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FINAL BASIS OF DESIGN REPORT FOR INTERIM CORRECTIVE MEASURES - SWMU 2-Langley Drive Disposal Site

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

Contract No. N69450-09-C-0072

January 5, 2011

Prepared by:

Right Way Environmental
Contractors, Inc.
Naranjito, Puerto Rico

Corrective Action for SWMUs 27, 28, 29 and Pico Del Este
Naval Activity Puerto Rico, Ceiba, Puerto Rico

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Naranjito, Puerto Rico 00719

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: **Mark E. Davidson**

Title: **BRAC Env. Coordinator**

Date: **January 5, 2011**

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ACOE	United States Army Corps of Engineers
Baker	Michael Baker Jr., Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CAO	Corrective Action Objective
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERFA	Community Environmental Response Facilitation Act (CERFA)
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CY	Cubic Yards
ECP	Environmental Condition of Property
FID	Flame Ionization Detector
ft	feet
ICM	Interim Corrective Measures
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity
NSRR	Naval Station Roosevelt Roads
NTR	Navy Technical Representative
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenol
PEM	Palustrine Emergent Persistent
PI	Photo Identified
PID	Photoionization Detector
PMO	Program Management Office
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROICC	Resident Officer in Charge of Construction
RWEC	Right Way Environmental Contractors
SAP	Sampling and Analysis Plan
SE	Southeast
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leachate Procedure
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

This document presents the Basis of Design (BOD) for Interim Corrective Measures (ICM) for the delineation soil sampling and removal of contaminated surface and subsurface soil from Solid Waste Management Units (SWMU) 2 (Langley Drive Disposal Site) at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. This BOD document has been prepared by Michael Baker, Jr., Inc. (Baker) for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast (SE) Office under contract with the Naval Facilities Engineering Command (NAVFAC) SE (Contract Number N69450-08-R-0093).

A regional map depicting the location of NAPR is included with this BOD as Figure 1-1. The location of SWMU 2 is shown on Figure 1-2. The results of past investigations conducted at SWMU 2 indicate that former surface debris piles and contaminated soil pose a potentially unacceptable risk to ecological receptors; therefore, a soil removal action will be conducted. This BOD report will address general requirements for defining the limits of excavation, contaminated soil excavation and disposal, and site restoration.

1.1 Purpose of the Basis of Design

The primary purposes of this BOD are to present background data on the project, describe the primary elements of the remedial design, recommended cleanup criteria, and present assumptions and special requirements that may affect the design. This document is not intended to be part of the construction plans or technical specifications to be utilized by the Contractor for execution of the Removal Action.

2.0 BACKGROUND INFORMATION

This section provides a site description, site history, and summary of pertinent environmental investigations and actions conducted at SWMU 2.

2.1 Site Descriptions and History

The following subsections briefly describe the location and history of NAPR and SWMU 2.

2.1.1 NAPR

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

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

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

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

Recovery Act [RCRA] Program) at several sites to permit a more detailed assessment (Naval Facilities Engineering Command [NAVFAC] Atlantic, 2005).

The United States Environmental Protection Agency (USEPA) issued a RCRA § 7003 Administrative Order on Consent (Environmental Protection Agency Docket No. RCRA-02-2007-7301 [USEPA, 2007]), which identified SWMUs 1 and 2 as having documented releases of solid and/or hazardous waste and hazardous constituents, and required follow-on actions. Following a public comment period the Consent Order became effective on January 29, 2007 (USEPA 2007).

2.1.2 SWMU 2 Langley Drive Disposal Site

SWMU 2 is located along Langley Drive, approximately 1,000 ft northeast of the Navy Commissary and encompasses an area of approximately 28 acres as presented in Figure 1-2. This site consists of an abandoned, unlined waste-pile/landfill, on the edges of, and protruding into the mangroves along the shoreline of Ensenada Honda. This site was utilized from 1939 to 1959 as a disposal area for solid and possibly hazardous wastes/constituents. Previous studies conducted at this site indicate the presence of metals (antimony, copper, lead, mercury and zinc) in the surface (0-1 ft bgs) and subsurface (1-2 ft bgs) soil.

2.2 Summary of Previous Environmental Investigations

Until 1993 all environmental operations, with the exception of underground storage tanks (USTs), were conducted at the base under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations as part of the Department of the Navy's (DoN) Installation Restoration (IR) Program. Naval Station Roosevelt Roads submitted a RCRA Part B Permit application for the storage of hazardous waste on the Base. Recognizing that corrective action would apply to unpermitted waste management units, the Navy performed a Supplemental Site Investigation (SSI) at a variety of units (including SWMUs 1 and 2) to provide additional site characterization information to the United States Environmental Protection Agency (USEPA) to assist in their permitting decisions. On October 20, 1994, a Final RCRA Part B permit was issued by the USEPA Region II to the Defense Reutilization and Marketing Office (DRMO) of NSRR as RCRA/HSWA Permit No. PR2170027203 (USEPA 1994). The corrective action provisions of the permit contained specific requirements for investigation, and potentially, remediation at SWMUs 1 and 2, as well as required RCRA Facility Investigation (RFI) activities at 25 SWMUs and 3 Areas of Concern (AOCs). Two additional SWMUs (53 and 54) were identified during May, 2000 bringing the total to 27 SWMUs and 3 AOCs.

RCRA regulations provide a procedure to investigate and remediate areas that may have been affected by a release of hazardous wastes. The first steps for investigating a site are the RCRA Facility Assessment (RFA) and the RFI. These assessments and investigations are studies on a property to determine if there has been a release of hazardous waste and to quantify any releases that have occurred. If these studies determine that a release has occurred, a CMS is performed to identify the most appropriate corrective measure for a given site.

A RFA was performed in 1988 and updated in 1993 by A.T. Kearney, Inc. for the USEPA to identify SWMUs and AOCs, and to assess the potential for the release of hazardous constituents from any areas or units. The RFA identified 52 SWMUs and 4 AOCs, and recommended additional investigation at 25 of the SWMUs and three of the AOCs.

The RCRA Part B permit required a full RFI for SWMUs 1 and 2. RFI Work Plans (Baker, 1995) were developed for NSRR that included SWMUs 1 and 2. The work plan provided the framework for site characterization activities; its scope was guided by the results of the SSI. The field investigations for SWMUs 1 and 2 proposed in this work plan were conducted during October/November 1996 and September/October 1997. The Revised Draft RCRA Facility Investigation Report for Operable Unit 3/5 (including SWMUs 1 and 2) was submitted in April 1999 (Baker, 1999), and EPA approved in a September 28, 1999 letter.

Based on the recommendations presented in the Revised Draft RFI Report for OU 3/5 (Baker, 1999), a Revised Final II CMS Work Plan was submitted on July 14, 2000 (Baker, 2000), and EPA approved on May 4, 2001. A Draft Screening-Level Ecological Risk Assessment Problem Formulation (Step 1) and Exposure Estimate, as well as the Draft Additional Data Collection Work Plan in Support of Ecological Risk Assessment for SWMUs 1 and 2 were submitted on August 10, 2001 (Baker, 2001). EPA approved the above documents in their letter dated October 4, 2001. The Navy submitted a letter to the EPA stating the lack of funding to perform the work associated with SWMUs 1 and 2. The Navy submitted a response to EPA's comment letter dated October 4, 2001, as well as submitted an Addendum to the Draft Screening-Level Ecological Risk Assessment Problem Formulation (Step 1) and Exposure Assessment for SWMUs 1 and 2 on May 14, 2003. The EPA approved the above addendum on June 10, 2003. The field investigation associated with the above-mentioned EPA approved Screening-Level ERA plan was initiated and completed in July 2003. This additional data collection report and Step 3a of the baseline ERA focus on the objectives found in Section 1.1 of this report.

Sampling activities at SWMU 2 have previously been conducted under a Confirmation Study in 1985 (Round 01) and 1987 (Round 2) (SWMUs 1 and 2), a Supplemental Investigation in 1993 (SWMUs 1 and 2), a Relative Risk Ranking in 1995 (SWMUs 1 and 2), and a RFI field investigation in 1996 (SWMUs 1 and 2), 1997 (SWMU 1) as mentioned in the Draft Screening-Level Ecological Risk Assessment Problem Formulation (Step 1) and Exposure Estimate (Baker, 2001), the Additional Data Collection Field Investigation in July 2003, and the Additional Data Collection Effort in October 2004.

During the 1993 Supplemental Investigation (Baker, 1994), a geophysical investigation (electromagnetic terrain profiling and magnetometry) was performed at SWMU 1 based on a review of photographs and map analysis as discussed in the Revised Draft RFI Report for OU 3/5 (Baker, 1999). Correlation was found to be high between the disposal features noted by the photo-interpretation, and disposal indications found during the land-clearing activities. It should be noted that the geophysical investigation only covered the horizontal extent of the disposal area. The vertical extent of the disposal areas shall be visually verified during removal of the debris piles and subsequent delineation soil sampling. The field investigation and associated analytical data for the Estuarine Wetland System Background data were presented and discussed in the Final CMS Investigation Report for SWMU 9 (Baker, 2003). The field investigations and associated analytical data for SWMUs 1 and 2 were presented and discussed in the EPA-approved Revised Draft RFI for Operable Unit (OU) 3/5 (Baker, 1999). The reader is referred to these documents for a detailed description of sampling activities and analytical data.

The objective of the Draft Final Additional Data Collection and Screening Level Ecological Risk Assessment and Step 3A of Baseline Ecological Risk Assessment at SWMUs 1 and 2 (Baker, 2005) was to perform additional sampling of surface water and sediment at SWMUs 1 and, 2 to address the data gaps presented in the Draft Screening Level Ecological Risk Assessment Problem Formulation (Step 1) and Exposure Estimate for SWMUs 1 and 2 (Baker, 2001). This objective was met with the performance of the field investigation conducted in July 2003 and October 2004.

In September 2009, a surface (0-1 foot) and subsurface (1-2) foot soil sampling event was conducted at SWMU 2. The sampling locations are presented on Figure 2-1 and 2-2. Soils were analyzed for antimony, cadmium, copper, lead, tin, mercury and zinc. These analytical results along with other historic sampling events were utilized to develop the initial limits of soil contamination.

In January 2010, Right Way Environmental Contractors (RWEC) removed approximately 20 tons of surface debris at SWMU 2. These removed surface debris piles are presented on Figure 2-1. Access corridors were established into the SWMU 2 work area for the purposes of identifying and removing surface debris. Minimal clearing and grubbing was performed to allow access and visually identify the debris. Care was taken during clearing and grubbing to limit the impact on adjacent estuarine wetland system.

2.3 Current Site Conditions

The soil removal areas are located in the upland area of the SWMU 2. The SWMU 2 upland area consists of heavily overgrown secondary growth vegetation with no unobstructed access to the site. There are no maintained access ways into the SWMU. The estuarine wetland is made up of a mangrove forest extending out to the open water located southeast of the SWMU. The field crew observed metal and wood scattered on the surface in isolated areas of the estuarine wetland of SWMU 2.

The location of SWMU 2 within proximity of low-lying and wetland areas requires that field work could only reasonably be attempted during the historically low precipitation winter months of December and January.

The estuarine wetland exists across the SWMU 2. The wetlands will be delineated in the field prior to excavation activities. This wetland delineation will determine the absence or presence of wetlands in the area where the work is to be conducted. If they are present in this area, then their boundary will be mapped and an evaluation will be conducted to determine if they may impact any of this work. Remedial activities such as excavation, decontamination and equipment staging will be performed outside of the designated wetland areas.

2.4 Remediation Levels

The corrective action objectives (CAO) established for the contaminants of concern (COC) for SWMU 2 surface and subsurface soil are:

- Antimony: 114,938 mg/kg
- Copper: 291 mg/kg
- Lead: 131 mg/kg
- Mercury: 0.18 mg/kg
- Zinc: 988 mg/kg

The Corrective Action Objectives Development for Terrestrial Avian Omnivores and Preliminary Delineation Investigation (Baker, 2010b) explains in detail how the CAOs were developed. SWMU 2 CAO values are based on evaluation of ecological exposure pathways for unacceptable risks to terrestrial avian omnivores from dietary exposures to COCs in soils as presented in Step 6 of BERA (Baker, 2010a). The identified risk is for ecological receptors, specifically terrestrial avian omnivores within the surface and subsurface soils. The CAOs were established based on an

acceptable risk threshold for the receptors. The risk is diminished by removing the surface and subsurface soils.

The Draft CAO Development document (Baker, 2010b) is undergoing concurrent regulator approval with the Draft Design Package for ICM for SWMU 2. EPA Comments dated October 14, 2010 on the CAOs have been addressed and updated values are included in this document. Therefore, the CAOs are not yet approved by the stakeholders. When the CAO Development document is approved, the CAOs within this document will reflect those CAOs in the Final CAO Development document.

2.5 Extent of Soil Contamination

The evaluation of chemicals detected in historic soil samples identified antimony, copper, lead, mercury and zinc as potential ecological risk drivers for terrestrial invertebrate and plant communities. Prior to interim corrective measure implementation, additional soil samples will be collected to further delineate the extent of the soil contamination.

Based on concentrations of potential ecological risk drivers detected in the soil and results of delineation sampling an extent of contamination was developed. Figures were developed to present the initial limits of excavation for contaminated soil removal action based on historic sampling results. Figure 2-3 represents the proposed extent of contaminated surface and subsurface soil removal and the location of proposed delineation soil samples. The extent of the soil removal activities as shown on the supporting figures represents the initial wetland boundaries which are subject to change pending the results of the delineation sampling.

The selected interim corrective measure, soil removal, will eliminate direct exposure pathways for terrestrial plants and invertebrates. Direct exposure pathways will be eliminated only in those areas where soil removal followed by placement of clean soil has been conducted. The required depth of soil excavations (1 foot or 2 foot bgs) are based on potential food web exposure for avian, amphibians, reptiles, and mammalian herbivores. Replacing the soil will be protective of the food web receptors. Soil excavation will terminate above the maximum required depth if groundwater or refusal (bedrock) is encountered above required depth.

3.0 FACTORS AFFECTING THE DESIGN AND IMPLEMENTATION OF THE REMOVAL ACTION

The following sections describe factors affecting the design and implementation of the proposed Removal Action. Supporting information and referenced data are presented in the Appendices as follows.

- Appendix A - Construction Schedule
- Appendix B - Supporting Calculations

3.1 Scope and Goals of the Proposed Removal Action

The proposed removal action for SWMU 2 will provide a cost-effective means of meeting the overall project goal which is the protection of human health and the environment. The Removal Action will provide protection by:

- Reducing the potential for human health and ecological exposure to contaminated surface soil; and

- Eliminating the future possibility of contaminants migrating to groundwater, surface water, and sediment.

3.2 Description of the Proposed Removal Actions

The major items associated with the proposed Removal Action (identification of limits of contamination and soil excavation) for SWMU 2 include:

- Wetland Delineation – Delineate wetland boundaries within the border at SWMU 2. Wetland delineation to be performed by an experienced wetland professional in accordance with ACOE guidelines;

- No contaminated soil removal activities will be performed within the defined wetland boundary. All work activities (i.e., sampling, excavation, clearing, etc.) will only be performed outside the wetland boundary;

- Avoid negatively impacting or disturbing wetlands during the ICM activities;

- Collect surface and subsurface soil samples (delineation samples) from areas outside the identified limits of excavation and at the depths shown on Figure 2-3 to verify soils beyond the limits of excavation do not exceed CAOs;

- If a delineation sample exceeds the CAOs, then an additional delineation sample will be collected 12.5 feet from the exceedance sample location in the cardinal direction, unless proposed additional sampling location had been previously sampled;

- Continue delineation sampling as needed until results are below CAOs;

- Extend the limits of excavation as necessary to include these identified contaminated areas;

- Excavation soil within the revised limits of excavation to either one or two feet below ground surface (bgs) based on results of delineation sampling;

- Collect and dispose of any non-soil debris encountered during excavation as appropriate;

- Excavated soil will be deposited directly into appropriate waste storage containers or in covered stockpile;

- While the excavated soil is awaiting transportation for disposal, the soils will be stored in appropriate waste storage containers with adequate cover or covered stockpile (The containers or stockpile liner will be positioned so that they slope and drain to one corner to allow collection of runoff liquid);

- Confirmation sampling of the sidewalls of each excavation. Soil samples will be collected from each sidewall; one sample per every 25 lineal feet of wall at a depth of either 1 foot bgs or 2 foot bgs depending on the required depth of excavation shown on Figure 2-3;

- If confirmation sampling results are above CAOs additional excavation will be performed to remove the contaminated soil. This additional excavation will include the 25 foot wall face associated with the confirmation sample and extend 5 feet horizontally into the wall face;

- If additional soils are removed from outside the initial limits of excavation area then confirmation samples will be collected from this additional excavation wall face of the excavation as described in the previous bullets;

- If groundwater is encountered during excavation, the excavation depth will be adjusted to restrict proceeding below groundwater table;

- Excavated soil will be transported to an off-site disposal facility in the appropriate waste storage containers; and

- Backfill existing excavated areas with clean fill to match existing grade.

The proposed construction schedule is presented in Appendix A. The following are a list of special requirements:

- The surface and subsurface delineation soil samples will be collected as indicated on figures prior to the commencement of excavation activities to ensure the extent of contamination is defined. These samples will be analyzed for antimony, copper, lead, mercury, and zinc in accordance with the methods described in the SAP;

- The wetlands must not be disturbed during construction activities. If it appears that construction activities have extended into a designated wetland area, then all construction activities will stop and the NTR will be notified for specific instructions on how to proceed at that time; and

- The confirmation sampling requires 24-hour laboratory analysis so results can be evaluated to ensure that the CAOs for antimony, copper, lead, mercury, antimony, and zinc are met before excavation is backfilled.

3.3 Preliminary Design Criteria and Rationale

The remediation goals presented in Section 2.4 were used to develop the BOD for this Removal Action.

Wetland Delineation - The estuarine wetland (E2SS3) resource boundary depicted on Figures 2-1 through 2-3 was delineated by Geo-marine, Inc. in December 1999 from 1993 color infrared and 1998 true color photography. As such, the wetland boundary does not represent a field delineated jurisdictional boundary. The estuarine wetland (E2SS3) boundary within the borders of SWMU 2 will be field-delineated in accordance with the U.S. Army Corps of Engineers Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (Environmental Laboratory, 2009).

Extent of Soil Removal - The extent of soil contamination in excess of the CAOs is initially limited to the areas, as shown on Figure 2-3 and any additional areas outside the limits of excavation resulting from delineation sampling that yield contaminants above CAOs. The limit of excavation areas were defined via laboratory analysis conducted as part of previous investigations. Excavation limits were defined based on available laboratory analytical results. Limits of excavation will be adjusted to prohibit work within delineated limits of the wetlands.

Side-wall confirmatory sampling will verify removal of contaminated soils. Excavation will not extend into the wetlands.

Soil will be removed from the limits of excavation areas presented in Figure 2-3 or as identified by delineation sampling for SWMU 2 as follows:

- A minimum of 126 delineation samples from 98 sample locations presented in Figure 2-3, will be collected and analyzed to verify and adjust the proposed limits of excavation;

- Delineation sampling will be performed until results are below CAOs for all COCs. If CAOs are exceeded an additional delineation sample will be collected 12.5 feet from that exceedance sample location in each cardinal direction unless a proposed additional sampling location had been previously sampled;

- Minimum of 2110 cubic yards (CY) (Appendix B) will be excavated in designated areas to a maximum depth of two feet below the ground surface. Volume includes soil above subsurface excavation (0 – 1 foot) to be handled similar to 1-2 foot soil; and

- After excavation is completed, a minimum of 135 confirmatory samples will be collected and analyzed to verify the remaining soils are below the CAOs for all COCs.

Confirmation Sampling - Confirmation soil samples will be collected from the surface of each wall, in undisturbed soil, every 25 lineal feet along face of sidewalls at a depth of 0-1 or 1-2 feet below the ground surface based on maximum excavation depth.

Backfill - The area of removed soil will be replaced with clean backfill in accordance with project specifications.

Revegetation - Once backfill soil is placed and graded in the excavation areas, the Contractor shall revegetate the site in accordance with project specifications.

Slope Stability - The existing ground surface is generally flat in the vicinity of the surface soils to be excavated at SWMU 2. There are no slope stability concerns at SWMU 2.

Storage Area - All contaminated surface soil will be placed in appropriate waste storage containers with adequate cover awaiting analysis of data identifying the ultimate disposal location.

Soil Stockpile Area – Contractor may elect to stockpile clean materials (backfill soil) in this designated area prior to backfilling the excavation.

3.4 General Operations and Maintenance Requirements

Minimal maintenance will be required subsequent to implementation of the removal action. Periodic visual inspections will be conducted during the initial weeks following revegetation to verify that vegetation is established. Subsequently, periodic inspections will be conducted to verify that the topsoil cover is not eroding and the vegetation is growing. Additionally, erosion control structures will be inspected and maintained until vegetation is sufficiently established whereupon erosion control structures will be removed.

4.0 COMPONENTS OF THE REMEDIAL ACTION

The following sections of this BOD describe the individual components of the removal action.

4.1 Mobilization and Preparatory Work

Mobilization involves the acquisition, delivery, and setup of equipment, material, and personnel at the work site which are necessary to accomplish the scope of work outlined for the removal action.

In addition, during the mobilization period, the Contractor shall prepare all necessary pre-construction submittals as described in the technical specifications. These specifications allow the Contractor up to sixty (60) days to prepare and submit the necessary pre-construction submittals. These submittals include:

- Erosion and Sedimentation Control Plan
- Site Specific Health and Safety Plan
- Sampling and Analysis Plan
- Complete Remedial Design Plans
- Organization Chart
- Project Schedule
- Submittal Register

The Contractor shall provide temporary facilities, including (but not limited to) equipment decontamination and laydown areas, contaminated water storage facilities, and clean soil stockpile/storage areas. The Contractor will also provide any temporary utilities necessary to complete the work.

Pre-construction submittals will be submitted in accordance with Section 01 33 00 of the Technical Specifications. The submittals will be included in the Interim Corrective Measures Work Plan for approval by the Navy and USEPA.

The Contractor will be required to coordinate and obtain any necessary construction permits (such as temporary excavation permits) and clearances prior to the start of construction. The Contractor will also be responsible for coordinating all required inspections with the regulators and the designated Navy and Puerto Rico Port Authority personnel, as identified during the project kickoff meeting.

4.2 Monitoring, Sampling, Testing, and Analysis

The Contractor will be responsible for all health and safety monitoring at SWMU 2. Sampling, testing and analysis that will be conducted by the Contractor will include characterization of materials that will be disposed or transported off site by the Contractor.

The Contractor will be required to submit to the USEPA and the Navy, for approval, a Sampling and Analysis Plan (SAP) describing the Contractor's sampling, analytical, and quality control procedures for the chemical data collected during the performance of work required by the specifications. The SAP will ensure that all chemical data generated are scientifically accurate and legally defensible. The SAP will describe the quantity, frequency, and media of samples to be collected and analyses to be performed.

The type and quantity of testing will be based on the requirements set forth in the specifications, the Contractor's Site Specific Health and Safety Plan and as required by disposal facilities which

will be utilized. All required testing, documentation, and submittal of test results (for samples collected by the Contractor) will be the responsibility of the Contractor.

4.2.1 Liquid Waste Sampling

The Contractor shall collect water samples for chemical analysis from the water generated as part of the Removal Action including, but not limited to, water collected from pressure washing, decontamination activities, and excavated soil stored in the appropriate waste storage containers.

4.2.2 Soil Sampling

Sampling of in situ soils will not be the responsibility of the NTR or Contractor. However, the Contractor will be responsible for allowing sampling teams access to soil removal areas and for coordinating construction activities to accommodate sampling procedures. Laboratory analysis will be performed on the samples collected by the sampling teams. The total number of required delineation and confirmatory samples will be based on results of initial sampling.

Laboratory analysis for confirmation and delineation sampling will be performed on a "quick turn" (24 hours maximum) basis to minimize this waiting period and the associated dewatering costs (if any). The excavation will remain open while results of the laboratory confirmation testing are obtained.

As outlined in the project specifications, any off-site borrow material to be used as backfill will be sampled (by the Contractor) at a frequency of one sample for every 5,000 CY of potentially clean/borrow material. A minimum of one backfill characterization sample is required per source. Alternately, the Contractor may submit certification indicating that the soil is clean, with approval from the Navy Technical Representative (NTR). The Contractor will also be required to perform geotechnical testing of soils as outlined in the Sampling and Analysis Plan (SAP) and specifications.

4.2.3 Debris, Waste, and Recyclable Material Sampling

The Contractor will be responsible for collecting samples of materials that will be transported off site for disposal. These materials may include, but are not limited to the following:

- Surface debris;
- Erosion and sediment controls;
- Recyclable materials such as metal and rubber;
- Decontamination pad;
- Excavated soil;
- Waste generated by the Contractor; and
- Personal Protective Equipment (PPE).

4.2.4 Testing and Analysis

The Contractor shall adhere to USEPA chain-of-custody procedures during the collection, transport, and analyses of all samples. Sampling parameters will be presented in SAP. Samples shall be analyzed as follows:

1. Characterization sampling – Excavated soil will be tested for COC metals (antimony, copper, lead, mercury, and zinc), Toxicity Characteristic Leachate Procedure (TCLP) metals, BTEX, paint filter liquids test, and Ignitability, Reactivity, and Corrosivity (IRC) or additional analysis as required by the disposal facility to ensure proper characterization for disposal in an off-site landfill.

2. Incidental Waste sampling - Fluids collected during excavation and decontamination will also be tested for COC metals, Full TCLP and IRC or as required by disposal facility.

3. Off-Site Soils to be used for backfill will be tested for parameters listed in Technical Specifications at a frequency of 1 test per source per 5,000 cubic yards.

4. Off-site borrow material will be used as clean fill after analytical results confirm the absence of contamination. Sampling and analysis frequencies and methods will be outlined in the Technical Specifications and Contractor's SAP. Alternately, the Contractor may submit certification indicating that the soil is clean, with approval from the NTR. Off-site borrow material should contain the same geotechnical and nutrient characteristics as the soil removed from the site.

5. Geotechnical testing (soil classification and compaction testing) of borrow soils and "clean" soils that will be placed as backfill. Test frequency and methodologies will be outlined in the Technical Specifications and Contractor's SAP.

6. Delineation sampling – Prior to excavation activities, soil samples will be collected and tested for COC metals (antimony, copper, lead, mercury, and zinc) to accurately identify the limits of soil excavation.

4.3 Site Work

Site work includes, but is not limited to, the following activities:

- Delineating the limits of the wetlands adjacent to SWMU 2 following ACOE guidelines prior to construction activities to minimize the impact to the wetlands during removal activities;

- Wetlands will be marked in the field and will be avoided during all construction activities including placement of the access roadway and soil stockpile areas;

- Document by survey the limits of wetland area;

- Locate by survey the initial excavation limits and proposed delineation samples;

- Delineation soil sampling in the areas located outside the initial limits of excavation;

- Clearing and grubbing where required (and associated chipping, mulching, transportation of mulch);

- Mobilization of excavation and transportation equipment, and appropriate waste storage containers;

- Construction of a decontamination pad and equipment laydown area;

- Installation of safety measures (such as safety fencing);

- Installation of erosion and sedimentation control facilities;

- Perform removal action activities (delineation sampling, excavation, confirmatory sampling, soil disposal, and backfill) as presented in Section 3.2;

- Collection, analysis, and disposal of water accumulated in soil filled appropriate waste storage container, open excavation and decontamination fluids;

- Survey the location of confirmation sampling and final limits of excavation;

- Earthwork, including: fill placement and site grading;

- Revegetate disturbed areas with like vegetation;

- Demobilization of all equipment, etc.; and

- Removal of erosion and sediment control structures upon establishment of vegetation.

4.4 Surface Water Collection and Control

The Contractor will be required to provide devices and facilities as necessary to prevent surface water from contacting contaminated materials (e.g., contaminated equipment, excavated soils, exposed debris/contaminated soils within the excavation) throughout the course of all construction activities. The Contractor shall be required to keep all excavated areas dewatered during construction and to collect, sample, analyze, and dispose of any water accumulated in the excavation and staging areas.

The liquid that accumulates within the excavated areas, as well as the liquid collected following contact with contaminated materials and equipment shall not be allowed to flow outside of the limits of construction.

The evacuation of water from the excavation areas can be accomplished via installation of sump pumps within the excavated area and pumping the accumulated water to an appropriate collection vessel (such as a Baker tank or tanker truck). For costing purposes, it is assumed that 1000 gallons of water will be collected from the site. The collected water will be tested for the parameters listed in SAP.

Groundwater elevation data from previous investigations at this SWMU indicates depth to groundwater greater than 2 feet bgs in the areas of the proposed excavation. Based on results of BERA (Baker 2007), the excavation will not extend below 2 feet bgs; therefore groundwater should not be encountered. Should groundwater be encountered in the excavation, work will be stopped at that depth and the excavation depth adjusted to restrict excavation below the groundwater table. No soil excavation will be performed in saturated soils or below the groundwater table.

To avoid surface water contact with contaminated materials, the Contractor may employ devises such as water proof barriers or covers (plastic sheeting) or construct earthen berms to divert surface water away from construction areas. Excavated soil shall be deposited directly into appropriate waste storage containers with appropriate and adequate covers which will not be susceptible to collection of surface water.

4.5 Solids Collection and Containment

The excavation of contaminated soil will be performed with earth moving equipment such as excavators and front-end loader in accordance with standard construction practices, while ensuring that there is minimal adverse impact to the site ecology.

The minimum anticipated extent of excavation is depicted on the Figure 2-3. It is estimated that approximately 1,264 CY of contaminated soil will be removed from the site. These volumes are initial estimates and do not include excavation associated with site work such as grading activities or increased limits of excavation based on delineation sampling.

The above volumes were calculated on the in situ soils and do not include bulking. The volumes are based on extent of contamination as defined via laboratory analyses that were conducted under previous investigations. Results of delineation sampling may increase the limits of excavation and require additional excavation. The Contractor will establish baselines or reference points as necessary to ensure that excavation is conducted in the proper location, and that the locations can be readily field verified via survey. Excavation will not commence without approval from the Navy's on-site representative.

The Contractor will not excavate beyond the designated areas or depths (as indicated on the design drawings) without approval from the Navy's on-site representative. If the delineation sampling or side-wall confirmatory soil sampling indicates that the in situ soils adjacent to the excavated areas exhibit contamination (above the established remediation goals), the Contractor will consult with the Navy's on-site representative to determine the additional areas of soils to be excavated. Excavation (and confirmatory soil sampling) will proceed until the remediation goals are met.

The excavated soil will be placed in appropriate waste storage containers located near the excavation area. Surveying will take place to determine confirmatory sample locations, extent of soil removal as well as post-construction site conditions.

4.6 Liquids Collection and Containment

The Contractor will provide a decontamination pad to collect liquids from the decontamination of personnel and construction equipment. The Contractor will also collect any water that may collect in the excavation areas. The resulting fluids will be collected for analysis and proper disposal or treatment.

4.7 Decontamination and Decommissioning

Demolition of structures is not anticipated. Miscellaneous surface debris, drums, tanks, spent PPE, and other non-hazardous solid waste will be disposed of in accordance with USEPA guidance (USEPA Publication 9345.3-05FS).

4.8 Disposal

The following materials will be containerized, manifested, and transported to an approved treatment or disposal facility off-base:

- Miscellaneous non-soil surface debris encountered during excavation;
- Contractor-generated waste (e.g., decontamination debris, liquids generated through decontamination procedures and liquids collected in appropriate waste storage containers);
- Surface water runoff and precipitation collected in the soil excavation area; and
- Excavated surface soil.

4.9 Site Restoration

After confirmatory sampling results indicate that the contamination has been removed from site, the excavated areas will be surveyed, backfilled with clean soil from off-site borrow sources and vegetated. SWMU 2 will be restored as indicated on the design drawings and in the technical specifications.

4.10 Demobilization

All temporary facilities, equipment, and supplies acquired for this contract shall be decontaminated and removed from the site upon completion of the removal actions.

Post-construction submittals will include: 1) a punch list showing correction of all listed items; 2) a letter from the Contractor certifying completion of all contracted work in accordance with the contract conditions, applicable regulations, and standards of practice; 3) a completed project current condition with an as-built survey for the entire site; 4) submittal, in one collated document, of all quality control daily reports manifests, bills of lading, samples collected, results of the sample analyses, corrective actions taken to correct unacceptable deviations from required quality standards (if required) results of corrective actions; problems encountered and resolved, and lessons learned; and, 5) submittal in one collated document of all quality assurance samples, sample analyses results, and corrective actions taken to correct unacceptable deviations from required quality standards (if required).

The Contractor will submit a detailed report summarizing the removal action, lessons learned, and recommendations for inclusion in future similar contracts.

5.0 REFERENCES

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FIGURES

FIGURE 1-1

REGIONAL LOCATION MAP

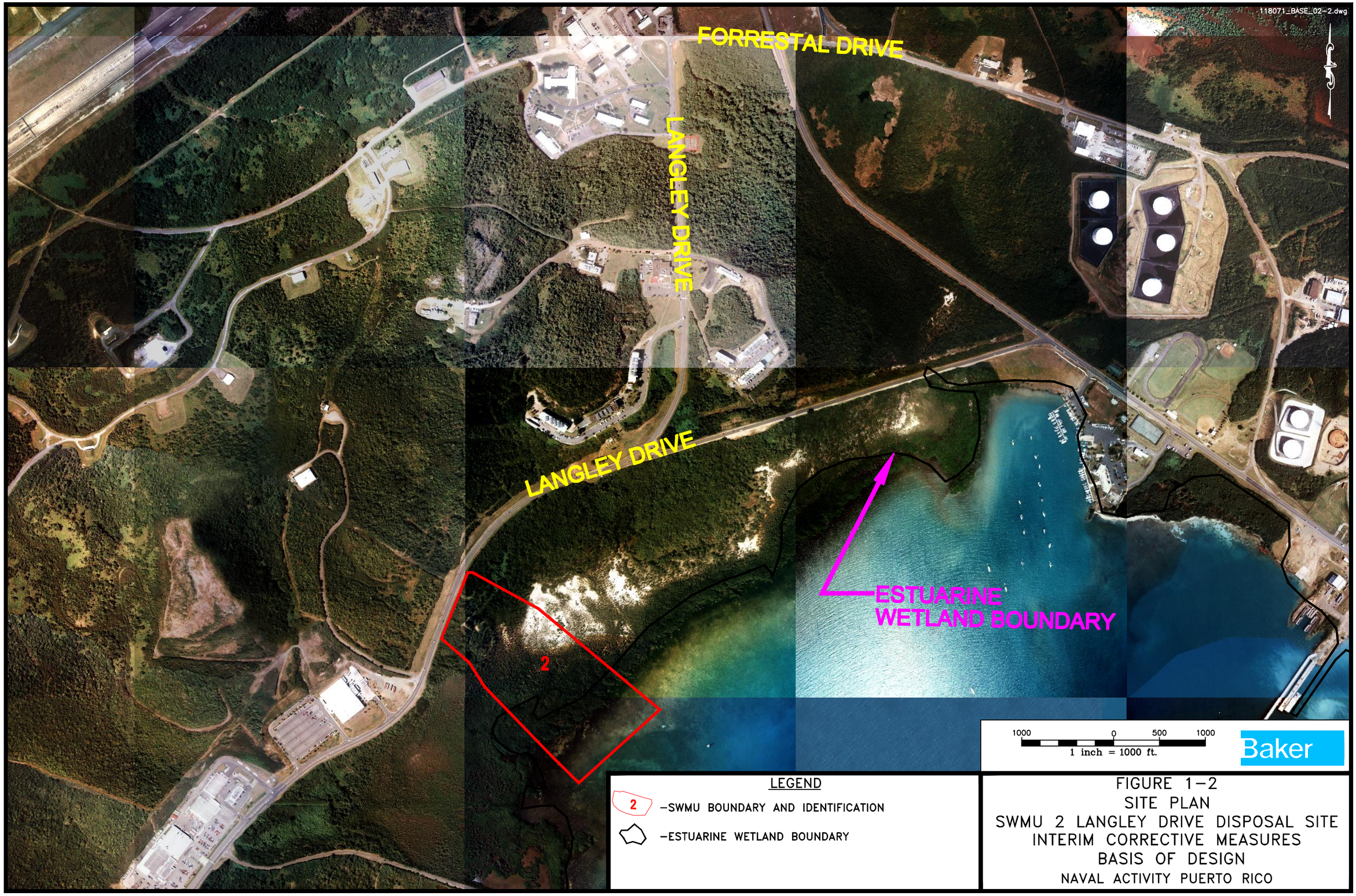
SWMU 2 LANGLEY DRIVE DISPOSAL SITE

INTERIM CORRECTIVE MEASURES

BASIS OF DESIGN

NAVAL ACTIVITY PUERTO RICO

SOURCE: METRODATA, INC., 1999.



LEGEND

2 –SWMU BOUNDARY AND IDENTIFICATION

–ESTUARINE WETLAND BOUNDARY

FIGURE 1–2
SITE PLAN
SWMU 2 LANGLEY DRIVE DISPOSAL SITE
INTERIM CORRECTIVE MEASURES
BASIS OF DESIGN
NAVAL ACTIVITY PUERTO RICO

118071_04_02-1_BOD.dwg

2SB01
2SD01
2MW02
2SB02
06SS101
06SS102
2SS04
2SS07
2SD03
2SS01
2SB03
2SS03
2SS05
06SS104
06SS106
2MW03
2SS02
2SB04
2SS10
2SS09
2SS14
2SD02
2SS12
2SB05
2SS13
2SS11
METAL STAGING AREA
2NEWSS04
2NEWSS01
06SS105
2NEWSS03
2NEWSS02
E2US2
E2SS3
EXTENT OF GRUBBING/ VEGETATION REMOVAL
WETLAND BOUNDARY TO BE DELINEATED PRIOR TO IMPLEMENTATION OF CORRECTIVE ACTION
SWMU 2 BOUNDARY
LANGLEY DRIVE
UPLAND
135
130
125
120
115
110
100

NOTE: ALL SAMPLES IN BLUE INDICATE ANALYTICAL RESULTS ABOVE CAO. WHILE ALL SAMPLES IN BLACK INDICATE ANALYTICAL RESULTS BELOW CAO.

70 0 35 70
1 inch = 70 ft.

Baker

LEGEND

- 2 — SWMU
- E2SS3 — E2SS3 WETLAND BOUNDARIES
- — MONITORING WELL/SURFACE SOIL SAMPLING LOCATION (1996 RFI)
- — SUBSURFACE SOIL SAMPLE LOCATION (SUPPLEMENTAL INVESTIGATION)
- — SURFACE SOIL SAMPLE LOCATION (1996 RFI)
- — SURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- — SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- — UNASSOCIATED SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- — UNASSOCIATED SURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- — SURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- — SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION ASSOCIATED WITH 2SS03 OR 06SS101 (2009 DELINEATION INVESTIGATION)
- — SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION ASSOCIATED 2SS05 (2009 DELINEATION INVESTIGATION)
- — FORMER DEBRIS PILES

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

WETLAND BOUNDARIES WERE DELINEATED BY GEO-MARINE INC. IN DECEMBER OF 1999 FROM 1993 COLOR INFRARED AND 1998 TRUE COLOR PHOTOGRAPHY. OBSERVATIONS DURING THE PRELIMINARY DELINEATION SAMPLING EVENT INDICATE THAT WETLAND BOUNDARIES DELINEATED BY AERIAL PHOTOGRAPHY ARE NOT ACCURATE.

FIGURE 2-1
SURFACE SOIL RESULTS GREATER THAN CORRECTIVE ACTION OBJECTIVES (0-1')
SWMU 2 - LANGLEY DRIVE DISPOSAL SITE
INTERIM CORRECTIVE MEASURES
BASIS OF DESIGN
NAVAL ACTIVITY PUERTO RICO

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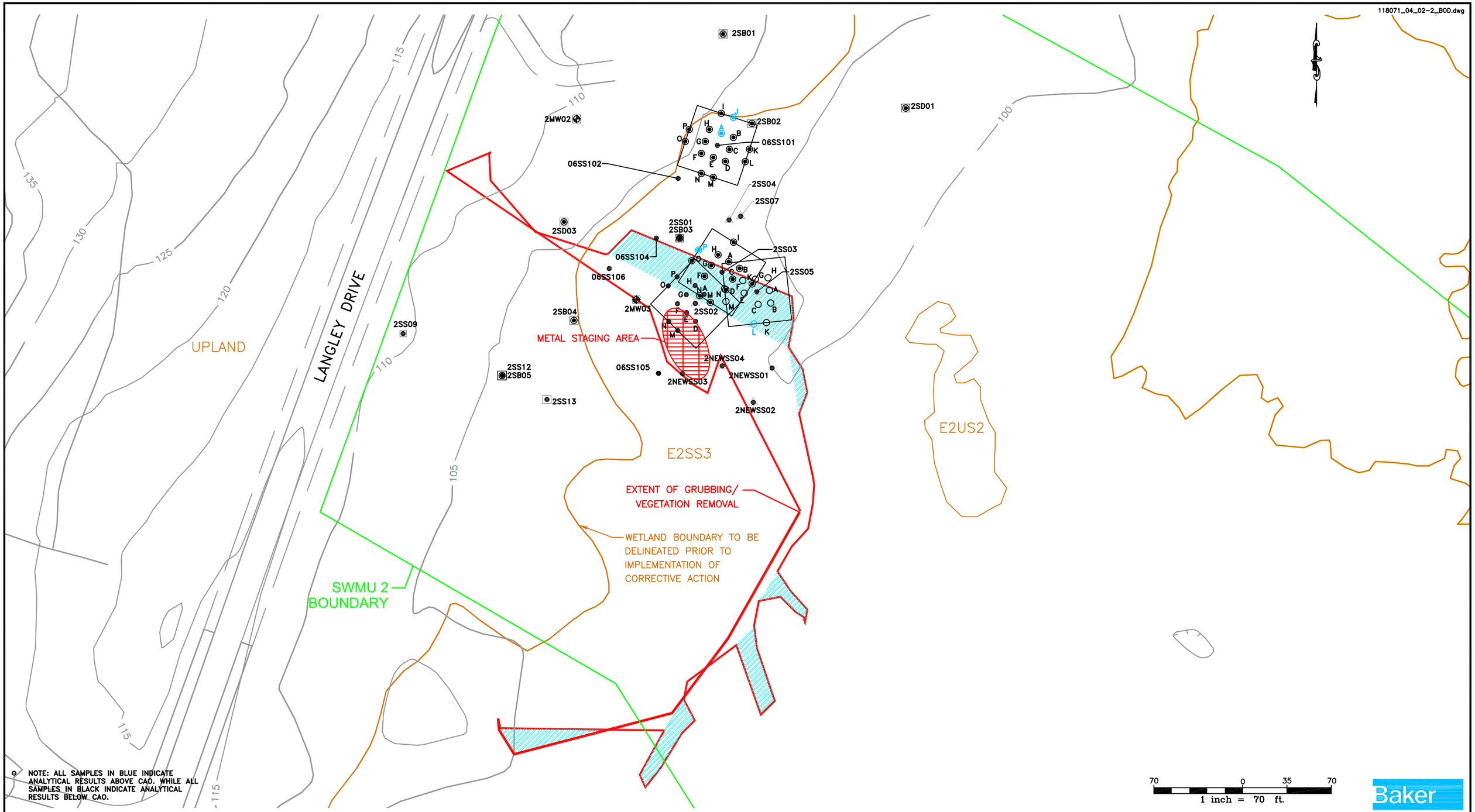

NOTE: ALL SAMPLES IN BLUE INDICATE ANALYTICAL RESULTS ABOVE CAO. WHILE ALL SAMPLES IN BLACK INDICATE ANALYTICAL RESULTS BELOW CAO.

70 0 35 70
1 inch = 70 ft.

Baker

LEGEND

- 2 – SWMU
- E2SS3 – E2SS3 WETLAND BOUNDARIES
- – MONITORING WELL/SURFACE SOIL SAMPLING LOCATION (1996 RFI)
- – SUBSURFACE SOIL SAMPLE LOCATION (SUPPLEMENTAL INVESTIGATION)
- – SURFACE SOIL SAMPLE LOCATION (1996 RFI)
- – SURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- – SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- – UNASSOCIATED SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
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- – SURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- – SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION ASSOCIATED WITH 2SS03 OR 06SS101 (2009 DELINEATION INVESTIGATION)
- – SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION ASSOCIATED 2SS05 (2009 DELINEATION INVESTIGATION)
- – FORMER DEBRIS PILES

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

WETLAND BOUNDARIES WERE DELINEATED BY GEO-MARINE INC. IN DECEMBER OF 1999 FROM 1993 COLOR INFRARED AND 1998 TRUE COLOR PHOTOGRAPHY. OBSERVATIONS DURING THE PRELIMINARY DELINEATION SAMPLING EVENT INDICATE THAT WETLAND BOUNDARIES DELINEATED BY AERIAL PHOTOGRAPHY ARE NOT ACCURATE.

FIGURE 2-2
SUBSURFACE SOIL RESULTS GREATER THAN CORRECTIVE ACTION OBJECTIVES (1-2')
SWMU 2 – LANGLEY DRIVE DISPOSAL SITE
INTERIM CORRECTIVE MEASURES
BASIS OF DESIGN
NAVAL ACTIVITY PUERTO RICO

118071_04_02-3_BOD.dwg

SWMU 2
BOUNDARY

2MW01
2SB01
2SD01
2MW02
2SB02
06SS101
06SS102
2SS04
2SS07
2SS01
2SB03
2SD03
06SS104
2SS03
2SS05
06SS106
2MW03
2SS02
2SS10
2SB04
2SS09
2SS12
2SB05
2SS13
06SS105
2NEWSS03
2SS11
E2US2
E2SS3
WETLAND BOUNDARY TO BE DELINEATED PRIOR TO IMPLEMENTATION OF CORRECTIVE ACTION
SWMU 2
BOUNDARY
UPLAND
LANGLEY DRIVE
135
130
125
120
115
110
105
100

70 0 35 70
1 inch = 70 ft.

Baker

LEGEND

- SWMU
- E2SS3 WETLAND BOUNDARIES
- MONITORING WELL/SURFACE SOIL SAMPLING LOCATION (1996 RFI)
- SUBSURFACE SOIL SAMPLE LOCATION (SUPPLEMENTAL INVESTIGATION)
- SURFACE SOIL SAMPLE LOCATION (1996 RFI)
- SURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2004 ADDITIONAL DATA COLLECTION INVESTIGATION)
- UNASSOCIATED SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- UNASSOCIATED SURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- SURFACE SOIL SAMPLE LOCATION (2009 DELINEATION INVESTIGATION)
- PROPOSED SOIL EXCAVATION 0–1'
- PROPOSED SOIL EXCAVATION 0–2'
- PROPOSED DELINEATION SOIL SAMPLING LOCATION

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

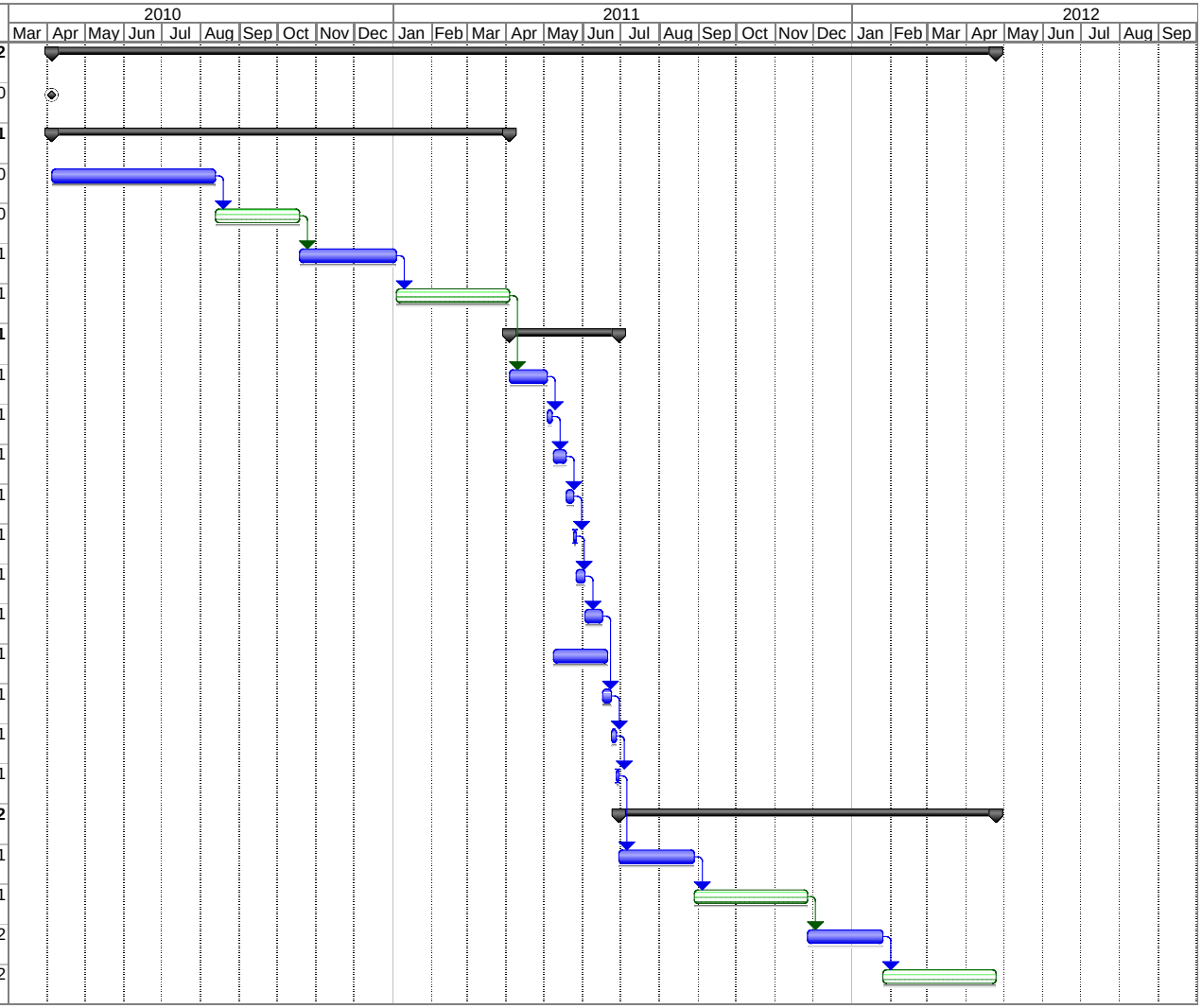
WETLAND BOUNDARIES WERE DELINEATED BY GEO-MARINE INC. IN DECEMBER OF 1999 FROM 1993 COLOR INFRARED AND 1998 TRUE COLOR PHOTOGRAPHY. OBSERVATIONS DURING THE PRELIMINARY DELINEATION SAMPLING EVENT INDICATE THAT WETLAND BOUNDARIES DELINEATED BY AERIAL PHOTOGRAPHY ARE NOT ACCURATE.

FIGURE 2–3
PROPOSED EXCAVATION AND DELINEATION SOIL SAMPLING LOCATIONS
SWMU 2 – LANGLEY DRIVE DISPOSAL SITE
INTERIM CORRECTIVE MEASURES
BASIS OF DESIGN
NAVAL ACTIVITY PUERTO RICO

APPENDIX A
CONSTRUCTION SCHEDULE

APPENDIX A
CONSTRUCTION SCHEDULE
SWMU 2 - LANGLEY DRIVE DISPOSAL SITE
BASIS OF DESIGN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Task Name	Duration	Start	Finish
SWMU 2 - CMI	**537 days**	**4/5/10**	**4/24/12**
Notice to Proceed	1 eday	4/5/10	4/6/10
CMI Design Package and Project Plans	**260 days**	**4/5/10**	**4/4/11**
Draft Documents	130 edays	4/5/10	8/13/10
Regulator Review	67 edays	8/13/10	10/19/10
Final Documents	77 edays	10/19/10	1/4/11
Regulator Review and Approval	90 edays	1/4/11	4/4/11
Corrective Measure	**63 days**	**4/4/11**	**6/29/11**
Mobilization	30 edays	4/4/11	5/4/11
Wetland Delineation and Marking	4 edays	5/4/11	5/8/11
Pre-Excavation Soil Sampling/Analysis	8 days	5/9/11	5/18/11
Field Staking of Contaminated Areas	4 days	5/19/11	5/24/11
ROICC/NTR Approval of Field Staked Areas	2 days	5/25/11	5/26/11
Excavation and Staging	7 edays	5/26/11	6/2/11
Confirmation and Characterization Sampling and Analysis	14 edays	6/2/11	6/16/11
Survey Locate (Wetland, Samples & Excavation)	31 days	5/9/11	6/20/11
Transportation and Off-Site Disposal	7 edays	6/16/11	6/23/11
Backfill and Revegetation	4 edays	6/23/11	6/27/11
Demobilization	2 edays	6/27/11	6/29/11
ICM Closeout Report	**214 days**	**6/29/11**	**4/24/12**
Draft Closeout Report	60 edays	6/29/11	8/28/11
Regulator Review	90 edays	8/28/11	11/26/11
Final Closeout Report	60 edays	11/26/11	1/25/12
Regualtor Review and Approval	90 edays	1/25/12	4/24/12



APPENDIX B
SUPPORTING CALCULATIONS

S.O. No. _____

Subject: SWMU 2 - LANGLEY DRIVE DISPOSAL SITE

Sheet No. 1 of 5

Drawing No. _____

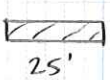
Computed by WRH Checked By DPJ Date 01/05/2011

AREA 1:

SURFACE SOIL EXCAVATION (0-1')

$25' \times 25' \times 6 \text{ GRIDS} \times 1' \text{ DEPTH} = 3750 \text{ c.f.}$

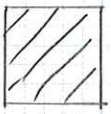
$$\frac{3750 \text{ c.f.} \mid 1 \text{ c.y.}}{27 \text{ c.f.}} = 138.9 \text{ c.y.}$$



$25' \times 5.1' \times 1 \text{ GRID} \times 1' \text{ DEPTH} = 127.5 \text{ c.f.}$

$$\frac{127.5 \text{ c.f.} \mid 1 \text{ c.y.}}{27 \text{ c.f.}} = 4.7 \text{ c.y.}$$

SUBSURFACE SOIL EXCAVATION (1-2')



$25' \times 25' \times 2 \text{ GRIDS} \times 1' \text{ DEPTH} = 1250 \text{ c.f.}$

$$\frac{1250 \text{ c.f.} \mid 1 \text{ c.y.}}{27 \text{ c.f.}} = 46.3 \text{ c.y.}$$

TOTAL DISPOSAL VOLUME

$138.9 \text{ c.y.} + 4.7 \text{ c.y.} + 46.3 \text{ c.y.} = 189.9 \text{ c.y.}$

BULKING FACTOR OF 30%, THEREFORE:

$189.9 \text{ c.y.} + [189.9 \text{ c.y.} \times 0.30] = \boxed{246.9 \text{ c.y.}}$

SCALE: 1" = 50'

S.O. No. _____

Subject: SWMU 2 - LANGLEY DRIVE DISPOSAL SITE

Sheet No. 2 of 5

Drawing No. _____

Computed by WRH Checked By DRS Date 01/05/2011

AREA 2:

SURFACE SOIL EXCAVATION (0-1')

25' x 25' x 20 GRIDS x 1' DEPTH = 12500 c.f.

$$\frac{12500 \text{ c.f.}}{27 \text{ c.f.}/1 \text{ c.y.}} = 463.0 \text{ c.y.}$$

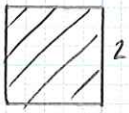
21.8' x 5.7' x 1 GRID x 1' DEPTH = 124.3 c.f.

$$\frac{124.3 \text{ c.f.}}{27 \text{ c.f.}/1 \text{ c.y.}} = 4.6 \text{ c.y.}$$

25' x 6.6' x 1 GRID x 1' DEPTH = 165 c.f.

$$\frac{165 \text{ c.f.}}{27 \text{ c.f.}/1 \text{ c.y.}} = 6.1 \text{ c.y.}$$

SUBSURFACE SOIL EXCAVATION (1-2')



25' x 25' x 2 GRIDS x 1' DEPTH = 1250 c.f.

$$\frac{1250 \text{ c.f.}}{27 \text{ c.f.}/1 \text{ c.y.}} = 46.3 \text{ c.y.}$$

TOTAL DISPOSAL VOLUME

463.0 c.y. + 4.6 c.y. + 6.1 c.y. + 46.3 c.y. = 520 c.y.

BULKING FACTOR OF 30%, THEREFORE:

520 c.y. + [520 c.y. x 0.30] = **676 c.y.**

SCALE: 1" = 50'

S.O. No. _____

Subject: SWMU 2 - LANGLEY DRIVE DISPOSAL SITE

Sheet No. 3 of 5

Drawing No. _____

Computed by WRH Checked By DPS Date 01/05/2011

Baker

AREA 3:

SURFACE SOIL EXCAVATION (0-1')

25' x 25' x 17 GRIDS x 1' DEPTH = 10625 c.f.

$$\frac{10625 \text{ c.f.} \mid 1 \text{ c.y.}}{27 \text{ c.f.}} = 393.5 \text{ c.y.}$$

TOTAL DISPOSAL VOLUME

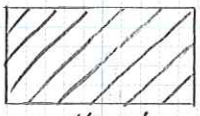
393.5 c.y.

BULKING FACTOR OF 30%, THEREFORE:

393.5 c.y. + [393.5 c.y. x 0.30] = **511.6 c.y.**

AREA 4:

SURFACE SOIL EXCAVATION (0-1)'



49.8' x 25' x 1 GRID x 1' DEPTH = 1245 c.f.

$$\frac{1245 \text{ c.f.} \mid 1 \text{ c.y.}}{27 \text{ c.f.}} = 46.1 \text{ c.y.}$$

SUBSURFACE SOIL EXCAVATION (1-2')

IDENTICAL VOLUME AS SURFACE EXCAVATION = 46.1 c.y.

TOTAL DISPOSAL VOLUME

46.1 c.y. + 46.1 c.y. = 92.2 c.y.

BULKING FACTOR OF 30%, THEREFORE:

92.2 c.y. + [92.2 c.y. x 0.30] = **119.9 c.y.**

SCALE: 1" = 50'

S.O. No. _____

Subject: SWMU 2 - LANGLEY DRIVE DISPOSAL SITE

Sheet No. 4 of 5

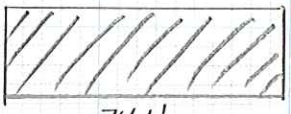
Drawing No. _____

Computed by WRH Checked By DPS Date 01/05/2011

Baker

AREA 5:

SURFACE SOIL EXCAVATION (0-1')



$74.1' \times 23' \times 1\,GRID \times 1'\,DEPTH = 1704.3\ c.f.$

$$\frac{1704.3\ c.f.}{27\ c.f.} \times 1\ c.y. = 63.1\ c.y.$$

SUBSURFACE SOIL EXCAVATION (1-2')

IDENTICAL VOLUME AS SURFACE EXCAVATION = 63.1 c.y.

TOTAL DISPOSAL VOLUME

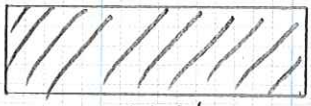
63.1 c.y. + 63.1 c.y. = 126.2 c.y.

BULKING FACTOR OF 30%, THEREFORE:

126.2 c.y. + [126.2 c.y. x 0.30] = **164.1 c.y.**

AREA 6:

SURFACE SOIL EXCAVATION (0-1')



$77.3' \times 22.6' \times 1\,GRID \times 1'\,DEPTH = 1747\ c.f.$

$$\frac{1747\ c.f.}{27\ c.f.} \times 1\ c.y. = 64.7\ c.y.$$

SUBSURFACE SOIL EXCAVATION (1-2')

IDENTICAL VOLUME AS SURFACE EXCAVATION = 64.7 c.y.

TOTAL DISPOSAL VOLUME

64.7 c.y. + 64.7 c.y. = 129.4 c.y.

BULKING FACTOR OF 30%, THEREFORE:

129.4 c.y. + [129.4 c.y. x 0.30] = **168.2 c.y.**

SCALE: 1" = 50'

S.O. No. _____

Subject: SWMU 2 - LANGLEY DRIVE DISPOSAL SITE

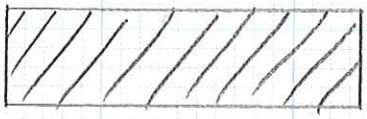
Sheet No. 5 of 5

Drawing No. _____

Computed by WRH Checked By ~~DRS~~ Date 01/05/2011

AREA 7:

SURFACE SOIL EXCAVATION (0-1')



92.6' x 25' x 1 GRID x 1' DEPTH = 2315 c.f.

$$\frac{2315 \text{ c.f.}}{27 \text{ c.f.}} \times 1 \text{ c.y.} = 85.7 \text{ c.y.}$$

SUBSURFACE SOIL EXCAVATION (1-2')

IDENTICAL VOLUME AS SURFACE EXCAVATION = 85.7 c.y.

TOTAL DISPOSAL VOLUME

85.7 c.y. + 85.7 c.y. = 171.4 c.y.

BULKING FACTOR OF 30%, THEREFORE:

171.4 c.y. + [171.4 c.y. x 0.30] = **222.8 c.y.**

TOTAL EXCAVATION VOLUME AT SWMU 2

AREA 1 = 246.9 c.y.
2 = 676 c.y.
3 = 511.6 c.y.
4 = 119.9 c.y.
5 = 164.1 c.y.
6 = 168.2 c.y.
7 = 222.8 c.y.

≈ 2110 c.y. TOTAL DISPOSAL VOLUME

SCALE: 1" = 50'