REVISED FINAL FULL RCRA FACILITY INVESTIGATION WORK PLAN SWMU 78 – POLE YARD

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

Prepared for:

Department of the Navy
NAVFAC SOUTHEAST
North Charleston, South Carolina

Prepared by:

Baker

Michael Baker Jr., Inc.
Moon Township, PA

Contract No. N62470-10-D-3000
DO JM01

March 21, 2011

IQC for A/E Services for Multi-Media Environmental Compliance Engineering Support

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Prepared by:

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

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

Signature: Mark E. Davidson

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Title: BRAC Env. Coordinator

Date: March 21, 2011

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LIST OF ACRONYMS AND ABBREVIATIONS

Baker	Michael Baker Jr., Inc.
bgs	below ground surface
BOS	Base Operating Support
BRAC	Base Realignment and Closure
CCC	Continuous Criteria Concentrations
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERFA	Community Environmental Response Facilitation Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
CSF	Cancer Slope Factor
DO	Delivery Order
DRO	Diesel Range Organics
EA	Environmental Assessment
ESLs	Ecological Screening Levels
EC_{50}	Median Effective Concentration
Eco-SSL	Ecological Soil Screening Level
FCVs	Final Chronic Values
GIS	Geographic Information System
GPS	Global Positioning System
GRO	Gasoline Range Organics
HHRA	Human Health Risk Assessment
HSA	Hollow-stem Auger
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
IDW	Investigation Derived Waste
IUR	Inhalation Unit Risk
kg	Kilograms
LOEC	Lowest Observed Effect Concentration
LOEL	Lowest Observable Effect Level
LC_{50}	Median Lethal Concentration
MATC	Maximum Acceptable Toxicant Concentration
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
MHSPE	Ministry of Housing, Spatial Planning and Environment
msl	mean sea level
MS/MSD	Matrix Spike/Matrix Spike Duplicate

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command Atlantic Division
NAWQC	National Ambient Water Quality Criteria
NFESC	Naval Facilities Engineering Service Center
NOEC	No Observed Effect Concentration
NOEL	No Observed Effect Level
NOAA	National Oceanic and Atmospheric Administration
NSRR	Naval Station Roosevelt Road
NTR	Navy Technical Representative
NTU	Nephelometric Turbidity Units
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PID	Photoionization Detector
PMO	Program Management Office
PCB	Polychlorinated Biphenyl
ppt	parts per thousand
PREQB	Puerto Rico Environmental Quality Board
PRWQS	Puerto Rico Water Quality Standards
PRWQSR	Puerto Rico Water Quality Standards Regulation
PVC	polyvinyl chloride
PWD	Public Works Department
QA/QC	Quality Assurance/Quality Control
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RCI	reactivity, corrosivity and ignitability
RCRA	Resource Conservation and Recovery Act
RfC	Inhalation Reference Concentrations
RfD	Reference Dose
RFI	Full RCRA Facility Investigation
SCV	Secondary Chronic Values
SE	Southeast
SL	Screening Levels
SQUIRT	Screening Quick Reference Tables
SWMU	Solid Waste Management Unit
SVOC	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

ULM	Upper Limit of the mean
UNEP	United Nations Environmental Program
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

This document presents the activities required for the performance of a Full Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 78 – Pole Yard located at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico (Figure 1-1). This work plan has been prepared by Michael Baker Jr., Inc. (Baker), for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast (SE) office under contract with the Naval Facilities Engineering Command (NAVFAC), SE (Contract Number N62470-10-D-3000, Delivery Order [DO] JM01). This work plan was developed in accordance with the RCRA § 7003 Administrative Order on Consent (United States Environmental Protection Agency [USEPA] Docket No. 02-2007-7301).

1.1 NAPR Description and History

NAPR occupies over 8,800 acres on the northern side of the east coast of Puerto Rico, along Vieques Passage with Vieques Island lying to the east about 10 miles off the harbor entrance (see Figure 1-1). NAPR also occupies the immediately adjacent islands of Piñeros and Cabeza de Perro, as presented on Figure 1-2. The northern entrance to NAPR is about 35 miles east along the coast road (Route 3) from San Juan. The property consists of 3,938 acres of upland (developable) property and 4,955 acres of environmentally sensitive areas including wetlands, mangrove, and wildlife habitat. The closest large town is Fajardo (population approximately 41,000), which is about 5 miles north of NAPR off Route 3. Ceiba (population approximately 18,000) adjoins the west boundary of NAPR (see Figure 1-1).

The facility was commissioned in 1943 as a Naval Operations Base, and finally re-designated a Naval Station in 1957. Naval Station Roosevelt Roads (NSRR) operated as a Naval Station from 1957 until March 31, 2004. NSRR was one of the largest naval facilities in the world with more than 100 miles of paved roads, approximately 1,300 buildings, a large scale airfield (Ofstie Field), a deep water port and over 30 tenant commands. NSRR played a major role in providing communication support to the Atlantic and Caribbean areas and also served as a major training site for fleet exercises.

Section 8132 of fiscal year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directed that NSRR be disestablished within 6 months, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the BRAC Act of 1990. This legislation required that the base closure be conducted in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), as amended by the Community Environmental Response Facilitation Act (CERFA). NSRR has undergone operational closure as of March 31, 2004 and has been designated as Naval Activity Puerto Rico. The mission of NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until final disposal of the property. NAPR will continue until the real estate disposal/transfer is completed.

The USEPA issued a RCRA § 7003 Administrative Order on Consent 'Consent Order' (USEPA Docket No. RCRA-02-2007-7301) to NAPR. The Order sets out the Navy's corrective action obligations under RCRA and replaces the 1994 RCRA permit for NAPR. Following a public comment period, the Consent Order became effective on January 29, 2007.

1.2 Site History

SWMU 78 covers an area of approximately 3.1 acres and is located on the edge of a steep slope off of Gilbert Island Street, as shown on Figure 1-3.

SWMU 78 was identified by the Navy on June 29, 2007 and designated as a SWMU by the USEPA on August 21, 2007. The Navy is required under the Consent Order to notify the USEPA no later than 15 days after discovery of any release of hazardous waste and/or constituents found after the effective date of the Consent Order. A base employee, who is also a Restoration Advisory Board (RAB) member, informed the Navy of the suspected release during the June 14, 2007 RAB meeting based on his observation of the area. Baker and Navy personnel visited the area on June 15, 2007 and June 19, 2007, respectively, and confirmed the presence of stained soil and stressed vegetation. The Navy provided notification to the USEPA in a letter dated June 29, 2007 that there was a newly discovered release of potential hazardous constituents identified at the transformer pad at the Pole Yard. The USEPA responded in a letter dated August 21, 2007 that affirmed that the transformer storage pad as well as the area surrounding the storage pad in the Pole Yard was likely impacted by past releases, and designated the area as SWMU 78. The USEPA also requested in the letter that the Navy prepare a Phase I RFI Work Plan for this SWMU. This is in accordance with the RCRA § 7003 Consent Order Section VIII, Paragraph 26 (USEPA, 2007a).

The Phase I RFI Work Plan was prepared to conduct the field investigation necessary to determine whether or not releases of solid and/or hazardous wastes or hazardous constituents are present both immediately adjacent to the transformer storage pad and in the area surrounding the storage pad (Baker, 2008a). The Phase I RFI Work Plan was approved by the USEPA on May 13, 2008. The field work for the Phase I RFI was conducted at the end of May 2008. Refer to Section 2.2.2 for a summary of the Phase I RFI.

The suspected release at the SWMU 78 is associated with a raised concrete curbed pad that is currently storing 127 transformers. The concrete pad was not present in aerial photographs of NAPR as late as 1995 (see Figure 1-4). The pad has a concrete berm surrounding the perimeter that acts as secondary containment. A valve is located in the berm to allow for the drainage of accumulated rainwater. Standing water, with a slight oily sheen, was observed in the bermed area and on the concrete pad. A small area (approximately 10 feet by 3 feet) of stained soil and stressed vegetation was observed at the discharge of the drainage valve (see Photograph A-1 in Appendix A).

Based on existing information, Polynuclear Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPH) Diesel Range Organics (DRO), and metals in the surface soil and metals in the subsurface soil, are thought to likely be the potential chemicals of concern. It should be noted that all Polychlorinated Biphenyl (PCB)-contaminated transformers and equipment were removed from NSRR prior to 1998 except for one remaining PCB-containing transformer located in Building 386 (NAVFAC Atlantic, 2005).

1.3 Objectives

The purpose of this work plan is to further delineate the environmental impact to media found during the Phase I RFI conducted at SWMU 78 (Baker, 2008).

Specifically, the objectives of this Full RFI are as follows:

- Delineate the PAHs, TPH DRO, and metals in the surface soil and metals in the subsurface soil, found during the Phase I RFI. Specifically, around Phase I RFI sample locations 78SB03, 78SB04, 78SB06, 78SB08, 78SB09, 78SB10, and 78SB11 the area of the storage trailers, and the lower southern boundary of the SWMU.

- Define the likely source area(s) of contamination.

1.4 Organization of the Work Plan

This work plan is organized into seven sections. Section 1.0 of this document includes the site history and objectives of this full RFI. Section 2.0 provides a description of the current conditions and usage of the site as well as a summary of the previous investigations, including the Phase I RFI performed in May 2008. Section 3.0 provides a description of the scope of investigations that will be used during the upcoming fieldwork including a soil sampling and analysis program, a temporary monitoring well installation program and groundwater sampling and analysis program (if groundwater is encountered), quality assurance/quality control (QA/QC) samples, as well as other investigation considerations. The reporting activities that will be conducted following the completion of the field investigation are described in Section 4.0. Section 5.0 discusses the proposed project schedule for the Full RFI process for SWMU 78. The site management structure that will be used during this investigation, including project team responsibilities and field reporting requirements, is presented in Section 6.0, while Section 7.0 presents the report references.

2.0 CURRENT CONDITIONS AND BASIS FOR A FULL RFI

The following sections provide a discussion of the current conditions that exist at SWMU 78 along with a summary of the results of the Phase I RFI (Baker, 2009). In addition, the terrestrial and aquatic habitats and associated biota at and contiguous to SWMU 78 are described and preliminary conceptual models for human and ecological receptors also are provided. The findings and recommendations of the Phase I RFI, comments from the USEPA and the Puerto Rico Environmental Quality Board (PREQB) on the draft reports, and the preliminary conceptual models form the basis for the Full RFI.

2.1 Current Site Conditions

SWMU 78 consists of two relatively small plateaus, encompassing approximately 3.1 acres on the edge of a steep slope off of Gilbert Island Street, near the intersection of Forrestal Drive and Valley Forge Road. There are two areas at the SWMU that are flat; the upper area where the raised concrete pad is located, and the lower laydown area. Ground surface contours at SWMU 78 range from approximately 200 to 220 feet above mean sea level (msl) in the areas of sample collection. Note that the Datum Plan used for NAPR is mean low water equals 100.00 feet as established by U.S. Navy Survey Section as of November 1941. The depth to the water table at this SWMU is estimated to be from 80 to 100 feet below ground surface (bgs) based on previous investigations at the adjacent Tow Way Fuel Farm (SWMU 7/8), and is most likely controlled by bedrock fractures. Wells located at the nearby Tow Way Fuel Farm that are at similar elevations as proposed samples at SWMU 78 indicate groundwater in the area near SWMU 78 should range from 105 to 110 feet above msl.

At the time the field activities for the Phase I RFI were completed (May 29 through May 31, 2008) the raised concrete curbed pad storing 127 transformers (116 pole mounted transformers and eleven large transformers) was still present at SWMU 78. The transformers were sampled in July 2009, see Section 2.2.3 for a discussion of the transformer sampling and results. Most of the transformers have labels stating that the contents do not contain PCBs (See Appendix A, Photographs A-2 and A-3). A concrete curb surrounds the perimeter of the pad and acts as a secondary containment. A concrete ramp over the curb into the pad provides access to the pad. Standing water (approximately 1-2 inches deep), with a slight oily sheen, was observed in the curbed area (Appendix A, Photograph A-4). A valve is installed in the curb to allow the drainage of accumulated rainwater. A small area (approximately 10 feet by 3 feet) of stained soil and stressed vegetation was observed at the discharge point of the valve. Spools of wire are located north of the concrete pad (see Appendix A, Photograph A-5). Although the Final Phase I RFI Work Plan for SWMU 78 (Baker, 2008) indicated that there are a few semi-trailers (use/function unknown) located south of the concrete pad (along Gilbert Island Street), the field investigation team could not confirm their presence, Photograph A-6. A lay down area which appears to have concrete poles is also present in the south central portion of the SWMU (Photographs A-7 and A-8).

2.1.1 Terrestrial and Aquatic Habitats

The upland habitat bounded by NAPR is classified as subtropical dry forest (Ewel and Witmore, 1973). Similar to other forested areas of Puerto Rico, this region was previously clear-cut in the early part of the century, primarily for pastureland (Geo-Marine, Inc., 1998). After acquisition by the Navy, a secondary growth of thick scrub, dominated by lead tree (*Leucaena* spp.), Christmas tree (*Randia aculeata*), sweet acacia (*Acacia farnesiana*), and Australian corkwood (*Sesbania grandiflora*) grew in the previously grazed sections (Geo-Marine, Inc., 1998). Secondary growth communities (upland coastal forest communities and coastal scrub forest communities) exist today throughout the station's undeveloped upland.

The upland vegetative community within undisturbed areas of SWMU 78 and surrounding areas is classified as a coastal scrub forest community. Specific vegetation occurring within the coastal scrub forest community has not been documented during previous investigations. However, based on observations recorded at other SWMUs containing similar upland habitat (i.e., SWMUs 1 and 2), herbaceous and shrub species, including *Panicum maximum* (guinea grass), lead tree (*Leucaena leucocephala*), almácigo (*Bursera simaruba*), Christmas tree (*Randia aculeate*are, are likely present. Dominant vegetation within the coastal scrub forest community will be documented during the Full RFI field investigation.

Cobana negra (*Stahlia monosperma*), a federally threatened tree species, is known to occur between the boundary of black mangrove communities and coastal upland forest communities. This species is also known to occur in coastal forests of southeastern Puerto Rico (Little and Wadsworth, 1964). A single individual was encountered at NAPR during recent surveys conducted by Geo-Marine, Inc. (NAVFAC, 2006). This individual is located within a coastal scrub forest community near the Capehart housing area, west of American Circle (approximately 3.0 miles from SWMU 78). No other plant species listed under the provisions of the Endangered Species Act of 1973 are known to occur or have the potential to occur at NAPR (Geo-Marine, Inc., 2000 and NAVFAC, 2006).

The aquatic habitats (open water marine and wetland habitat) occurring in the vicinity of SWMU 78 are depicted on Figure 2-1. The wetland units depicted on Figure 2-2, identified by the Cowardin Wetland Classification System (Cowardin et al., 1979; see Figure 2-3), were delineated by Geo-Marine, Inc. in December 1999 from 1993 color infrared and 1998 true color aerial photography. Twenty percent of the wetlands delineated by aerial photography were field checked by Geo-Marine, Inc. to verify the accuracy of the delineations. Field verification was based on the 1987 Corps of Engineers wetland delineation manual (United States Army Corps of Engineers [USACE], 1987). As evidenced by Figure 2-2, there are no freshwater or estuarine wetlands within or immediately contiguous to SWMU 78. A small estuarine wetland system is located approximately 1,400 feet west of SWMU 78, while an extensive estuarine wetland system is located approximately 1,800 feet north of SWMU 78. Neither of these wetland systems are hydrologically connected to SWMU 78. The nearest downgradient surface water body is the Ensenada Honda (approximately 700 feet south of SWMU 78). Seagrass beds are prevalent throughout much of the Ensenada Honda. Seagrass meadows within the Ensenada Honda are dominated by a nearly continuous cover of turtle grass with a high abundance of calcareous green algae (*Avranvilla* spp., *Ventricaria ventricosa*, *Caulerpa* spp., *Valonia* spp., and *Udotea* spp.) (Reid et al., 2001). As evidenced by Figure 2-1, sea grass meadows are absent from the portion of the embayment downgradient from SWMU 78.

2.1.2 Biota

A description of the biota occurring within Puerto Rico and the landmass encompassed by NAPR (including the surrounding marine environment) is provided in the sections that follow. Although the specific terrestrial biota occurring at SWMU 78 have not been recorded during previous investigations, generalizations are provided based on available habitat. Specific biota occurring at SWMU 78 will be documented during the Full RFI field investigation.

2.1.2.1 Mammals

A total of 22 terrestrial mammal species are known historically from Puerto Rico; however, all mammals except bats (13 species) have been extirpated (Mac et al., 1998). The specific bat species known to occur in Puerto Rico are listed below. None of the bats found in Puerto Rico are exclusive to the island, nor are they listed under provisions of the Endangered Species Act of 1973.

- 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-tounged 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*)

Of the endangered/threatened marine mammals that may occur in Puerto Rico, only the West Indian manatee is known to occur in the coastal waters surrounding NAPR (DoN, 2007). Manatee populations in Puerto Rico's coastal waters have been documented during three aerial surveys conducted from 1978 to 1979, 1984 to 1985, and in 1993 (United Nations Environmental Program [UNEP], 1995), a radio tracking study of manatee distribution and abundance (Reid and Kruer, 1998), and a year-long study of manatee distribution and abundance (Woods et al., 1984). Historical manatee sightings at NAPR are summarized on Figure 2-4. The figure (reproduced from DoN, 2007) includes information from most of the studies identified above. As evidenced by Figure 2-4, manatees have rarely been sited within the Ensenada Honda downgradient from SWMU 78. This can be attributed to the lack of seagrass within this portion of the embayment.

Several terrestrial mammals have been introduced into Puerto Rico, including the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and small Indian mongoose (*Herpestes javanicus*). These nonindigenous mammals are nuisance species that have been implicated in the decline of native bird and reptile populations (Mac et al., 1998 and USFWS, 1996a).

2.1.2.2 Birds

A total of 239 bird species are native to Puerto Rico (Raffaele, 1989). This total includes breeding permanent residents and non-breeding migrants. In addition, many nonindigenous bird species have been introduced into Puerto Rico, including the shiny cowbird (*Molothrus bonariensis*) and several parrot species, such as the budgerigar (*Melopsittacus undulates*), orange-fronted parrot (*Aratinga canicularis*), and monk parrot (*Myiopsitta monaqchus*). Of the 239 species native to Puerto Rico, 12 are endemic to the island (Raffaele, 1989).

Numerous native and migratory bird species have been reported at NAPR (Geo-Marine, Inc., 1998). A list compiled from literature-based information pre-dating 1990 (see Table 2-1) includes the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), little blue heron (*Florida caerulea*), black-crowned night heron (*Nycticorax nycticorax*), belted kingfisher (*Ceryle alcyon*), spotted sandpiper (*Actitis macularia*), greater yellowlegs (*Tringa melanoleauca*), black-bellied plover (*Squatarola squatarola*), clapper rail (*Rallus longirostris*), Royal tern (*Thalasseus maximus*), sandwich tern (*Thalasseus sandvicensis*), least tern (*Stema albifrons*), yellow warbler (*Dendroica petechia*), palm warbler (*Dendroica palmarum*), prairie warbler (*Dendroica discolar*), magnolia warbler (*Dendroica magnolia*), mourning dove (*Zenaida macroura*), red-legged thrush (*Mimocichla plumbea*), common nighthawk (*Chordeiles minor*), and red-tailed hawk (*Buteo jamaicensis*). Endemic species reported from NAPR include the Puerto Rican lizard cuckoo (*Saurothera vieilloti*), Puerto Rican flycatcher (*Myiarchus antillarum*), Puerto Rican woodpecker (*Malanerpes portoricensis*), Puerto Rican emerald (*Chlorostilbon maugaeus*), and yellow-shouldered blackbird (*Agelaius xanthomus*).

The yellow-shouldered blackbird is a federally endangered species. One of the principal reasons for the status of this species is attributed to parasitism by the nonindigenous shiny cowbird, which lays its eggs in blackbird nests and sometimes punctures the host's eggs (USFWS, 1983). Other factors contributing to the status of this species include nest predation by the introduced black rat, Norway rat, and mongoose, as well as habitat modification and destruction (USFWS 1996a). The entire land area of NAPR was declared critical habitat for the yellow-shouldered blackbird in 1976; however, a 1980 agreement with the USFWS exempted certain areas from this categorization (Geo-Marine, Inc., 1998). SWMU 78 is not located within the critical habitat designation for the yellow-shouldered blackbird. A study conducted by the Naval Facilities Engineering Service Center (NFESC, 1996) reported that the mangrove forests surrounding NAPR should be considered the most important nesting habitat for the yellow-shouldered blackbird. Based on the arboreal feeding behavior of the yellow-shouldered blackbird, potential feeding habitat (shrub layers) within the coastal scrub forest community present at the SWMU (Geo-Marine, Inc., 2000).

Other federally listed bird species that occur or have the potential to occur at NAPR are the Caribbean brown pelican (*Pelecanus occidentalis occidentalis*), roseate tern (*Sterna dougallii dougallii*), and piping plover (*Charadrius melodus*) (Geo-Marine, Inc., 1998). The piping plover is a rare, non-breeding winter visitor in Puerto Rico (Raffaele, 1989). This species breeds only in North America in three geographic regions (Atlantic Coast population [threatened], Great Lakes population [endangered], and Northern Great Plains population [threatened]; USFWS, 1996b). No piping plover observations were reported at NAPR during the 1990s or during sea turtle nesting surveys conducted in 2002 and 2004 (Geo-Marine, Inc., 2005). No historic evidence is available to indicate whether the roseate tern (threatened in Puerto Rico) has ever nested at NAPR and no roseate tern observations have been noted in or over coastal waters adjacent to NAPR (DoN, 2007). The nearest active roseate tern colony likely occurs on the eastern end of Vieques (more than 20 miles east of NAPR) (DoN, 2007). The Caribbean brown pelican (endangered in Puerto Rico) appears to be a seasonal resident at NAPR and in the surrounding coastal waters (Geo-Marine, Inc., 2005). Small numbers, primarily juveniles, have been seen day-roosting, feeding, and resting irregularly in onshore and near-shore habitats at NAPR; however, no brown pelican nesting colonies have been found at NAPR or on the small cays nearby (Geo-Marine, Inc., 2005). Based on the habitat preferences and observations recorded at NAPR, only the brown pelican has the potential to use the open water habitat downgradient from SWMU 78 (i.e., Ensenada Honda) as a food source. It is important to note that the USFWS recently published a proposed rule to remove the brown pelican from the federal list of endangered and threatened wildlife throughout its range, including Puerto Rico (see Federal Register: Volume 73, Number 34, Pages 9408 dated February 20, 2008). This proposed rule indicates that special consideration of the brown pelican at NAPR is not warranted.

2.1.2.3 Reptiles and Amphibians

A total of 23 amphibians and 47 reptiles are known from Puerto Rico and the adjacent waters (Mac et al., 1998). Fifteen of the amphibians and 29 of the reptiles are endemic, while four amphibian species and three reptilian species have been introduced (Mac et al., 1998). Puerto Rico's native amphibian species include 16 species of tiny frogs commonly called coquis. On the coastal lowlands, almost all coqui species are arboreal. The only amphibians listed under provisions of the Endangered Species Act of 1973 are the Puerto Rican crested toad (*Peltophryne lemur*) and the golden coqui (*Eleutherodactylus jasperi*). Both species are listed as threatened (USFWS, 2010). Distribution of the golden coqui is restricted to areas of dense bromeliad growth. All specimens to date have been collected from a small semicircular area of a 6-mile radius south of Cayey (approximately 30 miles southwest of NAPR), generally at elevations above 700 meters (USFWS, 1984). The Puerto Rican crested toad occurs at low elevations (below 200 meters) where there is exposed limestone or porous, well drained soil offering an abundance of fissures and cavities (USFWS, 1987). A single large population is known to exist from the southwest coast in Guánica Commonwealth Forest, while a small population is believed to survive on the north coast near Quebradillas, Arecibo, Barceloneta, Vega Baja, and Bayamón (USFWS, 1987). It also has been collected on the southeastern coastal plain near Coamo (USFWS, 1987). Given the habitat preferences and locations of known occurrences, these two species are not expected to occur at NAPR.

Puerto Rico's native reptilian species include 31 lizards, 8 snakes, 1 freshwater turtle, and 5 sea turtles (Mac et al., 1998). Of the five sea turtles, only the green sea turtle, hawksbill sea turtle (*Eretmochelys imbricata*), and loggerhead sea turtle (*Dermochelys coriacea*) nest within Puerto Rico. These three sea turtles, as well as the leatherback sea turtle (*Caretta caretta*) are listed under the provisions of the Endangered Species Act of 1973 (hawksbill sea turtle and leatherback sea turtle are listed as endangered, while the green sea turtle [Caribbean population] and loggerhead sea turtle are listed as threatened) (USFWS, 2010). Aerial surveys of turtles were performed from March 1984 through March 1995 along the Puerto Rican Coast. This information was summarized by Geo-Marine, Inc. (2005) in the Draft NAPR Disposal Environmental Assessment (EA). Figures 2-5 and 2-6 (reproduced from Geo-Marine, Inc., 2005) present cumulative sea turtle sightings and potential turtle nesting sites at NAPR. Significant turtle observations were made near the mouth of the Ensenada Honda, the northern shore of Pineros Island, Pelican Bay, and the Medio Mundo Passage, with the frequency of turtle observations listed as green > hawksbill > loggerhead > leatherback. No sea turtle sightings have been recorded within the Ensenada Honda downgradient from SWMU 78. Identical to the West Indian manatee, this can be attributed to the absence of seagrass (forage material) within this portion of the embayment.

The Puerto Rican boa (*Epicrates inornatus*) is a federally endangered species throughout its entire range (critical habitat has not been designated for this species [USFWS, 1986]). Four Puerto Rican boa sightings were reported at NAPR prior to 1999 and an additional four occurrences were reported between 2001 and 2003 (Geo-Marine, Inc., 2005). However, no boas were observed during 211 man-hours of surveys conducted within potential boa habitat in 2004 (Tolson, 2004). The Puerto Rican boa uses a variety of habitats but is most commonly found in Karst forest habitat (forested limestone hills). Based on the absence of preferred habitat, there is low probability of occurrence of this species at SWMU 78.

2.1.2.4 <u>Fish and Aquatic Invertebrates</u>

A diverse fish and invertebrate community can be found in the marine environment surrounding NAPR. This can be attributed to the varied habitats that include marine and estuarine open water habitat, mud flats, seagrass beds, and mangrove forests. The fish community is represented by stingrays, herrings, groupers, needlefish, mullets, barracudas, jacks, snappers, grunts, snooks, lizardfishes, parrotfishes, gobies, filefishes, wrasses, damselfishes, and butterflyfish (Geo-Marine, Inc., 1998). The benthic invertebrate community includes sponges, corals, anemones, sea cucumbers, sea stars, urchins, and crabs. A list of known species residing within the Ensenada Honda is not available from the literature.

2.2 Previous Investigations

Previous investigations at SWMU 78 include the Response Actions that were taken after the SWMU was discovered, the Phase I RFI, and the sampling of the transformers. These investigations are summarized below.

2.2.1 Response Actions

In a letter dated June 29, 2007 from the Navy to the USEPA, the Navy notified the USEPA of a newly detected release which is now designated as SWMU 78 (as mentioned in Section 1.2). The letter referred to a small area, approximately 10 feet by 3 feet of stained soil and stressed vegetation that was observed at the discharge of the drain valve of the concrete pad where transformers were stored. In this letter it was stated that the base operating support (BOS) contractor was to remove, sample and properly dispose of the soil. Housekeeping measures including removal and disposal of standing water within the bermed pad was also to be performed by the BOS contractor. After the initial removal and housekeeping measures were completed by the BOS contractor, the Draft Phase I RFI Work Plan was developed and submitted on November 28, 2007; was finalized April 17, 2008; was approved by the USEPA on May 13, 2008; and the soil sampling was conducted the end of May 2008, as discussed below.

2.2.2 Phase I RFI

The objectives of the Phase I RFI were to:

- Determine whether a release has occurred to the environmental media at the site, to the extent practical, from the completion of field activities (surface and subsurface soil sampling) as described in the approved 2008 Phase I RFI Work Plan (Baker, 2008).

Specific elements of the 2008 Phase I RFI work plan included:

- Surface soil sampling at 16 locations (78SB01-00 through 78SB16-00) and two duplicate samples (78SB01-00D and 78SB08-00D); six locations surrounding the north east corner of the raised, concrete curbed pad (including one sample at the area of suspected release); three locations north of the concrete pad along Hollandia Street where spools of wire were identified; two locations west and south around the perimeter of the concrete pad; and five locations further south of the concrete pad in an area that was once used for storage trailers and as a laydown area. All sixteen surface soil samples were analyzed for Appendix IX Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs), low-level PAHs, PCBs, TPH DRO and Gasoline Range Organics (GRO), and Appendix IX metals. Although the transformers are labeled as not containing PCBs, to be conservative, PCBs were included as part of the analysis for the Phase I RFI investigation.

- Subsurface soil sampling (number of samples and depths dependant upon depth of visual contamination impact) at 16 locations corresponding with the surface soil sample locations listed above. Twenty-nine primary subsurface soil samples and three duplicate samples were collected and analyzed during the Phase I RFI. All subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs (including low-level PAHs), PCBs, and metals, as well as TPH DRO and GRO.

A groundwater sampling program was proposed in the Phase I RFI Work Plan; however groundwater was not encountered at the SWMU during the sampling investigation.

Benzo(a)pyrene was detected above its residential Regional Screening Level (SL) in the surface soil sample collected from Phase I RFI borings 78SB01 and 78SB03, dibenz(a,h)anthracene was detected above its residential Regional SL the surface soil samples collected from boring 78SB03. These are located near the northeast corner of the concrete curbed pad in the vicinity of the release valve. TPH DRO was detected in surface soil at 78SB01 at a concentration of 8,000 milligrams per kilogram (mg/kg). Benzo(a)pyrene also exceeded human health screening criteria at two other locations further away from the concrete curbed pad, including one near the northwest corner of the SWMU boundary (78SB11) and one at the lower southern end of the SWMU boundary near the laydown area (78SB12). Metals (predominantly antimony, arsenic, barium, chromium, cobalt, copper, mercury, nickel, vanadium, and zinc) in surface soil were detected at concentrations that were above the Base Background values, the Regional Residential and/or Industrial SLs and/or selected ecological screening values and were spread across the SWMU.

DRO was detected at a concentration above its screening value in subsurface soil in the sample collected below the release valve (78SB01-01). The subsurface soil did not exhibit much contamination above background for metals that exceeded the human health or ecological screening criteria, with the exception of arsenic, barium, and cobalt. Arsenic exceeded both Regional residential and industrial SLs and background values in three samples (78SB11-05, 78SB12-02, and 78SB14-02). Barium exceeded its ecological screening value and background concentration in only one sample (78SB10-01). Cobalt exceeded SLs and/or ecological screening values as well as background in seven samples (78SB03-02, 78SB06-01, 78SB09-01, 78SB09-03, 78SB10-01, 78SB11-03D, and 78SB11-05). A summary of the positive detects for surface and subsurface soil samples collected as part of the May 2008 Phase I RFI and comparisons to applicable screening criteria are included as Appendix B. A detailed evaluation of this data is presented in the Final Phase I RFI, approved by the USEPA on August 11, 2009.

There were sixteen surface soil samples collected as part of the Phase I RFI, all were analyzed for PCBs and only one PCB (Aroclor-1260) was detected in two of the samples at low concentrations, well below the screening criteria. Twenty-nine subsurface soil samples were collected and analyzed for PCBs during the Phase I RFI. There were no detections of PCBs in subsurface soil samples.

Impact to the environment appears to have occurred at SWMU 78. A Full RFI Investigation is recommended in order to delineate the site contamination in surface and subsurface soil. The Full RFI should focus around Phase I RFI sample locations 78SB03, 78SB04, 78SB06, 78SB08, 78SB09, 78SB10, and 78SB11 the area of the storage trailers, and the lower southern boundary of the SWMU. Specifically, the Full RFI should include further investigation of PAHs, DRO, and metals in the surface soil and metals in the subsurface soil, define the likely source area(s). Specific objectives of this Full RFI investigation are discussed in Section 1.3.

2.2.3 Transformer Disposal

There are a total of 127 transformers stored within the concrete curbed pad at SWMU 78. There are 116 pole mounted transformers and eleven enclosed large transformers. The transformers were sampled to determine if any contained PCBs, and were also inventoried based on size and serial numbers for disposal purposes. This sampling event was conducted from July 14 through July 16, 2009. The 11 larger units were not sampled due to the lack of top access to the oil reservoir and spill potential associated with sampling through a bottom valve, which could fail. Of these 116 pole mount units, a total of 6 units were dry or contained no oil, so were not sampled. Therefore, samples were collected from 110 pole mount style transformer units.

The analytical results indicated that nine of the 110 transformers sampled contained detectable levels of PCBs in the oil ranging from 1.5 mg/kg to 17 mg/kg. According to the Toxic Substances Control Act (TSCA) and the PCB regulations found in 40 Code of Federal Regulations (CFR) 761 a *Non-PCB Transformer* means any transformer that contains less than 50 parts per million PCB. None of the transformers sampled at SWMU 78 contained concentrations above the TSCA criteria. The transformers are still present on the concrete pad. A contractor for the Base is planning to dispose of the transformers when funding is available.

2.3 Preliminary Conceptual Models for Human and Ecological Receptors

Preliminary conceptual models for ecological and human receptors are presented on Figures 2-7 and 2-8, respectively. The conceptual models outline potential sources of contaminants, transport pathways, exposure media, potential exposure routes, and receptor groups. Specific components of each preliminary conceptual model (i.e., source areas, transport pathways, and exposure pathways and routes) are discussed in the sections that follow.

2.3.1 Preliminary Conceptual Model for Ecological Receptors

The transformer storage pad and laydown area represent potential source areas for the release of chemicals to surface soil. Contaminated surface soil also represents a potential source for the release of chemicals to subsurface soil and downgradient surface soil. Finally, contaminated surface and subsurface soil represents a potential source for the release of chemicals to groundwater. Transport pathways associated with these source areas are identified and discussed in Section 2.4.1.1 below.

2.3.1.1 Transport Pathways

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. As depicted on Figure 2-7, potential mechanisms for contaminant transport from potential source areas at SWMU 78 are believed to include the following:

- Overland transport of chemicals with surface soil via surface runoff to downgradient surface soil.
- Leaching of chemicals from surface soil and/or subsurface soil by infiltrating precipitation and transport with groundwater to Ensenada Honda surface water and sediment.
- Uptake by biota from surface soil and subsurface soil and trophic transfer to upper trophic level receptors.

Based on the findings of the Phase I RFI, leaching of chemicals from surface soil and/or subsurface soil by infiltrating precipitation and transport with groundwater to Ensenada Honda surface water and sediment is considered a potentially complete, but insignificant transport pathway. As discussed in Section 2.2.2, groundwater was not encountered at SWMU 78 during the advancement of soil borings conducted as part of the Phase I RFI field investigation (Baker, 2009). Furthermore, the depth to the water table at this SWMU is estimated to be from 80 to 100 feet based on previous investigations at the adjacent Tow Way Fuel Farm (SWMU 7/8) (Baker, 2001). With the exception of cobalt and barium, chemicals were not detected in subsurface soil samples collected within the 1.0-foot to 11.0-foot depth interval at concentrations greater than the ecological-based soil screening value and upper limit of the mean (ULM) background concentrations (cobalt was detected in seven Phase I RFI subsurface soil samples at concentrations greater than the soil screening value and ULM background subsurface soil concentration of 13 milligram per kilogram (mg/kg) and 26.9 mg/kg, respectively [27mg/kg in 78SB03-02, 35 mg/kg in 78SB06-01, 33 mg/kg in 78SB09-01, 30 mg/kg in 78SB09-03, 34 mg/kg in 78SB10-01, 29J mg/kg in 78SB11-03D, and 32 mg/kg in 78SB11-05], while barium was detected in one Phase I RFI subsurface soil sample at a concentration greater than the ecological-based soil screening value and ULM background subsurface soil concentration of 330 mg/kg and 220 mg/kg, respectively [450 mg/kg in 78SB10-02]). These data indicate that vertical migration of chemicals with infiltrating precipitation is minimal and not likely reaching the water table. It is noted that if groundwater is encountered during the advancement of soil borings conducted as part of the proposed Full RFI field investigation, monitoring wells will be installed and groundwater samples will be collected (see Section 3.2).

2.3.1.2 Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors via exposure to one or more media. Requirements for a complete exposure pathway are listed below.

- A source of contamination must be present
- Release and transport mechanisms must be available to move the contaminants from the source to an exposure point
- An exposure point must exist where ecological receptors could contact affected media
- An exposure route must exist whereby the contaminant can be taken up by ecological receptors

As depicted on Figure 2-7, potentially complete and significant exposure pathways exist at SWMU 78. An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. Exposure pathways and routes applicable to SWMU 78 are discussed in the paragraphs that follow.

The most common exposure routes are dermal contact, direct uptake, ingestion, and inhalation. Terrestrial plants may be exposed to chemicals present in surface soil directly through their root surfaces during water and nutrient uptake. Terrestrial invertebrates may be exposed to chemicals in soil through dermal adsorption and ingestion. Much of the toxicological data available for terrestrial invertebrates are based upon *in situ* studies that represent both pathways. Invertebrates also represent a link between surface soil and upper trophic level receptors through food web transfer. As such, they are often included as prey items for upper trophic level dietary exposures.

Birds and mammals may be exposed to chemicals through: (1) the inhalation of gaseous chemicals or chemicals adhered to particulate matter; (2) the incidental ingestion of contaminated abiotic media (e.g., soil) during feeding or cleaning activities; (3) the ingestion of contaminated water; (4) the ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. These exposure routes, where applicable, are depicted on Figure 2-7. Their relative importance depends in part on the chemical being evaluated. For chemicals having the potential to bioaccumulate (e.g., polychlorinated biphenyls [PCBs]), the greatest exposure to wildlife is likely to be from the ingestion of prey. For chemicals having a limited potential to bioaccumulate (e.g., aluminum), the exposure of wildlife to chemicals is likely to be greatest through the direct ingestion of abiotic media, such as surface soil.

Direct ingestion of drinking water is only considered if the salinity of a potential drinking water source is less than 15 parts per thousand (ppt), the approximate toxic threshold for wildlife receptors (Humphreys, 1988). As evidenced by Figures 2-1 and 2-3, there are no potential drinking water sources within or contiguous to SWMU. Therefore, ingestion of surface water is not considered a exposure pathway for upper trophic level terrestrial receptors.

Certain potential exposure pathways and/or routes depicted on Figure 2-7 are considered insignificant relative to other pathways due to low potential for exposure and low levels of relevant contaminants. For example, dermal exposures are not considered significant relative to ingestion exposures for upper trophic level receptors. This is supported by evidence outlined in Suter II et al. (2000) and the

USEPA (2003a), including the general fate properties of the majority of compounds detected in soil (e.g., low affinity for dermal uptake), the low potential exposure frequency and duration, and the protection offered by feathers, fur, and scales to avian, mammalian, and reptilian receptors. In addition, literature reviews indicate that dermal exposures to wildlife from classes of chemicals known or suspected to be of concern via dermal adsorption (e.g., VOCs, organophosphorous pesticides, and petroleum compounds) are often overestimated in laboratory studies (where feathers/fur are removed) and do not represent realistic exposure scenarios (USEPA, 2003a). Furthermore, though burrowing reptiles (which would be expected to experience the most significant exposure) may inhabit the upland vegetative units at and contiguous to SWMU 78, chemicals known or suspected to be of concern via dermal adsorption are not known to be associated with historical activities at the site (e.g., organophosphorous pesticides) or were detected at a low frequency and concentration (e.g., VOCs). Moreover, USEPA (2003a) calculated that the contribution of dermal exposures to the total dose received by terrestrial receptors to be 0.5 percent or less and therefore omitted the dermal pathway from consideration during ecological soil screening level (Eco-SSL) development. Incidental ingestion of surface soil during feeding and preening activities by upper trophic level receptors, as well as direct contact exposures by lower trophic level terrestrial receptors (i.e., invertebrates) are considered significant exposure route (see Figure 2-7).

Inhalation of gaseous chemicals and chemicals adhered to particulate matter (e.g., soil) also is considered insignificant relative to ingestion pathways. As described above for dermal exposures, this approach is consistent with Suter II et al. (2000) and USEPA (1997 and 2003a), which recognize the relatively small contribution the inhalation pathway contributes to exposure estimates. For example, USEPA (2003a) estimates that the expected contribution to the total dose associated with the inhalation pathway is less than 0.01 percent for particulates and less than 1.0 percent for volatiles. Site conditions further reduce the importance of this exposure route relative to ingestion. The vegetative groundcover at SWMU 56 (grasses) will minimize the suspension of dust and the potential for exposure via inhalation of chemicals adhered to soil particles. Furthermore, inhalation of gaseous chemicals that have volatilized from surface soil is likely to be insignificant given that VOCs were generally detected at a low frequency and concentration during the Phase I RFI field investigation..

2.3.2 Preliminary Conceptual Model for Human Health Receptors

Development of a preliminary conceptual model of potential exposure is critical in evaluating exposures for the human receptors. The preliminary conceptual model considers all reasonable current and future potential exposures and media of concern under a no-action scenario. The following four elements are considered to determine whether a complete exposure pathway is present (USEPA, 1989):

- A source and potential mechanism of chemical release
- An environmental retention or transport medium
- A point of potential human contact with the contaminated medium; and
- A human exposure route (e.g., ingestion) at the contact point

SWMU 78 consists of a transformer storage pad and laydown area. Site history is presented in Section 1.2, while current site conditions are presented in Section 2.1 of this document. Analytical results from the Phase I RFI indicated detections of benzo(a)pyrene and dibenz(a,h)anthracene exceeding Regional Residential SLs in the surface soil near the concrete curbed pad. Benzo(a)pyrene also exceeded Regional Residential SLs at two other locations further away from the concrete curbed pad, including one near the northwest corner of the SWMU boundary and one at the lower southern end of the SWMU boundary near the laydown area. Metals (predominantly antimony, arsenic, cobalt, and vanadium) in surface soil were detected at concentrations that were above the Base Background values, as well as Regional Residential and/or Industrial SLs, and were spread across the

SWMU. DRO was detected at a concentration above its screening value in subsurface soil in the sample collected below the release valve (78SB01-01). The subsurface soil did not exhibit much contamination above background for metals that exceeded the human health screening criteria, with the exception of arsenic and cobalt.

Based on the available information on SWMU 78, potential migration, exposure pathways, and human receptors are identified (Figure 2-8). Potential contaminant release mechanisms from affected media include storm water runoff, leaching to underlying groundwater, and advective transport in the direction of groundwater flow. Potentially affected media at SWMU 78 may include one or more of the following: surface soil, subsurface soil, and groundwater.

Based on the findings of the Phase I RFI, leaching of chemicals from surface soil and/or subsurface soil by infiltrating precipitation and transport to groundwater is considered a potentially complete, but insignificant transport pathway. As discussed in Section 2.2.2, groundwater was not encountered at SWMU 78 during the advancement of soil borings conducted as part of the Phase I RFI field investigation (Baker, 2009). Furthermore, the depth to the water table at this SWMU is estimated to be from 80 to 100 feet based on previous investigations at the adjacent Tow Way Fuel Farm (SWMU 7/8) (Baker, 2001). With the exception of arsenic and cobalt, chemicals were not detected in subsurface soil samples collected within the 1.0-foot to 11.0-foot depth interval at concentrations greater than the Regional Residential and/or Industrial SL and background concentrations (cobalt was detected in seven Phase I RFI subsurface soil samples at concentrations greater than the Regional Residential and/or Industrial SL and ULM background subsurface soil concentration [27mg/kg in 78SB03-02, 35 mg/kg in 78SB06-01, 33 mg/kg in 78SB09-01, 30 mg/kg in 78SB09-03, 34 mg/kg in 78SB10-01, 29J mg/kg in 78SB11-03D, and 32 mg/kg in 78SB11-05], while arsenic was detected in three Phase I RFI subsurface soil samples at concentrations greater than the Regional Residential and/or Industrial SL and ULM background subsurface soil concentration [2.7 mg/kg in 78SB11-05, 2 mg/kg in 78SB12-02, and 1.8 mg/kg in 78SB14-02]). These data indicate that vertical migration of chemicals with infiltrating precipitation is minimal and not likely reaching the water table. It is noted that if groundwater is encountered during the advancement of soil borings conducted as part of the proposed Full RFI field investigation, monitoring wells will be installed and groundwater samples will be collected (see Section 3.2).

Current and potential future exposure scenarios for SWMU 78 presented in Figure 2-8 are as follows. Current exposures at SWMU 78 are trespassers. Future exposures at this site may consist of trespassers, adult industrial/commercial workers, and construction workers. Future residential land use is also conservatively assumed for SWMU 78, although it is not a likely receptor given expected future land use. A future residential exposure scenario is included for conservative comparison with other exposure scenarios and to estimate the worst-case exposure conditions. The preliminary conceptual model will be refined, as necessary, following data collection. This will serve as the basis for the exposure pathway evaluations in the baseline Human Health Risk Assessment (HHRA).

3.0 SCOPE OF INVESTIGATION

In choosing sample locations, consideration was given to site topography, site features, and reported operational features of the facility, as well as the analytical results of the Phase I RFI. The SWMU topography will be taken into consideration and the sampling locations may be adjusted as necessary. Following the sampling activities, the final locations will be surveyed. Any deviations to this work plan will be noted in the field notebooks by the sampling team.

3.1 Soil Sampling and Analysis Program

Twenty-seven (27) surface soil samples will be collected from 27 boring locations (78SB17 through 78SB26 and 78SB33 through 78SB49) located in the upper plateau where the concrete pad is located and the lower laydown area, as shown on Figure 3-1. A total of fifty-two (52) subsurface soil samples are proposed to be collected during the Full RFI as shown on Figure 3-1. Forty (40) subsurface soil samples are proposed from the 20 soil borings (78SB17 through 78SB32 and 78SB46 through 78SB49) located in the upper plateau of the SWMU also shown on Figure 3-1. Twelve subsurface soil samples (78SB37 through 78SB42) are proposed to be collected from the six borings located in the lower laydown area. Groundwater samples (up to three samples) will be collected if a saturated zone is encountered during soil boring advancement.

PAHs, TPH DRO, and metals in the surface soil and metals in the subsurface soil will be further investigated at locations where the Phase I RFI data indicated the need for additional information to define the extent of inorganic contamination and to delineate PAHs and TPH DRO. Sample matrices for this investigation are provided as Table 3-1 and Table 3-2. The proposed sample locations for the Full RFI at SWMU 78 (as well as the previous sample locations of the Phase I RFI) are shown on Figure 3-1.

Listed below is a summary of the rationale for the soil sampling locations and the analytical program. Borings for surface soil (0 to 1 foot bgs) sample collection will only be advanced to a depth of one-foot below ground surface to allow for sample collection. Borings from which subsurface soil (1 to 3 feet bgs and from an identified contaminated zone, at the direction of the field geologist) samples are scheduled to be collected and will be advanced to refusal (expected to be less than 20 to 25 feet bgs). If groundwater is encountered, one additional subsurface soil sample will be collected immediately above the water table.

The discussion has been broken out to discuss samples proposed that will be collected in the upper area of the SWMU where the raised concrete pad is located herein referred to as the “upper plateau” and the lower portion of the SWMU that served as a pole laydown area/trailer storage area herein referred to as the “laydown area”. Note that there is a steep slope in the northern portion of the site which is upgradient of the operational area and unlikely to contain contamination from the site, furthermore the steep slope prevents access with the drill rig for sampling. Therefore, sample collection is not proposed in the northern boundary of the SWMU.

Upper plateau - Twenty soil boring locations (78SB17 through 78SB32 and 78SB46 through 78SB49) are proposed in the area of the raised concrete pad. The proposed locations and analysis are discussed below.

- Borings 78SB17 through 78SB19 are proposed surrounding Phase I RFI location 78SB03, where TPH DRO, benzo(a)pyrene and dibenz(a,h)anthracene were detected above Regional Residential SLs in surface soil and to delineate TPH DRO to the west of the suspected release area near Phase I RFI sample location 78SB01. The metals antimony, arsenic, mercury and zinc in the surface soil sample will also be delineated. In the sample collected from the 3 to 5 feet interval in the subsurface soil from boring 78SB03, cobalt was detected at a concentration above the human health and background screening value. Surface and subsurface soil samples will be collected from these boring locations for analysis of Appendix IX low-level PAHs and metals, and TPH DRO.

- Three borings (78SB20, 78SB48 and 78SB49) will be installed on the southern end of the concrete pad around sample location 78SB08 to delineate arsenic, copper and zinc in the surface soil above human health and/or ecological screening values as well as Base background. Surface soil will be collected from these three locations for analysis of Appendix IX metals.

- Borings 78SB21, 78SB22, 78SB46, and 78SB47 are proposed east and south of Phase I RFI samples 78SB04 and 78SB06 to delineate antimony, arsenic, copper, vanadium and zinc in the surface soil and cobalt in the subsurface soil. Both surface and subsurface soil samples will be collected from these borings for analysis of Appendix IX metals.

- Four soil borings (78SB23 through 78SB26) will be installed northwest of the concrete pad along Hollandia Street surrounding Phase I RFI sample location 78SB11 to further evaluate the extent of benzo(a)pyrene, arsenic, barium, cobalt and zinc detected in surface and subsurface soil. Both surface and subsurface soil samples will be collected from these borings for analysis of Appendix IX low-level PAHs and metals.

- Six soil borings (78SB27 through 78SB32) will be installed north of the concrete pad along Hollandia Street where surrounding Phase I RFI sample locations 78SB09 and 78SB10. At each proposed location, subsurface soil samples will be collected to further evaluate the extent and impacts of barium and cobalt in subsurface soil noted in nearby borings 78SB09 and 78SB10 from the Phase I RFI investigation. Surface soil samples will not be collected from these locations as there were no exceedances found during the Phase I RFI in surface soil in 78SB09 or 78SB10. The subsurface soil samples will be analyzed for Appendix IX metals.

Lower Laydown Area – Thirteen soil borings are proposed in the lower area, as discussed below.

- Four borings (78SB33 through 78SB36) will be installed further south of the concrete pad in an area that was once used for storage trailers to delineate arsenic, copper and nickel detected in the surface soil during the Phase I RFI investigation (from sample locations 78SB15 and 78SB16). Surface soil samples will be collected from these four locations for analysis of Appendix IX metals.

- Six soil borings (78SB37 through 78SB42) will be installed in the southern portion of the site in the laydown area. Two soil borings (78SB37 and 78SB42) are proposed surrounding Phase I RFI soil boring 78SB14 to delineate arsenic, copper, and vanadium in the surface soil and arsenic in the subsurface soil. Four soil borings (78SB38 through 78SB41) will be installed surrounding Phase I RFI location 78SB12 to delineate benzo(a)pyrene, arsenic, cobalt and vanadium in the surface soil and arsenic in the subsurface detected during the Phase I RFI. Both surface and subsurface soil samples will be collected from these borings. Samples from boring 78SB37 and 78SB42 will be submitted for Appendix IX metals analysis. Samples from boring 78SB38 through 78SB41 will be submitted for Appendix IX low-level PAHs and metals.

- Three soil borings (78SB43 through 78SB45) will be installed surrounding Phase I sample location 78SB13 to delineate chromium in the surface soil along the southern boundary of the SWMU. Surface soil samples will be collected from these borings for analysis of Appendix IX metals.

If groundwater is encountered, up to three permanent monitoring wells will be installed and a groundwater sample will be collected from each well. An additional subsurface soil sample will also be collected immediately above the water table if groundwater is present and a well is installed at a boring location.

The subsurface soil samples will be obtained with a 66DT Geoprobe® drill rig capable of direct push and augering. Soil samples will be collected continuously from the ground surface to refusal using a 4-foot long Macro Core Sampler to advance the borings. It is expected that some soil borings will be advanced no more than 20 feet in the upper plateau where the concrete pad is located since the Phase I RFI investigation boring logs showed refusal ranging from 6.75 ft bgs to 12 ft bgs. Some boring logs did not indicate refusal, however saprolite was noted around 12 feet indicating that refusal to bedrock was likely around that depth. In the lower laydown area it is expected that soil borings will be advanced to no more than eight feet since during the Phase I RFI, refusal was encountered at 6 to 8 feet bgs. During soil boring installation, care will be taken to achieve maximum recovery so that a good stratigraphic profile can be developed. A boring log will be maintained indicating, among other things, lithology, water occurrence, photoionization detector (PID) measurements and other observations. At locations as determined in the field, one surface soil sample (0 to 1 foot bgs) and two subsurface soil samples will be collected for fixed-base laboratory analysis. Two subsurface soil samples per boring will be collected, one from the 1-3 ft interval and the other from the depth of suspected contamination (based on PID measurements, olfactory and/or visual screening) until bedrock is encountered and/or there is refusal when advancing the soil borings. If groundwater is encountered, one additional subsurface soil sample will be collected immediately above the water table. Surface and subsurface soil samples will be collected following the procedures in Final RCRA Facility Investigation Management Plans (Baker, 1995). All pertinent sampling information such as soil description (e.g., color and texture), sample number and location, presence or absence of soil discoloration, and the time of sample collection will be recorded in the field logbook.

The surface and subsurface soil samples collected from the boring locations will be analyzed for one or more of the following: Appendix IX low-level PAHs, TPH DRO, and Appendix IX metals, as shown on Table 3-1. Table 3-2 presents a summary of the QA/QC samples that will be collected as part of this investigation. All analyses at the laboratory will be performed using current methodologies as presented in Table 3-3.

Soil borings will be labeled consecutively (beginning with 78SB17 and ending with 78SB49) in a manner consistent with previous sample designations at NAPR. Extensions to the sample identification will reflect the depth at which the sample was obtained. For the purposes of this work plan, two-foot discrete depths will be used for subsurface soil samples. Sample identification extensions will follow the pattern shown below.

78SB17-00 - SMWU 78
78SB17-00 - Soil Boring
78SB17-00 - Soil boring location identifier
78SB17-00 –Depth designator - 0 to 12 inches bgs (surface soil) sampling interval

Subsurface soil samples will be designated as follows:

78SB17-01 - First subsurface sampling interval, 1 to 3 feet bgs
78SB17-02 - Second subsurface sampling interval, 3 to 5 feet, bgs and so on.

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

Samples will be packed in ice and shipped next day air to the fixed-base laboratory. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt of samples by the laboratory.

All analysis at the laboratory will be performed using current methods as presented in Table 3-3. All analytical work conducted on the mainland of the United States of America must be certified by a Puerto Rico licensed chemist. The specific laboratory and third party validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date. The validation services to be provided will include 100 percent validation of the data in accordance with the most recent USEPA guidelines.

3.2 Monitoring Well Installation Program

Although it is not expected, if groundwater is encountered during advancement of the soil borings, a monitoring well will be installed and a groundwater sample will be collected at up to three locations (as determined in the field by the Site Manager/Field Geologist) that correspond with the soil boring locations presented on Figure 3-1. Even thought it is proposed that three monitoring wells be installed, seventeen possible locations are shown on Figure 3-1 since it is not known which soil borings will produce yield or if groundwater will be encountered in any of the soil borings. Installation of a single monitoring well was proposed in the Phase I RFI Work Plan at the location of soil boring 78SB01 if field observations such as significant staining, and/or if PID measurements recorded during soil boring advancement indicated that contamination was suspected to extend to the bedrock interface. No such indications were present in the subsurface soil at 78SB01. Additionally, no signs of groundwater were encountered during the direct push sampling. In an attempt to induce groundwater to enter the boring, the boring at 78SB01 was repeated advancing a larger diameter (3.25-inch internal diameter) hollow stem auger to a depth of approximately 12 feet bgs where competent bedrock was encountered. However no signs of groundwater were encountered. Therefore, a monitoring well was not installed at this location nor was a groundwater sample obtained for laboratory analysis. SWMU 78 is located on two small plateaus on the edge of a steep slope. Ground surface contours at SWMU 78 range from approximately 200 to 220 feet above msl in the areas of sample collection. The depth to the water table at this SWMU is estimated to be from 80 to 100 feet bgs based on previous investigations at the adjacent Tow Way Fuel Farm (SWMU 7/8) (Baker, 2001), and is most likely controlled by bedrock fractures. However, this was not confirmed since groundwater was not encountered during the Phase I RFI investigation for SWMU 78. No further evaluation of the site specific hydrogeology was conducted for this SWMU during the Phase I RFI investigation.

If groundwater is encountered, monitoring wells installed in soil borings advanced with the 66DT Geoprobe rig will consist of a 2- inch diameter, Schedule 40 polyvinyl chloride (PVC), riser with a 10-foot screen. The well construction materials will be installed through the hollow-stem augers (HSAs), casing, or in an open borehole. For the monitoring wells, the well screen and bottom cap will be set at the bottom of the borehole. The screen will be connected to threaded, flush-joint, riser. An expandable, water tight locking cap or slip-cap with a vent hole will be placed at the top of the casing. The annular space around the well screen will be backfilled with a well-graded, fine to medium sand as the HSAs or casing are being withdrawn from the borehole. The sand will extend to approximately two feet above the top of the screened interval. The thickness of the sand above the screened interval may be reduced if the well is too shallow to allow for placement of adequate sealing material. An approximate two foot thick bentonite seal (minimum of 6 inches for very shallow wells) will be placed above the sand pack. If bentonite pellets or chips are used, they will be sized appropriately given the well and borehole diameter and placed in a careful manner that will prevent bridging. The bentonite will be hydrated with potable water, as necessary. The annular space above the bentonite seal will be backfilled with cement/bentonite grout to prevent surface and near subsurface water from infiltrating into the screened groundwater monitoring zone. The grout will consist of five to ten percent (by dry weight) of bentonite powder and seven gallons of potable water per 94-pound bag of Portland cement. The depth intervals of all backfilled materials will be measured with a weighted measuring tape to the nearest 0.1-foot and recorded in the field logbook.

Wells will be provided with 2 to 3 feet of "stickup" above ground surface. Steel protective casing will be placed over the riser and surrounded by a concrete pad. The pad will be a minimum of 2 feet by 2 feet (length x width) and 6 inches in thickness (with 2 inches set into the ground outside the casing), and extending 2 feet bgs inside the annular space around the well. If water table conditions prevent having a 24-inch thick bentonite seal, the concrete pad depth in the annular space around the well may be decreased.

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

- Clarity of water based on visual determination

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

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

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

- Clarity based on turbidity measurements [typically less than 20 Nephelometric Turbidity Units (NTU)]

A record of the well development will be completed to document the development process. Monitoring well installation and well development procedures will be conducted following the procedures in Final RCRA Facility Investigation Management Plans (Baker, 1995).

3.3 Groundwater Sampling and Analysis Program

If a saturated zone is encountered during the advancement of soil borings, up to three groundwater samples will be collected (locations determined in the field) to investigate the potential for groundwater contamination at SWMU 78 from the monitoring wells and submitted to the laboratory for analysis of Appendix IX low-level PAHs, TPH DRO, and Appendix IX metals (total and dissolved), as shown on Table 3-1.

The groundwater will be sampled using a low-flow sampling technique if the well exhibits sufficient yield, otherwise samples will be grabbed from the existing well volume. Appendix C includes a detailed description of the USEPA Region II low flow sampling technique. Field parameters of pH, temperature, turbidity, conductivity, dissolved oxygen, and oxidation-reduction potential will be obtained with appropriate instrumentation during sampling if enough volume of groundwater is present. Appendix D contains groundwater sampling forms for well detail and sampling logs, the low flow data sheets and daily meter calibration sheets that will be used if groundwater is sampled. The groundwater samples will be placed into appropriate laboratory supplied containers. Prior to sampling, a synoptic set of static water levels will be recorded in order to obtain data to more accurately interpret the groundwater flow direction at SWMU 78. Table 3-1 summarizes the samples that will be collected and the associated analyses, and Table 3-2 includes the proposed QA/QC samples.

The groundwater sample designations will be from the soil boring locations proposed if a saturated zone is encountered, as shown on Figure 3-1 and Table 3-1. Sample identification extensions will follow the pattern below.

78GW01 - SMWU 78 Sample
78GW01 - GW = Groundwater Sample
78GW01 - Monitoring well location identifier (corresponding to the associated soil boring)

Samples will be packed in ice and shipped next day air to the fixed-base laboratory. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt of samples by the laboratory.

All analysis at the laboratory will be performed using current methods as presented in Table 3-3. All analytical work conducted on the mainland of the United States of America must be certified by a Puerto Rico licensed chemist. The specific laboratory and third party validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date. The validation services to be provided will include 100 percent validation of the data in accordance with the most recent USEPA guidelines.

3.4 Quality Assurance/Quality Control Samples

QA/QC requirements for this investigation will consist of trip blanks, equipment rinsates, field blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSDs). These samples are listed on Tables 3-1 and 3-2. The Data Quality Assurance Project plan presented in the Final RCRA Facility Investigation Management Plans (Baker, 1995) will be used as guidance for the sampling and analysis plan.

3.4.1 Trip Blanks

Trip blank samples are required to accompany the samples submitted to the laboratory for TPH GRO and VOC analysis. No trip blank samples are required since TPH GRO or VOC analysis is not proposed as part of this investigation.

3.4.2 Equipment Rinsates

Equipment rinsate samples are collected from analyte-free water rinse of decontaminated equipment. Equipment rinsate blanks will be collected on a daily basis and submitted to a fixed-base analytical laboratory for analysis. The total number of equipment rinsate samples to be collected will be dependent on the length of the field investigation. The results from the blanks will be used to determine if the sampling equipment was free of contamination. The equipment rinsate samples are analyzed for the same parameters as the related samples. These samples will be associated with the surface and subsurface soil and groundwater sampling equipment. The samples will be obtained from a stainless steel spoon for collection of soil, macro core liner for collection of subsurface soil, and from the Teflon-lined polyethylene tubing used during the collection of groundwater. If groundwater samples are not collected, the representative equipment rinsate sample collection will not be required. These samples will be analyzed for the analytes presented in Table 3-2.

3.4.3 Field Blanks

Field blank samples consist of the source water used in equipment decontamination procedures. At a minimum, one field blank for each source of water must be collected and analyzed for the same parameters as the related samples. It is anticipated that two different sources of water (i.e., store-bought distilled water, and laboratory-grade de-ionized water) will be utilized for this investigation as shown in Table 3-2.

3.4.4 Field Duplicates

Field duplicate samples of the surface soil, subsurface soil, and groundwater will be collected during the same time the corresponding environmental sample is collected. One duplicate sample will be collected at a frequency of 10 percent of environmental samples collected per media as shown on Table 3-1.

3.4.5 Matrix Spike/Matrix Spike Duplicates

MS/MSDs are laboratory derived and are collected to evaluate the matrix effect of the sample upon the analytical methodology. One MS/MSD will be collected for every 20 samples collected of a similar matrix as shown on Table 3-1.

3.5 <u>Other Investigation Considerations</u>

During the investigation, the following activities will be performed:

- Clearing and Grubbing
- Utility Clearance
- Investigation Derived Waste (IDW) Management
- Decontamination
- Surveying
- Health and Safety Procedures

- Health and Safety Procedures
- Chain of Custody

Each of these activities is discussed in the following sections.

3.5.1 Clearing and Grubbing

It may be necessary for site clearing to be performed so the Geoprobe 66DT rig can gain access to delineate the suspected contamination. One day of site clearing will be performed by the direct push subcontractor if required.

3.5.2 Utility Clearance

The party conducting the implementation of this work plan will be responsible for clearing all proposed soil boring and well locations.

3.5.3 Investigation Derived Waste Management

The generation of IDW associated with monitoring well installation, including soil cuttings and decontamination fluids, will be collected and stored temporarily in 55-gallon drums. All the soil cuttings for soil borings that have monitoring wells installed will be placed in the same drum (there will not be one drum for each soil boring) and a composite sample will be collected and submitted for laboratory analysis. However, the soil cuttings associated with subsurface soil sampling will be placed back into the location where the cuttings were collected immediately after the subsurface soil samples are collected if a monitoring well is not going to be installed at that soil boring. Furthermore, soils last out of the hole will be returned first as much as possible, thereby approximating original stratigraphy.

Two IDW samples will be collected during this investigation. One composite aqueous sample will be collected from all drums containing decontamination fluid (from sampling equipment and drill rig), and one composite soil sample will be collected from all drums containing drill cuttings. The soil samples will be analyzed for toxicity characteristic leaching procedure (TCLP) metals, Appendix IX metals, and reactivity, corrosivity, and ignitibility (RCI) as shown in Table 3-2, as well as by methods presented in Table 3-3. The water samples will be analyzed for Appendix IX metals and RCI. These samples will provide the necessary data to be able to dispose of the generated IDW at an appropriate disposal facility. Upon completion of the field program, the drums will be moved and stored per the direction of Public Works Department (PWD) personnel. The soil and water IDW will be removed and disposed of from the site by an approved vendor upon receipt and review of the IDW sample analytical data.

3.5.4 Decontamination

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

3.5.5 Surveying

All sampling locations are pre-determined and presented on a figure prior to entering the field. This figure will be loaded into a field-grade global positioning system (GPS) unit for locating purposes in the field. After sample locations are determined in the field and flagged, a surveyor (subcontractor) will obtain and record the locations of each sample. Traditional survey equipment or survey grade GPS unit will be utilized to obtain vertical (+/- 0.01 foot) and horizontal (+/- 0.1 foot) locations and top of PVC elevations of the monitoring well(s).

3.5.6 Health and Safety Procedures

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

3.5.7 Chain-of-Custody

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

A chain-of-custody form will be completed for each shipment of samples in accordance with RFI Management Plans (Baker, 1995). After the samples are properly packaged, the shipping container will be sealed and prepared for shipment to the analytical laboratory.

4.0 REPORTING

This section outlines the reporting activities that are associated with the field investigation. The Full RFI report will include the following:

- Introduction
- Background
- Physical Characteristics of Study Area
- Full RFI Activities
- Physical Results
- Analytical Results
- Conclusions and Recommendations
- References

The Full RFI report sections that will address these requirements are discussed in the following subsections.

4.1 Introduction

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

4.2 Background

This section provides the history and description of NAPR and SWMU 78. This section will include a summary of the results of previous investigations conducted at SWMU 78.

4.3 Physical Characteristics of Study Area

This section will provide the environmental setting, including the regional and site-specific geology and hydrogeology. Regional and local climatic conditions that may be relevant to the environmental impacts of the contaminated media at the site will also be discussed, as relevant.

4.4 Full RFI Activities

This section will summarize the results of the previous investigation and describe the basis for the most recent investigation. This section will also describe the field activities of the most recent investigation to fulfill the Full RFI work plan objectives for the SWMU. This will include a description of the sample locations, sample collection and handling procedures, QA/QC procedures, and analytical methods used. This section will also discuss any problems encountered including any deviations from the work plan and problem resolution.

4.5 Physical Results

This section will present the current site conditions at SWMU 78 at the time of the Full RFI Investigation. The site geology and hydrogeology, as ascertained from the soil boring program and other information will also be discussed.

4.6 Analytical Results

This section will present analytical results of the environmental media and interpretation of the data, to characterize the contaminants present in the soil and groundwater (if applicable).

4.6.1 Media-Specific Ecological Screening Values

The sections that follow describe the various criteria and toxicological benchmarks that will be used as ecological-based media-specific screening values for chemicals in soil (surface and subsurface soil) and groundwater, if applicable. The media-specific screening values, listed in Tables 4-1 (soil) and 4-2 (groundwater) represent conservative exposure thresholds above which adverse ecological effects may occur.

4.6.1.1 Soil Screening Values

The literature-based toxicological benchmarks selected as screening values for chemicals in surface soil (0.0 to 1.0-foot depth interval) and subsurface soil (1.0 to 3.0-foot depth interval) are summarized in Table 4-1. USEPA Eco-SSLs (documentation available at http://www.epa.gov/ecotox/ecossl/) were preferentially used as soil screening values.

Eco-SSLs have been developed for eight receptor groups: plants, soil invertebrates, avian herbivores, avian ground insectivores, avian carnivores, mammalian herbivores, mammalian ground insectivores, and mammalian carnivores. For a given chemical, the lowest Eco-SSL value for plants, soil invertebrates, avian herbivores, avian ground insectivores, avian carnivores, mammalian herbivores was selected as the soil screening value. Eco-SSLs for mammalian ground insectivores were not considered for soil screening value development because there are no mammalian ground insectivores in Puerto Rico (mammalian insectivores are limited to aerial insectivores [i.e., bats]). As discussed in Guidelines for Developing Ecological Soil Screening Levels (USEPA, 2005), aerial and arboreal insectivorous birds and mammals were excluded from Eco-SSL development because they are considered inappropriate (i.e., they do not have a clear or indirect exposure pathway link to soil [indirect exposure pathways involve ingestion of prey that have direct contact with soil]). Eco-SSLs for mammalian carnivores also were not considered for soil screening value development because there are no carnivorous mammals on Puerto Rico. With the exception of bats, the terrestrial mammals represented by potentially complete exposure pathways are limited to nonindigenous, nuisance species (i.e., Norway rat, black rat, and mongoose) that have been implicated in the decline of native reptilian and bird populations (Mac et al., 1998 and United States Fish and Wildlife Service [USFWS], 1996). Eco-SSLs for mammalian herbivores are considered appropriate for soil screening value development based on the presence of fruit-eating and nectivorous bats in Puerto Rico.

For those chemicals lacking plant, soil invertebrate, avian herbivore, avian ground insectivore, avian carnivore, or mammalian herbivore Eco-SSLs, the literature-based toxicological benchmarks listed below were used as soil screening values.

- Toxicological thresholds for earthworms and microorganisms (Efroymson et al., 1997a)

- Toxicological thresholds for plants (Efroymson et al., 1997b)

Identical to the Eco-SSLs, when more than one screening value was available for a given chemical from Efroymson et al. (1997a and 1997b), the lowest value was selected as the soil screening value. For those chemicals lacking plant, soil invertebrate, avian herbivore, avian ground insectivore, avian carnivore, or mammalian herbivore Eco-SSL and a toxicological threshold from Efroymson et al.

(1997a and 1997b), the following literature-based values, listed in their order of decreasing preference, were used as soil screening values:

- Toxicity reference values for plants and invertebrates listed in USEPA (1999)
- Soil standards developed by the Ministry of Housing, Spatial Planning and Environment (MHSPE, 2000)
- Canadian soil quality guidelines (agricultural land use) developed by the Canadian Council of Ministers of the Environment (CCME, 2007)

Soil screening values based on MHSPE soil standards represent an average of the target and intervention soil standards. Values are based on a default organic carbon content of 2.0 percent, which represents the minimum adjustment range (2.0 to 30.0 percent). Soil screening values developed by CCME soil quality guidelines were given the lowest preference since many are background-based interim guidelines that do not represent effect-based concentrations.

4.6.1.2 Groundwater Screening Values

Puerto Rico Water Quality Standards (PRWQS) for Class SB coastal and estuarine waters listed in the Puerto Rico Water Quality Standards Regulation (PRWQSR) dated March 31, 2010 (PREQB, 2010) were preferentially used as groundwater screening values. PRWQS for Class SB coastal and estuarine waters were selected based on the likely discharge point of groundwater encountered at the SWMu (i.w., Ensenada Honda) and the classifications contained within Rule 1302.1 of the PRWQSR. For those chemicals lacking a PRWQS for Class SB coastal and estuarine waters, groundwater screening values were identified from the following information listed in their order of decreasing preference:

- Chronic saltwater National Ambient Water Quality Criteria (NAWQC) (USEPA, 2009a)
- Final Chronic Values (FCVs) for saltwater contained in ECO Update Volume 3, Number 2 (USEPA, 1996)
- USEPA Region 4 chronic screening values for saltwater contained in Ecological Risk Assessment Bulletins – Supplement to Risk Assessment Guidance for Superfund (RAGS) (USEPA 2001)
- Minimum chronic toxicity test endpoints (No Observed Effect Concentration [NOEC], No Observed Effect Level [NOEL], and Maximum Acceptable Toxicant Concentration [MATC] values) for marine species reported in the ECOTOX Database System (USEPA, 2007b)
- Chronic Lowest Observable Effect Levels (LOELs) for saltwater contained in National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 2008) with a safety factor of 10 (Wentsel et al., 1996).

The order of preference was selected based on their level of protection. For example, NAWQC and FCVs would be expected to offer a greater degree of protection than a single species NOEC, MATC, or LOEL since their derivation considers a larger toxicological database. In the absence of the above-mentioned NAWQC, FCVs, USEPA Region 4 chronic screening values, chronic test endpoints, and chronic LOELs, screening values were derived from the acute literature values listed below:

- Acute LOELs for saltwater contained in NOAA SQUIRTs (Buchman, 2008)

- Acute toxicity test endpoints (NOEC, NOEL, LOEL, Lowest Observed Effect Concentration [LOEC], median lethal concentration [LC_{50}], and median effective concentration [EC_{50}] values) for marine species contained in the ECOTOX Database System (USEPA, 2007b)

- LC_{50} values for marine species contained in Superfund Chemical Matrix (USEPA, 2004)

Chronic-based screening values were extrapolated from acute NOEC, NOEL, LOEC, LOEL, LC_{50}, and EC_{50} values as follows:

- An uncertainty factor of 30 was used to convert an acute NOEC or NOEL a chronic-based screening value (Wentsel et al., 1996)

- An uncertainty factor of 50 was used to convert an Acute LOEC or LOEL to a chronic-based screening value (Wentsel et al., 1996)

- An uncertainty factor of 100 was used to convert an EC_{50} or LC_{50} to a chronic-based screening value (Wentsel et al., 1996)

When acute toxicity data were used to extrapolate a chronic screening value, NOECs/NOELs were given preference over LOECs/LOELs, LOECs/LOELs were given preference over LC_{50} and EC_{50} values, and EC_{50} values were given preference over LC_{50} values. When more than one value was available from the literature for a given test endpoint (e.g., NOEC), the minimum value was conservatively used to extrapolate a chronic screening value.

As evidenced by Table 4-2, the total recoverable screening values selected for arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, and zinc are PRWQS for Class SD surface waters, while the total recoverable screening value selected for mercury is a USEPA saltwater NAWQC (CCC value). PRWQSR has adopted USEPA total recoverable NAWQC as PRWQS for arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc (the PRWQSR for these eight metals are identical to the total recoverable CCC values listed in National Recommended Water Quality Criteria [USEPA, 2009a]). Because groundwater collected at SWMU 78 will be analyzed for total recoverable and dissolved metals, dissolved screening values also were identified from the literature. PRWQS expressed in terms of the dissolved metal in the water column are not available from the PRWQSR. However, USEPA saltwater CCC values for arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc, as well as mercury, can be expressed as dissolved or total recoverable concentrations (USEPA, 2009a). Therefore, screening values for these nine metals, expressed in terms of the dissolved metal in the water column, were derived by multiplying total recoverable USEPA CCC values by the saltwater conversion factors listed below (USEPA, 2009a):

- Arsenic: 1.000
- Cadmium: 0.994
- Chromium: 0.993
- Copper: 0.830
- Lead: 0.951
- Mercury: 0.850
- Nickel: 0.990
- Selenium: 0.998
- Zinc: 0.946

Total recoverable screening values were conservatively used to screen dissolved analytical data for those metals lacking screening values expressed as dissolved concentrations (i.e., antimony, barium, beryllium, cobalt, silver, thallium, tin, and vanadium).

For those chemicals lacking saltwater toxicological thresholds and literature values, surface water screening values were identified or developed from the literature-based freshwater values listed below in their order of decreasing preference.

- PRWQS for Class SD surface waters (PREQB, 2010)
- Chronic freshwater NAWQC (USEPA, 2009b)
- FCVs for freshwater contained in ECO Update Volume 3, Number 2 (USEPA, 1996)
- USEPA Region 4 chronic screening values for freshwater contained in Ecological Risk Assessment Bulletins – Supplement to RAGs (USEPA 2001) and USEPA Region 5 ecological screening levels (ESLs) (http://www.epa.gov/reg5rcra/ca/ESL.pdf) (USEPA, 2003b)
- Minimum chronic toxicity test endpoints (NOEC, NOEL, and MATC values) for freshwater species reported in the ECOTOX Database System (USEPA, 2007b)
- Great Lakes basin Tier II Secondary Chronic Values (SCVs) listed in the Great Lakes Initiative Toxicity Data Clearinghouse (http://www.epa.gov/gliclearinghouse/) (USEPA, 2007c)
- Chronic LOELs for freshwater contained in NOAA SQUIRTs (Buchman, 2008) with a safety factor of 10 (Wentsel et al., 1996).

Identical to saltwater-based values, the order of preference was selected based on their level of protection. It is noted that USEPA Region 4 and Region 5 screening values were given equal preference. When a value was available from both sources, the minimum value was selected as the surface water screening value. In the absence of the above-mentioned freshwater FCVs, freshwater USEPA Region 4 and Region 5 screening values, freshwater chronic test endpoints, and freshwater chronic LOELs, screening values were derived from the acute literature values listed below:

- Acute LOELs for freshwater contained in NOAA SQUIRTs (Buchman, 2008)
- Acute toxicity test endpoints (NOEC, NOEL, LOEL, LOEC, LC_{50}, EC_{50} values) for freshwater species contained in the ECOTOX Database System (USEPA, 2007a)
- LC_{50} values for freshwater species contained in Superfund Chemical Matrix (USEPA, 2004)

Chronic-based screening values were extrapolated from acute NOEC, NOEL, LOEC, LOEL, LC_{50}, and EC_{50} values using the safety factors from Wentsel et al. (1996) identified above.

In some cases, acute and/or chronic saltwater LOELs for chemical classes (e.g., PAHs) were available from the literature (Buchman, 2008). A saltwater LOEL based on a chemical class was used as the groundwater screening value only if that chemical lacked freshwater and saltwater literature-based benchmarks and/or toxicity test endpoints.

4.6.2 Human Health Screening Values

Chemical concentrations detected at least once in the media of interest will be used for comparison to screening criteria. Applicable human health criteria for soils include USEPA Regional Industrial SLs and USEPA Regional Residential SLs (USEPA, 2010), and the upper limit of means background levels (inorganics only) (Baker, 2010). Applicable human health criteria for groundwater are USEPA Regional Tap Water SLs, Federal Drinking Water Maximum Contaminant Levels (MCLs) (USEPA, 2010), PRWQS (PREQB, 2010), and any inorganic background levels present in the groundwater at NAPR (Baker, 2010). In the case of groundwater comparison to human health screening criteria conducted as part of the Full RFI, the Regional Tap Water RSLs will be used to delineate the nature and extent of contamination in groundwater when the RSLs are more protective.

4.6.2.1 Regional Screening Levels

The Regional SLs were developed by the USEPA to support the risk assessment screening process, while improving consistency across USEPA Regions and incorporating updated guidance in a timely manner. The Regional SL Table was developed with the Department of Energy's Oak Ridge National Laboratory under an Interagency Agreement as an update of the individual screening tables that had previously been maintained by Regions 3, 4, and 9. As recommended by the USEPA, these Regional SLs are to replace all other screening values.

The Regional SL Table contains risk-based screening levels derived from standardized equations (representing ingestion, dermal contact, and inhalation exposure pathways), calculated using the latest toxicity values, default exposure assumptions and physical and chemical properties. The SLs contained in the Regional SL Table are generic; they are calculated without site-specific information. Regional SLs should be viewed as Agency guidelines, not legally enforceable standards. The SLs for potentially carcinogenic chemicals are based on a target Incremental Lifetime Cancer Risk (ILCR) of $1x10^{-06}$. The SLs for noncarcinogens are based on a target hazard quotient (HQ) of 1.0. However, in order to account for cumulative risk from multiple chemicals in a medium, the noncarcinogenic SLs will be divided by a factor of ten, yielding a target HQ of 0.1. For potential carcinogens, the toxicity criteria applicable to the derivation of SL values are oral Cancer Slope Factors (CSFs) and inhalation unit risk (IUR) factors; for noncarcinogens, they are chronic oral reference doses (RfDs) and inhalation reference concentrations (RfCs). These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. The Regional SL Table is updated periodically to reflect such changes. It should be noted that the most recent Regional SL Table update available at this time is from May 2010 (USEPA, 2010). However, the most current version available at the time the Full RFI is completed will be used for screening purposes.

4.6.2.2 Federal Drinking Water MCLs

Federal Drinking Water MCLs are enforceable standards for public water supplies promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCL Goals are calculated based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with a lifetime exposure (70-year lifetime) of an average adult (70 kilograms [kg]) consuming 2 liters of water per day. MCLs consider both the MCL Goal and the technical feasibility of removing the contaminant from the public water supply. Accordingly, MCLs are established as close to the MCL Goal as technically feasible (USEPA, 2010).

4.6.2.3 Puerto Rico Water Quality Standards

PRWQS are regulations designed to enhance maintain and preserve the quality of the waters of Puerto Rico. Rule 1303 establishes water quality standards and use classifications promulgated for the protection of the uses assigned to the classifications of the coastal, surface, estuarine, wetlands, and ground waters of the Commonwealth. In Rules 1303.1 (I) (1), 1303.1 (I) (2), 1303.1 (I) (3), 1303.1 (I) (4), and1303.1 (I) (5) specific substances are identified for which numeric water quality standards have been established (PREQB, 2010).

PRWQS for Class SG (groundwater intended for use as a source of drinking water supply and agricultural uses including irrigation) listed in the Puerto Rico Water Quality Standards Regulation amended March 31, 2010 (PREQB, 2010) are also included as groundwater screening values. The more stringent of the Federal MCL or PRWQS is used as the screening value.

4.6.3 Background Screening Values

For a given medium (i.e., soil and groundwater), analytical data for inorganic chemicals exceeding one or more of the screening values (human health or ecological) will be compared to NAPR background screening values (i.e., ULM background concentrations). The ULM background concentrations used in the evaluations are those derived from the inorganic data sets contained in the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, (Baker, 2010). The ULM background concentrations, as well as the ecological and human health screening values, will be compared to the Full RFI analytical data to determine if the proposed sampling effort delineated the extent of soil contamination detected during the Phase I RFI.

4.7 Conclusions and Recommendations

Information from the physical and analytical results (nature and extent of contamination) will be synthesized into conclusions regarding site conditions. As previously discussed, all analytical laboratory data will be validated to ensure data usability. In the data validation narrative included as part of the Full RFI, the usability of the data is discussed for each Sample Delivery Group that is received from the laboratory. The data validation reports in the draft Full RFI report should include discussions on surrogates, internal standards, post digest spikes, field duplicates, the extent of outlier exceedances, which results were affected, and how results were qualified. Recommendations will be made from the conclusions as to whether a Corrective Measures Study (CMS) is needed or the SWMU can proceed toward corrective action complete. If the conclusions from the Full RFI indicate exceedances of human health and/or ecological screening values and background screening values, then the Full RFI Report will recommend moving the SWMU to a CMS with the preparation of a Draft CMS Work Plan. A HHRA and ERA will be conducted as part of the CMS and the CMS Work Plan will present the specific methodology that will be employed for conducting these assessments.

Documentation generated during the reporting task will be posted to the NAPR web site under the document library. Additionally, all data obtained during the field effort will be incorporated into the web based Geographic Information System (GIS) system currently residing on the NAPR project team web site. The data that is loaded onto the NAPR website is validated, and validation qualifiers are included on the website. Before the data files are uploaded to the website, the hard copy of the validation reports are checked against the validated electronic data files. Baker will also provide updates of current activities associated with this project in the RCRA Quarterly Progress Report for NAPR.

4.8 References

Source material used in the development of the Full RFI Report will be documented in the References section of the report.

5.0 SCHEDULE

A schedule for the implementation of this work plan, and follow-up reports for the Full RFI for SWMU 78, is provided as Figure 5-1. It should be noted that this schedule is dependent upon EPA review time. Many other factors can also extend the schedule such as if further re-characterization is required, weather delays in the field, funding is delayed by the Navy, or consensus cannot be reached on how the EPA's comments are to be incorporated.

6.0 SITE MANAGEMENT

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

6.1 Project Team Responsibilities

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

The field activities of this project will consist of one field team managed by the Site Manager (to be determined). The Site Manager's responsibilities include directing the field team and subcontractors. Mr. Rick Aschenbrenner, P.G. will direct the reporting effort associated with the field investigation, ensuring that all necessary staffing is utilized to assist in developing the Full RFI Report for SWMU 78 – Pole Yard.

6.2 Field Reporting Requirements

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

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

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

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TABLES

TABLE 2-1
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT
NAVAL ACTIVITY PUERTO RICO
SWMU 78 – POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name (1)		
Pied-billed grebe	Red-billed tropicbird	Brown pelican (2)
Brown booby	Magnificent frigatebird	Great blue heron
Louisiana heron	Snowy egret	Great egret
Striated heron	Little blue heron	Cattle egret
Least bittern	Yellow-crowned night heron	Black-crowned night heron
White-cheeked pintail	Blue-winged teal	American widgeon
Red-tailed hawk	Osprey	Merlin
Clapper rail	American coot	Caribbean coot
Common gallinule	Piping plover (3)(4)	Semipalmated plover
Black-bellied plover	Wilson's plover	Killdeer
Ruddy turnstone	Black-necked stilt	Whimbrel
Spotted sandpiper	Semipalmated sandpiper	Short-billed dowitcher
Greater yellowlegs	Lesser yellowlegs	Willet
Stilt sandpiper	Pectoral sandpiper	Laughing gull
Royal tern	Sandwich tern	Bridled tern
Least tern	Brown noddy	White-winged dove
Zenaida dove	White-crowned pigeon	Mourning dove
Red-necked pigeon	Common ground dove	Bridled quail dove
Ruddy quail dove	Caribbean parakeet	Smooth-billed ani
Yellow-billed cuckoo	Mangrove cuckoo	Short-eared owl
Chuck-will's-widow	Common nighthawk	Antillean crested hummingbird
Green-throated carib	Antillean mango	Belted kingfisher

TABLE 2-1
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT NAVAL ACTIVITY PUERTO RICO
SWMU 78 – POLL YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [1]		
Gray kingbird	Loggerhead kingbird	Stolid flycatcher
Caribbean elaenia	Purple martin	Cave swallow
Barn swallow	Northern mockingbird	Pearly-eyed thrasher
Red-legged thrush	Black-whiskered vireo	American redstart
Parula warbler	Prairie warbler	Yellow warbler
Magnolia warbler	Cape May warbler	Black-throated blue warbler
Adelaide's warbler	Palm warbler	Black and white warbler
Ovenbird	Northern water thrush	Bananaquit
Striped-headed tanager	Shiny cowbird	Black-cowled oriole
Greater Antillean grackle	Yellow-shouldered blackbird [2]	Hooded mannikin
Yellow-faced grassquit	Black-faced grassquit	Least sandpiper
Western sandpiper	Puerto Rican woodpecker	Rock dove
Puerto Rican emerald	Puerto Rican flycatcher	Pin-tailed whydah
Spice finch	Ruddy duck	Peregrine falcon
Marbled godwit	Puerto Rican lizard cuckoo	Prothonotary warbler
Green-winged teal	Orange-cheeked waxbill	Roseate tern [3][4]
Least grebe	West Indian whistling duck	Puerto Rican screech owl
Puerto Rican tody	Green heron	

Notes:

(1) List of birds taken from Geo-Marine, Inc. (1998).
(2) Federally-designated endangered species.
(3) Federally-designated threatened species.
(4) Species has the potential to occur at Naval Activity Puerto Rico.

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Media	Sample Depth (ft bgs)	Fixed-based Analytical Laboratory Analysis: App IX low-level PAHs	TPH DRO	App IX Metals (Total)	App IX Metals (Dissolved)	Comment
Surface Soil Samples						
78SB17-00	0.0 - 1.0	X	X	X		
78SB18-00	0.0 - 1.0	X	X	X		
78SB19-00	0.0 - 1.0	X	X	X		
78SB19-00D	0.0 - 1.0	X	X	X		Duplicate
78SB19-00MS/MSD	0.0 - 1.0	X	X	X		Matrix Spike/Matrix Spike Duplicate
78SB20-00	0.0 - 1.0			X		
78SB21-00	0.0 - 1.0			X		
78SB22-00	0.0 - 1.0			X		
78SB23-00	0.0 - 1.0	X		X		
78SB24-00	0.0 - 1.0	X		X		
78SB25-00	0.0 - 1.0	X		X		
78SB25-00D	0.0 - 1.0	X		X		Duplicate
78SB25-00MS/MSD	0.0 - 1.0	X		X		Matrix Spike/Matrix Spike Duplicate
78SB26-00	0.0 - 1.0	X		X		
78SB33-00	0.0 - 1.0			X		
78SB34-00	0.0 - 1.0			X		
78SB35-00	0.0 - 1.0			X		
78SB36-00	0.0 - 1.0			X		
78SB37-00	0.0 - 1.0			X		
78SB37-00D	0.0 - 1.0			X		
78SB38-00	0.0 - 1.0	X		X		
78SB39-00	0.0 - 1.0	X		X		
78SB39-00D	0.0 - 1.0	X		X		Duplicate
78SB40-00	0.0 - 1.0	X		X		
78SB41-00	0.0 - 1.0	X		X		
78SB42-00	0.0 - 1.0			X		
78SB43-00	0.0 - 1.0			X		
78SB44-00	0.0 - 1.0			X		
78SB45-00	0.0 - 1.0			X		
78SB46-00	0.0 - 1.0			X		
78SB47-00	0.0 - 1.0			X		
78SB48-00	0.0 - 1.0			X		
78SB49-00	0.0 - 1.0			X		
Subsurface Soil Samples(2)						
78SB17-XX(1)	TBD	X	X	X		
78SB17-XX(1)	TBD	X	X	X		
78SB18-XX(1)	TBD	X	X	X		
78SB18-XX(1)	TBD	X	X	X		
78SB19-XX(1)	TBD	X	X	X		
78SB19-XXD(1)	TBD	X	X	X		Duplicate

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Fixed-based Analytical Laboratory Analysis				
Media	**Sample Depth (ft bgs)**	App IX low-level PAHs	TPH DRO	App IX Metals (Total)	App IX Metals (Dissolved)	**Comment**
Subsurface Soil Samples[2] continued						
78SB19-XXMS/MSD[1]	TBD	X	X	X		Matrix Spike/Matrix Spike Duplicate
78SB19-XX[1]	TBD	X	X	X		
78SB21-XX[1]	TBD			X		
78SB21-XX[1]	TBD			X		
78SB22-XX[1]	TBD			X		
78SB22-XX[1]	TBD			X		
78SB23-XX[1]	TBD	X		X		
78SB23-XXD[1]	TBD	X		X		Duplicate
78SB23-XX[1]	TBD	X		X		
78SB24-XX[1]	TBD	X		X		
78SB24-XX[1]	TBD	X		X		
78SB25-XX[1]	TBD	X		X		
78SB25-XX[1]	TBD	X		X		
78SB26-XX[1]	TBD	X		X		
78SB26-XX[1]	TBD	X		X		
78SB27-XX[1]	TBD			X		
78SB27-XX[1]	TBD			X		
78SB28-XX[1]	TBD			X		
78SB28-XX[1]	TBD			X		
78SB29-XX[1]	TBD			X		
78SB29-XX[1]	TBD			X		
78SB30-XX[1]	TBD			X		
78SB30-XXD[1]	TBD			X		Duplicate
78SB30-XXMS/MSD[1]	TBD			X		Matrix Spike/Matrix Spike Duplicate
78SB30-XX[1]	TBD			X		
78SB31-XX[1]	TBD			X		
78SB31-XX[1]	TBD			X		
78SB32-XX[1]	TBD			X		
78SB32-XX[1]	TBD			X		
78SB37-XX[1]	TBD			X		
78SB37-XX[1]	TBD			X		

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Fixed-based Analytical Laboratory Analysis				
Media	**Sample Depth (ft bgs)**	App IX low-level PAHs	TPH DRO	App IX Metals (Total)	App IX Metals (Dissolved)	**Comment**
Subsurface Soil Samples[2] continued						
78SB38-XX[1]	TBD	X		X		
78SB38-XXD[1]	TBD	X		X		Duplicate
78SB38-XX[1]	TBD	X		X		
78SB39-XX[1]	TBD	X		X		
78SB39-XX[1]	TBD	X		X		
78SB40-XX[1]	TBD	X		X		
78SB40-XX[1]	TBD	X		X		
78SB41-XX[1]	TBD	X		X		
78SB41-XX[1]	TBD	X		X		
78SB42-XX[1]	TBD			X		
78SB42-XX[1]	TBD			X		
78SB46-XX[1]	TBD			X		
78SB46-XX[1]	TBD			X		
78SB47-XX[1]	TBD			X		
78SB47-XX[1]	TBD			X		
Groundwater Samples						
78GW**[3]	NA	X	X	X	X	
78GW**D[3]	NA	X	X	X	X	Duplicate
78GW**MS/MSD[3]	NA	X	X	X	X	Matrix Spike/Matrix Spike Duplicate
78GW**[3]	NA	X	X	X	X	
78GW**[3]	NA	X	X	X	X	

Notes:

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

[2] Although two subsurface soil samples are proposed per boring, additional subsurface soil will be collected if areas of staining or other indicators of contamination are encountered at multiple depths.

[3] The "**" designation listed for the groundwater samples will be replaced with the appropriate soil boring designation if a saturated zone is encountered and a groundwater sample is collected.

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

TABLE 3-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - QA/QC SAMPLES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Analysis Requested					
Sample Media	**Media**	App IX Low-level PAHs	TPH DRO	Appendix IX Metals	Reactivity, Corrosivity and Ignitability	TCLP Metals and TCLP SVOCs	**Comment**
Equipment Rinsates	78ER01	X	X	X			Macro Core Acetate Liner
	78ER02	X	X	X			Stainless Steel Spoon
	78ER03	X	X	X			Stainless Steel Spoon
	78ER04	X	X	X			Teflon-lined polyethylene tubing
	78ER05	X	X	X			Macro Core Acetate Liner
Field Blanks	78FB01	X	X	X			Store Bought Distilled Water
	78FB02	X	X	X			Lab Grade Deionized Water
IDW	78-IDW01				X	X	Solid
	78-IDW02			X	X		Aqueous

TABLE 3-3 Revised: March 21, 2011

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CRQLs
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Low Level Quantitation Limits*		Preparation Methods			
Appendix IX - LL SVOCs	**Water (µg/L)**	**Low Soil (µg/kg)**	**Water**	**Soil**	**Method Number**	**Method Description**
Acenaphthene	0.2	6.7	3520C	3550B	8270D	Gas Chromotography/Mass Spectrometry (GC/MS)
Acenaphthylene	0.2	6.7	3520C	3550B	8270D	GC/MS
Anthracene	0.2	6.7	3520C	3550B	8270D	GC/MS
Benzo(a)anthracene	0.2	6.7	3520C	3550B	8270D	GC/MS
Benzo(b)fluoranthene	0.2	6.7	3520C	3550B	8270D	GC/MS
Benzo(k)fluoranthene	0.2	6.7	3520C	3550B	8270D	GC/MS
Benzo(g,h,i)perylene	0.2	6.7	3520C	3550B	8270D	GC/MS
Benzo(a)pyrene	0.2	6.7	3520C	3550B	8270D	GC/MS
Chrysene	0.2	6.7	3520C	3550B	8270D	GC/MS
Dibenzo(a,h)anthracene	0.2	6.7	3520C	3550B	8270D	GC/MS
Fluoranthene	0.2	6.7	3520C	3550B	8270D	GC/MS
Fluorene	0.2	6.7	3520C	3550B	8270D	GC/MS
Indeno(1,2,3-cd)pyrene	0.2	6.7	3520C	3550B	8270D	GC/MS
1-Methylnaphthalene	0.2	6.7	3520C	3550B	8270D	GC/MS
2-Methylnaphthalene	0.2	6.7	3520C	3550B	8270D	GC/MS
Naphthalene	0.2	6.7	3520C	3550B	8270D	GC/MS
Phenanthrene	0.2	6.7	3520C	3550B	8270D	GC/MS
Pyrene	0.2	6.7	3520C	3550B	8270D	GC/MS
	Quantitation Limits*		**Preparation Methods**			
Total Petroleum Hydrocarbons	**Water (µg/L)**	**Low Soil (µg/kg)**	**Water**	**Soil**	**Method Number**	**Method Description**
TPH DRO	100	3300	3520C	3550B	8015C	Gas chromotography
	Quantitation Limits*		**Preparation Methods**			
Reactivity, Corrosivity, Ignitibility	**Water (mg/L)**	**Soil (mg/kg)**	**Water**	**Soil**	**Method Number**	**Method Description**
Cyanide	1	1	9012A	9012A	9014	Titrimetric
Flashpoint/Ignitability	NA	NA	NA	NA	1010A/1030	Pensky-Martens Closed Cup Tester
pH	NA	NA	NA	NA	9040C/9045D	Electrometric
Sulfide	1	10	NA	9030B	9034	Titrimetric

Notes:

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

µg/L - micrograms per liter.

µg/kg - micrograms per kilogram. GC - Gas Chromotography

mg/kg - milligrams per kilogram. MS - Mass Spectrometry

TABLE 3-3 Revised: March 21, 2011

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CRQLs
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Quantitation Limits*		Preparation Methods		
Inorganics	**Method Number**	**Water (μg/L)**	**Low Soil (mg/kg)**	**Water**	**Soil**	**Method Description**
Antimony	6020A	2.0	2.0	3005A	3050B	Inductively Coupled Plasma - Mass Spectrometry - (ICP/MS)
Arsenic	6020A	1.0	1.0	3005A	3050B	6020A ICP/MS
Barium	6020A	10	1.0	3005A	3050B	6020A ICP/MS
Beryllium	6020A	1.0	0.4	3005A	3050B	6020A ICP/MS
Cadmium	6020A	1.0	0.5	3005A	3050B	6020A ICP/MS
Chromium	6020A	2.0	1.0	3005A	3050B	6020A ICP/MS
Cobalt	6020A	1.0	1.0	3005A	3050B	6020A ICP/MS
Copper	6020A	2.0	2.0	3005A	3050B	6020A ICP/MS
Lead	6020A	1.0	0.5	3005A	3050B	6020A ICP/MS
Mercury	7470A/7471B	0.2	0.02	7470A	7471A	7470A/7471B (Cold Vapor AA)
Nickel	6020A	1.0	4.0	3005A	3050B	6020A ICP/MS
Selenium	6020A	5.0	1.0	3005A	3050B	6020A ICP/MS
Silver	6020A	1.0	1.0	3005A	3050B	6020A ICP/MS
Thallium	6020A	1.0	1.0	3005A	3050B	6020A ICP/MS
Tin	6020A	5.0	5.0	3005A	3050B	6020A ICP/MS
Vanadium	6020A	5.0	1.0	3005A	3050B	6020A ICP/MS
Zinc	6020A	2.0	2.0	3005A	3050B	6020A ICP/MS
		Quantitation Limits*		**Preparation Methods**		
TCLP Metals	**Method Number**	**Soil (μg/L)**	**Water (μg/L)**	**Water**	**Soil**	**Method Description**
Arsenic	6010C (3050B/3010A)	1.0	10	NA	1311/3010A	Inductively Coupled Plasma
Barium	6010C (3050B/3010A)	1.0	10	NA	1311/3010A	Inductively Coupled Plasma
Cadmium	6010C (3050B/3010A)	0.50	5	NA	1311/3010A	Inductively Coupled Plasma
Chromium	6010C (3050B/3010A)	1.0	10	NA	1311/3010A	Inductively Coupled Plasma
Lead	6010C (3050B/3010A)	0.50	5.0	NA	1311/3010A	Inductively Coupled Plasma
Mercury	7471B/7470A	0.020	0.20	NA	1311/7470A	Cold Vapor AA
Selenium	6010C (3050B/3010A)	1.0	10	NA	1311/3010A	Inductively Coupled Plasma
Silver	6010C (3050B/3010A)	1.0	10	NA	1311/3010A	Inductively Coupled Plasma

Notes:

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

μg/L - micrograms per liter.

μg/kg - micrograms per kilogram.

mg/kg - milligrams per kilogram.

NA - Not Applicable

ICP/MS - Inductively Coupled Plasma/Mass Spectrometry

TCLP - Toxicity Characteristic Leaching Procedure

TABLE 4-1
ECOLOGICAL SOIL SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Soil Screening Value	Reference	Comment
PAHs (ug/kg):			
Low molecular weight PAHs [1]	29,000	USEPA 2007a	Ecological soil screening level for soil invertebrates
High molecular weight PAHs [2]	18,000	USEPA 2007a	Ecological soil screening level for soil invertebrates
Metals (mg/kg):			
Antimony	10.0	USEPA 2005a	Ecological soil screening level for mammalian herbivores
Arsenic	18.0	USEPA 2005b	Ecological soil screening level for plants
Barium	330	USEPA 2005c	Ecological soil screening level for soil invertebrates
Beryllium	21.0	USEPA 2005d	Ecological soil screening level for mammalian herbivores
Cadmium	0.77	USEPA 2005e	Ecological soil screening level for avian ground insectivores
Chromium, total	26.0	USEPA 2008	Ecological soil screening level for avian ground insectivores
Cobalt	13.0	USEPA 2005f	Ecological soil screening level for plants
Copper	28.0	USEPA 2007b	Ecological soil screening level for avian ground insectivores
Lead	11.0	USEPA 2005g	Ecological soil screening level for avian ground insectivores
Mercury	0.10	Efroymson et al. 1997a	Toxicological threshold for earthworms
Nickel	38.0	USEPA 2007c	Ecological soil screening level for plants
Selenium	0.52	USEPA 2007d	Ecological soil screening level for plants
Silver	4.2	USEPA 2006	Ecological soil screening level for avian ground insectivores
Thallium	1.00	Efroymson et al. 1997b	Toxicological threshold for plants
Tin	50.0	Efroymson et al. 1997b	Toxicological threshold for plants
Vanadium	7.8	USEPA 2005h	Ecological soil screening level for avian ground insectivores
Zinc	46.0	USEPA 2007e	Ecological soil screening level for avian ground insectivores

Notes:
USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
ug/kg = microgram per kilogram
mg/kg = milligram per kilogram

(1) 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 78 will be: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene.

(2) 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 78 will be: 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.

TABLE 4-1
ECOLOGICAL SOIL SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References:

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revisions. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revisions. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R3

United States Environmental Protection Agency (USEPA). 2008. Ecological Soil Screening Levels for Chromium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-66.

USEPA. 2007a. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs) (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-78.

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 Emergecny Response, Washington, D.C. OSWER Directive 9285.7-73.

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. OSWER Directive 9285.7-62.

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 9285.7-64.

USEPA. 2005e. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-65.

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

TABLE 4-1
ECOLOGICAL SOIL SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

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 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value [(1)]	Reference	Comment [(2)]
Volatile Organics (µg/L):			
1,1,1,2-Tetrachloroethane	200 [(3)]	USEPA 2007a	Minimum acute value (96-hour LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
1,1,1-Trichloroethane	312	USEPA 2001	USEPA Region 4 chronic screening value
1,1,2,2-Tetrachloroethane	90.2	USEPA 2001	USEPA Region 4 chronic screening value
1,1,2-Trichloroethane	340	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Pleuronectes platessa* [sand dab]) with a safety factor of 100
1,1-Dichloroethane	47.0 [(3)]	USEPA 2003	USEPA Region 5 ecological screening level
1,1-Dichloroethene	2,240	USEPA 2001	USEPA Region 4 chronic screening value
1,2,3-Trichloropropane	274 [(3)]	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
1,2-Dibromo-3-chloropropane	100	USEPA 2007a	Minimum acute value (48-hr EC_{50} for *Mercenaria mercenaria* [hard clam]) with a safety factor of 100
1,2-Dichloroethane	1,130	USEPA 2001	USEPA Region 4 chronic screening value
1,2-Dichloropropane	2,400	USEPA 2001	USEPA Region 4 chronic screening value
2-Butanone (MEK)	13,333	USEPA 2007a	Minimum acute value (96-hour NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
2-Chloro-1,3-butadiene	NA	---	---
2-Hexanone	99.0 [(3)]	USEPA 2003	USEPA Region 5 ecological screening level
3-Chloro-1-propene	3.40 [(3)]	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Xenopus laevis* [clawed toad]) with a safety factor of 100
4-Methyl-2-pentanone (MIBK)	170 [(3)]	USEPA 2003	USEPA Region 5 ecological screening level
Acetone	1,000	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Lumbriculus variegatus* [Oligochaete]) with a safety factor of 100
Acetonitrile	12,000 [(3)]	USEPA 2003	USEPA Region 5 ecological screening level
Acrolein	0.55	USEPA 2001	USEPA Region 4 chronic screening value
Acrylonitrile	58.1	USEPA 2007a	Minimum acute value (96-hr $LC_{50 \text{ for}}$ *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Benzene	109	USEPA 2001	USEPA Region 4 chronic screening value
Bromoform	640	USEPA 2001	USEPA Region 4 chronic screening value
Bromomethane	120	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
Carbon disulfide	15.0 [(3)]	USEPA 2003	USEPA Region 5 ecological screening level
Carbon tetrachloride	1,500	USEPA 2001	USEPA Region 4 chronic screening value
Chlorobenzene	105	USEPA 2001	USEPA Region 4 chronic screening value
Chlorodibromomethane	340 [(3)]	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Cyprinus carpio* [common carp] with a safety factor of 100
Chloroethane	NA	---	---
Chloroform	815	USEPA 2001	USEPA Region 4 chronic screening value
Chloromethane	2,700	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
cis-1,3-Dichloropropene	7.90	USEPA 2001	USEPA Region 4 chronic screening value (cis and trans)
Dibromomethane	1,280	Buchman 2008	Chronic LOEL for chemical class with a safety factor of 5
Dichlorobromomethane	2,400 [(3)]	USEPA 2007a	Minimum acute value (24-hr LC_{50} for *Tetrahymena pyriformis* [ciliate]) with a safety factor of 100
Dichlorodifluoromethane	1,280	---	Value for trichlorofluoromethane used as a surrogate
Ethylbenzene	4.30	USEPA 2001	USEPA Region 4 chronic screening value
Ethylene dibromide	48.0	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 100
Ethyl methacrylate	18,000 [(3)]	USEPA 2007a	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction [progeny counts])
Iodomethane	NA	---	---
Isobutyl alcohol	10,000	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Alburnus alburnus* [bleak]) with a safety factor of 100
Methacrylonitrile	NA	---	---

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment (2)
Volatile Organics (µg/L):			
Methylene chloride	2,560	USEPA 2001	USEPA Region 4 chronic screening value
Methyl methacrylate	2,800 (3)	USEPA 2003	USEPA Region 5 ecological screening level
Pentachloroethane	56.2	Buchman 2008	Chronic LOEL with a safety factor of 5
Propionitrile	15,200 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
Styrene	170	USEPA 2007a	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Tetrachloroethene	45.0	USEPA 2001	USEPA Region 4 chronic screening value
Toluene	37.0	USEPA 2001	USEPA Region 4 chronic screening value
trans-1,2-dichloroethene	4,480	Buchman 2008	Acute LOEL (summation of all isomers) with a safety factor of 50
trans-1,3-Dichloropropene	7.90	USEPA 2001	USEPA Region 4 chronic screening value (cis and trans)
trans-1,4-Dichloro-2-butene	NA	---	---
Trichloroethene	40.0	Buchman 2008	Acute LOEL with a safety factor of 50
Trichlorofluoromethane	1,280	Buchman 2008	Chronic LOEL for chemical class with a safety factor of 5
Vinyl acetate	100	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Crangon crangon* [sand shrimp]) with a safety factor of 100
Vinyl chloride	930 (3)	USEPA 2003	USEPA Region 5 ecological screening level
o-Xylene	27.0 (3)	---	Value for total xylene used as a surrogate
m,p-Xylene	27.0 (3)	---	Value for total xylene used as a surrogate
Xylenes, total	27.0 (3)	USEPA 2003	USEPA Region 5 ecological screening level
Semi-Volatile Organics (µg/L):			
1,2,4,5-Tetrachlorobenzene	10.0	USEPA 2007a	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
1,2,4-Trichlorobenzene	4.50	USEPA 2001	USEPA Region 4 chronic screening value
1,3,5-Trinitrobenzene	80.0 (3)	USEPA 2007a	Minimum chronic value (71-day NOEC for *Oncorhynchus mykiss* [rainbow trout] based on reproduction)
1,1-Biphenyl	230 (3)	USEPA 2007a	Minimum chronic value (21-day MATC for *Daphnia magna* [cladoceron] based on reproduction)
1,2-Dichlorobenzene	19.7	USEPA 2001	USEPA Region 4 chronic screening value
1,3-Dichlorobenzene	28.5	USEPA 2001	USEPA Region 4 chronic screening value
1,3-Dinitrobenzene	22.0 (3)	USEPA 2003	USEPA Region 5 ecological screening level
1,4-Dichlorobenzene	19.9	USEPA 2001	USEPA Region 4 chronic screening value
1,4-Dioxane	67,000	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
1,4-Naphthoquinone	NA	---	---
2,3,4,6-Tetrachlorophenol	8.80	Buchman 2008	Acute LOEL with a safety factor of 50
2,4,5-Trichlorophenol	11.0	Buchman 2008	Proposed Criteria Continuous Concentration
2,4,6-Trichlorophenol	12.1	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Palaemonetes pugio* [daggerblade grass shrimp]) with a safety factor of 100
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,4-Dichlorophenol	1.67	USEPA 2007a	Minimum acute value (96-hr NOEC for *Allorchestes compressa* [scud]) with a safety factor of 30
2,4-Dimethylphenol	131	USEPA 2007a	Minimum chronic value (28-day NOEC for *Menidia beryllina* [inland silverside] based on survival)
2,4-Dinitrophenol	48.5	USEPA 2001	USEPA Region 4 chronic screening value
2,4-Dinitrotoluene	44.0 (3)	USEPA 2003	USEPA Region 5 ecological screening level
2,6-Dichlorophenol	54.0	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Platichthys flesus* [european flounder]) with a safety factor of 100
2,6-Dinitrotoluene	81.0 (3)	USEPA 2003	USEPA Region 5 ecological screening level
1-Naphthylamine	70.0 (3)	USEPA 2007a	Minimum acute value (48-hour LC_{50} for *Oryzias latipes* [medaka high eyes]) with a safety factor of 100
2-Acetylaminofluorene	20.0 (3)	USEPA 2007a	Minimum acute value (96-hr LOEC for *Xenopus laevis* [clawed toad]) with a safety factor of 50

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment (2)
Semi-Volatile Organics (µg/L):			
2-Chloronaphthalene	0.15	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50
2-Chlorophenol	53.0	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [bay shrimp]) with a safety factor of 100
2-Methylphenol	102	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Elasmopus pectinicrus* [scud]) with a safety factor of 100
2-Naphthylamine	NA	---	---
2-Nitroaniline	48.9 (3)	USEPA 2007a	Minumum acute value (48-hr EC_{50} for *daphnia magna* [cladoceron]) with a safety factor of 100
2-Nitrophenol	10,000	USEPA 2007a	Minimum chronic value (28-day MATC for *Cyprinodon variegatus* [sheepshead minnow] based on egg hatchability)
2-Picoline	8,979 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
2-Toluidine	5.20 (3)	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
3,4-Methylphenol	33.6	---	Value for 4-methylphenol used as a surrogate
3,3'-Dichlorobenzidine	4.50 (3)	USEPA 2003	USEPA Region 5 ecological screening level
3,3'-Dimethylbenzidine	160 (3)	USEPA 2007a	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on behavior [equilibrium])
3-Methylcholanthrene	NA	---	---
3-Methylphenol	300	USEPA 2007a	Minimum acute value (96-hr EC50 for *gadus morhua* [Atlantic cod] based on multiple effects) with a safety factor of 100
3-Nitroaniline	9.80 (3)	USEPA 2007a	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
4,6-Dinitro-2-methylphenol	23.0 (3)	USEPA 2003	USEPA Region 5 ecological screening level
4-Aminobiphenyl	NA	---	---
4-Bromophenyl phenyl ether	1.50 (3)	USEPA 2003	USEPA Region 5 ecological screening level
4-Chloro-3-methylphenol	0.30 (3)	USEPA 2003	USEPA Region 5 ecological screening level
4-Chloroaniline	10.0 (3)	USEPA 2007a	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron]) based on reproduction)
4-Chlorophenyl phenyl ether	7.30 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Salvelinus fontinalis* [brook trout]) with a safety factor of 100
4-Methylphenol	33.6	USEPA 2007a	Minimum acute value (96-hr LC50 for Oncorhynchus goruscha [pink salmon]) with a safety factor of 100
4-Nitroaniline	170 (3)	USEPA 2007a	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
4-Nitrophenol	71.7	USEPA 2001	USEPA Region 4 chronic screening value
4-Nitroquinoline-1-oxide	NA	---	---
7,12-Dimethylbenz(a)anthracene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Acetophenone	1,550 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
A,A-Dimethyl phenethylamine	NA	---	---
Aniline	294	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Aramite, total	3.09 (3)	USEPA 2003	USEPA Region 5 ecological screening level
Benzyl alcohol	150	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
bis(2-Chloroethoxy)methane	1840 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
bis(2-Chloroethyl)ether	2,380 (3)	USEPA 2001	USEPA Region 4 chronic screeing value
bis(2-Ethylhexyl)phthalate	360	Buchman 2008	Proposed Criteria Continuous Concentration
Butyl benzyl phthalate	29.4	USEPA 2001	USEPA Region 4 chronic screening value
cis-Diallate	82.0 (3)	---	Value for total diallate used as a surrogate
trans-Diallate	82.0 (3)	---	Value for total diallate used as a surrogate
Diallate (total)	82.0 (3)	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Rasbora heteromorpha* [harlequinfish]) with a safety factor of 100
Dibenzofuran	33.3	USEPA 2007a	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Diethyl phthalate	75.9	USEPA 2001	USEPA Region 4 chronic screening value

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment (2)
Semi-Volatile Organics (µg/L):			
Dimethyl phthalate	580	USEPA 2001	USEPA Region 4 chronic screening value
Di-n-butyl phthalate	3.40	USEPA 2001	USEPA Region 4 chronic screening value (lowest reported plant value)
Di-n-octyl phthalate	1,150	USEPA 2007a	Minimum acute value (96-hr NOEC for *Americamysis bahia* [opossum shrimp]) with a safety factor of 30
Dinoseb	1.70	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Ethyl methanesulfonate	40.0 (3)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Clarias batrachus* [walking catfish]) with a safety factor of 100
Hexachlorobenzene	10.0	USEPA 2007a	Minimum acute value (48-hr EC_{50} for *Crassostrea virginica* [Virginia oyster]) with a safety factor of 100
Hexachlorobutadiene	0.32	USEPA 2001	USEPA Region 4 chronic screening value
Hexachlorocyclopentadiene	0.07	USEPA 2001	USEPA Region 4 chronic screening value
Hexachloroethane	9.40	USEPA 2001	USEPA Region 4 chronic screening value
Hexachlorophene	8.80 (3)	USEPA 2007a	Minimum chronic value (34-day NOEC for *Pimephales promelas* [fathead minnow] based on survival and growth)
Hexachloropropene	NA	---	---
Isophorone	129	USEPA 2001	USEPA Region 4 chronic screening value
Isosafrole	NA	---	---
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
Nitrobenzene	66.8	USEPA 2001	USEPA Region 4 chronic screening value
N-Nitro-o-toluidine	220 (3)	USEPA 2007a	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron] based on immobilization) with a safety factor of 100
N-Nitrosodiethylamine	768 (3)	USEPA 2003	USEPA Region 5 ecological screening level
N-Nitrosodimethylamine	25.0 (3)	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-butylamine	25.0 (3)	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-propylamine	25.0 (3)	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosodiphenylamine	25.0 (3)	USEPA 2007b	Indiana Department of Environmental Management Great Lakes Basin Tier II chronic criterion
N-Nitrosomethylethylamine	25.0 (3)	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
p-Dimethylamino azobenzene	NA	---	---
Pentachlorobenzene	129	USEPA 2001	USEPA Region 4 chronic screening value
Pentachloronitrobenzene	0.23	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Pentachlorophenol	7.90	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Phenacetin	NA	---	---
Phenol	58.0	USEPA 2001	USEPA Region 4 chronic screening value
p-Phenylene diamine	200 (3)	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Oryzias latires* [medika, high-eyes]) with a safety factor of 100
Pronamide	35.0	USEPA 2007a	Minimum acute value (96-hr EC_{50} for *Crassostrea virginica* [Virginia oyster]) with a safety factor of 100
Pyridine	500	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Safrole	NA	---	---
PAHs (µg/L):			
2-Methylnaphthalene	6.00	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Penaeus aztecus* [brown shrimp]) with a safety factor of 100
Acenaphthene	9.70	USEPA 2001	USEPA Region 4 chronic screening value
Acenaphthylene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for low molecular weight PAHs)
Anthracene	5.35	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment (2)
PAHs (µg/L):			
Benzo(a)anthracene	0.025 (3)	USEPA 2003	USEPA Region 5 ecological screening level
Benzo(a)pyrene	10.0	USEPA 2004	Acute value (LC_{50}) with a safety factor of 100
Benzo(b)fluoranthene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Benzo(g,h,i)perylene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Benzo(k)fluoranthene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Chrysene	10.0	USEPA 2004	Acute value (LC_{50}) with a safety factor of 100
Dibenzo(a,h)anthracene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Fluoranthene	11.0	USEPA 1996	Final Chronic Value
Fluorene	10.0	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Nereis arenaceodentata* [polychaete]) with a safety factor of 100
Indeno(1,2,3-cd)pyrene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Naphthalene	23.5	USEPA 2001	USEPA Region 4 chronic screening value
Phenanthrene	8.30	USEPA 1996	Final Chronic Value
Pyrene	0.248	USEPA 2007a	Minimum acute value (48-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Total Recoverable Metals (µg/L):			
Antimony	500	Buchman 2008	Proposed total recoverable Criteria Continuous Concentration
Arsenic	36.0	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Barium	16,667	USEPA 2007a	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Beryllium	310	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100
Cadmium	8.85	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Chromium, total	50.4 (5)	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Cobalt	45.0	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100
Copper	3.73	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Lead	8.52	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Mercury	1.11	USEPA 2009	Total recoverable Criteria Continuous Concentration
Nickel	8.28	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Selenium	71.1	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Silver	2.24	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Thallium	21.3	USEPA 2001	Total recoverable USEPA Region 4 chronic screening value
Tin	180 (3)	USEPA 2003	Total recoverable USEPA Region 5 ecological screening level
Vanadium	12.0 (3)	USEPA 2003	Total recoverable USEPA Region 5 ecological screening level
Zinc	85.6	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Dissolved Metals (µg/L):			
Antimony	500 (6)	Buchman 2008	Proposed total recoverable Criteria Continuous Concentration
Arsenic	36.0	USEPA 2009	Dissolved Criteria Continuous Concentration for trivalent arsenic
Barium	16,667 (6)	USEPA 2007a	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Beryllium	310 (6)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100
Cadmium	8.8	USEPA 2009	Dissolved Criteria Continuous Concentration
Chromium, total	50.0	USEPA 2009	Dissolved Criteria Continuous Concentration for hexavalent chromium
Cobalt	45.0 (6)	USEPA 2007a	Minimum acute value (96-hr LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100
Copper	3.1	USEPA 2009	Dissolved Criteria Continuous Concentration
Lead	8.1	USEPA 2009	Dissolved Criteria Continuous Concentration

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Dissolved Metals (µg/L):			
Mercury	0.94	USEPA 2009	Dissolved Criteria Continuous Concentration
Nickel	8.2	USEPA 2009	Dissolved Criteria Continuous Concentration
Selenium	71.0	USEPA 2009	Dissolved Criteria Continuous Concentration
Silver	2.24 [6]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Thallium	21.3 [6]	USEPA 2001	Total recoverable USEPA Region 4 chronic screening value
Tin	180 [3][6]	USEPA 2003	Total recoverable USEPA Region 5 ecological screening level
Vanadium	12.0 [3][6]	USEPA 2003	Total recoverable USEPA Region 5 ecological screening level
Zinc	81.0	USEPA 2009	Dissolved Criteria Continuous Concentration

Notes:

NA = Not Available
PREQB = Puerto Rico Environmental Quality Board
USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
LOEL = Lowest Observed Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NOEC = No Observed Effect Concentration
EC_{50} = Median Effective Concentration
LC_{50} = Median Lethal Concentration
µg/L = microgram per liter

(1) The values shown are marine/estuarine screening values unless otherwise noted. Estuarine/marine surface water screening values were preferentially used as groundwater screening values since the likely discharge point for groundwater at SWMU 78 is the Ensenada Honda.

(2) 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).

(3) The chemical lacks a marine/estuarine surface water screening value/literature-based toxicity value. The value shown is a freshwater screening value/toxicity value.

(4) The value shown is for 4-methylphenol.

(5) The value shown is for hexavalent chromium.

(6) The chemical lacks a screening value expressed as a dissolved concentration. The value shown is based on the total recoverable concentration of the metal in the water column.

Table References:

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables. NOAA OR&R Report 08-1. National Oceanic and Atmospheric Administration, Office of Response and Restoration Division, Seattle, WA.

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USEPA. 2009. National Recommended Water Quality Criteria. Office of Water and Office of Science and Technology, Washington, D.C. http://www.epa.gov/waterscience/criteria/wqctable/.

USEPA. 2007a. ECOTOX User Guide: Ecotoxicology Database System. Version 4.0. http:/www.epa.gov/ecotox/. Accessed May 14, 2008, July 2, 2008, January 8, 2009, April 1, 2009, and August 28, 2009.

TABLE 4-2
ECOLOGICAL GROUNDWATER SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

USEPA 2007b. Great Lakes Inititiative Toxicity Data Clearinghouse. http://www.epa.gov/gliclearinghouse/. Accessed January 8, 2009.

USEPA. 2004. Superfund Chemical Data Matrix. http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm .

USEPA. 2003. USEPA Region 5 Ecological Screening Levels Table. http://www.epa.gov/reg5rcra/ca/ESL.pdf.

USEPA. 2001. Region 4 Ecological Risk Assessment Bulletins - Supplement to RQGS. Waste Management Division, Atlanta, GA. http://www.epa.gov/region04/waste/ots/ecolbul.htm.

USEPA. 1996. Ecotox Thresholds. Eco Update, Volume 3, Number 2. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/F-95/038.

TABLE 4-3

Revised: March 21, 2011

HUMAN HEALTH SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Regional Screening Levels Residential Soil (1)	(units)	Regional Screening Levels Industrial Soil (1)	(units)	Regional Screening Levels Tap Water (1)	(units)	USEPA MCLs/ PRWQS (2)	(units)
PAHs								
Acenaphthene	340,000 (3)	ug/kg	3,300,000 (3)	ug/kg	220 (3)	ug/L	670 (10)	ug/L
Acenaphthylene	340,000 (3)(4)	ug/kg	3,300,000 (3)(4)	ug/kg	220 (3)(4)	ug/L	NE	
Anthracene	1,700,000 (3)	ug/kg	17,000,000 (3)	ug/kg	1,100 (3)	ug/L	8,300 (10)	ug/L
Benzo(a)anthracene	150	ug/kg	2,100	ug/kg	0.029	ug/L	0.038 (10)	ug/L
Benzo(b)fluoranthene	150	ug/kg	2,100	ug/kg	0.029	ug/L	0.038 (10)	ug/L
Benzo(k)fluoranthene	1,500	ug/kg	21,000	ug/kg	0.29	ug/L	0.038 (10)	ug/L
Benzo(g,h,i)perylene	170,000 (3)	ug/kg	1,700,000 (3)	ug/kg	110 (3)	ug/L	NE	
Benzo(a)pyrene	15	ug/kg	210	ug/kg	0.0029	ug/L	0.038 (10)	ug/L
Chrysene	15,000	ug/kg	210,000	ug/kg	2.9	ug/L	0.038 (10)	ug/L
Dibenzo(a,h)anthracene	15	ug/kg	210	ug/kg	0.0029	ug/L	0.038 (10)	ug/L
Fluoranthene	230,000 (3)	ug/kg	2,200,000 (3)	ug/kg	150 (3)	ug/L	130 (10)	ug/L
Fluorene	230,000 (3)	ug/kg	2,200,000 (3)	ug/kg	150 (3)	ug/L	1,100 (10)	ug/L
Indeno(1,2,3-cd)pyrene	150	ug/kg	2,100	ug/kg	0.029	ug/L	0.038 (10)	ug/L
1-Methylnaphthalene	22,000	ug/kg	99,000	ug/kg	2.3	ug/L	NE	
2-Methylnaphthalene	31,000 (3)	ug/kg	410,000 (3)	ug/kg	15 (3)	ug/L	NE	
Naphthalene	3,600	ug/kg	18,000	ug/kg	0.14	ug/L	NE	
Phenanthrene	170,000 (3)(5)	ug/kg	1,700,000 (3)(5)	ug/kg	110 (3)(5)	ug/L	NE	
Pyrene	170,000 (3)	ug/kg	1,700,000 (3)	ug/kg	110 (3)	ug/L	830 (10)	ug/L
Total Petroleum Hydrocarbons (TPH)								
TPH Diesel Range Organics	100 (6)	mg/kg	100 (6)	mg/kg	50 (6)	mg/L	NE	

TABLE 4-3

HUMAN HEALTH SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Regional Screening Levels Residential Soil (1)	(units)	Regional Screening Levels Industrial Soil (1)	(units)	Regional Screening Levels Tap Water (1)	(units)	USEPA MCLs/ PRWQS (2)	(units)
Metals								
Antimony	3.1 (3)	mg/kg	41 (3)	mg/kg	1.5 (3)	ug/L	5.6 (10)	ug/L
Arsenic	0.39	mg/kg	1.6	mg/kg	0.045	ug/L	10	ug/L
Barium	1,500 (3)	mg/kg	19,000 (3)	mg/kg	730 (3)	ug/L	2,000	ug/L
Beryllium	16 (3)	mg/kg	200 (3)	mg/kg	7.3 (3)	ug/L	4	ug/L
Cadmium	7 (3)	mg/kg	80 (3)	mg/kg	1.8 (3)	ug/L	5	ug/L
Chromium	12,000 (3)(7)	mg/kg	150,000 (3)(7)	mg/kg	5,500 (3)(7)	ug/L	100	ug/L
Cobalt	2.3 (3)	mg/kg	30 (3)	mg/kg	1.1 (3)	ug/L	NE	
Copper	310 (3)	mg/kg	4,100 (3)	mg/kg	150 (3)	ug/L	1,300	ug/L
Lead	400 (8)	mg/kg	800 (8)	mg/kg	15 (9)	ug/L	15	ug/L
Mercury	0.56 (3)	mg/kg	3.4 (3)	mg/kg	0.057 (3)	ug/L	0.05 (10)	ug/L
Nickel	150 (3)	mg/kg	2,000 (3)	mg/kg	73 (3)	ug/L	610 (10)	ug/L
Selenium	39 (3)	mg/kg	510 (3)	mg/kg	18 (3)	ug/L	50	ug/L
Silver	39 (3)	mg/kg	510 (3)	mg/kg	18 (3)	ug/L	NE	
Thallium	NE		NE		2 (9)	ug/L	0.24 (10)	ug/L
Tin	4,700 (3)	mg/kg	61,000 (3)	mg/kg	2,200 (3)	ug/L	NE	
Vanadium	0.55 (3)	mg/kg	7.2 (3)	mg/kg	0.26 (3)	ug/L	NE	
Zinc	2,300 (3)	mg/kg	31,000 (3)	mg/kg	1,100 (3)	ug/L	NE	

TABLE 4-3

HUMAN HEALTH SCREENING VALUES
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

ug/L - microgram per liter
ug/kg - microgram per kilogram
mg/L - milligram per liter
mg/kg - milligram per kilogram
USEPA - United States Environmental Protection Agency
PAH - Polynuclear Aromatic Hydrocarbon
MCL - Maximum Contaminant Level
NE - Not established
PREQB = Puerto Rico Environmental Quality Board
PRWQS - Puerto Rico Water Quality Standards

(1) USEPA Regional Screening Levels (May 2010)

(2) The more stringent of the USEPA MCL or PRWQS is listed.

(3) Noncarcinogenic Regional Screening Levels based on a target hazard quotient of 0.1 for conservative screening purposes.

(4) Value for acenaphthene used as a surrogate.

(5) Value for pyrene used as a surrogate.

(6) Total TPH values represents the Puerto Rico Environmental Quality Board recommended screening values for soil and groundwater.

(7) Value for chromium III used as a surrogate.

(8) USEPA Action Level for lead in soil.

(9) Value for MCL used as surrogate.

(10) Value designated by PRWQS for protection of water body for reasons of human health (PREQB. Puerto Rico Water Quality Standards Regulation. Regulation No. 7837. March 31, 2010).

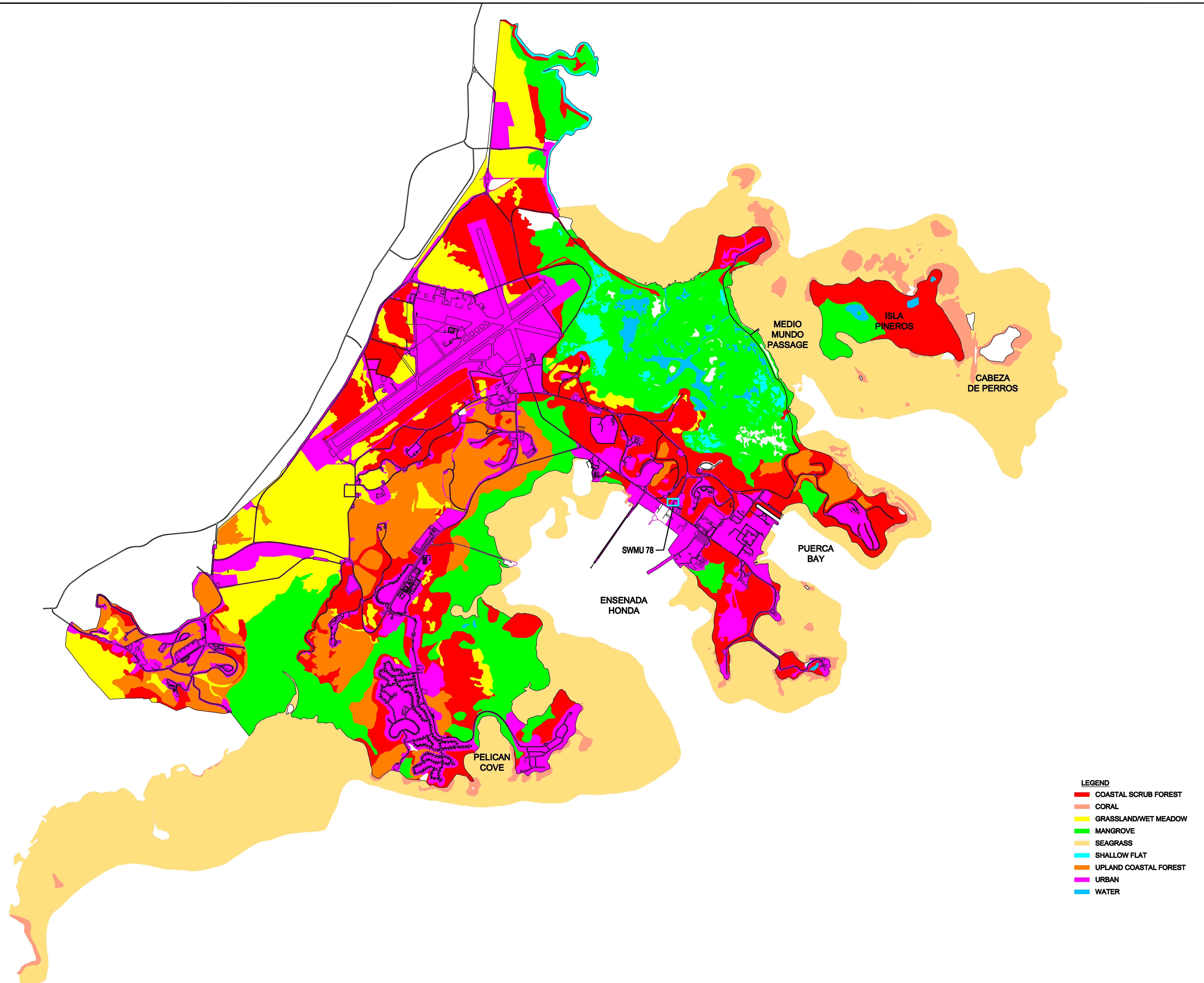
TABLE 4-4
NAPR BACKGROUND SCREENING VALUES
SWMU 78-POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Surface Soil (mg/L)	Subsurface Clay (mg/L)	Groundwater Metals (Total) ug/L	Groundwater Metals (Dissolved) ug/L
Metals	**Upper Limit of Means (x+2s)**	**Upper Limit of Means (x+2s)**	**Upper Limit of Means (x+2s)**	**Upper Limit of Means (x+2s)**
Antimony	3.17	--	12.24	11.19
Arsenic	2.65	1.59	18.89	14.03
Barium	199	220	686	260
Beryllium	0.59	0.596	2.21	5.400
Cadmium	1.02	0.54	16.62	36.42
Chromium	49.8	114.5	162.41	6.5
Cobalt	46.2	26.9	633.21	580.5
Copper	168	246	324	29
Lead	22	6.3	26.25	1.3
Mercury	0.109	0.108	0.15	0.157
Nickel	20.7	24.7	95.74	84.1
Selenium	1.48	5.94	29.88	23.92
Silver	--	--	18.31	3.67
Thallium	--	0.92	--	--
Tin	3.76	4	9.35	--
Vanadium	259	434	484.66	20.96
Zinc	115	88	547.53	360.64

Notes:
(--) - Could not be calculated (insufficient number of detections)

Reference: Baker, 2008, *Revised Final II Summary Report for Environmental Background Concentrations of* Inorganic Compounds, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. February 29, 2008.

FIGURES



SOURCE: GEO-MARINE, INC.

REVISIONS		
DRAWN	/RRR	
REVIEWED	MEK	
S.O.#	119197	
CADD#	119197_78_07.DWG	

NORTH

SWMU 78-POLE YARD
NAVAL ACTIVITY PUERTO RICO

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker

TERRESTRIAL AND AQUATIC HABITAT OCCURRING
AT NAVAL ACTIVITY PUERTO RICO
FULL RFI WORK PLAN

SCALE 1" = 2000'

DATE AUGUST 2010

FIGURE
2-1

119197_78_09

400 0 200 400

1 inch = 400 ft.

Baker

– APPROXIMATE SWMU 78 BOUNDARY

E2SS3 – E2SS3 WETLAND BOUNDARIES (SEE FIGURE 2-3 FOR CLASSIFICATIONS)

FIGURE 2-2
WETLAND LOCATION MAP
SWMU 78-POLE YARD
FULL RFI REPORT

NAVAL ACTIVITY PUERTO RICO

CONTOUR SOURCE: LANTDIV, FEB. 1992/1997

119197_78_08.DWG

M - MARINE

SYSTEM / SUBSYSTEM	CLASS	Subclass
1 - SUBTIDAL	RB - Rock Bottom	1 Bedrock 2 Rubble
	UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
	AB - Aquatic Bed	1 Algal 3 Rooted Vasc 5 Unknown
	RF - Reef	1 Coral 3 Worm
	OW - Open Water (unknown bottom)	
2 - INTERTIDAL	AB - Aquatic Bed	1 Algal 3 Rooted Vasc 5 Unknown
	RF - Reef	1 Coral 3 Worm
	RS - Rocky Shore	1 Bedrock 2 Rubble
	US - Unconsolidated Shore	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic

E - ESTUARINE

SYSTEM / SUBSYSTEM	CLASS	Subclass
1 - SUBTIDAL	RB - Rock Bottom	1 Bedrock 2 Rubble
	UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
	AB - Aquatic Bed	1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
	RF - Reef	2 Mollusk 3 Worm
	OW - Open Water *(unknown bottom)*	
2 - INTERTIDAL	AB - Aquatic Bed	1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
	RF - Reef	2 Mollusk 3 Worm
	SB - Streambed	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
	RS - Rocky Shore	1 Bedrock 2 Rubble
	US - Unconsolidated Shore	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Dead
	EM - Emergent	1 Persistent 2 Nonpersistent
	SS - Scrub-Shrub	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*
	FO - Forested	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*

R - RIVERINE

SUBSYSTEM: 1 - TIDAL; 2 - LOWER PERENNIAL; 3 - UPPER PERENNIAL; 4 INTERMITTENT; 5 - UNKNOWN PERENNIAL

CLASS	Subclass
RB - Rock	1 Bedrock 2 Rubble
UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
SB - Streambed	1 Bedrock 2 Rubble 3 Cobble - Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated
AB - Aquatic Bed	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
RS - Rocky Shore	1 Bedrock 2 Rubble
US - Unconsolidated Shore	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
OW - Open Water *(unknown bottom)*	
**EM - Emergent	2 Nonpersistent

L - LACUSTRINE

SYSTEM / SUBSYSTEM	CLASS	Subclass
1 - LIMNETIC	RB - Rock Bottom	1 Bedrock 2 Rubble
	UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
	AB - Aquatic Bed	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
	OW - Open Water *(unknown bottom)*	
2 - LITTORAL	RB - Rock Bottom	1 Bedrock 2 Rubble
	RS - Rocky Shore	1 Bedrock 2 Rubble
	UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
	AB - Aquatic Bed	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
	US - Unconsolidated Shore	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
	EM - Emergent	2 Nonpersistent
	OW - Open Water *(unknown bottom)*	

P - PALUSTRINE

CLASS	Subclass
RB - Rock Bottom	1 Bedrock 2 Rubble
UB - Unconsolidated Bottom	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic
AB - Aquatic Bed	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*
US - Unconsolidated Shore	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated
ML - Moss-Lichen	1 Moss 2 Lichen
EM - Emergent	1 Persistent 2 Nonpersistent
SS - Scrub-Shrub	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*
FO - Forested	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*
OW - Open Water *(unknown bottom)*	

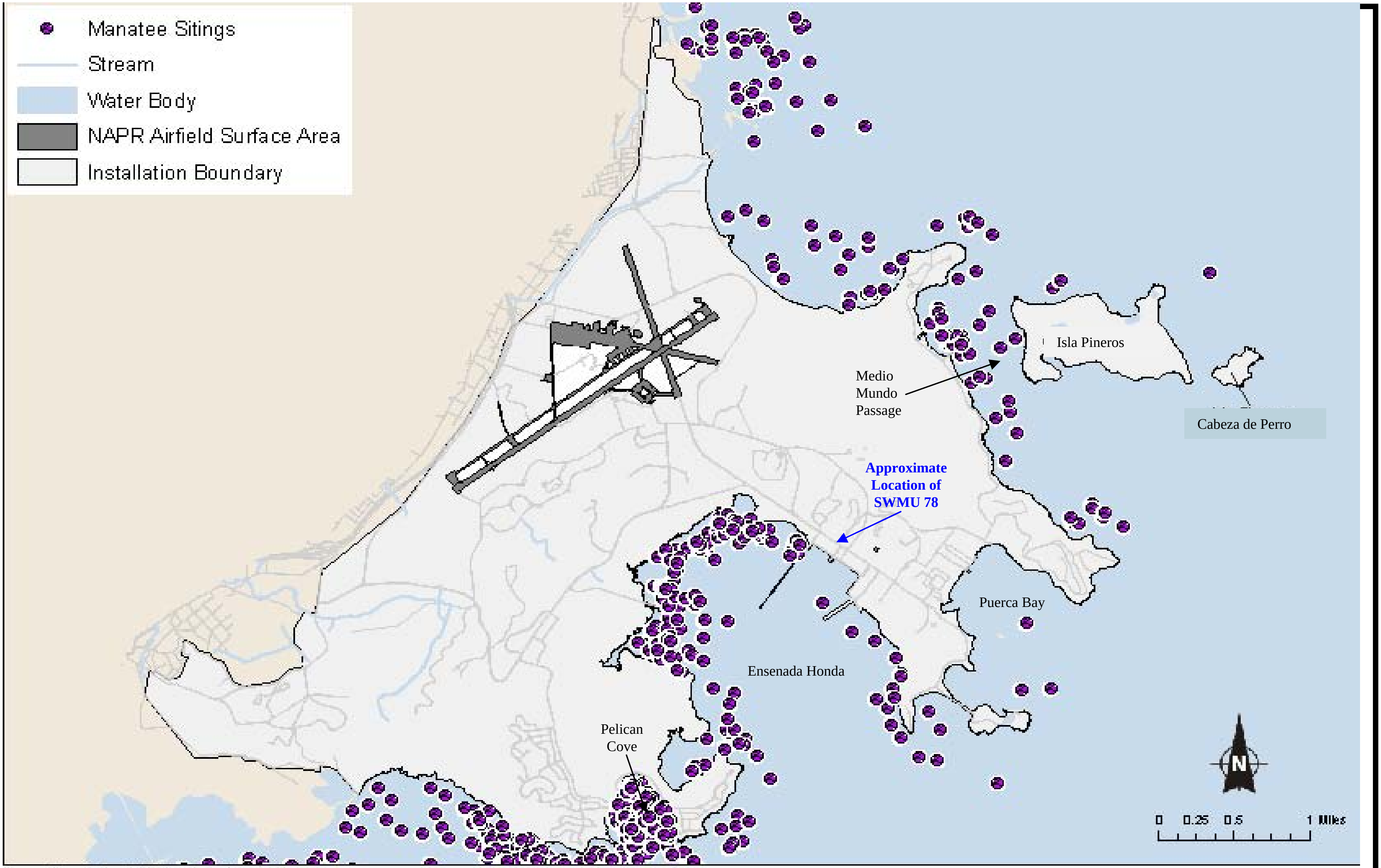
MODIFIERS

WATER REGIME				WATER CHEMISTRY			SOIL	SPECIAL
	Non-Tidal		**Tidal**	**Coastal Halinity**	**Inland Salinity**	**pH (fresh water)**		
A Temp. Flooded B Saturated C Seasonally Flooded D Seasonally Flooded/ Well Drained E Seasonally Flooded/ Saturated F Semipermanently Flooded G Intermittently Exposed	H Permanently Flooded J Intermittently Flooded K Artificially Flooded W Intermittently Flooded/ Temporary Y Saturated/Semipermanent/ Seasonal Z Intermittently Exposed Permanent U Unknown	K Artificially Flooded L Subtidal M Irregularly Flooded N Regularly Flooded P Irregularly Flooded * These water regimes are only used in tidally influenced, freshwater systems.	*S Temporary-Tidal *R Seasonal-Tidal *T Semipermanent- Tidal *V Permanent-Tidal U Unknown	1 Hyperhaline 2 Euhaline 3 Mixohaline 4 Polyhaline 5 Mesohaline 6 Oligohaline 0 Fresh	7 Hypersaline 8 Eusaline 9 Mixosaline 0 Fresh	a Acid t circumneutral i Alkaline	g Organic n Mineral	b Beaver d partially drained/ditched f Farmed h Diked/Impounded r Artificial Substrate s Spoil x Excavated

SOURCE: UNITED STATES, FISH AND WILDLIFE SERVICE. CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES, 1985

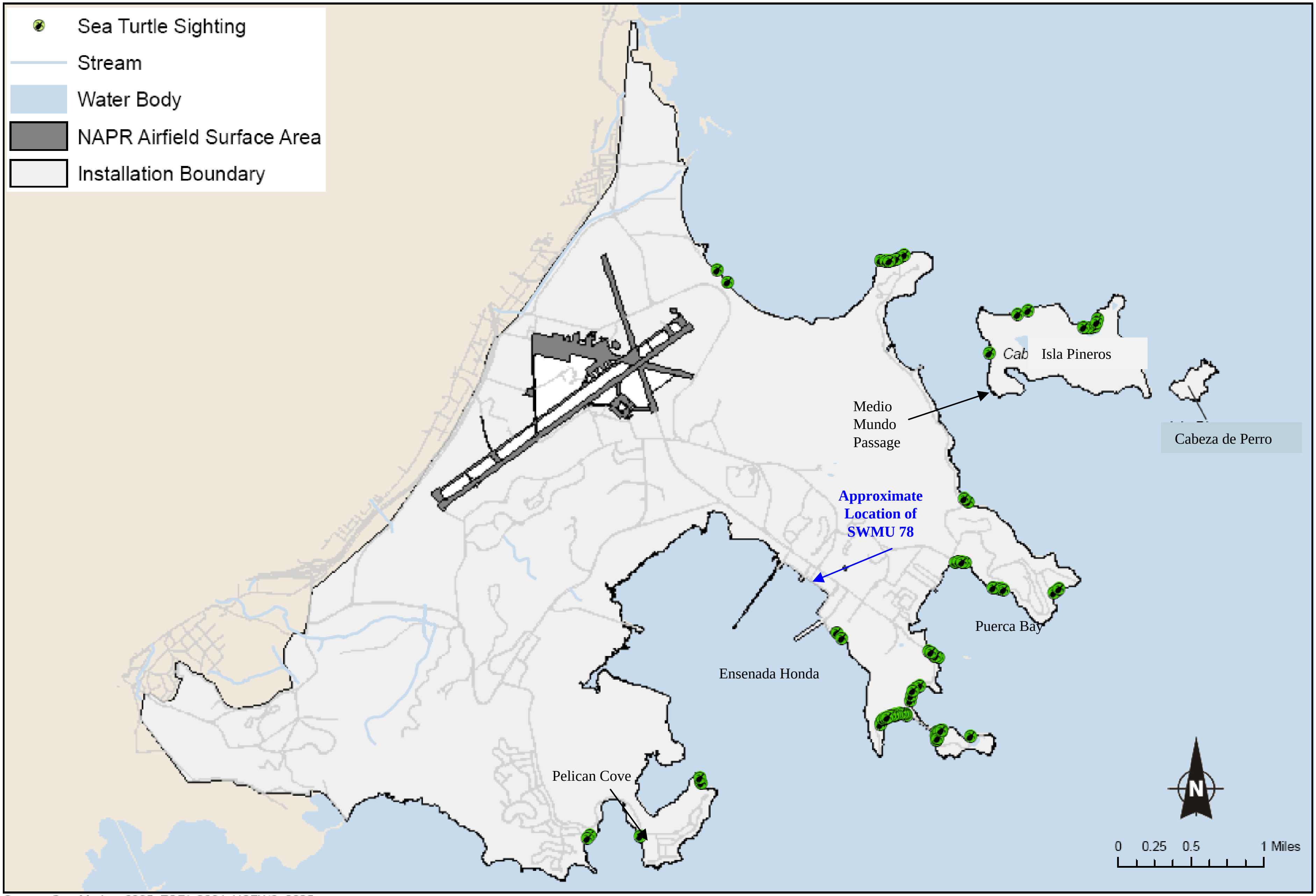
Baker

FIGURE 2-3
THE COWARDIN WETLAND CLASSIFICATION SYSTEM
SWMU 78-POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO



Source: Geo-Marine, 2005; ESRI, 2004; USFWS, 2005;

Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.	**FIGURE 2-4** **HISTORICAL MANATEE SIGHTINGS IN EASTERN PUERTO RICO** **SWMU 78 – POLE YARD** **FULL RFI WORK PLAN** **NAVAL ACTIVITY PUERTO RICO**

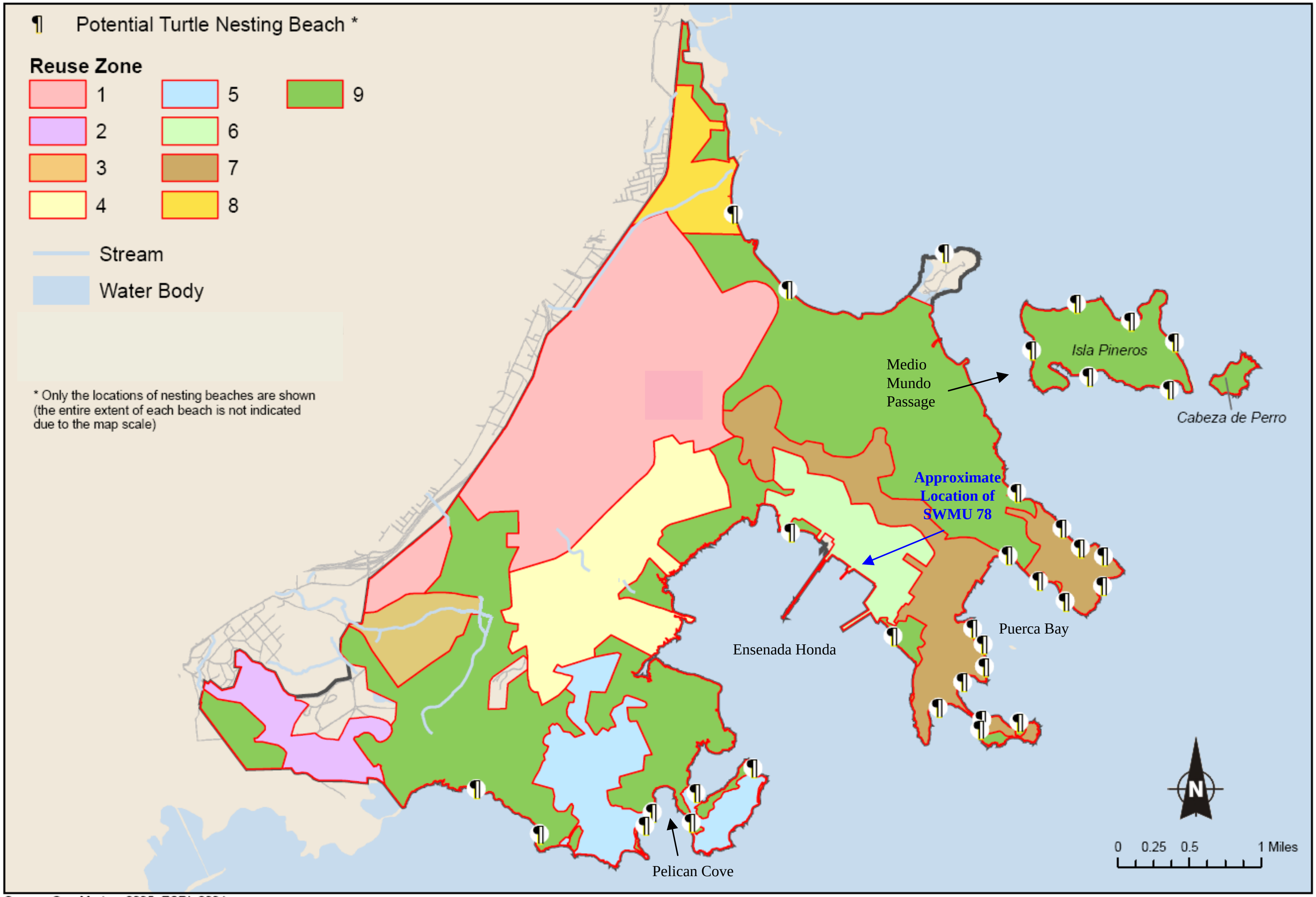


Source: Geo-Marine, 2005; ESRI, 2004; USFWS, 2005;

Cumulative sea turtle sightings from March 1984 through March 1995 obtained from weekly aerial surveys of the Former Naval station Roosevelt Roads.

Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

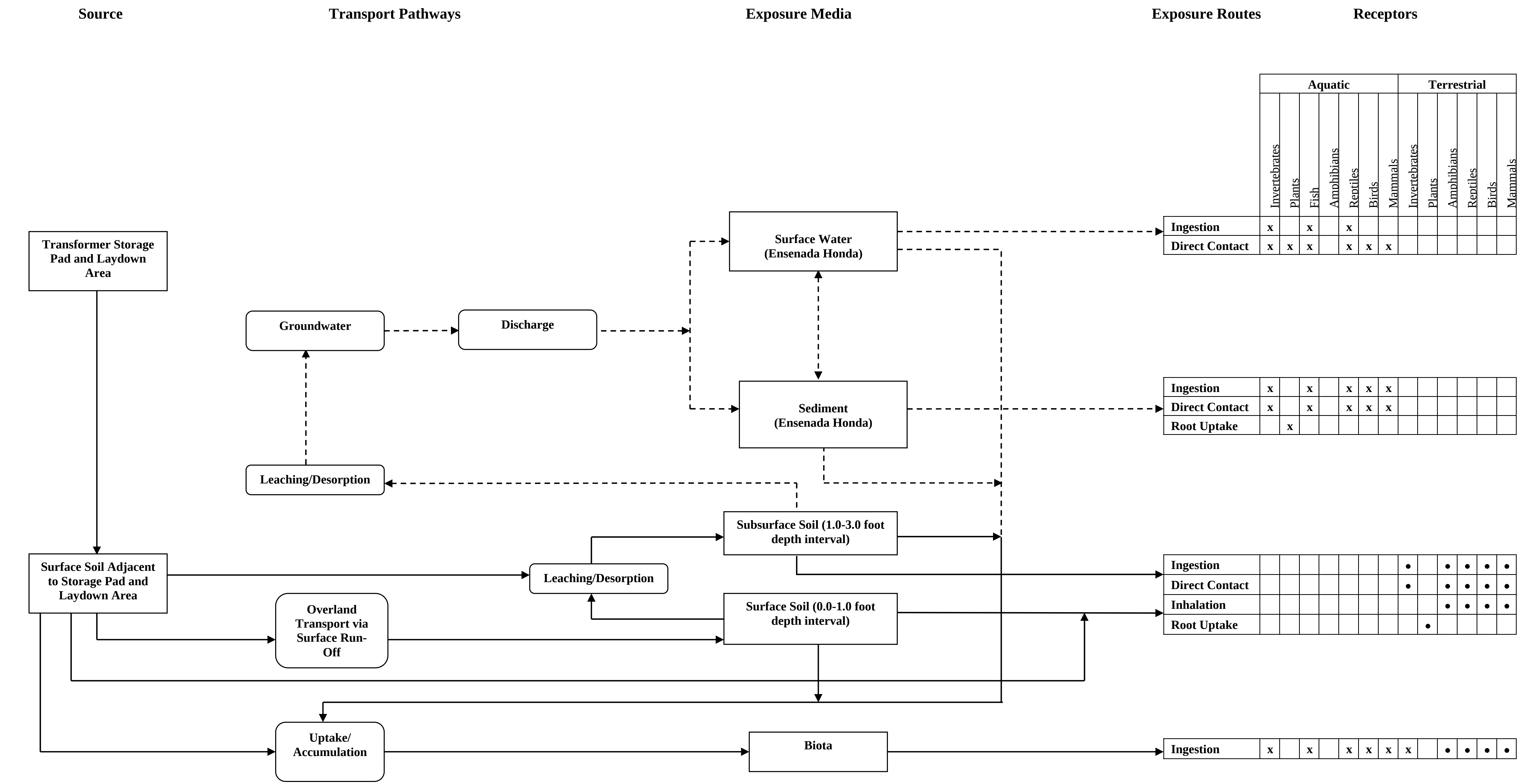
FIGURE 2-5
SEA TURTLE SIGHTINGS AT NAVAL ACTIVITY PUERTO RICO
SWMU 78 – POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO



Source: Geo-Marine, 2005; ESRI, 2004;

Figure from: Department of Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007

FIGURE 2-6
POTENTIAL TURTLE NESTING SITES
SWMU 2 – LANGLEY DRIVE DISPOSAL SITE
STEPS 6 AND 7 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO



Exposure Media	Exposure Routes	Aquatic Invertebrates	Aquatic Plants	Aquatic Fish	Aquatic Amphibians	Aquatic Reptiles	Aquatic Birds	Aquatic Mammals	Terrestrial Invertebrates	Terrestrial Plants	Terrestrial Amphibians	Terrestrial Reptiles	Terrestrial Birds	Terrestrial Mammals
Surface Water (Ensenada Honda)	Ingestion	x		x		x								
	Direct Contact	x	x	x		x	x	x						
Sediment (Ensenada Honda)	Ingestion	x		x		x	x	x						
	Direct Contact	x		x		x	x	x						
	Root Uptake		x											
Soil	Ingestion								•		•	•	•	•
	Direct Contact								•		•	•	•	•
	Inhalation										•	•	•	•
	Root Uptake									•				
Biota	Ingestion	x		x		x	x	x	x		•	•	•	•

FIGURE 2-7
PRELIMINARY CONCEPTUAL MODEL FOR ECOLOGICAL RECEPTORS
SWMU 78 – POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Legend:
- Solid arrow: Potentially complete and significant pathway
- Dashed arrow: Potentially complete and insignificant pathway

• - Receptor/represented by a potentially complete exposure pathway
x - Receptor/represented by a potentially complete and insignificant exposure pathway

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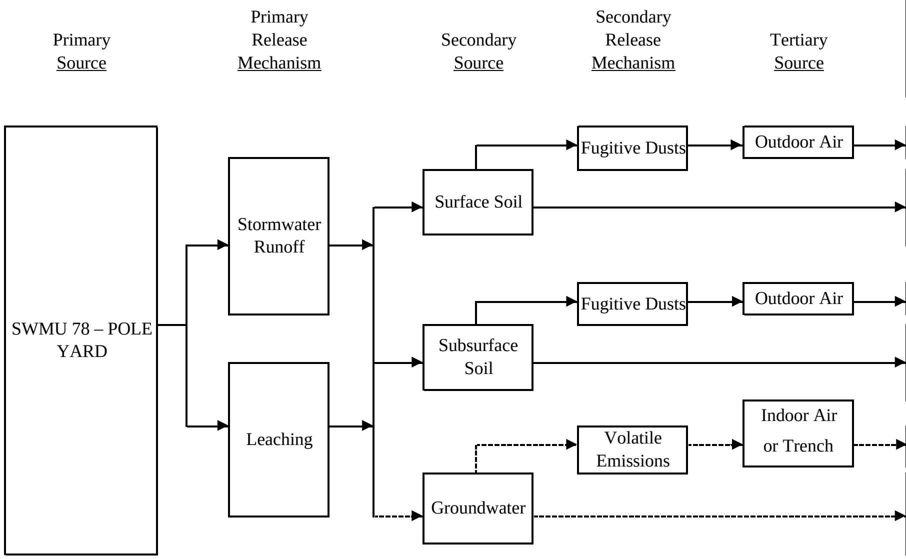
FIGURE 2-8
PRELIMINARY CONCEPTUAL MODEL FOR HUMAN RECEPTORS
SWMU 78 – POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

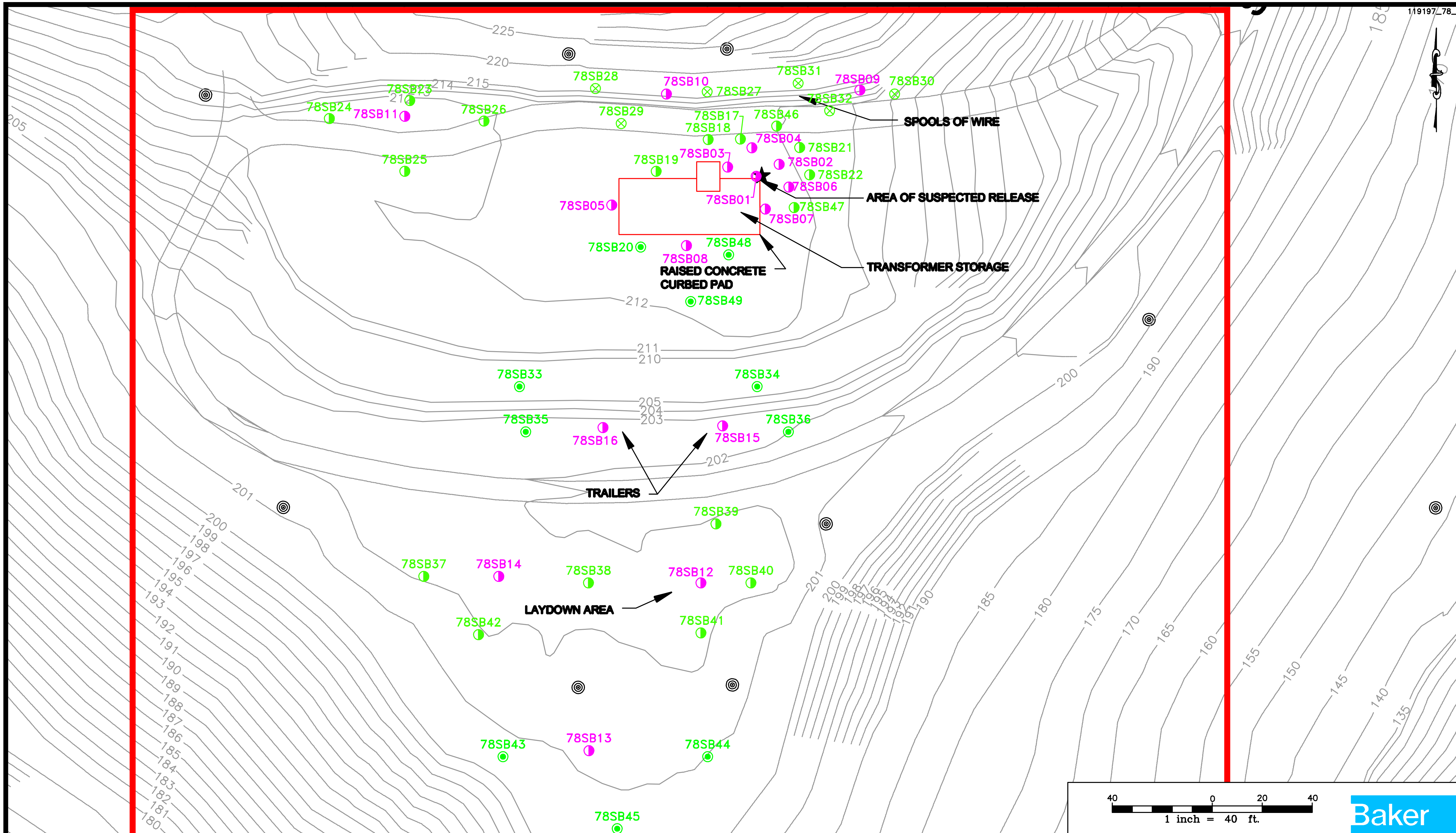


Exposure Route	Current and Future Adult Trespassers	Current and Future Youth Trespassers	Future Adult Industrial / Commercial Workers	Future Adult Residents	Future Young Child Residents	Future Adult Construction Workers
Inhalation	**CF**	**CF**	F	F	F	F
Ingestion	**CF**	**CF**	F	F	F	F
Dermal Contact	**CF**	**CF**	F	F	F	F
Inhalation			F	F	F	F
Ingestion			F	F	F	F
Dermal Contact			F	F	F	F
Inhalation			F	F	F	F
Ingestion				F	F	F
Dermal Contact				F	F	F

Potential Human Receptors

Legend

F	Future Exposure Pathway
CF	Current and Future Exposure Pathway
——▶	Potentially Complete Exposure Pathway
- - -▶	Potentially Complete and Insignificant Exposure Pathway



CONTOUR SOURCE: LANTDIV, FEB. 1992/1997

LEGEND

- APPROXIMATE SWMU BOUNDARY
- CONCRETE PAD
- PHASE I SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS (PHASE I RFI)
- PROPOSED FULL RFI SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLING LOCATIONS
- PROPOSED FULL RFI SURFACE SOIL SAMPLING LOCATIONS
- PROPOSED FULL RFI SUBSURFACE SOIL SAMPLING LOCATIONS
- UTILITY POLES
- 200 - GROUND SURFACE ELEVATION CONTOUR

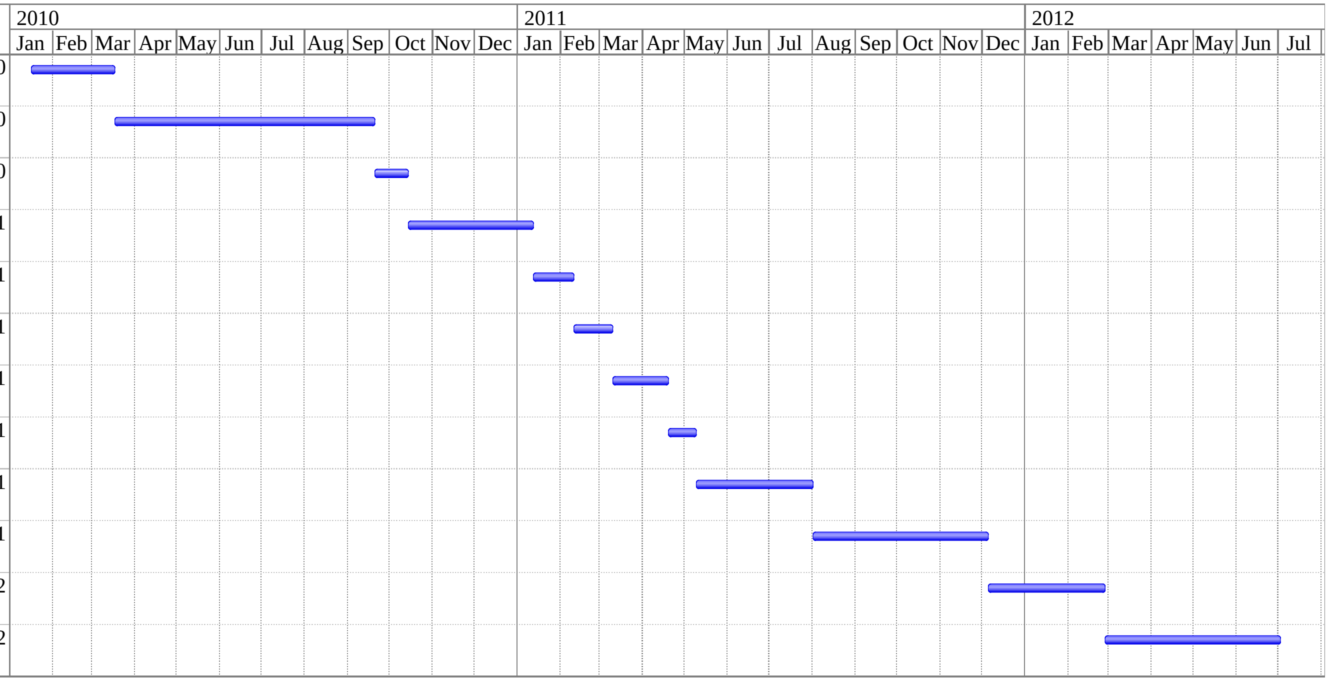
NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941

FIGURE 3-1
PROPOSED FULL RFI SAMPLE LOCATION MAP
SWMU 78-POLE YARD
FULL RFI REPORT

NAVAL ACTIVITY PUERTO RICO

FIGURE 5-1
PROPOSED PROJECT SCHEDULE
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

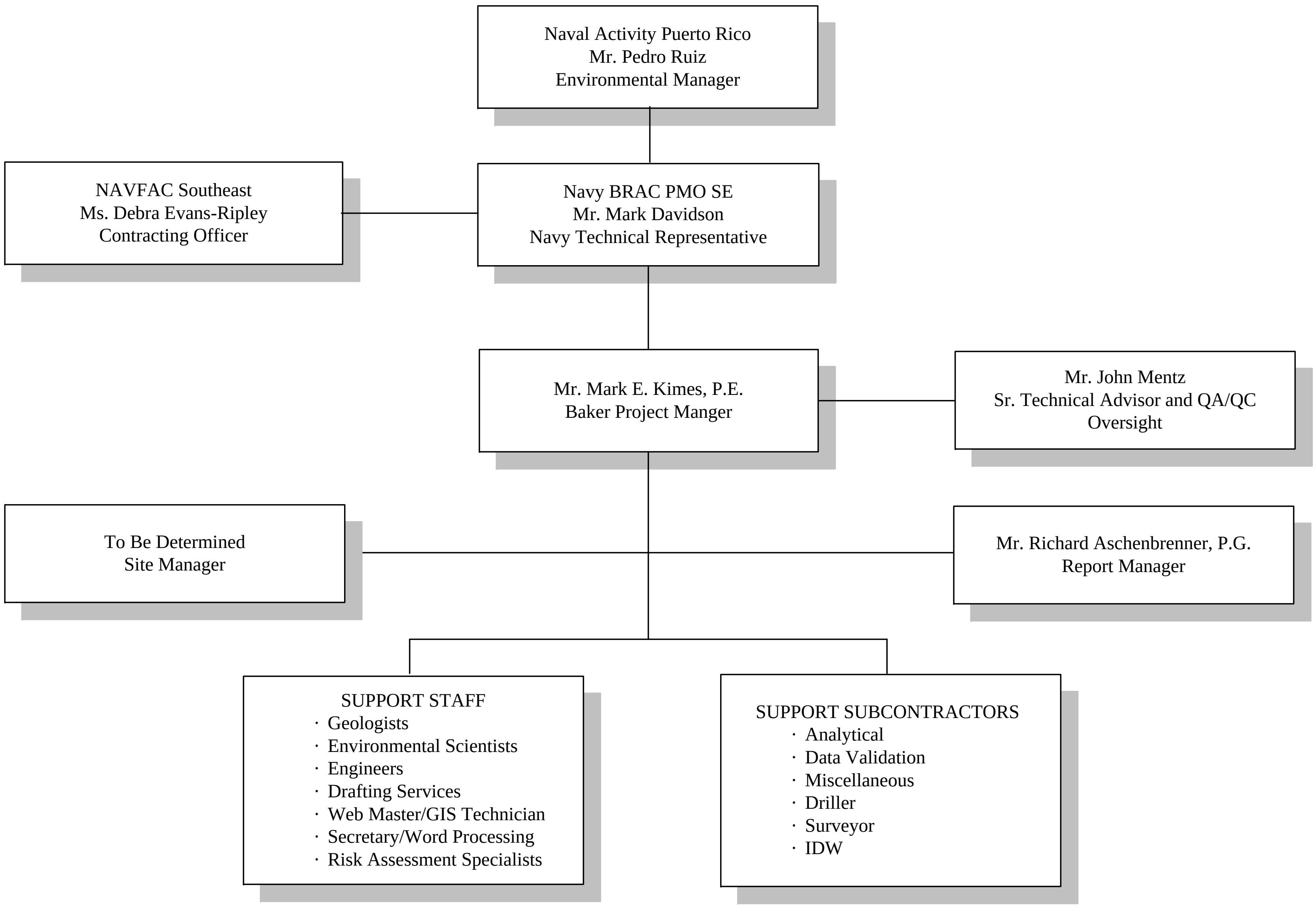
Task Name	Duration	Start	Finish
Draft Full RFI Work Plan to the EPA	60 edays	1/16/10	3/17/10
EPA Review/Comment Resolution	187 edays	3/17/10	9/20/10
Final Full RFI Work Plan to the EPA	24 edays	9/20/10	10/14/10
EPA Review & Approval	90 edays	10/14/10	1/12/11
Sub Procurement and Field Work Planning	21 days	1/13/11	2/10/11
Field Investigation	20 days	2/11/11	3/10/11
Laboratory Analysis	28 days	3/11/11	4/19/11
Data Validation	14 days	4/20/11	5/9/11
Draft Full RFI Report for SWMU 78 to EPA	60 days	5/10/11	8/1/11
EPA Review	90 days	8/2/11	12/5/11
Final Full RFI Report for SWMU 78 to EPA	60 days	12/6/11	2/27/12
EPA Review & Approval	90 days	2/28/12	7/2/12



Project: Full RFI Work Plan
Date: 10/7/10

Task

FIGURE 6-1
PROJECT ORGANIZATION
SWMU 78 – POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX A
SITE PHOTOGRAPHS

Appendix A – SWMU 78 Photographs

Photograph A-1: View of northern border of pad looking east to west. Staining of soil and stressed vegetation at discharge of drainage valve from raised concrete curbed pad storing transformers.

Photograph A-2: Transformer showing label that the contents do not contain PCBs.

Appendix A – SWMU 78 Photographs

Photograph A-3: Transformer showing label that the contents do not contain PCBs.

Photograph A-4: Transformers on raised concrete pad looking south toward the northern border of pad, showing accumulation of rainwater on pad.

Appendix A – SWMU 78 Photographs

Photo A-5. Spools of wire along Gilbert Island Street.

Photo A-6. Historical trailer storage area – note that trailers are not present.

Photo A-7. SWMU 78 laydown area. View looking southwest.

Photo A-8. Soil boring 78SB12 and poles in background.

APPENDIX B
SUMMARY OF PHASE I RFI ANALYTICAL RESULTS

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background (1)	78SB01 78SB01-00 5/31/2008 0.0-1.0	78SB01 78SB01-00D 5/31/2008 0.0-1.0	78SB02 78SB02-00 5/30/2008 0.0-1.0	78SB03 78SB03-00 5/31/2008 0.0-1.0	78SB04 78SB04-00 5/30/2008 0.0-1.0	78SB05 78SB05-00 5/30/2008 0.0-1.0
Volatile Organic Compounds (ug/kg)										
2-Hexanone	2,800,000 (2)	19,000,000 (2)	NE	NE	2.2 U	1.9 U	2.6 U	2.7 U	2.3 U	2.3 U
Acetone	6,10,000 (2)	61,000,000 (2)	NE	NE	250 J	210 J	96 UJ	100 UJ	71 UJ	200
Benzene	1,100	5,600	101	NE	0.83 U	0.73 U	0.99 U	1 U	0.88 U	0.87 U
Carbon disulfide	670,000 (2)	300,000 (2)	NE	NE	0.59 U	0.47 U	0.64 U	8	2.7 U	0.56 U
Chloromethane	1,700	8,400	NE	NE	0.74 U	0.65 U	0.89 U	2 J	0.79 U	0.78 U
Iodomethane	NE	NE	NE	NE	1.8 J	1.8 J	1.3 UJ	1.6 J	1.1 UJ	1.4 J
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000 (6)	NE	140 UJ	6.6 UJ	6.8 U	150 U	6.7 U	7.3 U
2-Methylnaphthalene	31,000 (2)	410,000 (2)	NE	NE	38 UJ	1.8 UJ	1.9 U	41 U	1.8 U	2 U
Acenaphthene	340,000 (2)	3,300,000 (2)	NE	NE	13 UJ	0.61 UJ	0.62 U	14 U	0.61 U	0.67 U
Acenaphthylene	340,000 (2)	3,300,000 (2)	NE	NE	38 UJ	1.8 UJ	1.9 U	41 U	1.8 U	2 U
Anthracene	1,700,000 (2)	170,000 (2)	NE	NE	38 UJ	1.8 UJ	1.9 U	41 U	1.8 U	2 U
Benzo[a]anthracene	150	2,100	NE	NE	38 UJ	6 J	1.9 U	41 U	1.8 U	4.5 J
Benzo[a]pyrene	15	210	NE	NE	**35** J	7 J	0.72 U	**110** J	0.71 U	3.7 J
Benzo[b]fluoranthene	150	2,100	NE	NE	17 UJ	13 J	0.83 U	74 J	0.82 U	7.3 J
Benzo[g,h,i]perylene	1,700	17,000	NE	NE	110 J	6 J	11 J	290 J	12 J	3.7 J
Benzo[k]fluoranthene	15	2,100	NE	NE	22 UJ	1.1 UJ	1.1 U	24 U	1.1 U	1.2 UJ
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010 (10)	NE	340 UJ	14 UJ	18 U	470 U	17 U	16 J
Chrysene	15,000	210,000	NE	NE	14 UJ	5.6 J	2.2 J	59 J	2 J	5 J
Dibenz(a,h)anthracene	15	210	NE	NE	13 UJ	2.4 J	0.64 U	**26** J	0.63 U	0.7 U
Dibenzofuran	NE	NE	NE	NE	94 UJ	4.5 UJ	4.6 U	100 U	4.5 U	5 U
Fluoranthene	230,000 (2)	2,200,000 (2)	NE	NE	38 UJ	9.3 J	1.9 U	51 J	1.8 U	6.2 J
Fluorene	230,000 (2)	2,200,000 (2)	NE	NE	17 UJ	0.82 UJ	0.84 U	19 U	0.83 U	0.91 U
Indeno[1,2,3-cd]pyrene	150	2,100	NE	NE	27 UJ	3.6 J	1.3 U	29 U	1.3 U	1.6 J
Naphthalene	3,900	20,000	NE	NE	13 UJ	0.67 J	0.65 UJ	15 UJ	0.73 J	0.92 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB01 78SB01-00 5/31/2008 0.0-1.0	78SB01 78SB01-00D 5/31/2008 0.0-1.0	78SB02 78SB02-00 5/30/2008 0.0-1.0	78SB03 78SB03-00 5/31/2008 0.0-1.0	78SB04 78SB04-00 5/30/2008 0.0-1.0	78SB05 78SB05-00 5/30/2008 0.0-1.0
Semivolatile Organic Compounds (ug/kg) (continued)										
Phenanthrene	NE	NE	NE	NE	38 UJ	2.2 J	1.9 U	41 U	1.8 U	2 U
Phenol	1,800,000 [2]	18,000,000 [2]	30,000 [6]	NE	110 UJ	5.1 UJ	6.5 J	120 U	5.3 J	5.7 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	38 UJ	7.9 J	1.9 U	110 J	1.9 J	5.5 J
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [11]	NE	233	19	11.6	263	11.2	16.7
High molecular weight PAHs	NE	NE	18,000 [12]	NE	314	52.6	21.6	763	22.3	33.2
PCBs (ug/kg)										
PCB-1260	220	740	NE	NE	33 J	5.2 U	5.3 U	5.8 U	5.2 U	5.7 U
Metals (mg/kg)										
Antimony	3.1 [2]	41 [2]	78 [8]	3.17	1.1 J	0.12 UJ	0.3 UJ	**4** J	**3.2** J	0.22 UJ
Arsenic	0.39	1.6	18 [4]	2.65	**1.6**	**1**	**0.76**	***4.2***	***4.1***	**1.1**
Barium	1,500 [2]	19,000 [2]	330 [5]	199	75 J	50 J	62	150	110	82
Beryllium	16 [2]	200 [2]	40 [5]	0.59	0.22	0.17	0.22	0.3	0.24	0.28
Cadmium	7 [2]	81 [2]	32 [4]	1.02	0.4	0.099 J	0.39	0.76	0.32	0.17
Chromium	280	1,400	57 [7]	49.8	15	14	13	21	25	16 J
Cobalt	2.3 [2]	30 [2]	13 [4]	46.2	**25** J	**17** J	**16**	**21**	**22**	**15**
Copper	310 [2]	4,100 [2]	70 [4]	168	160 J	78 J	49	100	120	93
Lead	400 [3]	800 [3]	120 [4]	22	21 R	2.8 R	3.4 R	180 R	80 R	13
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.109	0.021 J	0.004 U	0.0038 U	0.11	0.05	0.0042 U
Nickel	160 [2]	2,000 [2]	38 [4]	20.7	13	12	9.2	13	13	9.1
Selenium	39 [2]	510 [2]	0.52 [4]	NE	0.13 U	0.12 U	0.12 U	0.19 J	0.14 J	0.13 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.073 J	0.074 J	0.04 J	0.099 J	0.08 J	0.062 J
Thallium	0.51 [2]	6.6 [2]	1 [6]	NE	0.13 U	0.12 U	0.12 U	0.14 U	0.12 U	0.13 U
Tin	4700 [2]	61000 [2]	50	3.76	4.2 U	4 U	4 U	8.8 J	4.5 J	4.2 U
Vanadium	55 [2]	720 [2]	10 [9]	259	**140**	**140**	**130**	**130**	**140**	**130**
Zinc	2,300 [2]	31,000 [2]	120 [5]	115	150 J	59 J	53 J	490 J	240 J	110 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB01 78SB01-00 5/31/2008 0.0-1.0	78SB01 78SB01-00D 5/31/2008 0.0-1.0	78SB02 78SB02-00 5/30/2008 0.0-1.0	78SB03 78SB03-00 5/31/2008 0.0-1.0	78SB04 78SB04-00 5/30/2008 0.0-1.0	78SB05 78SB05-00 5/30/2008 0.0-1.0
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	8,000 J	12 J	1.7 J	820	4.6	5.1
Gasoline Range Organics	NE	NE	NE	NE	0.39 J	0.11 J	0.17 J	0.66 J	0.12 J	0.12 J
Total TPH	100	NE	NE	NE	**8,000** J	12.11 J	1.87 J	**821**	4.72 J	5.22 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background (1)	78SB06	78SB07	78SB08	78SB08	78SB09	78SB10
Sample ID					78SB06-00	78SB07-00	78SB08-00	78SB08-00D	78SB09-00	78SB10-00
Date					5/30/2008	5/30/2008	5/30/2008	5/30/2008	5/29/2008	5/29/2008
Depth Range					0.0-1.0	0.0-1.0	0.0-1.0	0.0-1.0	0.0-1.0	0.0-1.0
Volatile Organic Compounds (ug/kg)										
2-Hexanone	2,800,000 (2)	19,000,000 (2)	NE	NE	2.6 U	2.3 U	3.4 U	3.1 U	2.3 U	2 U
Acetone	6,10,000 (2)	61,000,000 (2)	NE	NE	37 J	130 J	100	79	11 J	37 J
Benzene	1,100	5,600	101	NE	0.98 U	0.87 U	1.3 U	1.2 U	0.87 U	0.75 U
Carbon disulfide	670,000 (2)	300,000 (2)	NE	NE	0.63 U	0.56 U	0.83 U	0.74 U	0.56 U	0.49 U
Chloromethane	1,700	8,400	NE	NE	0.88 U	0.78 U	1.1 U	1 U	0.79 U	0.68 U
Iodomethane	NE	NE	NE	NE	1.2 U	4.6 J	1.6 U	1.5 U	1.1 U	0.95 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000 (6)	NE	8.1 U	6.9 U	9.1 J	8.2 U	6.9 U	6.8 U
2-Methylnaphthalene	31,000 (2)	410,000 (2)	NE	NE	2.2 U	1.9 U	2.4 U	2.2 U	1.9 U	1.9 U
Acenaphthene	340,000 (2)	3,300,000 (2)	NE	NE	0.75 U	0.63 U	0.81 U	0.75 U	0.63 U	0.63 U
Acenaphthylene	340,000 (2)	3,300,000 (2)	NE	NE	2.2 U	1.9 U	2.4 U	2.2 U	1.9 U	1.9 U
Anthracene	1,700,000 (2)	170,000 (2)	NE	NE	2.2 U	1.9 U	2.4 U	2.2 U	1.9 U	1.9 U
Benzo[a]anthracene	150	2,100	NE	NE	2.2 U	1.9 U	2.4 U	2.9 J	1.9 U	1.9 U
Benzo[a]pyrene	15	210	NE	NE	1.6 J	0.73 U	1.2 J	2.1 J	0.73 U	0.73 U
Benzo[b]fluoranthene	150	2,100	NE	NE	3.6 J	0.84 U	1.1 J	2.1 J	0.84 U	0.84 U
Benzo[g,h,i]perylene	1,700	17,000	NE	NE	2.2 U	1.9 UJ	3.8 J	2.2 U	1.9 UJ	1.9 U
Benzo[k]fluoranthene	15	2,100	NE	NE	1.3 UJ	1.1 U	1.4 J	1.4 J	1.1 U	1.1 U
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010 (10)	NE	18 J	5.3 U	37 J	42 J	13 U	16 U
Chrysene	15,000	210,000	NE	NE	1.4 J	0.68 U	1.3 J	2 J	0.68 U	0.67 U
Dibenz(a,h)anthracene	15	210	NE	NE	0.77 U	0.66 U	0.83 U	0.78 U	0.65 U	0.65 U
Dibenzofuran	NE	NE	NE	NE	5.5 U	4.7 U	5.9 U	5.6 U	4.6 U	4.6 U
Fluoranthene	230,000 (2)	2,200,000 (2)	NE	NE	2.2 U	1.9 U	2.4 U	2.3 J	1.9 U	1.9 U
Fluorene	230,000 (2)	2,200,000 (2)	NE	NE	1 U	0.86 U	1.1 U	1 U	0.85 U	0.85 U
Indeno[1,2,3-cd]pyrene	150	2,100	NE	NE	1.6 U	1.3 U	1.7 U	1.6 U	1.3 UJ	1.3 U
Naphthalene	3,900	20,000	NE	NE	0.79 U	0.67 UJ	0.85 U	0.79 U	0.66 U	0.66 U

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB06 78SB06-00 5/30/2008 0.0-1.0	78SB07 78SB07-00 5/30/2008 0.0-1.0	78SB08 78SB08-00 5/30/2008 0.0-1.0	78SB08 78SB08-00D 5/30/2008 0.0-1.0	78SB09 78SB09-00 5/29/2008 0.0-1.0	78SB10 78SB10-00 5/29/2008 0.0-1.0
Semivolatile Organic Compounds (ug/kg) (continued)										
Phenanthrene	NE	NE	NE	NE	2.2 U	1.9 U	2.4 U	2.2 U	1.9 U	1.9 U
Phenol	1,800,000 (2)	18,000,000 (2)	30,000 (6)	NE	6.3 U	5.3 U	6.8 U	6.3 U	5.3 U	5.3 U
Pyrene	170,000 (2)	1,700,000 (2)	NE	NE	2.3 J	1.9 U	2.6 J	2.3 J	1.9 U	1.9 U
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 (11)	NE	13.5	11.7	14.8	13.6	11.6	11.6
High molecular weight PAHs	NE	NE	18,000 (12)	NE	17.0	11.0	16.3	17.4	11	11.0
PCBs (ug/kg)										
PCB-1260	220	740	NE	NE	6.2 U	5.3 U	6.8 U	6.4 U	5.3 U	5.2 U
Metals (mg/kg)										
Antimony	3.1 (2)	41 (2)	78 (8)	3.17	0.089 UJ	0.13 UJ	0.28 UJ	0.65 J	0.1 UJ	0.077 UJ
Arsenic	0.39	1.6	18 (4)	2.65	**1**	**0.69**	***2.8***	***2.2***	**0.58**	**0.66**
Barium	1,500 (2)	19,000 (2)	330 (5)	199	85	60	260 J	180 J	100	33
Beryllium	16 (2)	200 (2)	40 (5)	0.59	0.3	0.23	0.34	0.31	0.24	0.26
Cadmium	7 (2)	81 (2)	32 (4)	1.02	0.094 J	0.12	0.12 J	0.17	0.038 J	0.065 J
Chromium	280	1,400	57 (7)	49.8	18 J	14	11 J	19 J	20 J	18
Cobalt	2.3 (2)	30 (2)	13 (4)	46.2	**26**	**16**	***41***	***33***	**27**	**25**
Copper	310 (2)	4,100 (2)	70 (4)	168	190	28	280	220	110	12
Lead	400 (3)	800 (3)	120 (4)	22	1.8	2.6 R	4.2 R	27 R	1.3	2.2
Mercury	2.3 (2)	31 (2)	0.1 (6)	0.109	0.0051 U	0.0043 U	0.0063 J	0.032	0.004 U	0.0041 U
Nickel	160 (2)	2,000 (2)	38 (4)	20.7	24	8.9	20	22	19	17
Selenium	39 (2)	510 (2)	0.52 (4)	NE	0.14 U	0.13 U	0.18 J	0.21 J	0.12 U	0.12 U
Silver	39 (2)	510 (2)	560 (8)	NE	0.039 J	0.027 J	0.13 J	0.12 J	0.093 J	0.038 J
Thallium	0.51 (2)	6.6 (2)	1 (6)	NE	0.14 U	0.13 U	0.17 U	0.14 U	0.17 J	0.12 U
Tin	4700 (2)	61000 (2)	50	3.76	4.8 U	4.3 U	5.5 U	4.8 U	4.1 U	4.1 U
Vanadium	55 (2)	720 (2)	10 (9)	259	**410**	**130**	**250**	**240**	**200**	**190**
Zinc	2,300 (2)	31,000 (2)	120 (5)	115	85 J	46 J	70 J	150 J	57 J	65

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB06 78SB06-00 5/30/2008 0.0-1.0	78SB07 78SB07-00 5/30/2008 0.0-1.0	78SB08 78SB08-00 5/30/2008 0.0-1.0	78SB08 78SB08-00D 5/30/2008 0.0-1.0	78SB09 78SB09-00 5/29/2008 0.0-1.0	78SB10 78SB10-00 5/29/2008 0.0-1.0
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	1.4	3.3 J	2.6	5.2	1.1	0.89
Gasoline Range Organics	NE	NE	NE	NE	0.12 J	0.11 J	0.12 J	0.11 J	0.065 U	0.075 J
Total TPH	100	NE	NE	NE	1.52 J	3.41 J	2.72 J	5.31 J	1.1	0.965 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB11 78SB11-00 5/29/2008 0.0-1.0	78SB12 78SB12-00 5/29/2008 0.0-1.0	78SB13 78SB13-00 5/29/2008 0.0-1.0	78SB14 78SB14-00 5/29/2008 0.0-1.0	78SB15 78SB15-00 5/30/2008 0.0-1.0	78SB16 78SB16-00 5/30/2008 0.0-1.0
Volatile Organic Compounds (ug/kg)										
2-Hexanone	2,800,000 [2]	19,000,000 [2]	NE	NE	2.3 U	2.3 U	1.8 U	4.1 J	2.5 U	2.7 U
Acetone	6,10,000 [2]	61,000,000 [2]	NE	NE	86 J	4.8 U	36 J	34 J	58 J	85 J
Benzene	1,100	5,600	101	NE	1.4 J	0.86 U	0.76 J	1.1 J	1.1 J	1 U
Carbon disulfide	670,000 [2]	300,000 [2]	NE	NE	7.4	0.55 U	0.45 U	0.57 J	0.95 J	0.66 U
Chloromethane	1,700	8,400	NE	NE	0.77 U	0.77 U	0.62 U	0.73 U	0.85 U	0.92 U
Iodomethane	NE	NE	NE	NE	1.1 U	3.7 J	0.87 U	1 U	1.2 U	1.3 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000 [6]	NE	6.8 UJ	7.7 U	7.3 U	8.2 UJ	7.4 U	8.1 U
2-Methylnaphthalene	31,000 [2]	410,000 [2]	NE	NE	1.9 UJ	19	2 U	2.3 UJ	2 U	2.2 U
Acenaphthene	340,000 [2]	3,300,000 [2]	NE	NE	0.63 UJ	18	0.67 U	0.76 UJ	0.68 U	0.74 U
Acenaphthylene	340,000 [2]	3,300,000 [2]	NE	NE	1.9 UJ	26	2 U	2.3 UJ	2 U	2.2 U
Anthracene	1,700,000 [2]	170,000 [2]	NE	NE	2.6 J	43	2 U	2.3 UJ	2 U	2.2 U
Benzo[a]anthracene	150	2,100	NE	NE	33 J	68	4.8 J	2.3 UJ	2 U	2.2 R
Benzo[a]pyrene	15	210	NE	NE	**46** J	**76**	4.8 J	0.99 J	1.3 J	0.86 R
Benzo[b]fluoranthene	150	2,100	NE	NE	85 J	110	7.2 J	1 UJ	1.6 J	14 J
Benzo[g,h,i]perylene	1,700	17,000	NE	NE	39 J	34	3.6 J	2.3 UJ	2 U	19 J
Benzo[k]fluoranthene	15	2,100	NE	NE	1.1 UJ	1.2 U	1.2 U	1.3 UJ	1.7 J	1.3 R
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010 [10]	NE	35 UJ	12 U	13 U	10 UJ	18 U	26 R
Chrysene	15,000	210,000	NE	NE	48 J	66	4 J	0.81 UJ	1.5 J	34 J
Dibenz(a,h)anthracene	15	210	NE	NE	7.1 J	5.7 J	1.1 J	0.78 UJ	0.7 U	0.77 R
Dibenzofuran	NE	NE	NE	NE	4.6 UJ	33 J	4.9 U	5.6 UJ	5 U	5.5 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	57 J	180	10	2.3 UJ	2 U	15
Fluorene	230,000 [2]	2,200,000 [2]	NE	NE	0.85 UJ	53	1.3 J	1 UJ	0.92 U	1 U
Indeno[1,2,3-cd]pyrene	150	2,100	NE	NE	13 J	15 J	1.4 UJ	1.6 UJ	1.4 UJ	1.6 R
Naphthalene	3,900	20,000	NE	NE	0.66 UJ	99	1.2 J	0.8 UJ	0.71 U	1.9 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB11 78SB11-00 5/29/2008 0.0-1.0	78SB12 78SB12-00 5/29/2008 0.0-1.0	78SB13 78SB13-00 5/29/2008 0.0-1.0	78SB14 78SB14-00 5/29/2008 0.0-1.0	78SB15 78SB15-00 5/30/2008 0.0-1.0	78SB16 78SB16-00 5/30/2008 0.0-1.0
Semivolatile Organic Compounds (ug/kg) (continued)										
Phenanthrene	NE	NE	NE	NE	13 J	220	7.8 J	2.3 UJ	2 U	5.5 J
Phenol	1,800,000 [2]	18,000,000 [2]	30,000 [6]	NE	5.3 UJ	6 U	5.6 U	6.4 UJ	5.7 U	6.2 U
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	81 J	180	8.2	2.3 UJ	2.3 J	20
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [11]	NE	78.5	658	27.0	14.1	12.3	30.7
High molecular weight PAHs	NE	NE	18,000 [12]	NE	353	556	36.3	13.4	14.5	93.7
PCBs (ug/kg)										
PCB-1260	220	740	NE	NE	48 J	6.1 U	5.6 U	6.3 U	5.7 U	6.2 U
Metals (mg/kg)										
Antimony	3.1 [2]	41 [2]	78 [8]	3.17	0.33 J	0.091 UJ	0.15 UJ	0.097 UJ	0.66 J	0.14 UJ
Arsenic	0.39	1.6	18 [4]	2.65	***1.9***	**1.5**	***2.1***	***2.9***	***8.2***	***1.8***
Barium	1,500 [2]	19,000 [2]	330 [5]	199	380	130	160	120	78	80
Beryllium	16 [2]	200 [2]	40 [5]	0.59	0.42	0.35	0.42	0.42	0.19	0.27
Cadmium	7 [2]	81 [2]	32 [4]	1.02	0.17	0.066 J	0.14	0.062 J	0.22	0.23
Chromium	280	1,400	57 [7]	49.8	19	34 J	77 J	21 J	28 J	36 J
Cobalt	2.3 [2]	30 [2]	13 [4]	46.2	**17**	***47***	***34***	***42***	**18**	***40***
Copper	310 [2]	4,100 [2]	70 [4]	168	91	120	130	170	110	240
Lead	400 [3]	800 [3]	120 [4]	22	45	2.1	3.9	1.4	19	0.81
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.109	0.0082 J	0.032	0.016 J	0.015 J	0.013 J	0.0043 U
Nickel	160 [2]	2,000 [2]	38 [4]	20.7	22	23	22	29	15	49
Selenium	39 [2]	510 [2]	0.52 [4]	NE	0.25 J	1.4	0.54 J	0.41 J	0.32 J	0.14 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.06 J	0.03 J	0.08 J	0.039 J	0.065 J	0.11 J
Thallium	0.51 [2]	6.6 [2]	1 [6]	NE	0.13 U	0.14 U	0.13 J	0.15 U	0.14 U	0.14 U
Tin	4700 [2]	61000 [2]	50	3.76	14 J	4.8 U	4.4 U	5.1 U	4.5 U	4.7 U
Vanadium	55 [2]	720 [2]	10 [9]	259	**110**	**270**	**230**	**260**	**160**	**210**
Zinc	2,300 [2]	31,000 [2]	120 [5]	115	260	47 J	51 J	56 J	84 J	72 J

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Soil Screening Values	NAPR Basewide Background [(1)]	78SB11 78SB11-00 5/29/2008 0.0-1.0	78SB12 78SB12-00 5/29/2008 0.0-1.0	78SB13 78SB13-00 5/29/2008 0.0-1.0	78SB14 78SB14-00 5/29/2008 0.0-1.0	78SB15 78SB15-00 5/30/2008 0.0-1.0	78SB16 78SB16-00 5/30/2008 0.0-1.0
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	18	16	3.8	14	2.3	36
Gasoline Range Organics	NE	NE	NE	NE	0.17 J	0.12 J	0.2 J	0.37	0.2 J	0.11 U
Total TPH	100	NE	NE	NE	18.17 J	16.12 J	4 J	14.37	2.5 J	36

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

J - Estimated: The analyte was positively identified; the quantitation is an estimation
R - Result is rejected
U - Undetected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated
ft bgs - feet below ground surface
ug/kg - micrograms per kilogram
mg/kg - miligrams per kilogram
NA - Not Analyzed
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency

(1) NAPR basewide background surface soil screening value (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2008)
(2) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes
(3) USEPA Action Level for lead in soils
(4) Plant-based ecological soil screening level (USEPA,, 2005a [arsenic]; USEPA, 2005b [cadmium]; USEPA, 2005c [cobalt]; USEPA, 2005d [lead]; USEPA, 2007a [copper]; USEPA, 2007b [nickel]; USEPA, 2007c [selenium])
(5) Invertebrate-based ecological soil screening level (USEPA, 2005h [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007d [zinc])
(6) Toxicological threshold for earthworms (Efroymson et al., 1997a)
(7) Reproduction-based MATC for *Eisenia andrei* (earthworm)
(8) Ecological soil screening level (http://www.epa.gov/ecotox/ecossl/)
(9) Growth-based LOAEC for *Brassica oleracea* (broccoli) with a safety factor of 10
(10) Value for total phthalates (MHSPE 2000)
(11) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU78 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Maximum method detection limit was used if there were no detections.
(12) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 78 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. Maximum method detection limits were used for non-detected PAHs.

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References:

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USEPA. 2007c. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2007d. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

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USEPA. 2005b. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

USEPA. 2005c. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

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USEPA. 2005f. Ecological Soil Screening Levels for Barium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005g. Ecological Soil Screening Levels for Beryllium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005h. Ecological Soil Screening Levels for Antimony (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-61.

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [(1)]	78SB01 78SB01-01 5/31/2008 1.0-3.0	78SB01 78SB01-03 5/31/2008 5.0-7.0	78SB01 78SB01-03D 5/31/2008 5.0-7.0	78SB02 78SB02-01 5/30/2008 1.0-3.0	78SB02 78SB02-03 5/30/2008 5.0-7.0	78SB03 78SB03-01 5/31/2008 1.0-3.0
Volatile Organic Compounds (ug/kg)										
Acetone	6,10,000 [(2)]	61,000,000 [(2)]	NE	NE	180 J	36 UJ	15 UJ	170 J	20 UJ	21 UJ
Iodomethane	NE	NE	NE	NE	4.7 J	1.3 U	0.86 U	12 J	1.2 UJ	1.1 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	7 U	8 U	6.6 U	7.5 U	6.8 U	7 U
Benzo[a]pyrene	15	210	NE	NE	0.74 U	1.3 J	0.7 U	0.8 U	0.72 U	0.74 U
Benzo[b]fluoranthene	150	2,100	NE	NE	0.85 UJ	2 J	0.81 UJ	0.92 U	0.83 U	0.85 UJ
Benzyl alcohol	3,100,000 [(2)]	31,000,000 [(2)]	NE	NE	9 U	10 U	8.5 U	9.6 U	8.8 U	10 J
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	13 U	14 U	14 U	18 U	8.8 UJ	12 U
Chrysene	15,000	210,000	NE	NE	0.69 U	1.2 J	0.65 U	0.74 U	0.67 U	0.69 U
Naphthalene	3,900	20,000	NE	NE	0.67 UJ	0.77 UJ	0.64 UJ	0.72 UJ	0.66 UJ	0.67 UJ
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [(12)]	NE	11.7	13.5	11.1	12.3	11.6	11.7
High molecular weight PAHs	NE	NE	18,000 [(13)]	NE	11.0	14.7	10.6	11.8	11.0	11.0
Metals (mg/kg)										
Antimony	31 [(2)]	410 [(2)]	78 [(5)]	NE	0.077 UJ	0.093 UJ	0.092 UJ	0.4 UJ	0.079 UJ	0.4 UJ
Arsenic	0.39	1.6	18 [(4)]	1.59	**0.7**	**0.73**	**0.97**	**1.5**	**0.54**	**0.96**
Barium	1,500 [(2)]	19,000 [(2)]	330 [(5)]	220	38	30	32	41	32	86
Beryllium	16 [(2)]	200 [(2)]	40 [(5)]	0.596	0.25	0.22	0.2	0.22	0.15	0.21
Cadmium	7 [(2)]	81 [(2)]	32 [(4)]	0.54	0.073 J	0.045 J	0.09 J	3.7	0.16	0.63
Chromium	280	1,400	57 [(10)]	114.5	14	12	13	18	8.1	17
Cobalt	2.3 [(2)]	30 [(2)]	13 [(4)]	26.9	**18**	**11**	**13**	**17**	**14**	**24**
Copper	310 [(2)]	4,100 [(2)]	70 [(4)]	246	84	190	150	61	9.4	140
Lead	400 [(3)]	800 [(3)]	120 [(4)]	6.3	1.6 R	1.2 R	1.7 R	0.84 R	0.65 R	1.8 R
Mercury	2.3 [(2)]	31 [(2)]	0.1 [(6)]	0.108	0.0039 U	0.0048 U	0.0042 U	0.0048 U	0.0042 U	0.0043 U
Nickel	160 [(2)]	2,000 [(2)]	38 [(4)]	24.7	11	7	8.6	16	9.2	18

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB01 78SB01-01 5/31/2008 1.0-3.0	78SB01 78SB01-03 5/31/2008 5.0-7.0	78SB01 78SB01-03D 5/31/2008 5.0-7.0	78SB02 78SB02-01 5/30/2008 1.0-3.0	78SB02 78SB02-03 5/30/2008 5.0-7.0	78SB03 78SB03-01 5/31/2008 1.0-3.0
Metals (mg/kg) (continued)										
Selenium	39 [2]	510 [2]	0.52 [4]	5.94	0.12 U	0.15 U	0.12 U	0.13 U	0.13 U	0.13 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.029 J	0.043 J	0.028 J	0.16 J	0.075 J	0.14 J
Thallium	0.51 [2]	6.6 [2]	1 [7]	0.92	0.12 U	0.15 U	0.12 U	0.13 U	0.13 U	0.13 U
Vanadium	55 [2]	720 [2]	10 [11]	434	**140**	**130**	**130**	**220**	**100**	**190**
Zinc	2,300 [2]	31,000 [2]	120 [5]	88	70 J	39 J	35 J	66 J	37 J	61 J
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	180	2.1 J	1.5 J	1.4 J	1.2 J	14
Gasoline Range Organics	NE	NE	NE	NE	0.079 U	0.11 J	0.053 U	0.064 U	0.071 U	0.071 U
Total TPH	100	NE	NE	NE	**180**	2.21 J	1.5 J	1.4 J	1.2 J	14

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB03 78SB03-01D 5/31/2008 1.0-3.0	78SB03 78SB03-02 5/31/2008 3.0-5.0	78SB04 78SB04-01 5/30/2008 1.0-3.0	78SB04 78SB04-02 5/30/2008 3.0-5.0	78SB05 78SB05-01 5/30/2008 1.0-3.0	78SB06 78SB06-01 5/30/2008 1.0-3.0
Volatile Organic Compounds (ug/kg)										
Acetone	6,10,000 [2]	61,000,000 [2]	NE	NE	15 UJ	16 UJ	14 UJ	8.4 UJ	48 J	26 J
Iodomethane	NE	NE	NE	NE	1.1 U	1.1 U	0.79 UJ	0.83 UJ	1.2 U	1.9 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	7 U	6.9 U	6.6 U	6.7 UJ	7.8 J	7.4 U
Benzo[a]pyrene	15	210	NE	NE	0.75 U	0.74 U	0.7 U	0.71 U	0.78 UJ	0.79 UJ
Benzo[b]fluoranthene	150	2,100	NE	NE	0.86 UJ	0.85 UJ	0.81 U	0.82 UJ	0.9 U	0.91 U
Benzyl alcohol	3,100,000 [2]	31,000,000 [2]	NE	NE	9.1 U	8.9 U	8.5 U	8.6 UJ	9.4 U	9.6 U
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	17 U	12 U	5.1 U	27 U	11 J	5.8 U
Chrysene	15,000	210,000	NE	NE	0.69 U	0.68 U	0.65 U	0.65 U	0.72 U	0.73 U
Naphthalene	3,900	20,000	NE	NE	0.68 UJ	0.67 UJ	0.64 UJ	0.64 UJ	0.71 U	0.72 U
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [12]	NE	11.7	11.7	11.1	11.1	12.3	12.3
High molecular weight PAHs	NE	NE	18,000 [13]	NE	11.2	11.0	10.6	10.6	11.7	11.7
Metals (mg/kg)										
Antimony	31 [2]	410 [2]	78 [5]	NE	0.28 UJ	0.28 UJ	0.16 UJ	0.11 UJ	0.082 UJ	0.083 UJ
Arsenic	0.39	1.6	18 [4]	1.59	**0.87**	**1.1**	**0.95**	0.4 U	**0.68**	**0.61**
Barium	1,500 [2]	19,000 [2]	330 [5]	220	63	230	38	22	27	76
Beryllium	16 [2]	200 [2]	40 [5]	0.596	0.19	0.14	0.15	0.12	0.13	0.14
Cadmium	7 [2]	81 [2]	32 [4]	0.54	0.56	2.6	0.3	0.069 J	0.035 J	0.13
Chromium	280	1,400	57 [10]	114.5	17	10	5.6	9.1	5.7 J	13 J
Cobalt	2.3 [2]	30 [2]	13 [4]	26.9	**23**	**27**	**12**	**6.6**	**9**	***35***
Copper	310 [2]	4,100 [2]	70 [4]	246	100	120	24	16	84	130
Lead	400 [3]	800 [3]	120 [4]	6.3	1.4 R	1.2 R	1.8 R	1.2 R	0.96	0.76
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.108	0.0089 J	0.0042 U	0.0037 U	0.004 U	0.0046 U	0.0046 U
Nickel	160 [2]	2,000 [2]	38 [4]	24.7	17	12	6.3	4.8	5.7	20

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB03 78SB03-01D 5/31/2008 1.0-3.0	78SB03 78SB03-02 5/31/2008 3.0-5.0	78SB04 78SB04-01 5/30/2008 1.0-3.0	78SB04 78SB04-02 5/30/2008 3.0-5.0	78SB05 78SB05-01 5/30/2008 1.0-3.0	78SB06 78SB06-01 5/30/2008 1.0-3.0
Metals (mg/kg) (continued)										
Selenium	39 [2]	510 [2]	0.52 [4]	5.94	0.13 U	0.12 U	0.11 U	0.12 U	0.13 U	0.13 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.15 J	0.06 J	0.034 J	0.036 J	0.025 J	0.038 J
Thallium	0.51 [2]	6.6 [2]	1 [7]	0.92	0.13 U	0.12 U	0.11 U	0.12 U	0.13 U	0.13 U
Vanadium	55 [2]	720 [2]	10 [11]	434	**190**	**180**	**70**	55	**71**	**230**
Zinc	2,300 [2]	31,000 [2]	120 [5]	88	60 J	40 J	29 J	24 J	22 J	46 J
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	12	1.7 J	1.3 J	0.78 J	1.8	0.83
Gasoline Range Organics	NE	NE	NE	NE	0.063 U	0.072 U	0.056 U	0.062 U	0.2 J	0.082 U
Total TPH	100	NE	NE	NE	12	1.7 J	1.3 J	0.78 J	2 J	0.83

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB06 78SB06-02 5/30/2008 3.0-5.0	78SB07 78SB07-01 5/30/2008 1.0-3.0	78SB07 78SB07-02 5/30/2008 3.0-5.0	78SB08 78SB08-01 5/30/2008 1.0-3.0	78SB08 78SB08-02 5/30/2008 3.0-5.0	78SB09 78SB09-01 5/29/2008 1.0-3.0
Volatile Organic Compounds (ug/kg)										
Acetone	6,10,000 [2]	61,000,000 [2]	NE	NE	13 J	25 UJ	38 UJ	34 J	17 J	19 J
Iodomethane	NE	NE	NE	NE	0.99 U	1.4 UJ	3.2 J	1.3 U	1.2 U	1.9 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	7.1 UJ	6.9 U	7.2 U	7.3 U	7.3 U	6.8 U
Benzo[a]pyrene	15	210	NE	NE	0.76 UJ	0.73 U	0.77 U	0.77 UJ	0.77 UJ	0.73 U
Benzo[b]fluoranthene	150	2,100	NE	NE	0.88 UJ	0.84 UJ	0.89 UJ	0.89 U	0.89 U	0.84 U
Benzyl alcohol	3,100,000 [2]	31,000,000 [2]	NE	NE	9.2 UJ	8.9 U	9.3 U	9.4 U	9.4 U	8.8 U
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	12 UJ	18 U	21 U	10 J	5.6 U	12 U
Chrysene	15,000	210,000	NE	NE	0.7 UJ	0.68 U	0.71 U	0.71 U	0.71 U	0.67 U
Naphthalene	3,900	20,000	NE	NE	0.69 UJ	0.67 UJ	0.7 UJ	0.7 U	0.7 U	0.66 U
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [12]	NE	12.2	11.7	12.3	12.3	12.3	11.6
High molecular weight PAHs	NE	NE	18,000 [13]	NE	11.6	11.0	11.7	11.7	11.7	11.0
Metals (mg/kg)										
Antimony	31 [2]	410 [2]	78 [5]	NE	0.077 UJ	0.079 UJ	0.078 UJ	0.078 UJ	0.079 UJ	0.079 UJ
Arsenic	0.39	1.6	18 [4]	1.59	0.4 U	**0.65**	0.5 U	**0.66**	**0.62**	0.36 U
Barium	1,500 [2]	19,000 [2]	330 [5]	220	13	34	25	33	42	170
Beryllium	16 [2]	200 [2]	40 [5]	0.596	0.1 J	0.23	0.16	0.21	0.15	0.19
Cadmium	7 [2]	81 [2]	32 [4]	0.54	0.07 J	0.034 J	0.034 J	0.059 J	0.062 J	0.034 J
Chromium	280	1,400	57 [10]	114.5	12 J	14	11	9.9 J	12 J	15 J
Cobalt	2.3 [2]	30 [2]	13 [4]	26.9	**24**	**11**	**10**	**7.9**	**19**	***33***
Copper	310 [2]	4,100 [2]	70 [4]	246	86	21	18	200	82	170
Lead	400 [3]	800 [3]	120 [4]	6.3	0.38	0.73 R	0.45 R	0.68	0.5	0.78
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.108	0.0038 U	0.0044 U	0.004 U	0.0043 U	0.0043 U	0.0041 U
Nickel	160 [2]	2,000 [2]	38 [4]	24.7	17	7.5	6.8	6.3	12	22

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB06 78SB06-02 5/30/2008 3.0-5.0	78SB07 78SB07-01 5/30/2008 1.0-3.0	78SB07 78SB07-02 5/30/2008 3.0-5.0	78SB08 78SB08-01 5/30/2008 1.0-3.0	78SB08 78SB08-02 5/30/2008 3.0-5.0	78SB09 78SB09-01 5/29/2008 1.0-3.0
Metals (mg/kg) (continued)										
Selenium	39 [2]	510 [2]	0.52 [4]	5.94	0.12 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.037 J	0.03 J	0.03 J	0.022 J	0.053 J	0.089 J
Thallium	0.51 [2]	6.6 [2]	1 [7]	0.92	0.12 U	0.13 U	0.13 U	0.13 U	0.13 U	0.35 J
Vanadium	55 [2]	720 [2]	10 [11]	434	**170**	**120**	**74**	**110**	**130**	**200**
Zinc	2,300 [2]	31,000 [2]	120 [5]	88	41 J	33 J	25 J	19 J	29 J	60 J
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	0.9	0.66 U	0.7 U	1.2	1.8	2.2
Gasoline Range Organics	NE	NE	NE	NE	0.072 U	0.072 U	0.06 U	0.12 J	0.072 U	0.07 U
Total TPH	100	NE	NE	NE	0.9	0.732 U	0.76 U	1.32 J	1.8	2.2

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background (1)	78SB09 78SB09-03 5/29/2008 5.0-7.0	78SB10 78SB10-01 5/29/2008 1.0-3.0	78SB10 78SB10-02 5/29/2008 3.0-5.0	78SB11 78SB11-03 5/29/2008 5.0-7.0	78SB11 78SB11-03D 5/29/2008 5.0-7.0	78SB11 78SB11-05 5/29/2008 9-11
Volatile Organic Compounds (ug/kg)										
Acetone	6,10,000 (2)	61,000,000 (2)	NE	NE	5.2 U	8.1 J	9.5 J	33 J	11 J	5.6 J
Iodomethane	NE	NE	NE	NE	1.2 U	1.1 U	1.1 U	3.3 J	1.4 U	1 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	6.6 U	7.3 U	6.5 U	8.9 U	7.3 U	7 UJ
Benzo[a]pyrene	15	210	NE	NE	0.7 U	0.78 U	0.7 U	0.95 U	0.78 U	0.74 UJ
Benzo[b]fluoranthene	150	2,100	NE	NE	0.81 U	0.9 U	0.8 U	1.1 U	0.9 U	0.86 UJ
Benzyl alcohol	3,100,000 (2)	31,000,000 (2)	NE	NE	8.5 UJ	9.4 UJ	8.4 U	12 UJ	9.5 UJ	9 UJ
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	8.2 U	9.4 U	34 U	14 U	13 U	7.5 UJ
Chrysene	15,000	210,000	NE	NE	0.65 U	0.72 U	0.64 U	0.88 U	0.72 U	0.69 UJ
Naphthalene	3,900	20,000	NE	NE	0.64 U	0.71 U	0.63 U	0.86 U	0.71 U	0.85 J
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 (12)	NE	11.1	12.3	11.0	14.8	12.3	11.9
High molecular weight PAHs	NE	NE	18,000 (13)	NE	10.6	11.7	10.6	14.1	11.7	11.2
Metals (mg/kg)										
Antimony	31 (2)	410 (2)	78 (5)	NE	0.082 UJ	0.084 UJ	0.074 UJ	0.096 UJ	0.089 J	0.082 UJ
Arsenic	0.39	1.6	18 (4)	1.59	0.48 U	0.54 U	**0.54**	**1.1**	**1.2**	***2.7***
Barium	1,500 (2)	19,000 (2)	330 (5)	220	100	450	35	25 J	59 J	25
Beryllium	16 (2)	200 (2)	40 (5)	0.596	0.13	0.16	0.24	0.21	0.23	0.23
Cadmium	7 (2)	81 (2)	32 (4)	0.54	0.085 J	0.049 J	0.043 J	0.11 J	0.24	0.14
Chromium	280	1,400	57 (10)	114.5	12 J	18	14	15	15	17
Cobalt	2.3 (2)	30 (2)	13 (4)	26.9	**30**	***34***	**16**	**19** J	**29** J	***32***
Copper	310 (2)	4,100 (2)	70 (4)	246	63	29	8.2	34 J	55 J	130
Lead	400 (3)	800 (3)	120 (4)	6.3	0.5	1.7	1	1.1	1.2	0.65
Mercury	2.3 (2)	31 (2)	0.1 (6)	0.108	0.0042 U	0.0046 U	0.0042 U	0.0053 U	0.0044 U	0.0045 U
Nickel	160 (2)	2,000 (2)	38 (4)	24.7	17	12	11	5.6	9.3	19

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB09 78SB09-03 5/29/2008 5.0-7.0	78SB10 78SB10-01 5/29/2008 1.0-3.0	78SB10 78SB10-02 5/29/2008 3.0-5.0	78SB11 78SB11-03 5/29/2008 5.0-7.0	78SB11 78SB11-03D 5/29/2008 5.0-7.0	78SB11 78SB11-05 5/29/2008 9-11
Metals (mg/kg) (continued)										
Selenium	39 [2]	510 [2]	0.52 [4]	5.94	0.12 U	0.13 U	0.12 U	0.15 U	0.14 U	0.13 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.099 J	0.098 J	0.023 J	0.022 J	0.037 J	0.041 J
Thallium	0.51 [2]	6.6 [2]	1 [7]	0.92	0.25 J	0.13 U	0.12 U	0.15 U	0.14 U	0.13 U
Vanadium	55 [2]	720 [2]	10 [11]	434	**270**	**190**	**160**	**120**	**150**	**330**
Zinc	2,300 [2]	31,000 [2]	120 [5]	88	54 J	47	41	54	57	70
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	1.4	2.4	1.8	2.2	1.4	2.4
Gasoline Range Organics	NE	NE	NE	NE	0.059 U	0.065 U	0.062 U	0.095 U	0.074 U	0.068 U
Total TPH	100	NE	NE	NE	1.4	2.4	1.8	2.2	1.4	2.4

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB12 78SB12-02 5/29/2008 3.0-5.0	78SB12 78SB12-03 5/29/2008 5.0-7.0	78SB13 78SB13-01 5/29/2008 1.0-3.0	78SB14 78SB14-02 5/29/2008 3.0-5.0	78SB15 78SB15-01 5/30/2008 1.0-3.0	78SB15 78SB15-03 5/30/2008 5.0-7.0
Volatile Organic Compounds (ug/kg)										
Acetone	6,10,000 [2]	61,000,000 [2]	NE	NE	48 J	9.8 J	15 J	31 J	14 J	11 J
Iodomethane	NE	NE	NE	NE	5.7	1.2 U	0.86 U	1.5 J	1.2 U	1.2 U
Semivolatile Organic Compounds (ug/kg)										
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	6.5 U	6.6 U	6.7 U	6.9 UJ	7.1 U	6.5 U
Benzo[a]pyrene	15	210	NE	NE	0.69 U	0.7 U	0.71 U	0.73 UJ	0.76 U	0.69 U
Benzo[b]fluoranthene	150	2,100	NE	NE	0.8 U	0.81 U	0.82 U	0.84 UJ	0.88 U	0.79 U
Benzyl alcohol	3,100,000 [2]	31,000,000 [2]	NE	NE	8.4 U	8.5 U	8.6 UJ	8.8 UJ	9.2 UJ	8.4 U
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	22 U	17 U	17 U	6.8 UJ	12 U	9 U
Chrysene	15,000	210,000	NE	NE	0.64 U	0.65 U	0.66 U	0.67 UJ	0.7 U	0.64 U
Naphthalene	3,900	20,000	NE	NE	0.63 U	0.64 U	0.67 J	0.66 UJ	0.69 U	0.63 U
PAHs (ug/kg)										
Low molecular weight PAHs	NE	NE	29,000 [12]	NE	11.0	11.1	11.1	11.6	12.2	11.0
High molecular weight PAHs	NE	NE	18,000 [13]	NE	10.5	10.6	10.6	11.0	11.6	10.4
Metals (mg/kg)										
Antimony	31 [2]	410 [2]	78 [5]	NE	0.1 UJ	0.073 UJ	0.072 UJ	0.25 UJ	0.082 UJ	0.073 UJ
Arsenic	0.39	1.6	18 [4]	1.59	***2***	**0.55**	**1**	***1.8***	0.52 U	**0.54**
Barium	1,500 [2]	19,000 [2]	330 [5]	220	60	21	71	310	20	43
Beryllium	16 [2]	200 [2]	40 [5]	0.596	0.14	0.071 J	0.28	0.3	0.047 J	0.051 J
Cadmium	7 [2]	81 [2]	32 [4]	0.54	0.031 J	0.03 U	0.064 J	0.074 J	0.15	0.16
Chromium	280	1,400	57 [10]	114.5	31 J	21 J	32 J	9 J	21 J	26 J
Cobalt	2.3 [2]	30 [2]	13 [4]	26.9	**20**	**22**	**22**	**23**	**18**	**20**
Copper	310 [2]	4,100 [2]	70 [4]	246	210	98	74	190	72	110
Lead	400 [3]	800 [3]	120 [4]	6.3	1	0.42	1.3	1.4	0.29 U	0.29 U
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.108	0.0041 U	0.004 U	0.012 J	0.004 U	0.0042 U	0.0042 U
Nickel	160 [2]	2,000 [2]	38 [4]	24.7	15	21	22	8	19	19

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID / Sample ID / Date / Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background (1)	78SB12 / 78SB12-02 / 5/29/2008 / 3.0-5.0	78SB12 / 78SB12-03 / 5/29/2008 / 5.0-7.0	78SB13 / 78SB13-01 / 5/29/2008 / 1.0-3.0	78SB14 / 78SB14-02 / 5/29/2008 / 3.0-5.0	78SB15 / 78SB15-01 / 5/30/2008 / 1.0-3.0	78SB15 / 78SB15-03 / 5/30/2008 / 5.0-7.0
Metals (mg/kg) (continued)										
Selenium	39 (2)	510 (2)	0.52 (4)	5.94	0.3 J	0.12 U	0.35 J	0.14 J	0.13 U	0.12 U
Silver	39 (2)	510 (2)	560 (8)	NE	0.025 J	0.016 U	0.033 J	0.052 J	0.049 J	0.033 J
Thallium	0.51 (2)	6.6 (2)	1 (7)	0.92	0.12 U	0.12 U	0.11 U	0.13 U	0.13 U	0.12 U
Vanadium	55 (2)	720 (2)	10 (11)	434	**120**	**140**	**170**	**210**	**110**	**160**
Zinc	2,300 (2)	31,000 (2)	120 (5)	88	40 J	43 J	43 J	52 J	34 J	34 J
TPH DRO and GRO (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	5.2	1.1	1.2	1.4	1.7	1
Gasoline Range Organics	NE	NE	NE	NE	0.17 J	0.074 U	0.12 J	0.071 J	0.099 J	0.084 U
Total TPH	100	NE	NE	NE	5.2 J	1.1	1.32 J	1.4 J	1.7 J	1

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB16 78SB16-01 5/30/2008 1.0-3.0	78SB16 78SB16-03 5/30/2008 5.0-7.0
Volatile Organic Compounds (ug/kg)						
Acetone	6,10,000 [2]	61,000,000 [2]	NE	NE	24 J	8.3 J
Iodomethane	NE	NE	NE	NE	1.3 U	0.88 U
Semivolatile Organic Compounds (ug/kg)						
1,4-Dichlorobenzene	2,600	13,000	20,000	NE	6.9 U	6.7 U
Benzo[a]pyrene	15	210	NE	NE	0.73 U	0.71 U
Benzo[b]fluoranthene	150	2,100	NE	NE	0.84 U	0.82 U
Benzyl alcohol	3,100,000 [2]	31,000,000 [2]	NE	NE	8.9 U	8.6 U
Bis(2-ethylhexyl) phthalate	35,000	120,000	6,010	NE	14 U	12 U
Chrysene	15,000	210,000	NE	NE	0.68 U	0.66 U
Naphthalene	3,900	20,000	NE	NE	0.67 U	0.65 U
PAHs (ug/kg)						
Low molecular weight PAHs	NE	NE	29,000 [12]	NE	11.7	11.1
High molecular weight PAHs	NE	NE	18,000 [13]	NE	11.0	10.6
Metals (mg/kg)						
Antimony	31 [2]	410 [2]	78 [5]	NE	0.11 UJ	0.075 UJ
Arsenic	0.39	1.6	18 [4]	1.59	**1.4**	**0.73**
Barium	1,500 [2]	19,000 [2]	330 [5]	220	69	24
Beryllium	16 [2]	200 [2]	40 [5]	0.596	0.25	0.078 J
Cadmium	7 [2]	81 [2]	32 [4]	0.54	0.33	0.032 U
Chromium	280	1,400	57 [10]	114.5	19 J	16 J
Cobalt	2.3 [2]	30 [2]	13 [4]	26.9	**25**	**20**
Copper	310 [2]	4,100 [2]	70 [4]	246	110	76
Lead	400 [3]	800 [3]	120 [4]	6.3	4.7	0.5
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.108	0.0039 U	0.0039 U
Nickel	160 [2]	2,000 [2]	38 [4]	24.7	19	17

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential**	*Regional Screening Levels Industrial*	Selected Ecological Soil Screening Values	NAPR Basewide Background [1]	78SB16 78SB16-01 5/30/2008 1.0-3.0	78SB16 78SB16-03 5/30/2008 5.0-7.0
Metals (mg/kg) (continued)						
Selenium	39 [2]	510 [2]	0.52 [4]	5.94	0.12 U	0.12 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.059 J	0.071 J
Thallium	0.51 [2]	6.6 [2]	1 [7]	0.92	0.12 U	0.12 U
Vanadium	55 [2]	720 [2]	10 [11]	434	**150**	**180**
Zinc	2,300 [2]	31,000 [2]	120 [5]	88	37 J	27 J
TPH DRO and GRO (mg/kg)						
Diesel Range Organics	NE	NE	NE	NE	7.7	3.8
Gasoline Range Organics	NE	NE	NE	NE	0.069 U	0.074 U
Total TPH	100	NE	NE	NE	7.7	3.8

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

J - Estimated: The analyte was positively identified; the quantitation is an estimation
U - Undetected at the Limit of Detection.
R - Data is rejected and not usable
ft bgs - feet below ground surface
mg/kg - miligrams per kilogram
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency

Note that analytical results greater than three feet bgs are not compared to Ecological Soil Screening Values due to the lack of a complete exposure pathway for ecological receptors.

(1) NAPR basewide background soil screening value (upper limit of the means concentration [mean plus two standard deviations]) for Subsurface Soil Background Clay Table 3-4 (Baker, 2008)

(2) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes

(3) USEPA Action Level for lead in soils

(4) Plant-based ecological soil screening level (USEPA,, 2005a [arsenic]; USEPA, 2005b [cadmium]; USEPA, 2005c [cobalt]; USEPA, 2005d [lead]; USEPA, 2007a [copper]; USEPA, 2007b [nickel]; USEPA, 2007c [selenium])

(5) Invertebrate-based ecological soil screening level (USEPA, 2005h [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2000d [zinc])

(6) Toxicological threshold for earthworms (Efroymson et al., 1997a)

(7) Toxicogical threshold for plants (Efroymson et al., 1997b)

(8) Ecological soil screening level (http://www.epa.gov/ecotox/ecossl/)

(9) Ministry of Housing,Spatial Analysis and Environment (MHSPE), 2000, Circular on Target Values for Soil Remediation. Directirate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. February 4, 2000.

(10) Reproduction-based MATC for *Eisenia andrei* (earthworm)

(11) Growth-based LOAEC for *Brassica oleracea* (broccoli) with a safety factor of 10

(12) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU78 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Maximum method detection limit was used if there were no detections.

(13) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 78 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. Maximum method detection limits were used for non-detected PAHs.

APPENDIX B

SUMMARY OF DETECTED LABORATORY RESULTS - PHASE I RFI - SUBSURFACE SOIL
SWMU 78 - POLE YARD
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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USEPA. 2007c. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

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USEPA. 2005c. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

USEPA. 2005d. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEPA. 2005f. Ecological Soil Screening Levels for Barium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005g. Ecological Soil Screening Levels for Beryllium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

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APPENDIX C
USEPA REGION II GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

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

I. SCOPE & APPLICATION

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

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

II. METHOD SUMMARY

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

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

III. ADDRESSING POTENTIAL PROBLEMS

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

Insufficient Yield

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

Failure to Stabilize Key Indicator Parameters

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

Cascading

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

Cross-Contamination

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

Equipment Failure

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

IV. PLANNING DOCUMENTATION AND EQUIPMENT

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

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

- Polyethylene sheeting.

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

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

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

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

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

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

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

- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).

- Sample bottles.

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

- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

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

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

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

4. Remove well cap.

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

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

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

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

Sampling Procedures

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

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

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water

level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):
    - ±0.1 for pH
    - ±3% for specific conductance (conductivity)
    - ±10 mv for redox potential
    - ±10% for DO and turbidity

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

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

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

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

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

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

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

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

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

VII. DECONTAMINATION

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

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

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

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

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

D) Disassemble pump.

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

F) Rinse pump parts with potable water.

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

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

I) Rinse impeller assembly with potable water.

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

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

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

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

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

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

VIII. FIELD LOG BOOK

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

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

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APPENDIX D
GROUNDWATER SAMPLING FORMS

WELL DETAIL AND SAMPLING LOG

Well ID #: ______________________ **DATE:** ______________________

PROJECT: ______________________ **WEATHER:** ______________________

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad ________ Well Cap ________ PVC Locking Cap/Plug ________

Cap Lock ________ Cover Bolts ________ Water over PVC? Y / N

Casing (outer) ________ Casing (inner) ________ SWL Reference Mark ________ Reference Mark Location? ________

Casing Dia.: ________ Casing Material: ________ Flushmount / Stickup

Comments: ______________________

(OTHER): Static Water Level (ft.): ________ Time: ________ (**Pre-Pump** Installation)

Depth to Product (ft.): ________

Water Level (ft.): ________ Time: ________ (Post-Pump Installation, **Pre-Purge**)

Total Well Depth (ft.) - Post Sampling: ________ Time: ________

PID Reading (PPM) - Unopened: ________ Opened: ________

PURGE DATA

Pump Type: ______________________

From Boring Log: Total Depth (ft.): ________ Screened Interval (ft.): ________

Pump Intake Set @ (ft.): ________ Controller Settings / Pressure: ________

Comments: ______________________

SAMPLE DATA

Sample ID #: ______________________ Dup.: Y / N - (ID#: ________)

Sample Time: ________ MS / MSD: Y / N Field Filtered: Y / N

Sampled By: ______________________ Signature: ______________________

Sample Description: ______________________

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis

GENERAL COMMENTS

DAILY METER CALIBRATION RECORD

Date: ____________ Time: ____________

Model: YSI 556 MPS
Serial #:

		Initial	Adjusted
pH (Std. Units)			
Buffer:	4		
Buffer:	7		
Buffer:	10		
ORP (mV's)			
Std.:			
Sp.Cond. (mS/cm)			
Std.:			
D.O. (mg/l)			
Baro. Pressure (mm/Hg):			
Temp. (Celsius)			N/A

Model: RAE 2000
Serial #:

	Initial	Adjusted
Isobutylene (100ppm)		

Model:
Serial #:

		Initial	Adjusted
Turbidity (NTU's)			
Std.:	10		

LOW FLOW PURGE DATA SHEET

WELL ID: ______________________________

DATE: ______________________________ **SAMPLER (s):** ______________________________

PROJECT: ______________________________ **SAMPLE ID:** ______________________________

TIME [3-5 min.]	**DEPTH TO WATER** (ft) [<0.3 ft.]	**VOL.** (ml)	**PURGE RATE** (ml/min) [250-500 ml/min]	**TEMP.** (°C)	**SP. COND.** (mS/cm) [+/- 3%]	**D.O.** (mg/l) [+/- 10%]	**pH** (S.U.) [+/- 0.1]	**ORP** (mV) [+/- 10]	**TURBIDITY** (NTU) [+/- 10%]	**COMMENTS** (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
		- (Water Level : Post-Pump Installation, Pre-Start)								
	- (Start of Purging)									
	- Sample Time (Note: Flow rate to be btwn. 100 - 250 ml/min.)									**Sampler Signature:**

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.