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FINAL RESOURCE CONCERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT FOR SOLID WASTE MANAGEMENT UNIT 57 (SWMU 57) POL DRUM STORAGE AREA VOLUME 1 NAVAL ACTIVITY PUERTO RICO

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TETRA TECH

FULL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT

SWMU 57 – POL DRUM STORAGE AREA

Volume 1 - Text, Tables, Figures, Appendices A through D

Naval Activity Puerto Rico
(Former Naval Station Roosevelt Roads)
Ceiba, Puerto Rico

BRAC Program Management Office East
Contract Number N62472-03-D-0057
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FULL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT

SWMU 57 POL DRUM STORAGE AREA

Naval Activity Puerto Rico
(Former Naval Station Roosevelt Roads)
Ceiba, Puerto Rico

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ACRONYMS

ABS	Absorption from soil
ADAF	Age dependent adjustment factor
AFWTF	Atlantic Fleet Weapons Training Facility
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation Factor
BaP	Benzo(a)pyrene
BERA	Baseline Ecological Risk Assessment
bgs	Below ground surface
BRAC	Base Realignment and Closure Act of 1990
BTV	Background Threshold Value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CCME	Canadian Council of Ministers of the Environment
COPC	Chemical of potential concern
CSF	Cancer slope factor
CSM	Conceptual site model
CTE	Central tendency exposure
CTO	Contract Task Order
DAF	Dilution Attenuation Factor
DO	Dissolved oxygen
DOT	Department of Transportation
DPT	Direct-push technology
DQI	Data quality indicator
DQR	Data Quality Review
DRO	Diesel range organics
Eco SSL	Ecological Soil Screening Level
ECP	Environmental Condition of Property
EPC	Exposure point concentration
EEQ	Ecological effects quotient
ERA	Ecological risk assessment
ESL	Ecological screening level
EU	Exposure unit

°F	Degrees Fahrenheit
GPS	Global positioning system
GRO	Gasoline-range organics
HEAST	Health Effects Assessment Summary
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IDW	Investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
IUR	Inhalation risk
Katahdin	Katahdin Analytical Services, Inc.
LANL	Los Alamos National Laboratory
LCS	Laboratory control sample
LOAEL	Lowest observed adverse level
MCL	Maximum Contaminant Level
mg/kg	Milligram per kilogram
mg/kg-day	Milligram per kilogram day
mg/L	Milligram per liter
MGD	Million gallons per day
MRL	Minimal risk level
MS	Matrix spike
MSD	Matrix spike duplicate
msl	Mean sea level
NAD	North American Datum
NAPR	Naval Activity Puerto Rico
NAVFAC-LANT	Naval Facilities Engineering Command Atlantic
Navy	Department of Navy
NCEA	National Center for Environmental Assessment
NEESA	Naval Energy and Environmental Support Activity
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No observed adverse effects level
NSRR	Naval Station Roosevelt Roads
NTU	Nephelometric turbidity unit

OP	Organophosphorus
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORNL	Oakridge National Laboratory
PAH	Polynuclear aromatic hydrocarbon
PARCCS	Precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	Polychlorinated biphenyl
PID	Photoionization detector
POL	Petroleum, Oil, and Lubricant
PPRTV	Provisional Peer Reviewed Toxicity Values
PREQB	Puerto Rico Environmental Quality Board
PRWQS	Puerto Rico Water Quality Standards
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
QSM	Quality system manual
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RfD	Reference dose
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SDG	Sample delivery group
SDWA	Safe Drinking Water Act
SERA	Screening Level Ecological Risk Assessment
SQG	Soil Quality Guideline
SQUIRT	Screening Quick Reference Table
SSL	Soil screening level
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor

2,4,5-TP	2-(2,4,5-trichlorophenoxy)propionic acid (Silvex)
TPH	Total petroleum hydrocarbons
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
UFP	Uniform Federal Policy
µg/kg	Microgram per kilogram
µg/L	Microgram per liter
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UTL	Upper Tolerance Limit
VOC	Volatile organic compound

EXECUTIVE SUMMARY

E.1 PURPOSE AND OBJECTIVE OF REPORT

Tetra Tech has prepared this report to summarize activities and findings for the Full Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 57 located at Naval Activity Puerto Rico (NAPR) in Ceiba, Puerto Rico. SWMU 57 - Petroleum, Oil, and Lubricant (POL) Drum Storage Area is located at Facility No. 278 north of Antietam Road and just south and adjacent to SWMU 9 Area C. This report was prepared under Contract Task Order (CTO) JM02 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62472-03-D-0057.

The objective of this RFI was to collect and evaluate sufficient data to characterize the nature and extent of contamination at SWMU 57, and to quantify the potential risks posed to human health and the environment as a result of exposure to site-related contaminants. This Full RFI report describes the field activities and findings of the Full RFI field work conducted in June 2012.

Full RFI field activities included:

- Advancement of soil borings and evaluation of geologic materials
- Installation of permanent groundwater monitoring wells
- Collection and analysis of surface soil, subsurface soil, and groundwater samples
- Collection of groundwater level measurements associated with all permanent monitoring wells
- Surveying of sampling points and permanent monitoring well locations and elevations
- Analog geophysical survey of the scattered debris area

Additionally, results of Phase I RFI field work conducted in January 2010 (Baker, 2010), and Phase I/II Environmental Condition of Property (ECP) field work conducted in May 2004 (NAVFAV-LANT, 2005) are evaluated in the Full RFI Report. Site characterization activities including evaluation of nature and extent of contamination, continued refinement of the conceptual site model (CSM), and human health and ecological risk assessments incorporate results from all three field events.

E.2 SCOPE OF RFI

The SWMU 57 Full RFI consisted of sampling environmental media (surface and subsurface soil and groundwater), installation of monitoring wells, surveying of sample locations and monitoring well

locations, analog geophysical survey of the scattered debris area, collection of solid and aqueous investigation-derived waste (IDW) samples, and collection of a synoptic round of groundwater level measurements. The Full RFI was conducted in accordance with the Full RFI Sampling and Analysis Plan (SAP) for SWMU 57 - POL Drum Storage Area (Tetra Tech, 2012). All Full RFI laboratory data were subjected to data validation, and all SWMU 57 Full RFI data were entered into a database along with the Phase I RFI and Phase I/II ECP data. The soil data collected during the Full RFI, Phase I RFI, and Phase I/II ECP investigations were combined and used to conduct both a human health risk assessment (HHRA) and an ecological risk assessment (ERA) to support site decisions. For groundwater, only Full RFI (June, 2012) data were used for the HHRA and ERA because it is most representative of present-day conditions. The three sets of groundwater data were evaluated in the report for tendencies to determine if conditions have changed with time. The risk assessments include comparisons of analytical results to state and federal standards, and to facility and site-specific background levels.

E.3 HISTORICAL INFORMATION

NAPR, formerly known as Naval Station Roosevelt Roads (NSRR), is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan. NSRR was officially closed on March 31, 2004; the Navy established NAPR to serve as the caretaker of the property associated with NSRR and to assist in transfer of the property (NAVFAC, 2005). In anticipation of operational closure of NSRR, currently designated as NAPR, Naval Facilities Engineering Command Atlantic (NAVFAC-LANT) prepared the Phase I/II ECP Report to document the environmental condition of NSRR (NAVFAC-LANT, 2005). Section 8132 of the Fiscal Year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directed that NSRR be disestablished within 6 month, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the Base Realignment and Closure (BRAC) Act of 1990. This legislation requires that 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 United States Environmental Protection Agency (USEPA) issued a RCRA 7003 Administrative Order on Consent (USEPA Docket No. RCRA-02-2007-7301 [USEPA, 2007a]), identifying SWMU 57 (formerly referred to as ECP Site 3) as having numerous small spills and releases throughout the usage period of approximately 1958 through 1995.

SWMU 57 – POL Drum Storage Area was used for the storage of POL and other potentially hazardous materials, and numerous small spills and releases occurred while this site was operational (1958 through 1995). In addition, a historical aerial photograph appears to show a potential sludge disposal pit at SWMU 57 on the northwestern side of the concrete pad [similar to disposal areas at SWMU 9 (Baker,

2010)]. SWMU 9 Area C (tanks 216 and 217), a fuel management area, is located adjacent to SWMU 57. SWMU 57 is approximately 1.3 acres. The site consists of a large concrete pad, approximately 170 by 100 feet in size, and a loading dock surrounded by densely wooded areas on all sides except the northeastern side, which is a gravel access road and turn-around currently overgrown with long grass. A truck down-ramp drive-through which enabled vehicles access onto the pad is also located on the northeastern side of the pad. A 7-inch-high concrete containment curb surrounds the entire outer perimeter of the pad, including the loading dock on the northwestern side. Presently, vegetation on three sides of the pad extends to the pad itself, likely a result of discontinued maintenance following end of site operations. A mounded earthen area and grassy slope (and previously, an earthen drainage feature approximately 140 linear feet in length that is no longer visible) divert runoff around (away from) the northeastern portion of the concrete pad. The drainage area is upgradient of the concrete pad; therefore, releases to the concrete pad or loading dock could not have migrated to it. Miscellaneous scattered debris and hummocky soil mounding were observed immediately adjacent to the pad in the southwestern portion of SWMU 57 in a heavily vegetated area. The miscellaneous debris observed generally included construction debris and drum fragments.

E.4 GEOLOGY AND HYDROGEOLOGY

Several soil borings were advanced at SWMU 57 during the Phase I RFI and the Full RFI field investigations to profile surface and subsurface conditions. These soil borings described very thin (0.3 to 6 inches) organic top soils at the ground surface in vegetated areas. Near the road and pad, soils consisted of clays with increased amounts of silt, sand, and gravel. During both the Phase I and the Full RFI investigations, a large portion of SWMU 57 was found to be underlain by residuum generally consisting of clay (predominant), silt, and/or sand. Residuum thickness was observed to range between approximately 1.5 feet on the slope southwest of the pad to 8.0 feet northwest of the pad. The residuum appears to generally follow topography across the site, thinning out on steeper slopes southwest of the pad and increase in thickness in the center of the site where topography is more flat. Areas near the concrete pad were found to be underlain by fill material including varying combinations of clay to gravel or highly weathered bedrock. Weathered bedrock was observed beneath the residuum or fill. According to the Phase I RFI (Baker, 2010), this variability of shallow subsurface materials (i.e., residuum, fill, or highly weathered bedrock) is not unusual considering the cut and fill construction methods typically employed in hilly areas similar to the upland areas of NAPR. Also, a thin discontinuous bedrock of tuff was noted approximately 14 feet below ground surface (bgs) at select locations southwest of the concrete pad.

At SWMU 57, a grassy slope and man-made earthen mound (and historical drainage feature no longer visible) divert surface water runoff away from the concrete pad. There are no natural surface water

features at SWMU 57. Ultimately, overland flow near SWMU 57 drains to the northwest toward the Los Machos Mangrove Forest, which is located approximately 500 feet from the site.

During the Phase I RFI, groundwater was located approximately 16 to 23 feet bgs and the groundwater flow at the upland area of SWMU 57 was reported to be toward the north northwest with a gentle hydraulic gradient. During the 2012 Full RFI groundwater sampling event, the groundwater flow direction was generally consistent with that of the 2010 Phase I RFI with groundwater flow toward the north-northwest. The groundwater flow direction for the both the 2010 and 2012 groundwater data is consistent with the anticipated flow for SWMU 57 and is with the flow direction observed at adjacent SWMU 9 Area C also toward Los Machos Mangrove Forest. As in 2010, water levels in 2012 in the western portion of the site in the scattered debris area are nearly flat, with only 0.26 feet of elevation difference between 57GW07 and 57GW01. Based on soil boring logs, groundwater is first noted within the highly weathered bedrock and wells were then seated just above or across the transition into more competent bedrock. Overall water levels measured in June 2012 for the Full RFI are elevated approximately 2 feet higher than those measured in April 2010 across the site, which is expected based on available precipitation data for the months preceding the sampling events; the Full RFI water levels were collected during the traditional rainy season while a drought occurred in 2010 prior to the Phase I RFI field event.

E.5 NATURE AND EXTENT OF CONTAMINATION

Surface and subsurface soil samples were collected at SWMU 57 during the ECP investigation, Phase I RFI, and Full RFI. Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polynuclear aromatic hydrocarbons (PAHs), diesel range organics (DRO), total petroleum hydrocarbons (TPH), pesticides, polychlorinated biphenyls (PCBs) (only Aroclor-1260), and inorganics were detected in soil samples. Many of the detections were low, less than both human health and ecological screening levels, and detections were scattered throughout the site. A majority of the maximum detections were found in samples collected within and near the scattered debris area, although analytes were also detected in samples collected along the eastern and southeastern side of the concrete pad, along the western edge of the loading dock, north-northwest of the site, and near the access road. Overall, the greatest number of PAHs and other SVOCs were detected in samples collected from locations northwest of the concrete pad on the opposite side of the access road. PAHs in this area may be related to anthropogenic impacts near the road rather than site-specific releases; several inorganic maximum detected concentrations were also noted in this area. Many of the PAH and inorganic concentrations were less than site-specific and facility background threshold values (BTV).

For groundwater, a trend of decreasing concentrations of organics and fewer impacted wells is evident over time at SWMU 57. Few VOCs were detected in groundwater samples collected in 2004 (ECP) and 2010 (Phase I RFI), and no VOCs were detected in groundwater samples collected in 2012 (Full RFI). SVOCs, primarily PAHs, were detected in several groundwater samples collected in 2010, but in 2012, SVOCs were only detected in one monitoring, the SVOCs detected were fewer than in 2010 and all at lesser concentrations. Inorganics also show a trend of lower concentrations.

The possibility that shallow subsurface debris could be present within the scattered debris area, from debris originally placed on the ground surface or scraped off the concrete pad may have been covered with several inches of soil and/or leaf litter over time, was investigated during the Full RFI via an analog geophysical survey. As expected based on the CSM, there were no indications from the geophysical survey of shallow subsurface metallic debris, nor was there evidence of buried debris in the soil borings. All instrument signals were associated with observed debris on the ground surface only. Moreover, no hazardous debris was encountered that could serve as a future contaminant source, except for two intact marine batteries on the ground surface that were removed and the underlying soil sampled.

Further, during the RFI for adjacent SWMU 9 Area C, a test pit was advanced in the suspected sludge disposal pit area at SWMU 57. Only inorganics (barium, lead, and silver) were detected in the test pit soil sample (collected 11 feet bgs) and all were present at concentrations less than screening criteria in place at that time. No evidence of waste or a sludge disposal pit was noted during advancement of this test pit or during any of the SWMU 57 investigations (ECP, Phase I RFI, or Full RFI).

To evaluate the concrete pad during the Phase I RFI, four concrete wipe and four concrete chip samples were collected. The rectangular concrete pad was evaluated during the investigation and the number and locations of wipe and concrete chip samples were determined in the field based on visual observations. Although visible chemical staining was not evident, slight depressions were observed where rain water would collect and later evaporate. Based on this observation, wipe samples were collected within these small, isolated depressions. Further, significant physical degradation of the concrete was not evident, since significant degradation and/or staining were not evident, the concrete chip sample locations were spatially distributed on the pad considering the storage possibilities over the entire period of reported use. The concrete chip samples were collected to a depth of approximately ½ inch and a field determination was then made whether or not contamination may have penetrated deeper than the top ½ inch; however, evidence of contamination (e.g., staining) below ½ inch was not encountered and, therefore, no additional concrete chip samples were collected. Few SVOCs, DRO, and metals were detected in these samples. Although there are no criteria available for comparison, concentrations of these constituents are low and

do not indicate that surface contamination is be present or that surrounding soils have been impacted. Additional sampling was not warranted during the Full RFI.

E.6 HUMAN HEALTH RISK ASSESSMENT

An HHRA was completed for SWMU 57 that evaluated risks using combined site soil data collected during the ECP investigation, Phase I RFI, and Full RFI. Five potential receptor groups were evaluated: current and future construction workers, current and future industrial workers, current and future adolescent trespassers, future child, adolescent, and adult recreational users, and future child and adult residents. The risk characterization section of the HHRA evaluated risks to all receptors across the entire site as one exposure unit (EU). All receptors were evaluated for exposures to chemicals of potential concern (COPCs) in soil, combined for surface soil from 0 to 1 foot bgs and subsurface soil from 1 to 3 feet bgs. The two intervals were also evaluated separately. Construction workers were additionally evaluated for exposures to COPCs in subsurface soil greater than 3 feet bgs, which consists of data from samples collected mostly greater than 10 feet bgs. The HHRA calculated risks both with and without background considerations.

Based on the HHRA, only one analyte was identified as a risk driver (i.e., contaminant with non-cancer hazard quotient (HQ) greater than 1 or with a cancer risk greater than $1x10^{-6}$ in a scenario and medium with total cancer risks greater than $1x10^{-4}$) in the risk characterization: cobalt in subsurface soil 1 to 3 feet bgs based on child resident exposures. However, no risk drivers were identified for any receptors when the combined surface and subsurface soil, 0 to 3 feet bgs, data set was evaluated. This is important to note because a 0- to 3-foot bgs exposure scenario is a more likely exposure scenario for a child resident than 1 to 3 feet bgs. To access the 1- to 3-foot bgs soil depth interval, a child would very likely have to dig through the 0-to 1-foot depth interval. If the 1- to 3-foot bgs depth interval were somehow brought to the surface (e.g., construction), then that soil would be mixed with soil from the 0- to 1-foot depth interval, and site data show that there is no risk to future child residents when exposed to the 0-to 3-foot bgs depth interval. Therefore, although there is a potentially unacceptable risk for the child resident exposed to soil in the 1- to 3-foot depth interval, that exposure scenario is extremely unlikely, and the more realistic exposure scenario (0 to 3 feet bgs) is not associated with unacceptable risks for the child resident.

E.7 ECOLOGICAL RISK ASSESSMENT

In accordance with the SAP and risk assessment guidance, the ERA evaluated surface soil only, it did not evaluate soil collected from depths greater than 1 foot. After evaluation, no chemicals were retained as final ecological COPCs for risks to plants or soil invertebrates, aquatic organisms, herbivorous receptors, or omnivorous receptors.

Surface water is not present directly at the site, and ecological receptors are not directly exposed to contaminants in groundwater at the site. The ERA evaluated groundwater because infiltration through site soil is a potential source of contamination to groundwater, and groundwater may subsequently discharge to surface water of the Los Machos Mangrove Forest, located about 500 feet north-northwest of the site. After evaluation, no chemicals were retained as ecological COPCs for groundwater. Similarly, surface water was evaluated calculating a conservative dilution factor to adjust detected concentration in groundwater to account for mixing with the surface water, and no chemicals in groundwater were retained as COPCs for potential risks to aquatic organisms.

E.8 REVISED CONCEPTUAL SITE MODEL AND RECOMMENDATIONS

The SWMU 57 CSM has been updated based on information from the findings of this Full RFI. Revisions to the CSM include the following:

- Scattered Debris Area: Debris was most concentrated near the southwestern and southeastern edges of the concrete pad where previously it had been encountered during historical investigations, although the Full RFI found the area to be larger than previously indicated. Hummocky soil on the southwestern side of the pad indicated that possible subsurface disposal occurred in this area, but the magnetometer survey conducted during the Full RFI did not indicate any subsurface disposal in this area. No hazardous surface debris was encountered at the site.

- Suspected Sludge Disposal Pit Area: No evidence of a sludge disposal pit was noted during excavation of the test pit during the SWMU 9 Area C investigation or during any of the SWMU 57 investigations (ECP, Phase I RFI, or Full RFI).

Based on the results of all investigations to date, including risk assessments, No Further Action is recommended to address SWMU 57 soil and groundwater. Additionally, remediation of the concrete pad is not warranted, however, should it be decided to demolish the concrete pad, the selected disposal facility may require additional waste characterization based on the volume of concrete being disposed of and completion of waste characterization for ignitability, corrosivity, and reactivity and, potentially, other parameters, prior to allowing disposal as a nonhazardous solid waste. Alternatively, it may be more cost effective to power wash the concrete prior to demolishing, then sample and properly dispose of the power wash water. Further, the site does not adversely impact downgradient surface water in Los Machos Mangrove Forest.

There are two site-related recommendations to prepare the site for its pending intended land use:

- Abandon all existing monitoring wells
- Collect and properly dispose of all surface debris

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

Tetra Tech has prepared this report to summarize activities and findings for the Full Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 57 located at Naval Activity Puerto Rico (NAPR) in Ceiba, Puerto Rico (Figure 1-1). SWMU 57 - Petroleum, Oil, and Lubricant (POL) Drum Storage Area is located at Facility No. 278 north of Antietam Road and just south and adjacent to SWMU 9 Area C (Figure 1-2). This report was prepared under Contract Task Order (CTO) JM02 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62472-03-D-0057.

The objective of this RFI was to collect and evaluate sufficient data to characterize the nature and extent of contamination at SWMU 57, and to quantify the potential risks posed to human health and the environment as a result of exposure to site-related contaminants. This Full RFI report describes the field activities and findings of the Full RFI field work conducted in June 2012.

Full RFI field activities included:

- Advancement of soil borings and evaluation of geologic materials
- Installation of permanent groundwater monitoring wells
- Collection and analysis of surface soil, subsurface soil, and groundwater samples
- Collection of groundwater level measurements associated with all permanent monitoring wells
- Surveying of sampling points and permanent monitoring well locations and elevations
- Analog geophysical survey of the scattered debris area

Additionally, results of Phase I RFI field work conducted in January 2010 (Baker, 2010), and Phase I/II Environmental Condition of Property (ECP) field work conducted in May 2004 (NAVFAV-LANT, 2005) are evaluated in the Full RFI Report. Site characterization activities including evaluation of nature and extent, continued refinement of the conceptual site model (CSM), and human health and ecological risk assessments incorporate results from all three field events.

1.2 SCOPE OF RCRA FACILITY INVESTIGATION

The SWMU 57 Full RFI consisted of sampling environmental media (surface and subsurface soil and groundwater), installation of monitoring wells, surveying of sample locations and monitoring well

locations, analog geophysical survey of the scattered debris area, collection of solid and aqueous investigation-derived waste (IDW) samples, and collection of a synoptic round of groundwater level measurements. The Full RFI was conducted in accordance with the Full RFI Sampling and Analysis Plan (SAP) for SWMU 57 - POL Drum Storage Area (Tetra Tech, 2012), herein after referred to as the SWMU 57 Full RFI SAP. All Full RFI laboratory data were subjected to data validation, and all SWMU 57 Full RFI data were entered into a database along with the Phase I RFI and Phase I/II ECP data. The soil data collected during the Full RFI, Phase I RFI, and Phase I/II ECP investigations were combined and used to conduct both a human health risk assessment (HHRA) and an ecological risk assessment (ERA) to support site decisions. For groundwater, only Full RFI (June, 2012) data were used for the HHRA and ERA because it is most representative of present-day conditions. The three sets of groundwater data were evaluated in the report for trends to determine if conditions have changed with time. The risk assessments include comparisons of analytical results to state and federal standards, and to facility and site-specific background levels.

1.3 HISTORICAL INFORMATION

1.3.1 Facility Background

NAPR, formerly known as Naval Station Roosevelt Roads (NSRR), is located on the eastern coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan (Figure 1-1). The nearest major town is Fajardo, 10 miles north of the station. The facility occupied approximately 8,600 acres, and except for two adjacent unpopulated islands (Pineros and Cabeza de Perro) off the northeast coast of the facility, it is bordered on the north, south, and east by the marine waters of the Atlantic Ocean, Caribbean Sea, and Vieques Passage.

The property was acquired by the Navy between 1941 and 1945. In 1941, Fort Bundy was established in the southwestern portion of the facility as the United States Army headquarters for coastal artillery emplacements. In 1943, the northeastern portion of NSRR was commissioned as a Naval Operating Base to provide training for Atlantic Fleet Operations in the Caribbean. Both areas remained active until the end of World War II. Between the end of World War II and 1957, Fort Bundy and NSRR were deactivated and reactivated several times. In 1957, NSRR was reactivated as home of the new Atlantic Fleet Guided Missile Training Operations Center, which provided missile support to facilities and missile training to the Atlantic Fleet's submarine units (NAVFAC, 2005).

In 1963, the Atlantic Fleet Weapons Training Facility (AFWTF) was commissioned to support communications and weapons technology, maintenance and operation of weapons testing and exercises,

and military maneuvers training. The administrative functions of AFWTF, which were carried out from NSRR property, peaked in 1969 and declined significantly thereafter.

NSRR was officially closed on March 31, 2004; the Navy established NAPR to serve as the caretaker of the property associated with NSRR and to assist in transfer of the property (NAVFAC, 2005).

1.3.2 Regulatory Setting

In anticipation of operational closure of NSRR, currently designated as NAPR, Naval Facilities Engineering Command Atlantic (NAVFAC-LANT) prepared the Phase I/II ECP Report to document the environmental condition of NSRR (NAVFAC-LANT, 2005). Section 8132 of the Fiscal Year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directed that NSRR be disestablished within 6 month, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the Base Realignment and Closure (BRAC) Act of 1990. This legislation requires that 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 United States Environmental Protection Agency (USEPA) issued a RCRA 7003 Administrative Order on Consent [USEPA Docket No. RCRA-02-2007-7301 (USEPA, 2007a)], identifying SWMU 57 (formerly referred to as ECP Site 3) as having numerous small spills and releases throughout the usage period of approximately 1958 through 1995.

1.3.3 Site Background and History

SWMU 57 – POL Drum Storage Area was used for the storage of POL and other potentially hazardous materials, and numerous small spills and releases occurred while this site was operational (1958 through 1995). In addition, a historical aerial photograph appears to show a suspected sludge disposal pit at SWMU 57 on the northwestern side of the concrete pad [similar to disposal areas at SWMU 9 (Baker, 2010)]. SWMU 9 Area C (tanks 216 and 217), a fuel management area, is located adjacent to SWMU 57 (Figure 1-2).

SWMU 57 is approximately 1.3 acres. As shown on Figure 1-3, the site consists of a large concrete pad, approximately 170 by 100 feet in size, and a loading dock surrounded by densely wooded areas on all sides except the northeastern side, which is a gravel access road and turn-around currently overgrown with long grass. Significant physical degradation of the concrete and visible chemical staining were not evident during either the Phase I RFI or Full RFI, only minor pits and surface cracks were observed on the surface of the pad. A truck down-ramp drive-through which enabled vehicles access onto the pad is also located on the northeastern side of the pad. A 7-inch-high concrete containment curb surrounds the

entire outer perimeter of the pad, including the loading dock on the northwestern side. The curb is in good condition; no sections were observed to be broken, missing, or seriously distressed during the Phase I RFI and Full RFI. The SWMU 74 fuel line runs along the northern side of the access road to SWMU 57 and SWMU 9 Area C. Presently, vegetation on three sides of the pad extends to the pad itself, likely a result of discontinued maintenance following end of site operations. The access road bisects the northwesternmost portion of the SWMU 57 area, with the concrete pad located immediately adjacent to (southeast of) the road. Figure 1-3 presents the site layout and includes sample locations (Full RFI, Phase I RFI, and ECP).

A mounded earthen area and grassy slope (and previously, an earthen drainage feature approximately 140 linear feet in length that is no longer visible) divert runoff around (away from) the northeastern portion of the concrete pad. The drainage area is upgradient of the concrete pad; therefore, releases to the concrete pad or loading dock could not have migrated to it.

During the Phase I RFI and ECP investigations, miscellaneous scattered debris and hummocky soil mounding were observed immediately adjacent to the pad in the southwestern portion of SWMU 57 in a heavily vegetated area. The miscellaneous debris observed generally included construction debris and drum fragments.

1.3.4 Previous SWMU 57 and Other Related Environmental Investigations

Revised Draft RCRA Facility Investigation Report for SWMU 9 (Baker, 2010)

The Full RFI at SWMU 9 included completion of three phases of field investigations at Areas A, B, and C to assess the environmental impact of operations at the site. Appendix A presents figure showing the location of each SWMU 9 area, SWMU 9 Area C is located adjacent to SWMU 57. As part of the Phase I field investigation of SWMU 9 Area C (tanks 216 and 217), a test pit was excavated within the suspected sludge disposal pit at SWMU 57, as shown on figures presented in Appendix A. The test pit measured 15 feet in length and extended to a maximum depth of 11 feet below ground surface (bgs). According to the test pit record (provided in Appendix A), the top 1 foot of soil was dry brown topsoil, soil from 1 to 4 feet bgs was damp brown clay, and soil from 4 to 11 feet bgs was damp, brown, medium sand and clay with some rock fragments. No evidence of a sludge disposal pit was noted during excavation of the test pit. One subsurface soil sample (9TP11-05) was collected from the test pit at a depth of 11 feet bgs. The subsurface soil sample was analyzed for Appendix IX volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), RCRA metals, and total petroleum hydrocarbons (TPH) [diesel range organics (DRO) and gasoline range organics (GRO)]. VOCs, SVOCs, and TPH were not detected in the sample. Barium, lead, and silver, the only metals detected, were present at concentrations less than

screening criteria in place at that time (2010). Overall, the SWMU 9 RFI Report found that there was limited evidence of the impact of past site operations on subsurface soil at Area C.

Phase I/II ECP (NAVFAC-LANT, 2005)

The Aerial Photography Analysis conducted during the Phase I ECP identified the SWMU 57 area as photo identified (PI) Site 4, due to the observation of drum storage and staining on a concrete pad and surrounding soil from 1958-1995. The records review conducted during the Phase I ECP confirmed the area as the POL drum storage facility, and the Phase I ECP physical site inspections observed staining on the pad but no significant stressed vegetation immediately surrounding the pad. Phase I ECP interviews confirmed that POL and potentially other hazardous materials were stored at the site, with numerous small spills and releases throughout the usage period. The ECP also included a Phase II investigation which included sampling and analysis to determine if a release/disposal actually occurred at the ECP sites (SWMU 57 is identified as ECP Site 3 in the Phase I/II ECP Report) and, if so, if any potential risk to human health is present at the sites.

The ECP field investigation performed in 2004 included the collection of soil and groundwater samples and some small miscellaneous debris, including small cylinders and equipment were noted on the concrete pad. There were no signs of stains or stressed vegetation observed in this area during this investigation. Figure 1-3 shows the ECP soil and groundwater sample locations (3E-01, 3E-02, 3E-03, 3E-04, 3E-05, and 3E-06). Analytical results from the ECP are discussed and evaluated in the remaining sections of the Full RFI Report.

Six soil borings were advanced at SWMU 57 during the ECP investigation to evaluate surface and subsurface conditions. SWMU 57 was found to be underlain by thin residuum generally consisting of sand, silt, and/or clay. Residuum was observed to range from 0.2 foot thick at sample location 3E-04 at the eastern corner of the pad to more than 5 feet thick at sample location 3E-06 southwest of the pad. Weathered bedrock was observed beneath the residuum. Groundwater was not observed in residuum. Six surface soil and six subsurface soil samples were collected and analyzed for Appendix IX VOCs, SVOCs, pesticides/polychlorinated biphenyls (PCBs), organophosphorus (OP) pesticides, chlorinated herbicides, and metals. A groundwater investigation followed the soil sampling program with the installation of two temporary monitoring wells. At SWMU 57, depth to groundwater was approximately 13 to 20 feet bgs in bedrock fractures (NAVFAC-LANT, 2005). One groundwater sample was collected from each temporary well and analyzed for Appendix IX VOCs, SVOCs, pesticides/PCBs, chlorinated herbicides, and dissolved metals.

The ECP results indicated that SWMU 57 had locations with chlorinated compounds and metals at concentrations that exceeded USEPA Region III residential risk-based concentrations (RBCs) in effect at that time for the PCB Aroclor-1260 (surface soil), arsenic (soil), chromium (soil), and vanadium (soil and groundwater). VOCs and three other metals were detected in groundwater, but only the concentrations of vanadium exceeded its RBC. Of note, arsenic was the only metal that exceeded the background concentration in surface soil.

Based on the detections of fuel-related VOCs (ethylbenzene and xylene) in surface soil and exceedances of criteria for Aroclor-1260 and arsenic, it was concluded that soil at this site had been impacted by previous site activities. Based on the limited groundwater investigation and observations (e.g., absence of staining and stressed vegetation around the concrete pad and low estimated concentrations of VOCs in groundwater) during the ECP field event, it was tentatively concluded that groundwater had not been impacted by site activities. The ECP Report noted the limited nature of the investigation and added that greater concentrations may be present in the soil and groundwater due to its past use as a hazardous waste storage area. Further, the ECP data were verified according to laboratory protocol only, not USEPA Region II data validation protocol that was used for all other site data. However, to be conservative in the evaluation of SWMU 57, the ECP data were used in this report for determination of nature and extent of contamination and for risk assessment. Select portions of the Phase I/II ECP Report are presented in Appendix A.

Final Phase I RFI Report for SWMU 57 – POL Drum Storage Area (Baker, 2010)

During the SWMU 57 Phase I RFI, 12 surface soil samples were collected from seven boring locations and five additional discrete locations; 14 subsurface soil samples were collected from the seven boring locations; six groundwater samples were collected from the five newly installed permanent monitoring wells at SWMU 57 and one existing permanent well within the SWMU 9 Area C site boundary; and four concrete wipe and four concrete chip samples were collected from the concrete pad. Figure 1-3 shows the sample locations (57SB01 to 57SB07, 57SS08 to 57SS12, 13GW07, 57WS01 to 57WS04, and 57CC01 to 57CC04). The analysis of samples obtained during the Phase I RFI indicated that surface soil, subsurface soil, groundwater, and concrete had been impacted by past activities at SWMU 57. Soil samples were analyzed for Appendix IX VOCs, SVOCs with low-level polynuclear aromatic hydrocarbons (PAHs), PCBs, TPH GRO/DRO, and metals. Groundwater samples were analyzed for Appendix IX VOCs, SVOCs with low-level PAHs, PCBs, and total and dissolved metals, and TPH GRO/DRO. Concrete chips and wipe samples were analyzed for SVOCs with low-level PAHs, TPH DRO, and metals. Below presents findings of the Phase I RFI including a summary of the comparison of analytical results to project screening criteria (USEPA Regional residential and industrial soil screening levels (SSLs) and

select ecological soil screening values) and background levels in effect at the time of the Phase I RFI (2010). See Appendix A for analytical results comparison tables from the Phase I RFI.

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Surface Soil

- One PCB, Aroclor-1260, was detected in soil surface soil samples. Exceedances of USEPA Regional residential and industrial SSLs were noted in three samples. These samples were located in the area southwest of the pad where surface debris was observed. Surface debris and hummocky soil mounding indicative of possible placement soil scraped from the pad existed in this area.

- The metals arsenic, cadmium, cobalt, lead, mercury, and zinc were detected at concentrations exceeding one or more of the residential and/or industrial screening criteria and background values in surface soil for samples collected from the area southwest of the pad, topographically downgradient of the pad, and collected from topographically downgradient of the loading dock. Isolated exceedances of arsenic, chromium, cobalt, mercury, and nickel were also detected in surface soil samples in other areas of the site.

- During the Phase I RFI, analytical results for selenium were rejected in 6 of the 12 surface soil samples, constituting a data gap.

Shallow Subsurface Soil – 1 to 3 feet bgs

- The arsenic concentration in subsurface soil sample 57SB02-01, exceeded the background value and the industrial regional screening level.

- Lead and thallium were detected in subsurface soil at concentrations exceeding one or more of the project comparison criteria and background values for subsurface soil samples at each of the seven soil borings advanced during the Phase I RFI.

- Cobalt was detected at concentrations exceeding one or more of the project comparison criteria and the background value in subsurface soil samples at six of the seven soil borings.

- Mercury and zinc were detected at concentrations exceeding background values and ecological screening criteria at one location.

- Selenium results were rejected in 6 of the 14 subsurface soil samples (from 1 to 3 feet bgs), constituting a data gap.

Deep Subsurface Soil – 9 to 11 feet bgs

- Cobalt was detected at concentrations exceeding one or more of the project comparison criteria in four subsurface soil samples (9 – 11 feet bgs).

- Selenium results were rejected in 6 of the 14 subsurface soil samples (9 to 11 feet bgs), constituting a data gap.

Groundwater

- Concentrations of benzo(a)anthracene, benzo(a)pyrene (BaP), and benzo(b)fluoranthene in groundwater exceeded their tap water Regional screening levels and concentrations of benzo(a)anthracene also exceeded the associated ecological groundwater screening values for one groundwater sample (57GW05). The pyrene concentration exceeded only the ecological groundwater screening value in one groundwater sample (57GW05).

- Elevated photoionization detector (PID) readings [maximum of approximately 400 parts per million (ppm)], were observed through the interval of 15 to 20 feet bgs during the advancement of soil boring 57SB05. The soil boring location, which was turned into monitoring well 57GW05, is located downgradient of the suspected sludge disposal pit generated during SWMU 9 tank cleaning.

- Lead was detected at dissolved concentrations exceeding ecological screening and background criteria in sample 57GW05.

- Mercury was detected at total and dissolved concentrations exceeding background and one or more of the project comparison criteria in samples 57GW01, 57GW04, 57GW07, and 13GW07.

- Vanadium was detected at dissolved concentrations exceeding each of the three project comparison criterion in samples 57GW02, 57GW04, and 13GW07.

Concrete

- The rectangular concrete pad was evaluated during the investigation and the number and locations of wipe and concrete chip samples were determined in the field based on visual observations. Although

visible chemical staining was not evident, slight depressions were observed where rain water would collect and later evaporate. Based on this observation, wipe samples were collected within these small, isolated depressions. Further, significant physical degradation of the concrete was not evident, since significant degradation and/or staining were not evident, the concrete chip sample locations were spatially distributed on the pad considering the storage possibilities over the entire period of reported use. The concrete chip samples were collected to a depth of approximately ½ inch and a field determination was then made whether or not contamination may have penetrated deeper than the top ½ inch; however, evidence of contamination (e.g., staining) below ½ inch was not encountered and, therefore, no additional concrete chip samples were collected.

- A number of organic compounds and inorganic constituents were detected in concrete wipe and chip samples collected from the SWMU 57 concrete pad. Screening criteria are not available for concrete wipe and chip samples.

The Phase I RFI determined that impacts to the environment (soil and groundwater) had occurred at SWMU 57 from previous site operations, but that the lateral extent of contamination had not been fully defined and the suspected sludge disposal pit originally investigated at SWMU 9 Area C and loading dock area were not adequately investigated. Additionally, as discussed in Section 2.3.2, there is some uncertainty associated with Phase I data based on the results of the data validation assessment. It was noted that several unforeseen circumstances resulted in sample mishandling by the laboratory courier and by the laboratory. Overall, the data, as qualified by the validator, was determined to be acceptable for its intended use. A Full RFI was recommended to characterize the nature and extent of impacts to surface soil, subsurface soil, and groundwater at SWMU 57 and also to investigate the suspected sludge disposal pit and loading dock and area adjacent to and downgradient of the concrete pad.

1.3.5 Current Land Use and Anticipated Future Land Use

SWMU 57 is currently inactive. The site will remain under the ownership and control of the Navy until response actions are complete. According to the Supplemental Environmental Assessment, SWMU 57 will be located in Zone 4, the Marsh Vista Country Club, with a proposed 18-hole golf course including a clubhouse and 50 residential units (Navy, 2011). Potential future related activities include light recreation (walking, golfing), moderate to heavy construction related to house building, and construction and maintenance of the planned golf course. Additionally, the Lease in Furtherance of Conveyance (LIFOC) between the United States of America and Local Redevelopment Authority for Naval Station Roosevelt Roads at the Former Naval Station Roosevelt Roads, Ceiba, Puerto Rico, #N4769212RP12P31,

Execution Version January 25, 2012, identifies the future land use for SWMU 57 as commercial/recreational.

1.4 REPORT ORGANIZATION

This Full RFI report has been divided into eight sections, with tables and figures immediately following the text in each section. Section 1.0 presents the Full RFI objectives and report organization and background information including site location, and history.

Section 2.0 presents a description of the field investigation tasks that were performed at the site to collect the data for the Full RFI and the analytical methods followed to develop the data needed to evaluate the potential for unacceptable levels of contaminants to be present at the site. The objectives and descriptions of field tasks and sampling procedures and associated analytical parameters are presented for each investigative task. Also, a Data Usability Evaluation is presented that discusses the usability of the Full RFI, Phase I RFI, and ECP data to meet the project objectives and support the HHRA and ERA.

Section 3.0 presents a summary of the physical conditions at the site, including basic site features, topography and drainage, geology, and hydrogeology. Information collected and observations made during the Full RFI, Phase I RFI, and ECP field investigations were used to provide updated descriptions of these physical site characteristics.

Section 4.0 presents information on the nature and extent of contamination detected in site media, including analytical results for soil and groundwater. Analytical data are presented on tables and discussed in the text for each medium and in figures for selected parameters within each medium.

Section 5.0 presents information on contaminant fate and transport, including identification of potential contaminant migration routes, and physical, chemical, and biological factors that affect contaminant migration.

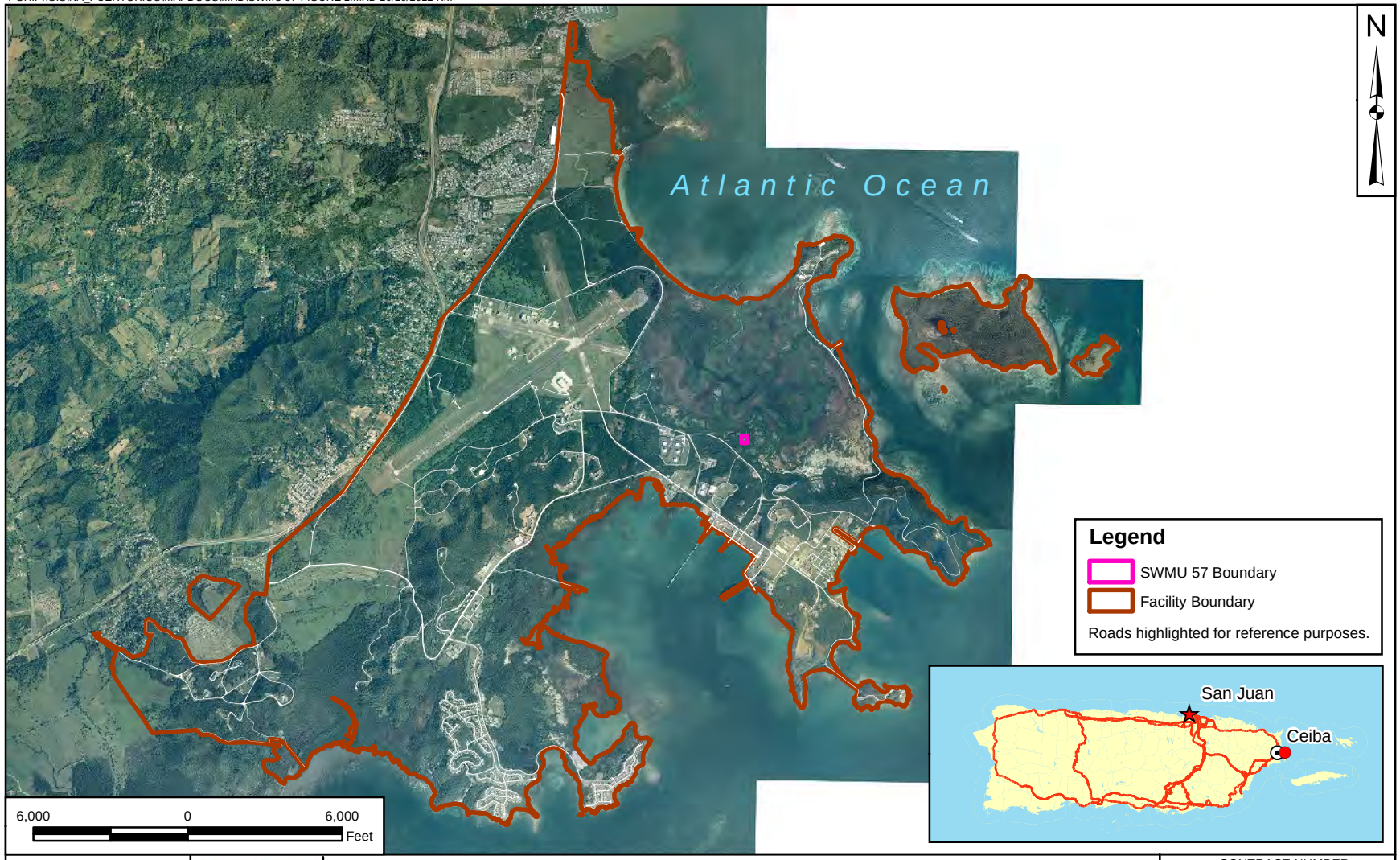
Section 6.0 presents the baseline HHRA.

Section 7.0 presents Steps 1 through 3A of the USEPA's eight-step ERA.

Section 8.0 presents a summary of HHRA and ERA results by medium, an updated CSM, and the overall conclusions and recommendations of the Full RFI.

The reference section presents the references used to develop the Full RFI Report.

PGH:P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU 57-FIGURE 1.MXD 10/16/2012 KM



DRAWN BY K. MOORE	DATE 8/18/10	FACILITY AND SWMU 57 MAP NAVAL ACTIVITY PUERTO RICO CEIBA, PERTO RICO	CONTRACT NUMBER JM02
CHECKED BY M. COFFMAN	DATE 10/16/12		APPROVED BY ___ / DATE ___
REVISED BY K. MOORE	DATE 10/16/12		APPROVED BY E. LOVE / DATE 10/11/11
SCALE AS NOTED			FIGURE NO. 1-1 / REV 0

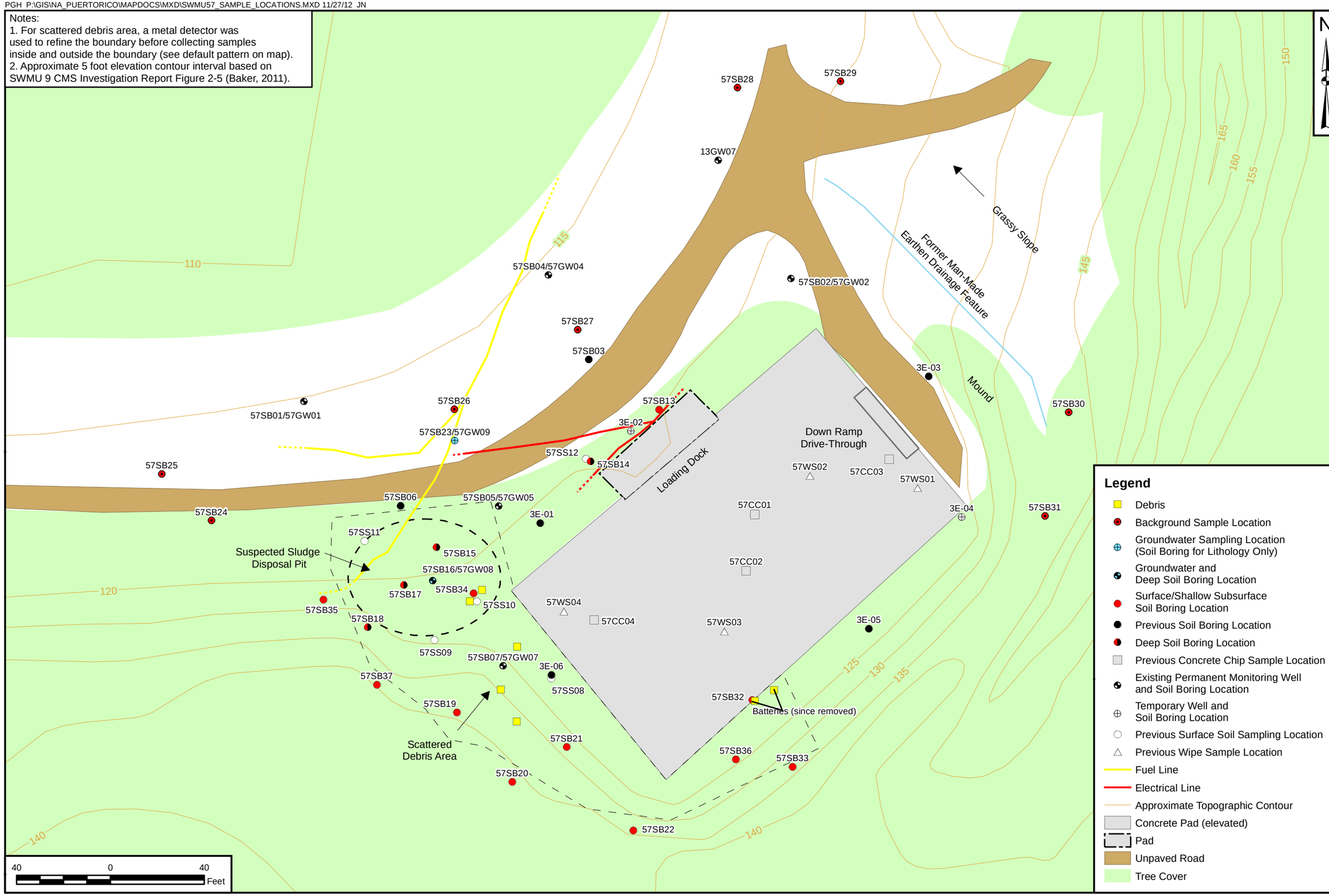
PGH:P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU57_SITEPLAN_AERIAL.MXD 11/14/2012 SP

DRAWN BY	DATE	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	08/22/11	—	JM02
CHECKED BY	DATE	APPROVED BY	DATE
M. COFFMAN	11/13/12	—	—
REVISED BY	DATE	APPROVED BY	DATE
S. PAXTON	11/13/12	L. KLINK	10/31/11
SCALE		FIGURE NO.	REV
AS NOTED		FIGURE 1-2	0

SITE PLAN
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

PGH P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU57_SAMPLE_LOCATIONS.MXD 11/27/12 JN

Notes:
1. For scattered debris area, a metal detector was used to refine the boundary before collecting samples inside and outside the boundary (see default pattern on map).
2. Approximate 5 foot elevation contour interval based on SWMU 9 CMS Investigation Report Figure 2-5 (Baker, 2011).



CONTRACT NUMBER —
CTO NUMBER JM02
APPROVED BY —
DATE —
APPROVED BY —
DATE —
FIGURE NO. FIGURE 1-3
REV 0

SAMPLE LOCATION MAP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

NAVFAC

DRAWN BY J. ENGLISH DATE 08/22/11
CHECKED BY M. COFFMAN DATE 11/27/12
REVISED BY J. NOVAK DATE 11/27/12
SCALE AS NOTED

2.0 FIELD INVESTIGATION AND ANALYTICAL METHODOLOGY

This section documents field work performed in 2012 for the SWMU 57 Full RFI. Discussion of the field work performed in 2010 during the Phase I RFI and in 2004 during the Phase I/II ECP is provided in Section 1.0 and the phase-specific reports (Baker, 2010; NAVFAC-LANT, 2005). The site-specific geology and hydrogeology information presented in this section was developed through evaluation of data collected from these three investigations. The Full RFI work was conducted in accordance with the Uniform Federal Policy (UFP) SAP prepared for this investigation (Tetra Tech, 2012). Monitoring wells were installed in accordance with Puerto Rico regulations and the Puerto Rico drilling permit, and well completion report are provided in Appendix B.

Table 2-1 provides a summary of samples collected, duplicate locations, and the analytical program for the Full RFI, and Table 2-2 provides the quality assurance (QA)/quality control (QC) and IDW samples. Full RFI soil boring, monitoring well, and site-specific background sample locations, and all previous sample locations, are shown on Figure 1-3.

2.1 DEVIATIONS FROM THE SAMPLING AND ANALYSIS PLAN

Full RFI field activities did not deviate from the 2012 Full RFI SAP, although minor adjustments were made in the field based on site conditions. One sample, the subsurface soil from 1 to 3 feet bgs at location SB22, was not collected because of site conditions since bedrock was encountered at 6 inches bgs at that location. In addition, the following sample locations were adjusted when a concrete pad was encountered at the loading dock (as shown on Figure 1-3) and when the scattered debris area was found to be larger than originally anticipated. The samples were moved to locations as close to the concrete unloading area as possible, if a spill had occurred on the concrete, it would have rolled/flowed off of the concrete pad to the area where the relocated samples were collected.

- Soil sample location 57SB13 was moved approximately 10 feet northwest to be off of the concrete loading dock pad.

- Soil sample location 57SB14 was moved approximately 20 feet northwest to be off of the concrete loading dock pad.

- Soil sample location 57SB20 was moved approximately 10 feet southwest to be just outside of the scattered debris area.

- Soil sample location 57SB22 was moved approximately 20 feet southwest to be just outside of the scattered debris area.

These deviations were necessary based on site conditions and are not considered to affect the quality or interpretation of the data. Data quality is discussed further in Section 2.3.2.

Additionally, the laboratory was required to concentration all PCB sample extracts to 2 ml instead of 10 ml in order to provide lower limits of detection in an attempt to achieve the very low project screening levels; the laboratory did not concentration the 2012 PCB samples to 2 ml. The implication of project screening level exceedances for Aroclor-1260 are that lower limits of detection would have helped to lower the uncertainty associated with these results but would not have eliminated uncertainty considering that the screening levels specified in the UFP-SAP were not achievable. Additional discussion is provided in Section 6.6.1 and Appendix G.

2.2 FIELD INVESTIGATION ACTIVITIES

This section provides a description of the field investigation tasks that were performed at the site to collect the data for the Full RFI. The objectives and descriptions of field tasks and sampling procedures and the associated analytical parameters are presented for each investigation task, as applicable. The UFP-SAP project personnel sign-off sheet and copies of field logbook pages are presented in Appendix C.

2.2.1 Utility Clearance/Site Access

Personnel were required to have security clearance for access to the former facility. All on-site personnel provided their social security number, presented a photo identification card, and provided vehicle registration information and proof of automobile insurance before entry to the facility was allowed. The drilling subcontractor, GeoEnviroTech, Inc., additionally performed utility clearance activities and cleared all monitoring well and soil boring locations using ground-penetrating radar and pipe/cable locator.

2.2.2 Analog Geophysical Survey

The analog geophysical survey was conducted on June 6, 2012, at the SWMU 57 POL Drum Storage area, in the area of the scattered debris. The survey was conducted to delineate the extent of the scattered debris currently on the ground surface and in the shallow subsurface where debris originally placed on the ground surface or scraped off the concrete pad may have been covered with leaf litter or soil over time. In addition, the types and sizes of debris in the area were to be documented. The survey was conducted using a White's Spectrum XLT E-Series all metals detector capable of identifying debris in

the shallow subsurface to a depth of 1 to 2 feet bgs, along with visual observations. Photographs taken during the survey are provided in Appendix D. The survey began at the southwestern corner of the concrete pad and proceeded to the north, west, south, and east along the suspected border of the debris area. Various debris items were located in the area during the survey, including corroded drums, batteries, metal pieces, and construction materials. Debris was most concentrated near the southwestern and southeastern edges of the concrete pad, with observations during historical investigations, but the area was larger than previously indicated. Figure 1-3 has been updated to reflect the actual boundary of debris. Debris was less dense further from the concrete pad. Two marine batteries were identified along the southeastern edge of the pad as shown on Figure 1-3. Upon discovery of the marine batteries, the facility POC was notified, and the batteries have since been removed from the site by the facility's waste disposal consultant (Power Cooling). Stray trash items (e.g., beverage cans, bottles, small plastic containers, etc.) were located at distances greater than 100 feet from the southwestern edge of the concrete pad in the forested area. These areas were not included in the debris area limits shown on Figure 1-3 due to low density and nonhazardous nature of the trash items. During the survey, all instrument signals were associated with observed scattered debris on the ground surface only and no indications of shallow subsurface debris were encountered.

The possibility that shallow subsurface debris could be present within the scattered debris area, from debris originally placed on the ground surface or scraped off the concrete pad may have been covered with several inches of soil and/or leaf litter over time, was investigated during the Full RFI via an analog geophysical survey. As expected based on the CSM, there were no indications from the geophysical survey of shallow subsurface metallic debris, nor was there evidence of buried debris in the soil borings. All instrument signals were associated with observed debris on the ground surface only. Moreover, no hazardous debris was encountered that could serve as a future contaminant source, except for two intact marine batteries on the ground surface that were removed and underlying soil sampled.

2.2.3 Surface and Subsurface Soil Sampling

Soil samples were collected via hand auger and direct-push technology (DTP) as described below. Soil samples were collected between June 6 and June 8, 2012. Soil sample log sheets and boring logs are provided in Appendix C.

2.2.3.1 Soil Sample Collection via Hand Auger

Nineteen surface soil (0 to 1 foot bgs) and five subsurface soil (1 to 3 feet bgs samples were collected during the Full RFI using hand auger sampling techniques. The hand auger system consisted of a stainless steel bucket bit (i.e., a cylinder 6.5 inches long with a nominal diameter of 3 inches) attached to

a 3-foot extension rod and a cross handle. The auger was decontaminated before and after each soil boring using Alconox/water solution wash and potable water rinse, wash water containerized as IDW. Each area to be sampled was cleared of any leaves, twigs, etc. prior to collecting the sample. For each sample, the hand auger was turned into the ground and the sample material was removed and placed into a Ziploc bag until the final desired depth was reached. Excess soil core material was returned to each hole. At each soil sampling location, a sample log sheet was generated that included information such as sample and location identification, sampling time, soil description, and sampling depth. Soil sample log sheets are provided in Appendix C. Any visual signs of potential contamination (e.g., soil staining, elevated PID readings, or odors) were noted on soil sample log sheets. Table 2-1 provides a summary of the samples collected and analyses conducted. Figure 1-3 shows the soil boring locations.

2.2.3.2 Soil Sample Collection via DPT

A DPT drill rig was used to collect soil samples at locations where deeper soil boring and monitoring wells were installed. Five surface soil (0 to 1 foot bgs), five subsurface soil (1 to 3 feet bgs), two subsurface soil (9 to 11 feet bgs), one subsurface (10 to 12 feet bgs), and two subsurface soil (13 to 15 feet bgs) samples were collected via DPT. One soil boring (57SB23) was installed for lithology only, soil samples were not collected from this soil boring. The entire length of each boring was logged using the Uniform Soil Classification System (USCS) and screened for organic vapors using a PID. Each soil boring log notes the soil type, color, rocks or minerals present, sample intervals, organic vapor, field screening measurements, and a qualitative indication of soil conditions. For each sample collected via DPT, a sample log sheet was generated that included information such as sample and location identification, sampling time, soil description, and sampling depth, boring logs were also generated. Soil sample log sheets and boring logs are provided in Appendix C. Monitoring wells 57GW08 and 57GW09 were installed at soil boring locations 57SB16 and 57SB23, respectively. Except for borings 57SB16 and 57SB23, where monitoring wells were installed, all other borings were abandoned after sampling by grouting the boreholes from the bottom up to the ground surface with a tremie pipe in accordance with Puerto Rico Environmental Quality Board (PREQB) regulations. Table 2-1 provides a summary of DPT soil samples and associated analyses. Figure 1-3 shows DPT soil boring locations.

2.2.4 Monitoring Well Installation

A DPT drill rig with augering capabilities was used to install permanent monitoring wells in boring 57SB16 (57GW08) and 57SB23 (57GW09). Both monitoring wells were constructed of 2-inch inside diameter, flush-threaded, polyvinyl chloride (PVC) well screen with a 0.010-inch slot size and compatibly threaded PVC well casing. A primary filter pack of Standard Sieve No. 20/30 clean silica sand was installed flush with the bottom of the well to a minimum of 24 inches above the top of the 10-foot long well screen. Wells

were installed using hollow-stem augers that allowed for a minimum 2-inch-thick sand pack in the annulus between all sides of each new well and the sidewalls of the borehole. A minimum 24-inch-thick seal of 100-percent bentonite pellets was installed above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations. A concrete pad (minimum of 6 inches thick and 3 feet by 3 feet square) was installed above the bentonite seal and around each casing. The stick-up wells were constructed using a 6-inch steel protective case with locking cap. Four concrete-filled steel bollards 7 feet in length, 3 feet in the ground and 4 feet out, were installed just outside the well pad. A boring log and well construction sheet was produced for each new well and are provided in Appendix C. Table 2-3 provides well construction details for these two new monitoring wells and monitoring wells installed during the Phase I RFI. Cuttings were containerized and managed as IDW. Augers and other well drilling equipment were decontaminated prior to the start of drilling, between each soil boring and well installed, and prior to demobilization from the site, wash water was containerized as IDW. Wells were installed in accordance with SOP GH-2.8 (Tetra Tech, 2012) and with applicable Puerto Rico regulations.

Licensed Puerto Rico driller, GeoEnviroTech, Inc., based in Guaynabo, Puerto Rico, installed the monitoring wells and abandoned the soil borings. The drilling permit and well completion reports are provided in Appendix B.

2.2.5 Water Level Measurements

One round of synoptic water level measurements, from all of the monitoring wells, was collected on June 9, 2012, using an electric water level indicator. The monitoring wells are screened in weathered bedrock as discussed in Section 3.0. Groundwater level measurements were recorded in the field log books which are provided in Appendix C. Groundwater levels and calculated elevations are summarized in Table 2-3.

2.2.6 Groundwater Sampling

A groundwater sampling and analyses summary is presented in Table 2-1, and copies of groundwater sample log sheets are provided in Appendix C. The monitoring wells were developed and then purged and sampled using low-flow techniques via a peristaltic pump. Monitoring well development records are provided in Appendix C. Prior to sampling, the wells were purged by pumping them at a higher rate than during sample collection. After removing 1 to 2 gallons, the pumping rate was lowered, and the wells were purged until the turbidity reached 10 nephelometric turbidity units (NTUs), if possible, and until the other water quality parameters had stabilized. The turbidities at 57GW05, 57GW07, 57GW08, and 57GW09 did not reach 10 NTU. Due to the extended purge times at these well and the stabilization of

the turbidity and other water quality readings, these monitoring wells were sampled with turbidity readings greater than 10 NTU.

Water-quality parameter data such as temperature, pH, specific conductance, turbidity, dissolved oxygen (DO), and salinity were collected during purging of the wells and recorded on low-flow purge sheets provided in Appendix C. Equipment calibration sheets for the turbidity meters, water quality meters, and PID also provided in Appendix C. The last water-quality readings prior to collecting the groundwater sample for each sampling point are summarized in Table 2-4.

2.2.7 Quality Assurance/Quality Control Samples

QA/QC samples were generated during sampling activities to monitor both field and laboratory procedures, in accordance with the approved SAP. QA/QC samples included field duplicates (see Table 2-1), matrix spike (MS) and matrix spike duplicates (MSD), trip blanks, and equipment rinsate blanks (see Table 2-2). The following types of QA/QC samples were collected during Full RFI field sampling:

Field duplicates consisted of a single sample split into two portions. Field duplicates were collected at the rate of 1 per 20 samples collected for laboratory analysis during the field investigation to assess the overall precision of the sampling and analysis program.

Matrix spike and matrix spike duplicate samples (MS/MSD) consisted of samples designated on the chain-of-custody forms. The MS/MSDs were collected at the rate of 1 per 20 samples collected for laboratory analysis to assess the accuracy and precision of the analytical method.

Trip blanks were collected and analyzed at a frequency of one per cooler containing VOC samples. Trip blanks were provided by the laboratory to assess potential volatile organic contamination.

Equipment rinsate blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over reusable sample collection equipment (DPT equipment used for soil sampling, hand auger, and bladder pump) after decontamination and before use. Equipment rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples and collected at the rate of 1 per 20 samples collected for laboratory analysis to assess potential decontamination contamination.

Sample log sheets were generated for each trip blank and equipment rinsate blank sample and are included in Appendix C. Locations where duplicate samples were collected are noted on soil sample log sheets included in Appendix C.

2.2.8 Decontamination Procedures

Decontamination of sampling equipment (i.e., DPT equipment, hand auger, and bladder pump) was conducted prior to and between sampling at each location. The decontamination procedure consisted of an Alconox detergent and water solution wash followed by a potable water rinse. Drilling equipment used by the DPT drill rig was also decontaminated. Decontamination fluids were containerized and characterized for appropriate disposal with other IDW.

2.2.9 Investigation-Derived Waste Management

IDW was containerized in Department of Transportation (DOT)-approved (DOT specification 17C) 55-gallon drums, and stored on the SWMU 57 concrete pad. The drums were labeled as soon as possible after they were filled.

Waste soils were generated during the installation of the soil borings and monitoring wells. The soil IDW consisted of the excess soil cuttings from the DPT soil borings that were not collected for laboratory analyses, and the soils produced during auger drilling of the boreholes for monitoring well installation. Waste soils generated during the Full RFI were collected and placed in 55-gallon drums for waste characterization sampling and analysis. Four 55-gallon drum of soil IDW were generated during the field sampling operations.

Waste water was generated during monitoring well purging, well development, sampling of the monitoring wells, and during decontamination procedures. All aqueous IDW was containerized. One 55-gallon drum of aqueous IDW was generated during Full RFI field sampling operations.

Solid IDW was analyzed for Toxicity Characteristic Leaching Procedure (TCLP) Regulatory List Organics, TCLP Regulatory List Inorganics, ignitability, pH, reactive cyanide and sulfide and aqueous IDW was analyzed for ignitability, pH, reactive cyanide and sulfide. Table 2-2 provides IDW sample information and sheets. The IDW drums were disposed in July 2013, see Appendix C for IDW disposal information.

2.2.10 Land and GPS Survey

All newly installed soil borings and monitoring wells and the corners of the concrete pad were surveyed (northing, easting, and elevations). A third-order survey was conducted by Antonio Melendez & Asociados, P.S.C, Bayamon, Puerto Rico. The survey data are provided in Appendix C. The survey consisted of establishing horizontal control tied to the State Plane Coordinate System for Puerto Rico and the United States Virgin Islands, Lambert Projection, North American Datum (NAD) 1983, Current Epoch of 2007. Horizontal control was established by global positioning system (GPS) (Trimble Dual Frequency Receivers). Previously installed monitoring wells were resurveyed at ground level with conventional equipment (Nikon Total Station), and elevations at the tops of the well risers were measured by means of differential leveling departing from closed circuits. A Geodetic Sokkia digital level and bar code rods were used for leveling of all of the monitoring wells (bench marks), and a closure of 0.003 inches was obtained. Some discrepancies between the newly acquired survey data and the previously reported values of some monitoring wells (bench marks) were noted. New elevations were assigned at the monitoring wells (bench marks). Only the bench marks (tops of monitoring well riser pipes) were measured by differential leveling; all other points were surveyed by conventional surveying (total station).

Hand auger soil sample locations were located by Tetra Tech personnel, and coordinates were recorded using a hand-held GPS unit. The horizontal locations were referenced to the State Plane Coordinate System for Puerto Rico and the United States Virgin Islands.

2.3 ANALYTICAL METHODOLOGY

2.3.1 Analytical Methods

Chemical analyses for Appendix IX VOCs (SW-846 Method 8260B), Appendix IX SVOCs including low-level PAHs [SW-846 Method 8270D and 8270D Selected Ion Method (SIM)], Appendix IX PCBs (SW-846 Method 8082A), Appendix IX metals (SW-846 Method 6020A/7470A), TCLP organics (SW-846 Methods 1311/8260B, 8270D, 8081A, and 8151A), TCLP Organics (SW-846 1311/8260B/8151A/8081A/8270D), TCLP Inorganics (SW-846 Methods 1311/6020A/7470A), and ignitability, pH, reactive cyanide, and reactive sulfide (SW-846 Methods 1010A, 9045D, 9040C, 9012A, and 9030/9034 and SM4500S-2 CF) were performed by Katahdin Analytical Services, Inc. (Katahdin), located in Scarborough, Maine. All samples were sent by FedEx under proper chain-of-custody protocols to the laboratory for analysis. Chain-of-custody forms are included in Appendix C.

Detailed laboratory analytical reports and data validation reports for Full RFI data are presented in Appendices E and F, respectively, and include sample results for surface and subsurface soil, groundwater, QC, and IDW.

2.3.2 Data Usability Assessment

The usability of the data generated during Full RFI activities directly affects whether project objectives have been achieved. The results from analytical laboratory samples were validated according to several specifications. A description of the data review processes used to determine whether analytical laboratory data are of acceptable technical quality for use in decision making and summary tables that support the review of the data collected during the Full RFI are presented in the Data Quality Review (DQR) in Appendix G. The Puerto Rico chemist's certification of the Full RFI data is presented in Appendix G.

Phase I RFI data were validated (Baker, 2010) as discussed below, and the Phase I RFI validation reports are presented in Appendix F for reference. A DQR was not completed for Phase I RFI data.

The ECP data were verified according to laboratory protocol, not USEPA Region II data validation protocol that was used for all other site data.. However, to be conservative, the ECP data were evaluated to determine the nature and extent of SWMU 57 contamination and for risk assessment. Further, of note, the laboratory did apply qualifiers to the ECP data which are different than those that were applied to the Full RFI and Phase I RFI data during validation. These laboratory qualifiers are described below and are also defined on the Section 4 tables in which ECP data are presented:

N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.

The DQR for the subject Full RFI data includes data verification and validation processes. Verification is a process used to ensure that contractual requirements were satisfied. Validation is a comparison of data quality indicators (DQIs) to prescribed acceptance criteria to assess analytical method performance. The DQIs include measures to assess the bias and precision of the analytical calibrations and sample analyses. Together, verification and validation are the first steps in evaluating the DQIs for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). Each of the PARCCS parameters is discussed in greater detail in the DQR. The DQR includes information on the data validation process, qualified results, rejected data, laboratory completeness, and a comparison of validated detection limits for non-detected parameters to project screening levels.

Assignment of data qualification flags conformed to rules established in USEPA Region II Hazardous Waste Supporting Branch SOPs HW-22 Revision #4 Validating Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) SW-846 Method 8270D and HW-45 Revision #1 Validating PCB Compounds by Gas Chromatography SW-846 Method 8082A, as well as the USEPA Region II document titled "Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILM 05.3 (SOP Rev 13), and the Department of Defense (DoD) document entitled Quality Systems Manual (QSM) for Environmental Laboratories (DoD, 2009) to the greatest extent practicable. Numerical criteria used in conjunction with these rules were specified in the SWMU 57 SAP. A complete printout of the Katahdin analytical data with validation flags, data validation summary narrative reports, and data validation qualifications and discussions can be found in the reports in Appendix F. A detailed description of the data qualification flags is provided in the DQR (Appendix G).

Full RFI DQR Summary

The majority of data collected is considered useable for the purposes of this project; however, laboratory QC accuracy issues resulted in the rejection of all soil data for the SVOCs 1,4-phenylenediamine, 7,12-dimethylphenethylamine, A,A-dimethylphenethylamine, hexachlorophene, and O,O,O-triethyl phosphorothioate and the VOCs acetonitrile, acrolein, isobutanol, and propionitrile, and all groundwater data for the SVOCs 1,3,5-trinitrobenzene, 1,4-naphthoquinone, 1,4-phenylenediamine, 3,3'-dimethlybenzidine, 7,12-dimethylphenethylamine, A,A-dimethylphenethylamine, hexachlorophene, and O,O,O-triethyl phosphorothioate and the VOCs acetonitrile, isobutanol, and propionitrile. All of those compounds listed above with rejected data are additional Appendix IX compounds (i.e. not TCL analytes) which often have poor recoveries due to the chemical nature of the compounds. The majority of the VOC and SVOC analytical data has concentrations less than detection limits indicating that those fractions are not present at the site and therefore that those compounds listed above (all of which are VOC and SVOCs) with rejected data are not likely present on-site.

Phase I RFI Validation Summary (Baker, 2010)

Laboratory analyses for the Phase I RFI data were performed by CompuChem, a Division of Liberty Analytical Corporation, located in Cary, North Carolina. Validation services for Phase I RFI data were provided by DataQual Environmental Services, LLC, located in St. Louis, Missouri. The validation indicated that most sample preparation and analysis was performed within Region II and/or method holding time requirements, with exceptions as discussed below. Changes in the results due to application of the data validation objectives did not significantly compromise the data quality objectives for the

SWMU 57 Phase I RFI. The data as qualified by the validator was determined to be acceptable for its intended use.

For samples 57SS08 through 57SS12, the original receipt of VOC samples was delayed because of courier shipment. The samples were recollected for VOCs, and analytical results for the recollected samples were included with the results for other constituents. Samples for TPH GRO analysis had to be resampled in May 2009 because of a laboratory error (originally sampled in January 2009). VOC results for sample 57SB02-00 exhibited less than 25 percent internal standards area recoveries for all standards; therefore, all positive results were qualified as estimated (J), and non-detect results were qualified as rejected (R). In addition, selenium results were rejected because the MS analysis submitted for the corresponding sample delivery group (SDG) exhibited non-compliant percent recoveries. GRO holding time for samples 57ER01, 57FB01, and 57TB02 were exceeded by 1 day; therefore, the positive results in all samples were qualified as estimated (J). Sample 57SS09D was analyzed 4 days after the 14-day holding time for VOCs; therefore, all positive results were qualified as estimated (J), and all non-detected results were rejected (R). Sample 57GW05 exhibited a pH of 7 and exceeded the 7-day holding for water samples with pH values greater than 2 by 5 days; therefore, all positive VOC results were qualified as estimated (J), and non-detect results were rejected (R). In addition, total and dissolved barium results were rejected because of an unfavorable comparison between total and dissolved metals. Due to SVOC recoveries below 10 percent for laboratory control samples (LCSs), all associated sample non-detect results for several compounds were qualified as rejected (see data validation narrative in Appendix F) for concrete chip samples 57CC01 through 57CC04.

TABLE 2-1

SUMMARY OF SAMPLES COLLECTED
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Location	Sample Number	Date Collected	Medium	Depth Collected (feet bgs)	Analyses
57SB13	57SB13-0001	06-07-12	Soil	0-1	Appendix IX VOCs, Appendix IX SVOCs (including low-level PAHs), Appendix IX metals, and Appendix IX PCBs
	57SB13-0001-D	06-07-12		0-1	
	57SB13-0103	06-07-12		1-3	
57SB14	57SB14-0001	06-07-12		0-1	
	57SB14-0103	06-07-12		1-3	
	57SB14-0911	06-07-12		9-11	
57SB15	57SB15-0001	06-07-12		0-1	
	57SB15-0103	06-07-12		1-3	
	57SB15-1315	06-07-12		13-15	
57SB16	57SB16-0001	06-06-12		0-1	
	57SB16-0103	06-06-12		1-3	
	57SB16-0911	06-06-12		9-11	
57SB17	57SB17-0001	06-07-12		0-1	
	57SB17-0103	06-07-12		1-3	
	57SB17-1315	06-07-12		13-15	
57SB18	57SB18-0001	06-07-12		0-1	
	57SB18-0103	06-07-12		1-3	
	57SB18-1012	06-07-12		10-12	
57SB19	57SB19-0001	06-07-12		0-1	
	57SB19-0103	06-07-12		1-2 Refusal at 2 feet bgs	
57SB20	57SB20-0001	06-07-12		0-1	
	57SB20-0001-D	06-07-12		0-1	
	57SB20-0103	06-07-12		1-3	
57SB21	57SB21-0001	06-07-12		0-1	
	57SB21-0103	06-07-12		1-2 Refusal at 2 feet bgs	
57SB22	57SB22-0001	06-07-12		0-0.5 Refusal at 0.5 feet bgs	
57SB32	57SB32-0001	06-08-12		0-1	
57SB33	57SB33-0001	06-08-12		0-1	

TABLE 2-1

SUMMARY OF SAMPLES COLLECTED
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Location	Sample Number	Date Collected	Medium	Depth Collected (feet bgs)	Analyses
57SB34	57SB34-0001	06-08-12		0-1	
	57SB34-0103	06-08-12		1-2	
57SB35	57SB35-0001	06-08-12		0-1	
57SB36	57SB36-0001	06-08-12		0-1	
57SB37	57SB37-0001	06-08-12		0-1	
57SB24	57SB24-0001	06-06-12		0-1	Appendix IX SVOCs (including low-level PAHs), and Appendix IX metals
57SB25	57SB25-0001	06-06-12		0-0.67 Refusal at 0.67 feet bgs	
57SB26	57SB26-0001	06-06-12		0-1	
57SB27	57SB27-0001	06-06-12	Soil	0-0.67 Refusal at 0.67 feet bgs	Appendix IX SVOCs (including low-level PAHs), and Appendix IX metals
57SB28	57SB28-0001	06-06-12		0-1	
57SB29	57SB29-0001	06-06-12		0-0.5 Refusal at 0.5 feet bgs	
57SB30	57SB30-0001	06-06-12		0-1	
57SB31	57SB31-0001	06-06-12		0-1	
13GW07	13GW07-060912	06-09-12	Groundwater	NA	Appendix IX metals (total) and Appendix IX PCBs
57GW01	57GW01-061012	06-10-12		NA	
57GW04	57GW04060912	06-09-12		NA	
57GW07	57GW07-060912	06-09-12		NA	
57GW02	57GW02-060912	06-09-12		NA	Appendix IX VOCs, Appendix IX SVOCs (including low-level PAHs), Appendix IX metals (total), and Appendix IX PCBs
57GW05	57GW05-060912	06-09-12		NA	
	57GW05-060912-D	06-09-12		NA	
57GW08	57GW08-061112	06-11-12		NA	
57GW09	57GW09-061012	06-10-12		NA	

bgs - below ground surface.
PCB - Polychlorinated biphenyl.
VOC - Volatile organic compound.
SVOC - Semivolatile organic compound.

A sample suffix of D indicates a duplicate.

TABLE 2-2

SUMMARY OF QA/QC AND IDW SAMPLES
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Sample Number	Date Collected	Medium	Analyses
QA/QC			
TB-060612-01	06-06-12	Trip blank	Appendix IX VOCs
TB-060712-01	06-07-12		
TB-060912-01	06-09-12		
EB-060612-01	06-06-12	DPT equipment for soil sampling	Appendix IX VOCs, Appendix IX SVOCs (including low-level PAHs), Appendix IX metals, and Appendix IX PCBs
EB-060812-01	06-08-12	Hand auger for soil sampling	
EB-061012-01	06-10-12	Bladder pump for groundwater sampling	
IDW			
IDW-060812-01	6-08-12	Drill cuttings	TCLP Organics, TCLP Inorganics (regulatory list) ignitability, pH, and reactive cyanide and sulfide
IDW-061012-01	6-10-12	Decontamination, development, and purge water	Ignitability, pH, reactive cyanide and sulfide

IDW Investigation-derived waste.
PAH Polynuclear aromatic hydrocarbons
PCBs Polychlorinated biphenyls.
QA/QC Quality assurance/quality control.
TCLP Toxicity Characteristic Leaching Procedure.
VOCs Volatile organic compounds.
SVOCs Semivolatile organic compounds.

TABLE 2-3

WELL CONSTRUCTION AND WATER LEVEL DATA SUMMARY
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Monitoring Well ID	Northing [a]	Easting [a]	Top of PVC Casing Elevation[b] (feet above msl)	Ground Surface Elevation (feet bove msl)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Top of Screen Elevation (ft above msl)	Bottom of Screen Elevation (ft above msl)	Date Installed	April 20, 2010		June 9, 2012	
										DTW (feet below TOC)	Groundwater Elevation (feet above msl)	DTW (feet)	Groundwater Elevation (feet above msl)
57GW01	804382.45	939223.77	118.42	115.40	22	12 - 22	103.4	93.4	01/28/10	16.90	101.52	15.24	103.18
57GW02	804434.82	939431.32	124.62	121.90	25	15 - 25	106.9	96.9	01/26/10	23.30	101.32	21.81	102.81
57GW04	804436.30	939327.88	119.26	116.40	22	12 - 22	104.4	94.4	01/28/10	17.82	101.44	16.22	103.04
57GW05	804337.85	939306.70	121.02	118.10	21	11 - 21	107.1	97.1	01/27/10	19.43	101.59	17.78	103.24
57GW07	804269.72	939308.66	124.19	121.30	29	19 - 29	102.3	92.3	01/27/10	22.55	101.64	20.85	103.34
57GW08	804299.26	939277.72	123.97	121.10	29	19 - 29	102.1	92.1	06/07/12	NA	NA	20.79	103.18
57GW09	804369.24	939299.78	120.09	117.35	23	13 - 23	104.4	94.4	06/05/12	NA	NA	16.99	103.1
13GW07[c]	804485.24	939400.35	121.67	118.90	30	NA - NA	NA	NA	01/15/09	20.30	101.37	18.84	102.83

a Survey coordinates from 2012 suvey; SPC - State Plane Co
b The datum used is Mean Low Water plus 100 feet as established by the U.S. Navy Survey Section (November 1941).
c Well installation data and screen interval are unknown.
NA - Information not available
msl - feet above mean sea level
bgs - below ground surface
TOC - top of casing
DTW - depth to water

TABLE 2-4

SUMMARY OF GROUNDWATER QUALITY PARAMETER DATA
COLLECTED DURING PURGING
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Well Number	Temperature (°C)	pH	Specific Conductance (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (ppt)	Turbidity (NTU)	TDS (g/L)	ORP (mV)
57GW01	28.31	6.65	9.91	0.00	5.6	1	6.24	259
57GW02	31.83	6.40	25.00	0.08	15.2	1	15.50	445
57GW04	29.81	7.63	5.43	0.00	2.9	10	3.42	407
57GW05	29.48	6.84	3.14	0.00	1.6	15	2.01	-55
57GW07	28.85	7.41	8.21	0.00	4.5	40	5.17	421
57GW08	29.41	6.79	9.56	0.13	5.3	19	6.02	149
57GW09	30.30	7.14	4.28	0.06	2.3	40	2.74	79
13GW07	29.64	5.98	11.80	0.00	6.7	5	7.30	482

mS/cm - milliSiemens per centimeter.
mg/L - milligram per liter.
NTU - Nephelometric Turbidity Unit.
mV - millivolts.
TDS - Total dissolved solids.
ppt - Parts per thousand.
g/L - grams per liter.

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section contains both general regional and site-specific information relative to the environmental setting at SWMU 57. The physical setting of NAPR was documented in the 1984 Initial Assessment Study (IAS) (NEESA, 1984). This information is the reference for the regional discussions that follow.

3.1 CLIMATE

The climate associated with NAPR is characterized as warm and humid, with frequent showers occurring throughout the year. A major factor affecting the weather is the pattern of trade winds associated with the Bermuda High. The prevailing wind direction reflects the easterly trade winds. The mean annual wind velocity is 5.5 knots, with a minimum in November and a maximum in August. Gales associated with westward-moving disturbances in the trade winds or hurricanes passing either north or south of the area have the highest probability of occurrence from June through October.

The warmest months are August and September, and the coolest are January and February. Mean annual maximum temperatures range from 82.0 degrees Fahrenheit (°F) in January to 88.2° F in August. The mean annual minimum temperatures vary from 64.0° F in January to 73.2° F in June. Rain usually occurs at least 9 days in every month, with an average of 60 inches per year, although a dry winter season occurs from December through April. The hurricane season is from mid-June through mid-September. An average of two tropical storms per year occurs in the NAPR area, one of which usually reaches hurricane intensity.

3.2 TOPOGRAPHY

The regional area of NAPR consists of an interrupted, narrow, coastal plain with small valleys extending from the Sierra de Luquillo range, which has been severely eroded by streams into valleys several hundreds of feet deep. Slopes of up to 60 degrees are common.

In the immediate area of NAPR, elevations range from sea level to approximately 295 feet. Immediately north of the NAPR boundary, the hills rise abruptly to heights of 800 to 1,050 feet above mean sea level (msl), with the tallest peak located within 2 kilometers of the NAPR boundary. There are three hilly areas on NAPR, two of which separate the southern airfield area from the former Port/Industrial, Housing, and Personnel Support areas, and the third is in the Bundy area. These ridgelines not only separate sections of NAPR but also dictate the degree of allowable development. Relief is low along the shoreline, and lagoons and mangrove swamps are common.

At SWMU 57, a steep vegetated hillside surrounds the concrete pad to the northeast, south, and southwest. Northwest of the pad, the topography flattens approaching the road before sloping steeply toward the Los Machos Mangrove Forest. A steep and bedrock-exposed hill lies immediately adjacent to the southeastern side of the concrete pad. Ground elevations range from approximately 15 to 35 feet above msl [i.e., 115 and 135 feet; the datum plan is Mean Low Water plus 100.00 foot as established by the U.S. Navy Survey Section (November 1941)]. The concrete pad is located at an approximate elevation of 23 feet above msl (123 feet).

3.3 HYDROLOGY

The surface waters that flow across the northeastern plain of Puerto Rico, where NAPR is located, originate on the eastern slopes of the Sierra De Luquillo Mountains. Surface runoff is channeled into various rivers and streams that eventually flow into the Caribbean Sea. The Daguao River and Quebrada Seca Stream (a tributary to Rio Daguao) collect surface waters from the hills immediately north of NAPR, and during periods of heavy rain, flooding on NAPR occurs. The Daguao-Quebrada Seca watershed comprises an area of approximately 7.6 square miles (4,900 acres), and the river falls some 700 feet from its source to sea level. Increased development in the town of Ceiba, especially in areas adjacent to NAPR's northern boundary, has significantly increased the surface runoff reaching NAPR. This condition has been alleviated by the construction of Route 3 immediately outside the fence and the realignment of Boxer Drive, both with attendant storm water management features.

In the low-lying shore areas of NAPR, seawater flooding results from storms, wind, and abnormally high tides. The tidal ranges in the NAPR area are rather small, with a maximum spring range of less than 3 feet. The tides are semi-diurnal and have a usual range of about 1 foot in the main harbor of NAPR.

The quality of surface waters at NAPR is variable, reflecting the drainage area through which the water flows. Generally, surface waters have high turbidities and high concentrations of bio-organics (i.e., naturally occurring organics such as decay products of vegetable and animal matter) due to the periodic heavy rains that can easily erode soils from steep slopes, exposed areas, and disturbed streambeds. Water from alluvial aquifers along the coast of NAPR is of a calcium bicarbonate type and has high concentrations of iron and manganese. The source of these minerals is unknown, but they may be derived from buried swamp or lagoon deposits.

At SWMU 57, a grassy slope and man-made earthen mound (and historical drainage feature no longer visible) divert surface water runoff away from the concrete pad. There are no natural surface water features at SWMU 57. The earthen drainage feature was dry at the time of the Phase I RFI, contained

little or no stream substrate, and terminated before the access road. Based on these conditions, this feature does not support aquatic organisms such as benthic macroinvertebrates. The earthen drainage feature was overgrown and not visible during the August 2011 site visit in support of the Full RFI. Ultimately, overland flow near SWMU 57 drains to the northwest toward the Los Machos Mangrove Forest, as shown on Figure 3-1.

3.4 GEOLOGY

3.4.1 Regional

Soil

The dominant soil associations at NAPR are typical of humid areas, namely the Swamps-Marshes Association and Mabi-Rio-Arriba-Cayagua Association, which cover over one half of NAPR's surface area and are equally distributed. The Descalabrado-Guayama Association, typical of dry areas, and isolated areas of the Caguabo-Mucara-Naranjito Association, Coloso-Toa-Bajura Association, and Jacana Amelia-Fraternidad Association are also found at NAPR.

Geology

The underlying geology of the NAPR area is predominantly volcanic (composed of lava and tuff), as well as sedimentary (rocks derived from discontinuous beds of limestone). These rocks all range in age from early Cretaceous to middle Eocene. The volcanic rocks and interbedded limestone have been complexly faulted, folded, metamorphosed, and variously intruded by dioritic rocks. This complex geological structuring occurred sometime after the deposition of the limestone during the middle Tertiary, when Puerto Rico was separated from the other major Antillean Islands by block faulting, and was arched, uplifted, and tilted to the northeast. Culebra, Vieques, and the Virgin Islands are part of the Puerto Rican block; they are separated from the main island simply because of the inundation that resulted from the tilting.

In addition to the predominant volcanic and sedimentary rock, unconsolidated alluvial and older deposits from the Quaternary period underlie the northwestern and western sections of the former base.

The primary geologic formations on and near NAPR are various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre, the Daguao Formation, and the Figuera Lava. The Peña Pobre fault zone traverses NAPR.

3.4.2 Site-Specific

Soil

Downgradient of SWMU 57, the Swamps-Marshes Association in the Los Machos Mangrove Forest consists of deep very poorly drained soils. This association is found in level or nearly level areas that are slightly above sea level but are wet, and when the tide is high, are covered or affected by saltwater or brackish water. The soils are sandy or clayey and contain organic materials from decaying mangrove trees and are underlain by coral, shells, and marl at varying depths. The high concentration of salt inhibits the growth of all vegetation except mangrove trees, and in small-scattered patches, other salt-tolerant plants.

Soils in the vicinity of SWMU 57, classified as the Descalabrado-Guayama Association, generally consists of shallow, well drained, strongly sloping to very steep soils on volcanic uplands. Soils of this association are found primarily in the hilly areas located directly inland and adjacent to the soils of the Swamps-Marshes Association. Soil borings from the Phase I RFI and Full RFI encountered very thin (0.3 to 6 inches) organic top soils at the ground surface in vegetated areas. Near the road and pad, soils consisted of clays with increased amounts of silt, sand, and gravel.

Geology

SWMU 57 is located in an upland area within the Forrestal Area of the former base. The upland areas of NAPR include the hills encompassing the Tow Way Fuel Farm and hospital areas and the hills encompassing the area behind the former Exchange, the former AFWTF Command, and the Bundy area. These upland areas are underlain by bedrock and exhibit varying degrees of weathering. The geologic map of Naguabo and portions of the Punta Puerca quadrangles (M'Gonigle, 1979) indicated that the site is underlain by the Daguao Formation, which includes interbedded volcanic breccia, lava, subordinate volcanic sandstone, and crystal tuff. Several soil borings were advanced at SWMU 57 during Phase I RFI (seven) and Full RFI (six) field activities to profile surface and subsurface conditions via cross sections. The location of each cross section is provided on Figure 3-1. Geologic cross sections (A-A' and B-B') were prepared to depict shallow subsurface conditions at SWMU 57 (Figures 3-2 and 3-3). Full RFI boring logs are provided in Appendix C and the Phase I RFI cross section and boring logs are provided in Appendix A for reference. The datum for both is Mean Low Water plus 100.00 feet as established by the U.S. Navy Survey Section (November 1941).

Consistent with the Phase I RFI, a large portion of SWMU 57 was found to be underlain by residuum generally consisting of clay (predominant), silt, and/or sand (57SB01, 57SB03, 57SB04, 57SB05,

57SB15, 57SB16, 57SB-17, and 57SB23). Residuum thickness ranged from approximately 1.5 feet at 57SB04 on the slope southwest of the pad to 8.0 feet northwest of the pad at 57SB01. The residuum appears to generally follow topography across the site, thinning out on the steeper slopes southwest of the pad and increasing in thickness in the center of the site where topography is more flat. As expected, areas near the concrete pad were found to be underlain by fill material (57SB02, 57SB06, and 57SB14) including varying combinations of clay to gravel, or highly weathered bedrock (57SB07). The fill thickness was approximately 4.0 feet at 57SB02, 3.2 feet at 57SB06, and 4.0 feet at 57SB14. Groundwater was not observed in residuum or fill at SWMU 57.

The residuum, defined as unconsolidated soil originating from weathered-in-place bedrock, transitions with depth into highly weathered bedrock with a similar composition to the residuum - clay, silt, and sand generally coarsening with depth, with some relic bedrock features (i.e., fractures). In addition, the degree of weathering was highly variable from boring to boring due to preferential weathering along fractures. Highly weathered bedrock was also observed directly beneath the fill. According to Baker (2010), this variability of shallow subsurface materials (i.e., residuum, fill, or highly weathered bedrock) is not unusual considering the cut and fill construction methods typically employed in similar hilly upland areas of NAPR.

Soil samples were collected from the ground surface to a maximum depth of 13 to 15 feet bgs (57SB15 and 57SB17) within the highly weathered bedrock. Across the site, the highly weathered bedrock generally consists of varying amounts of clay, silt, and sand. Several facility background soil types exist; based on the Phase I RFI and Full RFI boring logs, background data for clay soils were selected as most appropriate. Groundwater was noted within the highly weathered bedrock at 11 feet bgs in soil borings 57SB14, 57SB16, and 57SB23 and at 15 feet bgs in soil borings 57SB15 and 57SB17.

DPT refusal, indicating a transition to more competent bedrock, is indicated on the cross sections as a transition between highly weathered bedrock and weathered bedrock that was encountered at several boring locations including 57SB02 (15.0 feet bgs), 57SB04 (23.5 feet bgs), 57SB05 (21.0 feet bgs), 57SB16 (20 feet bgs), 57SB18 (12 feet bgs), and 57SB23 (20 feet bgs). As highly weathered bedrock transitions to more competent bedrock, the degree of weathering decreases and grain size is expected to increase to sands and gravel with more evident bedrock features. Also, a thin (0.5–foot-thick), discontinuous, resistant lens of bedrock (tuff) was noted at approximately 14 feet bgs at locations 57SB05, 57SB07, and 57SB23.

3.5 HYDROGEOLOGY

3.5.1 Regional

The available groundwater on NAPR is generally acceptable for most industrial and commercial uses. The "hardness" of this water shows a predominance of calcium, bicarbonate, and magnesium ions, but is within normally acceptable ranges. However, a seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico, usually within a short distance inland of the coastline. As the depths of wells increase and distances to the sea decrease, the levels of salt-water intrusion rise. No potable wells have been installed at the former base. Several potable wells were once installed upgradient of NAPR in Ceiba but were later abandoned due to high levels of salinity. Under a 1942 agreement, NAPR gets raw water from the Rio Blanco watershed (NAVFAC-LANT, 1987).

The NAPR potable water treatment plant receives raw water from the Rio Blanco through a 27-inch reinforced concrete pipe that replaced an old open channel. The intake is located at the foot of the El Yunque rain forest. This buried raw water line traverses a distance of 14 miles from the intake to the NAPR boundary. A raw water reservoir is located at the water treatment plant and has a 45-million-gallon capacity. Additionally, there are two fire protection storage reservoirs at the facility with a total capacity of 520,000 gallons.

NAPR has been served for over 30 years by the present water treatment facility. The plant (Building 88) has a capacity of 4.0 million gallons per day (MGD). Water flows by gravity into a 45-million-gallon raw water storage basin from which the plant draws its supply at a past rate of 1.3 MGD on average. Treatment consists of pre-chlorination, coagulation sedimentation, filtration, and post-chlorination.

3.5.2 Site-Specific

During the Phase I RFI, groundwater was encountered approximately 16 to 23 feet bgs, and groundwater flow in the upland area of SWMU 57 was reported to be toward the north northwest at a gentle hydraulic gradient. Furthermore, this groundwater flow direction is generally consistent with the anticipated flow for SWMU 57 based on the local topography and the flow direction observed at adjacent SWMU 9 Area C (i.e., toward Los Machos Mangrove Forest). The 2010 Phase I RFI map of the potentiometric surface is provided in Appendix A.

The groundwater elevation for well 57SB02 was not used in development of the potentiometric surface shown on Figure 5-4 of the Phase I RFI Report (Baker, 2010), provided in Appendix A. The Phase I RFI Report indicated that groundwater elevations for 57SB02 are consistently lower than expected. In

addition, DPT refusal was encountered at a depth of 15 feet bgs, and well 57SB02 had a very low yield and recharge rate (i.e., the well went dry during development, and the yield was insufficient for sampling using low-flow procedures). Based on the typical climate for NAPR, the Phase I RFI April 2010 event occurred at the end of the dry winter season and a drought occurred in 2010 prior to the Phase I RFI field event, and so groundwater levels appeared to be at or near low conditions across SWMU 57.

During the 2012 Full RFI groundwater sampling event, the groundwater flow direction to the north-northeast was generally consistent with that of the 2010 Phase I RFI, with flow toward the Los Machos Mangrove Forest with an average hydraulic gradient of approximately 0.0024. Hydraulic gradient was calculated between the 103.3 and 102.9 equipotential lines (a distance of 165 feet). As in 2010, water levels across the site are nearly flat along the primary groundwater flow direction, with only 0.3 foot of elevation difference between 57GW07 and 57GW04. Based on soil boring logs, groundwater was first encountered within the highly weathered bedrock, and wells were then installed immediately above or across the transition into more competent bedrock. The 2012 map of the potentiometric surface is provided as Figure 3-4.

The groundwater elevation for well 57SB02 was included in development of the Full RFI potentiometric surface map because elsewhere at SWMU 57 the potentiometric surface appears to occur in the weathered bedrock, even in wells screened across or in the less weathered/more competent bedrock, indicating an unconfined shallow aquifer (57SB01, 57GW02, 57GW07, 57GW08, 57GW09). In addition, the well 57SB02 water level was similar to elevations in nearby 13GW07 in both 2010 and 2013, with differences of 0.05 foot in 2010 and 0.02 foot in 2012. The slight variation in 2010 may have been due to groundwater flow variations in the more competent bedrock fractures occurring during drought conditions. Overall, groundwater elevations in June 2012 were approximately 2 feet higher than those in April 2010 across the site, which is expected based on available precipitation data for the months preceding the 2012 sampling event during the traditional rainy season, moreover, a drought occurred in 2010 prior to the Phase I RFI field event. The 2012 groundwater flow direction is consistent with the anticipated flow for SWMU 57 toward the Los Machos Mangrove Forest. Groundwater flow appears to be inconsistent with the flow direction observed at adjacent SWMU 9 Area C; however, the inconsistency can be readily explained. Based on the SWMU 57 data, groundwater flow is in fact to the north, not west at SWMU 57; the additional wells installed at SWMU 57 during the Full RFI allowed for a more accurate depiction of groundwater flow than what was provided in the SWMU 9 report for the western fringe of that site. In summary, groundwater is from the topographic highs east and south of the SWMUs (from weathered bedrock), flowing toward the mangrove swamp area (to sandy Holocene deposits). A potentiometric surface map for SWMU 9 is provided in Appendix A.

3.6 ECOLOGY AND NATURAL RESOURCES

The facility supports one plant (*Cobana negra*) that was classified as threatened in 1990 by the United States Fish and Wildlife Service (USFWS). The black mangrove (*Avicennia germinans)* is classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are conservation zones protected under federal law and are critical habitat for the endangered yellow-shouldered blackbird (*Agelaius xanthomus*).

Because of its island ecosystem, abundant and diverse species of terrestrial vertebrates are not found on Puerto Rico. The facility supports a variety of wildlife that have been listed by either the federal or Commonwealth governments as threatened, endangered, or vulnerable (Commonwealth only), including: five sea turtle species [green (*Chelonia mydas)*, loggerhead (*Agelaius xanthomus)*, hawksbill (*Eretmochelys imbricate*), leatherback (*Dermochelys coriacea)*, and olive ridley (Lepidochelys olivacea)]; one snake [Puerto Rican boa constrictor (*Epicrates inornatus)*]; 12 birds [including the endangered yellow-shouldered blackbird and brown pelican (*Pelecanus occidentalis occidentalis*)]; and one mammal [West Indian manatee (*Trichechus manatus*)].

The major mammal population in and near NAPR consists of introduced species such as stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. The reptile population (especially snakes) has been significantly reduced because of the large mongoose population.

Thirteen species of bats are known to occur on Puerto Rico. None of the bats found on Puerto Rico are exclusive to the island nor are they listed under provisions of the Endangered Species Act of 1973. The specific bat species known to occur on Puerto Rico include:

- Fruit-eating bats: Jamaican fruit bat (*Artibeus jamaicensis*), Antillean fruit bat (*Brachyphylla cavernarum*), and red fig-eating bat (*Stenoderma rufum*).

- Nectivorous bats: brown flower bat (*Erophylla sezekoni bombifrons*) and greater Antillean long-tongued bat (*Monophyllus redmani*).

- Insectivorous bats: Antillean ghost-faced bat (*Mormoops blainvillii*), Parnell's mustached bat (*Pteronotus parnellii*), sooty mustached bat (*Pteronotus quadridens*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), velvety free-tailed bat (*Molossus molossus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*).

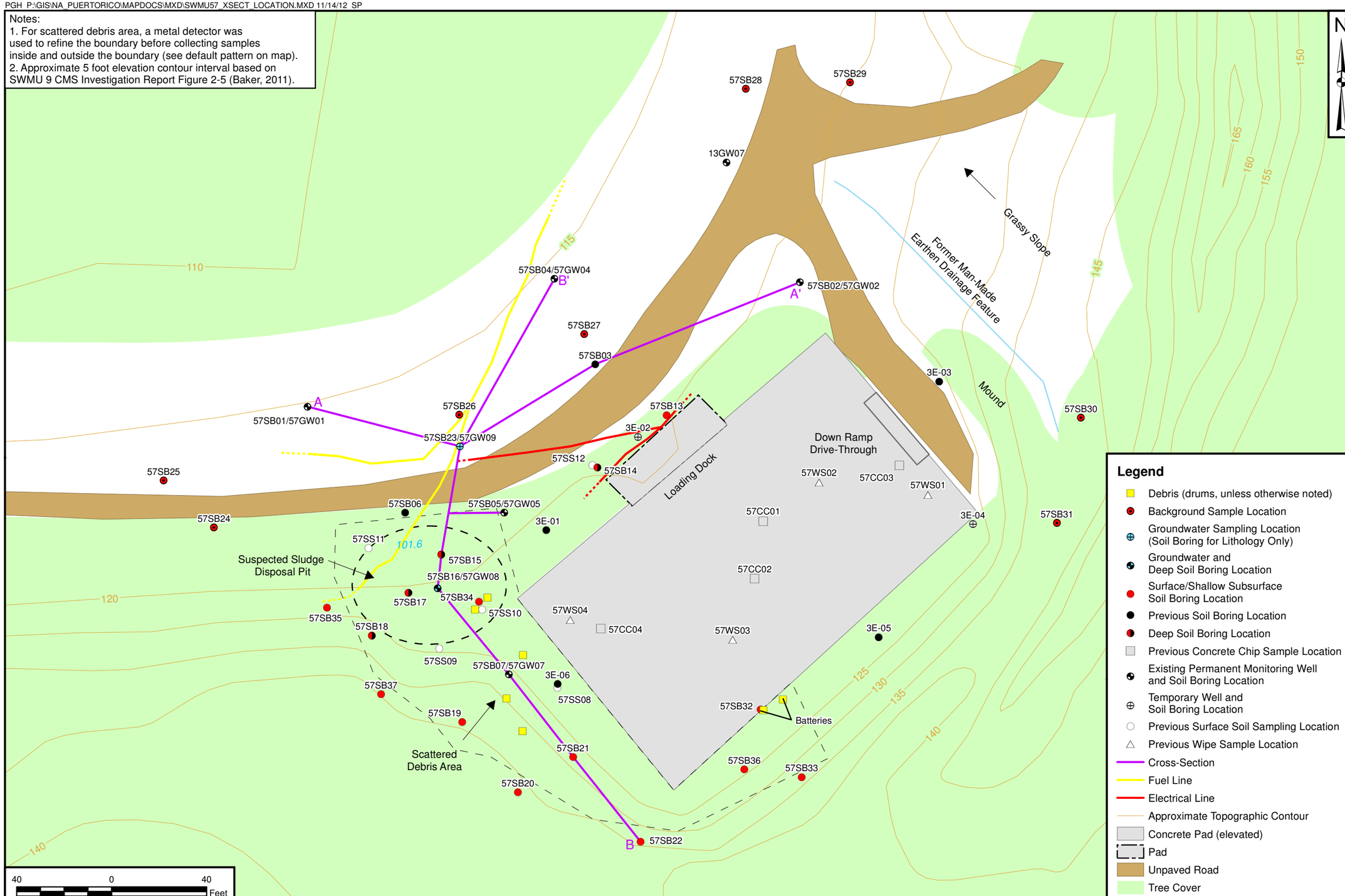
- Piscivorous bats: Mexican bulldog bat (*Noctilio leporinus*).

Based on the August 2011 SWMU 57 site visit in support of the Full RFI, upland vegetative species (such as guinea grass) were noted at SWMU 57 within the former drainage feature, with the surrounding area vegetated by flat lying grass and secondary growth. The drainage feature is no longer distinguishable from the grassy sloped area. No watercourses or aquatic natural resources (i.e., wetlands) exist at or in the immediate vicinity of SWMU 57.

Dominant herbaceous vegetation at SWMU 57 includes guinea grass (*Urochloa maxima*), ocean blue morning glory (*Ipomea indica*), flatleaf flatsedge (*Cyperus planifolius*), crack open (*Casearia sylvestris*), and knotgrass (*Paspalum distichum*). Dominant trees and shrubs identified include white lead tree (*Leucaena leucocephala*), white indigo berry (*Randia aculeata*), gumbo limbo (Bursera simaruba), and *Erythroxylum sp*.

PGH P:\GIS\NA_PUERTORICO\MAPDOCS\MXD\SWMU57_XSECT_LOCATION.MXD 11/14/12 SP

Notes:
1. For scattered debris area, a metal detector was used to refine the boundary before collecting samples inside and outside the boundary (see default pattern on map).
2. Approximate 5 foot elevation contour interval based on SWMU 9 CMS Investigation Report Figure 2-5 (Baker, 2011).

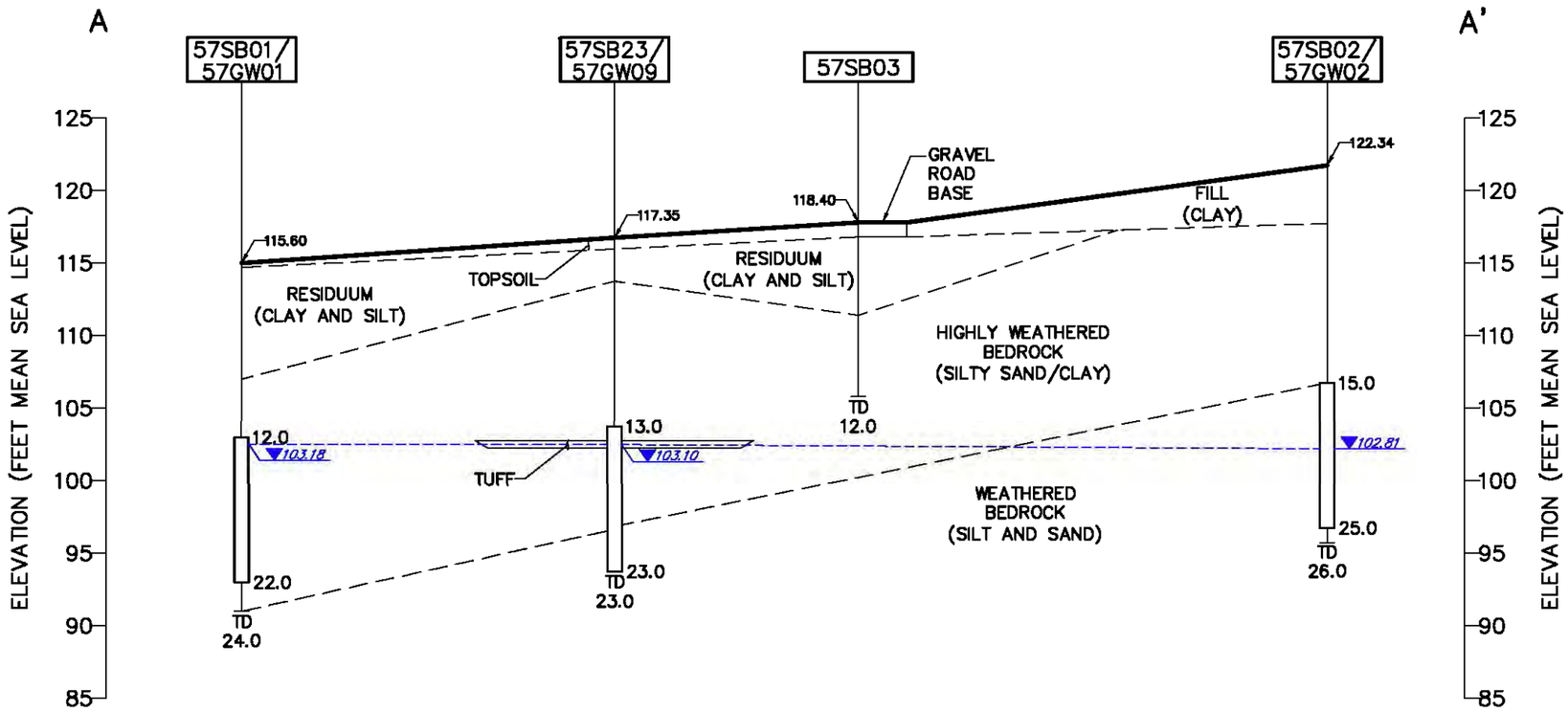


CONTRACT NUMBER —
CTO NUMBER JM02
APPROVED BY L. KLINK
DATE 11/02/11
APPROVED BY —
DATE —
FIGURE NO. FIGURE 3-1
REV 0

CROSS SECTION LOCATION MAP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

NAVFAC

DRAWN BY J. ENGLISH
DATE 08/22/11
CHECKED BY E. LOVE
DATE 11/14/12
REVISED BY S. PAXTON
DATE 11/14/12
SCALE AS NOTED



LEGEND:

MONITORING WELL OR BORING NUMBER — 57GW01

GROUND SURFACE ELEVATION (FT MSL) — 115.60

GROUND SURFACE

GROUND WATER ELEVATION (FT MSL) — 103.18

TOP OF MONITORED INTERVAL (FT BGS) — 12.0

LITHOLOGIC CONTACT (DASHED INDICATES INFERRED BETWEEN BORINGS)

BOTTOM OF MONITORED INTERVAL (FT BGS) — 22.0

TOTAL DEPTH OF WELL OR BORING (FT BGS) — TD 22.0

0 30 60
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET

DRAWN BY CK DATE 10-16-12	NAVFAC	GEOLOGIC CROSS SECTION A-A' SWMU57 – POL DRUM STORAGE AREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NO. 4454
CHECKED BY DATE			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3-2 / SIZE B / REV. 0

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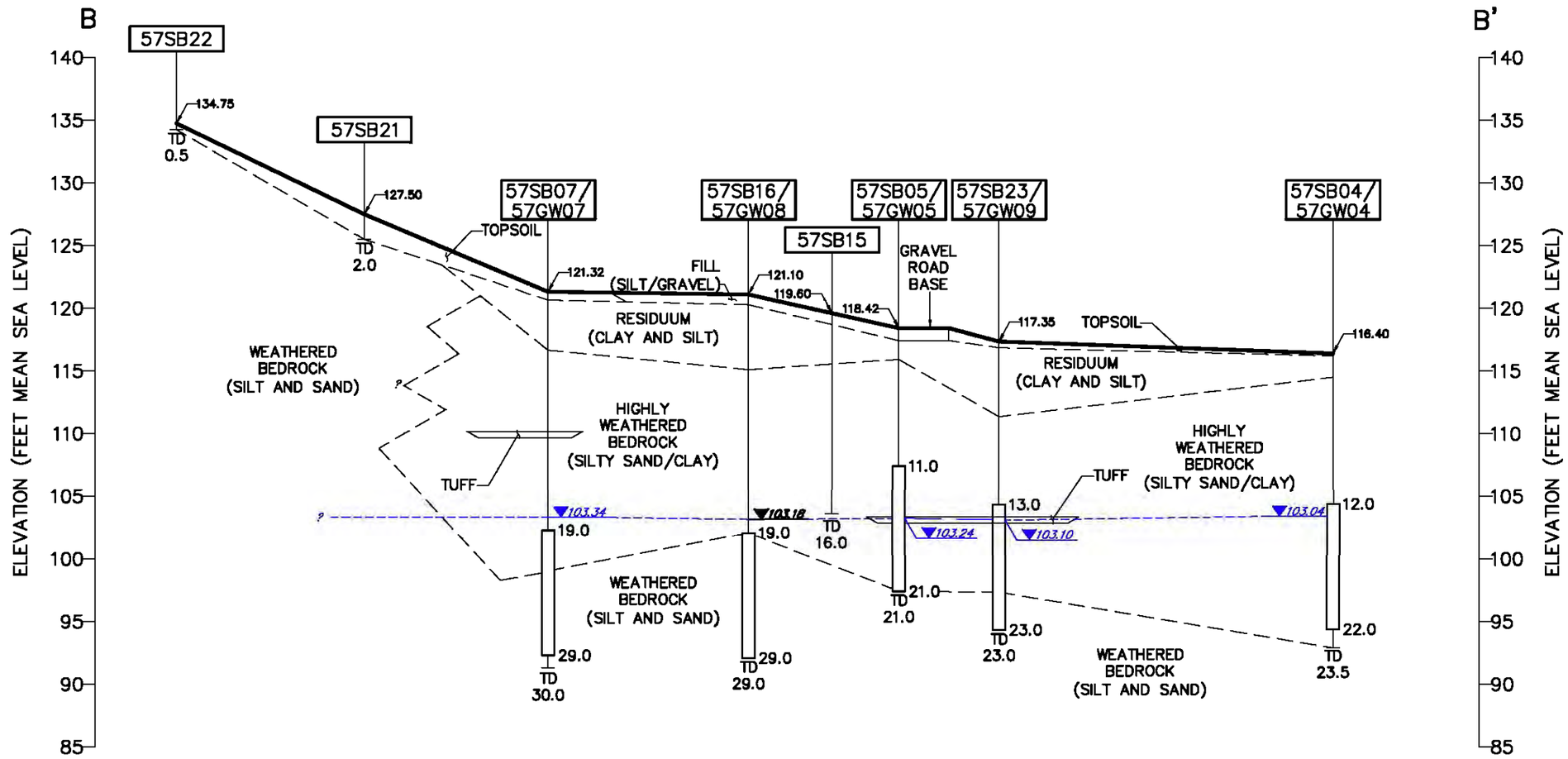

LEGEND:

MONITORING WELL OR BORING NUMBER — 57GW07

GROUND SURFACE ELEVATION (FT MSL) — 121.32

GROUND SURFACE

GROUND WATER ELEVATION (FT MSL) — 103.34

TOP OF MONITORED INTERVAL (FT BGS) — 19.0

LITHOLOGIC CONTACT (DASHED INDICATES INFERRED BETWEEN BORINGS)

BOTTOM OF MONITORED INTERVAL (FT BGS) — 29.0

TOTAL DEPTH OF WELL OR BORING (FT BGS) — TD 29.0

0 30 60
HORIZONTAL SCALE IN FEET

0 10 20
VERTICAL SCALE IN FEET

DRAWN BY CK DATE 10-16-12	NAVFAC	GEOLOGIC CROSS SECTION B–B' SWMU57 – POL DRUM STORAGE AREA NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NO. 4454
CHECKED BY DATE			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3–3 SIZE B REV. 0

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Notes:
1. For scattered debris area, a metal detector was used to refine the boundary before collecting samples inside and outside the boundary (see default pattern on map).
2. Approximate 5 foot elevation contour interval based on SWMU 9 CMS Investigation Report Figure 2-5 (Baker, 2011)
3. Well 13GW11 could not be located in 2012.
4. Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2011 ESRI and its data suppliers).

2012 POTENTIOMETRIC SURFACE MAP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CTO NUMBER	JM02
CONTRACT NUMBER	—
APPROVED BY	L. KLINK
DATE	06/06/13
APPROVED BY	—
DATE	—
FIGURE NO.	FIGURE 3-4
REV	0

DRAWN BY	J. ENGLISH
DATE	08/22/11
CHECKED BY	M. COFFMAN
DATE	06/06/13
REVISED BY	J. ENGLISH
DATE	06/06/13
SCALE	AS NOTED

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination relates to the characteristics of any contaminants that might be present and the size of the area affected by the contaminants. This section describes the nature and extent of contamination at SWMU 57 as defined by the results of sampling and laboratory analyses of soil and groundwater samples collected during the Phase I/II ECP, Phase I RFI, and Full RFI sampling programs. In addition, the location and analytical results of the SWMU 9 test pit historical soil sample collected at SWMU 57 are included in Appendix A.

SWMU 57 – POL Drum Storage Area 57 was used for the storage of POL and other potentially hazardous materials, and numerous small spills and releases occurred throughout its usage period (1950s through 1990s). In addition, a historical aerial photograph appeared to show a suspected sludge disposal pit at SWMU 57 on the northwestern side of the concrete drum pad, similar to disposal areas at adjacent SWMU 9. The Phase I/II ECP sampling program included the collection of six surface soil, six subsurface soil, and two groundwater samples. The Phase I RFI sampling program included the collection of 12 surface soil, 14 subsurface soil, 6 groundwater, 4 concrete wipe, and 4 concrete chip samples. The Full RFI sampling program included the collection of 24 surface soil samples including eight site-specific background surface soil samples, 15 subsurface soil samples, and seven groundwater samples. Soil and groundwater sample locations are shown on Figure 1-3. The investigation strategy for the SWMU 57 Full RFI was to divide the site into decision units based on the results of the Phase I/II ECP and Phase I RFI and to collect samples for analytes associated with those specific areas only. Decision units include the concrete pad, loading dock, scattered debris area, suspected sludge disposal pit, and groundwater. However, because the analytical results were similar, the analytical results from these decisions units are discussed together, by media.

Analytical results for soil and groundwater are presented in Tables 4-1 to 4-14 and on Figures 4-1 to 4-8. Refer to Appendix A for the SWMU 9 test pit soil sample results. The tag maps for site soil and groundwater present results that exceed human health and/or ecological screening criteria and NAPR facility background threshold values (BTVs), as applicable. Specific formatting is applied to the tag maps to indicate which screening criterion has been exceeded. Screening criteria used for comparison are described below. In summary statistics tables and on tag maps, sample and duplicate results are presented. The locations of the Phase I RFI concrete wipe and concrete chip samples are presented on the site figures and Table 4-15 presents the analytical results; however, these results are not presented on tags maps, because no additional information was gathered during the Full RFI. These results are discussed below and data tables are presented in Appendix E.

4.1 SCREENING CRITERIA

The soil (surface and subsurface soil) and groundwater data were compared to the most current USEPA screening criteria for evaluating risks to human receptors which were published at the time the data were being evaluated (November 2013). A discussion and comparison of the November 2013 RSLs to more recent RSLs published in 2015 is presented in Section 6.0. The surface soil and groundwater (evaluated as surface water) data were also compared to ecological screening criteria. The concrete chip and concrete wipe samples were compared to toxicity characteristic leaching procedure (TCLP) regulatory limits. A discussion of the screening criteria used in this section of the Full RFI Report is provided in the remainder of this section. In addition, soil and groundwater concentrations were compared to established NAPR facility BTVs (CH2MHill, 2013).

TPHs were added to the RSL tables in November 2013 as six different categories: aliphatic low, aliphatic medium, aliphatic high, aromatic low, aromatic medium, and aromatic high. Soil and groundwater samples collected in 2010 were analyzed for petroleum hydrocarbons and results are reported as GRO, DRO, and TPH. GRO, DRO, and TPH results are not directly comparable to TPH RSLs because the method of reporting used for the 2010 results does not provide the same hydrocarbon ranges as those used for developing the RSLs. GRO, DRO, and TPH detections are discussed below and presented on the media-specific positive detection tables.

4.1.1 USEPA Soil Screening Levels for Human Health

USEPA has developed a set of screening levels for soil (residential and industrial regional screening levels [RSLs]) and groundwater (tapwater RSLs) which were compared site-specific soil and groundwater concentrations (USEPA, 2013). The screening levels were developed by combining toxicity factors [reference doses (RfDs) and cancer slope factors (CSFs)] with “standard” exposure scenarios to calculate target analyte concentrations corresponding to fixed levels of risk [i.e., a Hazard Quotient (HQ) of 1 for non-carcinogens or an incremental lifetime cancer risk (ILCR) of 1×10^{-6}, whichever occurs at a lower concentration].

4.1.2 Puerto Rico Water Quality Standards

The Puerto Rico Water Quality Standards (PRWQS) (March, 2010) for Class SB and SC waters were compared to SWMU 57 groundwater data. The purposes of the PRWQS regulations are: (1) designate the uses for which the quality of the water bodies of Puerto Rico shall be maintained and protected; (2) prescribe the water quality standards required to sustain the designated uses; (3) identify other rules and regulations applicable to sources of pollution that may affect the quality of the waters subject to this

Regulation and (4) prescribe other measures necessary for achieving and maintaining the quality of the waters of Puerto Rico.

4.1.3 Soil and Surface Water Ecological Screening Criteria

Soil concentrations were compared to the various ecological screening criteria [USEPA Ecological Soil Screening Levels (Eco SSLs), Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Canadian Soil Quality Guidelines (CCME), and USEPA Region 5]. The lowest of the plant, invertebrate, mammal, and avian screening values was selected, as appropriate, as the minimum ecological screening criteria. Groundwater concentrations (evaluated as surface water) were compared to PRWQS, NRWQC (USEPA National Recommended Water Quality Criteria, chronic saltwater), Region 3 BTAG Marine Screening Levels, and NOAA Screening Quick Reference Tables, chronic marine.

4.1.4 TCLP Regulatory Limits

A waste material has the characteristic of “toxicity” if it is able to leach specific toxic metals, organic compounds, or pesticides into the soil or groundwater under landfill conditions. The Toxicity Characteristic Leaching Procedure (TCLP) is designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. This test is designed to simulate leaching that takes place in a sanitary landfill only. The extract obtained from the TCLP analysis (the "TCLP extract") is then analyzed to determine if any of the thresholds established for the 40 Toxicity Characteristic constituents have been exceeded or if the treatment standards established for the constituents listed in 40 CFR 268.40 have been met under the Land Disposal Restrictions regulations. If the TCLP extract contains any one of the Toxicity Characteristic constituents in an amount equal to or exceeding the concentrations specified in 40 CFR 261.24, the waste possesses the characteristic of toxicity and is a hazardous waste. If the TCLP extract contains constituents in an amount exceeding the concentrations specified in 40 CFR 268.40, the treatment standard for that waste has not been met, and further treatment is necessary prior to land disposal.

4.1.5 NAPR Facility Background

To provide perspective on the nature and extent of contamination, soil and groundwater data were compared to NAPR facility BTVs (CH2MHill, 2013). The background data set is used to assist in determining whether detected concentrations are attributable to site-related activities or natural and anthropogenic sources. NAPR facility BTVs for inorganics were established for surface soil, subsurface soil - clay, subsurface soil - fine sand/silt, subsurface soil - weathered bedrock, groundwater, surface

water - estuarine wetland, surface water - open water, sediment - estuarine wetland, and sediment - open water.

Samples were collected at NAPR in areas not believed to be associated with base activities for any SWMU. The NAPR background data sets were extracted from all the existing data available at NAPR. Twenty-one sample locations were determined to be suitable for inclusion in the surface soil background data set for inorganics, and thirty-eight samples from thirty locations were determined to be suitable for inclusion in the subsurface soil background data set for inorganics. The inorganic analytical data from 20 samples at 17 locations were used for the subsurface soil-clay data set, as discussed in Section 3, subsurface soil-clay background data is used for comparison with site-specific subsurface soil data. Fifteen samples were determined to be suitable for inclusion in the groundwater background data set for inorganics. Because no surface water and sediment samples were collected at SWMU 57, the surface water and sediment background data sets will not be discussed in this section. The surface water background data set will be discussed in Section 7.0, Ecological Risk Assessment, as it relates to the evaluation of contaminant migration via groundwater to surface water migration pathway.

It was determined in the Background Threshold Value Evaluation and Recommendations for Naval Activity Puerto Rico (CH2MHill, 2013) that the 95 percent upper confidence limits of the 95th percentile (known as 95/95 UTLs) are considered BTVs. These facility BTVs are presented on the positive detection tables (Tables 4-1, 4-2, 4-4, 4-6, 4-8, 4-10, 4-11, 4-13, and 4-14) for comparisons with SWMU 57 data.

4.1.6 Site-Specific Background

During the Full RFI, eight background surface soil samples, 0 to 1 foot bgs, (57SB24-0001 through 57SB31-0001) were collected to determine site-specific background concentrations of inorganics and SVOCs. These samples were collected in areas of the site unimpacted by historical hazardous waste/POL operations (see Figure 4-1 for sample locations). This background data set encompasses locations both along the site access road, which are reflective of anthropogenic conditions associated with vehicles (57SB24-0001 through 57SB29-0001), and within undisturbed areas of heavy vegetation, which are reflective of pristine background conditions (57SB30-0001 and 57SB31-0001). Samples were analyzed for Appendix IX metals and Appendix IX SVOCs, including low-level PAHs. Results for constituents detected at least once in site-specific surface soil background samples are presented on Table 4-1 and Table 4-2. Concentrations of analytes detected at least once were compared to human health direct contact soil screening criteria, ecological soil screening criteria, and facility surface soil BTVs. Metals were detected in all site-specific anthropogenic and pristine background surface soil

samples, only two detections of selenium and one detection of zinc in samples collected along the access road were detected at concentrations greater than ecological screening levels and facility BTVs. Several PAHs were detected in site-specific background surface soil samples, primarily in those samples collected along the access road; however, all were detected at concentrations less than screening criteria. Overall, results suggest that there may be low level anthropogenic effects (from truck traffic to site) along the access road, and, as expected, the pristine samples are relective of pristine background conditions. Figure 4-1 presents analytes detected in site-specific surface soil samples at concentrations greater than screening criteria and facility BTVs, as applicable. These results will be used qualitatively in this report to discuss site sample results in relation to site-specific background concentrations.

4.2 SOIL

4.2.1 Surface Soil

Surface soil samples, collected during all three investigations, were collected from 0 to 1 foot bgs. Six surface soil samples were collected during the Phase I/II ECP investigation and analyzed for VOCs, SVOCs, pesticides/PCBs, OP pesticides, chlorinated herbicides, and Appendix IX inorganics including cyanide. Twelve surface soil samples were collected during the Phase I RFI and analyzed for Appendix IX VOCs, Appendix IX SVOCs with low-level PAHs, Appendix IX PCBs, TPH, GRO/DRO, and Appendix IX metals. Twenty four surface soil samples were collected during the Full RFI. Eight of these samples were used for site-specific background as discussed in Section 4.1.6. The remaining 16 samples, as discussed below, were analyzed for Appendix IX VOCs, Appendix IX SVOCs, including low-level PAHs, Appendix IX PCBs, and Appendix IX metals. Table 4-3 presents frequencies of detection in surface soil samples collected and analyzed during the Phase I/II ECP, Phase I RFI, and Full RFI, and Table 4-4 summarizes results for parameters detected in at least one surface soil and also shows exceedances of human health and ecological screening criteria and facility BTVs, as applicable. Figure 4-2 presents analytes detected in surface soil samples at concentrations greater than screening criteria and facility BTVs, as applicable. Figure 4-2 also shows isopleths of analyte concentrations exceeding both facility background concentrations (inorganics only) as well as 10 times human health screening criteria or 10 times ecological screening criteria.

Eleven VOCs (2-butanone, 2-hexanone, acetone, benzene, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroform, ethylbenzene, tetrachloroethene, and total xylenes) were detected in one or more SWMU 57 surface soil samples. All VOCs were detected at concentration less than screening human health and ecological criteria. While some of these VOCs exceeded risk-based soil screening levels (SSLs), no VOCs were detected in groundwater samples collected during the Full RFI.

Only 2010 samples were analyzed for petroleum hydrocarbons. There are no applicable screening criteria for DRO, GRO, or TPH; therefore, results are not presented on Figure 4-2. DRO and TPH were detected in 11 of the 12 samples analyzed for these parameters at concentrations ranging from 4.1J milligrams per kilogram (mg/kg) to 72J mg/kg and 4.7J mg/kg to 72.6J mg/kg, respectively. GRO was not detected in any surface soil sample. These samples were collected primarily in and near the scattered debris area, with a few of the samples located northwest of the concrete pad and near the access road. The maximum detected concentrations of petroleum hydrocarbons were noted in samples 57SS08 and 57SS09, which were collected in the scattered debris area.

Only 2004 soil samples were analyzed for pesticides and herbicides. Detections included 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and 2,4,5-TP; all were detected at concentration less than human health and ecological screening criteria. Additionally, all pesticides were detected at concentrations less than risk-based SSLs and no pesticides were detected in groundwater samples collected during the Full RFI.

Aroclor-1260 was detected in 11 of 34 surface soil samples and in samples collected during all three sampling events, with the majority of the PCB detections in samples collected from the scattered debris area and near the loading dock. Aroclor-1260 exceeded ecological screening criteria in all samples in which it was detected. Aroclor-1260 exceeded the residential RSL in four samples located within the scattered debris area and also exceeded the industrial RSL in one of these samples. PCBs were detected at concentrations greater than the SSL in surface soil, indicating the potential for PCBs to migrate into deeper soil; however, PCBs were only detected in two corresponding subsurface soil samples, from 1 to 3 feet bgs, which were also detected at concentrations greater than screening criteria. PCBs were not detected in samples collected at depths greater than 3 feet bgs or in groundwater samples collected at SWMU 57. As shown on Figure 4-2, significant exceedances of ecological screening criteria (at least 10 times) for Aroclor-1260 were found along three sides of the concrete pad including the loading dock side of the concrete pad extending 40 to 50 feet from the southwestern edge of the concrete pad into the scattered debris area.

Nineteen PAHs and/or other SVOCs were detected in 25 of the 34 surface soil samples collected at SWMU 57. PAHs detected include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The only PAH exceedance of screening criteria was benzo(a)pyrene, which exceeded the residential RSL in one sample, 3E-SS06, which was collected during the Phase I/II ECP. Benzo(a)pyrene was detected at concentrations greater than the SSL in surface soil indicating the potential for migration to deeper soil. Benzo(a)pyrene was detected in subsurface soil (2 samples at

depths of 1 – 3 feet bgs and 3 samples at depths greater than 3 feet bgs), all benzo(a)pyrene detections in subsurface soil were at concentrations less than screening criteria. Benzo(a)pyrene was also detected in one Full RFI groundwater sample at a concentration greater than the tapwater RSL but less than the PRWQS. Non-PAH SVOCs detected include acetophenone and bis(2-ethylhexyl)phthalate. Bis(2-ethylhexyl)phthalate exceeded ecological screening criteria in all samples in which it was detected (17 samples) with detections at five sample locations at least 10 times ecological screening criteria. As shown on Figure 4-2, five small areas, centered around these locations (57SB12, 57SB13, 57SB32, 57SB33, and 57SB34), two adjacent to the loading dock, two off of the southeastern side of the concrete pad, and one within the scattered debris area are noted as significant exceedances. However, bis(2-ethylhexyl)phthalate is a common laboratory and field contaminant and was detected in both laboratory method blanks and field equipment blanks.

Inorganics were detected in all surface soil samples collected at SWMU 57. Arsenic, barium, cadmium, chromium, cobalt, lead, mercury, nickel, selenium, and zinc were detected at concentrations greater than screening criteria and facility BTVs in at least one surface soil sample. Thallium was also detected at concentrations greater than screening criteria, there is no surface soil facility BTV for thallium. As shown on Figure 4-2, significant exceedances of human health and ecological screening criteria (at least 10 times) that are greater than facility background, as applicable, are noted for several inorganics. Chromium, lead, mercury, and thallium exceeded ecological screening criteria by at least 10 times (thallium not shown on Figure 4-2), and thallium exceeded human health screening criteria by at least 10 times. Significant exceedances for chromium are noted at one location across the access road from the concrete pad and one location within the scattered debris area. Significant exceedances for lead are noted at two locations within the scattered debris area and one location just west of the scattered debris area. Significant exceedances for mercury are noted at one location within the scattered debris area and along the southeastern side of the concrete pad. Significant exceedances for thallium are noted at one location across the access road from the concrete pad and two locations within the scattered debris area. Overall, the majority of the significant exceedances are associated with the scattered debris area.

The above inorganics, with the exception of thallium and zinc, were detected at concentrations greater than SSLs, indicating the potential for migration to deeper soil. These inorganics were detected in deeper soil; however, only barium, cadmium, cobalt, lead, nickel, thallium and zinc, were detected at concentrations greater than screening criteria and facility background in deeper soil and only mercury, nickel, and thallium were detected in Full RFI groundwater samples at concentrations greater than screening criteria and facility background.

4.2.2 Subsurface Soil

Subsurface soil samples were collected from depths of greater than 1 foot. Six subsurface soil samples were collected during the Phase I/II ECP investigation and analyzed for VOCs, SVOCs, pesticides/PCBs, OP pesticides, chlorinated herbicides, and Appendix IX inorganics. Fourteen subsurface soil samples were collected during the Phase I RFI and analyzed for Appendix IX VOCs, Appendix IX SVOCs with low-level PAHs, Appendix IX PCBs, TPH, GRO/DRO, and Appendix IX metals. Fifteen subsurface soil samples were collected during the Full RFI and analyzed for Appendix IX VOCs, Appendix IX SVOCs, including low-level PAHs, Appendix IX PCBs, and Appendix IX metals. Subsurface soil results, combined from the three sampling events, are discussed separately for intervals of 1 to 3 feet bgs (23 samples) and greater than 3 feet bgs (12 samples). Tables 4-5 and 4-7 present the frequencies of detection in subsurface soil samples collected from 1 to 3 feet bgs and greater than 3 feet bgs, respectively. Tables 4-6 and 4-8 summarize results for parameters detected in at least one subsurface soil sample collected during these investigations and also show exceedances of human health and ecological screening criteria and facility BTVs, as applicable. Figure 4-3 presents analytes detected in subsurface soil samples collected from 1 to 3 feet bgs and Figure 4-4 presents analytes detected in subsurface soil samples collected from depths greater than 3 feet bgs. The tag maps for site subsurface soil present only analytes detected in subsurface soil samples at concentrations greater than screening criteria and facility BTVs, as applicable. The tag maps also show isopleths of analyte concentrations exceeding both facility background concentrations (inorganics only) as well as 10 times human health screening criteria or 10 times ecological screening criteria.

Seven VOCs (acetone, benzene, bromomethane, carbon disulfide, carbon tetrachloride, chloroform, and methyl iodide) were detected infrequently in subsurface soil samples collected from 1 to 3 feet bgs, all were detected at concentrations less than screening criteria. There is no screening criteria for methyl iodide which was only detected in one sample. While some of these VOCs exceeded risk-based SSLs, no VOCs were detected in subsurface soil samples collected at depths greater than 3 feet bgs and no VOCs were detected in groundwater samples collected during the Full RFI.

Petroleum hydrocarbons were only analyzed for in samples collected in 2010. DRO and TPH were detected in samples collected at depths of 1 to 3 feet bgs in six of seven samples and at depths greater than 3 feet bgs in five of seven samples. There is no applicable screening criteria for DRO or TPH; therefore, results are not presented on Figure 4-3. The maximum detected concentration of both DRO and TPH in samples collected from 1 to 3 feet bgs and greater than 3 feet bgs was at sample location 57SB07, which is in the scattered debris area.

Pesticides and herbicides were only analyzed for in 2004. 2,4,5-TP was detected in one subsurface soil sample at a depth of 1 to 3-feet bgs (3E-SB04-01) at concentrations less than screening criteria. No other pesticides or herbicides were detected in subsurface soil samples. Additionally, 2,4,5-TP was detected at a concentration less than risk-based SSLs and no pesticides or herbicides were detected in subsurface soil samples collected at depths greater than 3 feet bgs or in groundwater samples collected during the Full RFI.

Aroclor-1260 was detected in 2 of 23 subsurface soil samples at depths of 1 to 3 feet bgs at concentrations greater than ecological screening criteria. PCBs were not detected in samples collected from greater than 3 feet bgs. As shown on Figure 4-3, significant exceedances of ecological criteria were noted in these two subsurface soil samples and the isopheth for these exceedances extends from the southwest corner of the concrete pad into the scattered debris area. Aroclor-1260 was also detected in corresponding surface soil samples at these two locations at elevated concentrations at least 10 times ecological screening criteria. Aroclor-1260 was detected at concentrations slightly greater than the SSL, indicating a potential for migration; however, PCBs were not detected in any subsurface soil samples collected from depths greater than 3 feet bgs nor was it detected in any groundwater samples collected at SWMU 57.

Nineteen PAHs and/or other SVOCs were detected in 6 of 23 subsurface soil samples collected from 1 to 3 feet bgs. The individual PAHs detected include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The only PAH exceedance of screening criteria was benzo(a)pyrene, which exceeded the residential RSL in one sample, 57SB04-01, this sample is located across the access road from the loading dock. While benzo(a)pyrene was detected at concentrations greater than the SSL in soil samples collected from 1-3 feet bgs, it was not detected at concentrations greater than human health screening criteria or the SSL at depths greater than 3 feet bgs and it was not detected in groundwater samples collected during the Full RFI. One SVOC, bis(2-ethylhexyl)phthalate, was also detected in subsurface soil (1 to 3 feet bgs) and exceeded ecological screening criteria in all samples in which it was detected (6 samples), these detections are not considered significant exceedances because detected concentrations were less than 10 times screening criteria. Bis(2-ethylhexyl)phthalate was detected at concentrations greater than the SSL and was detected in deeper subsurface soil samples, but was not detected in any groundwater samples collected at SWMU 57.

Sixteen PAHs and/or SVOCs were detected in 6 of the 12 subsurface soil samples collected from depths greater than 3 feet bgs. The PAHs detected include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracenees), fluorene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene; all were detected at concentrations less than screening criteria. One SVOC, bis(2-ethylhexyl)phthalate, was detected at concentrations greater than ecological screening criteria in the three sample in which it was detected. The concentration of bis(2-ethylhexyl)phthalate at one isolated location, between the access road the northern edge of the scattered debris area, is considered a significant exceedance. While bis(2-ethylhexyl)phthalate was detected in the corresponding 1 to 3-foot bgs subsurface soil sample and the surface soil sample collected from this location at concentrations greater than ecological screening criteria, it was not detected at concentrations considered to be significant (i.e., at least 10 times). Bis(2-ethylhexyl)phthalate was detected at concentrations greater than the SSL at depths greater than 3 feet bgs but was not detected in any groundwater sample collected at SWMU 57.

Inorganics were detected in all subsurface soil samples collected at SWMU 57. Cadmium, cobalt, lead, thallium, tin, and zinc were detected at concentrations greater screening criteria and facility BTVs in at least one subsurface soil sample collected from 1 to 3 feet bgs. Lead posed a significant exceedance of ecological screening criteria at one location in the scattered debris area (see Figure 4-3). Thallium was also detected at concentrations which significantly exceeded ecological screening criteria at several locations and also human health screening criteria at two locations (see Figure 4-3); one north-northwest of the concrete pad and near the access road and one off of the northern corner of the concrete pad. While lead and thallium were detected at concentrations which significantly exceeded screening criteria in the surface soil, these exceedances were not at the same locations as those in the subsurface soil from 1-3 feet. Further, concentrations of lead in subsurface soil greater than 3 feet bgs were not greater than screening criteria although concentrations of thallium at depths greater than 3 feet bgs were significantly greater than ecological screening criteria. All of the above inorganics, with the exception of tin and zinc were detected at concentrations greater than SSLs indicating a potential for migration; however, only cadmium, cobalt, lead, thallium, and zinc were detected at concentrations greater than screening criteria and facility BTVs in deeper subsurface soil samples. Additionally, of the inorganics listed above, only mercury was detected in groundwater samples collected during the Full RFI at concentrations greater than human health or ecological screening criteria and facility BTVs.

Barium, cadmium, cobalt, lead, nickel, thallium, and zinc were detected at concentrations greater than screening criteria and facility BTVs in at least one subsurface soil sample collected from depths greater than 3 feet bgs. However, at depths greater than 3 feet bgs, only cobalt and thallium were detected at

concentrations that significantly exceeded screening criteria. Cobalt, at depths of 9 to 11 feet bgs, was found at concentrations that significantly exceeded human health or ecological screening criteria at two locations, one location within the scattered debris area and one location across the access road from the concrete pad. Cobalt was not detected at concentrations significantly greater than screening criteria (i.e., at least 10 times criteria) in any shallower subsurface soil or surface soil samples collected at SWMU 57. Similar to what was found in shallower subsurface soil, all of the above inorganics were detected at concentrations greater than SSLs indicating a potential for migration; however, of the inorganics listed above, only nickel and thallium were detected in groundwater samples collected during the Full RFI at concentrations greater than human health or ecological screening criteria and facility BTVs.

As described in Section 1.3.4, a test pit measuring 15 feet in length to a maximum depth of 11 feet bgs was excavated in the suspected sludge disposal pit area during the RFI for SWMU 9 Area C. One subsurface soil sample was collected from the test pit at 11 feet bgs and analyzed for Appendix IX VOCs, SVOCs, RCRA metals, and TPH (DRO and GRO). VOCs, SVOCs, and TPH were not detected in the test pit sample. Only barium, lead, and silver were detected in the sample and all three of these inorganics were present at concentrations less than screening criteria in place at that time. No evidence of a waste or sludge disposal pit was noted during advancement of this test pit.

Soil Summary

Significant exceedances for Aroclor-1260, bis(2-ethylhexyl)phthalate, chromium, cobalt, lead, mercury, and thallium were noted in either surface soil or subsurface soil. PCBs were detected at concentrations greater than screening criteria in soil, the majority of detections were found in samples collected from the scattered debris area and near the loading dock. At the loading dock area, exceedances were only noted in three surface soil samples, PCBs were non-detect at depths of 1-3 feet bgs at two of these locations where deeper soil samples were collected. Also, in samples collected across the access road from the loading dock, PCBs were not detected. PCBs exceeded either human health or ecological screening criteria in six samples collected from within the scattered debris area with two of those detections also within the suspected sludge disposal pit. The maximum detected concentration of Aroclor-1260 was at 57SS09 which is located within the scattered debris area just south of the suspected sludge disposal pit, concentrations of PCBs in this sample exceeded ecological screening criteria as well as residential and industrial RSLs. Subsurface soil samples, 1-3 feet bgs, were collected at three of these locations with two exceedances of ecological screening criteria, one from a sample collected from within the scattered debris area with one from a sample collected from within the suspected sludge disposal pit. PCBs were not detected in samples collected to the north, west, and south of these samples in the surface soil and in

the subsurface soil, where subsurface soil were collected. Bis(2-ethylhexyl)phthalate was detected at concentrations significantly greater than ecological screening criteria at several isolated surface soil sample locations and one subsurface soil sample location at a depth of 9 to 11 feet bgs, no pattern to these exceedances is evident. As discussed, chromium, cobalt, lead, mercury, and thallium exceeded either ecological or human health screening criteria by at least 10 times in soil; however, no pattern to these exceedances is evident. Of note, chromium and mercury were only significant exceedances in the surface soil and cobalt was only a significant exceedance in the subsurface soil (greater than 3 feet bgs).

In summary, there are indications of site-related impacts to surface and subsurface soil and further assessment of human health and ecological risks are warranted (refer to Sections 6.0 and 7.0, respectively).

4.3 GROUNDWATER

Seven groundwater samples from SWMU 57 were analyzed during the Full RFI for Appendix IX VOCs, Appendix IX SVOCs, including low-level PAHs, Appendix IX PCBs, and total metals. Table 4-9 presents the frequencies of detection in groundwater for samples collected during the Full RFI. Tables 4-10 and 4-11 present the parameters detected in at least one groundwater sample collected during the Full RFI and also shows exceedances of human health and ecological screening criteria, respectively, and facility background. Six groundwater samples were collected during the Phase I RFI and analyzed for Appendix IX VOCs, Appendix IX SVOCs with low-level PAHs, Appendix IX PCBs, TPH, GRO/DRO, and Appendix IX total and dissolved metals and two groundwater samples were collected during the Phase I/II ECP and were analyzed for VOCs, SVOCs, pesticides/PCBs, OP pesticides, chlorinated herbicides, total cyanide, total sulfide, and dissolved Appendix IX inorganics. Table 4-12 presents the frequencies of detection in groundwater for samples collected during the Phase I RFI and the Phase I/IIECP. Tables 4-13 and 4-14 present the parameters detected in at least one groundwater sample collected during the Phase I RFI and Phase I/II ECP and also shows exceedances of human health and ecological screening criteria, respectively, and facility BTVs. Note that surface water ecological screening criteria and estuarine surface water facility BTVs are presented on Tables 4-11 and 4-14 as groundwater is evaluated as surface water for purposes of ecological screening. Further, it should be noted that the groundwater samples collected during the Full RFI and Phase I RFI were collected from permanent monitoring wells and the Phase I/II ECP groundwater samples were collected from temporary monitoring wells. Figures 4-5 and 4-6 present analytes detected in at least one of the Full RFI groundwater samples at concentrations greater than applicable human health and ecological screening criteria and facility BTVs, respectively, and Figures 4-7 and 4-8 present analytes detected in at least one of the Phase I RFI and Phase I/II ECP groundwater samples at concentrations greater than applicable human health and

ecological screening criteria and facility BTVs, respectively. Groundwater contours and groundwater flow direction, as determined based on Full RFI groundwater sampling activities, are also presented on these figures. The Full RFI groundwater information is the most recent information and is most representative of current conditions and is therefore presented on both groundwater tag maps. As applicable, isopleths of groundwater contaminants which present significant exceedances of screening criteria (at least 10 times) are also shown on tag maps.

Full RFI

During the Full RFI, four of the eight groundwater samples were analyzed for SVOCs including low-level PAHs. Four PAHs (anthracene, benzo(a)anthracene, fluoranthene, and pyrene) were detected in the sample and duplicate sample collected from 57GW05, which is located just northeast of the scattered debris area, between the concrete pad and access road. Benzo(a)anthracene was detected at concentrations greater than tapwater RSLs in these samples and pyrene was detected at concentrations greater than ecological screening criteria. These exceedances are not considered to be significant (i.e., less than 10 times screening criteria). No other organics were detected at concentrations greater than screening criteria in groundwater samples collected in 2012 during the Full RFI. During water level measurement collection, all PID readings were zero with the exception of a low reading at 57GW09, which was 13.5 parts per million. There was no staining present in the associated soil boring (57SB23) nor were any organic compounds detected in the groundwater sample collected from this monitoring well which was installed at 57SB23 (57GW09). PCBs were not detected in any groundwater samples collected during the Full RFI.

Total metals were detected in all groundwater samples. Only total mercury was detected at concentrations greater than the human health screening criteria (tapwater RSLs and/or PRWQSs) and facility groundwater BTVs at three locations (13GW07, 57GW01, and 57GW07). Total thallium was also detected at concentrations greater than human health screening criteria (tapwater RSL at 57GW02); there is no facility BTV for total thallium. These exceedances are not considered to be significant (i.e., less than 10 times screening criteria). Total nickel exceeded ecological screening criteria and facility BTVs at two locations (57GW02 and 57GW08).

Phase I RFI and Phase I/II ECP

Six VOCs (2-butanone, acetone, carbon disulfide, chloroform, chloromethane, and methyl iodide) were detected in groundwater samples collected during the Phase I RFI and Phase I/II ECP. Only chloroform in one sample (57GW02 collected during the Phase I RFI) was detected at a concentration greater than human health screening criteria (tapwater RSL). There is no ecological or human health screening

criteria for methyl iodide which was detected in three samples, 2 collected during the Phase I/II ECP and one collected during the Phase I RFI, these results are not presented on Figures 4-7 and 4-8. All VOCs were detected a low levels, and most detections were qualified as estimated.

Thirteen SVOCs (mostly PAHs) were detected in groundwater samples collected during the Phase I RFI. The only SVOC screening criteria exceedances were found in 57GW05, this monitoring well is located just outside of the northeastern corner of the scattered debris area, between the concrete pad and the road. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene were detected at concentrations greater than human health screening criteria (tapwater RSLs or PRWQSs) and anthracene, fluoranthene, and pyrene were detected at concentrations greater than ecological screening criteria. These exceedances are not considered to be significant (i.e., less than 10 times screening criteria). GRO and TPH were also detected at 57GW05 during the Phase I RFI, there is no applicable screening criteria for GRO or TPH; therefore, the results are not presented on Figures 4-7 and 4-8. PCBs were not detected in any groundwater samples collected during the Phase I RFI.

Total and/or dissolved metals were detected in all groundwater samples collected during the Phase I RFI and Phase I/II ECP. Only total and dissolved cobalt, total and dissolved lead, total and dissolved mercury, and dissolved nickel were detected at concentrations greater than human health or ecological screening criteria and facility groundwater or estuarine surface water facility BTVs. Total thallium was also detected in in one monitoring well (57GW02) at a concentration greater than human health screening criteria; there is no facility BTV for total thallium. Of these exceedances, cobalt and thallium at 57GW02 are considered significant (at least 10 times greater than screening criteria). 57GW02 is located off of the northern corner of the concrete pad, between the concrete pad and the access road.

Groundwater Summary

Few VOCs were detected in groundwater samples collected in 2004 (Phase I/II ECP) and 2010 (Phase I RFI), and no VOCs were detected in groundwater samples collected in 2012 (Full RFI). Only one VOC, chloroform in one Phase I RFI sample was detected at a concentration greater than human health screening criteria. SVOCs, primarily PAHs, were detected in several groundwater samples collected in 2010, with maximum concentrations at 57GW05. In 2012, 57GW05 was the only well where SVOCs were detected in groundwater; fewer PAHs were detected in 2012 than in 2010. All PAH screening criteria exceedances are less than 10 times applicable screening criteria. GRO and TPH were also detected in 57GW05 in 2010 (TPH and GRO were not analyzed for in either 2004 or 2012). Monitoring well 57GW05 is located just outside of the northeastern corner of the scattered debris area between the concrete pad and the road. SVOCs, PAHs, DRO, and TPH were also detected in the surface soil sample

collected at 57SB05, and one PAH, DRO, and TPH were detected in the corresponding subsurface soil samples collected at 57SB05 (1 to 3-feet bgs and 9 to 11-feet bgs). The PAHs and petroleum constituents detected in monitoring well 57GW05 (installed at the 57SB05 location) were at low levels, 0.017J to 2.4 micrograms per liter (µg/L), respectively. Monitoring wells 57GW07 and 57GW08 are also located within the scattered debris area and only two PAHs were detected in the duplicate sample from 5GW07 in 2010 at concentrations less than screening criteria, GRO and TPH were not detected in these monitoring wells.

Few metals were detected in SWMU 57 groundwater at concentrations exceeding either human health or ecological screening criteria and facility BTVs. Only cobalt and thallium in samples collected from 57GW02 during the 2010 Phase I RFI were at concentrations at least 10 times greater than screening criteria. Dissolved cobalt was detected at 12.8J µg/L in the 2010 Phase I RFI, total cobalt was detected at 9.5J µg/L in the 2010 Phase I RFI and decreased to 4.5 µg/L in 2012 Full RFI. Concentrations of both total and dissolved cobalt were less than facility groundwater BTVs in 2010 and 2012 but the 2010 concentrations are greater than facility estuarine surface water BTVs and ecological screening levels. Dissolved thallium was not detected in the 2010 Phase I RFI sample collected at 57GW02, total thallium was detected at 5.6J µg/L in 2010 and decreased to 0.18J µg/L in 2012. Monitoring well 13GW07 is located downgradient of 57GW02, thallium was not detected in this monitoring well and cobalt was detected at concentrations less than screening criteria and facility BTVs. It should be noted that total metals were not collected in 2004 and dissolved metals were not collected in 2012. Additionally, cobalt and thallium were detected in subsurface soil samples (greater than 3 feet bgs) at concentrations that significantly exceeded human health or ecological screening criteria and facility BTVs.

4.4 CONCRETE CHIP AND WIPE SAMPLES

Four concrete chip samples (57CC01, 57CC02, 57CC03, and 57CC04) and one duplicate sample (57CC04D) were collected and analyzed during the 2010 Phase I RFI at SWMU 57. All concrete chip samples were analyzed for SVOCs with low-level PAHs, PCBs, TPH DRO, and metals. The complete data set for the concrete chip samples is provided in Appendix E. Two SVOCs, bis(2-ethylhexyl)phthalate and isophorone, DRO, and 11 metals (arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc) were detected in concrete chip samples.

Four concrete surface wipe samples (57WS01, 57WS02, 57WS03, and 57WS04) and one duplicate sample (57WS04D) were collected and analyzed during the 2010 Phase I RFI at SWMU 57. All concrete wipe samples were analyzed for SVOCs with low-level PAHs, PCBs, TPH DRO, and total metals. The complete data set for the concrete wipe samples is provided in Appendix E. Five SVOCs, including

PAHs, 4-chloro-3-methylphenol, acenaphthene, acenaphthylene, fluorene, and phenanthrene, DRO, and nine metals (antimony, chromium, cobalt, copper, lead, nickel, selenium, tin, and zinc) were detected in concrete wipe samples.

While there are no established screening criteria available for concrete chip samples or wipe samples, an evaluation of the potential toxicity of the concrete as defined by TCLP (Method 1311) for potential future disposal can be approximated based on the theoretical leachate concentration (known generally as the rule of 20). The factor of 20 was derived from the 20:1 liquid-to-solid ratio employed in the TCLP. The theoretical leachate concentration of contaminants was determined by dividing the concentration of any contaminant detected in the concrete samples (chip and wipe) that are listed in 40 CFR §261.24 by 20 and are presented in Table 4-15. The maximum leachable concentration is then compared to the maximum concentration of contaminants for the toxicity characteristic. Based on the detected concentration of constituents the theoretical leachate concentrations indicate that the concrete does not exhibit toxicity and appears to be nonhazardous. If the maximum leachable concentrations are less than the TCLP characteristic concentrations, then the waste can be assumed to be non-hazardous. As shown on Table 4-15, of the analytes that have TCLP levels, all theoretical leachate concentrations were less than TCLP regulatory levels.

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS IN SITE-SPECIFIC BACKGROUND SURFACE SOIL, ANTHROPOGENIC CONDITIONS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**Range of Detections Anthropogenic Site-Specific Background**	**57SB24** **57SB24-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB25** **57SB25-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB26** **57SB26-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB27** **57SB27-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB28** **57SB28-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB29** **57SB29-0001** **20120606** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)											
ANTIMONY	31	410	5	2.7	0.04 J - 0.15 J	0.15 J	0.13 J	0.12 J	0.13 J	0.07 J	0.04 J
ARSENIC	0.61	2.4	17	2.75	0.68 - 2.6	***2.6***	**1.8**	**1.6**	**2**	**1.2**	**0.68**
BARIUM	15000	190000	330	322	26.1 - 104	75.2	59	104	60	26.1	29.4
BERYLLIUM	160	2000	10	0.676	0.08 J - 0.39 J	0.27 J	0.27 J	0.39 J	0.19 J	0.08 J	0.14 J
CADMIUM	70	800	0.77	0.765	0.08 - 0.66	0.66	0.42	0.32	0.25	0.08	0.08 J
CHROMIUM (1)	120000	1500000	0.4	55	12.7 J - 35.2 J	27.4 J	23.1 J	31.4 J	35.2 J	12.7 J	16 J
COBALT	23	300	13	52.3	8.9 - 31	20	20.9	**31**	17.6	8.9	17.1
COPPER	3100	41000	28	192	32.8 - 119	119	108	80	63.9	32.8	55.1
LEAD	400	800	11	34.2	6 J - 28.6 J	18.1 J	13.3 J	23.9 J	28.6 J	6 J	6.2 J
MERCURY	10	43	0.013	0.131	0.04 - 0.05	0.04	0.03 U	0.05	0.016 U	0.02 U	0.014 U
NICKEL	1500	20000	38	28	7.7 J - 21 J	16.5 J	14.8 J	17.2 J	21 J	7.7 J	14.3 J
SELENIUM	390	5100	0.52	1.07	0.23 J - 1.2	1.1	0.64	1.2	0.72	0.35	0.23 J
SILVER	390	5100	4.2	NC	0.02 J - 0.09	0.09	0.06 J	0.07 J	0.04 J	0.02 J	0.03 J
THALLIUM	0.78	10	0.0569	NC	0.02 J - 0.05 J	0.05 J	0.04 J	0.05 J	0.04 J	0.02 J	0.02 J
VANADIUM	390	5100	7.8	286	52.2 - 168	120	122	168	110	52.2	101
ZINC	23000	310000	46	132	28.4 J - 132 J	132 J	88.4 J	85 J	50 J	28.4 J	55 J
POLYNUCLEARC AROMATIC HYDROCARBONS (µg/kg)											
BENZO(A)ANTHRACENE	150	2100	800	NC	2.3 J - 9.9 J	2.9 J	2.3 J	5.4 J	4.2 J	7.2 J	9.9 J
BENZO(A)PYRENE	15	210	18000	NC	4.2 J - 7.5 J	11 U	10 U	4.7 J	4.2 J	5.9 J	7.5 J
BENZO(B)FLUORANTHENE	150	2100	18000	NC	7.2 J - 12 J	11 U	10 U	12 U	7.2 J	10 J	12 J
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	2.6 J - 4.1 J	11 U	10 U	3 J	2.6 J	3 J	4.1 J
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	3.7 J - 4.8 J	11 U	10 U	12 U	12 U	3.7 J	4.8 J
CHRYSENE	15000	210000	18000	NC	4.1 J - 4.1 J	11 U	10 U	12 U	12 U	10 U	4.1 J
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	2 J - 2 J	11 U	10 U	12 U	12 U	10 U	2 J
FLUORANTHENE	2300000	22000000	29000	NC	3.3 J - 12 J	4.4 J	3.3 J	7.9 J	7.3 J	9.4 J	12 J
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	2.2 J - 4.5 J	2.2 J	10 U	3.3 J	3.1 J	3.5 J	4.5 J
PHENANTHRENE	1700000	17000000	29000	NC	1.8 J - 3.1 J	11 U	10 U	3.1 J	2.3 J	10 U	1.8 J
PYRENE	1700000	17000000	18000	NC	3.3 J - 13 J	4.2 J	3.3 J	7.8 J	6.8 J	10 J	13 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
BTV = Background threshold value.

(1) The value is for trivalent chromium.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS IN SITE-SPECIFIC BACKGROUND SURFACE SOIL, PRISTINE CONDITIONS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**Range of Detections Pristine Site-Specific Background**	**57SB30** **57SB30-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB31** **57SB31-0001** **20120606** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)							
ANTIMONY	31	410	5	2.7	0.04 J - 0.09 J	0.04 J	0.09 J
ARSENIC	0.61	2.4	17	2.75	0.35 J - 1	0.35 J	**1**
BARIUM	15000	190000	330	322	97.3 - 101	97.3	101
BERYLLIUM	160	2000	10	0.676	0.3 J - 0.39 J	0.3 J	0.39 J
CADMIUM	70	800	0.77	0.765	0.07 J - 0.13	0.07 J	0.13
CHROMIUM (1)	120000	1500000	0.4	55	23.6 J - 30.3 J	23.6 J	30.3 J
COBALT	23	300	13	52.3	27.8 - 31.8	27.8	**31.8**
COPPER	3100	41000	28	192	65.1 - 88.6	65.1	88.6
LEAD	400	800	11	34.2	3.6 J - 21.8 J	3.6 J	21.8 J
MERCURY	10	43	0.013	0.131	0.04 - 0.05	0.04	0.05
NICKEL	1500	20000	38	28	18 J - 20.3 J	20.3 J	18 J
SELENIUM	390	5100	0.52	1.07	0.4 J - 0.83	0.4 J	0.83
SILVER	390	5100	4.2	NC	0.02 J - 0.04 J	0.02 J	0.04 J
THALLIUM	0.78	10	0.0569	NC	0.02 J - 0.04 J	0.02 J	0.04 J
VANADIUM	390	5100	7.8	286	174 - 180	174	180
ZINC	23000	310000	46	132	71.8 J - 75.8 J	75.8 J	71.8 J
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)							
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	2.6 J	2.6 J	11 U

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
BTV = Background threshold value.

(1) The value is for trivalent chromium.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-3

FREQUENCY OF DETECTIONS IN SURFACE SOIL
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Inorganics (mg/kg)						
ANTIMONY	24/34	0.03 J	1.7 J	57SB07	57SB07-00-D	0.67 - 3.2
ARSENIC	31/34	0.18 J	5.2	57SS08	57SS08	0.34 - 1.2
BARIUM	34/34	14.6 J	374	57SB15	57SB15-0001	-
BERYLLIUM	28/34	0.07 J	0.74 J	57SB22	57SB22-0001	0.03 - 0.64
CADMIUM	28/34	0.06 J	5.3	57SS08	57SS08	0.17 - 0.58
CHROMIUM	34/34	8.1	108	57SB04	57SB04-00	-
COBALT	34/34	5.6	65.3	57SB15	57SB15-0001	-
COPPER	34/34	23 N	160 N	3E-02	3E-SS02	-
CYANIDE	2/6	0.46 B	0.53 B	3E-06	3E-SS06	0.59 - 0.8
LEAD	34/34	0.95 J	159 J	57SB34	57SB34-0001	-
MERCURY	28/34	0.0086 BN	0.45 J	57SS09	57SS09-D	0.018 - 0.03
NICKEL	34/34	4.8 J	39.2	57SB04	57SB04-00	-
SELENIUM	17/28	0.1 J	1.6	57SB15	57SB15-0001	0.21 - 1.6
SILVER	24/34	0.01 J	0.26 J	57SB02	57SB02-00	0.11 - 1.6
THALLIUM	27/34	0.01 J	8.8	57SS09	57SS09	0.026 - 1.6
TIN	18/34	0.97 J	4.1 B	3E-06	3E-SS06	1.7 - 3.9
VANADIUM	34/34	35	240	57SB07	57SB07-00-D	-
ZINC	34/34	34	210	3E-06	3E-SS06	-
PCB (µg/kg)						
AROCLOR-1260	11/34	18 J	760	57SS09	57SS09	8.1 - 55
Pesticides (µg/kg)						
4,4'-DDD	1/6	9.4 JP	9.4 JP	3E-06	3E-SS06	3.9 - 5.5
4,4'-DDE	2/6	1.4 J	11	3E-06	3E-SS06	3.9 - 5.5
4,4'-DDT	3/6	1.1	33	3E-06	3E-SS06	3.9 - 5
Herbicides (µg/kg)						
2,4,5-TP (SILVEX)	1/6	1.5 J	1.5 J	3E-01	3E-SS01	9.8 - 14
Polynuclear Aromatic Hydrocarbons (µg/kg)						
2-METHYLNAPHTHALENE	8/34	1 J	6 J	57SS08	57SS08	9.3 - 550
ACENAPHTHENE	6/34	0.82 J	2.4 J	57SS09	57SS09-D	9.3 - 550
ACENAPHTHYLENE	7/34	0.86 J	14 J	57SS09	57SS09-D	9.3 - 550
ANTHRACENE	9/34	0.67 J	7.9 J	57SS09	57SS09-D	9.3 - 550
BENZO(A)ANTHRACENE	13/34	0.98 J	79 J	3E-06	3E-SS06	9.3 - 550
BENZO(A)PYRENE	7/34	0.63 J	77 J	3E-06	3E-SS06	9.3 - 550
BENZO(B)FLUORANTHENE	8/34	1.5 J	95 J	3E-06	3E-SS06	9.3 - 550
BENZO(G,H,I)PERYLENE	7/34	0.65 J	97 J	3E-01	3E-SS01	9.3 - 550

TABLE 4-3

FREQUENCY OF DETECTIONS IN SURFACE SOIL
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
BENZO(K)FLUORANTHENE	6/34	0.9 J	76 J	3E-06	3E-SS06	9.3 - 550
CHRYSENE	11/34	1 J	110 J	3E-06	3E-SS06	9.3 - 550
DIBENZO(A,H)ANTHRACENE	2/34	0.71 J	0.75 J	57SB01	57SB01-00	9.3 - 550
FLUORANTHENE	13/34	2.5 J	120 J	3E-06	3E-SS06	9.3 - 550
FLUORENE	7/34	0.64 J	1.8 J	57SS09	57SS09-D	9.3 - 550
INDENO(1,2,3-CD)PYRENE	7/34	0.8 J	77 J	3E-01	3E-SS01	9.3 - 550
NAPHTHALENE	3/34	1.1 J	1.6 J	57SB07	57SB07-00	9.3 - 550
PHENANTHRENE	11/34	2.4 J	70 J	3E-06	3E-SS06	9.3 - 550
PYRENE	13/34	0.9 J	160 J	3E-06	3E-SS06	9.3 - 550
Semivolatile Organics (µg/kg)						
ACETOPHENONE	1/34	39 J	39 J	57SB07	57SB07-00	200 - 550
BIS(2-ETHYLHEXYL)PHTHALATE	17/34	50 J	1800	57SS12	57SS12	150 - 550
Volatile Organics (µg/kg)						
2-BUTANONE	2/33	97 J	120 J	57SB36	57SB36-0001	9.3 - 53
2-HEXANONE	1/33	35 J	35 J	57SB33	57SB33-0001	9.3 - 36
ACETONE	15/33	210 J	1200 J	57SB18	57SB18-0001	16 - 1100
BENZENE	2/33	1.9 J	2.6 J	57SB36	57SB36-0001	2.3 - 7.3
CARBON DISULFIDE	4/33	1.1 J	2.4 J	57SB01	57SB01-00	2.3 - 7.3
CARBON TETRACHLORIDE	4/33	2.4 J	8.8	3E-01	3E-SS01-D	2.3 - 7.3
CHLOROBENZENE	2/33	4.3 J	4.5 J	3E-03	3E-SS03	2.3 - 7.3
CHLOROFORM	2/33	1.9 J	4.3 J	3E-01	3E-SS01-D	2.3 - 7.3
ETHYLBENZENE	2/33	2.3 J	2.4 J	3E-03	3E-SS03	2.3 - 7.3
TETRACHLOROETHENE	3/33	4.2 J	6	3E-03	3E-SS03	2.3 - 7.3
TOTAL XYLENES	2/33	9	12	3E-01, 3E-03	3E-SS01-D, 3E-SS03	3.7 - 15
Petroleum Hydrocarbons (mg/kg)						
DIESEL RANGE ORGANICS	11/12	4.1 J	72 J	57SS09	57SS09	10 - 10
TOTAL PETROLEUM HYDROCARBONS	11/12	4.7 J	72.6 J	57SS09	57SS09	10.63 - 10.63

µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB13**		**57SB14**	**57SB15**
SAMPLE ID					**57SB13-0001**	**57SB13-0001-D**	**57SB14-0001**	**57SB15-0001**
SAMPLE DATE					**20120607**	**20120607**	**20120607**	**20120607**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.16 J	0.23 J	0.06 J	0.04 J
ARSENIC	0.61	2.4	17	2.75	**1.9 J**	**1.8 J**	**0.78**	**0.8**
BARIUM	15000	190000	330	322	107 J	46.4 J	55.4	374
BERYLLIUM	160	2000	10	0.676	0.13 J	0.07 J	0.35 J	0.57 J
CADMIUM	70	800	0.77	0.765	0.2 J	0.25 J	0.1	0.3
CHROMIUM (1)	120000	1500000	0.4	55	12.5	17.1	24.2 J	29.9 J
COBALT	23	300	13	52.3	8.5 J	5.9 J	**31.9**	**65.3**
COPPER	3100	41000	28	192	30.9 J	26 J	49.9	62.2
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	24.5 J	33.4 J	19.7 J	17.8 J
MERCURY	10	43	0.013	0.131	0.09	0.07	0.03 U	0.05
NICKEL	1500	20000	38	28	4.8 J	5.6 J	11.1 J	21.7 J
SELENIUM	390	5100	0.52	1.07	0.31 J	0.42 J	1.1	1.6
SILVER	390	5100	4.2	NC	0.01 J	0.02 J	0.04 J	0.13
THALLIUM	0.78	10	0.0569	NC	0.1	0.03 J	0.02 J	0.03 J
TIN	47000	610000	7.62	4.25	1.9 U	2.6 U	3.8 U	2.8 U
VANADIUM	390	5100	7.8	286	58.6	41.8	158	170
ZINC	23000	310000	46	132	46.1	47.3	47.8 J	69.3 J
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	68 J	57 J	8.1 U	8.7 U
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	10 U	9.3 U	9.9 U	9.8 U
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	9.3 U	9.9 U	9.8 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	10 U	9.3 U	9.9 U	9.8 U
ANTHRACENE	17000000	170000000	2500	NC	10 U	9.3 U	9.9 U	9.8 U
BENZO(A)ANTHRACENE	150	2100	800	NC	10 UJ	9.3 UJ	9.9 U	9.8 UJ
BENZO(A)PYRENE	15	210	18000	NC	10 UJ	9.3 UJ	9.9 U	9.8 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	10 UJ	9.3 U	9.9 U	9.8 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 UJ	9.3 U	9.9 U	9.8 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	10 UJ	9.3 U	9.9 U	9.8 U
CHRYSENE	15000	210000	18000	NC	10 U	9.3 U	9.9 U	9.8 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 UJ	9.3 U	9.9 U	9.8 U
FLUORANTHENE	2300000	22000000	29000	NC	10 U	9.3 U	9.9 U	9.8 U
FLUORENE	2300000	22000000	29000	NC	10 U	9.3 U	9.9 U	9.8 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 UJ	9.3 U	9.9 U	9.8 U
NAPHTHALENE	3600	18000	1000	NC	10 U	9.3 U	9.9 U	9.8 U
PHENANTHRENE	1700000	17000000	29000	NC	10 U	9.3 U	9.9 U	9.8 U
PYRENE	1700000	17000000	18000	NC	10 U	9.3 U	9.9 U	9.8 UJ

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION					**57SB13**		**57SB14**	**57SB15**
SAMPLE ID	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB13-0001**	**57SB13-0001-D**	**57SB14-0001**	**57SB15-0001**
SAMPLE DATE					**20120607**	**20120607**	**20120607**	**20120607**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	250 U	230 U	250 U	240 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	450	150 J	320 U	240 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	24 U	24 U	44 U	14 U
2-HEXANONE	210000	1400000	360	NC	14 UJ	15 UJ	15 UJ	12 UJ
ACETONE	61000000	630000000	2500	NC	230 J	270 J	390 J	270 J
BENZENE	1100	5400	255	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
CARBON DISULFIDE	820000	3700000	94.1	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
CHLOROBENZENE	290000	1400000	40000	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
CHLOROFORM	290	1500	8000	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
ETHYLBENZENE	5400	27000	5160	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
TETRACHLOROETHENE	22000	110000	360	NC	2.8 UJ	3 UJ	3 UJ	2.3 UJ
TOTAL XYLENES	630000	2700000	10000	NC	8.2 UJ	9 UJ	9 UJ	6.9 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB16** **57SB16-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB17** **57SB17-0001** **20120607** **NORMAL** **SO** **0** **1**	**57SB18** **57SB18-0001** **20120607** **NORMAL** **SO** **0** **1**	**57SB19** **57SB19-0001** **20120607** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.14 J	0.13 J	0.09 J	0.1 J
ARSENIC	0.61	2.4	17	2.75	**1.8**	**1.1**	**1.5 J**	**1.5 J**
BARIUM	15000	190000	330	322	95.4	128	90.1 J	89.2 J
BERYLLIUM	160	2000	10	0.676	0.38 J	0.38 J	0.34 J	0.31 J
CADMIUM	70	800	0.77	0.765	0.54	0.31	0.17 J	0.33 J
CHROMIUM [(1)]	120000	1500000	0.4	55	31 J	31.3 J	23.4	28.4
COBALT	23	300	13	52.3	**34.8**	**35**	22.9 J	**28.2 J**
COPPER	3100	41000	28	192	81.4	71.6	79.8 J	75.3 J
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	21.7 J	53.4 J	16.8 J	19.6 J
MERCURY	10	43	0.013	0.131	0.08	0.09	0.02 U	0.08
NICKEL	1500	20000	38	28	16.9 J	16 J	13.6 J	15.2 J
SELENIUM	390	5100	0.52	1.07	1.2	0.66	0.69 J	1.1 J
SILVER	390	5100	4.2	NC	0.21	0.11	0.04 J	0.07 J
THALLIUM	0.78	10	0.0569	NC	0.04 J	0.03 J	0.03 J	0.03 J
TIN	47000	610000	7.62	4.25	3.1 U	3 U	3.2 U	2.8 U
VANADIUM	390	5100	7.8	286	171	169	146	147
ZINC	23000	310000	46	132	90 J	82 J	78.2	73.6
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	9.9 U	9.8 UJ	9.7 UJ	10 UJ
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	12 U	10 U	12 U	12 U
ACENAPHTHENE	3400000	33000000	20000	NC	12 U	10 U	12 U	12 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	12 U	10 U	12 U	12 U
ANTHRACENE	17000000	170000000	2500	NC	12 U	10 U	12 U	12 U
BENZO(A)ANTHRACENE	150	2100	800	NC	12 U	10 UJ	12 UJ	12 U
BENZO(A)PYRENE	15	210	18000	NC	12 U	10 U	12 UJ	12 UJ
BENZO(B)FLUORANTHENE	150	2100	18000	NC	12 U	10 U	12 U	12 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	12 U	10 U	12 UJ	12 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	12 U	10 U	12 U	12 U
CHRYSENE	15000	210000	18000	NC	12 U	10 U	12 U	12 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	12 U	10 U	12 U	12 U
FLUORANTHENE	2300000	22000000	29000	NC	12 U	10 U	12 U	3.9 J
FLUORENE	2300000	22000000	29000	NC	12 U	10 U	12 U	12 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	12 U	10 U	12 U	12 U
NAPHTHALENE	3600	18000	1000	NC	12 U	10 U	12 U	12 U
PHENANTHRENE	1700000	17000000	29000	NC	12 U	10 U	12 U	12 U
PYRENE	1700000	17000000	18000	NC	12 U	10 UJ	12 UJ	12 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB16** **57SB16-0001** **20120606** **NORMAL** **SO** **0** **1**	**57SB17** **57SB17-0001** **20120607** **NORMAL** **SO** **0** **1**	**57SB18** **57SB18-0001** **20120607** **NORMAL** **SO** **0** **1**	**57SB19** **57SB19-0001** **20120607** **NORMAL** **SO** **0** **1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	290 U	260 U	300 U	290 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	290 U	260 U	300 U	290 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	14 U	26 U	53 U	97 J
2-HEXANONE	210000	1400000	360	NC	12 UJ	14 UJ	14 UJ	18 UJ
ACETONE	61000000	630000000	2500	NC	270 J	400 J	1200 J	1100 UJ
BENZENE	1100	5400	255	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
CARBON DISULFIDE	820000	3700000	94.1	NC	2.4 UJ	2.8 UJ	1.2 J	3.5 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
CHLOROBENZENE	290000	1400000	40000	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
CHLOROFORM	290	1500	8000	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
ETHYLBENZENE	5400	27000	5160	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
TETRACHLOROETHENE	22000	110000	360	NC	2.4 UJ	2.8 UJ	2.8 UJ	3.5 UJ
TOTAL XYLENES	630000	2700000	10000	NC	7.4 UJ	8.2 UJ	8.2 UJ	10 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB20**		**57SB21**	**57SB22**
SAMPLE ID					**57SB20-0001**	**57SB20-0001-D**	**57SB21-0001**	**57SB22-0001**
SAMPLE DATE					**20120607**	**20120607**	**20120607**	**20120607**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.03 J	0.06 J	0.03 J	0.04 J
ARSENIC	0.61	2.4	17	2.75	0.18 J	**0.77 J**	0.24 J	0.43 J
BARIUM	15000	190000	330	322	14.6 J	94.8 J	60.3 J	74.2 J
BERYLLIUM	160	2000	10	0.676	0.21 J	0.4 J	0.36 J	0.74 J
CADMIUM	70	800	0.77	0.765	0.06 J	0.54 J	0.13 J	0.14 J
CHROMIUM [(1)]	120000	1500000	0.4	55	25.8	27.9	19.4	14.3
COBALT	23	300	13	52.3	18.8 J	**45.6 J**	13.5 J	17.1 J
COPPER	3100	41000	28	192	57.3 J	45.8 J	124 J	130 J
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	0.95 J	22.3 J	11.7 J	1.7 J
MERCURY	10	43	0.013	0.131	0.02 U	0.02 U	0.05	0.05
NICKEL	1500	20000	38	28	19.3 J	11.4 J	12.8 J	9.8 J
SELENIUM	390	5100	0.52	1.07	0.1 J	1 J	0.39 J	0.15 J
SILVER	390	5100	4.2	NC	0.02 J	0.13	0.08 J	0.04 J
THALLIUM	0.78	10	0.0569	NC	0.026 U	0.04 J	0.033 U	0.01 J
TIN	47000	610000	7.62	4.25	1.7 U	2.1 U	2.5 U	2.1 U
VANADIUM	390	5100	7.8	286	140	165	189	175
ZINC	23000	310000	46	132	77.2	57.3	93.4	201
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	8.6 UJ	8.3 U	9.1 UJ	9 UJ
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	10 U	9.3 U	11 U	10 U
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	9.3 U	11 U	10 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	10 U	9.3 U	11 U	10 U
ANTHRACENE	17000000	170000000	2500	NC	10 U	9.3 U	11 U	10 U
BENZO(A)ANTHRACENE	150	2100	800	NC	10 U	9.3 UJ	3.9 J	10 U
BENZO(A)PYRENE	15	210	18000	NC	10 UJ	9.3 UJ	11 UJ	10 UJ
BENZO(B)FLUORANTHENE	150	2100	18000	NC	10 U	9.3 U	6.1 J	10 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 UJ	9.3 U	2.3 J	10 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	10 U	9.3 U	11 U	10 U
CHRYSENE	15000	210000	18000	NC	10 U	9.3 U	11 U	10 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 UJ	9.3 U	11 U	10 U
FLUORANTHENE	2300000	22000000	29000	NC	6.5 J	4.8 J	4.7 J	5.4 J
FLUORENE	2300000	22000000	29000	NC	10 U	9.3 U	11 U	10 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 U	9.3 U	2.1 J	10 U
NAPHTHALENE	3600	18000	1000	NC	10 U	9.3 U	11 U	10 U
PHENANTHRENE	1700000	17000000	29000	NC	10 U	9.3 U	11 U	10 U
PYRENE	1700000	17000000	18000	NC	10 U	9.3 UJ	4.7 J	2.6 J

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION					**57SB20**		**57SB21**	**57SB22**
SAMPLE ID	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB20-0001**	**57SB20-0001-D**	**57SB21-0001**	**57SB22-0001**
SAMPLE DATE					**20120607**	**20120607**	**20120607**	**20120607**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	250 U	230 U	270 U	250 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	150 U	110 J	270 U	250 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	24 U	34 U	20 U	32 U
2-HEXANONE	210000	1400000	360	NC	15 UJ	16 UJ	15 UJ	18 UJ
ACETONE	61000000	630000000	2500	NC	340 J	490 J	390 J	570 J
BENZENE	1100	5400	255	NC	2.5 J	1.9 J	3 UJ	3.5 UJ
CARBON DISULFIDE	820000	3700000	94.1	NC	3 UJ	1.1 J	3 UJ	3.5 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	3 UJ	3.2 UJ	3 UJ	3.5 UJ
CHLOROBENZENE	290000	1400000	40000	NC	3 UJ	3.2 UJ	3 UJ	3.5 UJ
CHLOROFORM	290	1500	8000	NC	3 UJ	3.2 UJ	3 UJ	3.5 UJ
ETHYLBENZENE	5400	27000	5160	NC	3 UJ	3.2 UJ	3 UJ	3.5 UJ
TETRACHLOROETHENE	22000	110000	360	NC	3 UJ	3.2 UJ	3 UJ	3.5 UJ
TOTAL XYLENES	630000	2700000	10000	NC	9 UJ	9.8 UJ	9 UJ	10 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB32** **57SB32-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB33** **57SB33-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB34** **57SB34-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB35** **57SB35-0001** **20120608** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.53 J	0.07 J	0.33 J	0.1 J
ARSENIC	0.61	2.4	17	2.75	**1.5 J**	**0.64 J**	***2.6 J***	**1.5**
BARIUM	15000	190000	330	322	56.3 J	97.2 J	138 J	99.2 J
BERYLLIUM	160	2000	10	0.676	0.11 J	0.35 J	0.36 J	0.37 J
CADMIUM	70	800	0.77	0.765	1.1 J	0.09 J	4.3 J	0.28 J
CHROMIUM [(1)]	120000	1500000	0.4	55	13.6	36	62.8	34.8
COBALT	23	300	13	52.3	9.4 J	**29.3 J**	**35.3 J**	**33.2 J**
COPPER	3100	41000	28	192	77.4 J	92.1 J	82 J	78.5 J
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	56.5 J	11.2 J	159 J	120 J
MERCURY	10	43	0.013	0.131	0.27	0.04	0.05	0.05
NICKEL	1500	20000	38	28	8.6 J	23.4 J	17.9 J	16.4 J
SELENIUM	390	5100	0.52	1.07	0.35 J	0.62 J	1.1 J	0.93
SILVER	390	5100	4.2	NC	0.01 J	0.06 J	0.1 J	0.08
THALLIUM	0.78	10	0.0569	NC	0.03 J	0.02 J	0.04 J	0.02 J
TIN	47000	610000	7.62	4.25	2.5 U	2.7 U	3.9 U	2.4 U
VANADIUM	390	5100	7.8	286	57.8	201	165	172
ZINC	23000	310000	46	132	126	80.7	174	114
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	37 J	9.2 UJ	41 J	9.5 UJ
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	10 U	11 U	12 U	11 U
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	11 U	12 U	11 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	10 U	11 U	12 U	11 U
ANTHRACENE	17000000	170000000	2500	NC	10 U	11 U	12 U	11 U
BENZO(A)ANTHRACENE	150	2100	800	NC	5.8 J	11 U	3.3 J	11 UJ
BENZO(A)PYRENE	15	210	18000	NC	4.8 J	11 UJ	4.3 J	11 UJ
BENZO(B)FLUORANTHENE	150	2100	18000	NC	13 J	11 U	12 J	11 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 U	11 U	6.2 J	11 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	3.8 J	11 U	12 U	11 U
CHRYSENE	15000	210000	18000	NC	10 U	11 U	12 U	11 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 U	11 U	12 U	11 U
FLUORANTHENE	2300000	22000000	29000	NC	8.9 J	11 U	7.8 J	11 U
FLUORENE	2300000	22000000	29000	NC	10 U	11 U	12 U	11 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 U	11 U	5.2 J	11 U
NAPHTHALENE	3600	18000	1000	NC	10 U	11 U	12 U	11 U
PHENANTHRENE	1700000	17000000	29000	NC	10 U	11 U	4.4 J	11 U
PYRENE	1700000	17000000	18000	NC	14 J	11 U	9.8 J	11 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB32** **57SB32-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB33** **57SB33-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB34** **57SB34-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB35** **57SB35-0001** **20120608** **NORMAL** **SO** **0** **1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	260 U	270 U	290 U	270 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	370	510	260 J	270 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	28 U	12 U	28 U	29 U
2-HEXANONE	210000	1400000	360	NC	15 UJ	35 J	18 UJ	18 UJ
ACETONE	61000000	630000000	2500	NC	260 J	210 J	480 J	540 J
BENZENE	1100	5400	255	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
CARBON DISULFIDE	820000	3700000	94.1	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
CHLOROBENZENE	290000	1400000	40000	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
CHLOROFORM	290	1500	8000	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
ETHYLBENZENE	5400	27000	5160	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
TETRACHLOROETHENE	22000	110000	360	NC	3 UJ	3 UJ	3.5 UJ	3.5 UJ
TOTAL XYLENES	630000	2700000	10000	NC	9 UJ	9 UJ	10 UJ	10 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB36** **57SB36-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB37** **57SB37-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB01** **57SB01-00** **20100128** **NORMAL** **SO** **0** **1**	**57SB02** **57SB02-00** **20100126** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.13 J	0.1 J	0.75 U	1.3 J
ARSENIC	0.61	2.4	17	2.75	**1.8**	**0.95**	0.74 U	**1.4**
BARIUM	15000	190000	330	322	44.1 J	48.2 J	82.8 J	90.8
BERYLLIUM	160	2000	10	0.676	0.13 J	0.17 J	0.26 J	0.45 U
CADMIUM	70	800	0.77	0.765	0.19 J	0.14 J	0.75	0.25 U
CHROMIUM [(1)]	120000	1500000	0.4	55	11.4	18.6	28.5	24.2
COBALT	23	300	13	52.3	7.1 J	16.4 J	**27.2**	**52.7**
COPPER	3100	41000	28	192	37.2 J	65.4 J	92.1	63.7 J
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	9.6 J	12 J	52.5	19.1 J
MERCURY	10	43	0.013	0.131	0.03 J	0.03 J	0.04 J	0.13
NICKEL	1500	20000	38	28	8.6 J	11.8 J	19.4	14.7
SELENIUM	390	5100	0.52	1.07	0.6	0.34 J	0.23 U	0.45 R
SILVER	390	5100	4.2	NC	0.02 J	0.04 J	0.12 U	0.26 J
THALLIUM	0.78	10	0.0569	NC	0.03 J	0.01 J	**8.3**	**3.6**
TIN	47000	610000	7.62	4.25	3.1 U	2.6 U	1.9 J	1.7 J
VANADIUM	390	5100	7.8	286	59.9	107	155	184
ZINC	23000	310000	46	132	62.8	60	99.5	45.7
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	12 UJ	8.6 UJ	38 U	39 U
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	14 U	9.3 U	3.1 J	11 U
ACENAPHTHENE	3400000	33000000	20000	NC	14 U	9.3 U	0.93 J	11 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	14 U	9.3 U	3.3 J	11 U
ANTHRACENE	17000000	170000000	2500	NC	14 U	9.3 U	2.5 J	11 U
BENZO(A)ANTHRACENE	150	2100	800	NC	14 UJ	9.3 UJ	8.2 J	11 U
BENZO(A)PYRENE	15	210	18000	NC	14 UJ	9.3 UJ	6.6 J	11 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	14 U	9.3 U	4.5 J	11 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	14 U	9.3 U	2.6 J	11 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	14 U	9.3 U	5.3 J	11 U
CHRYSENE	15000	210000	18000	NC	14 U	9.3 U	8.1 J	11 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	14 U	9.3 U	0.75 J	11 U
FLUORANTHENE	2300000	22000000	29000	NC	14 U	3.3 J	11 U	11 U
FLUORENE	2300000	22000000	29000	NC	14 U	9.3 U	0.97 J	11 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	14 U	9.3 U	3.5 J	11 U
NAPHTHALENE	3600	18000	1000	NC	14 U	9.3 U	11 UJ	1.1 J
PHENANTHRENE	1700000	17000000	29000	NC	14 U	9.3 U	7.3 J	11 U
PYRENE	1700000	17000000	18000	NC	14 U	9.3 U	13	11 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB36** **57SB36-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB37** **57SB37-0001** **20120608** **NORMAL** **SO** **0** **1**	**57SB01** **57SB01-00** **20100128** **NORMAL** **SO** **0** **1**	**57SB02** **57SB02-00** **20100126** **NORMAL** **SO** **0** **1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	340 U	230 U	220 U	220 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	160 J	120 J	160 J	110 J
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	120 J	12 U	13 U	13 R
2-HEXANONE	210000	1400000	360	NC	25 UJ	15 UJ	13 U	13 R
ACETONE	61000000	630000000	2500	NC	960 J	220 J	21 U	22 R
BENZENE	1100	5400	255	NC	2.6 J	3 UJ	5 U	5.1 R
CARBON DISULFIDE	820000	3700000	94.1	NC	1.7 J	3 UJ	2.4 J	5.1 R
CARBON TETRACHLORIDE	610	3000	1000000	NC	5 UJ	3 UJ	5 U	5.1 R
CHLOROBENZENE	290000	1400000	40000	NC	5 UJ	3 UJ	5 U	5.1 R
CHLOROFORM	290	1500	8000	NC	5 UJ	3 UJ	5 U	5.1 R
ETHYLBENZENE	5400	27000	5160	NC	5 UJ	3 UJ	5 U	5.1 R
TETRACHLOROETHENE	22000	110000	360	NC	5 UJ	3 UJ	5 U	5.1 R
TOTAL XYLENES	630000	2700000	10000	NC	15 UJ	9 UJ	5 U	5.1 R
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	10 U	6.9 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	10.63 U	7.55 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB03** **57SB03-00** **20100126** **NORMAL** **SO** **0** **1**	**57SB04** **57SB04-00** **20100128** **NORMAL** **SO** **0** **1**	**57SB05** **57SB05-00** **20100127** **NORMAL** **SO** **0** **1**	**57SB06** **57SB06-00** **20100128** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.95 J	1.2 J	1.5 J	1.2 J
ARSENIC	0.61	2.4	17	2.75	**1.4**	0.34 U	**2**	**1.2**
BARIUM	15000	190000	330	322	55.6	67.1	72	45.8
BERYLLIUM	160	2000	10	0.676	0.1 U	0.03 U	0.16 U	0.14 U
CADMIUM	70	800	0.77	0.765	0.26 U	0.17 U	0.58 U	0.49 U
CHROMIUM (1)	120000	1500000	0.4	55	16.9	108	29.1	20.7
COBALT	23	300	13	52.3	14.5	**38.7**	16.4	22.3
COPPER	3100	41000	28	192	49.4 J	127 J	86.3 J	65.8 J
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	9.2 J	10.3 J	20.6 J	10.2 J
MERCURY	10	43	0.013	0.131	0.026 J	0.019 U	0.04 J	0.041
NICKEL	1500	20000	38	28	10	39.2	10.7	13.7
SELENIUM	390	5100	0.52	1.07	0.4 R	0.43 R	0.51 R	0.42 R
SILVER	390	5100	4.2	NC	0.15 J	0.23 J	0.22 J	0.23 J
THALLIUM	0.78	10	0.0569	NC	**1.1 J**	**4**	**1.4 J**	**2.1**
TIN	47000	610000	7.62	4.25	1.6 J	2.3 J	2.3 J	0.97 J
VANADIUM	390	5100	7.8	286	74.9	154	149	120
ZINC	23000	310000	46	132	67.2	74.6	155	94.9
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	36 U	36 U	43 U	36 U
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	10 U	3.6 J	12 U	1.7 J
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	1.3 J	12 U	9.9 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	10 U	3.6 J	12 U	1.3 J
ANTHRACENE	17000000	170000000	2500	NC	10 U	7.1 J	12 U	2.1 J
BENZO(A)ANTHRACENE	150	2100	800	NC	10 U	8.9 J	12 U	3.3 J
BENZO(A)PYRENE	15	210	18000	NC	10 U	6.2 J	0.63 J	2.3 J
BENZO(B)FLUORANTHENE	150	2100	18000	NC	10 U	3.6 J	1.5 J	1.9 J
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 U	1.7 J	0.65 J	9.9 UJ
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	10 U	4.9 J	0.9 J	1.8 J
CHRYSENE	15000	210000	18000	NC	10 U	8.6 J	1.1 J	3.3 J
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 U	0.71 J	12 U	9.9 U
FLUORANTHENE	2300000	22000000	29000	NC	10 U	12	12 U	9.9 U
FLUORENE	2300000	22000000	29000	NC	10 U	1.5 J	12 U	0.71 J
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 U	2.5 J	0.8 J	9.9 U
NAPHTHALENE	3600	18000	1000	NC	1.2 J	9.9 UJ	12 U	9.9 UJ
PHENANTHRENE	1700000	17000000	29000	NC	10 U	15	12 U	5 J
PYRENE	1700000	17000000	18000	NC	10 U	17	0.9 J	9.9 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB03** **57SB03-00** **20100126** **NORMAL** **SO** **0** **1**	**57SB04** **57SB04-00** **20100128** **NORMAL** **SO** **0** **1**	**57SB05** **57SB05-00** **20100127** **NORMAL** **SO** **0** **1**	**57SB06** **57SB06-00** **20100128** **NORMAL** **SO** **0** **1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	200 U	200 U	250 U	200 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	97 J	200 U	250 U	110 J
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	12 U	9.3 U	13 U	10 U
2-HEXANONE	210000	1400000	360	NC	12 U	9.3 U	13 U	10 U
ACETONE	61000000	630000000	2500	NC	20 U	16 U	22 U	18 U
BENZENE	1100	5400	255	NC	4.7 U	3.7 U	5.3 U	4.2 U
CARBON DISULFIDE	820000	3700000	94.1	NC	4.7 U	3.7 U	5.3 U	4.2 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	4.7 U	3.7 U	5.3 U	4.2 U
CHLOROBENZENE	290000	1400000	40000	NC	4.7 U	3.7 U	5.3 U	4.2 U
CHLOROFORM	290	1500	8000	NC	4.7 U	3.7 U	5.3 U	4.2 U
ETHYLBENZENE	5400	27000	5160	NC	4.7 U	3.7 U	5.3 U	4.2 U
TETRACHLOROETHENE	22000	110000	360	NC	4.7 U	3.7 U	5.3 U	4.2 U
TOTAL XYLENES	630000	2700000	10000	NC	4.7 U	3.7 U	5.3 U	4.2 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	5.5 J	4.1 J	9.2 J	7 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	6.1 J	4.7 J	9.92 J	7.6 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB07**		**57SS08**	**57SS09**
SAMPLE ID					**57SB07-00**	**57SB07-00-D**	**57SS08**	**57SS09**
SAMPLE DATE					**20100127**	**20100127**	**20100129**	**20100129**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**ORIG**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	1.1 J	1.7 J	1 J	0.85 U
ARSENIC	0.61	2.4	17	2.75	**0.83 J**	**1.3 J**	***5.2***	**1.6**
BARIUM	15000	190000	330	322	95 J	161 J	163 J	190 J
BERYLLIUM	160	2000	10	0.676	0.53 U	0.64 U	0.3 J	0.34 J
CADMIUM	70	800	0.77	0.765	0.28 U	0.31 U	5.3	1.1
CHROMIUM (1)	120000	1500000	0.4	55	29.3	39.7	38.5	26.5
COBALT	23	300	13	52.3	**31.7**	**49.3**	**30.3**	**34**
COPPER	3100	41000	28	192	75.5 J	85.6 J	71.2	92.3
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	17.6 J	21.1 J	116	29.6 J
MERCURY	10	43	0.013	0.131	0.023 U	0.023 U	0.051	0.15 J
NICKEL	1500	20000	38	28	13.9	16.1	18.8	27.8 J
SELENIUM	390	5100	0.52	1.07	0.51 R	0.49 R	0.25 U	0.26 UJ
SILVER	390	5100	4.2	NC	0.18 J	0.24 J	0.14 J	0.13 U
THALLIUM	0.78	10	0.0569	NC	**1.5 J**	**3.2 J**	**8.5**	**8.8**
TIN	47000	610000	7.62	4.25	1.9 J	1.5 J	2.4 J	2.1 J
VANADIUM	390	5100	7.8	286	170	240	141	180
ZINC	23000	310000	46	132	73.5	77.4	183	136
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	**310 J**	130 J	**550**	***760***
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	12 U	12 U	6 J	2.3 J
ACENAPHTHENE	3400000	33000000	20000	NC	12 U	12 U	1.9 J	0.91 J
ACENAPHTHYLENE	3400000	33000000	20000	NC	12 U	12 U	1.8 J	1.4 J
ANTHRACENE	17000000	170000000	2500	NC	1.3 J	12 U	3.7 J	2.1 J
BENZO(A)ANTHRACENE	150	2100	800	NC	0.98 J	12 U	5.9 J	2.9 J
BENZO(A)PYRENE	15	210	18000	NC	12 U	12 U	12 UJ	11 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	12 UJ	12 U	12 UJ	11 UJ
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	12 U	12 U	12 UJ	11 UJ
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	12 U	12 U	12 UJ	11 U
CHRYSENE	15000	210000	18000	NC	1 J	12 U	6.7 J	3.1 J
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	12 U	12 U	12 UJ	11 U
FLUORANTHENE	2300000	22000000	29000	NC	2.5 J	12 U	16	11 UJ
FLUORENE	2300000	22000000	29000	NC	12 U	12 U	1.7 J	0.64 J
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	12 U	12 U	12 UJ	11 U
NAPHTHALENE	3600	18000	1000	NC	1.6 J	12 U	12 U	11 U
PHENANTHRENE	1700000	17000000	29000	NC	2.4 J	12 U	7.7 J	4.9 J
PYRENE	1700000	17000000	18000	NC	2 J	12 U	16	11 UJ

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION					**57SB07**		**57SS08**	**57SS09**
SAMPLE ID	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SB07-00**	**57SB07-00-D**	**57SS08**	**57SS09**
SAMPLE DATE					**20100127**	**20100127**	**20100129**	**20100129**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**ORIG**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	39 J	250 U	240 U	230 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	71 J	54 J	240 U	230 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	13 U	14 U	18 U	13 U
2-HEXANONE	210000	1400000	360	NC	13 U	14 U	18 U	13 U
ACETONE	61000000	630000000	2500	NC	22 U	23 U	48 U	22 U
BENZENE	1100	5400	255	NC	5.2 U	5.4 U	7.2 U	5.1 U
CARBON DISULFIDE	820000	3700000	94.1	NC	5.2 U	5.4 U	7.2 U	5.1 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	5.2 U	5.4 U	7.2 U	5.1 U
CHLOROBENZENE	290000	1400000	40000	NC	5.2 U	5.4 U	7.2 U	5.1 U
CHLOROFORM	290	1500	8000	NC	5.2 U	5.4 U	7.2 U	5.1 U
ETHYLBENZENE	5400	27000	5160	NC	5.2 U	5.4 U	7.2 U	5.1 U
TETRACHLOROETHENE	22000	110000	360	NC	5.2 U	5.4 U	7.2 U	5.1 U
TOTAL XYLENES	630000	2700000	10000	NC	5.2 U	5.4 U	7.2 U	5.1 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	13 J	16	70	72 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	13.74 J	16.74	70.6	72.6 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SS09** **57SS09-D** **20100129** **DUP** **SO** **0** **1**	**57SS10** **57SS10** **20100129** **NORMAL** **SO** **0** **1**	**57SS11** **57SS11** **20100129** **NORMAL** **SO** **0** **1**	**57SS12** **57SS12** **20100129** **NORMAL** **SO** **0** **1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	0.85 U	0.7 U	0.73 U	0.67 U
ARSENIC	0.61	2.4	17	2.75	**1.8**	**1.2**	**1.4**	**2.4**
BARIUM	15000	190000	330	322	88.9 J	98.1 J	200 J	42.2 J
BERYLLIUM	160	2000	10	0.676	0.27 J	0.27 J	0.32 J	0.07 J
CADMIUM	70	800	0.77	0.765	1.4	1.3	1.1	0.76
CHROMIUM [(1)]	120000	1500000	0.4	55	27.7	19.2	24.9	11
COBALT	23	300	13	52.3	**29.4**	**24.9**	**64.8**	8.2
COPPER	3100	41000	28	192	86.7	85.1	80.9	35.8
CYANIDE	22	140	0.9	NC	NA	NA	NA	NA
LEAD	400	800	11	34.2	46.4 J	60.6	33.7	30.5
MERCURY	10	43	0.013	0.131	0.45 J	0.037 J	0.058	0.018 U
NICKEL	1500	20000	38	28	14.8 J	15	15.4	4.9
SELENIUM	390	5100	0.52	1.07	0.93 J	0.21 U	0.22 U	0.21 U
SILVER	390	5100	4.2	NC	0.13 U	0.11 U	0.15 J	0.11 U
THALLIUM	0.78	10	0.0569	NC	**7.1**	**7.6**	**7.7**	**3.1**
TIN	47000	610000	7.62	4.25	2.2 J	1.5 J	1.5 J	1.8 J
VANADIUM	390	5100	7.8	286	150	118	141	44.4
ZINC	23000	310000	46	132	143	96.9	79.7	49.4
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	**610**	39 J	38 U	46
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	NA	NA	NA	NA
4,4'-DDE	1400	5100	93	NC	NA	NA	NA	NA
4,4'-DDT	1700	7000	93	NC	NA	NA	NA	NA
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	2.3 J	1.9 J	1 J	2 J
ACENAPHTHENE	3400000	33000000	20000	NC	2.4 J	1.8 J	10 U	0.82 J
ACENAPHTHYLENE	3400000	33000000	20000	NC	14 J	1.7 J	10 UJ	0.86 J
ANTHRACENE	17000000	170000000	2500	NC	7.9 J	2.7 J	0.67 J	3.8 J
BENZO(A)ANTHRACENE	150	2100	800	NC	30 J	17	2.9 J	1.3 J
BENZO(A)PYRENE	15	210	18000	NC	12 UJ	10 UJ	10 U	9.5 UJ
BENZO(B)FLUORANTHENE	150	2100	18000	NC	12 UJ	10 UJ	10 U	9.5 UJ
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	12 UJ	10 UJ	10 UJ	9.5 UJ
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	12 UJ	10 UJ	10 U	9.5 UJ
CHRYSENE	15000	210000	18000	NC	27 J	26	3.4 J	1.4 J
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	12 UJ	10 UJ	10 U	9.5 UJ
FLUORANTHENE	2300000	22000000	29000	NC	41 J	47	10 U	9.5 U
FLUORENE	2300000	22000000	29000	NC	1.8 J	1.3 J	10 UJ	0.8 J
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	12 UJ	10 UJ	10 U	9.5 UJ
NAPHTHALENE	3600	18000	1000	NC	12 U	10 UJ	10 UJ	9.5 U
PHENANTHRENE	1700000	17000000	29000	NC	9.4 J	34	3 J	2.5 J
PYRENE	1700000	17000000	18000	NC	63 J	69	10 U	9.5 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**57SS09** **57SS09-D** **20100129** **DUP** **SO** **0** **1**	**57SS10** **57SS10** **20100129** **NORMAL** **SO** **0** **1**	**57SS11** **57SS11** **20100129** **NORMAL** **SO** **0** **1**	**57SS12** **57SS12** **20100129** **NORMAL** **SO** **0** **1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	240 U	200 U	210 U	200 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	240 U	70 J	50 J	1800
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	13 R	14 U	12 U	11 U
2-HEXANONE	210000	1400000	360	NC	13 R	14 U	12 U	11 U
ACETONE	61000000	630000000	2500	NC	21 R	23 U	21 U	18 U
BENZENE	1100	5400	255	NC	5 R	5.5 U	4.9 U	4.3 U
CARBON DISULFIDE	820000	3700000	94.1	NC	5 R	5.5 U	4.9 U	4.3 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	5 R	5.5 U	4.9 U	4.3 U
CHLOROBENZENE	290000	1400000	40000	NC	5 R	5.5 U	4.9 U	4.3 U
CHLOROFORM	290	1500	8000	NC	5 R	5.5 U	4.9 U	4.3 U
ETHYLBENZENE	5400	27000	5160	NC	5 R	5.5 U	4.9 U	4.3 U
TETRACHLOROETHENE	22000	110000	360	NC	5 R	5.5 U	4.9 U	4.3 U
TOTAL XYLENES	630000	2700000	10000	NC	5 R	5.5 U	4.9 U	4.3 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	37 J	28	25	13
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	37.68 J	28.57	25.62	13.56

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**3E-01**		**3E-02**	**3E-03**
SAMPLE ID					**3E-SS01**	**3E-SS01-D**	**3E-SS02**	**3E-SS03**
SAMPLE DATE					**20040505**	**20040505**	**20040505**	**20040505**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	2.6 UN	2.8 UN	2.3 UN	2.4 UN
ARSENIC	0.61	2.4	17	2.75	**1.1 B**	**1.2 B**	***3.7***	1.2 U
BARIUM	15000	190000	330	322	110	70	81	55
BERYLLIUM	160	2000	10	0.676	0.35 B	0.34 B	0.2 B	0.17 B
CADMIUM	70	800	0.77	0.765	0.8	0.79	1.4	1.4
CHROMIUM [(1)]	120000	1500000	0.4	55	30	31	21	36
COBALT	23	300	13	52.3	**38**	**26**	14	**25**
COPPER	3100	41000	28	192	77 N	84 N	160 N	86 N
CYANIDE	22	140	0.9	NC	0.67 U	0.73 U	0.59 U	0.66 U
LEAD	400	800	11	34.2	20	21	32	2.8
MERCURY	10	43	0.013	0.131	0.049 N	0.05 N	0.0086 BN	0.0098 BSN
NICKEL	1500	20000	38	28	16	19	13	28
SELENIUM	390	5100	0.52	1.07	1.3 U	1.4 U	1.1 U	1.2 U
SILVER	390	5100	4.2	NC	1.3 U	1.4 U	1.1 U	1.2 U
THALLIUM	0.78	10	0.0569	NC	1.3 U	1.4 U	1.1 U	1.2 U
TIN	47000	610000	7.62	4.25	2.2 B	2.7 B	3.9 B	3.4 B
VANADIUM	390	5100	7.8	286	180	160	86	140
ZINC	23000	310000	46	132	87	90	130	70
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	46 U	50 U	55	44 U
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	4.6 U	5 U	3.9 U	4.4 U
4,4'-DDE	1400	5100	93	NC	4.6 U	5 U	3.9 U	4.4 U
4,4'-DDT	1700	7000	93	NC	4.6 U	5 U	3.9 U	4.4 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	1.5 J	12 U	9.8 U	11 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	460 U	500 U	390 U	440 U
ACENAPHTHENE	3400000	33000000	20000	NC	460 U	500 U	390 U	440 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	460 U	500 U	390 U	440 U
ANTHRACENE	17000000	170000000	2500	NC	460 U	500 U	390 U	440 U
BENZO(A)ANTHRACENE	150	2100	800	NC	460 U	500 U	390 U	440 U
BENZO(A)PYRENE	15	210	18000	NC	460 U	500 U	390 U	440 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	460 U	500 U	390 U	440 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	97 J	500 U	390 U	440 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	460 U	500 U	390 U	440 U
CHRYSENE	15000	210000	18000	NC	460 U	500 U	390 U	440 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	460 U	500 U	390 U	440 U
FLUORANTHENE	2300000	22000000	29000	NC	460 U	500 U	390 U	440 U
FLUORENE	2300000	22000000	29000	NC	460 U	500 U	390 U	440 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	77 J	500 U	390 U	440 U
NAPHTHALENE	3600	18000	1000	NC	460 U	500 U	390 U	440 U
PHENANTHRENE	1700000	17000000	29000	NC	460 U	500 U	390 U	440 U
PYRENE	1700000	17000000	18000	NC	35 J	500 U	390 U	440 U

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION					**3E-01**		**3E-02**	**3E-03**
SAMPLE ID	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**3E-SS01**	**3E-SS01-D**	**3E-SS02**	**3E-SS03**
SAMPLE DATE					**20040505**	**20040505**	**20040505**	**20040505**
SAMPLE CODE					**ORIG**	**DUP**	**NORMAL**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	460 U	500 U	390 U	440 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	460 U	500 U	52 J	440 U
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	29 U	35 U	28 U	30 U
2-HEXANONE	210000	1400000	360	NC	29 U	35 U	28 U	30 U
ACETONE	61000000	630000000	2500	NC	59 U	70 U	55 U	59 U
BENZENE	1100	5400	255	NC	5.9 U	7 U	5.5 U	5.9 U
CARBON DISULFIDE	820000	3700000	94.1	NC	5.9 U	7 U	5.5 U	5.9 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	4 J	8.8	2.4 J	5.7 J
CHLOROBENZENE	290000	1400000	40000	NC	5.9 U	4.3 J	5.5 U	4.5 J
CHLOROFORM	290	1500	8000	NC	1.9 J	4.3 J	5.5 U	2.9 J
ETHYLBENZENE	5400	27000	5160	NC	5.9 U	2.3 J	5.5 U	2.4 J
TETRACHLOROETHENE	22000	110000	360	NC	5.9 U	5.7 J	5.5 U	6
TOTAL XYLENES	630000	2700000	10000	NC	12 U	12 J	11 U	12
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Surface Soil BTVs	**3E-04**	**3E-05**		**3E-06**
SAMPLE ID					**3E-SS04**	**3E-SS05**	**3E-SS05-D**	**3E-SS06**
SAMPLE DATE					**20040505**	**20040505**	**20040505**	**20040505**
SAMPLE CODE					**NORMAL**	**ORIG**	**DUP**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	2.7	1 BN	2.5 UN	3.2 UN	3.2 UN
ARSENIC	0.61	2.4	17	2.75	**1.5**	**1.2 B**	***3.5***	***3.6***
BARIUM	15000	190000	330	322	83	36	62	74
BERYLLIUM	160	2000	10	0.676	0.22 B	0.088 B	0.13 B	0.26 B
CADMIUM	70	800	0.77	0.765	1.2	0.38 B	0.63 B	2.9
CHROMIUM (1)	120000	1500000	0.4	55	34	8.1	17	31
COBALT	23	300	13	52.3	**24**	5.6	10	18
COPPER	3100	41000	28	192	97 N	23 N	40 N	100 N
CYANIDE	22	140	0.9	NC	0.46 B	0.71 U	0.8 U	0.53 B
LEAD	400	800	11	34.2	48	16	32	120
MERCURY	10	43	0.013	0.131	0.16 SN	0.15 N	0.049 N	0.054 N
NICKEL	1500	20000	38	28	20	5.2	9.6	14
SELENIUM	390	5100	0.52	1.07	1.4 U	1.3 U	1.6 U	1.6 U
SILVER	390	5100	4.2	NC	1.4 U	1.3 U	1.6 U	1.6 U
THALLIUM	0.78	10	0.0569	NC	1.4 U	1.3 U	1.6 U	1.6 U
TIN	47000	610000	7.62	4.25	3.7 B	3 B	3.3 B	4.1 B
VANADIUM	390	5100	7.8	286	150	35	67	110
ZINC	23000	310000	46	132	120	34	63	210
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	18 J	48 U	55 U	**330**
PESTICIDES (µg/kg)								
4,4'-DDD	2000	7200	93	NC	4.8 U	4.8 U	5.5 U	9.4 JP
4,4'-DDE	1400	5100	93	NC	1.4 J	4.8 U	5.5 U	11
4,4'-DDT	1700	7000	93	NC	2.3 J	1.1 J	1.1 J	33
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	12 U	12 U	14 U	14 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	480 U	480 U	550 U	540 U
ACENAPHTHENE	3400000	33000000	20000	NC	480 U	480 U	550 U	540 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	480 U	480 U	550 U	540 U
ANTHRACENE	17000000	170000000	2500	NC	480 U	480 U	550 U	540 U
BENZO(A)ANTHRACENE	150	2100	800	NC	480 U	480 U	550 U	79 J
BENZO(A)PYRENE	15	210	18000	NC	480 U	480 U	550 U	**77 J**
BENZO(B)FLUORANTHENE	150	2100	18000	NC	480 U	480 U	550 U	95 J
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	480 U	480 U	550 U	67 J
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	480 U	480 U	550 U	76 J
CHRYSENE	15000	210000	18000	NC	480 U	480 U	550 U	110 J
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	480 U	480 U	550 U	540 U
FLUORANTHENE	2300000	22000000	29000	NC	480 U	480 U	550 U	120 J
FLUORENE	2300000	22000000	29000	NC	480 U	480 U	550 U	540 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	480 U	480 U	550 U	51 J
NAPHTHALENE	3600	18000	1000	NC	480 U	480 U	550 U	540 U
PHENANTHRENE	1700000	17000000	29000	NC	480 U	480 U	550 U	70 J
PYRENE	1700000	17000000	18000	NC	480 U	480 U	550 U	160 J

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS IN SURFACE SOIL
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION	**RESIDENTIAL**	*INDUSTRIAL*	ECOLOGICAL	NAPR Facility	**3E-04**	**3E-05**		**3E-06**
SAMPLE ID	**RSL**	*RSL*	SCREENING	Surface Soil	**3E-SS04**	**3E-SS05**	**3E-SS05-D**	**3E-SS06**
SAMPLE DATE			CRITERIA	BTVs	**20040505**	**20040505**	**20040505**	**20040505**
SAMPLE CODE					**NORMAL**	**ORIG**	**DUP**	**NORMAL**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**0**	**0**	**0**	**0**
BOTTOM DEPTH (feet)					**1**	**1**	**1**	**1**
SEMIVOLATILES ORGANICS (µg/kg)								
ACETOPHENONE	7800000	100000000	NC	NC	480 U	480 U	550 U	540 U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	480 U	480 U	550 U	130 J
VOLATILES ORGANICS (µg/kg)								
2-BUTANONE	28000000	200000000	89600	NC	32 U	36 U	36 U	36 U
2-HEXANONE	210000	1400000	360	NC	32 U	36 U	36 U	36 U
ACETONE	61000000	630000000	2500	NC	65 U	72 U	73 U	73 U
BENZENE	1100	5400	255	NC	6.5 U	7.2 U	7.3 U	7.3 U
CARBON DISULFIDE	820000	3700000	94.1	NC	6.5 U	7.2 U	7.3 U	7.3 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	6.5 U	3 J	7.3 U	7.3 U
CHLOROBENZENE	290000	1400000	40000	NC	6.5 U	7.2 U	7.3 U	7.3 U
CHLOROFORM	290	1500	8000	NC	6.5 U	7.2 U	7.3 U	7.3 U
ETHYLBENZENE	5400	27000	5160	NC	6.5 U	7.2 U	7.3 U	7.3 U
TETRACHLOROETHENE	22000	110000	360	NC	6.5 U	4.2 J	7.3 U	7.3 U
TOTAL XYLENES	630000	2700000	10000	NC	13 U	14 U	15 U	15 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-5

FREQUENCY OF DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Inorganics (mg/kg						
ANTIMONY	16/23	0.03 J	2.1 J	57SB02	57SB02-01	0.79 - 3.6
ARSENIC	19/23	0.54	2.5 J	57SB13	57SB13-0103	0.98 - 1.8
BARIUM	23/23	25	290	57SB02	57SB02-01	-
BERYLLIUM	18/23	0.08 J	0.61	57SB02	57SB02-01	0.39 - 0.61
CADMIUM	17/23	0.03 J	4.7 J	57SB34	57SB34-0103	0.12 - 0.91
CHROMIUM	23/23	6.4	110	3E-03	3E-SB03-01	-
COBALT	23/23	3.1 J	97	57SB02	57SB02-01	-
COPPER	23/23	17.9 J	120 N	3E-04, 3E-03	3E-SB04-01, 3E-SB03-01	-
LEAD	23/23	1.5	238 J	57SB18	57SB18-0103	-
MERCURY	14/23	0.007 J	0.11 J	57SB05	57SB05-01	0.015 - 0.033
NICKEL	23/23	2.5 J	37	3E-03	3E-SB03-01	-
SELENIUM	11/17	0.23 J	1.5	57SB16	57SB16-0103	1 - 2
SILVER	17/23	0.01 J	0.43 J	57SB05	57SB05-01-D	0.12 - 1.8
THALLIUM	17/23	0.01 J	10.2	57SB01	57SB01-01	0.98 - 1.8
TIN	13/23	0.91 J	17.6	57SB18	57SB18-0103	0.62 - 3
VANADIUM	23/23	30.5	237	57SB02	57SB02-01	-
ZINC	23/23	14.5	162	57SB34	57SB34-0103	-
PCB (µg/kg)						
AROCLOR-1260	2/23	30 J	34 J	57SB07	57SB07-01	8.2 - 61
Herbicides (µg/kg)						
2,4,5-TP (SILVEX)	1/6	4.1 J	4.1 J	3E-04	3E-SB04-01	9.3 - 15
Polynuclear Aromatic Hydrocarbons (µg/kg)						
2-METHYLNAPHTHALENE	3/23	1.1 J	3.4 J	57SB04	57SB04-01	9.4 - 610
ACENAPHTHENE	1/23	1.3 J	1.3 J	57SB04	57SB04-01	9.4 - 610
ACENAPHTHYLENE	2/23	0.98 J	6.8 J	57SB04	57SB04-01	9.4 - 610
ANTHRACENE	3/23	0.68 J	4.2 J	57SB04	57SB04-01	9.4 - 610
BENZO(A)ANTHRACENE	4/23	1.5 J	20	57SB04	57SB04-01	9.4 - 610
BENZO(A)PYRENE	2/23	0.74 J	17	57SB04	57SB04-01	9.4 - 610
BENZO(B)FLUORANTHENE	4/23	0.74 J	9.6 J	57SB04	57SB04-01	9.4 - 610
BENZO(G,H,I)PERYLENE	2/23	4 J	5.7 J	57SB04	57SB04-01	9.4 - 610
BENZO(K)FLUORANTHENE	2/23	0.8 J	11	57SB04	57SB04-01	9.4 - 610
CHRYSENE	3/23	1.6 J	20	57SB04	57SB04-01	9.4 - 610
DIBENZO(A,H)ANTHRACENE	1/23	1.8 J	1.8 J	57SB04	57SB04-01	9.4 - 610
FLUORANTHENE	4/23	1.9 J	18	57SB04	57SB04-01	9.8 - 610
FLUORENE	1/23	1.6 J	1.6 J	57SB04	57SB04-01	9.4 - 610
INDENO(1,2,3-CD)PYRENE	3/23	0.5 J	7 J	57SB04	57SB04-01	9.4 - 610
NAPHTHALENE	2/23	0.9 J	1.1 J	57SB02	57SB02-01	9.4 - 610
PHENANTHRENE	5/23	2.2 J	9.2 J	57SB04	57SB04-01	9.4 - 610
PYRENE	4/23	1.1 J	28 J	3E-06, 57SB04	3E-SB06-01, 57SB04-01	9.4 - 460
Semivolatile Organics (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	6/23	56 J	140 J	57SB03	57SB03-01	200 - 610

TABLE 4-5

FREQUENCY OF DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Volatile Organics (µg/kg)						
ACETONE	6/23	240 J	610 J	57SB19	57SB19-0103	17 - 2100
BENZENE	1/23	2 J	2 J	57SB20	57SB20-0103	2.3 - 210
BROMOMETHANE	2/23	1.1 J	1.9 J	57SB15	57SB15-0103	4.6 - 210
CARBON DISULFIDE	2/23	1 J	2.5 J	57SB19	57SB19-0103	2.3 - 210
CARBON TETRACHLORIDE	1/23	2.8 J	2.8 J	3E-02	3E-SB02-01	2.3 - 210
CHLOROFORM	1/23	1.8 J	1.8 J	3E-02	3E-SB02-01	2.3 - 210
METHYL IODIDE	1/23	2.8 J	2.8 J	57SB18	57SB18-0103	2.4 - 210
Petroleum Hydrocarbons (mg/kg)						
DIESEL RANGE ORGANICS	6/7	3.5 J	11 J	57SB07	57SB07-01	10 - 10
TOTAL PETROLEUM HYDROCARBONS	6/7	4.13 J	11.66 J	57SB07	57SB07-01	10.64 - 10.64

µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
J = Value is estimated.
N = The matrix spike recovery is not within control limtis.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB13** **57SB13-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB14** **57SB14-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB15** **57SB15-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB16** **57SB16-0103** **20120606** **NORMAL** **SO** **1** **3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	0.15 J	0.08 J	0.03 J	0.1 J
ARSENIC	0.61	2.4	17	3.15	***2.5 J***	0.54	**0.94**	**1.2**
BARIUM	15000	190000	330	347	39.9 J	195	148	103
BERYLLIUM	160	2000	10	0.672	0.14 J	0.48 J	0.47 J	0.45 J
CADMIUM	70	800	0.77	0.603	0.29 J	0.03 J	0.06 J	0.47
CHROMIUM [(1)]	12000	1500000	0.4	167	13.8	29.5 J	28.8 J	37.6 J
COBALT	23	300	13	49.8	5.7 J	**26.5**	20.8	**60**
COPPER	3100	41000	28	280	40.1 J	76.8	91.1	70.8
LEAD	400	800	11	6.97	15.9 J	6.8 J	26.9 J	31.5 J
MERCURY	10	43	0.013	0.119	0.02 U	0.015 U	0.07	0.08
NICKEL	1500	20000	38	34.1	6.5 J	18.2 J	10.4 J	16.3 J
SELENIUM	390	5100	0.52	2.57	0.47 J	0.95	0.78	1.5
SILVER	390	5100	4.2	NC	0.03 J	0.02 J	0.18	0.22
THALLIUM	0.78	10	0.0569	0.27	0.03 J	0.02 J	0.02 J	0.05 J
TIN	47000	610000	7.62	3.48	1.9 U	3 U	3 U	3 U
VANADIUM	390	5100	7.8	482	47.6	183	190	209
ZINC	23000	310000	46	111	37.5	87.8 J	65.2 J	70.1 J
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	8.2 UJ	10 U	11 UJ	9.1 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	10 U	11 U	12 U	12 U
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	11 U	12 U	12 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	10 U	11 U	12 U	12 U
ANTHRACENE	17000000	170000000	2500	NC	10 U	11 U	12 U	12 U
BENZO(A)ANTHRACENE	150	2100	800	NC	10 UJ	11 UJ	12 UJ	12 U
BENZO(A)PYRENE	15	210	18000	NC	10 UJ	11 U	12 U	12 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	10 U	11 U	12 U	12 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 U	11 U	12 U	12 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	10 U	11 U	12 U	12 U
CHRYSENE	15000	210000	18000	NC	10 U	11 U	12 U	12 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 U	11 U	12 U	12 U
FLUORANTHENE	2300000	22000000	29000	NC	10 U	11 U	12 U	12 U
FLUORENE	2300000	22000000	29000	NC	10 U	11 U	12 U	12 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 U	11 U	12 U	12 U
NAPHTHALENE	3600	18000	1000	NC	10 U	11 U	12 U	12 U
PHENANTHRENE	1700000	17000000	29000	NC	10 U	11 U	12 U	12 U
PYRENE	1700000	17000000	18000	NC	10 U	11 UJ	12 UJ	12 U
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	250 U	270 U	300 U	290 U
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	85 U	31 U	130 U	250 J
BENZENE	1100	5400	255	NC	2.4 UJ	2.5 UJ	2.5 UJ	2.4 UJ

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB13** **57SB13-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB14** **57SB14-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB15** **57SB15-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB16** **57SB16-0103** **20120606** **NORMAL** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	4.8 UJ	5 UJ	1.9 J	1.1 J
CARBON DISULFIDE	820000	3700000	94.1	NC	2.4 UJ	2.5 UJ	2.5 UJ	2.4 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	2.4 UJ	2.5 UJ	2.5 UJ	2.4 UJ
CHLOROFORM	290	1500	8000	NC	2.4 UJ	2.5 UJ	2.5 UJ	2.4 UJ
METHYL IODIDE	NC	NC	NC	NC	2.4 UJ	2.5 UJ	2.5 UJ	2.4 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB17** **57SB17-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB18** **57SB18-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB19** **57SB19-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB20** **57SB20-0103** **20120607** **NORMAL** **SO** **1** **3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	0.1 J	0.96 J	0.05 J	0.05 J
ARSENIC	0.61	2.4	17	3.15	**0.7**	**2.4 J**	**0.71 J**	**2.1**
BARIUM	15000	190000	330	347	197	165 J	31 J	39.2 J
BERYLLIUM	160	2000	10	0.672	0.43 J	0.16 J	0.22 J	0.08 J
CADMIUM	70	800	0.77	0.603	0.2	0.67 J	1.4 J	0.05 J
CHROMIUM [(1)]	12000	1500000	0.4	167	27.3 J	46.5	28.3	6.4
COBALT	23	300	13	49.8	14.6	12.3 J	15.1 J	3.1 J
COPPER	3100	41000	28	280	119	55.5 J	70.6 J	17.9 J
LEAD	400	800	11	6.97	58.2 J	238 J	2.4 J	1.7 J
MERCURY	10	43	0.013	0.119	0.02 U	0.05	0.04	0.007 J
NICKEL	1500	20000	38	34.1	13.8 J	9.3 J	18.7 J	2.5 J
SELENIUM	390	5100	0.52	2.57	0.68	0.46 J	0.23 J	0.27 J
SILVER	390	5100	4.2	NC	0.08	0.04 J	0.01 J	0.01 J
THALLIUM	0.78	10	0.0569	0.27	0.03 J	0.03 J	0.02 J	0.01 J
TIN	47000	610000	7.62	3.48	2.2 U	17.6	1.6 U	2 U
VANADIUM	390	5100	7.8	482	191	91.4	132	30.5
ZINC	23000	310000	46	111	115 J	154	113	14.5
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	9.3 UJ	9.2 UJ	9 UJ	8.5 UJ
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	11 U	11 U	11 U	9.4 U
ACENAPHTHENE	3400000	33000000	20000	NC	11 U	11 U	11 U	9.4 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	11 U	11 U	11 U	9.4 U
ANTHRACENE	17000000	170000000	2500	NC	11 U	11 U	11 U	9.4 U
BENZO(A)ANTHRACENE	150	2100	800	NC	11 UJ	11 UJ	11 U	9.4 U
BENZO(A)PYRENE	15	210	18000	NC	11 U	11 UJ	11 UJ	9.4 UJ
BENZO(B)FLUORANTHENE	150	2100	18000	NC	11 U	11 U	11 U	9.4 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	11 U	11 UJ	11 U	9.4 UJ
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	11 U	11 U	11 U	9.4 U
CHRYSENE	15000	210000	18000	NC	11 U	11 U	11 U	9.4 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	11 U	11 U	11 U	9.4 UJ
FLUORANTHENE	2300000	22000000	29000	NC	11 U	11 U	11 U	2.8 J
FLUORENE	2300000	22000000	29000	NC	11 U	11 U	11 U	9.4 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	11 U	11 U	11 U	9.4 U
NAPHTHALENE	3600	18000	1000	NC	11 U	11 U	11 U	9.4 U
PHENANTHRENE	1700000	17000000	29000	NC	11 U	11 U	11 U	9.4 U
PYRENE	1700000	17000000	18000	NC	11 UJ	11 UJ	11 U	9.4 U
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	280 U	270 U	270 U	230 U
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	33 U	390 J	610 J	240 J
BENZENE	1100	5400	255	NC	3 UJ	2.3 UJ	3 UJ	2 J

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB17** **57SB17-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB18** **57SB18-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB19** **57SB19-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB20** **57SB20-0103** **20120607** **NORMAL** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	6 UJ	4.6 UJ	6 UJ	5.5 UJ
CARBON DISULFIDE	820000	3700000	94.1	NC	3 UJ	2.3 UJ	2.5 J	2.8 UJ
CARBON TETRACHLORIDE	610	3000	1000000	NC	3 UJ	2.3 UJ	3 UJ	2.8 UJ
CHLOROFORM	290	1500	8000	NC	3 UJ	2.3 UJ	3 UJ	2.8 UJ
METHYL IODIDE	NC	NC	NC	NC	3 UJ	2.8 J	3 UJ	2.8 UJ
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB21** **57SB21-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB34** **57SB34-0103** **20120608** **NORMAL** **SO** **1** **3**	**57SB01** **57SB01-01** **20100128** **NORMAL** **SO** **1** **3**	**57SB02** **57SB02-01** **20100126** **NORMAL** **SO** **1** **3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	0.07 J	0.2 J	0.79 U	2.1 J
ARSENIC	0.61	2.4	17	3.15	**0.81 J**	**1.8**	**1.2 J**	**2.4**
BARIUM	15000	190000	330	347	63.6 J	125 J	79.3 J	290
BERYLLIUM	160	2000	10	0.672	0.45 J	0.26 J	0.44 J	0.61
CADMIUM	70	800	0.77	0.603	0.2 J	4.7 J	0.71	0.17 U
CHROMIUM [(1)]	12000	1500000	0.4	167	30	32.6	33.4	30.3
COBALT	23	300	13	49.8	**49.6 J**	**25.1 J**	**37.5**	**97**
COPPER	3100	41000	28	280	61.6 J	73.7 J	81.3	95.3 J
LEAD	400	800	11	6.97	76 J	63.6 J	27.7	44.1 J
MERCURY	10	43	0.013	0.119	0.03 J	0.04	0.067	0.021 U
NICKEL	1500	20000	38	34.1	11.6 J	16.2 J	14.3	25.9
SELENIUM	390	5100	0.52	2.57	1 J	0.78	0.44 J	0.44 R
SILVER	390	5100	4.2	NC	0.12	0.09	0.12 U	0.33 J
THALLIUM	0.78	10	0.0569	0.27	0.04 J	0.04 J	***10.2***	**8.6**
TIN	47000	610000	7.62	3.48	2.3 U	2.9 U	2 J	0.62 U
VANADIUM	390	5100	7.8	482	170	136	217	237
ZINC	23000	310000	46	111	58.5	162	58	96.2
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	8.8 UJ	30 J	38 U	38 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	11 U	10 U	1.2 J	10 U
ACENAPHTHENE	3400000	33000000	20000	NC	11 U	10 U	11 U	10 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	11 U	10 U	11 UJ	10 U
ANTHRACENE	17000000	170000000	2500	NC	11 U	10 U	0.68 J	10 U
BENZO(A)ANTHRACENE	150	2100	800	NC	11 U	2 J	1.5 J	10 U
BENZO(A)PYRENE	15	210	18000	NC	11 UJ	10 UJ	0.74 J	10 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	11 U	7.3 J	0.89 J	0.74 J
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	11 U	4 J	11 UJ	10 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	11 U	10 U	0.8 J	10 U
CHRYSENE	15000	210000	18000	NC	11 U	10 U	1.6 J	10 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	11 U	10 U	11 U	10 U
FLUORANTHENE	2300000	22000000	29000	NC	11 U	4.5 J	11 U	1.9 J
FLUORENE	2300000	22000000	29000	NC	11 U	10 U	11 UJ	10 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	11 U	2.6 J	0.5 J	10 U
NAPHTHALENE	3600	18000	1000	NC	11 U	10 U	11 UJ	1.1 J
PHENANTHRENE	1700000	17000000	29000	NC	11 U	3.1 J	2.2 J	2.9 J
PYRENE	1700000	17000000	18000	NC	11 U	5.6 J	11 U	1.1 J
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	270 U	130 J	58 J	60 J
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	280 J	310 J	19 U	22 U
BENZENE	1100	5400	255	NC	3 UJ	3 UJ	4.4 U	5.3 U

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB21** **57SB21-0103** **20120607** **NORMAL** **SO** **1** **3**	**57SB34** **57SB34-0103** **20120608** **NORMAL** **SO** **1** **3**	**57SB01** **57SB01-01** **20100128** **NORMAL** **SO** **1** **3**	**57SB02** **57SB02-01** **20100126** **NORMAL** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	6 UJ	6 UJ	6.5 U	7.7 U
CARBON DISULFIDE	820000	3700000	94.1	NC	3 UJ	1 J	4.4 U	5.3 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	3 UJ	3 UJ	4.4 U	5.3 U
CHLOROFORM	290	1500	8000	NC	3 UJ	3 UJ	4.4 U	5.3 U
METHYL IODIDE	NC	NC	NC	NC	3 UJ	3 UJ	4.4 U	5.3 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	10 U	3.5 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	10.64 U	4.13 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION					**57SB03**	**57SB04**	**57SB05**	
SAMPLE ID	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB03-01**	**57SB04-01**	**57SB05-01**	**57SB05-01-D**
SAMPLE DATE					**20100126**	**20100128**	**20100127**	**20100127**
SAMPLE CODE					**NORMAL**	**NORMAL**	**ORIG**	**DUP**
MATRIX					**SO**	**SO**	**SO**	**SO**
TOP DEPTH (feet)					**1**	**1**	**1**	**1**
BOTTOM DEPTH (feet)					**3**	**3**	**3**	**3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	1.4 J	1.2 J	1 J	1.7 J
ARSENIC	0.61	2.4	17	3.15	**1.5**	**1 J**	**0.97 J**	**1.7 J**
BARIUM	15000	190000	330	347	97.2	36.7	131 J	228 J
BERYLLIUM	160	2000	10	0.672	0.53 U	0.41 U	0.4 U	0.61 U
CADMIUM	70	800	0.77	0.603	0.19 U	0.12 U	0.7	0.81
CHROMIUM (1)	12000	1500000	0.4	167	30.6	23.1	24.9	30
COBALT	23	300	13	49.8	**33.6**	12.9	**43.2**	**73.9**
COPPER	3100	41000	28	280	76.6 J	56.2 J	52.9 J	68.7 J
LEAD	400	800	11	6.97	21.2 J	16.5 J	39.6 J	56 J
MERCURY	10	43	0.013	0.119	0.021 U	0.019 U	0.11 J	0.061 J
NICKEL	1500	20000	38	34.1	13.6	10.8	17.9	14.2
SELENIUM	390	5100	0.52	2.57	0.47 R	0.41 R	0.4 R	0.46 R
SILVER	390	5100	4.2	NC	0.24 J	0.19 J	0.37 J	0.43 J
THALLIUM	0.78	10	0.0569	0.27	**2**	**2**	**3.5**	**5**
TIN	47000	610000	7.62	3.48	1.9 J	1.7 J	0.91 J	1.6 J
VANADIUM	390	5100	7.8	482	225	155	172	220
ZINC	23000	310000	46	111	55.4	35.1	59.3	77
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	39 U	37 U	35 U	39 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	NA	NA
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	11 U	3.4 J	9.8 U	11 U
ACENAPHTHENE	3400000	33000000	20000	NC	11 U	1.3 J	9.8 U	11 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	11 U	6.8 J	9.8 U	11 U
ANTHRACENE	17000000	170000000	2500	NC	11 U	4.2 J	9.8 U	11 U
BENZO(A)ANTHRACENE	150	2100	800	NC	11 U	20	9.8 U	11 U
BENZO(A)PYRENE	15	210	18000	NC	11 U	**17**	9.8 U	11 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	11 U	9.6 J	9.8 U	11 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	11 U	5.7 J	9.8 U	11 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	11 U	11	9.8 U	11 U
CHRYSENE	15000	210000	18000	NC	11 U	20	9.8 U	11 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	11 U	1.8 J	9.8 U	11 U
FLUORANTHENE	2300000	22000000	29000	NC	11 U	18	9.8 U	11 U
FLUORENE	2300000	22000000	29000	NC	11 U	1.6 J	9.8 U	11 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	11 U	7 J	9.8 U	11 U
NAPHTHALENE	3600	18000	1000	NC	11 U	10 UJ	0.9 J	11 U
PHENANTHRENE	1700000	17000000	29000	NC	11 U	9.2 J	9.8 U	11 U
PYRENE	1700000	17000000	18000	NC	11 U	28	9.8 U	11 U
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	140 J	56 J	200 U	220 U
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	21 U	17 U	18 U	22 U
BENZENE	1100	5400	255	NC	5.1 U	4 U	4.3 U	5.2 U

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB03** **57SB03-01** **20100126** **NORMAL** **SO** **1** **3**	**57SB04** **57SB04-01** **20100128** **NORMAL** **SO** **1** **3**	**57SB05** **57SB05-01** **20100127** **ORIG** **SO** **1** **3**	**57SB05** **57SB05-01-D** **20100127** **DUP** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	7.4 U	5.8 U	6.2 U	7.5 U
CARBON DISULFIDE	820000	3700000	94.1	NC	5.1 U	4 U	4.3 U	5.2 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	5.1 U	4 U	4.3 U	5.2 U
CHLOROFORM	290	1500	8000	NC	5.1 U	4 U	4.3 U	5.2 U
METHYL IODIDE	NC	NC	NC	NC	5.1 U	4 U	4.3 U	5.2 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	6.7 J	4.2 J	7.9 J	6.5 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	7.36 J	4.81 J	8.49 J	7.16 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB06** **57SB06-01** **20100128** **NORMAL** **SO** **1** **3**	**57SB07** **57SB07-01** **20100127** **NORMAL** **SO** **1** **3**	**3E-01** **3E-SB01-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-02** **3E-SB02-01** **20040505** **NORMAL** **SO** **1** **3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	0.97 J	1.4 J	2.5 UN	2.7 UN
ARSENIC	0.61	2.4	17	3.15	**0.77 J**	**1.1 J**	**2**	**1.1 B**
BARIUM	15000	190000	330	347	47.2	115	120	93
BERYLLIUM	160	2000	10	0.672	0.39 U	0.57 U	0.43 B	0.48 B
CADMIUM	70	800	0.77	0.603	0.44 U	0.22 U	0.48 B	0.4 B
CHROMIUM [(1)]	12000	1500000	0.4	167	21.9	29.3	24	29
COBALT	23	300	13	49.8	**34.4**	**38**	12	**28**
COPPER	3100	41000	28	280	67.5 J	74.6 J	94 N	84 N
LEAD	400	800	11	6.97	17.4 J	20.3 J	71	18
MERCURY	10	43	0.013	0.119	0.043	0.05	0.052 SN	0.029 BSN
NICKEL	1500	20000	38	34.1	16.2	13.5	6.9	12
SELENIUM	390	5100	0.52	2.57	0.43 R	0.47 R	1.3 U	1.3 U
SILVER	390	5100	4.2	NC	0.42 J	0.18 J	1.3 U	1.3 U
THALLIUM	0.78	10	0.0569	0.27	**2**	**2.3**	1.3 U	1.3 U
TIN	47000	610000	7.62	3.48	1.1 J	1.7 J	2.2 B	2.8 B
VANADIUM	390	5100	7.8	482	149	184	190	220
ZINC	23000	310000	46	111	69.3	70.1	78	62
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	37 U	34 J	44 U	46 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	NA	NA	11 U	12 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	1.1 J	11 U	440 U	460 U
ACENAPHTHENE	3400000	33000000	20000	NC	10 U	11 U	440 U	460 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	0.98 J	11 U	440 U	460 U
ANTHRACENE	17000000	170000000	2500	NC	1.3 J	11 U	440 U	460 U
BENZO(A)ANTHRACENE	150	2100	800	NC	3 J	11 U	440 U	460 U
BENZO(A)PYRENE	15	210	18000	NC	10 U	11 U	440 U	460 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	10 U	11 U	440 U	460 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	10 UJ	11 U	440 U	460 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	10 U	11 U	440 U	460 U
CHRYSENE	15000	210000	18000	NC	2.9 J	11 U	440 U	460 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	10 U	11 U	440 U	460 U
FLUORANTHENE	2300000	22000000	29000	NC	10 U	11 U	440 U	460 U
FLUORENE	2300000	22000000	29000	NC	10 UJ	11 U	440 U	460 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	10 U	11 U	440 U	460 U
NAPHTHALENE	3600	18000	1000	NC	10 UJ	11 U	440 U	460 U
PHENANTHRENE	1700000	17000000	29000	NC	3.1 J	11 U	440 U	460 U
PYRENE	1700000	17000000	18000	NC	10 U	11 U	440 U	460 U
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	58 J	220 U	440 U	460 U
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	19 U	20 U	61 U	61 U
BENZENE	1100	5400	255	NC	4.5 U	4.6 U	6.1 U	6.1 U

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB06** **57SB06-01** **20100128** **NORMAL** **SO** **1** **3**	**57SB07** **57SB07-01** **20100127** **NORMAL** **SO** **1** **3**	**3E-01** **3E-SB01-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-02** **3E-SB02-01** **20040505** **NORMAL** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	6.6 U	6.7 U	6.1 U	6.1 U
CARBON DISULFIDE	820000	3700000	94.1	NC	4.5 U	4.6 U	6.1 U	6.1 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	4.5 U	4.6 U	6.1 U	2.8 J
CHLOROFORM	290	1500	8000	NC	4.5 U	4.6 U	6.1 U	1.8 J
METHYL IODIDE	NC	NC	NC	NC	4.5 U	4.6 U	6.1 U	6.1 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	4.7 J	11 J	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	5.32 J	11.66 J	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**3E-03** **3E-SB03-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-04** **3E-SB04-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-05** **3E-SB05-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-06** **3E-SB06-01** **20040505** **NORMAL** **SO** **1** **3**
INORGANICS (mg/kg)								
ANTIMONY	31	410	5	NC	2.1 UN	2 UN	2 UN	3.6 UN
ARSENIC	0.61	2.4	17	3.15	1 U	0.98 U	1 U	1.8 U
BARIUM	15000	190000	330	347	29	25	42	150
BERYLLIUM	160	2000	10	0.672	0.21 B	0.29 B	0.23 B	0.41 B
CADMIUM	70	800	0.77	0.603	0.69	1.9	0.96	0.91 U
CHROMIUM (1)	12000	1500000	0.4	167	110	28	14	21
COBALT	23	300	13	49.8	**32**	**29**	22	**33**
COPPER	3100	41000	28	280	120 N	120 N	95 N	60 N
LEAD	400	800	11	6.97	1.5	20	7.3	19
MERCURY	10	43	0.013	0.119	0.034 SN	0.02 UN	0.021 UN	0.033 UN
NICKEL	1500	20000	38	34.1	37	25	18	11
SELENIUM	390	5100	0.52	2.57	1 U	2 U	1 U	1.8 U
SILVER	390	5100	4.2	NC	1 U	0.12 B	1 U	1.8 U
THALLIUM	0.78	10	0.0569	0.27	1 U	0.98 U	1 U	1.8 U
TIN	47000	610000	7.62	3.48	2.7 B	2.1 B	2.9 B	2 B
VANADIUM	390	5100	7.8	482	140	180	140	140
ZINC	23000	310000	46	111	60	150	75	57
PCBS (µg/kg)								
AROCLOR-1260	220	740	0.332	NC	39 U	38 U	37 U	61 U
HERBICIDES (µg/kg)								
2,4,5-TP (SILVEX)	490000	4900000	109	NC	9.8 U	4.1 J	9.3 U	15 U
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)								
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	390 U	380 U	370 U	610 U
ACENAPHTHENE	3400000	33000000	20000	NC	390 U	380 U	370 U	610 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	390 U	380 U	370 U	610 U
ANTHRACENE	17000000	170000000	2500	NC	390 U	380 U	370 U	610 U
BENZO(A)ANTHRACENE	150	2100	800	NC	390 U	380 U	370 U	610 U
BENZO(A)PYRENE	15	210	18000	NC	390 U	380 U	370 U	610 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	390 U	380 U	370 U	610 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	390 U	380 U	370 U	610 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	390 U	380 U	370 U	610 U
CHRYSENE	15000	210000	18000	NC	390 U	380 U	370 U	610 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	390 U	380 U	370 U	610 U
FLUORANTHENE	2300000	22000000	29000	NC	390 U	380 U	370 U	610 U
FLUORENE	2300000	22000000	29000	NC	390 U	380 U	370 U	610 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	390 U	380 U	370 U	610 U
NAPHTHALENE	3600	18000	1000	NC	390 U	380 U	370 U	610 U
PHENANTHRENE	1700000	17000000	29000	NC	390 U	380 U	370 U	610 U
PYRENE	1700000	17000000	18000	NC	390 U	380 U	370 U	28 J
SEMIVOLATILES ORGANICS (µg/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	390 U	380 U	370 U	610 U
VOLATILES ORGANICS (µg/kg)								
ACETONE	61000000	630000000	2500	NC	53 U	2100 U	55 U	91 U
BENZENE	1100	5400	255	NC	5.3 U	210 U	5.5 U	9.1 U

TABLE 4-6

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, 1 TO 3 FEET BGS
COMPARISON TO HUMAN HEALTH AND ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**3E-03** **3E-SB03-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-04** **3E-SB04-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-05** **3E-SB05-01** **20040505** **NORMAL** **SO** **1** **3**	**3E-06** **3E-SB06-01** **20040505** **NORMAL** **SO** **1** **3**
BROMOMETHANE	7300	32000	NC	NC	5.3 U	210 U	5.5 U	9.1 U
CARBON DISULFIDE	820000	3700000	94.1	NC	5.3 U	210 U	5.5 U	9.1 U
CARBON TETRACHLORIDE	610	3000	1000000	NC	5.3 U	210 U	5.5 U	9.1 U
CHLOROFORM	290	1500	8000	NC	5.3 U	210 U	5.5 U	9.1 U
METHYL IODIDE	NC	NC	NC	NC	5.3 U	210 U	5.5 U	9.1 U
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
UN = Analyte not detected at the reported detection limit; matrix spike recovery is not within control limits.
J = Value is estimated.
N = The matrix spike recovery is not within control limits.
B = The reported result is an estimated concentration (inorganics only).
S = The result was determined by Method of Standard Addition.
P = The gas chromatography or high performance liquid chromatography confirmation criterion was exceeded.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-7

FREQUENCY OF DETECTIONS IN SUBSURFACE SOIL, GREATER THAN 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Inorganics (mg/kg)						
ANTIMONY	11/12	0.03 J	1.7 J	57SB02	57SB02-05	0.78 - 0.78
ARSENIC	11/12	0.35 J	1.4	57SB04	57SB04-05	0.77 - 0.77
BARIUM	12/12	10.4 J	1240	57SB04	57SB04-05	-
BERYLLIUM	8/12	0.18 J	2.5 J	57SB16	57SB16-0911	0.02 - 0.24
CADMIUM	7/12	0.03 J	1.8	57SB17	57SB17-1315	0.11 - 0.35
CHROMIUM	12/12	10.1	50.4	57SB02	57SB02-05	-
COBALT	12/12	13.8	301	57SB16	57SB16-0911	-
COPPER	12/12	38.4 J	207	57SB16	57SB16-0911	-
LEAD	12/12	0.92 J	15.2	57SB01	57SB01-05	-
NICKEL	12/12	8.2	41.4	57SB04	57SB04-05	-
SELENIUM	6/6	0.06 J	0.54 J	57SB18	57SB18-1012	-
SILVER	11/12	0.02 J	0.4 J	57SB04	57SB04-05	0.12 - 0.12
THALLIUM	10/12	0.01 J	7.3	57SB04	57SB04-05	0.036 - 0.045
TIN	7/12	0.72 J	1.7 J	57SB04	57SB04-05	2 - 3.3
VANADIUM	12/12	121	263	57SB04	57SB04-05	-
ZINC	12/12	70.6	414 J	57SB16	57SB16-0911	-
Polynuclear Aromatic Hydrocarbons (µg/kg)						
2-METHYLNAPHTHALENE	2/12	0.94 J	2.8 J	57SB01	57SB01-05	9.3 - 13
ACENAPHTHENE	1/12	0.79 J	0.79 J	57SB01	57SB01-05	9.3 - 13
ACENAPHTHYLENE	2/12	0.7 J	1.4 J	57SB01	57SB01-05	9.3 - 13
ANTHRACENE	2/12	0.8 J	2.1 J	57SB01	57SB01-05	9.3 - 13
BENZO(A)ANTHRACENE	4/12	0.96 J	4.2 J	57SB01	57SB01-05	9.3 - 13
BENZO(A)PYRENE	3/12	0.59 J	3.1 J	57SB01	57SB01-05	9.3 - 13
BENZO(B)FLUORANTHENE	3/12	1 J	7.6 J	57SB14	57SB14-0911	9.3 - 13
BENZO(G,H,I)PERYLENE	2/12	1 J	5.1 J	57SB14	57SB14-0911	9.3 - 13
BENZO(K)FLUORANTHENE	3/12	0.65 J	2.3 J	57SB01	57SB01-05	9.3 - 13
CHRYSENE	3/12	1.1 J	4.2 J	57SB01	57SB01-05	9.3 - 13
DIBENZO(A,H)ANTHRACENE	1/12	2.8 J	2.8 J	57SB14	57SB14-0911	9.3 - 13
FLUORENE	1/12	0.93 J	0.93 J	57SB01	57SB01-05	9.3 - 13
INDENO(1,2,3-CD)PYRENE	2/12	1.3 J	4.8 J	57SB14	57SB14-0911	9.3 - 13
NAPHTHALENE	2/12	0.92 J	0.96 J	57SB05	57SB05-05	9.7 - 13
PHENANTHRENE	2/12	2.3 J	5 J	57SB01	57SB01-05	9.3 - 13
Semivolatile Organics (µg/kg)						
BIS(2-ETHYLHEXYL)PHTHALATE	3/12	60 J	270	57SB06	57SB06-05	190 - 330
Petroleum Hydrocarbons (mg/kgG)						
DIESEL RANGE ORGANICS	5/7	3.7 J	10 J	57SB07	57SB07-05	10 - 11
TOTAL PETROLEUM HYDROCARBONS	5/7	4.37 J	10.61 J	57SB07	57SB07-05	10.64 - 11.56

µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
J = Value is estimated.

TABLE 4-8

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, GREATER THAN 3 FEET BGS
COMPARISON TO HUMAN HEALTH SAND ECOLOGICAL CREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB14** **57SB14-0911** **20120607** **NORMAL** **SO** **9** **11**	**57SB15** **57SB15-1315** **20120607** **NORMAL** **SO** **13** **15**	**57SB16** **57SB16-0911** **20120606** **NORMAL** **SO** **9** **11**	**57SB17** **57SB17-1315** **20120607** **NORMAL** **SO** **13** **15**	**57SB18** **57SB18-1012** **20120607** **NORMAL** **SO** **10** **12**	**57SB01** **57SB01-05** **20100128** **NORMAL** **SO** **9** **11**	**57SB02** **57SB02-05** **20100126** **NORMAL** **SO** **9** **11**
INORGANICS (mg/kg)											
ANTIMONY	31	410	5	NC	0.04 J	0.05 J	0.03 J	0.05 J	0.05 J	0.78 U	1.7 J
ARSENIC	0.61	2.4	17	3.15	0.4 J	0.57	**0.62**	0.35 J	0.38 J	0.77 U	0.4 J
BARIUM	15000	190000	330	347	38.2	121	310	27.2	274 J	10.4 J	21.8
BERYLLIUM	160	2000	10	0.672	0.18 J	0.86 J	2.5 J	0.24 J	0.59 J	0.44 J	0.02 U
CADMIUM	70	800	0.77	0.603	0.06 J	0.15	0.44	1.8	0.03 J	0.3 J	0.11 U
CHROMIUM (1)	120000	1500000	0.4	167	26.2 J	13.4 J	16.3 J	34.7 J	29.4	10.1	50.4
COBALT	23	300	13	49.8	**27**	14.6	***301***	21.3	**61 J**	18.2	**28.8**
COPPER	3100	41000	28	280	72.7	134	207	79.8	38.4 J	83.4	81.6 J
LEAD	400	800	11	6.97	1.5 J	0.92 J	3.1 J	2.4 J	2.1 J	15.2	3.3 J
NICKEL	1500	20000	38	34.1	21.6 J	11.9 J	32.7 J	22.9 J	21 J	8.2	30.5
SELENIUM	390	5100	0.52	2.57	0.06 J	0.16 J	0.47 J	0.28 J	0.54 J	0.36 J	0.37 R
SILVER	390	5100	4.2	NC	0.02 J	0.04 J	0.04 J	0.02 J	0.03 J	0.12 U	0.25 J
THALLIUM	0.78	10	0.0569	0.27	0.045 U	0.01 J	0.02 J	0.01 J	0.036 U	**6.1**	**4.6**
TIN	47000	610000	7.62	3.48	3.3 U	2.7 U	3.1 U	2 U	3 U	1.4 J	1.3 J
VANADIUM	390	5100	7.8	482	175	190	257	146	195	129	193
ZINC	23000	310000	46	111	83.9 J	203 J	414 J	124 J	100	223	78.9
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)											
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	12 U	12 U	13 U	11 U	12 U	2.8 J	9.3 U
ACENAPHTHENE	3400000	33000000	20000	NC	12 U	12 U	13 U	11 U	12 U	0.79 J	9.3 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	12 U	12 U	13 U	11 U	12 U	1.4 J	9.3 U
ANTHRACENE	17000000	170000000	2500	NC	12 U	12 U	13 U	11 U	12 U	2.1 J	9.3 U
BENZO(A)ANTHRACENE	150	2100	800	NC	2.8 J	12 UJ	13 U	11 UJ	12 UJ	4.2 J	9.3 U
BENZO(A)PYRENE	15	210	18000	NC	12 U	12 U	13 U	11 U	12 UJ	3.1 J	9.3 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	7.6 J	12 U	13 U	11 U	12 U	1.9 J	9.3 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	5.1 J	12 U	13 U	11 U	12 UJ	1 J	9.3 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	12 U	12 U	13 U	11 U	12 U	2.3 J	9.3 U
CHRYSENE	15000	210000	18000	NC	12 U	12 U	13 U	11 U	12 U	4.2 J	9.3 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	2.8 J	12 U	13 U	11 U	12 U	11 U	9.3 U
FLUORENE	2300000	22000000	29000	NC	12 U	12 U	13 U	11 U	12 U	0.93 J	9.3 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	4.8 J	12 U	13 U	11 U	12 U	1.3 J	9.3 U
NAPHTHALENE	3600	18000	1000	NC	12 U	12 U	13 U	11 U	12 U	11 UJ	0.92 J
PHENANTHRENE	1700000	17000000	29000	NC	12 U	12 U	13 U	11 U	12 U	5 J	9.3 U
SEMIVOLATILES ORGANICS (µg/kg)											
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	330 U	300 U	320 U	270 U	300 U	100 J	190 U
PETROLEUM HYDROCARBONS (mg/kg)											
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	NA	NA	NA	NA	NA	10 U	11 U
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	NA	NA	NA	NA	NA	10.64 U	11.56 U

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
J = Value is estimated.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-8

SUMMARY OF POSITIVE DETECTIONS IN SUBSURFACE SOIL, GREATER THAN 3 FEET BGS
COMPARISON TO HUMAN HEALTH SAND ECOLOGICAL CREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO
PAGE 2 OF 2

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX** **TOP DEPTH (feet)** **BOTTOM DEPTH (feet)**	**RESIDENTIAL RSL**	*INDUSTRIAL RSL*	ECOLOGICAL SCREENING CRITERIA	NAPR Facility Subsurface Soil Clay BTVs	**57SB03** **57SB03-05** **20100126** **NORMAL** **SO** **9** **11**	**57SB04** **57SB04-05** **20100128** **NORMAL** **SO** **9** **11**	**57SB05** **57SB05-05** **20100127** **NORMAL** **SO** **9** **11**	**57SB06** **57SB06-05** **20100128** **NORMAL** **SO** **9** **11**	**57SB07** **57SB07-05** **20100127** **NORMAL** **SO** **9** **11**
INORGANICS (mg/kg)									
ANTIMONY	31	410	5	NC	1.2 J	1.3 J	1.2 J	1.5 J	1.4 J
ARSENIC	0.61	2.4	17	3.15	0.52 J	**1.4**	0.42 J	**1.1 J**	0.55 J
BARIUM	15000	190000	330	347	72.8	1240	81.3	302	10.7 J
BERYLLIUM	160	2000	10	0.672	0.23 U	0.92	0.24 U	1.2	0.21 U
CADMIUM	70	800	0.77	0.603	0.15 U	0.35 U	0.2 U	0.63	0.27 U
CHROMIUM (1)	120000	1500000	0.4	167	15.4	44.9	22.3	10.8	21.4
COBALT	23	300	13	49.8	**23.7**	**149**	**33**	**104**	13.8
COPPER	3100	41000	28	280	87.3 J	104 J	72.8 J	147 J	58.7 J
LEAD	400	800	11	6.97	5.7 J	5.3 J	4.5 J	7.4 J	5.7 J
NICKEL	1500	20000	38	34.1	15.5	41.4	25.8	17	18.7
SELENIUM	390	5100	0.52	2.57	0.45 R	0.47 R	0.45 R	0.41 R	0.42 R
SILVER	390	5100	4.2	NC	0.26 J	0.4 J	0.14 J	0.22 J	0.12 J
THALLIUM	0.78	10	0.0569	0.27	**2.8**	**7.3**	**3.4**	**4.1**	**1.9**
TIN	47000	610000	7.62	3.48	1.3 J	1.7 J	1.6 J	0.72 J	0.92 J
VANADIUM	390	5100	7.8	482	198	263	136	215	121
ZINC	23000	310000	46	111	70.6	92	98.9	246	103
POLYNUCLEAR AROMATIC HYDROCARBONS (µg/kg)									
2-METHYLNAPHTHALENE	230000	2200000	29000	NC	11 U	11 U	10 U	0.94 J	10 U
ACENAPHTHENE	3400000	33000000	20000	NC	11 U	11 U	10 U	9.7 U	10 U
ACENAPHTHYLENE	3400000	33000000	20000	NC	11 U	11 UJ	10 U	0.7 J	10 U
ANTHRACENE	17000000	170000000	2500	NC	11 U	11 UJ	10 U	0.8 J	10 U
BENZO(A)ANTHRACENE	150	2100	800	NC	11 U	0.96 J	10 U	1.6 J	10 U
BENZO(A)PYRENE	15	210	18000	NC	11 U	0.59 J	10 U	0.93 J	10 U
BENZO(B)FLUORANTHENE	150	2100	18000	NC	11 U	11 U	10 U	1 J	10 U
BENZO(G,H,I)PERYLENE	1700000	17000000	18000	NC	11 U	11 UJ	10 U	9.7 UJ	10 U
BENZO(K)FLUORANTHENE	1500	21000	18000	NC	11 U	0.65 J	10 U	0.82 J	10 U
CHRYSENE	15000	210000	18000	NC	11 U	1.1 J	10 U	1.7 J	10 U
DIBENZO(A,H)ANTHRACENE	15	210	18000	NC	11 U	11 U	10 U	9.7 U	10 U
FLUORENE	2300000	22000000	29000	NC	11 U	11 UJ	10 U	9.7 UJ	10 U
INDENO(1,2,3-CD)PYRENE	150	2100	18000	NC	11 U	11 U	10 U	9.7 U	10 U
NAPHTHALENE	3600	18000	1000	NC	11 U	11 UJ	0.96 J	9.7 UJ	10 U
PHENANTHRENE	1700000	17000000	29000	NC	11 U	11 U	10 U	2.3 J	10 U
SEMIVOLATILES ORGANICS (µg/kg)									
BIS(2-ETHYLHEXYL)PHTHALATE	35000	120000	20	NC	60 J	230 U	210 U	270	210 U
PETROLEUM HYDROCARBONS (mg/kg)									
DIESEL RANGE ORGANICS (2)	NC	NC	NC	NC	3.8 J	3.7 J	5.1 J	4.1 J	10 J
TOTAL PETROLEUM HYDROCARBONS (2)	NC	NC	NC	NC	4.44 J	4.37 J	5.72 J	4.68 J	10.61 J

mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
NC = No criterion.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
J = Value is estimated.
R = Rejected.
BTV = Background threshold value.

(1) The value is for trivalent chromium.
(2) TPH RSLs not applicable for these results.

Bold indicates exceedance of Residential RSL.
Italics indicated exceedanc of Industrial RSL.
Orange shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-9

FREQUENCY OF DETECTIONS IN GROUNDWATER, FULL RFI
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Total Inorganics (µg/L)						
ARSENIC	8/8	3.3 J	6.2	57GW01	57GW01-061012	-
BARIUM	8/8	5.9	62.5	57GW02	57GW02-060912	-
CADMIUM	8/8	0.07 J	1.8	57GW08	57GW08-061112	-
COBALT	8/8	1.2	4.5	57GW02	57GW02-060912	-
COPPER	7/8	1.5	5.8	57GW09	57GW09-061012	2 - 2
LEAD	2/8	1	1.4	57GW07	57GW07-060912	0.5 - 0.5
MERCURY	5/8	0.03 J	0.92	57GW07	57GW07-060912	0.1 - 0.1
NICKEL	4/8	4.6	16.3	57GW02	57GW02-060912	2.3 - 3.8
SELENIUM	4/8	2 J	3.4 J	57GW01	57GW01-061012	3 - 3
SILVER	6/8	0.06 J	1	57GW07	57GW07-060912	0.4 - 0.4
THALLIUM	2/8	0.06 J	0.18 J	57GW02	57GW02-060912	0.4 - 0.4
VANADIUM	8/8	4.8 J	28.2	57GW04	57GW04-060912	-
ZINC	8/8	14.7	30.2	57GW09	57GW09-061012	-
Polynuclear Aromatic Hydrocarbons (µg/L)						
ANTHRACENE	1/4	0.13 J	0.17 J	57GW05	57GW05-060912-D	0.095 - 0.1
BENZO(A)ANTHRACENE	1/4	0.13 J	0.15 J	57GW05	57GW05-060912-D	0.095 - 0.1
FLUORANTHENE	1/4	0.93 J	1.3 J	57GW05	57GW05-060912-D	0.095 - 0.1
PYRENE	1/4	0.72 J	1.2 J	57GW05	57GW05-060912-D	0.095 - 0.1

µg/L = Micrograms per liter.
J = Value is estimated.

TABLE 4-10

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, FULL RFI
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	**Tapwater RSLs**	*Puerto Rico Water Quality Standards*	NAPR Facility Groundwater BTVs	**13GW07** **13GW07-060912** **20120609** **NORMAL** **GW**	**57GW01** **57GW01-061012** **20120610** **NORMAL** **GW**	**57GW02** **57GW02-060912** **20120609** **NORMAL** **GW**	**57GW04** **57GW04-060912** **20120609** **NORMAL** **GW**	**57GW05** **57GW05-060912** **20120609** **ORIG** **GW**	**57GW05** **57GW05-060912-D** **20120609** **DUP** **GW**
TOTAL INORGANICS (UG/L)									
ARSENIC	0.045	36	23.2	**4 J**	**6.2**	**4.3 J**	**4.9 J**	**4.4 J**	**3.4 J**
BARIUM	2900	NC	865	33.7	31.2	62.5	16.2	35.6	35.3
CADMIUM	6.9	8.85	46.7	0.44 J	0.44 J	1.7	0.11 J	0.08 J	0.07 J
COBALT	4.7	NC	778	2.3	2.5	4.5	1.2	1.4	1.4
COPPER	620	3.73	413	2.9 J	2 U	3.2	2.9 J	2 J	2 U
LEAD	NC	8.52	96.9	0.5 U	0.5 U	0.5 U	0.5 U	1.1	1
MERCURY	0.63	0.051	0.191	***0.78***	*0.58*	*0.08 J*	0.1 U	0.1 U	0.1 U
NICKEL	300	8.28	128	3.8 U	5.2	*16.3*	3.4 U	2.3 U	2.3 U
SELENIUM	78	71.14	41.6	3 U	3.4 J	3 U	3 U	3 U	3 U
SILVER	71	2.24	23.9	0.41 J	0.51 J	0.12 J	0.06 J	0.4 U	0.4 U
THALLIUM	0.16	0.47	NC	0.4 U	0.4 U	**0.18 J**	0.06 J	0.4 U	0.4 U
VANADIUM	63	NC	696	24.2	9.2	12.9	28.2	4.8 J	4.9 J
ZINC	4700	85.62	1540	17.4	18	27.1	19	16	14.7
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)									
ANTHRACENE	1300	40000	NC	NA	NA	0.1 U	NA	0.13 J	0.17 J
BENZO(A)ANTHRACENE	0.029	0.18	NC	NA	NA	0.1 U	NA	**0.13 J**	**0.15 J**
FLUORANTHENE	630	140	NC	NA	NA	0.1 UJ	NA	0.93 J	1.3 J
PYRENE	87	4000	NC	NA	NA	0.1 U	NA	0.72 J	1.2 J

µg/L = Micrograms per liter.
NA = Not analyzed.
NC = No criterion.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit fo rthe undetected result is estimated.
BTV = Background threshold value.

Bold indicates exceedance of Tapwater RSL.
Italics indicated exceedanc of PRWQS.
Underline indicates exceedance of BTV.

TABLE 4-10

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, FULL RFI
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	**Tapwater RSLs**	*Puerto Rico Water Quality Standards*	NAPR Facility Groundwater BTVs	**57GW07** **57GW07-060912** **20120609** **NORMAL** **GW**	**57GW08** **57GW08-061112** **20120611** **NORMAL** **GW**	**57GW09** **57GW09-061012** **20120610** **NORMAL** **GW**
TOTAL INORGANICS (UG/L)						
ARSENIC	0.045	36	23.2	**3.4 J**	**3.4 J**	**3.3 J**
BARIUM	2900	NC	865	5.9	11.3	31.7
CADMIUM	6.9	8.85	46.7	1.1	1.8	0.12 J
COBALT	4.7	NC	778	1.7	4.2	3.2
COPPER	620	3.73	413	*4.6*	3.5	*5.8*
LEAD	NC	8.52	96.9	1.4	0.5 U	0.5 U
MERCURY	0.63	0.051	0.191	***0.92***	0.03 J	0.1 U
NICKEL	300	8.28	128	4.6	*11*	2.6 U
SELENIUM	78	71.14	41.6	2.1 J	2.1 J	2 J
SILVER	71	2.24	23.9	1	0.14 J	0.4 U
THALLIUM	0.16	0.47	NC	0.4 U	0.4 U	0.4 U
VANADIUM	63	NC	696	13.7	22.5	16.7
ZINC	4700	85.62	1540	21	22.8	30.2
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)						
ANTHRACENE	1300	40000	NC	NA	0.095 U	0.095 U
BENZO(A)ANTHRACENE	0.029	0.18	NC	NA	0.095 U	0.095 U
FLUORANTHENE	630	140	NC	NA	0.095 UJ	0.095 U
PYRENE	87	4000	NC	NA	0.095 U	0.095 U

µg/L = Micrograms per liter.
NA = Not analyzed.
NC = No criterion.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit fo rthe undetected result is estimated.
BTV = Background threshold value.

Bold indicates exceedance of Tapwater RSL.
Italics indicated exceedanc of PRWQS.
Underline indicates exceedance of BTV.

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, FULL RFI
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	Surface Water Ecological Screening Criteria	NAPR Facility Estuarine Surface Water BTVs	**13GW07** **13GW07-060912** **20120609** **NORMAL** **GW**	**57GW01** **57GW01-061012** **20120610** **NORMAL** **GW**	**57GW02** **57GW02-060912** **20120609** **NORMAL** **GW**	**57GW04** **57GW04-060912** **20120609** **NORMAL** **GW**	**57GW05** **57GW05-060912** **20120609** **ORIG** **GW**	**57GW05** **57GW05-060912-D** **20120609** **DUP** **GW**
TOTAL INORGANICS (UG/L)								
ARSENIC	36	6.69	4 J	6.2	4.3 J	4.9 J	4.4 J	3.4 J
BARIUM	200	41.8	33.7	31.2	62.5	16.2	35.6	35.3
CADMIUM	8.85	NC	0.44 J	0.44 J	1.7	0.11 J	0.08 J	0.07 J
COBALT	1	6.44	2.3	2.5	4.5	1.2	1.4	1.4
COPPER	3.73	21.6	2.9 J	2 U	3.2	2.9 J	2 J	2 U
LEAD	8.52	2.76	0.5 U	0.5 U	0.5 U	0.5 U	1.1	1
MERCURY	0.94	0.0945	0.78	0.58	0.08 J	0.1 U	0.1 U	0.1 U
NICKEL	8.28	2.82	3.8 U	5.2	16.3	3.4 U	2.3 U	2.3 U
SELENIUM	71.74	8.67	3 U	3.4 J	3 U	3 U	3 U	3 U
SILVER	2.24	NC	0.41 J	0.51 J	0.12 J	0.06 J	0.4 U	0.4 U
THALLIUM	21.3	NC	0.4 U	0.4 U	0.18 J	0.06 J	0.4 U	0.4 U
VANADIUM	50	32.7	24.2	9.2	12.9	28.2	4.8 J	4.9 J
ZINC	85.62	30.6	17.4	18	27.1	19	16	14.7
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)								
ANTHRACENE	0.18	NC	NA	NA	0.1 U	NA	0.13 J	0.17 J
BENZO(A)ANTHRACENE	3	NC	NA	NA	0.1 U	NA	0.13 J	0.15 J
FLUORANTHENE	1.6	NC	NA	NA	0.1 UJ	NA	0.93 J	1.3 J
PYRENE	0.24	NC	NA	NA	0.1 U	NA	0.72 J	1.2 J

µg/L = Micrograms per liter.
NA = Not analyzed.
NC = No criterion.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit fo rthe undetected result is estimated.
BTV = Background threshold value.

Shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, FULL RFI
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	Surface Water Ecological Screening Criteria	NAPR Facility Estuarine Surface Water BTVs	**57GW07** **57GW07-060912** **20120609** **NORMAL** **GW**	**57GW08** **57GW08-061112** **20120611** **NORMAL** **GW**	**57GW09** **57GW09-061012** **20120610** **NORMAL** **GW**
TOTAL INORGANICS (UG/L)					
ARSENIC	36	6.69	3.4 J	3.4 J	3.3 J
BARIUM	200	41.8	5.9	11.3	31.7
CADMIUM	8.85	NC	1.1	1.8	0.12 J
COBALT	1	6.44	1.7	4.2	3.2
COPPER	3.73	21.6	4.6	3.5	5.8
LEAD	8.52	2.76	1.4	0.5 U	0.5 U
MERCURY	0.94	0.0945	0.92	0.03 J	0.1 U
NICKEL	8.28	2.82	4.6	11	2.6 U
SELENIUM	71.74	8.67	2.1 J	2.1 J	2 J
SILVER	2.24	NC	1	0.14 J	0.4 U
THALLIUM	21.3	NC	0.4 U	0.4 U	0.4 U
VANADIUM	50	32.7	13.7	22.5	16.7
ZINC	85.62	30.6	21	22.8	30.2
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)					
ANTHRACENE	0.18	NC	NA	0.095 U	0.095 U
BENZO(A)ANTHRACENE	3	NC	NA	0.095 U	0.095 U
FLUORANTHENE	1.6	NC	NA	0.095 UJ	0.095 U
PYRENE	0.24	NC	NA	0.095 U	0.095 U

µg/L = Micrograms per liter.
NA = Not analyzed.
NC = No criterion.
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit fo rthe undetected result is estimated.
BTV = Background threshold value.

Shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-12

FREQUENCY OF DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Total Inorganics (UG/L)						
ANTIMONY	1/6	3.7 J	3.7 J	57GW04	57GW04	2.9 - 2.9
BARIUM	5/5	17.9 J	83.8 J	57GW02	57GW02	-
CADMIUM	2/6	0.4 J	0.91 J	57GW07	57GW07	0.34 - 0.34
COBALT	6/6	0.83 J	9.5 J	57GW02	57GW02	-
COPPER	5/6	2.5 J	6.5	57GW02	57GW02	1.5 - 1.5
LEAD	1/6	17.7	17.7	57GW05	57GW05	1.8 - 2.7
MERCURY	4/6	0.13 J	1.4	57GW01	57GW01	0.1 - 0.1
SELENIUM	2/6	3.15	4.5 J	57GW07	57GW07-D	3.6 - 3.6
SILVER	2/6	1 J	1.3 J	57GW01	57GW01	0.96 - 1.2
THALLIUM	1/6	5.6 J	5.6 J	57GW02	57GW02	5.3 - 5.3
TIN	6/6	5.5 J	8.8 J	57GW07	57GW07	5.1 - 5.1
VANADIUM	6/6	6.5 J	37.5	57GW02	57GW02	-
ZINC	1/6	28	28	57GW02	57GW02	5.7 - 11
Dissolved Inorganics (UG/L)						
BARIUM	7/7	8.8 B	93.1 J	57GW02	57GW02	-
CHROMIUM	3/8	1.2 J	3.6 J	57GW07	57GW07-D	0.95 - 10
COBALT	6/8	1.6 J	12.8 J	57GW02	57GW02	10 - 10
COPPER	5/8	1.175	3.2 B	3E-04	3E-GW01	1.5 - 20
LEAD	1/8	14.9	14.9	57GW05	57GW05	1.8 - 5
MERCURY	6/8	0.11	1.2	57GW01	57GW01	0.1 - 0.1
NICKEL	5/8	1.3 J	17.4 J	57GW02	57GW02	2.2 - 40
SILVER	2/8	0.94	1.4 J	57GW07	57GW07-D	0.96 - 5
TIN	4/8	3.875	9.5 J	13GW07	13GW07	5.1 - 50
VANADIUM	8/8	8.6 J	28.3	57GW02	57GW02	-
ZINC	3/8	2.3 B	23.3	57GW02	57GW02	5.3 - 12.5
Semivolatile Organics (UG/L)						
DIETHYL PHTHALATE	1/8	0.6 J	0.6 J	57GW05	57GW05	5 - 10

TABLE 4-12

FREQUENCY OF DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample with Maximum Concentration	Range of Non-Detects
Volatile Organics (UG/L)						
2-BUTANONE	2/2	1.5 J	2.6 J	3E-04	3E-GW01	-
ACETONE	2/2	11 J	12 J	3E-02	3E-GW02	-
CARBON DISULFIDE	3/7	0.16 J	1.8	57GW02	57GW02	0.5 - 1
CHLOROFORM	1/7	5	5	57GW02	57GW02	0.5 - 3.2
CHLOROMETHANE	1/7	0.41 J	0.41 J	3E-04	3E-GW01	0.5 - 1
METHYL IODIDE	3/7	0.2 J	0.69 J	3E-04	3E-GW01	0.5 - 0.5
Polycyclic Aromatic Hydrocarbons (UG/L)						
ACENAPHTHENE	1/8	0.41	0.41	57GW05	57GW05	0.2 - 10
ACENAPHTHYLENE	2/8	0.011 J	0.03 J	57GW02	57GW02	0.2 - 10
ANTHRACENE	1/8	0.55	0.55	57GW05	57GW05	0.2 - 10
BENZO(A)ANTHRACENE	1/8	0.18 J	0.18 J	57GW05	57GW05	0.2 - 10
BENZO(A)PYRENE	1/8	0.023 J	0.023 J	57GW05	57GW05	0.2 - 10
BENZO(B)FLUORANTHENE	1/8	0.031 J	0.031 J	57GW05	57GW05	0.2 - 10
BENZO(G,H,I)PERYLENE	2/8	0.011 J	0.012 J	57GW05	57GW05	0.2 - 10
BENZO(K)FLUORANTHENE	1/8	0.025 J	0.025 J	57GW05	57GW05	0.2 - 10
CHRYSENE	3/8	0.017 J	0.19 J	57GW05	57GW05	0.2 - 10
FLUORANTHENE	1/8	2.4	2.4	57GW05	57GW05	0.2 - 10
PHENANTHRENE	3/8	0.049 J	0.078 J	57GW07	57GW07-D	0.2 - 10
PHENANTHRENE	3/8	0.049 J	0.078 J	57GW07	57GW07-AVG	0.2 - 10
PYRENE	1/8	1.9	1.9	57GW05	57GW05	0.2 - 10
Petroleum Hydrocarbons (MG/L)						
GASOLINE RANGE ORGANICS	1/6	2.1	2.1	57GW05	57GW05	0.5 - 0.5
TOTAL PETROLEUM HYDROCARBONS	1/6	2.6	2.6	57GW05	57GW05	1 - 1.06

µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
J = Value is estimated.
B = Value is estimated (inorganics).

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	**Tapwater RSLs**	*Puerto Rico Water Quality Standards*	NAPR Facility Groundwater BTVs	**3E-02** **3E-GW02** **20040510** **NORMAL** **GW**	**3E-04** **3E-GW01** **20040510** **NORMAL** **GW**	**13GW07** **13GW07** **20100131** **NORMAL** **GW**	**57GW01** **57GW01** **20100201** **NORMAL** **GW**	**57GW02** **57GW02** **20100131** **NORMAL** **GW**
DISSOLVED INORGANICS (UG/L)								
BARIUM	2900	NC	289	8.8 B	18	25.7 J	28 R	93.1 J
CHROMIUM	16000	NC	4.86	10 U	10 U	0.95 U	1.2 J	0.95 U
COBALT	4.7	NC	1300	10 U	10 U	3.6 J	3.5 J	**12.8 J**
COPPER	620	3.73	323	20 U	3.2 B	1.6 J	1.6 U	2.8 J
LEAD	NA	8.52	1.58	5 U	5 U	2.7 U	1.8 U	2 U
MERCURY	0.63	0.051	0.126	*0.41 B*	*0.44 B*	***1.1***	***1.2***	0.1 U
NICKEL	300	8.28	103	40 U	40 U	1.3 J	5.4 J	*17.4 J*
SILVER	71	2.24	1.91	5 U	5 U	1 J	1.1 U	0.96 U
TIN	9300	NC	NC	50 U	50 U	9.5 J	5.1 J	6.2 J
VANADIUM	63	NC	72.9	22	15	23.8	8.6 J	28.3
ZINC	4700	85.62	421	3.9 B	2.3 B	5.3 U	12.5 U	23.3
TOTAL INORGANICS (UG/L)								
ANTIMONY	6	640	18.2	NA	NA	2.9 U	2.9 U	2.9 U
BARIUM	2900	NC	865	NA	NA	30 J	17.3 R	83.8 J
CADMIUM	6.9	8.85	46.7	NA	NA	0.34 U	0.34 U	0.85 J
COBALT	4.7	NC	778	NA	NA	3.2 J	1.5 J	**9.5 J**
COPPER	620	3.73	413	NA	NA	2.8 J	1.5 U	*6.5*
LEAD	NC	8.52	96.9	NA	NA	1.8 U	2 U	2.7 U
MERCURY	0.63	0.051	0.191	NA	NA	***0.97***	***1.4***	0.1 U
SELENIUM	78	71.14	41.6	NA	NA	3.6 UJ	3.9 J	3.6 UJ
SILVER	71	2.24	23.9	NA	NA	1 J	1.3 J	1.2 U
THALLIUM	0.16	0.47	NC	NA	NA	5.3 U	5.3 U	***5.6 J***
TIN	9300	NC	17.2	NA	NA	7.9 J	5.5 J	8 J
VANADIUM	63	NC	696	NA	NA	24.4	6.5 J	37.5
ZINC	4700	85.62	1540	NA	NA	5.7 U	9.4 U	28
PETROLEUM HYDROCARBONS (MG/L)								
GASOLINE RANGE ORGANICS (1)	NC	NC	NC	NA	NA	0.5 U	0.5 UJ	0.5 U
TOTAL PETROLEUM HYDROCARBONS (1)	NC	NC	NC	NA	NA	1.03 U	1.01 UJ	1 U
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)								
ACENAPHTHENE	400	990	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
ACENAPHTHYLENE	400	NC	NC	10 U	10 U	0.21 U	0.21 U	0.03 J
ANTHRACENE	1300	40000	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
BENZO(A)ANTHRACENE	0.029	0.18	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
BENZO(A)PYRENE	0.0029	0.18	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
BENZO(B)FLUORANTHENE	0.029	0.18	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
BENZO(G,H,I)PERYLENE	87	NC	NC	10 U	10 U	0.011 J	0.21 U	0.2 U
BENZO(K)FLUORANTHENE	0.29	0.18	NC	10 U	10 U	0.21 UJ	0.21 UJ	0.2 UJ
CHRYSENE	2.9	0.18	NC	10 U	10 U	0.018 J	0.21 U	0.2 U
FLUORANTHENE	630	140	NC	10 U	10 U	0.21 U	0.21 U	0.2 U
PHENANTHRENE	87	NC	NC	10 U	10 U	0.06 J	0.21 U	0.2 U
PYRENE	87	4000	NC	10 U	10 U	0.21 U	0.21 U	0.2 U

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	**Tapwater RSLs**	*Puerto Rico Water Quality Standards*	NAPR Facility Groundwater BTVs	**3E-02** **3E-GW02** **20040510** **NORMAL** **GW**	**3E-04** **3E-GW01** **20040510** **NORMAL** **GW**	**13GW07** **13GW07** **20100131** **NORMAL** **GW**	**57GW01** **57GW01** **20100201** **NORMAL** **GW**	**57GW02** **57GW02** **20100131** **NORMAL** **GW**
SEMIVOLATILE ORGANICS (UG/L)								
DIETHYL PHTHALATE	11000	44000	NC	10 U	10 U	5.1 U	5.3 U	5 U
VOLATILE ORGANICS (UG/L)								
2-BUTANONE	4900	NC	NC	1.5 J	2.6 J	2.5 R	2.5 R	2.5 R
ACETONE	12000	NC	NC	12 J	11 J	3.5 R	3.5 R	4.4 R
CARBON DISULFIDE	720	NC	NC	1 U	1 U	0.5 U	0.5 U	1.8
CHLOROFORM	0.19	4700	NC	1 U	1 U	0.5 U	0.5 U	**5**
CHLOROMETHANE	190	NC	NC	1 U	0.41 J	0.5 U	0.5 U	0.5 U
METHYL IODIDE	NC	NC	NC	0.29 J	0.69 J	0.5 U	0.5 U	0.2 J

µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
NA = Not analyzed.
NC = No criteriaon
B = Value is estimated (inorganics).
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
R = Rejected.
BTV = Background threshold value.

(1) TPH RSLs not applicable for these results.

Bold indicates exceedance of Tapwater RSL.
Italics indicated exceedanc of PRWQS.
Underline indicates exceedance of BTV.

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	**Tapwater RSLs**	*Puerto Rico Water Quality Standards*	NAPR Facility Groundwater BTVs	**57GW04** **57GW04** **20100131** **NORMAL** **GW**	**57GW05** **57GW05** **20100201** **NORMAL** **GW**	**57GW07** **57GW07** **20100131** **ORIG** **GW**	**57GW07** **57GW07-D** **20100131** **DUP** **GW**
DISSOLVED INORGANICS (UG/L)							
BARIUM	2900	NC	289	25.7 J	22.5 J	16.3 J	16.3 J
CHROMIUM	16000	NC	4.86	2.9 J	0.95 U	3 J	3.6 J
COBALT	4.7	NC	1300	2.2 J	3.7 J	1.6 J	3.3 J
COPPER	620	3.73	323	1.9 J	1.5 U	1.5 U	1.6 J
LEAD	NA	8.52	1.58	2.1 U	*14.9*	1.8 U	1.8 U
MERCURY	0.63	0.051	0.126	*0.28*	0.1 U	0.1 U	*0.17 J*
NICKEL	300	8.28	103	4.3 J	2.2 U	5.7 J	6.5 J
SILVER	71	2.24	1.91	0.96 U	0.96 U	0.96 U	1.4 J
TIN	9300	NC	NC	5.1 U	5.1 U	5.2 J	5.1 U
VANADIUM	63	NC	72.9	28.1	9.2 J	10.7 J	11.5 J
ZINC	4700	85.62	421	11.1 U	5.5 U	5.7 U	7.8 U
TOTAL INORGANICS (UG/L)							
ANTIMONY	6	640	18.2	3.7 J	2.9 U	2.9 U	2.9 U
BARIUM	2900	NC	865	26.9 J	24.8 J	17.9 J	18.2 J
CADMIUM	6.9	8.85	46.7	0.34 U	0.34 U	0.91 J	0.4 J
COBALT	4.7	NC	778	1.3 J	3 J	2.1 J	0.83 J
COPPER	620	3.73	413	2.5 J	*5 J*	2.9 J	3 J
LEAD	NC	8.52	96.9	1.8 U	*17.7*	2.2 U	2.3 U
MERCURY	0.63	0.051	0.191	*0.19 J*	0.1 U	*0.13 J*	*0.22*
SELENIUM	78	71.14	41.6	3.6 UJ	3.6 UJ	3.6 UJ	4.5 J
SILVER	71	2.24	23.9	0.96 U	0.96 U	0.96 U	0.96 U
THALLIUM	0.16	0.47	NC	5.3 U	5.3 U	5.3 U	5.3 U
TIN	9300	NC	17.2	6.2 J	6.3 J	8.8 J	5.1 U
VANADIUM	63	NC	696	29.6	15.5 J	13.6 J	11.8 J
ZINC	4700	85.62	1540	10.1 U	9.5 U	11 U	10.6 U
PETROLEUM HYDROCARBONS (MG/L)							
GASOLINE RANGE ORGANICS (1)	NC	NC	NC	0.5 U	2.1	0.5 U	0.5 U
TOTAL PETROLEUM HYDROCARBONS (1)	NC	NC	NC	1.06 U	2.6	1 U	1.06 U
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)							
ACENAPHTHENE	400	990	NC	0.2 U	0.41	0.2 U	0.21 U
ACENAPHTHYLENE	400	NC	NC	0.2 U	0.011 J	0.2 U	0.21 U
ANTHRACENE	1300	40000	NC	0.2 U	0.55	0.2 U	0.21 U
BENZO(A)ANTHRACENE	0.029	0.18	NC	0.2 U	**0.18 J**	0.2 U	0.21 U
BENZO(A)PYRENE	0.0029	0.18	NC	0.2 U	**0.023 J**	0.2 U	0.21 U
BENZO(B)FLUORANTHENE	0.029	0.18	NC	0.2 U	**0.031 J**	0.2 U	0.21 U
BENZO(G,H,I)PERYLENE	87	NC	NC	0.2 U	0.012 J	0.2 U	0.21 U
BENZO(K)FLUORANTHENE	0.29	0.18	NC	0.2 UJ	0.025 J	0.2 UJ	0.21 UJ
CHRYSENE	2.9	0.18	NC	0.2 U	*0.19 J*	0.2 U	0.017 J
FLUORANTHENE	630	140	NC	0.2 U	2.4	0.2 U	0.21 U
PHENANTHRENE	87	NC	NC	0.2 U	0.049 J	0.2 U	0.078 J
PYRENE	87	4000	NC	0.2 U	1.9	0.2 U	0.21 U

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO HUMAN HEALTH SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION				**57GW04**	**57GW05**	**57GW07**	
SAMPLE ID			NAPR Facility	**57GW04**	**57GW05**	**57GW07**	**57GW07-D**
SAMPLE DATE	**Tapwater**	*Puerto Rico*	Groundwater	**20100131**	**20100201**	**20100131**	**20100131**
SAMPLE CODE	**RSLs**	*Water Quality*	BTVs	**NORMAL**	**NORMAL**	**ORIG**	**DUP**
MATRIX		*Standards*		**GW**	**GW**	**GW**	**GW**
SEMIVOLATILE ORGANICS (UG/L)							
DIETHYL PHTHALATE	11000	44000	NC	5 U	0.6 J	5 U	5.3 U
VOLATILE ORGANICS (UG/L)							
2-BUTANONE	4900	NC	NC	2.5 R	6.3 R	2.5 R	2.5 R
ACETONE	12000	NC	NC	3.5 R	8.6 R	3.5 R	3.5 R
CARBON DISULFIDE	720	NC	NC	0.25 J	1.3 R	0.16 J	0.19 J
CHLOROFORM	0.19	4700	NC	3.2 U	1.4 R	0.5 U	0.5 U
CHLOROMETHANE	190	NC	NC	0.5 U	1.3 R	0.5 U	0.5 U
METHYL IODIDE	NC	NC	NC	0.5 U	1.3 R	0.5 UJ	0.5 UJ

µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
NA = Not analyzed.
NC = No criteriaon
B = Value is estimated (inorganics).
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
R = Rejected.
BTV = Background threshold value.

(1) TPH RSLs not applicable for these results.

Bold indicates exceedance of Tapwater RSL.
Italics indicated exceedanc of PRWQS.
Underline indicates exceedance of BTV.

TABLE 4-14

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	Surface Water Ecological Screening Criteria	NAPR Facility Estuarine Surface Water BTVs	**3E-02** **3E-GW02** **20040510** **NORMAL** **GW**	**3E-04** **3E-GW01** **20040510** **NORMAL** **GW**	**13GW07** **13GW07** **20100131** **NORMAL** **GW**	**57GW01** **57GW01** **20100201** **NORMAL** **GW**	**57GW02** **57GW02** **20100131** **NORMAL** **GW**	**57GW04** **57GW04** **20100131** **NORMAL** **GW**
DISSOLVED INORGANICS (UG/L)								
BARIUM	200	39.8	8.8 B	18	25.7 J	28 R	93.1 J	25.7 J
CHROMIUM	56	3.21	10 U	10 U	0.95 U	1.2 J	0.95 U	2.9 J
COBALT	1	2.86	10 U	10 U	3.6 J	3.5 J	12.8 J	2.2 J
COPPER	3.73	11	20 U	3.2 B	1.6 J	1.6 U	2.8 J	1.9 J
LEAD	8.52	0.215	5 U	5 U	2.7 U	1.8 U	2 U	2.1 U
MERCURY	0.94	0.129	0.41 B	0.44 B	1.1	1.2	0.1 U	0.28
NICKEL	8.28	1.01	40 U	40 U	1.3 J	5.4 J	17.4 J	4.3 J
SILVER	2.24	NC	5 U	5 U	1 J	1.1 U	0.96 U	0.96 U
TIN	NC	0.527	50 U	50 U	9.5 J	5.1 J	6.2 J	5.1 U
VANADIUM	50	15.9	22	15	23.8	8.6 J	28.3	28.1
ZINC	85.62	27.5	3.9 B	2.3 B	5.3 U	12.5 U	23.3	11.1 U
TOTAL INORGANICS (UG/L)								
ANTIMONY	500	4.99	NA	NA	2.9 U	2.9 U	2.9 U	3.7 J
BARIUM	200	41.8	NA	NA	30 J	17.3 R	83.8 J	26.9 J
CADMIUM	8.85	NC	NA	NA	0.34 U	0.34 U	0.85 J	0.34 U
COBALT	1	6.44	NA	NA	3.2 J	1.5 J	9.5 J	1.3 J
COPPER	3.73	21.6	NA	NA	2.8 J	1.5 U	6.5	2.5 J
LEAD	8.52	2.76	NA	NA	1.8 U	2 U	2.7 U	1.8 U
MERCURY	0.94	0.0945	NA	NA	0.97	1.4	0.1 U	0.19 J
SELENIUM	71.74	8.67	NA	NA	3.6 UJ	3.9 J	3.6 UJ	3.6 UJ
SILVER	2.24	NC	NA	NA	1 J	1.3 J	1.2 U	0.96 U
THALLIUM	21.3	NC	NA	NA	5.3 U	5.3 U	5.6 J	5.3 U
TIN	NC	2.37	NA	NA	7.9 J	5.5 J	8 J	6.2 J
VANADIUM	50	32.7	NA	NA	24.4	6.5 J	37.5	29.6
ZINC	85.62	30.6	NA	NA	5.7 U	9.4 U	28	10.1 U
PETROLEUM HYDROCARBONS (MG/L)								
GASOLINE RANGE ORGANICS (1)	NC	NC	NA	NA	0.5 U	0.5 UJ	0.5 U	0.5 U
TOTAL PETROLEUM HYDROCARBONS (1)	NC	NC	NA	NA	1.03 U	1.01 UJ	1 U	1.06 U
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)								
ACENAPHTHENE	6.6	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
ACENAPHTHYLENE	6.6	NC	10 U	10 U	0.21 U	0.21 U	0.03 J	0.2 U
ANTHRACENE	0.18	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
BENZO(A)ANTHRACENE	3	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
BENZO(A)PYRENE	3	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
BENZO(B)FLUORANTHENE	3	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
BENZO(G,H,I)PERYLENE	3	NC	10 U	10 U	0.011 J	0.21 U	0.2 U	0.2 U
BENZO(K)FLUORANTHENE	3	NC	10 U	10 U	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ
CHRYSENE	3	NC	10 U	10 U	0.018 J	0.21 U	0.2 U	0.2 U
FLUORANTHENE	1.6	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U
PHENANTHRENE	1.5	NC	10 U	10 U	0.06 J	0.21 U	0.2 U	0.2 U
PYRENE	0.24	NC	10 U	10 U	0.21 U	0.21 U	0.2 U	0.2 U

TABLE 4-14

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	Surface Water Ecological Screening Criteria	NAPR Facility Estuarine Surface Water BTVs	**3E-02** **3E-GW02** **20040510** **NORMAL** **GW**	**3E-04** **3E-GW01** **20040510** **NORMAL** **GW**	**13GW07** **13GW07** **20100131** **NORMAL** **GW**	**57GW01** **57GW01** **20100201** **NORMAL** **GW**	**57GW02** **57GW02** **20100131** **NORMAL** **GW**	**57GW04** **57GW04** **20100131** **NORMAL** **GW**
SEMIVOLATILE ORGANICS (UG/L)								
DIETHYL PHTHALATE	75.9	NC	10 U	10 U	5.1 U	5.3 U	5 U	5 U
VOLATILE ORGANICS (UG/L)								
2-BUTANONE	NC	NC	1.5 J	2.6 J	2.5 R	2.5 R	2.5 R	2.5 R
ACETONE	564000	NC	12 J	11 J	3.5 R	3.5 R	4.4 R	3.5 R
CARBON DISULFIDE	NC	NC	1 U	1 U	0.5 U	0.5 U	1.8	0.25 J
CHLOROFORM	815	NC	1 U	1 U	0.5 U	0.5 U	5	3.2 U
CHLOROMETHANE	2700	NC	1 U	0.41 J	0.5 U	0.5 U	0.5 U	0.5 U
METHYL IODIDE	NC	NC	0.29 J	0.69 J	0.5 U	0.5 U	0.2 J	0.5 U

µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
NA = Not analyzed.
NC = No criteriaon
B = Value is estimated (inorganics).
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
R = Rejected.
BTVs = Background threshold values.

(1) TPH RSLs not applicable for these results.

Shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-14

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION		NAPR Facility	**57GW05**	**57GW07**	
SAMPLE ID	Surface Water	Estuarine	**57GW05**	**57GW07**	**57GW07-D**
SAMPLE DATE	Ecological	Surface Water	**20100201**	**20100131**	**20100131**
SAMPLE CODE	Screening	BTVs	**NORMAL**	**ORIG**	**DUP**
MATRIX	Criteria		**GW**	**GW**	**GW**
DISSOLVED INORGANICS (UG/L)					
BARIUM	200	39.8	22.5 J	16.3 J	16.3 J
CHROMIUM	56	3.21	0.95 U	3 J	3.6 J
COBALT	1	2.86	3.7 J	1.6 J	3.3 J
COPPER	3.73	11	1.5 U	1.5 U	1.6 J
LEAD	8.52	0.215	14.9	1.8 U	1.8 U
MERCURY	0.94	0.129	0.1 U	0.1 U	0.17 J
NICKEL	8.28	1.01	2.2 U	5.7 J	6.5 J
SILVER	2.24	NC	0.96 U	0.96 U	1.4 J
TIN	NC	0.527	5.1 U	5.2 J	5.1 U
VANADIUM	50	15.9	9.2 J	10.7 J	11.5 J
ZINC	85.62	27.5	5.5 U	5.7 U	7.8 U
TOTAL INORGANICS (UG/L)					
ANTIMONY	500	4.99	2.9 U	2.9 U	2.9 U
BARIUM	200	41.8	24.8 J	17.9 J	18.2 J
CADMIUM	8.85	NC	0.34 U	0.91 J	0.4 J
COBALT	1	6.44	3 J	2.1 J	0.83 J
COPPER	3.73	21.6	5 J	2.9 J	3 J
LEAD	8.52	2.76	17.7	2.2 U	2.3 U
MERCURY	0.94	0.0945	0.1 U	0.13 J	0.22
SELENIUM	71.74	8.67	3.6 UJ	3.6 UJ	4.5 J
SILVER	2.24	NC	0.96 U	0.96 U	0.96 U
THALLIUM	21.3	NC	5.3 U	5.3 U	5.3 U
TIN	NC	2.37	6.3 J	8.8 J	5.1 U
VANADIUM	50	32.7	15.5 J	13.6 J	11.8 J
ZINC	85.62	30.6	9.5 U	11 U	10.6 U
PETROLEUM HYDROCARBONS (MG/L)					
GASOLINE RANGE ORGANICS (1)	NC	NC	2.1	0.5 U	0.5 U
TOTAL PETROLEUM HYDROCARBONS (1)	NC	NC	2.6	1 U	1.06 U
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)					
ACENAPHTHENE	6.6	NC	0.41	0.2 U	0.21 U
ACENAPHTHYLENE	6.6	NC	0.011 J	0.2 U	0.21 U
ANTHRACENE	0.18	NC	0.55	0.2 U	0.21 U
BENZO(A)ANTHRACENE	3	NC	0.18 J	0.2 U	0.21 U
BENZO(A)PYRENE	3	NC	0.023 J	0.2 U	0.21 U
BENZO(B)FLUORANTHENE	3	NC	0.031 J	0.2 U	0.21 U
BENZO(G,H,I)PERYLENE	3	NC	0.012 J	0.2 U	0.21 U
BENZO(K)FLUORANTHENE	3	NC	0.025 J	0.2 UJ	0.21 UJ
CHRYSENE	3	NC	0.19 J	0.2 U	0.017 J
FLUORANTHENE	1.6	NC	2.4	0.2 U	0.21 U
PHENANTHRENE	1.5	NC	0.049 J	0.2 U	0.078 J
PYRENE	0.24	NC	1.9	0.2 U	0.21 U

TABLE 4-14

SUMMARY OF POSITIVE DETECTIONS IN GROUNDWATER, PHASE I RFI AND ECP
COMPARISON TO ECOLOGICAL SCREENING CRITERIA
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

LOCATION **SAMPLE ID** **SAMPLE DATE** **SAMPLE CODE** **MATRIX**	Surface Water Ecological Screening Criteria	NAPR Facility Estuarine Surface Water BTVs	**57GW05** **57GW05** **20100201** **NORMAL** **GW**	**57GW07** **57GW07** **20100131** **ORIG** **GW**	 **57GW07-D** **20100131** **DUP** **GW**
SEMIVOLATILE ORGANICS (UG/L)					
DIETHYL PHTHALATE	75.9	NC	0.6 J	5 U	5.3 U
VOLATILE ORGANICS (UG/L)					
2-BUTANONE	NC	NC	6.3 R	2.5 R	2.5 R
ACETONE	564000	NC	8.6 R	3.5 R	3.5 R
CARBON DISULFIDE	NC	NC	1.3 R	0.16 J	0.19 J
CHLOROFORM	815	NC	1.4 R	0.5 U	0.5 U
CHLOROMETHANE	2700	NC	1.3 R	0.5 U	0.5 U
METHYL IODIDE	NC	NC	1.3 R	0.5 UJ	0.5 UJ

µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
NA = Not analyzed.
NC = No criteriaon
B = Value is estimated (inorganics).
J = Value is estimated.
U = Analyte not detected at the reported detection limit.
UJ = Numerical detection limit for the undetected result is estimated.
R = Rejected.
BTVs = Background threshold values.

(1) TPH RSLs not applicable for these results.

Shading indicated exceedance of Ecological Screening Criteria.
Underline indicates exceedance of BTV.

TABLE 4-15

CONCRETE CHIP AND CONCRETE WIPE SAMPLES
RANGE OF THEORETICAL LEACHATE CONCENTRATIONS COMPARED TO TCLP REGULATORY LEVELS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

	Concrete Chip Samples Range of Theoretical Leachate Concentrations	TCLP Regulatory Level (mg/L)
Semivolatiles (ug/kg)		
Bis(2-ethylhexyl)phthalate	70	Not Regulated
Isophorone	60 - 2400	Not Regulated
TPH (mg/kg)		
Diesel Range Organics	1 - 10	Not Regulated
Inorganics (mg/kg)		
Arsenic	0.07 - 0.155	5
Barium	4.055 - 9.2	100
Beryllium	0.011 - 0.028	Not Regulated
Cadmium	0.01 - 0.145	1
Chromium	0.35 - 0.955	5
Cobalt	0.07 - 0.125	Not Regulated
Copper	0.605 - 1.56	Not Regulated
Lead	0.225 - 0.67	5
Nickel	0.18 - 0.64	Not Regulated
Vanadium	0.825 - 0.93	Not Regulated
Zinc	0.835 - 1.37	Not Regulated

	Concrete Wipe Samples Range of Theoretical Leachate Concentrations	TCLP Regulatory Level (mg/L)
Semivolatiles (ug/wipe)		
4-Chloro-3-methylphenol	1.4	Not Regulated
Acenaphthene	0.05 - 0.105	Not Regulated
Acenaphthylene	0.0445	Not Regulated
Fluorene	0.037 - 0.07	Not Regulated
Phenanthrene	0.085 - 0.185	Not Regulated
TPH (mg/wipe)		
Diesel Range Organics	0.09 - 0.11	Not Regulated
Inorganics (ug/wipe)		
Antimony	0.015 - 0.024	Not Regulated
Chromium	0.025 - 0.07	5
Cobalt	0.007	Not Regulated
Copper	0.025 - 1	Not Regulated
Lead	0.04 - 0.075	5
Nickel	0.005 - 1.155	Not Regulated
Selenium	0.024 - 0.025	Not Regulated
Tin	0.065 - 0.09	Not Regulated
Zinc	0.245 - 0.53	Not Regulated

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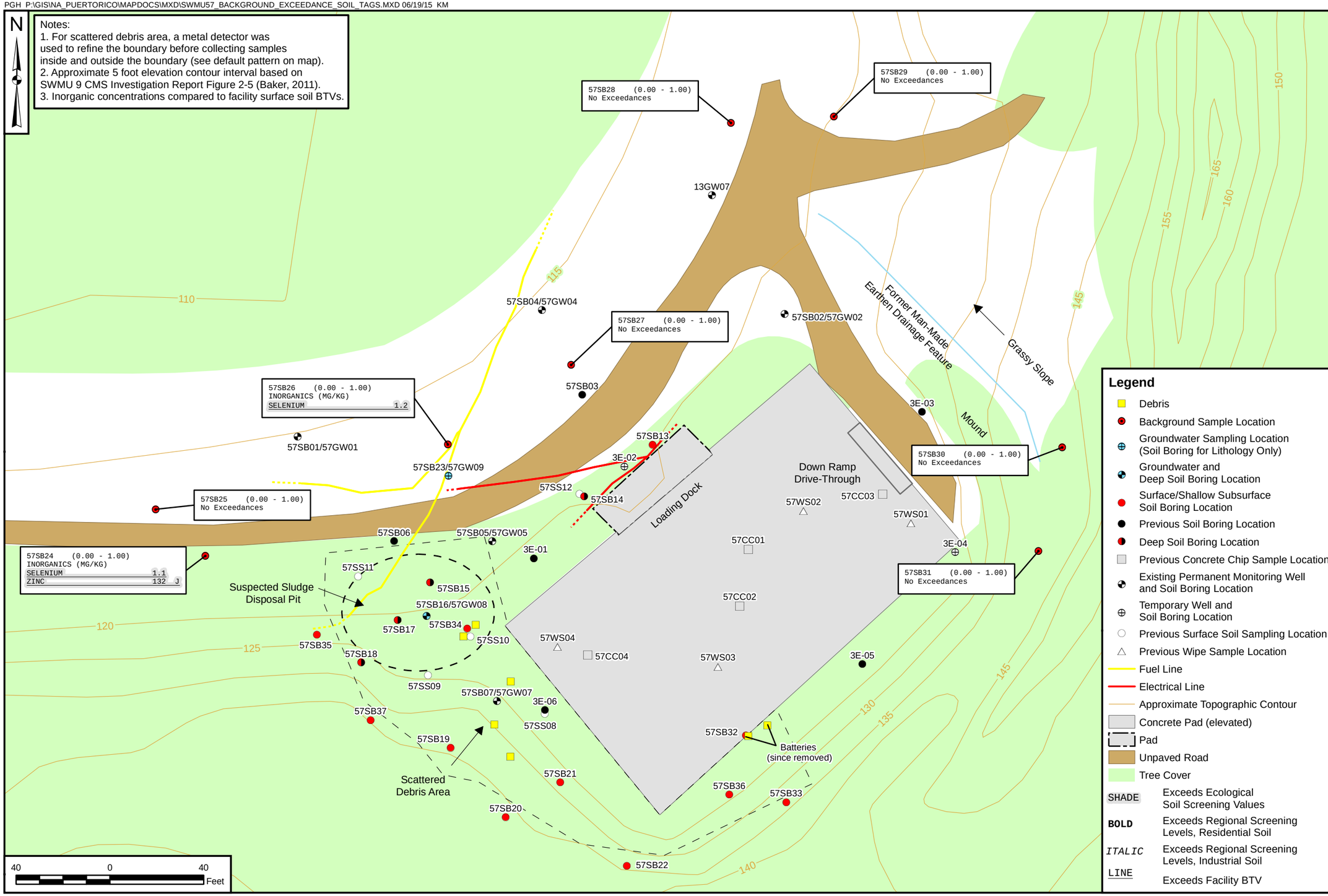

CTO NUMBER JM02

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APPROVED BY — DATE —

APPROVED BY — DATE —

FIGURE NO. FIGURE 4-1

REV 0

DETECTIONS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN SITE-SPECIFIC BACKGROUND SOIL

SWMU 57 - POL DRUM STORAGE AREA

NAVAL ACTIVITY PUERTO RICO

CEIBA, PUERTO RICO

NAVFAC

DRAWN BY K. MOORE DATE 10/16/12

CHECKED BY M. COFFMAN DATE 06/19/15

REVISED BY K. MOORE DATE 06/19/15

SCALE AS NOTED

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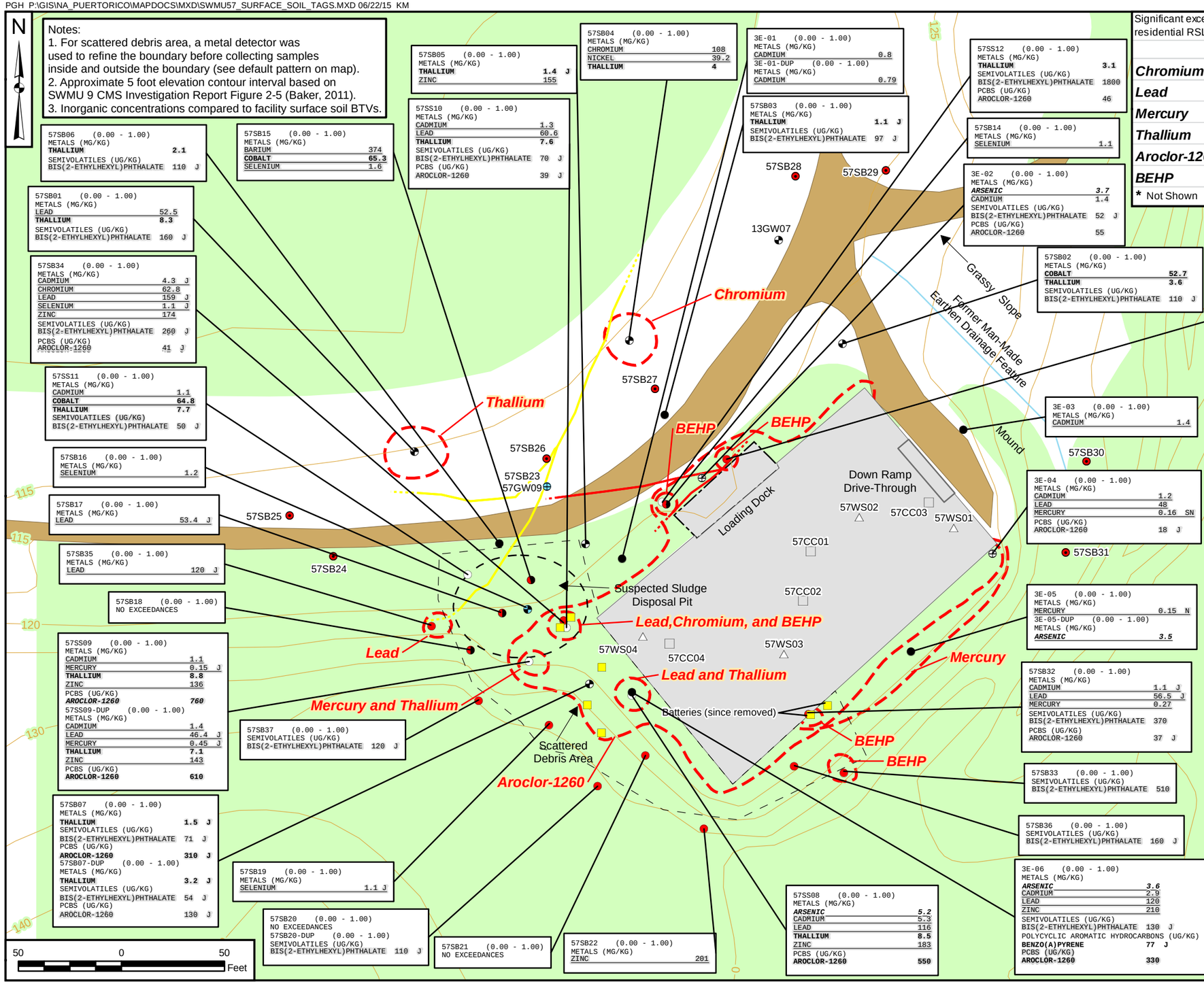

Significant exceedances > facility background and 10x human health residential RSLs or 10x ecological screening criteria as shown:

	Human Health	Ecological
Chromium		x
Lead		x
Mercury		x
Thallium	x	x *
Aroclor-1260		x
BEHP		x

* Not Shown

Legend

- Debris
- Background Sample Location
- Groundwater Sampling Location (Soil Boring for Lithology Only)
- Groundwater and Deep Soil Boring Location
- Surface/Shallow Subsurface Soil Boring Location
- Previous Soil Boring Location
- Deep Soil Boring Location
- Previous Concrete Chip Sample Location
- Existing Permanent Monitoring Well and Soil Boring Location
- Temporary Well and Soil Boring Location
- Previous Surface Soil Sampling Location
- Previous Wipe Sample Location
- Fuel Line
- Electrical Line
- Approximate Topographic Contour
- Concrete Pad (elevated)
- Exceedance
- Pad
- Unpaved Road
- Tree Cover

SHADE Exceeds Ecological Soil Screening Values

BOLD Exceeds Regional Screening Levels, Residential Soil

ITALIC Exceeds Regional Screening Levels, Industrial Soil

LINE Exceeds Facility BTV

CTO NUMBER JM02 | DATE | REV 0

CONTRACT NUMBER | APPROVED BY | DATE | APPROVED BY | DATE | FIGURE NO. 4-2

DETECTIONS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN SURFACE SOIL

SWMU 57 - POL DRUM STORAGE AREA

NAVAL ACTIVITY PURTO RICO

CEIBA, PUERTO RICO

		DATE
DRAWN BY	D. COUCH	07/24/13
CHECKED BY	M. COFFMAN	06/22/15
REVISED BY	K. MOORE	06/22/15

SCALE AS NOTED

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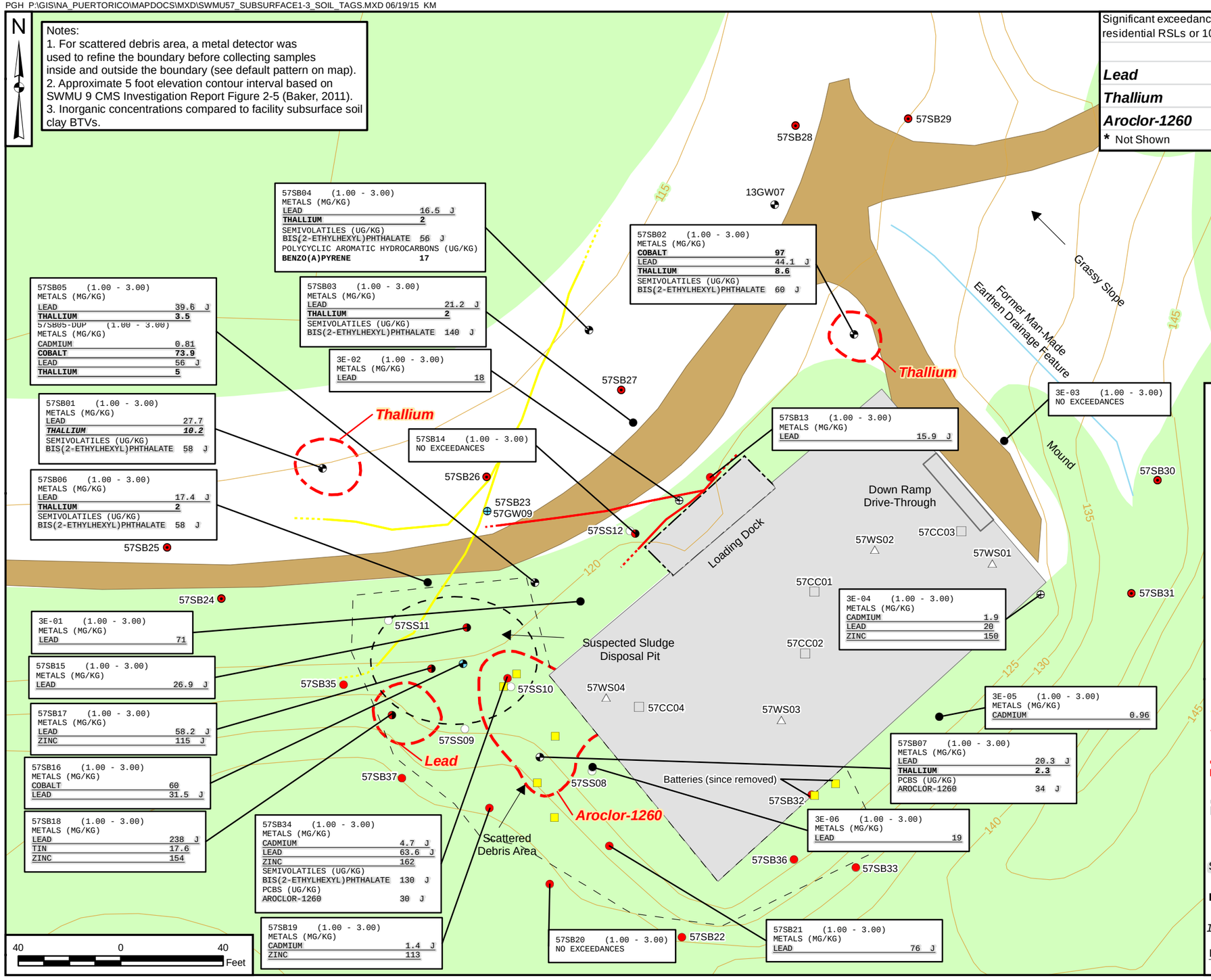

Significant exceedances > facility background and 10x human health residential RSLs or 10x ecological screening criteria as shown:

	Human Health	Ecological
Lead		x
Thallium	x	x *
Aroclor-1260		x

* Not Shown

Legend

- Debris
- Background Sample Location
- Groundwater Sampling Location (Soil Boring for Lithology Only)
- Groundwater and Deep Soil Boring Location
- Surface/Shallow Subsurface Soil Boring Location
- Previous Soil Boring Location
- Deep Soil Boring Location
- Previous Concrete Chip Sample Location
- Existing Permanent Monitoring Well and Soil Boring Location
- Temporary Well and Soil Boring Location
- Previous Surface Soil Sampling Location
- Previous Wipe Sample Location
- Fuel Line
- Electrical Line
- Approximate Topographic Contour
- Exceedance
- Concrete Pad (elevated)
- Pad
- Unpaved Road
- Tree Cover

SHADE — Exceeds Ecological Soil Screening Values

BOLD — Exceeds Regional Screening Levels, Residential Soil

ITALIC — Exceeds Regional Screening Levels, Industrial Soil

LINE — Exceeds Facility BTV

CTO NUMBER JM02

CONTRACT NUMBER —

APPROVED BY — DATE —

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FIGURE NO. 4-3

REV 0

DETECTIONS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN SUBSURFACE SOIL, 1-3 FEET BGS

SWMU 57 - POL DRUM STORAGE AREA

NAVAL ACTIVITY PURTO RICO

CEIBA, PUERTO RICO

NAVFAC

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CHECKED BY M. COFFMAN DATE 06/19/15

REVISED BY K. MOORE DATE 06/19/15

SCALE AS NOTED

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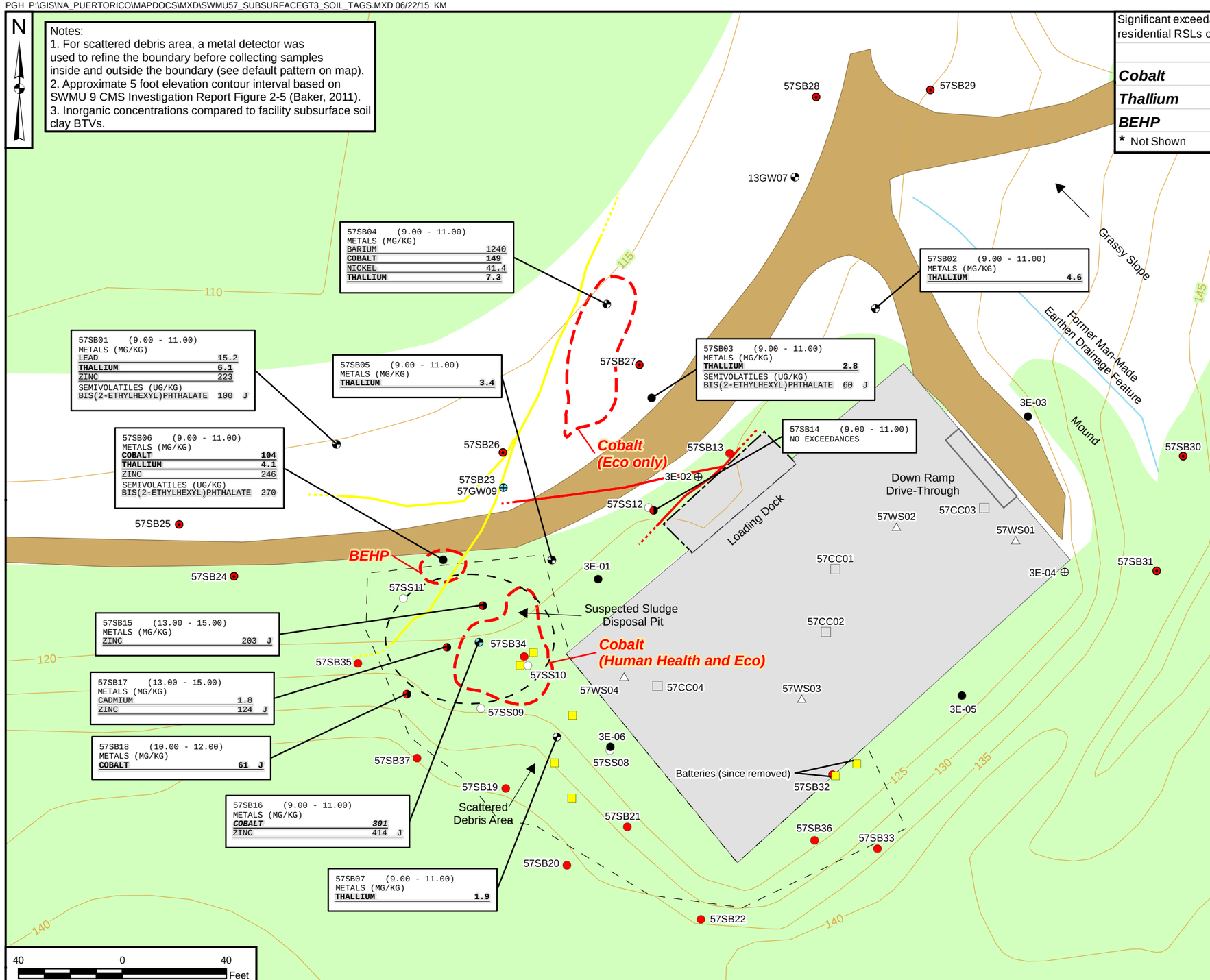

Significant exceedances > facility background and 10x human health residential RSLs or 10x ecological screening criteria as shown:

	Human Health	Ecological
Cobalt	x	x
Thallium		x *
BEHP		x
* Not Shown		

Legend

- Debris
- Background Sample Location
- Groundwater Sampling Location (Soil Boring for Lithology Only)
- Groundwater and Deep Soil Boring Location
- Surface/Shallow Subsurface Soil Boring Location
- Previous Soil Boring Location
- Deep Soil Boring Location
- Previous Concrete Chip Sample Location
- Existing Permanent Monitoring Well and Soil Boring Location
- Temporary Well and Soil Boring Location
- Previous Surface Soil Sampling Location
- Previous Wipe Sample Location
- Fuel Line
- Electrical Line
- Approximate Topographic Contour
- Exceedance
- Concrete Pad (elevated)
- Pad
- Unpaved Road
- Tree Cover

SHADE — Exceeds Ecological Soil Screening Values

BOLD — Exceeds Regional Screening Levels, Residential Soil

ITALIC — Exceeds Regional Screening Levels, Industrial Soil

LINE — Exceeds Facilty BVT

CTO NUMBER JM02 | DATE — | DATE — | REV 0

CONTRACT NUMBER — | APPROVED BY — | APPROVED BY — | FIGURE NO. 4-4

DETECTIONS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN SUBSURFACE SOIL, > 3 FEET BGS

SWMU 57 - POL DRUM STORAGE AREA

NAVAL ACTIVITY PURTO RICO

CEIBA, PUERTO RICO

NAVFAC

DRAWN BY	DATE	CHECKED BY	DATE	REVISED BY	DATE	SCALE
D. COUCH	07/25/13	M. COFFMAN	06/22/15	K. MOORE	06/22/15	AS NOTED

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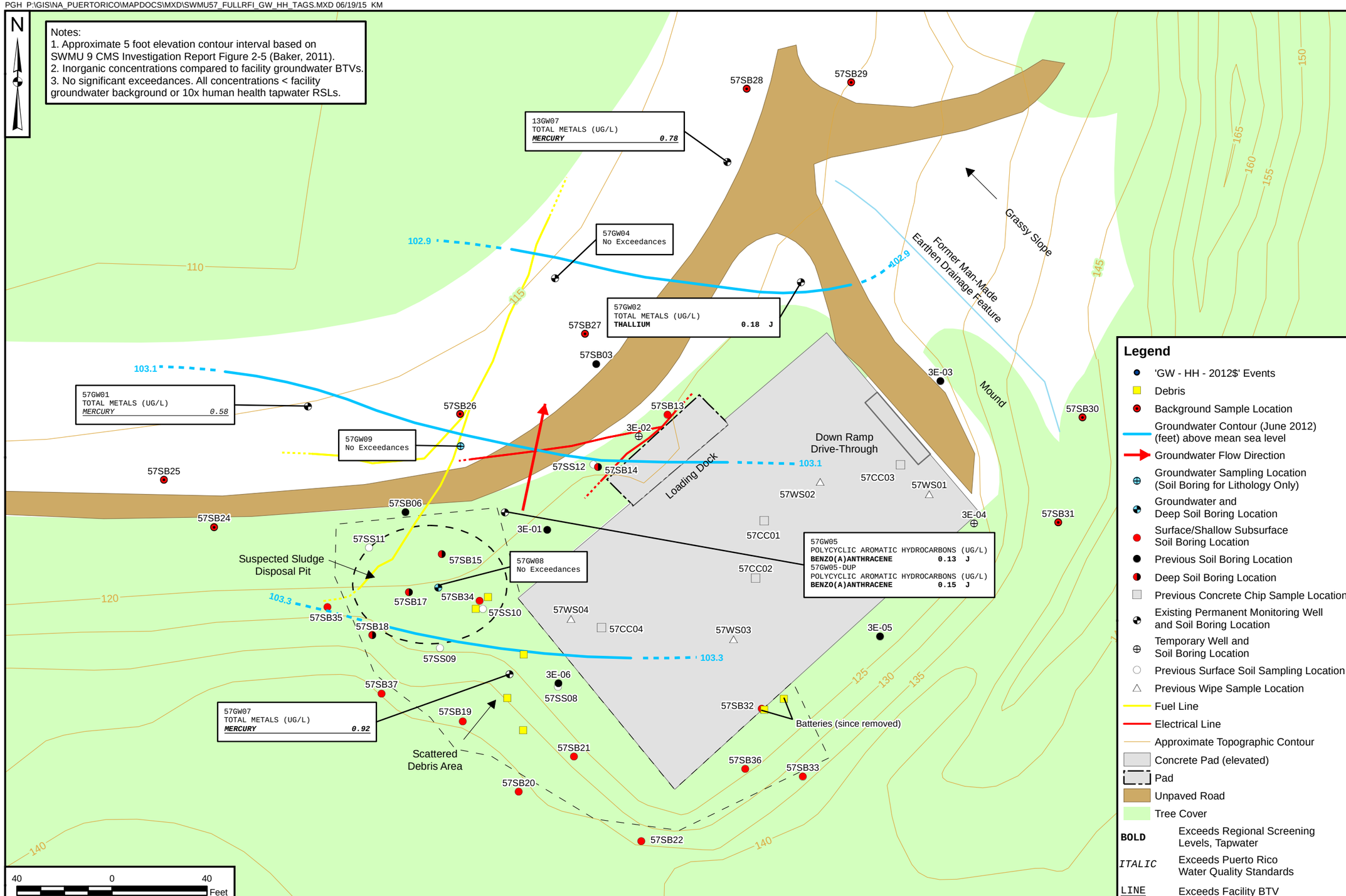

CTO NUMBER JM02 | REV 0

CONTRACT NUMBER — | APPROVED BY — DATE — | APPROVED BY — DATE —

FIGURE NO. FIGURE 4-5

DETECTIONS IN EXCESS OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND IN GROUNDWATER, FULL RFI
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PURTO RICO
CEIBA, PUERTO RICO

NAVFAC

DRAWN BY	DATE	CHECKED BY	DATE	REVISED BY	DATE	SCALE
D. COUCH	07/29/13	M. COFFMAN	06/19/15	K. MOORE	06/19/15	AS NOTED

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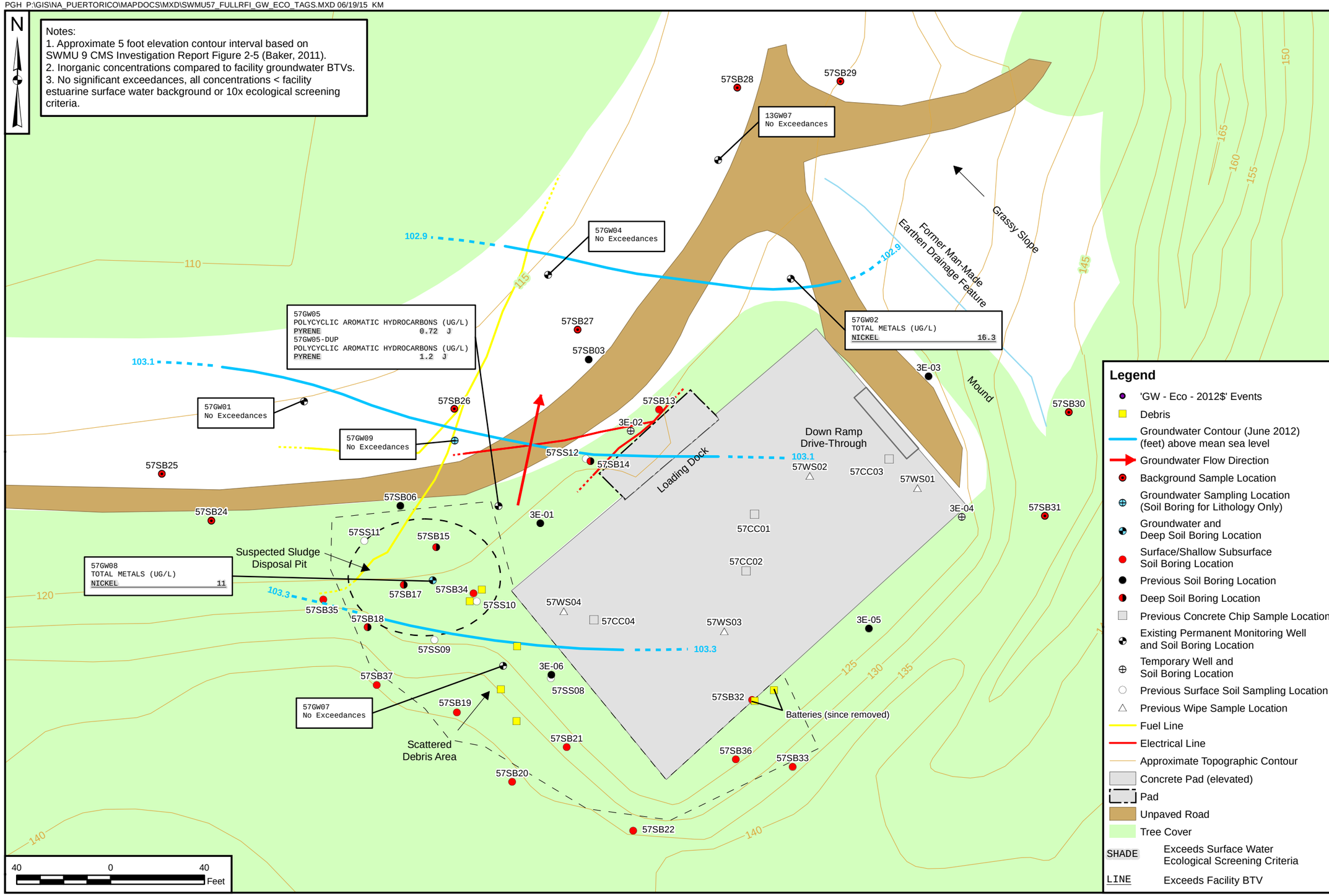

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DATE —
FIGURE NO. FIGURE 4-6
REV 0

DETECTIONS IN EXCESS OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN GROUNDWATER, FULL RFI
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PURTO RICO
CEIBA, PUERTO RICO

NAVFAC

DRAWN BY D. COUCH DATE 07/29/13
CHECKED BY M. COFFMAN DATE 06/19/15
REVISED BY K. MOORE DATE 06/19/15
SCALE AS NOTED

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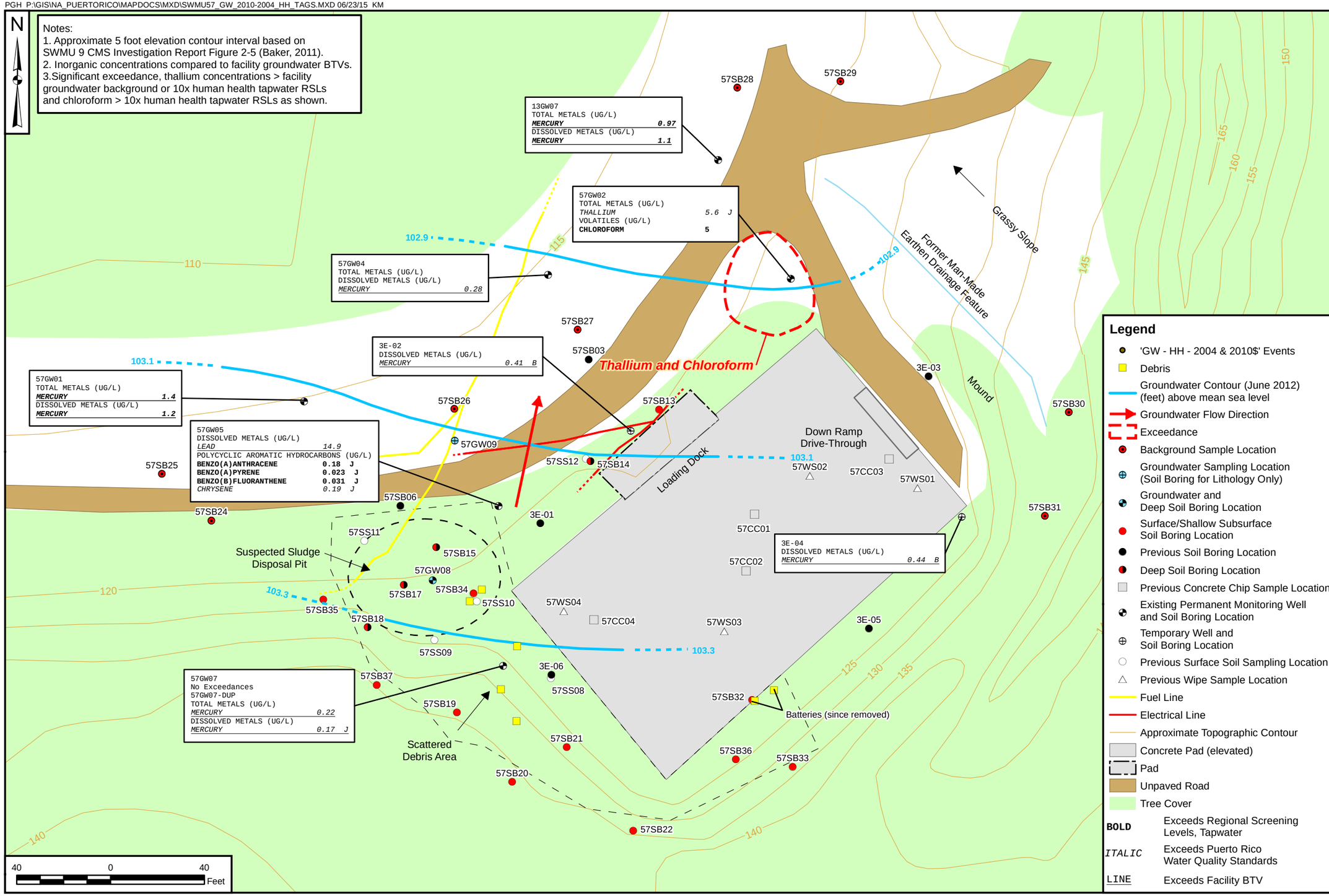

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CONTRACT NUMBER —

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FIGURE NO. FIGURE 4-7

REV 0

DETECTIONS IN EXCESS OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND IN GROUNDWATER, PHASE I RFI AND ECP
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PURTO RICO
CEIBA, PUERTO RICO

NAVFAC

DRAWN BY D. COUCH DATE 07/29/13

CHECKED BY M. COFFMAN DATE 06/23/15

REVISED BY K. MOORE DATE 06/23/15

SCALE AS NOTED

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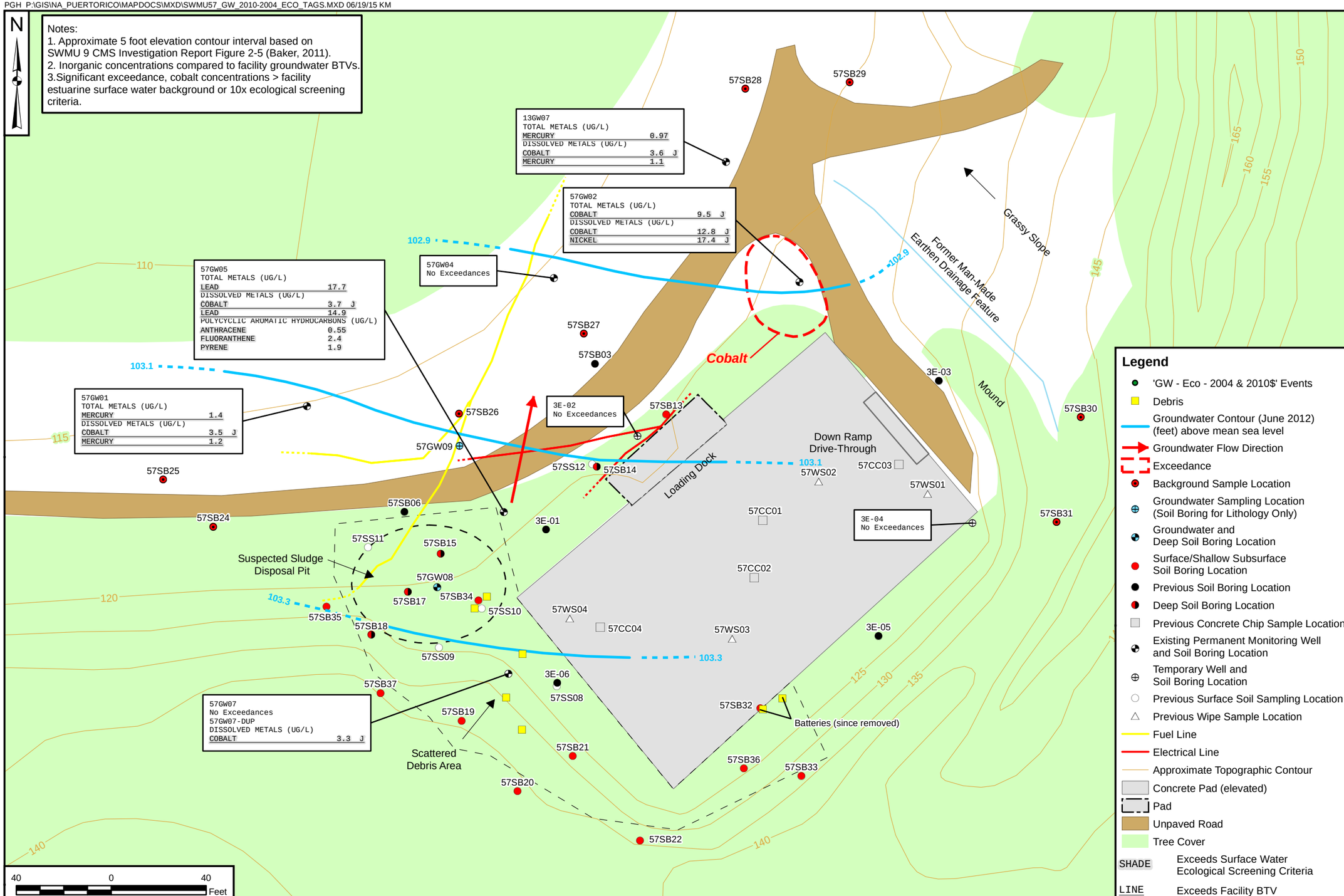

CTO NUMBER JM02

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FIGURE NO. FIGURE 4-8

REV 0

DETECTIONS IN EXCESS OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND IN GROUNDWATER, PHASE I RFI AND ECP

SWMU 57 - POL DRUM STORAGE AREA

NAVAL ACTIVITY PURTO RICO

CEIBA, PUERTO RICO

NAVFAC

DRAWN BY D. COUCH	DATE 07/29/13	SCALE AS NOTED
CHECKED BY M. COFFMAN	DATE 06/19/15	
REVISED BY K. MOORE	DATE 06/19/15	

5.0 CONTAMINANT FATE AND TRANSPORT ANALYSIS

This section discusses the evaluation of contaminant fate and transport at SWMU 57 to provide an understanding of potential contaminant migration. To support the evaluation, a discussion of the physical and chemical properties of the contaminants associated with SWMU 57 sources and their potential persistence, migration, dispersion, and degradation pathways and the CSM for contaminant migration are provided. Also, see Appendix I (Supporting Information for Ecological Risk Assessment) for additional discussion of the different chemical classes detected at the site, including toxicity information, potential food chain and trophic transfer, and bioaccumulation potential.

5.1 PHYSICAL AND CHEMICAL PROPERTIES

The persistence of various classes of contaminants and their chemical and physical properties in soil-water environments are discussed in this section. Several chemical transformation mechanisms affect contaminant persistence, including hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. The following general classes of contaminants were detected at SWMU 57:

- PAHs
- PCBs
- Pesticides
- Metals
- VOCs

5.1.1 PAHs

The class of SVOCs identified as PAHs that were detected at SWMU 57 are generally considered to be fairly immobile chemicals in the environment. PAHs are large molecules that have low solubilities, vapor pressures, and Henry's Law constants and high partitioning coefficients. The low-molecular-weight PAHs (e.g., acenaphthene, anthracene, fluorene, and phenanthrene) may volatilize from surface waters, whereas higher-molecular-weight PAHs [e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.] are less likely to volatilize. PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than through dissolution. These compounds, when found in surface soil, generally do not migrate vertically to a great extent. Instead, they are more likely to adhere to soil particles and be removed from the site via surface water runoff and erosional processes, especially when no pavement is present or if erosion controls are not present or functioning properly.

Bioconcentration of PAHs in aquatic organisms is greater for the higher-molecular-weight compounds than the lower-molecular-weight compounds. PAHs can be bioaccumulated from water, sediments, or lower organisms in the food chain. Bioaccumulation from water through biological membranes requires the chemical in the surrounding water to be available in a dissolved form. Environmental factors that reduce the amount of a chemical in true solution will also reduce the rate of uptake of the chemical. Among the most important processes that reduce bioavailability are adsorption to suspended solids, adsorption to sediments, adsorption to humic acids and other macromolecules, formation of colloidal suspensions, chelation, complexation, and ionization. Some of the bound chemicals may be available to benthic organisms through ingestion or direct uptake from pore water (Rand and Petrocelli, 1985).

PAHs are highly amenable to microbial degradation in soil and sediment. The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, 1989).

The most important fate processes for PAHs in water are photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic reactions, and hydrolysis is considered an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene, chrysene, fluorene, and pyrene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation, and they may be metabolized by microbes under oxygenated conditions (ATSDR, 1989). The mobility of PAHs via the groundwater pathway at SMWU 57 is not considered significant because PAHs were detected infrequently in groundwater.

5.1.2 PCBs

PCBs are generally inert and are relatively insoluble in water. PCBs are unlikely to migrate from soil to groundwater due to their affinity to adsorb to soil and sediment (ATSDR, 2000).

PCBs are considered to be environmentally persistent organic chemicals. Biodegradation is the major process known to transform PCBs under environmental conditions, and only the lighter isomers are measurably biodegraded (ATSDR, 2000). Although some microorganisms (e.g., the fungi *Phanaerochaete chrysosporium*) may biodegrade PCBs, such fungi may not exist in local soil. No abiotic processes are known to significantly degrade PCBs in soil and sediment (ATSDR, 2000). Base-, acid-, and neutral-promoted hydrolysis are considered to be inconsequential degradation mechanisms for PCBs (USEPA, 1982).

5.1.3 Pesticides

Three pesticides, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, were detected in SWMU 57 surface soil. Whether pesticides are sprayed, dusted, or applied directly to the soil, soil is generally the ultimate sink for these chemicals. These compounds will remain in the soil and do not leach significantly. Surface soil runoff may carry pesticides to adjacent surface water bodies where they are likely to settle in the sediment. In water, they would not be expected to biodegrade or hydrolyze to any significant extent and would likely bioconcentrate in aquatic organisms.

5.1.4 Metals

The fate and transport of metals are controlled mainly by the mobility of soil particles, dissolution into water present in the immediate environment, and geochemical reactions in soil. Metals do not undergo degradation reactions that most organic chemicals do; therefore, they are considered to be persistent. The major fate mechanisms for metals are adsorption to the soil matrix and bioaccumulation. The mobility of metals is influenced primarily by their physical and chemical properties, in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are the soil/pore water pH, soil/pore water Eh, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity.

There are some instances where metals are found at such concentrations or in such forms (e.g., oxidation states) that they may migrate in solution. It is possible that industrial activities could saturate all available exchange sites in soil and result in a metal being mobilized. Metals may also more mobile under acidic conditions or basic conditions. In these cases, it is possible for metals to migrate vertically through the soil column and reach the groundwater. Therefore, the metals detected in groundwater samples may represent the total of dissolved metals and metals adhering to any suspended soil material that may be present in the samples.

The following discussion of physical and chemical properties and general fate and transport of metals in the environment was summarized from information provided in chemical-specific Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles (September 2008). The information available on physical and chemical properties within ATSDR toxicological profiles on metals indicates that metals have low solubilities (milligrams per liter range) under controlled laboratory conditions in distilled water. However, solubilities can be significantly altered by environmental conditions (such as pH, oxidizing or reducing conditions, presence of various naturally occurring organic or inorganic chemical

species, water salinity, etc.), which can result in attenuating mechanisms such as precipitation, cation exchange, adsorption, etc. Often whether any metal is in a dissolved phase or solid phase depends on a combination of several chemical mechanisms that vary by metal and by oxidation state or valence. Acidity or alkalinity as measured by pH can directly influence the mobility of metals because metal solubilities generally increase with increasing hydrogen ion content (i.e., decreasing pH levels) and because pH may influence the intensity of reduction-oxidation reactions. Many studies have found that the predominant adsorbates of metal ions are iron and manganese oxides and organic matter such as detrial plant material and humic coatings on mineral surfaces. Metal hydroxides of iron, aluminum, and manganese are important reductive surfaces in subsurface materials with respect to interactions with charged species such as hydrogen, aluminum, cadmium, zinc, lead, and copper and with negatively charged species such as phosphate, sulfate, bicarbonate, and fluoride. The adsorption of species on oxides is strongly dependent on pH due to the variable pH-dependent surface charge and potential of metal hydroxides and due to a pH-dependent speciation of the adsorbate.

Metals are found naturally in varying concentrations in mineral ores, and consequently, anthropogenic activities (e.g., mining) or natural forces (e.g., surface water erosion, wind, etc.) tend to disperse them over large land areas. However, metals are also co-occurring constituents within the inorganic (non-combustible) fractions of fossil fuels (mainly coal and sometimes fuel oil) at various concentrations. Therefore, the combustion of fossil fuels, which has been a primary source of heat and energy, has resulted in the inadvertent concentration of these metals in the non-combustible portion of fuels (e.g., bottom ash or fly ash) at elevated levels in residential and industrial areas. Metals are also present at varying concentrations in commercial chemical products of daily industrial use. Therefore, at industrial sites, not only do operations involving combustion of fossil fuels lead to a release of metals, but operations involving plumbing (copper pipes, galvanized steel pipes, lead/tin solder, etc.), pesticide/insecticide application, paint, and preservation of wood timbers (especially in older buildings), etc., may also lead to their release.

5.1.5 VOCs

VOCs are generally more soluble in water than other chemicals and have a low capacity for retention by soil organic carbon. Therefore, VOCs are typically the most frequently detected organic chemicals in groundwater. These types of chemicals may migrate through the soil column after they are released by a spill event or by subsurface waste burial as infiltrating precipitation solubilizes them. Some fraction of these chemicals is retained by the soil, but most will continue migrating downward to the water table. At that time, migration occurs primarily laterally with the hydraulic gradient. Again, some portion of the chemical may be retained by the saturated soil.

5.2 CONCEPTUAL SITE MODEL OF CONTAMINANT MIGRATION

The CSM for SWMU 57 contaminant migration was developed based on site history and uses, site characterization (e.g., geology and hydrogeology information), and site contaminant fate and transport pathways and processes.

SWMU 57 was used for the storage of POL and other potentially hazardous materials, and numerous small spills and releases occurred throughout the usage period (1950s through 1990s). The historical drum storage and drum pad maintenance practices, such as the disposal of empty drums and other scattered debris on the hummocky, wooded, ground surface adjacent to the southwestern side of the pad led to contaminated surface soil, subsurface soil, and groundwater at SWMU 57. Contaminants released at SWMU 57 can migrate via several pathways, as discussed in Section 5.2.1. Potential exposure routes and receptors are discussed in Section 5.2.2.

5.2.1 Potential Contaminant Migration Pathways

Potential contaminant migration pathways include numerous known historical spills onto the concrete pad and possible historic spills onto the ground surface.

It is not expected that spills on the pad migrated to the ground surface because a 7-inch-high berm is present around the perimeter of the pad. However, debris from the pad may have been scraped off onto the ground surface and, if any associated contaminants were present, they may have migrated from relocated debris to surface soil via erosion or surface water runoff. Subsequently, surface soil contamination, if any, may have migrated to underlying subsurface soil, then to groundwater via infiltration.

Possible historical spills onto the ground surface, particularly spills near the loading dock that may have occurred during loading or unloading of drums, may have migrated to subsurface soil/ groundwater.

Possible residual releases from drums in the scattered debris area, if not empty at time of placement onto the ground surface, may have migrated to subsurface soils and/or groundwater.

5.2.2 Potential Exposure Routes and Receptors

Current human receptors (industrial workers, construction workers, and adolescent trespassers), pending future human receptors (industrial workers, construction workers, adolescent trespassers, adolescent and

adult recreational users, and child and adult residents) and ecological receptors may come into direct contact with surface and shallow subsurface soil and groundwater (future receptors only) at SWMU 57. Although recreational users and residents are not current receptors based on current site conditions, they are evaluated in the HHRA presented in Section 6.0 based on planned pending land use, which includes construction of the Marsh Vista Country Club including a proposed 18-hole golf course with clubhouse and 50 residential units (Navy, 2011). Ecological receptors may be exposed to contaminants that are in soil while digging for food or constructing burrows or that have been incorporated into the food chain (bioaccumulated in plants and animals). Groundwater is located approximately 13 to 20 feet bgs at SWMU 57 and groundwater is not used as a potable source of water at NAPR. Moreover, groundwater contamination detected to date is low in concentration, sporadic at the site, and limited to the area immediately adjacent to the SWMU 57 concrete pad. Based on this information, adverse human health or ecological impacts from groundwater discharge to the downgradient mangrove forest are not expected but are further evaluated in the human health and ecological risk assessments presented in Sections 6.0 and 7.0, respectively.

6.0 HUMAN HEALTH RISK ASSESSMENT

The HHRA was performed to characterize and quantify potential risks at SWMU 57 to select receptors based on current and future land use scenarios.

SWMU 57 is approximately 1.3 acres. The site consists of a large concrete pad and loading dock that is surrounded by a densely wooded area on all sides except the northern side, which is a gravel access road and turn-around that is currently overgrown with long grass. Potential receptors at SWMU 57 were identified as current/future construction workers, current/future industrial workers, current/future trespassers, future recreational users (child, adolescent, and adult), and future residents (child and adult). Risk Assessment Guidance for Superfund (RAGS)-Part D Table 1 in Appendix H-1 shows the selection of receptors and exposure pathways for evaluation in the HHRA.

Figure 6-1 shows the CSM that was developed for the SWMU 57 HHRA. The CSM indicates all of the receptors and potential pathways by which exposure could occur at SWMU 57. All receptors were evaluated for exposure to surface soil, which was defined as soil from 0 to 1 feet bgs, and subsurface soil from 1 to 3 feet bgs. All receptors were also evaluated for exposure to combined surface and subsurface soil 0 to 3 feet bgs. This was done because receptors would likely be exposed to chemicals in surface soil (0 to 1 foot bgs) if they are exposed to subsurface soil 1 to 3 feet bgs. Construction workers and future residents were also evaluated for exposure to total soil (0 to 10 feet bgs) because soil at depth may be brought to the surface. In addition, construction workers were evaluated for exposures to subsurface soil greater than 3 feet bgs, which was collected from depths ranging from 9 to 15 feet bgs, to be conservative. This was done because although it is unlikely that human receptors would be exposed to soil greater than 10 feet bgs, groundwater at SWMU 57 ranges from 13 to 20 feet bgs, and it is possible that construction could take place in the deeper unsaturated soil zone. Construction workers were also evaluated for exposures to groundwater that could be encountered during excavation activities. Residents were additionally evaluated for exposures to overburden groundwater used for domestic purposes; however, this is very conservative because overburden groundwater is not currently used for potable purposes at NAPR. Nevertheless, groundwater in Puerto Rico is classified as potable and future potable groundwater use is possible at SWMU 57, unless site-specific data demonstrates that groundwater is not potable. Future industrial receptor risks to groundwater used as a potable water supply were also evaluated. No evaluation of vapor intrusion is necessary because no sufficiently volatile and toxic chemicals were detected in groundwater at SWMU 57.

During the Full RFI sampling event, three decision units associated with soils at SWMU 57 were investigated: the loading dock area, the suspected sludge disposal pit, and the scattered debris area. The range of concentrations for the chemicals detected above residential screening levels (Aroclor-1260, benzo(a)pyrene, arsenic, cobalt, thallium, and vanadium) were compared in order to determine if the data should be evaluated as three separate decision units or as one exposure unit (EU) for SWMU 57 risk analysis. Based on the evaluation of the range of concentrations for those chemicals detected above residential screening levels, the analytical results of soil data collected from these three decision units were determined to be similar; therefore, soil samples from the three decision units were combined to represent one EU for SWMU 57 for risk analysis. Groundwater was also evaluated as one EU. The potential risks to human health at SWMU 57 are estimated based on the assumption that no actions are taken to control contaminant releases.

6.1 RISK ASSESSMENT PROCEDURES

Three major aspects of chemical contamination and exposure must be considered to assess potential public health risks: (1) contaminants with toxic characteristics must be identified in environmental media and be released by either natural processes or human action; (2) pathways by which actual or potential exposure occurs must be present; and (3) human receptors must be present at the point of exposure to complete the exposure route. Risk is a function of both toxicity and exposure; without one of the factors listed above, there is no risk. Once the three major aspects of chemical contamination and exposure identified above are considered, then the human health risk assessment process can begin.

The human risk assessment for SWMU 57 consists of the following four major components:

- Data evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization (including uncertainty analysis)

Data evaluation is primarily concerned with data usability and the selection of chemicals of potential concern (COPCs), which are those contaminants that pose the greatest potential for causing adverse human health effects. A discussion of data usability as related to the HHRA is provided in Section 6.2.1. Methods for selection of COPCs are described further in Section 6.2.2, and COPC selection tables are presented in Appendix H-1.

Exposure assessment is the process of identifying potential receptor populations and exposure pathways by which receptors may come in contact with contaminants at the site. Potential exposure routes under current and future land uses are developed from information gathered about the source area, contaminant concentrations, contaminant release mechanisms, patterns of human activity, and other pertinent information. The exposure assessment includes the methodologies used to calculate quantitative estimates of contaminant intake for each identified receptor, pathway, and route of exposure under reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios. Relevant exposure input parameters and equations used to estimate contaminant intakes are presented in Appendix H-1. The SWMU 57 exposure assessment is discussed further in Section 6.3 and Appendix H-2.

The toxicity assessment presents contaminant-specific toxicity criteria for all identified COPCs at SWMU 57. Toxicity criteria provide the basis for quantifying potential human health risks when integrated with estimated intakes developed in the exposure assessment. Toxicity assessment is further detailed in Section 6.4.

Risk characterization methodologies used to characterize risks associated with non-carcinogenic and carcinogenic effects to select receptors from exposure to COPCs are provided in Section 6.5. Various uncertainties are associated with risk characterization because the quantitative risk estimates developed are based on a number of assumptions (concerning exposure, land use, toxicity, etc.). An uncertainty analysis is provided in Section 6.6 that reviews general uncertainties associated with the risk evaluation for SWMU 57.

The HHRA for SWMU 57 was conducted with reference to current Navy, USEPA, and Puerto Rico human health risk assessment guidelines including:

- Department of Navy, December 2008. Navy Human Health Risk Assessment Guidance.

- USEPA, December 1989. Risk Assessment Guidance for Superfund - Volume I - Human Health Evaluation Manual (Part A) - Interim Final. EPA/540/1-89/002. Office of Emergency and Remedial Response.

- USEPA, February 1992. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Office of the Administrator, Washington, D.C.

- USEPA, May 1993a. Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response (OSWER), Washington, D.C.

- USEPA, July 1993b. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/R-93/089. Environmental Criteria and Assessment Office.

- USEPA, July 1994a. Revised Interim Guidance on Establishing Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9355.4-12.

- USEPA, August 1997a. Exposure Factors Handbook. EPA/600/8-89/043. Office of Health and Environmental Assessment, Exposure Assessment Group. Washington, D.C.

- USEPA, April 1999. Use of the TRW Interim Adult Lead Methodology in Risk Assessment. Memorandum from Pat Van Leewven and Paul White to Mark Maddaloni.

- USEPA, April 2002a. Role of Background in the CERCLA Cleanup Program. OSWER 9285.6-07P. Office of Solid Waste and Emergency Response, Washington, D.C.

- USEPA, May 2002b. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows 32-bit version. EPA 9285.7-42.

- USEPA, December 2002c. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. Office of Solid Waste and Emergency Response, Washington, D.C.

- USEPA, December 2002d. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response (OERR), Washington, D.C. OSWER 9285.6-10.

- USEPA, January 2003a. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Washington, DC. EPA-540-R-03-001. http://www.epa.gov/superfund/ programs/lead/adult.htm.

- USEPA, November 2003b. Assessing Intermittent or Variable Exposures at Lead Sites. Office of Solid Waste and Emergency Response, Washington, D.C. EPA-540-R03-008, OSWER #9285.7-76.

- USEPA, July 2004. Risk Assessment Guidance for Superfund, Volume I – Human Health Evaluation Manual – Part E, Supplemental Guidance for Dermal Risk Assessment – Final. Office of Superfund Remediation and Technology Innovation. EPA/540/R/99/005.

- USEPA, March 2005a. Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001B. Risk Assessment Forum, Washington, D.C.

- USEPA, March 2005b. Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. Risk Assessment Forum, Washington, D.C.

- USEPA, January 2009a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA-540-R-070-002, OSWER 9285.7-82.

- USEPA, May 2009b. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows 32-bit version. EPA 9285.7-42.

- USEPA, June 2009c. Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Baseline Geometric Standard Deviation Parameters. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA-540-R-070-002, OSWER 9200.2-82.

- PREQB, March 2010. Puerto Rico Water Quality Standards Regulation. Commonwealth of Puerto Rico.

- USEPA, May 2010a. ProUCL Version 4.1.00 User Guide. Office of Research and Development, Washington, D.C. EPA/600/R-07/038.

- USEPA, February 2010b. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows Version (IEUBK win v 1.1 Build 11).

- USEPA, September 2011. Exposure Factors Handbook: 2011 Edition. Office of Research and Development. EPA/600/R-09/052F.

- USEPA, October 2012a. Integrated Risk Information System, On-Line Data Base. Environmental Criteria and Assessment Office, Cincinnati, OH. http://www.epa.gov/iris/index.html.

- USEPA, November 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites, http://epa-prgs.ornl.gov/chemicals/index.shtml.

Deviations from the HHRA work plan are noted in Section 6.6.5 related to streamlining the process based on site conditions and nature and extent of contamination.

Analytical data for soil (surface, subsurface 1-3 feet bgs, and subsurface greater than 3 feet bgs) and groundwater used in the HHRA for SWMU 57 are expected to adequately characterize potential risks for direct and inadvertent exposure to contaminated site media. The list of COPCs was determined from data presented in Appendix E.

6.2 DATA EVALUATION

A site-specific data evaluation was performed to determine which of the detected contaminants at the site are most likely to present a risk to potential human receptors. The end result of this quantitative selection process is a list of COPCs for each environmental medium considered. Data from the following investigations were used in the HHRA for SWMU 57:

- For soil:
  - Phase I/II ECP Report (NAVFAC-LANT, 2005).
  - Final Phase I RFI Report for SWMU 57 (Baker, 2010).
  - Full RFI (Tetra Tech, 2012).

- For groundwater:
  - Full RFI (Tetra Tech, 2012).

Only the most recent groundwater data were used because these data are considered to be representative of current site conditions. Refer to Section 4.3 for a comparison of historical groundwater results with 2012 Full RFI results; a trend of lower concentrations and fewer impacted wells over time is evident.

Section 6.2.1 provides a summary of data usability for SWMU 57 as it pertains to the HHRA. The selection process used to identify COPCs is described in Section 6.2.2.

6.2.1 Data Usability

For the purposes of this risk assessment, overall data quality is sufficient to estimate site risks. The most notable anomalies were the rejection of all results for several VOC and SVOC compound results collected during the 2012 investigation (Tetra Tech 2012), and that the 2004 data (NAVFAC-LANT, 2005) was not validated in accordance with data validation guidelines used to validate other site data. The 2012 VOC and SVOC rejected compound results are additional Appendix IX compounds [i.e., not Target Compound List (TCL) analytes] that often have poor recoveries due to the chemical nature of the compounds. The majority of the VOC and SVOC analytical data used for this project has concentrations less than detection limits indicating that those fractions are not present at the site and therefore that those compounds listed above (all of which are VOC and SVOCs) with rejected data are not likely present on-site. So even though no data for several VOC and SVOC compounds was considered usable for human health risk assessment due to laboratory QC noncompliances; site data indicate that those compounds are not present on-site. For the 2004 data the laboratory did apply qualifiers to the ECP data which are different than those that were applied to the Full RFI and Phase I RFI data during validation. These laboratory qualifiers are defined on the Section 4 tables in which ECP data are presented. This is important to note because data verification was completed by the laboratory; however, it was not a rigorous as the data validation performed according to USEPA Region II data validation protocol used on the remaining data included in this risk assessment.

Data qualified during the data validation process are not expected to compromise the results of the HHRA. Analytical data qualified as rejected ("UR" or "R") were not used in the risk assessment. Analytical data qualified as estimated ("J") were used for the SWMU 57 HHRA. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared with the other uncertainties inherent in the risk evaluation process (e.g., uncertainties associated with land uses, exposure scenarios, toxicological criteria, etc.). When determining exposure concentrations via statistical procedures, the sample detection limit was used as a surrogate concentration for non-detected results (qualified "U"), as described in Section 6.3.4.

6.2.2 Selection of COPCs

The overall goal of the HHRA is to quantify risks associated with those contaminants that represent a potentially significant human health hazard on the basis of toxicity, environmental concentration, and mobility. USEPA guidance recommends focusing the risk assessment by quantifying risk only for a select list of COPCs at a site. COPCs, which are a subset of all detected contaminants in a given medium, are defined as those contaminants likely to dominate the overall potential risks for a site.

General selection criteria for inorganic and organic COPCs are discussed below:

Toxicity Screen. Current USEPA guidance recommends using the USEPA Regional Screening Level (RSL) table (USEPA, 2013) for a source of general screening criteria to be used in COPC selection. A discussion and comparison of the November 2013 RSLs to more recent RSLs published in 2015 is presented in Section 6.6. The USEPA RSL table provides soil and tap water screening levels. The USEPA RSLs for residential soil were used as the screening criteria for all receptors for soil data sets (i.e., combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs, surface, subsurface 1-3 feet bgs, and subsurface greater than 3 feet bgs) at the site. The USEPA RSLs for tap water, which are based on daily, residential exposure assumptions, were used to select COPCs for groundwater direct contact exposures. These residential criteria represent the most conservative land use scenario, and thus screening against residential criteria should be conservative for all potential future land uses. A carcinogenic contaminant detected at a maximum concentration equal to or less than the relevant USEPA RSL level was not selected as a COPC. A non-carcinogenic contaminant detected at a maximum concentration equal to or less than one-tenth of the relevant USEPA RSL value [based on a hazard quotient (HQ) of 1] was not selected as a COPC. One-tenth of the non-carcinogenic screening level (based on an HQ of 1) was used to account for potential cumulative effects of multiple compounds affecting the same target organ or producing the same target effect. Contaminants with maximum concentrations greater than the RSLs for carcinogens or one-tenth the RSLs (based on an HQ of 1) for non-carcinogens were selected as COPCs and carried through the quantitative risk assessment. TPHs were added to the RSL tables in November 2013 as six different categories: aliphatic low, aliphatic medium, aliphatic high, aromatic low, aromatic medium, and aromatic high. Soil (and groundwater samples) collected in 2010 were analyzed for petroleum hydrocarbons and results are reported as GRO, DRO, and TPH. GRO, DRO, and TPH results are not directly comparable to TPH RSLs because the method of reporting used for the 2010 results does not provide the same hydrocarbon ranges as those used for developing the RSLs; therefore, GRO, DRO, and TPH results were not compared to the various TPH fraction RSLs. Petroleum hydrocarbon detections are discussed in Section 4 and presented on the Section 4 tables. Facility background concentrations were used to screen site-specific COPCs; however, the site-specific background values were not used to screen COPCs but were used in the risk characterization to evaluate site background risks, as per agreements in the SAP worksheets. COPC selection tables are included in the RAGS-Part D tables presented in Appendix H-1.

Groundwater data were also compared to Federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) for Public Drinking Water Supplies (USEPA, 2012c) for informational purposes (i.e., MCLs were not used as screening criteria to select COPCs). Primary MCLs are

enforceable standards promulgated under the federal SDWA and are designed to be protective of human health. Primary MCLs are based on laboratory or epidemiological studies and apply to public water systems. A public water supply is defined as a system that provides water to the public for human consumption and that has at least 15 service connections or regularly serves an average of 25 individuals daily at least 60 days per year. Primary MCLs are designed for the prevention of adverse human health effects but also reflect the technical feasibility of removing a contaminant. Primary (i.e., health-based) and secondary (aesthetic-based) MCLs are promulgated under the SDWA. Primary MCLs are presented in the COPC selection table for groundwater.

Puerto Rico Water Quality Standards (PRWQS) were also used for groundwater COPC selection. PRWQS for Class SB and SC waters are presented on the COPC selection table in Appendix H-1. Class SB includes the coastal and estuarine waters not classified as Class SA or SC. Class SB also includes lagoons not classified under any other class. Class SC includes the segments of coastal and estuarine waters identified in the guidance (PREQB, 2010).

USEPA SSLs for migration of chemicals from soil to groundwater are presented on the USEPA RSL table. Chemicals with concentrations exceeding the SSLs may potentially migrate from the soil to groundwater in sufficient quantities to pose concerns regarding groundwater quality. The groundwater protection SSLs were not used to select COPCs for quantitative risk evaluation but were used to select COPCs to provide a qualitative evaluation of the potential for chemical migration from soil to groundwater. If chemicals were selected as COPCs for the migration to groundwater pathway, additional lines of evidence were considered to determine if those COPCs have impacted groundwater quality. These lines of evidence include 1) whether the COPC was detected in groundwater; 2) whether the COPC is also a groundwater COPC; and 3) whether the COPC exceeded groundwater protection risk-based SSLs and MCL-based SSLs based on a revised dilution attenuation factor (DAF).

Guidance from the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and OSWER recommends 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting where children are frequently present (USEPA, 1994a, 1994b, 2002b, 2005c). Conservatively, 400 mg/kg was used as the lead screening level for COPC selection for soil. However, guidance from the USEPA Technical Review Workgroup for lead indicates that “a reasonable screening level for soil lead at commercial/industrial (i.e., non-residential) sites is approximately 800 mg/kg for a typical non-contact intensive worker” (USEPA, 2009c). The USEPA RSL table lists 800 mg/kg as the RSL for lead in soil assuming an industrial land use scenario. This value, calculated using USEPA’s Adult Lead Model, is protective of a fetus carried by a pregnant female worker, and it is assumed that this value is also

protective of adult male and female workers. The SDWA Action Level for lead (15 µg/L) will be used as the screening level for lead in groundwater.

Chromium speciation data are not available in the data sets used in this HHRA. Toxicity criteria for trivalent chromium were used to evaluate total chromium in the toxicity screen. This was done because available site history does not indicate that hexavalent chromium would be the dominant species of chromium present at the site and evaluating chromium data as such would bias site risks unrealistically high as hexavalent chromium is far more toxic than trivalent chromium. In most soils, chromium will be present predominantly in the chromium(III) state (ATSDR, 2012). Organic matter in soil is expected to convert soluble chromate, chromium(VI), to insoluble chromium(III) oxide, Cr_2O_3 (ATSDR, 2012). This form of chromium has very low solubility and low reactivity resulting in low mobility in the environment and low toxicity in living organisms (ATSDR, 2012). The soils at SWMU 57 are sandy or clayey and contain organic materials from decaying trees and are underlain by coral, shells, and marl at varying depths; therefore, organic matter is present to convert soluble Cr(VI) to Cr(III). Additionally, chromium was not detected in groundwater. Section 6.4 contains a discussion of the toxicity criteria used for chromium in the quantitative HHRA. Uncertainty associated with the toxicity criteria for chromium is discussed in the uncertainty analysis (Section 6.6).

Facility BTVs for metals are available for some of the data sets evaluated. When applicable, facility BTVs are presented on the COPC selection tables for informational purposes; however, facility BTVs were not used to eliminate chemicals from COPC selection. Chemicals detected at concentrations exceeding COPC screening levels but less than facility BTVs are discussed in the site-specific risk assessment presented in Section 6.5.9.

Soil exposures for SWMU 57 were evaluated using five data sets: 1) a combined surface and subsurface soil 0 to 3 feet bgs data set, 2) a combined surface and subsurface soil 0 to 10 feet bgs data set, 3) a surface soil (0 to 1 foot bgs) data set, 4) a subsurface 1-3 feet bgs data set, and 5) a subsurface soil greater than 3 feet bgs data set. However, it should be noted that the depths of the samples included in the greater than 3 feet bgs subsurface soil data set range from 9 to 15 feet bgs. One data set was used for evaluating exposures to groundwater at SWMU 57.

The selection of COPCs for each environmental medium is summarized in the remainder of this section.

6.2.2.1 Soil

Direct Contact COPCs for Combined Surface and Subsurface Soil 0 to 3 feet bgs

RAGS-Part D Table 2.1, presented in Appendix H-1, shows the results of the comparison of maximum detected concentrations in combined surface and subsurface soil 0 to 3 feet bgs at SWMU 57 to screening levels based on USEPA RSLs for residential soil. The following chemicals were selected as surface soil COPCs because their maximum concentrations in combined surface and subsurface soil 0 to 3 feet bgs exceeded screening criteria based on USEPA RSLs for residential soil:

- Metals: arsenic, cobalt, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)pyrene.

Groundwater Protection COPCs for Combined Surface and Subsurface Soil 0 to 3 feet bgs

RAGS-Part D Table 2.2, presented in Appendix H-1, shows the results of the comparison of maximum detected concentrations in combined surface and subsurface soil 0 to 3 feet bgs at SWMU 57 to USEPA SSLs for migration of chemicals from soil to groundwater. The following chemicals were selected as surface soil COPCs because their maximum concentrations in surface soil exceeded USEPA SSLs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- Pesticides: 4,4'-DDD.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.
- SVOCs: bis(2-ethyhexyl)phthalate.
- Volatiles: 2-hexanone, benzene, bromomethane, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

Direct Contact COPCs for Surface Soil

RAGS-Part D Table 2.3, presented in Appendix H-1, shows the results of the comparison of maximum detected surface soil concentrations at SWMU 57 to screening levels based on USEPA RSLs for residential soil. The following chemicals were selected as surface soil COPCs because their maximum concentrations in surface soil exceeded screening criteria based on USEPA RSLs for residential soil:

- Metals: arsenic, cobalt, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)pyrene.

Groundwater Protection COPCs for Surface Soil

RAGS-Part D Table 2.4, presented in Appendix H-1, shows the results of the comparison of maximum detected surface soil concentrations at SWMU 57 to USEPA SSLs for migration of chemicals from soil to groundwater. The following chemicals were selected as surface soil COPCs because their maximum concentrations in surface soil exceeded USEPA SSLs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- Pesticides: 4,4'-DDD.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.
- SVOCs: bis(2-ethyhexyl)phthalate.
- Volatiles: 2-hexanone, benzene, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

Direct Contact COPCs for Subsurface Soil 1 to 3 feet bgs

RAGS-Part D Table 2.5, presented in Appendix H-1, shows the comparison of maximum detected subsurface soil concentrations at SWMU 57 to screening levels based on USEPA RSLs for residential

soil. The following chemicals were selected as COPCs for subsurface soil 1 to 3 feet bgs because their maximum concentrations exceeded screening criteria based on USEPA RSLs for residential soil:

- Metals: arsenic, cobalt, thallium, and vanadium.
- PAHs: benzo(a)pyrene.

Groundwater Protection COPCs for Subsurface Soil 1 to 3 feet bgs

RAGS-Part D Table 2.6, presented in Appendix H-1, shows the comparison of maximum concentrations detected in subsurface soil from 1 to 3 feet bgs at SWMU 57 to SSLs for migration of chemicals from soil to groundwater. The following chemicals were selected as groundwater protection COPCs for subsurface soil 1 to 3 feet bgs because their maximum concentrations exceeded USEPA SSLs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, and naphthalene.
- VOCs: benzene, bromomethane, carbon tetrachloride, and chloroform.

Direct Contact COPCs for Subsurface Soil Greater than 3 feet bgs

RAGS-Part D Table 2.7, presented in Appendix H-1, shows the comparison of maximum detected subsurface soil concentrations at SWMU 57 to screening levels based on USEPA RSLs for residential soil. The following chemicals were selected as COPCs for subsurface soil greater than 3 feet bgs because their maximum concentrations exceeded screening criteria based on USEPA RSLs for residential soil:

- Metals: arsenic, cobalt, thallium, and vanadium.

Groundwater Protection COPCs for Subsurface Soil Greater than 3 feet bgs

RAGS-Part D Table 2.8, presented in Appendix H-1, shows the comparison of maximum concentrations detected in subsurface soil greater than 3 feet bgs at SWMU 57 to USEPA SSLs for residential soil. The following chemicals were selected as COPCs for subsurface soil greater than 3 feet bgs because their maximum concentrations exceeded USEPA SSLs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc.

Direct Contact COPCs for Combined Surface and Subsurface Soil 0 to 10 feet bgs

RAGS-Part D Table 2.9, presented in Appendix H-1, shows the results of the comparison of maximum detected concentrations in combined surface and subsurface soil 0 to 10 feet bgs at SWMU 57 to screening levels based on USEPA RSLs for residential soil. The following chemicals were selected as surface soil COPCs because their maximum concentrations in combined surface and subsurface soil 0 to 10 feet bgs exceeded screening criteria based on USEPA RSLs for residential soil:

- Metals: arsenic, cobalt, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)pyrene.

Groundwater Protection COPCs for Combined Surface and Subsurface Soil 0 to 10 feet bgs

RAGS-Part D Table 2.10, presented in Appendix H-1, shows the results of the comparison of maximum detected concentrations in combined surface and subsurface soil 0 to 10 feet bgs at SWMU 57 to USEPA SSLs for migration of chemicals from soil to groundwater. The following chemicals were selected as surface soil COPCs because their maximum concentrations in surface soil exceeded USEPA SSLs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, vanadium, and zinc.
- PCBs: Aroclor-1260.
- Pesticides: 4,4'-DDD.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.
- SVOCs: bis(2-ethyhexyl)phthalate.
- Volatiles: 2-hexanone, benzene, bromomethane, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

6.2.2.2 Direct Contact COPCs for Groundwater

Groundwater COPC selection, presented in Appendix H-1 RAGS-Part D Table 2.11, was based upon the maximum concentration of a chemical detected in groundwater exceeding any one of the groundwater screening criteria (USEPA RSLs for tap water and PRWQS) and facility background. Unfiltered groundwater data were evaluated during the groundwater COPC selection process. The following chemicals were selected as COPCs for groundwater because their maximum concentrations exceeded one or more screening criteria:

- Metals: arsenic, cadmium, cobalt, copper, mercury, nickel, thallium, and vanadium.
- PAHs: benzo(a)anthracene.

6.3 EXPOSURE ASSESSMENT

The exposure assessment defines and evaluates the exposures experienced by likely receptor populations at a site. The exposure assessment consists of several subsections that characterize the physical site setting and potential receptors of concern. Additionally, the exposure assessment identifies the potential contaminant migration and exposure pathways, defines the contaminant concentrations at the point of exposure, and presents the exposure assumptions used to quantify exposure in terms of contaminant intake (dose). Appendix H-2 of this report includes the intake equations and sample calculations for the quantification of contaminant intakes. Spreadsheets presented in Appendix H-1 include the contaminant-specific intakes for each receptor and medium evaluated for SWMU 57. A summary of potential exposure pathways is provided in RAGS-Part D Table 1 in Appendix H-1. RAGS-Part D Table 3s in Appendix H-1 present the exposure point concentrations (EPCs) calculated for the COPCs. RAGS-Part D Table 4s in Appendix H-1 provide the exposure parameters used to calculate the contaminant-specific intakes.

6.3.1 Exposure Setting

Site background and history, and a description of sources of environmental contamination, contaminant release mechanisms, and transport/migration pathways are provided in Sections 1.0 and 5.0, respectively, of this report. Background data sets (facility and site-specific) are discussed in Section 4.0. A description of SWMU 57 is presented in Section 3.0.

6.3.1.1 Potential Exposure Routes

Potential receptors can come into contact with contaminants in many ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. For the purposes of this assessment an exposure route is defined as a description of the behavior that brings a receptor into contact with a contaminated medium. The CSM for SWMU 57 that displays the HHRA potential exposure routes is presented on Figure 6-1.

6.3.1.1.1 Air

The air pathway is based on the scenario that a receptor inhales air that contains suspended particulates and/or volatile organic vapors originating from the source area. However, exposures to volatile organic vapors were not evaluated for SWMU 57 because there were no volatile chemicals selected as COPCs in soil.

The release of contaminants from subsurface soil via fugitive dust is not expected at SWMU 57 under current land use conditions. The release of subsurface soil contaminants to the atmosphere can only occur as a result of ground-intrusive activities. Subsurface soil risk due to fugitive dust was evaluated for current/future construction worker exposed to subsurface soil from 1 to 3 feet bgs and subsurface soil greater than 3 feet bgs. Risk due to fugitive dust for current/future industrial workers, current/future trespassers, future recreational users, and future residents exposed to COPCs in subsurface soil 1 to 3 feet bgs was evaluated to be conservative. Risk due to fugitive dust for all receptors exposed to surface soil or to combined surface and subsurface soil 0 to 3 feet bgs was also evaluated. In addition, risk due to fugitive dust for construction workers and future residents exposed to combined surface and subsurface soil 0 to 10 feet bgs was also evaluated.

6.3.1.1.2 Ingestion of and Dermal Contact with Soil

Potential receptors may come into direct contact with soil affected by the release of contaminants from the source area. During the receptor's period of contact, the individual may be exposed via inadvertent ingestion of a small amount of soil or via dermal absorption of contaminants from the soil.

Dermal contact with contaminants detected in the soil may or may not result in a significant exposure. For contaminants to be percutaneously absorbed, they must first desorb from soil and diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness,

temperature, hydration, etc.), volatilization losses, and contaminant-specific properties. Dermal and ingestion exposures to contaminants in soil were evaluated quantitatively for this risk assessment.

6.3.1.1.3 Ingestion, Dermal Contact, and Inhalation of Volatiles from Groundwater

Groundwater is currently not used as a potable water supply at NAPR due to a combination of low yield and concentrations of total dissolved solids (TDS) that are greater than EPA's secondary drinking water standard for TDS (CH2MHill, 2012). However, treatment technologies do exist for TDS; therefore, future potable use of groundwater is possible. Nevertheless, groundwater in Puerto Rico is classified as potable and future potable groundwater use is possible at SWMU 57, unless site-specific data demonstrates that groundwater is not potable. Consequently, residential exposure to groundwater is very unlikely; however, risks due to residential exposure to groundwater were estimated in this HHRA to be conservative. Future industrial receptor risks to groundwater used as a potable water supply were also evaluated as part of the uncertainty analysis (Section 6.6). Incidental ingestion that may occur for construction workers encountering groundwater in an excavation trench was also evaluated.

Dermal contact with groundwater was evaluated for residents using groundwater as a domestic water source; however, this is very conservative because groundwater is not used as a potable water source at NAPR. Future industrial receptor risks to groundwater used as a potable water supply were also evaluated as part of the uncertainty analysis (Section 6.6). It was also assumed that construction workers may come into contact with groundwater during excavation activities or repair of utility lines; therefore, dermal contact exposure to groundwater was evaluated for current and future construction workers.

Volatile chemicals were not detected in site groundwater; therefore, quantitative risk evaluation of inhalation of volatiles in groundwater for residents (e.g., during showering/bathing) and for construction workers (e.g., in an excavation trench) was not necessary for SWMU 57.

6.3.2 Potential Receptors

Potential receptors were identified for both current and future land use conditions by analyzing current land use practices, possible future land use, and identified sources of contamination. Construction workers, industrial workers, and adolescent trespassers are considered to be potential human receptors for SWMU 57 under current and future land use.

Construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, and adult), and future residents (child and adult) may be potential receptors under future land use. Although current land use does not include residential land use, pending future land use consists of

construction of the Marsh Vista Country Club with a proposed 18-hole golf course with clubhouse as well as 50 residential units (Navy, 2011) and so recreational users and future residents were evaluated to aid in risk management decisions.

6.3.3 Exposure Pathways

The basic exposure assessment assumptions for SWMU 57 are as follows:

- The receptors evaluated include child, adolescent, adult, and lifelong recreational users; child, adult, and lifelong residents; industrial workers (e.g., the typical industrial/commercial workers performing routine activities), adolescent trespassers, and construction workers (e.g., remediation and excavation).

- The exposure routes include ingestion, dermal contact, and inhalation of air/dust particulates for soil, and ingestion of and dermal contact with groundwater. The potentially complete exposure pathways are summarized in the following table and discussed in Appendix H-2.

Potentially Complete Exposure Pathways	
Receptors	**Exposure Routes(1)(2)(3)(4)**
Construction Workers (current/future)	Soil Ingestion – (surface, subsurface 1-3 feet bgs, and subsurface greater than 3 feet bgs) Soil Dermal Contact (surface, subsurface 1-3 feet bgs, and subsurface greater than 3 feet bgs) Inhalation of Air/Dust Particulates (surface, subsurface 1-3 feet bgs, and subsurface greater than 3 feet bgs) Ingestion of Groundwater Dermal Contact with Groundwater
Industrial Worker (current/future)	Soil Ingestion – (surface and subsurface 1-3 feet bgs) Soil Dermal Contact (surface and subsurface 1-3 feet bgs) Inhalation of Air/Dust Particulates (surface and subsurface 1-3 feet bgs) Ingestion of Groundwater (future scenario)(5) Dermal Contact with Groundwater (future scenario)(5)

Potentially Complete Exposure Pathways	
Receptors	**Exposure Routes(1)(2)(3)(4)**
Adolescent Trespasser (current/future)	Soil Ingestion – (surface and subsurface 1-3 feet bgs) Soil Dermal Contact (surface and subsurface 1-3 feet bgs) Inhalation of Air/Dust Particulates (surface and subsurface 1-3 feet bgs)
Recreational Users (future)	Soil Ingestion – (surface and subsurface 1-3 feet bgs) Soil Dermal Contact (surface and subsurface 1-3 feet bgs) Inhalation of Air/Dust Particulates (surface and subsurface 1-3 feet bgs)
Residents (future)	Soil Ingestion – (surface and subsurface 1-3 feet bgs) Soil Dermal Contact (surface and subsurface 1-3 feet bgs) Inhalation of Air/Dust Particulates (surface and subsurface 1-3 feet bgs) Ingestion of Groundwater Dermal Contact with Groundwater

1 A combined surface and subsurface soil 0 to 3 feet bgs data set was also evaluated for all receptors. Additionally, a combined 0 to 10 feet bgs data set was evaluated for construction workers and residents.
2 Receptors were not evaluated for inhalation exposures to vapors in soil because no volatile chemicals were selected as direct-contact COPCs.
3 Construction workers were not evaluated for inhalation of volatiles in a trench and residents were not evaluated for inhalation of volatiles while showering because no sufficiently volatile and toxic chemicals were detected in groundwater.
4 Industrial workers and residents were not evaluated for exposures to vapors entering a building via vapor intrusion because no sufficiently volatile and toxic chemicals were detected in groundwater.
5 The evaluation of industrial workers exposed to groundwater is included in Section 6.6 (uncertainty analysis).

6.3.4 Exposure Point Concentrations

The following items summarize the protocol used in calculating EPCs for SWMU 57 media.

For soil EPCs, if the data set contained 5 or more analytical results, the 95-percent Upper Confidence Limit (UCL) on the mean was calculated and used as the EPC, unless the 95-percent UCL value exceeded the maximum detected concentration. In this case, the maximum detected concentration was used as the EPC for the RME and CTE scenarios. Use of the maximum value is recommended for small data sets because it is often difficult to define the distribution of a data set when fewer than five samples are available. The maximum concentration was also used as the EPC if there were few (i.e., less than

four) positive detections in a data set, in accordance with USEPA guidance (USEPA, 2010a). The EPCs for evaluating exposure to fugitive dust are presented on the RAGS Part D Table 7s in Appendix H-1.

For groundwater, the maximum detected concentration was used as the EPC. This was done to be conservative, as using the maximum concentration as the EPC assumes that receptors are exposed to the greatest concentration at the site for the entire exposure duration, which is unlikely.

The 95-percent UCLs on the mean for all COPCs were calculated following USEPAs Calculating UCLs for EPCs at Hazardous Waste Sites (USEPA, 2002d) and using USEPA's ProUCL (Version 4.1.01) software (USEPA, 2010a). The sample detection limit was used as an input for non-detected results in the EPC calculations. Averages of original and duplicate samples were not used in the calculation of EPCs for site media. Instead, the greater of the result from the original and duplicate sample was used as an input to ProUCL. Non-detected results were evaluated using the procedures in ProUCL. Appendix H-3 contains ProUCL output files.

EPCs for direct-contact COPCs selected for SWMU 57 are summarized in RAGS-Part D Tables 3.1 through 3.6 presented in Appendix H-1.

6.3.5 Quantification of Exposure

Exposure intakes for the identified potential receptor groups were calculated using current USEPA risk assessment guidance (USEPA, 1993a, 1997a, 2004, and 2009a). Site-specific values and details on the rationale for the selection of these values are included in Appendix H-2. Estimates of exposure are based on contaminant concentrations at exposure points and on scenario-specific assumptions and intake parameters. In general, standard default parameters that combine mid-range and upper-end exposure factors were used to assess the RME. CTE was assessed primarily by the use of mid-range exposure factors presented in current risk assessment guidance (USEPA, 1993b). The same EPCs and equations were used to estimate intakes under the CTE scenario, but exposure input parameters (e.g., exposure frequencies) were modified to reflect average case exposure. The exposure parameters used for the CTE calculations reflect the latest USEPA guidance (see RAGS-Part D Table 4s in Appendix H-1). Therefore, the exposure factors for the CTE differed from those used for the RME, but in accordance with current USEPA guidance, the EPCs were the same for the RME and CTE scenarios.

The most recent USEPA guidance was used to estimate intakes. USEPA guidance used for this risk assessment includes USEPA Soil Screening Guidance (USEPA, 2002c), USEPA Exposure Factors

Handbook (USEPA, 1997a), USEPA Child-Specific Exposure Factors Handbook (USEPA, 2008a), and the July 2004 Final USEPA Dermal Guidance (USEPA, 2004).

Exposure intake parameters were used in the equations presented in Appendix H-2 along with the EPCs previously defined to estimate contaminant intakes. Individual contaminant intakes for each receptor/exposure route combination at SWMU 57 are presented in the risk assessment spreadsheets in Appendix H-1. Example calculations are provided in Appendix H-2.

6.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to identify the potential adverse health effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COPCs. Quantitative toxicity values determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate non-carcinogenic health effects for ingestion and dermal exposures is the reference dose (RfD). The reference concentration (RfC) is used to evaluate non-carcinogenic health effects for inhalation exposures. RfDs and RfCs are estimates of the daily exposure level for the human population that are likely to be without appreciable risk during a portion or all of a lifetime. They are based on a review of available animal and/or human toxicity data, with adjustments for various uncertainties associated with the data. Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures and inhalation unit risk (IUR) for inhalation exposures, which is a plausible upper-bound estimate of the probability of development of cancer per unit intake of contaminant over a lifetime. It is based on available dose-response data from human and/or animal studies.

6.4.1 Toxicity Criteria for Oral and Inhalation Exposures

Oral RfDs and CSFs and inhalation RfCs and IURs used in this risk assessment were obtained from the following primary USEPA literature sources (USEPA, 2003c):

- Integrated Risk Information System (IRIS).
- USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk

Technical Support Center develops PPRTVs on a contaminant-specific basis when requested by USEPA's Superfund program.

- Other toxicity values – These sources include but are not limited to California Environmental Protection Agency toxicity values, Agency for Toxic Substances and Disease Registry (ATSDR) values, and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Although toxicity criteria can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated, and the presented values have been verified by USEPA. The USEPA RSL table may also be used as a source of toxicity criteria. This table is updated several times a year and reflects recent changes in IRIS. A discussion and comparison of the November 2013 RSLs which were used in this risk assessment to more recent RSLs published in 2015 is presented in Section 6.6. The toxicity criteria for the constituents selected as COPCs are presented in RAGs Part D Tables 5 and 6 presented in Appendix H-1.

6.4.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in the literature are frequently expressed as administered doses; therefore, these values are considered inappropriate for estimating risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before comparisons to estimated dermal exposure intakes are made.

When oral absorption is essentially complete (i.e., 100 percent), the absorbed dose is equivalent to the administered dose, and no toxicity adjustment is necessary. Conversely, when the gastrointestinal absorption of a contaminant is poor (e.g., 1 percent), the absorbed dose is smaller than the administered dose; thus, toxicity factors based on absorbed dose should be adjusted to account for the difference in the absorbed dose relative to the administered dose. USEPA (2004) recommends a cutoff of 50 percent absorption to reflect the intrinsic variability in the analysis of absorption studies. Therefore, the adjustment from administered to absorbed dose was only performed when the contaminant-specific gastrointestinal absorption efficiency was less than 50 percent. The adjustment from administered to absorbed dose was made using contaminant-specific gastrointestinal absorption efficiencies published in available guidance [i.e., USEPA, 2004 (the primary reference); USEPA, 1989, 2008a, 2009a] and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) \ / \ (ABS_{GI})$$

where:	ABS_{GI}	=	absorption efficiency in the gastrointestinal tract
	RfD_{dermal}	=	RfD for the dermal route of exposure
	RfD_{oral}	=	RfD for the oral route of exposure
	CSF_{dermal}	=	CSF for the dermal route of exposure
	CSF_{oral}	=	CSF of the oral route of exposure

If contaminant-specific gastrointestinal absorption efficiencies were not available, then complete oral absorption was assumed and the oral toxicity values were not adjusted for dermal absorbed doses. The contaminant-specific absorption efficiencies used in this HHRA are presented in RAGS-Part D Tables 5.1 and 6.1 in Appendix H-1.

6.4.3 Toxicity Criteria for Carcinogenic Effects of PAHs

Risk estimates for PAHs have, in the past, assumed that all PAHs have a potency equal to that for benzo(a)pyrene. Whereas benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF. USEPA has since published provisional guidance to assess PAHs (USEPA, 1993b). Estimated orders of potential potency Toxicity Equivalence Factors (TEFs) were developed and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin).

USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005a) and Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b) specify the use of age dependent adjustment factors (ADAFs) for carcinogens that act via a mutagenic mode of action. Carcinogenic PAHs are included in the group of contaminants that have been determined to act via the mutagenic mode of action. No contaminant-specific ADAFs have been derived for carcinogenic PAHs; therefore, the following default ADAFs were used: 10 for ages 0 to 2, 3 for ages 2 to 16, and 1 (no adjustment) for ages 16 to 70.

6.5 RISK CHARACTERIZATION

This section provides the methodologies used for the characterization of potential human health risks associated with exposure to SWMU 57 COPCs. Potential human health risks resulting from exposure to COPCs are estimated using algorithms established by USEPA (USEPA, 1989). The methods described by USEPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of contaminant concentration, human exposure parameters, and toxicity. Quantitative risks were first calculated including all chemicals

that exceeded screening criteria (i.e., without considering facility background screening). Quantitative risks were then calculated excluding chemicals that were selected as COPCs but were less than facility background screening in order to provide estimates of site-specific risks; a discussion of site-specific risks is also presented in this section. This is because chemicals with concentrations exceeding screening levels but that do not exceed facility background are likely representative of regional contamination and not site conditions. Therefore, this section provides also provides estimates for site-related contaminants at SWMU 57. However, as noted previously, no facility background values were used for COPC selection for the combined surface and subsurface soil data sets 0 to 3 feet bgs and 0 to 10 feet bgs because no combined surface and subsurface soil facility background values are available. Uncertainty associated with the lack of facility background values for the combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs data sets is discussed in Section 6.6.

Risks from hazardous contaminants are calculated for carcinogenic and non-carcinogenic effects. For carcinogenic contaminants that exhibit non-carcinogenic effects, potential impacts were characterized for both types of health effects. Section 6.5.1 defines the characterization methodology for carcinogenic effects. The methodology for non-carcinogenic effects is described in Section 6.5.2.

6.5.1 Carcinogenic Effects

Quantitative estimates of risk for contaminants other than lead were calculated according to risk assessment methods outlined in USEPA guidance (USEPA, 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as incremental lifetime cancer risks (ILCRs), based on CSFs and IURs.

ILCR estimates for ingestion and dermal exposures were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

If the above equation resulted in an ILCR greater than 0.01, the following equation was used:

$$\text{ILCR} = 1\text{-}[\exp(\text{-Estimated Exposure Intake})(\text{CSF})]$$

This is consistent with the linear low-dose model.

ILCR estimates for inhalation exposures were generated for each COPC using estimated exposure concentrations and published IURs, as follows:

$$ILCR = (IUR)(Exposure\ Concentration)(1{,}000\ \mu g/mg)$$

Estimated ILCRs are compared with the USEPA target risk range, 10^{-6} to 10^{-4}. Risks less than 10^{-6} (a risk less than 1 in 1 million) are generally considered to be "acceptable" by USEPA, whereas risks greater than 10^{-4} (1 in 10,000) are generally considered to be "unacceptable" by the agency. Depending on the risk management goals for the site, risks within 10^{-6} to 10^{-4} are also typically regarded as "acceptable."

6.5.2 Non-Carcinogenic Effects

Non-carcinogenic risks were assessed using the concept of hazard quotients (HQs) and hazard indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD and is calculated for ingestion and dermal exposures as follows:

$$HQ = (Estimated\ Exposure\ Intake)/(RfD)$$

For inhalation exposures, HQ is calculated as follows:

$$HQ = (Exposure\ Concentration)/(RfC)$$

An HI is generated by summing the individual HQs for all the COPCs. If the HI exceeds 1, a potential exists for non-carcinogenic (toxic) effects to occur. When the HI exceeds 1, it is necessary to segregate the HQs by target-organ effects because the HQs for all non-carcinogens are not considered to be truly additive unless similar target organs are affected. If the HI for an individual target organ exceeds 1, a potential exists for adverse non-carcinogenic health effects.

The estimation of non-carcinogenic effects (i.e., the calculation of HQs/HIs) should not be construed as a probability in the manner of the ILCR, but rather a numerical indicator of the extent to which a predicted intake exceeds, or is less than, an RfD.

6.5.3 Quantitative Risk Estimates – RME Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

Quantitative risk estimates for potential human receptors were developed for those contaminants identified as direct contact COPCs. Potential non-carcinogenic and carcinogenic risks for construction

workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and child and adult residents under the RME scenario using the combined surface and subsurface soil 0 to 3 feet bgs data set are summarized in Table 6-1. Risks for each receptor are summed across all applicable exposure routes. Risk spreadsheets containing the detailed contaminant-specific risks calculated for SWMU 57 are included in Appendix H-1. A discussion of the estimated non-carcinogenic and carcinogenic risks is provided in the remainder of this section.

Non-Carcinogenic Risks – RME Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

The cumulative HIs calculated for construction worker, industrial worker, adolescent trespasser, child, adolescent, and adult recreational users, and adult residents exposure to combined surface and subsurface soil 0 to 3 feet bgs, subsurface soil greater than 3 feet bgs (for construction workers only), and groundwater (for construction workers and residents) are less than or equal to 1, indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure scenario. The cumulative HI calculated for child residents exposure to combined surface and subsurface soil 0 to 3 feet bgs and groundwater exceeds 1 (HI = 3). The medium-specific HI for groundwater (HI = 3) exceeds 1; however, target organ HIs are less than or equal to 1. Therefore, adverse non-carcinogenic effects are not anticipated for child residents under the defined exposure scenario.

Carcinogenic Risks – RME Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

Carcinogenic risks estimated for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME conditions is below or within USEPA's acceptable range.

6.5.4 Quantitative Risk Estimates - CTE Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

An evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenario using the combined surface and subsurface soil 0 to 3 feet bgs data set are presented in Table 6-2.

Non-Carcinogenic Risks – CTE Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

Cumulative HIs estimated for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and child and adult residents exposed to combined surface and subsurface soil 0 to 3 feet bgs, subsurface soil greater than 3 feet bgs (for construction workers only), and groundwater (for construction workers and residents) under the CTE scenario are less than or equal to 1. Therefore, no adverse non-carcinogenic effects are anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks – CTE Evaluation – Combined Surface and Subsurface Soil 0 to 3 feet bgs

For the CTE, the cumulative ILCRs for construction workers, industrial workers, adolescent trespassers, recreational users (adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within USEPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under CTE conditions are below or within USEPA's acceptable range.

6.5.5 Quantitative Risk Estimates – RME Evaluation – Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

Quantitative risk estimates for potential human receptors were developed for those contaminants identified as direct contact COPCs. Potential non-carcinogenic and carcinogenic risks for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and child and adult residents under the RME scenario using the separate surface soil (0 to 1 foot bgs) and subsurface soil (1 to 3 feet bgs) data sets are summarized in Table 6-3. Risks for each receptor are summed across all applicable exposure routes. Risk spreadsheets containing the detailed contaminant-specific risks calculated for SWMU 57 are included in Appendix H-1. A discussion of the estimated non-carcinogenic and carcinogenic risks is provided in the remainder of this section.

Non-Carcinogenic Risks – RME Evaluation - Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

The cumulative HIs calculated for construction worker, industrial worker, adolescent trespasser, child, adolescent, and adult recreational users, and adult resident exposure to soil and/or groundwater are less than or equal to 1, indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure scenario. The cumulative HIs for child residents exposed to surface soil from

0 to 1 foot bgs and groundwater (HI = 5) and subsurface soil from 1 to 3 feet bgs and groundwater (HI = 5) are greater than 1. However, only the medium-specific HI for subsurface soil from 1 to 3 feet bgs exceeds 1 (HI = 2). The HI for the thyroid target organ exceeds 1 (HI = 2). Cobalt is the primary risk contributor via the ingestion exposure route, and the individual HQ for cobalt is 2.

Carcinogenic Risks – RME Evaluation - Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

Carcinogenic risks estimated for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME conditions is below or within USEPA's acceptable range.

6.5.6 Quantitative Risk Estimates - CTE Evaluation - Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

An evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenario are presented in Table 6-4.

Non-Carcinogenic Risks – CTE Evaluation - Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

Cumulative HIs estimated for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and adult residents exposed to surface soil (0 to 1 foot bgs), subsurface soil (1 to 3 feet bgs), subsurface soil greater than 3 feet bgs (for construction workers only), and groundwater (for construction workers and residents) under the CTE scenario are less than or equal to 1, indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure scenario. The cumulative HIs for child residents exposed to surface soil from 0 to 1 foot bgs and groundwater (HI = 2) and subsurface soil from 1 to 3 feet bgs and groundwater (HI = 2) are greater than 1. However, medium-specific HIs do not exceed 1. Therefore, no adverse non-carcinogenic effects are anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks – CTE Evaluation - Separate Surface Soil (0 to 1 foot bgs) and Subsurface Soil (1 to 3 feet bgs)

For the CTE, the cumulative ILCRs for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within USEPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under CTE conditions is below or within USEPA's acceptable range.

6.5.7 Quantitative Risk Estimates – RME Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

Quantitative risk estimates for potential human receptors were developed for those contaminants identified as direct contact COPCs. Potential non-carcinogenic and carcinogenic risks for construction workers and child and adult residents under the RME scenario using the combined surface and subsurface soil 0 to 10 feet bgs data set and groundwater are summarized in Table 6-5. Risks for each receptor are summed across all applicable exposure routes. Risk spreadsheets containing the detailed contaminant-specific risks calculated for SWMU 57 are included in Appendix H-1. A discussion of the estimated non-carcinogenic and carcinogenic risks is provided in the remainder of this section.

Non-Carcinogenic Risks – RME Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

The cumulative HI calculated for construction worker exposure to soil and groundwater are less than 1, indicating that adverse non-carcinogenic effects are not anticipated for this receptor under the defined exposure scenario. The cumulative HIs for child and adult residents exposed to surface soil from 0 to 10 feet bgs and groundwater (HIs = 3 and 2, respectively) are greater than 1. However, only the medium-specific HI for combined soil from 0 to 10 feet for the child resident exceeds 1 (HI = 3). The HI for the thyroid target organ exceeds 1 (HI = 2). Cobalt is the primary risk contributor via the ingestion exposure route, and the individual HQ for cobalt is 2.

Carcinogenic Risks – RME Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

Carcinogenic risks estimated for construction workers and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME conditions is below or within USEPA's acceptable range.

6.5.8 Quantitative Risk Estimates - CTE Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

An evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenario using the combined surface and subsurface soil 0 to 10 feet bgs data set are presented in Table 6-6.

Non-Carcinogenic Risks – CTE Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

Cumulative HIs estimated for construction workers and adult residents exposed to combined surface and subsurface soil 0 to 10 feet bgs and groundwater under the CTE scenario are less than or equal to 1. Therefore, no adverse non-carcinogenic effects are anticipated for these receptors under the defined exposure conditions. The cumulative HI for child residents exposed to surface soil from 0 to 10 feet bgs and groundwater (HI = 2) is greater than 1. However, no medium-specific HIs for the child resident exceed 1. Therefore, no adverse non-carcinogenic effects are anticipated for child residents under the defined exposure conditions.

Carcinogenic Risks – CTE Evaluation – Combined Surface and Subsurface Soil 0 to 10 feet bgs

For the CTE, the cumulative ILCRs for construction workers and residents (child, adult, and lifelong) are less than or within USEPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under CTE conditions is below or within USEPA's acceptable range.

6.5.9 Chemicals within Facility Background Concentrations

A background screen (i.e., a comparison of maximum site concentrations to established facility background concentrations) was not considered for COPC selection for chemicals detected at concentrations exceeding screening criteria in soil and groundwater at SWMU 57. In order to provide an estimate of site-specific risks, COPCs for metals were additionally compared to concentrations detected in facility background samples. If the maximum concentration of a COPC was less than the representative facility background concentration for soil and groundwater, that COPC is not included in the site-specific evaluation. The BTV presented in the Background Threshold Value Evaluation and Recommendations for Naval Activity Puerto Rico (CH2MHill, 2013) was used to represent facility background. The facility background values used for COPC selection are presented in the COPC

selection tables in Appendix H-1 for informational purposes only, because COPCs were not selected using facility background; additional COPC selection tables that do consider background are presented in Appendix H-4. In both cases, facility background values were not used for COPC selection for the combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs data sets, because facility background values are only available for either surface soil or subsurface soil. Therefore, facility background values were not used, to be conservative, and these data sets are not discussed in the site-specific risks presented in this section because site-specific risks are the same as total risks presented in Sections 6.5.3, 6.5.4, 6.5.7, and 6.5.8. Uncertainty associated with the lack of facility background values for the combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs data sets is discussed in this Section 6.6.

The following concentrations of the following chemicals are within facility background concentrations (Appendix H-4):

- Surface soil: vanadium.
- Subsurface soil, 1 to 3 feet bgs: **arsenic** and vanadium.
- Subsurface soil, greater than 3 feet bgs: **arsenic** and vanadium.
- Groundwater: **arsenic**, cadmium, cobalt, copper, nickel, and vanadium.

A chemical name is presented in **bold** font if the maximum concentration of the chemical exceeds the RSL based on an ILCR of $1x10^{-6}$ or an HQ of 1; the additional chemicals listed above, with the exception of copper and nickel in groundwater, exceed the RSL based on an HQ of 0.1 but do not exceed the RSL based on an HQ of 1. In groundwater, copper and nickel do not exceed the RSL-based screening criteria based on an HQ of 0.1 but exceed the PRWQS screening value.

Site-specific risks, excluding those chemicals eliminated as COPCs based on facility background comparisons, were calculated for the RME and CTE scenarios and are presented in Appendix H-4. The 95-percent UCLs on the mean were used as the EPCs for surface and subsurface soil data sets where applicable. Maximum concentrations were used as the EPCs for groundwater. A comparison of total risks and site-specific risks [calculated using separate surface soil (0 to 1 foot bgs) and subsurface soil (1 to 3 feet bgs) data sets] is presented below for the RME scenario.

ANALYSIS OF RISKS FOR CHEMICALS OMITTED FROM THE QUANTITATIVE RISK ASSESSMENT ON THE BASIS OF FACILITY BACKGROUND – RME SCENARIO – SWMU 57		
Receptor	**ILCR(1)**	**HI(1)**
Surface Soil, 0 to 1 foot bgs		
Construction Worker	6E-07 (6E-07)	0.4 (0.2)
Industrial Worker	1E-06 (1E-06)	0.1 (0.1)
Adolescent Trespasser	2E-07 (2E-07)	0.05 (0.04)
Child Recreational User	1E-06 (1E-06)	0.5 (0.4)
Adolescent Recreational User	4E-07 (4E-07)	0.09 (0.07)
Adult Recreational User	3E-07 (3E-07)	0.06 (0.05)
Lifelong Recreational User	7E-07 (2E-06)	NA
Child Resident	5E-06 (5E-06)	2 (1)
Adult Resident	2E-06 (2E-06)	0.2 (0.2)
Lifelong Resident	6E-06 (6E-06)	NA
Subsurface Soil, 1 to 3 feet bgs		
Construction Worker	6E-07 (5E-07)	0.5 (0.2)
Industrial Worker	1E-06 (1E-07)	0.2 (0.1)
Adolescent Trespasser	2E-07 (4E-08)	0.06 (0.04)
Child Recreational User	1E-06 (3E-07)	0.7 (0.5)
Adolescent Recreational User	3E-07 (8E-08)	0.1 (0.08)
Adult Recreational User	2E-07 (2E-08)	0.07 (0.05)
Lifelong Recreational User	6E-07 (4E-07)	NA
Child Resident	4E-06 (1E-06)	2 (2)
Adult Resident	1E-06 (3E-07)	0.3 (0.2)
Lifelong Resident	5E-06 (1E-06)	NA
Subsurface Soil, greater than 3 feet bgs		
Construction Worker	2E-06 (2E-06)	1 (0.9)
Groundwater		
Construction Worker	4E-09 (2E-11)	0.002 (0.0001)
Child Resident	5E-05 (3E-06)	3 (0.2)
Adult Resident	9E-05 (2E-06)	1 (0.09)
Lifelong Resident	1E-04 (5E-06)	NA

1 – Risk and HI values in parentheses are site-specific risks calculated in the risk assessment for COPCs only using separate surface soil and subsurface soil 1 to 3 feet bgs data sets. Risk and HI values not in parentheses include all COPCs.
NA – Not applicable.

Estimated ILCRs for total (i.e., including chemicals within facility background levels) site-specific risks (i.e., excluding chemicals within facility background levels) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Both total and site-specific HIs are less than or equal to 1 for all receptors except the child resident. For the child resident, total HIs exceed 1 but site-specific HIs are less than or

equal to 1 for both surface soil and groundwater; however, target organ HIs are less than or equal to 1 for these media. Also, both the total and site-specific HIs are equal to 2 for the child resident exposed to subsurface soil from 1-3 feet bgs, with the target organ HIs exceeding 1 due to cobalt. Based on this comparison, overall conclusions do not change if site-specific risks are evaluated instead of total risks.

6.5.10 Refined Evaluation of Chemical Migration from Soil to Groundwater

COPCs for groundwater protection were selected in Section 6.2.2. This section presents a more refined evaluation of the potential for chemical migration from soil to groundwater based on multiple lines of evidence including 1) whether the COPC is within facility background concentrations for soil, if applicable; 2) whether the COPC was detected in groundwater; 3) whether the COPC is also a groundwater COPC; 4) whether concentrations of the COPC in groundwater are within facility background concentrations; and 5) whether the COPC exceeded groundwater protection risk-based SSLs and MCL-based SSLs based on a revised DAF.

Groundwater Protection COPCs — Combined Surface and Subsurface Soil 0 to 3 feet bgs — The following chemicals in combined surface and subsurface soil 0 to 3 feet bgs soil were selected as COPCs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.
- SVOCs: bis(2-ethyhexyl)phthalate.
- Volatiles: 2-hexanone, benzene, bromomethane, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

The chemicals presented in the list above were detected at concentrations exceeding groundwater protection SSLs and were subsequently selected as COPCs for the migration to groundwater evaluation. (Facility background values were not used in COPC selection; however, no facility background values are available for combined surface and subsurface soil.) None of the VOC, SVOC, or PCB COPCs were detected in groundwater. The only PAH COPC detected in groundwater was benzo(a)anthracene.

Benzo(a)anthracene was also selected as a groundwater COPC. One of 4 benzo(a)anthracene results in groundwater exceed the tap water RSL, and the PRWQS is not exceeded. The maximum concentration of benzo(a)anthracene in groundwater is within one order of magnitude of the tap water RSL. Additionally, only 4 of 57 benzo(a)anthracene results (approximately 7 percent) in the combined surface and subsurface soil 0 to 3 feet bgs data set exceed the migration to groundwater criterion, and subsurface soil data greater than 3 feet bgs do not indicate that migration from shallower soils has occurred [benzo(a)antrhacene was not selected as a groundwater protection COPC for subsurface soil greater than 3 feet bgs]. Therefore, benzo(a)anthracene detected in the combined surface and subsurface soil 0 to 3 feet bgs data set is not expected to cause unacceptable risks in groundwater.

Of the metals COPCs listed above, arsenic, cadmium, cobalt, copper, mercury, nickel, and thallium were selected as COPCs in groundwater. However, arsenic, cadmium, cobalt, copper, and nickel concentrations in groundwater were within facility background concentrations. Additionally, concentrations of thallium in groundwater are less than the MCL, and concentrations of mercury in groundwater do not exceed the tap water RSL based on an HQ of 1. Therefore, the available groundwater data do not indicate that concentrations of COPCs in surface soil have negatively impacted groundwater quality.

No facility background values for combined surface and subsurface soil are available; therefore, facility background values were not used in the refined migration to groundwater evaluation for combined surface and subsurface soil 0 to 3 feet bgs. Uncertainty associated with the lack of facility background values for combined surface and subsurface soil 0 to 3 feet bgs is discussed in Section 6.6.

Groundwater Protection COPCs — Surface Soil — The following chemicals in surface soil were selected as COPCs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.

- SVOCs: bis(2-ethyhexyl)phthalate.

- Volatiles: 2-hexanone, benzene, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

The chemicals presented in the list above were detected at concentrations exceeding groundwater protection SSLs and were subsequently selected as COPCs for the migration to groundwater evaluation. However, none of the VOC, SVOC, or PCB COPCs were detected in groundwater. Benzo(a)anthracene was the only PAH COPC detected in groundwater. Benzo(a)anthracene was also selected as a groundwater COPC. One of 4 benzo(a)anthracene results in groundwater exceed the tap water RSL, and the PRWQS is not exceeded. The maximum concentration of benzo(a)anthracene in groundwater is within one order of magnitude of the tap water RSL. Additionally, only 3 of 34 benzo(a)anthracene results (approximately 9 percent) in the surface soil data set exceed the migration to groundwater criterion, and subsurface soil data greater than 3 feet bgs do not indicate that migration from shallower soils has occurred [benzo(a)anthracene was not selected as a groundwater protection COPC for subsurface soil greater than 3 feet bgs]. Therefore, benzo(a)anthracene detected in the surface soil data set is not expected to cause unacceptable risks in groundwater.

Of the metals COPCs listed above, antimony, arsenic, cadmium, cobalt, copper, mercury, nickel, thallium, and vanadium were selected as COPCs in groundwater. However, concentrations of antimony, copper, and vanadium in surface soil are within facility background concentrations, and concentrations of arsenic, cadmium, cobalt, copper, and nickel in groundwater are within facility background concentrations. Additionally, concentrations of thallium in groundwater are less than the MCL, and concentrations of mercury in groundwater do not exceed the tap water RSL based on an HQ of 1. Therefore, the available groundwater data do not indicate that concentrations of COPCs in surface soil have negatively impacted groundwater quality.

Groundwater Protection COPCs — Subsurface Soil, 1 to 3 feet bgs — The following chemicals in subsurface soil 1 to 3 feet bgs were selected as COPCs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, lead, mercury, nickel, selenium, thallium, and vanadium.
- PCBs: Aroclor-1260.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, and naphthalene.
- SVOCs: bis(2-ethylhexyl)phthalate.
- VOCs: benzene, bromomethane, carbon tetrachloride, and chloroform.

The chemicals presented in the list above were detected at concentrations exceeding groundwater protection SSLs and were subsequently selected as COPCs for the migration to groundwater evaluation. However, none of the VOC, SVOC, or PCB COPCs were detected in groundwater. Benzo(a)anthracene was the only PAH COPC detected in groundwater. Benzo(a)anthracene was also selected as a groundwater COPC. One of 4 benzo(a)anthracene results in groundwater exceed the tap water RSL, and the PRWQS is not exceeded. The maximum concentration of benzo(a)anthracene in groundwater is within one order of magnitude of the tap water RSL. Additionally, only 1 of 23 benzo(a)anthracene results (less than 5 percent) in the subsurface soil 1 to 3 feet bgs data set exceed the migration to groundwater criterion, and chemicals are unlikely to pose risks to water quality through leaching from soil to groundwater if they are detected infrequently (i.e., less than 5%) in soil. Furthermore, subsurface soil data greater than 3 feet bgs do not indicate that migration from shallower soils has occurred, as benzo(a)anthracene was not selected as a groundwater protection COPC for subsurface soil greater than 3 feet bgs. Therefore, benzo(a)anthracene detected in the surface soil data set is not expected to cause unacceptable risks in groundwater.

Of the metals COPCs listed above, only arsenic, cadmium, cobalt, copper, mercury, nickel, selenium, thallium, and vanadium were selected as COPCs in groundwater. However, concentrations of copper, selenium, and vanadium in subsurface soil 1 to 3 feet bgs were within facility background concentrations, and concentrations of arsenic, cadmium, cobalt, copper, and nickel in groundwater were within facility background concentrations. Additionally, concentrations of thallium in groundwater are less than the MCL, and concentrations of mercury in groundwater do not exceed the tap water RSL based on an HQ of 1. Therefore, the available groundwater data do not indicate that concentrations of COPCs in subsurface soil 1 to 3 feet have negatively impacted groundwater quality.

Groundwater Protection COPCs — Subsurface Soil, greater than 3 feet bgs — The following chemicals in subsurface soil greater than 3 feet bgs were selected as COPCs for migration from soil to groundwater:

- Metals: arsenic, antimony, barium, cadmium, cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc.
- SVOCs: bis(2-ethylhexyl)phthalate.

The chemicals presented in the list above were detected at concentrations exceeding groundwater protection SSLs and facility background levels, if available, and were subsequently selected as COPCs for the migration to groundwater evaluation. However, none of the SVOC COPCs were detected in

groundwater. Of the metals COPCs listed above, only arsenic, cadmium, cobalt, copper, nickel, and thallium were selected as COPCs in groundwater. However, concentrations of arsenic, copper, selenium, and vanadium in subsurface soil greater than 3 feet bgs were within facility background concentrations, and concentrations of arsenic, cadmium, cobalt, copper, and nickel in groundwater were within facility background concentrations. Additionally, concentrations of thallium in groundwater are less than the MCL. Therefore, the available groundwater data do not indicate that concentrations of COPCs in subsurface soil greater than 3 feet bgs have negatively impacted groundwater quality.

Groundwater Protection COPCs — Combined Surface and Subsurface Soil 0 to 10 feet bgs — The following chemicals in combined surface and subsurface soil 0 to 10 feet bgs soil were selected as COPCs for migration from soil to groundwater:

- Metals: antimony, arsenic, barium, cadmium, cobalt, copper, cyanide, lead, mercury, nickel, selenium, thallium, vanadium, and zinc.
- PCBs: Aroclor-1260.
- Pesticides: 4,4'-DDD.
- PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene.
- SVOCs: bis(2-ethyhexyl)phthalate.
- Volatiles: 2-hexanone, benzene, bromomethane, carbon tetrachloride, chloroform, ethylbenzene, and tetrachloroethene.

The chemicals presented in the list above were detected at concentrations exceeding groundwater protection SSLs and were subsequently selected as COPCs for the migration to groundwater evaluation. Comparing the combining surface and subsurface soil data sets of 0 to 3 feet bgs and 0 to 10 feet bgs, only zinc and 4,4'-DDD are additional chemicals selected as COPCs in the 0 to 10 feet bgs data set that were not selected as COPCs in the 0 to 3 feet bgs data set.

None of the VOC, SVOC, PCB, or pesticide COPCs were detected in groundwater. The only PAH COPC detected in groundwater was benzo(a)anthracene. Benzo(a)anthracene was also selected as a groundwater COPC. One of 4 benzo(a)anthracene results in groundwater exceed the tap water RSL, and the PRWQS is not exceeded. The maximum concentration of benzo(a)anthracene in groundwater is

within one order of magnitude of the tap water RSL. Additionally, only 5 of 66 benzo(a)anthracene results (approximately 8 percent) in the combined surface and subsurface soil 0 to 10 feet bgs data set exceed the migration to groundwater criterion, and subsurface soil data greater than 3 feet bgs do not indicate that migration from shallower soils has occurred [benzo(a)anthracene was not selected as a groundwater protection COPC for subsurface soil greater than 3 feet bgs]. Therefore, benzo(a)anthracene detected in the combined surface and subsurface soil 0 to 10 feet bgs data set is not expected to cause unacceptable risks in groundwater.

Of the metals COPCs listed above, only arsenic, cadmium, cobalt, copper, mercury, nickel, thallium, and vanadium were selected as COPCs in groundwater. However, concentrations of arsenic, cadmium, cobalt, copper, nickel, and vanadium were within facility background concentrations. (Facility background values were not available for combined surface and subsurface soil.) Additionally, concentrations of thallium in groundwater are less than the MCL, and concentrations of mercury in groundwater do not exceed the tap water RSL based on an HQ of 1. Therefore, the available groundwater data do not indicate that concentrations of COPCs in surface soil have negatively impacted groundwater quality.

6.6 UNCERTAINTY ANALYSIS

The uncertainties associated with the SWMU 57 HHRA are presented in this section. Deviations from the HHRA work plan (Tetra Tech, 2012) are also discussed in this section. Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route/scenario, the assumptions made to determine EPCs, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose response relationships and the weight of evidence used for determining the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple contaminants and the cumulative uncertainty from combining health protective assumptions developed following USEPA guidance made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, as listed above, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose response relationships. Throughout the entire risk assessment, assumptions that consider safety factors are made so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty, measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a contaminant, on the biological mechanism of action on a contaminant, or on the behavior of a contaminant in soil.

After the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions used are protective of sensitive subpopulations or the maximum exposed individuals. If a number of health protective assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. The assumptions developed following USEPA guidance are intended to avoid under-predicting risk and to be health protective. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable" risk level (i.e., $1x10^{-6}$), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an "acceptable" risk level (i.e., $1x10^{-4}$), a conclusion can be difficult unless uncertainty is considered.

6.6.1 Uncertainty in Selection of COPCs

A minor amount of uncertainty is associated with the selection of COPCs that may affect the numerical risk estimates presented in the risk assessments. The most significant issues related to uncertainty in COPC selection are: the existing database (i.e., the quality of the analytical data), the screening levels used, and the absence of screening levels for a few contaminants detected in the site media. A brief discussion of each of these issues is provided in the remainder of this section.

Existing Database

Groundwater and soil analytical data extracted from samples collected on site during the Full RFI sampling event were used to evaluate potential risks to human receptors. For soil, data collected during the Phase I RFI and Phase I/II ECP sampling events were also included in the data sets evaluated in the HHRA. All of the data collected during the Full RFI and Phase I RFI sampling events were validated according to USEPA Region II data validation protocol. The 2004 data collected were verified according to laboratory protocol only, not USEPA Region II data validation protocol that was used for all other site data used in the risk assessment; however, the 2004 soil data was used in the human health risk assessment in accordance with the SAP. The 2004 data are further discussed in the DQR presented in Appendix G.

Chemicals Potentially Attributable to Background

As noted in Section 6.2.2, no background criteria were used in selecting COPCs. However, facility background concentrations are available for metals for certain data sets evaluated and were considered in the site-specific risk evaluation presented in Section 6.5.9. However, facility background values were not used for COPC selection for the combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs data sets because facility background values are only available for either surface soil or subsurface soil. Therefore, facility background values were not used for these data sets to be conservative. Uncertainty associated with the lack of facility background values for the combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs data sets is also discussed in this section.

The facility background concentrations were available for metals only. The absence of facility background data for organic chemicals detected in site media adds some uncertainty. However, no organic chemicals were determined to be risk drivers in the risk characterization. Therefore, no significant uncertainty is associated with the absence of facility background values for organic chemicals. Although no facility background values were available for the combined surface and subsurface soil 0 to 3 feet bgs data set, no risk drivers were identified for this data set in the risk characterization. Therefore, no significant uncertainty is associated with the absence of facility background values for the combined surface and subsurface soil 0 to 3 feet bgs data set. Cobalt was a risk driver for noncancer risk in combined surface and subsurface soil 0 to 10 feet bgs. Therefore, there is some uncertainty associated with the absence of facility background values for cobalt. However, the maximum concentration of cobalt was greater than available separate facility background data sets for surface soil and subsurface soil.

Site-specific surface soil background data for SVOCs and metals were also collected during the Full RFI. In spite of the presence of anthropogenic PAHs present in site-specific background data, PAHs were not risk

drivers in the HHRA. Concerning metals, cobalt was identified as a risk driver in subsurface soil 1 to 3 feet bgs for the future child resident; site-specific background data were collected only for surface soil and so are inconclusive as site-specific background data for the 1 to 3 feet depth interval is unavailable. Both the maximum and 95-percent UCL concentrations of cobalt in subsurface soil 1 to 3 feet bgs (97 mg/kg and 40.7 mg/kg, respectively) exceed the maximum surface soil concentration of cobalt in pristine and anthropogenic background data sets (31.8 mg/kg and 31 mg/kg, respectively). Therefore, cobalt exceeds facility background concentrations and, tentatively, the site-specific background data set also supports the conclusion that cobalt concentrations in subsurface soil 1 to 3 feet bgs exceed background. However, it is very unlikely that a future child resident would be exposed to subsurface soil from 1 to 3 feet bgs only. The more likely scenario is that a receptor would be exposed from 0 to 3 feet bgs and no unacceptable risks were calculated for the 0 to 3 feet bgs exposure scenario.

COPC Screening Levels

The use of screening values based on conservative land use scenarios (i.e., residential land use for soil and tap water for groundwater) corresponding to ILCRs of $1x10^{-6}$ and HQs of 0.1 should ensure that the significant risk-contributing chemicals from SWMU 57 were evaluated. The elimination of chemicals that are present at concentrations that correspond to ILCRs less than $1x10^{-6}$ and HQs less than 0.1 should not affect the final conclusions of the risk assessment because these chemicals are not expected to cause a potential health concern for the receptors identified at the concentrations detected.

The November 2013 RSLs were used to select COPCs in this HHRA. After this HHRA was prepared, USEPA released the June 2015 RSLs. Tables 6-7 and 6-8 present comparisons of the November 2013 and June 2015 RSLs for chemicals detected in soil and groundwater, respectively, at SWMU 57. For the chemicals detected in groundwater, all of the June 2015 RSLs are greater than or equal to the November 2013 RSLs except for benzo(a)anthracene, which was previously selected as a groundwater COPC. Therefore, no new COPCs would be selected for groundwater if the June 2015 RSLs were used for COPC selection, and overall risk assessment conclusions should not be impacted by using the November 2013 RSLs. For the chemicals detected in soil, the June 2015 RSLs are either the same as or higher than the November 2013 RSLs for most chemicals; exceptions are some of the VOCs and cyanide. However, site concentrations of COPCs are still less than the June 2015 RSLs, in most cases by several orders of magnitude. Site concentrations of cyanide in several data sets exceed the June 2015 RSL based on an HQ of 0.1; however, site concentrations do not exceed the RSL at an HQ of 1. Pesticides (4,4'-DDE and 4,4'-DDT) would also be selected as COPCs for migration to groundwater; however, these pesticides were not detected in groundwater and therefore would not be retained as COPCs for migration to groundwater. Even though one new direct contact COPC for soil and several new direct contact

COPCs for migration to groundwater would be selected if using the June 2015 RSLs, overall risk assessment conclusions are not likely to change even if using the June 2015 RSLs for COPC selection. Consequently, the use of the November 2013 RSLs does not introduce any uncertainty into this HHRA.

Absence of COPC Screening Levels

Several contaminants had no available screening levels or toxicity information: diesel range organics and total petroleum hydrocarbons in combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs, surface soil, subsurface soil 1 to 3 feet bgs, and subsurface soil greater than 3 feet bgs; and methyl iodide in combined surface and subsurface soil 0 to 3 feet bgs and 0 to 10 feet bgs and subsurface soil 1 to 3 feet bgs. Therefore, these chemicals were not included as COPCs in the risk assessment. Exclusion of these chemicals from the COPC selection adds some uncertainty to the risk assessment in that risks may be underestimated if any of those chemicals excluded would have passed the COPC screening process if toxicity criteria existed for those chemicals. In addition, because risk assessments are generally designed to be health protective and are intended to avoid under-predicting risk, it is unlikely that the exclusion of these chemicals from the quantitative risk analysis will result in a significant underestimation of risk.

Surrogate Screening Levels

During COPC screening, the following surrogates were used for some chemicals lacking screening levels: acenaphthene was used as a surrogate for acenaphthylene, and pyrene was used for benzo(g,h,i)perylene and phenanthrene. Applying toxicity values for one compound to another adds to the uncertainty in the risk assessment, both in regard to the selection of COPCs and subsequently calculated risks. The direction of the bias is unknown.

Non-Detected Results Exceeding Screening Levels

Nondetected results greater than COPC screening levels used in the HHRA were not considered COPCs and were not retained for the quantitative risk assessment. However, such “non-detected results” are further evaluated (qualitatively) in this section to determine if risk management decisions would be impacted by the non-detected results exceed the screening levels. The DQR (Appendix G) provides further information about non-detected results exceeding project screening levels. Nondetected results exceeding screening levels are a potential source of underestimating risk; however, there is no evidence that a source exists for many of the chemicals that were not detected.

For this project it was anticipated that the laboratory would not be able to achieve PSLs for many of the parameters analyzed. An evaluation of those non-detected results for which PSLs were not met follows in accordance with the SAP. Tables 3, 4, and 5 of Appendix G list the percent of non-detected results per matrix that exceed ecological and human health PSLs. The potential impact of a chemical's non-detected result exceeding a PSL for 100% of samples analyzed is that the chemical may be present at a concentration greater than the PSL; however, due to the detection limit being greater than the PSL it is unknown whether or not that chemical is present at a concentration greater than the PSL. Therefore, a chemical may not be selected as a COPC when it potentially should have been (e.g., actual concentration is greater than PSL but that cannot be determined because the detection limit is greater than the PSL). Such a situation would bias estimated site risks low.

However, for those analytical fractions where many analytes have detection limits that do not meet PSLs (e.g., VOC, SVOCs), site data indicate that those fractions are not a contamination source at SWMU 57. For example, the Nature and Extent Section of this RFI (Section 4 main text) explains that VOCs were detected infrequently in surface and subsurface soil (not at all at soil depths greater than 3 feet) and were not detected at all in 2012 groundwater samples. None of the VOCs that were detected were selected as direct contact COPCs because the maximum concentrations of those VOCs detected were not greater than PSLs. Those VOCs that were selected as migration to groundwater from soil COPCs were not detected in groundwater indicating that the concentrations detected in soil are not a source for groundwater contamination. This data supports that the VOC fraction is not a contamination source at SWMU 57. Similar conditions were observed for the SVOC fraction (see Section 4 of main text for further detail). In conclusion, the main effect of detection limits exceeding PSLs for non-detected results is that chemicals may not be selected as COPCs when those chemicals potentially should be selected. If that did occur then site risks would be biased low. However, site data indicate that the fractions with the vast majority of detection limits exceeding PSLs (i.e., VOCs and SVOCs) are not contamination sources at SWMU 57 and therefore not expected to contribute significantly to human health and ecological site risks.

The laboratory concentrated PCB samples collected in 2012 to 10 mL instead of 2 mL as identified in the SAP, which would have helped to lower the uncertainty associated with the results, but would not have eliminated uncertainty considering that the PALs specified were not achievable. The concentrations of Aroclor-1260, the only PCB isomer detected in soil, did not result in unacceptable human health risks.

All surface soil and subsurface soil sensitivity exceedances were anticipated in the work plan except benzo(a)anthracene and dibenzo(a,h)anthracene. All groundwater sensitivity exceedances were anticipated except for dibenzofuran. In surface soil and subsurface soil benzo(a)anthracene and dibenzo(a,h)anthracene non-detected results unexpectedly exceeded corresponding PSLs. The

laboratory scope of work (SOW) for this project specified that all non-detected results must be reported to LODs; however, it also specified that results detected above the detection limit (DL), which has a lower value than a corresponding LOD, must be reported and qualified as estimated "J". The DLs for benzo(a)anthracene and dibenzo(a,h)anthracene in surface and subsurface soil were less than corresponding PSLs; therefore, even though a portion of results for those compounds are reported as non-detected (using the LOD) at values greater than PSLs if there were positive detections greater than the DLs the results reported would have been sensitive enough to meet PSL goals. Project data usability was not adversely affected by the portion of benzo(a)anthracene and dibenzo(a,h)anthracene non-detected results reported at concentrations above the respective PSLs. Since the DQR determined that project data usability was not adversely affected by the portion of benzo(a)anthracene and dibenzo(a,h)anthracene non-detected results reported at concentrations above the respective PSLs (as discussed above), risk management decisions are not expected to be impacted by non-detected results for these PAHs exceeding screening levels. The DQR stated that laboratory sensitivity was insufficient to determine whether dibenzofuran is present is groundwater at the project screening level. Although non-detected results for dibenzofuran (1.6 µg/L, qualified "U") were greater than the USEPA tap water screening level (0.58 µg/L based on an HQ of 0.1), the non-detected results do not exceed the tap water RSL based on an HQ of 1. Therefore, it is unlikely that overall risk assessment conclusions and risk management decisions would be impacted by non-detected dibenzofuran results exceeding screening levels in groundwater.

6.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises because of the methods used to calculate EPCs, the determination of land use conditions, the selection of receptors and scenarios, and the selection of exposure parameters. Each of these is discussed below.

Land Use

The past and current land use patterns at the site are well established, thereby reducing the uncertainty associated with land use assumptions. Currently, SWMU 57 is inactive. Future land use for SWMU 57 may include recreational and residential land uses, as SWMU 57 will be located in Zone 4, the Marsh Vista Country Club, with a proposed 18-hole golf course with clubhouse as well as 50 residential units according to the Supplemental Environmental Assessment (Navy, 2011). Additionally, the Lease in Furtherance of Conveyance (LIFOC) between the United States of America and Local Redevelopment Authority for Naval Station Roosevelt Roads at the Former Naval Station Roosevelt Roads, Ceiba, Puerto Rico, #N4769212RP12P31, Execution Version January 25, 2012, identifies the future land use for SWMU

57 as commercial/recreational. The SWMU 57 HHRA included an evaluation of future residential receptors to be protective of all potential future land uses.

Exposure Point Concentrations

Uncertainty is associated with the use of 95-percent UCLs on the mean as the EPCs. As a result of using 95-percent UCLs, the potential risk for the RME scenario are most likely overestimated because this is a representation of the upper limit to which potential receptors would be exposed to over the entire exposure period. Uncertainty is introduced when the non-detected results are incorporated into the UCL calculation by using detection limits for non-detects as input values when using ProUCL software. Uncertainty in the non-detected results may either overstate or understate the risks to the receptors. However, this methodology is in accordance with USEPA guidance (USEPA, 2010a). The use of the maximum concentration as the EPC also tends to overestimate risks because it assumes that receptors are exposed to the greatest concentration at the site for the entire exposure duration, which is unlikely. The maximum concentration was used as the EPC when evaluating groundwater COPCs.

Exposure Routes and Receptor Identification

An attempt was made to simplify the various receptor groups and exposure routes of potential concern in this report. The uncertainty associated with this approach is minimal because exposure routes and potential receptors are considered to be well defined based on the potential future land use of the site. The health protective exposure assumptions used in the risk assessment should be protective of receptor use of the site.

All receptors were evaluated for exposures to COPCs for the combined surface and subsurface soil 0 to 3 feet bgs, surface soil, and subsurface soil 1 to 3 feet bgs data sets. Construction workers and future residents were evaluated for exposures to COPCs for the combined surface soil 0 to 10 feet bgs. Construction workers were additionally evaluated for exposures to subsurface soil greater than 3 feet bgs. The subsurface soil greater than 3 feet bgs data set consisted of soil data collected from mostly 10 feet bgs or greater. Construction workers generally work to a maximum depth of 10 feet bgs; however, the evaluation of subsurface soil greater than 3 feet bgs was included for completeness. Exposure of other receptors to subsurface soil greater than 10 feet bgs is unlikely. Only cobalt and thallium were selected as COPCs in the subsurface soil greater than 3 feet bgs data set. The maximum concentration of thallium in subsurface soil greater than 3 feet bgs is less than the maximum concentrations of thallium in the surface soil and subsurface soil 1 to 3 feet bgs data sets. However, the maximum concentration of cobalt in the subsurface soil greater than 3 feet bgs data set (301 mg/kg) is greater than the maximum concentrations of cobalt in surface soil (65.3 mg/kg) and subsurface soil 1 to 3 feet bgs (97 mg/kg).

Cobalt was identified as a primary risk driver for child residents exposed to chemicals in subsurface soil 1 to 3 feet bgs and combined surface and subsurface soil 0 to 10 feet bgs. The 95-percent UCL for cobalt in subsurface soil greater than 3 feet bgs is 150 mg/kg. Based on this, evaluating all receptors for exposures to subsurface soil greater than 3 feet bgs would result in cobalt being identified as a primary risk driver for child residents.

Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, in most cases, USEPA guidelines (USEPA, 1993a) on the RME receptor were used, which generally specify the use of the 95th percentile for most parameters; therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, uncertainty can be assessed quantitatively for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (i.e., dermal absorption of organic contaminants from soil), greater uncertainty exists.

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values including USEPA guidance (USEPA, 1993a, 1997a, 2004). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be, or what risk range might be expected for individuals in the exposed population.

To address these issues, USEPA (USEPA, 1992) has suggested the use of the CTE receptor, whose intake variables are often set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although USEPA does provide limited guidance for the CTE evaluation (USEPA, 1993a).

6.6.3 Uncertainty in the Toxicological Evaluation

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

Derivation of Toxicity Criteria

Toxicity assessment uncertainty is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a contaminant that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination using USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data often suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, gender, and exposure route; when the magnitude of the response is clearly dose-related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the contaminant of concern is structurally similar to other contaminants for which the toxicity is more completely characterized. Because of the great variability in factors affecting the uncertainty arising from the nature and quality of animal and human data, the direction of bias (i.e., more or less conservative) is generally not known.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment and derivation of an RfD or RfC for the non-carcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the contaminant are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the

database used. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95-percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic (Williams and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for contaminants that exhibit a threshold for carcinogenicity.

For non-cancer effects, additional uncertainty factors may be applied in the derivation of the RfD or RfC to mitigate poor quality of the key study or gaps in the database. Uncertainty for non-cancer effects arises from the use of an effect level in the estimation of an RfD or RfC because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD or RfC for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more. The use of uncertainly and modifying factors tends to increase the conservatism in the risk assessment.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty, when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available. If adjustments for gastrointestinal absorption are not made, risks from dermal exposure may be underestimated by the use of oral RfDs.

Uncertainty Associated with Evaluation of the Dermal Exposure Pathway

Uncertainty is associated with evaluation of the dermal pathway. RAGS Part E only includes dermal absorption from soil (ABS) values for several contaminants. The contaminants with ABS values in RAGS-Part E evaluated in this assessment are arsenic, cadmium, PAHs, and PCBs. Therefore, the dermal route of exposure has been evaluated quantitatively for these contaminants only. Risks from dermal exposure to several metals identified as COPCs at SWMU 57 were not quantified in the risk assessment. Consequently, potential risks may be underestimated by excluding these constituents from the dermal risk assessment calculations.

Quantitation of the dermal pathway for PAHs may add additional uncertainty to the risk assessment because it may not be appropriate to use the oral slope factor to evaluate risks from dermal exposure to PAHs (USEPA, 1989). This is because PAHs are known to cause skin cancer at the point of contact rather than from systemic action.

Use of Chronic Toxicity Values for Construction Workers

Under the guidelines established by the Superfund program, exposures to construction workers of 1 year or less are classified as subchronic exposures. HIs for noncarcinogenic effects associated with subchronic exposures should incorporate toxicity values for subchronic and not chronic effects. Subchronic toxicity values used in this HHRA were obtained from USEPA's PPRTV internet site. Also, ATSDR Minimal Risk Levels (MRLs) were used as subchronic toxicity values when PPRTV values were not available. Unfortunately, subchronic toxicity values are not as widely available as chronic values. Therefore, chronic toxicity values were used when subchronic toxicity values were not available. However, because no unacceptable HIs were identified for receptors anticipated to have limited exposure durations (i.e., construction workers), the lack of subchronic toxicity values is not a significant source of uncertainty in this HHRA.

Use of Chromium Toxicity Criteria

Some uncertainty was associated with the evaluation of chromium. Toxicity criteria are available for different forms of chromium, which is considered to be more toxic in the hexavalent state. Criteria for trivalent chromium were used to evaluate total chromium concentrations in the risk assessment based the known SWMU 57 site history, which does not indicate that hexavalent chromium would be expected as the dominant species of chromium in soil. The following table compares the maximum total chromium concentrations reported for SWMU 57 samples to available USEPA RSLs.

COMPARISON OF SWMU 57 CHROMIUM RESULTS TO FACILITY BACKGROUND AND REGIONAL SCREENING LEVELS FOR HEXAVALENT AND TRIVALENT CHROMIUM

Maximum Site Chromium Concentration	Facility BTVs	USEPA (2013) Residential RSL - Hexavalent Chromium	USEPA (2013) Residential RSL - Trivalent Chromium
Surface soil: 108 mg/kg	49.8 mg/kg	0.29 mg/kg	120,000 mg/kg
Subsurface soil 1-3' bgs: 110 mg/kg	114.5 mg/kg		
Subsurface soil >3' bgs: 50.4 mg/kg			
Groundwater: Not Detected	162.41 µg/L	0.031 µg/L	16,000 µg/L

Although the maximum site concentrations detected in surface and subsurface soil exceed the USEPA RSL for hexavalent chromium, the maximum site subsurface soil concentrations in both the 1 to 3 feet bgs and greater than 3 feet bgs data sets are less than the facility background value. Additionally, only two surface soil concentrations exceed the facility background value (i.e., 108 mg/kg detected at location 57SB04 and 62.8 mg/kg detected at location 57SB34). Therefore, it is likely that most of the chromium detected in soil at SWMU 57 is attributable to background.

Uncertainty Associated with Thallium Toxicity Criteria

Thallium was identified as a COPC in all data sets evaluated in this HHRA. However, the maximum concentration of thallium in groundwater was less than the MCL. Toxicity criteria for thallium were not used to quantify risks because toxicity criteria used to derive the RSLs for thallium are only suitable for screening. Although there are human studies assessing the effects of exposure to thallium, the majority are case reports of poisonings, suicide attempts or accidental ingestion of rodenticides. Occupational exposure studies provide inconclusive associations between thallium exposure and any specific health effects. Generally, available human studies do not support oral RfD derivation (USEPA, 2010c). Animal studies assessing thallium exposure are also generally of poor quality (USEPA, 2012a). The study that was used to generate the USEPA RSL-based screening value suffers from severe study limitations and difficulties regarding the selection of appropriate toxicity endpoints. Therefore, an RfD was not derived and published by USEPA in IRIS. Hence, any evaluation of thallium suffers from severe limitations and fails to provide a basis for identifying it as a contaminant of concern.

6.6.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often chemicals affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a health protective estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be discussed for its impact on the risk assessment because it may either underestimate or overestimate potential human health risk.

6.6.5 Deviations from the HHRA Work Plan

The methodology presented in the HHRA work plan (Tetra Tech, 2012) was followed in the HHRA evaluation of SWMU 57 except as noted in this section.

Calculation of a Site-Specific DAF

The work plan stated that site-specific DAFs would be calculated as part of the evaluation of the fate and transport of COPCs. This is because a DAF of 1 is the lowest DAF value possible and assumes that no reduction in concentration occurs as the contaminant moves from the source to groundwater, or in other words, that the concentrations at the source and in groundwater are the same (i.e., a receptor is exposed to the leachate concentration). Although appropriate DAF values are highly variable depending on individual site characteristics, USEPA generally recommends a DAF of 20 as appropriate for contaminated soil sites up to 0.5 acre in size (USEPA, 1996). For COPC selection for the migration to groundwater pathway, chemical concentrations detected in soil were compared to risk-based groundwater protection SSLs based on a DAF of 1. However, a site-specific DAF was not calculated for the refined migration to groundwater evaluation because site groundwater results and soil results using the conservative DAF of 1 did not indicate that groundwater quality had been negatively impacted by chemical concentrations detected in site soil.

Evaluation of Groundwater Discharge to Surface Water

The work plan stated that “human health or ecological adverse impacts from groundwater discharge to the mangrove forest are not expected but possible and so will be evaluated following the Full RFI in both human health and ecological risk assessments.” However, groundwater discharge to the mangrove forest did not warrant evaluation in the HHRA because all groundwater risk estimates were within acceptable limits for the scenarios evaluated, which included use of groundwater as a domestic water supply for residents. Because estimated risks were within acceptable limits for these evaluations, it is assumed that risks for groundwater mixing with surface water would not pose unacceptable risks to human receptors.

6.6.6 Additional Evaluations for Construction Workers

In order to be consistent with other HHRAs conducted for NAPR, a set of risk tables using an exposure frequency of 250 days per year for construction worker exposures to soil under an RME scenario is included in Appendix H-5. Additionally, an exposure frequency of 250 days per year was used for construction worker exposures to groundwater in the risk tables presented in Appendix H-5. In contrast,

exposure frequencies of 150 days per year and 30 days per year were used for soil and groundwater, respectively, in the risk tables presented in Appendix H-1. Remaining exposure assumptions other than the exposure frequency were not changed from those presented in Appendix H-1. The construction worker risk tables in Appendix H-5 show that medium-specific HIs are less than or equal to 1 on a target organ basis and medium-specific cancer risks are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ for construction workers when assuming an exposure frequency of 250 days per year. Therefore, overall conclusions of the HHRA are not impacted by the use of the more conservative 250 day exposure frequency.

The cumulative HI estimate for construction workers exposed to soil from 0 to 3 feet bgs, soil greater than 3 feet bgs, and groundwater is approximately equal to 2, and the target organ for the respiratory system is also approximately equal to 2 primarily due to cobalt exposures via inhalation for the greater than 3 feet bgs subsurface soil depth interval. Similarly, the cumulative HI estimate for construction workers exposed to soil from 0 to 1 foot bgs, 1 to 3 feet bgs, and greater than 3 feet bgs and groundwater is approximately equal to 2, and the target organ for the respiratory system is approximately equal to 2 primarily due to cobalt via inhalation in the greater than 3 feet bgs subsurface soil depth interval. These cumulative HI estimates are very conservative because they assume that construction workers are exposed to the greater than 3 feet bgs depth interval for 250 days per year. Cumulative cancer risk estimates for soil plus groundwater exposures did not exceed the USEPA target cancer risk range.

6.6.7 Additional Evaluations for Industrial Workers

In order to be consistent with other HHRAs conducted for NAPR, a set of risk tables including an evaluation of groundwater exposures for industrial workers under an RME scenario are included in Appendix H-6. Industrial worker exposure to groundwater was not evaluated in the risk assessment tables presented in Appendix H-1. An ingestion rate of 1 L/day was used in the groundwater exposure evaluations to be consistent with other HHRAs conducted at NAPR. A duration-of-event value of 0.58 hours/event, which is the default value for the hypothetical adult resident exposed to groundwater, was conservatively used for the industrial worker. Remaining exposure assumptions were the same as those used for industrial worker exposures to soil. The industrial worker risk tables in Appendix H-6 show that medium-specific HIs are less than or equal to 1 and medium-specific cancer risks are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ for industrial workers exposed to groundwater. Additionally, cumulative (i.e., soil plus groundwater) HIs are less than or equal to 1, and cumulative cancer risks are within the USEPA target risk range. Therefore, overall conclusions of the HHRA are not impacted by including an evaluation of groundwater exposures for industrial workers.

6.7 SUMMARY AND CONCLUSIONS

This section and Tables 6-9 and 6-10 present a summary of the major risk assessment findings for SWMU 57. Tables 6-9 and 6-10 present risk summaries for evaluations including the combined surface and subsurface soil 0 to 3 feet bgs data set, separate surface soil and subsurface soil 1 to 3 feet bgs data sets, and combined surface and subsurface soil 0 to 10 feet bgs data set, respectively. Five potential receptor groups were evaluated: current and future construction workers, current and future industrial workers, current and future adolescent trespassers, future child, adolescent and adult recreational users, and future child and adult residents. The risk characterization section of the HHRA evaluated risks to all receptors across the entire site as one EU. All receptors were evaluated for exposures to COPCs in combined surface and subsurface soil 0 to 3 feet bgs, surface soil, and subsurface soil 1 to 3 feet bgs. Construction workers and future residents were evaluated for exposures to COPCs in combined surface and subsurface soil 0 to 10 feet bgs. Construction workers were additionally evaluated for exposures to COPCs in subsurface soil greater than 3 feet bgs, which consists of data from samples collected at depths mostly greater than 10 feet bgs. Construction workers and residents were additionally evaluated for exposures to COPCs in groundwater. The results of these evaluations are summarized below. Although the surface soil and subsurface soil 1 to 3 feet bgs data sets were evaluated separately, the combined surface and subsurface soil 0 to 3 feet bgs data set is expected to be the most realistic exposure scenario because receptors exposed to chemicals in subsurface soil 1 to 3 feet bgs would likely have to contact surface soil (0 to 1 foot bgs) first.

6.7.1 Summary of Risks

6.7.1.1 Non-Carcinogenic Risks – Combined Surface and Subsurface Soil 0 to 3 feet bgs

RME and CTE HIs are less than or equal to 1 for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and child and adult residents exposed to COPCs surface soil and subsurface soil 0 to 3 feet bgs. RME and CTE HIs are also less than or equal to 1 for construction workers exposed to COPCs in subsurface soil greater than 3 feet bgs and for construction workers and child and adult residents exposed to COPCs in groundwater. Therefore, no adverse non-carcinogenic effects are anticipated for any receptors under the defined exposure scenarios.

6.7.1.2 Non-Carcinogenic Risks – Separate Surface Soil and Subsurface Soil 1 to 3 feet bgs

RME and CTE HIs are less than or equal to 1 for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and adult residents exposed to COPCs surface soil and subsurface soil 1 to 3 feet bgs. RME and CTE HIs are also less than or equal to 1 for

construction workers exposed to COPCs in subsurface soil greater than 3 feet bgs and for construction workers and child and adult residents exposed to COPCs in groundwater.

The RME HI for child residents exposed to COPCs in subsurface soil 1 to 3 feet bgs was greater than 1; the target organ-specific HI for the thyroid exceeded 1 due to cobalt. RME HIs for child residents exposed to COPCs in surface soil and groundwater and all CTE HIs were less than or equal to 1.

6.7.1.3 Non-Carcinogenic Risks – Combined Surface and Subsurface Soil 0 to 10 feet bgs

RME and CTE HIs are less than or equal to 1 for construction workers and adult residents exposed to COPCs in combined surface soil and subsurface soil 0 to 10 feet bgs. RME and CTE HIs are also less than or equal to 1 for construction workers and child and adult residents exposed to COPCs in groundwater.

The RME HI for child residents exposed to COPCs in combined surface and subsurface soil 0 to 10 feet bgs was greater than 1; the target organ-specific HI for the thyroid exceeded 1 due to cobalt. RME HIs for child residents exposed to COPCs in surface soil and groundwater and all CTE HIs were less than or equal to 1.

6.7.1.4 Carcinogenic Risks – Combined Surface and Subsurface Soil 0 to 3 feet bgs

Carcinogenic risks estimated for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ under both the RME and CTE scenarios. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME or CTE conditions is below or within USEPA's acceptable range.

6.7.1.5 Carcinogenic Risks – Separate Surface Soil and Subsurface Soil 1 to 3 feet bgs

Carcinogenic risks estimated for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ under both the RME and CTE scenarios. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME or CTE conditions is below or within USEPA's acceptable range.

6.7.1.6 Carcinogenic Risks – Combined Surface and Subsurface Soil 0 to 10 feet bgs

Carcinogenic risks estimated for construction workers and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ under both the RME and CTE scenarios. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME or CTE conditions is below or within USEPA's acceptable range.

6.7.2 Human Health Risk Assessment Risk Drivers

Risk Drivers – Risk Characterization

Based on the non-cancer and cancer evaluations, the following USEPA risk drivers (i.e., contaminants with non-cancer HQs greater than 1 or with cancer risks greater than $1x10^{-6}$ in a scenario and medium with total cancer risks greater than $1x10^{-4}$) were identified in the risk characterization: cobalt in subsurface soil 1 to 3 feet bgs and in combined surface and subsurface soil 0 to 10 feet bgs based on child resident exposures.

No risk drivers were identified for any receptors when the combined surface and subsurface soil 0 to 3 feet bgs data set was evaluated. This is important to note because a 0 to 3 feet bgs exposure scenario is a more likely exposure scenario for a child resident than 1 to 3 feet bgs. To access the 1 to 3 feet bgs soil depth interval that child would very likely have to dig through the 0 to 1 foot depth interval to get there. If the 1 to 3 feet bgs depth interval were somehow brought to the surface (e.g., construction) then that soil would be mixed with soil from the 0 to 1 foot depth interval and site data shows that there is no risk when to the future child resident when exposed to the 0 to 3 feet bgs depth interval. In conclusion, even though there is a potentially unacceptable risk for the child resident exposed to soil in the 1 to 3 feet depth interval that exposure scenario is extremely unlikely and the more realistic exposure scenario (0 to 3 feet bgs) does not yield unacceptable risks for the child resident. There is a potentially unacceptable risk for the child resident exposed to soil for the 0 to 10 feet depth interval risk evaluation. However, the risk estimates for the 0 to 3 feet bgs evaluation did not result in unacceptable risks for the child resident. Therefore, the results of the risk evaluations indicate the chemical concentrations driving the unacceptable risks are in subsurface soil, not in surface soil, which is the depth interval to which child residents would more likely be exposed.

In order to determine if any "hotspot" locations exist, an evaluation of sample locations that drive unacceptable risks was conducted. This evaluation focuses on COCs causing potentially unacceptable risks. For example, under the RME scenario there is a potentially unacceptable risk to the hypothetical future child resident exposed to subsurface soil from 1-3 feet bgs due to the COC cobalt. The following

procedure has been developed to determine which sample or samples are driving unacceptable risk for this scenario:

1 – Cobalt soil concentrations in the 1-3 feet bgs depth range are sorted from highest to lowest.

2 – The highest cobalt concentration in that range is replaced with the cobalt USEPA residential screening level concentration (23 mg/kg; HI=1) to simulate site conditions without that location, and the EPC for cobalt in the 1-3 feet bgs depth range is then recalculated.

3 – The EPC calculated in Step 2 is used to recalculate hypothetical future child resident risks when exposed to soil in the 1-3 feet bgs depth range.

4 – If the risk calculated using the EPC in Step 3 is acceptable then it is concluded that the location for which the concentration was reduced (i.e., location with the highest cobalt soil concentration in the 1-3 feet bgs depth range) is the location driving unacceptable risks for this scenario. If not, then Steps 2 to 4 are repeated with the two highest cobalt concentrations being replaced with the cobalt USEPA residential screening level concentration. This process continues until an acceptable risk is calculated, resulting in a list of samples driving unacceptable risk.

Supporting information (i.e., ProUCL output files and Tables 7s and 9s for the child resident) for the last iteration of the scenarios described above is presented in Appendix H-7.

After determining the sample locations driving unacceptable risks, the spatial distributions of those locations are considered to determine if a “hotspot” exists. For example, if all the locations driving unacceptable risk are adjacent to one another then a “hotspot” would exist; however, if the locations driving unacceptable risk are sporadically located throughout the site, then a “hotspot” would not exist and/or would be small in size.

For the example scenario presented above, it was determined that location 57SB02, with a cobalt concentration of 97 mg/kg, is driving unacceptable risks for the hypothetical child resident exposed to soil in the 1 to 3 feet bgs depth range.

The only other scenario for which there was an unacceptable risk was for the hypothetical future child resident exposed to soil from 0 to 10 feet bgs due to the COC cobalt. Using the methodology described above it was determined that locations 57SB16; [Co] = 301 mg/kg (at 9 to 11 feet bgs) and 57SB04; [Co] = 149 mg/kg (at 9 to 11 feet bgs) were driving the potentially unacceptable risks.

The locations driving the potentially unacceptable risks (i.e., locations 57SB02, 57SB04, and 57SB16) are not located adjacent to one another based on a review of the sampling location figures. Therefore, a "hotspot" is not considered to exist for cobalt in site soils.

Uncertainty Associated with Cobalt Toxicity Criteria

Cobalt was identified as a COC for the hypothetical future child resident exposed to groundwater via ingestion (HI = 3); however, a risk management decision should be made to decide whether cobalt in groundwater should remain a COC moving forward due to the uncertainty associated with the RfD used to calculate the cobalt ingestion HI. Overall there is low confidence in the provisional chronic RfD used to calculate noncancer risks associated with cobalt due to low to medium confidence in the principal study used to derive the RfD and in the database researched to locate a principal study (USEPA, 2008). The principal study used to derive the RfD is a subchronic study based on twelve individuals examined over a two week period and only a single dose level was evaluated so a no observed adverse effect level (NOAEL) was not identified. Noncancer risks are calculated based on chronic exposures and the fact that a NOAEL was not observed means that it is unknown which level of cobalt ingestion does not cause health problems. Other studies with longer exposure durations were found in the databases searched; however, critical details of those studies are not available for assessment (USEPA, 2008). EPA states that a temporal relationship between prolonged oral cobalt exposure and adverse effects (in this case thyroid effects) is not clear, based upon the available data; therefore, confidence in the provisional cobalt RfD is low and it is considered a Tier II toxicity value by the EPA (USEPA, 2008).

TABLE 6-1

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	8E-08	--	--	--	0.10	--
		Dermal Contact	9E-09	--	--	--	0.001	--
		Inhalation	5E-07	--	--	--	0.2	--
		Total	5E-07	--	--	--	0.3	--
	Subsurface Soil (>3 feet bgs)	Incidental Ingestion	0E+00	--	--	--	0.1	--
		Dermal Contact	0E+00	--	--	--	0	--
		Inhalation	2E-06	--	--	Cobalt	0.8	--
		Total	2E-06	--	--	Cobalt	0.9	--
	Groundwater	Incidental Ingestion	2E-09	--	--	--	0.0004	--
		Dermal Contact	2E-09	--	--	--	0.003	--
		Total	4E-09	--	--	--	0.004	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		6E-07				0.3	
	Subsurface Soil (>3 ft bgs) and Groundwater		2E-06				0.9	
Industrial Worker	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	1E-06	--	--	--	0.1	--
		Dermal Contact	3E-07	--	--	--	0.001	--
		Inhalation	2E-08	--	--	--	0.0010	--
		Total	1E-06	--	--	--	0.1	--
Adolescent Trespasser	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	8E-08	--	--	--	0.03	--
		Dermal Contact	4E-08	--	--	--	0.0003	--
		Inhalation	4E-10	--	--	--	0.00006	--
		Total	1E-07	--	--	--	0.03	--
Child Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	1E-06	--	--	--	0.5	--
		Dermal Contact	1E-07	--	--	--	0.002	--
		Inhalation	9E-10	--	--	--	0.0002	--
		Total	1E-06	--	--	--	0.5	--
Adolescent Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	3E-07	--	--	--	0.09	--
		Dermal Contact	9E-08	--	--	--	0.0008	--
		Inhalation	1E-09	--	--	--	0.0002	--
		Total	3E-07	--	--	--	0.09	--
Adult Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.06	--
		Dermal Contact	4E-08	--	--	--	0.0003	--
		Inhalation	2E-09	--	--	--	0.0002	--
		Total	3E-07	--	--	--	0.06	--

TABLE 6-1

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Recreational User (child, adolescent, adult)	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	1E-06	--	--	--	NA	--
		Dermal Contact	3E-07	--	--	--	NA	--
		Inhalation	4E-09	--	--	--	NA	--
		Total	2E-06	--	--	--	NA	--
Child Resident	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	3E-06	--	--	Arsenic	1	--
		Dermal Contact	5E-07	--	--	--	0.006	--
		Inhalation	2E-08	--	--	--	0.004	--
		Total	4E-06	--	--	Arsenic	1	--
	Groundwater	Incidental Ingestion	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
		Dermal Contact	3E-07	--	--	--	0.2	--
		Total	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		6E-05				4	
Adult Resident	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	1E-06	--	--	--	0.2	--
		Dermal Contact	2E-07	--	--	--	0.0009	--
		Inhalation	7E-08	--	--	--	0.004	--
		Total	2E-06	--	--	--	0.2	--
	Groundwater	Incidental Ingestion	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
		Dermal Contact	5E-07	--	--	--	0.02	--
		Total	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		9E-05				1	
Lifelong Resident (child, adult)	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	5E-06	--	--	Arsenic	NA	--
		Dermal Contact	7E-07	--	--	--	NA	--
		Inhalation	9E-08	--	--	--	NA	--
		Total	6E-06	--	--	Arsenic	NA	--
	Groundwater	Incidental Ingestion	1E-04	--	Arsenic	Benzo(a)anthracene	NA	--
		Dermal Contact	8E-07	--	--	--	NA	--
		Total	1E-04	--	Arsenic	Benzo(a)anthracene	NA	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		1E-04				NA	

Notes:
NA - Not applicable.

TABLE 6-2

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	2E-08	--	--	--	0.02	--
		Dermal Contact	2E-09	--	--	--	0.0002	--
		Inhalation	2E-07	--	--	--	0.09	--
		Total	3E-07	--	--	--	0.1	--
	Subsurface Soil (>3 feet bgs)	Incidental Ingestion	0E+00	--	--	--	0.02	--
		Dermal Contact	0E+00	--	--	--	--	--
		Inhalation	1E-06	--	--	--	0.4	--
		Total	1E-06	--	--	--	0.4	--
	Groundwater	Incidental Ingestion	8E-10	--	--	--	0.0002	--
		Dermal Contact	5E-10	--	--	--	0.0008	--
		Total	1E-09	--	--	--	0.001	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		3E-07				0.1	
	Subsurface Soil (>3 ft bgs) and Groundwater		1E-06				0.4	
Industrial Worker	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.06	--
		Dermal Contact	8E-09	--	--	--	0.0001	--
		Inhalation	6E-09	--	--	--	0.0008	--
		Total	2E-07	--	--	--	0.07	--
Adolescent Trespasser	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	2E-08	--	--	--	0.007	--
		Dermal Contact	4E-09	--	--	--	0.00003	--
		Inhalation	1E-10	--	--	--	0.00001	--
		Total	2E-08	--	--	--	0.007	--
Child Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.1	--
		Dermal Contact	1E-08	--	--	--	0.0002	--
		Inhalation	2E-10	--	--	--	0.00006	--
		Total	3E-07	--	--	--	0.1	--
Adolescent Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	3E-08	--	--	--	0.02	--
		Dermal Contact	5E-09	--	--	--	0.00008	--
		Inhalation	2E-10	--	--	--	0.00005	--
		Total	4E-08	--	--	--	0.02	--
Adult Recreational User	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	3E-08	--	--	--	0.01	--
		Dermal Contact	1E-09	--	--	--	0.00002	--
		Inhalation	3E-10	--	--	--	0.00005	--
		Total	3E-08	--	--	--	0.01	--

TABLE 6-2

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Recreational User (child, adolescent, adult)	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	3E-07	--	--	--	NA	--
		Dermal Contact	2E-08	--	--	--	NA	--
		Inhalation	7E-10	--	--	--	NA	--
		Total	3E-07	--	--	--	NA	--
Child Resident	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	4E-07	--	--	--	0.6	--
		Dermal Contact	2E-08	--	--	--	0.0008	--
		Inhalation	4E-09	--	--	--	0.003	--
		Total	4E-07	--	--	--	0.6	--
	Groundwater	Incidental Ingestion	8E-06	--	--	Arsenic	1	--
		Dermal Contact	2E-08	--	--	--	0.03	--
		Total	8E-06	--	--	Arsenic	1	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		9E-06				2	
Adult Resident	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	1E-07	--	--	--	0.07	--
		Dermal Contact	6E-09	--	--	--	0.00009	--
		Inhalation	1E-08	--	--	--	0.003	--
		Total	2E-07	--	--	--	0.07	--
	Groundwater	Incidental Ingestion	1E-05	--	--	Arsenic	0.6	--
		Dermal Contact	4E-08	--	--	--	0.004	--
		Total	1E-05	--	--	Arsenic	0.6	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		1E-05				0.6	
Lifelong Resident (child, adult)	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	5E-07	--	--	--	NA	--
		Dermal Contact	3E-08	--	--	--	NA	--
		Inhalation	2E-08	--	--	--	NA	--
		Total	6E-07	--	--	--	NA	--
	Groundwater	Incidental Ingestion	2E-05	--	Arsenic	--	NA	--
		Dermal Contact	6E-08	--	--	--	NA	--
		Total	2E-05	--	Arsenic	--	NA	--
	Combined Surface/Subsurface Soil (0-3 feet bgs) and Groundwater		2E-05				NA	

Notes:
NA - Not applicable.

TABLE 6-3

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Surface Soil	Incidental Ingestion	9E-08	--	--	--	0.06	--
		Dermal Contact	1E-08	--	--	--	0.001	--
		Inhalation	5E-07	--	--	--	0.3	--
		Total	6E-07	--	--	--	0.4	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	7E-08	--	--	--	0.07	--
		Dermal Contact	7E-09	--	--	--	0.0009	--
		Inhalation	6E-07	--	--	--	0.4	--
		Total	6E-07	--	--	--	0.5	--
	Subsurface Soil (>3 feet bgs)	Incidental Ingestion	3E-08	--	--	--	0.1	--
		Dermal Contact	3E-09	--	--	--	0.0004	--
		Inhalation	2E-06	--	--	Cobalt	1	--
		Total	2E-06	--	--	Cobalt	1	--
	Groundwater	Incidental Ingestion	2E-09	--	--	--	0.0004	--
		Dermal Contact	2E-09	--	--	--	0.002	--
		Total	4E-09	--	--	--	0.002	--
	Surface Soil and Groundwater		6.E-07				0.4	
	Subsurface Soil (1-3 ft bgs) and Groundwater		6.E-07				0.5	
	Subsurface Soil (>3 ft bgs) and Groundwater		2.E-06				1	
Industrial Worker	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.1	--
		Dermal Contact	3E-07	--	--	--	0.001	--
		Inhalation	2E-08	--	--	--	0.001	--
		Total	1E-06	--	--	--	0.1	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	8E-07	--	--	--	0.2	--
		Dermal Contact	2E-07	--	--	--	0.0010	--
		Inhalation	2E-08	--	--	--	0.001	--
		Total	1E-06	--	--	--	0.2	--
Adolescent Trespasser	Surface Soil	Incidental Ingestion	2E-07	--	--	--	0.05	--
		Dermal Contact	8E-08	--	--	--	0.0006	--
		Inhalation	8E-10	--	--	--	0.0001	--
		Total	2E-07	--	--	--	0.05	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	1E-07	--	--	--	0.06	--
		Dermal Contact	6E-08	--	--	--	0.0005	--
		Inhalation	9E-10	--	--	--	0.0002	--
		Total	2E-07	--	--	--	0.06	--
Child Recreational User	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.5	--
		Dermal Contact	2E-07	--	--	--	0.002	--
		Inhalation	9E-10	--	--	--	0.0002	--
		Total	1E-06	--	--	--	0.5	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	9E-07	--	--	--	0.6	--
		Dermal Contact	1E-07	--	--	--	0.002	--
		Inhalation	1E-09	--	--	--	0.0003	--
		Total	1E-06	--	--	--	0.7	--
Adolescent Recreational User	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.09	--
		Dermal Contact	1E-07	--	--	--	0.0012	--
		Inhalation	1E-09	--	--	--	0.0002	--
		Total	4E-07	--	--	--	0.09	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.1	--
		Dermal Contact	1E-07	--	--	--	0.0010	--
		Inhalation	2E-09	--	--	--	0.0003	--
		Total	3E-07	--	--	--	0.1	--

TABLE 6-3

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Adult Recreational User	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.06	--
		Dermal Contact	4E-08	--	--	--	0.0003	--
		Inhalation	2E-09	--	--	--	0.0002	--
		Total	3E-07	--	--	--	0.06	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.07	--
		Dermal Contact	3E-08	--	--	--	0.0002	--
		Inhalation	3E-09	--	--	--	0.0003	--
		Total	2E-07	--	--	--	0.07	--
Lifelong Recreational User (child, adolescent, adult)	Surface Soil	Incidental Ingestion	5E-07	--	--	--	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	4E-09	--	--	--	NA	--
		Total	7E-07	--	--	--	NA	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	4E-07	--	--	--	NA	--
		Dermal Contact	1E-07	--	--	--	NA	--
		Inhalation	4E-09	--	--	--	NA	--
		Total	6E-07	--	--	--	NA	--
Child Resident	Surface Soil	Incidental Ingestion	4E-06	--	--	Arsenic	2	Target Organs HI < 1
		Dermal Contact	6E-07	--	--	--	0.007	--
		Inhalation	2E-08	--	--	--	0.005	--
		Total	5E-06	--	--	Arsenic	2	Target Organs HI < 1
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	3E-06	--	--	Arsenic	2	Cobalt
		Dermal Contact	5E-07	--	--	--	0.005	--
		Inhalation	2E-08	--	--	--	0.006	--
		Total	4E-06	--	--	Arsenic	2	Cobalt
	Groundwater	Incidental Ingestion	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
		Dermal Contact	3E-07	--	--	--	0.06	--
		Total	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
	Surface Soil and Groundwater		6.E-05				5	
	Subsurface Soil (1-3 ft bgs) and Groundwater		6.E-05				5	
Adult Resident	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.2	--
		Dermal Contact	3E-07	--	--	--	0.001	--
		Inhalation	7E-08	--	--	--	0.005	--
		Total	2E-06	--	--	Arsenic	0.2	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	1E-06	--	--	--	0.2	--
		Dermal Contact	2E-07	--	--	--	0.0008	--
		Inhalation	9E-08	--	--	--	0.006	--
		Total	1E-06	--	--	--	0.3	--
	Groundwater	Incidental Ingestion	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
		Dermal Contact	5E-07	--	--	--	0.020	--
		Total	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
	Surface Soil and Groundwater		9.E-05				1	
	Subsurface Soil (1-3 ft bgs) and Groundwater		9.E-05				1	

TABLE 6-3

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Resident (child, adult)	Surface Soil	Incidental Ingestion	5E-06	--	--	Arsenic	NA	--
		Dermal Contact	8E-07	--	--	--	NA	--
		Inhalation	9E-08	--	--	--	NA	--
		Total	6E-06	--	--	Arsenic	NA	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	4E-06	--	--	Arsenic	NA	--
		Dermal Contact	7E-07	--	--	--	NA	--
		Inhalation	1E-07	--	--	--	NA	--
		Total	5E-06	--	--	Arsenic	NA	--
	Groundwater	Incidental Ingestion	1E-04	--	Arsenic	Benzo(a)anthracene	NA	--
		Dermal Contact	8E-07	--	--	--	NA	--
		Total	1E-04	--	Arsenic	Benzo(a)anthracene	NA	--
	Surface Soil and Groundwater		2.E-04				NA	
	Subsurface Soil (1-3 ft bgs) and Groundwater		1.E-04				NA	

Notes:
NA - Not applicable.

TABLE 6-4

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Surface Soil	Incidental Ingestion	2E-08	--	--	--	0.02	--
		Dermal Contact	2E-09	--	--	--	0.0002	--
		Inhalation	2E-07	--	--	--	0.2	--
		Total	2E-07	--	--	--	0.2	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	2E-08	--	--	--	0.02	--
		Dermal Contact	1E-09	--	--	--	0.0001	--
		Inhalation	3E-07	--	--	--	0.2	--
		Total	3E-07	--	--	--	0.2	--
	Subsurface Soil (>3 feet bgs)	Incidental Ingestion	8E-09	--	--	--	0.04	--
		Dermal Contact	5E-10	--	--	--	0.00007	--
		Inhalation	1E-06	--	--	--	0.5	--
		Total	1E-06	--	--	--	0.5	--
	Groundwater	Incidental Ingestion	8E-10	--	--	--	0.0002	--
		Dermal Contact	5E-10	--	--	--	0.0004	--
		Total	0E+00	--	--	--	--	--
	Surface Soil and Groundwater		1E-09	--	--	--	0.0006	--
	Subsurface Soil (1-3 ft bgs) and Groundwater		3.E-07				0.2	
	Subsurface Soil (>3 ft bgs) and Groundwater		1.E-06				0.5	
Industrial Worker	Surface Soil	Incidental Ingestion	2E-07	--	--	--	0.06	--
		Dermal Contact	1E-08	--	--	--	0.0001	--
		Inhalation	6E-09	--	--	--	0.001	--
		Total	2E-07	--	--	--	0.06	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	1E-07	--	--	--	0.08	--
		Dermal Contact	6E-09	--	--	--	0.00008	--
		Inhalation	7E-09	--	--	--	0.001	--
		Total	1E-07	--	--	--	0.08	--
Adolescent Trespasser	Surface Soil	Incidental Ingestion	4E-08	--	--	--	0.01	--
		Dermal Contact	8E-09	--	--	--	0.00006	--
		Inhalation	2E-10	--	--	--	0.00003	--
		Total	5E-08	--	--	--	0.01	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	3E-08	--	--	--	0.01	--
		Dermal Contact	6E-09	--	--	--	0.00005	--
		Inhalation	2E-10	--	--	--	0.00004	--
		Total	4E-08	--	--	--	0.01	--
Child Recreational User	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.1	--
		Dermal Contact	2E-08	--	--	--	0.0002	--
		Inhalation	2E-10	--	--	--	0.00006	--
		Total	3E-07	--	--	--	0.1	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	2E-07	--	--	--	0.2	--
		Dermal Contact	1E-08	--	--	--	0.0002	--
		Inhalation	3E-10	--	--	--	0.00007	--
		Total	2E-07	--	--	--	0.2	--
Adolescent Recreational User	Surface Soil	Incidental Ingestion	4E-08	--	--	--	0.02	--
		Dermal Contact	7E-09	--	--	--	0.00012	--
		Inhalation	2E-10	--	--	--	0.00006	--
		Total	4E-08	--	--	--	0.02	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	3E-08	--	--	--	0.03	--
		Dermal Contact	5E-09	--	--	--	0.00010	--
		Inhalation	2E-10	--	--	--	0.00007	--
		Total	3E-08	--	--	--	0.03	--

TABLE 6-4

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Adult Recreational User	Surface Soil	Incidental Ingestion	3E-08	--	--	--	0.01	--
		Dermal Contact	2E-09	--	--	--	0.00002	--
		Inhalation	3E-10	--	--	--	0.00006	--
		Total	3E-08	--	--	--	0.01	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	2E-08	--	--	--	0.02	--
		Dermal Contact	9E-10	--	--	--	0.00002	--
		Inhalation	3E-10	--	--	--	0.00007	--
		Total	2E-08	--	--	--	0.02	--
Lifelong Recreational User (child, adolescent, adult)	Surface Soil	Incidental Ingestion	7E-08	--	--	--	NA	--
		Dermal Contact	9E-09	--	--	--	NA	--
		Inhalation	4E-10	--	--	--	NA	--
		Total	8E-08	--	--	--	NA	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	5E-08	--	--	--	NA	--
		Dermal Contact	6E-09	--	--	--	NA	--
		Inhalation	5E-10	--	--	--	NA	--
		Total	6E-08	--	--	--	NA	--
Child Resident	Surface Soil	Incidental Ingestion	5E-07	--	--	--	0.6	--
		Dermal Contact	3E-08	--	--	--	0.0009	--
		Inhalation	4E-09	--	--	--	0.003	--
		Total	5E-07	--	--	--	0.6	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	4E-07	--	--	--	0.8	--
		Dermal Contact	2E-08	--	--	--	0.0007	--
		Inhalation	5E-09	--	--	--	0.004	--
		Total	4E-07	--	--	--	0.8	--
	Groundwater	Incidental Ingestion	8E-06	--	--	Arsenic	1	--
		Dermal Contact	2E-08	--	--	--	0.010	--
		Total	8E-06	--	--	Arsenic	1	--
	Surface Soil and Groundwater		9.E-06				2	
	Subsurface Soil (1-3 ft bgs) and Groundwater		8.E-06				2	
Adult Resident	Surface Soil	Incidental Ingestion	1E-07	--	--	--	0.07	--
		Dermal Contact	7E-09	--	--	--	0.00010	--
		Inhalation	1E-08	--	--	--	0.003	--
		Total	2E-07	--	--	--	0.07	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	1E-07	--	--	--	0.08	--
		Dermal Contact	5E-09	--	--	--	0.00008	--
		Inhalation	2E-08	--	--	--	0.004	--
		Total	1E-07	--	--	--	0.09	--
	Groundwater	Incidental Ingestion	1E-05	--	--	Arsenic	0.6	--
		Dermal Contact	4E-08	--	--	--	0.006	--
		Total	1E-05	--	--	Arsenic	0.6	--
	Surface Soil and Groundwater		1.E-05				0.7	
	Subsurface Soil (1-3 ft bgs) and Groundwater		1.E-05				0.7	

TABLE 6-4

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - SEPARATE SURFACE SOIL AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Resident (child, adult)	Surface Soil	Incidental Ingestion	6E-07	--	--	--	NA	--
		Dermal Contact	3E-08	--	--	--	NA	--
		Inhalation	2E-08	--	--	--	NA	--
		Total	7E-07	--	--	--	NA	--
	Subsurface Soil (1- 3 feet bgs)	Incidental Ingestion	5E-07	--	--	--	NA	--
		Dermal Contact	3E-08	--	--	--	NA	--
		Inhalation	2E-08	--	--	--	NA	--
		Total	5E-07	--	--	--	NA	--
	Groundwater	Incidental Ingestion	2E-05	--	Arsenic	--	NA	--
		Dermal Contact	6E-08	--	--	--	NA	--
		Total	2E-05	--	Arsenic	--	NA	--
	Surface Soil and Groundwater		2.E-05				NA	
	Subsurface Soil (1-3 ft bgs) and Groundwater		2.E-05				NA	

Notes:
NA - Not applicable.

TABLE 6-5

RME SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 10 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	8E-08	--	--	--	0.08	--
		Dermal Contact	9E-09	--	--	--	0.0010	--
		Inhalation	7E-07	--	--	--	0.3	--
		Total	8E-07	--	--	--	0.4	--
	Groundwater	Incidental Ingestion	2E-09	--	--	--	0.0003	--
		Dermal Contact	2E-09	--	--	--	0.002	--
		Total	4E-09	--	--	--	0.002	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		8E-07				0.4	
Child Resident	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	3E-06	--	--	Arsenic	3	Cobalt
		Dermal Contact	4E-07	--	--	--	0.006	--
		Inhalation	3E-08	--	--	--	0.008	--
		Total	4E-06	--	--	Arsenic	3	Cobalt
	Groundwater	Incidental Ingestion	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
		Dermal Contact	3E-07	--	--	--	0.05	--
		Total	5E-05	--	Arsenic	Benzo(a)anthracene	3	Target Organs HI < 1
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		6E-05				6	
Adult Resident	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	1E-06	--	--	--	0.3	--
		Dermal Contact	2E-07	--	--	--	0.0009	--
		Inhalation	1E-07	--	--	--	0.008	--
		Total	2E-06	--	--	--	0.3	--
	Groundwater	Incidental Ingestion	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
		Dermal Contact	5E-07	--	--	--	0.02	--
		Total	9E-05	--	Arsenic	Benzo(a)anthracene	1	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		9E-05				2	
Lifelong Resident (child, adult)	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	5E-06	--	--	Arsenic	NA	--
		Dermal Contact	7E-07	--	--	--	NA	--
		Inhalation	2E-07	--	--	--	NA	--
		Total	5E-06	--	--	Arsenic	NA	--
	Groundwater	Incidental Ingestion	1E-04	--	--	Benzo(a)anthracene	NA	--
		Dermal Contact	8E-07	--	--	--	NA	--
		Total	1E-04	--	--	Benzo(a)anthracene	NA	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		1E-04				NA	

Notes:
NA - Not applicable.

TABLE 6-6

CTE SUMMARY OF CANCER RISKS AND HAZARD INDICES - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 10 FEET BGS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Worker	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	2E-08	--	--	--	0.02	--
		Dermal Contact	2E-09	--	--	--	0.0002	--
		Inhalation	4E-07	--	--	--	0.1	--
		Total	4E-07	--	--	--	0.2	--
	Groundwater	Incidental Ingestion	8E-10	--	--	--	0.0002	--
		Dermal Contact	5E-10	--	--	--	0.0004	--
		Total	1E-09	--	--	--	0.0006	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		4E-07				0.2	
Child Resident	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	4E-07	--	--	--	1.0	--
		Dermal Contact	2E-08	--	--	--	0.0008	--
		Inhalation	7E-09	--	--	--	0.005	--
		Total	4E-07	--	--	--	1.0	--
	Groundwater	Incidental Ingestion	8E-06	--	--	Arsenic	1	--
		Dermal Contact	2E-08	--	--	--	0.01	--
			0E+00	--	--	--	--	--
		Total	8E-06	--	--	Arsenic	1	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		9E-06				2	
Adult Resident	Combined Surface/Subsurface Soil (0-10 feet bgs)	Incidental Ingestion	1E-07	--	--	--	0.1	--
		Dermal Contact	6E-09	--	--	--	0.00009	--
		Inhalation	2E-08	--	--	--	0.005	--
		Total	2E-07	--	--	--	0.1	--
	Groundwater	Incidental Ingestion	1E-05	--	--	Arsenic	0.6	--
		Dermal Contact	4E-08	--	--	--	0.004	--
			0E+00	--	--	--	--	--
		Total	1E-05	--	--	Arsenic	0.6	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		1E-05				NA	
Lifelong Resident (child, adult)	Combined Surface/Subsurface Soil (0- 3 feet bgs)	Incidental Ingestion	5E-07	--	--	--	NA	--
		Dermal Contact	3E-08	--	--	--	NA	--
		Inhalation	3E-08	--	--	--	NA	--
		Total	6E-07	--	--	--	NA	--
	Groundwater	Incidental Ingestion	2E-05	--	--	--	NA	--
		Dermal Contact	6E-08	--	--	--	NA	--
		Total	2E-05	--	--	--	NA	--
	Combined Surface/Subsurface Soil (0-10 feet bgs) and Groundwater		2E-05				NA	--

Notes:
NA - Not applicable.

TABLE 6-7

COMPARISON OF NOVEMBER 2013 AND JUNE 2015 REGIONAL SCREENING LEVELS FOR RESIDENTIAL SOIL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CAS No.	Parameter	USEPA Regional Screening Levels			
		Adjusted Direct Contact Residential (mg/kg)[1]		Protection of Groundwater (mg/kg)[2]	
		November 2013	June 2015	November 2013	June 2015
METALS					
7440-36-0	ANTIMONY	3.1 N	3.1 N	**0.27**	0.35
7440-38-2	ARSENIC	**0.61 C**	0.68 C	**0.0013**	0.0015
7440-39-3	BARIUM	1500 N	1500 N	**120**	160
7440-41-7	BERYLLIUM	16 N	16 N	**13**	19
7440-43-9	CADMIUM	**7 N**	7.1 N	**0.52**	0.69
7440-47-3	CHROMIUM	12000 N[3]	12000 N[3]	**28000000 [3]**	40000000 [3]
7440-48-4	COBALT	2.3 N	2.3 N	**0.21**	0.27
7440-50-8	COPPER	310 N	310 N	**22**	28
57-12-5	CYANIDE	2.2 N	0.27 N	0.094	0.015
7439-92-1	LEAD	400	400	14 [4]	14 [4]
7439-97-6	MERCURY	2.3 N[5]	2.3 N[5]	0.033	0.033
7440-02-0	NICKEL	150 N	150 N	**20**	26
7782-49-2	SELENIUM	39 N	39 N	**0.4**	0.52
7440-22-4	SILVER	39 N	39 N	**0.6**	0.8
7440-28-0	THALLIUM	0.078 N	0.078 N	**0.011**	0.014
7440-31-5	TIN	4700 N	4700 N	**2300**	3000
7440-62-2	VANADIUM	39 N	39 N	**78**	86
7440-66-6	ZINC	2300 N	2300 N	**290**	370
PCBS					
11096-82-5	AROCLOR-1260	**0.22 C**	0.24 C	0.024	0.0055
PESTICIDES					
72-54-8	4,4'-DDD	**2 C**	2.3 C	**0.0064**	0.0072
72-55-9	4,4'-DDE	**1.4 C**	2 C	0.046	0.011
50-29-3	4,4'-DDT	**1.7 C**	1.9 C	**0.067**	0.077
HERBICIDES					
93-72-1	2,4,5-TP (SILVEX)	**49 N**	51 N	**0.046**	0.061
POLYCYCLIC AROMATIC HYDROCARBONS					
91-57-6	2-METHYLNAPHTHALENE	**23 N**	24 N	**0.14**	0.19
83-32-9	ACENAPHTHENE	**340 N**	360 N	**4.1**	5.5
208-96-8	ACENAPHTHYLENE	**340 N[6]**	360 N[6]	**4.1 [6]**	5.5 [6]
120-12-7	ANTHRACENE	**1700 N**	1800 N	**42**	58
56-55-3	BENZO(A)ANTHRACENE	**0.15 C**	0.16 C	0.01	0.00425
50-32-8	BENZO(A)PYRENE	**0.015 C**	0.016 C	**0.0035**	0.004
205-99-2	BENZO(B)FLUORANTHENE	**0.15 C**	0.16 C	**0.035**	0.041
191-24-2	BENZO(G,H,I)PERYLENE	**170 N[7]**	180 N[7]	**9.5 [7]**	13 [7]
207-08-9	BENZO(K)FLUORANTHENE	**1.5 C**	1.6 C	**0.35**	0.4
218-01-9	CHRYSENE	**15 C**	16 C	**1.1**	1.2
53-70-3	DIBENZO(A,H)ANTHRACENE	**0.015 C**	0.016 C	**0.011**	0.013
206-44-0	FLUORANTHENE	**230 N**	240 N	**70**	89
86-73-7	FLUORENE	**230 N**	240 N	**4**	5.4
193-39-5	INDENO(1,2,3-CD)PYRENE	**0.15 C**	0.16 C	0.2	0.13
91-20-3	NAPHTHALENE	**3.6 C**	3.8 C	**0.00047**	0.00054
85-01-8	PHENANTHRENE	**170 N[7]**	180 N[7]	**9.5 [7]**	13 [7]
129-00-0	PYRENE	**170 N**	180 N	**9.5**	13
SEMIVOLATILES					
98-86-2	ACETOPHENONE	780 N	780 N	**0.45**	0.58
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	**35 C**	39 C	**1.1**	1.3
VOLATILES					
78-93-3	2-BUTANONE	2800 N	2700 N	**1**	1.2
591-78-6	2-HEXANONE	21 N	20 N	**0.0079**	0.0088
67-64-1	ACETONE	6100 N	6100 N	**2.4**	2.9
71-43-2	BENZENE	**1.1 C**	1.2 C	**0.0002**	0.00023
74-83-9	BROMOMETHANE	0.73 N	0.68 N	**0.0018**	0.0019
75-15-0	CARBON DISULFIDE	82 N	77 N	**0.21**	0.24
56-23-5	CARBON TETRACHLORIDE	**0.61 C**	0.65 C	**0.00015**	0.00018
108-90-7	CHLOROBENZENE	29 N	28 N	**0.049**	0.053
67-66-3	CHLOROFORM	**0.29 C**	0.32 C	**0.000053**	0.000061

TABLE 6-7

COMPARISON OF NOVEMBER 2013 AND JUNE 2015 REGIONAL SCREENING LEVELS FOR RESIDENTIAL SOIL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CAS No.	Parameter	USEPA Regional Screening Levels			
		Adjusted Direct Contact Residential (mg/kg)[1]		Protection of Groundwater (mg/kg)[2]	
		November 2013	June 2015	November 2013	June 2015
100-41-4	ETHYLBENZENE	**5.4 C**	5.8 C	**0.0015**	0.0017
74-88-4	METHYL IODIDE	NA	NA	NA	NA
127-18-4	TETRACHLOROETHENE	8.6 N[8]	8.1 N[8]	**0.0044**	0.0051
1330-20-7	TOTAL XYLENES	**63 N**	65 N	0.19	0.19
PETROLEUM HYDROCARBONS					
--	DIESEL RANGE ORGANICS	NA	NA	NA	NA
--	TOTAL PETROLEUM HYDROCARBONS	NA	NA	NA	NA

Notes:
1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. Values correspond to a cancer risk level of 1E-06 or an adjusted hazard quotient (HQ) of 0.1.
2 - USEPA RSLs for Chemical Contaminants at Superfund Sites. Risk-based soil screening levels (SSLs) for groundwater protection. Values are based on a dilution attenuation factor (DAF) of 1.
3 - Value is for trivalent chromium.
4 - The Maximum Contaminant Level (MCL)-based SSL is presented.
5 - The value is for mercuric chloride (and other mercury salts).
6 - The value is for acenaphthene.
7 - Value is for pyrene.
8 - Ten percent of noncarcinogenic screening level is less then the carcinogenic screening level; therefore, the noncarcinogenic value is presented.

C - Carcinogenic
MCL - Maximum Contaminant Level
N - Noncarcinogenic
NA - Not Applicable/Not Available
SSL - Soil screening level

Bolded values indicate the November 2013 RSLs are less than the June 2015 RSLs.
Shading indicates the June 2015 RSLs are less than the November 2013 RSLs.

TABLE 6-8

COMPARISON OF NOVEMBER 2013 AND JUNE 2015 REGIONAL SCREENING LEVELS FOR TAP WATER
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CAS No.	Parameter	Adjusted USEPA Regional Screening Levels - Tap Water (ug/L)[1]	
		November 2013	June 2015
METALS			
7440-38-2	ARSENIC	**0.045 C**	0.052 C
7440-39-3	BARIUM	**290 N**	380 N
7440-43-9	CADMIUM	**0.69 N**	0.92 N
7440-48-4	COBALT	**0.47 N**	0.6 N
7440-50-8	COPPER	**62 N**	80 N
7439-92-1	LEAD	15	15
7439-97-6	MERCURY	**0.43 N[2]**	0.57 N[2]
7440-02-0	NICKEL	**30 N**	39 N
7782-49-2	SELENIUM	**7.8 N**	10 N
7440-22-4	SILVER	**7.1 N**	9.4 N
7440-28-0	THALLIUM	**0.016 N**	0.02 N
7440-62-2	VANADIUM	**6.3 N**	8.6 N
7440-66-6	ZINC	**470 N**	600 N
POLYCYCLIC AROMATIC HYDROCARBONS			
120-12-7	ANTHRACENE	**130 N**	180 N
56-55-3	BENZO(A)ANTHRACENE	0.029 C	0.012 C
206-44-0	FLUORANTHENE	**63 N**	80 N
129-00-0	PYRENE	**8.7 N**	12 N

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. RSLs for carcinogens correspond to a integrated lifetime cancer risk of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.

2 - The value is for mercuric chloride (and other mercury salts).

C - Carcinogenic

N - Noncarcinogenic

Bolded values indicate the November 2013 RSLs are less than the June 2015 RSLs.

Shading indicates the June 2015 RSLs are less than the November 2013 RSLs.

TABLE 6-9

RISK SUMMARY TABLE - COMBINED SURFACE AND SUBSURFACE SOIL 0 TO 3 FEET BGS
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Receptor	Medium	ILCR	Chemical of Concern[1]	EPC (mg/kg or µg/L)	HI	Chemical of Concern[1]	Target System	EPC (mg/kg or ug/L)
Current/Future Construction Worker	Combined SS/SB 0-3' bgs	5E-07	- -	- -	0.3	- -	- -	- -
	SB > 3' bgs	2E-06	- -	- -	0.9	- -	- -	- -
	GW	4E-09	- -	- -	0.004	- -	- -	- -
Current/Future Industrial Worker	Combined SS/SB 0-3' bgs	1E-06	- -	- -	0.1	- -	- -	- -
Current/Future Adolescent	Combined SS/SB 0-3' bgs	1E-07	- -	- -	0.03	- -	- -	- -
Future Child Recreational User	Combined SS/SB 0-3' bgs	1E-06	- -	- -	0.5	- -	- -	- -
Future Adolescent Recreational User	Combined SS/SB 0-3' bgs	3E-07	- -	- -	0.09	- -	- -	- -
Future Adult Recreational User	Combined SS/SB 0-3' bgs	3E-07	- -	- -	0.06	- -	- -	- -
Future Lifelong Recreational User	Combined SS/SB 0-3' bgs	2E-06	- -	- -	NA[2]	- -	- -	- -
Future Child Resident	Combined SS/SB 0-3' bgs	4E-06	- -	- -	1	- -	- -	- -
	GW	5E-05	- -	- -	3[3]	- -	- -	- -
Future Adult Resident	Combined SS/SB 0-3' bgs	2E-06	- -	- -	0.2	- -	- -	- -
	GW	9E-05	- -	- -	1	- -	- -	- -
Future Lifelong Resident	Combined SS/SB 0-3' bgs	6E-06	- -	- -	NA[2]	- -	- -	- -
	GW	1E-04	- -	- -	NA[2]	- -	- -	- -

All ILCRs and HIs are values for the RME scenario.

Footnotes
1 - For receptors with a total RME ILCR greater than $1x10^{-4}$ or target organ HI greater than 1, any carcinogenic chemical with an ILCR greater than $1x10^{-6}$ or a non-carcinogenic chemical contributing to target organ HI greater than 1.
2 - HIs are not calculated for lifelong receptors because noncancer HIs are not additive.
3 - Target organ HIs are less than or equal to 1.

Acronyms
bgs = below ground surface
EPC = Exposure Point Concentration
GW = Groundwater
HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
mg/kg = milligram per kilogram
NA = Not Applicable
SB = Subsurface Soil
SS = Surface Soil

TABLE 6-10

RISK SUMMARY TABLE - SEPARATE SURFACE AND SUBSURFACE SOIL 1 TO 3 FEET BGS
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

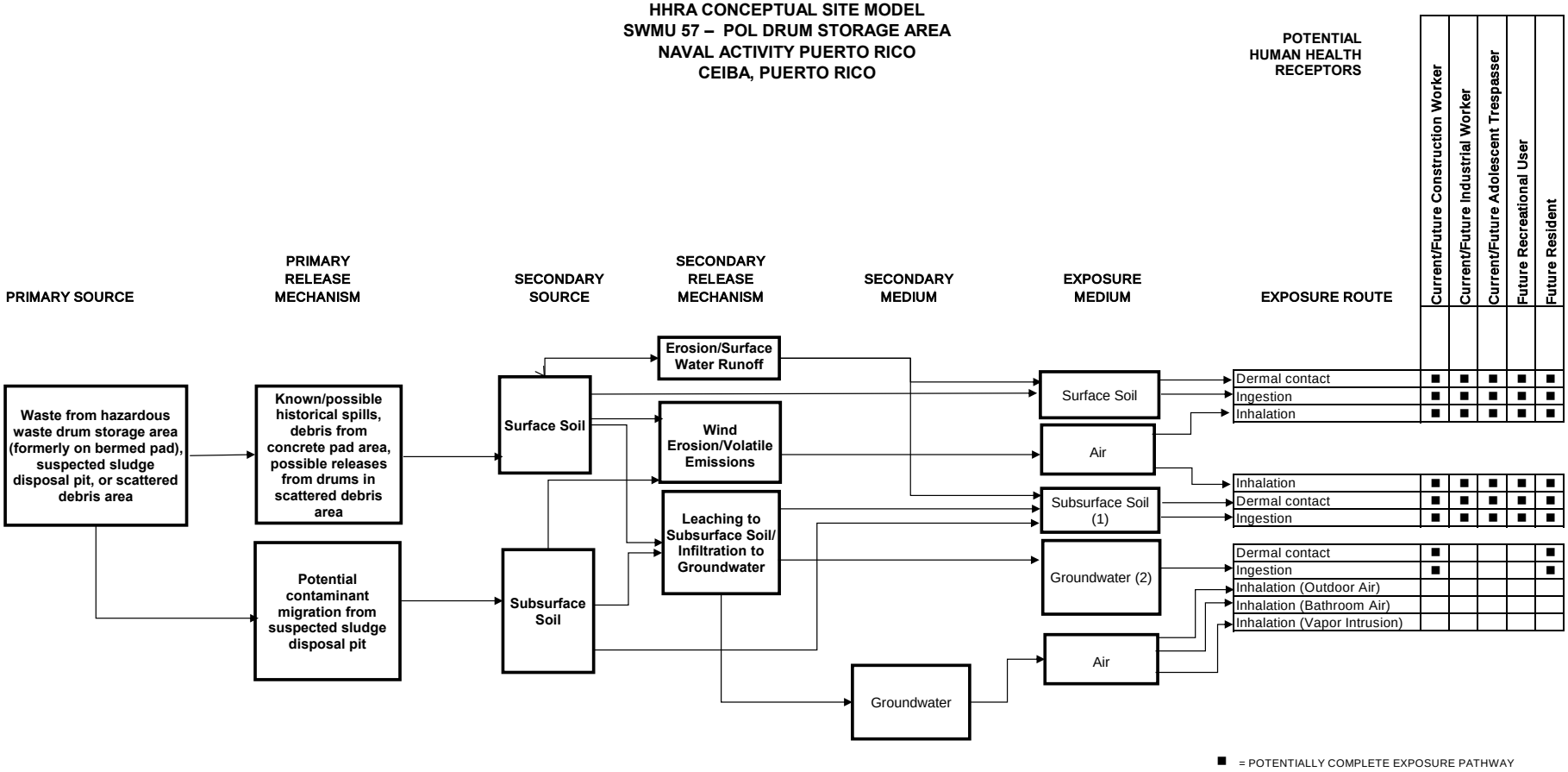
Receptor	Medium	ILCR	Chemical of Concern[1]	EPC (mg/kg or µg/L)	HI	Chemical of Concern[1]	Target System	EPC (mg/kg or ug/L)
Current/Future Construction Worker	SS	6.E-07	- -	- -	0.2	- -	- -	- -
	SB 1-3' bgs	6.E-07	- -	- -	0.3	- -	- -	- -
	SB > 3' bgs	2.E-06	- -	- -	0.9	- -	- -	- -
	GW	4.E-09	- -	- -	0.002	- -	- -	- -
Current/Future Industrial Worker	SS	1.E-06	- -	- -	0.1	- -	- -	- -
	SB 1-3' bgs	1.E-06	- -	- -	0.1	- -	- -	- -
Current/Future Adolescent Trespasser	SS	1E-07	- -	- -	0.02	- -	- -	- -
	SB 1-3' bgs	1E-07	- -	- -	0.03	- -	- -	- -
Future Adolescent Recreational User	SS	1E-06	- -	- -	0.40	- -	- -	- -
	SB 1-3' bgs	1E-06	- -	- -	0.50	- -	- -	- -
Future Adolescent Recreational User	SS	4E-07	- -	- -	0.07	- -	- -	- -
	SB 1-3' bgs	3E-07	- -	- -	0.09	- -	- -	- -
Future Adult Recreational User	SS	3E-07	- -	- -	0.05	- -	- -	- -
	SB 1-3' bgs	2E-07	- -	- -	0.06	- -	- -	- -
Future Lifelong Recreational User	SS	2E-06	- -	- -	NA[2]	- -	- -	- -
	SB 1-3' bgs	2E-06	- -	- -	NA[2]	- -	- -	- -
Future Child Resident	SS	5E-06	- -	- -	1	- -	- -	- -
	SB 1-3' bgs	4E-06	- -	- -	2	Cobalt	Thyroid	40.7
	GW	5E-05	- -	- -	3[3]	- -	- -	- -
Future Adult Resident	SS	2E-06	- -	- -	0.2	- -	- -	- -
	SB 1-3' bgs	1E-06	- -	- -	0.2	- -	- -	- -
	GW	9E-05	- -	- -	1	- -	- -	- -
Future Lifelong Resident	SS	6E-06	- -	- -	NA[2]	- -	- -	- -
	SB 1-3' bgs	5E-06	- -	- -	NA[2]	- -	- -	- -
	GW	1E-04	- -	- -	NA[2]	- -	- -	- -

All ILCRs and HIs are values for the RME scenario.

Footnotes
1 - For receptors with a total RME ILCR greater than $1x10^{-4}$ or target organ HI greater than 1, any carcinogenic chemical with an ILCR greater than $1x10^{-6}$ or a non-carcinogenic chemical contributing to target organ HI greater than 1.
2 - HIs are not calculated for lifelong receptors because noncancer HIs are not additive.
3 - Target organ HIs are less than or equal to 1.

Acronyms
bgs = below ground surface
EPC = Exposure Point Concentration
GW = Groundwater
HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
mg/kg = milligram per kilogram
NA = Not Applicable
SS = Subsurface Soil
SB = Surface Soil

FIGURE 6-1
HHRA CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



1. Exposures to subsurface soil 1 to 3 feet below ground surface (bgs) were evaluated for all potential receptors to be conservative. However, construction workers are the only potential receptors expected to contact subsurface soil. Construction workers were additionally evaluated for exposures to subsurface soil greater than 3 feet bgs, which was typically collected greater than 10 feet bgs.

2. No sufficiently volatile/toxic chemicals were selected as chemicals of potential concern (COPCs) for groundwater; therefore, inhalation of volatile chemicals from groundwater in outdoor air was not evaluated for the construction worker, inhalation of bathroom air was not evaluated for residents, and vapor intrusion was not evaluated for industrial workers/residents.

7.0 ECOLOGICAL RISK ASSESSMENT

The goal of this ERA for SWMU 57 was to evaluate the potential for adverse ecological impacts due to site-related contamination. This goal was accomplished by identifying COPCs detected at concentrations that exceed screening levels, identifying the locations of these exceedances, and concluding whether or not further investigation and/or remedial action at SWMU 57 at NAPR, Puerto Rico is warranted from an ecological perspective.

7.1 INTRODUCTION

The screening-level ERA (SERA) methodology used at NAPR is in accordance with the following guidance documents:

- Department of Navy (Navy) Environmental Policy Memorandum 97-04: Use of Ecological Risk Assessments dated May 16, 1997.
- Navy Policy for Conducting Ecological Risk Assessments (Navy, 1999).
- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997c).

This ERA consists of Steps 1, 2, and 3a of the eight-step ecological risk evaluation process discussed in USEPA guidance (USEPA, 1997c and 1998) and the Navy Policy for Conducting ERAs (Navy, 1999). The first two screening steps comprise the SERA, and correspond with Tier 1 of the Navy Policy (Navy, 1999), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step of a baseline ecological risk assessment (BERA) and consists of refining the Tier 1 assumptions following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. Step 3a corresponds with the first part of Tier 2 of the Navy Policy (Navy, 1999). Steps 3b through 7 are conducted if additional evaluations or investigations are necessary. Aspects of Step 8, risk management, are addressed throughout the ERA process, in cooperation with regulators.

A schematic diagram of the general risk assessment process is provided on Figure 7-1.

7.2 TIER 1, STEP 1: SCREENING-LEVEL PROBLEM FORMULATION

The screening-level problem formulation is the first step of the ERA and includes identification of potential receptor groups, COPCs, and the mechanisms for contaminant fate, transport, and toxicity. The complete exposure pathways that exist at a site are determined at this point to facilitate receptor selection. The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints), the measurements that were used to evaluate risks to those resources (known as measurement endpoints) and the chemicals, geographic areas, and environmental media relevant to the risk assessment.

As part of receptor identification, site habitats and potential ecological receptors, as they apply to ecological risk, are described in the following subsections.

7.2.1 Environmental Setting

SWMU 57 – POL Drum Storage Area is located within NAPR (Figure 1-1). The site covers approximately 1.3 acres and was used for storage of POL and other potentially hazardous materials. SWMU 57 consists of a bermed concrete pad and loading dock. Approximately 0.4 acres of SWMU 57 are covered by the concrete pad. The site is bounded by forest on three sides and a gravel access road overgrowth with grass to the north. Approximately 500 feet downgradient and north/northwest of the site, is the Los Machos Mangrove Forest. The Los Machos Mangrove Forest provides habitat for birds, mammals, fish and other aquatic organisms. A steep vegetated hillside surrounds the concrete pad to the northeast, south, and southwest. A grassy slope and man-made earthen mound divert surface water runoff away from the concrete pad.

Several endangered and threatened species potentially may inhabit SWMU 57, such as the yellow-shouldered blackbird. However, limited habitat is available at the site as SWMU 57 is small (less than 1 acre when discounting the concrete pad). However, the bird species may be present in the Mangrove Forest approximately 500 feet downgradient and north of the site.

7.2.2 Physical and Chemical Characteristics of Contaminants

Based on historical site usage, VOCs, SVOCs, PCBs, and metals are among the site-related chemical contaminants known to be present or potentially present in environmental media at SWMU 57. Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioaccumulation factors (BAFs), K_{OC}s, and K_{OW}s. Appendix I includes a general discussion of the chemical classes detected at the site.

7.2.3 Potential Exposure Pathways

Section 1.3 of this RFI Report describes the operational history for SWMU 57 and presents detailed descriptions of previous investigations for SWMU 57. The site was used for storage of POL and other potentially hazardous materials. Drum fragments and other debris are present on the ground southwest of the pad. Sludge material may have been disposed of in a pit at the western side of the pad. Chemicals may have entered surface soil, subsurface soil, and groundwater from spills at the concrete pad and suspected sludge disposal pit. As discussed in Section 4.0, sludge disposal and associated impacts was not evident; however, ecological evaluation is still warranted to confirm this tentative conclusion. Infiltration through the soil is a potential source of contamination to groundwater. Groundwater may discharge to surface water.

7.2.3.1 Surface Soil

Several groups of terrestrial ecological receptors can be exposed to contaminants in surface soil. Invertebrates such as earthworms are exposed to contaminants as they move through the soil and ingest soil particles while searching for food. Plants are exposed to contaminants via direct contact as contaminants are absorbed through the roots, and contaminants are then translocated to different parts of the plants (e.g., leaves, seeds). These pathways are evaluated in the ERA.

Small mammals/birds may be exposed to contaminants in soil via several exposure routes. They may be exposed by direct contact as they search for food or burrow into the soil. Exposure of terrestrial wildlife to contaminants in the soil via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue. Therefore, the dermal pathway was not evaluated in the ERA. Small mammals also may be exposed to contaminants in soil via incidental ingestion of soil and ingestion of plants and/or invertebrates that have accumulated contaminants from the soil. No invertivorous mammals are present in Puerto Rico; therefore, the ERA assumed all terrestrial ecological receptors were omnivorous or herbivorous. These pathways are evaluated in the ERA.

Larger predatory species such as a hawk can be indirectly exposed to soil contaminants by ingesting small mammals/birds that have accumulated contaminants from soil.

7.2.3.2 Groundwater

Surface water is not present directly at the site and ecological receptors are not directly exposed to contaminants in groundwater at the site. However, contaminated groundwater may discharge to the Los Machos Mangrove Forest, which is about 500 feet north/northwest of the site. Aquatic organisms such as fish and invertebrates that live in the mangrove can be exposed to chemicals in surface water after mixing with the groundwater. In addition, sediment invertebrates can be exposed to chemicals in the pore-water after mixing with groundwater. Although aquatic organisms may accumulate contaminants from the surface water, this pathway is considered to be insignificant at this site because most bioaccumulative chemicals (i.e., pesticides, PCBs) are not water soluble and will not migrate through the groundwater, and the actual exposure of contaminants in the groundwater will be very low after mixing with the surface water. Therefore, although the direct exposure of aquatic organisms to the chemicals in surface water was evaluated in the ERA, exposure to piscivorous wildlife consuming aquatic organisms was not evaluated.

7.2.3.3 Air

Inhalation of particulates by mammals and birds is not considered a complete pathway at SWMU 57 because there are no activities causing air contamination. Also, inhalation pathways are not typically evaluated in ERAs because of the uncertainty inherent in estimating exposure levels and toxicological effects. Therefore, the air inhalation pathway is not evaluated in the ERA.

7.2.4 Assessment Endpoints and Measurement Endpoints

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997c). The selection of these endpoints is based on the habitats present, migration pathways of probable contaminants, and relevant exposure routes for the receptors. Measurement endpoints are estimates of measurable biological impacts (e.g., mortality, growth, and reproduction) that are used to evaluate the assessment endpoints. The assessment endpoints and measurement endpoints for SWMU 57 are presented in Table 7-1.

7.2.4.1 Assessment Endpoints

Based on the habitat at SWMU 57, which consists of mostly grass with nearby forested areas and the chemicals present at the site, the assessment endpoints include protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Terrestrial vegetation
- Soil invertebrates
- Aquatic organisms
- Herbivorous birds
- Omnivorous birds and mammals

The following paragraphs discuss the above assessment endpoints.

Terrestrial Vegetation: Terrestrial vegetation at SWMU 57 consists of grasses, shrubs, and trees. They serve as a food source and provide shade and cover for many organisms, and they help to prevent soil erosion, among other important functions. They also can accumulate some contaminants that can then be transferred to the higher trophic-level organisms that consume plants.

Soil Invertebrates: Soil invertebrates are present in soil at SWMU 57. They aid in the formation of soil and the redistribution and decomposition of organic matter in the soil, and they serve as a food source for higher trophic-level organisms. They also can accumulate bioaccumulative contaminants that can then be transferred to the higher trophic-level organisms that consume soil invertebrates.

Aquatic Organisms: Aquatic organisms such as amphibians, insects and other invertebrates serve as a food source for higher trophic-level organisms (i.e., birds, mammals). These organisms are present in the Los Machos Mangrove Forest. They can also accumulate contaminants, which can be transferred to higher trophic-level organisms that consume them.

Herbivorous Birds and Mammals: Herbivorous birds and mammals (i.e., animals that consume only plant tissue) forage in some portions of SWMU 57. Their role in the community is essential because, without them, higher trophic levels could not exist (Smith, 1966). They may be exposed to and accumulate contaminants present in the plants they consume.

Omnivorous Birds and Mammals: Omnivorous birds and mammals are present in the forested areas bordering the site and the grass areas at SWMU 57. They consume plants and insects. They may be exposed to and accumulate contaminants present in the food items they consume.

Not all of the potential assessment endpoints were evaluated in this ERA. As indicated in USEPA guidance (USEPA, 1997c), “it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site.”

Therefore, the ERA focused on the endpoints that will tend to yield the highest risks, which should then account for endpoints that will have lower risks.

Omnivores were selected as assessment endpoints instead of invertivores because no invertivorous mammals are known to be present. Large carnivorous birds and mammals were not selected as assessment endpoints because their home range (hundreds of acres) is much larger than SWMU 57 (approximately 0.9 acres excluding the concrete pad), so they would only consume a small portion of food from the site. Therefore, risks would be greater to small mammals and birds that may obtain all of their food from the site. Although reptiles may be present, they were not selected as assessment endpoints because of the general lack of toxicity information and the lack of methods to evaluate their exposure to chemicals.

7.2.4.2 Measurement Endpoints

The following measurement endpoints were used to evaluate the assessment endpoints in the SERA:

- Soil screening values - Mortality, growth, and reproduction of plants and soil invertebrates were evaluated by comparing the measured concentrations of chemicals in surface soil to screening values designed to be protective of ecological receptors.

- Surface water screening values - Mortality, growth, and reproduction of aquatic organisms were evaluated by comparing the measured concentrations of chemicals in groundwater both before and after applying dilution factors to screening values designed to be protective of ecological receptors.

- Wildlife toxicity reference values (TRVs) - Mortality, reproductive, and/or developmental effects of birds and mammals were evaluated by comparing the estimated dose incurred (based on conservative and average assumptions) from ingestion of contaminants in surface soil, plants, and invertebrates to wildlife TRVs.

7.2.4.3 Selection of Receptor Species

Many receptors in the terrestrial/aquatic environment at SWMU 57 are typically grouped into general categories such as invertebrates and vegetation. This is a reflection of the nature of the threshold values, effects values, or criteria typically used to characterize risk for such organisms. However, for vertebrate receptors, selection of a representative species is required so that risks to these upper-level species incurred by intake through eating and drinking can be estimated.

Ingestion is the primary route of exposure for most mammals and birds. The selection of species used to represent the receptor groups identified in Section 7.2.4.1 was based on considerations of their preferred habitat, body size, sensitivity to contaminants, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). The availability of exposure parameters such as body mass, feeding rate, and drinking rate was also a factor in selecting surrogate species. The following surrogate species were used in the food chain modeling conducted as part of this ERA based on the factors listed above and because they may be present at SWMU 57:

- Herbivorous bird - Mourning dove
- Omnivorous mammal – Norway rat
- Omnivorous bird – Northern mockingbird

Receptor profiles for each of the species above are presented in Appendix I.

7.2.4.4 Conceptual Site Model

A conceptual model in problem formulation is a written description and visual representation of predicted relationships between ecological entities and the stressors to which they may be exposed. The conceptual model consists of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response and a diagram that illustrates the relationships (USEPA, 1998).

The primary sources of known or potential contamination at SWMU 57 were identified based on past operational practices and the physical characteristics of the site. The primary sources of contamination are spills at the concrete pad and, although not evident, sludge disposal. The contamination then migrated to the surface soil, subsurface soil, and groundwater. Ecological receptors may be exposed to contaminants in the surface soil and groundwater, as discussed above in Section 7.2.3. In summary, the primary receptors for contaminants in surface soil are plants and soil invertebrates and secondary receptors are birds and mammals, while the primary receptors for contaminants in the groundwater, are aquatic organisms in the mangrove after the groundwater discharges to and mixes with the surface water. Figure 7-2 represents the ecological CSM for SWMU 57.

7.3 TIER 1, STEP 2: SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK QUOTIENTS

7.3.1 Ecological Effects Evaluation

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicological evaluation, it may also include descriptions of apparent effects seen during the site visit (e.g., stressed vegetation). Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as soil for soil invertebrates. For vertebrates such as mammals and birds, toxicity data are typically available as doses, with units equal to mass of contaminant per unit of body mass per unit of time (usually mg/kg-day).

As the first step in the ecological effects evaluation, surface soil and groundwater ecological screening levels are compiled. For surface soil, chemical concentrations were compared to USEPA Ecological Soil Screening Levels (Eco SSLs) (USEPA, 2007b and supporting documents) because they are the most current screening levels. If USEPA Eco SSLs were not available, Region 5 soil ecological screening levels (ESLs) (USEPA, 2003d) were used next in order of preference, followed by the values from Canadian Soil Quality Guidelines (SQG) [Canadian Council of Ministers of the Environment (CCME), 1999a-f, 2001, 2004a-c, 2010] and the Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for invertebrates (Efroymson et al., 1997a) and plants (Efroymson et al., 1997b), and Los Alamos National Laboratory (LANL) ECORISK database (version 3; LANL, 2011). Note that because most of the Region 5 ESLs are based on risks to invertivorous mammals, screening levels specific to birds, plants or invertebrates from other sources were used preferentially for those endpoints, when available. Also, although invertivorous mammals are not present in Puerto Rico, use of the Region 5 ESLs that are based on risks to those mammals is conservative because they are almost always lower than values for herbivorous or omnivorous mammals. Table 7-2 presents the soil screening levels for plants, invertebrates, mammals, and birds for each chemical and the sources of each value.

For groundwater that discharges to surface water, the Puerto Rico Water Quality Standards for aquatic life, classes SB and SC (PREQB, 2010), followed by USEPA National Recommended Water Quality Criteria, chronic saltwater criteria (USEPA, 2009d), Region 3 marine ESLs (USEPA, 2006a), and National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRT), chronic marine values (Buchman, 2008) were used as the screening levels. These surface water screening values are protective of aquatic organisms.

7.3.2 Exposure Characterization

To determine whether a chemical has the potential to impact an ecological receptor, a chemical concentration or dose must first be determined. That concentration/dose is then compared to the ecological effects data presented above. The following paragraphs describe the concentrations/doses used for each set of ecological receptors.

Terrestrial invertebrates and plants are exposed to chemicals in the surface soil through direct contact and/or ingestion. Aquatic receptors are exposed to chemicals in surface water through direct contact. Because the screening values developed for these receptors are in units of chemical concentration in each medium, maximum chemical concentrations were used in the screening step to select COPCs. Aquatic organisms are not exposed to groundwater until it discharges to the surface water, at which point it will immediately mix with the surface water. Therefore, aquatic organisms are not exposed to the groundwater until it is diluted with surface water, even in the sediment porewater where dilution will also occur. Because of this, a dilution factor of 5.86 was calculated by estimating the dilution that would occur along the potential groundwater flow path (see Appendix I). The site-specific dilution was calculated in response to a regulator comment on a previous version of this report. This was done by calculating the volume of unimpacted groundwater and yearly precipitation for the area between the potentially impacted area and its discharge point, and dividing that amount by the volume of potentially impacted groundwater at SWMU 57. This approach is very conservative because it does not account for other factors such as diffusion, retardation and degradation that would further reduce the chemical concentrations between the site and the mangrove.

As indicated above, the dilution factor of 5.86 only accounts for the amount of groundwater dilution as it moves from the site to the surface water, so it provides an overly conservative estimate of the sediment porewater concentration. This is because it does not account for any additional dilution once the groundwater enters the sediment and pore water, and ultimately discharges to the surface water. As indicated in USEPA (2008), the groundwater/surface water transition zone represents a region beneath the bottom of a surface-water body where conditions change from a ground-water dominated to surface-water dominated system within the substrate. It is a region that includes both the interface between ground-water and surface-water as well as the broader region in the substrate (and, on occasion, up into the surface-water body) where ground-water and surface-water mix (USEPA, 2008c). Therefore, the water in the transition zone, where the benthic organisms will primarily live, consists of a mixture of surface water and groundwater. The surface water mixing in this transition zone will further dilute the groundwater concentrations, although the amount of this additional dilution cannot be quantified with the available information. Nevertheless, the amount of dilution is likely to be significant in the shallow

transition zone so the overall dilution factor would be much greater than 5.86. However, because this additional dilution cannot be easily quantified, the conservative dilution factor of 5.86 was used to adjust the concentration in the groundwater for comparison to surface water screening levels.

However, for terrestrial wildlife (mammals and birds), doses in mg/kg-day were estimated for using exposure dose equations. The food chain models were conducted on a dry-weight basis to be consistent with the soil concentrations which are reported on a dry-weight basis. Therefore, the concentrations in the food items were estimated on a dry-weight basis. The following generic equation was used to calculate the EPCs for terrestrial wildlife from exposure to chemicals in soil and associated food items such as plants and soil invertebrates:

$$CDI = \frac{[(Cf * If) + (Cs * Is)] * H}{BW}$$

Where:	CDI	=	Chronic daily intake [(mg/kg)-day]
	Cf	=	Chemical concentration in food – (see discussion below)
	Cs	=	Chemical concentration in surface soil (mg/kg)
	If	=	Food ingestion rate (kg/day)
	Is	=	Incidental surface soil ingestion rate (kg/day)
	H	=	Portion of food intake from the contaminated area (unitless)
	BW	=	Body weight (kg)

The exposure factors used for the food chain model, their derivation, and the receptor profiles for the surrogate species are presented in Appendix I. The exposure assumptions (i.e., ingestion rate, body weight) were obtained primarily from Food Requirements of Wild Animals: Predictive Equations for Free-living Mammals, Reptiles, and Birds (Nagy, 2001) and USEPA Eco SSL Guidance Attachment 4-1 (USEPA, 2007b) with other sources used as necessary.

Chemical concentrations in food items for soil omnivorous and herbivorous receptors were calculated using soil-to-invertebrate or soil-to-plant BAFs and regression equations from the USEPA Eco SSL Guidance Document Attachment 4-1 (USEPA, 2007b) or BAFs from published sources. The following equation was used to calculate chemical concentrations in plants or invertebrates when BAFs were used:

$$Cf = Cs * BAF$$

Where: Cf = Contaminant concentration in food (mg/kg)
Cs = Contaminant concentration in surface soil (mg/kg)
BAF = Biota-soil bioaccumulation factor (unitless)

A default value of 1.0 was used for the BAF when chemical-specific data was not available. Sources of BAFs are documented in Appendix I.

The food chain model scenarios were calculated using various exposure assumptions to present a range of potential risks. For selecting chemicals as COPCs, the following Tier 1 exposure assumptions were used:

- Maximum soil concentrations
- 90th percentile BAFs (or maximum value if a 90th percentile value is not available) or regression equations
- Conservative receptor body weight and ingestion rates
- Receptors spend 100% of their time at the Site

7.3.3 Risk Characterization

An Ecological Effects Quotient (EEQ) approach was used to characterize the risk to ecological receptors. This approach characterizes potential effects by comparing exposure concentrations with effects data. The EEQs for terrestrial receptors were calculated as follows:

$$EEQ = \frac{Css}{SSSL}$$

where: EEQ = Ecological Effects Quotient (unitless)
C_{ss} = Contaminant concentration in surface soil (µg/kg or mg/kg)
SSSL = Surface soil screening level (µg/kg or mg/kg)

The EEQs for aquatic organisms were calculated as follows:

$$EEQ = \frac{Csw}{SwSL}$$

where: EEQ = Ecological Effects Quotient (unitless)
Csw = Chemical concentration in groundwater (µg/L)
SwSL = Surface water screening level (µg/L)

The EEQs for terrestrial wildlife were calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where: EEQ = Ecological effects Quotient (unitless)
CDI = Chronic daily intake dose (mg/kg-day)
TRV = Toxicity reference value [No observed adverse effects level (NOAEL) or lowest observed effects level (LOAEL)] (mg/kg-day)

An EEQ of greater than 1.0 was considered to indicate potential risk. Such values do not necessarily indicate that an effect will occur but only that a low (i.e., conservative) threshold has been exceeded.

7.3.4 Tier 1, Step 2: Selection of Contaminants of Potential Concern

This section presents the results of the COPC selection, which was conducted using the following rules:

- A contaminant was retained as a COPC for risks to terrestrial plants, soil invertebrates, or aquatic organisms if the maximum detected concentration in surface soil or groundwater exceeded the associated screening level or a screening level was not available.

- If a contaminant had a maximum detected concentration that exceeded associated soil screening level for birds or mammals or a screening level was not available for a bioaccumulative chemical, then the chemical was retained for food chain modeling for wildlife. If the EEQ was greater than 1.0 based on the conservative food chain model, the chemical was selected as a COPC. The EEQ is defined below in Section 7.3.1.2.

- DRO and TPH were not selected as COPCs because they lack ecological screening levels. However, because the soil samples were analyzed for VOCs, SVOCs (including low-level PAHs), risks from these compounds are evaluated indirectly by evaluating risks from the individual chemicals. Therefore, risks from DRO and TPH are not discussed below.

Contaminants retained as COPCs were further evaluated as part of Step 3a of the eight-step ERA process.

Tables 7-3 and 7-4 provide the results of the COPC selection for surface soil and groundwater. Table 7-5 presents the results of the Tier 1 food chain model for surface soil.

7.3.4.1 Terrestrial Plants

Table 7-3 presents the COPC selection for terrestrial plants in SWMU 57 surface soil. Seven VOCs, two SVOCs and nine PAHs were selected as COPCs because screening levels were not available. Nine inorganics were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

7.3.4.2 Soil Invertebrates

Table 7-3 presents the COPC selection for soil invertebrates in SWMU 57 surface soil. Five VOCs, two SVOCs and one herbicide were selected as COPCs because screening levels were not available. Seven inorganics were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

7.3.4.3 Aquatic Organisms

Table 7-4 presents the COPC selection for aquatic organisms exposed to groundwater. One PAH and three inorganics and were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

7.3.4.4 Wildlife

Table 7-5 summarizes the results of the Tier 1 inputs food chain modeling for terrestrial soil receptors. Appendix I presents the calculation worksheets. The following summarizes the results of the food chain modeling for terrestrial receptors using maximum concentrations and Tier 1 input parameters:

- Herbivorous bird: Five inorganics had EEQs greater than 1.0 in the food chain model.

- Omnivorous mammal: One PCB (Aroclor-1260) and six inorganics had EEQs greater than 1.0 in the food chain model.

- Omnivorous bird: One PCB (Aroclor-1260) and seven inorganics had EEQs greater than 1.0 in the food chain model.

7.4 TIER 2, STEP 3A – COPC REFINEMENT

Step 3a consists of refining the conservative exposure assumptions/concentrations used to evaluate potential risks to ecological receptors and re-evaluating the analytical data using benchmarks that are more appropriate for the assessment endpoints. The objective of the Step 3a refinement was to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical might not be retained as a COPC in soil based on low risks to plants but might be retained for evaluating risks to wildlife. This is important because if the site proceeds further to a BERA, the studies in the BERA should only focus on the receptors that are at potential risk.

For chemicals evaluated further in Step 3a, the following factors were evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels). All of these factors may not be discussed for each chemical and/or receptor group.

- Magnitude of criterion exceedance: Although the magnitude of risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability and concern that an unacceptable risk exists.

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity and concentrations and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample represents.

- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the environment in forms that are typically not bioavailable, and limited bioavailability was considered when evaluating exposures of receptors to site contaminants. Contaminants with generally less

bioavailability are considered to be less toxic than more bioavailable contaminants, all other factors being equal.

- Habitat: Although exceedances of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat was used qualitatively when considering additional evaluation. Areas with little habitat were less of a concern than areas with suitable habitat to support the receptors of interest.

- Alternate benchmarks: These benchmarks are used to further evaluate risks to specific groups of ecological receptors (e.g., plants, invertebrates).

- Food Chain Modeling: Exposure via the food chain is a major pathway of concern for chemicals known to significantly bioaccumulate and/or biomagnify. Thus, potential risk to upper level receptors was evaluated using food chain models. The Tier 1 exposure doses calculated for terrestrial wildlife were re-calculated using the following Tier 2, Step 3a exposure assumptions and chemical concentrations:

  - Average soil concentrations
  - Median or mean BAFs (if available)
  - Average receptor body weights and ingestion rates

- Background: Concentrations of chemicals in surface soil and groundwater were compared to facility BTVs. If the concentrations of detected chemicals are less than the BTV, the chemical was considered similar to facility background, not site-related, and eliminated as a COPC. Surface soil inorganic concentrations were compared to facility BTVs as discussed in Section 4.0. For this reason, copper and vanadium are eliminated as COPCs in surface soil and are not further evaluated. Groundwater inorganic concentrations were compared to facility BTVs for groundwater and estuarine wetland surface water for total metals (see Tables 4-10 and 4011). The non-diluted groundwater concentrations for cobalt, copper, and nickel were less than surface water facility BTVs and are eliminated as COPCs in groundwater.

As part of the Step 3a evaluation for terrestrial wildlife, Table 7-6 presents the results of the food chain models for surface soil using Step 3a exposure assumptions and chemical concentrations. A detailed evaluation of the Step 3a evaluation is discussed in the following sections.

7.4.1 Tier 2, Step 3a: Plants

Several VOCs were selected as COPCs for plants because screening levels were not available. No VOCs were retained as COPCs because their maximum detected concentrations exceeded a screening level. Most VOCs were detected infrequently (4 or less of 33 samples) with the exception of acetone, a common laboratory contaminant. The available screening levels for the detected VOCs ranged from 3,800 to 55,000 µg/kg. The maximum detected concentration of any of the VOCs without a screening level was 1,200 µg/kg (for acetone), which was much lower than the screening levels for other detected VOCs. Therefore, although there is some uncertainty in whether the VOCs without screening levels are impacting plants, based on their low detection frequency and low concentrations relative to screening levels for other VOCs, it is not likely that plants are being significantly impacted by VOCs in the soil. For these reasons, VOCs are eliminated as COPCs for plants.

Two SVOCs (acetophenone and bis(2-ethylhexyl)phthalate) were selected as COPCs for plants because screening levels were not available. Acetophenone was detected in only one of 34 samples. It was detected at location 57SB07, which was collected in the area of scattered debris. Therefore, potential impacts (if any) would be limited to a small area so acetophenone is eliminated as a COPC for plants. The maximum concentration of bis(2-ethylhexyl)phthalate (1,800 µg/kg) was less than plant screening levels for other phthalates, such as diethylphthalate (100,000 µg/kg) (Efroymson et al., 1997b); moreover, bis(2-ethylhexyl)phthalate is a common laboratory and field contaminant. Therefore, it is not likely that plants are being significantly impacted by bis(2-ethylhexyl)phthalate and it is eliminated as a COPC for plants.

Several PAHs were selected as COPCs because screening levels were not available. An Eco SSL is not available for plants for PAHs; however, data presented on Table 3.1 in the Eco SSL document for PAHs shows that PAHs are typically not toxic to plants except at high soil concentrations with the lowest listed EC_{50} of 30 mg/kg from Mitchell et al. (1988). Also, Canadian SQGs are available for anthracene (2,500 µg/kg), benzo(a)pyrene (20,000 µg/kg), and fluoranthene (50,000 µg/kg) (CCME, 2010). All concentrations of PAHs are well below these values so it does not appear that PAH concentrations in soil are likely to impact plants. Therefore, PAHs are not expected to impact plants at the site and are eliminated as COPCs.

Chromium, cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc were initially selected as COPCs for plants because the maximum concentration exceeded the screening value. Copper and vanadium are considered similar to facility BTVs and are not further evaluated.

Only the maximum concentration of chromium (108 mg/kg) exceeded the screening value (78 mg/kg). The maximum chromium concentration was located downgradient from the site at 57SB04. The maximum concentration was also slightly less than 2 times the facility BTV (55 mg/kg).

Most cobalt concentrations exceed the screening value (13 mg/kg); however, only three samples exceeded the facility BTV (52.3 mg/kg). The cobalt concentrations in these four samples ranged from 52.7 mg/kg to 65.3 mg/kg, so they were not much greater than the facility BTV. These samples were collected from the suspected sludge disposal pit (57SS11 and 57SB15) and northeast of the concrete pad near the gravel road (57SB02).

Only the maximum concentration of lead (159 mg/kg) exceeded the screening value (120 mg/kg). The maximum lead concentration was located at the suspected sludge disposal pit (57SB34). Other samples collected from the area of the suspected sludge disposal pit had lead concentrations less than the screening value; therefore, any potential impacts to plants would be limited to a small area. For this reason, lead is eliminated as a COPC for plants.

Only the maximum concentration of nickel (39.2 mg/kg) slightly exceeded the screening value (38 mg/kg). The maximum chromium concentration was located north of the site at 57SB04. Based on this slight exceedance of a conservative screening level it is unlikely that nickel is impacting plants at the site so nickel is eliminated as a COPC for plants.

Several selenium concentrations exceed the screening value (0.52 mg/kg); however, they only slightly exceeded the facility BTV (1.07 mg/kg). Selenium concentrations exceeding BTVs ranged from 1.1 to 1.6 mg/kg. Therefore, any potential impacts to plants are expected to be similar to background. For this reason, selenium is eliminated as a COPC for plants.

Several thallium concentrations exceeded the screening value (1.4 mg/kg). These samples were collected from the suspected sludge disposal pit (57SB06, 57SS09, 57SS10, 57SS11), an area of scattered debris (57SB07, 57SS08), northeast of the concrete pad near the gravel road (57SB02), north of the loading dock near the gravel road (57SS12), and downgradient from the site (57SB01, 57SB04). There is much uncertainty in the thallium detections, however, because all surface soil samples collected in 2012 had thallium detections 0.1 mg/kg or less and all 2004 samples were non-detect. However, the samples collected in 2010 had thallium concentrations ranging from 1.1 mg/kg to 8.8 mg/kg, with several detections greater than 5 mg/kg. The same pattern was observed in the subsurface soil samples. Several of the samples collected in 2010 were collected in the same general area as the 2012 samples that had much lower concentrations. The samples collected in 2010 were analyzed using USEPA

Method 6010B, which is prone to false positives for thallium. The 2012 data were analyzed using USEPA Method 6020A, which is not prone to the same problem. This is likely the reason for the elevated detections in 2010. For that reason, and because all of the 2012 detections were much lower than the plant screening level, thallium is eliminated as a COPC for plants.

Four of the 34 samples had zinc concentrations that exceeded the screening value (160 mg/kg). These samples were collected along the western side of the concrete pad. The samples were collected from the suspected sludge disposal pit (57SB34), area of scattered debris (57SS08 and 3E-6), and at the southwest corner of the concrete pad (57SB22). Other samples collected in these areas had zinc concentrations less than the screening value; any potential impacts to plants would be limited to a small area. Also, the maximum detected zinc concentration was 210 mg/kg, which was only slightly greater than the screening level. For these reasons, zinc is eliminated as a COPC for plants.

In summary, concentrations of a few metals exceeded their respective plant benchmarks and facility BTVs in some of the surface soil samples. All of the detections, however, were only slightly greater than their screening level or facility BTV (whichever was higher). Therefore, although there are a few samples with elevated metals concentrations that are not bounded by samples with lower concentrations, significant impacts to plants at the site from metals in the surface soil are not expected for the following reasons. Plant benchmarks are by design, conservative values, so an exceedance of these benchmarks does not necessarily indicate that adverse impacts to plants are occurring. At this site, the exceedances are relatively slight and most detections are not much greater than facility BTVs. Also, the majority of the site other than the concrete pad and gravel road is vegetated, so it does not appear that plants are being impacted. For these reasons, even though some isolated potential risks to plants cannot be ruled out, risks are not great enough to warrant carrying any of the metals further in the ERA process. Therefore, no metals are retained as COPCs for risks to plants.

7.4.2 Tier 2, Step 3a: Soil Invertebrates

Acetophenone was eliminated as COPC for soil invertebrates for reasons similar to those presented above. Copper and vanadium are considered similar to facility BTVs and are not further evaluated.

Several VOCs were selected as COPCs for soil invertebrates because screening levels were not available. No VOCs were retained as COPCs because their maximum detected concentrations exceeded a screening level. Most VOCs were detected infrequently (4 or less of 33 samples) with the exception of acetone, a common laboratory contaminant. The available screening levels for the detected VOCs ranged from 3,800 to 1,000,000 µg/kg. The maximum detected concentrations of any of the VOCs

without a screening level was 1,200 µg/kg (for acetone), which was much lower than the screening levels for other detected VOCs. Therefore, although there is some uncertainty in whether the VOCs without screening levels are impacting invertebrates, based on their low detection frequency and low concentrations relative to screening levels for other VOCs, it is not likely that invertebrates are being significantly impacted by VOCs in the soil. For this reason, VOCs are eliminated as COPCs for invertebrates.

One SVOC, (bis[2-ethylhexyl]phthalate) (a common laboratory and field contaminant), was selected as a COPC for soil invertebrates because a screening level was not available. The maximum concentration of bis(2-ethylhexyl)phthalate (1,800 µg/kg) was less than screening levels for another phthalate, dimethylphthalate (200,000 µg/kg) (Efroymson et al., 1997a). Therefore, it is not likely that invertebrates are being significantly impacted by bis(2-ethylhexyl)phthalate and it is eliminated as a COPC for invertebrates.

One herbicide 2-(2,4,5-Trichloropphenoxy)propionic acid (2,4,5-TP) was selected as a COPC for soil invertebrates because a screening level was not available. 2,4,5-TP was only detected in one of six samples at a low concentration of 1.5 µg/kg. No toxicity data was located regarding the toxicity of 2,4,5-TP to soil invertebrates, but because the herbicide was detected infrequently at a very low concentration, it is not likely that invertebrates are being significantly impacted by 2,4,5-TP and it is eliminated as a COPC for invertebrates.

Barium, chromium, mercury, thallium, and zinc were initially selected as COPCs for plants because the maximum concentration exceeded the screening value.

Only the maximum concentration of barium (374 mg/kg) slightly exceeded the screening value (330 mg/kg). This sample (57SB15) was collected from the suspected sludge disposal pit. Other samples collected from the area of the suspected sludge disposal pit had barium concentrations less than the screening value; therefore, any potential impacts to invertebrates would be limited to a small area. For this reason, barium is eliminated as a COPC for invertebrates.

Chromium exceeded its screening value of 0.4 mg/kg in all samples. The screening value for chromium is the Region 5 ESL (0.4 mg/kg), which is a screening benchmark for hexavalent chromium. This value is overly conservative, as it is well below facility BTVs (55 mg/kg) and is based on a chromium salt in solution being added to the soil. This makes the chromium much more bioavailable then it would be in the environment. A more appropriate benchmark is the Canadian SQG for plants/invertebrates of 78 mg/kg because it is based on a more robust data set (CCME, 1999a). Only the maximum

concentration of chromium (108 mg/kg) exceeded the alternate screening value (78 mg/kg). The maximum chromium concentration was located north of the site at 57SB04.

Mercury exceeded its screening value of 0.1 mg/kg in several samples. The screening value for mercury is the Region 5 ESL (0.1 mg/kg) that was based on a study in which mercury chloride was added to soil. As noted in Allen (2002), metals from freshly salt-spiked soil are much more toxic than equivalent metal concentrations in field collected soil. A more appropriate benchmark is the Canadian SQG for plants/invertebrates of 12 mg/kg because it is based on a more robust data set (CCME, 1999b). All mercury concentrations are less than the alternate screening value (the maximum detected concentration was 0.45 mg/kg); therefore, mercury is eliminated as a COPC for invertebrates.

Several thallium concentrations exceeded the screening value (1.4 mg/kg). The screening level is the Canadian SQG which is protective of plants and invertebrates because it is based on the lower of the two receptor toxicity data (CCME, 1999e). In the case of thallium, plants were more sensitive so the screening level is based on plant toxicity data. There was limited soil invertebrate data reported in the SQG document for thallium, but the 14-day no observed effects concentration for mortality for earthworms was 12 mg/kg. All thallium detections at the site are less than this value. Also, as discussed above for plants, there is much uncertainty in the thallium detections and they are likely the result of false positives. For that reason, and because all of the 2012 detections were much lower than the plant screening level, thallium is eliminated as a COPC for invertebrates.

Eight of the 34 samples (not including duplicates) had zinc concentrations that exceeded the screening value (120 mg/kg). Three of those detections were less than 150 mg/kg, and just slightly exceeded the screening level. The concentrations in the other five samples ranged from 155 mg/kg to 210 mg/kg. Therefore, all of the detected concentrations were less than twice the screening level. These samples were collected from the suspected sludge disposal pit (57SS09, 57SB34), area of scattered debris (57SS08 and 3E-6), near the gravel road (57SB05, 3E-2), the southern edge of the concrete pad (57SB32), and at the southwest corner of the concrete pad, upgradient of the site (57SB22).

In summary, concentrations of a few metals exceeded their respective soil invertebrate benchmarks and facility BTVs in some of the surface soil samples. All of the detections, however, were only slightly greater than their screening level or facility BTV (whichever was higher). Therefore, although there are a few samples with elevated metals concentrations not bounded by samples with lower concentrations, significant impacts to plants at the site from metals in the surface soil are not expected for the following reasons. Soil invertebrate benchmarks are by design, conservative values, so an exceedance of these benchmarks does not necessarily indicate that adverse impacts to soil invertebrates are occurring. At this

site, the exceedances are relatively slight and most detections are not much greater than facility BTVs. For this reason, even though some isolated potential risks to soil invertebrates cannot be ruled out, risks are not great enough to warrant carrying any of the metals further in the ERA process. Therefore, no metals are retained as COPCs for risks to soil invertebrates.

7.4.3 Tier 2, Step 3a: Aquatic Organisms

Three total inorganics (cobalt, copper, and nickel) and one PAH (pyrene) were initially selected as COPCs because the maximum concentration in groundwater exceeded the surface water screening value (see Table 7-4). As discussed above, the concentrations of these inorganics are considered similar to groundwater and estuarine wetland surface water facility BTVs (see Tables 4-10 and 4-11) so they were eliminated as COPCs. Also, all EEQs for the inorganics were less than 1.0 using the dilution factor of 5.86. As discussed in Section 7.3.2, the conservative dilution factor of 5.86 was used to adjust the concentration in the groundwater to account for the mixing and dilution of the groundwater between the site and the exposure point. The EEQ for pyrene based on the undiluted groundwater was only 5.0. Therefore, using the conservative dilution factor of 5.86, resulted in the concentration of pyrene in groundwater being less than the screening level so it was also eliminated as a COPC. As a result, no chemicals in groundwater are retained as COPCs for potential risks to aquatic organisms.

7.4.4 Tier 2, Step 3a: Terrestrial Wildlife

As presented in Section 7.3.2.4, the EEQs from the terrestrial food chain modeling were greater than 1.0 for several inorganics and one PCB (Aroclor-1260) using maximum chemical concentrations and Tier 1 exposure assumptions. Therefore, as part of the Step 3a refinement, risks were recalculated using average chemical concentrations and the Tier 2, Step 3a exposure parameters as presented in Appendix I. These parameters are summarized on the exposure factors table in Appendix I. The food chain model calculation sheets are also provided in Appendix I.

Table 7-6 presents the result of the less conservative food chain model for surface soil. A discussion of the risks to mammal and birds is presented below.

- Herbivorous bird: The EEQ for vanadium for the dove (3.6) was slightly greater than 1.0 using the NOAEL as the TRV. Vanadium is considered similar to the facility BTVs and is not further evaluated. Therefore, no chemicals were retained as COPCs for impacts to herbivorous birds.

- Omnivorous mammal: The EEQ for thallium for the rat (10) was greater than 1.0 using the NOAEL as the TRV. The LOAEL EEQ for thallium was slightly greater than 1.0 for the rat (1.04). Because an

earthworm BAF was not available for thallium a default BAF of 1 was used, which basically equates the tissue concentrations in the prey items to the soil concentrations. This is an overly conservative estimate as thallium is not considered a bioaccumulative chemical. Earthworms are assumed to comprise 50% of the rat's diet. Limited habitat is available as the site is small and portions of the site are covered by a concrete pad and a gravel road as discussed above. Also, as discussed above, all of the thallium detections greater than 1.0 mg/kg are likely false positives. Therefore, impacts to omnivorous mammals from the relatively low EEQ are expected to be minimal; therefore, thallium is eliminated as a COPC.

- Omnivorous bird: The EEQs for copper (1.8), lead (1.7), mercury (10), and vanadium (7.3) for the mockingbird were greater than 1.0 using the NOAEL as the TRV. Copper and vanadium are considered similar to facility BTVs and are not further evaluated. Lead had an EEQ only slightly greater than 1.0 based on the NOAEL and the LOAEL EEQ for lead was less than 1.0 for the mockingbird. Mercury had a NOAEL EEQ greater than 1.0 and the LOAEL EEQ was slightly greater than 1.0 for the mockingbird (1.05). The food chain model assumes that receptors obtain their entire diet from the site. Receptors are unlikely to obtain their entire diet from the site because limited habitat is available as the site is small and portions of the site are covered by a concrete pad and a gravel road as discussed above. Therefore, impacts to omnivorous birds are expected to be minimal and lead and mercury are also eliminated as COPCs.

7.5 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section discusses some of the uncertainties associated with the SWMU 57 ERA.

7.5.1 Uncertainty in Data

Only surface soil samples were evaluated in the ERA; however, some terrestrial receptors such as burrowing mammals or deep-rooted trees could be exposed to shallow layers of contaminated subsurface soils. Chemical concentrations in shallow subsurface soil (1 to 3 feet) were generally similar or less than concentrations in surface soil (0 to 1 foot). Two VOCs (bromomethane and methyl iodide) were detected in subsurface soil, but not detected in surface soil; however these VOCs were detected infrequently and at concentrations similar to the other VOCs detected. One PAH (dibenzo[a,h]anthracene) was detected at a slightly greater maximum concentration in shallow subsurface soil (1.8 µg/kg) compared to surface soil (0.75 µg/kg). One herbicide (2,4,5-TP) was detected at a slightly greater maximum concentration in shallow subsurface soil (4.1 µg/kg) compared to surface soil (1.5 µg/kg). Six inorganics (antimony, cobalt, lead, silver, thallium, and tin) were detected at greater maximum concentrations in shallow

subsurface soil compared to surface soil. However, these inorganic concentrations would not result in changes to the risk conclusions for the ecological receptors.

7.5.2 Uncertainty in Assessment Endpoints and Measurement Endpoints

Measurement endpoints were used to evaluate the assessment endpoints selected for the ERA. For the ERA, the measurement endpoints were not the same as the assessment endpoints. Measurement endpoints were used to predict effects to the assessment endpoints by selecting surrogate species to be evaluated. For example, a decrease in reproduction of a rat was used to assess a decrease in reproduction of the small mammal population. However, predicting a decrease in reproduction of a rat may either underprotect or overprotect the small mammal population based on differences in ingestion rates, toxicity, food preferences, home ranges, etc. between different species.

Risks to reptiles were not quantitatively evaluated because exposure factors are not established for most species and because toxicity data are very limited. As discussed in Section 7.2.1, several endangered and threatened species or species of special concern may be present at SWMU 57. Risks to these species were not specifically calculated, so the uncertainties of not calculating risks to these species are presented here. Unacceptable risks to the Brown pelican are not expected because habitat is not available. The Brown pelican require open water habitat, which is not available at SWMU 57, but is available near the Los Machos Mangrove Forest.

Yellow-shouldered blackbirds, an endangered species potentially present at SWMU 57, consume mostly insects present in trees, as opposed to the worms that are assumed to be consumed by the mockingbird in the food-chain model. Because worms are in direct contact with soil, it is expected that they would have greater levels of contaminants at SWMU 57 than aboveground insects; therefore, risks to the mockingbird from consuming worms are expected to be greater than risks to the yellow-shouldered blackbirds from consuming aboveground insects. By protecting the mockingbird, this other omnivorous bird will also be protected. Also, limited habitat is available directly at SWMU 57, so it is not likely that the blackbirds will be present in this area.

Finally, there are uncertainties in risks to reptiles because there is a lack of exposure factors for reptiles and a lack of reptile toxicity data for the detected chemicals. The Puerto Rican Boa, an endangered reptilian species may be present. However, based on the preferred habitat of the boa and the limited habitat available at SWMU 57, this species likely does not inhabit areas of SWMU 57. Risks to carnivorous reptiles were not specifically calculated; however, risks are accounted for by using omnivorous birds and mammals as surrogates.

7.5.3 Uncertainty in Exposure Characterization

The contaminant dose to terrestrial wildlife was calculated using an equation that incorporates ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors were obtained from literature studies, or predicted using various equations. Ingestion rates and body weights vary between species, especially between species inhabiting different habitats.

Bioaccumulation of contaminants into various biological media (e.g., plants, invertebrates, small mammals) depends on characteristics of the media such as pH, organic carbon, etc. Therefore, actual BAFs at the sites may be different than those used in the SERA and obtained from the literature. Also, the bioavailability of contaminants reported in toxicity studies is typically greater than the contaminants in environmental media. Typically, highly bioavailable forms of the chemicals are used when conducting toxicity tests and/or conducting dosing studies for wildlife.

There is uncertainty in the chemical data collected at the site. Measured levels of chemicals are only estimates of true site chemical concentrations. At SWMU 57, samples were deliberately biased toward known or suspected high concentrations, so predicted doses are probably higher than actual doses. Whereas this is a conservative approach in predicting exposure concentrations, actual exposure of ecological receptors to chemical concentrations at SWMU 57 is likely overestimated. In particular, wildlife that typically roam over multiple sample locations are unlikely to obtain all of their food from within the most contaminated areas at SWMU 57.

There is uncertainty in what the actual pore water concentrations would be after groundwater migrates from the site and discharges to the surface water. However, even after using a very conservative dilution factor of 5.86, no chemical concentrations exceeded the surface water screening levels.

7.5.4 Uncertainty in Ecological Effects Data

Uncertainty exists in the ecological effects data, including the screening levels and wildlife TRVs. Several of the screening levels are very conservative, and typically are based on studies where the bioavailability of the chemical is much greater than it is in the environment. Also, toxicity data was not available or was limited for some chemicals.

The NOAELs/LOAELs used for the wildlife endpoints species are based on species other than the endpoint species (e.g., rats, mice). Uncertainty exists in the application of toxicity data across species

because the contaminant may be more or less toxic to the endpoint species than it was to the test study species.

7.5.5 Uncertainty in Risk Characterization

Risks are possible if an EEQ is greater than or equal to 1.0 regardless of the magnitude of the EEQ. However, the magnitude of effects to ecological receptors cannot be inferred based on the magnitude of the EEQ. Rather, an EEQ greater than 1.0 simply indicates that the dose used to derive the toxicity reference value was exceeded.

Finally, there is uncertainty in how the predicted risks to a species at a site translate into risk to the population in the area as a whole.

7.6 ECOLOGICAL RISK SUMMARY AND CONCLUSIONS

This ERA evaluated surface soil and groundwater. Based on the initial screening of the chemical data, several chemicals were initially selected as COPCs in surface soil and groundwater because they were detected at concentrations that exceeded conservative screening levels, they had EEQs greater than 1.0 in the conservative food chain model, or because they did not have screening levels.

These chemicals were then further evaluated to refine the list of COPCs, and to better characterize risks to ecological receptors. The following presents the results of the ERA.

7.6.1 Soil Invertebrates and Terrestrial Plants

No chemicals were retained as COPCs for risks to plants or soil invertebrates.

7.6.2 Aquatic Organisms

No chemicals were retained as COPCs for risks to aquatic organisms.

7.6.3 Mammals and Birds

No chemicals were retained as COPCs for herbivorous receptors and omnivorous receptors.

TABLE 7-1

ASSESSMENT ENDPOINTS AND MEASUREMENT ENDPOINTS
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Assessment Endpoint	Measurement Endpoint
Adverse effects on the survival, reproduction, and/or growth of soil invertebrates	• Survival, growth, and/or reproduction of soil invertebrates were evaluated by comparing the measured concentrations of chemicals in the surface soil to invertebrate soil screening levels.
Adverse effects on the survival, reproduction, and/or growth of aquatic organisms	• Survival, growth, and/or reproduction of aquatic organisms were evaluated by comparing the measured concentrations of chemicals in the groundwater to surface water screening levels.
Adverse effects on the survival, reproduction, and/or growth of terrestrial plants	• Survival, growth, and/or reproduction of terrestrial plants were evaluated by comparing the measured concentrations of chemicals in the surface soil to plant soil screening levels.
Adverse effects on the survival, reproduction, and/or increase in development effects of omnivorous birds and mammals	• Survival, reproduction, and/or increase in development effects of omnivorous birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the surface soil, plants and invertebrates to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) for surrogate wildlife species.
Adverse effects on the survival, reproduction, and/or increase in development effects of herbivorous birds and mammals	• Survival, reproduction, and/or increase in development effects of herbivorous birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the surface soil and plants to NOAELs and LOAELs for surrogate wildlife species.

TABLE 7-2

ECOLOGICAL SOIL SCREENING LEVELS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

	Ecological Soil Screening Level							
	Plant		Invertebrate		Avian		Mammal	
Parameter	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**
METALS (mg/kg)								
ANTIMONY	5	ORNL	78	EcoSSL	NA	NA	10	EcoSSL
ARSENIC	18	EcoSSL	17	CCME	43	EcoSSL	170	EcoSSL
BARIUM	500	ORNL	330	EcoSSL	820	LANL	3200	EcoSSL
BERYLLIUM	10	ORNL	40	EcoSSL	NA	NA	21	EcoSSL
CADMIUM	32	EcoSSL	140	EcoSSL	0.77	EcoSSL	73	EcoSSL
CHROMIUM	78	CCME	0.4	Region 5	26	EcoSSL	380	EcoSSL
COBALT	13	EcoSSL	1000	ORNL(1)	120	EcoSSL	2100	EcoSSL
COPPER	70	EcoSSL	80	EcoSSL	28	EcoSSL	1100	EcoSSL
CYANIDE	0.9	CCME	0.9	CCME	11	CCME	1.33	Region 5
LEAD	120	EcoSSL	1700	EcoSSL	11	EcoSSL	1200	EcoSSL
MERCURY	12	CCME	0.1	Region 5	0.013	LANL(2)	3	LANL(2)
NICKEL	38	EcoSSL	280	EcoSSL	210	EcoSSL	340	EcoSSL
SELENIUM	0.52	EcoSSL	4.1	EcoSSL	1.2	EcoSSL	2.7	EcoSSL
SILVER	560	EcoSSL	50	ORNL(1)	4.2	EcoSSL	1500	EcoSSL
THALLIUM	1.4	CCME	1.4	CCME	1	CCME	0.0569	Region 5
TIN	50	ORNL	2000	ORNL(1)	NA	NA	7.62	Region 5
VANADIUM	130	CCME	130	CCME	7.8	EcoSSL	1300	EcoSSL
ZINC	160	EcoSSL	120	EcoSSL	46	EcoSSL	6800	EcoSSL
SEMIVOLATILES (mg/kg)								
ACETOPHENONE	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	0.02	LANL	1.1	LANL
VOLATILES (mg/kg)								
2-BUTANONE	NA	NA	NA	NA	NA	NA	89.6	Region 5
2-HEXANONE	NA	NA	NA	NA	0.36	LANL	6.1	LANL
ACETONE	NA	NA	NA	NA	7.5	LANL	2.5	Region 5
BENZENE	31	CCME	31	CCME	25	CCME	0.255	Region 5
CARBON DISULFIDE	NA	NA	NA	NA	NA	NA	0.0941	Region 5
CARBON TETRACHLORIDE	NA	NA	1000	ORNL(1)	NA	NA	NA	NA
CHLOROBENZENE	NA	NA	40	ORNL	NA	NA	54	LANL
CHLOROFORM	NA	NA	NA	NA	NA	NA	8	LANL
ETHYLBENZENE	55	CCME	55	CCME	910	CCME	5.16	Region 5
TETRACHLOROETHENE	3.8	CCME	3.8	CCME	NA	NA	0.36	LANL
TOTAL XYLENES	10	Region 5	65	CCME	3700	CCME	3700	CCME
POLYNUCLEAR AROMATIC HYDROCARBONS (mg/kg)								
2-METHYLNAPHTHALENE	NA	NA	29	EcoSSL	NA	NA	350	EcoSSL
ACENAPHTHENE	20	ORNL	29	EcoSSL	NA	NA	350	EcoSSL
ACENAPHTHYLENE	20	ORNL(3)	29	EcoSSL	NA	NA	350	EcoSSL
ANTHRACENE	2.5	CCME	29	EcoSSL	NA	NA	350	EcoSSL
BENZO(A)ANTHRACENE	18	LANL	18	EcoSSL	0.8	LANL	39	EcoSSL
BENZO(A)PYRENE	20	CCME	18	EcoSSL	NA	NA	39	EcoSSL
BENZO(B)FLUORANTHENE	18	LANL	18	EcoSSL	NA	NA	39	EcoSSL
BENZO(G,H,I)PERYLENE	NA	NA	18	EcoSSL	NA	NA	39	EcoSSL
BENZO(K)FLUORANTHENE	NA	NA	18	EcoSSL	NA	NA	39	EcoSSL
CHRYSENE	NA	NA	18	EcoSSL	NA	NA	39	EcoSSL
DIBENZO(A,H)ANTHRACENE	NA	NA	18	EcoSSL	NA	NA	39	EcoSSL
FLUORANTHENE	50	CCME	29	EcoSSL	NA	NA	350	EcoSSL
FLUORENE	NA	NA	29	EcoSSL	NA	NA	350	EcoSSL
INDENO(1,2,3-CD)PYRENE	NA	NA	18	EcoSSL	NA	NA	39	EcoSSL
NAPHTHALENE	1	LANL	29	EcoSSL	3.4	LANL	350	EcoSSL
PHENANTHRENE	NA	NA	29	EcoSSL	NA	NA	350	EcoSSL
PYRENE	NA	NA	18	EcoSSL	34	LANL	39	EcoSSL
PESTICIDES/PCBS (mg/kg)								
4,4'-DDD	12	CCME(4)	12	CCME(4)	0.093	EcoSSL	24	EcoSSL
4,4'-DDE	12	CCME(4)	12	CCME(4)	0.093	EcoSSL	24	EcoSSL
4,4'-DDT	12	CCME	12	CCME	0.093	EcoSSL	24	EcoSSL
AROCLOR-1260	33	CCME	33	CCME	0.88	LANL	0.000332	Region 5
HERBICIDES (mg/kg)								
2,4,5-TP (SILVEX)	0.109	Region 5	NA	NA	NA	NA	NA	NA
PETROLEUM HYDROCARBONS (mg/kg)								
DIESEL FUEL	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-2

ECOLOGICAL SOIL SCREENING LEVELS
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Ecological Screening Level sources used in the order of preference:
EcoSSL - EPA Ecological Soil Screening Levels (USEPA, 2005d-k, 2006b, 2007c-h, 2008b). For mammals, value for herbivorous mammal is presented.
Region 5 - USEPA Region 5 Ecological Screening Levels (USEPA, 2003d). Most mammalian values are based on risk to shrews, which are not present at the site. However, these values are appropriate for screening as they are conservative values.
CCME - Canadian Soil Quality Guidelines (CCME, 1999a-f, 2001, 2004a-c, 2010).
ORNL - Oak Ridge National Laboratory Toxicological Benchmarks for plants and invertebrates (Efroymson et al., 1997a, 1997b).
LANL (3.0 database; LANL, 2011). For mammals, value for desert cotton tail or deer mouse is presented.

Footnotes:
1 - Value for microorganisms.
2 - Available Canadian SQG was not selected because it was based on organic mercury toxicity to a pig.
3 - Value for acenaphthylene.
4 - Value for 4,4'-DDT.

NA - Not available.

TABLE 7-3

SURFACE SOIL ECOLOGICAL COPC SELECTION
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Sample of Maximum Detection	Range of Nondetects	Average of Detections[1]	Average of All Results[2]	Screening Levels[3]				EEQs[4]				Deletion or Selection of COPCs for Invertebrates/Plants		Further Evaluated in Terrestrial Food Chain Modeling[5]	
								Plants	Invertebrates	Birds	Mammals	Plants	Invertebrates	Birds	Mammals	COPC (yes/no)?	Rationale	Evaluated (yes/no)?	Rationale
Inorganics (mg/kg)																			
ANTIMONY	24/34	0.03 J	1.7 J	57SB07-00-D	0.67 - 3.2	0.49	0.6	5	78	NA	10	0.34	0.022	NA	0.17	NO	BSL	NO	NONBIO
ARSENIC	31/34	0.18 J	5.2	57SS08	0.34 - 1.2	1.6	1.5	18	17	43	170	0.29	0.31	0.12	0.031	NO	BSL	NO	BSL
BARIUM	34/34	14.6 J	374	57SB15-0001	-	94.1	94.1	500	330	820	3200	0.75	1.1	0.46	0.12	YES	ASL	NO	BSL
BERYLLIUM	28/34	0.07 J	0.74 J	57SB22-0001	0.03 - 0.64	0.29	0.26	10	40	NA	21	0.074	0.019	NA	0.035	NO	BSL	NO	NONBIO
CADMIUM	28/34	0.06 J	5.3	57SS08	0.17 - 0.58	0.98	0.83	32	140	0.77	73	0.17	0.038	6.9	0.073	NO	BSL	YES	ASL
CHROMIUM	34/34	8.1	108	57SB04-00	-	28.5	28.5	78	0.4	26	380	1.4	270	4.2	0.28	YES	ASL	YES	ASL
COBALT	34/34	5.6	65.3	57SB15-0001	-	26.8	26.8	13	1000	120	2100	5.0	0.065	0.54	0.031	YES	ASL	NO	BSL
COPPER	34/34	23 N	160 N	3E-SS02	-	78.5	78.5	70	80	28	1100	2.3	2.0	5.7	0.15	YES	ASL	YES	ASL
CYANIDE	2/6	0.46 B	0.53 B	3E-SS06	0.59 - 0.8	0.5	0.39	0.9	0.9	11	1.33	0.59	0.59	0.05	0.40	NO	BSL	NO	BSL
LEAD	34/34	0.95 J	159 J	57SB34-0001	-	36.4	36.4	120	1700	11	1200	1.3	0.094	14.5	0.13	YES	ASL	YES	ASL
MERCURY	28/34	0.0086 BN	0.45 J	57SS09-D	0.018 - 0.03	0.073	0.062	12	0.1	0.013	3	0.038	4.5	34.6	0.15	YES	ASL	YES	ASL
NICKEL	34/34	4.8 J	39.2	57SB04-00	-	15.4	15.4	38	280	210	340	1.03	0.14	0.19	0.12	YES	ASL	NO	BSL
SELENIUM	17/28	0.1 J	1.6	57SB15-0001	0.21 - 1.6	0.72	0.6	0.52	4.1	1.2	2.7	3.1	0.39	1.3	0.59	YES	ASL	YES	ASL
SILVER	24/34	0.01 J	0.26 J	57SB02-00	0.11 - 1.6	0.11	0.21	560	50	4.2	1500	0.00046	0.0052	0.062	0.00017	NO	BSL	NO	BSL
THALLIUM	27/34	0.01 J	8.8	57SS09	0.026 - 1.6	2.2	1.8	1.4	1.4	1	0.0569	6.3	6.3	8.8	155	YES	ASL	YES	ASL
TIN	18/34	0.97 J	4.1 B	3E-SS06	1.7 - 3.9	2.4	1.9	50	2000	NA	7.62	0.082	0.0021	NA	0.54	NO	BSL	NO	NONBIO
VANADIUM	34/34	35	240	57SB07-00-D	-	137	137	130	130	7.8	1300	1.8	1.8	30.8	0.18	YES	ASL	YES	ASL
ZINC	34/34	34	210	3E-SS06	-	96.9	96.9	160	120	46	6800	1.3	1.8	4.6	0.031	YES	ASL	YES	ASL
Semivolatile Organics (µg/kg)																			
ACETOPHENONE	1/34	39 J	39 J	57SB07-00	200 - 550	39.0	141	NA	NA	NA	NA	NA	NA	NA	NA	YES	NSL	NO	NONBIO
BIS(2-ETHYLHEXYL)PHTHALATE	17/34	50 J	1800	57SS12	150 - 550	263	210	NA	NA	20	1100	NA	NA	90	1.6	YES	NSL	YES	ASL
Volatile Organics (µg/kg)																			
2-BUTANONE	2/33	97 J	120 J	57SB36-0001	9.3 - 53	109	17.1	NA	NA	NA	89600	NA	NA	NA	0.0013	YES	NSL	NO	NONBIO
2-HEXANONE	1/33	35 J	35 J	57SB33-0001	9.3 - 36	35.0	9.7	NA	NA	360	6100	NA	NA	0.097	0.0057	YES	NSL	NO	BSL
ACETONE	15/33	210 J	1200 J	57SB18-0001	16 - 1100	455	233	NA	NA	7500	2500	NA	NA	0.16	0.48	YES	NSL	NO	BSL
BENZENE	2/33	1.9 J	2.6 J	57SB36-0001	2.3 - 7.3	2.4	2.2	31000	31000	25000	255	0.000084	0.000084	0.00010	0.010	NO	BSL	NO	BSL
CARBON DISULFIDE	4/33	1.1 J	2.4 J	57SB01-00	2.3 - 7.3	1.6	2.1	NA	NA	NA	94.1	NA	NA	NA	0.026	YES	NSL	NO	NONBIO
CARBON TETRACHLORIDE	4/33	2.4 J	8.8	3E-SS01-D	2.3 - 7.3	4.4	2.3	NA	1000000	NA	NA	NA	0.0000088	NA	NA	YES	NSL	NO	NONBIO
CHLOROBENZENE	2/33	4.3 J	4.5 J	3E-SS03	2.3 - 7.3	4.4	2.3	NA	40000	NA	54000	NA	0.00011	NA	0.000083	YES	NSL	NO	NONBIO
CHLOROFORM	2/33	1.9 J	4.3 J	3E-SS01-D	2.3 - 7.3	3.0	2.2	NA	NA	NA	8000	NA	NA	NA	0.00054	YES	NSL	NO	NONBIO
ETHYLBENZENE	2/33	2.3 J	2.4 J	3E-SS03	2.3 - 7.3	2.4	2.1	55000	55000	910000	5160	0.000044	0.000044	0.000003	0.00047	NO	BSL	NO	BSL
TETRACHLOROETHENE	3/33	4.2 J	6	3E-SS03	2.3 - 7.3	5.3	2.4	3800	3800	NA	360	0.0016	0.0016	NA	0.017	NO	BSL	NO	NONBIO
TOTAL XYLENES	2/33	9	12	3E-SS01-D, 3E-SS03	3.7 - 15	10.5	4.5	10000	65000	3700000	3700000	0.0012	0.00018	0.000003	0.000003	NO	BSL	NO	BSL
Polynuclear Aromatic Hydrocarbons (µg/kg)																			
2-METHYLNAPHTHALENE	8/34	1 J	6 J	57SS08	9.3 - 550	2.7	45.7	NA	29000	NA	350000	NA	0.00021	NA	0.000017	YES	NSL	NO	NONBIO
ACENAPHTHENE	6/34	0.82 J	2.4 J	57SS09-D	9.3 - 550	1.4	45.6	20000	29000	NA	350000	0.00012	0.000083	NA	0.0000069	NO	BSL	YES	BIO
ACENAPHTHYLENE	7/34	0.86 J	14 J	57SS09-D	9.3 - 550	2.9	45.8	20000	29000	NA	350000	0.00070	0.00048	NA	0.000040	NO	BSL	YES	BIO
ANTHRACENE	9/34	0.67 J	7.9 J	57SS09-D	9.3 - 550	3.2	45.7	2500	29000	NA	350000	0.0032	0.00027	NA	0.000023	NO	BSL	YES	BIO
BENZO(A)ANTHRACENE	13/34	0.98 J	79 J	3E-SS06	9.3 - 550	12.1	41.1	18000	18000	800	39000	0.0044	0.0044	0.099	0.0020	NO	BSL	NO	BSL
BENZO(A)PYRENE	7/34	0.63 J	77 J	3E-SS06	9.3 - 550	14.5	40.4	20000	18000	NA	39000	0.0039	0.0043	NA	0.0020	NO	BSL	YES	BIO
BENZO(B)FLUORANTHENE	8/34	1.5 J	95 J	3E-SS06	9.3 - 550	17.2	41.3	18000	18000	NA	39000	0.0053	0.0053	NA	0.0024	NO	BSL	YES	BIO
BENZO(G,H,I)PERYLENE	7/34	0.65 J	97 J	3E-SS01	9.3 - 550	25.4	35.7	NA	18000	NA	39000	NA	0.0054	NA	0.0025	YES	NSL	YES	BIO
BENZO(K)FLUORANTHENE	6/34	0.9 J	76 J	3E-SS06	9.3 - 550	15.5	40.3	NA	18000	NA	39000	NA	0.0042	NA	0.0019	YES	NSL	YES	BIO
CHRYSENE	11/34	1 J	110 J	3E-SS06	9.3 - 550	16.8	42.2	NA	18000	NA	39000	NA	0.0061	NA	0.0028	YES	NSL	YES	BIO
DIBENZO(A,H)ANTHRACENE	2/34	0.71 J	0.75 J	57SB01-00	9.3 - 550	0.73	46.0	NA	18000	NA	39000	NA	0.000042	NA	0.000019	YES	NSL	YES	BIO
FLUORANTHENE	13/34	2.5 J	120 J	3E-SS06	9.3 - 550	20.0	44.1	50000	29000	NA	350000	0.0024	0.0041	NA	0.00034	NO	BSL	YES	BIO
FLUORENE	7/34	0.64 J	1.8 J	57SS09-D	9.3 - 550	1.2	45.4	NA	29000	NA	350000	NA	0.000062	NA	0.0000051	YES	NSL	YES	BIO
INDENO(1,2,3-CD)PYRENE	7/34	0.8 J	77 J	3E-SS01	9.3 - 550	20.3	34.6	NA	18000	NA	39000	NA	0.0043	NA	0.0020	YES	NSL	YES	BIO
NAPHTHALENE	3/34	1.1 J	1.6 J	57SB07-00	9.3 - 550	1.3	45.9	1000	29000	3400	350000	0.0016	0.000055	0.00047	0.0000046	NO	BSL	NO	BSL
PHENANTHRENE	11/34	2.4 J	70 J	3E-SS06	9.3 - 550	14.4	41.4	NA	29000	NA	350000	NA	0.0024	NA	0.00020	YES	NSL	YES	BIO
PYRENE	13/34	0.9 J	160 J	3E-SS06	9.3 - 550	29.1	40.6	NA	18000	34000	39000	NA	0.0089	0.0047	0.0041	YES	NSL	NO	BSL
PCB (µg/kg)																			
AROCLOR-1260	11/34	18 J	760	57SS09	8.1 - 55	189	69.1	33000	33000	880	0.332	0.023	0.023	0.86	2289	NO	BSL	YES	ASL
Pesticides (µg/kg)																			
4,4'-DDD	1/6	9.4 JP	9.4 JP	3E-SS06	3.9 - 5.5	9.4	3.5	12000	12000	93	24000	0.00078	0.00078	0.10	0.00039	NO	BSL	NO	BSL
4,4'-DDE	2/6	1.4 J	11	3E-SS06	3.9 - 5.5	6.2	3.6	12000	12000	93	24000	0.00092	0.00092	0.12	0.00046	NO	BSL	NO	BSL
4,4'-DDT	3/6	1.1	33	3E-SS06	3.9 - 5	12.1	7.2	12000	12000	93	24000	0.0028	0.0028	0.35	0.0014	NO	BSL	NO	BSL
Herbicides (µg/kg)																			
2,4,5-TP (SILVEX)	1/6	1.5 J	1.5 J	3E-SS01	9.8 - 14	1.5	5.2	109	NA	NA	NA	0.014	NA	NA	NA	YES	NSL	NO	NONBIO

TABLE 7-3

SURFACE SOIL ECOLOGICAL COPC SELECTION
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Sample of Maximum Detection	Range of Nondetects	Average of Detections[1]	Average of All Results[2]	Screening Levels[3]				EEQs[4]				Deletion or Selection of COPCs for Invertebrates/Plants		Further Evaluated in Terrestrial Food Chain Modeling[5]	
								Plants	Invertebrates	Birds	Mammals	Plants	Invertebrates	Birds	Mammals	COPC (yes/no)?	Rationale	Evaluated (yes/no)?	Rationale
Petroleum Hydrocarbons (mg/kg)																			
DIESEL RANGE ORGANICS	11/12	4.1 J	72 J	57SS09	10 - 10	21.6	20.2	NA	NA	NA	NA	NA	NA	NA	NA	NO	[6]	NO	[6]
TOTAL PETROLEUM HYDROCARBONS	11/12	4.7 J	72.6 J	57SS09	10.63 - 10.63	22.2	20.8	NA	NA	NA	NA	NA	NA	NA	NA	NO	[6]	NO	[6]
Miscellaneous Parameters (%)																			
TOTAL SOLIDS	16/16	66	98	57SB20-0001	-	87.7	87.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Shaded chemical name indicates that the chemical was selected as a COPC. Shaded cells indicate that the EEQ exceeds 1.

1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - The sources of the screening levels are presented in Table 7-2.
4 - EEQ is calculated by dividing the chemical concentration by its screening level.
5 - Chemicals with EEQs for birds or mammals greater than 1.0 or bioaccumulative chemicals without bird or mammal screening values are retained for food chain modeling.
6 - Risks from parameter considered by evaluating volatiles and PAHs.

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient
NA - Not available or not applicable

Rationale Codes for COPC Selection:
ASL - Above COPC Screening Level
BSL - Below COPC Screening Level
NSL - No Screening Level Available
BIO - Bioaccumulative
NONBIO - Not Bioaccumulative

TABLE 7-4

GROUNDWATER ECOLOGICAL COPC SELECTION
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample ID of Maximum Detection	Range of Nondetects	Average of Detections[1]	Average of All Results[2]	Maximum Detection Adjusted by Dilution Factor[3]				Screening Level[4]		EEQ[5]				COPC (yes/no)?	Rationale for COPC selection
									1	10	25	50	Value	Source	1	10	25	50		
Inorganics (µg/L)																				
ARSENIC	8/8	3.3 J	6.2	57GW01	57GW01-061012	-	4.2	4.2	6.2	0.62	0.25	0.12	36	PRWQS	0.17	0.017	0.0069	0.0034	NO	Max BSL
BARIUM	8/8	5.9	62.5	57GW02	57GW02-060912	-	28.5	28.5	62.5	6.3	2.5	1.3	200	NOAA	0.31	0.031	0.013	0.0063	NO	Max BSL
CADMIUM	8/8	0.07 J	1.8	57GW08	57GW08-061112	-	0.72	0.72	1.8	0.18	0.072	0.036	8.85	PRWQS	0.20	0.020	0.0081	0.0041	NO	Max BSL
COBALT	8/8	1.2	4.5	57GW02	57GW02-060912	-	2.6	2.6	4.5	0.45	0.18	0.090	1	NOAA	**4.5**	0.45	0.18	0.090	**YES**	Max ASL
COPPER	7/8	1.5	5.8	57GW09	57GW09-061012	2 - 2	3.5	3.2	5.8	0.58	0.23	0.12	3.73	PRWQS	**1.6**	0.16	0.062	0.031	**YES**	Max ASL
LEAD	2/8	1	1.4	57GW07	57GW07-060912	0.5 - 0.5	1.2	0.49	1.4	0.14	0.056	0.028	8.52	PRWQS	0.16	0.016	0.0066	0.0033	NO	Max BSL
MERCURY	5/8	0.03 J	0.92	57GW07	57GW07-060912	0.1 - 0.1	0.48	0.32	0.92	0.092	0.037	0.018	0.94	NRWQC	0.98	0.098	0.039	0.020	NO	Max BSL
NICKEL	4/8	4.6	16.3	57GW02	57GW02-060912	2.3 - 3.8	9.3	5.4	16.3	1.6	0.65	0.33	8.28	PRWQS	**2.0**	0.20	0.079	0.039	**YES**	Max ASL
SELENIUM	4/8	2 J	3.4 J	57GW01	57GW01-061012	3 - 3	2.4	2.0	3.4	0.34	0.14	0.068	71.74	PRWQS	0.047	0.0047	0.0019	0.00095	NO	Max BSL
SILVER	6/8	0.06 J	1	57GW07	57GW07-060912	0.4 - 0.4	0.37	0.33	1	0.10	0.040	0.020	2.24	PRWQS	0.45	0.045	0.018	0.0089	NO	Max BSL
THALLIUM	2/8	0.06 J	0.18 J	57GW02	57GW02-060912	0.4 - 0.4	0.12	0.18	0.18	0.018	0.0072	0.0036	21.3	Region 3	0.0085	0.00085	0.00034	0.00017	NO	Max BSL
VANADIUM	8/8	4.8 J	28.2	57GW04	57GW04-060912	-	16.5	16.5	28.2	2.8	1.1	0.56	50	NOAA	0.56	0.056	0.023	0.011	NO	Max BSL
ZINC	8/8	14.7	30.2	57GW09	57GW09-061012	-	21.4	21.4	30.2	3.0	1.2	0.60	85.62	PRWQS	0.35	0.035	0.014	0.0071	NO	Max BSL
Polynuclear Aromatic Hydrocarbons (µg/L)																				
ANTHRACENE	1/4	0.13 J	0.17 J	57GW05	57GW05-060912-D	0.095 - 0.1	0.15	0.074	0.17	0.017	0.0068	0.0034	0.18	Region 3	0.94	0.094	0.038	0.019	NO	Max BSL
BENZO(A)ANTHRACENE	1/4	0.13 J	0.15 J	57GW05	57GW05-060912-D	0.095 - 0.1	0.14	0.071	0.15	0.015	0.0060	0.0030	3	NOAA[6]	0.0500	0.00500	0.00200	0.00100	NO	Max BSL
FLUORANTHENE	1/4	0.93 J	1.3 J	57GW05	57GW05-060912-D	0.095 - 0.1	1.1	0.32	1.3	0.13	0.052	0.026	1.6	Region 3	0.81	0.081	0.033	0.016	NO	Max BSL
PYRENE	1/4	0.72 J	1.2 J	57GW05	57GW05-060912-D	0.095 - 0.1	0.96	0.28	1.2	0.12	0.048	0.024	0.24	Region 3	**5.0**	0.50	0.20	0.10	**YES**	Max ASL

Shaded chemical name indicates that the chemical was selected as a COPC. Shaded cells indicate that the EEQ exceeds 1.

1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Maximum detected chemical concentration adjusted by dilution factors of 1, 10, 25, and 50.
4 - Order of preference was PRWQS, NRWQC, Region 3, followed by NOAA.
- PRWQS - Puerto Rico Water Quality Standards for aquatic life, Classes SB and SC (Puerto Rico, 2010)
- NRWQC - USEPA National Recommended Water Quality Criteria, chronic saltwater (USEPA, 2009d)
- Region 3 - USEPA Region 3 BTAG Marine Screening Levels (USEPA, 2006a)
- NOAA - NOAA Screening Quick Reference Tables, chronic marine (Buchman, 2008)
5 - EEQ is calculated by dividing the maximum detected chemical concentration adjusted by the dilution factor by its screening level. Value is unitless.
6 - Value based on acute, lowest observed effects level (LOEL). The value was divided by 10 to estimate a chronic value and was divided by 10 to estimate a no observed effects level (NOEL).

Abbreviations:
COPC - Chemical of Potential Concern
EEQ - Ecological Effects Quotient

Rationale Codes for COPC Selection:
Max ASL - Maximum Concentration without dilution factor above COPC screening level
Max BSL - Maximum Concentration without dilution factor below COPC screening level

TABLE 7-5

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
OMNIVOROUS AND HERBIVOROUS RECEPTORS - SURFACE SOIL
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

	Omnivorous Receptors EEQs				Herbivorous Receptor EEQs	
	Norway Rat		Northern Mockingbird		Mourning Dove	
Chemical	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**
Inorganics						
CADMIUM	3.2E+00	3.5E-01	6.5E+00	7.3E-01	5.6E-01	6.3E-02
CHROMIUM	1.3E+00	5.5E-02	3.5E+00	1.4E-01	1.5E+00	6.3E-02
COPPER	1.4E+00	9.4E-02	3.2E+00	2.2E-01	1.2E+00	8.4E-02
LEAD	9.7E-01	2.4E-02	2.6E+00	6.6E-02	1.1E+00	2.7E-02
MERCURY	7.1E+00	1.4E+00	6.3E+00	1.3E+00	1.4E+01	2.7E+00
SELENIUM	1.2E+00	2.5E-01	1.9E+00	4.1E-01	1.4E+00	3.1E-01
THALLIUM	9.3E+01	9.3E+00	2.2E+02	2.2E+01	3.2E+01	3.2E+00
VANADIUM	4.5E-01	2.0E-01	2.1E+00	9.2E-01	1.6E+00	6.9E-01
ZINC	5.8E-01	1.5E-01	1.1E+00	2.9E-01	3.1E-01	7.8E-02
Semivolatile Organics						
BIS(2-ETHYLHEXYL)PHTHALATE	7.7E-03	7.7E-04	1.8E-02	1.8E-03	2.6E-03	2.6E-04
Polynuclear Aromatic Hydrocarbons						
ACENAPHTHENE	7.5E-04	1.4E-04	2.9E-04	5.3E-05	1.9E-03	3.6E-04
ACENAPHTHYLENE	3.7E-04	6.9E-05	7.6E-04	1.4E-04	3.7E-05	6.8E-06
ANTHRACENE	3.2E-05	5.8E-06	5.2E-05	9.6E-06	2.8E-05	5.2E-06
BENZO(A)PYRENE	1.4E-02	2.2E-04	3.0E-02	4.8E-04	6.5E-03	1.0E-04
BENZO(B)FLUORANTHENE	3.4E-02	5.4E-04	6.8E-02	1.1E-03	1.3E-02	2.1E-04
BENZO(G,H,I)PERYLENE	3.8E-02	6.0E-04	7.7E-02	1.2E-03	1.2E-02	1.9E-04
BENZO(K)FLUORANTHENE	2.6E-02	4.1E-04	5.4E-02	8.6E-04	7.2E-03	1.1E-04
CHRYSENE	3.3E-02	5.3E-04	6.9E-02	1.1E-03	1.0E-02	1.6E-04
DIBENZO(A,H)ANTHRACENE	2.2E-04	3.6E-06	4.8E-04	7.6E-06	6.2E-05	1.0E-06
FLUORANTHENE	4.8E-04	8.9E-05	9.4E-04	1.7E-04	2.2E-04	4.1E-05
FLUORENE	9.8E-04	1.8E-04	4.0E-04	7.3E-05	2.5E-03	4.6E-04
HIGH MOLECULAR WEIGHT PAHS	2.9E-02	4.6E-04	5.9E-02	9.5E-04	2.0E-02	3.2E-04
INDENO(1,2,3-CD)PYRENE	2.8E-02	4.5E-04	5.9E-02	9.5E-04	5.9E-03	9.5E-05
LOW MOLECULAR WEIGHT PAHS	2.2E-04	4.1E-05	3.2E-04	5.9E-05	3.1E-04	5.8E-05
PHENANTHRENE	3.2E-04	5.9E-05	3.8E-04	7.0E-05	5.0E-04	9.2E-05
PCB						
AROCLOR-1260	1.3E+01	1.3E+00	2.8E+01	2.8E+00	3.0E-01	3.0E-02

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 7-6

TERRESTRIAL FOOD CHAIN MODEL - AVERAGE SCENARIO
OMNIVOROUS AND HERBIVOROUS RECEPTORS - SURFACE SOIL
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

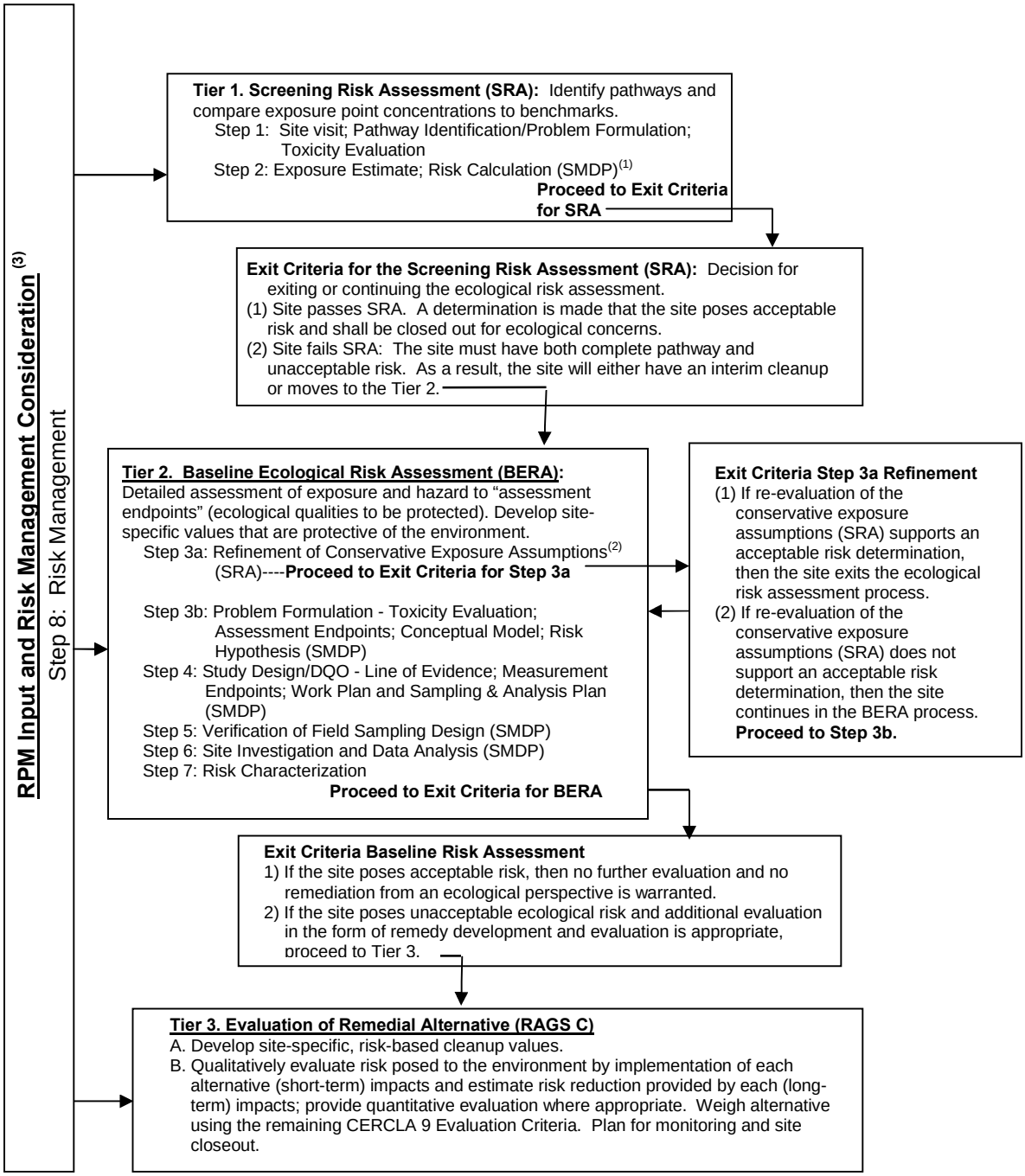
	Omnivorous Receptor EEQs				Herbivorous Receptor EEQs	
	Norway Rat		Northern Mockingbird		Mourning Dove	
Chemical	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**	**NOAEL-based**	**LOAEL-based**
Inorganics						
CADMIUM	4.2E-01	4.7E-02	1.5E+00	1.6E-01	1.1E-01	1.2E-02
CHROMIUM	1.8E-01	7.5E-03	7.1E-01	2.9E-02	1.7E-01	6.8E-03
COPPER	3.9E-01	2.7E-02	1.3E+00	9.0E-02	3.8E-01	2.6E-02
LEAD	1.5E-01	3.9E-03	5.8E-01	1.5E-02	1.2E-01	3.1E-03
MERCURY	6.1E-01	1.2E-01	2.1E+00	4.2E-01	1.9E-01	3.8E-02
SELENIUM	2.8E-01	6.0E-02	7.9E-01	1.7E-01	3.1E-01	6.7E-02
THALLIUM	1.0E+01	1.04E+00	4.0E+01	4.0E+00	2.2E+00	2.2E-01
VANADIUM	9.0E-02	3.9E-02	6.0E-01	2.6E-01	3.0E-01	1.3E-01
ZINC	2.5E-01	6.3E-02	8.2E-01	2.1E-01	1.2E-01	3.1E-02
PCB						
AROCLOR-1260	2.8E-01	2.8E-02	1.1E+00	1.1E-01	8.6E-03	8.6E-04

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

FIGURE 7-1

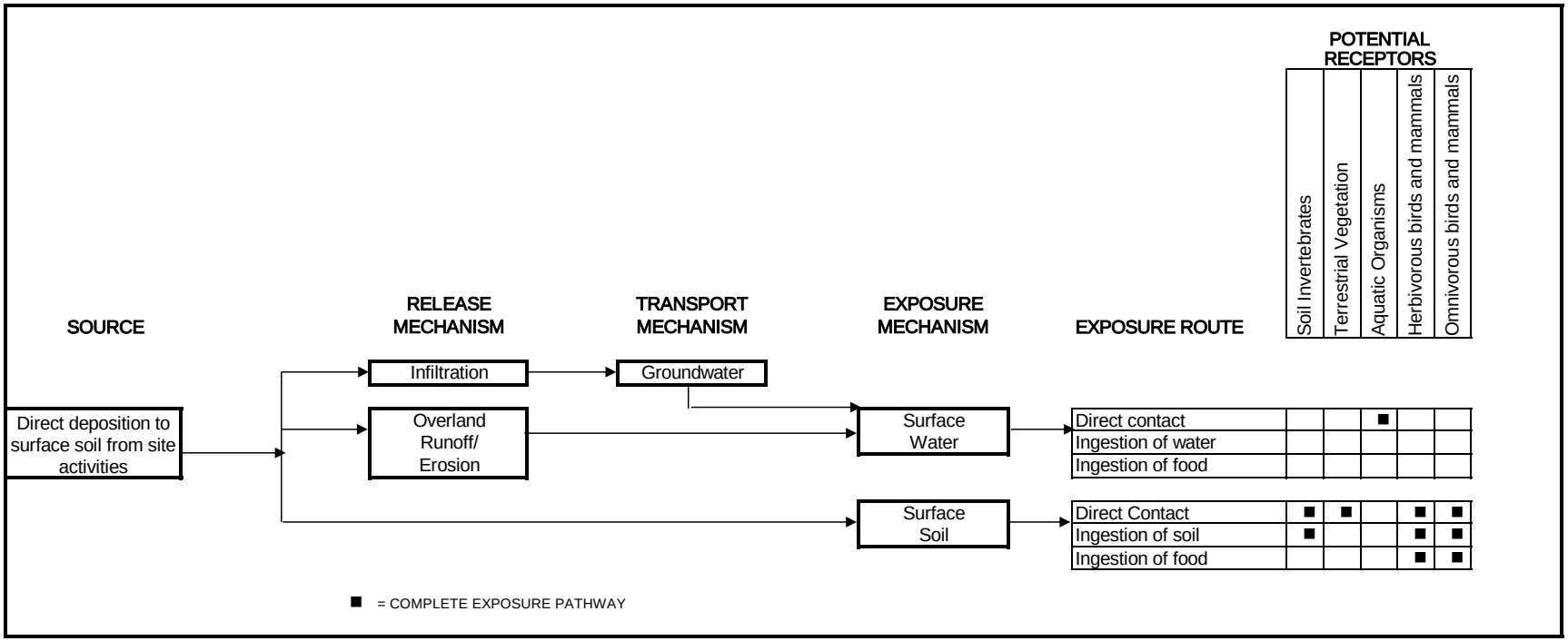
NAVY ECOLOGICAL RISK ASSESSMENT TIERED APPROACH
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



Notes: 1 See USEPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2 Refinement includes but is not limited to background, bioavailability, detection frequency, etc.
3 Risk management is incorporated throughout the tiered approach.

FIGURE 7-2

ECOLOGICAL CONCEPTUAL SITE MODEL
SWMU 57 - POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable, potential exposure.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Tetra Tech has prepared this report to summarize activities and findings for the Full RFI at SWMU 57 located at NAPR in Ceiba, Puerto Rico (Figure 1-1). The subsections below summarize the conclusions and recommendations for SWMU 57 based on site media (soil and groundwater) and also provides a revised CSM.

8.1.1 Soil

At SWMU 57, a steep vegetated hillside surrounds the concrete pad to its northeast, south, and southwest; the opposite (western) side of the access road is generally flat. A steep and bedrock-exposed hill lies immediately adjacent to the southeast side of the concrete pad. Ground elevations at SWMU 57 range between approximately 15 and 35 feet above msl. The concrete pad is located at an approximate elevation of 23 feet above msl.

Several soil borings were advanced at SWMU 57 during the Phase I RFI and the Full RFI field investigations to profile surface and subsurface conditions. These soil borings described very thin (0.3 to 6 inches) organic top soils at the ground surface in vegetated areas. Near the road and pad, soils consisted of clays with increased amounts of silt, sand, and gravel. During both the Phase I and the Full RFI investigations, a large portion of SWMU 57 was found to be underlain by residuum generally consisting of clay (predominant), silt, and/or sand. Residuum thickness was observed to range between approximately 1.5 feet on the slope southwest of the pad to 8.0 feet northwest of the pad. The residuum appears to generally follow topography across the site, thinning out on steeper slopes southwest of the pad and increase in thickness in the center of the site where topography is more flat. Areas near the concrete pad were found to be underlain by fill material including varying combinations of clay to gravel or highly weathered bedrock. Weathered bedrock was observed beneath the residuum or fill. According to the Phase I RFI (Baker, 2010), this variability of shallow subsurface materials (i.e., residuum, fill, or highly weathered bedrock) is not unusual considering the cut and fill construction methods typically employed in hilly areas similar to the upland areas of NAPR. Also, a thin discontinuous bedrock of tuff was noted approximately 14 feet bgs at select locations southwest of the concrete pad.

Surface and subsurface soil samples were collected at SWMU 57 during the ECP, Phase I RFI, and Full RFI investigations. VOCs, SVOCs, PAHs, DRO, TPH, pesticides, PCBs (only Aroclor-1260), and inorganics were detected in soil samples. Many of the detections were low, below both human health and

ecological screening levels, and detections were scattered throughout the site. A majority of the maximum detections were found in samples collected within and near the scattered debris area, although analytes were also detected in samples collected along the eastern and south eastern side of the concrete pad, along the western edge of the loading dock, north-northwest of the site, and near the access road. Overall, the most individual PAHs and SVOCs were detected in samples collected from locations northwest of the concrete pad on the opposite side of the access road which may be related to anthropogenic concentrations near the road rather than site-specific releases; several inorganic maximum detected concentrations were also noted in this area. Many of the PAH and inorganic concentrations were within site-specific and facility background levels.

The possibility that shallow subsurface debris could be present within the scattered debris area, from debris originally placed on the ground surface or scraped off the concrete pad may have been covered with several inches of soil and/or leaf litter over time, was investigated during the Full RFI via an analog geophysical survey. As expected based on the CSM, there were no indications from the geophysical survey of shallow subsurface metallic debris, nor was there evidence of buried debris in the soil borings. All instrument signals were associated with observed debris on the ground surface only. Moreover, no hazardous debris was encountered that could serve as a future contaminant source, except for two intact marine batteries on the ground surface that were removed and underlying soil sampled.

The concrete pad was evaluated during the Phase I RFI, four concrete wipe and four concrete chip samples were collected. Few SVOCs, DRO and metals were detected in these samples. While there are no criteria available for comparison, concentrations of these constituents are low and do not indicate that surface contamination is be present or than surrounding soils have been impacted. Additionally, remediation of the concrete pad is not warranted, however, should it be decided to demolish the concrete pad, the selected disposal facility may require additional waste characterization based on the volume of concrete being disposed of and completion of waste characterization for ignitability, corrosivity, and reactivity and, potentially, other parameters, prior to allowing disposal as a nonhazardous solid waste. Alternatively, it may be more cost effective to power wash the concrete prior to demolishing, then sample and properly dispose of the power wash water.

Further, during the RFI for adjacent SWMU 9 Area C, a test pit was advanced in the suspected sludge disposal pit at SWMU 57. Only inorganics (barium, lead, and silver) were detected in this sample and all were present at concentrations less than screening criteria in place at that time. No evidence of waste or a sludge disposal pit was noted during advancement of this test pit or during any of the SWMU 57 investigations (ECP, Phase I RFI, and Full RFI).

Human Health Risk Assessment Summary

An HHRA was completed for SWMU 57 which evaluated risks using combined site soil data collected during the ECP, Phase I RFI, and Full RFI investigations. Five potential receptor groups were evaluated: current and future construction workers, current and future industrial workers, current and future adolescent trespassers, future child, adolescent, and adult recreational users, and future child and adult residents. The risk characterization section of the HHRA evaluated risks to all receptors across the entire site as one EU. All receptors were evaluated for exposures to COPCs in soil, combined for surface soil from 0 to 1 foot bgs and subsurface soil from 1 to 3 feet bgs; the two intervals were also evaluated each separately. Construction workers were additionally evaluated for exposures to COPCs in subsurface soil greater than 3 feet bgs, which consists of data from samples collected mostly greater than 10 feet bgs. The HHRA calculated risks both with and without background considerations. The results of these evaluations are summarized below.

Non-Carcinogenic Risks

RME and CTE HIs are less than or equal to 1 for construction workers, industrial workers, adolescent trespassers, child, adolescent, and adult recreational users, and adult residents exposed to COPCs in the combined surface soil and subsurface soil, 0 to 3 feet bgs, data set and the separated data sets for surface soil, 0 to 1 foot bgs, and subsurface soil, 1 to 3 feet bgs.

The RME and CTE HIs for child residents exposed to COPCs for the combined soil data set, 0 to 3 feet bgs, was less than or equal to 1 on a target-organ basis. Similarly, RME and CTE HIs for child residents exposed to COPCs in surface soil and all CTE HIs were less than or equal to 1 on a target-organ basis. However, for the subsurface soil interval from 1 to 3 feet bgs, although the CTE HI was less than or equal to 1, the RME HI was greater than 1; the target organ-specific HI for the thyroid exceeded 1 due to cobalt. The combined surface and subsurface soil 0 to 3 feet bgs data set is expected to be the most realistic exposure scenario because receptors exposed to chemicals in subsurface soil 1 to 3 feet bgs would likely have to contact surface soil (0 to 1 foot bgs) first. RME and CTE HIs are also less than or equal to 1 for construction workers exposed to COPCs in subsurface soil greater than 3 feet bgs.

Carcinogenic Risks

Carcinogenic risks estimated for construction workers, industrial workers, adolescent trespassers, recreational users (child, adolescent, adult, and lifelong), and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ under both the RME and CTE scenarios.

Therefore, adverse effects due to carcinogenic chemicals at SWMU 57 are not anticipated for any receptor exposed under RME or CTE conditions.

Risk Drivers – Risk Characterization

Based on the non-cancer and cancer evaluations, the following USEPA risk driver (i.e., contaminants with non-cancer HQs greater than 1 or with cancer risks greater than $1x10^{-6}$ in a scenario and medium with total cancer risks greater than $1x10^{-4}$) was identified in the risk characterization: cobalt in subsurface soil 1 to 3 feet bgs based on child resident exposures. No risk drivers were identified for any receptors when the combined surface and subsurface soil 0 to 3 feet bgs data set was evaluated. This is important to note because a 0 to 3 feet bgs exposure scenario is a more likely exposure scenario for a child resident than 1 to 3 feet bgs. To access the 1 to 3 feet bgs soil depth interval that child would very likely have to dig through the 0 to 1 foot depth interval to get there. If the 1 to 3 feet bgs depth interval were somehow brought to the surface (e.g., construction) then that soil would be mixed with soil from the 0 to 1 foot depth interval and site data shows that there is no risk when to the future child resident when exposed to the 0 to 3 feet bgs depth interval. Therefore, even though there is a potentially unacceptable risk for the child resident exposed to soil in the 1 to 3 feet depth interval that exposure scenario is extremely unlikely and the more realistic exposure scenario (0 to 3 feet bgs) does not yield unacceptable risks for the child resident.

Ecological Risk Assessment Summary

In accordance with the SAP and risk assessment guidance, the ERA evaluated surface soil, it did not evaluate soil collected from depths greater than 1 foot. Based on the initial screening of the chemical data, several chemicals were initially selected as COPCs in surface soil because they were detected at concentrations that exceeded conservative screening levels, they had EEQs greater than 1.0 in the conservative food chain model, or because they did not have screening levels. These chemicals were then further evaluated to refine the list of COPCs, and to better characterize risks to ecological receptors. After further evaluation, no chemicals were retained as COPCs for risks to plants or soil invertebrates, aquatic organisms, herbivorous receptors, and omnivorous receptors.

8.1.2 Groundwater and Impact on Surface Water

At SWMU 57, a grassy slope and man-made earthen mound (and historical drainage feature no longer visible) divert surface water runoff away from the concrete pad. There are no natural surface water features at SWMU 57. Ultimately, overland flow near SWMU 57 drains to the northwest toward the Los Machos Mangrove Forest which is located approximately 500 feet from the site.

During the Phase I RFI, groundwater was located approximately 16 to 23 feet bgs and the groundwater flow at the upland area of SWMU 57 was reported to be toward the north northwest with a gentle hydraulic gradient. During the 2012 Full RFI groundwater sampling event, the groundwater flow direction was generally consistent with that of the 2010 Phase I RFI with groundwater flow toward the north-northwest. The groundwater flow direction for the both the 2010 and 2012 groundwater data is consistent with the anticipated flow for SWMU 57 and is with the flow direction observed at adjacent SWMU 9 Area C, also toward Los Machos Mangrove Forest. As in 2010, water levels in 2012 in the western portion of the site in the scattered debris area are nearly flat, with only 0.26 feet of elevation difference between 57GW07 and 57GW01. Based on soil boring logs, groundwater is first noted within the highly weathered bedrock and wells were then seated just above or across the transition into more competent bedrock. Overall water levels measured in June 2012 are elevated approximately 2 feet higher than those measured in April 2010 across the site, which is expected based available precipitation data for the months preceding the sampling event during the traditional rainy season; moreover, a drought occurred in 2010 prior to the Phase I RFI field event.

Concerning organics, a trend of lower concentrations and fewer impacted wells is evident. Few VOCs were detected in groundwater samples collected in 2004 (Phase I/II ECP) and 2010 (Phase I RFI) and no VOCs were detected in groundwater samples collected in 2012 (Full RFI). SVOCs, primarily PAHs, were detected in several groundwater samples collected in 2010 while in 2012, only one monitoring well had SVOCs detected in groundwater; the PAHs encountered were fewer than in 2010 and all at lesser concentrations. Inorganics also show a trend of lower concentrations. Based on BTVs, metals detected in SWMU 57 groundwater at concentrations exceeding facility background concentrations included mercury in 2010 and 2012 and lead in 2010. Thallium, for which no facility background value is available, was also detected in groundwater at SWMU 57. It should be noted that total metals were not collected in 2004 and dissolved metals were not collected in 2012.

Human Health Risk Assessment Summary

An HHRA was completed for SWMU 57 using site groundwater data collected during the Full RFI investigation. Current and future construction workers and future child and adult residents were evaluated for exposures to COPCs in groundwater. The results of these evaluations are summarized below.

Non-Carcinogenic Risks

RME and CTE HIs are less than or equal to 1 on a target-organ basis for construction workers and child and adult residents exposed to COPCs in groundwater. Therefore, no adverse non-carcinogenic effects are anticipated for these receptors under the defined exposure conditions

Carcinogenic Risks

Carcinogenic risks estimated for construction workers and residents (child, adult, and lifelong) are less than or within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ under both the RME and CTE scenarios. Therefore, the likelihood of cancer from site-related chemicals at SWMU 57 for any receptor exposed under RME conditions is below or within USEPA's acceptable range.

Risk Drivers – Risk Characterization

Based on the non-cancer and cancer evaluations no drivers (i.e., contaminants with non-cancer HQs greater than 1 or with cancer risks greater than $1x10^{-6}$ in a scenario and medium with total cancer risks greater than $1x10^{-4}$) were identified in the groundwater.

Ecological Risk Assessment Summary

The ERA evaluated groundwater. Infiltration through the soil is a potential source of contamination to groundwater and groundwater may discharge to surface water. Surface water is not present at the site and ecological receptors are not directly exposed to contaminants in groundwater at the site. However, contaminated groundwater may discharge to the Los Machos Mangrove Forest, which is about 500 feet north-northwest of the site. Based on the initial screening of the chemical data, several chemicals were initially selected as COPCs in groundwater because they were detected at concentrations that exceeded conservative screening levels, they had EEQs greater than 1.0 in the conservative food chain model, or because they did not have screening levels. These chemicals were then further evaluated to refine the list of COPCs, and to better characterize risks to ecological receptors. After further evaluation, no chemicals were retained as COPCs for groundwater. Similarly, surface water was evaluated, using a site-specific dilution factor to adjust the concentration in the groundwater to account for the mixing with the surface water and no chemicals in groundwater were retained as COPCs for potential risks to aquatic organisms.

8.1.3 Revised Conceptual Site Model

The CSM describes the site and its environmental setting. The CSM has been updated based on information from the findings of this Full RFI and is presented in Table 8-1, a graphical representation of the CSM is presented on Figure 8-1. Revisions to the CSM include:

- Scattered Debris Area: Debris was most concentrated near the southwestern and southeastern edges of the concrete pad where previously encountered during historical investigations, although the Full RFI

found the area to be larger than previously indicated. The CSM and hummocky soil on the southwestern side of the pad indicated that possible shallow subsurface disposal occurred in this area but the analog geophysical survey conducted during the Full RFI eliminated this prospect; all instrument signals were associated with observed debris on the ground surface only. No hazardous surface debris was encountered at the site except for two intact marine batteries on the ground surface that were removed and underlying soil sampled.

- Suspected Sludge Disposal Pit Area: No evidence of a sludge disposal pit was noted during advancement of this test pit during the SWMU 9 Area C investigation or during any of the SWMU 57 investigations (ECP, Phase I RFI, and Full RFI).

8.2 RECOMMENDATIONS

Based on the results of all investigations to date, including risk assessments, No Further Action is recommended concerning site soil and groundwater. Additionally, remediation of the concrete pad is not warranted. Further, the site does not adversely impact the downgradient surface water at Los Machos Mangrove Forest.

There are two site-related recommendations:

- Abandon all existing monitoring wells
- Collect and properly dispose of all surface debris.

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
Site Profile	Installation Name	NAPR
	Installation Location	Ceiba, Puerto Rico
	Site Name	SWMU 57 – Facility No. 278 POL Drum Storage Area, previously known as photo-identified (PI) Site 4 and ECP Site 3
	Site Location	SWMU 57 is located at Facility No. 278 north of Antietam Road, just south of SWMU 9 Area C, and northeast of the former Fuel Farm Area.
	Site History	SWMU 57 was used for the storage of POL and other potentially hazardous materials, and numerous small spills and releases occurred throughout the usage period (1950s through 1990s).
	Site Area and Layout	SWMU 57 is approximately 1.3 acres. The site is a large concrete pad and loading dock surrounded by densely wooded area on all sides except the northern side, which is a gravel access road and turn-around that is currently overgrown with long grass. Presently, vegetation on three sides of the pad extends to the pad itself, likely a result of discontinued maintenance following end of site operations. The access road bisects the northwestern-most portion of the SWMU with the concrete pad located immediately adjacent (southeast). A mounded earthen area and grassy slope beyond (and previously, an earthen drainage feature approximately 140 linear feet in length which is no longer visible) divert runoff around (away from) the northeastern portion of the concrete pad. The drainage area traverses an area upgradient of the concrete pad; therefore, releases to the concrete pad or loading dock cannot migrate to it. Miscellaneous scattered debris including corroded drum fragments, batteries, metal pieces, and construction materials were observed at SWMU 57. Debris was most concentrated near the southwestern and southeastern edges of the concrete pad where previously encountered during historical investigations (Baker, 2010), although the Full RFI found the area to be larger than previously indicated. Various trash pieces were located along the southwestern edge of the concrete pad. Debris was less dense further from the concrete pad. Debris was also located along the southeastern edge of the pad. Stray trash items (e.g., beverage cans, bottles, small plastic containers, etc.) were also located at distances greater than 100 feet from the concrete pad in the forested area. (photographs provided in Appendix D)

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
	Site Structures	A rectangular concrete pad approximately 170 by 100 feet in size and in relatively good condition aside from a few cracks and pitting is located at SWMU 57. A truck drive-through down ramp onto the pad is located on the northeast side of the pad. A concrete loading lock (5 feet high at the edge of the concrete pad) is located on the western side of the pad. A 7-inch high concrete containment curb surrounds the entire outer perimeter of the pad, including the loading dock. The curb is also in good condition; no sections were observed to be broken, missing, or seriously distressed. The SWMU 74 fuel pipeline runs along the north side of the access road to SWMU 57 and adjacent SWMU 9 Area C.
	Source	Potential source areas investigated included the following locations: • POL drum storage area formerly on the bermed pad and associated spills on or off the pad. • Based on historical aerial photographs, a potential disposal pit for sludge at SWMU 57 adjacent to the northwest corner of the pad was suspected (similar to disposal pits encountered for SWMU 9 sludge), however, no evidence of a sludge disposal pit was found during any SWMU 57 or adjacent SWMU 9 investigations. • Empty drums and other scattered debris on the hummocky, wooded ground surface adjacent to the southwest/southeastern side of the pad observed at the time of the Phase I RFI; no buried debris was present based on the Full RFI magnetometer survey.
	Release Mechanisms	Release Mechanisms include the following: • Numerous known historic spills onto the concrete pad. It is not expected that spills on the pad migrated to the ground surface because a 7-inch high berm is present around the perimeter of the pad. However, debris from the pad may have been scraped off onto the ground surface and, if any associated contaminants were present, then migrated to the subsurface and groundwater. • Possible historic spills onto the ground surface, particularly spills near the loading dock that may have occurred during loading or unloading of drums, with migration to subsurface soil/ groundwater. • Possible residual releases from drums (and other debris) in the scattered debris area, if not empty at time of placement onto the ground surface, with migration to subsurface soils and/or groundwater.
	Site Boundaries	N: Approximately 125 feet north of the concrete pad S: Approximately 50 feet beyond the concrete pad. E: Approximately 50 feet beyond the concrete pad. W: Approximately 50 feet beyond the concrete pad.

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
	Site Security	SWMU 57 is located within NAPR, which is currently a secure facility. Restricted access is via guard at Gate 3 (or at the gate near the airfield). Because of NAPR closure, only a skeleton crew remains at the station and Base security will be more limited in the future. There is no site-specific security.
Physical	Climate	Puerto Rico has a tropical marine climate characterized by minimal temperature fluctuations, relatively moderate humidity, and frequent rain showers. Mean annual maximum temperatures range from 82.0° Fahrenheit (F) in January to 88.2° F in August. The mean annual minimum temperatures vary from 64.0° F in January to 73.2° F in June. The rainy season is typically defined as May through November with an average of 60 inches of rain per year; a dry winter season occurs from December through April. Hurricane season is from June 1st through November 30th.
	Topography	A steep vegetated hillside surrounds the concrete pad to its northeast, south, and southwest; in front of the pad (northwest) the topography flattens approaching the road before sloping steeply toward the Los Machos Mangrove Forest. A steep and bedrock-exposed hill lies immediately adjacent to the southeast side of the concrete pad. Ground elevations range between approximately 15 and 35 feet above msl [i.e., 115 and 135 feet datum; the datum plan is Mean Low Water plus 100.00 foot as established by the U.S. Navy Survey Section (November 1941)]. The concrete pad is located at an approximate elevation of 23 feet above msl (123 feet datum).

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
	Soil	Soil borings from the Phase I RFI and the Full RFI described very thin (0.3 to 6 inches) organic topsoils at the ground surface in vegetated areas. Near the road and pad, soils consisted of clays with increased amounts of silt, sand, and gravel. A large portion of SWMU 57 is underlain by residuum generally consisting of clay (predominant), silt, and/or sand (57SB01, 57SB03, 57SB04, 57SB05, 57SB15, 57SB16, 57SB17, and 57SB23). Residuum thickness was observed to range between approximately 1.5 feet at 57SB04 on the slope southwest of the pad and 8.0 feet northwest of the pad at 57SB01. The residuum appears to generally follow topography across the site, thinning out on the steeper slopes southwest of the pad, and increase in thickness in the center of the site where topography is more flat. The residuum transitions into highly weathered bedrock with depth. Areas near the concrete pad were found to be underlain by fill material (57SB02, 57SB06, and 57SB14) including varying combinations of clay to gravel, or highly weathered bedrock (57SB07). The fill thickness was approximately 4.0 feet at 57SB02, 3.2 feet at 57SB06, and 4 feet at 57SB14. Highly weathered bedrock was also observed directly beneath the fill. Variability of shallow subsurface materials (i.e., residuum, fill, or highly weathered bedrock) is not unusual considering the cut and fill construction methods typically employed in similar hilly upland areas of NAPR.
	Geology	These upland areas of NAPR are underlain by bedrock and exhibit varying degrees of weathering. Transition to more competent bedrock was observed in several locations at 15 feet (57SB02), 23.5 feet (57SB04), 21 feet (57SB05), 20 feet (57SB16), 12 feet (57SB18), and 20 feet (57SB23) bgs. The geologic map of Naguabo and portions of the Punta Puerca quadrangles indicate that the site is underlain by the Daguao Formation which includes interbedded volcanic breccia, lava, subordinate volcanic sandstone, and crystal tuff.
	Hydrogeology	Groundwater was not observed in residuum or fill. Depth to groundwater was observed approximately 16 to 23 feet bgs during the Phase I RFI during drought conditions and higher, approximately 15 to 21 feet bgs, during the Full RFI field activities of the rainy season. The groundwater flow at upland area SWMU 57 is toward the north-northwest with an average hydraulic gradient of approximately 0.0043 across the site. This groundwater flow direction in 2012 is consistent with the anticipated flow direction for SWMU 57, and the flow direction observed at adjacent SWMU 9 Area C (i.e., toward Los Machos Mangrove Forest).

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
	Hydrology	A grassy slope and man-made earthen mound (and historical drainage feature no longer visible) divert surface water runoff away from the concrete pad. There are no natural surface water features directly at SWMU 57. The earthen drainage feature was dry at the time of the Phase I RFI and Full RFI, contained little or no stream substrate, and terminated before the access road. As such, this feature does not support aquatic organisms such as benthic macroinvertebrates. The earthen drainage feature was overgrown and not visible during the August 2011 site visit. Ultimately, surface water runoff flows north approximately 500 feet to the Los Machos Mangrove Forest.
	Vegetation	Based on the August 2011 site visit in support of the Full RFI, upland vegetative species (such as guinea grass) were previously noted within the former drainage feature, with the surrounding area vegetated by flat lying grass and secondary growth. Moreover, the feature is no longer distinguishable from the grassy sloped area. No watercourses or aquatic natural resources (i.e., wetlands) exist at or in the immediate vicinity of SWMU 57. Downgradient (north) of the site, approximately 500 feet, is the Los Machos Mangrove Forest. Dominant herbaceous vegetation includes guinea grass (*Urochloa maxima*), ocean blue morning glory (*Ipomea indica*), flatleaf flatsedge (*Cyperus planifolius*), crack open (*Casearia sylvestris*), and knotgrass (*Paspalum distichum*). Dominant trees and shrubs identified include white lead tree (*Leucaena leucocephala*), white indigo berry (*Randia aculeata*), gumbo limbo (*Bursera simaruba*), and *Erythroxylum sp*.

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
Release	Contaminant distribution	Surface and subsurface soil samples were collected at SWMU 57 during the ECP, Phase I RFI, and Full RFI investigations. VOCs, SVOCs, PAHs, DRO, TPH, pesticides, PCBs (only Aroclor-1260), and inorganics were detected in soil samples. Many of the detections were low, below both human health and ecological screening levels, and detections were scattered throughout the site. A majority of the maximum detections were found in samples collected within and near the scattered debris area, although analytes were also detected in samples collected along the eastern/south eastern side of the concrete pad, along the western edge of the loading dock, north northwest of the site, and near the access road. Overall, the most individual PAHs and SVOCs were detected in samples collected from locations northwest of the concrete pad on the opposite side of the access road which may be related to anthropogenic concentrations near the road rather than site-specific releases; several inorganic maximum detected concentrations were also noted in this area. Many of the PAH and inorganic concentations were within site-specific and facility background levels. Further, during the RFI for adjacent SWMU 9 Area C a test pit was advanced in the suspected sludge disposal pit area at SWMU 57. Only inorganics (barium, lead, and silver) were detected in this sample and all were present at concentrations less than screening criteria in place at that time. No evidence of a sludge disposal pit was noted during advancement of this test pit or during any of the SWMU 57 investigations (ECP, Phase I RFI, and Full RFI).

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
Release	Contaminant distribution	Groundwater samples were collected at SWMU 57 during the ECP, Phase I RFI, and Full RFI investigations. Concerning organics in groundwater, a trend of lower concentrations and fewer impacted wells is evident. Few VOCs were detected in groundwater samples collected in 2004 (Phase I/II ECP) and 2010 (Phase I RFI) and no VOCs were detected in groundwater samples collected in 2012 (Full RFI). SVOCs, primarily PAHs, were detected in several groundwater samples collected in 2010 with the highest concentrations found in samples collected from monitoring well 57GW05. In 2012, monitoring well 57GW05 was the only well where SVOCs were detected in groundwater; the PAHs encountered were fewer than in 2010 and all at lesser concentrations. GRO and TPH were also detected in 57GW05 in 2010 (TPH and GRO were not sampled for in either 2004 or 2012). Monitoring well 57GW05 is located just outside of the northeast corner of the scattered debris area between the concrete pad and the road. SVOCs, PAHs, DRO, and TPH were also detected in surface soil sample 57SB05-00, and one PAH, DRO, and TPH were detected in the corresponding subsurface soil samples collected at 57SB05. The PAHs and petroleum constituents detected in monitoring well 57GW05 were at low levels, 0.017J to 2.4 µg/L, respectively, and may be present as a result of the scattered debris area. However, monitoring wells 57GW07 and 57GW08 are located within the scattered debris area and only two PAHs were detected in the duplicate of 5GW07 in 2010. Inorganics also show a trend of lower concentrations. Metals detected in SWMU 57 groundwater at concentrations exceeding facility background concentrations included mercury in 2012, lead in 2010, and vanadium in 2004 and 2010. Thallium, for which no background vale is available, was also detected in groundwater at SWMU 57. It should be noted that total metals were not collected in 2004 and dissolved metals were not collected in 2012.
Land Use and Exposure Profile	Current Land Use	SWMU 57 is currently inactive.
	Current Human Receptors	Potential current human receptors include industrial workers, construction workers, and adolescent trespassers.
	Current Activities	Currently, no activities take place on this site.
	Potential Future Land Use	SWMU 57 will remain under the ownership and control of the Navy until response actions are complete. According to the Supplemental Environmental Assessment, SWMU 57 will be located in Zone 4, the Marsh Vista Country Club, with a proposed 18-hole golf course with clubhouse as well as 50 residential units (Navy, 2011).

TABLE 8-1

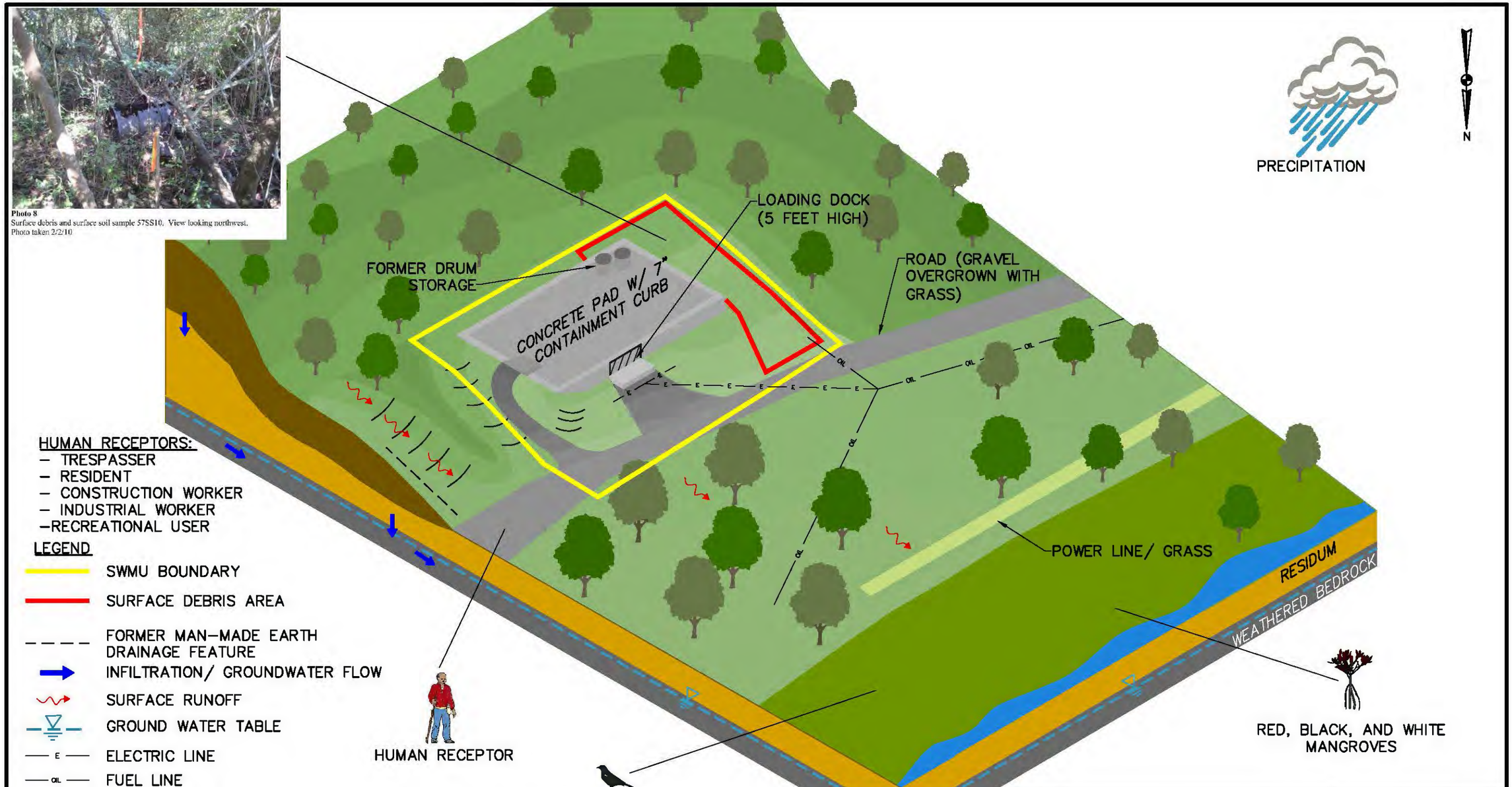
CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
	Potential Future Human Receptors	Pending future human receptors include industrial workers, construction workers, adolescent trespassers, adolescent and adult recreational users, and child and adult residents.
	Potential Future Land Use Related Activities	Potential future related activities include light recreation (walking, golfing), moderate to heavy construction related to house building, and construction and maintenance of the planned golf course.
	Zoning/Land Use Restrictions	There are no site-specific restrictions at this time.
	Demographics/ Zoning	Ceiba's population density is approximately 230 people per square mile. Because of NAPR closure, only a skeleton crew remains at the station.
	Beneficial Resources	There are no SWMU 57-specific beneficial resources.
Ecological	Habitat Type	The habitat is upland forest and a majority of the site is heavily vegetated.
	Degree of Disturbance	Moderate – Historically, the concrete pad was constructed. Hummocky soil on the southwestern side of the pad indicated that possible subsurface disposal occurred in this area but the magnetometer survey conducted during the Full RFI eliminated this prospect.
	Ecological Receptors and Species of Special Concern	The major mammal population in and near NAPR consists of introduced species such as stray dogs and cats, Norway and gray-bellied rats, mice, and mongooses. More than 200 species of birds inhabit the island of Puerto Rico; specifically the yellow-shouldered blackbird is of special concern. The species observed at NAPR that are classified as endangered under federal law, any of which could be present within the overall boundaries of SWMU 77 include sea turtles (hawksbill [*Eretmochelys imbricate*] and leatherback [*Dermochelys coriacea*]) one snake (Puerto Rican boa constrictor [*Epicrates inornatus*]), birds (yellow-shouldered blackbird and brown pelican *[Pelecanus occidentalis occidentalis]*), and one mammal (West Indian Manatee [*Trichechus manatus*]). Three species of vegetation of concern include are the black (*Avicennia germinans*), red (*Rhizophora mangle)*, and white (*Laguncularia racemosa*) mangrove. The black mangrove (*Avicennia germinans)* is classified as threatened under federal law. Because the mangrove areas are considered wetlands, they are protected under federal law and are critical habitat for the yellow shouldered blackbird (*Agelaius xanthomus*). Of note, NAPR supports one plant (*Cobana negra*) classified as threatened in 1990 by USFWS.

TABLE 8-1

CONCEPTUAL SITE MODEL
SWMU 57 – POL DRUM STORAGE AREA
NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

Profile Type	Information Need	Findings
General Exposure Profile	Relationship of contaminant Sources to Habitat and Potential Receptors	Human and ecological receptors may come into direct contact with surface and subsurface soil at SWMU 57. Both human health and ecological risk assessments were completed to evaluate this exposure. No chemicals were retained as COPCs for risks to plants or soil invertebrates, aquatic organisms, herbivorous receptors, and omnivorous receptors; therefore, no ecological risks are expected. During the human health risk assessment for any receptor exposed under RME or CTE conditions for soil, only cobalt in subsurface soil 1 to 3 feet bgs based on child resident exposures presented a risk; however, exposure by the child resident only to chemicals in subsurface soil is unlikely; more likely, receptors would likely be also exposed to chemicals in surface soil (0 to 1 foot bgs) if they are exposed to subsurface soil 1 to 3 feet bgs and risks for the combined data set (0 to 3 feet bgs) were acceptable. The mangrove forest is approximately 500 feet away from the edge of the concrete pad at SWMU 57 but ecological adverse impacts are not expected beyond the site, based on evaluation of groundwater contaminant migration to surface water. Groundwater is located approximately 13 to 20 feet bgs and is not used as a potable source of water on NAPR; therefore, potential risk from direct contact or ingestion of groundwater is low for human receptors. Moreover, groundwater contamination encountered to date is low concentration, sporadic, and nearby SWMU 57. Based on the human health risk assessment,adverse effects due to chemicals at SWMU 57 are not anticipated for any receptor exposed under RME or CTE conditions for groundwater or surface water.



DRAWN BY NN	DATE 6/15/11	SWMU 57 – CONCEPTUAL SITE MODEL NAVAL ACTIVITY PUERTO RICO CEIBA, PUERTO RICO	CONTRACT NO. 0057
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APPENDIX A

HISTORICAL SUPPORTING INFORMATION

A-1 ECP REPORT INFORMATION

A-2 PHASE I RFI REPORT INFORMATION

A-3 PHASE I RFI HISTORICAL WELL CONSTRUCTION LOGS

A-4 NOTES FROM AUGUST 2011 SITE VISIT

A-5 REVISED DRAFT SWMU 9 RFI INFORMATION

A-6 GEOLOGY OF SWMU 57

A-1 ECP REPORT INFORMATION

Table 5-5. ECP Sites at NSRR

ECP Site No.	ECP Site Descriptor
1	Active Small Arms Ranges on Punta Medio Mundo
2	Hangar 200 Apron in Airfield Area
3	Facility No. 278 – POL Drum Storage Area North of Antietam Rd.
4	Former Rifle Range at Punta Puerca
5	Former Vehicle Maintenance and Refueling Area on East Side of Forrestal Dr.
6	Former Landfill at Marina
7	Former Bundy Area Maintenance Facilities South of Bldg. 1686
8	Former Disposal Area in Southwest Bundy
9	Former Pistol Range at New BEQ West of Langley Dr.
10	Former Skeet Range at Ofstie Airfield
11	Former UST No. 208 Southwest of Hangar 200
12	Former UST No. 209 Southwest of Hangar 200
13	Former Gas Station North of the Ofstie Tennis Courts
14	Former Fire Training Area in Southwest End of the Ofstie Airfield Area
15	Aircraft Parking Apron West and East of Ofstie Airfield Runway
16	Disposal Area Northwest of Station Landfill
17	Quarry Disposal Site at the Commissary Parking Lot
18	Building 31 – Public Works Department
19	DRMO Scrap Metal Recycling Yard near the Camp Moscrip Area and Dry Dock
20	Fuel Pipelines and Hydrant Pits
21	Building 976 – Fire Deluge Pumphouse in the Waterfront Area next to Pier 3
22	Building 2300 – US Army Reserve Boat Maintenance Facility
23	Piñeros and Cabeza de Perro Islands East of NSRR Proper

This section of the report is organized by ECP site and addresses each of the following topics for each ECP site:

1. Site History and Description

2. Site Hydrogeology

3. Field Investigation and Sampling

4. Nature and Extent of Contamination

5. Qualitative Risk Analysis

6. Summary and Conclusion

Specifics for the ECP Phase II investigation, to include Quality Assurance/Quality Control (QA/QC) procedures and results, sampling methodology and procedures, and standards use for the risk analysis, are presented in Appendix F.

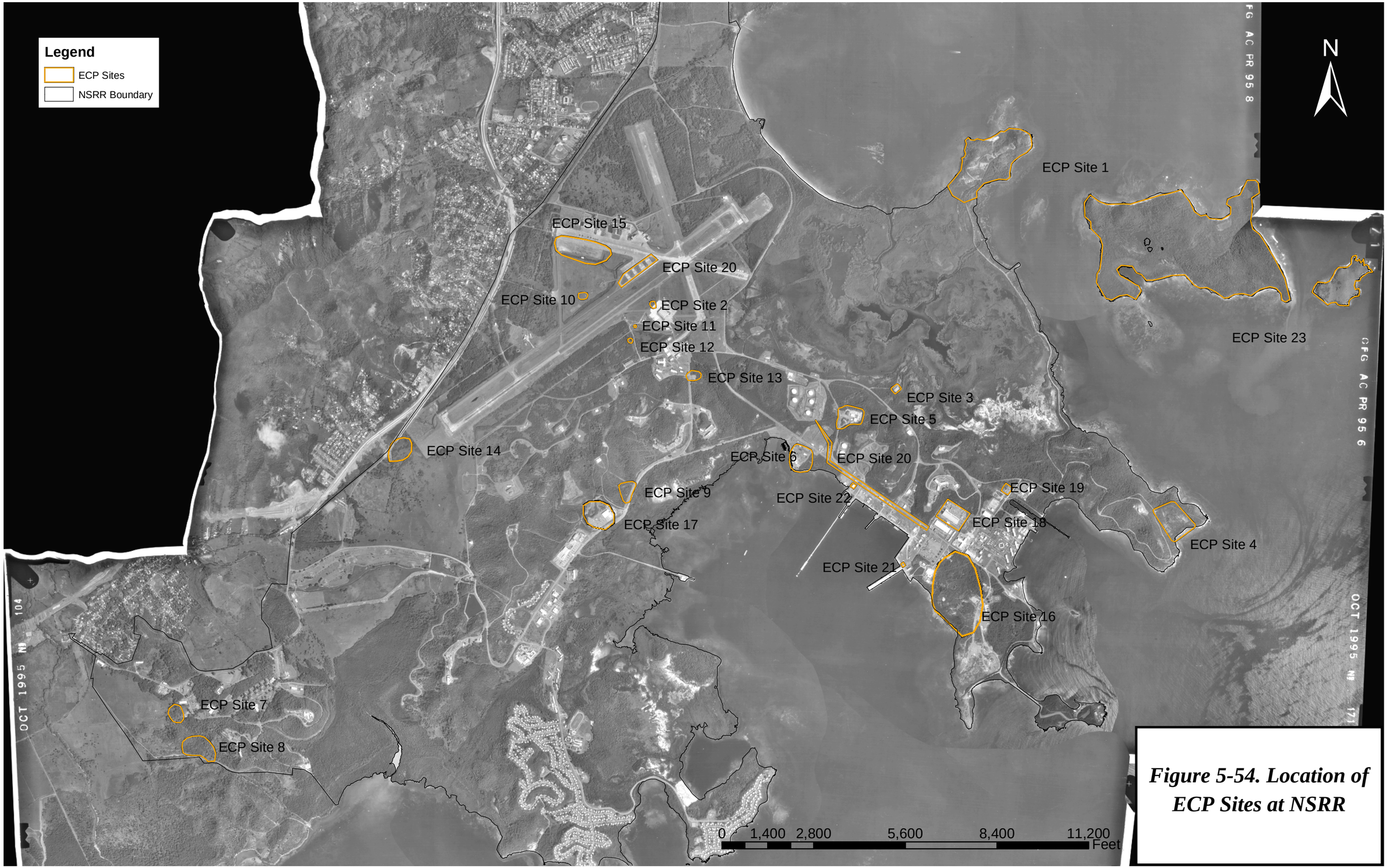


Figure 5-54. Location of ECP Sites at NSRR

elevated levels of lead. Other COPCs considered in the sediment at the site included acetone, PAHs, and several other inorganics. None of these other COPCs were determined to pose a significant risk. Surface water is presumed to be transient due to the nature of a drainage ditch and was not considered as a risk to human health and the environment despite the presence of slightly elevated concentrations of copper and mercury.

Further investigation at this site will be conducted under the RCRA Corrective Action/IRP process.

5.4.3 ECP Site 3

5.4.3.1 Site History and Description

This site is located at Facility No. 278, which is a rectangular concrete pad approximately 100' x 160' in size, surrounded by flat lying grass and secondary growth vegetation on the north side of Antietam Road just south of Solid Waste Management Unit (SWMU) 9 Area C (see Figure 5-58).

*Background aerial photograph from 1958

Figure 5-58. ECP Site 3 - Facility No. 278, POL Drum Storage Area

The APA identified this area as PI Site 4, due to the observation of drum storage and staining on a concrete pad and surrounding soil from 1958-1995. The records review confirmed the area as the POL drum storage facility from the 1950s to the 1990s, and the physical site inspections observed staining on the pad but no significant stressed vegetation immediately surrounding the pad. Interviews confirmed that POL and potentially other HM were stored at site, with numerous small spills and releases throughout the usage period.

During the Phase II ECP investigation, some small miscellaneous debris including, small cylinders and equipment, were observed on the concrete pad (see Photos G-4 through G-8 in Appendix G). There were no signs of any stains or stressed vegetation observed during the investigation.

5.4.3.2 Site Hydrogeology

ECP Site 3 is located in the upland area just south of SWMU 9 Area C. ECP Site 3 is underlain by thin residuum, which generally consists of sand, silt, and/or clay. Residuum was observed to range from 0.2-feet (sample 3E-04) to more than 5-feet thick (sample 3E-06). Weathered bedrock (Gabbro) was observed beneath the residuum. Groundwater was not observed in residuum. At ECP Site 3, depth to groundwater was observed approximately 13- to 20-feet bgs. At this depth groundwater would be present in bedrock fractures. A strong fuel odor was evident at temporary well 3E-TW04.

5.4.3.3 Field Investigation and Sampling Program

The area surrounding the concrete slab utilized for POL Drum storage was investigated at ECP Site 3. As presented in the Phase II ECP Work Plan (NAVFAC Atlantic, 2004b), the sample locations at this site were field located with a hand held GPS receiver. As mentioned previously, there were no signs of staining or stressed vegetation observed at this site. Therefore, the originally proposed six locations within the work plan were utilized, with the exception of three locations (3E-01, 3E-04, and 3E-06) because of site access issues including site topography. At these three locations, the borings had to be offset by a few feet to allow for necessary operating clearance for the Geoprobe® rig.

A total of six soil borings were advanced around the perimeter of Facility Number 278 (ECP Site 3) as presented on Figure 5-59. One soil boring was located along each of the northeastern and southwestern edges of the concrete slab, while two soil borings were located along each of the northwestern and southeastern edges of the concrete slab.

Figure 5-59.
ECP Site 3 - Facility No. 278, POL Drum Storage Area Sample Location Map

Surface soil was collected from each soil boring location utilizing a stainless steel spoon. One surface soil sample was obtained from each of the six sampling locations (3E-01 through 3E-06) from a depth of 0 to 1 foot bgs. Subsurface soil samples were collected from two-foot intervals (i.e., 1 to 3 feet bgs, 3 to 5 feet bgs, etc.). The depth of the soil borings at this site ranged from 5 feet bgs to 33.5 feet bgs (3E-SB02/TW02). A minimum of two subsurface soil samples were obtained from each boring location (3E-01 through 3E-06). All surface and subsurface soil samples were screened in the field utilizing a photo-ionization detector (PID) and a flame-ionization detector (FID) with the results recorded in the field logbook. The screening results were compared against background to indicate if the soil has been impacted by past operations. [See Appendix G for full PID and FID screening results on a per site basis.] A total of four subsurface soil samples were collected from soil boring 3E-04 based on observed FID/PID readings. According to the decision tree for this site, additional subsurface soil samples were to be collected at greater depths until groundwater is encountered, and/or the FID/PID readings are at background levels. However, only one subsurface soil sample from this boring was sent to a fixed-base analytical laboratory based on professional judgment.

A total of six surface soil and six subsurface soil samples were submitted to the fixed-base laboratory, including surface soil samples 3E-SS01 through 3E-SS06, and subsurface soil samples 3E-SB01-01, 3E-SB02-01, 3E-SB03-01, 3E-SB04-01, 3E-SB05-01, and 3E-SB06-01. These samples were analyzed for full Appendix IX analysis.

A groundwater program followed the soil-sampling program, with the installation of two temporary monitor wells based on the field screening results of the subsurface soil. The field screening results indicated that one temporary monitor well was to be installed at soil boring 3E-02, while another temporary monitor well was to be installed at soil boring location 3E-04. Groundwater samples were then collected from each temporary monitor well based on a modified version of the low flow sampling technique, with results submitted to the fixed-base analytical laboratory for full Appendix IX analysis.

5.4.3.4 Nature and Extent of Contamination

The results of the analytical program for this site can be seen in Tables 5-10 through 5-15. In the surface soil, there were six VOCs, eleven SVOCs, three pesticides, one PCB, and one chlorinated herbicide detected (Table 5-10). Fifteen inorganic compounds were found in the surface soil as well (Table 5-11). Locations 3E-01 and 3E-03 had the most detections of VOCs, while locations 3E-01 and 3E-06 had the most detections of SVOCs. All SVOC concentrations were estimated.

Table 5-10. Summary of Organic Detections in Surface Soil at ECP Site 3 – Facility No. 278, POL Drum Storage Area

Site ID	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs (ug/kg)**	3E-01	3E-01	3E-02	3E-03	3E-04	3E-05	3E-05	3E-06	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
Sample ID			3E-SS01	3E-SS01D	3E-SS02	3E-SS03	3E-SS04	3E-SS05	3E-SS05D	3E-SS06					
Sample Date			05/05/04	05/05/04	05/05/04	05/05/04	05/05/04	05/05/04	05/05/04	05/05/04					
Sample Depth (ft bgs)			0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00					
Volatile Organic Compounds (ug/kg)															
Chlorobenzene	2,000,000	160,000	5.9 U	4.3 J	5.5 U	4.5 J	6.5 U	7.2 U	7.3 U	7.3 U	0/8		0/8		3E-SS03
Ethylbenzene	10,000,000	780,000	5.9 U	2.3 J	5.5 U	2.4 J	6.5 U	7.2 U	7.3 U	7.3 U	0/8		0/8		3E-SS03
Carbon tetrachloride	22,000	4,900	4 J	8.8	2.4 J	5.7 J	6.5 U	3 J	7.3 U	7.3 U	0/8		0/8		3E-SS01D
Chloroform	1,000,000	78,000	1.9 J	4.3 J	5.5 U	2.9 J	6.5 U	7.2 U	7.3 U	7.3 U	0/8		0/8		3E-SS01D
Tetrachloroethene	5,300	1,200	5.9 U	5.7 J	5.5 U	6	6.5 U	4.2 J	7.3 U	7.3 U	0/8		0/8		3E-SS03
Xylene	20,000,000	1,600,000	12 U	12 J	11 U	12	13 U	14 U	15 U	15 U	0/8		0/8		3E-SS03
Semivolatile Organic Compounds (ug/kg)															
Benzo(b)fluoranthene	3,900	870	460 U	500 U	390 U	440 U	480 U	480 U	550 U	95 J	0/8		0/8		3E-SS06
Benzo(a)anthracene	3,900	870	460 U	500 U	390 U	440 U	480 U	480 U	550 U	79 J	0/8		0/8		3E-SS06
Benzo(k)fluoranthene	39,000	8,700	460 U	500 U	390 U	440 U	480 U	480 U	550 U	76 J	0/8		0/8		3E-SS06
bis(2-Ethylhexyl)phthalate	200,000	46,000	460 U	500 U	52 J	440 U	480 U	480 U	550 U	130 J	0/8		0/8		3E-SS06
Chrysene	390,000	87,000	460 U	500 U	390 U	440 U	480 U	480 U	550 U	110 J	0/8		0/8		3E-SS06
Benzo(a)pyrene	390	87	460 U	500 U	390 U	440 U	480 U	480 U	550 U	77 J	0/8		0/8		3E-SS06
Fluoranthene	4,100,000	310,000	460 U	500 U	390 U	440 U	480 U	480 U	550 U	120 J	0/8		0/8		3E-SS06
Indeno(1,2,3-cd)pyrene	3,900	870	77 J	500 U	390 U	440 U	480 U	480 U	550 U	51 J	0/8		0/8		3E-SS01
Benzo(g,h,i)perylene	NE	NE	97 J	500 U	390 U	440 U	480 U	480 U	550 U	67 J	NE		NE		3E-SS01
Phenanthrene	NE	NE	460 U	500 U	390 U	440 U	480 U	480 U	550 U	70 J	NE		NE		3E-SS06
Pyrene	3,100,000	230,000	35 J	500 U	390 U	440 U	480 U	480 U	550 U	160 J	0/8		0/8		3E-SS06
Pesticides/PCBs (ug/kg)															
4,4'-DDD	12,000	2,700	4.6 U	5 U	3.9 U	4.4 U	4.8 U	4.8 U	5.5 U	9.4 JP	0/8		0/8		3E-SS06
4,4'-DDE	8,400	1,900	4.6 U	5 U	3.9 U	4.4 U	1.4 J	4.8 U	5.5 U	11	0/8		0/8		3E-SS06
4,4'-DDT	8,400	1,900	4.6 U	5 U	3.9 U	4.4 U	2.3 J	1.1 J	1.1 J	33	0/8		0/8		3E-SS06
Aroclor-1260	1,400	320	46 U	50 U	55	44 U	18 J	48 U	55 U	**330**	0/8		1/8	330	3E-SS06
OP-Pesticides (ug/kg)															
Not Detected															
Chlorinated Herbicides (ug/kg)															
2,4,5-TP	NE	NE	1.5 J	12 U	9.8 U	11 U	12 U	12 U	14 U	14 U	NE		NE		3E-SS01

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 realtive 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 5-11. Summary of Inorganic Detections in Surface Soil at ECP Site 3 – Facility No. 278, POL Drum Storage Area

Site ID	EPA Region III	**EPA Region III**	2x Average	3E-01		3E-01		3E-02		3E-03		3E-04		3E-05		3E-05		3E-06		Number Exceeding	Range Exceeding	**Number Exceeding**	**Range Exceeding**	Number Exceeding	Range Exceeding	
Sample ID	Industrial	**Residential**	Detected	3E-SS01		3E-SS01D		3E-SS02		3E-SS03		3E-SS04		3E-SS05		3E-SS05D		3E-SS06		EPA Region III	EPA Region III	**EPA Region III**	**EPA Region III**	2x Average	2x Average	Location of
Sample Date	RBCs	**RBCs**	Background	05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		Industrial	Industrial	**Residential**	**Residential**	Detected	Detected	Maximum
Sample Depth (ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		0.00 - 1.00		RBCs	RBCs	**RBCs**	**RBCs**	Background	Background	Detection
Appendix IX Inorganics (mg/kg)																										
Arsenic	1.9	0.43	2.4	**1.1**	B	**1.2**	B	**3.7**		1.2	U	**1.5**		**1.2**	B	**3.5**		**3.6**		3/8	3.5 - 3.7	7/8	1.1B - 3.7	3/8	3.5 3.7	3E-SS02
Barium	7,200	550	181	110		70		81		55		83		36		62		74		0/8		0/8		0/8		3E-SS01
Beryllium	200	16	0.45	0.35	B	0.34	B	0.2	B	0.17	B	0.22	B	0.09	B	0.13	B	0.26	B	0/8		0/8		0/8		3E-SS01
Cadmium	100	7.8	0.27	0.8		0.79		1.4		1.4		1.2		0.38	B	0.63	B	2.9		0/8		0/8		8/8	0.38B - 2.9	3E-SS06
Cobalt	2,000	160	44.0	38		26		14		25		24		5.6		10		18		0/8		0/8		0/8		3E-SS01
Chromium	310	23	59.3	**30**		**31**		21		**36**		**34**		8.1		17		**31**		0/8		5/8	30 - 36	0/8		3E-SS03
Copper	4,100	310	234	77	N	84	N	160	N	86	N	97	N	23	N	40	N	100	N	0/8		0/8		0/8		3E-SS02
Nickel	2,000	160	16.6	16		19		13		28		20		5.2		9.6		14		0/8		0/8		3/8	19 - 28	3E-SS03
Lead	400[(1)]	400[(1)]	125	20		21		32		2.8		48		16		32		120		0/8		0/8		7/8	16 - 120	3E-SS06
Antimony	41	3.1	2.3	2.6	UN	2.8	UN	2.3	UN	2.4	UN	1	BN	2.5	UN	3.2	UN	3.2	UN	0/8		0/8		0/8		3E-SS04
Tin	61,000	4,700	2.43	2.2	B	2.7	B	3.9	B	3.4	B	3.7	B	3	B	3.3	B	4.1	B	0/8		0/8		7/8	2.7B - 4.1B	3E-SS06
Vanadium	100	7.8	355	**180**		**160**		**86**		**140**		**150**		**35**		**67**		**110**		5/8	110 - 180	8/8	35 - 180	0/8		3E-SS01
Zinc	31,000	2,300	125	87		90		130		70		120		34		63		210		0/8		0/8		2/8	130 - 210	3E-SS06
Cyanide	2,000	160	0.52	0.67	U	0.73	U	0.59	U	0.66	U	0.46	B	0.71	U	0.8	U	0.53	B	0/8		0/8		1/8	0.53B	3E-SS06
Mercury	31[(2)]	2.3[(2)]	0.11	0.05	N	0.05	N	0.01	BN	0.01	BSN	0.16	SN	0.15	N	0.05	N	0.05	N	0/8		0/8		2/8	0.15N - 0.16N	3E-SS04

Notes:

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

N - The matrix spike recovery is not within control limtis.

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.

Table 5-12. Summary of Organic Detections in Subsurface Soil at ECP Site 3 – Facility No. 278, POL Drum Storage Area

															Number	Range	**Number**	**Range**	
Site ID	EPA Region III	**EPA Region III**	3E-01		3E-02		3E-03		3E-04		3E-05		3E-06		Exceeding	Exceeding	**Exceeding**	**Exceeding**	
Sample ID	Industrial	**Residential**	3E-SB01-01		3E-SB02-01		3E-SB03-01		3E-SB04-01		3E-SB05-01		3E-SB06-01		EPA Region III	EPA Region III	**EPA Region III**	**EPA Region III**	Location of
Sample Date	RBCs	**RBCs**	05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		Industrial	Industrial	**Residential**	**Residential**	Maximum
Sample Depth (ft bgs)	(ug/kg)	(ug/kg)	1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		RBCs	RBCs	**RBCs**	**RBCs**	Detection
Volatile Organic Compounds (ug/kg)																			
Carbon tetrachloride	22,000	4,900	6.1	U	2.8	J	5.3	U	210	U	5.5	U	9.1	U	0/6		0/6		3E-SB02-01
Semivolatile Organic Compounds (ug/kg)																			
Pyrene	3,100,000	230,000	440	U	460	U	390	U	380	U	370	U	28	J	0/6		0/6		3E-SB06-01
Pesticides/PCBs (ug/kg)																			
Not Detected																			
OP-Pesticides (ug/kg)																			
Not Detected																			
Chlorinated Herbicides (ug/kg)																			
2,4,5-TP	NE	NE	11	U	12	U	9.8	U	4.1	J	9.3	U	15	U	NE		NE		3E-SB04-01
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.																			
NE - Not Established.																			
ft bgs - feet below ground surface.																			
ug/kg - micrograms per kilogram.																			

Table 5-13. Summary of Inorganic Detections in Subsurface Soil at ECP Site 3 – Facility No. 278, POL Drum Storage Area

Site ID	EPA Region III Industrial RBCs	**EPA Region III Residential RBCs**	2x Average Detected Background	3E-01		3E-02		3E-03		3E-04		3E-05		3E-06		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
Sample ID				3E-SB01-01		3E-SB02-01		3E-SB03-01		3E-SB04-01		3E-SB05-01		3E-SB06-01								
Sample Date				05/05/04		05/05/04		05/05/04		05/05/04		05/05/04		05/05/04								
Sample Depth (ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00		1.00 - 3.00								
Appendix IX Inorganics (mg/kg)																						
Silver	510	39	0.46	1.3	U	1.3	U	1	U	0.12	B	1	U	1.8	U	0/6		0/6		0/6		3E-SB04-01
Arsenic	1.9	0.43	2.05	**2**		**1.1**	B	1	U	0.98	U	1	U	1.8	U	1/6	2	2/6	1.1B - 2	0/6		3E-SB01-01
Barium	7,200	550	222	120		93		29		25		42		150		0/6		0/6		0/6		3E-SB06-01
Beryllium	200	16	0.74	0.43	B	0.48	B	0.21	B	0.29	B	0.23	B	0.41	B	0/6		0/6		0/6		3E-SB02-01
Cadmium	100	7.8	0.74	0.48	B	0.4	B	0.69		1.9		0.96		0.91	U	0/6		0/6		2/6	0.96 - 1.9	3E-SB04-01
Cobalt	2,000	160	30.0	12		28		32		29		22		33		0/6		0/6		2/6	32 - 33	3E-SB06-01
Chromium	310	23	133	**24**		**29**		**110**		**28**		14		21		0/6		4/6	24 - 110	0/6		3E-SB03-01
Copper	4,100	310	193	94	N	84	N	120	N	120	N	95	N	60	N	0/6		0/6		0/6		3E-SB03-01, 3E-SB04-01
Nickel	2,000	160	31.9	6.9		12		37		25		18		11		0/6		0/6		1/6	37	3E-SB03-01
Lead	400[(1)]	400[(1)]	8.68	71		18		1.5		20		7.3		19		0/6		0/6		4/6	18 - 71	3E-SB01-01
Tin	61,000	4,700	2.96	2.2	B	2.8	B	2.7	B	2.1	B	2.9	B	2	B	0/6		0/6		0/6		3E-SB05-01
Vanadium	100	7.8	462	**190**		**220**		**140**		**180**		**140**		**140**		6/6	140 - 220	6/6	140 - 220	0/6		3E-SB02-01
Zinc	31,000	2,300	88.6	78		62		60		150		75		57		0/6		0/6		1/6	150	3E-SB04-01
Mercury	31[(2)]	2.3[(2)]	0.093	0.05	SN	0.03	BSN	0.03	SN	0.02	UN	0.02	UN	0.03	UN	0/6		0/6		0/6		3E-SB01-01

Notes:

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

N - The matrix spike recovery is not within control limtis.

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.

Table 5-14. Summary of Organic Detections in Groundwater at ECP Site 3 – Facility No. 278, POL Drum Storage Area

Site ID Sample ID Sample Date	Federal MCLs (ug/L)	**EPA Region III Tap Water RBCs** (ug/L)	PR Water Quality Standards (ug/L)	3E-04 3E-GW01 05/10/04		3E-02 3E-GW02 05/10/04		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)														
2-Butanone	NE	700	NE	2.6	J	1.5	J	NE		0/2		NE		3E-GW01
Iodomethane	NE	NE	NE	0.69	J	0.29	J	NE		NE		NE		3E-GW01
Acetone	NE	550	NE	11	J	12	J	NE		0/2		NE		3E-GW02
Chloromethane	NE	19	NE	0.41	J	1	U	NE		0/2		NE		3E-GW01
Semivolatile Organic Compounds (ug/L)														
Not Detected														
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 5-15. Summary of Inorganic Detections in Groundwater at ECP Site 3 – Facility No. 278, POL Drum Storage Area

Site ID Sample ID Sample Date	Federal MCLs (mg/L)	**EPA Region III Tap Water RBCs** (mg/L)	PR Water Quality Standards (mg/L)	3E-04 3E-GW01 05/10/04		3E-02 3E-GW02 05/10/04		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 (Dissolved) Inorganics (mg/L)														
Barium	2	0.26	NE	0.018		0.0088	B	0/2		0/2		NE		3E-GW01
Copper	1.3[1]	0.15	1.3	0.0032	B	0.02	U	0/2		0/2		0/2		3E-GW01
Vanadium	NE	0.0037	NE	**0.015**		**0.022**		NE		2/2	0.015 - 0.022	NE		3E-GW02
Zinc	NE	1.1	NE	0.0023	B	0.0039	B	NE		0/2		NE		3E-GW02
Mercury	0.002	0.0011[2]	0.002	0.0004	B	0.0004	B	0/2		0/2		0/2		3E-GW01
Total Cyanide and Sulfide (mg/L)														
Not Detected														

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.

mg/L - milligrams per liter.

Pesticides and the PCB Aroclor 1260 were found in samples located at 3E-02, 3E-04 through 3E-06, with the highest detections found in 3E-06. The chlorinated herbicide, 2,4,5-TP, was found at an estimated concentration in sample 3E-01. Inorganic detections were similar at all locations.

In the subsurface soil, one VOC, one SVOC, and one chlorinated herbicide were detected at low, estimated concentrations (Table 5-12). Fourteen inorganic compounds were detected (Table 5-13). Location 3E-02 had the VOC carbon tetrachloride in it at a similar concentration to the associated surface soil sample. Location 3E-06 had the SVOC pyrene in it at a lower concentration than in the associated surface soil sample. Chlorinated herbicide 2,4,5-TP was found at 3E-04, and this detection is not coincident with the surface soil detection of this compound.

Groundwater environmental samples indicated that four VOCs (Table 5-14) and five inorganic compounds (Table 5-15) were detected. Most compounds were detected in both samples.

In general, the VOCs and SVOCs detected in the surface and subsurface soil samples were primarily related to fuel contamination, although a few chlorinated compounds were detected in the surface soil, as well as Aroclor 1260. The VOCs detected in the groundwater samples were very low, estimated concentrations; and they were, in general, not related to fuel contamination. It should be noted that during the field investigation, a strong fuel odor was observed in the groundwater at location 3E-04. This observation was not verified by the analytical results. At location 3E-04, high FID and PID readings on the soil were observed as well, but these were not confirmed with any detections in the soil samples.

Comparison to criteria was done with all the results as shown in Tables 5-10 through 5-15. One organic compound, Aroclor 1260 (surface soil), exceeded the EPA Region III Residential RBC. Three inorganic compounds exceeded criteria, including arsenic (soil), chromium (soil), and vanadium (soil and groundwater). Only one of these, arsenic, exceeded twice the average detected background concentration, and only in the surface soil matrix. Arsenic is associated with industrial chemicals as a wood preservative, and in herbicides, insecticides, and poisons. Vanadium is present at high concentrations in the background soils at NSRR. It is likely that the exceedance of this compound in groundwater is a result of leaching from naturally occurring vanadium in the soil.

From the detections of fuel and chlorinated compounds and exceedance of criteria for Aroclor 1260 and arsenic, it is concluded that the soil at this site has been impacted by previous activities. Based on the limited groundwater investigation and observations noted during the field event, it is tentatively concluded that the groundwater has not been impacted by previous activities.

5.4.3.5 Qualitative Risk Assessment

COPC Identification

The only COPCs identified for surface soil at Site 3 are Aroclor-1260 and arsenic. Aroclor-1260 was detected in a single sample out of eight total samples at a concentration that exceeds the residential RBC. Arsenic is the only inorganic analyte that exceeds both the residential RBC and the base background criteria. This occurs in three of the eight samples.

No COPCs were identified in subsurface soil. Arsenic, chromium, and vanadium were detected at concentrations in excess of the residential RBC but less than the base background concentrations.

No organic analytes were identified as COPCs in groundwater and vanadium is the only inorganic COPC.

Potential Risk Discussion

The reasonably anticipated land use for the future at Site 3 can be approximated by the industrial/commercial use. This land use can be qualitatively assessed by comparing data to industrial RBCs. The concentration of Aroclor-1260 in a single surface soil sample is less than the industrial RBC indicating a low potential risk. Furthermore, a single sample does not reflect the probable exposure point concentration of Aroclor-1260. Based on the data, the average concentration of Aroclor-1260 that a receptor could be exposed to over the entire site would be even less. The arsenic concentrations in surface soil exceed the industrial RBCs, however, the low concentrations (3.5 to 3.7 mg/kg) are very near the base background criterion and it is unlikely that these concentrations reflect site-related contamination. These levels of arsenic pose a low potential risk.

Potential exposure to groundwater at NSRR is unlikely. Groundwater is not currently used for potable purposes because drinking water is available from El Yunque which supplies all of NSRR's present needs. The most likely exposure route to groundwater is from inhalation of vapors emitted from volatile organics through the overlying soil, particularly into buildings. Vanadium is not volatile and the RBC used to select it as a COPC is based on a noncarcinogenic toxicity criteria set at one-tenth of the level considered acceptable by EPA to account for potential additive effects of multiple contaminants. As there is only a single noncarcinogenic COPC in groundwater at Site 3, the single contaminant RBC can be used for comparison, which is ten times higher than the tap water RBCs presented in previous tables. The vanadium levels in groundwater are probably a result of leaching from the generally high levels of vanadium in soil at NSRR and are less than the single contaminant RBC (based on the unlikely but assumed exposure via ingestion of groundwater) of 0.037 mg/L. Therefore, the potential

risk from exposure to vanadium in groundwater is minimal even if the groundwater were to be used for potable purposes in the future.

5.4.3.6 Summary of Site Conditions

PCBs, arsenic, and vanadium were determined to be COPCs at this site based on their exceedance of Residential RBCs. However, none of the COPCs exceeded industrial RBCs in the soil except arsenic, and groundwater was evaluated under an unlikely exposure scenario. Arsenic was assumed to be within background concentrations.

Further investigation at this site will be conducted under the RCRA Corrective Action/IRP process.

5.4.4 ECP Site 4

5.4.4.1 Site History and Description

This site is located at Punta Puerca, on the southeast portion of the Site in an upland area covered with secondary growth vegetation (see Figure 5-60). The APA identified this area as PI Site 6, due to the observation of structures and clearing associated with a small arms range in 1958. During the records review of historic maps of the base, this area was identified as a former rifle range. The physical site inspection identified what appeared to be a concrete berm backstop and target placements. Interviews confirmed use of the area as a rifle range in the 1940's. Exact usage dates and frequency of use are unknown.

During the Phase II ECP investigation, the berm backstop was observed. However, it appears that the backstop is made out of fieldstone and mortar, rather than concrete. In addition, a concrete bermed structure that was found southeast of the berm backstop mentioned above. This structure contained galvanized piping protruding from the top of concrete berm. This structure appears to be related to the target placements observed during the physical site inspection. This site is completely covered with very dense, secondary growth vegetation as mentioned above. There were no signs of stains or stressed vegetation observed during the investigation.

5.3.8 SWMU 8 - Tow Way Fuel Farm Sludge Disposal Pits [IR Site 12]

SWMU 8 is collocated with SWMU 7 (see Figure 5-9 above). This unit consists of unlined earthen pits adjacent to the TWFF fuel tanks where sludges were buried and covered with soil when the fuel tanks were periodically cleaned. This SWMU is part of OU 2, where benzene, lead and other hazardous constituents have been detected in groundwater above action levels, and evidence of soil contamination has been described. SWMU 8 was combined with SWMU 7 (with EPA approval) since the releases from each are inseparable. As such, see the description for SWMU 7 for details regarding this SWMU.

5.3.9 SWMU 9 - Tanks 212-217 Sludge Disposal Pits [IR Site 13]

SWMU 9 consists of unlined earthen pits in which petroleum sludges were buried after tank cleanings. These burial pits are associated with fuel tanks 212 through 217, located along Forrestal Drive. SWMU 9 has been divided into three separate areas due to the groupings of the tanks. Area A includes Tanks 212 and 213. Area B is Tanks 214 and 215, while Area C consists of Tanks 216 and 217 (see Figures 5-10 and 5-11). Although the unit is a part of OU 2, it is now treated as a separate entity since SWMU 7/8 is so complicated. The tanks were installed in 1940, and were cleaned approximately every five years, until 1978, resulting in burial of sludges. During the IR Round 1 (1986) Investigation, 11 groundwater monitor wells were installed. Rounds 1 and 2 sampling found benzene and toluene in the groundwater at levels above relevant action levels. In addition, during Rounds 1 and 2, 6 sediment samples were collected in the mangrove swamps, downslope from the tanks. Organic constituents (benzene, chlorobenzene, methylene chloride, toluene, TCE) and lead were detected in these sediment samples, but below relevant action levels. No soil borings were made for visual, odor, or organic vapor Photoionization Detector (PID) observations. An RFI encompassing soils and groundwater was required in the permit. Based on the results, investigations were required for surface water and sediments.

The RFI included three phases of investigations. The RFI indicated that Area A has been impacted by past fuel management activities. Human Health COPCs were identified for subsurface soil, groundwater, sediment, and surface water from Area A. The HHRA did not identify an incremental lifetime cancer risk greater than the EPA limits in Area A. Minimal noncarcinogenic risk may potentially exist for future military child resident and future construction worker in Area A. The results of the screening-level ERA are not sufficient to conclude that risks to the ecological receptors at Area A are negligible.

The RFI indicated that Area B has been impacted by past fuel management activities. The HHRA did not identify an incremental lifetime cancer risk greater than the acceptable EPA limits in Area B. There were no unacceptable

noncarcinogenic risks associated with exposures to contaminants detected in Area B as estimated in the HHRA. The results of the screening-level ERA indicated that the assessment endpoints for Area B were not met. As such the results of the screening-level ERA are not sufficient to conclude that risks to the ecological receptors at Area B are negligible.

The RFI also indicated that evidence of the impact of past site operations on Area C surface and subsurface soil is limited. There is no evidence of the impact of past site operations on groundwater at Area C. The HHRA did not identify an incremental lifetime cancer risk greater than the acceptable EPA limits in Area C. Minimal noncarcinogenic risk may potentially exist for future young child military resident in Area C. The results of the screening-level ERA indicated that the assessment endpoints for Area C were not met. As such the results of the screening-level ERA are not sufficient to conclude that risks to the ecological receptors at Area C are negligible.

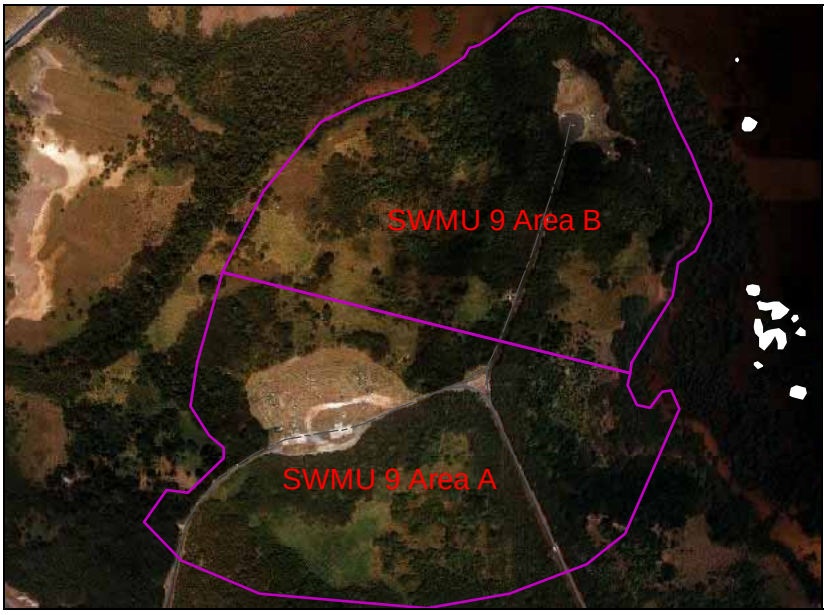
The RFI recommended the collection of additional surface water samples and background samples be collected. The RFI has been completed and approved by the EPA.

A CMS investigation was conducted and the additional data was utilized to perform a screening-level ERA for SWMU 9. Based on the results of the assessment, no further evaluation of ecological risk was recommended for Areas A and C surface soil, Areas A/B and C surface water, and Area C sediment. However, there appears to be a potential risk to both soil invertebrates and upper trophic level receptors at Area B from lead and zinc in surface soil. There also appears to be a potential risk to benthic invertebrates and upper tropic level receptors from lead detected in Area A/B sediment. It was recommended that additional sampling of surface soils be conducted in the vicinity of Tank 214 to characterize the extent of lead and zinc contamination and additional sampling of the sediment in the vicinity of Tank 214 to characterize the lead contamination. Once the characterization is completed Step 3A of the ERA should be reevaluated before making a decision of whether or not this site should move forward to Step 3B of move into the CMS stage. The EPA approved this document.

Additional data collection was conducted from SWMU 9 as recommended in the CMS Investigation Report. The results from the Additional Data Collection indicate that lead is considered a potential risk driver for terrestrial plant and omnivore populations at SWMU 9 Area B. Lead is also a potential risk driver to aquatic invertebrates and upper avian invertebrate consumers within the estuarine wetland downgradient from SWMU 9 Area B. It is recommended that the ERA process proceed to Step 3B (baseline risk assessment problem formulation). This document is currently under review by the EPA.

All three areas of this unit currently contain areas of grass and secondary growth

vegetation, as well as wetland areas.



*Background aerial photograph from 1998

Figure 5-10. SWMU 9 – Tanks 212-215 Sludge Disposal Pits

*Background aerial photograph from 1998

Figure 5-11. SWMU 9 – Tanks 216 - 217 Sludge Disposal Pits

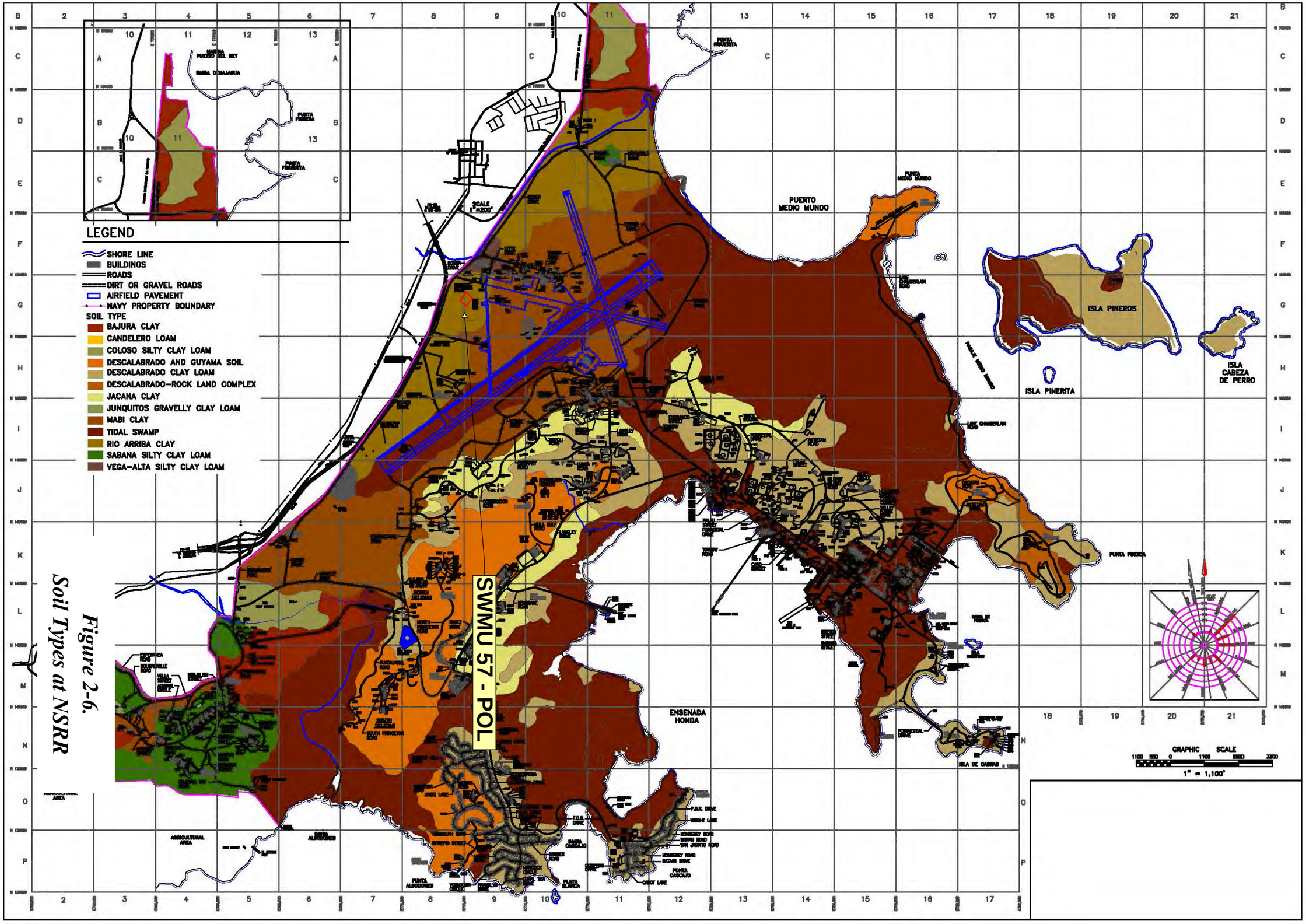


Figure 2-6.
Soil Types at NSRR

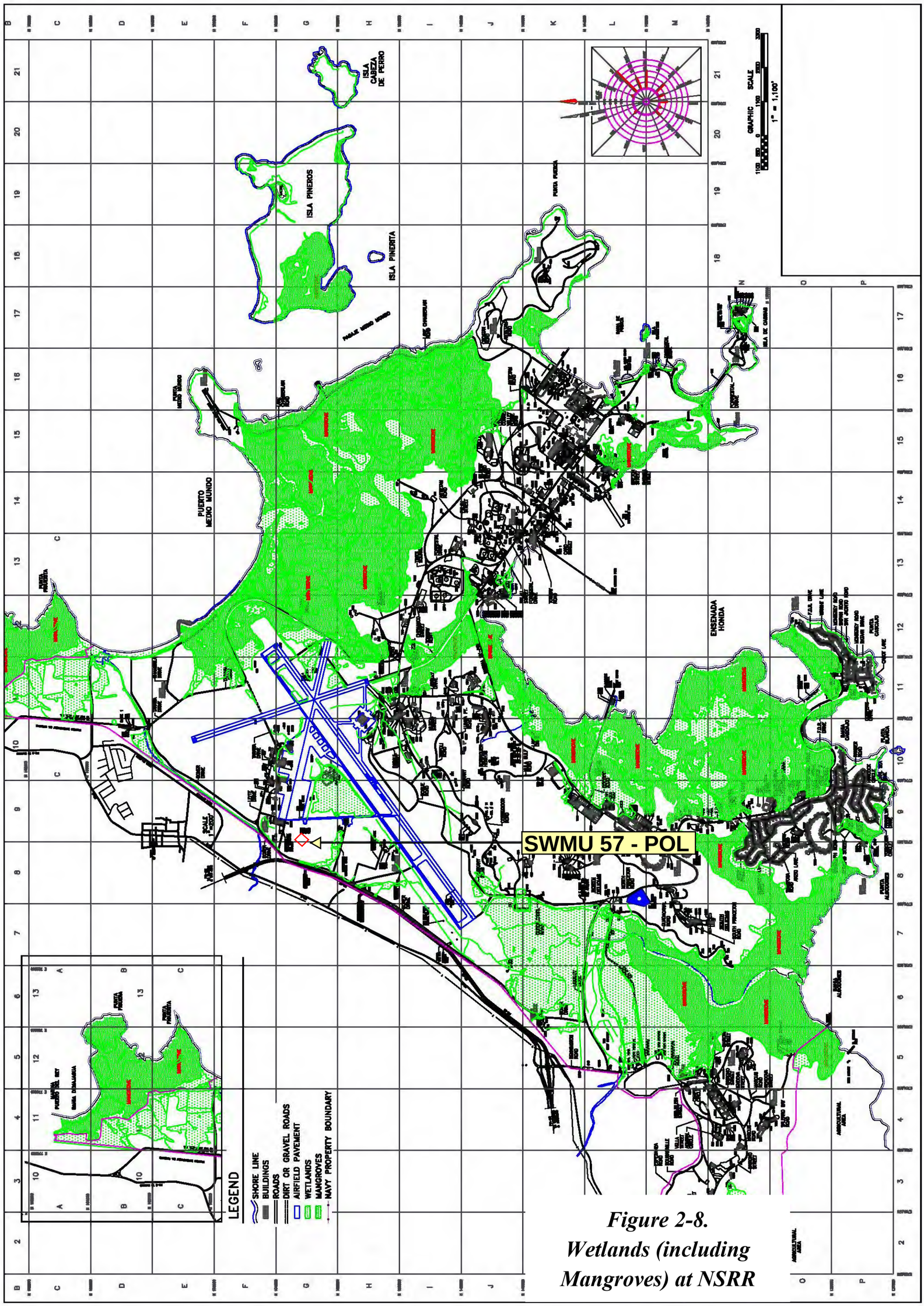
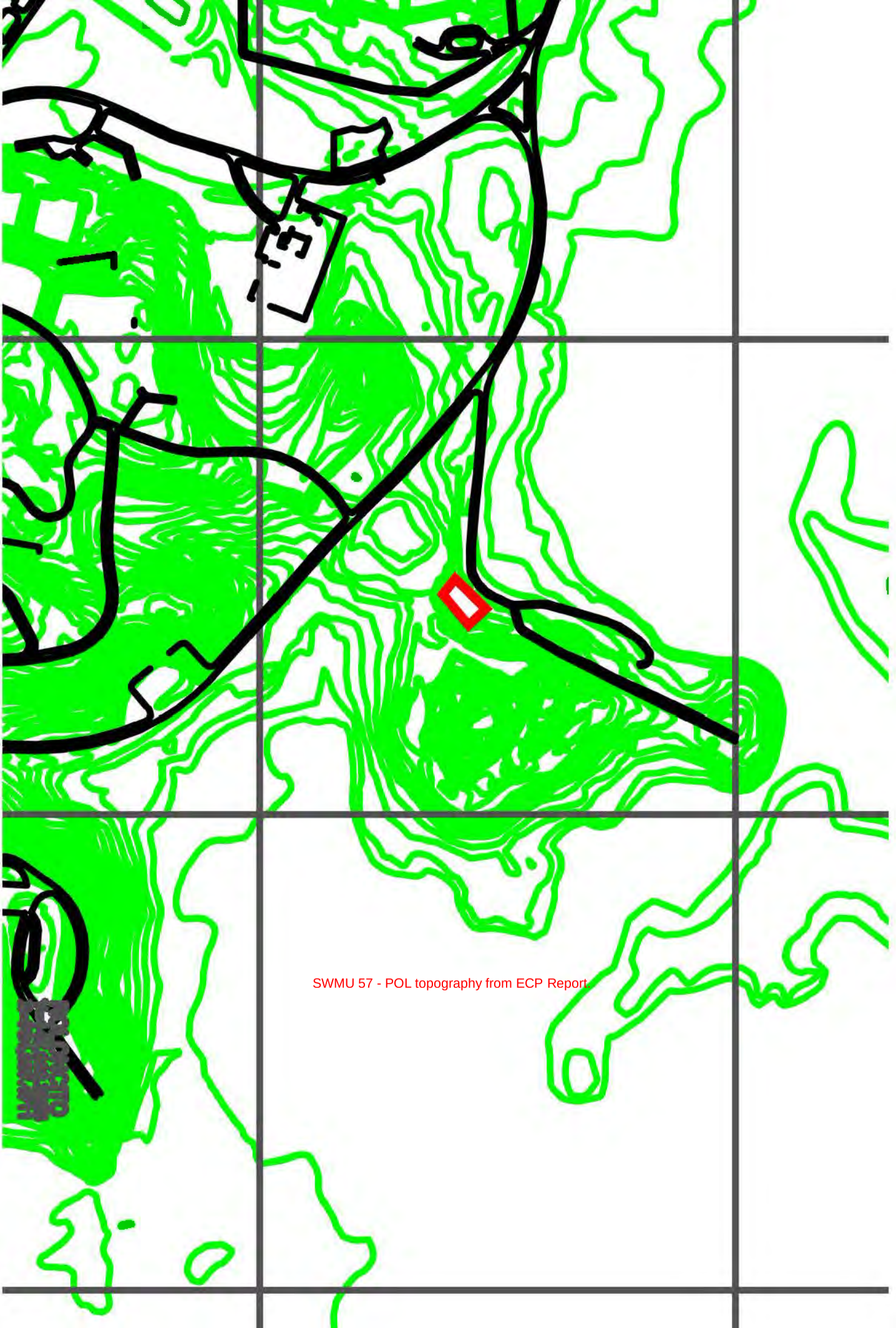


Figure 2-8. Wetlands (including Mangroves) at NSRR


SWMU 57 - POL topography from ECP Report

A-2 PHASE 1 RFI REPORT INFORMATION

FIGURE NOT TO SCALE

Baker

LEGEND

- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -1964 POLYGON FEATURE
- -1976 POLYGON FEATURE
- -1977 POLYGON FEATURE
- -1985 POLYGON FEATURE
- -1995 POLYGON FEATURE
- – EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- – EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- – EXISTING MONITORING WELL FROM SWMU 9
- – SWMU BOUNDARY

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

FIGURE 2-3
SITE LAYOUT AND ECP SAMPLE LOCATION MAP
1958 AERIAL PHOTOGRAPH
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

30 0 30 60

1 inch = 60 ft.

Baker

LEGEND

- 1956 POLYGON FEATURE
- 1961 POLYGON FEATURE
- 1964 POLYGON FEATURE
- 1976 POLYGON FEATURE
- 1977 POLYGON FEATURE
- 1985 POLYGON FEATURE
- 1995 POLYGON FEATURE
- SWMU BOUNDARY
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING MONITORING WELL FROM SWMU 9

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

FIGURE 2-4
SITE LAYOUT AND ECP SAMPLE LOCATION MAP
2000 AERIAL PHOTOGRAPH
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

SOURCE: USGS, NOV. 2006.

Baker

LEGEND

- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -1964 POLYGON FEATURE
- -1976 POLYGON FEATURE
- -1977 POLYGON FEATURE
- -1985 POLYGON FEATURE
- -1995 POLYGON FEATURE
- SWMU BOUNDARY
- EARTHEN DRAINAGE FEATURE
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING MONITORING WELL FROM SWMU 9
- PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS
- PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION
- PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS
- PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS
- PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

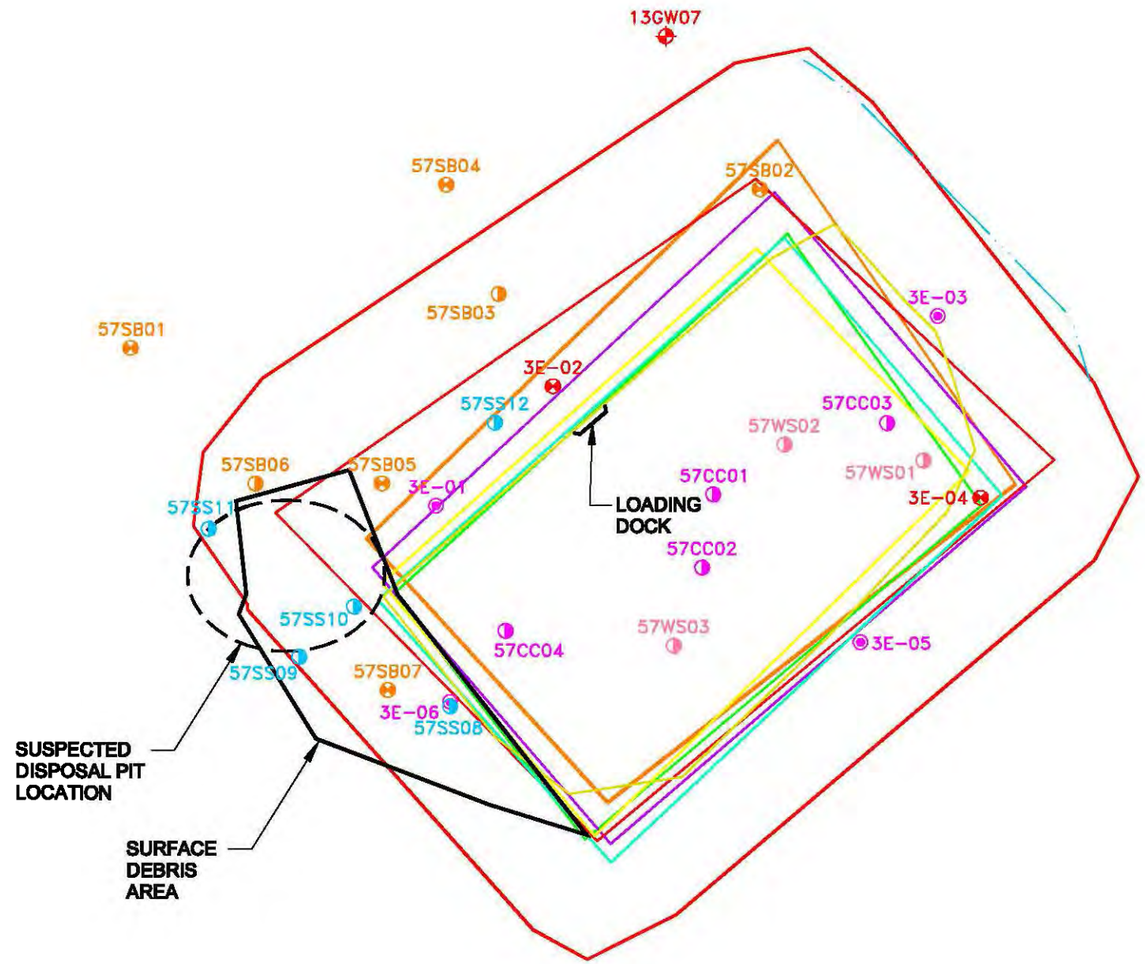
50 0 25 50

1 inch = 50 ft.

FIGURE 4-1

SAMPLE LOCATION MAP-2006 AERIAL PHOTOGRAPH
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JMO1\SWMU 57\CADD\ 119197_57_16.dwg



SOURCE: USGS, NOV. 2006.

Baker

LEGEND

- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -1964 POLYGON FEATURE
- -1976 POLYGON FEATURE
- -1977 POLYGON FEATURE
- -1985 POLYGON FEATURE
- -1995 POLYGON FEATURE
- SWMU BOUNDARY
- EARTHEN DRAINAGE FEATURE
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING MONITORING WELL FROM SWMU 9
- PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS
- PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION
- PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS
- PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS
- PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 4-2

SAMPLE LOCATION MAP
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

Baker

LEGEND

- PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLING LOCATIONS
- CROSS SECTION LOCATION
- EARTHEN DRAINAGE FEATURE

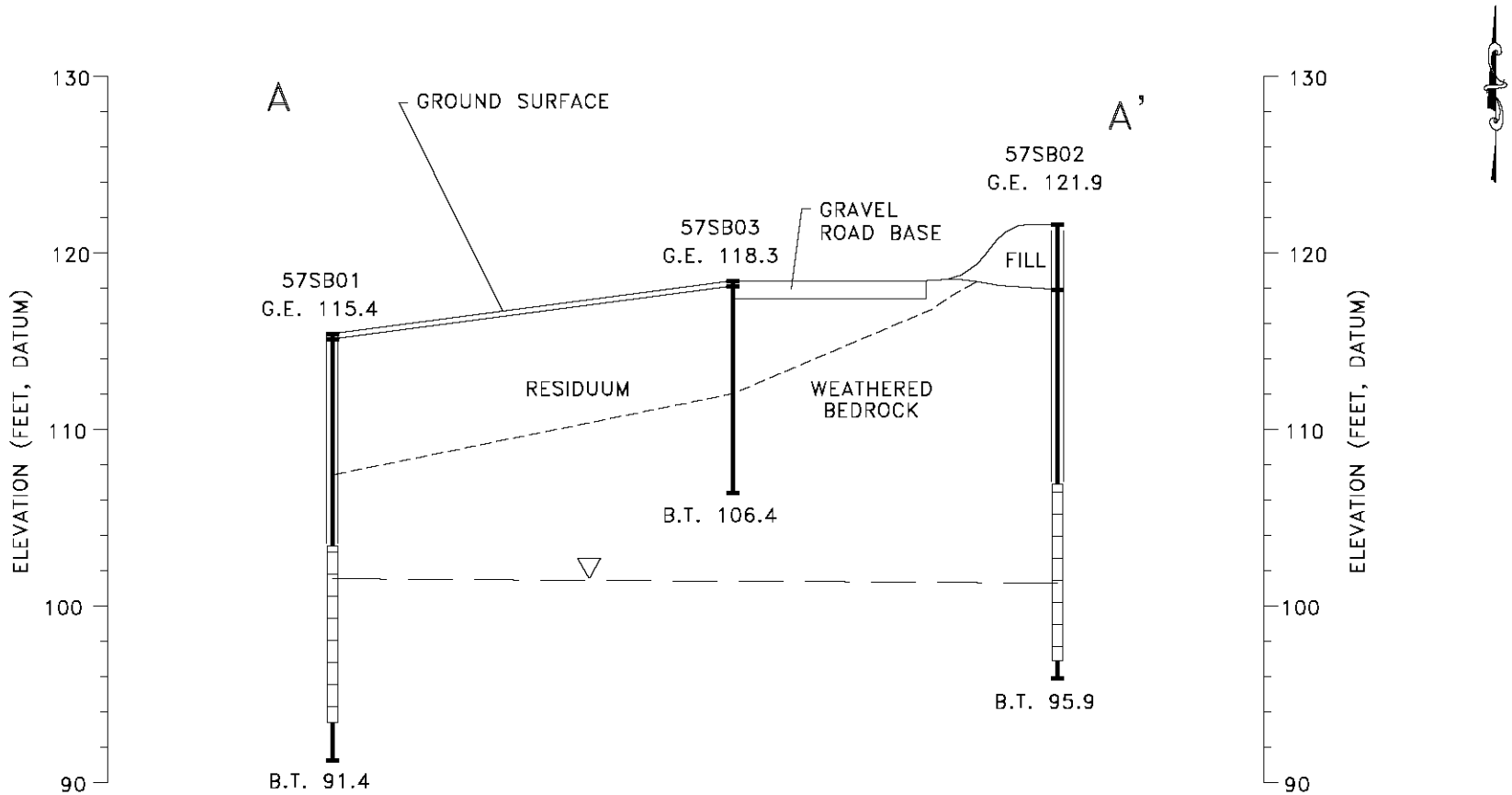
SOURCE: USGS, NOV. 2006.

40 0 20 40

1 inch = 40 ft.

FIGURE 5-1
GEOLOGIC CROSS SECTION LOCATION MAP
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

119197_57_01



THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

NOTE: DATUM PLAN USED IS THE MEAN LOW WATER +100.00 FOOT AS ESTABLISHED BY THE U.S. NAVY SECTION (NOVEMBER 1941).

Baker

10 0 5 10
1 inch = 10 ft.
HORIZONTAL SCALE

10 0 5 10
1 inch = 10 ft.
VERTICAL SCALE

LEGEND

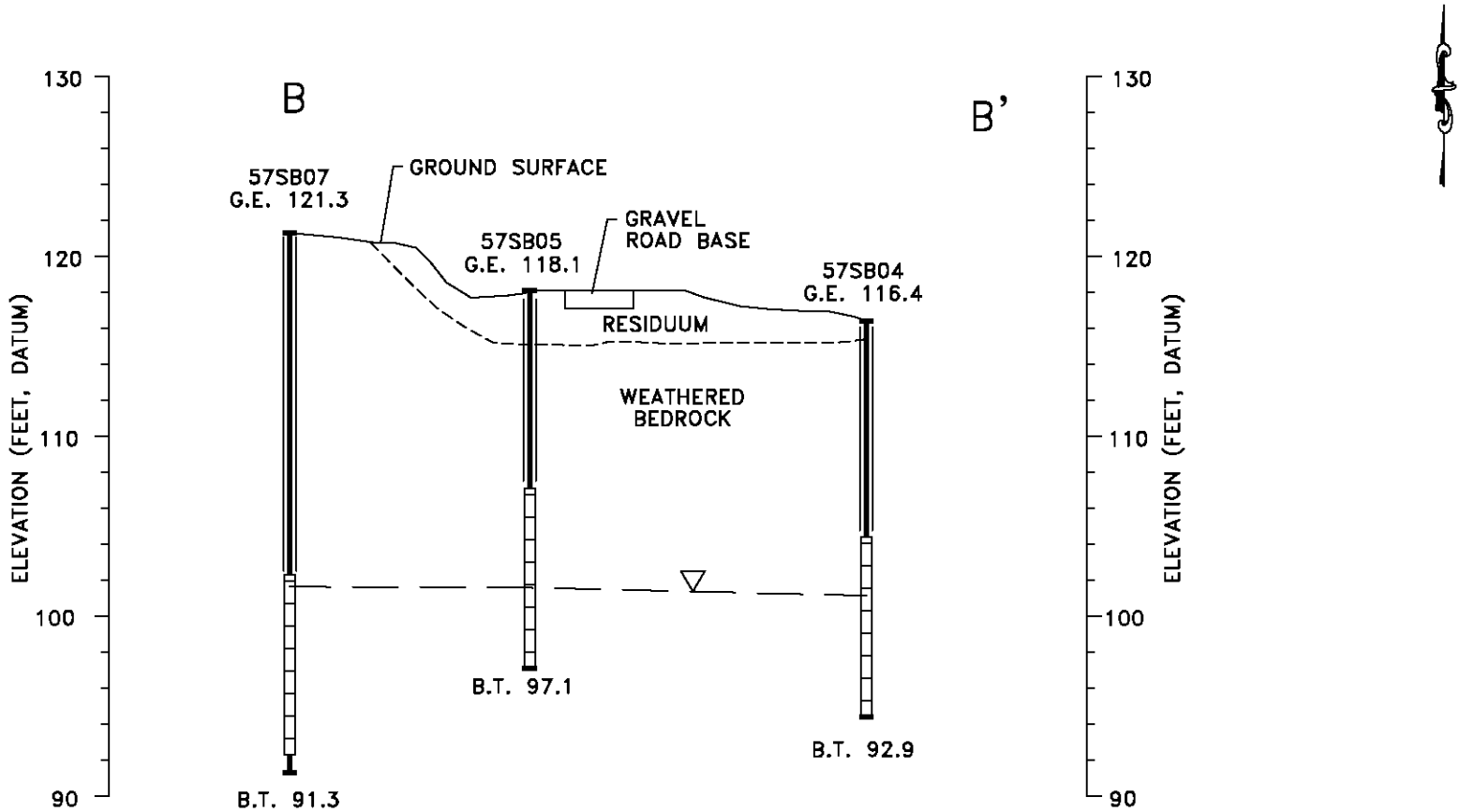
- ESTIMATED/PROJECTED CONTACT
- ESTMATED TOP OF GROUNDWATER
- BORING
- BORING AND RISER
- SCREEN

G.E. 115.4 –GROUND ELEVATION, DATUM ELEVATION
B.T. 91.4 –BORING TERMINATED, DATUM ELEVATION

FIGURE 5–2
GEOLOGIC CROSS SECTION A–A'
SWMU 57
POL DRUM STORAGE AREA

PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

119197_57_02



THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

NOTE: DATUM PLAN USED IS THE MEAN LOW WATER +100.00 FOOT AS ESTABLISHED BY THE U.S. NAVY SECTION (NOVEMBER 1941).

Baker

10 0 5 10
1 inch = 10 ft.
HORIZONTAL SCALE

10 0 5 10
1 inch = 10 ft.
VERTICAL SCALE

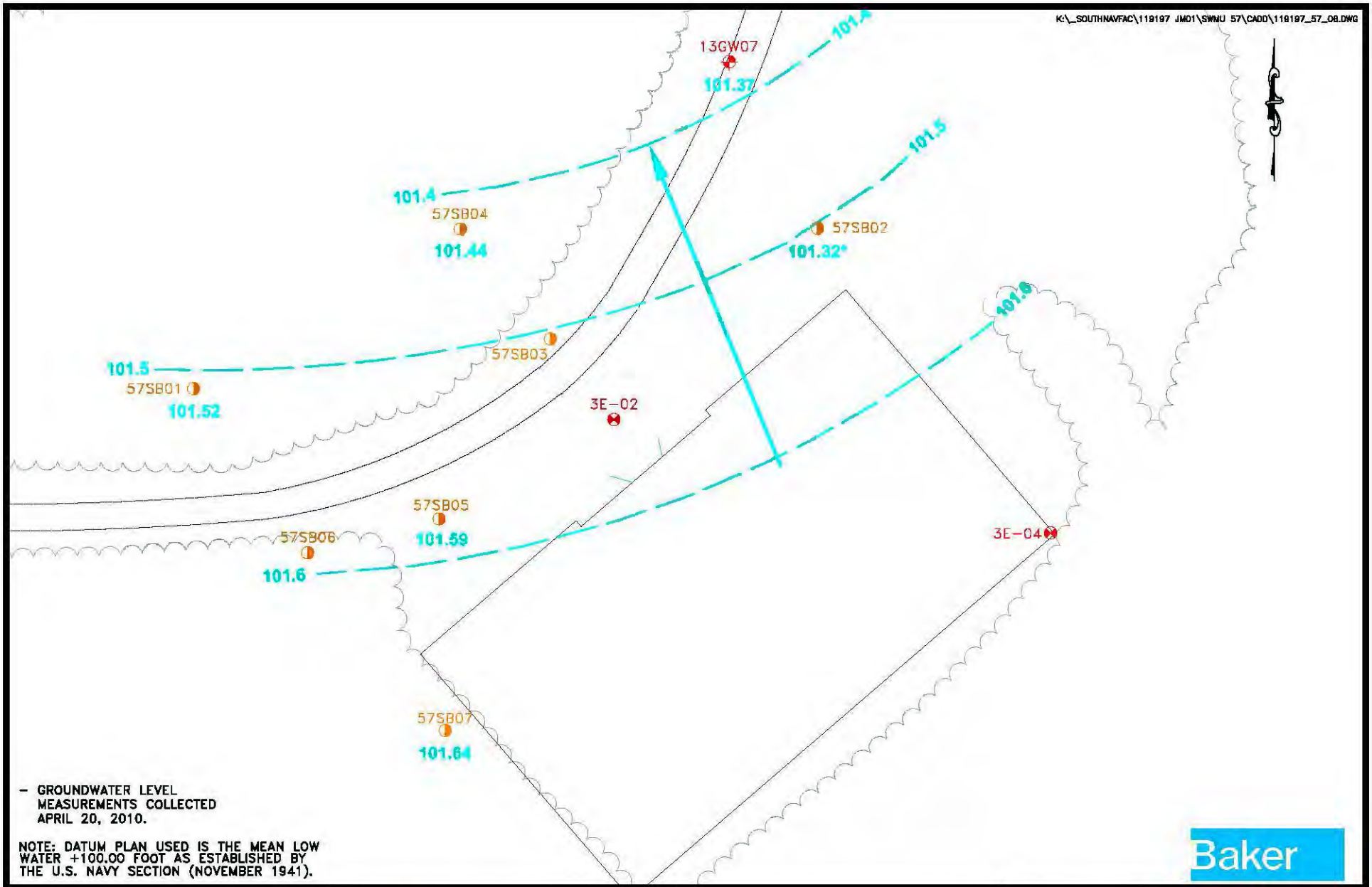
LEGEND

- -ESTIMATED/PROJECTED CONTACT
- -ESTMATED TOP OF GROUNDWATER
- -BORING
- -BORING AND RISER
- -SCREEN

G.E. 121.3 -GROUND ELEVATION, DATUM ELEVATION
B.T. 91.3 -BORING TERMINATED, DATUM ELEVATION

FIGURE 5-3
GEOLOGIC CROSS SECTION B-B'
SWMU 57
POL DRUM STORAGE AREA

PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO



LEGEND

- EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING MONITORING WELL FROM SWMU 9
- PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS
- 101.64 – GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR LINE (ESTIMATED)
- GROUNDWATER FLOW DIRECTION
- * – VALUE NOT USED FOR CONTOURING
- PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

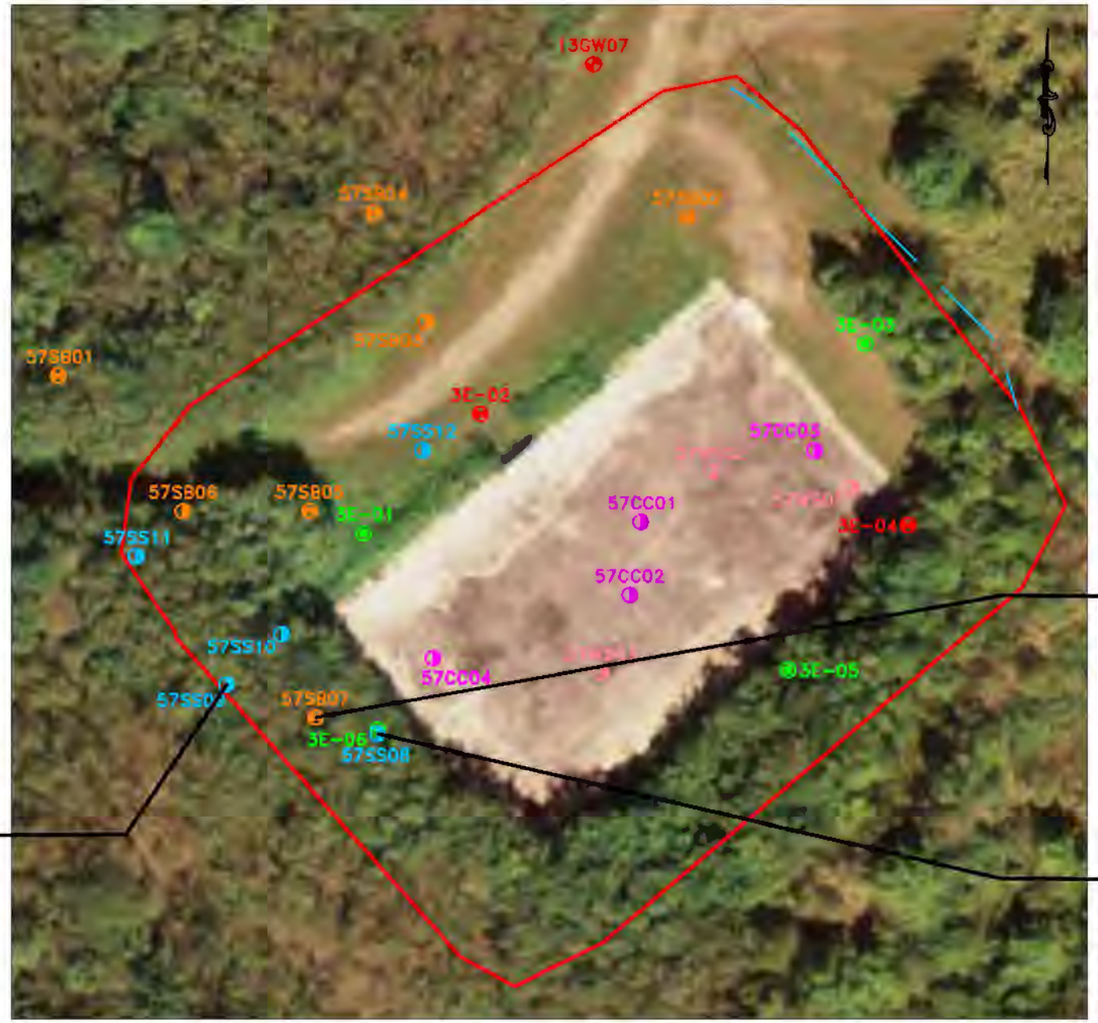
SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

40 0 20 40

1 inch = 40 ft.

FIGURE 5-4
GROUNDWATER CONTOUR MAP
SWMU 57-FACILITY NO. 278
POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO

Note: Organic concentrations are reported in ug/kg, per Table 6-1.



Site ID	57SB07
Sample ID	57SB07-00D
Sampling Date	1/27/2010
Depth (feet bgs)	0.0-1.0
Organics (ug/kg)	
Aroclor-1260	310J

Site ID	57SS09
Sample ID	57SS09
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Organics (ug/kg)	
Aroclor-1260	780

Site ID	57SS09
Sample ID	57SS09-D
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Organics (ug/kg)	
Aroclor-1260	610

Site ID	57SS08
Sample ID	57SS08
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Organics (ug/kg)	
Aroclor-1260	580

Baker

SOURCE: USGS, NOV. 2006.

LEGEND

J: Estimated: The analyte was positively identified; the quantitation is an estimation

Exceeds Ecological Soil Screening Values

BOLD Exceeds Regional Screening Levels, Residential soil

ITALIC Exceeds Regional Screening Levels, Industrial soil

UNDERLINE Exceeds Basewide Background

Depth Range Feet Below Ground Surface

– EARTHEN DRAINAGE FEATURE

– SWMU BOUNDARY

– PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

– EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING MONITORING WELL FROM SWMU 9

– PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS

– PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS

– PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS

– PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 6-1

DETECTED ORGANICS IN EXCESS OF HUMAN HEALTH SCREENING CRITERIA IN SURFACE SOIL

SWMU 57-FACILITY NO. 278

POL DRUM STORAGE AREA

PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 57\CADD\ 119197_57_10.dwg

Site ID	57SB04
Sample ID	57SB04-00
Sampling Date	1/28/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Chromium	108
Nickel	39.2

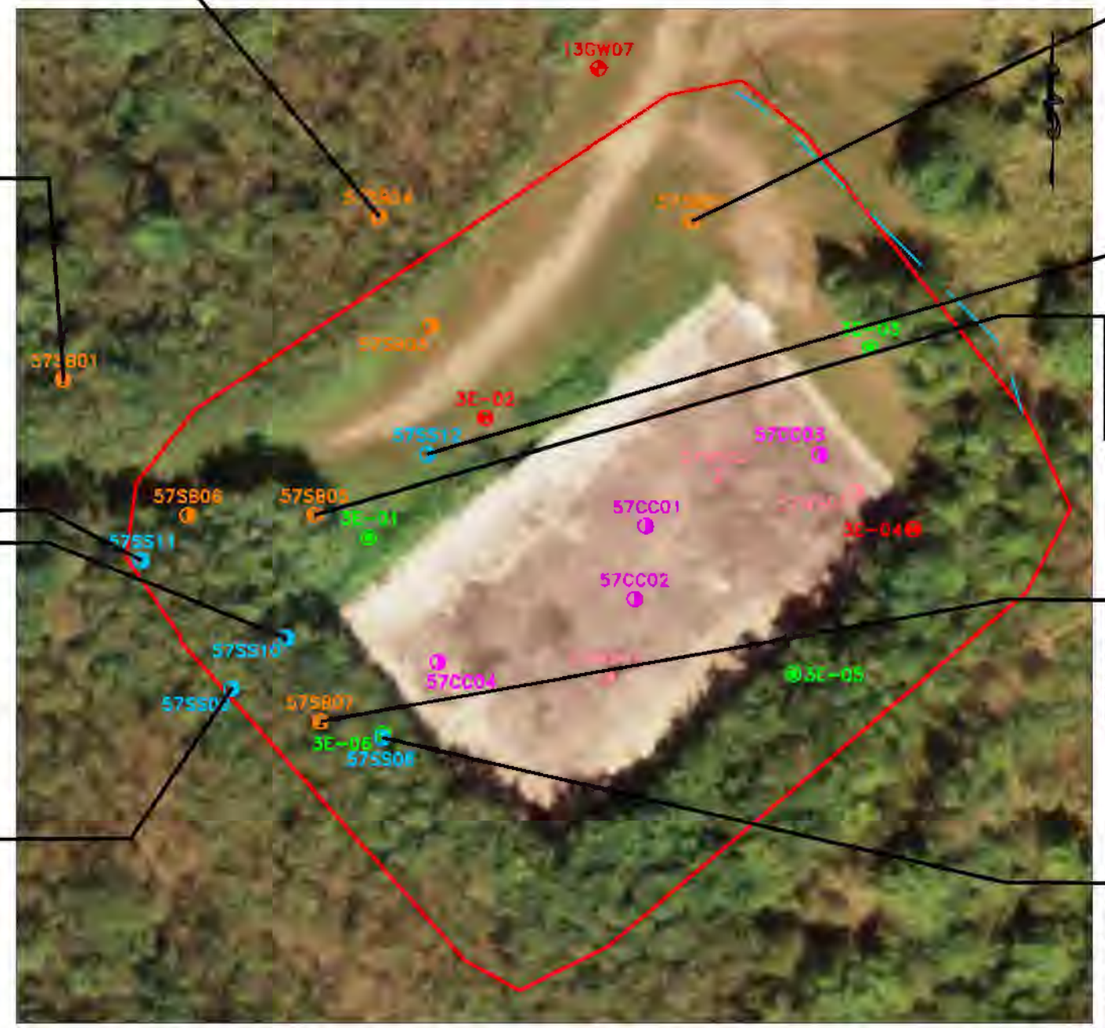
Site ID	57SB01
Sample ID	57SB01-00
Sampling Date	1/28/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Lead	***[illegible]***

Site ID	57SS11
Sample ID	57SS11
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cadmium	1.1
Cobalt	***[illegible]***
Lead	33.7

Site ID	57SS10
Sample ID	57SS10
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cadmium	1.3
Lead	***[illegible]***

Site ID	57SS09
Sample ID	57SS09
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cadmium	1.1
Lead	***[illegible]***
Mercury	0.15J
Zinc	136

Site ID	57SS09
Sample ID	57SS09-D
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cadmium	1.4
Lead	***[illegible]***
Mercury	0.45J
Zinc	143



Site ID	57SB02
Sample ID	57SB02-00
Sampling Date	1/26/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cobalt	***[illegible]***
Mercury	0.13

Site ID	57SS12
Sample ID	57SS12
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Lead	30.5

Site ID	57SB05
Sample ID	57SB05-00
Sampling Date	1/27/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Zinc	155

Site ID	57SB07
Sample ID	57SB07-00D
Sampling Date	1/27/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Cobalt	***[illegible]***

Site ID	57SS08
Sample ID	57SS08
Sampling Date	1/29/2010
Depth (feet bgs)	0.0-1.0
Inorganics (mg/kg)	
Arsenic	***[illegible]***
Cadmium	5.3
Lead	***[illegible]***
Zinc	183

Baker

SOURCE: USGS, NOV. 2006.

LEGEND

J: Estimated: The analyte was positively identified; the quantitation is an estimation

Exceeds Ecological Soil Screening Values

BOLD Exceeds Regional Screening Levels, Residential soil

ITALIC Exceeds Regional Screening Levels, Industrial soil

UNDERLINE Exceeds Basewide Background

Depth Range Feet Below Ground Surface

– EARTHEN DRAINAGE FEATURE

– SWMU BOUNDARY

– PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

– EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING MONITORING WELL FROM SWMU 9

– PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS

– PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS

– PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS

– PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 6-2

DETECTED INORGANICS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL AND BACKGROUND SCREENING CRITERIA IN SURFACE SOIL

SWMU 57-FACILITY NO. 278

POL DRUM STORAGE AREA

PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 57\CADD\ 119197_57_11.dwg

Site ID	57SB04
Sample ID	57SB04-01
Sampling Date	1/28/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Lead	16.5J
Thallium	2

Site ID	57SB04
Sample ID	57SB04-05
Sampling Date	1/28/2010
Depth (feet bgs)	9.0-11.0
Inorganics (mg/kg)	
Cobalt	***149***

Site ID	57SB02
Sample ID	57SB02-01
Sampling Date	1/26/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Arsenic	***2.4***
Cobalt	***57***
Lead	***44.1J***
Thallium	8.6
Zinc	96.2

Site ID	57SB02
Sample ID	57SB02-05
Sampling Date	1/26/2010
Depth (feet bgs)	9.0-11.0
Inorganics (mg/kg)	
Cobalt	***38.8***

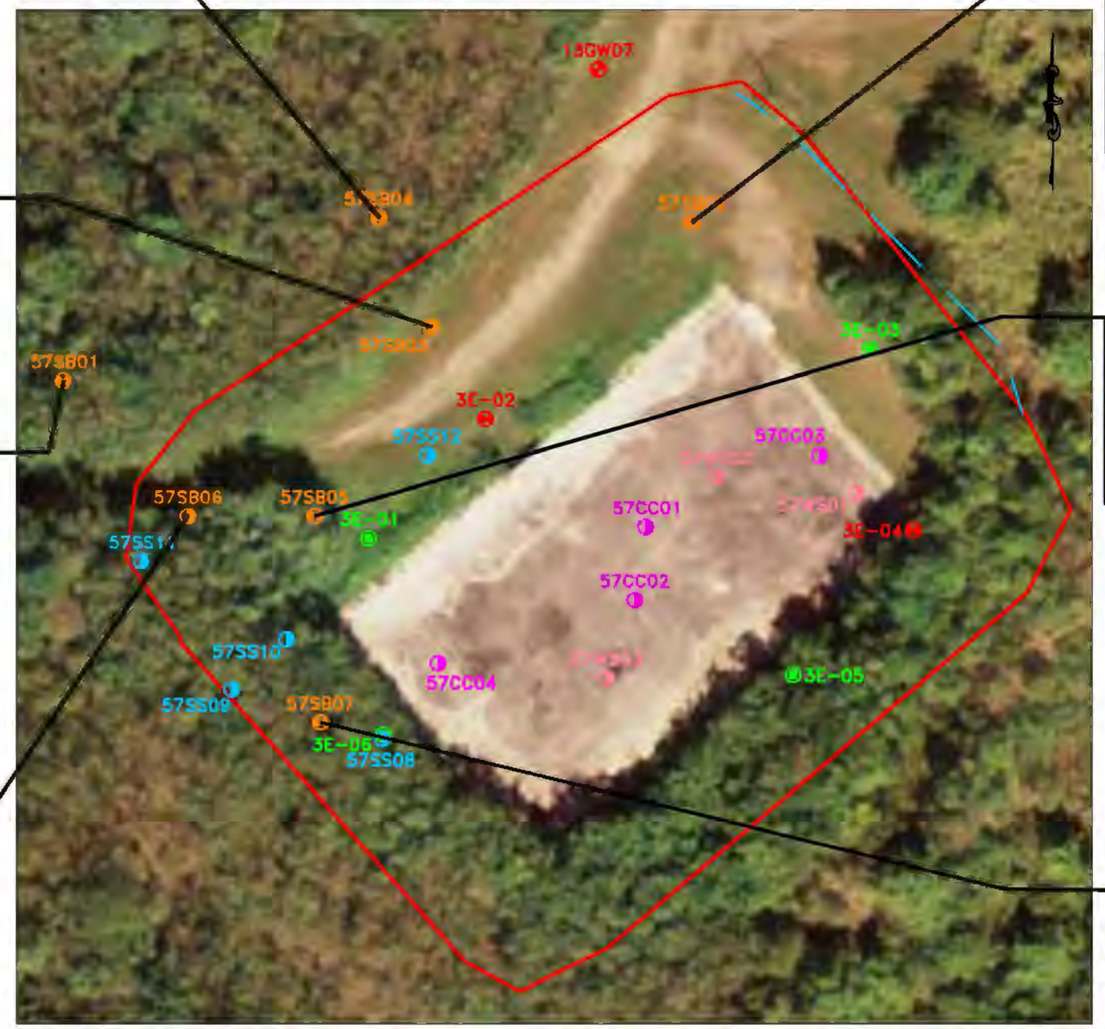
Site ID	57SB03
Sample ID	57SB03-01
Sampling Date	1/26/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Cobalt	***33.8***
Lead	21.2J
Thallium	2

Site ID	57SB01
Sample ID	57SB01-01
Sampling Date	1/28/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Cobalt	***37.6***
Lead	27.7
Thallium	10.2

Site ID	57SB05
Sample ID	57SB05-01
Sampling Date	1/27/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Cobalt	***42.2***
Lead	39.6J
Mercury	0.11J
Thallium	3.5

Site ID	57SB05
Sample ID	57SB05-01D
Sampling Date	1/27/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Arsenic	***1.7***
Cadmium	0.81
Cobalt	***73.9***
Lead	***99J***
Thallium	5

Site ID	57SB05
Sample ID	57SB05-05
Sampling Date	1/27/2010
Depth (feet bgs)	9.0-11.0
Inorganics (mg/kg)	
Cobalt	***33***



Site ID	57SB06
Sample ID	57SB06-01
Sampling Date	1/28/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Cobalt	***34.4***
Lead	17.4J
Thallium	2

Site ID	57SB06
Sample ID	57SB06-05
Sampling Date	1/28/2010
Depth (feet bgs)	9.0-11.0
Inorganics (mg/kg)	
Cobalt	***104***

Site ID	57SB07
Sample ID	57SB07-01
Sampling Date	1/27/2010
Depth (feet bgs)	1.0-3.0
Inorganics (mg/kg)	
Cobalt	***37***
Lead	20.3J
Thallium	2.3

Baker

SOURCE: USGS, NOV. 2006.

LEGEND

J: Estimated: The analyte was positively identified; the quantitation is an estimation

Exceeds Ecological Soil Screening Values

BOLD Exceeds Regional Screening Levels, Residential soil

ITALIC Exceeds Regional Screening Levels, Industrial soil

UNDERLINE Exceeds Basewide Background

Depth Range Feet Below Ground Surface

– EARTHEN DRAINAGE FEATURE – SWMU BOUNDARY

– PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

– EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING MONITORING WELL FROM SWMU 9

– PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS

– PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS

– PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS

– PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 6-3

DETECTED INORGANICS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL AND BACKGROUND SCREENING CRITERIA IN SUBSURFACE SOIL

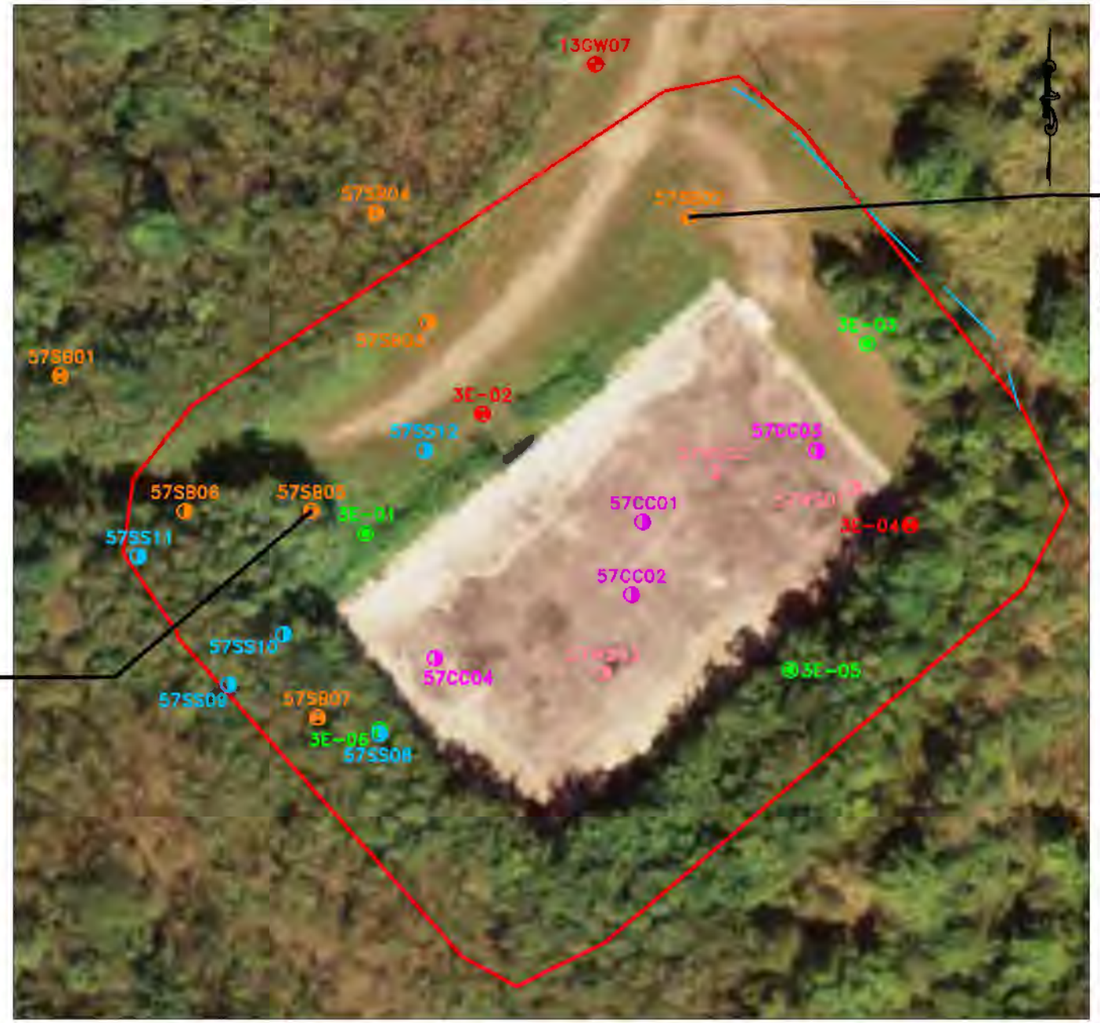
SWMU 57-FACILITY NO. 278

POL DRUM STORAGE AREA

PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 57\CADD\ 119197_57_12.dwg



Site ID	57SB02
Sample ID	57GW02
Sampling Date	1/31/2010
Dissolved Inorganics (ug/L)	
Chloroform	**5**

Site ID	57SB05
Sample ID	57GW05
Sampling Date	2/1/2010
Semivolatiles (ug/L)	
Benzo(a)anthracene	**0.18J**
Benzo(a)pyrene	**0.02J**
Benzo(a)fluoranthene	**0.03J**
Pyrene	1.9

SOURCE: USGS, NOV. 2006.

Baker

LEGEND

J: Estimated: The analyte was positively identified; the quantitation is an estimation

Exceeds Ecological Groundwater Screening Values

BOLD Exceeds Regional TAP Water Screening Levels

UNDERLINE Exceeds Basewide Background

Depth Range Feet Below Ground Surface

– EARTHEN DRAINAGE FEATURE

– SWMU BOUNDARY

– PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

– EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING MONITORING WELL FROM SWMU 9

– PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS

– PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS

– PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS

– PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 6-4

DETECTED ORGANICS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL AND BACKGROUND SCREENING CRITERIA IN GROUNDWATER

SWMU 57-FACILITY NO. 278

POL DRUM STORAGE AREA

PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JMO1\SWMU 57\CADD\ 119197_57_14.dwg

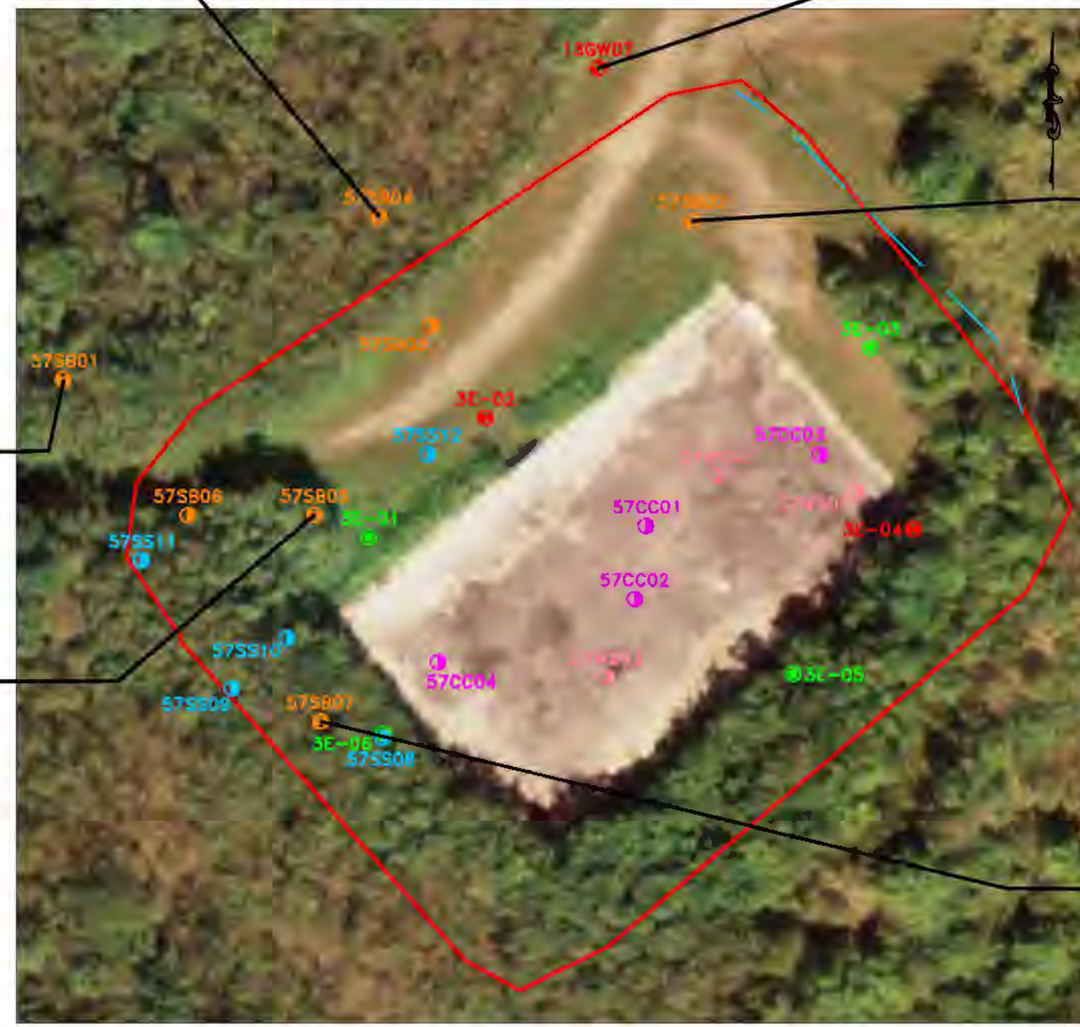
Site ID	57SB04
Sample ID	57GW04
Sampling Date	1/31/2010
Total Inorganics (ug/L)	
Mercury	**0.19**
Dissolved Inorganics (ug/L)	
Mercury	**0.28**
Vanadium	**28.1**

Site ID	13GW07
Sample ID	13GW07
Sampling Date	1/31/2010
Total Inorganics (ug/L)	
Mercury	**0.97**
Dissolved Inorganics (ug/L)	
Mercury	**1.1**
Vanadium	**23.8**

Site ID	57SB02
Sample ID	57GW02
Sampling Date	1/31/2010
Dissolved Inorganics (ug/L)	
Vanadium	**28.3**

Site ID	57SB01
Sample ID	57GW01
Sampling Date	2/1/2010
Total Inorganics (ug/L)	
Mercury	**1.4**
Dissolved Inorganics (ug/L)	
Mercury	**1.2**

Site ID	57SB05
Sample ID	57GW05
Sampling Date	2/1/2010
Dissolved Inorganics (ug/L)	
Lead	14.9



Site ID	57SB07
Sample ID	57GW07-D
Sampling Date	1/31/2010
Total Inorganics (ug/L)	
Mercury	**0.22**
Dissolved Inorganics (ug/L)	
Mercury	**0.17**

Baker

SOURCE: USGS, NOV. 2006.

LEGEND

J: Estimated: The analyte was positively identified; the quantitation is an estimation

Exceeds Ecological Groundwater Screening Values

BOLD Exceeds Regional TAP Water Screening Levels

UNDERLINE Exceeds Basewide Background

Depth Range Feet Below Ground Surface

– EARTHEN DRAINAGE FEATURE

– SWMU BOUNDARY

– PHASE I RFI SURFACE, SUBSURFACE AND GROUNDWATER SAMPLE LOCATION

– EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)

– EXISTING MONITORING WELL FROM SWMU 9

– PHASE I RFI SURFACE AND SUBSURFACE SAMPLING LOCATIONS

– PHASE I RFI CONCRETE CHIP SAMPLING LOCATIONS

– PHASE I RFI CONCRETE WIPE SAMPLING LOCATIONS

– PHASE I RFI SURFACE SOIL SAMPLING LOCATIONS

50 0 25 50

1 inch = 50 ft.

FIGURE 6-5

DETECTED INORGANICS IN EXCESS OF HUMAN HEALTH AND/OR ECOLOGICAL AND BACKGROUND SCREENING CRITERIA IN GROUNDWATER

SWMU 57-FACILITY NO. 278

POL DRUM STORAGE AREA

PHASE I RFI REPORT

NAVAL ACTIVITY PUERTO RICO

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB01 57SB01-00 1/28/2010 0.0 - 1.0	57SB02 57SB02-00 1/26/2010 0.0 - 1.0	57SB03 57SB03-00 1/26/2010 0.0 - 1.0	57SB04 57SB04-00 1/28/2010 0.0 - 1.0	57SB05 57SB05-00 1/27/2010 0.0 - 1.0
Volatiles (ug/kg)									
Carbon Disulfide	82,000 [2]	370,000 [2]	NE	NE	2.4 J	5.1 R	4.7 U	3.7 U	5.3 U
Semivolatiles (ug/kg)									
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	3.1 J	11 U	10 U	3.6 J	12 U
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	0.93 J	11 U	10 U	1.3 J	12 U
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	3.3 J	11 U	10 U	3.6 J	12 U
Acetophenone	780,000 [2]	10,000,000 [2]	NE	NE	220 U	220 U	200 U	200 U	250 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	2.5 J	11 U	10 U	7.1 J	12 U
Benzo(a)anthracene	150	2,100	NE	NE	8.2 J	11 U	10 U	8.9 J	12 U
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	6.6 J	11 U	10 U	6.2 J	0.63 J
Benzo(b)fluoranthene	150	2,100	NE	NE	4.5 J	11 U	10 U	3.6 J	1.5 J
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	2.6 J	11 U	10 U	1.7 J	0.65 J
Benzo(k)fluoranthene	1,500	21,000	NE	NE	5.3 J	11 U	10 U	4.9 J	0.9 J
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	160 J	110 J	97 J	200 U	250 U
Chrysene	15,000	210,000	NE	NE	8.1 J	11 U	10 U	8.6 J	1.1 J
Dibenz(a,h)anthracene	15.0	210	NE	NE	0.75 J	11 U	10 U	0.71 J	12 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	11 U	11 U	10 U	12	12 U
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	0.97 J	11 U	10 U	1.5 J	12 U
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	3.5 J	11 U	10 U	2.5 J	0.8 J
Naphthalene	3,600	18,000	NE	NE	11 UJ	1.1 J	1.2 J	9.9 UJ	12 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	7.3 J	11 U	10 U	15	12 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	13	11 U	10 U	17	0.9 J
PAH totals (ug/kg)									
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	40.1	78.1	71.2	54	96
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	52.55	99	90	54.11	30.48

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB01 57SB01-00 1/28/2010 0.0 - 1.0	57SB02 57SB02-00 1/26/2010 0.0 - 1.0	57SB03 57SB03-00 1/26/2010 0.0 - 1.0	57SB04 57SB04-00 1/28/2010 0.0 - 1.0	57SB05 57SB05-00 1/27/2010 0.0 - 1.0
PCBs (ug/kg)									
Aroclor-1260	220	740	NE	NE	38 U	39 U	36 U	36 U	43 U
TPH (mg/kg)									
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	10 U	6.9 J	5.5 J	4.1 J	9.2 J
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.63 U	0.65 U	0.6 U	0.6 U	0.72 U
Total TPH	100 [5]	100 [5]	NE	NE	10.63 U	7.55 J	6.1 J	4.7 J	9.92 J
Inorganics (mg/kg)									
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	3.17	0.75 U	1.3 J	0.95 J	1.2 J	1.5 J
Arsenic	0.390	1.60	18.0 [13]	2.65	0.74 U	**1.4**	**1.4**	0.34 U	***2***
Barium	1,500 [2]	19,000 [2]	330 [14]	199	82.8 J	90.8	55.6	67.1	72
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.590	0.26 J	0.45 U	0.1 U	0.03 U	0.16 U
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	1.02	0.75	0.25 U	0.26 U	0.17 U	0.58 U
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	49.8	28.5	24.2	16.9	108	29.1
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	46.2	**27.2**	***52.7***	**14.5**	***38.7***	**16.4**
Copper	310 [2]	4,100 [2]	28.0 [19]	168	92.1	63.7 J	49.4 J	127 J	86.3 J
Lead	40.0	80.0	11.0 [20]	22.0	**52.5**	19.1 J	9.2 J	10.3 J	20.6 J
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.109	0.04 J	0.13	0.026 J	0.019 U	0.04 J
Nickel	150 [2]	2,000 [2]	38.0 [22]	20.7	19.4	14.7	10	39.2	10.7
Selenium	39.0 [2]	510 [2]	0.520 [23]	1.48	0.23 U	0.45 R	0.4 R	0.43 R	0.51 R
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.12 U	0.26 J	0.15 J	0.23 J	0.22 J
Thallium	NE	NE	1.0 [24]	NE	8.3	3.6	1.1 J	4	1.4 J
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.76	1.9 J	1.7 J	1.6 J	2.3 J	2.3 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	259	***155***	***184***	***74.9***	***154***	***149***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	115	99.5	45.7	67.2	74.6	155

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB06 57SB06-00 1/28/2010 0.0 - 1.0	57SB07 57SB07-00 1/27/2010 0.0 - 1.0	57SB07 57SB07-00D 1/27/2010 0.0 - 1.0	57SS08 57SS08 1/29/2010 0.0 - 1.0	57SS09 57SS09 1/29/2010 0.0 - 1.0
Volatiles (ug/kg)									
Carbon Disulfide	82,000 [2]	370,000 [2]	NE	NE	4.2 U	5.2 U	5.4 U	7.2 U	5.1 U
Semivolatiles (ug/kg)									
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	1.7 J	12 U	12 U	6 J	2.3 J
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	9.9 U	12 U	12 U	1.9 J	0.91 J
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	1.3 J	12 U	12 U	1.8 J	1.4 J
Acetophenone	780,000 [2]	10,000,000 [2]	NE	NE	200 U	39 J	250 U	240 U	230 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	2.1 J	1.3 J	12 U	3.7 J	2.1 J
Benzo(a)anthracene	150	2,100	NE	NE	3.3 J	0.98 J	12 U	5.9 J	2.9 J
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	2.3 J	12 U	12 U	12 UJ	11 U
Benzo(b)fluoranthene	150	2,100	NE	NE	1.9 J	12 UJ	12 U	12 UJ	11 UJ
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	9.9 UJ	12 U	12 U	12 UJ	11 UJ
Benzo(k)fluoranthene	1,500	21,000	NE	NE	1.8 J	12 U	12 U	12 UJ	11 U
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	110 J	71 J	54 J	240 U	230 U
Chrysene	15,000	210,000	NE	NE	3.3 J	1 J	12 U	6.7 J	3.1 J
Dibenz(a,h)anthracene	15.0	210	NE	NE	9.9 U	12 U	12 U	12 UJ	11 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	9.9 U	2.5 J	12 U	16	11 UJ
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	0.71 J	12 U	12 U	1.7 J	0.64 J
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	9.9 U	12 U	12 U	12 UJ	11 U
Naphthalene	3,600	18,000	NE	NE	9.9 UJ	1.6 J	12 U	12 U	11 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	5 J	2.4 J	12 U	7.7 J	4.9 J
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	9.9 U	2 J	12 U	16	11 UJ
PAH totals (ug/kg)									
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	40.51	55.8	96	50.8	34.25
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	52.2	75.98	108	100.6	83

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB06 57SB06-00 1/28/2010 0.0 - 1.0	57SB07 57SB07-00 1/27/2010 0.0 - 1.0	57SB07 57SB07-00D 1/27/2010 0.0 - 1.0	57SS08 57SS08 1/29/2010 0.0 - 1.0	57SS09 57SS09 1/29/2010 0.0 - 1.0
PCBs (ug/kg)									
Aroclor-1260	220	740	NE	NE	36 U	**310** J	130 J	**550**	***760***
TPH (mg/kg)									
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	7 J	13 J	16	70	72 J
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.6 U	0.74 U	0.74 U	0.6 UJ	0.6 UJ
Total TPH	100 [5]	100 [5]	NE	NE	7.6 J	13.74 J	16.74	70.6	72.6 J
Inorganics (mg/kg)									
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	3.17	1.2 J	1.1 J	1.7 J	1 J	0.85 U
Arsenic	0.390	1.60	18.0 [13]	2.65	**1.2**	**0.83** J	**1.3** J	***5.2***	**1.6**
Barium	1,500 [2]	19,000 [2]	330 [14]	199	45.8	95 J	161 J	163 J	190 J
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.590	0.14 U	0.53 U	0.64 U	0.3 J	0.34 J
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	1.02	0.49 U	0.28 U	0.31 U	5.3	1.1
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	49.8	20.7	29.3	39.7	38.5	26.5
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	46.2	**22.3**	***31.7***	***49.3***	***30.3***	***34***
Copper	310 [2]	4,100 [2]	28.0 [19]	168	65.8 J	75.5 J	85.6 J	71.2	92.3
Lead	40.0	80.0	11.0 [20]	22.0	10.2 J	17.6 J	21.1 J	***116***	29.6 J
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.109	0.041	0.023 U	0.023 U	0.051	0.15 J
Nickel	150 [2]	2,000 [2]	38.0 [22]	20.7	13.7	13.9	16.1	18.8	27.8 J
Selenium	39.0 [2]	510 [2]	0.520 [23]	1.48	0.42 R	0.51 R	0.49 R	0.25 U	0.26 UJ
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.23 J	0.18 J	0.24 J	0.14 J	0.13 U
Thallium	NE	NE	1.0 [24]	NE	2.1	1.5 J	3.2 J	8.5	8.8
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.76	0.97 J	1.9 J	1.5 J	2.4 J	2.1 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	259	***120***	***170***	***240***	***141***	***180***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	115	94.9	73.5	77.4	183	136

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SS09 57SS09D 1/29/2010 0.0 - 1.0	57SS10 57SS10 1/29/2010 0.0 - 1.0	57SS11 57SS11 1/29/2010 0.0 - 1.0	57SS12 57SS12 1/29/2010 0.0 - 1.0
Volatiles (ug/kg)								
Carbon Disulfide	82,000 [2]	370,000 [2]	NE	NE	5 R	5.5 U	4.9 U	4.3 U
Semivolatiles (ug/kg)								
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	2.3 J	1.9 J	1 J	2 J
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	2.4 J	1.8 J	10 U	0.82 J
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	14 J	1.7 J	10 UJ	0.86 J
Acetophenone	780,000 [2]	10,000,000 [2]	NE	NE	240 U	200 U	210 U	200 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	7.9 J	2.7 J	0.67 J	3.8 J
Benzo(a)anthracene	150	2,100	NE	NE	30 J	17	2.9 J	1.3 J
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	12 UJ	10 UJ	10 U	9.5 UJ
Benzo(b)fluoranthene	150	2,100	NE	NE	12 UJ	10 UJ	10 U	9.5 UJ
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	12 UJ	10 UJ	10 UJ	9.5 UJ
Benzo(k)fluoranthene	1,500	21,000	NE	NE	12 UJ	10 UJ	10 U	9.5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	240 U	70 J	50 J	1800
Chrysene	15,000	210,000	NE	NE	27 J	26	3.4 J	1.4 J
Dibenz(a,h)anthracene	15.0	210	NE	NE	12 UJ	10 UJ	10 U	9.5 UJ
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	41 J	47	10 U	9.5 U
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	1.8 J	1.3 J	10 UJ	0.8 J
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	12 UJ	10 UJ	10 U	9.5 UJ
Naphthalene	3,600	18,000	NE	NE	12 U	10 UJ	10 UJ	9.5 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	9.4 J	34	3 J	2.5 J
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	63 J	69	10 U	9.5 U
PAH totals (ug/kg)								
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	90.8	100.4	54.67	29.78
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	192	172	76.3	69.2

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SS09 57SS09D 1/29/2010 0.0 - 1.0	57SS10 57SS10 1/29/2010 0.0 - 1.0	57SS11 57SS11 1/29/2010 0.0 - 1.0	57SS12 57SS12 1/29/2010 0.0 - 1.0
PCBs (ug/kg)								
Aroclor-1260	220	740	NE	NE	**610**	39 J	38 U	46
TPH (mg/kg)								
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	37 J	28	25	13
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.68 UJ	0.57 UJ	0.62 UJ	0.56 UJ
Total TPH	100 [5]	100 [5]	NE	NE	37.68 J	28.57	25.62	13.56
Inorganics (mg/kg)								
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	3.17	0.85 U	0.7 U	0.73 U	0.67 U
Arsenic	0.390	1.60	18.0 [13]	2.65	***1.8***	**1.2**	**1.4**	***2.4***
Barium	1,500 [2]	19,000 [2]	330 [14]	199	88.9 J	98.1 J	200 J	42.2 J
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.590	0.27 J	0.27 J	0.32 J	0.07 J
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	1.02	1.4	1.3	1.1	0.76
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	49.8	27.7	19.2	24.9	11
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	46.2	**29.4**	**24.9**	***64.8***	**8.2**
Copper	310 [2]	4,100 [2]	28.0 [19]	168	86.7	85.1	80.9	35.8
Lead	40.0	80.0	11.0 [20]	22.0	**46.4** J	**60.6**	33.7	30.5
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.109	0.45 J	0.037 J	0.058	0.018 U
Nickel	150 [2]	2,000 [2]	38.0 [22]	20.7	14.8 J	15	15.4	4.9
Selenium	39.0 [2]	510 [2]	0.520 [23]	1.48	0.93 J	0.21 U	0.22 U	0.21 U
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.13 U	0.11 U	0.15 J	0.11 U
Thallium	NE	NE	1.0 [24]	NE	7.1	7.6	7.7	3.1
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.76	2.2 J	1.5 J	1.5 J	1.8 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	259	***150***	***118***	***141***	***44.4***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	115	143	96.9	79.7	49.4

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

Analytical results for VOCs for samples 57SS08 through 57SS12 were collected on 2/2/2010; GRO was colleted on 5/20/2010

U - Undetected at the Method Detection Limit
UJ - Reported quantitation limit is qualified as estimated
J - Estimated: The analyte was positively identified; the quantitation is an estimation
R - Rejected data; data is not usable
NA - Not Analyzed
NE - Not Established

ft bgs - feet below ground surface
ug/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NAPR - Naval Activity Puerto Rico
PCB - Polychlorinated Biphenyls
TPH - Total Petroleum Hydrocarbons

(1) NAPR basewide background surface soil screening value (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2010)
(2) Noncarcinogenic Regional Screening Levels based on a target hazard quotient of 0.1 for conservative screening purposes.
(3) Value for acenaphthene used as a surrogate.
(4) Value for pyrene used as a surrogate.
(5) Puerto Rico specific value - Puerto Rico Environmental Quality Board (PREQB)
(6) Value for chromium III used as a surrogate.
(7) The screening value shown is an average of the target and intervention soil standards. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent).
(8) The value represents a total concentration for all phthalates. [MHSPE 2000]
(9) Ecological soil screening level for soil invertebrates [USEPA 2007a]
(10) Low molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 56 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene.
(11) High molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 56 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene.
(12) Ecological soil screening level for mammalian herbivores [USEPA 2005a]
(13) Ecological soil screening level for plants [USEPA 2005b]
(14) Ecological soil screening level for soil invertebrates [USEPA 2005c]
(15) Ecological soil screening level for mammalian herbivores [USEPA 2005d]
(16) Ecological soil screening level for avian ground insectivores [USEPA 2005e]
(17) Ecological soil screening level for avian ground insectivores [USEPA 2008]
(18) Ecological soil screening level for plants [USEPA 2005f]
(19) Ecological soil screening level for avian ground insectivores [USEPA 2007b]
(20) Ecological soil screening level for avian ground insectivores [USEPA 2005g]
(21) Toxicological threshold for earthworms [Efroymson et al. 1997a]
(22) Ecological soil screening level for plants [USEPA 2007c]
(23) Ecological soil screening level for plants [USEPA 2007d]
(24) Ecological soil screening level for avian ground insectivores [USEPA 2006]
(25) Toxicological threshold for plants [Efroymson et al. 1997b]
(26) Ecological soil screening level for avian ground insectivores [USEPA 2005h]
(27) Ecological soil screening level for avian ground insectivores [USEPA 2007e]

TABLE 6-1

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References:

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USEPA. 2007b. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEPA. 2007c. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

USEPA. 2007d. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2007e. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2006. Ecological Soil Screening Levels for Silver (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWEER Directive 9285.7-77.

USEPA. 2005a. Ecological Soil Screening Levels for Antimony (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-61.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA. 2005c. Ecological Soil Screening Levels for Barium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005d. Ecological Soil Screening Levels for Beryllium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005e. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

USEPA. 2005f. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

USEPA. 2005g. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEPA. 2005h. Ecological Soil Screening Levels for Vanadium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-75.

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB01 57SB01-01 1/28/2010 1.0 - 3.0	57SB01 57SB01-05 1/28/2010 9.0 - 11.0	57SB02 57SB02-01 1/26/2010 1.0 - 3.0	57SB02 57SB02-05 1/26/2010 9.0 - 11.0	57SB03 57SB03-01 1/26/2010 1.0 - 3.0
Semivolatiles (ug/kg)									
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	1.2 J	2.8 J	10 U	9.3 U	11 U
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	11 U	0.79 J	10 U	9.3 U	11 U
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	11 UJ	1.4 J	10 U	9.3 U	11 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	0.68 J	2.1 J	10 U	9.3 U	11 U
Benzo(a)anthracene	150	2,100	NE	NE	1.5 J	4.2 J	10 U	9.3 U	11 U
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	0.74 J	3.1 J	10 U	9.3 U	11 U
Benzo(b)fluoranthene	150	2,100	NE	NE	0.89 J	1.9 J	0.74 J	9.3 U	11 U
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	11 UJ	1 J	10 U	9.3 U	11 U
Benzo(k)fluoranthene	1,500	21,000	NE	NE	0.8 J	2.3 J	10 U	9.3 U	11 U
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	58 J	100 J	60 J	190 U	140 J
Chrysene	15,000	210,000	NE	NE	1.6 J	4.2 J	10 U	9.3 U	11 U
Dibenz(a,h)anthracene	15.0	210	NE	NE	11 U	11 U	10 U	9.3 U	11 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	11 U	11 U	1.9 J	9.3 U	11 U
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	11 UJ	0.93 J	10 U	9.3 U	11 U
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	0.5 J	1.3 J	10 U	9.3 U	11 U
Naphthalene	3,600	18,000	NE	NE	11 UJ	11 UJ	1.1 J	0.92 J	11 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	2.2 J	5 J	2.9 J	9.3 U	11 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	11 U	11 U	1.1 J	9.3 U	11 U
PAH totals (ug/kg)									
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	59.08	35.02	55.9	66.02	88
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	39.03	40	71.84	83.7	99
PCBs (ug/kg)									
Aroclor-1260	220	740	NE	NE	38 U	38 U	38 U	34 U	39 U

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB01 57SB01-01 1/28/2010 1.0 - 3.0	57SB01 57SB01-05 1/28/2010 9.0 - 11.0	57SB02 57SB02-01 1/26/2010 1.0 - 3.0	57SB02 57SB02-05 1/26/2010 9.0 - 11.0	57SB03 57SB03-01 1/26/2010 1.0 - 3.0
TPH (mg/kg)									
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	10 U	10 U	3.5 J	11 U	6.7 J
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.64 U	0.64 U	0.63 U	0.56 U	0.66 U
Total TPH	100 [5]	100 [5]	NE	NE	10.64 U	10.64 U	4.13 J	11.56 U	7.36 J
Inorganics (mg/kg)									
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	NE	0.79 U	0.78 U	2.1 J	1.7 J	1.4 J
Arsenic	0.390	1.60	18.0 [13]	1.59	**1.2** J	0.77 U	***2.4***	**0.4** J	**1.5**
Barium	1,500 [2]	19,000 [2]	330 [14]	220	79.3 J	10.4 J	290	21.8	97.2
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.596	0.44 J	0.44 J	0.61	0.02 U	0.53 U
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	0.539	0.71	0.3 J	0.17 U	0.11 U	0.19 U
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	114	33.4	10.1	30.3	50.4	30.6
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	26.9	***37.5***	**18.2**	***97***	**28.8**	***33.6***
Copper	310 [2]	4,100 [2]	28.0 [19]	246	81.3	83.4	95.3 J	81.6 J	76.6 J
Lead	40.0	80.0	11.0 [20]	6.29	27.7	15.2	**44.1** J	3.3 J	21.2 J
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.108	0.067	0.02 U	0.021 U	0.018 U	0.021 U
Nickel	150 [2]	2,000 [2]	38.0 [22]	24.7	14.3	8.2	25.9	30.5	13.6
Selenium	39.0 [2]	510 [2]	0.520 [23]	5.94	0.44 J	0.36 J	0.44 R	0.37 R	0.47 R
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.12 U	0.12 U	0.33 J	0.25 J	0.24 J
Thallium	NE	NE	1.0 [24]	0.924	10.2	6.1	8.6	4.6	2
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.56	2 J	1.4 J	0.62 U	1.3 J	1.9 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	434	***217***	***129***	***237***	***193***	***225***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	88.1	58	223	96.2	78.9	55.4

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB03 57SB03-05 1/26/2010 9.0 - 11.0	57SB04 57SB04-01 1/28/2010 1.0 - 3.0	57SB04 57SB04-05 1/28/2010 9.0 - 11.0	57SB05 57SB05-01 1/27/2010 1.0 - 3.0	57SB05 57SB05-01D 1/27/2010 1.0 - 3.0
Semivolatiles (ug/kg)									
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	11 U	3.4 J	11 U	9.8 U	11 U
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	11 U	1.3 J	11 U	9.8 U	11 U
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	11 U	6.8 J	11 UJ	9.8 U	11 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	11 U	4.2 J	11 UJ	9.8 U	11 U
Benzo(a)anthracene	150	2,100	NE	NE	11 U	20	0.96 J	9.8 U	11 U
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	11 U	**17**	0.59 J	9.8 U	11 U
Benzo(b)fluoranthene	150	2,100	NE	NE	11 U	9.6 J	11 U	9.8 U	11 U
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	11 U	5.7 J	11 UJ	9.8 U	11 U
Benzo(k)fluoranthene	1,500	21,000	NE	NE	11 U	11	0.65 J	9.8 U	11 U
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	60 J	56 J	230 U	200 U	220 U
Chrysene	15,000	210,000	NE	NE	11 U	20	1.1 J	9.8 U	11 U
Dibenz(a,h)anthracene	15.0	210	NE	NE	11 U	1.8 J	11 U	9.8 U	11 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	11 U	18	11 U	9.8 U	11 U
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	11 U	1.6 J	11 UJ	9.8 U	11 U
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	11 U	7 J	11 U	9.8 U	11 U
Naphthalene	3,600	18,000	NE	NE	11 U	10 UJ	11 UJ	0.9 J	11 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	11 U	9.2 J	11 U	9.8 U	11 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	11 U	28	11 U	9.8 U	11 U
PAH totals (ug/kg)									
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	88	54.5	88	69.5	88
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	99	120.1	58.3	88.2	99
PCBs (ug/kg)									
Aroclor-1260	220	740	NE	NE	38 U	37 U	40 U	35 U	39 U

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB03 57SB03-05 1/26/2010 9.0 - 11.0	57SB04 57SB04-01 1/28/2010 1.0 - 3.0	57SB04 57SB04-05 1/28/2010 9.0 - 11.0	57SB05 57SB05-01 1/27/2010 1.0 - 3.0	57SB05 57SB05-01D 1/27/2010 1.0 - 3.0
TPH (mg/kg)									
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	3.8 J	4.2 J	3.7 J	7.9 J	6.5 J
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.64 U	0.61 U	0.67 U	0.59 U	0.66 U
Total TPH	100 [5]	100 [5]	NE	NE	4.44 J	4.81 J	4.37 J	8.49 J	7.16 J
Inorganics (mg/kg)									
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	NE	1.2 J	1.2 J	1.3 J	1 J	1.7 J
Arsenic	0.390	1.60	18.0 [13]	1.59	**0.52** J	**1** J	**1.4**	**0.97** J	***1.7*** J
Barium	1,500 [2]	19,000 [2]	330 [14]	220	72.8	36.7	1240	131 J	228 J
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.596	0.23 U	0.41 U	0.92	0.4 U	0.61 U
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	0.539	0.15 U	0.12 U	0.35 U	0.7	0.81
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	114	15.4	23.1	44.9	24.9	30
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	26.9	**23.7**	**12.9**	***149***	***43.2***	***73.9***
Copper	310 [2]	4,100 [2]	28.0 [19]	246	87.3 J	56.2 J	104 J	52.9 J	68.7 J
Lead	40.0	80.0	11.0 [20]	6.29	5.7 J	16.5 J	5.3 J	39.6 J	**56** J
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.108	0.02 U	0.019 U	0.02 U	0.11 J	0.061 J
Nickel	150 [2]	2,000 [2]	38.0 [22]	24.7	15.5	10.8	41.4	17.9	14.2
Selenium	39.0 [2]	510 [2]	0.520 [23]	5.94	0.45 R	0.41 R	0.47 R	0.4 R	0.46 R
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.26 J	0.19 J	0.4 J	0.37 J	0.43 J
Thallium	NE	NE	1.0 [24]	0.924	2.8	2	7.3	3.5	5
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.56	1.3 J	1.7 J	1.7 J	0.91 J	1.6 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	434	***198***	***155***	***263***	***172***	***220***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	88.1	70.6	35.1	92	59.3	77

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB05 57SB05-05 1/27/2010 9.0 - 11.0	57SB06 57SB06-01 1/28/2010 1.0 - 3.0	57SB06 57SB06-05 1/28/2010 9.0 - 11.0	57SB07 57SB07-01 1/27/2010 1.0 - 3.0	57SB07 57SB07-05 1/27/2010 9.0 - 11.0
Semivolatiles (ug/kg)									
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	10 U	1.1 J	0.94 J	11 U	10 U
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	10 U	10 U	9.7 U	11 U	10 U
Acenaphthylene	340,000 [2][3]	3,300,000 [2][3]	NE	NE	10 U	0.98 J	0.7 J	11 U	10 U
Anthracene	1,700,000 [2]	17,000,000 [2]	NE	NE	10 U	1.3 J	0.8 J	11 U	10 U
Benzo(a)anthracene	150	2,100	NE	NE	10 U	3 J	1.6 J	11 U	10 U
Benzo(a)pyrene (BaP)	15.0	210	NE	NE	10 U	10 U	0.93 J	11 U	10 U
Benzo(b)fluoranthene	150	2,100	NE	NE	10 U	10 U	1 J	11 U	10 U
Benzo(g,h,i)perylene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	10 U	10 UJ	9.7 UJ	11 U	10 U
Benzo(k)fluoranthene	1,500	21,000	NE	NE	10 U	10 U	0.82 J	11 U	10 U
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010 [7][8]	NE	210 U	58 J	270	220 U	210 U
Chrysene	15,000	210,000	NE	NE	10 U	2.9 J	1.7 J	11 U	10 U
Dibenz(a,h)anthracene	15.0	210	NE	NE	10 U	10 U	9.7 U	11 U	10 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	10 U	10 U	9.7 U	11 U	10 U
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	10 U	10 UJ	9.7 UJ	11 U	10 U
Indeno(1,2,3-cd)pyrene	150	2,100	NE	NE	10 U	10 U	9.7 U	11 U	10 U
Naphthalene	3,600	18,000	NE	NE	0.96 J	10 UJ	9.7 UJ	11 U	10 U
Phenanthrene	170,000 [2][4]	1,700,000 [2][4]	NE	NE	10 U	3.1 J	2.3 J	11 U	10 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	10 U	10 U	9.7 U	11 U	10 U
PAH totals (ug/kg)									
Low molecular weight PAHs	NE	NE	29,000 [9][10]	NE	70.96	46.48	43.54	88	80
High molecular weight PAHs	NE	NE	18,000 [9][11]	NE	90	75.9	44.85	99	90
PCBs (ug/kg)									
Aroclor-1260	220	740	NE	NE	38 U	37 U	35 U	34 J	37 U

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background[1]	57SB05 57SB05-05 1/27/2010 9.0 - 11.0	57SB06 57SB06-01 1/28/2010 1.0 - 3.0	57SB06 57SB06-05 1/28/2010 9.0 - 11.0	57SB07 57SB07-01 1/27/2010 1.0 - 3.0	57SB07 57SB07-05 1/27/2010 9.0 - 11.0
TPH (mg/kg)									
Diesel Range Organics (DRO)	100 [5]	100 [5]	NE	NE	5.1 J	4.7 J	4.1 J	11 J	10 J
Gasoline Range Organics (GRO)	100 [5]	100 [5]	NE	NE	0.62 U	0.62 U	0.58 U	0.66 UJ	0.61 U
Total TPH	100 [5]	100 [5]	NE	NE	5.72 J	5.32 J	4.68 J	11.66 J	10.61 J
Inorganics (mg/kg)									
Antimony	3.10 [2]	41.0 [2]	10.0 [12]	NE	1.2 J	0.97 J	1.5 J	1.4 J	1.4 J
Arsenic	0.390	1.60	18.0 [13]	1.59	**0.42** J	**0.77** J	**1.1** J	**1.1** J	**0.55** J
Barium	1,500 [2]	19,000 [2]	330 [14]	220	81.3	47.2	302	115	10.7 J
Beryllium	16.0 [2]	200 [2]	21.0 [15]	0.596	0.24 U	0.39 U	1.2	0.57 U	0.21 U
Cadmium	7.0 [2]	80.0 [2]	0.770 [16]	0.539	0.2 U	0.44 U	0.63	0.22 U	0.27 U
Chromium	12,000 [2][6]	150,000 [2][6]	26.0 [17]	114	22.3	21.9	10.8	29.3	21.4
Cobalt	2.30 [2]	30.0 [2]	13.0 [18]	26.9	***33***	***34.4***	***104***	***38***	**13.8**
Copper	310 [2]	4,100 [2]	28.0 [19]	246	72.8 J	67.5 J	147 J	74.6 J	58.7 J
Lead	40.0	80.0	11.0 [20]	6.29	4.5 J	17.4 J	7.4 J	20.3 J	5.7 J
Mercury	0.560 [2]	3.40 [2]	0.10 [21]	0.108	0.02 U	0.043	0.018 U	0.05	0.02 U
Nickel	150 [2]	2,000 [2]	38.0 [22]	24.7	25.8	16.2	17	13.5	18.7
Selenium	39.0 [2]	510 [2]	0.520 [23]	5.94	0.45 R	0.43 R	0.41 R	0.47 R	0.42 R
Silver	39.0 [2]	510 [2]	4.20 [23]	NE	0.14 J	0.42 J	0.22 J	0.18 J	0.12 J
Thallium	NE	NE	1.0 [24]	0.924	3.4	2	4.1	2.3	1.9
Tin	4,700 [2]	61,000 [2]	50.0 [25]	3.56	1.6 J	1.1 J	0.72 J	1.7 J	0.92 J
Vanadium	0.550 [2]	7.20 [2]	7.80 [26]	434	***136***	***149***	***215***	***184***	***121***
Zinc	2,300 [2]	31,000 [2]	46.0 [27]	88.1	98.9	69.3	246	70.1	103

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

U - Undetected at the Method Detection Limit
UJ - Reported quantitation limit is qualified as estimated
J - Estimated: The analyte was positively identified; the quantitation is an estimation
R - Rejected data; data is not usable
NE - Not Established

ft bgs - feet below ground surface
ug/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NAPR - Naval Activity Puerto Rico
PCB - Polychlorinated Biphenyls
TPH - Total Petroleum Hydrocarbons

(1) NAPR basewide bkg subsurface soil screening value for clay [Table 3-4] (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2010)
(2) Noncarcinogenic Regional Screening Levels based on a target hazard quotient of 0.1 for conservative screening purposes.
(3) Value for acenaphthene used as a surrogate.
(4) Value for pyrene used as a surrogate.
(5) Puerto Rico specific value
(6) Value for chromium III used as a surrogate.
(7) The screening value shown is an average of the target and intervention soil standards. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent).
(8) The value represents a total concentration for all phthalates. [MHSPE 2000]
(9) Ecological soil screening level for soil invertebrates [USEPA 2007a]
(10) Low molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 56 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene.
(11) High molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 56 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene.
(12) Ecological soil screening level for mammalian herbivores [USEPA 2005a]
(13) Ecological soil screening level for plants [USEPA 2005b]
(14) Ecological soil screening level for soil invertebrates [USEPA 2005c]
(15) Ecological soil screening level for mammalian herbivores [USEPA 2005d]
(16) Ecological soil screening level for avian ground insectivores [USEPA 2005e]
(17) Ecological soil screening level for avian ground insectivores [USEPA 2008]
(18) Ecological soil screening level for plants [USEPA 2005f]
(19) Ecological soil screening level for avian ground insectivores [USEPA 2007b]
(20) Ecological soil screening level for avian ground insectivores [USEPA 2005g]
(21) Toxicological threshold for earthworms [Efroymson et al. 1997a]
(22) Ecological soil screening level for plants [USEPA 2007c]
(23) Ecological soil screening level for plants [USEPA 2007d]
(24) Ecological soil screening level for avian ground insectivores [USEPA 2006]
(25) Toxicological threshold for plants [Efroymson et al. 1997b]
(26) Ecological soil screening level for avian ground insectivores [USEPA 2005h]
(27) Ecological soil screening level for avian ground insectivores [USEPA 2007e]

TABLE 6-2

SUMMARY OF DETECTED LABORATORY RESULTS - SUBSURFACE SOIL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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USEPA. 2007c. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

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USEPA. 2007e. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2006. Ecological Soil Screening Levels for Silver (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWEER Directive 9285.7-77.

USEPA. 2005a. Ecological Soil Screening Levels for Antimony (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-61.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA. 2005c. Ecological Soil Screening Levels for Barium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005d. Ecological Soil Screening Levels for Beryllium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005e. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

USEPA. 2005f. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

USEPA. 2005g. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEPA. 2005h. Ecological Soil Screening Levels for Vanadium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-75.

TABLE 6-3

Revised: 11/24/2010

SUMMARY OF DETECTED LABORATORY RESULTS - GROUNDWATER
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date	**Regional Tap Water Screening Levels**	Selected Ecological Groundwater Screening Values	*Puerto Rico Water Quality Standards*	NAPR Basewide Background[1]	13GW07 13GW07 1/31/2010	57SB01 57GW01 2/1/2010	57SB02 57GW02 1/31/2010	57SB04 57GW04 1/31/2010	57SB05 57GW05 2/1/2010	57SB07 57GW07 1/31/2010	57SB07 57GW07D 1/31/2010
Volatiles (ug/L)											
Carbon Disulfide	100 [2]	15.0 [8][9]	NE	NE	0.5 U	0.5 U	1.8	0.25 J	1.3 R	0.16 J	0.19 J
Chloroform	0.190	815 [10]	57	NE	0.5 U	0.5 U	**5**	3.2 U	1.4 R	0.5 U	0.5 U
Methyl Iodide	NE	NE	NE	NE	0.5 U	0.5 U	0.2 J	0.5 U	1.3 R	0.5 UJ	0.5 UJ
Semivolatiles (ug/L)											
Acenaphthene	220 [2]	9.70 [10]	670	NE	0.21 U	0.21 U	0.2 U	0.2 U	0.41	0.2 U	0.21 U
Acenaphthylene	220 [2][3]	6.0 [11]	670	NE	0.21 U	0.21 U	0.03 J	0.2 U	0.011 J	0.2 U	0.21 U
Anthracene	1,100 [2]	5.35 [12]	8,300	NE	0.21 U	0.21 U	0.2 U	0.2 U	0.55	0.2 U	0.21 U
Benzo(a)anthracene	0.0290	0.0250 [9][13]	0.038	NE	0.21 U	0.21 U	0.2 U	0.2 U	***0.18*** J	0.2 U	0.21 U
Benzo(a)pyrene (BaP)	0.00290	10.0 [14]	0.038	NE	0.21 U	0.21 U	0.2 U	0.2 U	**0.023** J	0.2 U	0.21 U
Benzo(b)fluoranthene	0.0290	6.0 [15]	0.038	NE	0.21 U	0.21 U	0.2 U	0.2 U	**0.031** J	0.2 U	0.21 U
Benzo(g,h,i)perylene	110 [2][4]	6.0 [15]	NE	NE	0.011 J	0.21 U	0.2 U	0.2 U	0.012 J	0.2 U	0.21 U
Benzo(k)fluoranthene	0.290	6.0 [15]	0.038	NE	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.025 J	0.2 UJ	0.21 UJ
Chrysene	2.90	10.0 [14]	0.038	NE	0.018 J	0.21 U	0.2 U	0.2 U	0.19 J	0.2 U	0.017 J
Diethyl Phthalate (DEP)	2,900 [2]	75.9 [10]	17,000	NE	5.1 U	5.3 U	5 U	5 U	0.6 J	5 U	5.3 U
Fluoranthene	150 [2]	11.0 [16]	130	NE	0.21 U	0.21 U	0.2 U	0.2 U	2.4	0.2 U	0.21 U
Phenanthrene	110 [2][4]	8.30 [16]	830	NE	0.06 J	0.21 U	0.2 U	0.2 U	0.049 J	0.2 U	0.078 J
Pyrene	110 [2]	0.248 [12]	830	NE	0.21 U	0.21 U	0.2 U	0.2 U	1.9	0.2 U	0.21 U
PCBs (ug/kg)											
Not Detected											
TPH (mg/L)											
Diesel Range Organics (DRO)	50.0 [5]	NE	NE	NE	0.53 U	0.51 U	0.5 U	0.56 U	0.5 U	0.5 U	0.56 U
Gasoline Range Organics (GRO)	50.0 [5]	NE	NE	NE	0.5 U	0.5 UJ	0.5 U	0.5 U	2.1	0.5 U	0.5 U
Total TPH	50.0 [5]	NE	NE	NE	1.03 U	1.01 UJ	1 U	1.06 U	2.6	1 U	1.06 U

TABLE 6-3

Revised: 11/24/2010

SUMMARY OF DETECTED LABORATORY RESULTS - GROUNDWATER
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date	**Regional Tap Water Screening Levels**	Selected Ecological Groundwater Screening Values	*Puerto Rico Water Quality Standards*	NAPR Basewide Background[1]	13GW07 13GW07 1/31/2010	57SB01 57GW01 2/1/2010	57SB02 57GW02 1/31/2010	57SB04 57GW04 1/31/2010	57SB05 57GW05 2/1/2010	57SB07 57GW07 1/31/2010	57SB07 57GW07D 1/31/2010
Total Inorganics (ug/L)											
Antimony	1.50 [2]	500 [24]	5.6	12.2	2.9 U	2.9 U	2.9 U	**3.7** J	2.9 U	2.9 U	2.9 U
Barium	730 [2]	16,667 [18]	2000[26]	686	30 J	17.3 R	83.8 J	26.9 J	24.8 J	17.9 J	18.2 J
Cadmium	1.80 [2]	8.85 [25]	5	16.6	0.34 U	0.34 U	0.85 J	0.34 U	0.34 U	0.91 J	0.4 J
Cobalt	1.10 [2]	45.0 [20]	NE	633	**3.2** J	**1.5** J	**9.5** J	**1.3** J	**3** J	**2.1** J	0.83 J
Copper	150 [2]	3.73 [25]	1,300	324	2.8 J	1.5 U	6.5	2.5 J	5 J	2.9 J	3 J
Lead	15.0 [7]	8.52 [25]	15	26.3	1.8 U	2 U	2.7 U	1.8 U	***17.7***	2.2 U	2.3 U
Mercury	0.0570 [2]	1.11 [25]	0.5	0.15	**0.97**	**1.4**	0.1 U	**0.19** J	0.1 U	**0.13** J	**0.22**
Selenium	18.0 [2]	71.1 [25]	50	29.88	3.6 UJ	3.9 J	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	4.5 J
Silver	18.0 [2]	2.24 [10]	NE	18.31	1 J	1.3 J	1.2 U	0.96 U	0.96 U	0.96 U	0.96 U
Thallium	2.0 [7]	21.3 [10]	0.24	NE	5.3 U	5.3 U	**5.6** J	5.3 U	5.3 U	5.3 U	5.3 U
Tin	2,200 [2]	180 [9][13]	NE	9.4	7.9 J	5.5 J	8 J	6.2 J	6.3 J	8.8 J	5.1 U
Vanadium	0.260 [2]	12.0 [9][13]	NE	484.66	**24.4**	**6.5** J	**37.5**	**29.6**	**15.5** J	**13.6** J	**11.8** J
Zinc	1,100 [2]	85.6 [25]	NE	547.53	5.7 U	9.4 U	28	10.1 U	9.5 U	11 U	10.6 U
Dissolved Inorganics (ug/L)											
Barium	730 [2]	16,667 [17][18]	2000[26]	260.0	25.7 J	28 R	93.1 J	25.7 J	22.5 J	16.3 J	16.3 J
Chromium	5,500 [2][6]	50 [19]	100	6.5	0.95 U	1.2 J	0.95 U	2.9 J	0.95 U	3 J	3.6 J
Cobalt	1.10 [2]	45.0 [17][20]	NE	580.5	**3.6** J	**3.5** J	**12.8** J	**2.2** J	**3.7** J	**1.6** J	**3.3** J
Copper	150 [2]	3.10 [21]	1,300	29.0	1.6 J	1.6 U	2.8 J	1.9 J	1.5 U	1.5 U	1.6 J
Lead	15.0 [7]	8.10 [21]	15	1.3	2.7 U	1.8 U	2 U	2.1 U	14.9	1.8 U	1.8 U
Mercury	0.0570 [2]	0.940 [21]	0.5	0.157	**1.1**	**1.2**	0.1 U	**0.28**	0.1 U	0.1 U	**0.17** J
Nickel	73.0 [2]	8.20 [22]	610	84.1	1.3 J	5.4 J	17.4 J	4.3 J	2.2 U	5.7 J	6.5 J
Silver	18.0 [2]	2.24 [17][21]	NE	3.67	1 J	1.1 U	0.96 U	0.96 U	0.96 U	0.96 U	1.4 J
Tin	2,200 [2]	180 [9][13][17]	NE	84.1	9.5 J	5.1 J	6.2 J	5.1 U	5.1 U	5.2 J	5.1 U
Vanadium	0.260 [2]	12.0 [9][13][17]	NE	20.96	**23.8**	**8.6** J	**28.3**	**28.1**	**9.2** J	**10.7** J	**11.5** J
Zinc	1,100 [2]	81.0 [23]	NE	360.64	5.3 U	12.5 U	23.3	11.1 U	5.5 U	5.7 U	7.8 U

TABLE 6-3

Revised: 11/24/2010

SUMMARY OF DETECTED LABORATORY RESULTS - GROUNDWATER
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

U - Undetected at the Method Detection Limit
UJ - Reported quantitation limit is qualified as estimated
J - Estimated: The analyte was positively identified; the quantitation is an estimation
R - Rejected data; data is not usable
NE - Not Established
PRWQS - Puerto Rico Water Quality Standards

ug/L - micrograms per liter
mg/L - milligrams per liter
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency
TPH - Total Petroleum Hydrocarbons
MCL - Maximum Contaminant Level

(1) NAPR basewide background groundwater screening value (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2008)
(2) Noncarcinogenic Regional Screening Levels based on a target hazard quotient of 0.1 for conservative screening purposes.
(3) Value for acenaphthene used as a surrogate.
(4) Value for pyrene used as a surrogate.
(5) Puerto Rico specific value
(6) Value for chromium III used as a surrogate.
(7) Value for MCL
(8) The safety factors applied to acute endpoints (i.e., LC_{50}, EC_{50}, NOEC, and LOEL values) and chronic endpoints (i.e., LOELs) are those recommended by Wentsel et al. (1996).
(9) USEPA Region 5 ecological screening level [USEPA 2003]
(10) USEPA Region 4 chronic screening value [USEPA 2001]
(11) Acute LOEL for chemical class with a safety factor of 50 (value for low molecular weight PAHs) [Buchman 2008]
(12) Minimum acute value (48-hr LC50 for Americamysis bahia [opossum shrimp]) with a safety factor of 100 [USEPA 2007]
(13) The chemical lacks a marine/estuarine surface water screening value/literature-based toxicity value. The value shown is a freshwater screening value/toxicity value.
(14) Acute value (LC50) with a safety factor of 100 [USEPA 2004]
(15) Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs) [Buchman 2008]
(16) Final Chronic Value [USEPA 1996]
(17) The chemical lacks a screening value expressed as a dissolved concentration. The value shown is expressed as a total recoverable concentration.
(18) Minimum acute value (96-hr NOEC for Cyprinodon variegatus [sheepshead minnow]) with a safety factor of 30 [USEPA 2007]
(19) Dissolved Criteria Continuous Concentration for hexavalent chromium [USEPA 2009]
(20) Minimum acute value (96-hr LC50 for Nitocra spinipes [Harpacticoid copepod]) with a safety factor of 100 [USEPA 2007]
(21) Criteria Continuous Concentration based on Final Residaul Value/Puerto Rico Water Quality Standard [USEPA 2009/PREQB 2003]
(22) Dissolved Criteria Continuous Concentration [USEPA 2009]
(23) Dissolved Criteria Continuous Concentration/Puerto Rico Water Quality Standard [USEPA 2009/PREQB 2003]
(24) Proposed Criteria Continuous Concentration [Buchman 2008]
(25) Total recoverable Criteria Continuous Concentration [USEPA 2009]
(26) MCL was used; there is not a PRWQS value established

TABLE 6-3

SUMMARY OF DETECTED LABORATORY RESULTS - GROUNDWATER
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References:

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TABLE 6-4

SUMMARY OF DETECTED LABORATORY RESULTS - CONCRETE CHIP
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	57CC01	57CC02	57CC03	57CC04	57CC04
Sample ID	57CC01	57CC02	57CC03	57CC04	57CC04D
Sample Date	1/30/2010	1/30/2010	1/30/2010	1/30/2010	1/30/2010
Semivolatiles (ug/kg)					
Bis(2-ethylhexyl) Phthalate	8100 U	5200 U	5400 U	1400 J	5200 U
Isophorone	48000	1200 J	6000	11000	1700 J
TPH (mg/kg)					
Diesel Range Organics	20 J	200	72	130	70
Inorganics (mg/kg)					
Arsenic	2.3	1.7	3.1	1.5	1.4
Barium	184	81.1	150	109	94.4
Beryllium	0.55	0.22 J	0.37 J	0.39 J	0.28 J
Cadmium	2.8 J	0.2 J	1.3 J	2.9 J	1.5 J
Chromium	13.3	7.2	19.1	8.1	7
Cobalt	1.4	1.9	2.5	1.5	1.8
Copper	12.1 J	13.3 J	31.2 J	23 J	12.9 J
Lead	13.4	7.6	8.3	6.6 J	4.5 J
Nickel	5.3	3.6 J	12.8	5.2	4.1
Vanadium	17.6	18.5	18.6	18	16.5
Zinc	16.7 J	17.3 J	23.2 J	19.2 J	27.4 J

Notes:

U - Not detected
J - Analyte present - Reported value is estimated
TPH - Total Petroleum Hydrocarbons

ug/kg - micrograms per kilogram
mg/kg - milligrams per kilogram

TABLE 6-5

SUMMARY OF DETECTED LABORATORY RESULTS - CONCRETE WIPE
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	57WS01	57WS02	57WS03	57WS04	57WS04
Sample ID	57WS01	57WS02	57WS03	57WS04	57WS04D
Sample Date	1/30/2010	1/30/2010	1/30/2010	1/30/2010	1/30/2010
Semivolatiles (ug/wipe)					
4-Chloro-3-methylphenol	330 U	28 J	330 U	660 U	660 U
Acenaphthene	1.4 J	2.1 J	1 J	1.6 J	1.5 J
Acenaphthylene	8.3 U	8.3 U	0.89 J	17 U	17 U
Fluorene	1 J	1.4 J	0.73 J	0.96 J	1.2 J
Phenanthrene	2.8 J	3.7 J	1.7 J	2.8 J	2.9 J
TPH (mg/wipe)					
Diesel Range Organics	2.1	1.9	1.9	1.8	2.2
Inorganics (ug/wipe)					
Antimony	0.29 U	0.48 J	0.29 U	0.29 U	0.29 J
Chromium	0.56 J	0.76 J	1.4	0.55 J	0.49 J
Cobalt	0.08 U	0.08 U	0.13 J	0.08 U	0.08 U
Copper	0.45 J	0.87 J	2	0.56 J	0.49 J
Lead	0.8 J	0.96 J	1.5 J	1.3 J	0.87 J
Nickel	0.1 J	0.23 J	23.1	0.1 U	0.1 J
Selenium	0.36 U	0.36 U	0.5 J	0.47 J	0.36 U
Tin	1.3 J	1.8 J	1.4 J	1.3 J	1.8 J
Zinc	4.9	7.3	6.5	10.6 J	5.5 J

Notes:

U - Not detected
J - Analyte present - Reported value is estimated
TPH - Total Petroleum Hydrocarbons

ug/wipe - micrograms per wipe
mg/wipe - milligrams per wipe

TABLE 6-6

SUMMARY OF DETECTED LABORATORY RESULTS - QUALITY ASSURANCE / QUALITY CONTROL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates								Field Blanks	
Sample ID	57ER01	57ER02	57ER03	57ER04[1]	57ER05	57ER06	57ER07	57ER08	57FB01	57FB02
Sample Date	1/26/2010	1/27/2010	1/28/2010	1/29/2010	1/30/2010	1/31/2010	2/1/2010	5/20/2010	1/26/2010	2/1/2010
Volatiles (ug/L)										
2-Butanone	2.2 J	1.4 J	1.3 J	0.61 J	NA	0.67 J	0.94 J	NA	1.8 J	4 J
Acetone	4.6	4	3.7	3 J	NA	2.9 J	2.5 J	NA	5.7	8.3 J
Acetonitrile	0.26 J	0.5 U	0.32 J	0.23 J	NA	0.5 U	0.26 J	NA	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	1.1
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	2.1
Chloroform	0.19 J	0.19 J	0.16 J	0.17 J	NA	0.2 J	0.18 J	NA	0.18 J	4.8
Chloromethane	0.46 J	0.5 U	0.31 J	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	1.2
Methylene Chloride	13	14	13	12	NA	14	13	NA	12	0.58
Toluene	5.1	4.8	3.7	3.3	NA	4.5	4.8	NA	4.9	0.5 U
Semivolatiles (ug/L)										
2-Methylnaphthalene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.068 J	NA	0.21 U	0.019 J
Acenaphthene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.08 J	NA	0.21 U	0.2 U
Acenaphthylene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.011 J	NA	0.21 U	0.2 U
Anthracene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.085 J	NA	0.21 U	0.2 U
Benzo(a)anthracene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.044 J	NA	0.21 U	0.2 U
Benzo(g,h,i)perylene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.013 J	NA	0.21 U	0.2 U
Benzyl Alcohol	5.1 U	5.3 U	5.4 UJ	5.4 UJ	5.26 U	5.1 U	5 U	NA	5.1 U	0.6 J
Chrysene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.039 J	NA	0.21 U	0.2 U
Fluorene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.06 J	NA	0.21 U	0.2 U
Indeno(1,2,3-cd)pyrene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.011 J	NA	0.21 U	0.2 U
Naphthalene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.2 U	NA	0.21 U	0.067 J
Phenanthrene	0.21 U	0.21 U	0.22 U	0.22 U	0.21 U	0.21 U	0.25	NA	0.21 U	0.2 U
Pyrene	0.21 U	0.21 U	0.028 J	0.22 U	0.21 U	0.21 U	0.12 J	NA	0.21 U	0.2 U
TPH (mg/L)										
Gasoline Range Organics	0.048 J	0.038 J	0.043 J	0.03 J	NA	0.029 J	0.035 J	0.04 J	0.048 J	0.03 J

TABLE 6-6

SUMMARY OF DETECTED LABORATORY RESULTS - QUALITY ASSURANCE / QUALITY CONTROL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates								Field Blanks	
Sample ID	57ER01	57ER02	57ER03	57ER04[1]	57ER05	57ER06	57ER07	57ER08	57FB01	57FB02
Sample Date	1/26/2010	1/27/2010	1/28/2010	1/29/2010	1/30/2010	1/31/2010	2/1/2010	5/20/2010	1/26/2010	2/1/2010
Total Inorganics (ug/L)										
Beryllium	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	NA	0.23 U	0.28 J
Copper	1.5 U	1.5 U	1.5 J	1.5 U	1.5 U	1.5 U	1.6 J	NA	1.5 U	1.5 U
Lead	2.2 J	1.8 J	1.8 U	2.9 J	1.8 U	2.5 J	2.7 J	NA	1.8 U	1.8 U
Nickel	0.96 U	0.96 U	2.1 J	0.96 U	0.96 U	0.96 U	0.96 U	NA	0.96 U	0.96 U
Zinc	1.3 J	7.8 J	2.9 J	1.2 J	1.7 J	6.8 J	34.5	NA	0.53 U	0.96 J

TABLE 6-6

SUMMARY OF DETECTED LABORATORY RESULTS - QUALITY ASSURANCE / QUALITY CONTROL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Trip Blanks						
Sample ID	57TB01	57TB02	57TB03	57TB04	57TB05	57TB06	57TB07
Sample Date	1/26/2010	1/26/2010	1/27/2010	1/29/2010	2/1/2010	2/2/2010	5/20/2010
Volatiles (ug/L)							
2-Butanone	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	NA	NA
Acetone	3.5 U	3.5 U	3.5 R	3.5 R	3.5 R	NA	NA
Acetonitrile	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Methylene Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
Semivolatiles (ug/L)							
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA
TPH (mg/L)							
Gasoline Range Organics	0.051 J	0.031 J	0.034 J	0.036 J	NA	0.029 J	0.036 J

TABLE 6-6

SUMMARY OF DETECTED LABORATORY RESULTS - QUALITY ASSURANCE / QUALITY CONTROL
SWMU 57 – FACILITY NO. 278 POL DRUM STORAGE AREA
PHASE I RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Trip Blanks						
Sample ID	57TB01	57TB02	57TB03	57TB04	57TB05	57TB06	57TB07
Sample Date	1/26/2010	1/26/2010	1/27/2010	1/29/2010	2/1/2010	2/2/2010	5/20/2010
Total Inorganics (ug/L)							
Beryllium	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA

Notes:

U - Not detected
UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
R - Result is rejected and unusable
NA - Not Analyzed
TPH - Total Petroleum Hydrocarbons
(1) The VOCs are from 2/2/2010; the TPH GRO results are from 5/20/2010

ug/L - micrograms per liter
mg/L - milligrams per liter

A-3 PHASE I RFI HISTORICAL WELL CONSTRUCTION LOGS

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT:	Naval Activity Puerto Rico SWMU 57		
PROJ. NO.:	119197, 6.2	BORING NO.:	57SB01
COORDINATES:	EAST: 939227.2415	NORTH:	804379.7914
ELEVATION:	SURFACE: 115.4	TOP OF PVC CASING:	118.42

Rig: Geoprobe 6610DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1.48"	--	3.25"	--	1/28/2010	0.0 - 24.0	Sunny, mid 80s	
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.1.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
1					57SB01-00		TOPSOIL (organics) 0.3		115.1
							CLAY w/ silt and f. sand, orange br, damp; slight plasticity, soft (residuum)		
2		D-1	2.7 68%		57SB01-01	BKG			
3								cement grout to surface	
4	4.0								
5								2" PVC Riser	
6		D-2	3.4 85%			BKG			
7									
8	8.0						8.0		107.4
9							CLAY w/ silt and little f. sand, orange br w/ tan/gray and blk mottling, damp, med plasticity, med stiff 9.8	Bentonite 8 to 10'	
		D-3	3.7 93%			BKG			105.6
10					57SB01-05		SAA (same as above) w/ increase in silt, friable		

DRILLING CO.:	JFA Geo & Enviro Scientists	BAKER REP.:	Robert Roselius
DRILLER:	Domingo Gonzalez	BORING NO.:	57SB01 SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB01

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						Continued from Sheet 1 (11)	2" PVC Riser	104.4
12	12.0	D-3 3.7 93%			BKG	Same as 8.0' to 9.8' (12)		103.4
13						SILT, orange br, moist to wet, no plasticity, loose		
14		D-4 1.8 45%			BKG		Sand 10 to 22'	
15						15.6'-16.0': CLAY w/ silt, lt gray and blk laminated, moist, med plasticity,		
16	16.0					med stiff (16)		99.4
17						same as 12.0' to 15.6' (moist silt)	2" PVC Screen 12 to 22'	
18		D-5 2.5 63%			BKG			
19						(18.5) same as 15.6 to 16.0' (laminated clay)		96.9
20	20.0					(20)		95.4
21						CLAY w/ silt and f. sand, orange br w/ tan/gray and blk mottling, friable, damp, slight plasticity, soft		
22		D-6 2.7 68%			BKG	(22)		93.4
23							Soil	
24	24.0							91.4
25						End of Boring at 24'		
26								
27								
28								
29								
30								

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB01 SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT:	Naval Activity Puerto Rico SWMU 57		
PROJ. NO.:	119197, 6.2	BORING NO.:	57SB02
COORDINATES:	EAST: 939428.8164	NORTH:	804431.4509
ELEVATION:	SURFACE: 121.9	TOP OF PVC CASING:	124.62

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1.48"	--	3.25"	--	1/26/2010	0.0 - 26.0	Sunny 84	
Length	4'	--	5'	--	1/27/2010	NA		23.39 TOC
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.1.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	15.0
Schedule 40 PVC Screen	2"	15.0	25.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
1				57SB02-00		TOPSOIL (organics) 0.3		121.6
						CLAY, some silt; brown; moist; med stiff; med plasticity (fill) 1.1		120.8
2	D-1	3.6 90%		57SB02-01	BKG	CLAY to COARSE SAND w/ some fine gravel; orange br. (some black mottling in fine grained matrix); dry to damp; no plasticity (fill)	cement grout to surface	
3								
4	4.0					4.0		117.9
5						CLAY to FINE SAND (weathered bedrock); tan br. w/ white mottling; damp; no plasticity	2" PVC Riser	
6	D-2	4.0 100%			BKG			
7								
8	8.0							
9						same as above (SAA) to 15'		
10	D-3	4.0 100%		57SB02-05	BKG			

DRILLING CO.:	JFA Geo & Enviro Scientists	BAKER REP.:	Robert Roselius
DRILLER:	Domingo Gonzalez	BORING NO.:	57SB02 SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB02

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11		D-3	4.0 100%			BKG	Continued from Sheet 1		
12	12.0							Bentonite 11 to 13'	
13		D-4	3.0 100%			BKG	SAA to 15'	2" PVC Riser	
14									
15	15.0						DPT refusal at 15', auger to depth for well installation 15.0		106.9
16		A-N					SAA to 26' (as observed from auger cuttings)		
17								Sand 13 to 25'	
18							tough augering at 18' (lt grey, hard, gravel sized pieces); easier augering thereafter		
19									
20									
21								2" PVC Screen 15 to 25'	
22									
23									
24									
25									
26	26.0							Soil	95.9
27							End of Boring at 26.0'		
28									
29									
30									

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB02 SHEET 2 OF 2

TEST BORING RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB03
COORDINATES: EAST: 939342.5 NORTH: 804396.0
ELEVATION: SURFACE: 118.4

Rig:	Geoprobe Track Rig 6610 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1.48"				1/26/2010	0.0 - 12.0	sunny, mid-80s	
Length	4'							
Type								
Hammer Wt.								
Fall								

Remarks: PID background (BKG) is 0.1.

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
					57SB03-00		TOPSOIL (organics)	0.3	118.1
1							SILT to SAND w/ gravel (former road base)	1.0	117.4
2		D-1	2.8 70%		57SB03-01	BKG	CLAY, little silt; orange br. w/ tan/gray, damp, med plasticity, med stiff (residuum)		
3									
4	4.0								
5									
6		D-2	4.0 100%			BKG		6.4	112.0
7							similar to above w/ some fine sand, friable, some olive color w/ black mottling, damp, slight to low plasticity, med stiff, soft (weathered bedrock)		
8	8.0								
9		D-3	4.0 100%		57SB03-05	BKG			
10									

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB03 SHEET 1 OF 2

TEST BORING RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
SO NO.: 119197, 6.2 BORING NO.: 57SB03

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11	D-3	4.0 100%			BKG	Continued from Sheet 1	
12 12.0						12.0	106.4
						End of Boring at 12.0'	
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB03 SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT:	Naval Activity Puerto Rico SWMU 57		
PROJ. NO.:	119197, 6.2	BORING NO.:	57SB04
COORDINATES:	EAST: 939313.4627	NORTH:	804431.8766
ELEVATION:	SURFACE: 116.4	TOP OF PVC CASING:	119.26

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1.48"	--	3.25"	--	1/28/2010	0.0 - 23.5	Sunny, mid 80s	
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				57SB04-00		TOPSOIL (organics) 0.2		116.2
1						CLAY, little silt and fine to med sand; damp; med plasticity; soft (residuum) 1.0		
2	D-1	2.7 68%		57SB04-01	BKG	1.9		114.5
3						CLAY, silt to fine sand, little med sand; olive; damp; very low plasticity; soft (residuum)	cemente grout to surface	
4	4.0					CLAY, little silt; orange br. w/ tan/ gray and some blk mottling, damp, med to high plasticity, med stiff		
5							2" PVC Riser	
6	D-2	3.8 95%			BKG			
7								
8	8.0							
9						SAA w/ more tan (whitish)/gray and less blk	Bentonite 8 to 10'	
10	D-3	3.9 98%		57SB04-05	BKG			

DRILLING CO.:	JFA Geo & Enviro Scientists	BAKER REP.:	Robert Roselius
DRILLER:	Domingo Gonzalez	BORING NO.:	57SB04 SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB04

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11 – 12.0	D-3	3.9 98%			BKG	Continued from Sheet 1	2" PVC Riser	
12.0 – 16.0	D-4	3.8 95%			BKG		Sand 10 to 22'	
16.0 – 20.0	D-5	3.7 93%			BKG		2" PVC Screen 12 to 22'	
20.0 – 23.5	D-6	3.5 100%			BKG	22 DPT refusal at 23.5'; build well w/ 22' TD based on possible GW ~18'	Soil	94.4 92.9
23.5 – 30						End of Boring at 23.5'		

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB04 SHEET 2 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB05
COORDINATES: EAST: 939306.6980 NORTH: 804337.846
ELEVATION: SURFACE: 118.1 TOP OF PVC CASING: 121.02

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1.48" ID	--	3.25" ID	--	1/27/2010	0.0 - 21.0	Sunny, 84	
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.6.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	11.0
Schedule 40 PVC Screen	2"	11.0	21.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				57SB05-00		TOPSOIL (organics) 0.3		117.8
1, 2	D-1	3.0 75%		57SB05-01 & duplicate	BKG	CLAY to F. SAND w/ some f. gravel, orange br. and dk br., damp, slight plasticity, med stiff (residuum) 3.0		115.1
3, 4 (4.0)						CLAY, little silt; orange br. w/ tan/ gray, damp, med to high plasticity, med stiff SAA w/ some black mottling 5.8	cemente grout to surface	
5, 6, 7, 8 (8.0)	D-2	4.0 100%			BKG	SAA w/ slight increase in grain size and friable	2" PVC Riser; Bentonite 9 to 11'	112.3
9, 10	D-3	4.0 100%		57SB05-05	BKG	SAA to 10.3' 10.3	Sand 9 to 21'	107.8

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB05 SHEET 1 OF 2

TEST BORING AND WELL CONSTRUCTION RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57

PROJ. NO.: 119197, 6.2 BORING NO.: 57SB05

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						Continued from Sheet 1		
12 (12.0)	D-3	4.0 100%			BKG	SILT to F. SAND w/ little clay; blk, gray & br mottled; damp; slight plasticity; soft (weathered bedrock)	Sand 9 to 21'	
13								
14	D-4	4.0 100%			1.5	14		104.1
					BKG	lt gray hard bedrock 14.5		103.6
15					20+	SILT to F. SAND w/ little clay; blk, gray & br mottled; damp; slight plasticity; soft (weathered bedrock)	2" PVC Screen 11 to 21'	
16 (16.0)								
17					60-150	17		101.1
18	D-5	4.0 100%			400+ peak at 18'	SILT and F. SAND w/ little clay; orange br, tan/gray and some blk, gray and dk br; wet at 18.0'; slight petro odor		
19					20-50			
20 (20.0)				below 18-20'				
21 (21.0)		1.0 100%			BKG	SAA, wet, DPT refusal at 21'; attempt to auger; auger refusal at 21'		97.1
22						End of Boring at 21.0'		
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius

DRILLER: Domingo Gonzalez BORING NO.: 57SB05 SHEET 2 OF 2

TEST BORING RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
PROJ. NO.: 119197, 6.2 BORING NO.: 57SB06
COORDINATES: EAST: 939264.2 NORTH: 804326.9
ELEVATION: SURFACE: 117.2

Rig:	Geoprobe Track Rig 6610 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1.48"				1/28/2010	0.0 - 12.0	sunny, mid-80s	
Length	4'							
Type								
Hammer Wt.								
Fall								

Remarks: PID background (BKG) is 0.1.

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
1				57SB06-00		TOPSOIL (organics) 0.3	116.9
2	D-1	3.0 75%		57SB06-01	BKG	CLAY w/ silt and fine to coarse sand, br, damp, slight to low plasticity, soft (fill/reworked)	
3						3.2	114.0
4	4.0					CLAY and SILT w/ f. sand, orange br w/ tan/gray (very little blk), damp, med plasticity, med stiff (residuum)	
5							
6	D-2	3.2 80%			BKG		
7						6.2	111.0
8	8.0					SILT and F. SAND w/ some clay, friable, orange/br w/ tan/gray, damp, slight plasticity, soft	
9							
10	D-3	3.0 75%		57SB06-05	BKG		

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB06 SHEET 1 OF 2

TEST BORING RECORD

Michael Baker Jr., Inc.

PROJECT: Naval Activity Puerto Rico SWMU 57
SO NO.: 119197, 6.2 BORING NO.: 57SB06

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11							Continued from Sheet 1	
		D-3	3.0			BKG		
12	12.0		75%					105.2
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: JFA Geo & Enviro Scientists BAKER REP.: Robert Roselius
DRILLER: Domingo Gonzalez BORING NO.: 57SB06 SHEET 2 OF 2

A-4 NOTES FROM AUGUST 2011 SITE VISIT

Appendix A.4

SWMU 57 (aka Pad 278)

Notes from Tetra Tech/Navy site visit of 8/2/11

A planning site visit was conducted between the Navy and Tetra Tech on August 2, 2011. Participants were Pedro Ruiz (NAVFAC Atlantic), Linda Klink (Tetra Tech PM), and Mike Whitten (Tetra Tech ecological risk assessment specialist).

The site consists of a large concrete pad and loading dock and the area immediately surrounding the pad and loading dock. The long axis of the concrete pad is oriented northeast to southwest. Grasses and other herbaceous vegetation such as Guinea grass (*Urochloa maxima*), ocean blue morning glory (*Ipomea indica*),flatleaf flatsedge (*Cyperus planifolius*), crack-open, also known as wild coffee (*Casearia sylvestris*), and knotgrass (*Paspalum distichum*) form a dense ground cover adjacent to the north and northwest edges of the concrete pad, and northward beyond the site. A dense upland forest is adjacent to the east, south, and southwest edges of the concrete pad. Trees and shrubs in the forested area include white lead tree, which is also known as tamarindillo (*Leucaena leucocephala*), white indigo berry (*Randia aculeata*), gumbo limbo (*Bursera simaruba*), and *Erythroxylum* sp.

Various birds and a few lizards were observed at SWMU 57 during the site visit. Wildlife that use the site, either or occasionally, are probably the same species found in other upland areas of NA Puerto Rico. These would include stray dogs and cats, rats, mice, mongooses, numerous birds, and various reptiles and amphibians.

A 7-inch high concrete containment curb surrounds the perimeter of the pad. No obvious cracks were observed in the curb, suggesting that rain runoff probably does not flow offsite from the pad, at least to any substantial extent.

There are no surface water bodies at or in the vicinity of the site. Based on available aerial photographs, the nearest water body is a mangrove swamp approximately 400 feet north of the site.

There are no ditches or signs of erosion or previous standing water at the site. Previous reports indicated that an “earthen drainage feature” (presumably a ditch) was located north of the site. No ditches exist north of the site in the area indicated by the previous reports, but a slight swale (only a few inches lower than the surrounding area) was noted. The swale was thickly vegetated by tall grass, and no signs of previous surface water were visible. This swale is upgradient of the concrete pad and drains away from SWMU 57, so it would not provide a potential migration pathway for contamination from the site.

The ground surface adjacent to the east, south, and southwest edges of the concrete pad slopes slightly downward (a few inches to approximately one foot), forming a shallow, nearly flat-bottomed swale about 10-20 feet wide. A steep hillside lies beyond the swale-like area. The hilltop varies in height (relative to the concrete pad) from about 8 feet to 20 feet. The swale contains scattered miscellaneous debris items such as plastic containers, scrap metal, and rusted drums. Hummocky soil mounding is present in some portions of the swale, presumably preventing or at least retarding the extent of surface water runoff from the swale. No water marks or other signs of previous standing water or water flow were noted in this swale.

Based on the topography and ground cover described above, surface water flow as a potential contaminant migration pathway from the site appears to be negligible. Previous reports indicate that the direction of groundwater flow in the vicinity of SWMU 57 is north-northwest toward the previously mentioned mangrove swamp located about 400 feet from the site, so groundwater might provide a contaminant migration pathway from the site to the swamp.

A-5 REVISED DRAFT SWMU 9 RFI INFORMATION

123236.PM.PC/D1.D1

Revised Draft

RCRA Facility Investigation Report for SWMU 9

Naval Station Roosevelt Roads

RCRA/HSWA Permit No. PR2170027203

Ceiba, Puerto Rico

Text - Volume I of II

Prepared For

Department of the Navy

Atlantic Division
Naval Facilities Engineering Command

Norfolk, Virginia

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CTO-099

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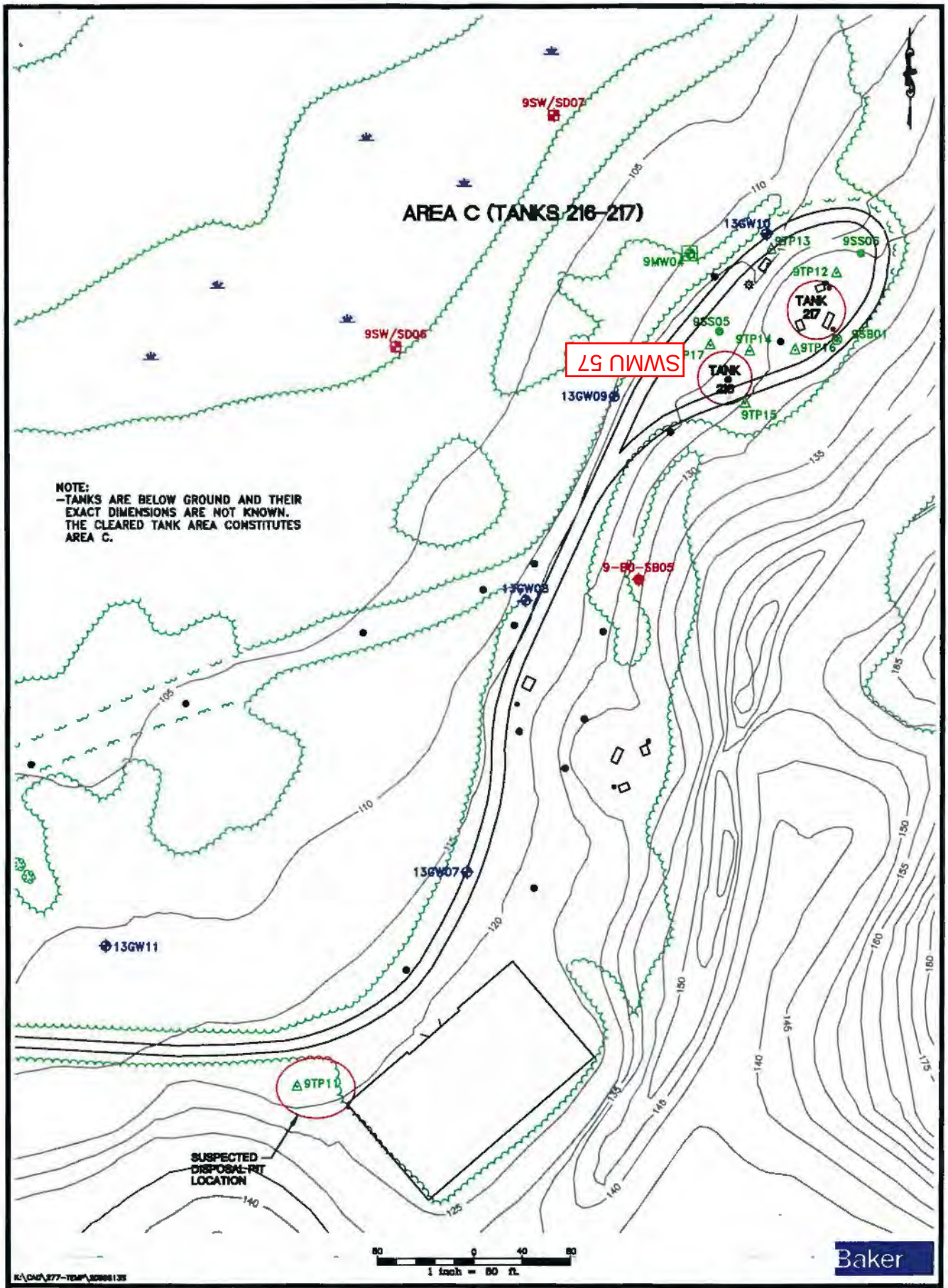
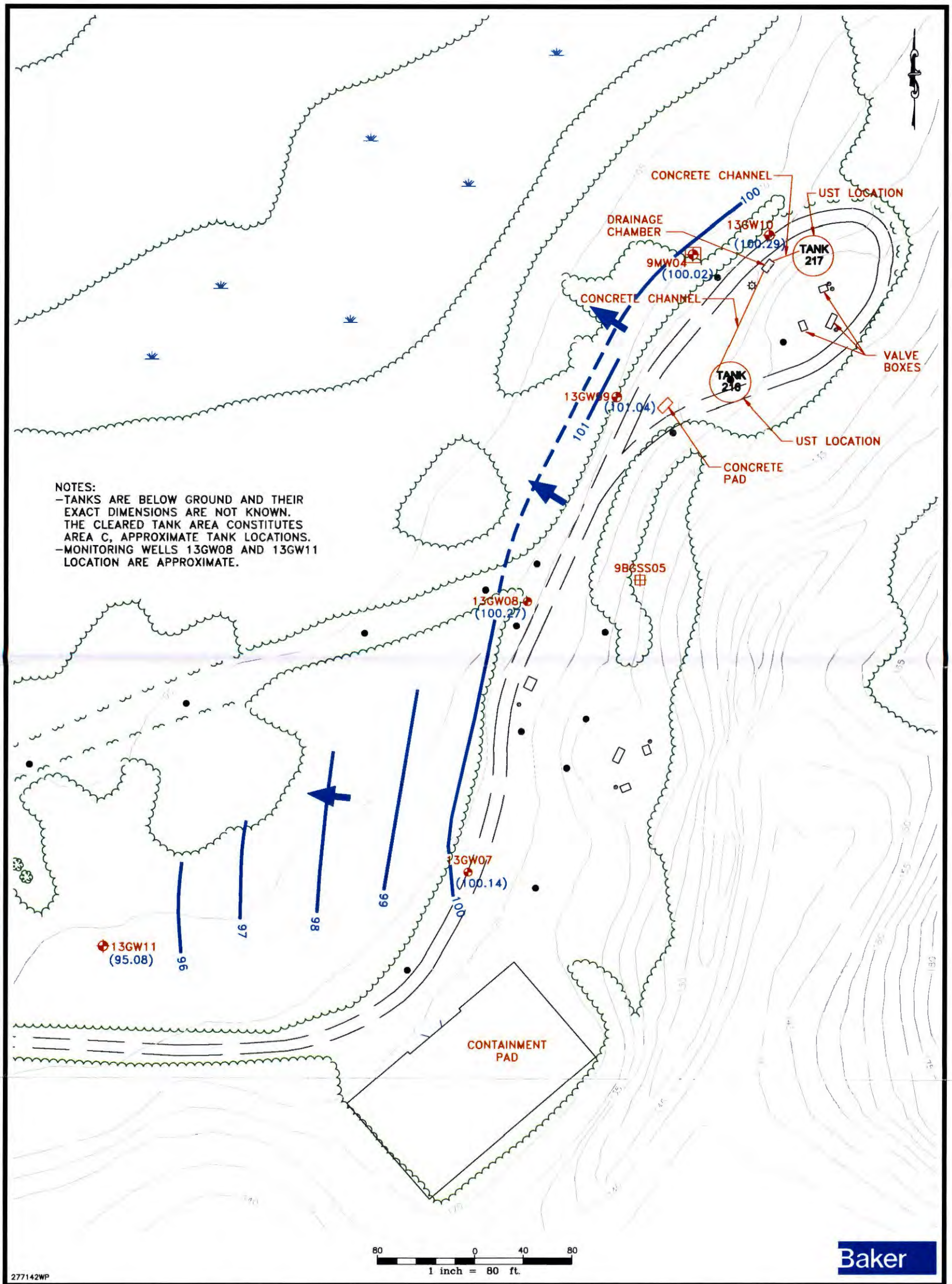


LEGEND

- SURFACE SOIL SAMPLE LOCATION (PHASE I)
- TEST PIT LOCATION (PHASE I)
- SOIL BORING LOCATION (PHASE I)
- EXISTING MONITORING WELL LOCATION
- MONITORING WELL LOCATION (PHASE I)
- SURFACE WATER AND SEDIMENT SAMPLE LOCATION (PHASE III)
- HYDROPUNCH SOIL AND/OR GROUNDWATER SAMPLE LOCATION (PHASE III)
- SURFACE ELEVATION CONTOUR
- SUSPECTED LOCATION OF DISPOSAL PIT
- TELEPHONE POLE

FIGURE 3-3
SAMPLING LOCATIONS
SWMU 9 – AREA C
TANKS 216 – 217

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



LEGEND

- EXISTING MONITORING WELL LOCATION
- MONITORING WELL LOCATION (PHASE I)
- (95.08) – GROUNDWATER ELEVATION (FT., MSL)
- 95 – GROUNDWATER ELEVATION CONTOUR
- 95 – INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- SURFACE ELEVATION CONTOUR
- TELEPHONE POLE

FIGURE 4-5
GROUNDWATER CONTOUR MAP – MAY 10, 1996
SWMU 9 – AREA C
TANKS 216 – 217

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

TEST PIT RECORD

Project:	NSRR-OU2-SWMU 9		CTO No.:	277	
Test Pit No.:	9TP11	Date:	4/13/96	Weather:	Sunny 80's
Endpoint Coordinates:		North:		North:	
		East:		East:	
		Elevation:		Elevation:	
Contractor:	Soil Tech	Equipment:	Ford 555D	Baker Rep.:	KAT/APS

AIR MONITORING

Time	PID (PS/BG)	FID (PS/BG)	Source

Definitions

PID=Photo Ionization Detector
FID=Flame Ionization Detector
PS=Point Source (in ppm)
BG=Background (in ppm)

TEST PIT CROSS SECTION

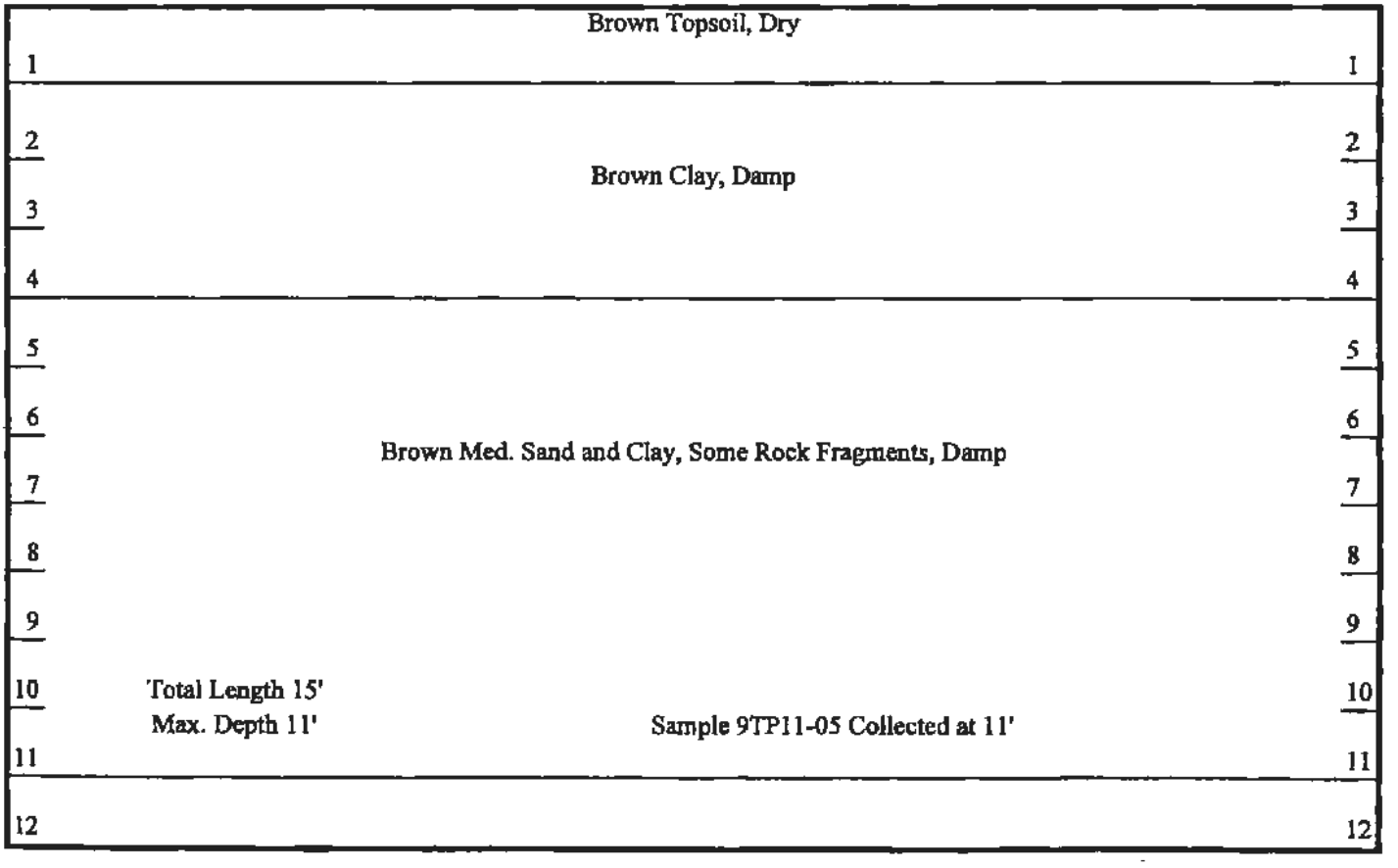


TABLE 3-3

SWMU 9 AREA C - TANKS 216-217
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

				Analysis Requested									Analysis Requested											
				Solid Samples									Aqueous Samples											
				Stateside Laboratory									Stateside Laboratory											
Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Benzene Toluene	Ethylbenzene Xylene	TPH-DRO/GRO(1)	Volatile Organic Compounds	Semivolatile Organic Compounds	Sulfide	Metalloids *	RCRA(2) Metals	Appendix IX Inorganics	Volatile Organic Compounds	Semivolatile Organic Compounds	Polychlorinated Biphenyls	Benzene Toluene Ethylbenzene Xylene	Water Quality	TPH DRO/GRO(1)	Cadmium	Total RCRA Metals	Total Metalloids *	Dissolved Metaloids *	Total Appendix IX Inorganics	Comments
I	**SURFACE SOIL SAMPLES**																							
	9SS05	0-1	3/20/96			X	X	X			X													
	9SS06	0-1	3/20/96			X	X	X			X													
	9MW04-00	0-1	3/20/96			X	X	X			X													
	SUBSURFACE SOIL SAMPLES																							
	9MW04-03	6-8	4/19/96			X	X	X			X													
	9MW04-05	10-12	4/19/96			X	X	X			X													
	9TP11-05	11	4/13/96			X	X	X			X													Test Pit
	9TP13-04	9	4/13/96			X	X	X			X													Test Pit
	9TP13-04D	9	4/13/96			X	X	X			X													Duplicate
	9TP14-05	10	4/13/96			X	X	X			X													Test Pit
	9TP14-05D	10	4/13/96			X	X	X			X													Duplicate
	9TP15-05	10	4/13/96			X	X	X			X													Test Pit
	9TP16-05	10	4/13/96			X	X	X			X													Test Pit
	9TP17-05	10	4/14/96			X	X	X			X													Test Pit
	GROUNDWATER SAMPLES																							
	9MW04	NA	4/24/96										X	X	X			X		X				Monitoring Well
	13GW07	NA	3/24/96										X	X	X			X						Monitoring Well
	13GW08	NA	3/24/96										X	X	X			X						Monitoring Well
	13GW09	NA	3/24/96										X	X	X			X						Monitoring Well
	13GW10	NA	3/24/96										X	X	X			X						Monitoring Well
	13GW11	NA	3/25/96										X	X	X			X						Monitoring Well

Notes:

bgs - below ground surface

* - arsenic and cyanide

(1) TPH-DRO/GRO - Total Petroleum Hydrocarbon Diesel Range Organics/Gasoline Range Organics

(2) RCRA Metals - Resource Conservation and Recovery Act Metals

TABLE 3-3

SWMU 9 AREA C - TANKS 216-217
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

				Analysis Requested								Analysis Requested											
				Solid Samples								Aqueous Samples											
				Stateside Laboratory								Stateside Laboratory											
Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Benzene Toluene Ethylbenzene Xylene	TPH-DRO/GRO(1)	Volatile Organic Compounds	Semivolatile Organic Compounds	Sulfide	Metalloids *	RCRA(2) Metals	Appendix IX Inorganics	Volatile Organic Compounds	Semivolatile Organic Compounds	Polychlorinated Biphenyls	Benzene Toluene Ethylbenzene Xylene	Water Quality	TPH DRO/GRO(1)	Cadmium	Total RCRA Metals	Total Metalloids *	Dissolved Metaloids *	Total Appendix IX Inorganics	Comments
	SEDIMENT SAMPLES																						
	9SD06	0-0.5	6/29/99			X	X	X	X		X												
	9SD07	0-0.5	6/29/99			X	X	X	X		X												
	SURFACE WATER SAMPLES																						
	9SW06	NA	6/29/99									X	X							X		X	
III	9SW07	NA	6/29/99									X	X							X		X	
	GROUNDWATER SAMPLES																						
	9MW04	NA	6/29/99													X		X					Monitoring Well
	13GW10	NA	6/29/99										X			X							Monitoring Well
	13GW10D	NA	6/29/99										X										Duplicate
	13GW11	NA	6/29/99									X				X							Monitoring Well

Notes:

bgs - below ground surface
* - arsenic and cyanide

(1) TPH-DRO/GRO - Total Petroleum Hydrocarbon Diesel Range Organics/Gasoline Range Organics
(2) RCRA Metals - Resource Conservation and Recovery Act Metals

TABLE 5-36

SUMMARY OF ORGANIC DETECTIONS IN SUBSURFACE SOIL - AREA C
SWMU 09 (TANKS 216 - 217)
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Sample ID Sample Date Depth Range (ft bgs)	EPA Region III Industrial RBC (ug/kg)	**EPA Region III Residential RBC (ug/kg)**	9MW04-03 04/19/96 6.00-8.00	9MW04-05 04/19/96 10.00-12.00	9TP11-05 04/13/96 11.00	9TP13-04D 04/13/96 9.00	9TP13-04 04/13/96 9.00	9TP14-05D 04/13/96 10.00	9TP14-05 04/13/96 10.00	9TP15-05 04/13/96 10.00	9TP16-05 04/13/96 10.00	9TP17- 04/14/ 10.0(
Volatiles (ug/kg)												
Acetone	204,400,000	7,821,429	11 U	12 U	12 U	95	74 J	11 U	11 UJ	12 UJ	24 J	31
Xylene (total)	4,088,000,000	156,428,571	6 U	6 U	6 U	6 U	2 J	6 U	6 U	6 U	6 U	7
Semivolatiles (ug/kg)												
Not Detected												
TPH (ug/kg)												
Gasoline Range Organics	100,000 [1]	100,000 [1]	33 U	33 U	35 U	34 U	19 J	33 U	33 U	35 U	37 U	41

Data Qualifiers:
J - Analyte present. Reported value may not be accurate or precise.
U - Not detected. The associated number indicates approximate sample concentration necessary to be dtected.
UJ - Not detected. Quantitation limit may be inaccurate or imprecise.

Notes:
NE - Not established.
ft bgs - feet below ground surface
ug/kg - micrograms per kilogram.
[1] Puerto Rico Environmental Quality Board Criteria.

TABLE 5-37

SUMMARY OF INORGANIC DETECTIONS IN SUBSURFACE SOIL - AREA C
SWMU 09 (TANKS 216 - 217)
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

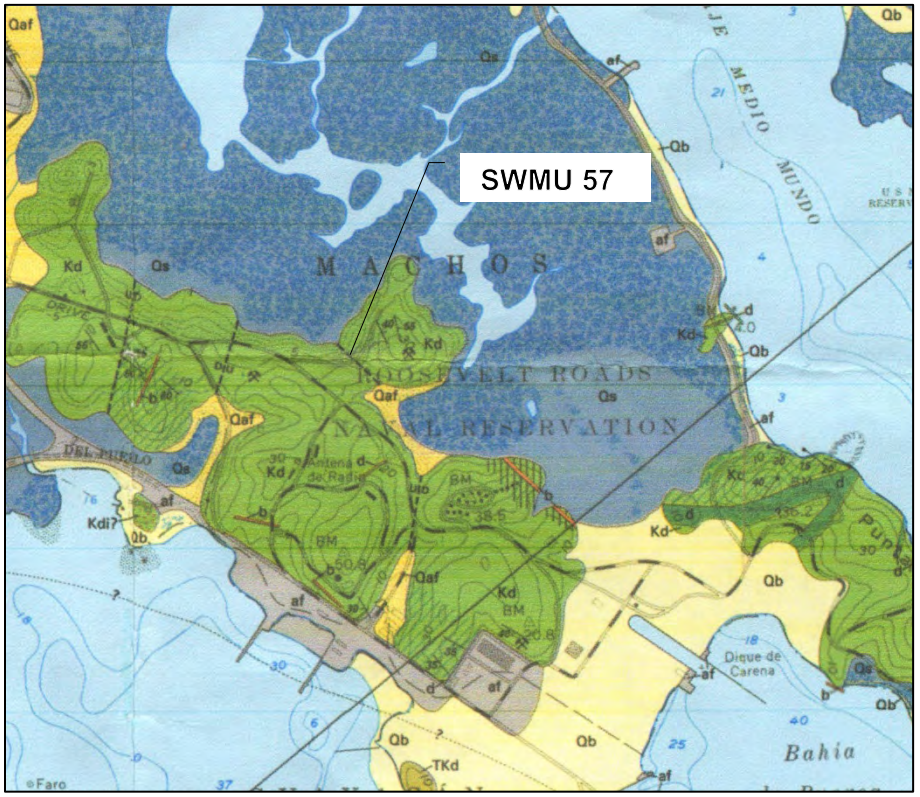
Sample ID Sample Date Depth Range (ft bgs)	2 X Average Detected Background (mg/kg)	**EPA Region III Industrial RBC** (mg/kg)	EPA Region III Residential RBC (mg/kg)	9MW04-03 04/19/96 6.00-8.00	9MW04-05 04/19/96 10.00-12.00	9TP11-05 04/13/96 11.00	9TP13-04 04/13/96 9.00	9TP13-04D 04/13/96 9.00	9TP14-05 04/13/96 10.00	9TP14-05D 04/13/96 10.00	9TP15-05 04/13/96 10.00	9TP16-05 04/13/96 10.00	9TP17- 04/14/ 10.0(
RCRA Metals (mg/kg)													
Barium	131	143,080	5,475	96.9	35.6	77.7	31.6	34.8	82.1	81.7	83.8	59.2	57.2
Chromium	26.90	6,100 [1]	230 [1]	28.3	20.4	24.2 R	24.4 R	26.2 R	22.4 R	22.4 R	22.4 R	29.1 R	24.9
Lead	4.79	400 [2]	400 [2]	1.4	1.2	5.2 J	6.4 J	14.5 J	26.2 J	22.1 J	24 J	31.5 J	2.2
Silver	ND	10,220	391	0.72	0.71	0.57	0.71	0.79	0.35 U	0.36 U	0.39 U	0.86	0.67

Data Qualifiers:
J - Analyte present. Reported value may not be accurate or precise.
U - Not detected. The associated number indicates approximate sample concentration necessary to be detected.
R - Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.

Notes:
NE - Not established.
mg/kg - milligrams per kilogram.
ft bgs - feet below ground surface
[1] The RBC for Chromium VI was used for screening because there is not a total chromium RBC available.
[2] 1996 EPA Soil Screening Guidance.

A-6 GEOLOGY OF SWMU 57

Appendix A.6 – Geology of SWMU 57



STRATIFIED ROCKS

Kd / Kdi — Daguao Formation; Kdi = intrusive breccia

Q — Alluvium, fanglomerate, and beach deposits

N

CONTACT—moderately to well-exposed between arrows, dotted where concealed, queried where inferred. Quaternary deposit contacts approximately located or gradational

FAULT—long dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain. U, upthrown side; D, downthrown side; number and arrow shows dip of fault; wrench faults and relative directions of movement shown by parallel arrows on map, by T (toward) and A (away) in cross sections

STRIKE AND DIP OF PRIMARY FOLIATION IN PLUTONIC ROCKS—Shown by planar arrangement of mafic minerals and autoliths(?).

- Inclined
- Vertical

STRIKE AND DIP OF FOLIATION IN METAVOLCANICLASTIC ROCKS—Inclined

STRIKE AND DIP OF BEDS

- Inclined
- Top determined from graded bedding or cross-bedding
- Possibly slumped outcrop
- Shear. Value shows dip where known

EPIDOTIZED ROCKS—Yellowish-gray to pale olive altered volcaniclastic rocks and lavas. Tremolite-actinolite fibers seen in former vesicles; mafic minerals bleached light-colored; in general original rock textures visible. Many altered areas too small to plot on map occur throughout quadrangles.

PILLOW LAVAS—zones of locally pillowed lavas in the Figuera Lava

af — ARTIFICIAL FILL

QUARRY OR BORROW PIT

Qaf — ALLUVIUM AND FANGLOMERATE (HOLOCENE AND PLEISTOCENE)—Unconsolidated to weakly consolidated, poorly- to well-sorted, clay- to boulder-sized material in fans and in stratified alluvial valley-fill deposits. Locally terraced; includes slope wash, small landslides and channel-fill deposits. Gradational into units mapped as predominantly alluvium, alluvial plain, and terraced deposits. Thickness locally more than 25 m

Qla — LAGOON DEPOSITS (HOLOCENE)—Mud and calcareous sand deposits periodically inundated by very shallow marine waters. Gradational into swamp deposits. Found on western side of Ensenada Honda. Thickness uncertain

Kd / Kdh / s — DAGUAO FORMATION (LOWER CRETACEOUS)—Interbedded volcanic breccia, lava, and subordinate volcanic sandstone and crystal tuff. The volcanic breccia is medium gray, massive, and is composed of clasts of dark-gray irregularly shaped subangular to subrounded granule- to cobble-size porphyritic andesite lava in a medium gray coarse-grained plagioclase and clinopyroxene crystal tuff matrix. The breccia units are commonly cut by fine-grained and porphyritic lava dikes. Breccia beds are generally exposed only in artificial excavations, and float on natural slopes consists largely of lava clasts. Lavas are principally medium-dark gray andesites with a pilotaxitic texture and andesine and clinopyroxene phenocrysts; they are locally amygdaloidal. Some of these lavas are flow breccias, with porphyritic andesite clasts commonly more than 5 cm in diameter, either welded together or in a matrix of sheared andesite. Some dark-greenish-gray, very fine-grained flows are also autobrecciated. Typical massive tuff breccia can be seen in housing excavations just northwest of Daguao; good breccia and lava exposures can be found along the coast southeast of Húcares. Coarse autoclastic lavas may be found throughout the section in the ridge directly west of Ensenada Honda and Langley Drive, on the Roosevelt Roads Naval Reservation. Dark- to medium-gray volcanic sandstones and tuffs are usually laminated to thin-bedded and graded, and are locally crossbedded. A few crystal tuffs are hornblende-rich; most sandstones and tuffs are composed of plagioclase and clinopyroxene grains like the matrix of the massive volcanic breccias, and fairly commonly are calcareous. The sandstones and tuffs generally form units only a few meters thick in the western part of the mapped area. Notably thicker sequences in the east are shown by diagonal lines. Thick sequences of thin-bedded to laminated tuff are well exposed along the coast from Punta Algodones to Punta Cascajo, on the Roosevelt Roads Naval Reservation. Rocks of the Daguao Formation are commonly epidotized and chloritized in varying degrees. Volcaniclastic hornfels (Kdh) occurs in a few places near the diorite and granodiorite stocks, and small exposures of phyllitic to schistose rocks (s) occur in one area north of Daguao, south of the keratophyre stocks (TKk). The formation interfingers with the overlying Figuera Lava in a few places (see text); its base is not exposed. The thickness of the Daguao is estimated to be on the order of 1000 to 1500 meters

SCALE 1:20 000

1 ½ 0 1 MILE

1 .5 0 1 2 KILOMETERS

CONTOUR INTERVAL 10 METERS
DASHED LINES REPRESENT 5-METER CONTOURS
DOTTED LINES REPRESENT 1-METER CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 0.3 METERS

APPENDIX B

AUTHORIZATIONS AND PERMITS

GOBIERNO DE PUERTO RICO

Departamento de Recursos Naturales y Ambientales

JUN 28 2012

PERMISO DE CONSTRUCCIÓN
POZO DE INVESTIGACIÓN AMBIENTAL

Navy BRAC Program Management Office Southeast POC
4130 Faber Place Drive, Suite 202
North Charleston, SC 29405

Permiso Núm. O-FA-PRE11-SJ-00338-30052012

El Solicitante en epígrafe radicó ante este Departamento una Solicitud de Permiso para construir dos (2) pozos de Investigación Ambiental en terrenos propiedad de Navy BRAC Program Management Office Southeast POC, localizados en la carretera Forestal Dr., Sector Roosevelt Roads, Municipio de Ceiba.

La construcción del pozo será utilizada para investigación del subsuelo en el área.

El Departamento de Recursos Naturales y Ambientales en virtud de los poderes que nos confiere la Ley Número 23 del 20 de junio de 1972, y la Ley Número 136 del 3 de junio de 1976, CONCEDE este permiso al solicitante (en adelante Concesionario) para construir dos (2) pozos de Investigación Ambiental en el lugar arriba indicado para los fines y propósitos antes mencionados, y conforme a las siguientes condiciones:

CONDICIONES GENERALES

1. El aprovechamiento del agua del pozo se limitará únicamente al uso del agua necesaria para las pruebas de calidad que se realicen.

2. El Concesionario permitirá al personal del Departamento la inspección de los pozos autorizados y someterá la información que se le solicite con relación a los mismos.

3. Este permiso o copia de éste con el sello del Secretario al relieve estará disponible para ser inspeccionado en el lugar de la perforación o de la construcción durante todo el tiempo en que se realice la obra.

4. Dentro de un periodo no mayor de treinta (30) días de finalizada la construcción del pozo, el Concesionario someterá a este Departamento un Informe de Terminación de Obras. El informe será firmado y certificado correcto por el contratista o ingeniero a cargo de las obras.

5. El Concesionario vendrá obligado a responder por los daños que pueda irrogarle a terceras personas o a la propiedad pública o privada en el proceso de construcción y/o utilización de las obras autorizadas mediante este permiso.

6. Este permiso no podrá ser transferido sin la autorización previa del Departamento de Recursos Naturales y Ambientales.

7. Este permiso estará sujeto a enmienda, suspensión o revocación por este Departamento conforme con el Reglamento para el Aprovechamiento, Uso, Conservación y Administración de las Aguas de Puerto Rico. No se entenderá que impone obligación alguna al Estado Libre Asociado de Puerto Rico o sus funcionarios a indemnizar al Concesionario por los daños que pueda sufrir como consecuencia de enmienda, suspensión o revocación.

PO Box 366147, San Juan, PR 00936
Tel. 787.999.2200 • Fax. 787.999.2303

CONDICIONES ESPECIALES

1. Se autoriza al Concesionario a hincar dos (2) pozos de Investigación Ambiental a nivel freático.

2. Este permiso se concede por el término de un (1) año el cual comenzará a partir de la fecha de aprobación.

3. El Informe de Terminación de Obras que se solicita en el Inciso Número 4 de las Condiciones Generales de este permiso deberá someterse utilizando el formato que acompaña este permiso. Este informe será sometido en original.

4. Junto al Informe de Terminación de Obras el Concesionario someterá los resultados de todas aquellas pruebas del subsuelo realizadas, incluyendo los niveles de agua medidos en el acuífero.

5. El Concesionario someterá los resultados al Departamento de todos los análisis de calidad, realizados a las aguas extraídas del pozo.

6. El Concesionario notificará a la Oficina Regional de Humacao de este Departamento al teléfono (787) 852-3666/3663 la fecha de comienzo de las obras autorizadas en este permiso.

El Concesionario tendrá derecho a solicitar una reconsideración a la determinación del Departamento o solicitar una vista administrativa de acuerdo a las disposiciones del Artículo 13 del Reglamento para el Aprovechamiento, Uso, Conservación y Administración de las Aguas de Puerto Rico, de no estar de acuerdo con algunas de las condiciones del presente Permiso. La solicitud deberá ser radicada por escrito dentro de un término de treinta (30) días a partir de la fecha de aprobación de este Permiso en la Secretaría del Departamento. De no recibirse dentro del término aquí establecido una solicitud de vista administrativa u objeción, se entenderá que el Concesionario aceptó el permiso con todos sus términos y condiciones.

Cualquier violación a la Ley Número 23 de 20 de junio de 1972, a la Ley 136 de 3 de junio de 1976, y a la Ley Número 416 de 22 de septiembre de 2004, según enmendadas, o el incumplimiento de cualesquiera de las condiciones en la presente Autorización podrá conllevar la revocación de esta.

Notifíquese:

Johanna Vázquez Arce
Secretaria Auxiliar
Secretaría Auxiliar de Permisos, Endosos y Servicios Especializados

Aprobado hoy 28 de junio de 2012.

DEPARTAMENTO DE RECURSOS NATURALES Y AMBINETALES
SECRETARÍA AUXILIAR DE PERMISOS, ENDOSOS
Y SERVICIOS ESPECIALIZADOS
DIVISIÓN DE PERMISOS Y FRANQUICIAS DE AGUA

INSTRUCCIONES GENERALES PARA COMPLETAR INFORME DE TERMINACIÓN DE OBRAS PARA POZOS

Complete las partes núm. 2 y núm. 3 para cada uno de los pozos autorizados en la Resolución de Permiso de Construcción de pozo. Asegúrese de que todos los anejos incluidos sean claros, precisos y leibles. Los términos utilizados en el informe se describen a continuación:

DUEÑO O USUARIO **Esta información deberá coincidir con la indicada en el permiso de construcción de pozo otorgado por el Departamento.**

DISEÑO Y CONSTRUCCIÓN DEL POZO **En la columna de "tipo y tamaño" de las perforaciones, especifique el tamaño de la perforación y la camisilla.**

SELLO SANITARIO **Especifique la profundidad desde la superficie a la parte inferior del sello. Los intervalos de roca sellados se refieren a aquellas partes del pozo sellado para evitar contaminación o para evitar la mezcla de agua proveniente de distintos estratos productivos.**

CERTIFICACIÓN **Es imprescindible que este informe sea certificado por el ingeniero o contratista a cargo de la construcción del pozo. Esta persona deberá llenar este informe y certificar el mismo. Todo informe que no esté debidamente certificado será devuelto al solicitante. NO SE OTORGARÁ NINGUNA FRANQUICIA PARA APROVECHAMIENTO DE AGUAS PÚBLICAS SI ESTE INFORME NO HA SIDO ACEPTADO POR ESTE DEPARTAMENTO.**

El Departamento solicitará información adicional cuando lo considere necesario para completar la evaluación de la solicitud de Franquicia pendiente.

Todo informe será radicado ante el Departamento de Recursos Naturales y Ambientales o enviado por correo no más tarde de 30 días de finalizada la obra, a la siguiente dirección:

DEPARTAMENTO DE RECURSOS NATURALES Y AMBIENTALES
DIVISIÓN DE PERMISOS Y FRANQUICIAS DE AGUA
P.O. BOX 366147
SAN JUAN, P.R. 00936

En caso de dudas sobre este informe puede escribir a la dirección anterior o llamar al teléfono 787-999-2200, extensión 2802 ó 2803.

INFORME DE TERMINACIÓN DE OBRAS PARA POZOS

I. DATOS DEL DUEÑO DE LOS TERRENOS O USUARIO DEL POZO

A. Dueño de los terrenos

Nombre _____

Dirección Postal _____
_____

Dirección Residencial _____
_____
Número Teléfono Residencial _____
Número Teléfono Trabajo_____

B. Usuario (de ser igual al dueño, indique igual):

Nombre:_____
Número Teléfono Residencial:_____
Número Teléfono Trabajo:_____
Dirección Residencial:_____
_____
Número de Permiso Construcción de Pozo: _____
Si posee una Franquicia de Agua, indique el número:_____
Indique el número de pozos construidos:_____

II. DATOS DEL POZO (DISEÑO Y CONSTRUCCIÓN)

A. Tipo de acción tomada:

construcción _____
profundización _____
rehabilitación pozo existente_____

B. Localización:

Municipio_____ Barrio_____
Carretera_____ kilómetro_____
Nombre o número asignado al pozo por el dueño o usuario:_____
Coordenadas: latitud_____ longitud_____
Elevación del terreno sobre el nivel del mar: _____pies

C. Fecha en que concluyó la construcción del pozo: _____/_____/_____
día mes año

D. Método de construcción:

a mano_____
rotatorio_____
percusión_____
otro_____
Explique_____

E. Perfil Litológico (de ser necesario use hojas adicionales):

Intervalos	Material Geológico
de_____a_____pies	_____
de_____"_____ "	_____
de_____"_____ "	_____
de_____"_____ "	_____

* Indique los intérvalos que producen agua.
** Describa el tipo de roca perforada por color, tipo de material, dureza, etc.

F. Tipo de camisilla:

acero_____ plástico_____ hormigón_____
otro_____ especifique_____

G. Especificaciones del pozo:

	profundidad (pies)	diámetro (pulg.)	material
barreno	de_____a_____	_____	
	de_____a_____	_____	
	de_____a_____	_____	
camisilla	de_____a_____	_____	_____
	de_____a_____	_____	_____
	de_____a_____	_____	_____
rejilla	de_____a_____	_____	_____
filtro grava	de_____a_____	_____	_____

H. Profundidad final del pozo: _____ pies.

I. Sello sanitario:

Dimensiones, en pies, del sello sanitario sobre la superficie del terreno:
espesor_____ largo_____ancho
Profundidad del sello sanitario bajo la superficie del terreno:_____ pies.
Material usado para el sello e intérvalos del pozo sellados:

Intérvalo	Material Usado
De _____pies hasta_____pies	_____
De _____ " " _____ "	_____
De _____ " " _____ "	_____

III. DATOS DEL POZO (BOMBEO Y PRODUCCIÓN):

A. Prueba de bombeo
Incluya los datos del nivel del agua vs. tiempo.
Fecha de inicio de la prueba: ____/____/_____; _____
día mes año hora
Tiempo de duración de la prueba de bombeo:_____horas
Nivel del agua antes de comenzar la prueba:_____pies
Razón de extracción durante la prueba:_____gal/min
Nivel del agua (nivel dinámico) al finalizar el bombeo: _____pies
Nivel de agua alcanzado, luego de finalizado el bombeo y recuperado el sistema:_____pies

Tiempo de recuperación del sistema:
_____horas_____min.

B. Indique si se realizó una prueba de acuífero:
_____no_____si

Incluya anejo en donde detallará el número de pozos de observación utilizados, la distancia de estos pozos al pozo de producción y los datos del nivel del agua vs. tiempo para cada uno de los pozos.

Fecha de inicio de la prueba:____día____mes____año.
Hora de inicio de la prueba:_____.
Tiempo de duración de la prueba:_____horas.

C. Análisis de calidad de agua del (los) pozo(s):
Incluya copia del análisis de calidad certificado por un químico licenciado.

D. Especificaciones del motor y la bomba

Marca y modelo del motor:_____
Capacidad del motor:_____HP
Marca y modelo de la bomba:_____
Capacidad de la bomba:_____gal/min.
Profundidad a que se instaló la bomba:_____pies
Incluya gráfica de curvas de eficiencia de la bomba

E. Metro de flujo instantáneo y/o acumulativo

Marca:
Número de serie:
Modelo:
Unidades de medida del metro:_____
Lectura instantánea
Lectura acumulativa registrada:_____
Factor de conversión:_____
Fecha de instalación:_____

CERTIFICACIÓN

Certifico que este pozo fue construido bajo mi supervisión y que la información declarada en este informe es cierta y correcta según mi mejor entender y conocimiento.

_____ Fecha

_____ firma del contratista o ingeniero a cargo de las obras

Nombre del contratista o ingeniero a cargo de las obras:_____
Dirección postal:_____
_____
_____

INFORME DE TERMINACIÓN DE OBRAS PARA POZOS

I. DATOS DEL DUEÑO DE LOS TERRENOS O USUARIO DEL POZO

A. Dueño de los terrenos

Nombre NAVY BRAC Program Management Office Southeast POC

Dirección Postal 4130 Faber Place Drive, Suite 202
North Charleston, SC 29405

Dirección Residencial Naval Activity Puerto Rico, Ceiba

Número Teléfono Residencial _____
Número Teléfono Trabajo 843-743-2130

B. Usuario (de ser igual al dueño, indique igual):

Nombre: Igual
Número Teléfono Residencial: _____
Número Teléfono Trabajo: _____
Dirección Residencial: _____

Número de Permiso Construcción de Pozo: O-FA-PRE11-SJ-00338-30052012
Si posee una Franquicia de Agua, indique el número: _____
Indique el número de pozos construidos: 2

II. DATOS DEL POZO (DISEÑO Y CONSTRUCCIÓN)

A. Tipo de acción tomada:

construcción x
profundización _____
rehabilitación pozo existente _____

B. Localización:

Municipio Ceiba **Barrio** Roosevelt Roads
Carretera Forestal Drive **kilómetro** _____
Nombre o número asignado al pozo por el dueño o usuario: 57GW09
Coordenadas: latitud 804369.24 **longitud** 939299.78
Elevación del terreno sobre el nivel del mar: 118.42 **pies**

C. Fecha en que concluyó la construcción del pozo: 05 / 06 / 2012
día mes año

D. Método de construcción:

a mano _____
rotatorio x
percusión _____
otro _____
Explique _____

E. Perfil Litológico (de ser necesario use hojas adicionales): Ver Bitácora de Cata adjunta Num. 57SB23/57GW09

Intervalos	Material Geológico
de _____ a _____ pies	_____
de _____ " _____ "	_____
de _____ " _____ "	_____
de _____ " _____ "	_____

* **Indique los intérvalos que producen agua.**
** **Describa el tipo de roca perforada por color, tipo de material, dureza, etc.**

INFORME DE TERMINACIÓN DE OBRAS PARA POZOS

I. DATOS DEL DUEÑO DE LOS TERRENOS O USUARIO DEL POZO

A. Dueño de los terrenos

Nombre NAVY BRAC Program Management Office Southeast POC

Dirección Postal 4130 Faber Place Drive, Suite 202
North Charleston, SC 29405

Dirección Residencial Naval Activity Puerto Rico, Ceiba

Número Teléfono Residencial _____
Número Teléfono Trabajo 843-743-2130

B. Usuario (de ser igual al dueño, indique igual):

Nombre: Igual
Número Teléfono Residencial: _____
Número Teléfono Trabajo: _____
Dirección Residencial: _____

Número de Permiso Construcción de Pozo: O-FA-PRE11-SJ-00338-30052012
Si posee una Franquicia de Agua, indique el número: _____
Indique el número de pozos construidos: 2

II. DATOS DEL POZO (DISEÑO Y CONSTRUCCIÓN)

A. Tipo de acción tomada:

construcción x
profundización _____
rehabilitación pozo existente _____

B. Localización:

Municipio Ceiba **Barrio** Roosevelt Roads
Carretera Forestal Drive **kilómetro** _____
Nombre o número asignado al pozo por el dueño o usuario: 57GW08
Coordenadas: latitud 804299.26 **longitud** 939277.72
Elevación del terreno sobre el nivel del mar: 121.10 **pies**

C. Fecha en que concluyó la construcción del pozo: 07 / 06 / 2012
día mes año

D. Método de construcción:

a mano _____
rotatorio x
percusión _____
otro _____
Explique _____

E. Perfil Litológico (de ser necesario use hojas adicionales): Ver Bitácora de Cata adjunta Num. 57SB16/57GW08

Intervalos	Material Geológico
de _____ a _____ pies	_____
de _____ " _____ "	_____
de _____ " _____ "	_____
de _____ " _____ "	_____

* Indique los intérvalos que producen agua.
** Describa el tipo de roca perforada por color, tipo de material, dureza, etc.

2012 JUL 18 AM 9:32

APPENDIX C

FIELD FORMS DOCUMENTATION

C-1 PROJECT PERSONNEL SIGN OFF SHEET

C-2 FIELD LOGBOOKS

C-3 SAMPLE LOG SHEETS – SOIL

C-4 BORING LOGS

C-5 MONITORING WELL CONSTRUCTION SHEETS

C-6 SAMPLE LOG SHEETS– GROUNDWATER

C-7 MONITORING WELL DEVELOPMENT RECORDS

C-8 LOW FLOW DATA SHEETS

C-9 EQUIPMENT CALIBRATION SHEETS

C-10 SAMPLE LOG SHEETS - QC

C-11 SAMPLE LOG SHEETS - IDW

C-12 SURVEY DATA

C-13 CHAIN OF CUSTODY RECORDS

C-14 IDW DISPOSAL MANIFEST

C-1 PROJECT PERSONNEL SIGN OFF SHEET

SAP WORKSHEET #4 -- PROJECT PERSONNEL SIGN-OFF SHEET

(UFP-QAPP Manual Section 2.3.2)

Name	Organization/Title/ Role	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Linda Klink, PE	Tetra Tech PM	See Worksheet No. 1 Tetra Tech Title and Approval Page	All	
Tom Johnson, PhD.	Tetra Tech QAM	See Worksheet No. 1 Tetra Tech Title and Approval Page	All	
Matt Soltis	Tetra Tech HSM/Manages Corporate Health and Safety Program	See HASP signature Page		
Fred Ramser	FOL/SSO		All	
Joseph Samchuck	DVM		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-37	6-28-12
Kelly Carper	Project Chemist		Worksheet s #12, #14, #15, #19, #20,# 23-28, #30, #34-37	6/4/12
Jennifer Obrin	Katahdin PM		Worksheets #12, #14, #15E, #19, #20, #23-28, #30, #34-37	
~~GEOENVIROTECH~~ TBD Héctor R. Babilonia	Driller		Worksheets #12, #14, #17	6/4/12
UTILITY CLEARANCE (LOCATOR) HARDY Rodriguez	GEOENVIRONTECH			6/4/12

SAP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET

(UFP-QAPP Manual Section 2.3.2)

Name	Organization/Title/ Role	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Linda Klink, PE	Tetra Tech PM	See Worksheet No. 1 Tetra Tech Title and Approval Page	All	
Tom Johnson, PhD.	Tetra Tech QAM	See Worksheet No. 1 Tetra Tech Title and Approval Page	All	
Matt Soltis	Tetra Tech HSM/Manages Corporate Health and Safety Program	See HASP signature Page		
Fred Ramser	FOL/SSO	Fred W Ramser	All	5/25/12
Joseph Samchuck	DVM		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-37	
Kelly Carper	Project Chemist		Worksheet s #12, #14, #15, #19, #20,# 23-28, #30, #34-37	
Jennifer Obrin	Katahdin PM	Jennifer Obrin	Worksheets #12, #14, #15E, #19, #20, #23-28, #30, #34-37	5/24/12
TBD	Driller		Worksheets #12, #14, #17	
Chuck Kelly	SSHSO	Chuck W Kly	All	6/4/12

C-2 FIELD LOGBOOKS

Work continued from Page /

SWMU 57 RFI Analog Geophysical Investigation
6/6/12 0800 Temp 86° Sunny

- Investigation started @ SW corner of Pad and proceeded N - then W - and S along suspected border of scattered debris area.
- Conducted by C Kelly using White's Spectrum XLT E-series and visual observations
- Various debris located in area. Major debris including corroded out drums, metal pieces, construction materials, and various trash pieces were located along the ~~SE~~ - SW edge of the concrete pad.
- Debris started to become less dense ~~as I moved~~ further from pad
- Debris was also located along SE edge of Pad, including old battery, trash, and varios construction supplies
- Debris area was pin flagged and GPS'd @ PI's
- Area boundaries were extended to SE Edge of Pad
- Some various trash pieces (i.e. beer cans, bottles, various small plastic containers) were located far (~ >100') beyond debris area in forested locations. These areas were not included in the debris area due to very low density of trash
- A second battery was located after further Investigation
- A total of 5 drums were located
- Locations of drums and batteries were GPS'd

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Work continued to Page

SIGNATURE DATE

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

B 100 P ©

Work continued from Page 57

Photo Log	Description	Facing
001	Outboard motor cover	N
002	Construction Timber	W
003	Electrical line detached from Pole	W
004	" " cut	W
005	Steel pipe protruding from ground	S
006	Concrete block	S
007	various trash (beer cans)	N
008	Screen filter trash	E
009	class and screen trash	S
010	Pipe protruding from ground	N
011	Corroded Drum	S
012	"	N
013	Electrical Box	E
014	Plastic Pipe	E
015	PVC Pipe (6")	E
016	Old Battery	S
017	"	N
018	Construction timbers	S
019	Corroded drum	SW
020	Scrap metal debris	NE
021	Corroded drum	W
022	"	E
023	Scrap metal, possibly auto muffler	W
024	"	W
025	Rubber tubing / Hose	S
026	"	SW
027	Corroded drum	E
028	"	S
029	Bottom of drum	E
030	Battery #2	N
031	Battery #2	N

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Work continued to Page

SIGNATURE

DATE

DISCLOSED TO AND UNDERSTOOD BY DATE WITNESS DATE

B 100 P ©

6-4-12

FRED W RAMSER + CHUCK KELLY
ENROUTE TO PUERTO RICO
1330 - ARR IN SAN JUAN A.P.
1400+ PICK UP TWO CYL. N_2 GAS
+ ENROUTE TO NARR
- RUN LATE
1645 PICK UP COOLERS @
VISITOR CENTER
+ EQUIPMENT LOCKED
CM. KAZALL GONE FOR
THE DAY
+ DO BOT. INVENTORY
- A FEW "4" 1 GALS BROKE
STILL HAVE ENOUGH FOR JOB.
1730 FWR + CK LV NAPR FOR PARQUADO
HOTEL.
- SHOPPING FOR DISPOSABLE
SUPPLIES

6-5-12

0700 FRED W RAMSER & CHUCK K.
ON SITE

+ UTILITY LOCATOR ON SITE
- HARDY RODRIGUEZ (GEOPHYSO
- HECTOR BABILONIA DRILLER/
+ HELPER

1000 ABRAHAM NUNEX ARR ONSITE
W/ RIG
(- SET UP DECON

MARKED OUT FUEL LINE
- NEEDED TO MOVE

1200 DRILLERS go to LUNCH
-

1230 CALIBRATE PID

1445 SPL REFUSAL @ 20' @ 576W09
DRY HOLE @ 1500
- Decided to AUGER DOWN
- WL @ 576W01 = 12.5' BGS
TD ~ 27.5' BGS

TUESDAY

6-5-12

WELL CONSTRUCTION MATL.
- 0.010 SLOT SCREEN
+ 20/30 SAND
- STANDARD ~~SAND~~ SILICA CO
DAVENPORT FLA JACKSONVILLE, FLA, MIAMI FLA
- CETCO BENTONITE

CUTTINGS ARE MOIST +/WET TO 22'
+ INSTALL WELL 576W09
- 13-23 SCREEN
- 11-23 SAND 5.5 BAG #50
+ 8-11 BENT ~3/4 BAG
HYDRATED BENT ~ 10 gals H2O

1735 FWR + GK GOTO FIELD OFFICE
- EQUIP ON CHARGE
- DRILLER CLEAN UP/GROUT 576W09
- MTG @ 0700 TOMORROW

WEDNESDAY

6-6-12

0700 CHUCK KELLY + FREDERICK LV HOTEL FOR SITE
0730 ONSITE: FRED WRIGHT } PLANS
CHUCK KELLY }

ABRAHAM NUNEZ } GEOSYNTEC
HECTOR BABILONIA }

SOW: CK: MAG SURVEY ON
DEBRIS AREA

DRILLERS/FWR
+ SPL @ 575B16 INSTALL 57 GW08
- 575B16 0001 } FULL SUITE
0103 } VOCs
~10-12 } metals
SVOCs
+ PCBs

0900 GENERATED TRIP BLANK
FOR SOILS MED LEVEL
+ LOW LEVEL APPIX VOCs
TB-060612-01

1400 GENERATED EQUIPMENT/RINSATE
BLANK FOR DPT SOIL SAMPLE
TOOLS. DI H_2O: LOT 080099
EXP 2012-09
NERL REAGENT GRADE
EB-060612-01 DI H_2O

6-6-12

1430 BEGIN TO INSTALL
576W08
DID SCREEN @ 29 / 19 29
(SAND 20-30)
SAND 17-29'
BENTONITE 15-17
5 1/2 BAGS SAND
#50
HYDRATED SEAL w/ ~10 gal H_2O

1700 DRILLERS COMPLETED
PAD @ 576W09

- DRILLERS USED TEMP PC.
OF RISER @ 576W08 TO
GRT SCREEN/SAND/BENT. SEAL
INSTALLED ⇒ PLAN TO GROUT
+ PAD TO MORROW MORNING

6-7-12

0700 FRED W RAMSER } TETRA TECH
CHUCK KELLY }

ABRAHAM NUNEZ } DRILLERS
HECTOR BABILONIA }

SOW: C.K. + COLLECT SOIL
CONTINUE SPLS
AS DETERMINED
+ 0-3' SB @ LOADING DOCK
GPS UTILITIES/LOADDOCK
FWR: DEVELOP 576W09
DO SBs (DEEP) w/
DRILLERS
DRILLERS: GROUT + PAD
@ 576W08

0800 CALIBRATED HORIBA + PID
- DECON 12VDC PUMP FOR
DEV.
0800 GENERATED TB-060712-02 FOR SOIL SPLS
0840 FWR SET UP TO DEV. 576W09
- DRILLERS CONT. TO INSTALL 576W08

1055 COMPLETED DEV. WELL 576W09

6-7-12

1130 COMPLETED PAD + BOLLARDS @ 576W08

1140 DRILLERS LV. SITE FOR LUNCH + PLAN TO DO SB14 1ST THEN PROCEED TO SB's IN THE DISPOSAL PIT AREA + COMPLETED DEV. OF 576W09

CONTACTED SURVEY - ARRANGED FOR HIM TO BE HERE ON MONDAY AM: 700-800

1300 SET UP ON 575B13 -0-12' 0 ppm NO STAINING TWO HITS ON PID

1320 MOVE TO 575B14

1400 COLLECTED 0001, 0103 + 0911 @ 575B14 NO PID HITS NO VISIBLE STAINING. METAL SCRAPP AT SURFACE SCARCE

6-7-12

~~1317~~ MOVE RIG TO SB15

1435 BEGIN TO DRT @ 575B15

1530 MOVE RIG TO 575B17

COMPLETE 575B17

MOVE RIG TO 575B18

COMPLETED SPL @ 575B18

WILL HOLD SPL'S TO SHIP TO-MORROW

6-7-12

1800 FLR + CK W SITE

+ DRILLER DEMOB RIG
- WILL RETURN TOMORROW TO COMPLETE PARS & PAINT
CLEAN UP SITE

6-8-12

0700 FRED W ROBINSON } TETRA
CHUCK KELLY } TECH
+ ON SITE
- CALIBRATE EQUIP
- LOAD SPL EQUIP
+ SOW
- CK COMPLETE CONT. SOIL SAMPLING
- FLR DEV. 576W08

1110 COMPLETED DEV. OF 576W08
W/D ~ 30 gal

- FLR DOES PAPER WORK
+ CK CONT COLLECT SPLS
- SURVEY IN CONT. POINTS

1300 ABRAHAM NUNEZ ARR
ON SITE
- CLEAN UP
- BOLLARDS
- PAINT

1315 COLLECT IDW SOIL FROM
~~TWO~~ THREE DRUMS 1 FULL + 1/4 FUL
INVENTORY 1 DRUM H_2O
3 DRUMS SOIL
IDW-060812-01 (SOIL)

6-8-12

1440 DRILLERS COMPLETED WORK ON SITE

1450 GENERATED EB ON HAND AUGER
EB-060812-02

PACK SPLS FOR SHIPMENT

1630 FUR + CK ON SITE
+ CONTACTED LAB
- PROVIDED TRACKING # FOR SAT. DELIVERY/PICKUP

6-9-12

0745 FRED W. RAMSER TETRA
CHUCK KELLY TECH
+ SOW
SAMPLE GW WELLS

FUR: 576W02: M/SVOC/PCBS
COLLECT DUP → 576W05: V/M/SVOC/PCBS
576W03: M/PCBS

CK: 136W07: M/PCBS
576W07 M/PCBS
576W04 M/PCBS

0800 TRIP BLANK: TB-060912-03
- COLLECT ROUND WL'S

1800 TO DAYS SUMMARY
- CK COLLECTED SPCS
136W07, 576W07 + 576W04
METALS + PCBS (NO PCB. NEED)

- FUR COLLECT 576W02 +
576W05 ⇒ FULL-SUITE + DUP
FD060912-01

6/9/12 WATER LEVELS

WELL	DTW	PID	TIME
576W02	21.81	0.0	900
136W07	18.84	0.0	902
576W09	16.99	13.5	905
576W05	17.78	0.0	906
576W04	16.22	0.0	908
576W01	15.24	0.0	909
576W08	20.79	0.0	910
576W07	20.85	0.0	911

6-10-12 SUNDAY

0730 ONSITE: FRED W. RAMSER
CHUCK KELLY

SOW: SAMPLE GW WELLS

FWR: 576W09: V, MET, SV, PCB, PLUS
VOS/MS/D

CK: 576W01: Mets/PCBs
- COLLECT RINSATE
V, SV, METS + PCBs

1050 COLLECTED AQUEOUS IDW SPL
IDW-061012-01

1200 GENERATED EB-061012-03
RINSATE BLANK FOR
BLADDER PUMP
LOT # 059169
EXP JULY 2012
NERL REAGENT GRADE
WATER POURED OVER PUMP

6-10-12

1500 PACK SAMPLES ON ICE/CLEAN UP OFFICE

1600 PUR + CK LV SITE

6-11-12

0700 FRED WRIGHT } TERRA
CHUCK KELLY } TECH
SOW - DEMOB EQUIPMENT (CK)
- PREP SPLS FOR SHIPPING

PUR: COLLECT SPL FRO 576W08 PLUS MS/MSD

0815 RAFAEL OCAMPO ARR ON SITE
- CHUCK TO ESCORT THROUGH POINTS TO BE SURVEYED

1300 COLLECT SPL @ 576W08 PLUS DUPLICATE
- DEMOB ACTIVITIES

1430 CK TO RETURN N_2 CYL.
PUR PACK SPLS/EQUIP TO SHIP

1600 PUR LV SITE

C-3 SAMPLE LOG SHEETS - SOIL

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB13-0001
Sample Location: 57SB13
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1055 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Brown	Sandy silt, very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

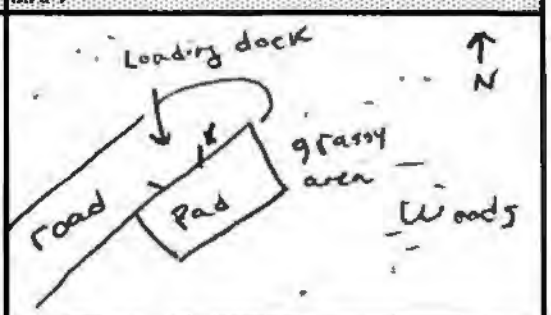
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2oz	✓	

OBSERVATIONS / NOTES:

- Some large shell fragments in soil
- No refusal
- very few roots / organic matter

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	FD-060712-01 / 0000HRS

Signature(s): Charles Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB13-0103
Sample Location: 57SB13
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12	1-3 ft	1'-1.5' Brown	Sandy Silt, mostly dry
Time: 1130		1.5'-2.5' light tan	Sand, dry
Method: HA			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

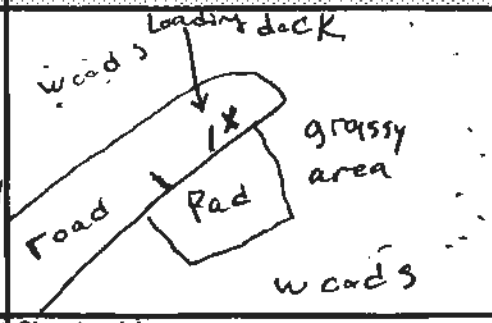
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2oz	✓	

OBSERVATIONS / NOTES:

- Refusal @ 2.5', large packed Shell and Coral fragments
- 1-1.5' bgs had some shells & gravel
- 1.5'-2.5' very large shell & coral pieces

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): C Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB14-0001
Sample Location: 57SB14
Sampled By: FRED W. RAMSEY
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1340 Method: DPT Monitor Reading (ppm): 0.0	0 - 1 ft	DK BRN	SAND/CLAY/GRAVEL (DRY)

COMPOSITE SAMPLE DATA:

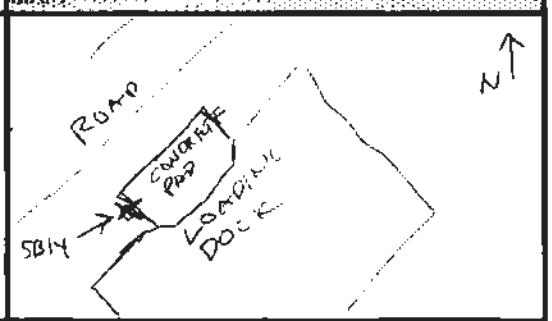
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred W. Ramsey

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB14-0103
Sample Location: 57SB14
Sampled By: FRED W RAMSEY
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1345 Method: DPT Monitor Reading (ppm): 0	1-3 ft	YEL BRN	CLAY TR SILT DRY TR GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB14-0911
Sample Location: 57SB14
Sampled By: FRED WRAMI
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1355 Method: DPT Monitor Reading (ppm): 0	9'-11'	VARIEGATED BRN/BLK/GRAY	SAND+SILT WEATHERED BDRK MOIST

COMPOSITE SAMPLE DATA:

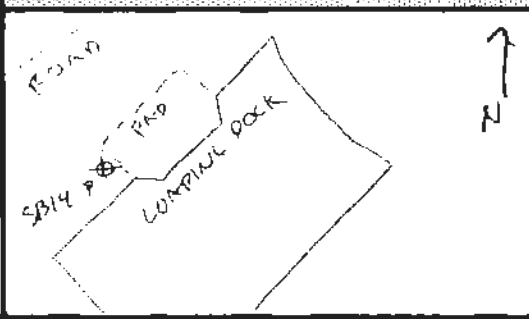
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred W Ramen

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB15-0001
Sample Location: 57SB15
Sampled By: FRED RAMSER
C.O.C. No.: 0942

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1500 Method: DPT Monitor Reading (ppm): 0	0 - 1 ft	DK BRN	SAND/SILT/CLAY/GRAVEL DRY

COMPOSITE SAMPLE DATA:

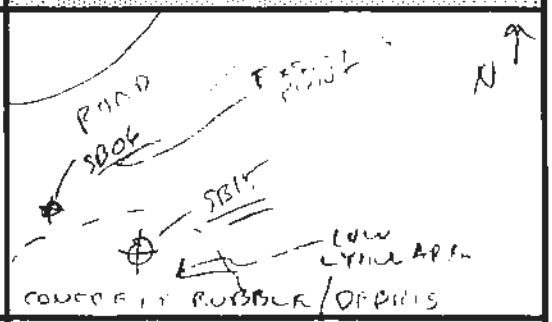
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2 oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD: —
Duplicate ID No.: —

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB15-0103
Sample Location: 57SB15
Sampled By: F RAMSER
C.O.C. No.: 0942

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1505 Method: DPT Monitor Reading (ppm): 0	1-3 ft	YEL BRN	CLAY DRY

COMPOSITE SAMPLE DATA:

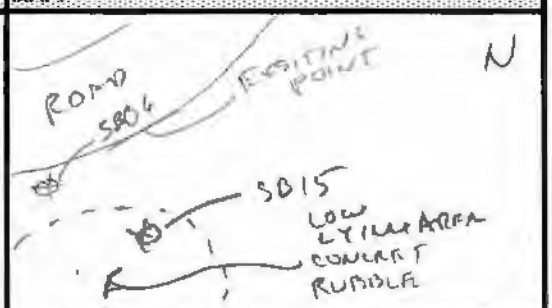
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core		
App IX Metals	4 oz		
App IX SVOCs and LL PAHs/PCBs	8 oz		
MOISTURE CONT.	2 oz		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB15-1315
Sample Location: 57SB15
Sampled By: F RAMSER
C.O.C. No.: 0942

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1515 Method: DPT Monitor Reading (ppm): 0	13-15	VARIEGATED BRN/YEL/BLK GRAY	SILT + SAND + CLAY MOIST

COMPOSITE SAMPLE DATA:

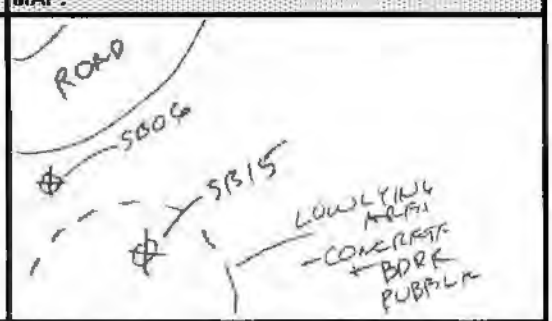
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core		
App IX Metals	4 oz		
App IX SVOCs and LL PAHs/PCBs	8 oz		
MOISTURE CONT.	2oz		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.: ____

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB16-0001
Sample Location: 57SB16
Sampled By: FRED RAMSER
C.O.C. No.: 0941

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-6-12 Time: 0900 Method: DPT Monitor Reading (ppm): 0	0 - 1 ft	DK BRN	SILT+CLAY TTL GRAVEL DRY HARD/STIFF

COMPOSITE SAMPLE DATA:

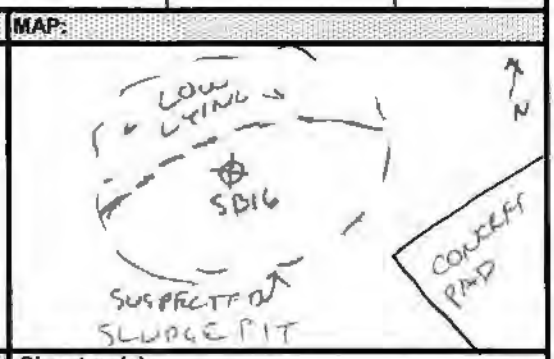
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2 oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred M Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB16-0103
Sample Location: 57SB16
Sampled By: FRED W. RAMSER
C.O.C. No.: 0941

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-6-12 Time: 0910 Method: DPT Monitor Reading (ppm): 0	1-3 ft	MED BRN	CLAY + SILT DRY TR GRAVEL STIFF

COMPOSITE SAMPLE DATA:

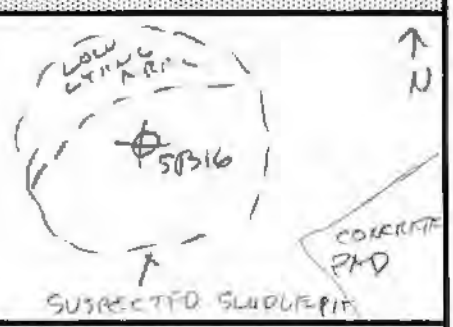
	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2 oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred W Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB16-0911
Sample Location: 57SB16
Sampled By: FRED W RAMSER
C.O.C. No.: 0941

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-6-12 Time: 0920 Method: DPT Monitor Reading (ppm): 0	9-11'	VARIEGATED DK YEL/ORG BLK + BRN	SILTY SAND MOIST TO WET.

COMPOSITE SAMPLE DATA:

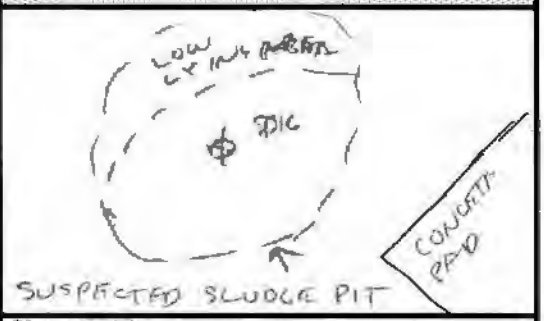
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core		
App IX Metals	4 oz		
App IX SVOCs and LL PAHs/PCBs	8 oz		
MOISTURE CONTENT	2 oz		

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred W Ramser

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SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB17-0001
Sample Location: 57SB17
Sampled By: FRED RAMSEY
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1600 Method: DPT Monitor Reading (ppm): 0	0 - 1 ft	DK BRN	SILT/SAND/CLAY DRY

COMPOSITE SAMPLE DATA:

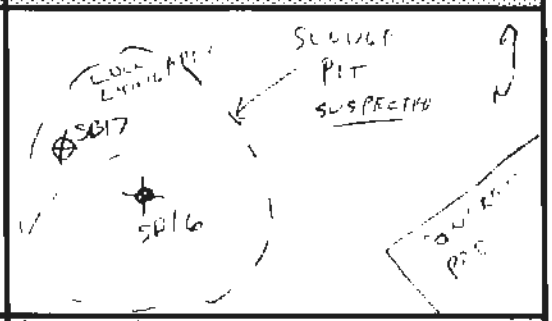
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB17-0103
Sample Location: 57SB17
Sampled By: FRED W. RANKSER
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1605 Method: DPT Monitor Reading (ppm): 0	1-3 ft	YEL BRN	CLAY DRY +SILT

COMPOSITE SAMPLE DATA:

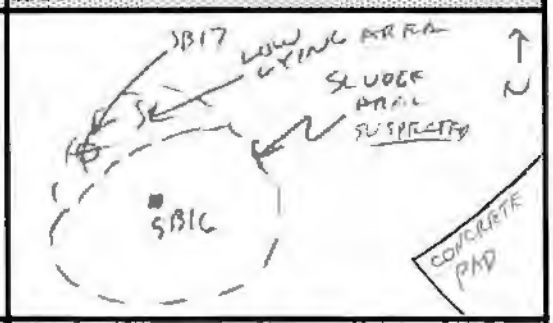
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ranker

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB17-1315
Sample Location: 57SB17
Sampled By: FRED W. RAMSEY
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1615 Method: DPT Monitor Reading (ppm): 0	13-15	VARIEGATED BRN/YEL/BLK	SILT MOIST f-g SAND

COMPOSITE SAMPLE DATA:

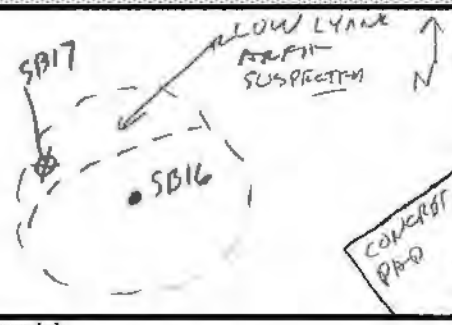
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W. Ramsey

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB18-0001
Sample Location: 57SB18
Sampled By: F. RAMSAR
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1700 Method: DPT Monitor Reading (ppm): 0	0 - 1 ft	MOD BRN	CLAY + SILT VERY DRY STIFF

COMPOSITE SAMPLE DATA:

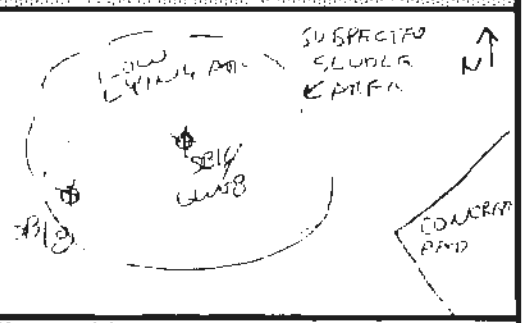
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred W Ramsar

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB18-0103
Sample Location: 57SB18
Sampled By: E. RAMSER
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1205 Method: DPT Monitor Reading (ppm): 0	1-3 ft	YEL BRN GREENISH GRAY	SAND/SILT/GRAVEL DRY

COMPOSITE SAMPLE DATA:

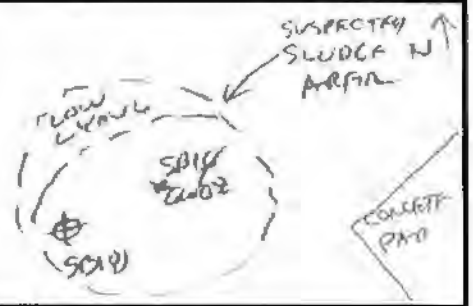
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2 oz	—	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Eric M Ramser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB18-1012
Sample Location: 57SB18
Sampled By: FRED W RAUSER
C.O.C. No.: 0942

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6-7-12 Time: 1720 Method: DPT Monitor Reading (ppm): 0	10-12	VARIEGATED	SANDY SILT MOIST

COMPOSITE SAMPLE DATA:

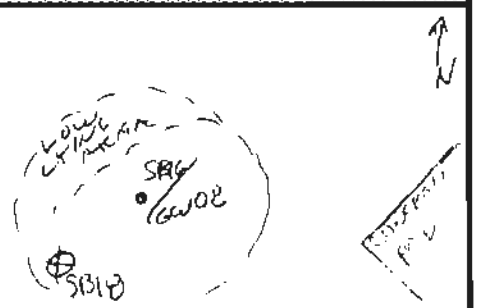
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Rauser

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB19-0001
Sample Location: 57SB19
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1310 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Dark Brown	Sandy Silt, mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

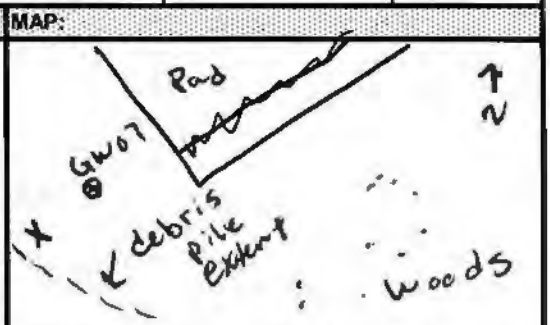
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT	2 oz	✓	

OBSERVATIONS / NOTES:

- Lots of organic Matter in soil
- Some rocks ~ 1" ø
- No refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chad Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB19-0103
Sample Location: 57SB19
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 6/7/12	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1330	1-3 ft	Medium Brown	Sandy, Gravelly Silt low moisture
Method: HA			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

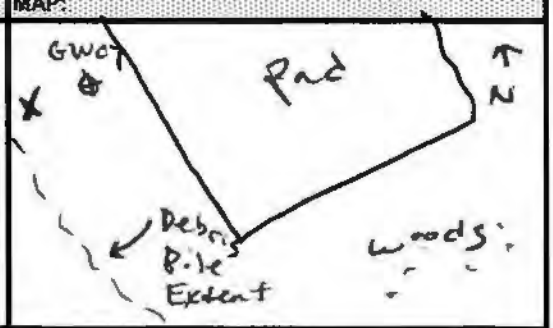
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	—	
App IX SVOCs and LL PAHs/PCBs	8 oz	—	
MOISTURE CONT	2 oz	✓	

OBSERVATIONS / NOTES:

- Lots of gravel and larger stones in sample
- Refusal @ 2' bgs

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chad Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB20-0001
Sample Location: 57SB20
Sampled By: CKelly
C.O.C. No.: 0943

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1630 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Light Brown	Gravely sand Very very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

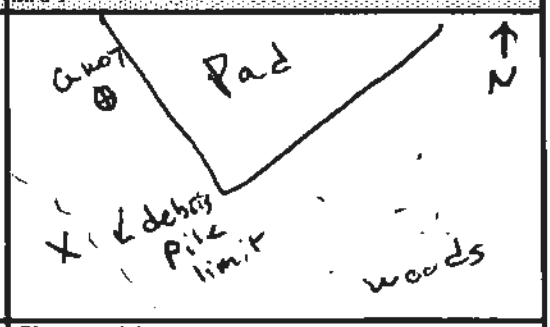
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT	2 oz	✓	

OBSERVATIONS / NOTES:

- very gravely sand
- some shells mixed in
- No Refusal

MAP:



Circle if Applicable:

MS/MSD — MS/MSD

Duplicate ID No.: FD060712-02 (0000)

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB20-0103
Sample Location: 57SB20
Sampled By: Chuck
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1650 Method: HA Monitor Reading (ppm): 0.0	1-3 ft	Sandy gravel	Light Brown very very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

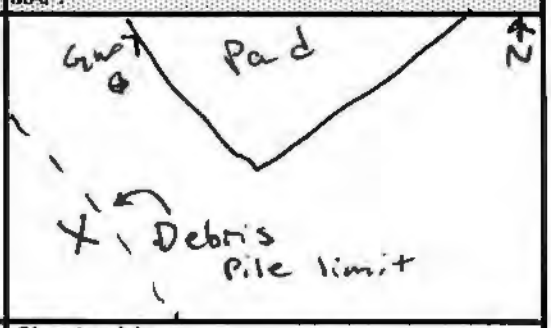
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2oz	✓	

OBSERVATIONS / NOTES:

- No Refusal
- Many stones ~ 1" ø in soil
- very few fines, sample mostly gravely sand

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Chuck Ky

~ MS/MSD

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB21-0001
Sample Location: 57SB21
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1410 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Dark Brown	Sandy silt, mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

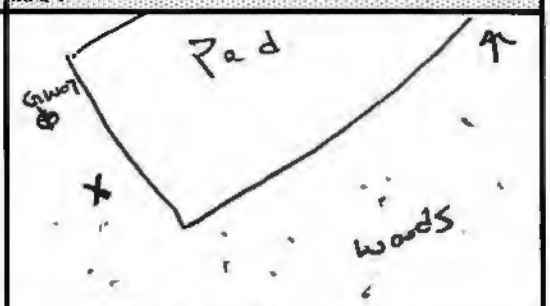
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2 oz	✓	

OBSERVATIONS / NOTES:

- Some rocks / gravel and organic matter
- No refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Charles Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB21-0103
Sample Location: 57SB21
Sampled By: C Kelly
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1430 Method: HA Monitor Reading (ppm): 0.0	1-3 ft	Medium Brown	Sandy clayey Silt Mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

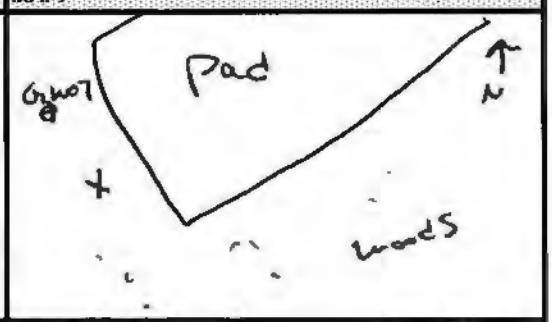
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2 oz	✓	

OBSERVATIONS / NOTES:

- Some large rock pieces
- more clay-like than other samples
- refusal @ 2' bgs @ rocks layer

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Charles Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB22-0001
Sample Location: 57SB22
Sampled By: C Ely
C.O.C. No.: 0943

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/7/12 Time: 1530 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Dark Brown	Silty loam, very Dry

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

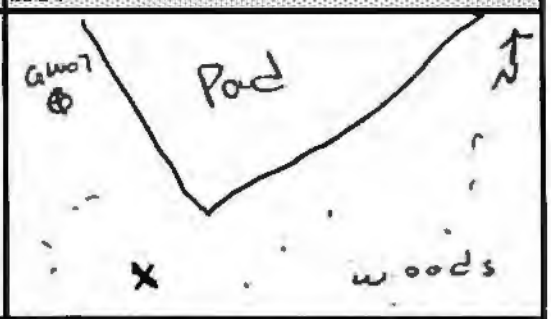
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

- Refusal @ 6" bgs
- Silty loam with a lot of root material on top on bedrock
- Some vegetation in area, but all very shallow roots

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Ely

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB22-0103
Sample Location: 57SB22
Sampled By: C Kelly
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:	1-3 ft		
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

NOT COLLECTED

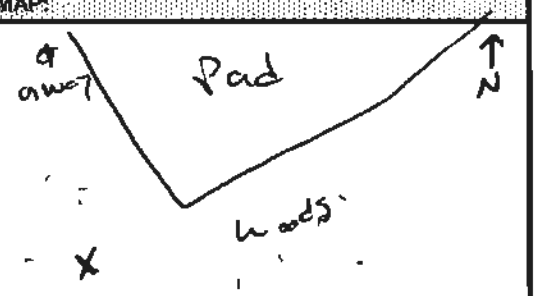
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core		
App IX Metals	4 oz		
App IX SVOCs and LL PAHs/PCBs	8 oz		

OBSERVATIONS / NOTES:

- No Sample Collected
- Refusal @ 6" bgs, bedrock
- silty loam material w/ a lot of root material on top of Bedrock

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB24-0001
Sample Location: 57SB24
Sampled By: C Kelly
C.O.C. No.: 0941

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6/12 Time: 1240 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Dark Brown	Sandy silt, some rocks & organic matter, mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

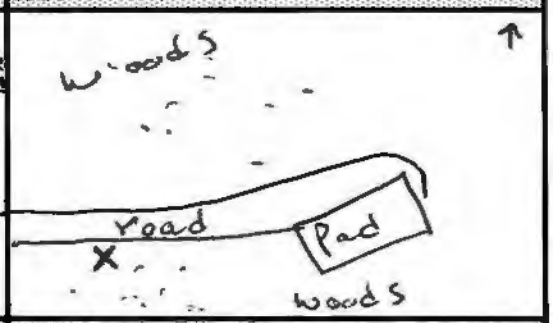
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	—	
App IX SVOCs and LL PAHs	8 oz	—	

OBSERVATIONS / NOTES:

- Some rock material encountered
- roots intermixed
- No refusal to 1' bgs

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Chad Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB25-0001
Sample Location: 57SB25
Sampled By: C Kelly
C.O.C. No.: 0941

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6/12 Time: 1225 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Medium Brown	Silty Sand, very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

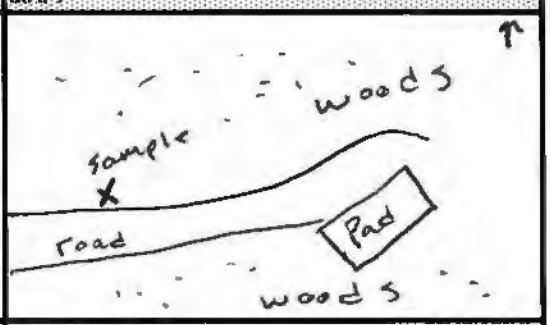
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

- Some gravel in sample, less than 1", removed
- very dry, hard
- No odor
- refusal due to rock @ 8"

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Charlie Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB26-0001
Sample Location: 57SB26
Sampled By: S Kelly
C.O.C. No.: 0941

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6/12 Time: 1300 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	Dark Brown	Sandy Silt, mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

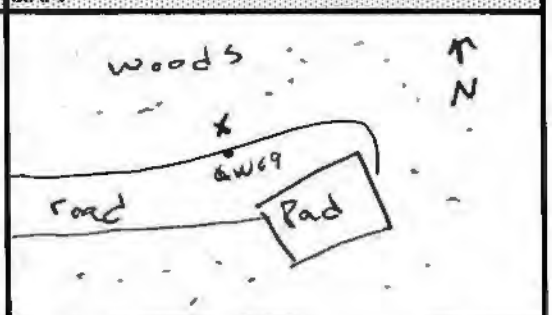
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

- Some roots and organic matter in soil
- Very little gravel
- No refusal to 1' bgs

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Charles Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB27-0001
Sample Location: 57SB27
Sampled By: C Kelly
C.O.C. No.: 0941

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6 Time: 1430 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	0-6" - Brown 6"-8" - Light tan	Sandy silt, very dry Sand, very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

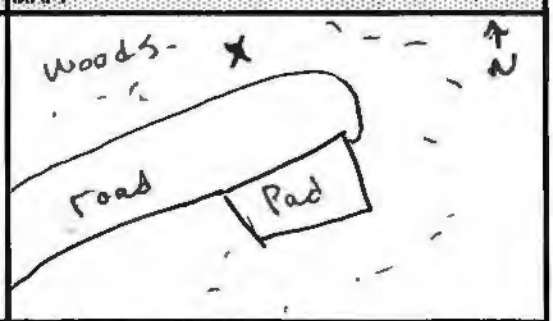
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

refusal @ 8" due to rock
some gravel, very little
organic matter
2 layers - 0-6" & 6"-8"

MAP:



Circle If Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Charity Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB28-0001
Sample Location: 57SB28
Sampled By: S Kelly
C.O.C. No.: 0941

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6	0 - 1 ft	0-6" Dark Brown	Sandy silt, mostly dry
Time: 1320		6-12" Light tan	Sand, dry
Method: HA			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

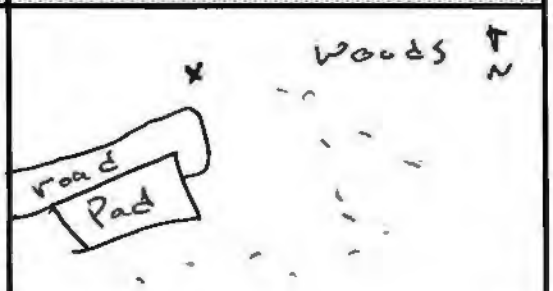
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

- Very light organic matter & rocks
- Layers 0-6" & 6"-12"
- No refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
✓	

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB29-0001
Sample Location: 57SB29
Sampled By: C Kelly
C.O.C. No.: 0941

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6 Time: 1330 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	medium Brown	Hard Silt, very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

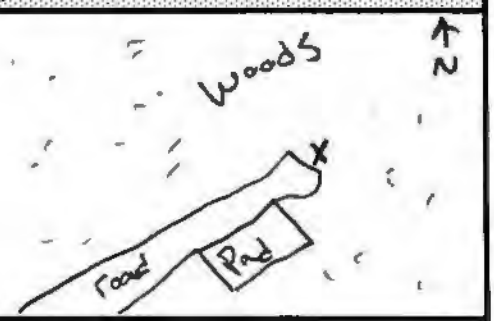
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

Refusal @ 6" bgs
very rocky
Some roots in sample

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB30-0001
Sample Location: 57SB30
Sampled By: C Kelly
C.O.C. No.: 0941

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/6 Time: 1450 Method: HA Monitor Reading (ppm): 0.0	0 - 1 ft	rust Brown	very dry, Silty Sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
		~~[illegible]~~ WK	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

- Lots of gravel in sample
- No refusal to 1' bgs

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 57SB31-0001
Sample Location: 57SB31
Sampled By: C Kelly
C.O.C. No.: 0941

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 10/6 Time: 1420 Method: HA Monitor Reading (ppm):	0 - 1 ft	Medium Brown	Sandy Silt, very dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs	8 oz	✓	

OBSERVATIONS / NOTES:

Some rocks & gravel
Very few roots
No refusal to 1' bgs

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
✓	

Signature(s): Chuck Fry

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB32-G001
Sample Location: 57SB32
Sampled By: C Kelly
C.O.C. No.: 0943

[X] Surface Soil
Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 6/8/12	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0850	0-1'	Dark Brown	Sandy Silt loam Mostly dry
Method: HA			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

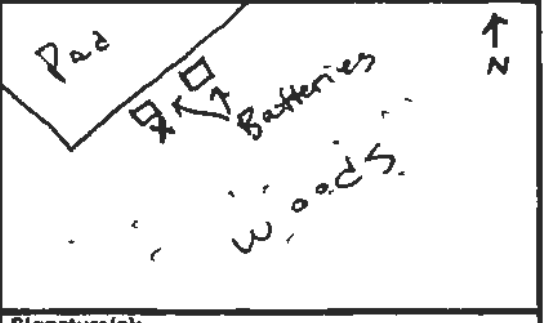
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

- Sample collected adjacent to ~~[illegible]~~ South-East Battery
- Some gravel & shells in soil
- No refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB 33-0001
Sample Location: 57SB 33
Sampled By: C Kelly
C.O.C. No.: 0943

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/8/12 Time: 0910 Method: HA Monitor Reading (ppm): 0.0	0 - 1'	Medium / Light Brown	Clayey Silt, Semi-moist

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

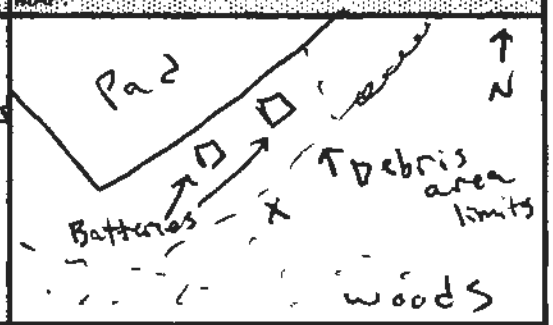
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2oz	✓	

OBSERVATIONS / NOTES:

- Sample collected partway up hillside beyond debris area limits ~ SE Edge of Pad
- Some gravel, no organic material
- No Refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB 34
Sample Location: 57SB34-0001
Sampled By: C Kelly
C.O.C. No.: 0944

[X] Surface Soil
Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/8/12 Time: 1600 Method: HA Monitor Reading (ppm): 0.0	0-1'	Dark Brown	Sandy Silt, semi-moist

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

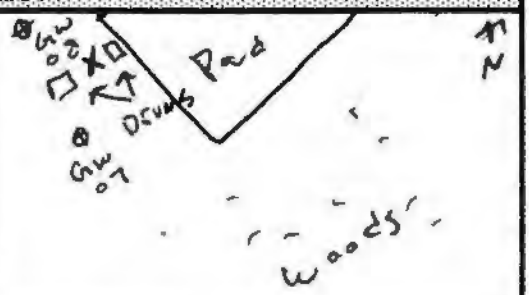
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONT.	2 oz	✓	

OBSERVATIONS / NOTES:

- very little gravel or organic matter
- sample collected between 2 corroded drums near corner of Pad
- No Refusal

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB34-0103
Sample Location: 57SB34
Sampled By: C Kelly
C.O.C. No.: 0944

[x] Surface Soil
[ ] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/8/12 Time: 1035 Method: HA Monitor Reading (ppm): 0.0	1-3'	Medium Brown	Silt Mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

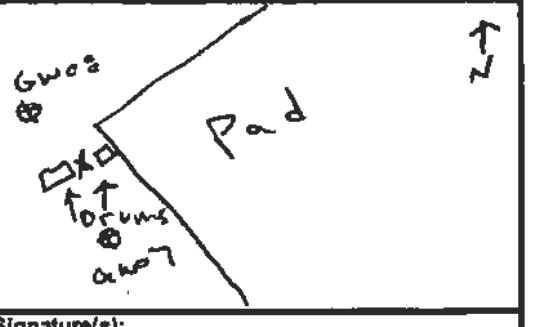
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2 oz	✓	

OBSERVATIONS / NOTES:

- Refusal @ 2' bgs
- very little gravel or organic material
- Collected between 2 corroded Drums

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[x] Surface Soil
Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: 57SB35-0001
Sample Location: 57SB35
Sampled By: C Kelly
C.O.C. No.: 0944

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/8/12 Time: 1100 Method: HA Monitor Reading (ppm): 0.0	0-1'	Medium Brown	Light Silt mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

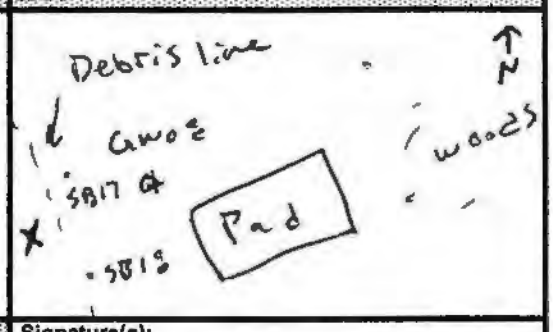
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2 oz	✓	

OBSERVATIONS / NOTES:

- No refusal
- very few rocks or gravel
- some organic matter

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB36-0001
Sample Location: 57SB36
Sampled By: CKelly
C.O.C. No.: 0944

[X] Surface Soil
Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/5/12	0-1'	0-6" - Medium/Dark Brown	Silt, mostly dry
Time: 1200		6"-1' Light	Sandy w/ Shell Frag - dry
Method: HA			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

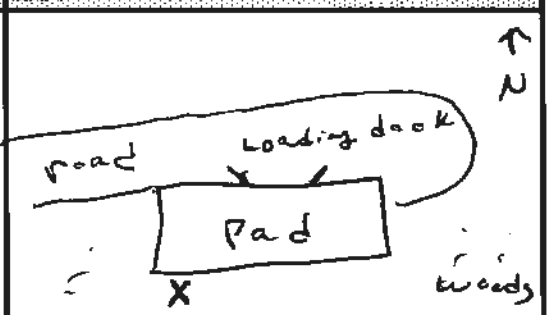
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2oz	✓	

OBSERVATIONS / NOTES:

- 0-6" & 6"-1' layers
- Some gravel & organics in top
- Lots of shells and sand in Bottom

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Clark Kelly

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

Sample ID No.: 57SB 37-0001
Sample Location: 57SB 37
Sampled By: C Kelly
C.O.C. No.: 0944

[x] Surface Soil
[ ] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/8/12 Time: 1130 Method: HA Monitor Reading (ppm): 0.0	0-1'	medium/ Dark Brown	Light Silt mostly dry

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

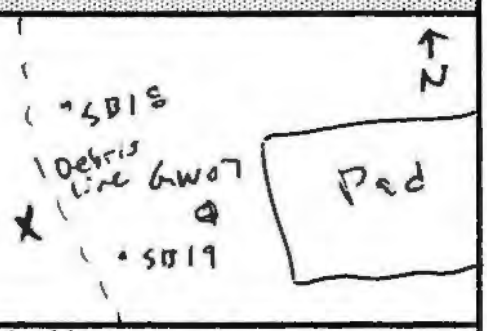
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
App IX VOCs	3 x Terra Core	✓	
App IX Metals	4 oz	✓	
App IX SVOCs and LL PAHs/PCBs	8 oz	✓	
MOISTURE CONTENT	2oz	✓	

OBSERVATIONS / NOTES:

- some rocks and gravel
- No refusal
- No organic Matter

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

C-4 BORING LOGS

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEOPROBE 6600

BORING No.: 57SB14
DATE: 6-7-12
GEOLOGIST: FRED WRAMSM
DRILLER: A. NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						LTBRN	CLAY/SILT/GRAVEL		DRY	0			
	2				STIFF	LT. BRN	CLAY	MH	COLLECTED (0001) @ 1340				
										0			
	4		4/4						COLLECTED (0103) @ 1345				
S-2					MED	YEL	WEATHER BDRK		FRIABLE	0			
	6				DENSE	BRN	SILT & SAND	SM					
										0			
	8		4/4						FRIABLE				
S-3						BLK GRY	AS ABOVE		VARIEGATED BRN	0			
	10				DENSE	YEL BRN	LESS WEATHERED		VERY FRAC. BLK/GRAY				
						ORG BRN							
	12		4/4						WET @ 11'	0			
									COLLECTED DEEP @ 9'-11'				
							EOB @ 12'		@ 1355				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEOPROBE 6600

BORING No.: 57SB15
DATE: 6-7-12
GEOLOGIST: FRED W RAMSER
DRILLER: A. NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						DK BRN	GRAVEL + CLAY + SAND		DRY				
	2					YEL BRN	CLAY	MH	COLLECTED	0			
									0001 @ 1500				
	4		3/4						0103 @ 1505	0			
S-2					STIFF	YEL BRN	CLAY TRS LT		DRY				
	6						CORSENING DOWNWARD		TO MOIST	0			
	8		3.5/4		DENSE	WEATHERED		SM	MOTTLED	0			
S-3						BDRK	VARIEGATED		FRIABLE				
	10						SAND/SILT/CLAY		DECOMP	0			
	12		4/4							0			
S-4							AS ABOVE		LESS WEATHER				
	14						SILT + CLAY		COLLECTED				
				▽			VERT. FRACTURES		57SB15	0			
	16		4/4						WET/STICKY				
									@ 15' ②				
							EOB @ 16'		1515 HRS				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes ___ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEOPROBE 6600

BORING No.: 57SB16/57GW08
DATE: 6-6-12
GEOLOGIST: FRED W RAMSER
DRILLER: ABRAHAM NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 0910						DK	SILT+GRAVEL	GM	SPL 57SB16-0001 ARCVLAR @ 0900 HR				
	2					BRN		↓	GRAVEL DRY				
						YEL	CLAY+SILT FR	CL	COLLECTED				
	4		4/4			BRN	GRAVEL 510mm ø		COLLECTED 57SB16-0103	DK			
S-2					VERY		CLAY + SILT		@ 0910	0			
	6				STIFF		LESS GRAV	↓	GRADING DOWN				
					MED		SILTY SAND (f.g)	SM	LIKED TO SANDY CLAY/CLAYEY				
	8		4/4		DENSE		FRIABLE DRY/MOIST		SAND @ 8' MOIST				
S-3							AS ABOVE		COLECT SPL	0			
	10						GRADING DOWNWARD TO		@ 9'-11' FOR CHEM				
				▽			VARIEGATED		ANALYSIS @ 0920 FROM WINGS				
	12		4				YEL/BRN/DK ORANGE SMALL BLK		MOIST TO WET				
S-4							AS ABOVE		@ 11' MAY BE PERCHED	0			
	14						DK GREYISH BLK REL	↓	WEATHERED				
					DENSE		VERT. FRACTURES	SM/SP	BEDRK	0			
	16		4				AS ABOVE						
							WEATHERED BDRK		BECOMING	0			
	18								HARDER/DRYER DOWNWARD				
							MOIST		ABUNDANT	0			
	20		4/4				TO WET		ANIMAL FRAG (DKS) + OLIVE				
							AS ABOVE		DECIDED TO				
							SAND CONT.		LOG CUTTINGS	0			
							INC. DOWNWARD		SOIL SAMP IN BHAND CORE				
	25									0			

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 00

Remarks: 25-29 WEATHERED BDRK YEL BRN MED DENSE
SCREEN 19-29

Converted to Well: Yes X No ___ Well I.D. #: 57GW08

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 57 PQL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEO PROBE 6000

BORING No.: 57SB17
DATE: 6-7-12
GEOLOGIST: FRED WRANSEN
DRILLER: A. NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1							DK BRN SILT/SAND/GRAVEL		DRY				
	2						DEL BRN CLAY	CL	COLLECT 57SB17000,	0			
					STIFF				@1600				
	4		3.5/4				COARSENING DOWNWARD		57SB17010S @1605	0			
S-2							SILT + CLAY	ML					
	6						TR F-g SAND		DECOMPOSED BORE	0			
					MED								
	8		4/4		DENSE				FRIABLE	0			
S-3							AS ABOVE						
	10						SAND COUL.	SM	VERTICAL	0			
					DENSER		INC. DOWNWARD		FRAC.				
	12		4/4						(BLK LINED)	0			
S-4							AS ABOVE			0			
	14				VERY		VARIEGATED						
					DENSE		WET @ 15'		WET @ 15'	0			
	16		4/4						STICKY				
									COLLECTED				
							EOB @ 16'		SPL @ 13-15				
									@1615				

* When rock coring, enter rock brokeness

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" + 4' MACRO CORE W/ SLEEVES

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEOPROBE 6000

BORING No.: 57SB18
DATE: 6-7-12
GEOLOGIST: FRED W. RAMSEY
DRILLER: A. NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						BRN	GRAVEL + SILT	GM	COLLECT 57SB180001				
	2				VERY	DK BRN	CLAY + SILT	CL	@1700	0			
					STIFF	MOD	(1-2') SLUGE? SILT 2-3	MH	COLLECT 57SB180103				
	4		4/4			GREENISH GRAY	SANDY GRAVEL		@1705	0			
S-2						YEL BRN	C-g SAND + SILT						
	6				DENSE		COARSENING DOWNWARD	SM	DECOMPOSING ROCK	0			
	8		4/4						FRIABLE	0			
S-3							AS ABOVE			0			
	10				VERY								
					DENSE		VARIEGATED		VERTICAL	0			
	12		4/4				SANDY SILT		FRAG. WEATHERED ROCK	0			
							REFUSAL @ 12'		BENT MOST MACRO				
							BENT SAMPLER		CORE DAMP @ 12'				
									COLLECTED 10-12 57SB181012 @1720				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 2" x 4' MACRO CORE W/ PLASTIC SLEEVES

Drilling Area Background (ppm): 0

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
DRILLING COMPANY: GeoEnviroTech, Inc.
DRILLING RIG: GEOPROBE 6000?

BORING No.: 57SB23/57GW09
DATE: 6-5-12
GEOLOGIST: FRED W. RAMSER
DRILLER: ABRAHAM NUNEZ

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1						BRN	DK BRN TOP SOIL ~6"			0			
	2						GRAVEL 6"	GM	FILL? ROAD MATL.	0	0		
						DK BRN	CLAY + SILT	ML	SUBBASE?	0			
	4		3/4		VERY	MOD	YEL BRN CLAY	CL	NATL. MATL.	0			
S-2					STIFF		TR SILT		COARSENING				
	6					DK	YEL ORANGE		DOWNWARD	0			
					MED LOOSE		CLAYEY SAND	SC	SAPROLITE?	0			
	8		4/4			YEL BRN	SILTY SAND		MOIST	0			
S-3							COARSENING		DECOMP. ROCK				
	10						DOWNWARD						
										0			
	12		4/4		HARD	GREYISH ORG.	SAND STONE?	SM	WEATHERED MOIST BD RK TO WET				
S-4							LESS WEATHERED	SC		0			
	14						DOWNWARD		FRIABLE MOIST				
							SANDSTONE? CRYSTAL TUFF? NO H_2O IN HOLE						
	16		4/4		VERY HARD		AS ABOVE	SC	YEL BRN W/ GREY VERT. STRINGERS				
									TROUBLE W/				
	18								SPL JAMMED				
							AS ABOVE		IN CORE TOOL.				
	20		3/4						NO H_2O IN HOLE				
							AS ABOVE						
				EOB @23'					WATER IN				
									HOLE WHILE INST. PVC				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: 4' x 2" MACRO CORE SPL FOR LITHOLOGY ONLY
SPL TO 20, CONVERTED TO HSA

Converted to Well: Yes _____ No _____ Well I.D. #: _____

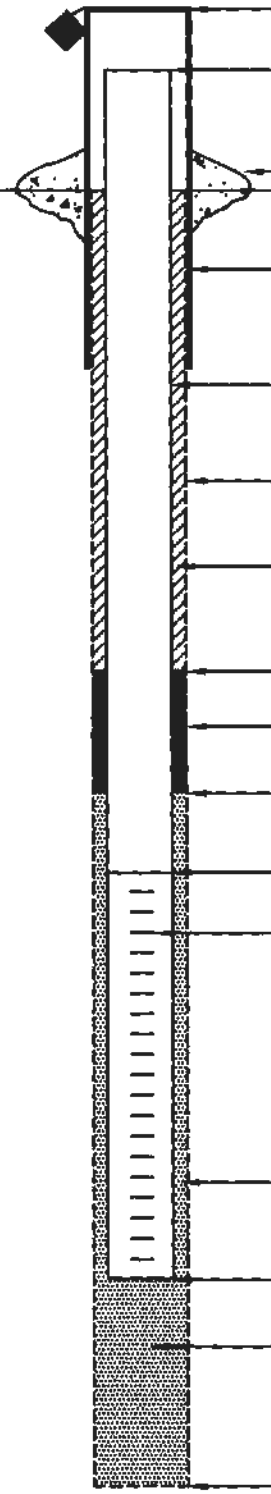
C-5 MONITORING WELL CONSTRUCTION SHEETS

WELL NO.: 576W08

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT SWMU 57 RFI	LOCATION NAPR	DRILLER ABRAHAM NUNEZ
PROJECT NO. 112G03371	BORING 57SB16	DRILLING METHOD DPT / HSA
DATE BEGUN 6-6-12	DATE COMPLETED 6-7-12	
FIELD GEOLOGIST FRED W. RAMSER		DEVELOPMENT METHOD SURGE/PUMP
GROUND ELEVATION	DATUM	



ELEVATION/HEIGHT OF TOP OF SURFACE CASING: /

ELEVATION/HEIGHT OF TOP OF RISER PIPE: /

TYPE OF SURFACE SEAL: 3'x3'x6" CONCRETE PAD

I.D. OF SURFACE CASING: 4" SQ
TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 2"
TYPE OF RISER PIPE: PVC SCH. 40

BOREHOLE DIAMETER: ~8 IN

TYPE OF BACKFILL: PORTLAND CEMENT GROUT

ELEVATION/DEPTH TOP OF SEAL: /15'

TYPE OF SEAL: BENTONITE CETCO GRANULAR

DEPTH TOP OF SAND PACK: 17'

ELEVATION/DEPTH TOP OF SCREEN: /19'

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010 x 10'

I.D. OF SCREEN: 2"

TYPE OF SAND PACK: 20/30 SILICA SAND STANDARD SAND + SILICA CO. FL.

ELEVATION/DEPTH BOTTOM OF SCREEN: /29'

ELEVATION/DEPTH BOTTOM OF SAND PACK: /29'
BACKFILL MATERIAL BELOW SAND:

ELEVATION/DEPTH OF HOLE: /29'

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WELL NO.: 576W09

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT SWMU 57 RFI
PROJECT NO. 112G03371
DATE BEGUN 6-5-12
FIELD GEOLOGIST FRED W. RAMSER
GROUND ELEVATION _____

LOCATION NAPR
BORING 57SB23
DATE COMPLETED 6-5-12
DATUM _____

DRILLER ABRAHAM NUNEZ
DRILLING METHOD DPT / HSA
DEVELOPMENT METHOD SURGE/PUMP

ELEVATION/HEIGHT OF TOP OF SURFACE CASING: /
ELEVATION/HEIGHT OF TOP OF RISER PIPE: /
TYPE OF SURFACE SEAL: 3'x3'x6" CONCRETE PAD
I.D. OF SURFACE CASING: 4" SQ
TYPE OF SURFACE CASING: STEEL
RISER PIPE I.D.: 2"
TYPE OF RISER PIPE: PVC SCH. 40
BOREHOLE DIAMETER: ~8 IN
TYPE OF BACKFILL: PORTLAND CEMENT GROUT
ELEVATION/DEPTH TOP OF SEAL: /9'
TYPE OF SEAL: BENTONITE CETCO GRANULAR
DEPTH TOP OF SAND PACK: 11'
ELEVATION/DEPTH TOP OF SCREEN: /13'
TYPE OF SCREEN: PVC
SLOT SIZE x LENGTH: 0.010 x 10'
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: 20/30 SILICA SAND STANDARD SAND + SILICA CO. FL.
ELEVATION/DEPTH BOTTOM OF SCREEN: /23'
ELEVATION/DEPTH BOTTOM OF SAND PACK: /23'
BACKFILL MATERIAL BELOW SAND: NONE
ELEVATION/DEPTH OF HOLE: /23'

ACAD:FORM_MWSU.dwg 07/28/99 INL

C-6 SAMPLE LOG SHEETS - GROUNDWATER

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW01-061012
Sample Location: 57GW01
Sampled By: C Kelly
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 06/10/12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1625	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	10.65	9.91	28.31	0.92	0.00	259	5.6	6.24

PURGE DATA:

Date: 06/10/12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 22' bgs								
Static Water Level (WL): ~~16.65~~ 15.65								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 0900								
End Purge (hrs): 1025								
Total Purge Time (min): 85								
Total Vol. Purged (gal/L) 17L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Total Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	(2) 1 L Glass amber glass	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

2 ft stick up
J plug in Good Condition
Pump set @ 17' bgs

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chuck Kelly

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW02-060912
Sample Location: 57GW02
Sampled By: FRED W. RAMSER
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-9-12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1235	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	6.40	25.0	31.83	1	0.08	445	15.2	15.5

PURGE DATA:

Date: 6-9-12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 25' bgs 27.20 TPVC								
Static Water Level (WL): 21.80								
One Casing Volume(gal/L): ~~27.70~~ NA								
Start Purge (hrs): 1028								
End Purge (hrs): 1235								
Total Purge Time (min): 127 min								
Total Vol. Purged (gal/L): 10 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	(2) 1 L Glass amber glass	✓
APP IX SVOCs include LL PAHs	4°	(2) 1 L Glass amber glass	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

27.20
21.80
5.40

Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s):

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW04- 060912
Sample Location: 57GW04
Sampled By: C Kelly
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6/9/12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1350	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	7.63	5.43	29.81	9.58	0.00	407	2.9	3.42

PURGE DATA:

Date: 6/9/12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 22' bgs								
Static Water Level (WL): 16.48								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 1240								
End Purge (hrs): 1350								
Total Purge Time (min): 70								
Total Vol. Purged (gal) 6.32								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	U
APP IX PCBs	4°	(2) 1 L Glass amber glass	—

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

I plug in Good working Condition
Pump set at 17' bgs
Stick up - 2" well

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Charles Kelly

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW05-060912
Sample Location: 57GW05
Sampled By: FRED RAMSRC
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-9-12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1620	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	6.84	3.14	29.48	15	0.00	-55	1.6	2.01

PURGE DATA:

Date: 6-9-12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 21' bgs 23.5 TPVC								
Static Water Level (WL): 17.79								
One Casing Volume(gal/L): N/A								
Start Purge (hrs): ~~2.56~~ 1456 HR								
End Purge (hrs): 1620								
Total Purge Time (min): 84 min								
Total Vol. Purged (gal/L): 6 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	2 x 1 L Glass amber glass	✓
APP IX SVOCs include LL PAHs	4°	2 x 1 L Glass amber glass	✓
APP IX VOCs	HCL 4°	3 x 40mL glass vial	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

23.5
17.8
5.7

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
1.10	FD-060912-01 1625 HRS	Fred Ramsey

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW07-060912
Sample Location: 57GW07
Sampled By: C Kelly
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 06/09/12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1645	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	7.41	8.21	28.85	39.9	0.00	421	4.5	5.17

PURGE DATA:

Date: 6/9/12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 29' bgs								
Static Water Level (WL): 21.14								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 1450								
End Purge (hrs): 1645								
Total Purge Time (min): 115								
Total Vol. Purged (gal/L): 0 15 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	(2) 1 L Glass amber glass	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

Pump set @ 24' bgs
Well - 2" stick up
Plug in good and functional Condition

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Charles W Kelly

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW08- 061112
Sample Location: 57GW08
Sampled By: FRED W. RAMSEY
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-11-12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 0950	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	6.79	9.56	29.41	19	0.13	149	5.3	6.02

PURGE DATA:

Date: 6-11-12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 31.65								
Static Water Level (WL): 20.86								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 801								
End Purge (hrs): 0950								
Total Purge Time (min): 111								
Total Vol. Purged (gal/L): 11 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	x 3
APP IX PCBs	4°	2 x 1 L Glass amber glass	x 3
APP IX SVOCs	4°	2 x 1 L Glass amber glass	x 3
APP IX VOCs	HCL 4°	3 x 40mL glass vial	x 3

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

801
31.65
-20.86
10.79

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	—

Signature(s): Fred Ramsey

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 57GW09-061012
Sample Location: 57GW09
Sampled By: FRED W RAMSEY
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 6-10-12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1115	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	7.14	4.28	30.30	40	0.06	79	2.3	2.74

PURGE DATA:

Date: 6-10-12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 13.5								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 26.08 TPVC								
Static Water Level (WL): 17.02 TPVC								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 0905								
End Purge (hrs): 1115								
Total Purge Time (min): 140 MIN								
Total Vol. Purged (gal/L): 10.5 l								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	2 x 1 L Glass amber glass	✓
APP IX SVOCs	4°	2 x 1 L Glass amber glass	✓
APP IX VOCs	HCL 4°	3 x 40mL glass vial	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

26.08
17.02
9.06

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Fred W Ramsey

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[x] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 13GW07-060912
Sample Location: 13GW07
Sampled By: C Kelly
C.O.C. No.: 0945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 06/09/12	pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Time: 1150	Standard	mS/cm	°C	NTU	mg/L	mV	ppt	g/L
Method: Low Flow	5.98	11.8	29.64	4.52	0.00	482	6.7	7.30

PURGE DATA:

Date: 06/09/12	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0.0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 32.25								
Static Water Level (WL): 19.56								
One Casing Volume(gal/L): NA								
Start Purge (hrs): 1015								
End Purge (hrs): 1150								
Total Purge Time (min): 95								
Total Vol. Purged (gal/L): 23.75								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3 4°	1 liter HDPE plastic container	✓
APP IX PCBs	4°	(2) 1 L Glass amber glass	✓

OBSERVATIONS / NOTES:

* collect both dissolved (filtered) and total metals if turbidity is greater than 50 NTUs

Stickup - 2" well
Pump set @ 27.25 btoc, TD = 32.25 btoc
J plug functional & in good condition

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Chuck Kelly

C-7 MONITORING WELL DEVELOPMENT RECORDS

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Well: 57GW09
Site: SWMU 57
Date Installed: 6-5-12
Date Developed: 6-7-12
Dev. Method: PUMP
Pump Type: 12VDC SUB.

Depth to Bottom (ft.): 26.10
Static Water Level Before (ft.): 16.95 TPVC
Static Water Level After (ft.): 16.95
Screen Length (ft.): 10'
Specific Capacity:
Casing ID (in.): 2"

Responsible Personnel: FRED W RAMSEUR
Drilling Co.: GeoEnviroTech, Inc.
Project Name: POL RFI NAPR
Project Number: 112G03371 CTO JM54

START PUMPING @ 0946 ~1.5 gpm
PUMPED DRY THICK DISCHARGE (BRN)
ALLOWED TO RECOVER

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm) / TDS	Turbidity (NTU)	Remarks (odor, color, etc.)
0955	~0.5							Q = 1 l/min
0955	0	~15 GAL	22.50	30.12	7.11	4.49	373	
1005		~17 gal	22.22	30.33	7.36	4.27	144	TDS=2.73, SAL=2.3ppt ORP=123mV
1002	0	~18.5	22.39	30.30	7.45	4.11 / 2.64	60	SAL=2.2ppt, ORP=181 DO=2.39 mg/l
1022		~21.0	22.22	30.22	7.51	405 / 2.60	60	2.2ppt / 239 / 2.47
1041	0	~	20.81	30.77	7.40	409 / 2.81	19	2.3ppt / 224 / 3.63
1046			20.55	30.85	7.36	4.02 / 2.85	20	2.4ppt / 225 / 3.72
1051			20.20	30.89	7.36	4.04 / 2.90	23	2.4ppt / 214 / 3.64
								COMPLETED DEV @
								1051 HRS

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of _____

Well: 57GW08
Site: SWMU 57
Date Installed: 6-7-12
Date Developed: 6-8-12
Dev. Method: PUMP/SURGE
Pump Type: 12VDC SUBMERSIBLE

Depth to Bottom (ft.): 31.20 TPVC
Static Water Level Before (ft.): 20.73 TPVC
Static Water Level After (ft.): 20.74 TPVC
Screen Length (ft.): 10
Specific Capacity: _____
Casing ID (in.): 2"

Responsible Personnel: FRED W. RAMSEYER
Drilling Co.: GeoEnviroTech, Inc.
Project Name: POL RFI NAPR
Project Number: 112G03371 CTO JM54

START PUMPING 0835 HRS / THICK YEL BRN / WITH DRILL ~15 GAL
@ 0905 REC ~5' BEGIN PUMPING / LESS THICK
0920 BEGIN TO CLEAR
@ 9004 DRY ALLOW TO REC.
@ 930 LL Q~ 500 ml/min

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ____)	TDS	Turbidity (NTU)	Remarks (odor, color, etc.) mV ORP	mg/l DO	ppt SAL
0930	~0.3'	~20 GAL	24.03	29.33	6.54	8.76	5.52	945	122	3.84	4.9 ppt
0940			23.65	29.45	6.86	8.99	5.66	371	111	2.42	5.0
0952			23.08	29.95	6.91	9.62	6.06	180	153	2.65	5.4
1010			22.72	30.48*	6.99	9.65	6.08	65	171	3.10	5.4
1021			22.07	31.00*	6.91	9.46	5.95	64	127	6.66	5.3
1031			21.91	31.40*	6.91	9.53	6.00	68	183	6.51	5.3
1041			21.80	31.46	6.88	9.60	6.11	60	181	6.67	5.4
1051		~40 gal 38 gal	21.64	31.65	6.91	9.59	6.09	58	186	6.65	5.3
									COMPLETED DEV, @ 1051 HRS		

* SUN ON WATER DISCHARGE LINE

C-8 LOW FLOW DATA SHEETS

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 57GW01-061012
DATE: 06/10/12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	Comments TDS
0900	15.51	200								Begin Purge, Light Brown
0905	15.58	200	6.57	~~435~~ 10.4	183	7.29	28.72	6.0	329	6.63 Turb, no odor
0910	15.59	200	6.59	~~453~~ 10.6	218	1.03	28.36	6.1	355	6.69
0915	15.64	200	6.61	10.7	163	0.55	28.29	6.0	338	6.63
0920	15.64	200	6.62	10.6	90.9	0.41	28.26	6.0	331	6.56 Begining to clear
0925	15.63	200	6.62	10.5	49.5	0.31	28.30	5.9	323	6.51
0930	15.64	200	6.64	10.3	30.4	0.15	28.30	5.8	310	6.41 clear
0935	15.64	200	6.63	10.3	13.0	0.70	28.28	5.8	258	6.37
0940	15.64	200	6.63	10.2	10.73	0.08	28.25	5.8	268	6.33
0945	15.64	200	6.63	10.2	5.79	0.00	28.25	5.7	272	6.30
0950	15.64	200	6.64	10.1	5.00	0.00	28.27	5.7	274	6.27
0955	15.64	200	6.63	10.1	4.54	0.00	28.26	5.7	277	6.24
1000	15.63	200	6.64	10.1	2.70	0.00	28.24	5.7	277	6.24
1005	15.64	200	6.65	9.95	1.80	0.00	28.29	5.7	252	6.26
1010	15.64	200	6.65	9.95	1.50	0.00	28.28	5.6	251	6.27
1015	15.64	200	6.64	9.93	0.91	0.00	28.29	5.6	256	6.25
1020	15.64	200	6.65	9.90	0.86	0.00	28.30	5.6	258	6.24
1025	15.65	200	6.65	9.91	0.92	0.00	28.31	5.6	259	6.24 SAMPLE

SIGNATURE(S): Chuck Kay

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 576W02
DATE: 6-9-12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	g/L TDS	Comments
1035	22.20	100	6.50	24.9	200	1.71	31.26	15.1	57	15.5	Q = 200 mL/min
1045	22.40	80	6.51	25.0	28	1.06	31.45	15.2	517	15.5	TO 100 mL
1055	22.60	80	6.48	25.1	13.1	0.76	31.49	15.2	517	15.5	
1105	22.80	80	6.46	25.1	7.7	0.57	31.41	15.2	517	15.6	
1115	22.95	80	6.46	25.1	6.7	0.46	31.40	15.3	510	15.6	
1125	23.23	80	6.43	25.1	5.6	0.31	31.49	15.4	504	15.7	
1135	23.38	80	6.42	25.1	4.1	0.26	31.45	15.3	498	15.6	
1145	23.49	80	6.42	25.1	3.3	0.18	31.56	15.3	493	15.6	
1155	23.75	80	6.40	25.1	2.8	0.14	31.60	15.3	478	15.6	
1205	24.00	80	6.43	25.2	2.5	0.14	31.68	15.3	472	15.6	
1215	24.31	80	6.43	25.1	2	0.08	31.75	15.2	468	15.5	
1225	24.52	80	6.41	25.1	1	0.08	31.73	15.2	459	15.5	
1230	24.70	80	6.40	25.0	1	0.08	31.80	15.2	451	15.5	
1235	24.74	80	6.40	25.0	1	0.08	31.83	15.2	445	15.5	COMPLETED PURGE
											BEGIN TO FILL CONT

SIGNATURE(S): Fred M Ramer

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 57GW04
DATE: 6/9/12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	TDS	Comments
1240	16.45	90	~~9.5~~								Begin Purge - water cloudy, no odor
1245	16.45	90	7.55	5.61	43.1	2.37	31.18	3.0	498	3.54	
1250	16.47	90	7.54	5.65	38.5	1.74	31.03	3.0	497	5.56	
1255	16.48	90	7.60	5.59	27.3	0.76	30.62	3.0	484	3.52	
1300	16.46	90	7.59	5.58	25.5	0.78	30.59	3.0	480	3.51	
1305	16.48	90	7.63	5.52	20.8	0.47	30.38	3.0	472	3.48	
1310	16.48	90	7.65	5.49	19.4	0.28	30.21	2.9	454	3.45	
1315	16.48	90	7.64	5.47	19.6	0.27	30.19	2.9	441	3.44	
1320	16.48	90	7.62	5.46	19.2	0.19	30.17	2.9	426	3.44	
1325	16.48	90	7.67	5.45	14.6	0.13	30.09	2.9	414	3.43	clear now
1330	16.48	90	7.62	5.44	11.6	0.05	30.07	2.9	409	3.43	
1335	16.48	90	7.62	5.43	11.6	0.03	29.92	2.9	408	3.42	
1340	16.48	90	7.63	5.43	9.61	0.00	29.79	2.9	406	3.42	
1345	16.48	90	7.62	5.44	9.60	0.00	29.80	2.9	407	3.42	
1350	16.48	90	7.63	5.43	9.58	0.00	29.81	2.9	407	3.42	collect Sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371

WELL ID.: 576W05
DATE: 6-9-12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	g/L TDS Comments
1500	17.97	125	6.81	3.38	752	1.21	30.89	1.8	350	LOWERED Q TO 100
1510	17.99	95	6.70	3.32	306	0.72	30.45	1.7	351	LOWERED Q TO 75
1520	17.99	75	6.70	3.30	160	0.40	30.30	1.7	333	2.11
1530	17.99	75	6.83	3.28	40	0.24	30.09	1.7	318	2.09
1540	17.99	75	6.84	3.24	29	0.10	30.04	1.7	297	2.07
1545	17.99	75	6.84	3.22	27	0.06	29.97	1.7	272	2.06
1550	17.99	75	6.84	3.21	28	0.06	29.92	1.7	210	2.05
1555	17.99	75	6.84	3.19	25	0.05	29.83	1.7	104	2.04
1600	17.99	75	6.84	3.18	24	0.01	29.79	1.7	23	2.04
1605	17.99	75	6.84	3.17	24	0.01	29.64	1.7	-28	2.03
1610	17.99	75	6.84	3.16	16	0.00	29.59	1.6	-49	2.02
1615	17.99	75	6.84	3.14	15	0.00	29.52	1.6	-52	2.02
1620	17.99	75	6.84	3.14	15	0.00	29.48	1.6	-55	2.01

SIGNATURE(S): [illegible]

PAGE___OF___

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 57GW07
DATE: 6/9/12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	TDS	Comments
1450	~~21~~ 21.18	100									Began Purge - very Turbid
1455	21.16	100	7.55	7.90	831	2.76	30.77	4.4	467	4.99	No odor, light Brown
1500	21.04	100	7.51	8.04	859	1.48	30.34	4.4	452	5.07	Turbidity
1505	21.04	100	7.51	8.07	670	1.02	30.07	4.5	443	5.09	
1510	21.04	100	7.49	8.08	596	0.86	29.96	4.5	439	5.09	
1515	21.04	100	7.48	8.09	514	0.59	29.80	4.5	431	5.10	
1520	21.04	100	7.46	8.26	541	0.56	29.74	4.6	425	5.20	
1525	21.04	100	7.46	8.23	489	0.37	29.66	4.6	421	5.19	
1530	21.05	100	7.45	8.21	581	0.28	29.57	4.5	419	5.17	
1535	21.04	100	7.45	8.20	327	0.18	29.49	4.5	418	5.17	
1540	21.04	100	7.45	8.20	195	0.15	29.50	4.5	418	5.17	
1545	21.05	100	7.44	8.20	270	0.13	29.45	4.5	418	5.16	
1550	21.05	100	7.43	8.20	168	0.03	29.32	4.5	417	5.16	
1555	21.05	100	7.44	8.20	152	0.04	29.35	4.5	418	5.16	
1600	21.05	100	7.44	8.20	108.9	0.01	29.31	4.5	417	5.17	Beginning to clear
1605	21.05	100	7.44	8.21	99.8	0.00	29.26	4.5	420	5.17	
1610	21.05	100/200	7.41	8.22	99.8	0.04	29.08	4.6	420	5.18	Purge rate increased to
1615	21.15	200	7.43	8.24	92.3	0.00	29.08	4.6	420	5.18	try to clear
1620	21.10	200	7.44	8.23	64.6	0.00	29.08	4.6	421	5.18	turbidity
1625	21.12	200	7.41	8.22	47.9	0.00	28.91	4.5	421	5.18	
1630	21.13	200	7.42	8.21	48.4	0.00	28.88	4.5	421	5.18	
1635	21.13	200	7.42	8.21	40.1	0.00	28.84	4.5	421	5.17	
1640	21.13	200	7.41	8.21	39.8	0.00	28.84	4.5	421	5.17	
1645	21.14	200	7.41	8.21	39.9	0.00	28.85	4.5	421	5.17	SAMPLE

SIGNATURE(S): Charles W Ney

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 576W08
DATE: 6-11-12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	Comments TDS
0810	21.35	250	6.71	9.05	>1000	3.95	28.40	5.0	160	LOWER Q TO 100mL
0815	21.16	100	6.73	9.05	768	1.38	28.61	5.0	158	5.70
0845	21.17	100	6.72	9.05	200	0.43	28.71	5.0	166	5.70
0850	21.17	100	6.72	9.05	71	0.35	28.81	5.0	164	5.70
~~0860~~ 0900	21.18	100	6.75	9.05	54	0.29	28.85	5.0	161	5.70
0910	21.16	100	6.76	9.04	41	0.24	28.89	5.0	159	5.70
0920	21.17	100	6.76	9.62	24	0.19	28.97	5.4	155	6.06
0930	21.17	100	6.77	9.58	22	0.18	29.15	5.4	153	6.03
0935	21.17	100	6.78	9.56	21	0.16	29.24	5.4	152	6.03
0940	21.18	100	6.79	9.56	20	0.13	29.29	5.4	151	6.02
0945	21.18	100	6.79	9.55	20	0.13	29.32	5.3	150	6.02
0950	21.18	100	6.79	9.56	19	0.13	29.41	5.3	149	6.02 COMPLETED PURGE

SIGNATURE(S): [illegible]

PAGE__ OF__

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 576W09
DATE: 6-10-12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	Comments TDS
0915	~~75~~ 17.16	75	7.16	4.11	155	2.48	30.40	2.2	117	2.64
0925	17.18	75	7.15	4.18	75	1.53	30.24	2.2	127	2.68
0935	17.18	75	7.14	4.20	33	1.10	30.28	2.2	128	2.69
0945	17.19	75	7.13	4.20	31	0.72	30.25	2.2	124	2.69
0955	17.19	75	7.13	4.23	46	0.50	30.22	2.2	117	2.71
1005	17.19	75	7.13	4.29	53	0.56	30.18	2.3	108	2.74
1015	17.19	75	7.13	4.31	52	0.30	30.20	2.3	101	2.76
1025	17.19	75	7.13	4.32	58	0.21	30.20	2.3	96	2.76
1035	17.19	75	7.13	4.31	58	0.14	30.20	2.3	92	2.76
1045	17.19	75	7.14	4.30	48	0.09	30.17	2.3	87	2.75
1050	17.20	75	7.13	4.30	56	0.07	30.15	2.3	86	2.75
1055	17.20	75	7.13	4.29	46	0.07	30.14	2.3	85	2.75
1100	17.21	75	7.13	4.29	47	0.07	30.20	2.3	84	2.75
1105	17.21	75	7.14	4.29	39	0.07	30.23	2.3	83	2.74
1110	17.21	75	7.14	4.28	42	0.06	30.28	2.3	80	2.74
1115	17.22	75	7.14	4.28	40	0.06	30.30	2.3	79	2.74

SIGNATURE(S): Fred M Lanser

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Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: SWMU 57 POL RFI NAPR
PROJECT NUMBER: 112G03371
WELL ID.: 13GW07
DATE: 06/09/12

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Salinity (ppt)	ORP (mV)	Comments TDS
1015	19.46	250								Clear, very light
1020	19.48	"	7.30	12.2	42.1	1.72	29.97	6.4	429	7.46 Sul fur odor
1025	19.47	"	7.72	11.9	24.6	0.94	29.82	6.8	415	7.40
1030	19.47	"	7.75	11.9	20.6	0.85	29.81	6.8	413	7.36
1035	19.49	"	7.57	11.8	18.1	0.57	29.77	6.7	420	7.34
1040	19.49	"	7.50	11.8	12.4	0.49	29.79	6.7	424	7.33 No odor, clear
1045	19.48	"	7.40	11.8	13.2	0.41	29.75	6.7	427	7.30
1050	19.51	"	5.34	11.9	11.9	0.43	29.78	6.7	548	7.30
1055	19.55	"	5.61	11.7	9.37	0.27	29.69	6.7	524	7.28
1100	19.53		6.17	11.7	7.72	0.18	29.75	6.7	495	7.28
1105	19.55	"	6.41	11.7	6.75	0.08	29.68	6.7	476	7.27
1110	19.55	"	6.45	11.7	5.04	0.03	29.68	6.7	470	7.27
1115	19.55		6.41	11.7	7.06	0.00	29.71	6.7	472	7.27
1120	19.55	"	6.37	11.7	5.54	0.00	29.67	6.7	473	7.27
1125	19.55		5.69	11.8	4.69	0.02	29.67	6.7	507	7.30
1130	19.55	5.71	~~5.16~~	11.8	5.16	0.00	29.68	6.7	505	7.31
1135	19.55		5.84	11.8	3.97	0.00	29.64	6.7	494	7.30
1140	19.55		5.94	11.8	4.55	0.00	29.62	6.7	485	7.30
1145	19.55		5.98	11.8	4.48	0.00	29.63	6.7	483	7.30
1150	19.55		5.98	11.8	4.52	0.00	29.64	6.7	482	7.30 Collect Sample

SIGNATURE(S): Chad W May

C-9 EQUIPMENT CALIBRATION SHEETS

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : SWMU 57 POL RFI NAPR

INSTRUMENT NAME/MODEL: Turbidity Meter

SITE NAME: NAPR Puerto Rico

MANUFACTURER: LaMotte 2020e

PROJECT No.: 112G03371 CTO JM54

SERIAL NUMBER: ME 14290

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 - NTU Readings		10 - NTU Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
6/9/12	1	CWK	0.06	0.00	10.58	10.01	/	
6/10/12	1	CWK	0.05	0.00	11.2	10.00		
6/11/12	1	CWK	0.06	0.00	10.02	10.00		

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : SWMU 57 POL RFI NAPR

SITE NAME: NAPR Puerto Rico

PROJECT No.: 112G03371 CTO JM54

INSTRUMENT NAME/MODEL: Water Quality Meter U-5000

MANUFACTURER: HORIBA

SERIAL NUMBER: UORK8WKW

Date of Calibration	Person Performing Calibration	PRE-CALIBRATION READINGS			POST-CALIBRATION READINGS			Calibration Standard (Lot No.)	Remarks and Comments
		pH (Standard)	Cond. (mS/cm)	DO (mg/L)	pH (Standard)	Cond. (mS/cm)	DO (mg/L)		
6/7/12	FWR	4.07	4.50	8.33	4.01	4.50	8.54	HG 5W 6TLVJW50	
6/8/12	FWR	4.02	4.52	8.06	4.01	4.50	8.10	"	
6/9/12	CWK	4.13	4.71	9.75	4.00	4.51	8.38	"	
6/10/12	CWK	4.02	4.24	8.21	4.00	4.51	8.27	"	
6/11/12	CWK	4.05	4.56	11.15	4.01	4.52	8.83	"	

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : SWMU 57 POL RFI NAPR

INSTRUMENT NAME/MODEL: PID

SITE NAME: NAPR Puerto Rico

MANUFACTURER: MINI RAE

PROJECT No.: 112G03371 CTO JM54

SERIAL NUMBER: 110 004011

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Zero Reading		Span Reading		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
6/5/12	110-004011	FREDR.	0.00	0.00	98	100	0504FF11	
6/6/12	"	C Kelly	0.00	0.00	99	100	"	
6/7/12	"	C Kelly	0.00	0.00	93.9	100.2	"	
6/8/12	"	"	0.00	0.00	106.7	100	"	
6/9/12	"	"	0.00	0.00	96.9	98.9	"	

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : SWMU 57 POL RFI NAPR

SITE NAME: NAPR Puerto Rico

PROJECT No.: 112G03371 CTO JM54

INSTRUMENT NAME/MODEL: Turbidity Meter

MANUFACTURER: LaMotte 2020 e

SERIAL NUMBER: ME 12882

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	0 - NTU Readings		10 - NTU Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
6/9/12	2	CWK	0.00	0.00	10.14	10.00	/	
6/10/12	2	CWK	0.00	0.00	10.4	10.00		

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : SWMU 57 POL RFI NAPR

SITE NAME: NAPR Puerto Rico

PROJECT No.: 112G03371 CTO JM54

INSTRUMENT NAME/MODEL: Water Quality Meter U-5000

MANUFACTURER: Horiba

SERIAL NUMBER: RYRG JNBZ

Date of Calibration	Person Performing Calibration	PRE-CALIBRATION READINGS			POST-CALIBRATION READINGS			Calibration Standard (Lot No.)	Remarks and Comments
		pH (Standard)	Cond. (mS/cm)	DO (mg/L)	pH (Standard)	Cond. (mS/cm)	DO (mg/L)		
6/9/12	CWK	4.10	4.45	8.65	4.01	4.47	9.73	6TLVJW5D	
6/10/12	CWK	4.68	4.53	10.40	3.99	4.48	9.88	"	

C-10 SAMPLE LOG SHEETS– QC

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project Number: 112G03371 CTO JM54
Sample Location:
QA Sample Type:

Sample ID Number: TB-060612-01
Sampled By: Fred W. Ramser
C.O.C. Number: 0941

[x] Trip Blank
[] Source Water Blank
[] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 6-6-12
Time: 0900
Method: From Lab.

WATER SOURCE:

[x] Laboratory Prepared
[] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name:
Supplier:
Manufacturer:
Order Number:
Lot Number:
Expiration Date:

RINSATE INFORMATION (If Applicable):

Media Type:
Equipment Used:
Equipment Type:
[] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs (V8260TCL)	Cool 4°C & HCl	3 X 40 ml Vials	YES / NO
VOA low soil TB	NaHSO4	2 X 40 ml Vials	YES / NO
VOA med soil TB	MeOH	1 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s):
Fred W Ramser

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project Number: 112G03371 CTO JM54
Sample Location:
QA Sample Type:

Sample ID Number: TB-060712-02
Sampled By: Fred W. Ramser
C.O.C. Number: 0942

[x] Trip Blank
[] Source Water Blank
[] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 6-7-12
Time: 0800
Method: From Lab.

WATER SOURCE:

[x] Laboratory Prepared
[] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name:
Supplier:
Manufacturer:
Order Number:
Lot Number:
Expiration Date:

RINSATE INFORMATION (If Applicable):

Media Type:
Equipment Used:
Equipment Type:
[] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs (V8260TCL)	Cool 4°C & HCl	3 X 40 ml Vials	YES / NO
VOA low soil TB	NaHSO4	2 X 40 ml Vials	YES / NO
VOA med soil TB	MeOH	1 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s):

Fred W Ramser

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Sample ID Number: TB-060912-03
Project Number: 112G03371 CTO JM54
Sampled By: Fred W. Ramser
Sample Location:
C.O.C. Number:
QA Sample Type:

[x] Trip Blank
[] Rinsate Blank
[] Source Water Blank
[] Other Blank

SAMPLING DATA:

Date: 6-9-12
Time: 0800
Method: From Lab.

WATER SOURCE:

[x] Laboratory Prepared
[] Tap
[] Purchased
[] Fire Hydrant
[] Other

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name:
Supplier:
Manufacturer:
Order Number:
Lot Number:
Expiration Date:

RINSATE INFORMATION (If Applicable):

Media Type:
Equipment Used:
Equipment Type:
[] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs (V8260TCL)	Cool 4°C & HCl	3 X 40 ml Vials	YES / NO
VOA low soil TB	NaHSO4	2 X 40 ml Vials	YES / NO
VOA med soil TB	MeOH	1 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s):

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project Number: 112G03371 CTO JM54
Sample Location:
QA Sample Type:

[] Trip Blank
[] Source Water Blank

Sample ID Number: EB-060612-01
Sampled By: Fred Ramser
C.O.C. Number: 941

[x] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 6/6/2012
Time: 1400 hrs
Method: Macro Core tool and plastic sleeve

WATER SOURCE:

[] Laboratory Prepared
[x] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: Reagent Grade Water
Supplier: Scientific Sales
Manufacturer: NERL
Order Number: na
Lot Number: 80099
Expiration Date: Sep-12

RINSATE INFORMATION (If Applicable):

Media Type: DPT soil
Equipment Used: DPT Macro Core and sleeve
Equipment Type:

[] Dedicated
[x] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3	HDPE	YES / NO
APP IX PCBs	None	Amber Glass	YES / NO
APP IX SVOCs +LL PAH's	None	Amber Glass	YES / NO
APP IX VOCs	HCL	3 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s):

Fred W Ramser

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project Number: 112G03371 CTO JM54
Sample Location:
QA Sample Type:

[] Trip Blank
[] Source Water Blank

Sample ID Number: EB-060812-02
Sampled By: Fred Ramser
C.O.C. Number: 944

[x] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 6/8/2012
Time: 1450 hrs
Method: Hand Auger

WATER SOURCE:

[] Laboratory Prepared
[x] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: Reagent Grade Water
Supplier: Scientific Sales
Manufacturer: NERL
Order Number: na
Lot Number: 80099
Expiration Date: Sep-12

RINSATE INFORMATION (If Applicable):

Media Type: Soil
Equipment Used: Hand Auger
Equipment Type:
[] Dedicated
[x] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3	HDPE	YES / NO
APP IX PCBs	None	Amber Glass	YES / NO
APP IX SVOCs	None	Amber Glass	YES / NO
APP IX VOCs	HCL	3 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s): Fred Ramser

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project Number: 112G03371 CTO JM54
Sample Location:
QA Sample Type:

[] Trip Blank
[] Source Water Blank

Sample ID Number: EB-061012-03
Sampled By: Fred Ramser
C.O.C. Number: 945

[x] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 6/10/2012
Time: 1200
Method: Bladder Pump

WATER SOURCE:

[] Laboratory Prepared
[x] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: Reagent Grade Water
Supplier: Scientific Sales
Manufacturer: NERL
Order Number: na
Lot Number: 59169
Expiration Date: Jul-12

RINSATE INFORMATION (If Applicable):

Media Type: Groundwater
Equipment Used: Bladder Pump
Equipment Type:
[] Dedicated
[x] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
APP IX Metals*	HNO3	HDPE	YES / NO
APP IX PCBs	None	Amber Glass	YES / NO
APP IX SVOCs + LL PAHS	None	Amber Glass	YES / NO
APP IX VOCs	HCL	3 X 40 ml Vials	YES / NO

OBSERVATIONS / NOTES:

Signature(s): Fred M Ramser

C-11 SAMPLE LOG SHEETS – IDW

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Surface Soil
[] Subsurface Soil
[] Sediment
[x] Other: Composite sample from three 55-gal drums.
[] QA Sample Type:

Sample ID No.: IDW-060812-01
Sample Location: SWMU 57
Sampled By: Fred Ramser
C.O.C. No.: 944

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 6/6/12	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1315	NA	Yellow brown	Sand, Silt and Clay moist
Method: Direct fill			
Monitor Reading (ppm): 0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCLP VOCs	4 oz	✓	
TCLP Inorganics plus RCI	8 oz	✓	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred Ramser

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 57 POL RFI NAPR
Project No.: 112G03371 CTO JM54

[] Domestic Well Data
[] Monitoring Well Data
[x] Other Well Type: IDW sample collected from one 55-gal drum
[] QA Sample Type:

Sample ID No.: IDW-061012-01
Sample Location: SWMU 57
Sampled By: Fred Ramser
C.O.C. No.: 945
Type of Sample:
[x] Low Concentration
[] High Concentration

SAMPLING DATA:

		pH	S.C.	Temp.	Turbidity	DO	ORP	Sal	TDS
Date:	6/10/2012	Standard	mS/cm	^{0}C	NTU	mg/L	mV	ppt	g/L
Time:	1050 hrs								
Method:	Direct fill w/pump	na	na	na	na	na	na	na	na

PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	TDS
Method: Bladder pump								
Monitor Reading (ppm): 0								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Reactive CN and Sulfide, and pH	None 4°	0.5 liter HDPE plastic container	✓
Ignitability	None 4°	250 mL amber glass	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
NO	NO

Signature(s): Fred Ramser

C-12 SURVEY DATA

antonio melendez & asociados, p.s.c.

B17 Marginal Ext. Forest Hills
Bayamon, Puerto Rico, 00959
T. 787-787-6010 F. 787-787-6015
E. tony@amapsc.com

SURVEY REPORT

July 9, 2012

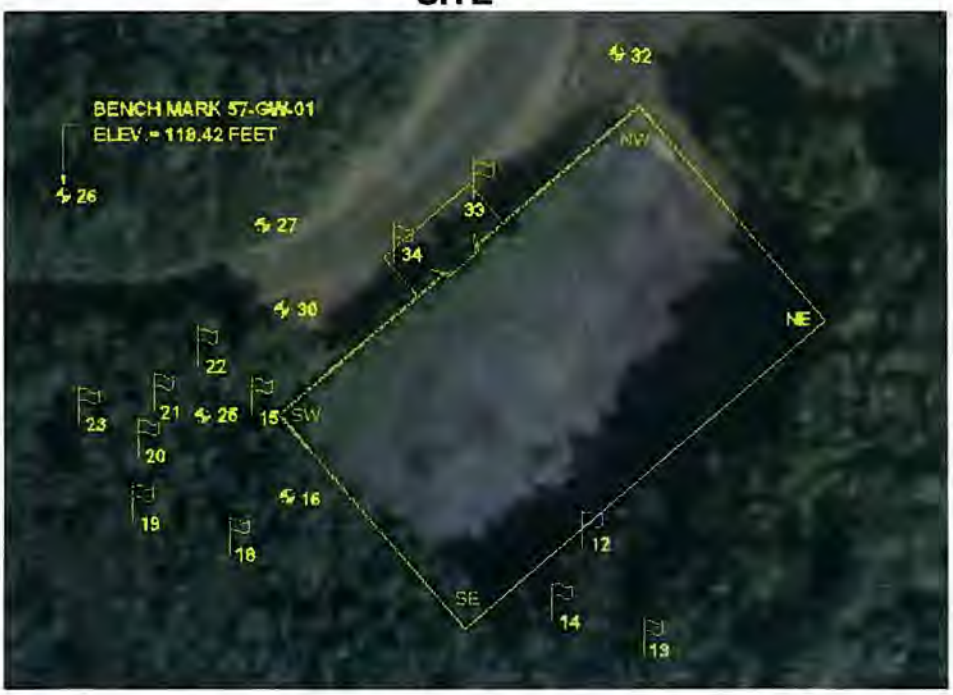
Att. Linda Klink
Project Manager
Tetra Tech Inc.
661 Andersen Drive
Pittsburgh, PA, 15220

REF:Survey of Monitor Wells and Flags
Naval Activity, Ceiba, Puerto Rico

Dear Mrs. Klink:

On June 12 of 2012 our survey crew performed measurements for Tetra Tech, Inc. on the project at Roosevelt Roads (Naval Activity, Ceiba, Puerto Rico).
The project consisted of establishing horizontal control tied to the State Plane Coordinate System for Puerto Rico and the US Virgin Islands, Lambert Projection, NAD83, Current Epoch of 2007. Horizontal Control was established by GPS (Trimble Dual Frequency Receivers). The project was also referred to Monitor Well Number 57GW01 (Elevation = 118.42 feet). Previously established monitor wells were surveyed at ground level with conventional equipments (Nikon Total Station), and elevations at top of pipes were
measured by the means of differential leveling departing from closed circuits. A Geodetic Sokkia digital level and bar code rods were used for the leveling of the Monitor Wells (Bench Marks) and a closure of 0.003' was obtained.
Some discrepancies among the previously published values of some Monitor Wells (Bench Marks) were found, and as instructed, BM 57GW01 was used for departure. New elevations were assigned at Monitor Wells (Bench Marks). In addition, 2 new Monitor Wells were surveyed (57GW08 and 57GW09), along with several flags and the corners of a concrete pad. Only the Bench Marks (top of pipes of Monitor Wells) were measured by differential leveling, all other points were surveyed by conventional surveying (Total Station).

SITE



AMA ID	NORTHING	EASTING	ELEVATION	DESCRIPTION	REMARKS
NE	804334.27	939505.05	122.77	CURB	CONCRETE PAD
NE	804334.19	939505.80	123.25	GROUND	GROUND LEVEL
SE	804220.60	939373.42	123.27	GROUND	GROUND LEVEL
SE	804221.35	939373.59	122.69	CURB	CONCRETE PAD
SW	804299.84	939306.12	122.19	CURB	CONCRETE PAD
SW	804299.79	939305.53	122.68	GROUND	GROUND LEVEL
NW	804413.16	939437.76	123.11	GROUND	GROUND LEVEL
NW	804412.29	939437.58	122.80	CURB	CONCRETE PAD
12	804250.37	939416.47	122.68	57-SB-32	FLAG AT GROUND
13	804210.80	939438.98	127.74	57-SB-33	FLAG AT GROUND
14	804224.22	939405.44	122.38	57-SB-36	FLAG AT GROUND
15	804299.48	939296.03	121.16	57-SB-34	FLAG AT GROUND
16	804269.67	939308.60	121.32	57-GW-07 AT GROUND	OLD MONITOR
			124.05	57-GW-07-BM	OLD MONITOR-TOP OF PIPE
18	804248.16	939287.62	126.42	57-SB-19	FLAG AT GROUND
19	804260.22	939252.64	127.75	57-SB-37	FLAG AT GROUND
20	804284.14	9392S4.63	120.38	57-SB-18	FLAG AT GROUND
21	804300.99	939260.25	118.36	57-SB-17	FLAG AT GROUND
22	804317.57	939276.15	118.35	57-SB-1S	FLAG AT GROUND
23	804295.77	939232.91	118.85	57-SB-35	FLAG AT GROUND
25	804299.26	939277.72	121.10	57-GW-8 AT GROUND	NEW MONITOR
			123.97	57-GW-8-BM	NEW MONITOR-TOP OF PIPE
26	804380.04	939227.20	115.60	57-GW-01 AT GROUND	OLD MONITOR
			118.42	57-GW-01-BM	OLD MONITOR USED AS BENCH MARK
27	804369.24	939299.78	117.35	57-GW-09 AT GROUND	NEW MONITOR
			120.09	57-GW-09-BM	NEW MONITOR-TOP OF PIPE
30	804338.18	939306.67	118.42	57-GW-05 AT GROUND	OLD MONITOR
			120.91	57-GW-05-BM	OLD MONITOR-TOP OF PIPE
31	804485.67	939400.00	118.80	13-GW-07 AT GROUND	OLD MONITOR
			121.55	13-GW-07-BM	OLD MONITOR-TOP OF PIPE
32	804432.08	939429.21	122.34	57-GW-02 AT GROUND	OLD MONITOR
			124.61	57-GW-02-BM	OLD MONITOR-TOP OF PIPE
33	804378.99	939376.94	118.87	57-GW-13	FLAG ON GROUND
34	804355.21	939347.47	118.65	57-SW-14	FLAG ON GROUND

I hereby certify correct,

C-13 CHAIN OF CUSTORY RECORDS

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER № 0941 | PAGE ___ OF ___

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03371	NAPR	LINDA KLINK	412-921-8650	KATAHDIN ANAL. SERV. J. OBRIN
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
Fred W Ramser		FRED W RAMSER	412-921-8838	600 TECHNOLOGY WAY
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FEDEX 8747 2337 3041		SCARBOROUGH ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

SF3337

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	APPIX VOA LOW L.	APPIX VOA MED L.	APPIX METALS MASS/MGDH	APPIX SVOCS + PCBS L.L. PAH	APPIX PCBS 4°	MOISTURE CONT. 4°	APPIX VOA 4°	APPIX SVOCS/LL PAHS HCL	4°	COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)									G	G	G	G	G	G	G			
PRESERVATIVE USED																		
6/6	0900	TB-060612-01	—	—	—	QC	—	3	3	—	—	—	—	—	—			
	0900	57SB16-0001	57 SB16	0	1	SO	G	6	3	1	1	—	1	—	—			
	0910	57SB16-0103	"	1	3	SO	G	6	3	1	1	—	1	—	—			
	0920	57SB16-0911	"	9	11	SO	G	6	3	1	1	—	1	—	—			
	1400	EB-060612-01	—	—	—	QC	—	8	—	1	—	2	—	3	2			
	1225	57SB25-0001	57 SB25	0	1	SO	G	2	—	1	—	—	—	—	1			
	1240	57SB24-0001	SB24	0	1	SO	G	2	—	1	—	—	—	—	1			
	1300	57SB26-0001	SB26	0	1	SO	G	2	—	1	—	—	—	—	1			
	1320	57SB28-0001	SB28	0	1	SO	G	2	—	1	—	—	—	—	1			
	1330	57SB29-0001	SB29	0	1	SO	G	2	—	1	—	—	—	—	1			
	1420	57SB31-0001	SB31	0	1	SO	G	2	—	1	—	—	—	—	1			
	1430	57SB27-0001	SB27	0	1	SO	G	2	—	1	—	—	—	—	1			
6/6	1450	57SB30-0001	SB30	0	1	SO	G	2	—	1	—	—	—	—	1			

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramser	6-7-12	1600	1. RECEIVED BY: FED EX PICK UP		
2. RELINQUISHED BY			2. RECEIVED BY: [signature]	6-7-12	09:00
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER № 0942 | PAGE 1 OF 3

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03371	NAPR	LINDA KLINK	412-921-8650	KATAHDIN ANAL SERV. J. ORBRIN
SAMPLERS (SIGNATURE): Fred W Ramsey		FIELD OPERATIONS LEADER: FRED W. RAMSEY	PHONE NUMBER: 412-921-8838	ADDRESS: 600 TECHNOLOGY WAY
		CARRIER/WAYBILL NUMBER: FEDEX 8736 9347 5802		CITY, STATE: SCARBOROUGH ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: NaOH, MeOH, 4°, 4°, 4°, HCL, HNO3, 4°, 4°

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: APP IX LOW L VOA & MEOH	APP IX METALS	APP IX SVOCS + PCBS	MOISTURE CONT.	APP IX VOA	APP IX METALS	APP IX PCBS	APP IX SVOCS	COMMENTS
6/7	0800	TB-060712-02	—	—	—	QC	FROM LAB	3	3	—	—	—	—	—	—	—	TRIP BLANK
	1340	57SB14-0001	57 SB14	0	1	SO	G	6	3	1	1	1	—	—	—	—	
	1345	57SB14-0103	57 SB14	1	3	SO	G	6	3	1	1	1	—	—	—	—	
	1355	57SB14-0911	"	9	11	SO	G	6	3	1	1	1	—	—	—	—	
	1500	57SB15-0001	57 SB15	0	1	SO	G	6	3	1	1	1	—	—	—	—	
	1505	57SB15-0103	"	1	3	SO	G	6	3	1	1	1	—	—	—	—	
	1515	57SB15-1315	"	13	15	SO	G	6	3	1	1	1	—	—	—	—	
	1600	57SB17-0001	57 SB17	0	1	SO	G	6	3	1	1	1	—	—	—	—	
	1605	57SB17-0103	"	1	3	SO	G	6	3	1	1	1	—	—	—	—	
	1615	57SB17-1315	"	13	15	SO	G	6	3	1	1	1	—	—	—	—	
	1700	57SB18-0001	57 SB18	0	1	SO	G	6	3	1	1	1	—	—	—	—	
	1705	57SB18-0103	"	1	3	SO	G	6	3	1	1	1	—	—	—	—	
6/7	1720	57SB18-1012	"	10	12	SO	G	6	3	1	1	1	—	—	—	—	

SF3419/ SF3420

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: Fred W Ramsey	6/8/12	1600	1. RECEIVED BY: FED Ex Pick UP		
2. RELINQUISHED BY: FedEx	06/09/12	09:10	2. RECEIVED BY: [signature]	06/09/12	09:10
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY) 4/02R

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER № 0943 | PAGE 2 OF 3

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03771	NAPR	LINDA KLINK	412-921-8650	KATAHDIN J. ORBIN
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		FREDERICK RAMSER	412-921 8838	600 TECHNOLOGY WAY
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FED EX 8736 9347 5802		SCARBOROUGH ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED

SF3419/ SF3420

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: APP IX LOW L MISO L	APP IX METALS	APP IX SVOCS+LLPAHS	MOISTURE CONT				COMMENTS
									NO3,SO4 M4001 4°C	4°C	4°C					
6/7	1630	57SB20-0001	57 SB20	0	1	SO	G	12	6*	2*	2*	2*				RUN MS/MSD
	0000	FD060712-02	—	—	-	SO	G	6	3	1	1	1				
	1650	57SB20-0103	57 SB20	1	3	SO	G	12	6*	2*	2*	2*				RUN MS/MSD
	1530	57SB22-0001	57 SB22	0	1	SO	G	6	3	1	1	1				
	1430	57SB21-0103	57 SB21	1	3	SO	G	6	3	1	1	1				
	1410	57SB21-0001	"	0	1	SO	G	6	3	1	1	1				
	1330	57SB19-0103	57 SB19	1	3	SO	G	6	3	1	1	1				
	1310	57SB19-0001	"	0	1	SO	G	6	3	1	1	1				
	1130	57SB13-0103	57 SB13	1	3	SO	G	6	3	1	1	1				
	1055	57SB13-0001	"	0	1	SO	G	6	3	1	1	1				
6/7	0000	FD-060712-01	—	—	-	SO	G	6	3	1	1	1				
6/8	0850	57SB32-0001	57 SB32	0	1	SO	G	6	3	1	1	1				
6/8	0910	57SB33-0001	57 SB33	0	1	SO	G	6	3	1	1	1				

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	6-8-12	1600	1. RECEIVED BY FED EX PICK UP		
2. RELINQUISHED BY Fed Ex	06/09/12	09:10	2. RECEIVED BY [signature]	06/09/12	09:10
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY) 4/02R

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER № 0944 | PAGE 3 OF 3

PROJECT NO: 112G03771	FACILITY: NAPR	PROJECT MANAGER: LINDA KLINK	PHONE NUMBER: 412-921-8650
LABORATORY NAME AND CONTACT: KATAHDIN J. ORBIN			
SAMPLERS (SIGNATURE): Fred W Ramsar		FIELD OPERATIONS LEADER: FRED W RAMSAR	PHONE NUMBER: 412-921-8838
ADDRESS: 600 TECHNOLOGY WAY			
CARRIER/WAYBILL NUMBER: FED Ex 8736 9347 5802		CITY, STATE: SCARBOROUGH ME 04074	

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED

DATE YEAR 2012	TIME	SAMPLE ID (SF3419/SF3420)	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	APPIX LOW L VOA NaSO4	APPIX MEOH L	APPIX METALS 4°C	APPIX SVOCS+LLPAH	APPIX PCBS	MOISTURE CONT	APPIX VOA HCL	APPIX METALS HNO3	APPIX SVOCS+LLPAH 4°C	APPIX PCBS 4°C	COMMENTS
6/8	1000	57SB34-0001	57 SB34	0	1	SO	G	6	3	1	1	1	—	—	—	—			
	1035	57SB34-0103	11	1	3	SO	G	6	3	1	1	1	—	—	—	—			
	1100	57SB35-0001	57 SB35	0	1	SO	G	6	3	1	1	1	—	—	—	—			
	1130	57SB37-0001	57 SB37	0	1	SO	G	6	3	1	1	1	—	—	—	—			
	1200	57SB36-0001	57 SB36	0	1	SO	G	6	3	1	1	1	—	—	—	—			
	1450	EB-060812-02	—	—	—	QC	G	8	—	—	—	—	3	1	2	2			
6/8	1315	IDW-060812-01	—	—	—	SO	C	2*									*	TCLP VOA TCLP INORGANIC+RCI	

1. RELINQUISHED BY: Fred W Ramsar	DATE: 6-8-12	TIME: 1600	1. RECEIVED BY: FED Ex Pick	DATE	TIME
2. RELINQUISHED BY: FedEx	DATE: 06/09/12	TIME: 09:10	2. RECEIVED BY: S. Shewer	DATE: 06/09/12	TIME: 09:10
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TINUS 001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY

NUMBER № 0945

PAGE 1 OF 1

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03771	NAPR	LINDA KLINK	412-921-8650	KATAHDIN J. ORBIN
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
Fred W Ramser		FRED W. RAMSER	412-921-8838	600 TECHNOLOGY WAY
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FED EX 8747 2337 3096		SCARBOROUGH ME 04074

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

SF 3442

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	APPIX VOA	APPIX METALS	APPIX SVOCS+LL PAH	APPIX PCBS	REACTIVE CN & SULFIDE	IGNITABILITY			COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)									G	P	G	G	G	P			
PRESERVATIVE USED									HCL	HNO3	NONE	NONE	NONE	NONE			
6/9	0800	TB-060912-03	—	—	—	QC	FROM LAB	3	3	—	—	—					
	1235	576W02-060912	57 GW02	—	—	GW	G	5	—	1	2	2					
	1620	576W05-060912	57 GW05	—	—	GW	G	8	3	1	2	2					
	1625	FD-060912-01	—	—	—	GW	G	8	3	1	2	2					
	1150	136W07-060912	13 GW07	—	—	GW	G	3	—	1	—	2					
	1645	576W07-060912	57 GW07	—	—	GW	G	3	—	1	—	2					
6/9	1350	576W04-060912	57 GW04	—	—	GW	G	3	—	1	—	2					
6/10	1025	576W01-061012	57 GW01	—	—	GW	G	3	—	1	—	2					
	1115	576W09-061012	57 GW09	—	—	GW	G	8	3	1	2	2					
	1050	IDW-061012-01	—	—	—	GW	C	2	—	—	—	—	1	1			
6/10	1200	EB-061012-03	—	—	—	QC	G	8	3	1	2	2					
6/11	0950	576W08-061112	57 GW08	—	—	GW	G	24	9	3	6	6					RUN MS/MSD

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY Fred W Ramser	6-11-12	1530	1. RECEIVED BY FEDEX PICK UP		
2. RELINQUISHED BY			2. RECEIVED BY	6-12-12	09:15
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R

FORM NO. TtNUS-001

C-14 IDW DISPOSAL MANIFEST

ALLIED WASTE SERVICES
A REPUBLIC SERVICES COMPANY

32900

NON-HAZARDOUS SPECIAL WASTE & ASBESTOS MANIFEST

If waste is asbestos waste, complete Sections I, II, III and IV
If waste is **NOT** asbestos waste, complete Sections I, II and III

I. GENERATOR (Generator completes Ia-r)

a. Generator's US EPA ID Number	b. Manifest Document Number	c. Page 1 of

d. Generator's Name and Location:	e. Generator's Mailing Address:
NAVAL ACTIVITY PUERTO RICO RT 3 CEIBA, PR f. Phone:	NAVAL ACTIVITY PR RT 3 CEIBA, PR g. Phone:
If owner of the generating facility differs from the generator, provide: h. Owner's Name:	i. Owner's Phone No.:

j. Waste Profile #	k. Exp. Date	l. Waste Shipping Name and Description	m. Containers No.	m. Containers Type	n. Total Quantity	o. Unit Wt/Vol
42171310670	04/14 04-18-2014	Rinse Water from Soil Sampling			[illegible]	lb

GENERATOR'S CERTIFICATION: I hereby certify that the above named material is not a hazardous waste as defined by 40 CFR 261 or any applicable state law, has been properly described, classified and packaged, and is in proper condition for transportation according to applicable regulations; AND, if this waste is a treatment residue of a previously restricted hazardous waste subject to the Land Disposal Restrictions. I certify and warrant that the waste has been treated in accordance with the requirements of 40 CFR 268 and is no longer a hazardous waste as defined by 40 CFR 261.

p. Generator Authorized Agent Name (Print)	q. Signature	r. Date
Pedro Ruiz	[illegible]	7/1/13

II. TRANSPORTER (Generator completes IIa-b and Transporter completes IIc-e)

a. Transporter's Name and Address:
Caribe Hydroblasting Corp.
PO Box 790 Peñuelas, PR 00624
b. Phone: 787-836-1110

c. Driver Name (Print)	d. Signature	e. Date
[illegible]	[illegible]	7/1/13

III. DESTINATION (Generator complete IIIa-c and Destination Site completes IIId-g)

a. Disposal Facility and Site Address:	c. US EPA Number	d. Discrepancy Indication Space:
(787) 841-7775 PONCE LANDFILL AVE. BARAMAYA #500 PONCE, P. R. 00732 b.	IDF-58-0008	

I hereby certify that the above named material has been accepted and to the best of my knowledge the foregoing is true and accurate.

e. Name of Authorized Agent (Print)	f. Signature	g. Date

IV. ASBESTOS (Generator completes IVa-f and Operator complete IVg-i)

a. Operator's Name and Address:	c. Responsible Agency Name and Address:
b. Phone:	d. Phone:

e. Special Handling Instructions and Additional Information:

f. ☐ Friable ☐ Non-Friable ☐ Both % Friable % Non-Friable

OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in all respects in proper condition for transport by highway according to applicable international and national governmental regulations.

g. Operator's Name and Title (Print)	h. Signature	i. Date

*Operator refers to the company which owns, leases, operates, controls, or supervises the facility being demolished or renovated, or the demolition or renovation operation or both

APPENDIX D

PHOTOGRAPH LOG

Select Photograph from Phase I RFI (Baker, 2010)
SWMU 57 - POL Drum Storage Area
Naval Activity Puerto Rico
Ceiba, Puerto Rico

Photo 001: SWMU 57 concrete pad, view looking south. Photo taken 1/27/10 by Baker (Baker, 2010).

Photo 002: Former loading dock, concrete pad in background, looking southeast. Photo taken 1/28/10 by Baker (Baker, 2010).

Photo 003: Outboard motor cover in debris area (Facing North) (06/2012)

Photo 004: Construction timbers in debris area (Facing West) (06/2012)

Photo 005: Electrical line detached from pole (Facing West) (06/2012)

Photo 006: Electrical line cut (Facing West) (06/2012)

Photo 007: Steel pipe protruding from ground in debris area (Facing South) (06/2012)

Photo 008: Concrete block in debris area (Facing South) (06/2012)

Photo 009: Various trash pieces in debris area (Facing North) (06/2012)

Photo 010: Screen filter in debris area (Facing East) (06/2012)

Photo 011: Glass and pieces of screen in debris area (Facing South) (06/2012)

Photo 012: Pipe protruding from ground in debris area (Facing North) (06/2012)

Photo 013: Corroded drum in debris area (Facing South) (06/2012)

Photo 014: Corroded drum in debris area (Facing North) (06/2012)

Photo 015: Electrical box in debris area (Facing East) (06/2012)

Photo 016: Plastic pipe in debris area (Facing East) (06/2012)

Photo 017: 6-inch diameter PVC pipe in debris area (Facing East) (06/2012)

Photo 018: Old battery in debris area (Facing South) (06/2012)

Photo 019: Old battery in debris area (Facing North) (06/2012)

Photo 020: Construction timbers in debris area (Facing South) (06/2012)

Photo 021: Corroded drums in debris area (Facing South-West) (06/2012)

Photo 022: Scrap metal debris in debris area (Facing North-East) (06/2012)

Photo 023: Corroded drum in debris area (Facing West) (06/2012)

Photo 024: Corroded drum in debris area (Facing East) (06/2012)

Photo 025: Scrap metal, possibly an auto muffler, in debris area (Facing West) (06/2012)

Photo 026: Scrap metal, possibly an auto muffler, in debris area (Facing East) (06/2012)

Photo 027: Rubber tubing/hose in debris area (Facing South) (06/2012)

Photo 028: Rubber tubing/hose in debris area (Facing South-West) (06/2012)

Photo 029: Corroded drum in debris area (Facing East) (06/2012)

Photo 030: Corroded drum in debris area (Facing South) (06/2012)

Photo 031 Bottom of corroded drum in debris area (Facing East) (06/2012)

Photo 032: Old battery in debris area (Facing North) (06/2012)

Photo 033: Old battery in debris area (Facing North) (06/2012)