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REVISED FINAL FULL RCRA FACILITY INVESTIGATION WORK PLAN SWMU 62 – FORMER BUNDY DISPOSAL AREA

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:

Michael Baker Jr., Inc.
Moon Township, PA

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

April 14, 2011

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

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DELIVERY ORDER JM01

Prepared by:

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

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

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Title: **BRAC Env. Coordinator**

Date: **April 14, 2011**

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LIST OF ACRONYMS AND ABBREVIATIONS

APA	Aerial Photograph Analysis
Baker	Michael Baker Jr., Inc.
bgs	Below Ground Surface
BRAC	Base Realignment and Closure
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERFA	Community Environmental Response Facilitation Act
CMS	Corrective Measures Study
CSFs	Cancer Slope Factors
DO	Delivery Order
DoN	Department of the Navy
EA	Environmental Assessment
Eco-SSLs	Ecological Soil Screening Levels
ECP	Environmental Condition of Property
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
IDW	Investigation Derived Waste
IUR	Inhalation Unit Risk
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
mg/kg	milligram per kilogram
MHSPE	Ministry of Housing, Spatial Planning and Environment
MS/MSDs	Matrix Spike/Matrix Spike Duplicates
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command Atlantic Division
NFESC	Naval Facilities Engineering Service Center
NSRR	Naval Station Roosevelt Road
NTR	Navy Technical Representative
OP	Organophosphorus
PCBs	Polychlorinated Biphenyls
PEMB1	Palutrine Wetland System
PID	Photoionization Detector

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

PMO	Program Management Office
ppt	Parts Per Thousand
PREQB	Puerto Rico Environmental Quality Board
PWD	Public Works Department
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBCs	Risk-Based Concentrations
RCI	Reactivity, Corrosivity and Ignitability
RCRA	Resource Conservation and Recovery Act
RfCs	Inhalation Reference Concentrations
RfDs	Reference Doses
RFI	RCRA Facility Investigation
SE	Southeast
SL	Screening Levels
SWMU	Solid Waste Management Unit
SVOCs	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
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
USGS	United States Geological Survey
VOCs	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) 62 – Former Bundy Disposal Area 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) (USEPA, 2007).

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.

In anticipation of operational closure of NSRR, the Naval Facilities Engineering Command, Atlantic Division (LANTDIV) prepared Phase I/Phase II Environmental Condition of Property (ECP) Reports to document the environmental condition of NSRR. The Draft Phase I Environmental Condition of Property Report dated March 31, 2004 (LANTDIV, 2004) identified new sites at NAPR based on the results of a review of records, an analysis of historic aerial photographs, physical site inspections, and interviews with persons familiar with past and current operations and activities. The new ECP sites had not been previously identified or investigated under existing environmental program areas. A Phase II ECP field investigation was performed in 2004 to conduct environmental sampling to determine if a release/disposal actually occurred at any of the Phase I ECP sites recommended for further evaluation in the Phase I ECP and, if so, whether any potential risk to human health was

present. The Final Phase II Environmental Condition of Property Report recommended additional sampling (to be undertaken as part of the RCRA Program) at several sites to permit a more detailed assessment (NAVFAC, 2005). The final ECP report recommended completion of RCRA facility investigation of SWMU 62.

The USEPA issued a RCRA 7003 Administrative Order on Consent 'Consent Order' (USEPA Docket No. RCRA-02-2007-7301) to NAPR, identifying SWMU 62 (formerly referred to as ECP Site 8) as having documented releases of solid and/or hazardous waste and hazardous constituents (USEPA, 2007). 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 Location and Description

SWMU 62, referred to as the "Former Bundy Disposal Area" is located in the southwestern portion of the base in the Bundy area as shown on Figure 1-2. The Aerial Photography Analysis (APA) conducted during the Phase I ECP identified this area as Photo Identified Site 12, due to the observation of a disposal or fill area with multi-toned, mounded materials from 1958-1961 (see Figure 1-3). The records review and interviews conducted during the Phase I ECP did not confirm or repudiate the area as a disposal area. However, the Phase I ECP indicated that the Physical Site Inspection observed numerous piles of mounded gravel and charcoal, metal and building debris, and two empty 55-gallon drums. During the Phase II ECP investigation, the field crew observed the same type of site features as described above. There were no signs of any stressed vegetation observed during the Phase II ECP investigation. Appendix A provides photographs of the site from the Phase I RFI conducted in 2008. Figure 1-4 shows the SWMU boundary and sample locations from the previous investigations.

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 62 (Baker, 2008).

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

- Delineate the metals in the surface and subsurface soil found during the Phase I RFI, specifically, around Phase I RFI sample locations 62SB04, 62SB06, 62SB07, 62SB08 and 62SB09.

- Conduct a general inventory of the types of debris (i.e., concrete, steel, etc.) within the vicinities of the proposed sample locations (location(s) of the debris will be verified with a global positioning system [GPS]).

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, a summary of the previous investigations, including the Phase II ECP investigation performed in 2004 and the Phase I RFI performed in May/June 2008, and preliminary conceptual models for ecological and human receptors. Section 3.0 provides a description of the scope of investigations for the Full RFI fieldwork including a soil sampling and analysis program, 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 62. 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 62 along with a summary of the results of the Phase I and II ECP investigation (NAVFAC Atlantic, 2005) and Phase I RFI (Baker, 2010a). In addition, the terrestrial and aquatic habitats and associated biota at and contiguous to SWMU 62 are described and preliminary conceptual models for human and ecological receptors 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 Phase I RFI report, and preliminary conceptual models form the basis for the Full RFI.

2.1 Current Site Conditions

The entire SWMU 62 area consists of approximately 13 acres of dense, secondary growth vegetation. The site was located on United States Geographical Survey (USGS) mapping (Naguabo, PR 7.5 minute quadrangle, photorevised 1982) and evaluated for topographic relief and drainage patterns. The Former Bundy Disposal Area slopes predominantly to the south and does not contain drainage systems such as streams or rivers. Site reconnaissance observations made during the Phase I RFI investigation were similar to those made during the Phase I and II ECP investigations: numerous piles of mounded gravel and charcoal, and metal and building debris were visible within the central portion of the SWMU near sample 8E-01 (see Figure 1-4). Only one partially buried drum was found (see photo A-7 and A-8 in Appendix A). The location of the drum was surveyed using a GPS. Additionally, groundwater was not encountered during the installation of the shallow borings for the ECP and Phase I RFI investigations.

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). Reforestation has also led to the growth of trees such as ucar (*Bucida buceras*), sandbox (*Hura crepitans*), figs (*Ficus* spp.), flamboyant tree (*Delonix regia*), Puerto Rican royal palm (*Roystonea borinquena*), ginep (*Melicoccus bijugatus*) and Indian almond (*Terminalia catappa*), any of which may reside in SWMU 62 (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 62 and surrounding areas is classified as an upland coastal forest community. Specific vegetation occurring within the upland coastal 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 upland coastal 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 1.5 miles from SWMU 62). 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).

Terrestrial and aquatic habitats occurring at NAPR are depicted on Figure 2-1. The aquatic habitats occurring in the vicinity of SWMU 62, limited to wetlands in this instance, are depicted on Figure 2-2. 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 62. There is, however, a small palustrine wetland system (PEM1B) located approximately 700 feet northwest of SWMU 62 that is not hydrologically connected to the SWMU. The nearest downgradient surface water body is the Caribbean Sea (approximately 3,500 feet southeast of SWMU 62). Seagrass beds are prevalent along this region of the coast. As evidenced by Figure 2-1, seagrass meadows extend several miles west from this area, downgradient from SWMU 62.

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 62 have not been recorded during previous investigations, generalizations are provided based on available habitat. Specific biota occurring at SWMU 62 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 (Department of the Navy [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 been sited along the coast, downgradient from SWMU 62. This can be attributed to the abundance of coastal seagrass.

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 United States Fish and Wildlife Service [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 62 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 62 (i.e., Caribbean Sea) 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 Cove, and the Medio Mundo Passage,

with the frequency of turtle observations listed as green > hawksbill > loggerhead > leatherback. No sea turtle sightings have been recorded downgradient from SWMU 62, despite the presence of seagrass (forage material) along this portion of the coast.

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 62.

2.1.2.4 Fish and Aquatic Invertebrates

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 62 include the Phase I and II ECP Investigation and the Phase I RFI. These investigations are summarized below.

2.2.1 Phase I and II ECP Investigation

The Phase I and II ECP investigations performed in 2004 noted that there were no signs of any stains or stressed vegetation (NAVFAC Atlantic, 2005). As previously noted, numerous piles of mounded gravel and charcoal, metal and building debris, and two empty 55-gallon drums were observed.

During the Phase II ECP investigation, three soil borings (8E-01, 8E-02, and 8E-03), as shown on Figure 1-4, were advanced in the Former Bundy Disposal Area. These borings were placed in areas of disturbance as determined through the aerial photo interpretation. Figure 1-3 identifies the polygons from the historical aerial photo review along with the 1958 photo. Three surface soil samples were collected at this site (sample locations 8E-01 through 8E-03) from a depth of 0 to 1 foot below ground surface (bgs). Subsurface soil samples were then collected from a depth of 1 to 3 feet bgs (sample locations 8E-01 and 8E-03) using a hand auger. (A track-mounted Geoprobe® rig was unable to traverse the topography at this site.) A subsurface soil sample was not obtained from soil boring location 8E-02 due to auger refusal at 1 foot bgs. The depth of subsurface soil collection at other locations was limited by the shallow depth of bedrock. Geology at the site was characterized as a thin residual sand and silt overlaying weathered bedrock (Gabbro); no debris was encountered in the soil borings. Groundwater was not encountered.
The surface and subsurface soil samples were analyzed for Appendix IX volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), organophosphorus (OP)-pesticides, chlorinated herbicides, and metals. A summary of analytical results from the Phase II ECP is presented in Appendix B. In the surface soil, a few VOCs and pesticides were detected. Of the VOCs and pesticides detected, none exceeded USEPA Region III

Residential or Industrial Risk-Based Concentrations (RBCs) at this SWMU. SVOCs, PCBs, OP-pesticides, and chlorinated herbicides were not detected in the surface soil. Organic compounds were not detected in the subsurface soil matrix.

Inorganic detections were representative of background concentrations found at NAPR with the exception of barium in the subsurface soil matrix. Three metals exceeded the USEPA Region III Residential RBCs, including arsenic and vanadium in the surface soil and barium and vanadium in the subsurface soil. At 8E-03 the barium concentration in the subsurface soil also exceeded twice the average detected background concentration, indicating possible contamination. It should be noted that barium also exceeded the background screening value in two of the three surface soil samples, although it did not exceed its RBC. The concentrations of arsenic and vanadium in the soil did not exceed the background concentrations established at NAPR.

The Draft Phase II ECP Report concluded that SWMU 62 had been impacted by past and present operations at NAPR. The results of the ECP Phase II Investigation indicated that the SWMU was characterized as presenting a low potential risk to human health. Potential ecological risk was undetermined. The results of the Phase II ECP indicated that barium exceeded background and human health screening criteria in soil. It was concluded that site contamination had occurred from previous activities. Barium is associated with ignition equipment and acid batteries, and is a component of gray and ductile irons. These items could have been disposed of at the site as indicated by the past use of the site and as shown by a feature in the 1958 aerial photograph (LANTDIV, 2004), at the site of sample 8E-03. Based on the findings of the ECP, the final ECP report recommended the completion of a RCRA facility investigation at SWMU 62.

2.2.2 Phase I RFI

The Phase I RFI Work Plan was prepared to conduct the field investigation necessary to further characterize and delineate VOCs, pesticides, and metals detected during the ECP Phase II Investigation in the surface soil and metals detected in the subsurface soil (Baker, 2008). 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/beginning of June 2008. Figure 1-4 shows the SWMU boundary and sample locations from the previous investigations.

The objective of the Phase I RFI was 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 USEPA approved 2008 Phase I RFI Work Plan (Baker, 2008).

Specific elements of the 2008 Phase I RFI included:

- Collection of surface soil samples at nine locations (62SB01-00 through 62SB09-00) and one duplicate sample (62SB08-00D): four locations in the vicinity of the 1958 polygon surrounding the ECP sample 8E-03 where barium concentrations were detected at elevated levels; four locations surrounding ECP sample 8E-01 where an area of disturbed soil noted in the 1958 aerial photograph was targeted for investigation; and one location in the immediate vicinity of a partially buried drum. Surface soil samples 62SB01-00, 62SB02-00, 62SB04-00, 62SB05-00, and 62SB07-00 were analyzed for Appendix IX VOCs, pesticides, and

metals. Surface soil samples 62SB03-00, 62SB06-00, 62SB08-00, and 62SB08-00D were analyzed for Appendix IX SVOCs and PCBs in addition to the Appendix IX VOCs, pesticides, and metals analysis. Surface soil sample 62SB09-00 was advanced near the partially buried drum identified on-site and was analyzed for Appendix IX VOCs, SVOCs, pesticides, PCBs, and metals.

- Collection of eighteen primary subsurface soil samples and two duplicate samples (number of samples and depths dependent upon depth of visual contamination impact) at nine locations corresponding with the surface soil sample locations listed above. Nine of the subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, and PCBs in addition to metals. The remaining 11 samples were analyzed for metals only.

As previously noted groundwater was not encountered at the SWMU during either the Phase II ECP or Phase I RFI sampling investigations.

A summary of analytical results from the Phase I RFI is presented in Appendix C. VOCs, SVOCs, and pesticides were detected in surface soil at concentrations that did not exceed the screening criteria (Regional Screening Levels [SLs] and selected ecological screening values). PCBs were not detected in surface soil. Metals (predominantly arsenic, barium, beryllium, cobalt, copper, tin, and vanadium) 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. However, only arsenic and barium exceeded both risk-based screening criteria and NAPR basewide background concentrations. Arsenic exceeded the Regional Screening Level (SL) for residential and industrial soil, as well as its background screening value. Barium exceeded its ecological screening value and its background screening value.

Since arsenic was the only analyte that exceeded both Regional SLs (residential and industrial) for soil and background and it was detected at relatively low concentrations, a human health risk evaluation was completed as part of the Phase I RFI to determine potential risks the arsenic concentrations in SWMU 62 surface soil may present to human receptors. Preliminary risk calculations were performed under a future residential exposure scenario in order to more fully evaluate potential human health risks from arsenic in soil. Evaluation of a future residential exposure scenario provides an upper bound for potential human health risk to site-specific media. The calculations were performed using standard carcinogenic and noncarcinogenic risk equations found in USEPA's Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989) and USEPA-promulgated exposure parameters and toxicity criteria. The low carcinogenic and noncarcinogenic risk levels calculated demonstrate that arsenic in soil would not be a risk driver if a baseline human health risk assessment was conducted.

VOCs, SVOCs, and pesticides were detected in subsurface soil at concentrations that did not exceed Regional SLs. PCBs were not detected in subsurface soil. Metals (predominantly arsenic, barium, beryllium, cobalt, copper, and vanadium) in subsurface 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. Only barium and copper in subsurface soil (specifically, 1 to 3 feet bgs) exceeded both ecological screening criteria and background screening values.

The Phase I RFI concluded that impact to the environment appeared to have occurred at SWMU 62, although the contamination appears to be limited to metals. A Full RFI Investigation was recommended to characterize the nature and extent of metals in the surface and subsurface soils, define the likely source area(s), and determine the potential for unacceptable risks to human health and/or the environment. VOCs, SVOCs, pesticides, and PCBs will not be included in the analytical program for the Full RFI Investigation. Particular attention should focus around Phase I RFI sample

locations 62SB04, 62SB06, 62SB07, 62SB08 and 62SB09. In addition, the Phase I RFI recommended a general inventory of the types of debris (i.e., concrete, steel, etc.) within the SWMU boundaries and verification of the debris location(s) with a GPS.

2.3 Preliminary Conceptual Models for Ecological and Human 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 mounds of surface debris and two empty 55-gallon drums 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 2.3.1.1 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 62 are believed to include the following:

- Overland transport of chemicals with surface soil via surface runoff to downgradient surface soil.
- 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 the Caribbean Sea surface water and sediment is not being considered as a potentially complete transport pathway. As discussed in Section 2.2.2, groundwater was not encountered at SWMU 62 during the advancement of soil borings conducted as part of the Phase I RFI field investigation (Baker, 2010a). Furthermore, the distance of 3,500 feet to the Caribbean Sea is too far to allow for such transport. With the exception of barium and copper, 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 (barium was detected in one Phase I RFI subsurface soil sample at a concentration greater than the soil screening value and ULM background subsurface soil concentration of 330 milligrams per kilogram (mg/kg) and 207 mg/kg, respectively [350 mg/kg in 62SB06-01], while copper 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 70 mg/kg and 120 mg/kg, respectively [140 mg/kg in 62SB06-01]). Both detections were made in the 1.0-foot to 3.0-foot depth interval. Barium was detected twice more in surface soil at concentrations greater than the 330 mg/kg ecological-based soil screening value and 199 mg/kg ULM background surface soil concentration [520 mg/kg in 62SB04-00 and 350 mg/kg in 62SB07-00]. These data indicate that vertical migration of chemicals with infiltrating precipitation is minimal and not likely reaching the water table.

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 62. 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 62 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., 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 (2003), 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, 2003). 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 62, 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 (2003) 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 routes (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 2003), which recognize the relatively small contribution the inhalation pathway contributes to exposure estimates. For example, USEPA (2003) 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 62 (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 62 is a former fill area that contains numerous piles of mounded gravel and charcoal, metal and building debris, and a few 55-gallon drums. A history of the site is presented in Section 1.2. Current site conditions are presented in Section 2.1. Analytical results from two soil investigations were reviewed to develop this preliminary conceptual model, i.e., the Phase II ECP investigation and the Phase I RFI. Groundwater was not encountered at this SWMU and will not be considered further in the development of the preliminary conceptual model.

The Phase II ECP indicated the following:

- No organic chemicals exceeded the USEPA Region III residential or industrial RBCs in surface or subsurface soils
- Only barium exceeded Base background concentrations and the USEPA Region III residential RBCs in subsurface soil and background concentrations in the surface soil samples

The Phase I RFI indicated the following:

- No organic chemicals detected in surface or subsurface soils exceeded Regional Residential and/or Industrial SLs
- Only arsenic and barium exceeded both the Regional Residential and/or Industrial SLs and Base background concentrations in surface soil

Based on the available information for SWMU 62, potential migration, exposure pathways, and human receptors have been identified (Figure 2-8). Potentially affected media at SWMU 62 include surface and subsurface soils and direct contact exposures to metals detected in these media. Preliminary risk calculations were performed as part of Phase I RFI assuming a future residential land use scenario to more fully evaluate the potential risks from arsenic in soil. The resulting non-carcinogenic and carcinogenic risk levels calculated showed that arsenic in soil would not pose an unacceptable risk to future residents on the site. However, risks from potential exposures to all chemicals in soil that exceed applicable screening criteria in the Full RFI, as well arsenic concentrations detected during the Phase I RFI, will be evaluated as part of the Corrective Measures Study (CMS), as appropriate.

Current and potential future exposure scenarios for SWMU 62 are presented in Figure 2-8. Current exposure scenarios for SWMU 62 are trespassers (adult and youth [6 to 16 years]). Future exposures at this site may consist of adult and youth trespassers, adult industrial/commercial workers, and adult construction workers. Future residential land use is also conservatively assumed for SWMU 62, although it is not likely given expected future land use. A future residential exposure scenario (adult and young child [1 to 6 years] residents) 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. However, sampling locations may be adjusted in the field, as necessary to account for varying field conditions. 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.

Metals in the surface soil and 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:

- A total of 14 surface soil samples will be collected from 5 surface soil sampling locations and 4 soil boring locations (62SS06 through 62SS10 and 62SB10 through 62SB13, respectively) located within the 1958 polygon in the central portion of the SWMU surrounding Phase I RFI sample locations 62SB06, 62SB07, 62SB08 and 62SB09 and from five surface soil sampling locations (62SS01 through 62SS05) in the southeastern portion of the SWMU surrounding Phase I RFI sample location 62SB04.

- A total of eight subsurface soil samples are proposed to be collected during the Full RFI from the four soil borings (62SB10 through 62SB13) located within the 1958 polygon in the central portion of the SWMU surrounding Phase I RFI sample location 62SB06.

Sample matrices for this investigation are provided in Tables 3-1 and 3-2. The proposed sample locations for the Full RFI at SWMU 62 (as well as the previous sample locations of the Phase II ECP investigation and the Phase I RFI) are shown on Figure 3-1.

The subsections that follow outline the specific sampling rationale and protocol.

3.1 Soil Sampling and Analysis Program

Listed below is a summary of the rationale for the soil sampling locations and the analytical program.

- Surface soil samples (62SS01 through 62SS05) are proposed northwest, west, and south of Phase I RFI sample 62SB04 to delineate barium in the surface soil. The surface soil samples will be collected from these borings for analysis of Appendix IX metals.

- Surface soil samples (62SS06 through 62SS10) are proposed around Phase I RFI locations 62SB07, 62SB08, and 62SB09. Arsenic was detected above Regional Residential SLs and background in surface soil at locations 62SB08 and 62SB09, while barium was detected above ecological screening criteria and background at location 62SB07. Surface soil will be collected from these five locations for analysis of Appendix IX metals.

- Borings 62SB10 through 62SB13 are proposed surrounding Phase I RFI location 62SB06, where arsenic was detected above Regional Residential SLs and background in surface soil and barium and copper were detected above ecological screening criteria and background in subsurface soil. Surface and subsurface soil samples will be collected from these boring locations for analysis of Appendix IX metals.

The surface soil (0 to 1 foot bgs) samples that are to be collected from the surface soil sample only locations shown on Figure 3-1 will be obtained using a stainless steel bucket auger. Borings from

which surface and subsurface soil samples are to be collected will be advanced to refusal (expected to be less than 20 feet bgs) using a 66DT Geoprobe® drill rig capable of direct push and augering. Subsurface soil samples will be collected from 1 to 3 feet bgs and from 5 to 7 feet bgs (unless other indicators of contamination are encountered at other depth intervals). The selection of these depth intervals is based on the analytical results from the Phase I RFI samples collected from location 62SB06, which showed metals contamination at 1 to 3 feet bgs but not at the subsequent depth interval sampled (i.e., 5 to 7 feet bgs). 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 the soil borings in the central portion of the SWMU will be advanced no more than 20 feet since the Phase I RFI investigation boring logs typically showed refusal ranging from 5.4 feet bgs to 7.4 feet bgs in this area. 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 soil boring locations, one surface soil sample (0 to 1 foot bgs) and two subsurface soil samples will be collected (one from the 1 to 3 foot interval and one from 5 to 7 feet bgs [unless other indicators of contamination are encountered at other depth intervals]). 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. Individual sample intervals, whether surface or subsurface, will be thoroughly mixed using disposable pie pans and disposable stainless steel spoons. The use of disposable equipment will eliminate decontamination of equipment and the potential for cross contamination between sample intervals. Equipment rinsate samples will be collected of the disposable equipment used, including pie pans and disposable stainless steel spoons. Additionally, field observations recorded in the field logbook will also include identification of debris observed in soil borings (as applicable).

The surface and subsurface soil samples collected from the boring locations will be analyzed for 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.

Surface soil samples will be labeled consecutively (beginning with 62SS01 and ending with 62SS10). Similarly, soil borings will be labeled consecutively (beginning with 62SB10 and ending with 62SB13) 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.

62SB10-00 - SMWU 62
62SB10-00 - Soil Boring
62SB10-00 - Soil boring location identifier
62SB10-00 –Depth designator - 0 to 12 inches bgs (surface soil) sampling interval

Subsurface soil samples will be designated as follows:

62SB10-01 - First subsurface sampling interval, 1 to 3 feet bgs
62SB10-02 - 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 (beyond 3 feet bgs) 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 data 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 Quality Assurance/Quality Control Samples

QA/QC requirements for this investigation will consist of 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.

3.2.1 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 sampling equipment. The samples will be obtained from stainless steel bucket augers for collection of surface soil and macro core liner for collection of surface and subsurface soil. These samples will be analyzed for the analytes presented in Table 3-2.

3.2.2 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 at the site 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.

3.2.3 Field Duplicates

Field duplicate samples of the surface soil and subsurface soil 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.

3.2.4 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.

3.3 Other Investigation Considerations

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
- Chain of Custody
- Debris Inventory
- Vegetation and Biota Documentation

Each of these activities is discussed in the following sections.

3.3.1 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 or other subcontractor, if required.

3.3.2 Utility Clearance

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

3.3.3 Investigation Derived Waste Management

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. It should be noted that whenever possible, the soil cuttings from the subsurface soil sampling will be placed back into the boring from which they came, unless contamination is indicated as determined by the field manager based on PID measurements and visual/olfactory signs of contamination. If contamination is indicated, the soil cuttings associated with that soil boring will be stored temporarily in a 55-gallon drum.

A composite soil sample will be compiled from individual discrete (grab) samples of equal volume collected from each of the 55-gallon drums of containerized IDW soil. Each individual discrete soil sample will be placed into a decontaminated stainless-steel bowl (or other appropriate container) and thoroughly homogenized prior to filling the appropriate laboratory provided sample containers. The soil samples will be analyzed for toxicity characteristic leaching procedure (TCLP) metals, and reactivity, corrosivity, and ignitibility (RCI) as shown in Table 3-2, using methods presented in Table 3-3.

The IDW composite water samples will be collected similar to the soil composite sample with the exception that the individual discrete (grab) samples of equal volume collected from each of the 55-gallon drums of containerized IDW water will be placed directly into the appropriate laboratory provided sample containers. The water samples will be analyzed for Appendix IX metals and RCI as shown in Table 3-2, using methods presented in Table 3-3.

These samples will provide the necessary data to be able to dispose of the generated IDW at an appropriate disposal facility. Upon receipt of the IDW composite samples for soil and water media,

the data will be evaluated and a Generator Waste Profile Sheet completed for submittal to a chosen disposal facility. The waste profile will categorize the waste as hazardous or non-hazardous and further define if the wastes contain PCBs, pesticides/herbicides, infectious, or any other specialized waste characteristics. If the sample exceeds the RCRA hazardous waste characteristics then it will be considered hazardous and disposed in an approved state-side hazardous waste facility. If the RCRA hazardous waste characteristics are not exceeded in the sample, then the IDW will be disposed as a non-hazardous waste following the selected facility's permit requirements. The disposal facility will not evaluate the waste based on an exceedance of risk based concentrations.

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 from the site by an approved vendor upon receipt and review of the IDW sample analytical data.

3.3.4 Decontamination

All reusable (non-dedicated and non-disposable) soil sampling 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.

3.3.5 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 GPS unit for locating purposes in the field. The field-grade GPS used at NAPR can achieve sub-meter accuracy. After sample locations are determined in the field and flagged, a surveyor (subcontractor) will obtain and record the locations of each sample.

3.3.6 Health and Safety Procedures

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

3.3.7 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 and accompany 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.

3.3.8 Debris Inventory

A description of the type (i.e., concrete, metal, etc.) of surficial debris in the immediate vicinity (within 10 to 15 feet) of a sample location will be recorded in the field logbook for the purpose of identifying potential local sources of metals contamination. The locations of significant pieces of debris or debris piles, as judged by the field manager, will be verified with a GPS.

3.3.9 Vegetation and Biota Documentation

Dominant vegetation and terrestrial biota, if any, observed in the upland vegetative community at SWMU 62 during the field activities will be documented in the field logbook and/or in a photographic log.

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 62. This section also includes a summary of the results of previous investigations conducted at SWMU 62.

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, including types of debris present, at SWMU 62 at the time of the Full RFI field 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 of the Full RFI Report will present analytical results of the samples collected from environmental media at the SWMU and interpretation of the data to characterize site contamination. Human health and ecological screening values along with background screening values will be used to identify the presence and extent of potential contaminants of concern. Note that although human health and ecological risk assessments will not be conducted as part of the Full RFI, potential impacts to groundwater will be discussed as part of the evaluation and interpretation of the analytical results (human health and ecological risk assessments may be conducted as part of a future CMS, if necessary).

All data from the laboratory will be certified by a Puerto Rican Chemist and laboratory data will be validated to ensure data usability. Only usable data will be included in the evaluation and the conclusions and recommendations sections of the report. Data validation reports will be included as an appendix to the Full RFI report and will discuss:

- Overall Evaluation of the Data
- Potential Usability Issues
- Data Completeness
- Technical Holding Times
- Initial and Continuing Calibrations
- Method and QC Blanks
- Laboratory Control Samples
- Matrix Spikes
- Quantitation and Data Qualifications

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). The media-specific screening values, listed in Table 4-1 (soil) represent conservative exposure thresholds above which adverse ecological effects may occur.

Soil Screening Values

The literature-based toxicological benchmarks selected as screening values for chemicals in surface soil (0 to 1-foot depth interval) and subsurface soil (1 to 3-foot depth interval) are summarized in Table 4-1. USEPA ecological soil screening levels (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 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.

It is noted that the approach described above for selecting soil screening values based on Eco-SSLs was adopted for Phase I and Full RFIs at NAPR based on Puerto Rico Environmental Quality Board (PREQB) comments dated August 27, 2009 on the Draft Full RCRA Facility Investigation Report for SWMU 9 (Area B, Tank 214 Area) dated July 14, 2009. Prior to adopting this approach, only Eco-SSLs for terrestrial plants and invertebrates were considered for soil screening value development. As such, soil screening values for several chemicals listed in Table 4-1 differ from the soil screening values used in the Revised Final Phase I RCRA Facility Investigation Report for SWMU 62 (Baker, 2010a; see Appendix C).

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.

4.6.2 Human Health Screening Values

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, 2010b). The USEPA Regional Industrial and Residential SLs selected as screening values for chemicals in surface soil (0 to 1-foot depth interval) and subsurface soil (1 to 10-foot depth interval) are summarized in Table 4-2.

Regional Screening Levels

The Regional SLs (available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm) 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, 6, and 9. As recommended by the USEPA, these Regional SLs 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.

4.6.3 Background Screening Values

For a given medium (i.e., surface soil and subsurface soil), 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), as presented in Table 4-3. 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, 2010b). 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. Recommendations will be made from these conclusions as to whether a 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 website. 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 62, is provided as Figure 5-1. It should be noted that this schedule is dependent upon Environmental Protection Agency (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 62 – Former Bundy Disposal Area.

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.

7.0 REFERENCES

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TABLES

Revised: April 14, 2011

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM – ENVIRONMENTAL SAMPLES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Fixed Based Analytical Lab Analysis		
Media	**Sample Depth (ft bgs)**	**App IX Metals**	**Comment**
Surface Soil Samples			
62SS01	0.0 - 1.0	X	
62SS01D	0.0 - 1.0	X	Duplicate
62SS02	0.0 - 1.0	X	
62SS03	0.0 - 1.0	X	
62SS04	0.0 - 1.0	X	
62SS05	0.0 - 1.0	X	
62SS06	0.0 - 1.0	X	
62SS07	0.0 - 1.0	X	
62SS08	0.0 - 1.0	X	
62SS09	0.0 - 1.0	X	
62SS10	0.0 - 1.0	X	
62SS10-D	0.0 - 1.0	X	Duplicate
62SS10-MS/MSD	0.0 - 1.0	X	Matrix Spike/Matrix Spike Duplicate
62SB10-00	0.0 - 1.0	X	
62SB11-00	0.0 - 1.0	X	
62SB12-00	0.0 - 1.0	X	
62SB13-00	0.0 - 1.0	X	
Subsurface Soil Samples[(2)]			
62SB10-01	1.0 - 3.0	X	
62SB10-03[(1)]	5.0 - 7.0	X	
62SB11-01	1.0 - 3.0	X	
62SB11-03[(1)]	5.0 - 7.0	X	
62SB12-01	1.0 - 3.0	X	
62SB12-03[(1)]	5.0 - 7.0	X	
62SB13-01	1.0 - 3.0	X	
62SB13-01D	1.0 - 3.0	X	Duplicate
62SB13-01MS/MSD	1.0 - 3.0	X	Matrix Spike/Matrix Spike Duplicate
62SB13-03[(1)]	5.0 - 7.0	X	

Notes:

[(1)] Samples will be collected from 5 to 7 feet bgs, unless indicators of contamination are encountered at other depths, in which case additional samples will be collected.

[(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.

bgs - below ground surface.

App IX - Appendix IX

TABLE 3-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - QA/QC SAMPLES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Analysis Requested			
Sample Media	**Media**	Appendix IX Metals	Reactivity, Corrosivity and Ignitability	TCLP Metals	**Comment**
Equipment Rinsates	62ER01	X			Macro Core Acetate Liner
	62ER02	X			Stainless Steel Bucket Auger
	62ER03	X			Stainless Steel Bucket Auger
Field Blanks	62FB01	X			Store Bought Distilled Water
	62FB02	X			Lab Grade Deionized Water
IDW	62-IDW01		X	X	Solid
	62-IDW02	X	X		Aqueous

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TABLE 3-3

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CRQLs
SWMU 62 - FORMER BUNDY DISPOSAL AREA
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	1	3005A	3050B	ICP/MS
Arsenic	6020A	1.3	0.25	3005A	3050B	6020A ICP/MS
Barium	6020A	1.4	0.25	3005A	3050B	6020A ICP/MS
Beryllium	6020A	0.25	0.05	3005A	3050B	6020A ICP/MS
Cadmium	6020A	0.2	0.05	3005A	3050B	6020A ICP/MS
Chromium	6020A	2.5	0.5	3005A	3050B	6020A ICP/MS
Cobalt	6020A	0.3	0.03	3005A	3050B	6020A ICP/MS
Copper	6020A	1.1	0.5	3005A	3050B	6020A ICP/MS
Lead	6020A	0.5	0.2	3005A	3050B	6020A ICP/MS
Mercury	7470A/7471B	0.1	0.0088	7470A	7471A	7470A/7471B (Cold Vapor AA)
Nickel	6020A	2	1	3005A	3050B	6020A ICP/MS
Selenium	6020A	1.1	1	3005A	3050B	6020A ICP/MS
Silver	6020A	0.25	0.1	3005A	3050B	6020A ICP/MS
Thallium	6020A	0.25	0.05	3005A	3050B	6020A ICP/MS
Tin	6020A	1.4	5.1	3005A	3050B	6020A ICP/MS
Vanadium	6020A	3.2	0.55	3005A	3050B	6020A ICP/MS
Zinc	6020A	8.4	3	3005A	3050B	6020A ICP/MS
		Quantitation Limits		**Preparation Methods**		
TCLP Metals	**Method Number**	**Water (µg/L)**	**Soil (µg/L)**	**Water**	**Soil**	**Method Description**
Arsenic	1311/6010C	NA	200	NA	1311/3010A	ICP
Barium	1311/6010C	NA	1,000	NA	1311/3010A	ICP
Cadmium	1311/6010C	NA	100	NA	1311/3010A	ICP
Chromium	1311/6010C	NA	200	NA	1311/3010A	ICP
Lead	1311/6010C	NA	200	NA	1311/3010A	ICP
Mercury	1311/7470A	NA	20	NA	1311/7470A	Cold Vapor AA
Selenium	1311/6010C	NA	500	NA	1311/3010A	ICP
Silver	1311/6010C	NA	100	NA	1311/3010A	ICP
		Quantitation Limits*		**Preparation Methods**		
Reactivity, Corrosivity, Ignitibility	**Method Number**	**Water (mg/L)**	**Soil (mg/kg)**	**Water**	**Soil**	**Method Description**
Cyanide	9012B/9012B	0.005	0.27	9012A	9012A	Titrimetric
Flashpoint / Ignitability	1010A/1030	NA	NA	NA	NA	Pensky-Martens Closed Cup Tester
pH	9040B/9045D	NA	NA	NA	NA	Electrometric
Sulfide	9034/9034	1	60	NA	9030B	Titrimetric

Notes:

µg/L - micrograms per liter.
µg/kg - micrograms per kilogram.
mg/L - milligrams per liter.
mg/kg - milligrams per kilogram.
CRQL - Contract Required Quantitation Limit
ICP - Inductively Couple Plasma
MS - Mass Spectrometry
TCLP - Toxicity Characteristic Leaching Procedure
NA - Not Applicable

Revised: April 14, 2011

TABLE 4-1
ECOLOGICAL SOIL SCREENING VALUES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Soil Screening Value	Reference	Comment
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 2007a	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 2007b	Ecological soil screening level for plants
Selenium	0.52	USEPA 2007c	Ecological soil screening level for plants
Silver	4.2	USEPA 2006	Ecological soil screening level for avian ground insectivores
Thallium	1.0	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	USEPA 2007d	Ecological soil screening level for avian ground insectivores

Notes:

Ecological surface soil screening values are based on the minimum of plant, invertebrate, avian ground insectivore, avian herbivore, avian carnivore, and mammalian herbivore ECO-SSL concentrations
USEPA = United States Environmental Protection Agency
mg/kg = milligram per kilogram

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

TABLE 4-1
ECOLOGICAL SOIL SCREENING VALUES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

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 Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEPA. 2007b. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

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 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

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

HUMAN HEALTH SCREENING VALUES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
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)
Metals				
Antimony	3.1 [2]	mg/kg	41 [2]	mg/kg
Arsenic	0.39	mg/kg	1.6	mg/kg
Barium	1,500 [2]	mg/kg	19,000 [2]	mg/kg
Beryllium	16 [2]	mg/kg	200 [2]	mg/kg
Cadmium	7 [2]	mg/kg	80 [2]	mg/kg
Chromium	12,000 [2][3]	mg/kg	150,000 [2][3]	mg/kg
Cobalt	2.3 [2]	mg/kg	30 [2]	mg/kg
Copper	310 [2]	mg/kg	4,100 [2]	mg/kg
Lead	400 [2]	mg/kg	800 [2]	mg/kg
Mercury	0.56 [2]	mg/kg	3.4 [2]	mg/kg
Nickel	150 [2]	mg/kg	2,000 [2]	mg/kg
Selenium	39 [2]	mg/kg	510 [2]	mg/kg
Silver	39 [2]	mg/kg	510 [2]	mg/kg
Thallium	NE		NE	
Tin	4,700 [2]	mg/kg	61,000 [2]	mg/kg
Vanadium	0.55 [2]	mg/kg	7.2 [2]	mg/kg
Zinc	2,300 [2]	mg/kg	31,000 [2]	mg/kg

mg/kg - milligram per kilogram
USEPA - United States Environmental Protection Agency
NE - Not established

[1] USEPA Regional Screening Levels (May 2010)

[2] Noncarcinogenic Regional Screening Levels based on a target hazard quotient of 0.1 for conservative screening purposes.

[3] Value for chromium III used as a surrogate.

TABLE 4-3
NAPR BACKGROUND SCREENING VALUES
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

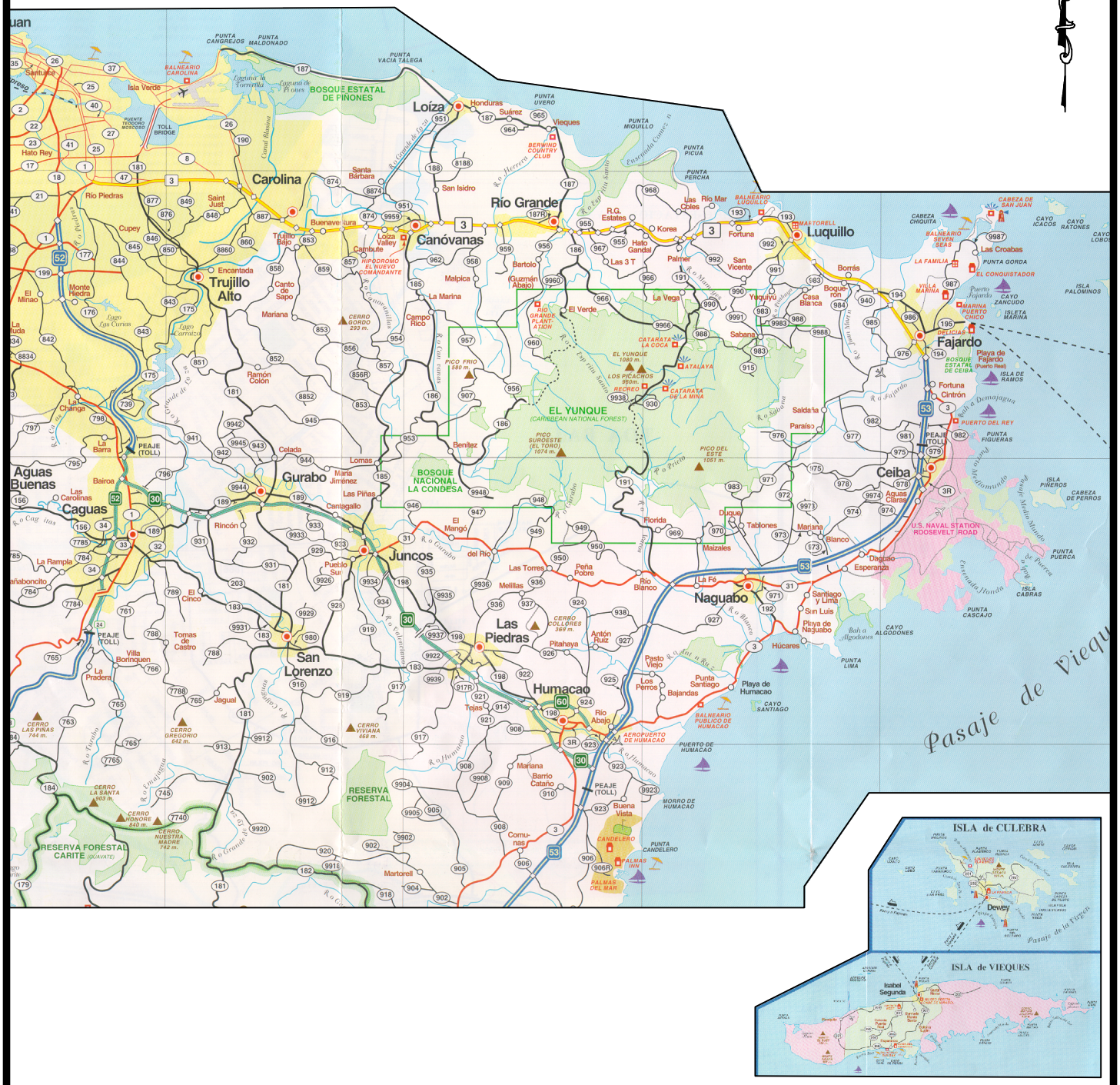
	Surface Soil (mg/kg)	Subsurface Soil Fine Sand/Silt (mg/kg)
Metals	**Upper Limit of Means (x+2s)**	**Upper Limit of Means (x+2s)**
Antimony	3.17	7.44
Arsenic	2.65	6.66
Barium	199	207
Beryllium	0.59	0.933
Cadmium	1.02	0.57
Chromium	49.8	47.9
Cobalt	46.2	63.1
Copper	168	120
Lead	22	6.2
Mercury	0.109	0.067
Nickel	20.7	26.5
Selenium	1.48	1.19
Silver	--	--
Thallium	--	--
Tin	3.76	3.47
Vanadium	259	256
Zinc	115	92

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

Reference: Baker, 2010. *Revised Final II Summary Report for Environmental* Background Concentrations of Inorganic Compounds, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. February 29, 2008.

FIGURES

K:_SOUTHNAVFAC\119197 JM01\SWMU 62\CADD\ 111626_62_01.dwg



4 0 2 4 8

1 inch = 4 miles

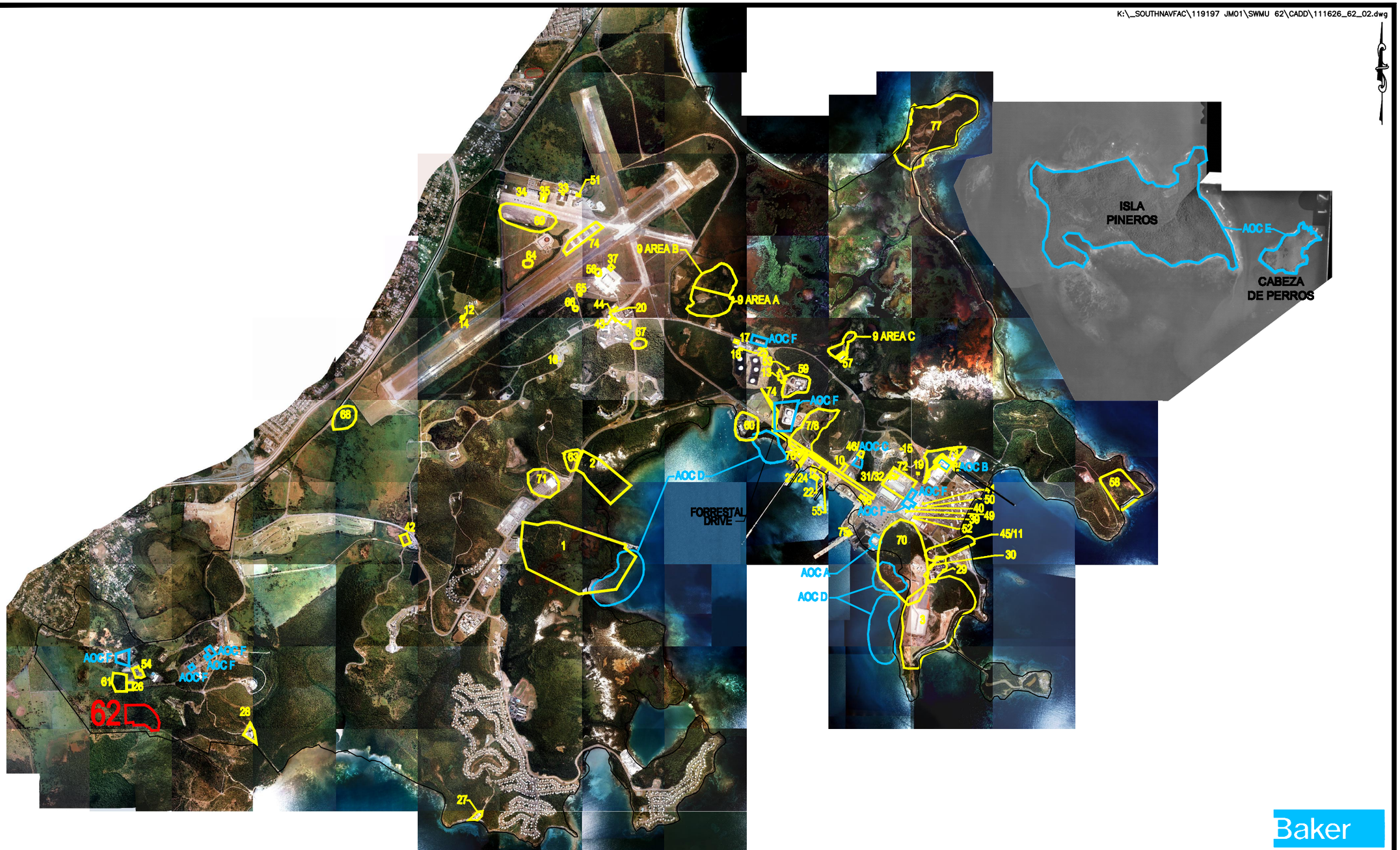
Baker

FIGURE 1-1
REGIONAL LOCATION MAP
SWMU 62-FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 62\CADD\111626_62_02.dwg



LEGEND

1 – SWMUs

62 – AREA TO WHICH THIS INVESTIGATION PERTAINS

AOC D – AOCs

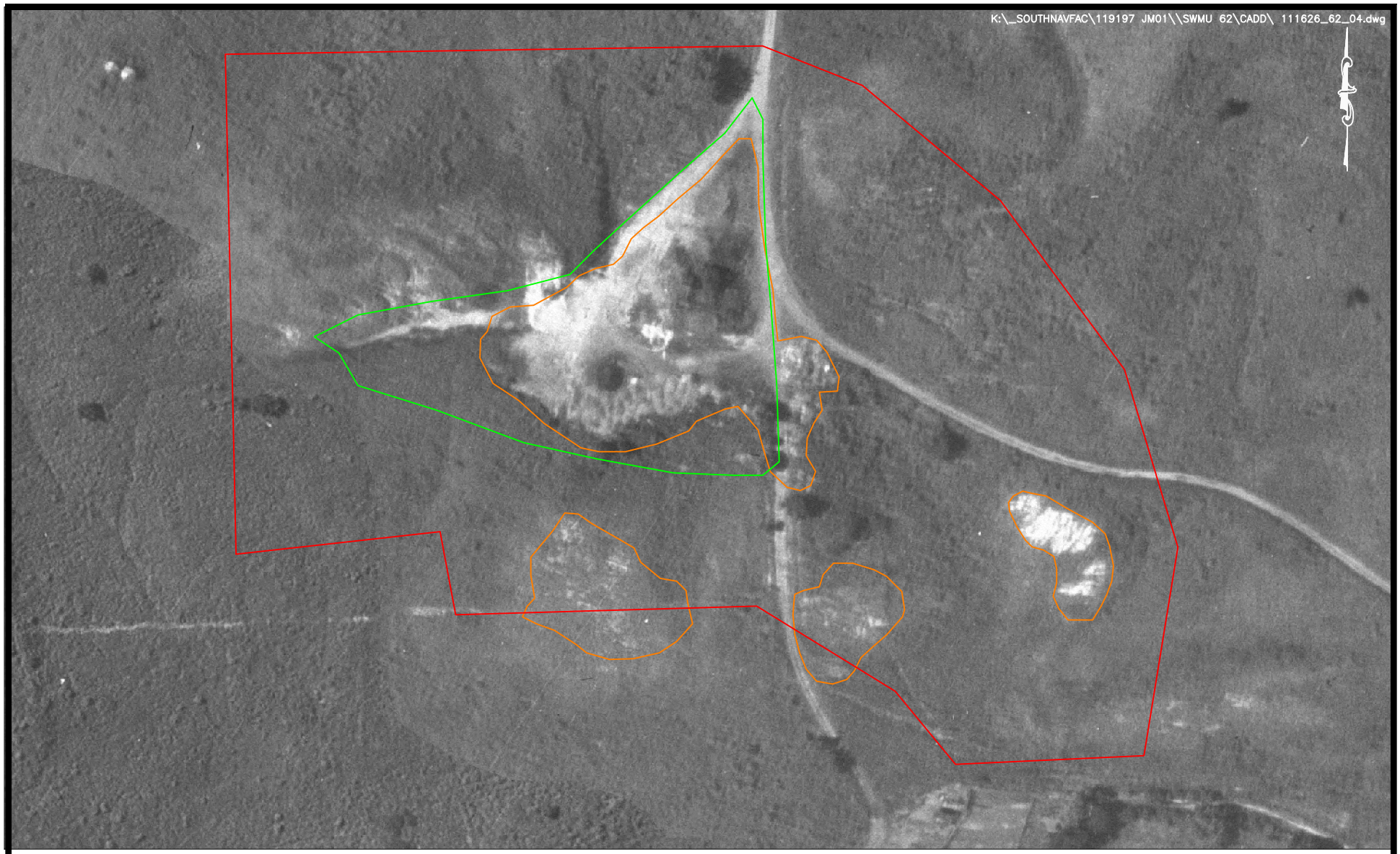
SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

3000 0 1500 3000

1 inch = 3000 ft.

FIGURE 1-2
SWMU/AOC LOCATION MAP
SWMU 62-FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO



Baker

150 0 75 150

1 inch = 150 ft.

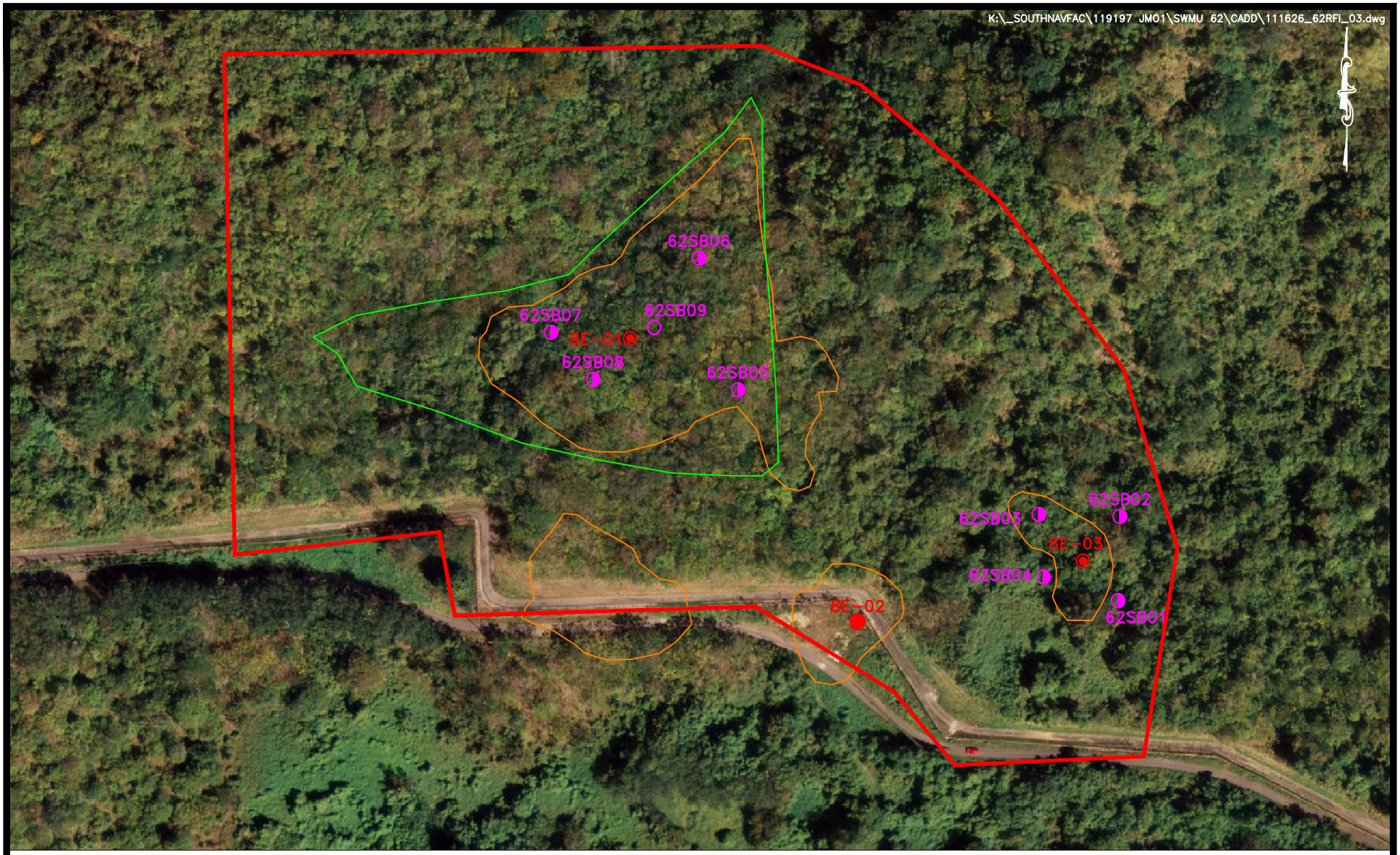
LEGEND

- 1958 POLYGON FEATURE
- 1961 POLYGON FEATURE
- SWMU BOUNDARY

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

FIGURE 1-3
1958 AERIAL PHOTOGRAPH
SWMU 62-FORMER
BUNDY DISPOSAL AREA
FULL RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO



Baker

150 0 75 150

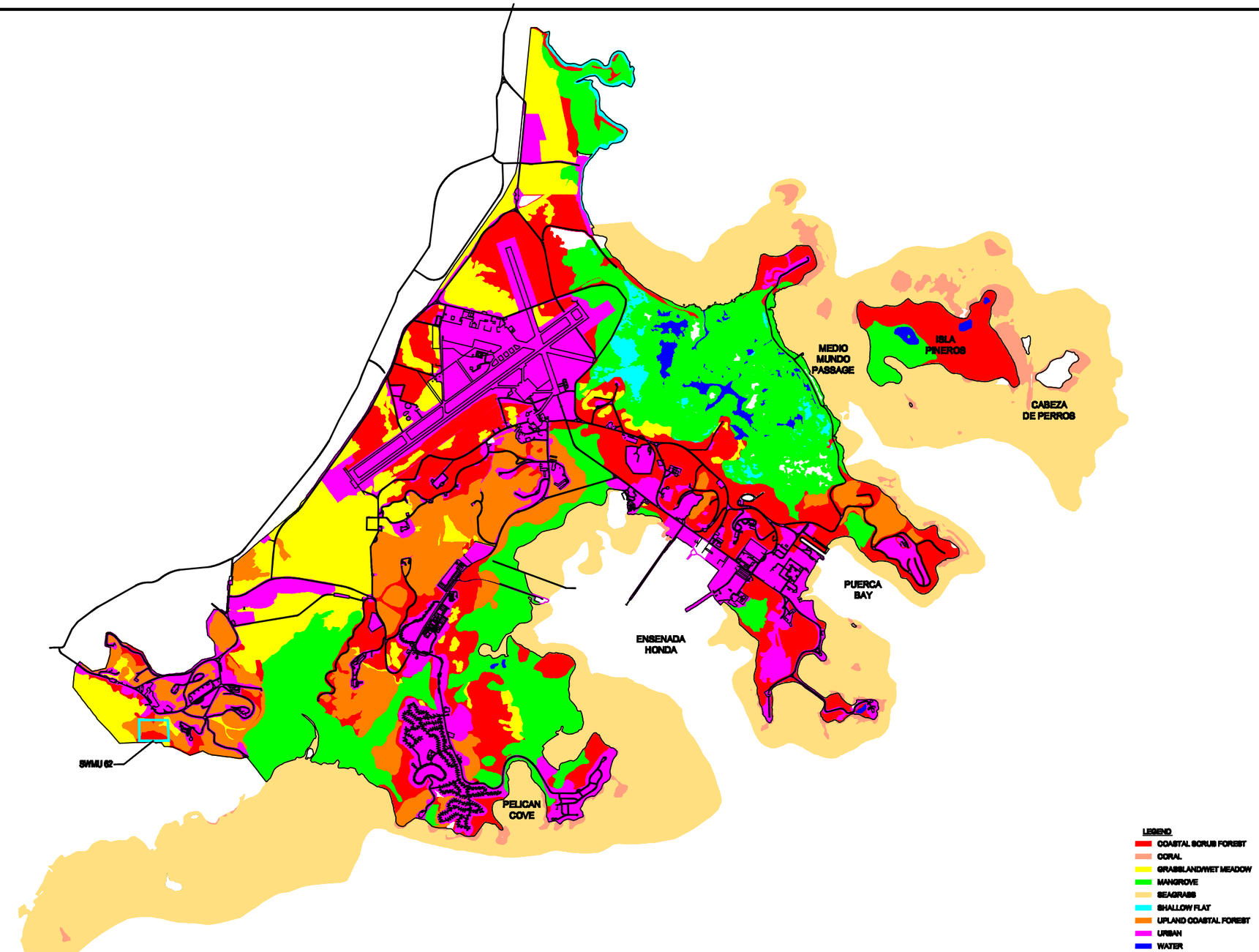
1 inch = 150 ft.

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

LEGEND

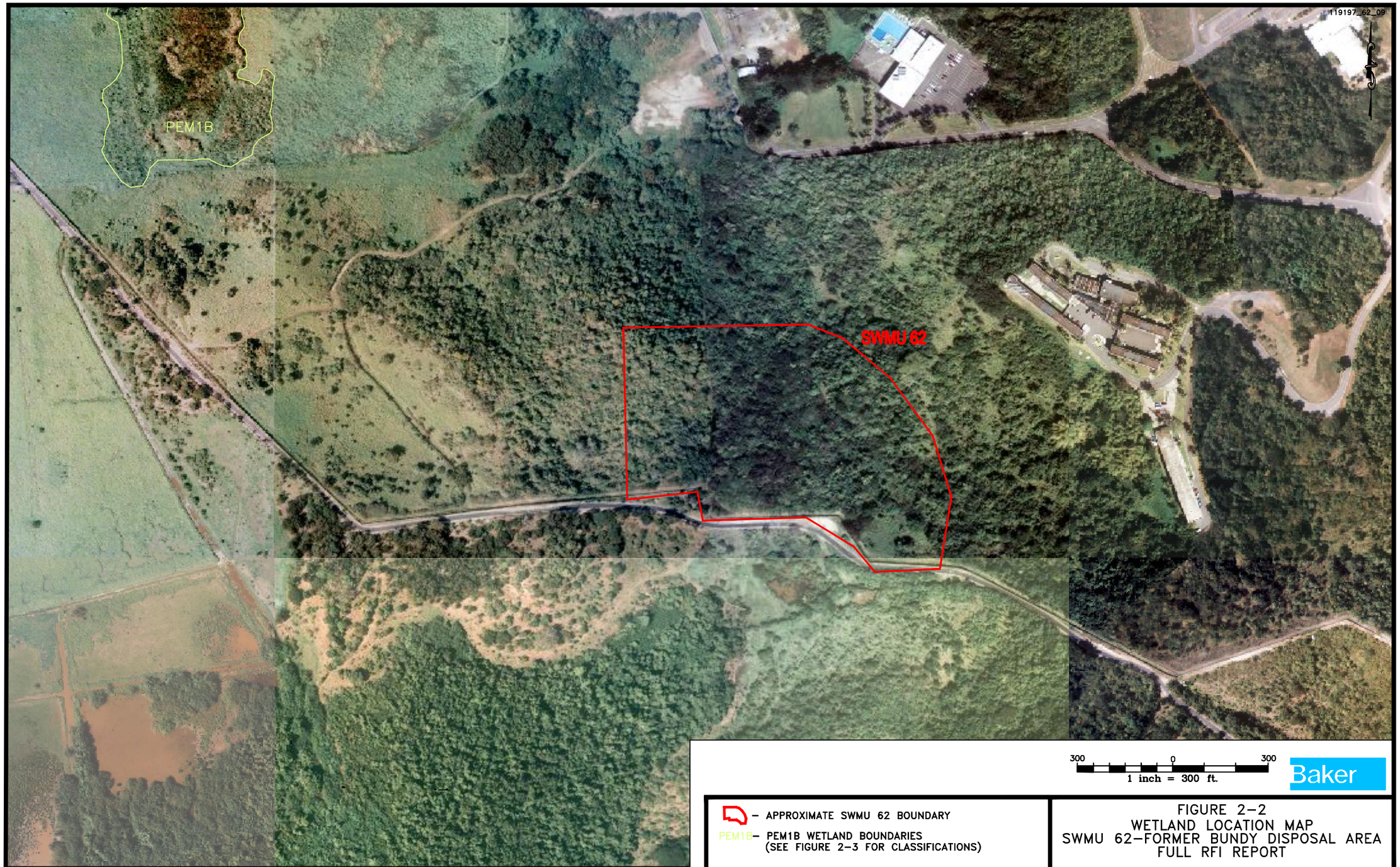
- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -EXISTING SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION (PHASE II ECP 2004)
- -EXISTING SURFACE SOIL SAMPLING LOCATION (PHASE II ECP 2004)
- -SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION (PHASE I RFI 2008)
- -SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION FOR PARTIALLY BURIED DRUM(PHASE I RFI 2008)
- -SWMU BOUNDARY

FIGURE 1-4
ECP AND PHASE I RFI
SAMPLE LOCATION MAP
SWMU 62-FORMER
BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO



SOURCE: GEO-MARINE, INC.

REVISIONS		NORTH					FIGURE
	DRAWN /RRR REVIEWED MEK S.O.# 119197 CADD# 119197_62_07.DWG			SWMU 62-FORMER BUNDY DISPOSAL AREA 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	2-1



– APPROXIMATE SWMU 62 BOUNDARY

PEM1B– PEM1B WETLAND BOUNDARIES
(SEE FIGURE 2–3 FOR CLASSIFICATIONS)

FIGURE 2–2
WETLAND LOCATION MAP
SWMU 62–FORMER BUNDY DISPOSAL AREA
FULL RFI REPORT

NAVAL ACTIVITY PUERTO RICO

CONTOUR SOURCE: LANTDIV, FEB. 1992/1997

119197_62_08.DWG

M - MARINE

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

E - ESTUARINE

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

R - RIVERINE

SYSTEM	R - RIVERINE							
SUBSYSTEM	1 - TIDAL	2 - LOWER PERENNIAL		3 - UPPER PERENNIAL		4 INTERMITTENT		5 - UNKNOWN PERENNIAL
CLASS	RB - Rock	UB - Uncon-solidated Bottom	SB - Streambed	AB - Aquatic Bed	RS - Rocky Shore	US - Uncon-solidated Shore	OW - Open Water (unknown bottom)	**EM - Emergent
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble - Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic		2 Nonpersistent

L - LACUSTRINE

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

P - PALUSTRINE

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

MODIFIERS

WATER REGIME

Non-Tidal

- 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

Tidal

- K Artificially Flooded
- L Subtidal
- M Irregularly Flooded
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent- Tidal
- *V Permanent-Tidal
- U Unknown

* These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

- 1 Hyperhaline
- 2 Euhaline
- 3 Mixohaline
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

pH (fresh water)

- a Acid
- t circumneutral
- i Alkaline

SOIL

- g Organic
- n Mineral

SPECIAL

- 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 62-FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

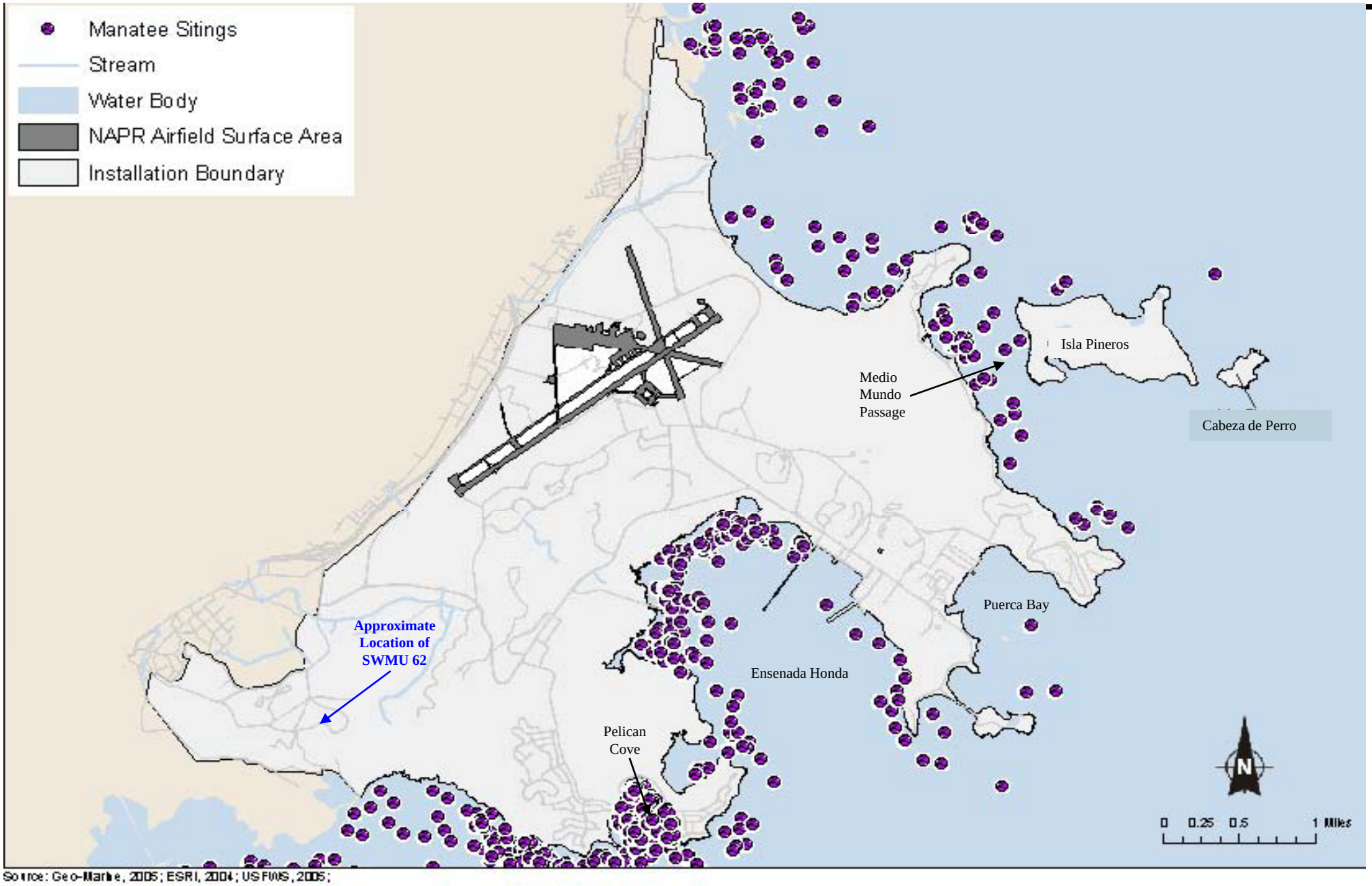
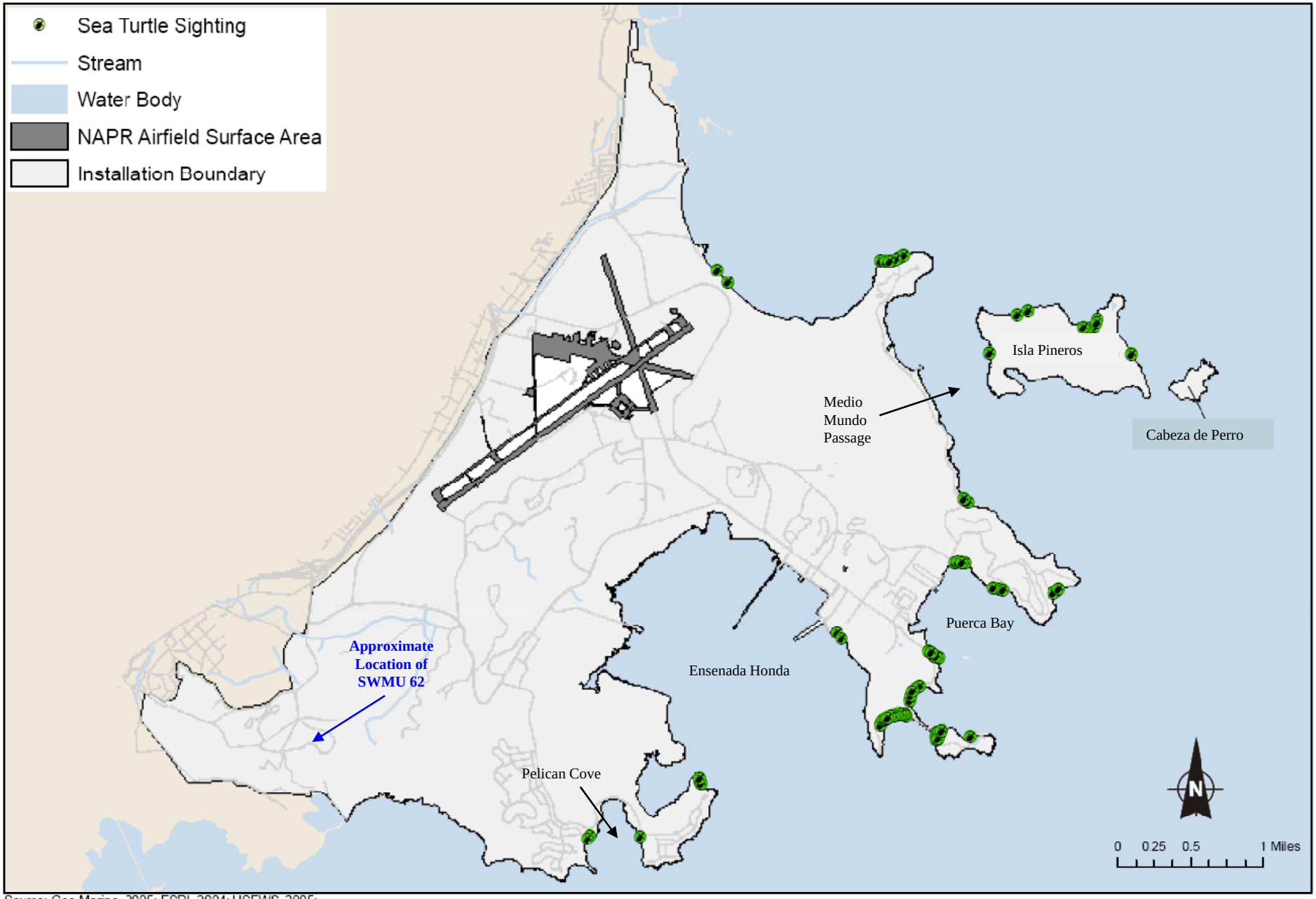


Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

FIGURE 2-4
HISTORICAL MANATEE SIGHTINGS IN EASTERN PUERTO RICO
SWMU 62 – FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

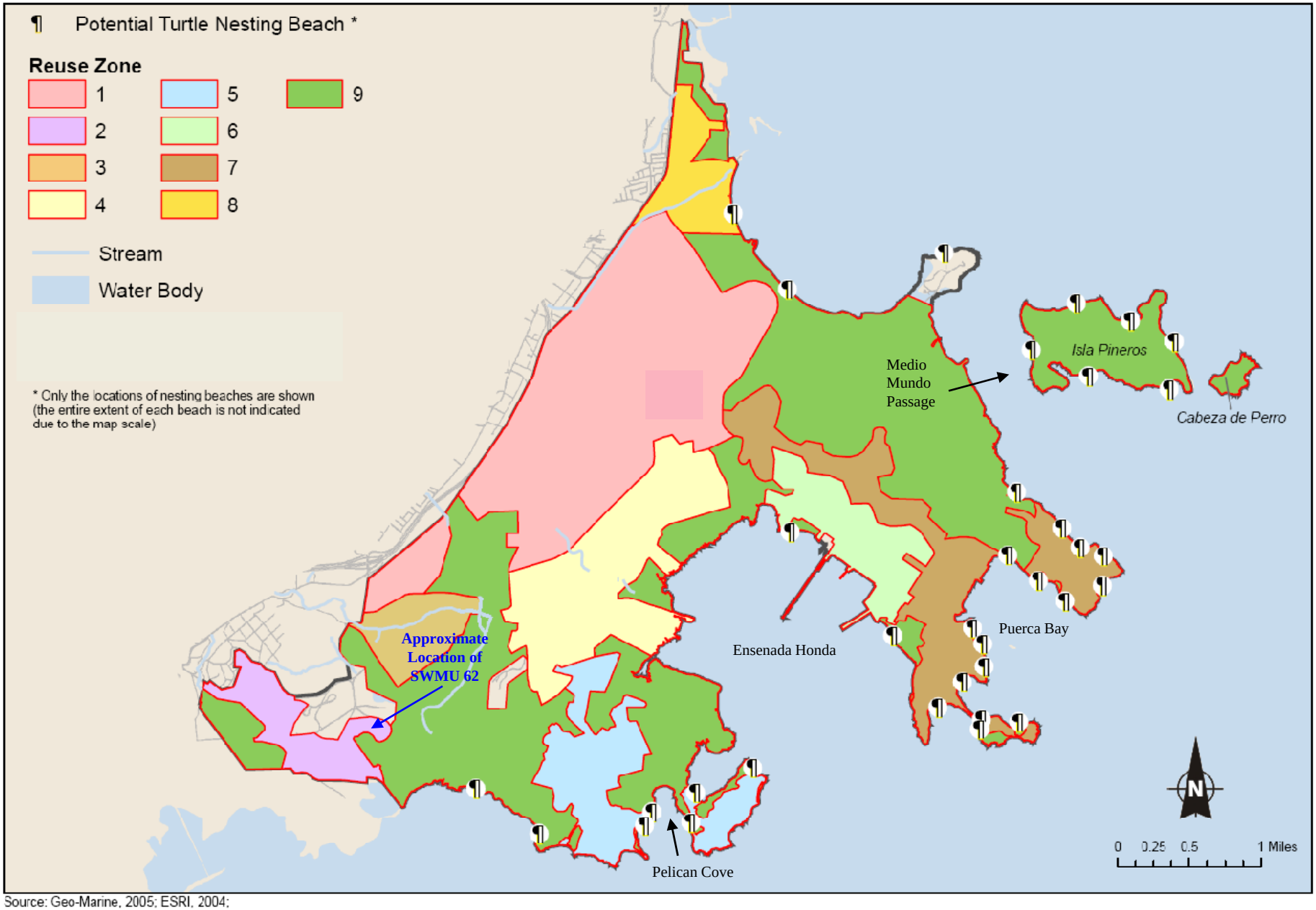


Source: Geo-Marine, 2005; ESRI, 2004; USFWS, 2005;

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.

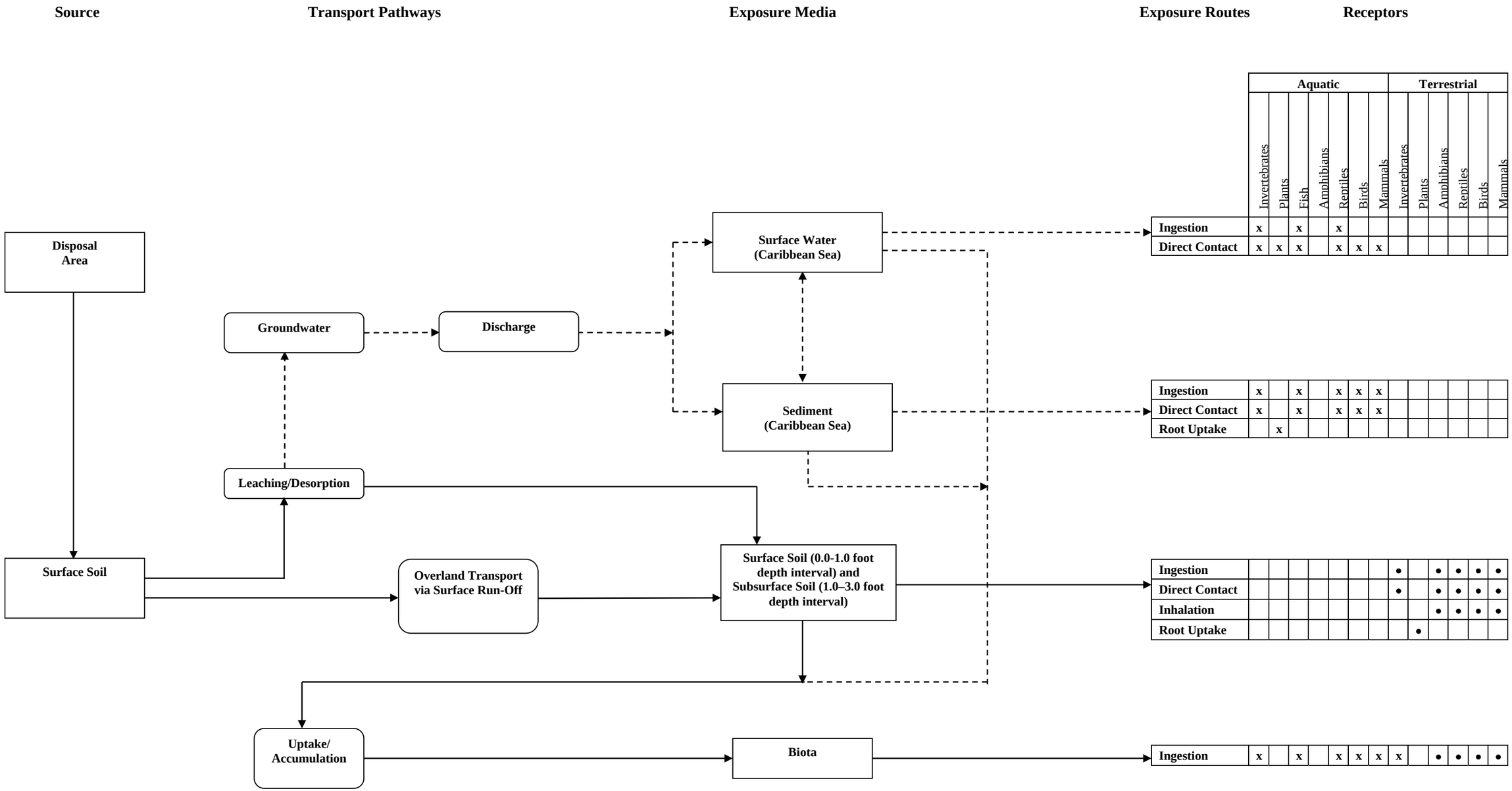
FIGURE 2-5
SEA TURTLE SIGHTINGS AT NAVAL ACTIVITY PUERTO RICO
SWMU 62 – FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO



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 62 – FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO



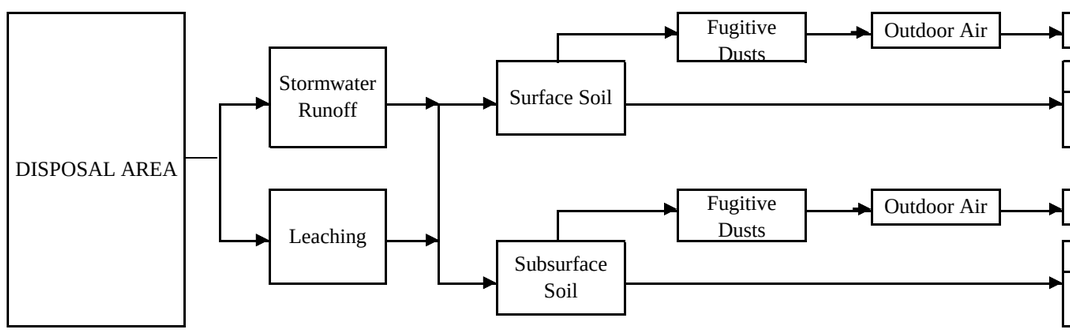
Potentially complete and significant pathway
Potentially complete and insignificant pathway

FIGURE 2-7
PRELIMINARY CONCEPTUAL MODEL FOR ECOLOGICAL RECEPTORS
SWMU 62 – FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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

FIGURE 2-8

PRELIMINARY CONCEPTUAL MODEL FOR HUMAN RECEPTORS
SWMU 62 - FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

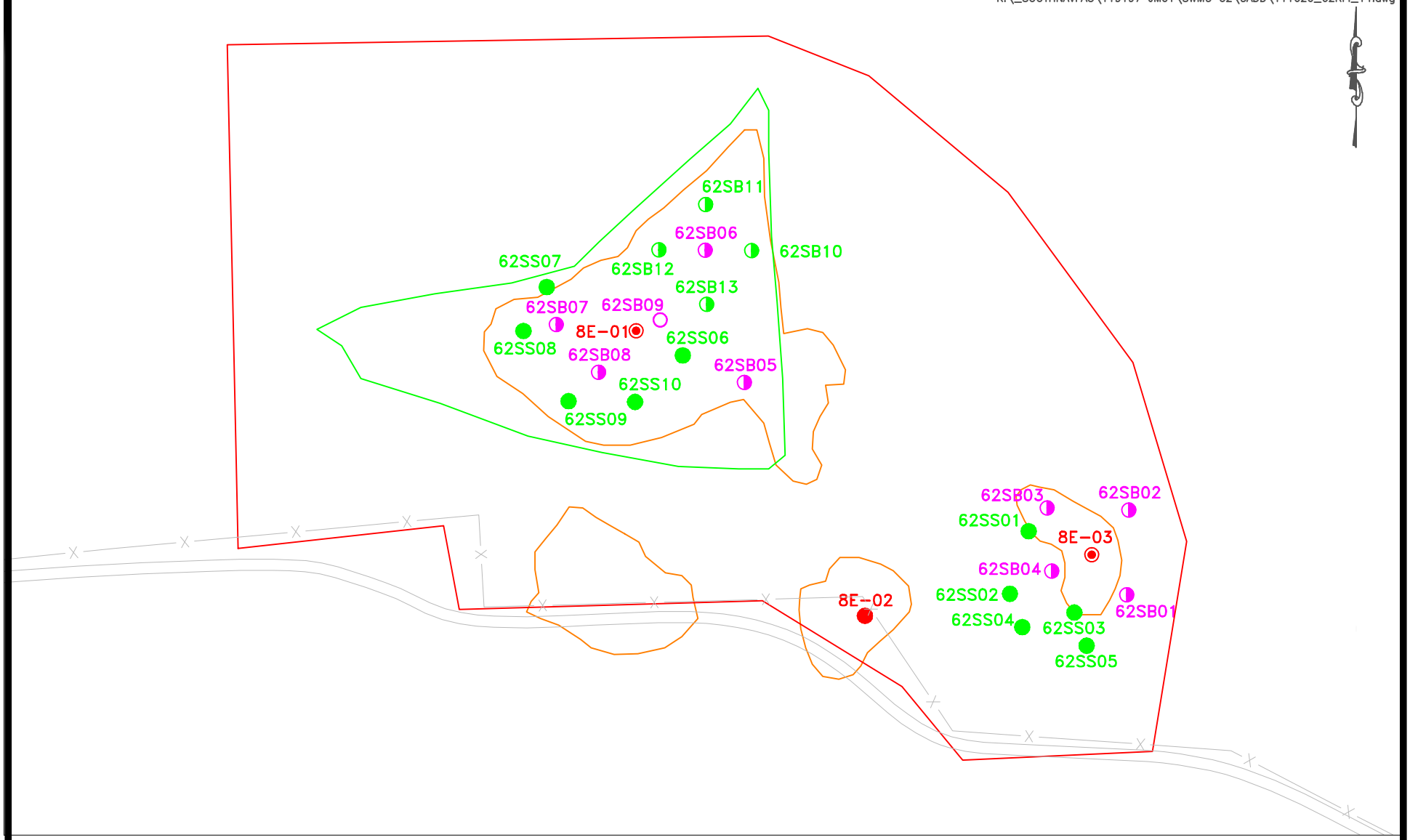


Exposure Route	Potential Human Receptors					
	Current and Future Adult Trespassers	Current and Future Young Child Trespassers	Future Adult Industrial / Commercial Workers	Future Adult Construction Workers	Future Adult Residents	Future Young Child Residents
Inhalation	***CF***	***CF***	**F**	**F**	**F**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

Legend

F	Future Exposure Pathway	⟶	Complete Exposure Pathway
CF	Current and Future Exposure Pathway	- · - · →	Incomplete Exposure Pathway

K:_SOUTHNAVFAC\119197 JM01\SWMU 62\CADD\111626_62RFI_14.dwg



Baker

150 0 75 150

1 inch = 150 ft.

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

LEGEND

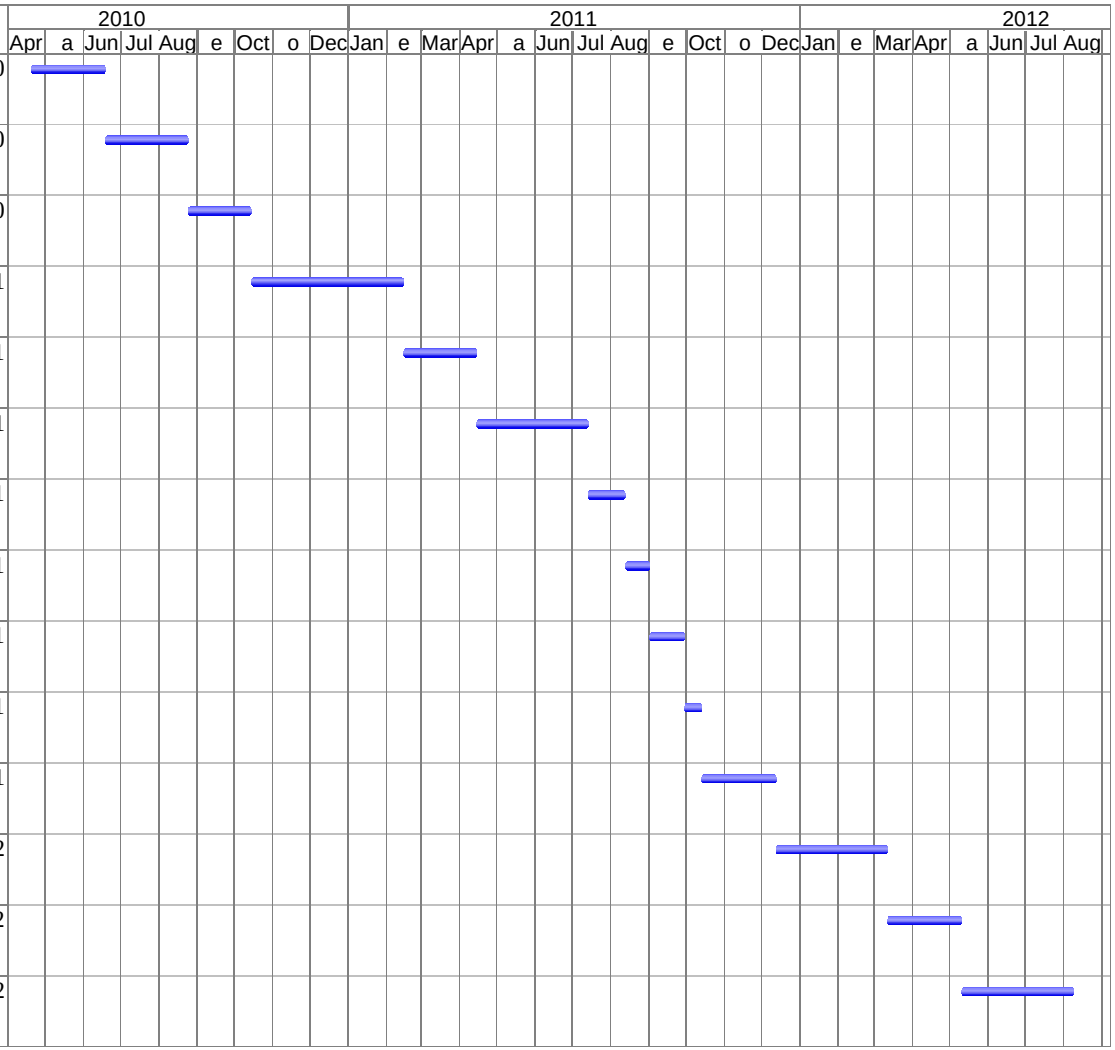
- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -EXISTING SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION (PHASE II ECP 2004)
- -EXISTING SURFACE SOIL SAMPLING LOCATION (PHASE II ECP 2004)
- -SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION (PHASE I RFI 2008)
- -SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION FOR PARTIALLY BURIED DRUM(PHASE I RFI 2008)
- -PROPOSED FULL RFI SURFACE AND SUBSURFACE SOIL SAMPLING LOCATION
- -PROPOSED FULL RFI SURFACE SOIL SAMPLING LOCATION
- -SWMU BOUNDARY

FIGURE 3-1
PROPOSED SAMPLE LOCATION MAP
SWMU 62-FORMER
BUNDY DISPOSAL AREA
FULL RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO

FIGURE 5-1
PROPOSED PROJECT SCHEDULE
SWMU 62 - FORMER BUNDY DISPOSAL
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

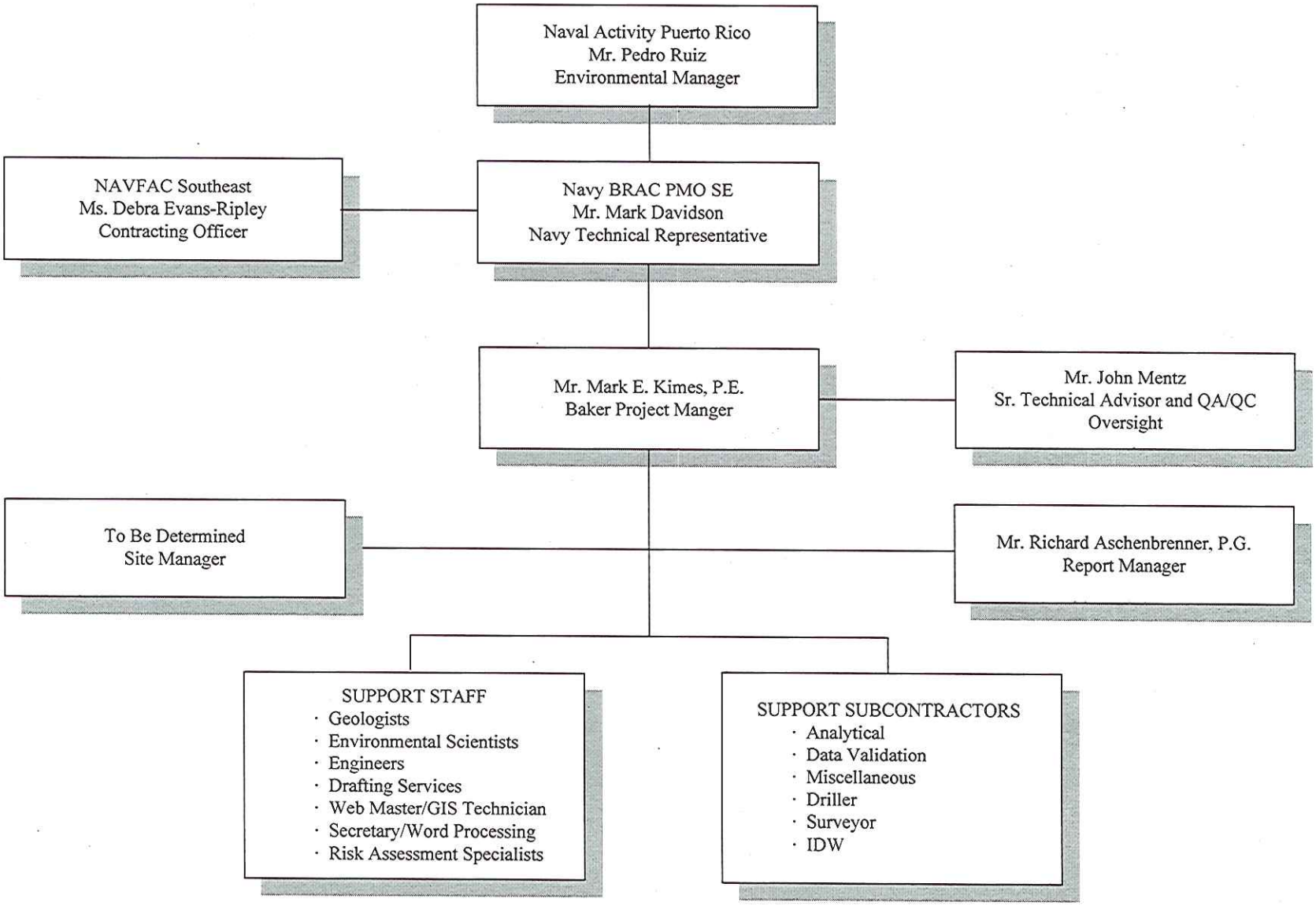
Task Name	Duration	Start	Finish
Draft Full RFI Work Plan to the EPA	60 edays	Mon 4/19/10	Fri 6/18/10
EPA Review	67 edays	Fri 6/18/10	Tue 8/24/10
Final Full RFI Work Plan to the EPA	51 edays	Tue 8/24/10	Thu 10/14/10
EPA Review	123 edays	Thu 10/14/10	Mon 2/14/11
Revised Final Full RFI Work Plan to the EPA	59 edays	Mon 2/14/11	Thu 4/14/11
EPA Review & Approval	90 edays	Thu 4/14/11	Wed 7/13/11
Sub Procurement and Field Work Planning	30 edays	Wed 7/13/11	Fri 8/12/11
Field Investigation	20 edays	Fri 8/12/11	Thu 9/1/11
Laboratory Analysis	28 edays	Thu 9/1/11	Thu 9/29/11
Data Validation	14 edays	Thu 9/29/11	Thu 10/13/11
Draft Full RFI Report for SWMU 62 to EPA	60 edays	Thu 10/13/11	Mon 12/12/11
EPA Review	90 edays	Mon 12/12/11	Sun 3/11/12
Final Full RFI Report for SWMU 62 to EPA	60 edays	Sun 3/11/12	Thu 5/10/12
EPA Review & Approval	90 edays	Thu 5/10/12	Wed 8/8/12



Project: Full RFI Work Plan

Task

FIGURE 6-1
PROJECT ORGANIZATION
SWMU 62 – FORMER BUNDY DISPOSAL AREA
FULL RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX A
SITE PHOTOGRAPHS

PHOTOS ASSOCIATED WITH THE SOUTHWESTERN PORTION OF SWMU 62 (SOIL BORINGS 62SB01 – 62SB04)

Photo A-1. Post site clearing during 2008 Phase I RFI.
View looking south.

Photo A-2. Preparation for soil boring advancement at 62SB01.

Photo A-3. Preparation for soil boring advancement at 62SB04.

PHOTOS ASSOCIATED WITH THE CENTRAL PORTION OF SWMU 62
(SOIL BORINGS 62SB05 – 62SB09)

Photo A-4. Post site clearing during 2008 Phase I RFI.
View looking south.

Photo A-5. Remnants of discarded building materials adjacent to 62SB06.

Photo A-6. Water line discovered during site clearing activities.
View looking northeast.

Photo A-7. 62SB09 advanced near partially buried drum identified on site.

Photo A-8. Close-up view of partially buried drum.

Photo A-9. Miscellaneous building debris found near 62SB09.

APPENDIX B
SUMMARY OF PHASE II ECP ANALYTICAL RESULTS

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	8E-01 8E-SS01 05/14/04 0.00 - 1.00	8E-02 8E-SS02 05/14/04 0.00 - 1.00	8E-02 8E-SS02D 05/14/04 0.00 - 1.00	8E-03 8E-SS03 05/14/04 0.00 - 1.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)											
Tetrachloroethene	5,300	1,200	11	1.8 J	3.6 J	2.7 J	0/4		0/4		8E-SS01
Chlorobenzene	2,000,000	160,000	3.9 J	5.2 U	2.2 J	5.8 U	0/4		0/4		8E-SS01
Semivolatile Organic Compounds (ug/kg)											
Not Detected											
Pesticides/PCBs (ug/kg)											
4,4'-DDT	8,400	1,900	0.64 J	3.7 U	3.6 U	4 U	0/4		0/4		8E-SS01
4,4'-DDE	8,400	1,900	1.5 J	3.7 U	3.6 U	4 U	0/4		0/4		8E-SS01
OP-Pesticides (ug/kg)											
Not Detected											
Chlorinated Herbicides (ug/kg)											
Not Detected											

Notes:

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

SUMMARY OF INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	8E-01 8E-SS01 05/14/04 0.00 - 1.00	8E-02 8E-SS02 05/14/04 0.00 - 1.00	8E-02 8E-SS02D 05/14/04 0.00 - 1.00	8E-03 8E-SS03 05/14/04 0.00 - 1.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)														
Arsenic	1.9	0.43	2.4	**1.3**	1.1 U	**0.91** B	1 U	0/4		2/4	0.91B - 1.3	0/4		8E-SS01
Barium	7,200	550	181	220 N	90 N	120 N	190 N	0/4		0/4		2/4	190N - 220N	8E-SS01
Beryllium	200	16	0.45	0.37 B	0.26 B	0.21 B	0.58	0/4		0/4		1/4	0.58	8E-SS03
Chromium	310	23	59.3	12	2.8	2.4	12	0/4		0/4		0/4		8E-SS01, 8E-SS03
Cobalt	2,000	160	44.0	12	1.9	2	11	0/4		0/4		0/4		8E-SS01
Copper	4,100	310	234	130 N	60 N	58 N	13 N	0/4		0/4		0/4		8E-SS01
Lead	400[(1)]	400[(1)]	125	18	1.3	0.91	2	0/4		0/4		0/4		8E-SS01
Mercury	31[(2)]	2.3[(2)]	0.11	0.039	0.02 U	0.021 U	0.038	0/4		0/4		0/4		8E-SS01
Nickel	2,000	160	16.6	6.4	1.1 B	1 B	3.4 B	0/4		0/4		0/4		8E-SS01
Sulfide	NE	NE	27.1	32 U	28 U	27 B	30 U	NE		NE		0/4		8E-SS02D
Tin	61,000	4,700	2.43	3.2 B	3.5 B	3 B	1.9 B	0/4		0/4		3/4	3B - 3.5B	8E-SS02
Vanadium	100	7.8	355	**82**	**34**	**36**	**35**	0/4		4/4	34 - 82	0/4		8E-SS01
Zinc	31,000	2,300	125	45 E	11 E	13 E	6.2 E	0/4		0/4		0/4		8E-SS01

Notes:

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

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

SUMMARY OF INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	8E-01 8E-SB01-01 05/14/04 1.00 - 3.00	8E-03 8E-SB03-01 05/14/04 1.00 - 3.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)												
Barium	7,200	550	222	180 N	**590** N	0/2		1/2	590N	1/2	590N	8E-SB03-01
Beryllium	200	16	0.74	0.77	0.56	0/2		0/2		1/2	0.77	8E-SB01-01
Chromium	310	23	133	2.7	8.2	0/2		0/2		0/2		8E-SB03-01
Cobalt	2,000	160	30.0	11	5.4	0/2		0/2		0/2		8E-SB01-01
Copper	4,100	310	193	22 N	14 N	0/2		0/2		0/2		8E-SB01-01
Lead	400[1]	400[1]	8.68	0.93	0.91	0/2		0/2		0/2		8E-SB01-01
Nickel	2,000	160	31.9	1.6 B	2.8 B	0/2		0/2		0/2		8E-SB03-01
Tin	61,000	4,700	2.96	2.4 B	2.3 B	0/2		0/2		0/2		8E-SB01-01
Vanadium	100	7.8	462	**24**	**34**	0/2		2/2	24 - 34	0/2		8E-SB03-01
Zinc	31,000	2,300	88.6	14 E	11 E	0/2		0/2		0/2		8E-SB01-01

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
N - The matrix spike recovery is not within control limtis.
E- The reported value is an estimated because of the presence of matrix interference.
[1] - 1996 Soil Screening Guidance.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

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

APPENDIX C
SUMMARY OF PHASE I RFI ANALYTICAL RESULTS

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE I RFI REPORT
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 Surface Soil Screening Values	NAPR Basewide Background [1]	62SB01 62SB01-00 5/31/2008 0.0-1.0	62SB02 62SB02-00 6/1/2008 0.0-1.0	62SB03 62SB03-00 6/1/2008 0.0-1.0	62SB04 62SB04-00 5/31/2008 0.0-1.0	62SB05 62SB05-00 6/1/2008 0.0-1.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	140 J	120 J	67 J	42 UJ	19 J
Benzene	1,100	5,600	101	NE	0.94 U	0.84 U	0.85 U	0.97 U	0.8 U
Iodomethane	NE	NE	NE	NE	1.2 UJ	1.3 J	1.1 UJ	1.2 UJ	1 UJ
Semivolatile Organic Compounds (ug/kg)									
1,4-Dioxane	44,000	160,000	NE	NE	NA	NA	9.2 U	NA	NA
2-Methylnaphthalene	310,000 [2]	4,100,000 [2]	NE	NE	NA	NA	2 U	NA	NA
Benzo[a]anthracene	150	2,100	NE	NE	NA	NA	2 U	NA	NA
Benzo[a]pyrene	15	210	NE	NE	NA	NA	0.76 U	NA	NA
Benzo[b]fluoranthene	1,500	21,000	NE	NE	NA	NA	0.88 U	NA	NA
Benzo[g,h,i]perylene	1,700	17,000	NE	NE	NA	NA	2 U	NA	NA
Benzo[k]fluoranthene	1,500	21,000	NE	NE	NA	NA	1.2 U	NA	NA
Chrysene	15,000	210,000	NE	NE	NA	NA	0.7 U	NA	NA
Dibenzofuran	NE	NE	NE	NE	NA	NA	4.8 U	NA	NA
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	NA	NA	2 U	NA	NA
Indeno[1,2,3-cd]pyrene	150	2,100	NE	NE	NA	NA	1.4 U	NA	NA
Naphthalene	3,900	20,000	NE	NE	NA	NA	0.69 U	NA	NA
Phenanthrene	NE	NE	NE	NE	NA	NA	2 U	NA	NA
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	NA	NA	2 U	NA	NA
Pesticides (ug/kg)									
4,4'-DDD	2,000	7,200	401	NE	28	0.42 U	0.41 U	0.4 U	0.37 U
4,4'-DDE	1,400	5,100	401	NE	73	0.37 U	0.37 U	0.36 U	5.5
4,4'-DDT	1,700	7,000	401	NE	51	0.6 U	0.6 U	0.58 U	2.3 J

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE I RFI REPORT
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 Surface Soil Screening Values	NAPR Basewide Background [1]	62SB01 62SB01-00 5/31/2008 0.0-1.0	62SB02 62SB02-00 6/1/2008 0.0-1.0	62SB03 62SB03-00 6/1/2008 0.0-1.0	62SB04 62SB04-00 5/31/2008 0.0-1.0	62SB05 62SB05-00 6/1/2008 0.0-1.0
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	2.65	***1.7***	**0.93**	**0.92**	**1.2**	**1.2**
Barium	1,500 [2]	19,000 [2]	330 [5]	199	130	80	150	520	80
Beryllium	16 [2]	200 [2]	40 [5]	0.59	0.32	0.32	0.34	0.49	0.37
Cadmium	7 [2]	81 [2]	32 [4]	1.02	0.092 J	0.033 U	0.032 U	0.032 U	0.03 U
Chromium	280	1,400	57 [7]	49.8	32	12	9.5	16	2.6
Cobalt	2.3 [2]	30 [2]	13 [4]	46.2	**19**	**3**	2.2	**5.6**	**6.8**
Copper	310 [2]	4,100 [2]	70 [4]	168	41	7.5	11	19	9.6
Lead	400 [3]	800 [3]	120 [4]	22	3.5	1.4	1.1	1.6	0.6
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.109	0.032	0.034	0.035	0.027	0.0038 U
Nickel	160 [2]	2,000 [2]	38 [4]	20.7	8.6	3.1	2.7	4.9	1.2
Selenium	39 [2]	510 [2]	0.52 [4]	1.48	0.38 J	0.36 J	0.25 J	0.16 J	0.14 J
Silver	39 [2]	510 [2]	560 [8]	NE	0.025 J	0.017 UJ	0.017 UJ	0.016 UJ	0.016 UJ
Tin	4,700 [2]	61,000 [2]	50 [10]	3.76	4.4 U	4.2 U	4.1 U	4.1 U	3.9 U
Vanadium	55 [2]	720 [2]	10 [9]	259	**82** J	27 J	25 J	41 J	33 J
Zinc	2,300 [2]	31,000 [2]	46 [5]	115	46	5.8	7	11	7.8

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE I RFI REPORT
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 Surface Soil Screening Values	NAPR Basewide Background [1]	62SB06 62SB06-00 6/1/2008 0.0-1.0	62SB07 62SB07-00 6/1/2008 0.0-1.0	62SB08 62SB08-00 6/1/2008 0.0-1.0	62SB08 62SB08-00D 6/1/2008 0.0-1.0	62SB09 62SB09-00 6/1/2008 0.0-1.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	200 J	150 J	83 J	63 J	72 UJ
Benzene	1,100	5,600	101	NE	1.4 J	0.94 U	1.1 U	0.77 U	0.74 U
Iodomethane	NE	NE	NE	NE	1.1 UJ	1.2 UJ	1.4 UJ	0.98 UJ	0.94 U
Semivolatile Organic Compounds (ug/kg)									
1,4-Dioxane	44,000	160,000	NE	NE	8.4 U	NA	15 J	8.5 UJ	8.6 U
2-Methylnaphthalene	310,000 [2]	4,100,000 [2]	NE	NE	1.8 U	NA	23 J	56 J	1.8 U
Benzo[a]anthracene	150	2,100	NE	NE	1.8 U	NA	4.8 J	5.2 J	2.6 J
Benzo[a]pyrene	15	210	NE	NE	0.69 U	NA	0.71 UJ	0.7 UJ	2.6 J
Benzo[b]fluoranthene	1,500	21,000	NE	NE	0.8 U	NA	0.82 UJ	0.8 UJ	3.2 J
Benzo[g,h,i]perylene	1,700	17,000	NE	NE	1.8 U	NA	1.8 UJ	1.8 UJ	5.8 J
Benzo[k]fluoranthene	1,500	21,000	NE	NE	1 U	NA	1.1 UJ	4 J	2.2 J
Chrysene	15,000	210,000	NE	NE	0.64 U	NA	4.8 J	6.8 J	3.3 J
Dibenzofuran	NE	NE	NE	NE	4.4 U	NA	8.9 J	20 J	4.5 U
Fluoranthene	230,000 [2]	2,200,000 [2]	NE	NE	1.8 U	NA	6.7 J	8.5 J	5.4 J
Indeno[1,2,3-cd]pyrene	150	2,100	NE	NE	1.3 U	NA	1.3 UJ	1.3 UJ	1.5 J
Naphthalene	3,900	20,000	NE	NE	0.63 U	NA	13 J	33 J	1.2 J
Phenanthrene	NE	NE	NE	NE	1.8 U	NA	29 J	50 J	4.5 J
Pyrene	170,000 [2]	1,700,000 [2]	NE	NE	1.8 U	NA	9.1 J	11 J	4.8 J
Pesticides (ug/kg)									
4,4'-DDD	2,000	7,200	401	NE	0.38 U	0.4 U	0.89 J	0.39 U	0.39 U
4,4'-DDE	1,400	5,100	401	NE	0.34 U	0.35 U	7.6 J	1.5 J	0.35 U
4,4'-DDT	1,700	7,000	401	NE	0.55 U	0.57 U	7.7 J	1.9 J	0.56 U

SUMMARY OF DETECTED LABORATORY RESULTS - SURFACE SOIL
SWMU 62 - FORMER BUNDY DISPOSAL AREA
PHASE I RFI REPORT
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 Surface Soil Screening Values	NAPR Basewide Background [1]	62SB06 62SB06-00 6/1/2008 0.0-1.0	62SB07 62SB07-00 6/1/2008 0.0-1.0	62SB08 62SB08-00 6/1/2008 0.0-1.0	62SB08 62SB08-00D 6/1/2008 0.0-1.0	62SB09 62SB09-00 6/1/2008 0.0-1.0
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	2.65	***3.3***	***2.3***	***2.4***	***3***	***3.7***
Barium	1,500 [2]	19,000 [2]	330 [5]	199	53	350	260 J	170 J	140
Beryllium	16 [2]	200 [2]	40 [5]	0.59	0.13	0.42	0.68 J	0.44 J	0.27
Cadmium	7 [2]	81 [2]	32 [4]	1.02	0.072 J	0.042 J	0.038 J	0.043 J	0.064 J
Chromium	280	1,400	57 [7]	49.8	12	19	7.9 J	15 J	9.6
Cobalt	2.3 [2]	30 [2]	13 [4]	46.2	**7.6**	**18**	**8.7**	**7.4**	**11**
Copper	310 [2]	4,100 [2]	70 [4]	168	45	140	30	37	60
Lead	400 [3]	800 [3]	120 [4]	22	2	1.8	1.6	2	12
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.109	0.0038 U	0.0049 J	0.0093 J	0.007 J	0.004 U
Nickel	160 [2]	2,000 [2]	38 [4]	20.7	6	9.7	3.9	3.7	4.4
Selenium	39 [2]	510 [2]	0.52 [4]	1.48	0.14 J	0.24 J	0.28 J	0.24 J	0.18 J
Silver	39 [2]	510 [2]	560 [8]	NE	0.019 J	0.031 J	0.016 UJ	0.021 J	0.018 J
Tin	4,700 [2]	61,000 [2]	50 [10]	3.76	3.9 U	4.1 U	4.1 U	4.1 U	4.5 J
Vanadium	55 [2]	720 [2]	10 [9]	259	**61** J	**160** J	42	48	**61**
Zinc	2,300 [2]	31,000 [2]	46 [5]	115	29	41	19	22	45

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Notes/Qualifiers:

Ecological surface soil screening values based on the minimum of plant and invertebrate ECO-SSL concentrations only
J - Estimated: The analyte was positively identified; the quantitation is an estimation
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
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]) for Subsurface Soil Background Fine Sand/Silt Table 3-5 (Baker, 2010b)

(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, 2005e [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007d [zinc])

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

(7) Reproduction-based MATC for the earthworm *Eisenia andrei* (USEPA, 2008)

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

(9) Growth-based LOAEC for *Brassica oleracea* (broccoli) from USEPA (2005h) with a safety factor of 10

(10) Toxicological threshold for plants (Efroymson et al., 1997b)

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USEPA. 2007b. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

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

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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

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.

Table References (continued):

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

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 Vanadium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

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Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Surface Soil Screening Values	NAPR Basewide Background [1]	62SB01 62SB01-03 5/31/2008 5.0-7.0	62SB01 62SB01-05 5/31/2008 9.0-11.0	62SB02 62SB02-01 6/1/2008 1.0-3.0	62SB02 62SB02-03 6/1/2008 5.0-7.0	62SB03 62SB03-01 6/1/2008 1.0-3.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	NA	NA	NA	NA	24 J
Carbon disulfide	670,000 [2]	3,000,000 [2]	NE	NE	NA	NA	NA	NA	0.5 U
Iodomethane	NE	NE	NE	NE	NA	NA	NA	NA	0.99 UJ
Semivolatile Organic Compounds (ug/kg)									
Naphthalene	3,900	20,000	NE	NE	NA	NA	NA	NA	0.66 U
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	6.66	**1.1**	**1.1**	**1**	**1.1**	**1.2**
Barium	1,500 [2]	19,000 [2]	330 [5]	207	66	87	79	18	41
Beryllium	16 [2]	200 [2]	40 [5]	0.933	0.38	0.46	0.49	0.26	0.51
Cadmium	7 [2]	81 [2]	32 [4]	0.57	0.032 U	0.034 U	0.033 U	0.032 U	0.033 U
Chromium	280	1,400	57 [7]	47.9	38	31	17	18	7.6
Cobalt	2.3 [2]	30 [2]	13 [4]	63.1	**11**	**14**	**3.8**	1.9	**6.8**
Copper	310 [2]	4,100 [2]	70 [4]	120	19	17	13	4.2	16
Lead	400 [3]	800 [3]	120 [4]	6.2	2.4	1.7	1.2	0.83	1.3
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.067	0.018 J	0.053	0.0048 J	0.0038 U	0.0044 U
Nickel	160 [2]	2,000 [2]	38 [4]	26.5	5.3	6.1	3.7	3.2	2.2
Selenium	39 [2]	510 [2]	0.52 [4]	1.19	0.13 U	0.16 J	0.14 J	0.17 J	0.16 J
Silver	39 [2]	510 [2]	560 [8]	NE	0.017 UJ	0.018 UJ	0.017 UJ	0.017 UJ	0.017 UJ
Vanadium	55 [2]	720 [2]	10 [9]	256	**86** J	**130** J	41 J	35 J	34 J
Zinc	2,300 [2]	31,000 [2]	46 [5]	92	13	16	9.9	5.3	7.4

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Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Surface Soil Screening Values	NAPR Basewide Background [1]	62SB03 62SB03-05 6/1/2008 9.0-11.0	62SB04 62SB04-03 5/31/2008 5.0-7.0	62SB04 62SB04-03D 5/31/2008 5.0-7.0	62SB04 62SB04-05 5/31/2008 9.0-11.0	62SB05 62SB05-01 6/1/2008 1.0-3.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	10 J	NA	NA	NA	NA
Carbon disulfide	670,000 [2]	3,000,000 [2]	NE	NE	0.61 U	NA	NA	NA	NA
Iodomethane	NE	NE	NE	NE	1.2 UJ	NA	NA	NA	NA
Semivolatile Organic Compounds (ug/kg)									
Naphthalene	3,900	20,000	NE	NE	0.62 R	NA	NA	NA	NA
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	6.66	***1.9***	**1.3**	**1.4**	**1.3**	**1.2**
Barium	1,500 [2]	19,000 [2]	330 [5]	207	410	67	83	240	83
Beryllium	16 [2]	200 [2]	40 [5]	0.933	1	0.35	0.37	0.53	0.42
Cadmium	7 [2]	81 [2]	32 [4]	0.57	0.03 U	0.033 J	0.031 U	0.033 U	0.029 U
Chromium	280	1,400	57 [7]	47.9	2.6	5.3 J	21 J	39	1.4
Cobalt	2.3 [2]	30 [2]	13 [4]	63.1	**13**	**6.1**	**6.1**	**29**	**7.6**
Copper	310 [2]	4,100 [2]	70 [4]	120	37	11	11	15	5.4
Lead	400 [3]	800 [3]	120 [4]	6.2	0.6	1.5	1.2	2.8	0.43
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.067	0.0039 U	0.0042 U	0.0041 U	0.0044 U	0.0038 U
Nickel	160 [2]	2,000 [2]	38 [4]	26.5	3	3 J	4.8 J	5.3	1.4
Selenium	39 [2]	510 [2]	0.52 [4]	1.19	0.2 J	0.15 J	0.17 J	0.13 J	0.12 J
Silver	39 [2]	510 [2]	560 [8]	NE	0.015 UJ	0.016 UJ	0.016 UJ	0.017 UJ	0.015 UJ
Vanadium	55 [2]	720 [2]	10 [9]	256	32 J	37 J	44 J	**120** J	30 J
Zinc	2,300 [2]	31,000 [2]	46 [5]	92	18	10	11	15	8.8

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Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Surface Soil Screening Values	NAPR Basewide Background [1]	62SB05 62SB05-02 6/1/2008 3.0-5.0	62SB06 62SB06-01 6/1/2008 1.0-3.0	62SB06 62SB06-03 6/1/2008 5.0-7.0	62SB07 62SB07-01 6/1/2008 1.0-3.0	62SB07 62SB07-02 6/1/2008 3.0-5.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	NA	40 J	14 J	NA	NA
Carbon disulfide	670,000 [2]	3,000,000 [2]	NE	NE	NA	0.68 J	0.6 U	NA	NA
Iodomethane	NE	NE	NE	NE	NA	1.2 UJ	1.2 UJ	NA	NA
Semivolatile Organic Compounds (ug/kg)									
Naphthalene	3,900	20,000	NE	NE	NA	0.65 U	0.69 U	NA	NA
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	6.66	**0.99**	**1**	***5.2***	**1.1**	**0.84**
Barium	1,500 [2]	19,000 [2]	330 [5]	207	58	350	430	110	240
Beryllium	16 [2]	200 [2]	40 [5]	0.933	0.26	0.21	0.85	0.3	0.23
Cadmium	7 [2]	81 [2]	32 [4]	0.57	0.028 U	0.032 U	0.032 U	0.035 U	0.029 U
Chromium	280	1,400	57 [7]	47.9	20	29	1.8	1.9	2.2
Cobalt	2.3 [2]	30 [2]	13 [4]	63.1	**4.1**	**17**	2.3	**4.7**	**5.6**
Copper	310 [2]	4,100 [2]	70 [4]	120	6.1	140	2.6	50	55
Lead	400 [3]	800 [3]	120 [4]	6.2	0.36	0.65	2	0.32 U	0.28 U
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.067	0.011 J	0.027	0.0043 J	0.0042 U	0.0035 U
Nickel	160 [2]	2,000 [2]	38 [4]	26.5	1.5	19	0.74	1.5	1.6
Selenium	39 [2]	510 [2]	0.52 [4]	1.19	0.11 J	0.14 J	0.46 J	0.13 U	0.11 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.015 UJ	0.036 J	0.017 UJ	0.018 UJ	0.015 UJ
Vanadium	55 [2]	720 [2]	10 [9]	256	25 J	**110** J	31 J	35	34
Zinc	2,300 [2]	31,000 [2]	46 [5]	92	6.2	40	3.8 J	16	17

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Site ID Sample ID Date Depth Range	**Regional Screening Levels Residential Soil**	*Regional Screening Levels Industrial Soil*	Selected Ecological Surface Soil Screening Values	NAPR Basewide Background [1]	62SB08 62SB08-01 6/1/2008 1.0-3.0	62SB08 62SB08-02 6/1/2008 3.0-5.0	62SB08 62SB08-02D 6/1/2008 3.0-5.0	62SB09 62SB09-01 6/1/2008 1.0-3.0	62SB09 62SB09-02 6/1/2008 3.0-5.0
Volatile Organic Compounds (ug/kg)									
Acetone	6,100,000 [2]	61,000,000 [2]	NE	NE	39 J	40 UJ	30 UJ	28 UJ	5.3 UJ
Carbon disulfide	670,000 [2]	3,000,000 [2]	NE	NE	0.62 J	0.57 U	0.49 U	0.6 U	0.62 U
Iodomethane	NE	NE	NE	NE	1.2 UJ	1.1 U	0.95 U	1.2 U	2.4 J
Semivolatile Organic Compounds (ug/kg)									
Naphthalene	3,900	20,000	NE	NE	0.64 UJ	0.67 UJ	0.82 J	0.65 UJ	0.62 UJ
Metals (mg/kg)									
Arsenic	0.39	1.6	18 [4]	6.66	***1.8***	**1.4**	***1.9***	***2***	**1.4**
Barium	1,500 [2]	19,000 [2]	330 [5]	207	130	160	140	160	180
Beryllium	16 [2]	200 [2]	40 [5]	0.933	0.84	0.45	0.36	1	1.2
Cadmium	7 [2]	81 [2]	32 [4]	0.57	0.031 U	0.033 U	0.037 J	0.032 U	0.029 U
Chromium	280	1,400	57 [7]	47.9	1.9	4.8	8.2	2.4	1.7
Cobalt	2.3 [2]	30 [2]	13 [4]	63.1	**7.4**	**4.5**	**6.9**	**4.7**	**7.5**
Copper	310 [2]	4,100 [2]	70 [4]	120	22	22	19	9.1	4.2
Lead	400 [3]	800 [3]	120 [4]	6.2	0.54	1.1	2	0.5	0.34
Mercury	2.3 [2]	31 [2]	0.1 [6]	0.067	0.0043 U	0.026	0.033	0.0042 U	0.0039 U
Nickel	160 [2]	2,000 [2]	38 [4]	26.5	1.4	2.3	3.2	1.1	1
Selenium	39 [2]	510 [2]	0.52 [4]	1.19	0.2 J	0.35 J	0.36 J	0.2 J	0.15 J
Silver	39 [2]	510 [2]	560 [8]	NE	0.016 UJ	0.03 J	0.022 J	0.016 UJ	0.015 UJ
Vanadium	55 [2]	720 [2]	10 [9]	256	33	38	42	32	25
Zinc	2,300 [2]	31,000 [2]	46 [5]	92	13	10	12	14	17

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Notes/Qualifiers:

Ecological surface soil screening values base on the minimum of plant and invertebrate ECO-SSL concentrations only
J - Estimated: The analyte was positively identified; the quantitation is an estimation
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
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]) for Subsurface Soil Background Fine Sand/Silt Table 3-5 (Baker, 2010b)
(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

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

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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

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.