequency of five percent per media.

3.6 Other Field Activities

During the investigation, the following activities will be performed:

- Utility Clearance
- Investigation Derived Waste (IDW) Management
- Decontamination
- Surveying
- Health and Safety Procedures
- Chain of Custody

3.6.1 Utility Clearance

If this work plan is initiated while NAPR is still under operation, the following procedure must be followed to obtain utility clearance. Fifteen days prior to the initiation of the proposed fieldwork, a digging permit request will be submitted to the Facility Management Transportation and Utility Division (FMTUD) of the Public Works Department at NAPR. Although utilities are not identified on the Geographic Information System (GIS) utility layer, all proposed soil borings and monitoring well locations will be cleared by the base utility department.

3.6.2 Investigation Derived Wastes

The generation of IDW associated with soil and sediment sampling, including soil cuttings and decontamination fluids, will be collected and stored temporarily in 55-gallon drums. However, the soil cuttings from the subsurface soil sampling will be placed back into the boring from which they came, unless visible contamination is present. As much as possible, soils last out of the hole will be returned first, thereby, approximating original stratigraphy.

Two IDW samples will be collected during this investigation. One composite aqueous sample will be collected from all drums containing decontamination fluid (from sampling equipment and drill rig), and one composite soil sample will be collected from all drums containing drill cuttings. The samples will be analyzed for parameters as shown in Table 3-3, as well as by methods presented in Table 3-2. These samples will provide the necessary data to be able to dispose of the generated IDW at an appropriate disposal facility. Upon completion of the field program, the drums will be moved and stored at a secure location by the contractor. The soil and water IDW will be removed and disposed of from the site by an approved vendor upon receipt and review of the IDW sample analytical data.

3.6.3 Decontamination

All reusable (non-dedicated and non-disposable) soil sampling and monitoring well installation equipment (i.e. augers, split-spoon samplers, etc.), will be decontaminated between each sampling location in accordance with SOPs F501 and F502 (Baker, 1995). The drill rig will be decontaminated before arriving at the site and before leaving the site. The remaining contaminant-free sampling equipment and materials utilized during this investigation will be disposable.

3.6.4 Surveying

All sampling locations will be surveyed. Traditional survey equipment or survey grade GPS unit will be utilized to obtain vertical (+/- 0.01 foot) and horizontal (+/- 0.1 foot) locations and top of PVC elevations of the wells for generating groundwater contours used for reporting purposes.

3.6.5 Health and Safety Procedures

The health and safety procedures previously presented in the RFI Management Plans (Baker, 1995) will be employed during this investigation.

3.6.6 Chain-of-Custody

Chain-of-Custody procedures will be followed to ensure a documented, traceable link between measurement results and the sample/parameter that they represent. These procedures are intended to provide a legally acceptable record of sample preparation, storage, and analysis.

To track sample custody transfers before ultimate disposition, sample custody will be documented using a similar chain-of-custody form as presented in the RFI Management Plans (Baker, 1995). A chain-of-custody form will be completed for each shipment in which the samples are shipped. After the samples are properly packaged, the shipping container will be sealed and prepared for shipment to the analytical laboratory.

3.7 Data Validation

All mainland laboratory data generated by the investigation will be subjected to independent, third party, validation. The USEPA Region II Data Validation Standard Operating Procedures will be followed. The specific data validator will be determined at a later date.

4.0 REPORTING

This section outlines the reporting activities that are associated with the field investigation. The reports shall include at a minimum:

- Introduction
- SWMU Investigation
- Physical Characteristics of Study Area
- Nature and Extent of Contamination
- Conclusions and Recommendations
- References

The Phase I RFI reports sections are discussed in the following subsection.

4.1 Introduction

The introduction will consist of a discussion of the historical background of any investigations conducted at the SWMU. The introduction will also provide a regulatory framework for NAPR and the SWMU, as well as a discussion of current conditions.

4.2 SWMU Investigation

The investigation methodologies employed to fulfill the Phase I RFI work plan objectives for the SWMU will be discussed including the sample locations, sample collection and handling procedures, QA/QC procedures, and analytical methods used. This section will also discuss any problems encountered including any deviations from the work plan and problem resolution.

4.3 Physical Characteristics of Study Area

The physical characteristics of the SWMU will be recorded in the field. Those observations will be photographically recorded and summarized in this section.

4.4 Nature and Extent of Contamination

The nature and extent of contamination section will present analytical results and interpretation of the data. The surface and subsurface soil analytical data will be screened against USEPA Region IX Residential and Industrial Preliminary Remediation Goals (PRGs). Analytical data for surface soil and subsurface soil collected from the 1 to 3-foot depth interval also will be compared to ecological soil screening values previously developed for use in ecological risk assessments (ERAs) at NAPR (Baker, 2006a and 2006b). The ecological soil screening values will be updated as necessary to reflect current information from the literature (i.e., ecological soil screening levels [Eco-SSLs] available at http://www.epa.gov/ecotox/ecossl/). Analytical data for subsurface soil collected from deeper depth intervals (e.g., 3 to 5-feet bgs) will not be compared to ecological soil screening values since these depths are not likely to represent a significant exposure point for ecological receptors (most heterotrophic activity and soil invertebrates occur on the surface or within the oxidized root zone [Suter II, 1995]). The sediment analytical data will be compared to ecological sediment screening values. Identical to the ecological soil screening values, ecological sediment screening values used in the comparison will be those previously developed for use in ERAs at NAPR (Baker, 2006a and 2006b). They will be updated as necessary to reflect current information from the literature. The groundwater analytical data will be compared to USEPA Region IX Tap Water PRGs and federal maximum contaminant levels (MCLs). The groundwater analytical data will be compared to ecological surface water screening values based on the close proximity of SWMU 60 to the Ensenada Honda (see Figure 1-2) A comparison of groundwater data to ecological surface water screening values will be performed as SWMU 60 is located contiguous to a surface water body (see Figure 1-2).

For a given medium (surface soil, subsurface soil, sediment and groundwater), analytical data for inorganic chemicals exceeding one or more of the screening values (human health or ecological) will be statistically compared to background analytical data in accordance with Navy guidance (Naval Facilities Engineering Service Center [NFESC], 2002 and 2003). The background analytical data used in the statistical evaluations will be those contained in the Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2006c). The process that will be used to statistically evaluate the data is depicted in Figure 4-1. As shown by the figure, statistical evaluations will include descriptive summaries of each data set (range of detected values, range of non-detected values, maximum, mean, and 95 percent upper confidence limit [UCL] of the mean concentrations), statistical tests on the mean/median of the distributions (i.e., student's t-test, Gehan test, Satterthwaite's t-test, or Wilcoxon rank sum test), statistical tests on the right tail of the distributions (i.e., quantile test and slippage test), and proportional statistics (two-sample test of proportions). The significance level (the probability criteria for rejecting the null hypotheses that data sets were sampled from the same population) will be set at 0.05 for all statistical tests in accordance with Navy guidance (NFESC, 2002 and 2003).

The results of the screening and statistical evaluations will be presented on tables and figures with textual explanation. Results of QA/QC procedures also will be presented within the nature and extent of contamination section.

4.5 Conclusions and Recommendations

Information from the nature and extent of contamination will be synthesized into conclusions regarding the extent of releases previously detected at the site. Recommendations will be made from these conclusions as to whether a full RFI is needed or the SWMU can proceed toward a determination of Corrective Action Complete.

5.0 SCHEDULE

A schedule for the implementation of this work plan, and follow-up reports for SWMU 60 is provided as Figure 5-1.

It should be noted that this schedule is dependent upon USEPA review time. Many other factors can also extend the schedule such as resampling if further re-characterization is required, weather delays in the field, funding is delayed by the Navy, or consensus cannot be reached on how the USEPA's comments are to be incorporated.

6.0 SITE MANAGEMENT

An organization chart presenting the proposed staffing for this project is provided on Figure 6-1. This section also outlines the responsibilities and reporting requirements of field personnel and staff.

6.1 Project Team Responsibilities

Mr. Mark Kimes, P.E., Activity Coordinator for all work in Puerto Rico, will manage the Baker Project Team. His responsibilities will be to direct the technical performance of the project staff, costs and schedule, ensuring that QA/QC procedures are followed during the course of the project. He will maintain communication with the BRAC PMO SE, Navy Technical Representative (NTR), Mr. Mark Davidson. Mr. John Mentz will administer overall QA/QC for this project.

The field activities of this project will consist of one field team managed by the Geologist, Mr. Joseph Burawa. Mr. Burawa's responsibilities include directing the field team and subcontractors. Mr. Rick Aschenbrenner, P.E. will direct the reporting effort associated with the field investigation, ensuring that all necessary staffing is utilized to assist in developing the Phase I RFI Report for SWMU 60.

6.2 Field Reporting Requirements

The Geologist will maintain a daily summary of each day's field activities. The following information will be included in this summary:

- Contractor and subcontractor personnel on site
- Major activities of the day
- Samples collected
- Problems encountered
- Other pertinent site information

The Geologist will receive direction from the Project Manager regarding any changes in scope of the investigation.

7.0 REFERENCES

Baker Environmental, Inc. (Baker). 2006a. Final Additional Data Collection Report and Screening-Level Ecological Risk Assessment and Step 3a of the Baseline Ecological Risk Assessment at SWMUs 1 and 2, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. May 18, 2006.

Baker. 2006b. Final Additional Data Collection Report and Screening-Level Ecological Risk Assessment and Step 3a of the Baseline Ecological Risk Assessment at SWMU 45, Naval Activity Puerto Rico, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. January 11, 2006.

Baker. 2006c. Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. September 1, 2006. Moon Township, Pennsylvania.

Baker. 1995. Final RCRA Facility Investigation Management Plans, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. September 14, 1995.

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Naval Facilities Engineering Command (LANTDIV). 2004. Draft Phase I Environmental Condition of Property, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. March 31, 2004. Norfolk, Virginia.

Naval Facilities Engineering Command (NAVFAC). 2005. Final Phase I/II Environmental Condition of Property, Former U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Norfolk, Virginia.

Naval Facilities Engineering Service Center (NFESC). 2003. Guidance for Environmental Background Analysis. Volume II: Sediment. NFESC User's Guide UG-2054-ENV. April 2003

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Suter II, G.W. 1995. Guide for Performing Screening Ecological Risk Assessments at DOE Facilities. Oak Ridge National Laboratory, Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-153.

TABLES

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

		Fixed Based Analytical Lab Analysis							
Media	**Sample Depth (ft bgs)**	App IX VOCs	App IX SVOCs	Appendix IX Pesticides	App IX Low Level PAHs	TPH DRO/GRO	Appendix IX Metals	Appendix IX Metals (Dissolved)	**Comment**
Surface Soil Samples									
60SB01-00	0.0 - 1.0	X	X	X	X		X		
60SB02-00	0.0 - 1.0	X	X	X	X		X		
60SB03-00	0.0 - 1.0	X	X	X	X		X		
60SB03-00D	0.0 - 1.0	X	X	X	X		X		Duplicate
60SB03-00MS/MSD	0.0 - 1.0	X	X	X	X		X		Matrix Spike/Matrix Spike Duplicate
60SB04-00	0.0 - 1.0	X	X	X	X	X	X		
60SB05-00	0.0 - 1.0	X	X	X	X	X	X		
Subsurface Soil Samples(2)									
60SB01-XX(1)	TBD	X	X	X	X		X		
60SB01-XX(1)	TBD	X	X	X	X		X		
60SB02-XX(1)	TBD	X	X	X	X		X		
60SB02-XX(1)	TBD	X	X	X	X		X		
60SB03-XX(1)	TBD	X	X	X	X		X		
60SB03-XX(1)	TBD	X	X	X	X		X		
60SB04-XX(1)	TBD	X	X	X	X	X	X		
60SB04-XXD(1)	TBD	X	X	X	X	X	X		Duplicate
60SB04-XXMS/MSD(1)	TBD	X	X	X	X	X	X		Matrix Spike/Matrix Spike Duplicate
60SB04-XX(1)	TBD	X	X	X	X	X	X		
60SB05-XX(1)	TBD	X	X	X	X	X	X		
60SB05-XX(1)	TBD	X	X	X	X	X	X		
Sediment Samples									
60SD01	NA		X	X	X		X		
60SD02	NA		X	X	X		X		
60SD03	NA		X	X	X		X		
60SD03D	NA		X	X	X		X		Duplicate

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Media	Sample Depth (ft bgs)	Fixed Based Analytical Lab Analysis							Comment
		App IX VOCs	App IX SVOCs	Appendix IX Pesticides	App IX Low Level PAHs	TPH DRO/GRO	Appendix IX Metals	Appendix IX Metals (Dissolved)	
Groundwater Samples									
MW1/SB1	NA	X	X	X	X	X	X	X	
60GW04	NA	X	X	X	X	X	X	X	
60GW05	NA	X	X	X	X	X	X	X	
60GW05D	NA	X	X	X	X	X	X	X	Duplicate
60GW05MS/MSD	NA	X	X	X	X	X	X	X	Matrix Spike/Matrix Spike Duplicate

Notes:

(1) XX - The designator for the depth interval from which the sample will be collected (i.e., 01 = 1-3ft bgs, 02 = 3-5 ft bgs, etc This will be established in the field.

(2) - Although two subsurface soil samples are proposed per boring, additional subsurface soil will be collected if areas of staining or other indicators of contamination are encountered at multiple depths. In this event, the number of QA/QC samples outlined in Section 3.3 and listed on Table 3-3 will be adjusted.

ft bgs - feet below ground surface.
NA - Not Applicable.
TBD - To be determined in the field

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

	Quantitation Limits*		
Volatiles	Water (μg/L)	Low Soil (μg/kg)	Method Number
Acetone	25	50	8260B (5030B)(low level)
Acetonitrile	40	200	8260B (5030B)(low level)
Acrolein	20	100	8260B (5030B)(low level)
Acrylonitrile	20	100	8260B (5030B)(low level)
Benzene	1.0	5.0	8260B (5030B)(low level)
Bromodichloromethane	1.0	5.0	8260B (5030B)(low level)
Bromoform	1.0	5.0	8260B (5030B)(low level)
Bromomethane	1.0	10	8260B (5030B)(low level)
Carbon Disulfide	1.0	5.0	8260B (5030B)(low level)
Carbon Tetrachloride	1.0	5.0	8260B (5030B)(low level)
Chlorobenzene	1.0	5.0	8260B (5030B)(low level)
Chloroethane	1.0	10	8260B (5030B)(low level)
Chloroform	1.0	5.0	8260B (5030B)(low level)
Chloromethane	1.0	10	8260B (5030B)(low level)
Chloroprene	1.0	5.0	8260B (5030B)(low level)
3-Chloro-1-propene	1.0	5.0	8260B (5030B)(low level)
1,2-Dibromo-3-chloropropane	1.0	10	8260B (5030B)(low level)
Dibromochloromethane	1.0	5.0	8260B (5030B)(low level)
1,2-Dibromoethane	1.0	5.0	8260B (5030B)(low level)
Dibromomethane	1.0	5.0	8260B (5030B)(low level)
trans-1,4-Dichloro-2-butene	2.0	10	8260B (5030B)(low level)
Dichlorodifluoromethane	1.0	5.0	8260B (5030B)(low level)
1,1-Dichloroethane	1.0	5.0	8260B (5030B)(low level)
1,2-Dichloroethane	1.0	5.0	8260B (5030B)(low level)
trans-1,2-dichloroethene	1.0	5.0	8260B (5030B)(low level)
1,1-Dichloroethene	1.0	5.0	8260B (5030B)(low level)
Methylene Chloride	5.0	5.0	8260B (5030B)(low level)
1,2-Dichloropropane	1.0	5.0	8260B (5030B)(low level)
cis-1,3-Dichloropropene	1.0	5.0	8260B (5030B)(low level)
trans-1,3-Dichloropropene	1.0	5.0	8260B (5030B)(low level)
Ethyl benzene	1.0	5.0	8260B (5030B)(low level)
Ethyl methacrylate	1.0	5.0	8260B (5030B)(low level)
2-Hexanone	10	25	8260B (5030B)(low level)
Iodomethane	5.0	5.0	8260B (5030B)(low level)
Isobutanol	40	200	8260B (5030B)(low level)
Methacrylonitrile	20	100	8260B (5030B)(low level)
2-Butanone	10	25	8260B (5030B)(low level)
Methyl methacrylate	1.0	5.0	8260B (5030B)(low level)
4-Methyl-2-pentanone	10	25	8260B (5030B)(low level)

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Volatiles (Cont.)	Quantitation Limits* Water (μg/L)	Quantitation Limits* Low Soil (μg/kg)	Method Number
Pentachloroethane	5.0	25	8260B (5030B)(low level)
Propionitrile	20	100	8260B (5030B)(low level)
Stryene	1.0	5.0	8260B (5030B)(low level)
1,1,1,2-Tetrachloroethane	1.0	5.0	8260B (5030B)(low level)
1,1,2,2-Tetrachloroethane	1.0	5.0	8260B (5030B)(low level)
Tetrachloroethene	1.0	5.0	8260B (5030B)(low level)
Toluene	1.0	5.0	8260B (5030B)(low level)
1,1,1-Trichloroethane	1.0	5.0	8260B (5030B)(low level)
1,1,2-Trichloroethane	1.0	5.0	8260B (5030B)(low level)
Trichloroethene	1.0	5.0	8260B (5030B)(low level)
Trichlorofluoromethane	1.0	5.0	8260B (5030B)(low level)
1,2,3-Trichloropropane	1.0	5.0	8260B (5030B)(low level)
Vinyl Acetate	2.0	10	8260B (5030B)(low level)
Vinyl Chloride	1.0	10	8260B (5030B)(low level)
Xylene	2.0	10	8260B (5030B)(low level)

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles	Quantitation Limits*		Method Number
	Water (μg/L)	Low Soil (μg/kg)	
Acenaphthene	10	330	8270C
Acenaphthylene	10	330	8270C
Acetophenone	10	330	8270C
2-Acetylaminofluorene	10	330	8270C
4-Aminobiphenyl	20	330	8270C
Aniline	20	660	8270C
Anthracene	10	330	8270C
Aramite	10	330	8270C
Benzo(a)anthracene	10	330	8270C
Benzo(b)fluoranthene	10	330	8270C
Benzo(k)fluoranthene	10	330	8270C
Benzo(g,h,i)perylene	10	330	8270C
Benzo(a)pyrene	10	330	8270C
Benzyl alcohol	10	330	8270C
Bis(2-chloroethoxyl)methane	10	330	8270C
Bis(2-chloroethyl)ether	10	330	8270C
Bis(2-ethylhexyl)phthalate	10	330	8270C
4-Bromophenyl phenyl ether	10	330	8270C
Butylbenzylphthalate	10	330	8270C
4-Chloroaniline	20	660	8270C
4-Chloro-3-methylphenol	10	330	8270C
2-Chloronaphthalene	10	330	8270C
2-Chlorophenol	10	330	8270C
4-Chlorophenyl phenyl ether	10	330	8270C
Chrysene	10	330	8270C
3&4 Methylphenol	10	330	8270C
2-Methylphenol	10	330	8270C
Diallate	10	330	8270C
Dibenzofuran	10	330	8270C
Di-n-butyl phthalate	10	330	8270C
Dibenzo(a,h)anthracene	10	330	8270C
o-Dichlorobenzene	10	330	8270C
m-Dichlorobenzene	10	330	8270C
p-Dichlorobenzene	10	330	8270C
3,3'-Dichlorobenzidine	20	660	8270C
2,4-Dichlorophenol	10	330	8270C
2,6-Dichlorophenol	10	330	8270C
Diethylphthalate	10	330	8270C
p-(Dimethylamino)azobenzene	10	330	8270C
7,12-Dimethyl benz(a)anthracene	10	330	8270C
3,3-Dimethyl benzidine	20	1,700	8270C
2,4-Dimethylphenol	10	330	8270C
alpha, alpha-Dimethylphenethylamine	2,000	67,000	8270C
Dimethyl phthalate	10	330	8270C

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles (Cont.)	Quantitation Limits* Water (μg/L)	Quantitation Limits* Low Soil (μg/kg)	Method Number
m-Dinitrobenzene	10	330	8270C
4,6-Dinitro-2-methylphenol	50	1,700	8270C
2,4-Dinitrophenol	50	1,700	8270C
2,4-Dinitrotoluene	10	330	8270C
2,6-Dinitrotoluene	10	330	8270C
Di-n-octylphthalate	10	330	8270C
1,4-Dioxane	10	330	8270C
Dinoseb	10	330	8270C
Ethylmethanesulfonate	10	330	8270C
Fluoranthene	10	330	8270C
Fluorene	10	330	8270C
Hexachlorobenzene	10	330	8270C
Hexachlorobutadiene	10	330	8270C
Hexachlorocyclopentadiene	10	330	8270C
Hexachloroethane	10	330	8270C
Hexachlorophene	5,000	170,000	8270C
Hexachloropropene	10	330	8270C
Indeno(1,2,3-cd)pyrene	10	330	8270C
Isophorone	10	330	8270C
Isosafrole	10	330	8270C
Methapyrilene	2,000	67,000	8270C
3-Methylcholanthrene	10	330	8270C
Methyl methanesulfonate	10	330	8270C
2-Methylnaphthalene	10	330	8270C
Naphthalene	10	330	8270C
1,4-Naphthoquinone	10	330	8270C
1-Naphthylamine	10	330	8270C
2-Naphthylamine	10	330	8270C
2-Nitroaniline	50	1,700	8270C
3-Nitroaniline	50	1,700	8270C
4-Nitroaniline	50	1,700	8270C
Nitrobenzene	10	330	8270C
2-Nitrophenol	10	330	8270C
4-Nitrophenol	50	1,700	8270C
4-Nitroquinoline-1-oxide	20	3,300	8270C
n-Nitrosodi-n-butylamine	10	330	8270C
n-Nitrosodiethylamine	10	330	8270C
n-Nitrosodimethylamine	10	330	8270C
n-Nitrosodiphenylamine	10	330	8270C
n-Nitrosodi-n-propylamine	10	330	8270C
n-Nitrosomethylethylamine	10	330	8270C
n-Nitrosomorpholine	10	330	8270C
n-Nitrosopiperidine	10	330	8270C
n-Nitrosopyrrolidine	10	330	8270C

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles (Cont.)	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (µg/kg)	Method Number
5-Nitro-o-toluidine	10	330	8270C
bis-(2-chloroisopropyl)ether	10	330	8270C
Pentachlorobenzene	10	330	8270C
Pentachloronitrobenzene	10	330	8270C
Pentachlorophenol	50	1,700	8270C
Phenacetin	10	330	8270C
Phenanthrene	10	330	8270C
Phenol	10	330	8270C
1,4-Phenylenediamine	2,000	1,700	8270C
2-Picolin	10	330	8270C
Pronamide	10	330	8270C
Pyrene	10	330	8270C
Pyridine	50	330	8270C
Safrole	10	330	8270C
1,2,4,5-Tetrachlorobenzene	10	330	8270C
2,3,4,6-Tetrachlorophenol	10	330	8270C
o-Toluidine	20	330	8270C
1,2,4-Trichlorobenzene	10	330	8270C
2,4,5-Trichlorophenol	10	330	8270C
2,4,6-Trichlorophenol	10	330	8270C
1,3,5-Trinitrobenzene	10	330	8270C
Low Level PAHs	**Quantitation Limits* Water (µg/L)**	**Quantitation Limits* Low Soil (µg/kg)**	**Method Number**
Acenaphthene	0.2	6.7	8270C
Acenaphthylene	0.2	6.7	8270C
Anthracene	0.2	6.7	8270C
Benzo(a)anthracene	0.2	6.7	8270C
Benzo(b)fluoranthene	0.2	6.7	8270C
Benzo(k)fluoranthene	0.2	6.7	8270C
Benzo(g,h,i)perylene	0.2	6.7	8270C
Benzo(a)pyrene	0.2	6.7	8270C
Chrysene	0.2	6.7	8270C
Dibenzo(a,h)anthracene	0.2	6.7	8270C
Fluoranthene	0.2	6.7	8270C
Fluorene	0.2	6.7	8270C
Indeno(1,2,3-cd)pyrene	0.2	6.7	8270C
1-Methylnaphthalene	0.2	6.7	8270C
2-Methylnaphthalene	0.2	6.7	8270C
Naphthalene	0.2	6.7	8270C
Phenanthrene	0.2	6.7	8270C
Pyrene	0.2	6.7	8270C

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Pesticides	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
Aldrin	0.05	1.7	8081A
Alpha-BHC	0.05	1.7	8081A
beta-BHC	0.05	1.7	8081A
delta-BHC	0.05	1.7	8081A
gamma-BHC	0.05	1.7	8081A
Chlordane	0.5	17	8081A
Chlorobenzilate	0.5	17	8081A
4,4'-DDT	0.1	3.3	8081A
4,4'-DDE	0.1	3.3	8081A
4,4'-DDD	0.1	3.3	8081A
Dieldrin	0.1	3.3	8081A
Endosulfan I	0.05	1.7	8081A
Endosulfan II	0.1	3.3	8081A
Endosulfan sulfate	0.1	3.3	8081A
Endrin	0.1	3.3	8081A
Isodrin	0.05	3.3	8081A
Kepone	1.0	170	8081A
Toxaphene	5.0	170	8081A
Endrin Aldehyde	0.1	3.3	8081A
Heptachlor	0.05	1.7	8081A
Heptachlor epoxide	0.05	1.7	8081A
Methyoxychlor	0.5	17	8081A
Total Petroleum Hydrocarbons	**Quantitation Limits***		**Method Number**
	Water (µg/L)	**Low Soil (µg/kg)**	
TPH DRO	100	3300	8015B
TPH GRO	50	250	8015B

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.
µg/L - micrograms per liter.
µg/kg - micrograms per kilogram.

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Inorganics	Method Number	Quantitation Limits* Water (μg/L)	Low Soil (mg/kg)	Method Description
Antimony	6010B	20	2.0	Inductively Coupled Plasma
Arsenic	6010B	10	1.0	Inductively Coupled Plasma
Barium	6010B	10	1.0	Inductively Coupled Plasma
Beryllium	6010B	4.0	0.4	Inductively Coupled Plasma
Cadmium	6010B	5.0	0.5	Inductively Coupled Plasma
Chromium	6010B	10	1.0	Inductively Coupled Plasma
Cobalt	6010B	10	1.0	Inductively Coupled Plasma
Copper	6010B	20	2.0	Inductively Coupled Plasma
Lead	6010B	5.0	0.5	Inductively Coupled Plasma
Mercury	7470A/7471A	0.2	0.02	Cold Vapor AA
Nickel	6010B	40	4.0	Inductively Coupled Plasma
Selenium	6010B	10	1.0	Inductively Coupled Plasma
Silver	6010B	10	1.0	Inductively Coupled Plasma
Thallium	6010B	10	1.0	Inductively Coupled Plasma
Tin	6010B	10	5.0	Inductively Coupled Plasma
Vanadium	6010B	10	1.0	Inductively Coupled Plasma
Zinc	6010B	20	2.0	Inductively Coupled Plasma
RCRA Metals	**Method Number**	**Quantitation Limits* Soil (mg/kg)**	**Water (μg/L)**	**Method Description**
Arsenic	6010B (3050B/3010A)	1.0	10	Inductively Coupled Plasma
Barium	6010B (3050B/3010A)	1.0	10	Inductively Coupled Plasma
Cadmium	6010B (3050B/3010A)	0.50	5	Inductively Coupled Plasma
Chromium	6010B (3050B/3010A)	1.0	10	Inductively Coupled Plasma
Lead	6010B (3050B/3010A)	0.50	5.0	Inductively Coupled Plasma
Mercury	7471A/7470A	0.020	0.20	Cold Vapor AA
Selenium	6010B (3050B/3010A)	1.0	10	Inductively Coupled Plasma
Silver	6010B (3050B/3010A)	1.0	10	Inductively Coupled Plasma

Notes:

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.

μg/L - micrograms per liter.

mg/kg - milligrams per kilogram.

TABLE 3-3

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
QA/QC and IDW SAMPLES
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

	Aqueous Samples Analysis Requested								Solid Samples Analysis Requested		
Media	App IX VOCs	App IX SVOCs	App IX Pesticides	App IX Low Level PAHs	App IX Metals (Total)	TPH DRO/GRO	Benzene	RCRA Metals	Benzene	RCRA Metals	**Comment**
Trip Blank Samples											
60TB01	X[1]					X[1]					VOCs and GRO only
60TB02	X[1]					X[1]					VOCs and GRO only
60TB03	X[1]					X[1]					VOCs and GRO only
Equipment Rinsate Samples											
60ER01	X	X	X	X	X	X					Stainless Steel Spoon
60ER02	X	X	X	X	X	X					Split Spoon Sampler
60ER03		X	X	X	X	X					Petite Ponar Dredge, Acetate Sediment Liner, Stainless Steel Spoon, or Aluminum Pie Pan
60ER04	X	X	X	X	X	X					Polyethylene and silicon tubing
Field Blank Samples											
60FB01	X	X	X	X	X	X					Lab Grade Deionized Water
60FB02	X	X	X	X	X	X					Store Bought Distilled Warer
60FB03	X	X	X	X	X	X					NAPR Potable Water
IDW Samples											
60IDW01							X	X			Aqueous
60IDW02									X	X	Solid

Note:

[1] - The analysis required for this sample will be dependent on which samples are being accompanied in the cooler.

FIGURES

4 0 2 4 8

1 inch = 4 miles

Baker

FIGURE 1–1
REGIONAL LOCATION MAP
SWMU 60–FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 5 – RFI Work Plans\SWMU 60 RFI\CAD\ 111626_60_02

Baker

LEGEND

— SWMUs

— AOCs

60 — AREA TO WHICH THIS INVESTIGATION PERTAINS

SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

3000 0 1500 3000

1 inch = 3000 ft.

FIGURE 1-2
SWMU/AOC LOCATION MAP
SWMU 60-FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO

Baker

LEGEND

–1958 POLYGON FEATURE

–SWMU SITE BOUNDARY

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.

FIGURE 1–3
1958 AERIAL PHOTOGRAPH
SWMU 60–FORMER LANDFILL
AT THE MARINA
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO

SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

Baker

LEGEND

- 1958 POLYGON FEATURE
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE WATER AND SEDIMENT SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- GASOLINE/DIESEL AST
- APPROXIMATE LOCATION OF UNDERGROUND PIPING SYSTEM
- ESTUARINE WETLAND BOUNDARY
- M2US2 – COWARDIAN WETLAND CLASSIFICATION
- SWMU BOUNDARY

FIGURE 1-4
SITE LAYOUT AND ECP SAMPLE LOCATION MAP
SWMU 60-FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

150 0 75 150

1 inch = 150 ft.

SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

Baker

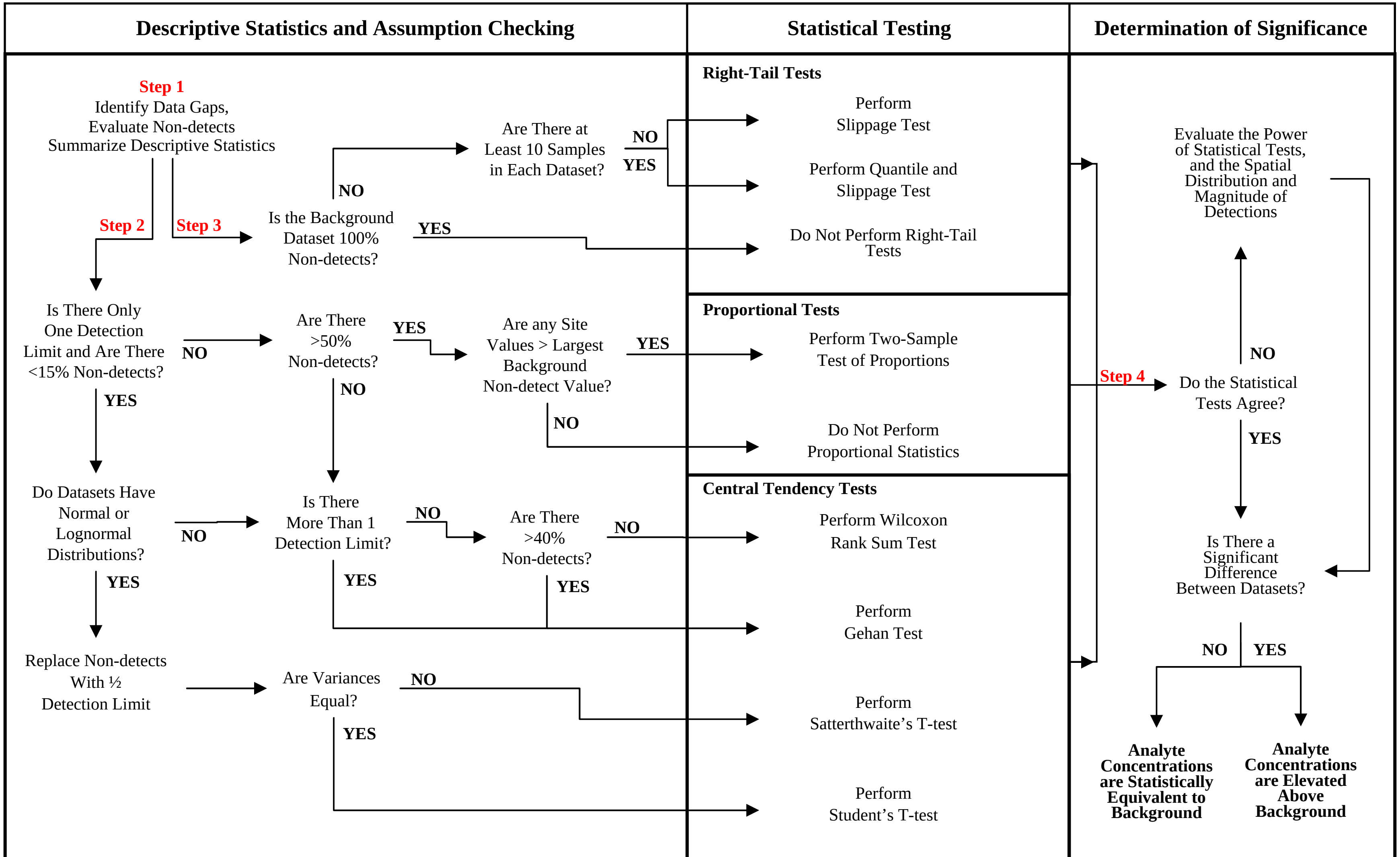
LEGEND

- 1958 POLYGON FEATURE
- PROPOSED SURFACE AND SUBSURFACE SOIL SAMPLE LOCATIONS
- PROPOSED SEDIMENT SAMPLE LOCATIONS
- PROPOSED SURFACE SOIL, SUBSURFACE AND GROUNDWATER SOIL SAMPLE LOCATIONS
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE WATER AND SEDIMENT SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SOIL AND GROUNDWATER SAMPLE LOCATION (1999 SITE CHARACTERIZATION)
- GASOLINE/DIESEL AST
- ESTUARINE WETLAND BOUNDARY
- M2US2 – COWARDIAN WETLAND CLASSIFICATION
- APPROXIMATE LOCATION OF UNDERGROUND PIPING SYSTEM
- SWMU BOUNDARY

FIGURE 3-1
PROPOSED SAMPLE LOCATION MAP
SWMU 60-FORMER LANDFILL
AT THE MARINA
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO

FIGURE 4-1
STATISTICAL ANALYSIS PROCESS
SWMU 60 – FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

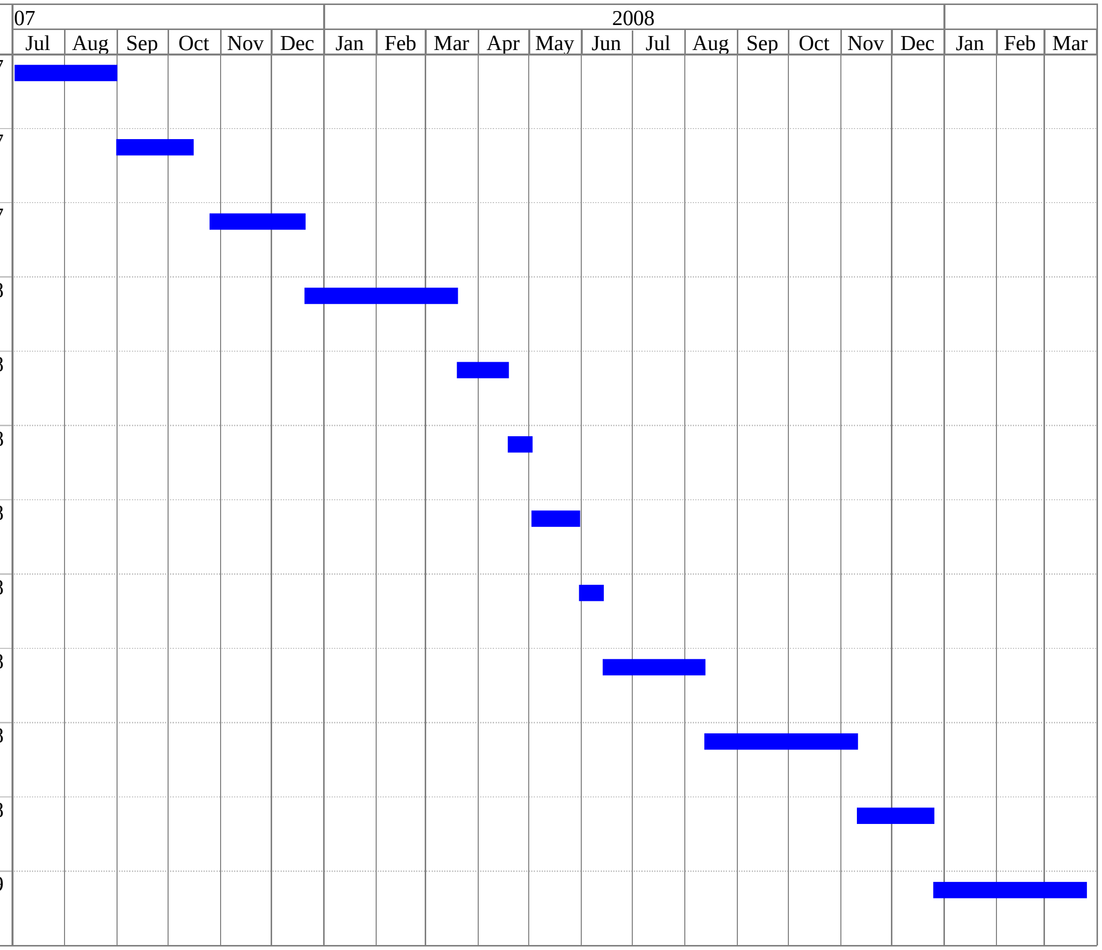


T-tests performed on log-transformed data if datasets have lognormal distributions.

Revised: December 20, 2007

FIGURE 5-1
PROPOSED PROJECT SCHEDULE
SWMU 60- FORMER LANDFILL AT THE MARINA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

ID	Task Name	Duration	Start	Finish
1	Draft RFI Work Plan to the EPA	60 edays	7/2/07	8/31/07
2	EPA Review	48 edays	8/31/07	10/18/07
3	Final RFI Work Plan to the EPA	56 edays	10/25/07	12/20/07
4	EPA Review & Approval	90 edays	12/21/07	3/20/08
5	Initiate Field Work	30 edays	3/20/08	4/19/08
6	Field Investigation	14 edays	4/19/08	5/3/08
7	Laboratory Analysis	28 edays	5/3/08	5/31/08
8	Data Validation	14 edays	5/31/08	6/14/08
9	Draft Phase I RFI Report for SWMU 60 to EPA	60 edays	6/14/08	8/13/08
10	EPA Review	90 edays	8/13/08	11/11/08
11	Final Phase I RFI Report for SWMU 60 to EPA	45 edays	11/11/08	12/26/08
12	EPA Review & Approval	90 edays	12/26/08	3/26/09

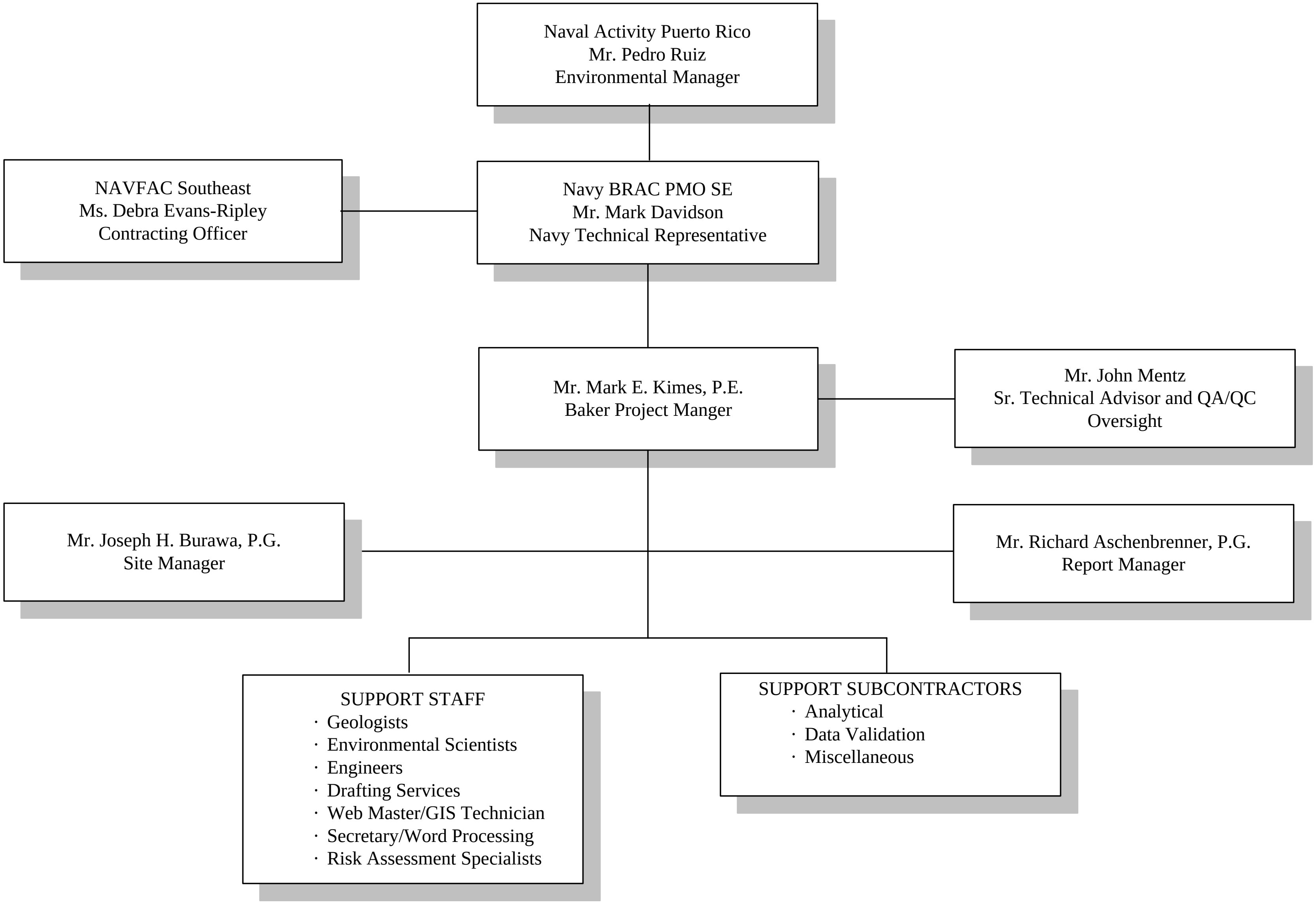


Project:Phase I RFI Work Plan
Date: 12/18/07

Task

Revised: December 20, 2007

FIGURE 6-1
PROJECT ORGANIZATION
PHASE I RFI WORK PLAN – SWMU 60
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX A
Photographs of SWMU 60 – Former Landfill at the Marina

SWMU 60 - Former Landfill at the Marina

Photograph A-1: View Looking West from the Vicinity of Sample 6E-01

Photograph A-2: View Looking North from the Vicinity of Sample 6E-03

APPENDIX B
Summary of Analytical Results from
Site Characterization Report (CH2MHill, 1999)

TABLE B-1
Summary of TEG Laboratory Soil Analytical Results
Marina, Roosevelt Roads, U.S. Naval Station, Ceiba, Puerto Rico

Soil Boring	**Date Sampled**	**TEG Laboratory**		
		EPA Method 8015M (GRO) TPH (mg/kg)	**EPA Method 8015M (DRO) TPH (mg/kg)**	**EPA Method 8020 Total BTEX (mg/kg)**
Marina-SB-1 (4-6’)	5/5/99	<10	<25	<0.30
Marina-SB-2 (2-4’)	5/5/99	<10	<25	<0.30
Marina-SB-3 (2-4’)	5/6/99	3,200	<25	426.2
Marina-SB-4 (0-2’)	5/6/99	600	<25	66.5
Marina-SB-5 (0-2’)	5/6/99	3,100	<25	464.6
Marina-SB-6 (0-2’)	5/6/99	610	<25	58.96
Marina-SB-7 (2-4’)	5/6/99	<10	<25	1.97
Marina-SB-8 (0-2’)	5/6/99	<10	<25	<0.30
Marina-SB-9 (0-2’)	5/6/99	<10	<25	<0.30
Marina-SB-10	NC	NC	NC	NC
Marina-SB-11 (2-4’)	5/7/99	<10	<25	<0.30
Marina-SB-12 (0-2’)	5/10/99	<10	<25	<0.30
PREQB UST Target Levels		100	100	NS

Notes:	PREQB	=	Puerto Rico Environmental Quality Board
	TPH	=	Total Petroleum Hydrocarbons
	Total BTEX	=	Sum of Benzene, Toluene, Ethylbenzene, and Xylene Concentrations
	mg/kg	=	Milligrams per Kilogram
	NS	=	No Standards in Puerto Rico
	UST	=	Underground Storage Tanks
	NC	=	Not Collected
	EPA	=	Environmental Protection Agency
	8015M (GRO)	=	EPA Method 8015M Gasoline Range Organics
	8015M (DRO)	=	EPA Method 8015M Diesel Range Organics
	NA	=	Not analyzed

TABLE B-2
Summary of Groundwater Analytical Results
Marina, Roosevelt Roads, U.S. Naval Station, Ceiba, Puerto Rico

Parameters	PREBQ Target Levels	U.S. EPA MCL	Marina-MW-1	Marina-MW-2	Marina-MW-3	Marina-MW-4
Date Sampled			**7/13/99**	**7/13/99**	**7/13/99**	**7/13/99**
Benzene (μg/L)	5.0	1.0	<5	<5	190	<5
Toluene (μg/L)	1,000	1,000	<5	<5	160	<5
Ethylbenzene (μg/L)	700	700	<5	<5	180	<5
Total Xylenes (μg/L)	10,000	10,000	<15	<15	270	<15
Total BTEX (μg/L)	50,000	NS	<30	<30	800	<30
TPH (GRO) (μg/L)	50,000	NS	<10,000	<10,000	12,000	<10,000
TPH (DRO) (μg/L)	50,000	NS	<25,000	<25,000	<25,000	<25,000
PNA (μg/L)	NS	NS	*	**	***	****
Lead (μg/L) Unfiltered	15	15	1400	460	250	1400
Lead (μg/L) Filtered (45 micron filter)	15	15	830	490	270	1300

Notes:

μg/L	=	Micrograms per Liter
PREQB	=	Puerto Rico Environmental Quality Board
Total BTEX	=	Sum of Benzene, Toluene, Ethylbenzene, and Xylenes
TPH (GRO)	=	EPA Method 8015M Gasoline Range Organics
TPH (DRO)	=	EPA Method 8015M Diesel Range Organics
PAH	=	Polynuclear Aromatic Hydrocarbon (excluding total naphthalene's)
NS	=	No Standard
NA	=	Not Collected or Analyzed
MCL	=	Maximum Contaminant Level
BDL	=	Below Detection Levels
*	=	Detected Benzo(b)Fluoranthene/Benzo(k)Fluoranthene, Benzo (a) Pyrene, and Dibenzo(ah)Anthracene-Indeno (1, 2, 3-cd) Pyrene at concentrations of 0.07, 0.57, and 0.15 mg/L respectively
**	=	Detected Benzo(b)Fluoranthene/Benzo(k)Fluoranthene, and Dibenzo(ah)Anthracene-Indeno (1, 2, 3-cd) Pyrene at concentrations of 0.05 and 0.19 mg/L respectively
***	=	Detected Naphthalene, Benzo(b)Fluoranthene/Benzo(k)Fluoranthene, and Dibenzo(ah)Anthracene-Indeno (1, 2, 3-cd) Pyrene at concentrations of 0.04, 0.32, and 0.09 mg/L respectively
****	=	Detected Dibenzo(ah)Anthracene-Indeno (1, 2, 3-cd) Pyrene at concentrations of 0.09 mg/L
US EPA	=	United States Environmental Protection Agency

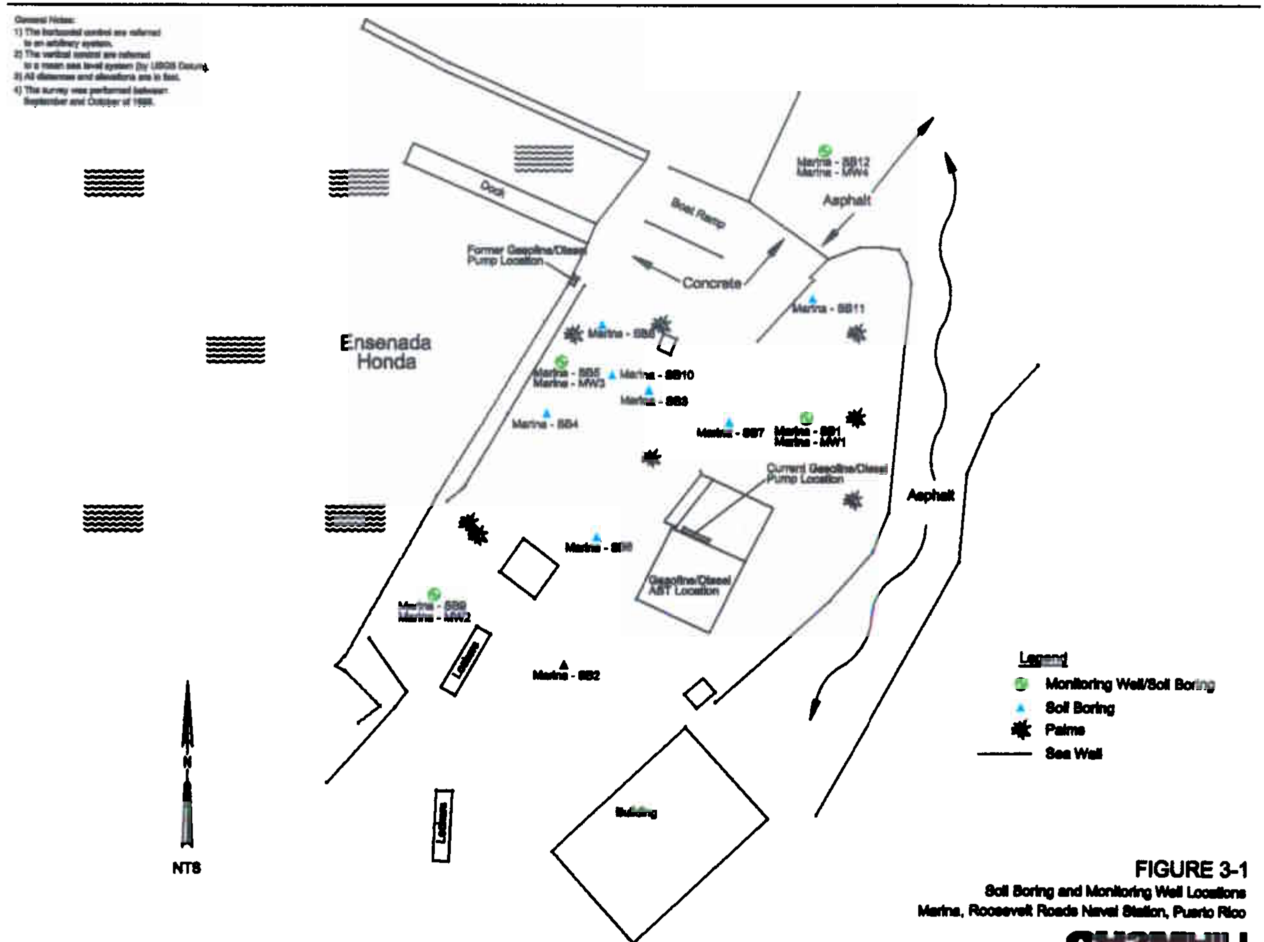


FIGURE 3-1
Soil Boring and Monitoring Well Locations
Marina, Roosevelt Roads Naval Station, Puerto Rico

CH2MHILL

Figure 3-1.dwg 07-July-1999

APPENDIX C
Summary of Analytical Results from Phase II ECP Study

TABLE C-1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	6E-03 6E-SS03 05/07/04 0.00 - 0.50	6E-03 6E-SS03D 05/07/04 0.00 - 0.50	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)									
Chlorobenzene	2,000,000	160,000	4.5 U	2.5 J	0/2		0/2		6E-SS03D
Tetrachloroethene	5,300	1,200	4.5 U	2.2 J	0/2		0/2		6E-SS03D
Semivolatile Organic Compounds (ug/kg)									
Benzo(g,h,i)perylene	NE	NE	58 J	370 U	NE		NE		6E-SS03
Fluoranthene	4,100,000	310,000	57 J	42 J	0/2		0/2		6E-SS03
Indeno(1,2,3-cd)pyrene	3,900	870	58 J	370 U	0/2		0/2		6E-SS03
Pyrene	3,100,000	230,000	48 J	43 J	0/2		0/2		6E-SS03
Pesticides/PCBs (ug/kg)									
4,4'-DDE	8,400	1,900	2.8 J	3 J	0/2		0/2		6E-SS03D
4,4'-DDT	8,400	1,900	3.6 U	0.76 JP	0/2		0/2		6E-SS03D
OP-Pesticides (ug/kg)									
Not Detected									
Chlorinated Herbicides (ug/kg)									
Not Detected									

Notes:

J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
P - The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two GC columns or HPLC detectors.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

TABLE C-2

Revised: December 20, 2007

SUMMARY OF INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	6E-03 6E-SS03 05/07/04 0.00 - 0.50	6E-03 6E-SS03D 05/07/04 0.00 - 0.50	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)												
Arsenic	1.9	0.43	2.4	**2.1**	**2.1**	2/2	2.1 - 2.1	2/2	2.1 - 2.1	0/2		63-SS03, 6E-SS03D
Barium	7,200	550	181	110	89	0/2		0/2		0/2		6E-SS03
Beryllium	200	16	0.45	0.22 B	0.22 B	0/2		0/2		0/2		63-SS03, 6E-SS03D
Cadmium	100	7.8	0.27	0.085 B	0.076 B	0/2		0/2		0/2		6E-SS03
Chromium	310	23	59.3	18	21	0/2		0/2		0/2		6E-SS03D
Cobalt	2,000	160	44.0	18 E	15 E	0/2		0/2		0/2		6E-SS03
Copper	4,100	310	234	91	98	0/2		0/2		0/2		6E-SS03D
Lead	400(1)	400(1)	125	15	16	0/2		0/2		0/2		6E-SS03D
Mercury	31(2)	2.3(2)	0.11	0.02	0.017 B	0/2		0/2		0/2		6E-SS03
Nickel	2,000	160	16.6	8.8	8.7	0/2		0/2		0/2		6E-SS03
Tin	61,000	4,700	2.43	2 B	2.9 B	0/2		0/2		1/2	2.9B	6E-SS03D
Vanadium	100	7.8	355	**120**	**120**	0/2		2/2	120 - 120	0/2		63-SS03, 6E-SS03D
Zinc	31,000	2,300	125	60	63	0/2		0/2		0/2		6E-SS03D

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
E - The reported value is an estimated because of the presence of matrix interference.
(1) - 1996 Soil Screening Guidance.
(2) - Value based on the RBC for Mercuric Chloride.
NE - Not Established.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

Shading indicates exceedance of EPA Region III Industrial BCs
Bold indicates exceedance of EPA Region III Residential RBCs
Underline indicates exceedance of 2 x Average Detected Background

TABLE C-3

SUMMARY OF ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	6E-01 6E-SB01-02 05/07/04 3.00 - 5.00	6E-02 6E-SB02-01 05/07/04 1.00 - 3.00	6E-03 6E-SB03-01 05/07/04 1.00 - 3.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)										
Carbon disulfide	10,000,000	780,000	3.5 J	5.8 U	5.4 U	0/3		0/3		6E-SB01-02
Toluene	20,000,000	1,600,000	5.7 U	5.8 U	6.3	0/3		0/3		6E-SB03-01
Xylene	20,000,000	1,600,000	11 U	12 U	4.8 J	0/3		0/3		6E-SB03-01
Semivolatile Organic Compounds (ug/kg)										
Benzo(g,h,i)perylene	NE	NE	390 U	400 U	35 J	NE		NE		6E-SB03-01
Fluoranthene	4,100,000	310,000	390 U	400 U	77 J	0/3		0/3		6E-SB03-01
Pyrene	3,100,000	230,000	42 J	400 U	58 J	0/3		0/3		6E-SB03-01
Pesticides/PCBs (ug/kg)										
4,4'-DDD	12,000	2,700	30	1.5 J	41	0/3		0/3		6E-SB03-01
4,4'-DDE	8,400	1,900	46	14	60	0/3		0/3		6E-SB03-01
4,4'-DDT	8,400	1,900	210 D	0.98 J	1.2 JP	0/3		0/3		6E-SB01-02
OP-Pesticides (ug/kg)										
Not Detected										
Chlorinated Herbicides (ug/kg)										
Not Detected										

Notes:

J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
P - The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two GC columns or HPLC detectors.
D - The reported result is from a secondary dilution.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

TABLE C-4

Revised: December 20, 2007

SUMMARY OF INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	6E-01 6E-SB01-02 05/07/04 3.00 - 5.00	6E-02 6E-SB02-01 05/07/04 1.00 - 3.00	6E-03 6E-SB03-01 05/07/04 1.00 - 3.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)													
Antimony	41,000	3,100	2.8	2.3 U	1.4 B	2.3 U	0/3		0/3		0/3		6E-SB02-01
Arsenic	1.9	0.43	2.05	**1.6**	**3.3**	**2.9**	2/3	2.9 - 3.3	3/3	1.6 - 3.3	2/3	2.9 - 3.3	6E-SB02-01
Barium	7,200	550	222	76	62	49	0/3		0/3		0/3		6E-SB01-02
Beryllium	200	16	0.74	0.17 B	0.11 B	0.16 B	0/3		0/3		0/3		6E-SB01-02
Cadmium	100	7.8	0.74	0.28 B	0.31 B	0.22 B	0/3		0/3		0/3		6E-SB02-01
Chromium	310	23	133	12	14	16	0/3		0/3		0/3		6E-SB03-01
Cobalt	2,000	160	30.0	11 E	6.4 E	9.4 E	0/3		0/3		0/3		6E-SB01-02
Copper	4,100	310	193	84	82	65	0/3		0/3		0/3		6E-SB01-02
Lead	400(1)	400(1)	8.68	20	63	16	0/3		0/3		3/3	16 - 63	6E-SB02-01
Mercury	31(2)	2.3(2)	0.093	0.057 S	0.03	0.025	0/3		0/3		0/3		6E-SB01-02
Nickel	2,000	160	31.9	6.2	4.9	8.3	0/3		0/3		0/3		6E-SB03-01
Sulfide	NE	NE	32.58	30 B	30 B	31 U	NE		NE		0/3		6E-SB01-02, 6E-SB02-01
Tin	61,000	4,700	2.96	3.6 B	4 B	2.6 B	0/3		0/3		2/3	3.6B - 4B	6E-SB02-01
Vanadium	100	7.8	462	**94**	**47**	**68**	0/3		3/3	47 - 94	0/3		6E-SB01-02
Zinc	31,000	2,300	88.6	100	94	56	0/3		0/3		2/3	94 - 100	6E-SB01-02

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
E - The reported value is an estimated because of the presence of matrix interference.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
S - The result was determined by Method of Standard Addition.
(1) - 1996 Soil Screening Guidance.
(2) - Value based on the RBC for Mercuric Chloride.
NE - Not Established.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

Shading indicates exceedance of EPA Region III Industrial BCs
Bold indicates exceedance of EPA Region III Residential RBCs
Underline indicates exceedance of 2 x Average Detected Background

TABLE C-5

SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date	Federal MCLs (ug/L)	**EPA Region III Tap Water RBCs** (ug/L)	PR Water Quality Standards (ug/L)	6E-01 6E-GW01 05/09/04	6E-02 6E-GW02 05/09/04	Number Exceeding Federal MCLs	Range Exceeding Federal MCLs	**Number Exceeding EPA Region III Tap Water RBCs**	**Range Exceeding EPA Region III Tap Water RBCs**	Number Exceeding PR Water Quality Standards	Range Exceeding PR Water Quality Standards	Location Maximum Detection
Volatile Organic Compounds (ug/L)												
Acetone	NE	550	NE	7.8 J	25 U	NE		0/2		NE		6E-GW01
2-Butanone	NE	700	NE	1.8 J	10 U	NE		0/2		NE		6E-GW01
Carbon disulfide	NE	100	NE	0.77 J	1 U	NE		0/2		NE		6E-GW01
Toluene	1,000	75	1,000	0.93 J	0.93 J	0/2		0/2		0/2		6E-GW01, 6E-GW02
Semivolatile Organic Compounds (ug/L)												
Cresol, m & p	NE	NE	NE	5 J	10 U	NE		NE		NE		6E-GW01
Pesticides/PCBs (ug/L)												
Not Detected												
OP-Pesticides (ug/L)												
Not Detected												
Chlorinated Herbicides (ug/L)												
Not Detected												

Notes:
J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
ug/L - micrograms per liter.
NE - Not Established.

TABLE C-6

SUMMARY OF (DISSOLVED) INORGANIC DETECTIONS IN GROUNDWATER
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date	Federal MCLs (mg/L)	**EPA Region III Tap Water RBCs** (mg/L)	PR Water Quality Standards (mg/L)	6E-01 6E-GW01 05/09/04	6E-02 6E-GW02 05/09/04	Number Exceeding Federal MCLs	Range Exceeding Federal MCLs	**Number Exceeding EPA Region III Tap Water RBCs**	**Range Exceeding EPA Region III Tap Water RBCs**	Number Exceeding PR Water Quality Standards	Range Exceeding PR Water Quality Standards	Location Maximum Detection
Appendix IX Inorganics (mg/L)												
Barium	2	0.26	NE	0.18	**0.33**	0/2		1/2	0.33	NE		6E-GW02
Chromium	0.1	0.011	NE	**0.0016** B	0.01 U	0/2		0/2		NE		6E-GW01
Cobalt	NE	0.073	NE	0.01 U	0.0084 B	NE		0/2		NE		6E-GW02
Copper	1.3[1]	0.15	1.3	0.1 U	0.0075 B	0/2		0/2		0/2		6E-GW02
Mercury	0.002	0.0011[2]	0.002	0.00054 B	0.002 U	0/2		0/2		0/2		6E-GW01
Nickel	NE	0.073	NE	0.04 U	0.0049 B	NE		0/2		NE		6E-GW02
Vanadium	NE	0.0037	NE	**0.015** B	0.0024 B	NE		1/2	0.015B	NE		6E-GW01

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
[1] - EPA action level.
[2] - Value based on the Tap Water RBC for Mercuric Chloride.
NE - Not Established. **Bold** indicates exceedance of EPA Region III Tap Water RBCs
mg/L - milligrams per liter.

TABLE C-7

SUMMARY OF ORGANIC DETECTIONS IN SEDIMENT
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	Marine Sediment Screening Values (ug/kg)	6E-SW/SD01 6E-SD01 05/14/04 0.00 - 0.50		6E-SW/SD02 6E-SD02 05/14/04 0.00 - 0.50		Number Exceeding Marine Sediment Screening Values	Range Exceeding Marine Sediment Screening Values	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)								
Not Detected								
Semivolatile Organic Compounds (ug/kg)								
Benzo(a)anthracene	74.8	190	J	770	U	1/2	190J	6E-SD01
Benzo(a)pyrene	88.8	240	J	770	U	1/2	240J	6E-SD01
Benzo(b)fluoranthene	1,800	240	J	770	U	0/2		6E-SD01
Benzo(g,h,i)perylene	670	130	J	770	U	0/2		6E-SD01
Benzo(k)fluoranthene	1,800	250	J	770	U	0/2		6E-SD01
bis(2-Ethylhexyl)phthalate	182	370	J	770	U	1/2	370J	6E-SD01
Chrysene	108	230	J	770	U	1/2	230J	6E-SD01
Fluoranthene	113	270	J	770	U	1/2	270J	6E-SD01
Indeno(1,2,3-cd)pyrene	600	130	J	770	U	0/2		6E-SD01
Phenanthrene	86.7	72	J	770	U	0/2		6E-SD01
Pyrene	153	300	J	770	U	1/2	300J	6E-SD01
Pesticides/PCBs (ug/kg)								
4,4'-DDE	2.07	12		7.7	U	1/2	12	6E-SD01
OP-Pesticides (ug/kg)								
Not Detected								
Chlorinated Herbicides (ug/kg)								
Not Detected								

Notes:

J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

Shading indicates exceedance of Marine Sediment Screening Value

TABLE C-8

SUMMARY OF INORGANIC DETECTIONS IN SEDIMENT
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	Marine Sediment Screening Values (mg/kg)	6E-SW/SD01 6E-SD01 05/14/04 0.00 - 0.50	6E-SW/SD02 6E-SD02 05/14/04 0.00 - 0.50	Number Exceeding Marine Sediment Screening Values	Range Exceeding Marine Sediment Screening Values	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)						
Arsenic	7.24	7.8	2.1 U	1/2	7.8	6E-SD01
Barium	48.0	18	9.4	0/2		6E-SD01
Beryllium	NA	0.14 B	0.83 U	NA		6E-SD01
Chromium	52.3	25	9.9	0/2		6E-SD01
Cobalt	10.0	4.6	2 B	0/2		6E-SD01
Copper	18.7	98	13	1/2	98	6E-SD01
Lead	30.2	20	5.8	0/2		6E-SD01
Mercury	0.13	0.15 S	0.043 U	1/2	0.15S	6E-SD01
Nickel	15.9	7.7	2.7 B	0/2		6E-SD01
Sulfide	NA	87	340	NA		6E-SD02
Tin	3.40	5.7 B	4.4 B	2/2	4.4B - 5.7B	6E-SD01
Vanadium	57.0	42	19	0/2		6E-SD01
Zinc	124	70	16	0/2		6E-SD01

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
S - The result was determined by Method of Standard Addition.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
NA - Not Available.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

Shading indicates exceedance of Marine Sediment Screening Value

TABLE C-9

SUMMARY OF INORGANIC DETECTIONS IN SURFACE WATER
SWMU 60 - FORMER LANDFILL AT THE MARINA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date	PR Water Quality Standards (mg/L)	**Surface Water Screening Values** (mg/L)	6E-SW/SD01 6E-SW01 05/14/04	6E-SW/SD01 6E-SW01D 05/14/04	6E-SW/SD02 6E-SW02 05/14/04	6E-SW/SD02 6E-SW02D 05/14/04	Number Exceeding PR Water Quality Standards	Range Exceeding PR Water Quality Standards	**Number Exceeding Surface Water Screening Values**	**Range Exceeding Surface Water Screening Values**	Location Maximum Detection
Appendix IX (Total) Inorganics (mg/L)											
Barium	NE	50	0.007 B	0.0069 B	0.0069 B	0.0072 B	NE		0/4		6E-SW02D
Vanadium	NE	0.120(1)	0.05 U	0.0043 B	0.05 U	0.05 U	NE		0/4		6E-SW01D

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.

U - The compound was analyzed for, but was not detected at or above the MDL/PQL.

(1) - This chemical lacks a marine/estuarine surface water screening value. The value shown is a freshwater screening value.

NE - Not Established.

mg/L - milligrams per liter.

APPENDIX D
USEPA Region II Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump=s intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of four options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough Adaily@ decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

< Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump

intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

< Well construction data, location map, field data from last sampling event.

< Polyethylene sheeting.

< Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

< Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

< Interface probe or equivalent device for determining the presence or absence of NAPL.

< Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

< Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

< Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

< Power source (generator, nitrogen tank, etc.).

< Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

< Decontamination supplies (see Section VII, below).

< Logbook (see Section VIII, below).

< Sample bottles.

< Sample preservation supplies (as required by the analytical methods).

< Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.
6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO)

approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

±0.1 for pH
±3% for specific conductance (conductivity)
±10 mv for redox potential
±10% for DO and turbidity

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

< Field duplicates
< Trip blanks for VOCs only
< Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use (Adaily decon@) and after each well is sampled (Abetween-well decon@). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using Adaily decon@ procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use (Adaily decon@).

EPA=s field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.)

must be decontaminated after each well is sampled (Abetween-well decon,@ see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

< Well identification number and physical condition.
< Well depth, and measurement technique.
< Static water level depth, date, time, and measurement technique.
< Presence and thickness of immiscible liquid layers and detection method.
< Collection method for immiscible liquid layers.
< Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
< Well sampling sequence and time of sample collection.
< Types of sample bottles used and sample identification numbers.
< Preservatives used.
< Parameters requested for analysis.

- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

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