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FINAL FULL RCRA FACILITY INVESTIGATION SWMU 28 – BUNDY WASTEWATER TREATMENT PLANT SLUDGE DRYING BEDS

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. N62470-07-D-0502
DO 0002

August 28, 2008

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

FINAL

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Prepared by:

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

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

Signature

Name: David Criswell, P.E.

Title: Deputy Base Closure Manager

Date: August 28, 2008

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LIST OF ACRONYMS AND ABBREVIATIONS

AFWTF	Atlantic Fleet Weapons Training Facility
AOC	Areas of Concern
AQUIRE	Aquatic Toxicity Information Retrieval
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
CLEAN	Comprehensive Long-Term Environmental Action Navy Program
CMS	Corrective Measures Study
COPC	Chemicals of Potential Concern
CRQL	Contract Required Quantitation Limit
CSF	Carcinogenic Slope Factor
%D	Percent Difference
DoN	Department of Navy
DPT	Direct Push Technology
DRMO	Defense Restoration and Marketing Office
EA	Environmental Assessment
ECO-SSLs	Ecological Soil Screening Levels
ECP	Environmental Condition of Property
EC_{50}	Median Effect Concentration
ERA	Ecological Risk Assessment
E2FO3	Estuarine, Intertidal, Forested, Broad-Leaved Evergreen
F	Fahrenheit
FCV	Final Chronic Value
GPS	Global Positioning System
GRO	Gasoline Range Organics
HI	Hazard Index
HHRA	Human Health Risk Assessment
HSWA	Hazardous and Solid Waste Amendments (to RCRA)
IAS	Initial Assessment Study
ILCR	Incremental Lifetime Cancer Risk
Inc.	Incorporated
IR	Installation Restoration
kg	Kilograms
LC_{50}	Median Lethal Concentration
LOEC	Lowest observed Effect Concentration
LOEL	Lowest Observed Effect Level
MATC	Maximum Acceptable Toxicant Concentration

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

MCL	Maximum Contaminant Level
mg	Milligrams
mgd	Million Gallons per Day
mg/kg	Milligrams per Kilogram
MHSPE	Ministry of Housing, Spatial Planning and Environment
MRL	Method Reporting Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD	North American Datum
NAWQC	National Ambient Water Quality Criteria
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command Atlantic Division
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NSRR	Naval Station Roosevelt Roads
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PMO	Program Management Office
ppt	parts per thousand
PRDNR	Puerto Rico Department of Natural Resources
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RFI	RCRA Facility Investigation
RTK	Real-time Kinematics
SCV	Secondary Chronic Values
SDG	Sample Delivery Group
SQUIRTS	Screening Quick Reference Tables
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TGO	Trimble Geomatics Office
TPH	Total Petroleum Hydrocarbons
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
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

Based on results obtained during the Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) conducted in November 2006 at the Solid Waste Management Unit (SWMU) 28 - Bundy Waste Water Treatment Plant (WWTP) Sludge Drying Beds located at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico a Full RFI was performed. This document contains the screening data collected from the Phase I investigation and the additional data collected during the Full RFI.

This document was prepared by Michael Baker Jr., Inc. (Baker), for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast. This RFI Report is being developed under IQC for A/E Services for Multi-Media Environmental Compliance Engineering Support, Contract Number N62470-07-D-0502, Delivery Order 0002. This Full RFI Report was developed in accordance with the RCRA § 7003 Administrative Order on Consent (United States Environmental Protection Agency [USEPA] Docket No. 02-2007-7301).

1.1 Purpose

This report has been prepared to document the findings of the 2008 Full RFI field work. The data is compared against current evaluation criteria to identify and delineate chemicals of potential concern (COPC) and to conduct preliminary screening of the analytical data against human health and ecological criteria.

1.2 Objectives

The objectives of the Full RFI are to delineate contaminants identified during the Phase I RFI from past operations of the sludge drying beds, to the extent practical, from the completion of field activities (surface soil, subsurface soil and groundwater sampling) as described in the USEPA approved 2007 Full RFI Work Plan (Baker, 2007);

Specific elements of the 2008 field effort performed to support this Full RFI include:

- Surface soil sampling at seven locations;
- Subsurface soil sampling at four locations;
- The installation of four permanent monitoring wells at four subsurface soil sampling locations;
- Groundwater sampling at the four monitoring wells.

1.3 Organization of the Full RFI Report

This report is organized into seven sections. Section 1.0 of this document discusses the purpose and objectives of this RFI. Section 2.0 provides a description of the current conditions of the site, including the history of SWMU 28, and a summary of previous investigations. Section 3.0 provides a description of the physical characteristics of the study area including climatology, topography, geology, hydrology, hydrogeology, and potential receptors. The scope of field investigation that was conducted in 2008 is provided in Section 4.0 (work plan summary) – this includes a surface and subsurface soil sampling and analysis program, a monitoring well installation program, a groundwater sampling and analysis program, a quality assurance/quality control (QA/QC) sampling program, as well as other investigation considerations. The nature

and extent of contamination as determined from the results is reported in Section 5.0. Section 6.0 presents the conclusions and recommendations from the RFI, while Section 7.0 lists relevant report references.

2.0 FACILITY BACKGROUND

This section provides the history and description of NAPR and SWMU 28, as well as the current conditions at SWMU 28.

2.1 NAPR Description and History

NAPR occupies over 8,890 acres of the northern portion 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 2-1. NAPR also occupies the immediately adjacent islands of Piñeros and Cabeza de Perro. The northern entrance to NAPR is about 35 miles east along the coast road (Route 3) from San Juan. The property consists of 3,938 acres of upland (developable) property and 4,955 acres of environmentally sensitive areas including wetlands, mangrove, and wildlife habitat. The closest large town is Fajardo (population approximately 37,000), which is about 5 miles north of NAPR off Route 3. Ceiba (population approximately 17,000) adjoins the west boundary of NAPR.

The facility was commissioned in 1943 as a Naval Operations Base and re-designated Naval Station Roosevelt Roads (NSRR) in 1957. NSRR operated until March 31, 2004 when NSRR underwent operational closure. On April 1, 2004 NSRR was re-designated as NAPR. The current primary 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.

On October 20, 1994, a Final RCRA Part B permit was issued by United States Environmental Protection Agency (USEPA) Region II to NSRR. This permit listed 52 SWMUs and 4 Areas of Concern (AOCs) and contained requirements for RFI activities at 24 of these SWMUs and three of these AOCs. An additional 25 SWMUs and 2 AOCs were added to the program over the years. Figure 2-2 shows the locations of all SWMUs and AOCs at NAPR. Prior to 1993, environmental activities at NSRR, exclusive of underground storage tanks (USTs), were conducted in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations under the Department of the Navy's Installation Restoration (IR) Program. The RCRA Part B permit, issued for the Defense Reutilization and Marketing Office (DRMO) at NSRR, included provisions for corrective action under the Hazardous and Solid Waste Amendments (HSWA) to RCRA.

The USEPA issued a RCRA 7003 Administrative Order (EPA Docket No. RCRA-02-2007-7301), which became effective on January 29, 2007. SWMU 28 is identified as one of three SMWUs/treatment plants containing sludge drying beds that warranted Phase I RFIs, because of the NAPR closure. A Phase I RFI was conducted in November 2006 at SWMU 28 and based on the Phase I RFI data evaluation, a "Full" RFI was recommended by the Navy; USEPA concurred in a comment letter dated June 28, 2007.

2.2 SWMU 28 Description and History

SWMU 28 consists of the domestic sewage treatment plant serving the Bundy area. The focus of this investigation is limited to the sludge drying beds located adjacent to the treatment plant, see Figure 2-3. Based on information available (verbal statements, and Navy letters of August 31, 1993 and June 30, 1992), this unit does not manage or generate RCRA hazardous wastes or constituents. NAPR has no knowledge or evidence of systematic and routine releases of hazardous wastes or constituents from this SWMU.

2.3 Current Conditions/Usage

The Bundy sludge drying beds are utilized on a limited basis due to the minimal amount of flow moving through the plant since the operational closure of Naval Station Roosevelt Roads on March 31, 2004 and the transition of the facility into caretaker status. A total of seven concrete sludge drying beds are located centrally in the plant. These beds are split to three beds to the west and four beds to the east as shown on Figure 2-3. The area between the two sets of drying beds is covered in concrete. Grassy areas surround the sludge drying beds with a steep grade uphill to the west of the beds.

2.4 Previous Investigations

SWMU 28 was identified in the RCRA/HSWA Permit dated October 20, 1994. No RFI was required for this SWMU based on verbal statements and Navy letters of August 31, 1993 and June 30, 1992 stating that no knowledge or evidence of systematic and routine releases of hazardous wastes or constituents was known from this SWMU. However, the NAPR RCRA § 7003 Administrative Order on Consent dated January 2007 required a Phase I RFI for all sludge drying beds at SWMUs 27, 28, and 29.

In anticipation of the requirements outlined in the RCRA § 7003 Administrative Order on Consent, a Phase I RFI Work Plan was developed. On September 15, 2006 the Phase I RFI Work Plans (Baker, 2006a) were developed and later approved by the USEPA on October 20, 2006. Mobilization for the RFI field activities occurred November 12, 2006 with demobilization on November 20, 2006.

The results of the Phase I investigation indicated that contamination (related to the presence of metals and sporadic detections of Aroclors) has occurred due to Navy activities at SWMU 28. Several inorganic compounds were present in excess of human health and ecological screening values in both the surface soil and groundwater media. Aroclor 1260 was detected in the surface soil at four of the nine locations.

Higher concentrations of most metals (especially mercury) were found in the surface soil along the eastern and southern edges of the sludge drying beds. Concentrations of arsenic exceeded its residential and industrial screening levels at several locations. Concentrations of vanadium exceeded its residential screening level, but did not exceed its industrial screening level in all but one sample. The concentration of Aroclor 1260 exceeded its residential screening level, but did not exceed its industrial screening level at one location (28SB02) in the surface soil sample (0 to 1 foot below ground surface) southeast of the beds. Although Aroclor 1260 was detected at low concentrations at other locations, they did not exceed screening levels. At the locations where higher concentrations of surface soil contamination were found, the subsurface soil samples were found to contain significantly lower concentrations of metals and non-detectable levels of polychlorinated biphenyls (PCBs).

Concentrations of arsenic and barium exceeded their screening levels in groundwater at all locations. The highest groundwater concentrations of metals, with several exceedances of maximum contaminant levels (MCLs) were detected in 28TW01, located south of the drying beds. This well was also the only one drilled into the bedrock below the site and ten inorganic compounds exceeded the human health or ecological screening values only in the unfiltered samples. However, the dissolved concentrations of metals at this location were among the lowest at the site. It is likely that the lack of a sand pack and bentonite seal above the screen has resulted

in the transfer of contaminated soil particles from the overburden into the bedrock zone where the screen was set.

Based on the Phase I RFI report and subsequent USEPA comments, a Full RFI Investigation was recommended in order to delineate the site contamination in surface soil, subsurface soil, and groundwater, as well as evaluate the potential for human health and ecological risk.

The Full RFI Work Plan for SWMU 28 was approved by USEPA in a comment letter dated January 07, 2008. Mobilization for the Full RFI field activities occurred on February 11, 2008 with demobilization on February 19, 2008. This document presents the results of the Full RFI field activities.

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

The physical setting of NAPR was documented in the 1984 Initial Assessment Study (IAS) (NEESA, 1984). This information is summarized in the paragraphs that follow. The physical results from the Phase I RFI and this Full RFI also are incorporated into the descriptions of the Site-Specific Hydrogeology given in Section 3.3.4.

3.1 Climatology

The climate associated with NAPR is characterized as warm and humid, with frequent showers occurring throughout the year. A major factor affecting the weather is the pattern of trade winds associated with the Bermuda High, the center of which is in the vicinity of 30° North, 30° West. The prevailing wind direction reflects the easterly trade winds. The area receives a surface flow varying between the northeast to the southeast about 75 percent of the year, and as much as 95 percent of the time in July when the easterly winds are strongest. The differential heating of the land and sea during the day tends to give a more northerly component to the flow on the northern side of the island and a more southerly component on the southern side. During the night, a land breeze causes a prevailing southeasterly flow in the north and a prevailing northeasterly flow over the southern coast. The mean annual wind velocity is 5.5 knots, with a minimum in November and a maximum in August. Gales associated with westward moving disturbances in the trade winds or hurricanes passing either north or south of the area have the highest probability of occurrence from June through October.

Uniform temperatures prevail, with small diurnal ranges as a result of insular exposure and the relatively small land areas. The warmest months are August and September, while the coolest are January and February. Mean annual maximum temperatures range from 82.0° Fahrenheit (F) in January to 88.2° F in August. The mean annual minimum temperatures vary from 64.0° F in January to 73.2° F in June. The highest maximum temperature recorded was 95.0° F, while the lowest minimum was 59.0° F. Rain usually occurs at least nine days in every month, with an average of 60 inches per year although a dry winter season occurs from December through April. About 22 thunderstorm-days occur per year, with maximum frequencies of 3 days per month from May through October.

In late summer, the mean sky cover begins a steady decrease from a monthly maximum average of 6.5-tenths coverage in September to a minimum monthly average of 4.4-tenths coverage in February. From March through August, the monthly average cloud cover increases steadily from 4.5- to 6.0 tenths coverage during the period. Over the open sea, a maximum of clouds (usually broken stratocumulus) occurs during early morning, with the skies clearing or becoming scattered with cumulus by afternoon. Completely clear or overcast skies are rare during daylight hours, while clear skies frequently occur at night.

The hurricane season is from mid-June through mid-September; maximum winds exceed 95 knots during severe hurricanes. An average of two tropical storms per year occurs in the study area, one of which usually reaches hurricane intensity.

3.2 Topography

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

In the immediate area of NAPR, elevations range from sea level to approximately 295 feet. Immediately to the north of the NAPR boundary, the hills rise abruptly to heights of 800 to 1,050 feet above sea level, with the tallest peak located within 2 kilometers of the NAPR boundary. There is a series of three hilly areas on NAPR, two of which separate the southern airfield area from the Port/Industrial, Housing, and Personnel Support areas. The third set of hills is in the Bundy area. These ridgelines not only separate sections of NAPR, but also dictate the degree of allowable development. The ridgeline south of the airfield provides an excellent barrier, which effectively decreases the aircraft-generated noise reaching the Unaccompanied Enlisted Personnel Housing areas to an acceptable level. Relief is low along the shoreline and lagoons and mangrove swamps are common.

3.3 Geology, Hydrology, and Hydrogeology

Subsections 3.3.1 through 3.3.4 below present descriptions of the geologic, hydrologic, and hydrogeologic conditions across NAPR. These are generally applicable, but may or may not be specifically-applicable, to the SWMU 28 area. In 2004, Baker conducted a series of Phase II Environmental Condition of Property (ECP) investigations across NAPR (NAVFAC, 2004). Subsection 3.3.4 discusses hydrogeologic information most relevant to SWMU 28 gained from the ECP investigations. Section 3.3.4 also incorporates the hydrogeologic information from the Phase I RFI as well as from this Full RFI.

3.3.1 Soils

The soil associations found at NAPR are predominantly of two types typical of humid areas, namely the Swamps-Marshes Association and the Mabi-Rio-Arriba-Cayagua Association, as well as the Descalabrado-Guayama Association, which is typical of dry areas. In addition, isolated areas of the Caguabo-Mucara-Naranjito Association, the Coloso-Toa-Bajura Association, and the Jacana Amelia-Fraternidad Association are found at NAPR.

The Swamps-Marshes and Mabi-Rio-Arriba-Cayagua associations cover over one half of NAPR's surface area and are equally distributed. Primarily the Descalabrado-Guayama and Caguabo-Mucara-Naranjito associations cover the remaining area.

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

The Mabi-Rio-Arriba-Cayagua Association consists generally of deep, somewhat poorly drained and moderately well drained, nearly level to moderately steep soils found on foot and side slopes, terraces, and alluvial fans. Soils of this association at NAPR are basically clayey.

The Descalabrado-Guayama Association generally consists of shallow, well drained, strongly sloping to very steep soils on volcanic uplands. Soils of this association are found primarily in the hilly areas located directly inland and adjacent to the soils of the Swamps-Marshes Association.

The Caguabo-Mucara-Naranjito Association consists generally of shallow and moderately deep, well drained, sloping to very steep soils on volcanic uplands. This association consists of soils that formed in residual material weathered from volcanic rocks. This association is represented at

NAPR by soils of the Sabana series, which are found on the side slopes and the hilly terrain west of Langley Drive in the Fort Bundy area. These soils are suited for pasture and woodland. Steep slopes, susceptibility to erosion, and depth to bedrock are the main limitations for farming and for recreation and urban areas.

The Coloso-Toa-Bajura Association consists of deep, moderately well drained to poorly drained, nearly level soils found on floodplains. This soil association extends along the western boundary of NAPR and around the airfield. The soils of this association formed in fine-textured and moderately fine-textured sediment of mixed origin on floodplains. The Coloso soils are deep and somewhat poorly drained; the Toa soils are deep and moderately well drained; and the Bajura soils and Maunabo soils are deep and poorly drained. The Reilly soils, also part of this association, are shallow sand and gravel and are excessively drained; they lie adjacent to streams. The minor soils are Talante, Vivi, Fortuna, Vega Alta, and Vega Baja. The Talante, Vivi, Fortuna, and Vega Baja soils are found on floodplains, while the Vega Alta soils occupy slightly higher positions on terraces.

The Jacana-Amelia-Fraternidad Association consists generally of moderately deep and deep, well drained and moderately well drained, nearly level to strongly sloping soils on terraces, alluvial fans, and foot slopes. This association is represented at NAPR by soils of the Jacana series, which consist of moderately deep, well-drained soils found on the foot slopes and low rolling hills along Langley Drive and just east of the airfield. These soils formed in fine-textured sediment and residuum derived from basic volcanic rocks.

3.3.2 Regional Geology

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

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

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

3.3.3 Regional Hydrology

The surface waters that flow across the northeastern plain of Puerto Rico, where NAPR is located, originate on the eastern slopes of the Sierra De Luquillo Mountains. Surface runoff is channeled into various rivers and streams that eventually flow into the Caribbean Sea. The Daguao River and Quebrada Seca Stream (a tributary to Rio Daguao) collect surface waters from the hills immediately north of NAPR and, in periods of heavy rain, flooding on NAPR occurs. The Daguao-Quebrada Seca watershed comprises an area of approximately 7.6 square miles (4,900 acres), and the river falls some 700 feet from its source to sea level. Increased development in the town of Ceiba, especially in areas adjacent to NAPR's northern boundary, has

significantly increased the surface runoff reaching NAPR, causing ponding and erosion in the Boxer Drive area. Boxer Drive, for a major portion of its length, is subject to surface water flooding, as are Hangar 200 and AIMD Hangar 379 and adjacent apron areas. This condition has been alleviated by the construction of a new highway (Route 3) immediately outside the fence and the realignment of Boxer Drive both with attendant storm water management features.

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

Little information exists concerning the hydrogeology of NAPR. The only known potential sources of groundwater lie in lenticular beds of clay, sand and gravel, and rock fragments, which occur at a depth of less than 30 meters. No wells have been developed on site from these layers. Some wells had been developed up gradient of NAPR in Ceiba, some three kilometers from base headquarters, but were abandoned due to high levels of salinity.

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

A seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico, usually within a short distance inland of the coastline.

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

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

3.3.4 Site-Specific Hydrogeology

In 2004, Baker conducted a Phase II Environmental Condition of Property (ECP) investigation involving 20 sites throughout NAPR. Some consistent stratigraphic trends were observed during the ECP. The site-specific hydrogeology can be better understood in the context of NAPR regional geology. For the sake of simplicity, the NAPR regional geology can be divided into three regions:

- Upland areas
- Near-shore flat lands
- Inland flat lands

The upland areas of NAPR includes the hills encompassing the Tow Way Fuel Farm and hospital areas, and the hills encompassing the area behind the Exchange, the former Atlantic Fleet Weapons Training Facility (AFWTF) Command, and Fort Bundy area. These upland areas are underlain by bedrock (predominately Gabbro) and exhibit varying degrees of weathering. Typically, the bedrock is overlain be a relatively thin residual soil (i.e., residuum). Residuum is unconsolidated soil, originating from weathered-in-place bedrock. This residuum generally consists of sand, silt, and clay.

The near-shore areas include the mangrove swamp areas as well as the shores of Ensenada Honda and Puerca Bay. The near-shore areas are typically underlain by marine sand layers (with coral and shell fragments), silt and clay layers, and occasional peat layers. In some near-shore areas, particularly by the harbor and Camp Moscrip in the southeastern portion of the base, fill material overlays the marine layers. The fill consists of rock fragments, debris (e.g., brick), sand, silt, and clay.

The inland flat land area generally encompasses the airfield and golf course areas. The inland flat land area is typically underlain by relatively thick residuum. The residuum generally consists predominately of clay. Fill material overlays the residuum in some areas, particularly the airfield, and generally consists of sand and gravel with lesser amounts of silt and clay.

SWMU 28 is located in the hilly upland areas of NAPR. The stratigraphic sequence, observed during the 2006 RFI investigation, indicated mostly fill material and rock fragments mixed with silt and clay. Bedrock refusal utilizing the Geoprobe was encountered at 28SB01 at 12 feet below ground surface (bgs), at 28SB02 at 14 feet bgs, at 28SB03 at 14 feet bgs, and at 28SB04 at 4.8 feet bgs. Groundwater was encountered in these borings prior to refusal, with the exception of 28SB01. At this location, a larger 6620 Geoprobe rig was brought in to auger into rock and find water. Bedrock was very hard and a total of three additional feet was drilled to 15 feet bgs. No water bearing zones were observed during drilling, but water did accumulate in the temporary well after 24 hours. Groundwater yields at SWMU 28 were not measured quantitatively during the Phase I RFI, but were observed to be very low.

The 2008 Full RFI investigation confirmed the stratigraphic sequence identified in the Phase I RFI; primarily fill material and rock fragments mixed with silt and clay. Bedrock refusal using the Geoprobe was encountered at 13 feet bgs in 28SB05 and 28SB06, at 9 feet bgs in 28SB07 and at 8 feet bgs in 28SB08. The boring locations and a cross section location are shown on Figure 3-1. Figure 3-2 provides a cross section through the site, looking northeast showing the relatively thin soil layer overlying the bedrock. Saturated zones were encountered in the silt and clay in 28SB05, 28SB07 and 28SB08 at depths of approximately 11, 5 and 7 feet bgs, respectively.

Static water levels, summarized on Table 3-1, were measured prior to sampling of the monitoring wells (February 15, 2008), prior to conducting slug tests on the wells (February 17, 2008), on May 20, 2008 and on June 12, 2008. Groundwater contours developed from the June 12, 2008 groundwater level measurements are shown on Figure 3-3. The groundwater flow direction from this data is generally to the east with variations from east-southest to northeast; the magnitude of the hydraulic gradient was calculated as 0.022 ft/ft. Groundwater recharge at Well 28GW06 was very slow and did not report water within the well until May 20, 2008. Groundwater was encountered in Wells 28GW05 and 28GW06 at the bedrock interface, while Wells 28GW07 and 28GW08 were found to produce significant water within the overburden/fill material encountered at their locations. Groundwater flow is generally to the east towards these filled in areas and the existing topographic surface drainage to the south towards the Caribbean Sea.

Rising and falling head slug tests were performed during the Full RFI field investigation in wells 28MW05, 28MW07 and 28MW08 (installed in borings 28SB05, 28SB07 and 28SB08, respectively); monitoring well 28MW06, installed in boring 28SB06 was dry at the time of testing. Testing and evaluation procedures used for the slug tests are described in Section 4.3. The hydraulic conductivity values calculated from the slug test data from each well are summarized on Table 3-2. Hydraulic conductivity values from the rising head slug tests ranged from 1.02 ft/day to 1.87 ft/day. Hydraulic conductivities from the falling head portion of the tests ranged from 0.06 ft/day to 1.91 ft/day. The average hydraulic conductivity for SWMU 28 was 1.13 ft/day (3.99×10^{-04} cm/sec). These hydraulic conductivity ranges are typical of silt to very fine sand (Bear, 1972).

3.4 Potential Receptor Information

3.4.1 Human Receptors

NSRR underwent operational closure on March 31, 2004. On April 1, 2004, NSRR was re-designated as NAPR. The current primary 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. It is assumed that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same. Based on information available regarding the physical features, site setting, site historical activities, and current and expected land uses, five potential human receptors have been selected for evaluation. These include:

- Current On-site Adult Trespasser
- Current On-site Adolescent Trespasser (9-15 years)
- Current/Future On-site Adult Workers
- Future Construction Worker

Presently, the wastewater treatment plant is operating on a limited basis. The land use at SWMU 28 is likely to remain the same in the future. What is known of the site history and some additional background information about this site can be found in Section 2.2 of this report. The following paragraphs are a general description of potential human receptor scenarios.

In the current scenario, it is conservatively assumed that on-site trespassers and on-site workers could access the site and potentially be exposed to COPCs at the site. Potential exposure via ingestion of and dermal contact with surface soil was considered for adult and adolescent trespassers. Additionally, the inhalation pathway (fugitive dusts) is considered for soil. The potential exposure pathways evaluated for the on-site worker include ingestion and dermal contact with surface soil and subsurface soil as well as inhalation of fugitive dusts from soil. Soil at this depth could be accessible to a current on-site worker performing grounds-keeping/site maintenance activities or a future on-site worker should the site become a commercial/industrial setting, in which case shallow subsurface soil could be disturbed and brought to the surface. Currently, groundwater is not used for potable purposes at the site; consequently exposure to groundwater in the current scenario would not be evaluated.

Future construction workers that may perform excavation and construction at the site are also considered for ingestion and dermal contact exposures to (as appropriate) excavated surface soil and subsurface soil, as well as the inhalation of fugitive dusts emanating from soil during excavation/construction activities. Dermal contact exposure with groundwater during excavation activities were also considered as a conservative measure for the construction worker receptor.

Specifically, the following potential human receptor and exposure pathway combinations are identified for SWMU 28.

Current On-Site Adult/Adolescent Trespassers

- Ingestion of Surface Soil
- Dermal Contact with Surface Soil
- Inhalation of Fugitive Dusts

Current/Future On-Site Adult Workers

- Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil and Subsurface Soil
- Inhalation of Fugitive Dusts

Future Construction Workers

- Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil, Subsurface Soil, and Groundwater
- Inhalation of Fugitive Dusts in Soil

3.4.2 Ecological Receptors

The sections that follow provide a brief description of the habitats occurring within and contiguous to SWMU 28, as well as the biota that may be present. The description of habitats and biota relies primarily on literature-based information for Puerto Rico and NAPR.

3.4.2.1 Terrestrial 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 aculeate*), sweet acacia (*Acacia famesiana*), and Australian corkwood (*Sesbania grandiflora*) grew in the previously grazed sections (Geo-Marine, Inc., 1998). Secondary growth communities (upland coastal forest communities and coastal scrub forest communities) exist today throughout NAPR's undeveloped upland. The upland vegetative community at SWMU 28 is extremely limited due to the presence of paved surfaces and structures associated with domestic sewage treatment operations. The community is limited to patches of maintained grasses of unknown species composition (likely to include *Bothriochloa ischaemum*, *Chloris barbata*, and *Digitaria* sp. based on maintained grasses identified during a habitat characterization conducted at SWMU 45 in May 2000 [(Geo-Marine, Inc., 2000]). An upland coastal forest community is located west and south of SWMU 28 (see Figure 3-4). Identical to the maintained grassy areas within SWMU 28, the species composition of this community is not known. However, vegetation identified within upland coastal forest communities elsewhere at NAPR have included lead tree, almacigo (*Bursa simaruba*), Christmas tree, oxhorn bucida (*Bucida buceras*), basket wiss (*Trichostigma octandrum*), and common guayaba (*Psidium guajava*) (Geo-Marine, Inc., 2000). Many of these species are likely present with the upland coastal forest community adjacent SWMU 28.

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 has been reported at NAPR. Although the location of the sighting was not documented, NAPR personnel believe the tree is located within the coastal forest community behind the former Navy Exchange store, northwest of Langley Drive (approximately 2.25 miles northeast of SWMU 28).

3.4.2.2 Aquatic Habitats

Approximately 460 acres at NAPR are covered by palustrine habitat, which includes all freshwater wetlands. These wetlands include wet meadows and marshes, dominated by cattails (*Typha spp*.) and grasses (*Panicum spp*. and *Paspalum spp*.), as well as wet coastal scrub forests. The marine environment surrounding NAPR includes mudflats, mangroves and seagrass beds. The total area of mudflats, mangroves, and seagrass beds in the offshore environment is approximately 161 acres, 2,700 acres, and 1,900 acres, respectively (Geo-Marine, Inc., 1998). Coral reefs are also located in the offshore marine environment (see Figure 3-4). Coral reef types within the waters surrounding NAPR, as well as their associated acreage cover are provided within the table below (Department of the Navy [DoN], 2007).

Reef Habitat Type	**Area (acres)**
Colonized Bedrock	266
Linear reef	84
Patch Reef (Aggregated)	146
Patch reef (Individual)	175
Scattered Coral-Rock	5

Mangroves at NAPR mainly consist of red mangrove (*Rhizophora mangle*), black mangrove (*Avicenia germinans*), and white mangrove (*Laguncularia racemosa*) (Geo-Marine, Inc., 2000 and 2005). Red mangroves tolerate relatively deep water levels, grow in unstable, soft soil, and tolerate a salinity range of 10 to 55 parts per thousand (ppt). They develop large prop roots which usually extend above the water surface. Black and white mangroves generally grow in areas that are not inundated by water. Mangroves at NAPR are natural filters for upland runoff and protect the coastline from storm damage (Lewis, 1986). They also provide habitat for wildlife, fish, and benthic invertebrates. Lewis (1986) reported 112 species of birds that use the NAPR mangroves as habitat for feeding, nesting, and roosting. The red mangrove prop root habitat in Puerto Rico also is used by at least 13 species of fish (including the gray snapper [*Lutijanus griseus*], lane snapper [*Lutijanus synagris*], and gold and black tricolor [*Holocanthus tricolor*]), several crustaceans (including the flat tree oyster [*Isognomon alatus*]), gastropods (including the coffee bean snail [*Melampus coffeus*] and mangrove periwinkle [*Littorina angulifera*]), echinoids (including the long-spined sea urchin [*Diadema antillarum*] and pencil sea urchin [*Eucidaris tribuloides*]), sponges (including the fire sponge [*Tedania ignis*]), ascidians (including the black tunicate [*Acsidia nigra*]), and hydroids (including the feathered hydroid [*Halocordyle disticha*]) (Geo-Marine, Inc., 2005).

The seagrass beds in eastern Puerto Rico are typical of well developed climax meadows found throughout the tropical Atlantic and Caribbean basin, consisting primarily of dense continuous coverage of turtle grass (*Thalassia testudinum*) with lesser amounts of manatee grass (*Syringodium filiforme*) and a wide diversity of calcareous algae (Reid et al., 2001). Patchy and sparse beds of mixed species, including shoal grass (*Halodule wrightii*), manatee grass, and paddle grass (*Halophila decipiens*), occur in localized areas affected and maintained by different wave regimes, substrate type, and turbidity than what is normally found in association with the climax turtle grass meadows.

The nearest marine habitat downgradient from SWMU 28 is the Atlantic Ocean (approximately 1,100 feet south of SWMU 28). A map showing the spatial relationship of SWMU 28 to the open water marine environment is provided as Figure 3-5. Included on this figure are freshwater and marine wetland units identified by the Cowardin Wetland Classification System (Cowardin et al., 1979 [see Figure 3-6]). The wetlands depicted on Figure 3-6 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 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 3-5, there are no freshwater wetland units within SWMU 28. However, as Figure 3-5, SWMU 28 borders an estuarine wetland unit classified as Estuarine, Intertidal, Forested, Broad-Leaved Evergreen (E2FO3) by the Cowardian Wetland Classification System.

Seagrass and coral reef habitats are not located within the near-shore marine environment immediately south of SWMU 28 (see Figure 3-4). However, both habitat types are present approximately 300 feet from the shoreline. The seageass beds (dominated by turtle grass) represent potential grazing areas for the West Indian manatee (*Trichechas manatus*), a federally endangered species throughout its range, and the green sea turtle (*Chelonia mydas*), a federally threatened species in Puerto Rico, while the coral reef habitat represents potential foraging habitat for the hawksbill sea turtle (*Eretmochelys imbricata*), a federally endangered species, and loggerhead sea turtle (*Dermochelys coriacea*), a federally threatened species.

3.4.2.3 Biota

A description of the biota occurring within Puerto Rico and the landmass encompassed by NAPR is provided in the sections that follow. It is noted that the biota occurring at and immediately contiguous to SWMU 28 has not been documented during previous investigations.

3.4.2.3.1 Mammals

A total of 22 terrestrial mammal species are known historically from Puerto Rico; however, all mammals except bats (13 species) have been extirpated (United States Geological Survey [USGS], 1999). None of the bats found on Puerto Rico are exclusive to the island. The specific bat species known to occur on Puerto Rico are listed below:

- 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*)

The absence of fruit-bearing and flowering vegetation at SWMU 28 excludes potential exposures by fruit-eating species (Jamaican fruit bat, Antillean fruit bat, red fig-eating bat) and nectar-feeding species (brown flower bat and Greater Antillean long-tongued bat). It is noted that the upland coastal forest community west and south of SWMU 28 may provide foraging habitat for

several of these species. Insectivorous bats (Antillean ghost-faced bat, Parnell's mustached bat, sooty mustached bat, big brown bat, red bat, velvety free-tailed bat, and Brazilian free-tailed bat) feed primarily on flying insects that would not be expected to have any appreciable exposure to soil contaminants At SWMU 28. Finally, the lack of any surface water body within SWMU 28 precludes potential exposures to chemicals detected in surface and subsurface soil by fish-eating bats (Mexican bulldog bat). However, the estuarine wetland community east of SWMU 28 may provide foraging habitat for this piscivorous bat species.

Of the endangered/threatened marine mammals that may occur in Puerto Rico, only the West Indian manatee is known to occur in the marine environment surrounding NAPR (DoN, 2007). Manatee populations in Puerto Rico's coastal waters have been documented during three aerial surveys conducted from 1978 to 1979, 1984 to 1985, and in 1993 (United Nations Environmental Program [UNEP], 1995), a radio tracking study of manatee distribution and abundance (Reid and Kruer, 1998), and a year-long study of manatee distribution and abundance (Woods et al., 1984). Historical manatee sightings at NAPR are summarized on Figure 3-7. The figure (reproduced from DoN, 2007) includes information from most of the studies identified above. Feeding manatees are most often recorded within Pelican Cove and the Ensenada Honda (see Figure 3-7). They have also been encountered within the offshore marine environment downgradient from SWMU 28 where seagrass beds are present.

Several mammals have been introduced into Puerto Rico, including the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and mongoose (*Herpestes javanicus*). These nonindigenous mammals have been implicated in the decline of native bird and reptile populations (USGS, 1999 and United States Fish and Wildlife Service [USFWS], 1996a).

3.4.2.3.2 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 to 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 of bird species reported at NAPR or having the potential to occur is provided in Table 3-3. The list, compiled from literature-based information pre-dating 1990, 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 (*Dendrocia 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 28 is not located within the critical habitat designation. A study conducted by the Naval Facilities Engineering Command (NFESC, 1996) reported that the mangrove forests surrounding NAPR should be considered the most important nesting habitats for the yellow-shouldered blackbird. A survey conducted in July 2002 by the Puerto Rico Department of Natural Resources (PRDNR, 2002) reported fifteen yellow-shouldered blackbirds (including five juveniles) at NAPR. At the time of the survey, the birds were using the structures at the NAPR airport for resting cover (the nearest airport structure is approximately 3.2 miles northeast of SWMU 28). Although nesting pairs were not observed (the survey was not conducted during the breeding season), the airport structures contained several inactive nests. The inactive nests and juvenile birds indicate that a small breeding population is present at NAPR. As discussed in Section 3.4.2.1, the vegetative community at SWMU 28 is limited to maintained grasses of unknown species composition. Because yellow-shouldered blackbirds are arboreal feeders that forage within the canopy and sub-canopy of trees (USFWS, 1996a), they are not expected to forage within the available habitat at SWMU 28. However, the adjacent upland coastal forest community represents potential feeding habitat for this species.

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 the 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 of these three species and observations recorded at NAPR, only the Caribbean brown pelican has the potential to use the offshore marine environment downgradient from SWMU 28 as a food source.

3.4.2.3.3 Reptiles and Amphibians

A total of 23 amphibians and 47 reptiles are known from Puerto Rico and the adjacent waters (USGS, 1999). Fifteen of the amphibians and 29 of the reptiles are endemic, while four amphibian species and three reptilian species have been introduced (USGS, 1999). 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 ridge-headed toad (*Peltophryene lemur*) and the golden coqui (*Eleutherodactylus jasperi*). Both species are listed as threatened. 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 ridge-headed 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, and a small population is believed to survive on the north coast near Quebradillas, Arecibo, Barceloneta, Vega Baja, and Bayamón (USFWS, 1987). It has also 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 (USGS, 1999). 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, 2008). 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 Environmental Assessment (EA) for the Disposal of NAPR. Figures 3-8 and 3-9 (reproduced from Geo-Marine, Inc., 2005) present cumulative sea turtle sightings and potential turtle nesting sites at NAPR. Significant turtle observations were made near the mouth of the Ensenada Honda, the northern shore of Pineros Island, Pelican Bay, and the Medio Mundo Passage with the frequency of turtle observations listed as green > hawksbill > loggerhead > leatherback. Based on the life history information for each turtle species (summarized in Baker, 2006b and 2006c) and the availability of forage material (in the form of sea grasses, hard bottom corals, and most likely sponges), the green, hawksbill, and loggerhead sea turtles have the potential to forage within the off-shore marine environment downgradient from SWMU 28.

The Puerto Rican boa (*Epicrates inornatus*) is a federally endangered species. 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 28 or the adjacent upland coastal forest community.

3.4.2.3.4 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, sea grass 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. Fish and invertebrate species inhabiting the marine/estuarine habitats contiguous to SWMU 28 have not been documented in the literature or during previous investigations.

4.0 2008 FULL RCRA FACILITY INVESTIGATION ACTIVITIES

The areas around the sludge drying beds at SWMU 28 were investigated in February 2008. Section 4.1 discusses soil boring advancement and monitoring well installation. Section 4.2 discusses the groundwater level measurements and Section 4.3 explains the well head testing activities. Section 4.4 discusses the soil and groundwater sampling and analysis program. Section 4.5 presents a discussion of the QA/QC sampling programs involved with the Full RFI. Section 4.6 discusses how the sample locations were surveyed. The physical results of this investigation are presented in Section 3.3.4 and the analytical results are discussed in detail in Section 5.0. Figure 3-1 depicts the sampling locations at SWMU 28. The field notes from the various personnel involved with this investigation are provided in Appendix A.1.

No significant deviations to the approved work plan were performed during the Full RFI at SWMU 28.

4.1 Soil Boring Advancement and Monitoring Well Installation

Surface and subsurface soil samples were collected using direct-push technology (DPT) through the use of a Geoprobe® Macro Core Sampler in conjunction with a Geoprobe® 66DT track-mounted rig. GeoEnviroTech of San Juan, Puerto Rico was the DPT contractor. As presented in the Final Full RFI Work Plan (Baker, 2007), a total of four soil borings (28SB05 through 28SB08) were advanced at SWMU 28 (Figure 3-1). In addition to direct push sampling, hollow stem augering was performed using the Geoprobe® 66DT track-mounted rig for the bottom foot of the borings at 28SB05 and 28SB07, for the bottom five feet of boring 28SB06 and for the bottom seven feet of boring 28SB08 to allow for setting the monitoring well across the soil-bedrock interface. In addition, seven surface soils samples (28SS06 through 28SS12) were also collected from SWMU 28.

The soil borings/monitoring wells were advanced at the following locations:

- 28SB05/28MW05 was advanced north of the sludge drying beds to provide an upgradient location to evaluate site-specific background data.

- 28SB06/28MW06 was installed at the southwest corner of the sludge drying beds to evaluate potential metals contamination in this downgradient area.

- 28SB07/28MW07 was installed south and downgradient of the sludge drying beds to provide the downgradient extent of contamination.

- 28SB08/28MW08 was installed east of the sludge drying beds to evaluate potential metals contamination in this area.

Surface soil samples were collected at the above boring locations. Seven additional surface soil samples were also collected from the following locations:

- Three surface soil samples (28SS06, 28SS07 and 28SS08) were collected from the western and southern edges of the sludge drying beds to provide further data on the extent of elevated metals contamination that was observed during the Phase I RFI.

- Two surface soil samples (28SS09 and 28SS11) were collected from the vicinity of a PCB compound (Aroclor 1260) detection in the Phase 1 RFI (arsenic and mercury were also detected in this vicinity at concentrations exceeding their screening levels in the

Phase I RFI). These samples will aid in determining the horizontal extent of contamination in the area.

- Two surface soil samples (28SS10 and 28SS12) were collected from a drainage area downgradient from 28SB03 where elevated arsenic and mercury concentrations were detected in the Phase I RFI. These samples will aid in evaluating the extent of contamination in this area.

Each boring site was field located with a survey grade Global Positioning System (GPS) receiver. An elevation was obtained from the top of the polyvinyl chloride (PVC) casing for water level elevation calculations and a spot ground surface elevation. Soil boring and well construction logs have been produced and are provided in Appendix A.2. No elevated photoionization detector (PID) levels were observed at the four soil borings.

After collection of the subsurface soil samples, the borings were augered to a diameter of 8-inches using 4-1/4 inch inside diameter hollow stem augers. Permanent monitoring wells then were constructed in each boring using 1.5-inch diameter, Schedule 40, Geoprobe Prepack well screen threaded to 1.5-inch diameter, Schedule 40 PVC riser. Screen lengths varied between locations depending on borehole depth and location of the water bearing zone from a minimum of approximately 6 feet to 10 feet. If possible, screens were installed to straddle the soil-bedrock interface since this appears to be the first water bearing zone at this SWMU. Each well was secured with a concreted flush mount wellhead.

The monitoring wells were developed after a period of approximately one day following installation to ensure the annular seal was properly cured and to assure that groundwater enters the well screen freely, thus yielding a representative groundwater sample and water level measurement, to remove water that may have been introduced during drilling and well installation, to remove very fine-grained sediment in the filter pack and nearby formation to minimize groundwater sample turbidity and silting of the well, and to maximize the efficiency of the filter pack for accurate aquifer hydraulic testing.

Monitoring wells were developed using dedicated bailers. Generally, water removal continued until the groundwater appeared to clear of fine sediments. Specific conductivity, pH and temperature were measure after the removal of each well volume of water. Turbidity of the removed water was visually noted. A record of the well development is provided in the field log in Appendix A.1.

4.2 Groundwater Level Measurements

Groundwater levels were measured in each monitoring well using an electronic water level meter to the nearest 0.01 foot. Measurements were taken immediately prior to collecting groundwater samples, prior to conducting the slug tests and on May 20, 2008 and June 12, 2008. Water level measurements and calculated groundwater elevations are presented on Table 3-1. Groundwater elevation contours from the June 12, 2008 measurements are provided on Figure 3-3.

4.3 Aquifer Characterization Testing

Falling and rising head slug tests were performed at each of the newly installed permanent monitoring wells following completion of well installation, development and groundwater sampling. The purpose of the slug tests was to estimate the hydraulic conductivity of the saturated zone in the immediate vicinity of the monitoring well by measuring the aquifers response to a change in static conditions induced by introduction or removal of a slug of known

volume from the well. For this test, a 1.5-inch diameter slug (approximately 1.5-inches in diameter by 3 foot long) was used.

Each test was initiated by measuring the static water level in the well. A pressure transducer attached to a computerized data logger was then installed in the well and the water levels allowed to re-equilibrate. The slug was introduced into the well and the change in the water level over time was measured for the falling head portion of the slug test. Measurements continued until water levels stabilized at which point the slug was removed from the well and the change in water level was again measured until the water levels stabilized for the rising head portion of the test.

The electronic water level measurements were processed using Microsoft Excel and AQTESOLV® for Windows®, version 3.5. The Bouwer and Rice method (Bouwer and Rice, 1976 and 1989) for analyzing slug test data in unconfined aquifers was selected as the solution method. A saturated thickness of 20 feet was used, based on observations made during drilling. The aquifer was assumed to be isotropic and therefore an anisotropy ratio of 1 was used. A boring radius of 0.19 ft and a casing radius of 0.08 ft were used as inputs for all well tests for calculating hydraulic conductivity. The remaining input parameters used for calculating hydraulic conductivity, in addition to the time and water level measurements, included initial displacement, total well penetration depth, static water column height and screen length. These parameters varied by well location based on well construction and water level. A summary of the input parameters used for calculating the hydraulic conductivity and the graphical analysis is provided in Appendix A.3. The hydraulic conductivity values calculated from the slug test data from each well are summarized on Table 3-2 and are discussed in Section 3.3.4.

4.4 Environmental Sampling and Analysis Program

Table 4-1 provides a summary of the soil and groundwater sampling and analytical program performed for the 2008 Full RFI program at SWMU 28. In addition, this table shows information related to field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples (since these are collected concurrent with the environmental samples). Other QA/QC samples (trip blanks, field blanks, and equipment rinsates) were collected and analyzed in accordance with Table 4-2. Analytical methods/descriptions, parameter lists, and Contract Required Quantitation Limits (CRQL) are presented in Table 4-3. The chain-of-custodies for the sampling at SWMU 28 are provided as Appendix A.4.

4.4.1 Surface and Subsurface Soils

Surface soil samples were collected at soil borings 28SB05 through 28SB08 and from surface soils sample locations 28SS06 through 28SS012 from a depth of 0 to 1.0-foot bgs. Subsurface soil samples were collected from the four soil borings from two foot intervals from below the surface soil sample (generally 1.0 to 3.0 feet bgs) to just above the water table (variable depth). Five subsurface soil samples were collected from 28SB05; four subsurface soil samples were collected from 28SB06; two subsurface soil samples were collected from 28SB07; and three were collected from 28SB08. This sampling scheme resulted in the collection of 11 surface soil samples and 14 subsurface soil primary environmental samples. The surface soil samples were submitted to Test America Laboratory in Savannah, Georgia for analysis of Appendix IX PCBs and metals. The subsurface soil samples were submitted only for Appendix IX metals analysis.

4.4.2 Groundwater

Three primary environmental groundwater samples were collected, one from each of the monitoring wells installed (28MW05, 28MW07 and 28MW08), except for well 28MW06 which was dry. Groundwater samples were collected using low flow sampling techniques, as specified in the Full RFI Work Plan (Baker 2007). Groundwater samples were given the GW designation in the sample name and the corresponding well number; for example, the groundwater sample collected from monitoring well 28MW05 was designated as 28GW05. All of the samples were submitted to the analytical laboratory for Appendix IX total and dissolved metals.

4.5 Quality Assurance/Quality Control Sampling and Analysis Program

Quality Assurance/Quality Control samples were collected throughout the field investigation to assist in evaluating the usability of the resultant soil and groundwater data. QA/QC samples collected for this investigation included field duplicates, matrix spike/matrix spike duplicates, field blanks and equipment rinsates. Each of these is discussed in the following sections.

4.5.1 Field Duplicates

A total of 11 surface soil samples, 14 subsurface soil samples and three groundwater samples were collected as part of the 2008 Full RFI field sampling activity at SWMU 28. The RFI Work Plan specifies one duplicate sample to be collected for every ten primary soil samples collected. Thus, two field duplicate samples (28SS11D and 28SS12D) were collected concurrently with the surface soil samples; two additional field duplicate samples (28SB06-01D and 28SB08-01D) were collected concurrently with the subsurface soil samples. Each surface soil sample was analyzed for Appendix IX PCBs and metals while the subsurface soil samples were only analyzed for Appendix IX metals. One groundwater duplicate sample was collected at 28MW08 (sample 28GW08D) and analyzed for Appendix IX total and dissolved metals. Duplicate samples are useful in evaluating the field sampling methodology.

4.5.2 Trip Blanks

For the Full RFI for SWMU 28, samples were not analyzed for VOCs or for total petroleum hydrocarbons (TPH) gasoline range organics (GRO); consequently, no trip blank samples were collected for this investigation.

4.5.3 Matrix Spike/Matrix Spike Duplicates

A total of 11 surface soil samples, 14 subsurface soil samples and three groundwater samples were collected as part of the 2008 Full RFI field sampling activity at SWMU 28. The RFI Work Plan specifies one matrix spike/matrix spike duplicate sample be collected for every 20 primary samples collected (for each matrix). Therefore, one QA/QC soil sample, 28SS12MS/MSD, was collected from the surface soil to evaluate the matrix effect upon the analytical methodology. Similarly, one QA/QC subsurface soil sample, 28SB06-01MS/MSD was collected. Each surface soil sample was analyzed for Appendix IX PCBs and metals while the subsurface soil samples were only analyzed for Appendix IX metals. Separate MS and MSD samples of groundwater were collected: 28GW08MS and 28GW08MSD. Soil samples were analyzed for Appendix IX PCBs and metals; groundwater samples were analyzed for Appendix IX total and dissolved metals.

4.5.4 Field Blanks

Field blank samples were collected from two different source waters encountered during this investigation. One field blank sample (FB01) was collected from lab grade deionized water used as the source water for the equipment rinsates. The other field blank sample (FB02) was from a NAPR potable water source used for soil sample collection equipment washing. No store bought distilled water was purchased during this investigation, so a third field blank for store bought distilled water was not necessary.

Field blank samples are always analyzed for the same parameters as the related environmental samples. Therefore, both field blank samples were sent to the laboratory for analysis of Appendix IX PCBs and total metals. Field blank testing is useful in determining if other water sources used in the cleaning/decontamination procedures associated with the sampling event are free of contamination.

4.5.5 Equipment Rinsates

Four decontaminated equipment rinsate samples were collected, submitted, and analyzed as part of the QA/QC program. Sample ER03 is a rinsate of the stainless steel spoon associated with the soil sampling activities. In addition, samples ER04 and ER06 are rinsates from the Macrocore® Acetate liner used during soil sampling while ER10 is a rinsate from the groundwater sample tubing.

Equipment rinsate samples are always analyzed for the same parameters as the related environmental samples. Therefore, each equipment rinsate sample was analyzed for Appendix IX PCBs and/or total metals. Results from equipment rinsate samples are useful in determining if the sampling equipment was contaminant-free during the field investigation.

4.6 Surveying

Survey activities were performed using Real-Time Kinematic (RTK) GPS methods. RTK GPS surveying achieves better accuracy, which can be used specifically to produce groundwater contour mapping. RTK GPS surveying employs a GPS base station and a GPS rover that reads satellite carrier phase signals. Using the carrier phase signal in conjunction with a base station allows horizontal accuracy of approximately 0.1 feet and an elevation accuracy of approximately 0.02 feet. The specific coordinate system utilized for this activity included U.S. State Plane 1983, Puerto Rico/Virgin Is 5200, and the North American Datum (NAD) 1983, with units in survey feet.

Once installed, each monitoring well was surveyed using the RTK GPS method. An elevation was obtained from the top of polyvinyl chloride (PVC) casing for water level elevation calculations and a spot ground surface elevation was also obtained. All survey data was appropriately downloaded and processed using Trimble Geomatics Office (TGO). TGO is a software application tool used to convert survey data collected in the field into electronic files such as “AutoCAD” useful for application in the office.

5.0 NATURE AND EXTENT OF CONTAMINATION

This section discusses the nature of SWMU 28 contamination determined from chemical analysis of environmental samples from the February 2008 Full RFI. The laboratory analytical data went through a formal data validation process. Complete validated data tables for the 2008 Full RFI field effort are included in Appendix B; in addition, relevant portions of the data validation reports for the 2008 Full RFI Sample Delivery Groups (SDGs) are provided in Appendix C; a summary discussion of the necessary laboratory level data adjustments to the 2008 data is presented in Section 5.5.

The results of the Phase I RFI indicated that Aroclor 1260 was present in the surface soil; the highest concentration was detected at 28SB02, south of the sludge drying beds. Concentrations of metals (especially mercury) were found in the surface soil along the eastern and southern edges of the sludge drying beds. Concentrations of arsenic exceeded its residential and industrial screening levels at several locations. Concentrations of vanadium exceeded its residential screening level, but did not exceed its industrial screening level in all but one sample. At the locations where higher concentrations of surface soil contamination were found, the subsurface soil samples were found to contain significantly lower concentrations of metals and non-detectable levels of PCBs.

Concentrations of arsenic and barium exceeded their screening levels in groundwater at all locations. The highest groundwater concentrations of metals, with several exceedances of maximum contaminant levels (MCLs) were detected in 28TW01, located south of the drying beds. This well was also the only one drilled into the bedrock below the site and ten inorganic compounds exceeded the human health or ecological screening values only in the unfiltered samples. However, the dissolved concentrations of metals at this location were among the lowest at the site. It is likely that the lack of a sand pack and bentonite seal above the screen has resulted in the transfer of contaminated soil particles from the overburden into the bedrock zone where the screen was set.

The Full RFI was implemented to further define potential metals contamination within the surrounding area of the sludge drying beds.

5.1 Human Health and Ecological Screening Values

Detected results for surface soils, subsurface soils, and groundwater media are discussed in the following sections. Detected compounds for each media are compared to applicable regulatory and background criteria. These criteria, and the rationale for their usage for comparison to a specific media, are described in detail below.

5.1.1 Human Health

Applicable human health criteria for soils include USEPA Region IX Industrial Preliminary Remediation Goals (PRGs) and USEPA Region IX Residential PRGs (USEPA, 2004), and the upper limit of means background levels (inorganics only) (Baker, 2008). Applicable human health criteria for groundwater are USEPA Region IX Tap Water PRGs (USEPA, 2004), Federal Drinking Water Maximum Contaminant Levels (MCLs), and any inorganic background levels present in the groundwater at NAPR (Baker, 2008).

The USEPA Region IX PRGs are tools for determining preliminary COPCs for human health risk assessments as part of evaluating and cleaning up contaminated sites. They are risk based concentrations derived from standardized equations (representing ingestion, dermal contact, and

inhalation exposure pathways), combining exposure information assumptions and USEPA toxicity data. The PRGs contained in the Region IX PRG Table are generic; they are calculated without site-specific information. Region IX PRGs should be viewed as Agency guidelines, not legally enforceable standards. The PRGs for potentially carcinogenic chemicals are based on a target Incremental Lifetime Cancer Risk (ILCR) of $1x10^{-6}$. The PRGs for noncarcinogens are based on a target hazard quotient of 1.0. In order to account for cumulative risk from multiple chemicals in a medium, it is necessary to derive the PRGs based on a target hazard quotient of 0.1. Noncarcinogenic PRGs based on a target hazard quotient of 0.1 and the most recent toxicological criteria available, results in a set of values that can be used as screening criteria. In order to yield a hazard index (HI) of 0.1, the noncarcinogenic PRGs were divided by a factor of ten. For potential carcinogens, the toxicity criteria applicable to the derivation of PRG values are oral and inhalation Carcinogenic Slope Factors (CSFs); for noncarcinogens, they are chronic oral and inhalation reference doses (RfDs). These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. The PRG table is updated periodically to reflect such changes. It should be noted that the most recent update was in October 2004 (USEPA, 2004). Also, it should be noted that even though subsurface soil analytical results from below 10 feet would not be used in human health risk assessments due to the unlikely exposure route below that depth, all subsurface soil analytical results were screened against the PRGs for completeness.

5.1.2 Ecological

5.1.2.1 Soil

USEPA ecological soil screening levels (Eco-SSLs) for terrestrial plants and invertebrates (available at http://www.epa.gov/ecotox/ecossl/) were preferentially used as soil screening values. For a given metal, if an Eco-SSL has been established for both terrestrial plants and invertebrates, the lowest value was selected as the soil screening value. For those chemicals lacking an Eco-SSL, 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)

When more than one screening value was available from Efroymson et al. (1997a and 1997b), the lowest value was selected as the surface soil screening value. For those chemicals lacking an Eco-SSL or 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), assuming a minimum default soil organic carbon content of 2.0 percent.

- Canadian soil quality guidelines (agricultural land use) developed by the Canadian Council of Ministers of the Environment (CCME, 2006).

CCME soil quality guidelines were given the lowest preference since they are background-based values that do not represent effect concentrations.

In addition, the upper limit of means background levels (inorganics only) (Baker, 2008) were used to compare the soil concentrations to those present at NAPR in unimpacted soil. Both surface soil background levels and subsurface soil background levels for a clay soil type (most prevalent soil type at SWMU 28) were used in screening.

As a general rule, screening of soil results for ecological purposes would include surface soil, as well as subsurface soil results from the 1 – 2 foot depth range. At SWMU 28, four samples were collected at depths of 1- 3 feet (see Table 4-1). For the sake of completeness, these four samples will also undergo ecological screening.

5.1.2.2 Groundwater

Groundwater concentrations were compared to ecological surface water screening values in case of groundwater discharge to surface water. Chronic saltwater National Ambient Water Quailty Criteria (NAWQC) (USEPA, 2006) were selected for use as surface water screening values. USEPA NAWQC for cadmium, copper, chromium, lead, mercury, selenium, and zinc are expressed as dissolved concentrations. As a measure of conservatism in this screening-level ecological risk assessment (ERA), they were converted to total recoverable concentrations using the appropriate conversion factors (USEPA, 2006). For those chemicals lacking a saltwater NAWQC, surface water screening values were identified from the following information listed in their order of decreasing preference:

- Final Chronic Values (FCVs) for saltwater contained in Ecotox Thresholds (USEPA, 1996a)

- Chronic screening values for saltwater contained in Ecological Risk Assessment Bulletins – Supplement to Risk Assessment Guidelines (RAGS) (USEPA, 2001)

- Minimum chronic toxicity test endpoints (No Observed Effect Concentration [NOEC] and Maximum Acceptable Toxicant Concentration [MATC] values) for saltwater species reported in the ECOTOX Database System (Aquatic Toxicity Information Retrieval [AQUIRE] database) (USEPA, 2003)

- Chronic Lowest Observable Effect Levels (LOELs) for saltwater contained in National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 1999)

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

- Acute LOELs for saltwater contained in NOAA SQUIRTs (Buchman, 1999)

- Acute toxicity test endpoints (No Observed Effect Concentration [NOEC], Lowest Observed Effect Concentration [LOEC], median lethal concentration [LC_{50}], and median effective concentration [EC_{50}] values) for saltwater species contained in the ECOTOX Database System (AQUIRE database) (USEPA, 2003).

- LC_{50} values for saltwater species contained in Superfund Chemical Matrix (USEPA, 1996b)

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

- An uncertainty factor of 10 was used to convert an acute NOEC, LOEC, or LOEL to a chronic-based screening value.

- An uncertainty factor of 100 was used to convert an EC_{50} or LC_{50} to a chronic-based screening value.

When acute toxicity data were used to extrapolate a chronic screening value, NOECs were given preference over LOECs/LOELs, LOECs/LOELs were given preference over LC_{50} and EC_{50} values, and EC_{50} values were given preference over LC_{50} values. When more than one value was available from the literature for a given test endpoint (e.g., NOEC), the minimum value was conservatively used to extrapolate a chronic screening value. In some cases, chronic and acute LOELs for chemical classes (e.g., polynuclear aromatic hydrocarbons [PAHs]) were available from Buchman (1999). A LOEL based on a chemical class was used to derive a chronic screening value only if that chemical lacked literature-based benchmarks and/or toxicity test endpoints.

For those chemicals lacking saltwater toxicological thresholds and literature values, surface water screening values were identified or developed from freshwater values using the sources and procedures discussed in the preceding paragraphs with one exception. This exception involved the consideration of freshwater Secondary Chronic Values (SCVs) developed by the USEPA (1996a) and Suter II (1996).

NAPR base wide groundwater background criteria (inorganics only) were also used in the comparison (Baker, 2008), when available.

5.2 Surface Soils

Eleven surface soil samples and two duplicate samples were collected and analyzed during the 2008 Full RFI. All of the surface soil samples were analyzed for Appendix IX PCBs and metals. A detected results table for the surface soil data set is presented in Table 5-1. Results are compared to USEPA Region IX Residential Soil PRGs, Industrial Soil PRGs, ecological surface soil screening values and NAPR Basewide Background (inorganics only) criteria. For comparison, the 2006 Phase I RFI surface soil data is presented in Table 5-4.

Figure 5-1 presents the locations of the parameters that exceeded the USEPA Region IX Soil PRGs (Residential and Industrial). Aroclor 1260 was found in three of the 11 samples from the 2008 sampling event (and in the duplicate sample) with the maximum concentration of 300 µg/kg at 28SS10 (east of the drying beds), above the USEPA Region IX Residential Soil PRG. Aroclor 1260 was also detected in four of nine surface soil samples collected during the 2006 sampling event; the highest detection (above residential soil PRGs) occurred in sample 28SB02-00. All of the Aroclor 1260 detections and exceedances in surface soil occurred to the east or south of the sludge drying beds.

Fourteen of the 16 detected metals exceeded one or more of the criteria for surface soil. These are:

- Antimony
- Arsenic

- Barium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Selenium
- Silver
- Tin
- Vanadium
- Zinc
- Mercury

Figure 5-1 also presents the locations of the metals that exceeded the USEPA Region IX Soil PRGs (Residential and Industrial) and NAPR basewide background values for both the 2006 and 2008 data sets. Vanadium exceeded the residential soil PRGs at all locations from the 2008 sampling event and at all locations in the 2006 data set; however, the concentration of vanadium did not exceed the background screening value in either the 2006 or 2008 data sets. Arsenic exceeded the residential soil PRGs at 7 of 11 locations, the industrial soil PRGs at 3 of 11 locations and it also exceeded the background screening value at one location, 28SS10 in the 2008 data set. There were similar results for arsenic in the 2006 data set with the concentration at two locations (28SB02 and 28SB04) exceeding both the industrial PRGs and the base background screening criteria. Antimony and silver also exceeded the residential soil PRG at 28SS10 in the 2008 data set. Mercury exceeded both the residential soil PRG and the background screening criteria at two locations from the 2008 data set, 28SS10 and 28SB08, both east of the sludge drying beds. Mercury concentrations detected in the 2006 data set also exceeded both the residential soil PRG and the background screening criteria at two locations, 28SB02 and 28SB03, east and south of the sludge drying beds. Note that barium was not detected in excess of the residential soil PRGs in the 2008 data set, however, it was detected in excess of both the residential soil PRGs and the base background screening value in the 2006 data set at 28SB01, south of the sludge drying beds.

Figure 5-2 presents the locations of parameters that exceeded ecological screening criteria and NAPR basewide background values. Chromium and vanadium exceeded their ecological screening criteria at all locations in both data sets; however, the chromium and vanadium concentrations did not exceed the NAPR basewide background screening value. Mercury exceeded the ecological screening value in 5 of 11 locations (primarily south and east of the sludge drying beds); each of these values also exceeded the basewide background screening value. Similar results were noted for mercury in the 2006 data set. Copper and Zinc were each detected at two locations in excess of the ecological screening values in the 2008 data set; copper concentrations at one location and zinc concentrations at both locations also exceeded the basewide background screening value. Other metals, including barium, lead, selenium and tin were also detected at 28SS10 in the 2008 data set at concentrations exceeding the ecological screening values and basewide background screening values (for barium, lead and tin); barium was also noted in the 2006 data set at 28SB01 at concentrations exceeding the ecological screening criteria and background screening criteria.

Based on the above evaluation, surface soil contamination in excess of human health and ecological screening criteria was noted primarily east and south of the sludge drying beds. The highest levels of contamination are in the vicinity of 28SS10, 28SB08 and 28SB02 east and southeast of the sludge drying beds, and 28SB01 and 28SB07 south of the sludge drying beds.

The lateral extent of primarily Aroclor 1260, arsenic, barium and mercury contamination south and east of the sludge drying beds has not been fully delineated.

5.3 Subsurface Soils

Fourteen subsurface soil samples plus two duplicate samples were collected and analyzed during the 2008 Full RFI. All of the subsurface soil samples were analyzed for Appendix IX metals. A detected results table for the subsurface soil data set is presented on Table 5-2. Results are compared to USEPA Region IX Residential Soil PRGs, Industrial Soil PRGs, ecological surface soil screening values and NAPR Basewide Background criteria. For comparison, the 2006 Phase I RFI subsurface soil data is presented on Table 5-5.

Six of the 17 detected metals exceeded one or more of the criteria for subsurface soil. These are:

- Arsenic
- Barium
- Beryllium
- Chromium
- Nickel
- Vanadium

Figure 5-3 presents the locations of the parameters that exceeded the USEPA Region IX Soil PRGs (Residential and Industrial) and NAPR Basewide background values. Vanadium exceeded the residential soil PRG at each of the sampling locations in both the 2006 and 2008 data sets; however, the concentration of vanadium did not exceed the basewide background screening value at any of the locations. Arsenic exceeded the residential soil PRG at six of the 14 locations in the 2008 data set and at all locations in the 2006 data set; however, the concentration of arsenic did not exceed the basewide background screening value at any of the locations. Barium exceeded both the residential soil PRG and the background screening value at one location, 28SB06-01 located near the southwest corner of the sludge drying beds.

Figure 5-4 presents the locations of inorganic parameters that exceeded ecological screening criteria and NAPR basewide background values. This screening was only applied to four samples from the 2008 data set collected from depths shallower than 3.0 feet below the ground surface, 28SB05-01, 28SB06-01, 28SB07-01 and 28SB08-01 and to three samples (28SB02-01, 28SB03-01 and 28SB04-01) from the 2006 data set. Chromium and vanadium exceeded their ecological screening criteria at all locations from both data sets; however, the chromium and vanadium concentrations did not exceed the NAPR basewide background screening criteria. Barium exceeded both the ecological screening value and the background screening value at 28SB06-01, located near the southwest corner of the sludge drying beds and 28SB03-01 located east of the sludge drying beds.

Subsurface soils from 28SB06-01 (1.0 to 3.0 feet bgs), located south/southwest of the sludge drying beds, and 28SB03-01 (1.0 to 3.0 feet bgs) located east of the sludge drying beds appear to be impacted by barium contamination.

5.4 Groundwater

Three groundwater samples plus one duplicate sample were collected and analyzed during the 2008 Full RFI. All of the groundwater samples were analyzed for Appendix IX total and dissolved metals. A detected results table for the groundwater data set is presented in Table 5-3. Results are compared to USEPA Region IX Tap Water PRGs, USEPA MCLs, ecological surface

water screening values and NAPR Basewide Background criteria. For comparison, the 2006 Phase I RFI groundwater data is presented on Table 5-6.

Twelve of the 13 detected total metals exceeded one or more of the criteria for groundwater. These are:

- Arsenic
- Barium
- Beryllium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Vanadium
- Zinc

Figure 5-5 presents the locations of the parameters that exceeded the USEPA Region IX Tap Water PRGs and NAPR Basewide background criteria. Total vanadium and chromium exceeded the tap water PRG at each of the sampling locations in the 2008 data set; however, the concentration of vanadium and chromium did not exceed the basewide background screening criteria. Total arsenic exceeded the tap water PRG at two of the three locations; however, the concentration of total arsenic did not exceed the basewide background screening criteria. Total barium exceeded the tap water PRG at each of the locations in both the 2008 and 2006 data sets; samples from two locations, 28MW07 and 28MW08 from the 2008 data set also exceeded the basewide background screening criteria; total barium concentrations in samples from two locations, 28TW01 and 28TW03 from the 2006 data set also exceeded basewide background screening criteria. These locations are east and south of the sludge drying beds.

Figure 5-6 presents the locations of total metals that exceeded ecological screening criteria and NAPR basewide background values. Chromium, cobalt, copper, lead, nickel, silver, vanadium and zinc exceeded their ecological screening criteria at one or more locations in the 2008 data set; however, none of these compounds exceeded the basewide background screening criteria. There were numerous detections of total metals in sample 28TW01 from the 2006 data set; however, as discussed in the Phase 1 RFI, the results from this location may not accurately represent groundwater quality at this location.

Two of the five detected dissolved metals exceeded one or more of the criteria for groundwater. These are:

- Barium
- Vanadium

Figure 5-5 presents the locations of the parameters that exceeded the USEPA Region IX Tap Water PRGs and NAPR Basewide background criteria. Dissolved vanadium exceeded the tap water PRG at each of the sampling locations from the 2008 data set and at two of three locations from the 2006 data; however, the concentration of vanadium did not exceed the basewide background screening criteria. Dissolved barium exceeded the tap water PRG at one location, 28MW08 for the 2008 data set and from two locations, 28TW02 and 28TW03 from the 2006 data

set; samples from these locations also exceeded the basewide background screening criteria. These locations are east and southeast of the sludge drying beds.

None of the samples for dissolved metals exceeded the ecological surface water screening values.

Total and dissolved barium was detected in the groundwater samples collected from areas south and east of the sludge drying beds at levels in excess of background screening criteria and human health screening criteria, although MCLs and ecological screening criteria were not exceeded.

5.5 2008 Laboratory Data Validation Summary

A discussion of the compounds detected in the Field QA/QC samples is presented in Section 5.5.1. A summary of the data validation findings, as they relate to each SDG, are discussed in Sections 5.5.2 through 5.5.5 below. Data validation reports are included in Appendix C.1 through C.4. In addition, the Puerto Rican Chemist Certifications for each Test America SDG are presented in Appendix C.5.

5.5.1 Summary of Detected Compounds in Field QA/QC Samples

Field generated QA/QC samples for the 2008 field effort consisted of field blanks, equipment rinsates, and environmental duplicates. Other blanks were analyzed for all fractions requested in this investigation including Appendix IX PCBs and metals. Table 5-7 presents the detected compounds found in the equipment rinsates and field blanks.

Two field blank samples were collected; FB01 representing laboratory grade DI water and FB02, representing NAPR potable water. Detections in the field blanks included three metals (barium, silver, and zinc) in the NAPR potable water FB02; there were no detections in the laboratory grade DI water, FB01.

Four equipment rinsate samples were collected as indicated on Table 4-2. There were no detections of metals or PCBs in ER03. Zinc was detected in ER04 from a macro core acetate liner, thallium was detected in ER06 also from a macro core acetate liner, and lead was detected in ER10 from the groundwater sampling tubing.

5.5.2 Test America Savannah SDG 34206

This SDG (34206) is relevant to the analytical findings associated with the surface soil samples collected from SWMU 28 during the 2008 Full RFI field investigation. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

PCBs

- No qualification of the data was required.

Metals

- Blank contamination was noted and qualification was required in the samples in this SDG. Details are provided in Appendix C.1.

- One of the submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte antimony. Reported results in the soil samples were qualified as estimated J/UJ.

- One of the field duplicate pairs exhibited a non-compliant relative percent difference (RPD) for the analyte chromium. The reported results for chromium in the field duplicate pair were qualified as estimated.

Data Validation Summary for SDG 34206

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

5.5.3 Test American Savannah SDG 34289-1

This SDG (34289-1) is relevant to the analytical findings associated with the subsurface soil samples collected from SWMU 28 during the 2008 Full RFI field investigation. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

PCBs

- One result exhibited a column quantitation percent difference (%D) greater than 25 percent but less than 71 percent. This result was qualified as estimated J.

Metals

- Blank contamination was noted and qualification was required in the samples in this SDG. Details are provided in Appendix C.2.

- One of the submitted matrix duplicate pairs exhibited a non-compliant RPD for the analyte barium. Reported results in the soil samples were qualified as estimated J/UJ.

- The associated serial dilution exhibited non-compliant %Ds for three analytes. Positive results for the analytes cobalt, vanadium, and zinc were qualified as estimated J.

- One of the field duplicate pairs exhibited non-compliant RPDs for the analytes chromium, cobalt, and copper. The reported results for chromium, cobalt, and copper in the field duplicate pair were qualified as estimated.

Data Validation Summary for SDG 34289-1

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

5.5.4 Test America Savannah SDG 34321

This SDG (34321) is relevant to the analytical findings associated with the groundwater samples collected from SWMU 28 during the 2008 Full RFI field investigation. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

Metals

- Blank contamination was noted and qualification was required in the samples in the SDG. Details are provided in Appendix C.3.

- The submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte mercury. Reported results in the water samples were qualified as estimated J/UJ.

Data Validation Summary for SDG 34321

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

5.5.5 Test America Savannah SDG 34320-2

This SDG (34320-2) is relevant to the analytical findings associated with the 2008 QA/QC sampling, specifically the field blanks FB01 and FB02. Laboratory analyses were performed by Test America, (Savannah, Georgia). Validation services were provided by DataQual Environmental Services, LLC (St. Louis, Missouri). Validation conclusions are as follows:

Metals

- Blank contamination was noted and qualification was required in the samples in the SDG. Zinc was qualified as estimated in FB02; copper was qualified as non-detect up to the reporting limit in FB01 and FB02; and chromium was qualified as non-detect up to the reporting limit in FB02. Additional details are provided in Appendix C.4.

- The associated matrix duplicate exhibited non-compliant %Ds for one analyte. Positive and non-detect results for the analyte copper were qualified as estimated J in the field samples.

Data Validation Summary for SDG 34320-2

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The objectives of the Full RFI were to delineate, to the extent practical, the contaminants resulting from past operations of the sludge drying beds at SWMU 28 and to compare the data resulting from the Full RFI to applicable human health and ecological screening criteria to provide an indication as to whether corrective measures need to be further pursued at this site.

It is evident from the analyses of samples obtained during the Phase I RFI investigation and this Full RFI that there has been some impact on the environment due to Navy activities at SWMU 28.

Surface soil contamination in excess of human health and ecological screening criteria was noted primarily east and south of the sludge drying beds and primarily consisted of the compounds Aroclor 1260, arsenic, barium and mercury. The highest levels of contamination are in the vicinity of 28SS10, 28SB08 and 28SB02 east and southeast of the sludge drying beds, and 28SB01 and 28SB07 south of the sludge drying beds. The lateral extent of contamination south and east of the sludge drying beds has not been fully delineated.

Subsurface soils from 28SB06-01 (1.0 to 3.0 feet bgs), located south/southwest of the sludge drying beds, and 28SB03-01 (1.0 to 3.0 feet bgs) located east of the sludge drying beds appear to be impacted by barium contamination. The lateral distribution of this contamination was not fully defined in the southern portion of the site

Total and dissolved barium was detected in the groundwater samples collected from areas south and east of the sludge drying beds at levels in excess of background screening criteria and human health screening criteria, although MCLs and ecological screening criteria were not exceeded.

6.2 Recommendations

The data generated during the Phase I RFI and this Full RFI indicated limited impact to the surface soil, subsurface soil and groundwater by past activities at SWMU 28. Exceedances of human health and ecological screening criteria above background screening criteria were observed in surface and subsurface soil indicating potential human health and/or ecological risks. The extent of Aroclor 1260 and metals contamination, primarily arsenic, mercury and barium in surface soil east and south of the site has not been fully delineated. Additionally, the presence of various compounds at concentrations in excess of both ecological screening values and background values indicates further ecological evaluation is needed for this site. A Corrective Measures Study (CMS) is recommended to further delineate contamination and to further define and quantify potential risk to human health and ecological receptors. The CMS will include a baseline human health risk assessment (HHRA) and an ecological risk assessment (ERA) (Steps 1, 2 and 3a of the Navy ERA process described at http://web.ead.anl.gov/ecorisk/).

It should be noted that USEPA issued new Regional Screening Levels (USEPA, 2008) on May 27, 2008. As recommended by the USEPA, these Screening Levels are to replace the Region IX PRGs. The Regional Screening Levels were developed to support the risk assessment screening process, while improving consistency across Regions and incorporating updated guidance in a timely manner. The environmental data for this Full RFI were screened using the Region IX PRGs prior to the issuance of the Regional Screening Levels, and the screening criteria have not been revised for this version of the report. However, based on a review of the PRGs versus the Regional Screening Levels, it is expected that the results of the screening would not be

significantly impacted and that the conclusions and recommendations of this Full RFI would remain the same upon replacement of PRGs with the Regional Screening Levels. None the less, in keeping with current USEPA guidance, the Regional Screening Levels will be incorporated in subsequent versions of this report.

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TABLES

TABLE 3-1

GROUNDWATER ELEVATION SUMMARY
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Well Identification	Northing	Easting	Elevation (msl) Top of PVC	Total Well Depth (ft)	Depth to Groundwater 2/15/2008 (ft)	Groundwater Elevation 2/15/2008 (msl)	Depth to Groundwater 2/17/2008 (ft)	Groundwater Elevation 2/17/2008 (msl)
28MW05	792859.1	921386.7	114.87	15.3	9.12	105.75	9.21	105.66
28MW06	792735.5	921373.4	115.18	12.8	---	---	---	---
28MW07	792677.7	921496.4	108.74	8.7	3.97	104.77	3.14	105.6
28MW08	792783.2	921537.2	108.95	15.1	6.38	102.57	6.45	102.5

Well Identification	Northing	Easting	Elevation (msl) Top of PVC	Total Well Depth (ft)	Depth to Groundwater 5/20/2008 (ft)	Groundwater Elevation 5/20/2008 (msl)	Depth to Groundwater 6/12/2008 (ft)	Groundwater Elevation 6/12/2008 (msl)
28MW05	792859.1	921386.7	114.87	15.3	9.85	105.02	9.03	106.38
28MW06	792735.5	921373.4	115.18	12.8	9.25	105.93	8.28	106.9
28MW07	792677.7	921496.4	108.74	8.7	4.3	104.4	2.89	105.9
28MW08	792783.2	921537.2	108.95	15.1	6.5	102.5	5.94	103.0

msl - mean sea level; elevations given are mean sea level plus 100 feet
ft - feet

TABLE 3-2

SUMMARY OF SLUG TEST RESULTS
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI RERORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Location	Date	Rising Head Test (feet/day)	Falling Head Test (feet/day)	Average Hydraulic Conductivity (feet/day)	Comment
28MW05	2/17/2008	1.02	0.06	0.54	Water within screened interval
28MW06	2/17/2008	---	---	---	Dry at time of testing
28MW07	2/17/2008	1.64	0.30	0.97	Water within screened interval
28MW08	2/17/2008	1.87	1.91	1.89	Water within screened interval
Average				**1.13**	

TABLE 3-3
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT NAVAL ACTIVITY PUERTO RICO
SWMU 28 – BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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

TABLE 3-3
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT NAVAL ACTIVITY PUERTO RICO
SWMU 28 – BUNDY WWTP SLUDGE DRUING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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

Notes:

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

TABLE 4-1

SUMMARY OF 2008 RFI SURFACE SOIL, SUBSURFACE SOIL AND GROUNDWATER SAMPLING AND ANALYSIS
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

				Analysis Requested			
Sample Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	App IX PCBs	App IX Metals (Total)	App IX Metals (Dissolved)	**Comment**
Surface Soil	28SB05	28SB05-00	0.0 - 1.0	X	X		
	28SB06	28SB06-00	0.0 - 1.0	X	X		
	28SB07	28SB07-00	0.0 - 1.0	X	X		
	28SB08	28SB08-00	0.0 - 1.0	X	X		
	28SS06	28SS06	0.0 - 1.0	X	X		
	28SS07	28SS07	0.0 - 1.0	X	X		
	28SS08	28SS08	0.0 - 1.0	X	X		
	28SS09	28SS09	0.0 - 1.0	X	X		
	28SS10	28SS10	0.0 - 1.0	X	X		
	28SS11	28SS11	0.0 - 1.0	X	X		
		28SS11D	0.0 - 1.0	X	X		Duplicate
	28SS12	28SS12	0.0 - 1.0	X	X		
		28SS12D	0.0 - 1.0	X	X		Duplicate
		28SS12MS/MSD	0.0 - 1.0	X	X		Matrix Spike/Matrix Spike Duplicate

TABLE 4-1

SUMMARY OF 2008 RFI SURFACE SOIL, SUBSURFACE SOIL AND GROUNDWATER SAMPLING AND ANALYSIS
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

				Analysis Requested			
Sample Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	App IX PCBs	App IX Metals (Total)	App IX Metals (Dissolved)	**Comment**
Subsurface Soil	28SB05	28SB05-01	1.0-3.0		X		
		28SB05-02	3.0-5.0		X		
		28SB05-03	5.0-7.0		X		
		28SB05-04	7.0-9.0		X		
		28SB05-05	9.0-11.0		X		
	28SB06	28SB06-01	1.0-3.0		X		
		28SB06-01D	1.0-3.0		X		Duplicate
		28SB06-01 MS/MSD	1.0-3.0		X		Matrix Spike/Matrix Spike Duplicate
		28SB06-02	3.0-5.0		X		
		28SB06-03	5.0-7.0		X		
		28SB06-04	7.0-9.0		X		
	28SB07	28SB07-01	1.0-3.0		X		
		28SB07-02	3.0-5.0		X		
	28SB08	28SB08-01	1.0-3.0		X		
		28SB08-01D	1.0-3.0		X		Duplicate
		28SB08-02	3.0-5.0		X		
		28SB08-03	5.0-7.0		X		
Groundwater	28MW05	28GW05	NA		X	X	
	28MW07	28GW07	NA		X	X	
	28MW08	28GW08	NA		X	X	
		28GW08D	NA		X	X	Duplicate
		28GW08 MS	NA		X	X	Matrix Spike
		28GW08 MSD	NA		X	X	Matrix Spike Duplicate

Notes:
ft bgs - feet below ground surface.

TABLE 4-2

SUMMARY OF 2008 RFI QA/QC SAMPLING AND ANALYSIS
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Analysis Requested		
Media	App. IX PCBs	App IX Metals (Total)	**Comment**
Equipment Rinsate Sample			
ER03	X	X	Stainless Steel Spoon
ER04		X	Macro Core Acetate Liner
ER06		X	Macro Core Acetate Liner
ER10		X	Groundwater Tubing
Field Blank Samples			
FB01	X	X	Lab Grade Deionized Water
FB02	X	X	NAPR Potable Water

TABLE 4-3

PARAMETER LISTS AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - PCBs	Quantitation Limits*		Method Number (Description)
	Water (µg/L)	Low Soil (µg/kg)	
Aroclor-1016	1.0	33	8082
Aroclor-1221	2.0	67	8082
Aroclor-1232	1.0	33	8082
Aroclor-1242	1.0	33	8082
Aroclor-1248	1.0	33	8082
Aroclor-1254	1.0	33	8082
Aroclor-1260	1.0	33	8082
Appendix IX - Metals (Total)	**Quantitation Limits***		**Method Number (Description)**
	Water (µg/L)	**Low Soil (mg/kg)**	
Antimony	20	2.0	6010 (Inductively Coupled Plasma)
Arsenic	10	1.0	6010 (Inductively Coupled Plasma)
Barium	10	1.0	6010 (Inductively Coupled Plasma)
Beryllium	4.0	0.4	6010 (Inductively Coupled Plasma)
Cadmium	5.0	0.5	6010 (Inductively Coupled Plasma)
Chromium	10	1.0	6010 (Inductively Coupled Plasma)
Cobalt	10	1.0	6010 (Inductively Coupled Plasma)
Copper	20	2.0	6010 (Inductively Coupled Plasma)
Lead	5.0	0.5	6010 (Inductively Coupled Plasma)
Mercury	0.2	0.02	7470/7471 (Cold Vapor AA)
Nickel	40	4.0	6010 (Inductively Coupled Plasma)
Selenium	10	1.0	6010 (Inductively Coupled Plasma)
Silver	10	1.0	6010 (Inductively Coupled Plasma)
Thallium	10	1.0	6010 (Inductively Coupled Plasma)
Tin	10	5.0	6010 (Inductively Coupled Plasma)
Vanadium	10	1.0	6010 (Inductively Coupled Plasma)
Cyanide	0.010	1.0	9012 (Colorimetric)
Sulfide	1.0	25	9030 (Titrimetric, Iodine)
Zinc	20	2.0	6010 (Inductively Coupled Plasma)

Notes:

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

µg/L - micrograms per liter
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not Applicable

TABLE 5-1

SUMMARY OF DETECTED RESULTS - 2008 SURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sample Depth (ft bgs)** **Sampling Date**	**USEPA Region IX Residential Soil PRGs**	*USEPA Region IX Industrial Soil PRGs*	Selected Ecological Surface Soil Screening Values	NAPR [1] Basewide Background	**28SS06** **28SS06** **0.0 - 1.0** **02/12/08**	**28SS07** **28SS07** **0.0 - 1.0** **02/12/08**	**28SS08** **28SS08** **0.0 - 1.0** **02/12/08**	**28SS09** **28SS09** **0.0 - 1.0** **02/12/08**	**28SS10** **28SS10** **0.0 - 1.0** **02/12/08**	**28SS11** **28SS11** **0.0 - 1.0** **02/12/08**
PCBs (ug/kg)										
Aroclor-1260	220	740	2,510	NE	5.5 U	5.6 U	6 U	5.8 U	**300**	100
Metals (mg/kg)										
Antimony	3.1 [2]	41 [2]	78 [8]	3.17	0.23 UJ	0.36 J	0.23 UJ	0.74 J	**5.2** J	0.58 J
Arsenic	0.39	1.59	18 [4]	2.65	0.68 U	0.58 U	**1.2**	**1.2**	**3.2**	0.74 U
Barium	537 [2]	6658 [2]	330 [5]	199	120	200	210	150	360	190
Beryllium	15.44 [2]	1941 [3]	40 [5]	0.59	0.46	0.41 J	0.39 J	0.3 J	0.38 J	0.52
Cadmium	3.7 [2]	45.14 [2]	32 [4]	1.02	0.43 U	0.64	0.84	0.99	2.6	1.3
Chromium	211	448	0.4 [6]	49.8	9.6	16	22	22	53	21
Cobalt	903	1921	13 [4]	46.2	6.4	10	15	12	6.2	7.2
Copper	313 [2]	4088 [2]	70 [4]	168	13	38	53	110	170	38
Lead	400 [3]	800 [3]	120 (4)	22	1.8	1.9	2.1	14	190	31
Nickel	156 [2]	2043 [2]	38 [4]	20.7	4.9	6.8	10	9.6	9.5	7.8
Selenium	39 [2]	511 [2]	0.52 (4)	NE	0.22 U	0.21 U	0.22 U	0.28 J	1.3 J	0.2 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.14 U	0.066 U	0.11 U	0.41 U	**52**	10
Tin	4700 [2]	10,000	50 [7]	3.76	4.3 U	4.3 U	4.4 U	4.2 U	140	18
Vanadium	7.82 [2]	102 [2]	2 [7]	259	**32**	**67**	**95**	**97**	**52**	**34**
Zinc	2346 [2]	100,000	120 [5]	115	36	39	47	100	350	150
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.109	0.03	0.023 J	0.024	0.52	**22**	1.8

TABLE 5-1

SUMMARY OF DETECTED RESULTS - 2008 SURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sample Depth (ft bgs)** **Sampling Date**	**USEPA Region IX Residential Soil PRGs**	*USEPA Region IX Industrial Soil PRGs*	Selected Ecological Surface Soil Screening Values	**28SS11** **28SS11D** **0.0 - 1.0** **02/12/08**	**28SS12** **28SS12** **0.0 - 1.0** **02/12/08**	**28SS12** **28SS12D** **0.0 - 1.0** **02/12/08**	**28SB05** **28SB05-00** **0.0 - 1.0** **02/13/08**	**28SB06** **28SB06-00** **0.0 - 1.0** **02/13/08**	**28SB07** **28SB07-00** **0.0 - 1.0** **02/14/08**	**28SB08** **28SB08-00** **0.0 - 1.0** **02/14/08**
PCBs (ug/kg)										
Aroclor-1260	220	740	2,510	120	5.3 U	5.4 U	5.1 U	5.2 U	5.6 U	32 J
Metals (mg/kg)										
Antimony	3.1 (2)	41 (2)	78 (8)	0.78 J	0.21 UJ	0.23 UJ	0.64 U	0.36 U	0.73 U	1.4 U
Arsenic	0.39	1.59	18 (4)	0.74 U	0.76 U	0.79 U	**0.64** J	**0.88** J	***1.9***	***1.6***
Barium	537 (2)	6658 (2)	330 (5)	180	96	98	190 J	210 J	300	240 J
Beryllium	15.44 (2)	1941 (3)	40 (5)	0.51	0.53	0.49	0.34 J	0.28 J	0.54	0.55
Cadmium	3.7 (2)	45.14 (2)	32 (4)	1.2	0.38 U	0.37 U	0.23 J	0.19 J	0.47 J	1
Chromium	211	448	0.4 (6)	21	20 J	13 J	24	9.9	18	24
Cobalt	903	1921	13 (4)	7.2	6.5	6	11 J	8.4 J	7.4 J	9.1 J
Copper	313 (2)	4088 (2)	70 (4)	39	13	10	27	24	53	56
Lead	400 (3)	800 (3)	120 (4)	31	2.3	1.2	2.4	2.7	13	31
Nickel	156 (2)	2043 (2)	38 (4)	8.1	8	5.9	12	4.7	10	11
Selenium	39 (2)	511 (2)	0.52 (4)	0.21 U	0.2 U	0.22 U	0.56 U	0.19 U	0.37 U	0.21 U
Silver	39 (2)	510 (2)	560 (8)	11	0.16 U	0.095 U	0.37 U	0.13 U	0.53 U	13
Tin	4700 (2)	10,000	50 (7)	19	4 U	4.3 U	3.8 U	3.9 U	4.4 U	18
Vanadium	7.82 (2)	102 (2)	2 (7)	**35**	**32**	**28**	**56** J	**55** J	**46** J	**50** J
Zinc	2346 (2)	100,000	120 (5)	150	26	22	35 J	46 J	84 J	110 J
Mercury	2.35 (2)	30.7 (2)	0.1 (6)	2.3	0.041	0.034	0.093	0.013 J	0.14	**2.7**

TABLE 5-1

SUMMARY OF DETECTED RESULTS - 2008 SURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes/Qualifiers:

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
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency

(1) NAPR basewide background surface soil screening value (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2008)
(2) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes
(3) USEPA Action Level for lead in soils
(4) Plant-based ecological soil screening level (USEPA,, 2005a [arsenic]; USEPA, 2005b [cadmium]; USEPA, 2005c [cobalt]; USEPA, 2005d [lead]; USEPA, 2007a [copper]; USEPA, 2007b [nickel]; USEPA, 2007c [selenium])
(5) Invertebrate-based ecological soil screening level (USEPA, 2005e [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007e [zinc])
(6) Toxicological threshold for earthworms (Efroymson et al., 1997a)
(7) Toxicogical threshold for plants (Efroymson et al., 1997b)
(8) Ecological soil screening level (http://www.epa.gov/ecotox/ecossl/)

TABLE 5-1

SUMMARY OF DETECTED RESULTS - 2008 SURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Table References:

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

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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.

TABLE 5-2

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sample Depth (ft bgs)** **Sampling Date**	**USEPA Region IX Residential Soil PRGs**	*USEPA Region IX Industrial Soil PRGs*	Selected Ecological Surface Soil Screening	NAPR [1] Basewide Background	**28SB05** **28SB05-01** **1.0 - 3.0** **02/13/08**	**28SB05** **28SB05-02** **3.0 - 5.0** **02/13/08**	**28SB05** **28SB05-03** **5.0 - 7.0** **02/13/08**	**28SB05** **28SB05-04** **7.0 - 9.0** **02/13/08**	**28SB05** **28SB05-05** **9.0 - 11.0** **02/13/08**
Metals (mg/kg)									
Antimony	3.1 [2]	41 [2]	78 [8]	NE	0.2 U	0.38 U	0.49 U	0.43 U	0.2 U
Arsenic	0.39	1.59	18 [4]	1.59	0.31 U	0.37 J	0.32 U	0.34 U	0.32 U
Barium	537 [2]	6658 [2]	330 [5]	220	120 J	120 J	96 J	270 J	98 J
Beryllium	15.44 [2]	1941 [3]	40 [5]	0.59	0.16 J	0.21 J	0.25 J	0.2 J	0.23 J
Cadmium	3.7 [2]	45.14 [2]	32 [4]	0.54	0.097 J	0.11 J	0.053 J	0.11 J	0.059 J
Chromium	211	448	0.4 [6]	114.5	1.4	1.3	1.3 J	6.3	1.5
Cobalt	903	1921	13 [4]	26.9	5.4 J	6 J	4.4	5.5 J	5.2 J
Copper	313 [2]	4088 [2]	70 [4]	246	1.2 U	4.2	4.2	3.6	3
Lead	400 [3]	800 [3]	120 [4]	6.3	0.22 U	0.83	1.1	0.68	0.85
Nickel	156 [2]	2043 [2]	38 [4]	24.7	1 U	1 U	1.1 U	1.7 U	1.2 U
Selenium	39 [2]	511 [2]	0.52 [4]	5.94	0.19 U	0.2 U	0.19 U	0.21 U	0.19 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.037 U	0.04 U	0.085 U	0.072 U	0.096 U
Thallium	0.52 [2]	6.75 [2]	1 [7]	0.92	0.44 U	0.46 U	0.45 U	0.48 U	0.45 U
Tin	4700 [2]	10,000	50 [7]	4	3.7 U	4 U	3.8 U	4.1 U	3.8 U
Vanadium	7.82 [2]	102 [2]	2 [7]	434	**25** J	**28** J	**23** J	**29** J	**19** J
Zinc	2346 [2]	100,000	120 [5]	88	19 J	25 J	22 J	22 J	20 J
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.108	0.0038 U	0.0045 J	0.0042 U	0.043	0.0062 J

TABLE 5-2

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sample Depth (ft bgs)** **Sampling Date**	**USEPA Region IX Residential Soil PRGs**	*USEPA Region IX Industrial Soil PRGs*	Selected Ecological Surface Soil Screening	NAPR [1] Basewide Background	**28SB06** **28SB06-01** **1.0 - 3.0** **02/13/08**	**28SB06** **28SB06-01D** **1.0 - 3.0** **02/13/08**	**28SB06** **28SB06-02** **3.0 - 5.0** **02/13/08**	**28SB06** **28SB06-03** **5.0 - 7.0** **02/13/08**	**28SB06** **28SB06-04** **7.0 - 9.0** **02/13/08**	**28SB07** **28SB07-01** **1.0 - 3.0** **02/14/08**	**28SB07** **28SB07-02** **3.0 - 5.0** **02/14/08**
Metals (mg/kg)											
Antimony	3.1 [2]	41 [2]	78 [8]	NE	0.27 U	0.34 U	0.69 U	0.5 U	0.38 U	0.23 U	0.42 U
Arsenic	0.39	1.59	18 [4]	1.59	**0.62** J	**0.47** J	0.29 U	**0.43** J	0.32 U	0.35 U	**0.51** J
Barium	537 [2]	6658 [2]	330 [5]	220	**620** J	**800** J	150 J	120 J	230 J	170 J	140 J
Beryllium	15.44 [2]	1941 [3]	40 [5]	0.59	0.16 J	0.15 J	0.15 J	0.15 J	0.18 J	0.71	0.56
Cadmium	3.7 [2]	45.14 [2]	32 [4]	0.54	0.14 J	0.1 J	0.075 J	0.059 J	0.078 J	0.082 J	0.044 U
Chromium	211	448	0.4 [6]	114.5	2.4	1.7	1.2	1.6	6.6	11	9.5
Cobalt	903	1921	13 [4]	26.9	5.6 J	5.7 J	6 J	6.3 J	6.4 J	6.5 J	6.2 J
Copper	313 [2]	4088 [2]	70 [4]	246	2.4	1.5 U	0.79 U	1.3 U	6.8	11	8.3
Lead	400 [3]	800 [3]	120 [4]	6.3	0.54	0.46 U	0.44 U	0.34 U	0.74	1.5	0.98
Nickel	156 [2]	2043 [2]	38 [4]	24.7	1.1 U	1 J	1.1 J	1.1 J	1.6 J	5	4.8
Selenium	39 [2]	511 [2]	0.52 [4]	5.94	0.19 U	0.19 U	0.18 U	0.2 U	0.2 U	0.21 U	0.22 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.055 U	0.038 U	0.036 U	0.041 U	0.061 U	0.21 U	0.068 U
Thallium	0.52 [2]	6.75 [2]	1 [7]	0.92	0.44 U	0.45 U	0.42 U	0.47 U	0.46 U	0.5 U	0.51 U
Tin	4700 [2]	10,000	50 [7]	4	3.7 U	3.8 U	3.6 U	4 U	3.9 U	4.2 U	4.3 U
Vanadium	7.82 [2]	102 [2]	2 [7]	434	**30** J	**26** J	**32** J	**24** J	**32** J	**32** J	**32** J
Zinc	2346 [2]	100,000	120 [5]	88	19 J	19 J	23 J	24 J	23 J	18 J	15 R
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.108	0.0036 U	0.0039 U	0.0039 U	0.0038 U	0.0057 J	0.026	0.0062 J

TABLE 5-2

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sample Depth (ft bgs)** **Sampling Date**	**USEPA Region IX Residential Soil PRGs**	*USEPA Region IX Industrial Soil PRGs*	Selected Ecological Surface Soil Screening	NAPR [1] Basewide Background	**28SB08** **28SB08-01** **1.0 - 3.0** **02/14/08**	**28SB08** **28SB08-01D** **1.0 - 3.0** **02/14/08**	**28SB08** **28SB08-02** **3.0 - 5.0** **02/14/08**	**28SB08** **28SB08-03** **5.0 - 7.0** **02/14/08**
Metals (mg/kg)								
Antimony	3.1 [2]	41 [2]	78 [8]	NE	0.32 U	0.21 U	0.48 U	0.57 U
Arsenic	0.39	1.59	18 [4]	1.59	**0.79** J	0.33 U	**0.59** J	**0.76** J
Barium	537 [2]	6658 [2]	330 [5]	220	200 J	240 J	360 J	240 J
Beryllium	15.44 [2]	1941 [3]	40 [5]	0.59	0.69	0.74	0.69	0.58
Cadmium	3.7 [2]	45.14 [2]	32 [4]	0.54	0.082 J	0.063 J	0.11 J	0.042 U
Chromium	211	448	0.4 [6]	114.5	37 J	14 J	58	6.2
Cobalt	903	1921	13 [4]	26.9	10 J	6.2 J	10 J	4.8 J
Copper	313 [2]	4088 [2]	70 [4]	246	17 J	9.9 J	21	27
Lead	400 [3]	800 [3]	120 [4]	6.3	1.9	1.4	14	1.2
Nickel	156 [2]	2043 [2]	38 [4]	24.7	17	6.7	25	3.3
Selenium	39 [2]	511 [2]	0.52 [4]	5.94	0.21 U	0.2 U	0.21 U	0.21 U
Silver	39 [2]	510 [2]	560 [8]	NE	0.061 U	0.078 U	0.047 U	0.067 U
Thallium	0.52 [2]	6.75 [2]	1 [7]	0.92	0.49 U	0.48 U	0.5 U	0.49 U
Tin	4700 [2]	10,000	50 [7]	4	4.2 U	4.1 U	4.3 U	4.1 U
Vanadium	7.82 [2]	102 [2]	2 [7]	434	**41** J	**29** J	**48** J	**32** J
Zinc	2346 [2]	100,000	120 [5]	88	19 J	18 J	24 J	14 R
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.108	0.049	0.026	0.027	0.023

TABLE 5-2

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes/Qualifiers:

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

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

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

(3) USEPA Action Level for lead in soils

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

(5) Invertebrate-based ecological soil screening level (USEPA, 2005e [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007e [zinc])

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

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

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

TABLE 5-2

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Table References:

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TABLE 5-3

SUMMARY OF DETECTED RESULTS - 2008 GROUNDWATER
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sampling Date**	**USEPA Region IX Tap Water PRGs**	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR Basewide Background	**28MW05** **28GW05** **02/17/08**	**28MW07** **28GW07** **02/17/08**	**28MW08** **28GW08** **02/17/08**	**28MW08** **28GW08D** **02/17/08**
Total Metals (ug/L)								
Arsenic	0.045	10	36 (3)	18.89	5.9 U	**9.6** J	**6.2** J	**8.8** J
Barium	260 (11)	2,000	50,000 (4)	686	**600**	**1100**	**850**	**780**
Beryllium	7 (11)	4	310 (5)	2.21	0.99 J	3.7 J	1.2 J	1.2 J
Cadmium	1.8 (11)	5	8.85 (3)	16.62	1.1 J	1.6 U	1.2 U	0.99 U
Chromium	11 (11,12)	100	50.4 (3)	162.41	**88**	**79**	**17**	**21**
Cobalt	73 (11)	NE	45 (6)	633.21	27	49	11	12
Copper	150 (11)	1,300.00	3.73 (3)	324	52	110	26	32
Lead	NE	15 (13)	8.52 (3)	26.25	9.5	9.5	8	11
Mercury	1.1 (11)	2.00	1.15 (3)	0.15	0.25	0.29 J	0.4 J	0.43 J
Nickel	73 (11)	NE	8.28 (3)	95.7	32 J	54	11 U	10 U
Silver	18.2 (11)	NE	0.23 (7)	18.31	0.51 U	0.51 U	2.3 J	2.6 J
Vanadium	3.6 (11)	NE	120 (8)	484.66	**100**	**280**	**46**	**52**
Zinc	1,090 (11)	NE	85.6 (3)	547.53	110	140	71	73
Dissolved Metals (ug/L)								
Barium	260 (11)	2,000	50,000 (4)	260	42	42	**450**	**430**
Cobalt	73 (11)	NE	45 (6)	580.5	1.5 J	8.1 J	3.1 J	11
Nickel	73 (11)	NE	8.2 (10)	84.1	2 U	3.7 J	2 U	2 U
Vanadium	3.6 (11)	NE	120 (8)	265.61	**15**	**26**	**10**	**11**
Zinc	1,090 (11)	NE	81 (10)	360.64	11 J	6.3 J	14 J	14 J

TABLE 5-3

SUMMARY OF DETECTED RESULTS - 2008 GROUNDWATER
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes:

U - Not detected
J - Analyte present - Reported value is estimated
NE - Not Established
ug/l - micrograms per liter
(1) NAPR Basewide Groundwater Background - Upper Limit of Means (Mean + 2 standard deviations) Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker Environmental (Baker, 2008)
(2) Minimun acute value (96-hour LC_{50} for Lumbriculus variegatus [oligochaete])with a safety factor of 100
(3) USEPA National recommended water quality criterion (total recoverable saltwater CCC derived by dividing the dissolved CCC value by the USEPA recommended conversion factor) (USEPA, 2006)
(4) Minimum acute value (96-hour LC_{50} for *Americanysis bahia* [opposum shrimp]) with safety factor of 100 (values expressed as a total recoverable concentration) (USEPA, 2003)
(5) Minimum acute value (96-hour LC_{50} for *Fundulus heteroclitus* [mummichog]) with safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).
(6) Minimum acute value (96-hour LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003)
(7) USEPA Region 4 chronic screening value (USEPA, 2001)
(8) Minimum chronic value (28-day NOEC for *Pimephales promelas* [fathead minnow]) based on growth (value expressed as a total recoverable concentration) (USEPA, 2003)
(9) Proposed CCC (value expressed asa total recoverable concentration) (Buchman, 1999)
(10) USEPA National recommended water quality criterion (dissolved saltwater CCC) (USEPA, 2006)
(11) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes
(12) Tap-Water PRG value for hexavalent chromium presented
(13) USEPA Action Level for lead in drinking water

TABLE 5-4

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**USEPA**	*USEPA*	Selected		**28SS01**	**28SS02**	**28SS03**	**28SS04**	**28SS04D**	**28SS05**
Sample ID	**Region IX**	*Region IX*	Ecological	NAPR [1]	**28SS01**	**28SS02**	**28SS03**	**28SS04**	**28SS04D**	**28SS05**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Basewide	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values	Background	**11/14/06**	**11/14/06**	**11/14/06**	**11/15/06**	**11/15/06**	**11/14/06**
Volatiles (ug/kg)										
Acetone	1,412,657 [10]	5,432,098 [10]	NE	NE	440 J	350 J	160 J	380	340	170 J
Benzene	643	1,409	101 [3]	NE	7.8 U	5.6 U	6.0 UJ	2.3 J	2.1 J	6.5 U
Iodomethane	NE	NE	NE	NE	7.8 U	5.6 U	6.0 UJ	1.5 J	8.0 UJ	6.5 U
Isobutanol	1,251,392 [10]	40,000,000	NE	NE	310 R	220 R	240 R	290 R	250 R	260 R
Methyl Ethyl Ketone	2,231,120 [10]	11,326,440 [10]	NE	NE	26 J	23 J	30 U	23 J	26 J	32 U
Semivolatiles (ug/kg)	**(none detected)**									
PAHs (ug/kg)										
Benzo[a]anthracene	621	2,110	1,200 [4]	NE	11 U	8.7 U	9.1 U	10 U	10 U	9.6 U
Chrysene	62,146	210,962	1,200 [4]	NE	11 U	8.7 U	9.1 U	10 U	10 U	9.6 U
Pyrene	231,595 [10]	2,912,620 [10]	1,200 [4]	NE	11 U	8.7 U	9.1 U	10 U	10 U	9.6 U
PCBs (ug/kg)										
Aroclor 1260	220	740	2,510 [5]	NE	55 U	43 U	45 U	51 U	50 U	47 U
TPH (mg/kg)										
Diesel Range Organics	NE	NE	NE	NE	6.3 U	11	4.5 U	5.1 U	5.0 U	4.7 U
Gasoline Range Organics	NE	NE	NE	NE	0.29 J	0.43	0.25 J	0.27 J	0.34	0.39

TABLE 5-4

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**USEPA**	*USEPA*	Selected		**28SS05**	**28SB01**	**28SB02**	**28SB03**	**28SB04**
Sample ID	**Region IX**	*Region IX*	Ecological	NAPR [1]	**28SS05D**	**28SB01-00**	**28SB02-00**	**28SB03-00**	**28SB04-00**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Basewide	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values	Background	**11/14/06**	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**
Volatiles (ug/kg)									
Acetone	1,412,657 [10]	5,432,098 [10]	NE	NE	150 J	25 J	120 J	56 J	450 J
Benzene	643	1,409	101 [3]	NE	7.6 U	6.0 U	6.6 U	5.7 U	5.6 U
Iodomethane	NE	NE	NE	NE	7.6 U	6.0 U	6.6 U	5.7 U	5.6 UJ
Isobutanol	1,251,392 [10]	40,000,000	NE	NE	300 R	240 U	210 J	230 U	220 R
Methyl Ethyl Ketone	2,231,120 [10]	11,326,440 [10]	NE	NE	38 U	30 U	33 U	29 U	24 J
Semivolatiles (ug/kg)	**(none detected)**								
PAHs (ug/kg)									
Benzo[a]anthracene	621	2,110	1,200 [4]	NE	10 U	7.0 U	11 J	41 U	2.0 J
Chrysene	62,146	210,962	1,200 [4]	NE	10 U	1.1 J	11 J	41 U	3.0 J
Pyrene	231,595 [10]	2,912,620 [10]	1,200 [4]	NE	2.1 J	1.6 J	14 J	9.8 J	3.4 J
PCBs (ug/kg)									
Aroclor 1260	220	740	2,510 [5]	NE	50 U	49	**510**	180	21 J
TPH (mg/kg)									
Diesel Range Organics	NE	NE	NE	NE	5.7 U	3.5 U	5.3 U	4.0 U	5.2 U
Gasoline Range Organics	NE	NE	NE	NE	0.28 J	0.24 U	0.13 J	0.13 J	0.16 J

TABLE 5-4

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**USEPA**	*USEPA*	Selected		**28SS01**	**28SS02**	**28SS03**	**28SS04**	**28SS04D**	**28SS05**
Sample ID	**Region IX**	*Region IX*	Ecological	NAPR [1]	**28SS01**	**28SS02**	**28SS03**	**28SS04**	**28SS04D**	**28SS05**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Basewide	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values	Background	**11/14/06**	**11/14/06**	**11/14/06**	**11/15/06**	**11/15/06**	**11/14/06**
Inorganics (mg/kg)										
Antimony	3.13 [10]	40.88 [10]	78 [6]	2.46	6.5 UJ	4.4 UJ	4.9 UJ	5.8 UJ	5.6 UJ	5.3 UJ
Arsenic	0.39	1.59	18 [6]	2.65	***1.7 J***	**1.2 J**	***1.8 J***	***1.7 J***	**1.5 J**	***1.8 J***
Barium	537 [10]	6658 [10]	330 [6]	199	150 J	180 J	220 J	240	230	210 J
Beryllium	15.44 [10]	1,941	40 [6]	0.590	0.30 J	0.36 J	0.40 J	0.34 J	0.35 J	0.36 J
Cadmium	3.7 [10]	45.14 [10]	32 [6]	5.76	0.11 J	0.050 J	0.11 J	0.22 J	0.24 J	0.23 J
Chromium	211	448	0.4 [7]	49.8	15	21	20	18	17	20
Cobalt	903	1,921	13 [6]	46.2	13 J	10 J	15 J	12	12	14 J
Copper	312.86 [10]	4087.67 [10]	70 [6]	168	49 J	26 J	58 J	47 J	44 J	56 J
Lead	400 [2]	800 [2]	120 [6]	22.0	4.9	1.3	4.1	5.0	4.7	5.8
Nickel	156.43 [10]	2043.92 [10]	30 [8]	20.7	13 U	10 J	9.8 U	12 U	11 U	11 U
Selenium	39.11 [10]	511 [10]	1 [8]	1.18	0.40 J	2.2 U	0.40 J	0.43 J	0.31 J	0.37 J
Silver	39.11 [10]	510.99 [10]	560 [6]	NE	3.3 U	2.2 U	2.4 U	0.32 J	0.33 J	0.29 J
Thallium	0.52 [10]	6.75 [10]	1 [8]	NE	3.3 U	2.2 U	2.4 U	2.9 U	2.8 UJ	2.6 U
Tin	4692 [10]	100,000.00	50 [8]	3.76	16 UJ	11 UJ	12 UJ	14 UJ	14 U	13 UJ
Vanadium	7.82 [10]	102.2 [10]	2 [8]	287	**87 J**	**54 J**	**98 J**	**69**	**68**	**86 J**
Zinc	2346 [10]	100,000	50 [8]	115	47	28	51	68 J	68 J	77
Mercury - 7471A	2.35 [10]	30.66 [10]	0.1 [7]	0.109	0.039 J	0.040 J	0.20 J	0.13 J	0.12 J	0.12 J
Cyanide Total - 9012A	120 [10]	1200 [10]	0.9 [9]	NE	0.83 U	0.64 U	0.68 U	0.76 U	0.76 U	0.41 J
Sulfide - 9034	NE	NE	NE	37	42 U	32 U	50	39 U	38 U	36 U

TABLE 5-4

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**USEPA**	*USEPA*	Selected		**28SS05**	**28SB01**	**28SB02**	**28SB03**	**28SB04**
Sample ID	**Region IX**	*Region IX*	Ecological	NAPR [1]	**28SS05D**	**28SB01-00**	**28SB02-00**	**28SB03-00**	**28SB04-00**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Basewide	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values	Background	**11/14/06**	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**
Inorganics (mg/kg)									
Antimony	3.13 [10]	40.88 [10]	78 [6]	2.46	5.4 UJ	3.9 UJ	1.2 J	1.2 J	4.6 UJ
Arsenic	0.39	1.59	18 [6]	2.65	***2.4 J***	**1.4 J**	***2.7***	***1.9 J***	***3.2***
Barium	537 [10]	6658 [10]	330 [6]	199	230 J	**980 J**	270 J	220 J	120 J
Beryllium	15.44 [10]	1,941	40 [6]	0.590	0.39 J	0.56 J	0.43 J	0.40 J	0.25 J
Cadmium	3.7 [10]	45.14 [10]	32 [6]	5.76	0.25 J	0.18 J	2.2 J	1.2 J	0.30 J
Chromium	211	448	0.4 [7]	49.8	22	11 J	27 J	31	19
Cobalt	903	1,921	13 [6]	46.2	16 J	7.3	7.9	8.3 J	12 J
Copper	312.86 [10]	4087.67 [10]	70 [6]	168	63 J	19 J	84 J	67 J	47 J
Lead	400 [2]	800 [2]	120 [6]	22.0	6.5	4.4 J	54 J	55	9.8
Nickel	156.43 [10]	2043.92 [10]	30 [8]	20.7	11 J	5.9 J	11 J	12 J	9.2 U
Selenium	39.11 [10]	511 [10]	1 [8]	1.18	0.39 J	2.0 U	0.79 J	0.55 J	0.25 J
Silver	39.11 [10]	510.99 [10]	560 [6]	NE	0.30 J	1.4 J	19 J	16 J	1.4 J
Thallium	0.52 [10]	6.75 [10]	1 [8]	NE	0.17 J	2.0 U	2.3 U	2.3 U	2.3 U
Tin	4692 [10]	100,000.00	50 [8]	3.76	13 UJ	9.8 UJ	46 J	34	11 UJ
Vanadium	7.82 [10]	102.2 [10]	2 [8]	287	***110 J***	**35 J**	**45 J**	**45 J**	**64 J**
Zinc	2346 [10]	100,000	50 [8]	115	86	36 J	300 J	160	77
Mercury - 7471A	2.35 [10]	30.66 [10]	0.1 [7]	0.109	0.080 J	0.70 J	**5.1 J**	**8.0**	0.21 J
Cyanide Total - 9012A	120 [10]	1200 [10]	0.9 [9]	NE	0.74 U	0.52 U	0.62 U	0.60 U	0.56 U
Sulfide - 9034	NE	NE	NE	37	38	26 U	33	47	29 U

TABLE 5-4

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

(1) NAPR Basewide Surface Soil Background - Upper Limit of Means (Mean + 2 standard deviations) from Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR

(2) USEPA action level for lead in soils

(3) The screening value shown is an average of the target and intervention soil standards. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent) (MHSPE, 2000)

(4) Plant-based surface soil screening value for benzo(a)pyrene used as a surrogate (USEPA, 1999)

(5) Toxicological threshold for earthworms (USEPA, 1999)

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

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

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

(9) Soil quality guideline (CCME. 2006)

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

UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
U - Not detected
R - Validator rejected analytical result
NA - Not Analyzed
ND - Not Detected
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
ft bgs - feet below ground surface
CCME - Canadian Council of Ministers of the Environment
mg/kg - milligram per kilogram
ug/kg - microgram per kilogram

TABLE 5-5

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SUBSURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	**USEPA**	*USEPA*	Selected Ecological		**28SB01**	**28SB01**	**28SB02**	**28SB02**	**28SB03**	**28SB03**	**28SB04**
Sample ID	**Region IX**	*Region IX*	Surface Soil	NAPR [2]	**28SB01-03**	**28SB01-05**	**28SB02-01**	**28SB02-05**	**28SB03-01**	**28SB03-03**	**28SB04-01**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Screening	Basewide	**(5.0 - 7.0)**	**(9.0 - 11.0)**	**(1.0 - 3.0)**	**(9.0 - 11.0)**	**(1.0 - 3.0)**	**(5.0 - 7.0)**	**(1.0 - 3.0)**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Values [1]	Background	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**	**11/13/06**
Volatiles (ug/kg)											
Acetone	1,412,657 [8]	5,432,098 [8]	NE	NE	48 U	43 U	40 U	44 U	24 J	17 J	52 UJ
Semivolatiles (ug/kg)											
Bis(2-ethylhexyl) phthalate	34,741	123,121	6,010 [4]	NE	350 U	340 U	360 U	410 U	100 J	370 U	360 U
PAHs (ug/kg)	**(none detected)**										
PCBs (ug/kg)	**(none detected)**										
TPH (mg/kg)											
Gasoline Range Organics	NE	NE	NE	NE	0.23 U	0.27 U	0.23 U	0.20 U	0.19 U	0.27 U	0.079 J
Inorganics (mg/kg)											
Arsenic	0.39	1.59	18 [5]	6.66	**0.86 J**	**0.55 J**	**1.4 J**	**1.2 J**	**2.3**	**1.0 J**	**1.4 J**
Barium	537 [8]	6657 [8]	330 [5]	207	250 J	210 J	230 J	64 J	380 J	250 J	230 J
Beryllium	15.44 [8]	1941 [8]	40 [5]	0.963	0.78 J	0.46 J	0.51 J	0.35 J	0.64 J	0.57 J	0.61 J
Chromium	211	448	0.4 [6]	47.9	1.4 J	1.1 J	6.2 J	5.7 J	21	11	8.1
Cobalt	903	1,921	13 [5]	63.1	4.9	7.1	6.7	6.4	12 J	7.9 J	7.3 J
Copper	313 [8]	4088 [8]	70 [5]	120	4.1 UJ	5.4 R	11 R	4.8 U	27 J	14 R	10 R
Lead	400 [3]	800 [3]	120 [5]	6.2	0.27 J	0.47 J	0.83 J	1.6 J	4.4 J	1.1	1.1
Nickel	156 [8]	2044 [8]	30 [7]	26.5	0.98 J	1.2 J	3.4 J	2.6 J	8.6 UJ	8.2 U	8.4 J
Selenium	39 [8]	511 [8]	1 [7]	1.19	2.1 U	1.8 U	2.0 U	0.24 J	0.39 J	2.0 U	2.1 U
Vanadium	7.82 [8]	102.2 [8]	2 [7]	256	**26 J**	**33 J**	**31 J**	**23 J**	**53 J**	**31 J**	**28 J**
Zinc	2346 [8]	100,000	50 [7]	92	27 J	47 J	19 J	7.9 J	21	17	19
Mercury -7471A	2.35 [8]	30.66 [8]	0.1 [6]	0.067	0.021 J	0.020 UJ	0.014 J	0.019 J	0.016 J	0.021 J	0.030 J
Sulfide - 9034	NE	NE	NE	NE	27 U	210	28 U	46	29 U	28 U	35

TABLE 5-5

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI SUBSURFACE SOIL
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

(1) Surface Soil Screening values compared to 28SB02-02, 28SB03-01, and 28SB04-01 only, since they were from 1 to 3 feet bgs, and anything above 2 feet is ecologically significant

(2) NAPR Basewide Subsurface Soil Background - SILT - Upper Limit of Means from Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker Environmental Inc.

(3) USEPA action level for lead in soils

(4) The screening value shown is an average of the target and intervention soil standards. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent) (MHSPE, 2000)

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

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

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

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

U - Not detected
UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
NE - Not Established
PRG - Preliminary Remedial Goal
ft bgs - feet below ground surface
NAPR - Naval activity Puerto Rico
mg/kg - milligram per kilogram
ug/kg - microgram per kilogram

TABLE 5-6

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI GROUNDWATER
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID **Sample ID** **Sampling Date**	**USEPA Region IX Tap Water PRGs**	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR [1] Basewide Background	**28TW01** **28TW01** **11/17/06**	**28TW02** **28TW02** **11/14/06**	**28TW02D** **28TW02D** **11/14/06**	**28TW03** **28TW03** **11/15/06**
Volatiles (ug/L)								
Acetone	548 [11]	NE	1,000 [2]	NE	9.6 J	25 U	25 U	25 U
Semivolatiles (ug/L)	**(none detected)**							
PAHs (ug/L)	**(none detected)**							
PCBs (ug/L)	**(none detected)**							
TPH (ug/L)								
Diesel Range Organics	NE	NE	NE	NE	0.14	0.10 U	0.096 U	0.82
Gasoline Range Organics	NE	NE	NE	NE	0.016 J	0.050 U	0.050 U	0.050 U
Inorganics (ug/L)								
Arsenic	0.045	10	36 [3]	18.89	***29***	10 U	10 U	**7.0 J**
Barium	260 [11]	2,000	50,000 [4]	686	**12000**	**350**	**340**	**1400**
Beryllium	7 [11]	4	310 [5]	2.21	***78***	4.0 U	4.0 U	2.0 J
Cadmium	1.8 [11]	5	8.85 [3]	55.83	**4.1 J**	5.0 U	5.0 U	0.30 J
Chromium	11 [11,12]	100	50.4 [3]	162.41	*1700*	10 U	10 U	**61**
Cobalt	73 [11]	NE	45 [6]	633.21	**550 J**	0.58 J	0.62 J	26
Copper	150 [11]	1,300.00	3.73 [3]	593.00	**380 J**	20 U	20 U	29 R
Lead	NE	15 [13]	8.52 [3]	26.25	***45***	5.0 U	5.0 U	4.5 J
Nickel	73 [11]	NE	8.28 [3]	84.1	**280**	40 U	40 U	40 U
Selenium	18 [11]	50.00	71.1 [3]	33.98	2.3 J	10 U	10 U	3.5 J
Silver	18.2 [11]	NE	0.23 [7]	2.00	5.1 J	10 U	10 U	10 U
Tin	2,190 [11]	NE	NE	20.68	26 UJ	10 UJ	10 UJ	3.1 J
Vanadium	3.6 [11]	NE	120 [8]	484.66	**820**	10 U	10 U	**130**
Zinc	1,090 [11]	NE	85.6 [3]	547.53	**1400 J**	5.8 J	12 J	61 J
Mercury - 7470A (ug/L)	1.1 [11]	2.00	1.15 [3]	0.29	***4.6***	0.20 U	0.20 U	0.40 U
Sulfide - 9034 (mg/L)	NE	NE	NE	NE	1.1	1.0 U	1.0 U	1.0 U

TABLE 5-6

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI GROUNDWATER
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Sample ID **Sampling Date**	**USEPA Region IX Tap Water PRGs**	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR [1] Basewide Background	**28TW01** **28TW01** **11/17/06**	**28TW02** **28TW02** **11/14/06**	**28TW02D** **28TW02D** **11/14/06**	**28TW03** **28TW03** **11/15/06**
Dissolved Inorganics (ug/L)								
Antimony Dissolved	1.46 [11]	6.00	500 [9]	15.40	1.2 J	20 U	20 U	20 U
Arsenic, Dissolved	0.045	10	36 [10]	20.41	**1.5 J**	**1.6 J**	**0.85 J**	**3.6 J**
Barium, Dissolved	260 [11]	2,000	50,000 [4]	260	40	**340 J**	**330 J**	**710 J**
Beryllium Dissolved	7 [11]	4	310 [5]	2.21	4.0 U	4.0 U	4.0 U	0.16 J
Chromium, Dissolved	11 [11,12]	100	50 [10]	9.0	1.6 J	10 U	10 U	5.5 J
Cobalt, Dissolved	73 [11]	NE	45 [6]	580.5	13	2.9 J	0.73 J	13
Nickel, Dissolved	73 [11]	NE	8.2 [10]	84.1	40 U	1.2 J	0.51 J	4.0 J
Selenium, Dissolved	18 [11]	50	71 [10]	33.98	1.5 J	10 U	10 U	1.8 J
Vanadium, Dissolved	3.6 [11]	NE	120 [8]	265.61	**25**	10 U	10 U	**19**
Zinc, Dissolved	1,090 [11]	NE	81 [10]	360.64	7.8 J	7.2 J	10 J	15 J

TABLE 5-6

SUMMARY OF DETECTED RESULTS - 2006 PHASE I RFI GROUNDWATER
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

(1) NAPR Basewide Groundwater Background - Upper Limit of Means (Mean + 2 standard deviations) Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR

(2) Minimun acute value (96-hour LC_{50} for Lumbriculus variegatus [oligochaete])with a safety factor of 100

(3) USEPA National recommended water quality criterion (total recoverable saltwater CCC derived by dividing the dissolved CCC value by the USEPA recommended conversion factor) (USEPA, 2006)

(4) Minimum acute value (96-hour LC_{50} for *Americanysis bahia* [opposum shrimp]) with a safety factor of 100 (values expressed as a total recoverable concentration) (USEPA, 2003)

(5) Minimum acute value (96-hour LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).

(6) Minimum acute value (96-hour LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003)

(7) USEPA Region 4 chronic screening value (USEPA, 2001)

(8) Minimum chronic value (28-day NOEC for *Pimephales promelas* [fathead minnow]) based on growth (value expressed as a total recoverable concentration)

(9) Proposed CCC (value expressed asa total recoverable concentration) (Buchman, 1999)

(10) USEPA National recommended water quality criterion (dissolved saltwater CCC) (USEPA, 2006)

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

(12) Tap-Water PRG value for hexavalent chromium presented

(13) USEPA Action Level for lead in drinking water

U - Not detected
UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
NE - Not Established
ug/l - micrograms per liter

TABLE 5-7

SUMMARY OF DETECTED RESULTS - QUALITY ASSURANCE/QUALITY CONTROL
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

	Equipment Rinsates				Field Blanks	
Sample ID	**ER03**	**ER04**	**ER06**	**ER10**	**FB01**	**FB02**
Sampling Date	**2/12/2008**	**2/13/2008**	**2/14/2008**	**2/17/2008**	**2/16/2008**	**2/16/2008**
Metals (ug/L)						
Barium	2 U	2 U	2 U	2 U	2 U	2.3 J
Lead	2.3 U	2.3 U	2.3 U	2.5 J	2.3 U	2.3 U
Silver	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.77 J
Thallium	4.6 U	4.6 U	4.9 J	4.6 U	4.6 U	4.6 U
Zinc	8.4 U	8.6 J	8.4 U	8.4 U	8.4 U	160

Qualifiers/Notes:
J - Analyte present - Reported value is estimated
U - Not detected
ug/l - micrograms per liter

FIGURES

K:_SOUTHNAVFAC\111626 D02\Task 9 - Phase II RFIs\SWMU 28 Full RFI Report\CAD\111626_28FUL-01

4 0 2 4 8

1 inch = 4 miles

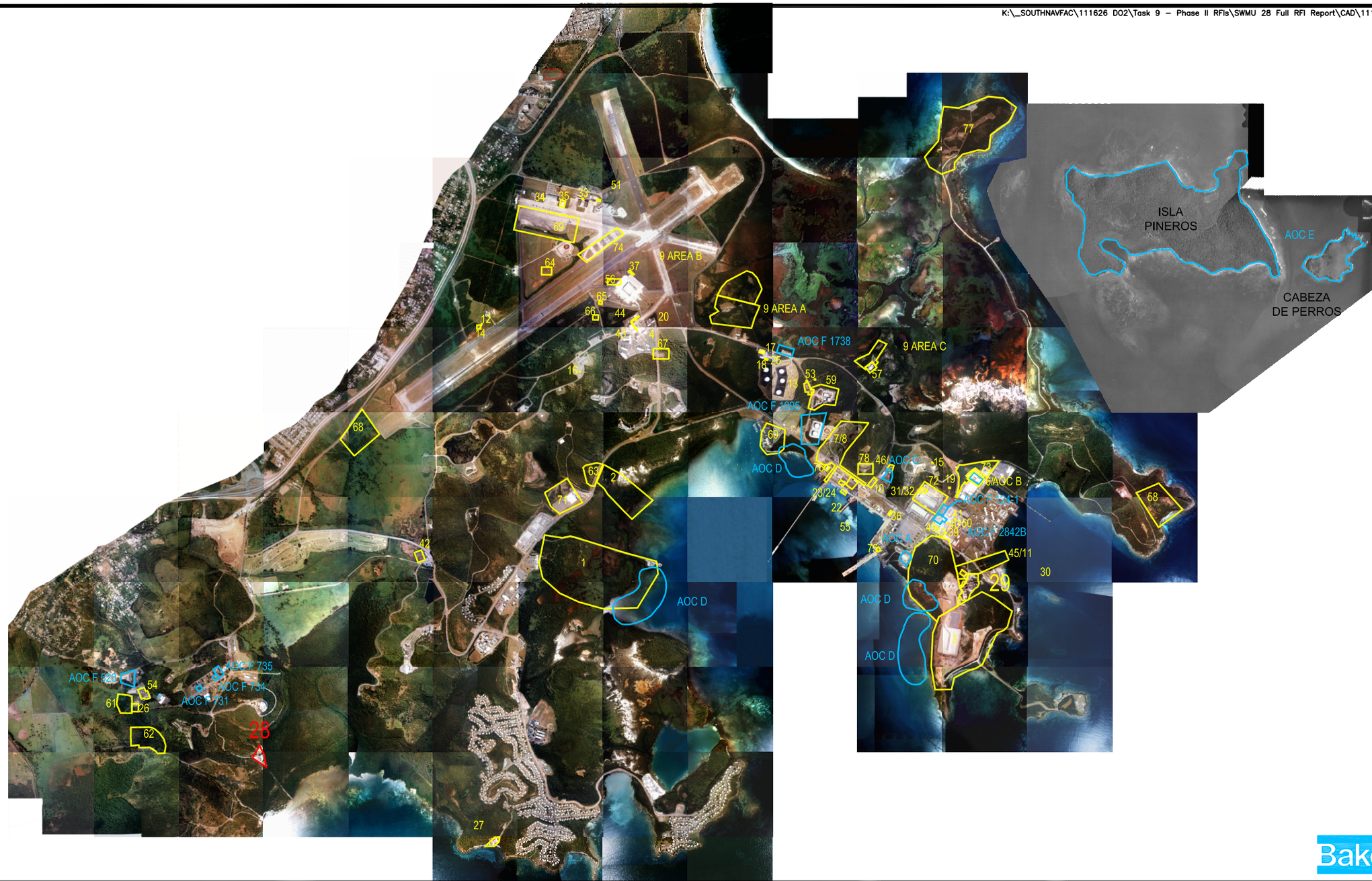
Baker

FIGURE 2-1
REGIONAL LOCATION MAP
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 9 – Phase II RFIs\SWMU 28 Full RFI Report\CAD\111626_28FUL-02



LEGEND

– SWMUs

– 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 2-2
SWMU/AOC LOCATION MAP
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI

NAVAL ACTIVITY PUERTO RICO

80 0 40 80

1 inch = 80 ft.

Baker

LEGEND

– SITE BOUNDARY

– WETLAND DELINEATION

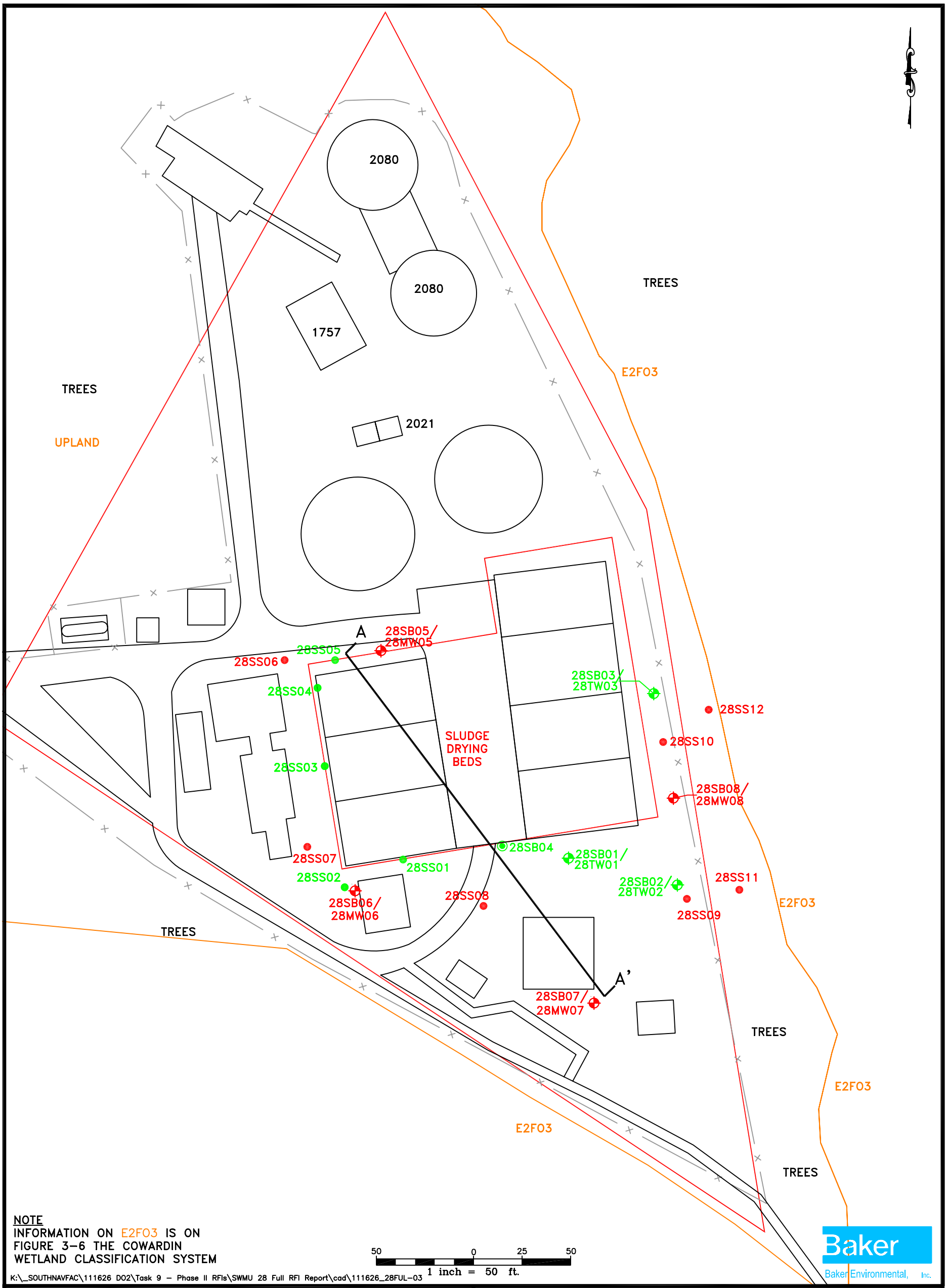
NOTE

INFORMATION ON E2FO3 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

FIGURE 2-3
SWMU 28 LOCATION MAP

SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI

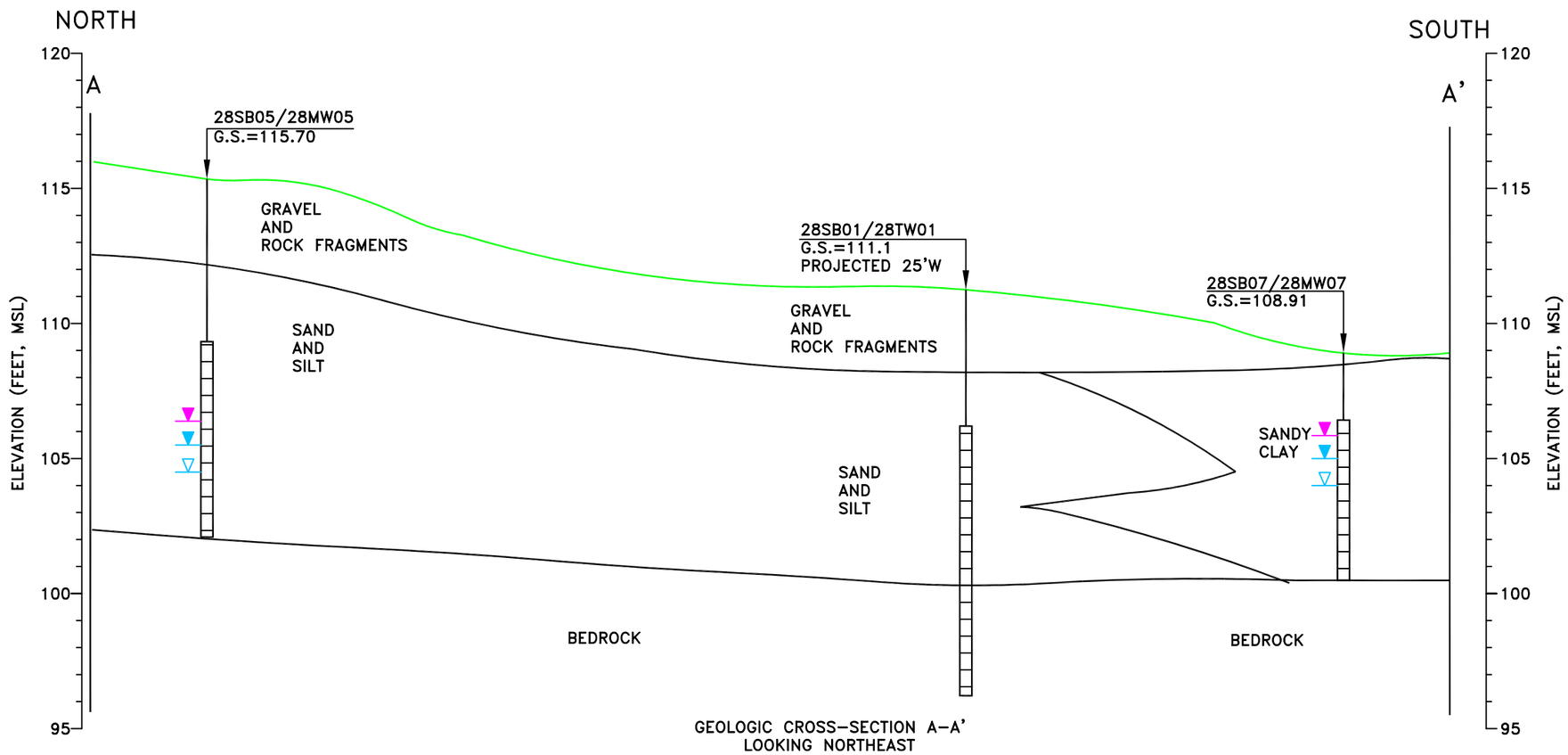
NAVAL ACTIVITY PUERTO RICO



LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION
- A A' – CROSS SECTION

FIGURE 3-1
SITE PLAN AND CROSS SECTION
LOCATION MAP
SWMU 28-BUNDY WWTP SLUDGE
DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO



GEOLOGIC CROSS-SECTION A-A'
LOOKING NORTHEAST

5 0 2.5 5
1 inch = 5 ft.
VERTICAL SCALE
EXACGERATION 8x

25 0 12.5 25
1 inch = 25 ft.
HORIZONTAL SCALE

Baker

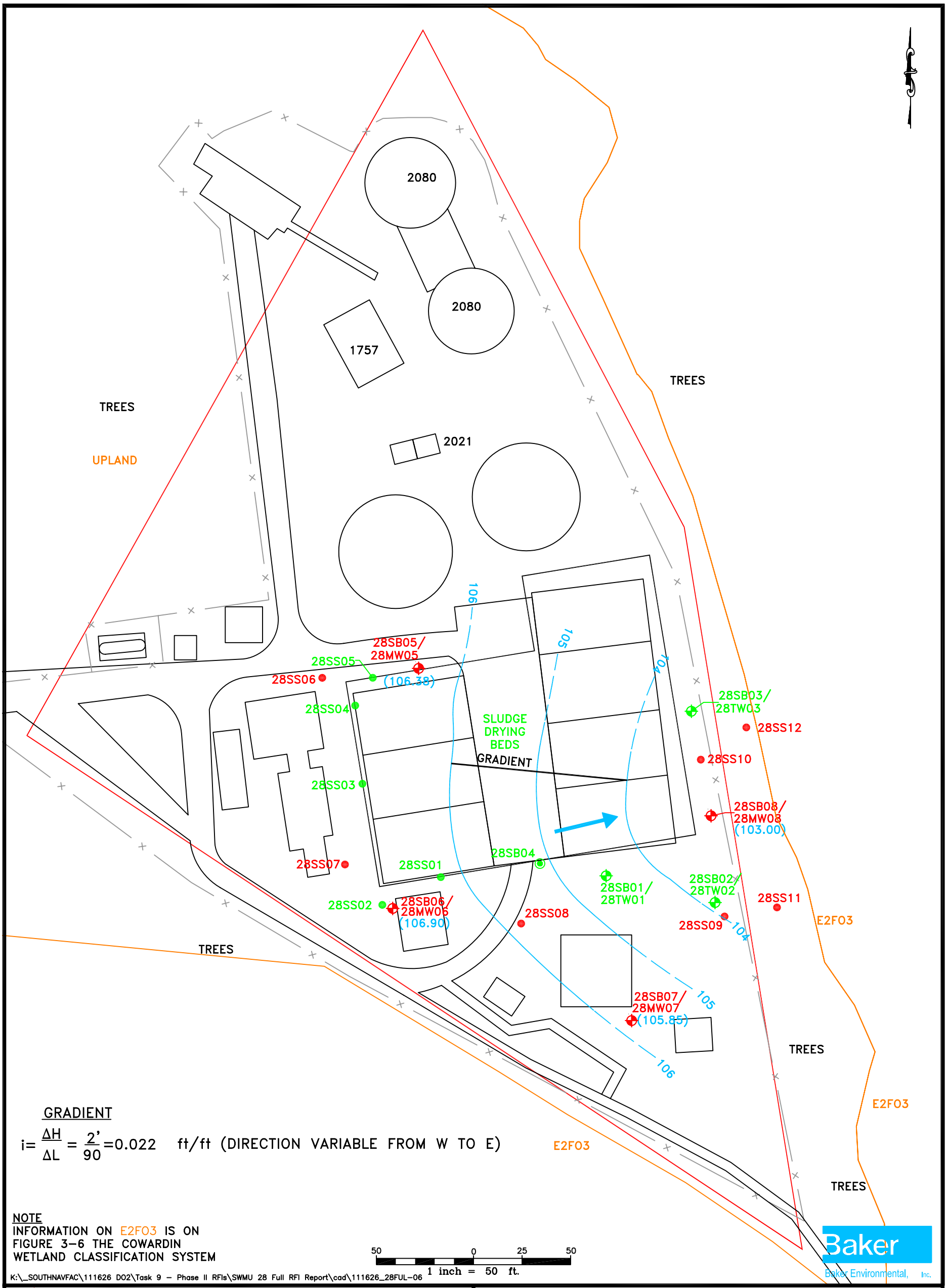
LEGEND

ft.	FEET	I	WELL RISER
msl	MEAN SEA LEVEL		WELL SCREEN INTERVAL
———	ESTIMATED	— —	PROJECTED
G.S.	GROUND SURFACE, ft. msl		
▼	GROUNDWATER SURFACE (FEBRUARY 15, 2008)		
▼	GROUNDWATER SURFACE (JUNE 12, 2008)		
▽	GROUNDWATER ENCOUNTERED DURING DRILLING		

ALL ELEVATIONS SHOWN ARE MEAN SEA LEVEL PLUS 100 FEET

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 3-2
GEOLOGIC CROSS-SECTION A-A'
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO



GRADIENT

$$i = \frac{\Delta H}{\Delta L} = \frac{2'}{90} = 0.022 \quad \text{ft/ft (DIRECTION VARIABLE FROM W TO E)}$$

NOTE
INFORMATION ON E2F03 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

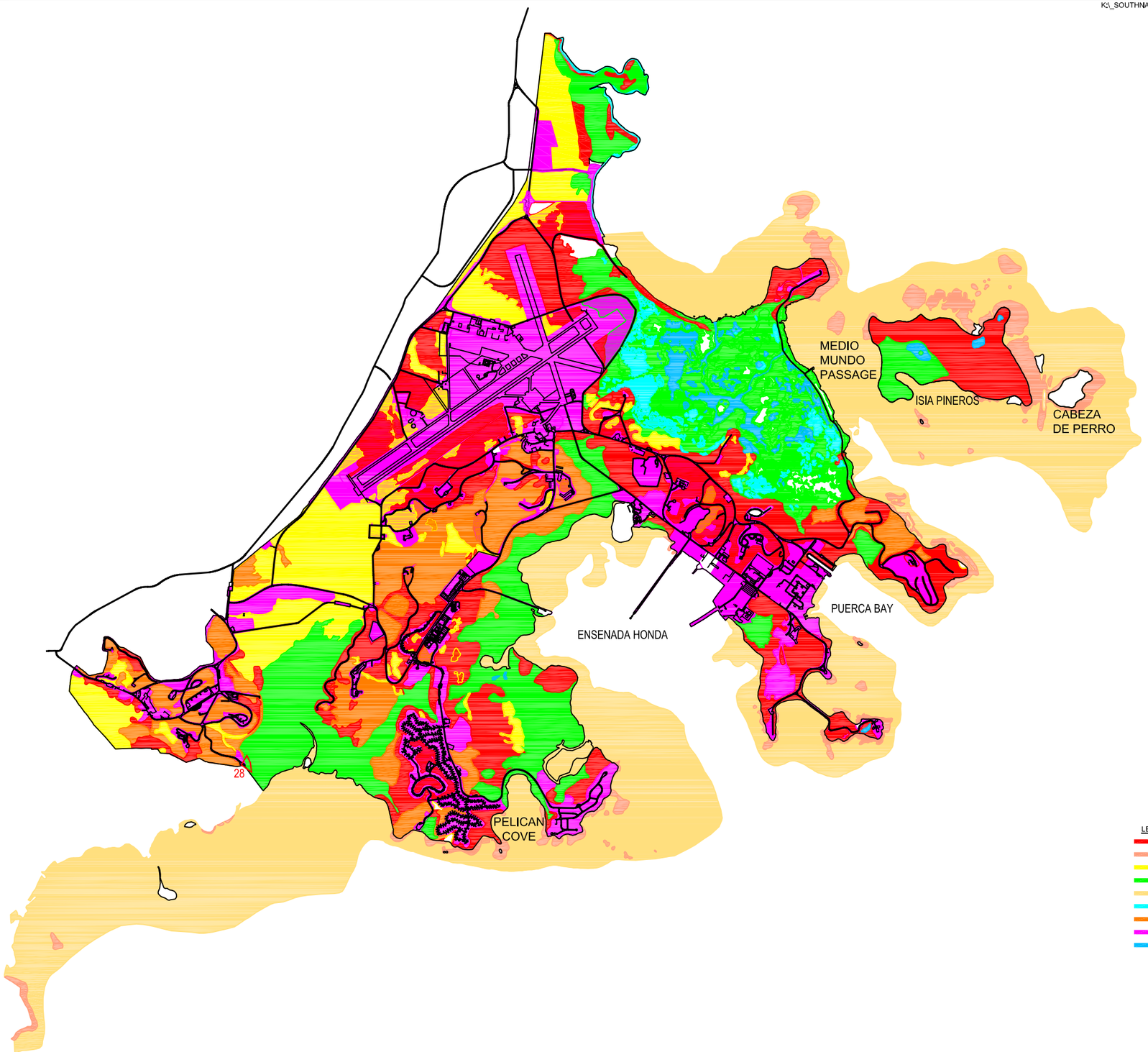
K:_SOUTHNAVFAC\111626 DO2\Task 9 – Phase II RFIs\SWMU 28 Full RFI Report\cad\111626_28FUL-06

LEGEND

- SITE BOUNDARY
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- (103.00) – GROUNDWATER ELEVATION, ft. msl
- GROUNDWATER FLOW
- 103 – GROUNDWATER ELEVATION CONTOUR, FEET .MSL (ELEVATIONS ARE MEAN SEA LEVEL PLUS 100 FEET)
- WETLAND DELINEATION

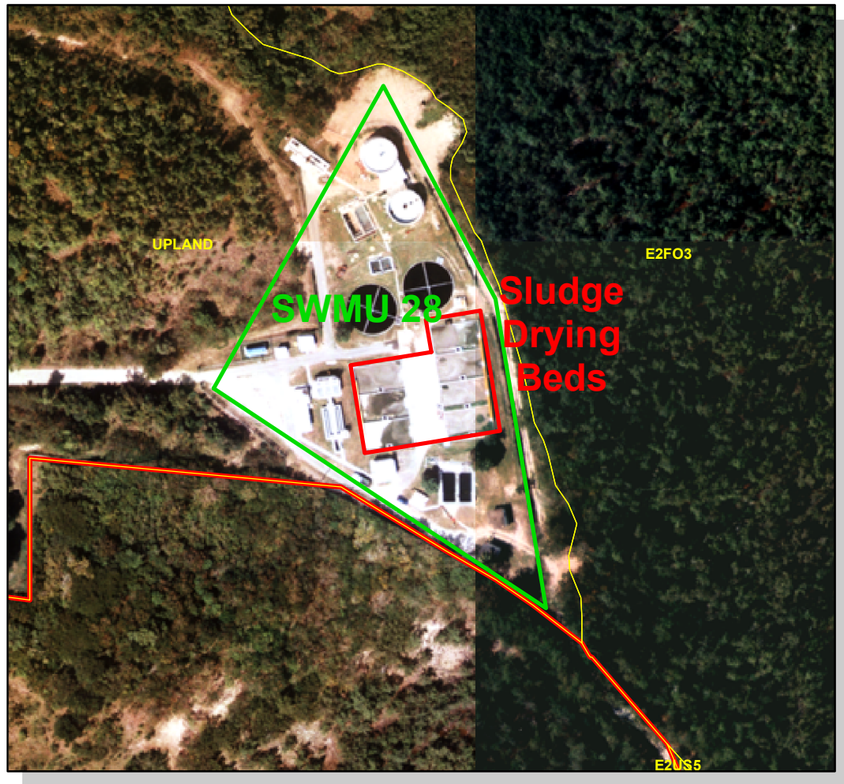
FIGURE 3-3
GROUNDWATER CONTOUR MAP
(JUNE 12, 2008)
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 9 - Phase II RFIs\SWMU 28 Full RFI\cad\111626_28FUL-10



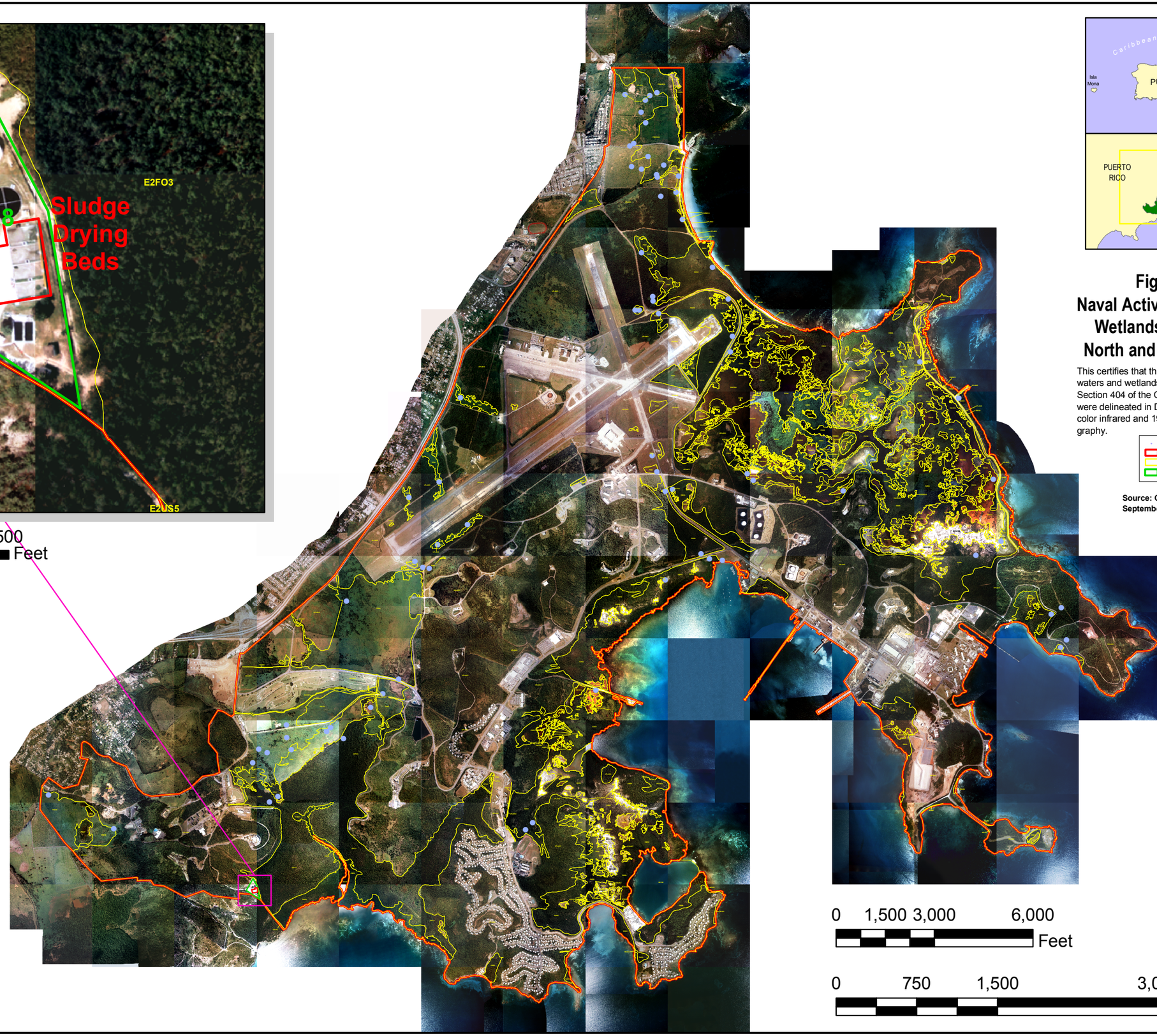
SOURCE: GEO-MARINE, INC, 1998

REVISIONS		NORTH		SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS NAVAL ACTIVITY PUERTO RICO	Baker	"TERRESTRIAL AND AQUATIC HABITAT OCCURRING AT NAVAL ACTIVITY PUERTO RICO" FULL RCRA FACILITY INVESTIGATION	FIGURE
	DRAWN RRR REVIEWED MEK S.O.# 111626 CADD# 111626_28FUL-10.dwg			BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania		SCALE FULLSIZE 1" = 600' DATE JUNE 2008	3-4



0 125 250 500 Feet

0 25 50 100 Meters



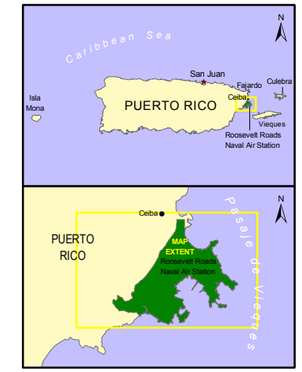


Figure 3-5
Naval Activity Puerto Rico Wetlands Delineation North and East Sections

This certifies that this plat identifies potential waters and wetlands regulated persuant to Section 404 of the Clean Water Act. Wetlands were delineated in December, 1999 from 1993 color infrared and 1998 true color aerial photography.

Data form locations
Roosevelt Roads base boundary
Wetland boundaries
SWMU's

N

Source: Geo-Marine, Inc., September 6, 2000

0 1,500 3,000 6,000 Feet

0 750 1,500 3,000 Meters

FIGURE 3-6
THE COWARDIN WETLAND CLASSIFICATION SYSTEM
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RCRA FACILITY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO

SYSTEM: M - MARINE

SUBSYSTEM	1 - SUBTIDAL					2 - INTERTIDAL			
CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)	AB - Aquatic Bed	RF - Reef	RS - Rocky Shore	US - Unconsolidated 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

SYSTEM: E - ESTUARINE

SUBSYSTEM	1 - SUBTIDAL			2 - INTERTIDAL						
CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)	AB - Aquatic Bed	RF - Reef	SB - Streambed	RS - Rocky Shore	US - Unconsolidated 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*

SYSTEM: R - RIVERINE

SUBSYSTEM	1 - TIDAL		2 - LOWER PERENNIAL	3 - UPPER PERENNIAL		4 INTERMITTENT		5 - UNKNOWN PERENNIAL
CLASS	RB - Rock	UB - Unconsolidated Bottom	SB - Streambed	AB - Aquatic Bed	RS - Rocky Shore	US - Unconsolidated 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

SYSTEM: L - LACUSTRINE

SUBSYSTEM	1 - LIMNETIC				2 - LITTORAL					
CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	OW - Open Water (unknown bottom)	RB - Rock Bottom	RS - Rocky Shore	UB - Unconsolidated Bottom	AB - Aquatic Bed	US - Unconsolidated 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	

SYSTEM: P - PALUSTRINE

CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	US - Unconsolidated 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-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	

MODIFIERS

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

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

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

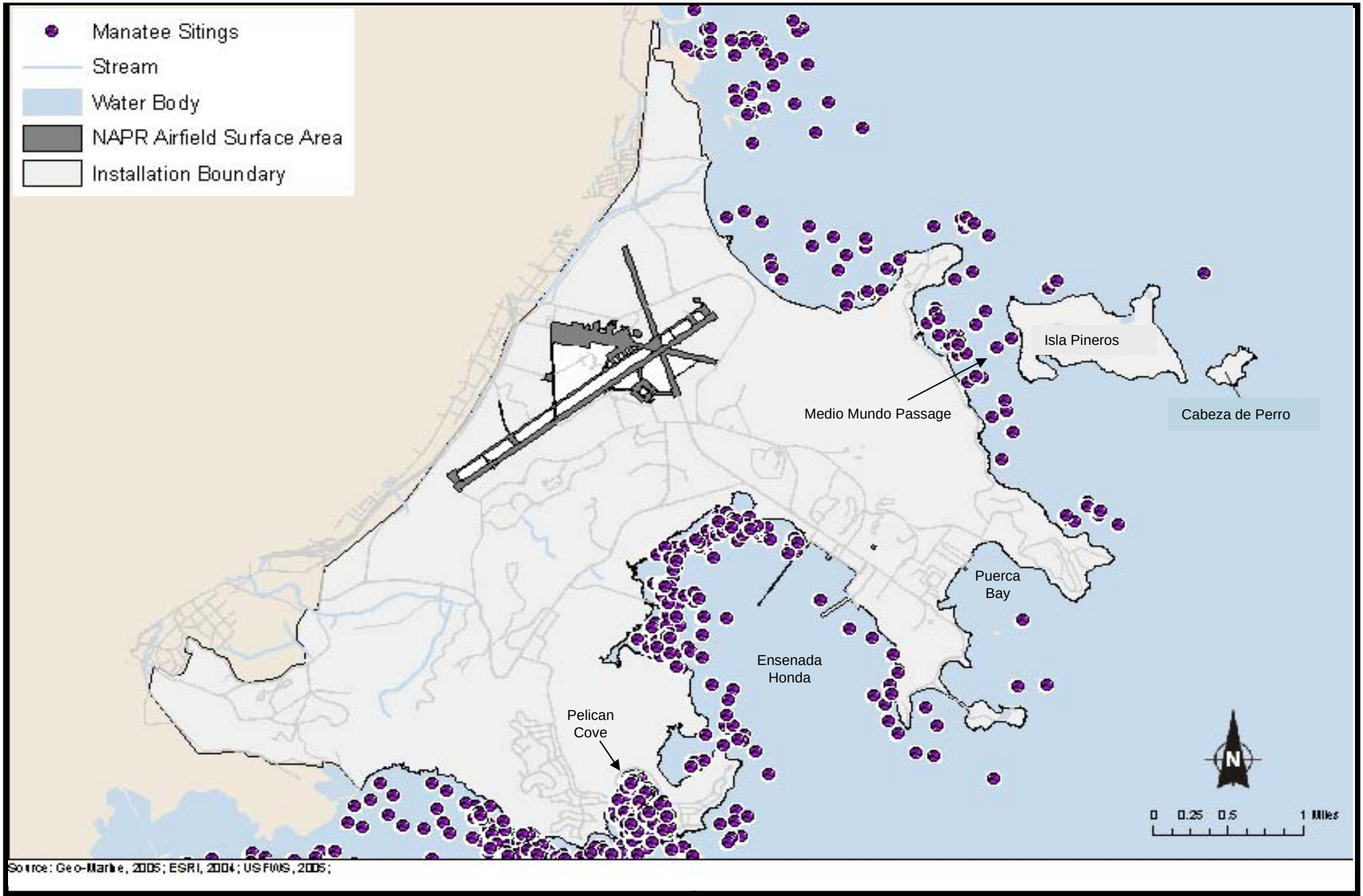
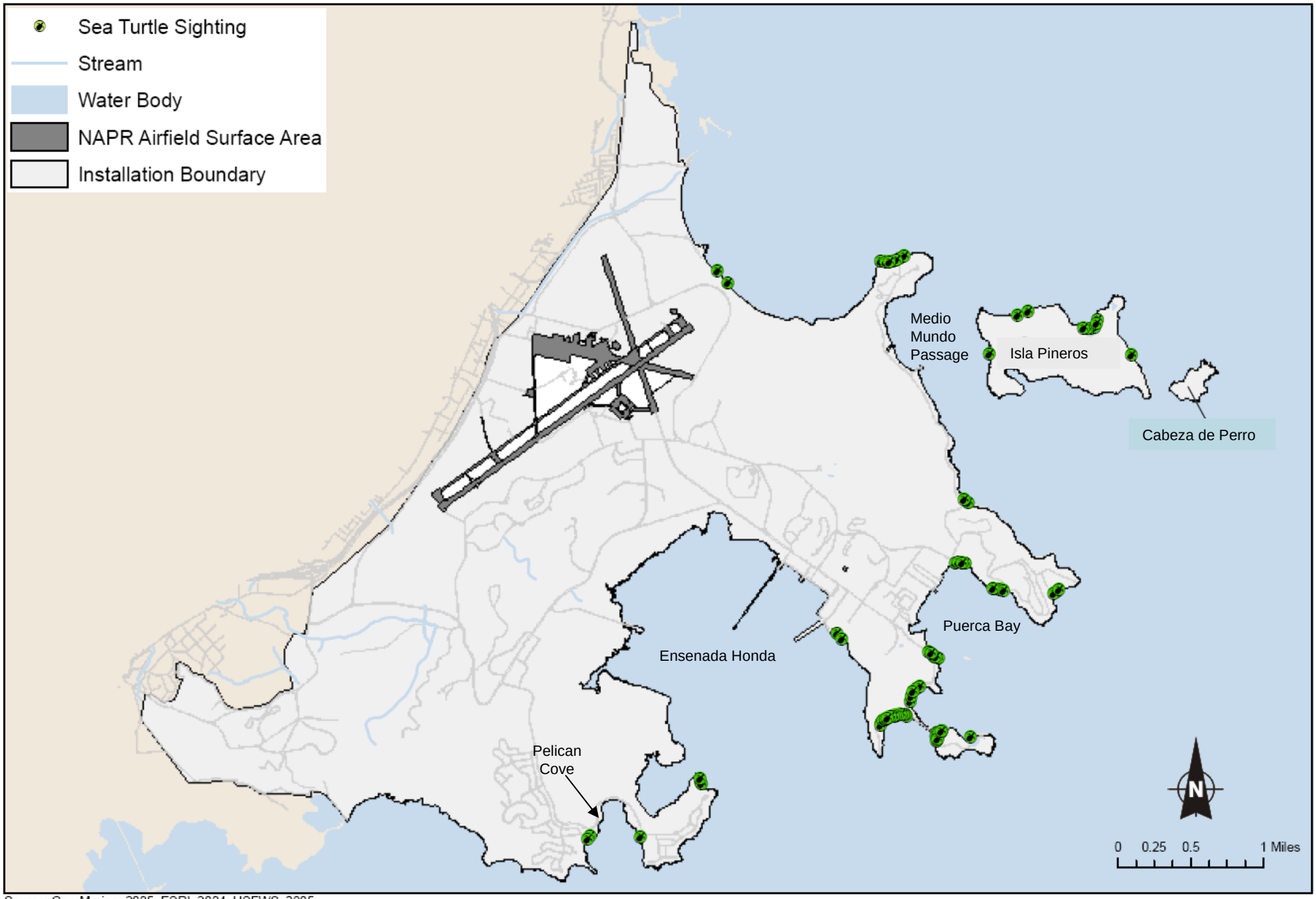


Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

FIGURE 3-7
HISTORICAL MANATEE SIGHTINGS IN EASTERN PUERTO RICO
SWMU 28 – BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

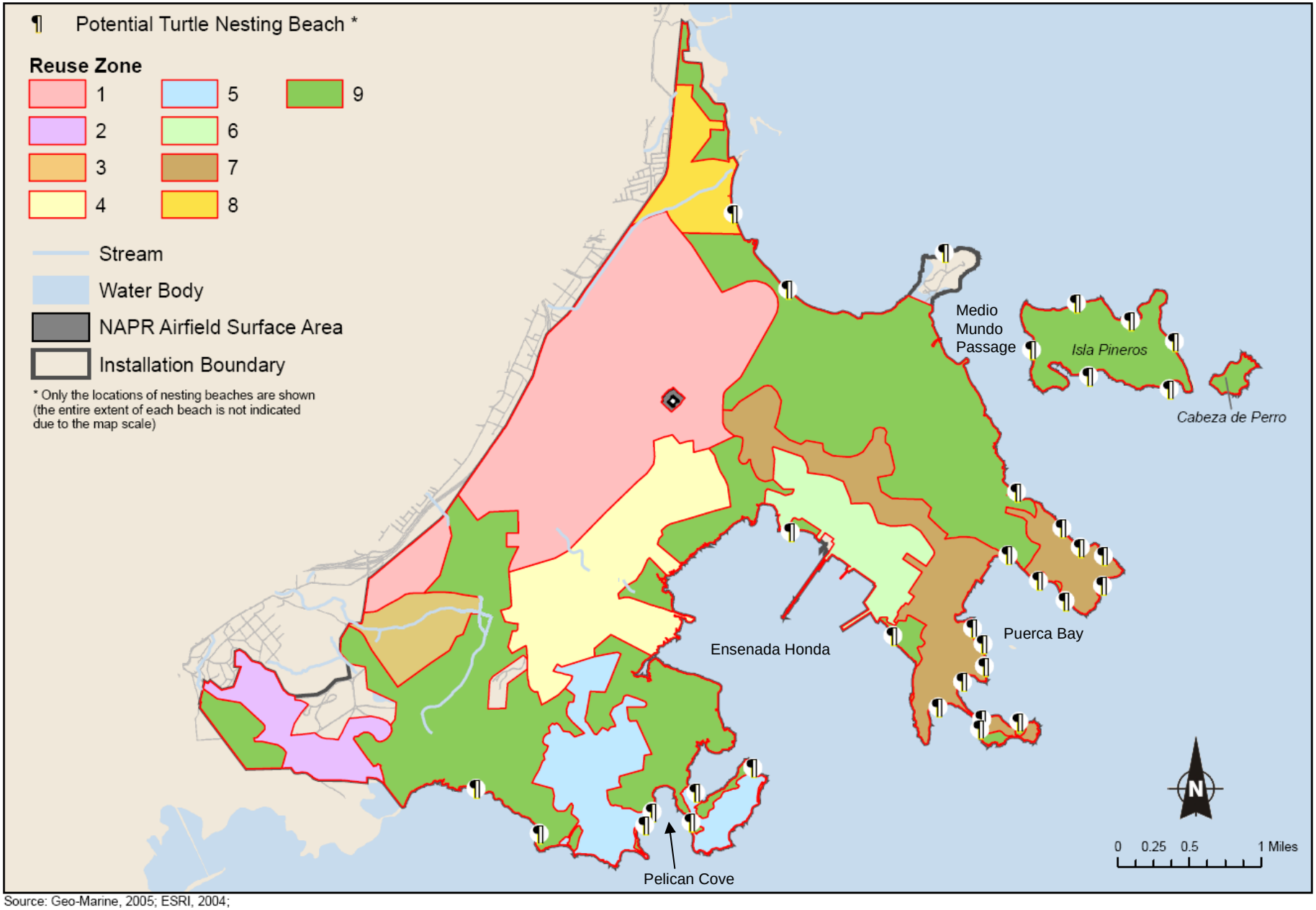


Source: Geo-Marine, 2005; ESRI, 2004; USFWS, 2005;

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.

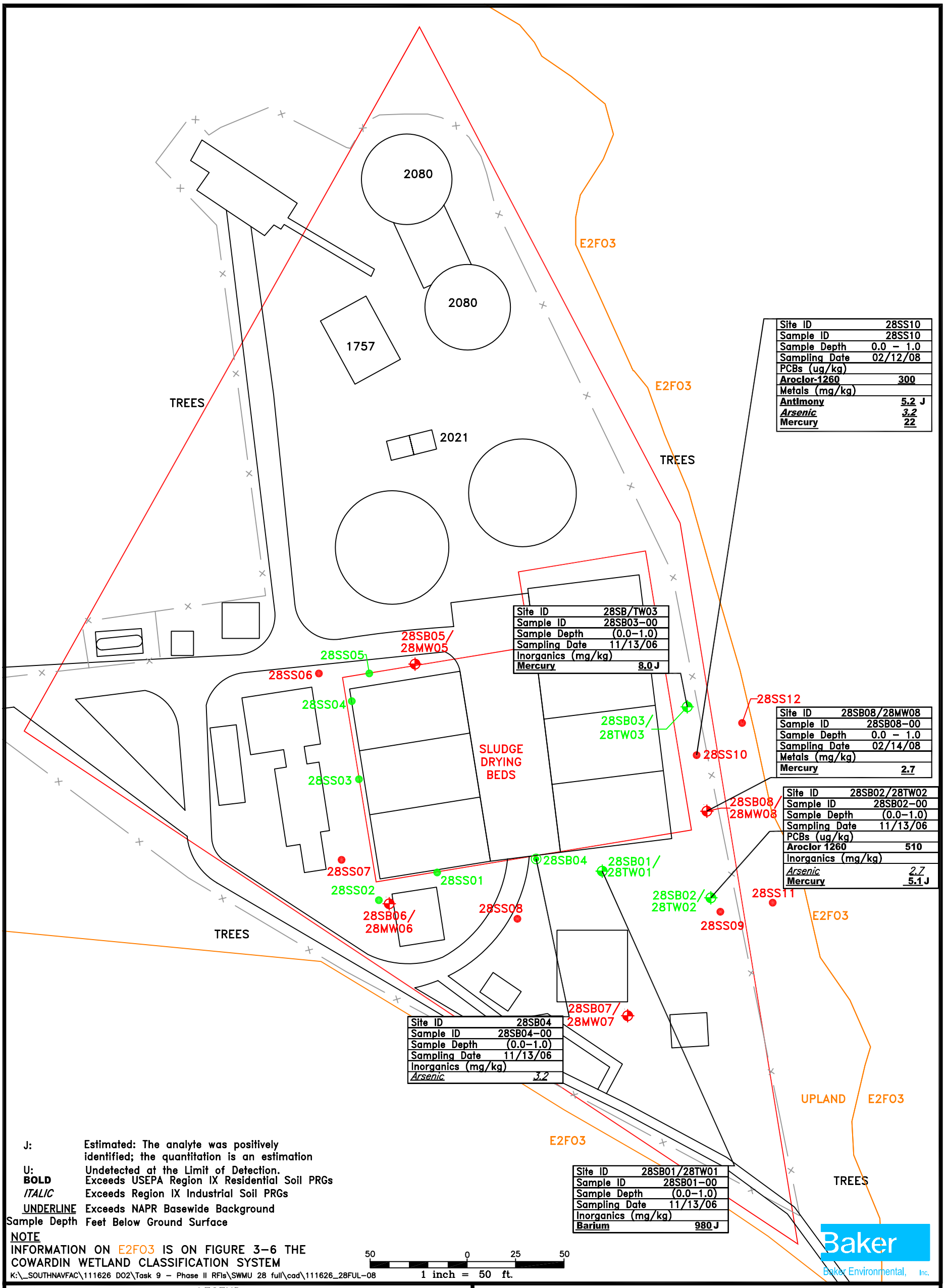
FIGURE 3-8
SEA TURTLE SIGHTINGS AT NAVAL ACTIVITY PUERTO RICO
SWMU 28 – BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



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 3-9
POTENTIAL TURTLE NESTING SITES
SWMU 28 – BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



J: Estimated: The analyte was positively identified; the quantitation is an estimation

U: Undetected at the Limit of Detection.

BOLD Exceeds USEPA Region IX Residential Soil PRGs

ITALIC Exceeds Region IX Industrial Soil PRGs

UNDERLINE Exceeds NAPR Basewide Background

Sample Depth Feet Below Ground Surface

NOTE

INFORMATION ON E2F03 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

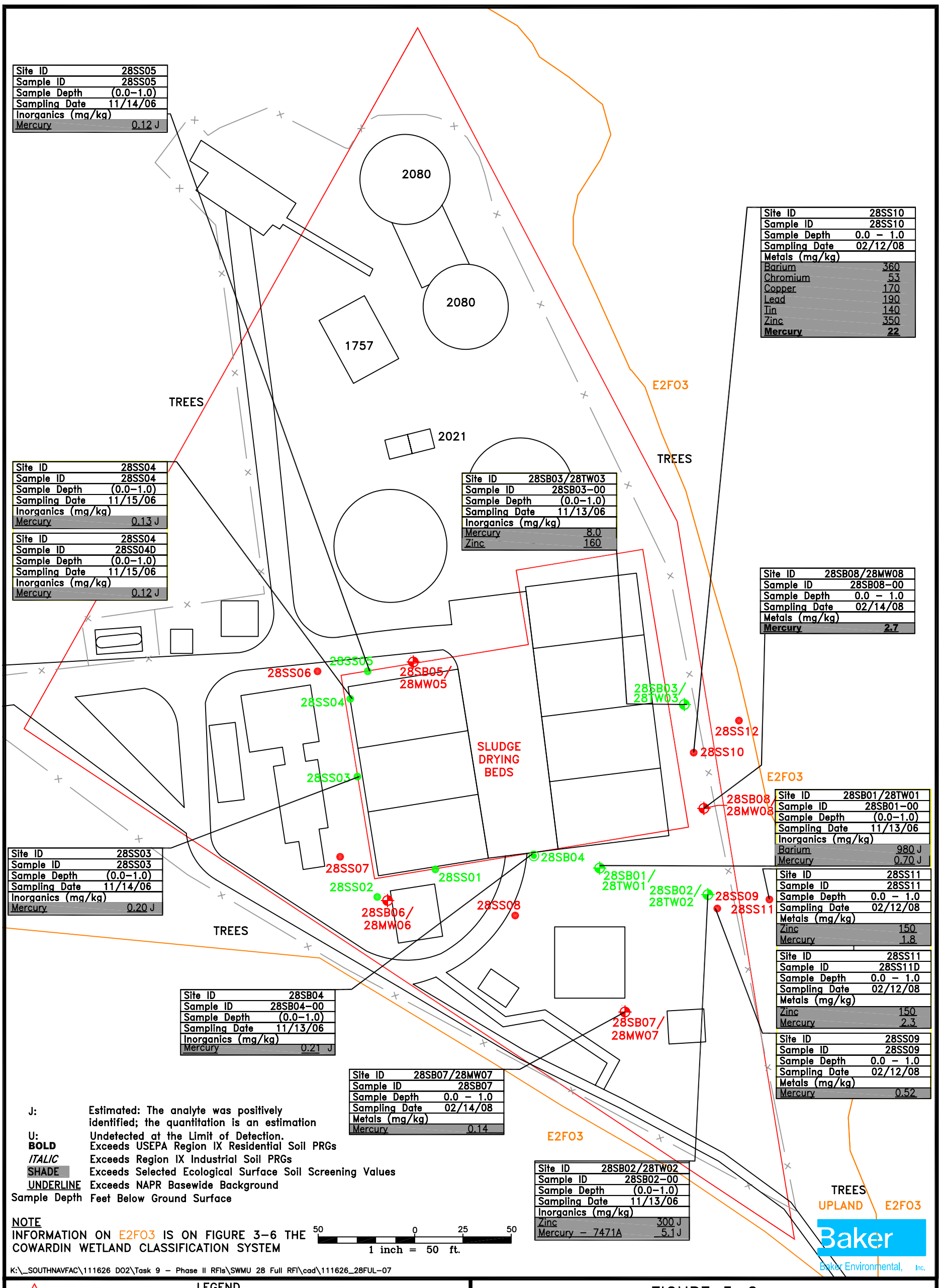
K:_SOUTHNAVFAC\111626 D02\Task 9 - Phase II RFIs\SWMU 28 full\cad\111626_28FUL-08

LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION

FIGURE 5-1
EXCEEDANCES OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND FOR SURFACE SOIL
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI

NAVAL ACTIVITY PUERTO RICO



Site ID	28SS05
Sample ID	28SS05
Sample Depth	(0.0–1.0)
Sampling Date	11/14/06
Inorganics (mg/kg)	
Mercury	0.12 J

Site ID	28SS10
Sample ID	28SS10
Sample Depth	0.0 – 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Barium	360
Chromium	53
Copper	170
Lead	190
Tin	140
Zinc	350
Mercury	**22**

Site ID	28SS04
Sample ID	28SS04
Sample Depth	(0.0–1.0)
Sampling Date	11/15/06
Inorganics (mg/kg)	
Mercury	0.13 J

Site ID	28SS04
Sample ID	28SS04D
Sample Depth	(0.0–1.0)
Sampling Date	11/15/06
Inorganics (mg/kg)	
Mercury	0.12 J

Site ID	28SB03/28TW03
Sample ID	28SB03–00
Sample Depth	(0.0–1.0)
Sampling Date	11/13/06
Inorganics (mg/kg)	
Mercury	8.0
Zinc	160

Site ID	28SB08/28MW08
Sample ID	28SB08–00
Sample Depth	0.0 – 1.0
Sampling Date	02/14/08
Metals (mg/kg)	
Mercury	**2.7**

Site ID	28SB01/28TW01
Sample ID	28SB01–00
Sample Depth	(0.0–1.0)
Sampling Date	11/13/06
Inorganics (mg/kg)	
Barium	980 J
Mercury	0.70 J

Site ID	28SS03
Sample ID	28SS03
Sample Depth	(0.0–1.0)
Sampling Date	11/14/06
Inorganics (mg/kg)	
Mercury	0.20 J

Site ID	28SS11
Sample ID	28SS11
Sample Depth	0.0 – 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Zinc	150
Mercury	1.8

Site ID	28SS11
Sample ID	28SS11D
Sample Depth	0.0 – 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Zinc	150
Mercury	2.3

Site ID	28SB04
Sample ID	28SB04–00
Sample Depth	(0.0–1.0)
Sampling Date	11/13/06
Inorganics (mg/kg)	
Mercury	0.21 J

Site ID	28SS09
Sample ID	28SS09
Sample Depth	0.0 – 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Mercury	0.52

Site ID	28SB07/28MW07
Sample ID	28SB07
Sample Depth	0.0 – 1.0
Sampling Date	02/14/08
Metals (mg/kg)	
Mercury	0.14

Site ID	28SB02/28TW02
Sample ID	28SB02–00
Sample Depth	(0.0–1.0)
Sampling Date	11/13/06
Inorganics (mg/kg)	
Zinc	300 J
Mercury – 7471A	5.1 J

J: Estimated: The analyte was positively identified; the quantitation is an estimation
U: Undetected at the Limit of Detection.
BOLD Exceeds USEPA Region IX Residential Soil PRGs
ITALIC Exceeds Region IX Industrial Soil PRGs
SHADE Exceeds Selected Ecological Surface Soil Screening Values
UNDERLINE Exceeds NAPR Basewide Background
Sample Depth Feet Below Ground Surface

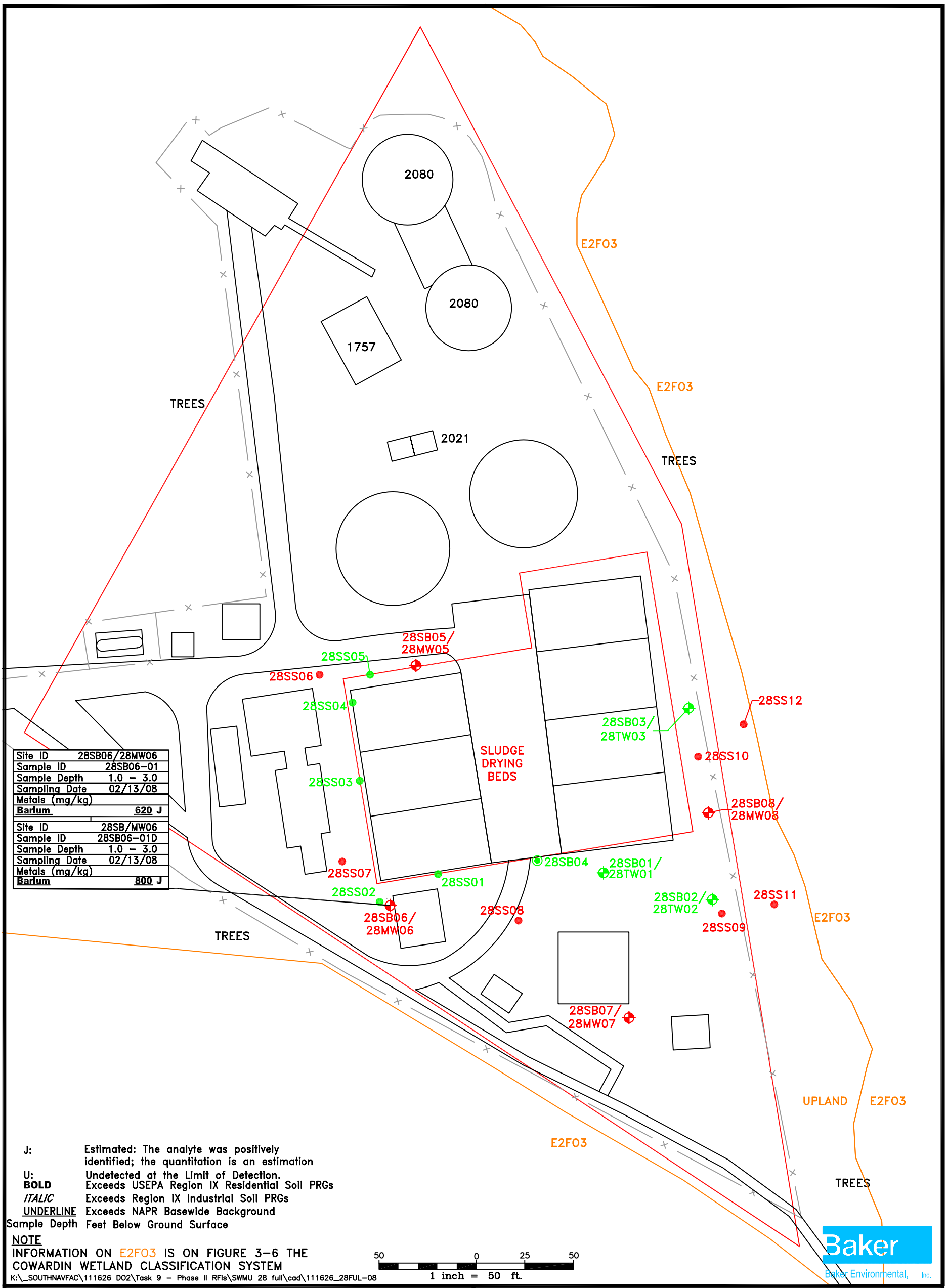
NOTE
INFORMATION ON E2F03 IS ON FIGURE 3–6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

50 0 25 50
1 inch = 50 ft.

K:_SOUTHNAVFAC\111626 D02\Task 9 – Phase II RFIs\SWMU 28 Full RFI\cad\111626_28FUL–07

LEGEND
– SITE BOUNDARY
– FENCE
– EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
– SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
– SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
– SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
– SURFACE SOIL LOCATION (MARCH 2008)
– WETLAND DELINEATION

FIGURE 5–2
EXCEEDANCES OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND FOR SURFACE SOIL
SWMU 28–BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

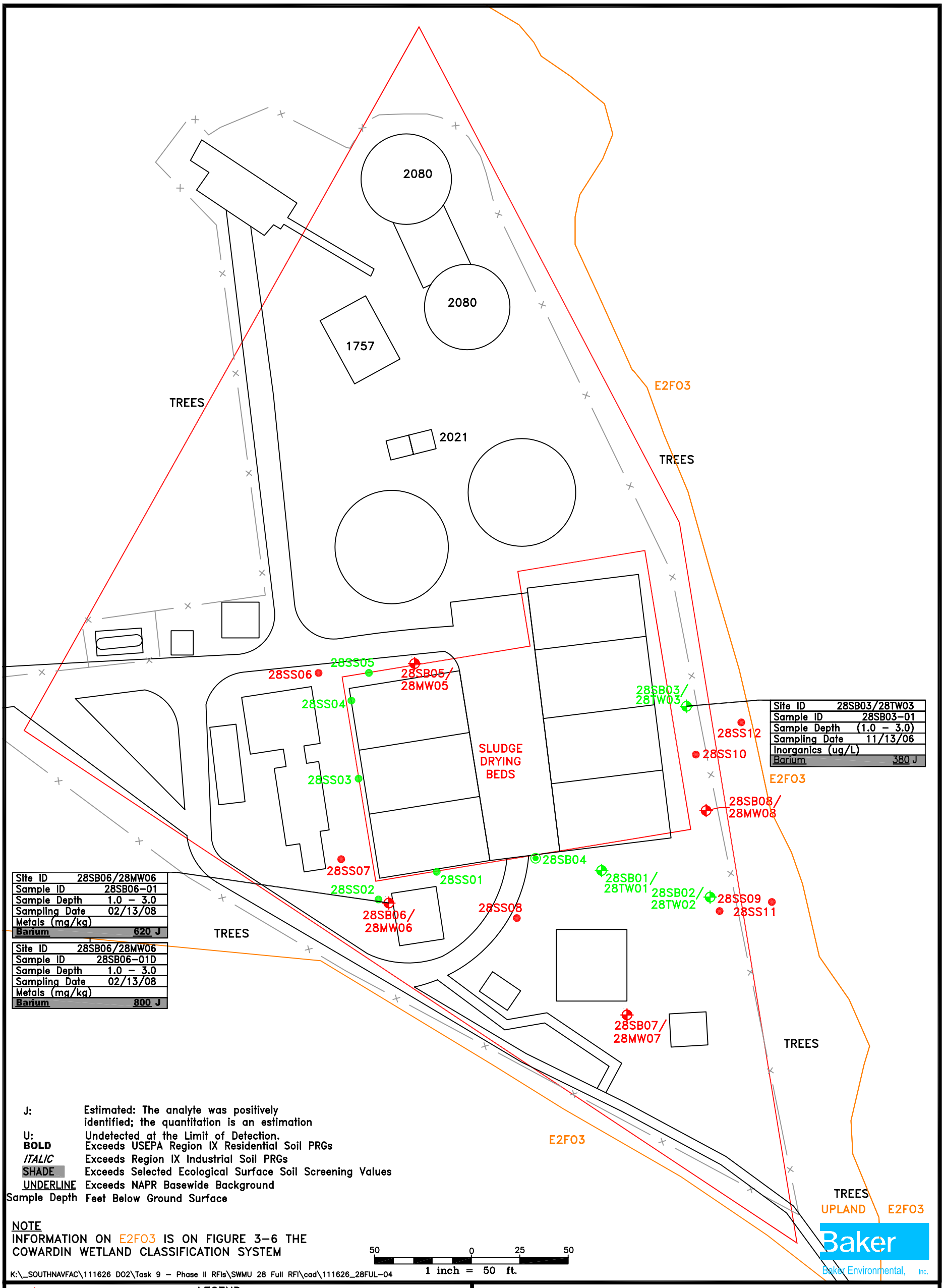


LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION

FIGURE 5-3
EXCEEDANCES OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND FOR SUBSURFACE SOIL
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI

NAVAL ACTIVITY PUERTO RICO



Site ID	28SB03/28TW03
Sample ID	28SB03-01
Sample Depth	(1.0 – 3.0)
Sampling Date	11/13/06
Inorganics (ug/L)	
Barium	380 J

Site ID	28SB06/28MW06
Sample ID	28SB06-01
Sample Depth	1.0 – 3.0
Sampling Date	02/13/08
Metals (mg/kg)	
Barium	620 J

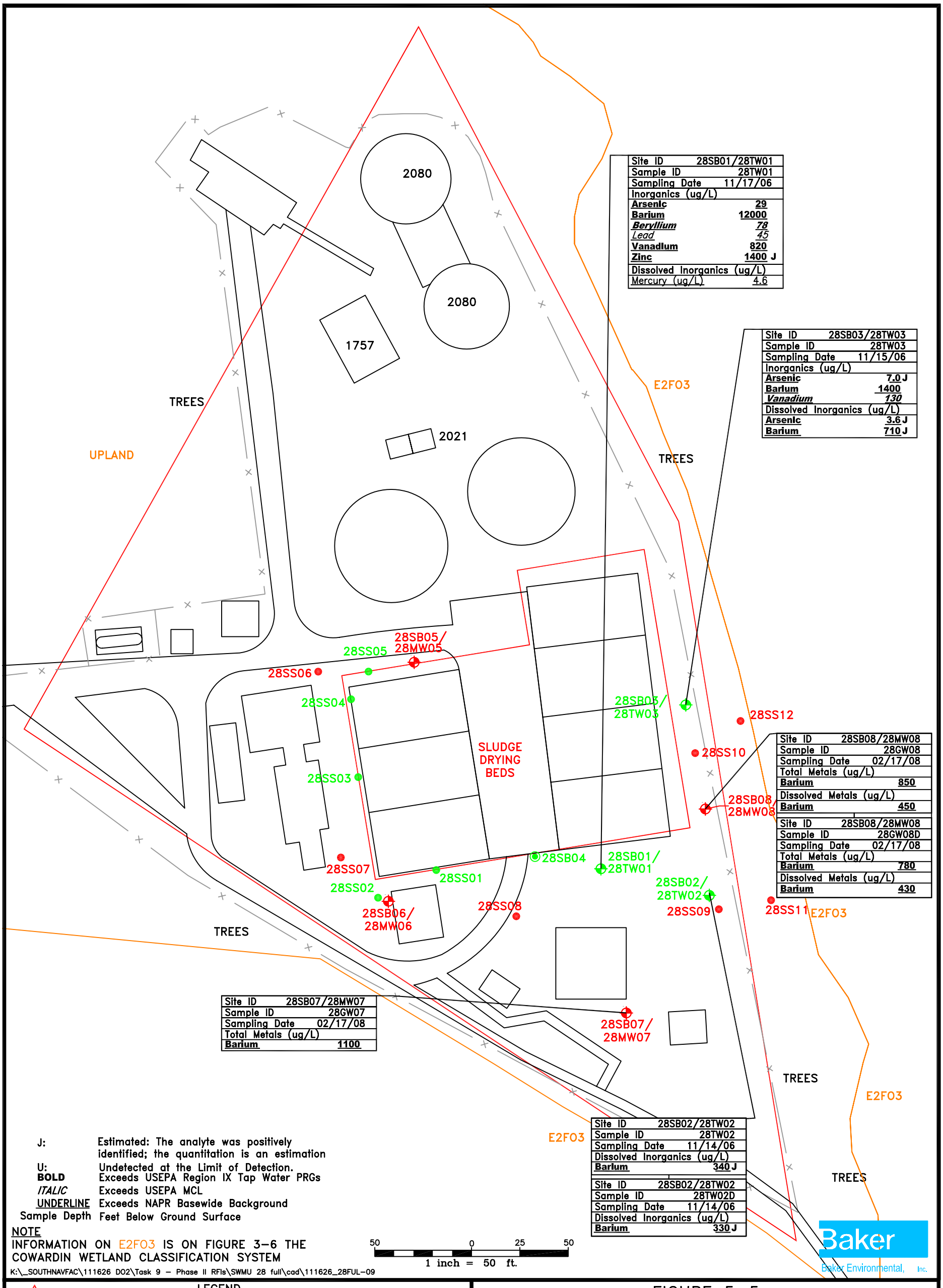
Site ID	28SB06/28MW06
Sample ID	28SB06-01D
Sample Depth	1.0 – 3.0
Sampling Date	02/13/08
Metals (mg/kg)	
Barium	800 J

J: Estimated: The analyte was positively identified; the quantitation is an estimation
U: Undetected at the Limit of Detection.
BOLD Exceeds USEPA Region IX Residential Soil PRGs
ITALIC Exceeds Region IX Industrial Soil PRGs
SHADE Exceeds Selected Ecological Surface Soil Screening Values
UNDERLINE Exceeds NAPR Basewide Background
Sample Depth Feet Below Ground Surface

NOTE
INFORMATION ON E2F03 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

LEGEND
- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION

FIGURE 5-4
EXCEEDANCES OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND FOR SUBSURFACE SOIL
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO



Site ID	28SB01/28TW01
Sample ID	28TW01
Sampling Date	11/17/06
Inorganics (ug/L)	
Arsenic	**29**
Barium	**12000**
Beryllium	***78***
Lead	*45*
Vanadium	**820**
Zinc	**1400 J**
Dissolved Inorganics (ug/L)	
Mercury (ug/L)	4.6

Site ID	28SB03/28TW03
Sample ID	28TW03
Sampling Date	11/15/06
Inorganics (ug/L)	
Arsenic	**7.0 J**
Barium	**1400**
Vanadium	***130***
Dissolved Inorganics (ug/L)	
Arsenic	**3.6 J**
Barium	**710 J**

Site ID	28SB08/28MW08
Sample ID	28GW08
Sampling Date	02/17/08
Total Metals (ug/L)	
Barium	**850**
Dissolved Metals (ug/L)	
Barium	**450**

Site ID	28SB08/28MW08
Sample ID	28GW08D
Sampling Date	02/17/08
Total Metals (ug/L)	
Barium	**780**
Dissolved Metals (ug/L)	
Barium	**430**

Site ID	28SB07/28MW07
Sample ID	28GW07
Sampling Date	02/17/08
Total Metals (ug/L)	
Barium	**1100**

Site ID	28SB02/28TW02
Sample ID	28TW02
Sampling Date	11/14/06
Dissolved Inorganics (ug/L)	
Barium	**340 J**

Site ID	28SB02/28TW02
Sample ID	28TW02D
Sampling Date	11/14/06
Dissolved Inorganics (ug/L)	
Barium	**330 J**

J: Estimated: The analyte was positively identified; the quantitation is an estimation
U: Undetected at the Limit of Detection.
BOLD Exceeds USEPA Region IX Tap Water PRGs
ITALIC Exceeds USEPA MCL
UNDERLINE Exceeds NAPR Basewide Background
Sample Depth Feet Below Ground Surface

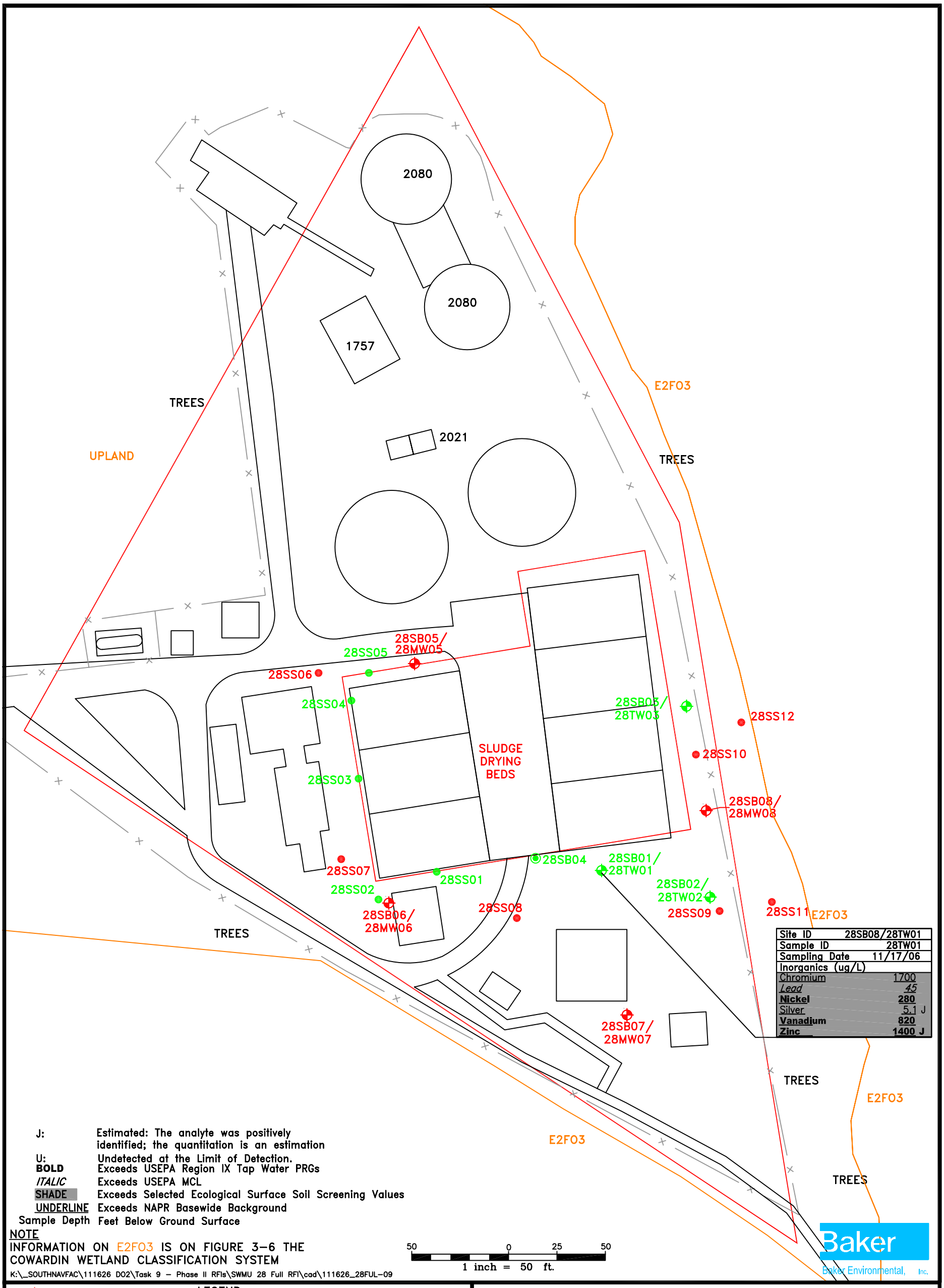
NOTE
INFORMATION ON E2F03 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

K:_SOUTHNAVFAC\111626 D02\Task 9 - Phase II RFIs\SWMU 28 full\cad\111626_28FUL-09

LEGEND
- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION

FIGURE 5-5
EXCEEDANCES OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND FOR GROUNDWATER
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI

NAVAL ACTIVITY PUERTO RICO



Site ID	28SB08/28TW01
Sample ID	28TW01
Sampling Date	11/17/06
Inorganics (ug/L)	
Chromium	1700
Lead	*45*
Nickel	**280**
Silver	5.1 J
Vanadium	**820**
Zinc	**1400 J**

J: Estimated: The analyte was positively identified; the quantitation is an estimation
U: Undetected at the Limit of Detection.
BOLD Exceeds USEPA Region IX Tap Water PRGs
ITALIC Exceeds USEPA MCL
SHADE Exceeds Selected Ecological Surface Soil Screening Values
UNDERLINE Exceeds NAPR Basewide Background
Sample Depth Feet Below Ground Surface

NOTE
INFORMATION ON E2F03 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

K:_SOUTHNAVFAC\111626 D02\Task 9 – Phase II RFIs\SWMU 28 Full RFI\cad\111626_28FUL-09

LEGEND
- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- WETLAND DELINEATION

FIGURE 5-6
EXCEEDANCES OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND FOR GROUNDWATER
SWMU 28-BUNDY
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

APPENDIX A
2008 FIELD ACTIVITIES

APPENDIX A.1
SWMU 28 FIELD LOG BOOK NOTES

2-13-08

285B05 Start 1010am

0-4'
Rec. 3.5'

One inch topsoil - clay loam med to dark brown, mod soft, dry
Then gravel to 6" at 6"
light gray and light brown, sand and silt, little clay, some gravel dry, tight

4-8'
Rec. 4'

some light gray and brown sand and silt some gravel
tight, hard, dry

8-12'
Rec. 3'

some light gray and brown sand and silt, some gravel, tight hard, dry.
moist to wet starting at 11'

12-13'
Recovery 1'

Brown sand, med grained moist to wet, some gravel then light gray gravel (rock) very hard,

2-13-08

Collected Samples

285B05-00	Surface Soil	Metals	+ PCBs
285B05-01	1-3'	metals	
285B05-02	3-5'	↓	
285B05-03	5-7'		
285B05-04	7-9'		
285B05-05	9-11'		

285B06 Start 1300

0-2' Top soil first 6", med dark Brown
Rec. 2' silt Loam, mod soft, damp.
then sand and gravel, mostly
gravel to 0.9' light gray
very hard. dry
0.9 - 2' Sand and gravel
mostly sand, med grained, loose
some silt, dry light gray brown

2-4' Same sand and gravel light
Rec 2' gray brown, loose, dry
coarser grained sand
Drill to 5'

Sampled, 5-7 light brown coarse grained sand
Rec. 2' well sorted, rounded pebble
gravel throughout, some silt
damp to dry

Sampled 7-8' Very Hard, Sand and Silt
1' Rec trace of gravel, light gray
Set well @ 13' with 10' screen

2-13-08

Collected Samples

285B06-00	Surface Soil	Metals + PCBs
285B06-01	1-3'	Metals
285B06-01D		Dup
285B06-01MS		Spike
285B06-01MSD		Spike Dup
285B06-02	3-5'	
285B06-03	5-7'	
285B06-04	7-9'	

Collected Equipment Rinsate
Geoprobe Sheare ER04
2-13-08
1500

28SB07

0-4'
3' Rec.

Topsoil first 7" med brown
mod soft, damp, silt loam
some pebbles
Gravel limestone, 7" - 10"
hard loose
10" Olive brown Sandy clay
mod soft, med. grained sand.
Some gravel throughout
damp to moist

4-8'
2' Rec.

↓

Becomes wet and saturated at
5 - 5.5' same olive brown gray
sandy clay some coarser sand

Drill to 9' Auger Refusal
Set well at 9'
6' 2" - 0.010" - slot PVC Screen
Sand to 2' Bentonite to 1'
Flushmount

2-14-08

Samples Collected at 28SB07

28SB07-00	Surface Soil	PCBs + Met
28SB07-01	1-3'	Met
28SB07-02	3-5'	Met.

2-14-08

28SB08

0-4'
4' Recovery

Top soil first 3" Silt loam brown, roots dry
then Sandy clay and gravel mod hard, iron-staining, some limestone gravel, damp to dry
Becomes olive gray and med brown at 1.5', mod soft damp gravel throughout, med. grained sand.

4-8'
4' Recovery

Greenish gray sandy clay damp to moist, mod soft to soft
some gravel, med. grained sand,

wood frags (roots) from 6.2 to 6.5'

6.8' Dark gray, clayey sand, wet, well sorted, very soft
no gravel

2-14-08

Samples Collected 28SB08

28SB08-00	Surface Soil	PCBs + Metals
28SB08-01	1-3'	
28SB08-01D		Dup
28SB08-02	3-5'	
28SB08-03	5-7'	

* Collect rinsate of sleeve ER06 1630

GW2806
W: No water
TD: 12.85

GW2805
W: 9.47
TD: 15.30

SWMU 28 GW Well dev.

28GW05 -
I - 9.12
TD - 15.32

1st gallon
pH - 8.15
Temp - 29.58 °c
Cond - 1.553

Turbid light Brown

2nd gallon
pH - 7.96
Temp - 29.45
Cond - 1.579

Lighter/clearing

3rd gallon
pH - 7.93
Temp - 29.43
Cond - 1.573

Clear

28GW06
I - Dry
TD - 12.80

28GW07

I - 3.97
TD - 8.70

1st gallon
pH - 9.15
Temp - 28.96
Cond - 1.004

2nd gallon ½
pH - 9.13
Temp - 27.45
Cond - 1.102

Purge dry

AC.

Smky/Turbid 2-15-08

28GW08
I - 6.38
TD - 15.05

1st gallon
pH - 7.49
Temp - 27.87 °c
Cond - 2.880

Smky. Turbid

2nd gallon
pH - 7.31
Temp - 27.43
Cond - 2.191

Light Brown

3rd gallon
pH - 7.03
Temp - 2.082
Cond - 2.098

A.C.

2-16-08

Collected Equipment Rinsates

ER08 Pan Rinsate
PAHs and Metals

ER09 Bucket Auger Rinsate
PAHs and Metals
used a new clean auger for each sample.

Also collected Field Blank

LAB DI Water - Metals
VOCs
PCBs
PAHs

NAPR TAP Water - Metals
VOCs
PCBs
PAHs

285B07 V 3.14 initial

Sample @ 1150
pH - 8.93
spec. Cond - 1.047
Temp - 27.08
Turbidity - ER 2 (greater 1,000)

275B08 V - 1.94 Initial

275B04 V - 3.55 Initial.

2-18-08

275B05 V 1.85 static
7:50 slug Test Falling and Rising

275B06 V 6.81 static

275B07 V 4.25 static

APPENDIX A.2
SOIL BORING LOGS AND WELL CONSTRUCTION RECORDS

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 28		
PROJ. NO.:	111626	BORING NO.:	28SB05/MW05
COORDINATES:	EAST: 921385.1	NORTH:	792859.1
ELEVATION:	SURFACE: 115.70	TOP OF PVC CASING:	115.41

Rig:	Geoprobe 66DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	2.5"	--	4-1/4"	--	2/13/2008	0.0 - 15.0	Sunny 82	
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	6.0
Schedule 40 PVC Screen	2"	6.0	13.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1					28SB05 -00 (0-12")	<1	TOP SOIL, SAND and GRAVEL, 0.5'	PVC Riser	115.20
2		D-1	3.5 88%		28SB05 -01 (1-3')		GRAVEL, light gray brown,dry, loose coarse grained		
3						<1		Bentonite	
4	4.0				28SB05 -02 (3-5')		4.0		111.70
5					28SB05 -03 (5-7')		SAND/SILT, light grey and brown some gravel, tight and hard		
6		D-2	4.0 100%			<1		2" PVC Screen	
7					28SB05 -04 (7-9')				
8	8.0					<1	8.0		107.70
9							SAND/SILT, light grey and brown some gravel, tight and hard moist to wet starting at 11'	Silica Sand	
10		D-3	3.0 75%						

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	28SB05/MW05 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Roosevelt Roads Puerto Rico, SWMU 28

SO NO.: 111626 BORING NO.: 28SB05/MW05

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11		D-3	3.0 75%				Continued from Sheet 1	2" PVC Screen	103.70
12	12.0						12.0		
13	13.0	A	NA				Med. Grained brown SAND moist to wet, some gravel, hard 13.0	Sand	
14							End of Boring at 13.0'		
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Joe Burawa

DRILLER: Abraham Nunez BORING NO.: 28SB06/MW05 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 28		
PROJ. NO.:	111626	BORING NO.:	28SB06/MW06
COORDINATES:	EAST: 921386.7	NORTH:	792735.5
ELEVATION:	SURFACE: 115.33	TOP OF PVC CASING:	115.18

Rig: Geoprobe 66DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"	--	4-1/4"	--	2/13/2008	0.0 - 13.0	Sunny 82	
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	13.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1		D-1	4.0 100%		28SB06-00 (0-12")	<1	TOP SOIL, SAND and GRAVEL, light gray, dry, very hard (0.9')	Bentonite, PVC, Riser	114.28
2					28SB06-01 (1-3')		mostly SAND, med. grained, some GRAVEL, light gray brown,dry, loose coarse grained		
3						<1		2" PVC Screen	
4	4.0				28SB06-02 (3-5')				
5		D-2	3.0 75%				(5.0)		110.18
6					28SB06-03 (5-7')	<1	SAND, course grained, well sorted, pebble GRAVEL throughout, some SILT, light brown, damp to dry		
7							(7.0)		108.18
8	8.0				28SB06-04 (7-9')	<1	SAND and SILT, trace GRAVEL, light gray, very hard	Silica Sand	
9		A	NA						
10									

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	28SB06/MW06 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Roosevelt Roads Puerto Rico, SWMU 28

SO NO.: 111626 BORING NO.: 28SB06/MW06

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1	2" PVC	
12	A	NA					Screen	
13	13.0					13.0	Silica Sand	
14						End of Boring at 13.0'		
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Joe Burawa

DRILLER: Abraham Nunez BORING NO.: 28SB06/MW06 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 28		
PROJ. NO.:	111626	BORING NO.:	28SB07/MW07
COORDINATES:	EAST: 921496.4	NORTH:	792677.7
ELEVATION:	SURFACE: 108.91	TOP OF PVC CASING:	108.74

Rig: Geoprobe 66DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"	--	4-1/4"	--	2/13/2008	0.0 - 10.0	Sunny 82	5
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	9.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1					28SB07 -00 (0-12")		TOP SOIL, silt-loam, med. brown	Bentonite	
							10"	2" PVC Riser	107.91
2		D-1	3.0 75%		28SB07 -01 (1-3')	<1	SANDY CLAY, med. grained, some GRAVEL, olive brown, mod. soft, damp to moist		
3									
4	4.0				28SB07 -02 (3-5')			2" PVC Screen	
5							5.0		103.74
6		D-2	2.0 50%			<1	Wet and saturated, olive brown/gray		
7								Silica Sand	
8	8.0						8.0		
9	9.0	A	NA				Auger refusal 9.0		
10							End of Boring at 9.0'		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	28SB07/MW07 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Roosevelt Roads Puerto Rico, SWMU 28

PROJ. NO.: 111626 BORING NO.: 28SB08/MW08

COORDINATES: EAST: 921537 NORTH: 792677.7

ELEVATION: SURFACE: 115.23 TOP OF PVC CASING: 115.05

Rig:	Geoprobe 66DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"		4-1/4"		2/14/2008	0.0 - 15.0	Sunny 82	6.38
Length	4'		5'					
Type			HSA					
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	15.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1					28SB08 -00 (0-12")		TOP SOIL, SANDY CLAY, GRAVEL some limestone gravel, brown, mod. hard damp to dry, iron-staining	2" PVC Riser	
2		D-1	4.0 100%		28SB08 -01 (1-3')	<1	SAND, med.-grained, olive gray and med. Brown, mod. soft, damp	Bentonite	113.55
3									
4	4.0				28SB08 -02 (3-5')		1.5		111.05
5							GRAVEL, greenish gray, damp to moist	Silica Sand	
6		D-2	4.0 100%		28SB08 -03 (5-7')	<1	wood frags (roots) to 6.5'		
7							6.8	2" PVC Screen	108.25
8	8.0						CLAYEY SAND, dark gray very soft, well sorted, wet		
9		A	NA						
10									

DRILLING COMPANY: GeoEnviroTech, Inc. BAKER REP.: Joe Burawa

DRILLER: Abraham Nunez BORING NO.: 28SB08/MW08 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Roosevelt Roads Puerto Rico, SWMU 28

SO NO.: 111626 BORING NO.: 28SB08/MW08

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS

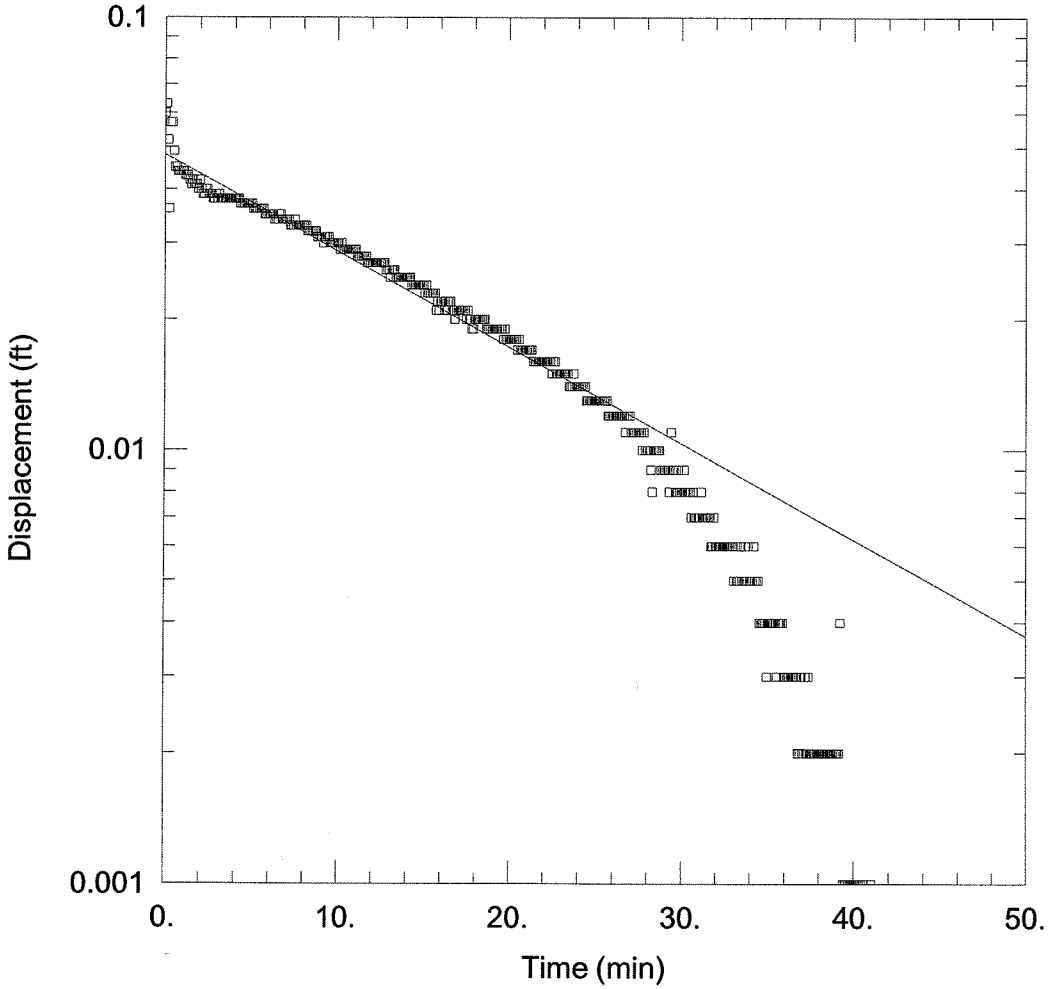
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11							Continued from Sheet 1		
12								2" PVC Screen	
13		A	NA						
14								Silica Sand	
15	15.0								
							End of Boring at 15.0'		
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Joe Burawa

DRILLER: Abraham Nunez BORING NO.: 28SB08/MW08 SHEET 2 OF 2

APPENDIX A.3
WELL HEAD (SLUG) TEST RESULTS AND ANALYSIS



28MW05F2

Data Set: K:\...\28MW05f2.aqt
Date: 05/29/08 Time: 10:17:01

PROJECT INFORMATION

Test Well: 28MW05f2

AQUIFER DATA

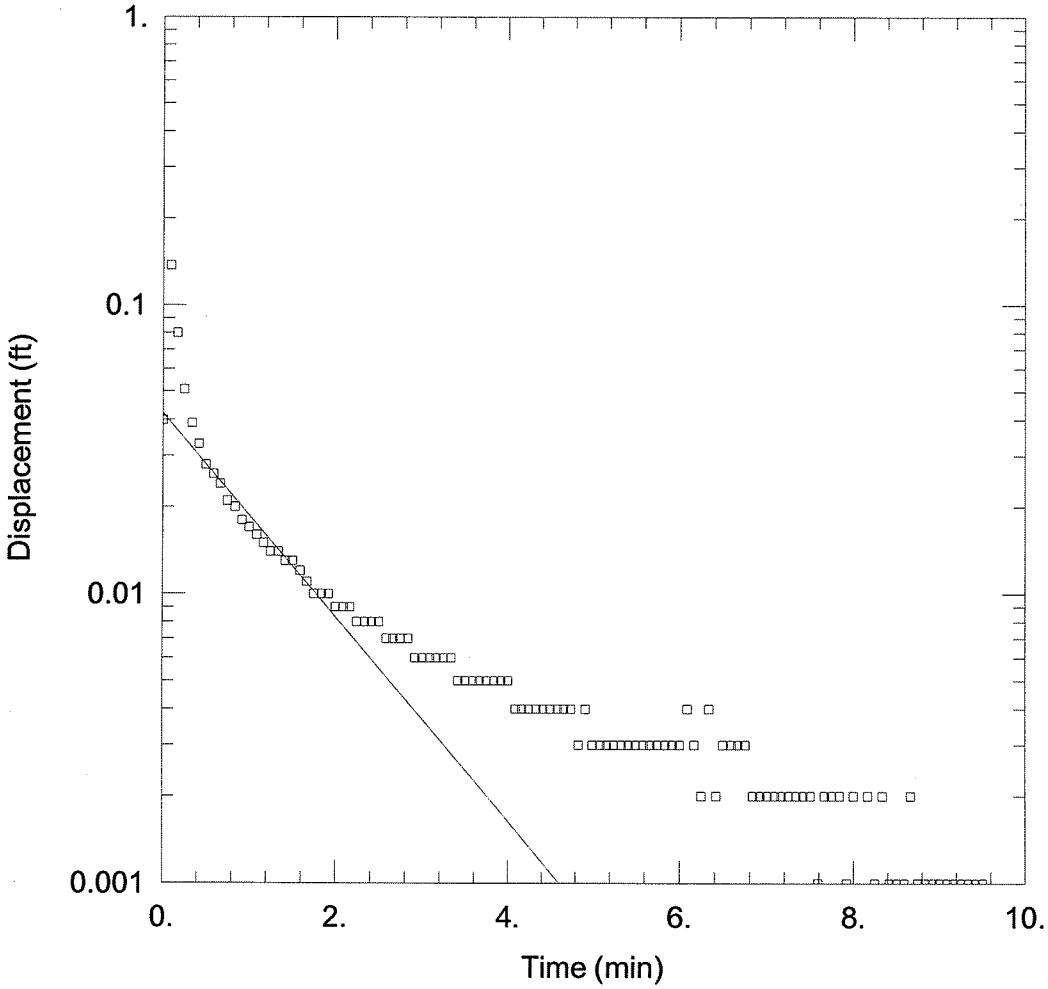
Saturated Thickness: 6.18 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW05f2)

Initial Displacement: 0.06 ft
Total Well Penetration Depth: 6.18 ft
Casing Radius: 0.08 ft
Static Water Column Height: 6.18 ft
Screen Length: 10. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.453E-05 ft/min
y0 = 0.04803 ft



28MW05R

Data Set: K:\...\28MW05r.aqt
Date: 05/29/08 Time: 10:17:46

PROJECT INFORMATION

Test Well: 28MW05r

AQUIFER DATA

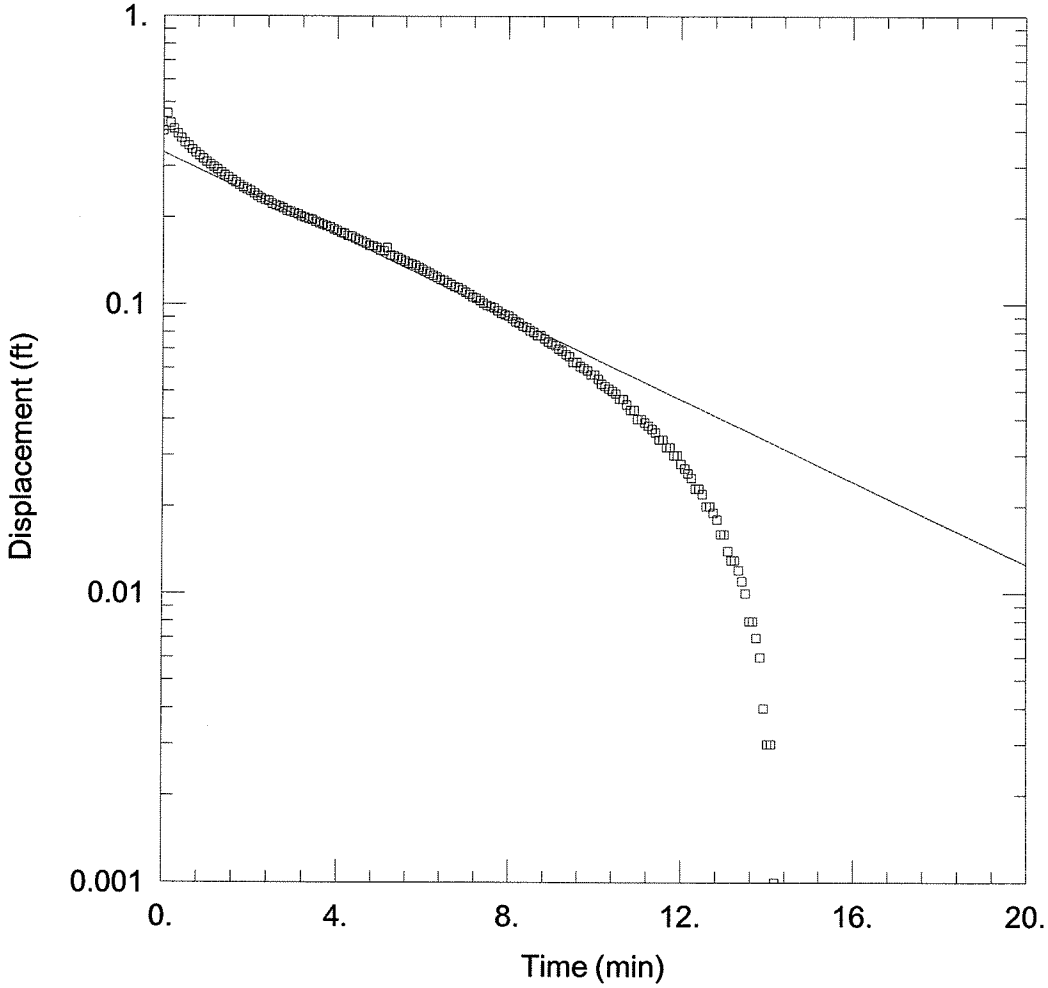
Saturated Thickness: 6.18 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW05r)

Initial Displacement: 0.04 ft
Total Well Penetration Depth: 6.18 ft
Casing Radius: 0.08 ft
Static Water Column Height: 6.18 ft
Screen Length: 10. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0007069 ft/min
y0 = 0.04219 ft



28MW07F

Data Set: K:\...\28MW07f.aqt
Date: 05/29/08 Time: 10:18:28

PROJECT INFORMATION

Test Well: 28MW07f

AQUIFER DATA

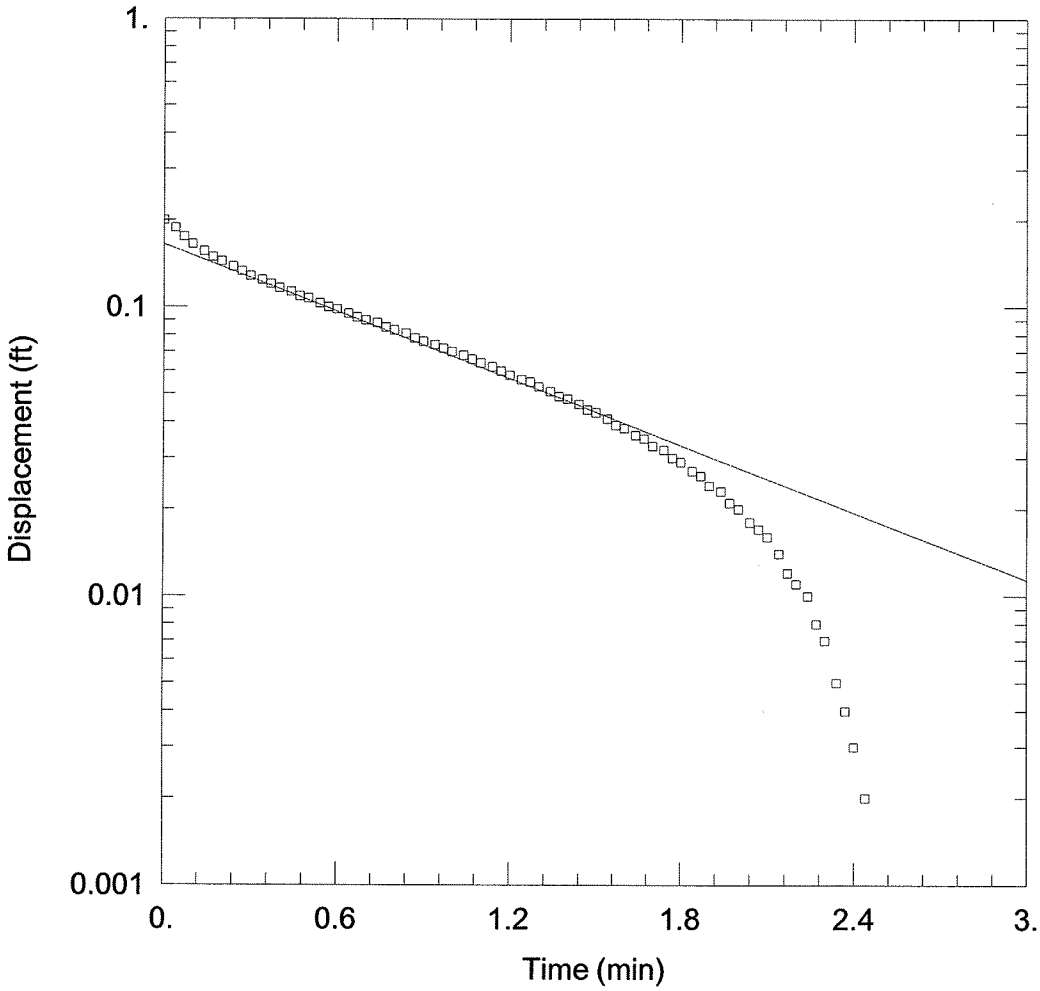
Saturated Thickness: 4.27 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW07f)

Initial Displacement: 0.4 ft
Total Well Penetration Depth: 4.27 ft
Casing Radius: 0.08 ft
Static Water Column Height: 4.27 ft
Screen Length: 6. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0002099 ft/min
y0 = 0.3359 ft



28MW07R

Data Set: K:\...\28MW07r.aqt
Date: 05/29/08 Time: 10:19:06

PROJECT INFORMATION

Test Well: 28MW07r

AQUIFER DATA

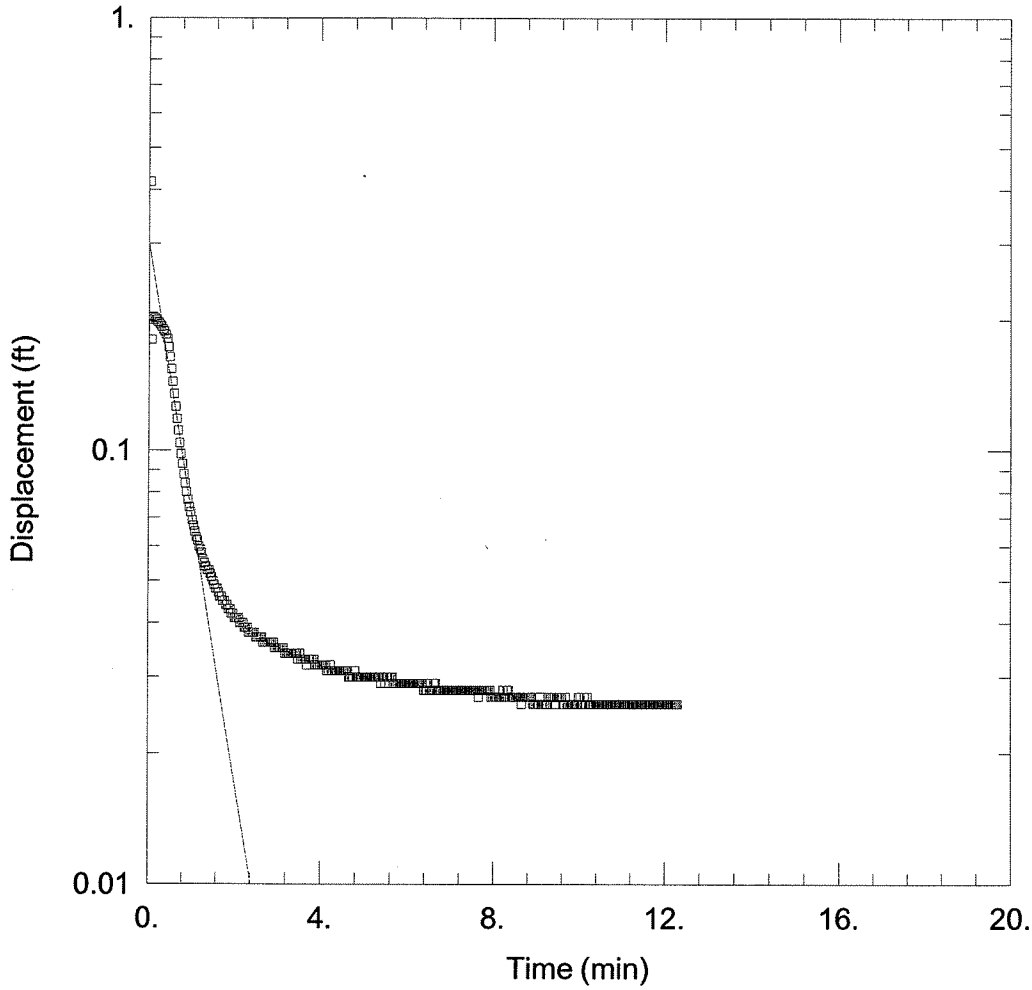
Saturated Thickness: 4.27 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW07r)

Initial Displacement: 0.2 ft
Total Well Penetration Depth: 4.27 ft
Casing Radius: 0.08 ft
Static Water Column Height: 4.27 ft
Screen Length: 6. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001139 ft/min
y0 = 0.1647 ft



28MW08F

Data Set: K:\...\28MW08f.aqt
Date: 05/29/08 Time: 10:20:08

PROJECT INFORMATION

Test Well: 28MW08f

AQUIFER DATA

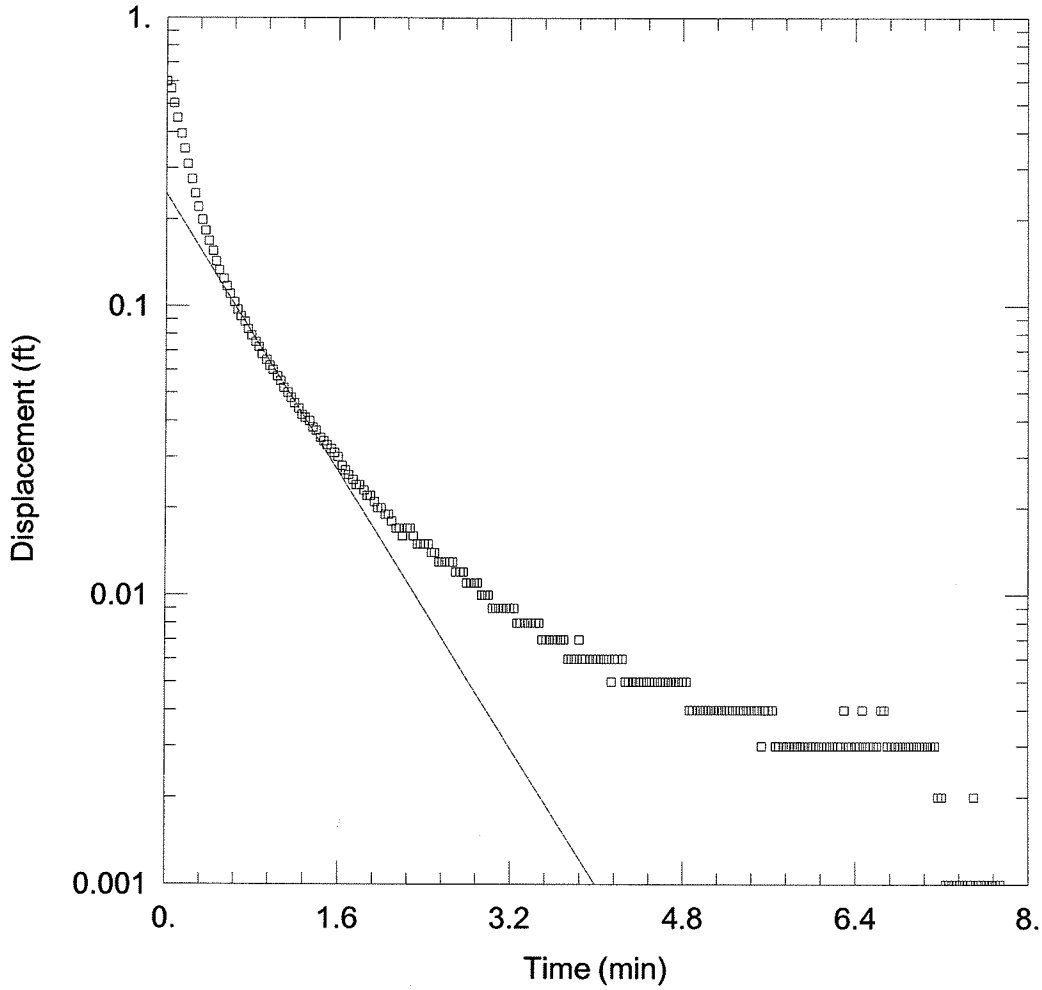
Saturated Thickness: 8.67 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW08f)

Initial Displacement: 0.2 ft
Total Well Penetration Depth: 8.67 ft
Casing Radius: 0.08 ft
Static Water Column Height: 8.67 ft
Screen Length: 10. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001325 ft/min
y0 = 0.3019 ft



WELL TEST ANALYSIS

Data Set: K:\...\28MW08r.aqt
Date: 05/29/08 Time: 10:20:50

PROJECT INFORMATION

Test Well: 28MW08r

AQUIFER DATA

Saturated Thickness: 8.67 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (28MW08r)

Initial Displacement: 0.6 ft
Total Well Penetration Depth: 8.67 ft
Casing Radius: 0.08 ft
Static Water Column Height: 8.67 ft
Screen Length: 10. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001301 ft/min
y0 = 0.2456 ft

APPENDIX A.4
CHAIN-OF-CUSTODY FORMS

Serial Number 000499

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

8480 2694 7525

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
SWMU 28	111626 9.3	PR

TAL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
Kathy Smith		

CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
Mark Kimes	412-337-7465	

CLIENT NAME	CLIENT E-MAIL
Michael Baker Jr., Inc.	mkimes@mbakercorp.com

CLIENT ADDRESS: 100 Airside Drive, Moon Twp., PA 15108

COMPANY CONTRACTING THIS WORK (if applicable)

PAGE 1 OF 1

STANDARD REPORT DELIVERY ●

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ○

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	Appendix IX Metals	PCBs									REMARKS
								NUMBER OF CONTAINERS SUBMITTED										
2/12/08	925	285506			X			1	1									
2/12/08	935	285507			X			1	1									
2/12/08	945	285508			X			1	1									
2/12/08	955	285509			X			1	1									
2/12/08	1005	285510			X			1	1									
2/12/08	1015	285511			X			1	1									
2/12/08	1015	285511D			X			1	1									Duplicate
2/12/08	1030	285512			X			1	1									
2/12/08	1030	285512D			X			1	1									Duplicate
2/12/08	1030	285512MS			X			1	1									Matrix Spike
2/12/08	1030	285512MSD			X			1	1									Matrix Spike Dup.
2/12/08	1500	ER03		X				1	1									Spoon Rinse

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	2/12/08	1530						

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT YES ○ NO ○	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS.

TAL8240-680 (1207)

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client: Michael Baker Jr., Inc.	Project Manager: Mark E. Kimes	Date: 2-14-08	Chain of Custody Number: 374320
Address: 100 Airside Drive	Telephone Number (Area Code)/Fax Number: 412-269-2009	Lab Number:	Page 1 of 2
City: Moon Township; State: PA; Zip Code: 15001	Site Contact: Joe Burawa	Lab Contact: Kathy Smith	
Project Name and Location (State): Naval Activity Puerto Rico	Carrier/Waybill Number: 8480 2694 7503		
Contract/Purchase Order/Quote No.			

Analysis (Attach list if more space is needed)

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH		Appendix IX Metals	PCBs										Special Instructions/ Conditions of Receipt
285B05-00	2-13-08					X		2							X	X										
285B05-01						X		1							X											
285B05-02						X		1							X											
285B05-03						X		1							X											
285B05-04						X		1							X											
285B05-05						X		1							X											
285B06-00	2-13-08					X		2							X	X										
285B06-01						X		1							X											
285B06-01D						X		1							X											Duplicate
285B06-01MS						X		1							X											Matrix Spike
285B06-01 MSD						X		1							X											Matrix Spike Duplicate
285B06-02						X		1							X											

Possible Hazard Identification: ☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other 28 DAY

QC Requirements (Specify)

1. Relinquished By: Joe Burawa	Date: 2-14-08	Time: 1700	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4142 (0907)

Client: Michael Baker Jr., Inc.	Project Manager: Mark E. Kimes	Date:	Chain of Custody Number: 374314
Address: 100 Airside Drive	Telephone Number (Area Code)/Fax Number: 412 269-2009	Lab Number:	Page 2 of 2
City: Moon Township; State: PA; Zip Code: 15108	Site Contact: Joe Bruawa	Lab Contact: Kathy Smith	
Project Name and Location (State): Naval Activity Puerto Rico	Carrier/Waybill Number: 8480 2694 7503		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH		Analysis (Attach list if more space is needed): Appendix IX Metals	PCBs									Special Instructions/ Conditions of Receipt
28SB06-03	2-13-08					X		1							X										
28SB06-04	2-13-08					X		1							X										
28SB07-00	2-14-08					X		2							X	X									
28SB07-01	↓					X		1							X										
28SB07-02	↓					X		1							X										
28SB08-00	2-14-08					X		2							X	X									
28SB08-01	↓					X		1							X										
28SB08-01D	↓					X		1							X										Duplicate
28SB08-02	↓					X		1							X										
28SB08-03	↓					X		1							X										
ER04	2-13-08			X						1					X										Rinsate Sleeve
ER06	2-14-08			X						1					X										Rinsate Sleeve

Possible Hazard Identification: ☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other 28 DAY

QC Requirements (Specify):

	Date	Time		Date	Time
1. Relinquished By: Joe Bruawa	2-14-08	1700	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Serial Number 000964

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE: NAPR SUMM 28	PROJECT NO.: 1116261 9.3	PROJECT LOCATION (STATE): PA
TAL (LAB) PROJECT MANAGER: Kathy Smith	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: MARK KIMES	CLIENT PHONE: 412 337 7465	CLIENT FAX:
CLIENT NAME: Michael Baker Jr, Inc.	CLIENT E-MAIL: mKimes@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Drive, Moon Twp, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 1 OF

STANDARD REPORT DELIVERY ●

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ○

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	Approved 1X Metals Total	Approved 1X Metals Dissolved		Benzene	RCRA Metals (Total)							REMARKS
2-17-08		28GW05		X				1	1										
		28GW07		X				1	1										
		28GW08		X				1	1										
		28GW08D		X				1	1										Duplicate
		28GW08 MS/MSD		X				1	1										Matrix Spike/MS Dup.
		ER10		X				1											Tubing Rinse
2-17-08		1DW01									3	1							

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
Joseph H Bonar	2-18-08	1700						
RECEIVED BY: (SIGNATURE)	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT YES ○ NO ○	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS

TAL8240-680 (1207)

APPENDIX B
LABORATORY ANALYTICAL RESULTS

APPENDIX B.1
SURFACE SOIL

APPENDIX B.1

SURFACE SOIL ANALYTICAL RESULTS
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**28SS06**	**28SS07**	**28SS08**	**28SS09**	**28SS10**	**28SS11**	**28SS11 D**	**28SS12**	**28SS12 D**	**28SB05**
Sample ID	**28SS06-00**	**28SS07-00**	**28SS08-00**	**28SS09-00**	**28SS10-00**	**28SS11-00**	**28SS11-00 D**	**28SS12-00**	**28SS12-00 D**	**28SB05-00**
Sample Depth (ft bgs)	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/12/2008**	**2/13/2008**
PCBs (ug/kg)										
PCB-1016	4.3 U	4.4 U	4.7 U	4.6 U	4.4 U	4.2 U	4.3 U	4.2 U	4.3 U	4.1 U
PCB-1221	15 U	15 U	16 U	16 U	15 U	14 U	15 U	14 U	15 U	14 U
PCB-1232	8.5 U	8.7 U	9.4 U	9 U	8.8 U	8.3 U	8.5 U	8.2 U	8.5 U	8 U
PCB-1242	5.5 U	5.6 U	6 U	5.8 U	5.6 U	5.3 U	5.5 U	5.3 U	5.4 U	5.1 U
PCB-1248	5.8 U	5.9 U	6.4 U	6.1 U	6 U	5.6 U	5.8 U	5.6 U	5.8 U	5.5 U
PCB-1254	2.6 U	2.7 U	2.9 U	2.8 U	2.7 U	2.5 U	2.6 U	2.5 U	2.6 U	2.5 U
PCB-1260	5.5 U	5.6 U	6 U	5.8 U	300	100	120	5.3 U	5.4 U	5.1 U
Metals (mg/kg)										
Antimony	0.23 UJ	0.36 J	0.23 UJ	0.74 J	5.2 J	0.58 J	0.78 J	0.21 UJ	0.23 UJ	0.64 U
Arsenic	0.68 U	0.58 U	1.2	1.2	3.2	0.74 U	0.74 U	0.76 U	0.79 U	0.64 J
Barium	120	200	210	150	360	190	180	96	98	190 J
Beryllium	0.46	0.41 J	0.39 J	0.3 J	0.38 J	0.52	0.51	0.53	0.49	0.34 J
Cadmium	0.43 U	0.64	0.84	0.99	2.6	1.3	1.2	0.38 U	0.37 U	0.23 J
Chromium	9.6	16	22	22	53	21	21	20 J	13 J	24
Cobalt	6.4	10	15	12	6.2	7.2	7.2	6.5	6	11 J
Copper	13	38	53	110	170	38	39	13	10	27
Lead	1.8	1.9	2.1	14	190	31	31	2.3	1.2	2.4
Nickel	4.9	6.8	10	9.6	9.5	7.8	8.1	8	5.9	12
Selenium	0.22 U	0.21 U	0.22 U	0.28 J	1.3 J	0.2 U	0.21 U	0.2 U	0.22 U	0.56 U
Silver	0.14 U	0.066 U	0.11 U	0.41 U	52	10	11	0.16 U	0.095 U	0.37 U
Thallium	0.51 U	0.5 U	0.52 U	0.5 U	0.52 U	0.47 U	0.5 U	0.47 U	0.51 U	0.45 U
Tin	4.3 U	4.3 U	4.4 U	4.2 U	140	18	19	4 U	4.3 U	3.8 U
Vanadium	32	67	95	97	52	34	35	32	28	56 J
Zinc	36	39	47	100	350	150	150	26	22	35 J
Mercury	0.03	0.023 J	0.024	0.52	22	1.8	2.3	0.041	0.034	0.093

APPENDIX B.1

SURFACE SOIL ANALYTICAL RESULTS
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**28SB06**	**28SB07**	**28SB08**
Sample ID	**28SB06-00**	**28SB07-00**	**28SB08-00**
Sample Depth (ft bgs)	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**2/13/2008**	**2/14/2008**	**2/14/2008**
PCBs (ug/kg)			
PCB-1016	4.1 U	4.4 U	4.3 U
PCB-1221	14 U	15 U	15 U
PCB-1232	8.1 U	8.7 U	8.5 U
PCB-1242	5.2 U	5.6 U	5.4 U
PCB-1248	5.5 U	5.9 U	5.7 U
PCB-1254	2.5 U	2.7 U	2.6 U
PCB-1260	5.2 U	5.6 U	32 J J
Metals (mg/kg)			
Antimony	0.36 U	0.73 U	1.4 U
Arsenic	0.88 J	1.9	1.6
Barium	210 J	300	240 J
Beryllium	0.28 J	0.54	0.55
Cadmium	0.19 J	0.47 J	1
Chromium	9.9	18	24
Cobalt	8.4 J	7.4 J	9.1 J
Copper	24	53	56
Lead	2.7	13	31
Nickel	4.7	10	11
Selenium	0.19 U	0.37 U	0.21 U
Silver	0.13 U	0.53 U	13
Thallium	0.45 U	0.52 U	0.48 U
Tin	3.9 U	4.4 U	18
Vanadium	55 J	46 J	50 J
Zinc	46 J	84 J	110 J
Mercury	0.013 J	0.14	2.7

APPENDIX B.2
SUBSURFACE SOIL

APPENDIX B.2

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**28SB05**	**28SB05**	**28SB05**	**28SB05**	**28SB05**	**28SB06**	**28SB06**	**28SB06**	**28SB06**	**28SB06**
Sample ID	**28SB05-01**	**28SB05-02**	**28SB05-03**	**28SB05-04**	**28SB05-05**	**28SB06-01**	**28SB06-01D**	**28SB06-02**	**28SB06-03**	**28SB06-04**
Sample Depth (ft bgs)	**1.0 - 3.0**	**3.0 - 5.0**	**5.0 - 7.0**	**7.0 - 9.0**	**9.0 - 11.0**	**1.0 - 3.0**	**1.0 - 3.0**	**3.0 - 5.0**	**5.0 - 7.0**	**7.0 - 9.0**
Sampling Date	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**	**02/13/08**
Metals (mg/kg)										
Antimony	0.2 U	0.38 U	0.49 U	0.43 U	0.2 U	0.27 U	0.34 U	0.69 U	0.5 U	0.38 U
Arsenic	0.31 U	0.37 J	0.32 U	0.34 U	0.32 U	0.62 J	0.47 J	0.29 U	0.43 J	0.32 U
Barium	120 J	120 J	96 J	270 J	98 J	620 J	800 J	150 J	120 J	230 J
Beryllium	0.16 J	0.21 J	0.25 J	0.2 J	0.23 J	0.16 J	0.15 J	0.15 J	0.15 J	0.18 J
Cadmium	0.097 J	0.11 J	0.053 J	0.11 J	0.059 J	0.14 J	0.1 J	0.075 J	0.059 J	0.078 J
Chromium	1.4	1.3	1.3 J	6.3	1.5	2.4	1.7	1.2	1.6	6.6
Cobalt	5.4 J	6 J	4.4	5.5 J	5.2 J	5.6 J	5.7 J	6 J	6.3 J	6.4 J
Copper	1.2 U	4.2	4.2	3.6	3	2.4	1.5 U	0.79 U	1.3 U	6.8
Lead	0.22 U	0.83	1.1	0.68	0.85	0.54	0.46 U	0.44 U	0.34 U	0.74
Nickel	1 U	1 U	1.1 U	1.7 U	1.2 U	1.1 U	1 J	1.1 J	1.1 J	1.6 J
Selenium	0.19 U	0.2 U	0.19 U	0.21 U	0.19 U	0.19 U	0.19 U	0.18 U	0.2 U	0.2 U
Silver	0.037 U	0.04 U	0.085 U	0.072 U	0.096 U	0.055 U	0.038 U	0.036 U	0.041 U	0.061 U
Thallium	0.44 U	0.46 U	0.45 U	0.48 U	0.45 U	0.44 U	0.45 U	0.42 U	0.47 U	0.46 U
Tin	3.7 U	4 U	3.8 U	4.1 U	3.8 U	3.7 U	3.8 U	3.6 U	4 U	3.9 U
Vanadium	25 J	28 J	23 J	29 J	19 J	30 J	26 J	32 J	24 J	32 J
Zinc	19 J	25 J	22 J	22 J	20 J	19 J	19 J	23 J	24 J	23 J
Mercury	0.0038 U	0.0045 J	0.0042 U	0.043	0.0062 J	0.0036 U	0.0039 U	0.0039 U	0.0038 U	0.0057 J

APPENDIX B.2

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**28SB07**	**28SB07**	**28SB08**	**28SB08**	**28SB08**	**28SB08**
Sample ID	**28SB07-01**	**28SB07-02**	**28SB08-01**	**28SB08-01D**	**28SB08-02**	**28SB08-03**
Sample Depth (ft bgs)	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**1.0 - 3.0**	**3.0 - 5.0**	**5.0 - 7.0**
Sampling Date	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**
Metals (mg/kg)						
Antimony	0.23 U	0.42 U	0.32 U	0.21 U	0.48 U	0.57 U
Arsenic	0.35 U	0.51 J	0.79 J	0.33 U	0.59 J	0.76 J
Barium	170 J	140 J	200 J	240 J	360 J	240 J
Beryllium	0.71	0.56	0.69	0.74	0.69	0.58
Cadmium	0.082 J	0.044 U	0.082 J	0.063 J	0.11 J	0.042 U
Chromium	11	9.5	37 J	14 J	58	6.2
Cobalt	6.5 J	6.2 J	10 J	6.2 J	10 J	4.8 J
Copper	11	8.3	17 J	9.9 J	21	27
Lead	1.5	0.98	1.9	1.4	14	1.2
Nickel	5	4.8	17	6.7	25	3.3
Selenium	0.21 U	0.22 U	0.21 U	0.2 U	0.21 U	0.21 U
Silver	0.21 U	0.068 U	0.061 U	0.078 U	0.047 U	0.067 U
Thallium	0.5 U	0.51 U	0.49 U	0.48 U	0.5 U	0.49 U
Tin	4.2 U	4.3 U	4.2 U	4.1 U	4.3 U	4.1 U
Vanadium	32 J	32 J	41 J	29 J	48 J	32 J
Zinc	18 J	15 R	19 J	18 J	24 J	14 R
Mercury	0.026	0.0062 J	0.049	0.026	0.027	0.023

APPENDIX B.3
GROUNDWATER

APPENDIX B.3

GROUNDWATER ANALYTICAL RESULTS
SWMU 28-BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**28MW05**	**28MW07**	**28MW08**	**28MW08D**
Sample ID	**28GW05**	**28GW07**	**28GW08**	**28GW08D**
Sampling Date	**02/17/08**	**02/17/08**	**02/17/08**	**02/17/08**
Metals (total) (ug/L)				
Antimony	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic	5.9 U	9.6 J	6.2 J	8.8 J
Barium	600	1100	850	780
Beryllium	0.99 J	3.7 J	1.2 J	1.2 J
Cadmium	1.1 J	1.6 U	1.2 U	0.99 U
Chromium	88	79	17	21
Cobalt	27	49	11	12
Copper	52	110	26	32
Lead	9.5	9.5	8	11
Nickel	32 J	54	11 U	10 U
Selenium	3.6 U	3.6 U	3.6 U	3.6 U
Silver	0.51 U	0.51 U	2.3 J	2.6 J
Thallium	4.6 U	4.6 U	4.6 U	4.6 U
Tin	3.6 U	3.2 U	3.2 U	5.9 U
Vanadium	100	280	46	52
Zinc	110	140	71	73
Mercury	0.25	0.29 J	0.4 J	0.43 J
Metals (dissolved) (ug/L)				
Antimony	5.1 U	5.1 U	5.1 U	5.1 U
Arsenic	2.3 U	7.6 U	3.5 U	2.3 U
Barium	42	42	450	430
Beryllium	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.72 U	0.72 U	0.72 U	0.72 U
Chromium	1.1 U	1.1 U	1.4 U	1.5 U
Cobalt	1.5 J	8.1 J	3.1 J	11
Copper	6.7 U	4.5 U	3.9 U	3.6 U
Lead	2.1 U	2.1 U	2.1 U	2.1 U
Nickel	2 U	3.7 J	2 U	2 U
Selenium	5.5 U	5.5 U	5.5 U	5.5 U
Silver	0.7 U	0.7 U	0.7 U	0.7 U
Thallium	3.6 U	3.6 U	3.6 U	3.6 U
Tin	3.4 U	3.4 U	3.4 U	3.4 U
Vanadium	15	26	10	11
Zinc	11 J	6.3 J	14 J	14 J
Mercury, Dissolved	0.08 UJ	0.08 UJ	0.08 UJ	0.08 UJ

APPENDIX B.4
QUALITY ASSURANCE / QUALITY CONTROL

APPENDIX B.4

QA/QC ANALYTICAL RESULTS
SWMU 28 - BUNDY WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, PUERTO RICO

		Equipment Rinsates			Field Blanks	
Sample ID	**ER03**	**ER04**	**ER06**	**ER10**	**FB01**	**FB02**
Sampling Date	**2/12/2008**	**2/13/2008**	**2/14/2008**	**2/17/2008**	**2/16/2008**	**2/16/2008**
PCBs (ug/L)						
Aroclor-1016	0.092 U	NA	NA	NA	0.093 U	0.099 U
Aroclor-1221	0.38 U	NA	NA	NA	0.38 U	0.41 U
Aroclor-1232	0.078 U	NA	NA	NA	0.08 U	0.085 U
Aroclor-1242	0.091 U	NA	NA	NA	0.092 U	0.098 U
Aroclor-1248	0.078 U	NA	NA	NA	0.08 U	0.085 U
Aroclor-1254	0.086 U	NA	NA	NA	0.088 U	0.093 U
Aroclor-1260	0.094 U	NA	NA	NA	0.096 U	0.1 U
Metals (ug/L)						
Antimony	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic	5.9 U	5.9 U	5.9 U	5.9 U	5.9 U	5.9 U
Barium	2 U	2 U	2 U	2 U	2 U	2.3 J
Beryllium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U
Chromium	1.4 U	1.3 U	1.4 U	1.3 U	1.3 U	1.7 U
Cobalt	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Copper	2.2 U	2.3 U	2.2 U	2.2 U	2.8 U	9.2 U
Lead	2.3 U	2.3 U	2.3 U	2.5 J	2.3 U	2.3 U
Nickel	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
Selenium	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Silver	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.77 J
Thallium	4.6 U	4.6 U	4.9 J	4.6 U	4.6 U	4.6 U
Tin	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Vanadium	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Zinc	8.4 U	8.6 J	8.4 U	8.4 U	8.4 U	160
Mercury	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U

APPENDIX C
2008 RFI DATA VALIDATION SUMMARIES

APPENDIX C.1
TEST AMERICA SAVANNAH SDG 34206

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34206, Test America-Savannah
NAPR SWMU 28, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34206. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory; the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (for 8082A: Rev 1, October 2006-SOP #HW-45), and professional judgment. For those methods that do not have an applicable Region II checklist SOP (SW-846 methods 6010B, 7471A and 7470A for appendix IX metals), worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	Metals	PCB
ER03	680-34206-10	water	X	X
28SS06	680-34206-1	soil	X	X
28SS07	680-34206-2	soil	X	X
28SS08	680-34206-3	soil	X	X
28SS09	680-34206-4	soil	X	X
28SS10	680-34206-5	soil	X	X
28SS11	680-34206-6	soil	X	X
28SS11D	680-34206-7	soil	X	X
28SS12	680-34206-8	soil	X	X
28SS12MS	680-34206-8MS	soil	X	X
28SS12SD	680-34206-8MSD	soil	X	X
28SS12D	680-34206-9	soil	X	X

The following quality control samples were provided with this SDG: sample ER03-equipment blank; sample 28SS11D-field duplicate of sample 28SS11; sample 28SS12D-field duplicate of sample 28SS12.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- GC Performance *
- Initial/Continuing Calibrations *
- CRDL Standards *
- ICSA/ICSAB Standards *

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- Blanks
- Internal Standards *
- Surrogate Recoveries *
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates
- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

PCBs

No qualification of the data was required.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

One of the submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte antimony. Reported results in the soil samples were qualified as estimated J/UJ.

One of the field duplicate pairs exhibited a non-compliant RPD for the analyte chromium. The reported results for chromium in the field duplicate pair were qualified as estimated.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. One form 13 was missing a sample for the metals fraction. A correction was requested and provided. A copy of the e-mail correspondence is included in the validation worksheets.

Technical Holding Times

According to chain of custody records, sampling was performed on 2/12/08 and samples were received at the laboratory 2/14/08. Sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBlk – soils	arsenic	0.341J ug/Kg	RL	U at reported value
ICB – soils	cadmium	0.440J ug/L – 0.0440 mg/Kg	RL	U at reported value
	silver	0.532J ug/L – 0.0532 mg/Kg	RL	U at reported value
CCB – waters	chromium	1.42J ug/L	RL	U at reported value

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
28SS06, 28SS12, 28SS12D	cadmium	U up to action level
28SS06, 28SS07, 28SS08, 28SS09, 28SS12, 28SS12D	silver	
28SS06, 28SS07, 28SS11, 28SS11D, 28SS12, 28SS12D	arsenic	
ER03	chromium	

Matrix Spike

Metals

The matrix spike of sample 28SS12 exhibited non-compliant recoveries for antimony that required qualification in the field samples. A summary of this non-compliances and affected samples are noted in the following table.

MS/SD	Analytes	Samples	%R	Q Flag
28SS12	antimony	all soil samples	71%/74%	J/UJ

Field Duplicates

Metals

The field duplicate pair of samples 28SS12 and 28SS12D exhibited non-compliant reproducibility for chromium (RPD > 35%). Therefore, the reported positive results for chromium in the field sample and field duplicate were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

PCBs

Sample ID	Compound	Results	Q flag
No qualifications were required			

Metals

Sample ID	Analyte	Results	Q flag
28SS06, 28SS12, 28SS12D	cadmium	+J up to action level	U at reported value
28SS06, 28SS07, 28SS08, 28SS09, 28SS12, 28SS12D	silver		
28SS06, 28SS07, 28SS11, 28SS11D, 28SS12, 28SS12D	arsenic		
ER03	chromium		
all soil samples	antimony	+/-	J/UJ
28SS12, 28SS12D	chromium	+	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.
R -	Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.
J -	Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.2
TEST AMERICA SAVANNAH SDG 34289-1

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34289-1, Test America-Savannah
NAPR SWMU 28, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34289-1. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory; the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (for 8082A: Rev 1, October 2006-SOP #HW-45), and professional judgment. For those methods that do not have an applicable Region II checklist SOP (SW-846 methods 6010B, 7471A and 7470A for appendix IX metals), worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	Metals	PCB
28SB05-00	680-34289-1	soil	X	X
28SB05-01	680-34289-2	soil	X	
28SB05-02	680-34289-3	soil	X	
28SB05-03	680-34289-4	soil	X	
28SB05-04	680-34289-5	soil	X	
28SB05-05	680-34289-6	soil	X	
28SB06-00	680-34289-7	soil	X	X
28SB06-01	680-34289-8	soil	X	
28SB06-01MS	680-34289-8MS	soil	X	
28SB06-01MSD	680-34289-8MSD	soil	X	
28SB06-01D	680-34289-9	soil	X	
28SB06-02	680-34289-10	soil	X	
28SB06-03	680-34289-11	soil	X	
28SB06-04	680-34289-12	soil	X	
28SB07-00	680-34289-13	soil	X	X
28SB07-01	680-34289-14	soil	X	
28SB07-02	680-34289-15	soil	X	
28SB08-00	680-34289-16	soil	X	X
28SB08-01	680-34289-17	soil	X	
28SB08-01D	680-34289-18	soil	X	
28SB08-02	680-34289-19	soil	X	
28SB08-03	680-34289-20	soil	X	
ER04	680-34289-21	water	X	
ER06	680-34289-22	water	X	

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The following quality control samples were provided with this SDG: sample ER04 and ER06-equipment blanks; sample 28SB08-01D-field duplicate of sample 28SB08-01; sample 28SB06-01D-field duplicate of sample 28SB06-01.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- GC Performance *
- Initial/Continuing Calibrations *
- CRDL Standards *
- ICSA/ICSAB Standards *
- Blanks
- Internal Standards *
- Surrogate Recoveries *
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs
- Serial Dilutions
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

PCBs

One result exhibited a column quantitation %D greater than 25% but less than 71%. This result was qualified as estimated J.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

One of the submitted MD pairs exhibited a non-compliant RPD for the analyte barium. Reported results in the soil samples were qualified as estimated J/UJ.

The associated serial dilution exhibited non-compliant %Ds for three analytes. Positive results for the analytes cobalt, vanadium and zinc were qualified as estimated J.

One of the field duplicate pairs exhibited non-compliant RPDs for the analytes chromium, cobalt, and copper. The reported results for chromium, cobalt and copper in the field duplicate pair were qualified as estimated.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 2/13-14/08 and samples were received at the laboratory 2/14/08. Sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBlk – soils	lead	0.529J mg/Kg	RL	U at reported value
CCB – soils	chromium	1.826J ug/L – 0.1826 mg/Kg	RL	U at reported value
	nickel	1.992J ug/L – 0.1992 mg/Kg	RL	U at reported value
	silver	0.483J ug/L – 0.0483 mg/Kg	RL	U at reported value
	selenium	3.452J ug/L – 0.3452 mg/Kg	RL	U at reported value
	antimony	4.194J ug/L – 0.4194 mg/Kg	RL	U at reported value
CCB – waters	chromium	1.728J ug/L	RL	U at reported value
	copper	2.360J ug/L	RL	U at reported value
FB02	copper	9.2J ug/L – 0.92 mg/Kg	RL	U at reported value
	silver	0.77J ug/L – 0.077 mg/Kg	RL	U at reported value
	zinc	160 ug/L – 16 mg/Kg	16 mg/Kg to 160 mg/Kg	J
			> MDL but < 16 mg/Kg	R

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
ER04, ER06	chromium	U up to action level
ER04, 28SB05-01, 28SB06-01D, 28SB06-02, 28SB06-03	copper	
28SB05-01, 28SB05-02, 28SB05-03, 28SB05-04, 28SB05-05, 28SB06-01	nickel	
all soil samples	silver	
28SB05-00, 28SB07-00	selenium	
all soil samples	antimony	
all samples except 28SB07-02, 28SB08-03	zinc	J
28SB07-02, 28SB08-03	zinc	R

Matrix Duplicates

Metals

The matrix duplicate of sample 28SB06-01 exhibited a non-compliant RPD for barium that required qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

MD	Analytes	Samples	RPD	Q Flag
28SB06-01	barium	all soil samples	63.6%	J/UJ

Serial Dilutions

Metals

The serial dilution of sample 28SB06-01 exhibited non-compliant %Ds for cobalt, vanadium and zinc that required qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
28SB06-01	cobalt	all soil samples	19.7%	J+
	vanadium		13.0%	
	zinc		15.8%	

Field Duplicates

Metals

The field duplicate pair of samples 28SB08-01 and 28SB08-01D exhibited non-compliant reproducibility for chromium, cobalt and copper (RPD > 35%). Therefore, the reported positive results for chromium in the field sample and field duplicate were qualified as estimated J.

Identification/ Quantitation

PCBs

One result in sample 28SB08-00 exhibited a column quantitation %D greater than 40% but less than 71% at 70.7%. The result for AR1260 was qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

PCBs

Sample ID	Compound	Results	Q flag
28SB05-00	AR1260	+J	J

Metals

Sample ID	Analyte	Results	Q flag
ER04, ER06	chromium	+J up to action level	U at reported value
ER04, 28SB05-01, 28SB06-01, 28SB06-02, 28SB06-03	copper		
28SB05-01, 28SB05-02, 28SB05-03, 28SB05-04, 28SB05-05, 28SB06-01	nickel		
all soil samples	silver		
28SB05-00, 28SB07-00	selenium		
all soil samples	antimony		
28SB07-02, 28SB08-03	zinc	+ up to blank level	R
all soil samples except 28SB07-02, 28SB08-03	zinc	+ > blank level up to 10X blank level	J
all soil samples	barium	+/-	J/UJ
all soil samples	cobalt vanadium zinc	+	J
28SB08-01, 28SB08-01D	chromium cobalt copper	+	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.
R -	Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.
J -	Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.3
TEST AMERICA SAVANNAH SDG 34321

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34321, Test America-Savannah
NAPR SWMU 28, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34321. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the samples in this SDG (SW-846 methods 6010B & 7470A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	TMetals	DMetals
28GW05	680-64321-1	water	X	X
28GW07	680-64321-2	water	X	X
28GW08	680-64321-3	water	X	X
28GW08MS	680-64321-3MS	water	X	X
28GW08MSD	680-64321-3MSD	water	X	X
28GW08D	680-64321-4	water	X	X
ER10	680-64321-5	water	X	

The following quality control samples were provided with this SDG: sample ER10-equipment blank; and sample 28GW08D-field duplicate of sample 28GW08.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- Initial/Continuing Calibrations *
- CRDL Standards *
- ICSA/ICSAB Standards *
- Blanks
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates *

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- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

The submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte mercury. Reported results in the water samples were qualified as estimated J/UJ.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. No resubmissions were required.

Technical Holding Times

According to chain of custody records, sampling was performed on 2/17/08 and samples were received at the laboratory 2/19/08. Sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
ICB – dissolved	arsenic	3.126J ug/L	RL	U at reported value
CCB – dissolved	chromium	1.412J ug/L	RL	U at reported value
	copper	2.727J ug/L	RL	U at reported value
ICB – total	tin	4.147J ug/L	RL	U at reported value
CCB – total	nickel	2.821J ug/L	RL	U at reported value
	cadmium	0.589J ug/L	RL	U at reported value

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
28GW07F, 28GW08F	arsenic	U up to action level
28GW08F, 28GW08DF	chromium	
28GW05F, 28GW07F, 28GW08F, 28GW08DF	copper	
28GW05, 28GW08D	tin	
28GW08, 28GW08D	nickel	
28GW07, 28GW08, 28GW08D	cadmium	

Matrix Spike

Metals

The matrix spikes of samples 28GW08 and 28GW08F exhibited non-compliant recoveries for mercury that required qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

MS/SD	Analytes	Samples	%R	Q Flag
28GW08	mercury	all water samples	71%/66%	J/UJ
28GW08F	mercury		61%/66%	

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

Metals

Sample ID	Analyte	Results	Q flag
28GW07F, 28GW08F	arsenic	+J up to action level	U at reported value
28GW08F, 28GW08DF	chromium		
28GW05F, 28GW07F, 28GW08F, 28GW08DF	copper		
28GW05, 28GW08D	tin		
28GW08, 28GW08D	nickel		
28GW07, 28GW08, 28GW08D	cadmium		
all water samples	mercury	+/-	J/UJ

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with waters to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.
R -	Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.
J -	Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.4
TEST AMERICA SAVANNAH SDG 34320-2

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34320-2, Test America-Savannah
NAPR SWMU 14, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34320-2. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (for 8260B: Rev 2, October 2006-SOP #HW-24 and for 8270D-Rev 3, October 2006-SOP #HW-22), and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganics methods in this SDG (SW-846 methods 6010B, 7471A, 9045C & 9060). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	VOA App IX	LL-PAH	Metals	PCB	TOC	pH
FB01	680-34320-28	water	X	X	X	X		
FB02	680-34320-29	water	X	X	X	X		
14D-SB10-00	680-34320-21	soil		X	X		X	X
14D-SB10-01	680-34320-22	soil		X	X			
14D-SB11-00	680-34320-23	soil		X	X		X	X
14D-SB11-00D	680-34320-24	soil		X	X			
14D-SB11-01	680-34320-35	soil		X	X			
ER08	680-34320-26	water		X	X			
ER09	680-34320-27	water		X	X			

The following quality control samples were provided with this SDG: Samples FB01 and FB02-field blanks; Samples ER08 and ER09-equipment blanks; Sample 14D-SB11-00D-field duplicate of sample 14D-SB11-00.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- GC/MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- Blanks
- Internal Standards *

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- Surrogate Recoveries *
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria.

VOA

The continuing calibration exhibited compounds with high %D and low RRF values that resulted in qualifications to the data.

Positive results were exhibited in one of the field blanks, the laboratory re-analyzed the sample to confirm the results. The results were confirmed; the results were used from the initial analysis.

SVOA

No qualifications were required to be added to the data.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

The associated matrix duplicate exhibited non-compliant %Ds for one analyte. Positive and non-detect results for the analyte copper were qualified as estimated J in the field samples.

The field duplicate pair exhibited non-compliant RPDs. The reported results for chromium and cobalt were qualified as estimated J in the field duplicate pair of sample 14D-SB11-00.

Wet Chemistry

No qualifications were required.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 02/16/08 and samples were received at the laboratory 02/19/08. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRFs that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
CC 02/25/08	iodomethane	26.5%	FB01, FB02	J/UJ
	isobutyl alcohol	0.01715		J/R

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
CCB – soils	antimony	5.444J mg/Kg	RL	U at reported value
	silver	0.406J mg/Kg	RL	U at reported value
CCB-waters	copper	2.360J ug/L	RL	U at reported value
	chromium	1.728J ug/L	RL	U at reported value
FB02	zinc	160 ug/L – 16 mg/Kg	10X Blank Level	J
ER08	cadmium	0.99 ug/L – 0.099 mg/Kg	RL	U at reported value

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
14D-SB10-00, 14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	antimony	U up to action level
14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	silver	
ER08, ER09, FB01, FB02	copper	
ER09, FB02	chromium	
14D-SB10-00, 14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	cadmium	
all field samples	zinc	J

Matrix Duplicates

Metals

The matrix duplicate of sample 14D-SB11-01 exhibited a non-compliant %D for copper that required qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

MD	Analytes	Samples	RPD	Q Flag
14D-SB11-01	copper	all soil samples	47.5%	J/UJ

Field Duplicates

Metals

The field duplicate pair of samples 14D-SB11-00 and 14D-SB11-00D exhibited non-compliant reproducibility for chromium and cobalt (RPD > 35%). Therefore, the reported positive results for these analytes were qualified as estimated J in both the field sample and the field duplicate.

Identification/Quantitation

VOA

Sample FB02 was reanalyzed to confirm positive results that were detected in the initial analysis. The results were confirmed; therefore the reanalysis was rejected and the initial analysis was used.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q-Flag
FB01, FB02	iodomethane	+/-	J/UJ
FB01, FB02	isobutyl alcohol	+/-	J/R
FB02RE	all results	+/-	R

SVOA

Sample ID	Compound	Results	Q flag
No qualifications required.			

Metals

Sample ID	Analyte	Results	Q flag
14D-SB10-00, 14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	antimony	+J up to CRDL	U at reported value
14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	silver		
ER08, ER09, FB01, FB02	copper		
ER09, FB02	chromium		
14D-SB10-00, 14D-SB10-01, 14DSB11-00, 14D-SB11-00D, 14D-SB11-01	cadmium		
all soil samples	zinc	+ >blank level up to 10X blank level	J
all soil samples	copper	+/-	J/UJ
14D-SB11-00 and 14D-SB11-00D	chromium cobalt	+	J

Wet Chemistry

Sample ID	Parameter	Results	Q flag
No qualifications required.			

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.
R -	Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.
J -	Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.5
PUERTO RICAN CHEMIST CERTIFICATIONS

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34206-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1202842

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Lic. Abraham Ortiz Charne

Mar 14, 08

QUIMICO LICENCIADO

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34289-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1158148

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Lic. Abraham Ortiz Charriez

Mar 14, 08

QUIMICO LICENCIADO

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34320-2,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

ESTADO LIBRE ASOCIADO DE PUERTO RICO

A 1202809

Lic Abraham Ortiz Charriez

Lic. Q.

Jun 3, 08

QUIMICO LICENCIADO

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34321-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1202812

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Lic. Abraham Ortiz Charriez

Jun 3, 09

QUIMICO LICENCIADO

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34320-2,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

ESTADO LIBRE ASOCIADO DE PUERTO RICO

A 1202809

Lic Abraham Ortiz Charriez

Lic. Q.

Jun 3, 08

QUIMICO LICENCIADO

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

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Abraham Ortiz

$1.00 $1.00

A 1202812

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Lic. Abraham Ortiz Charriez

Jun 3, 09

QUIMICO LICENCIADO