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Final

**Engineering Evaluation/Cost Analysis for Surface
MEC Removal from the Munitions Response
Area-Surface Impact Area, Former VNTR
Vieques, Puerto Rico**



Prepared for

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1 Executive Summary

2 This document presents an Engineering Evaluation and Cost Analysis (EE/CA) for a Non-
3 time-critical Removal Action (NTCRA) for select areas located within the Munitions
4 Response Area-Surface Impact Area (MRA-SIA), at Vieques Naval Training Range (VNTR)
5 on Vieques, Puerto Rico. The areas identified for surface clearance of munitions and
6 explosives of concern (MEC) in this document have the potential for unauthorized public
7 access and therefore present a risk to human health. The purpose of this document is to
8 present the interim remedial action alternatives to reduce risks to human health associated
9 with the MEC that exist at the sites. Reducing risks to human health would be accomplished
10 by minimizing the potential for human contact. This action will reduce the potential for
11 unauthorized personnel to come into contact with MEC.

12 This EE/CA will be completed as a NTCRA as required by section 300.415(b)(4)(i) of the
13 National Oil and Hazardous Substance Pollution Contingency Plan (NCP; 40 Code of
14 Federal Regulations [CFR] Part 300). Submittal of this document fulfills the requirements for
15 NTCRAs defined by the Comprehensive Environmental Response, Compensation, and
16 Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act
17 of 1986 (SARA). This EE/CA has been prepared in general accordance with the United
18 States (U.S.) Environmental Protection Agency's (USEPA) guidance document *Superfund,*
19 *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA*, PB93-963402
20 (USEPA, 1993).

21 To address the risks posed by the MEC, alternatives designed to prevent exposure pathways
22 were analyzed. The three alternatives considered for the select areas are:

- 23 1. No Action.
- 24 2. Engineering controls to prevent access by unauthorized personnel.
- 25 3. Removal of surface detected MEC from select areas within the MRA-SIA with a high
26 potential for trespassing.

27 Alternative 1 serves as a baseline for the evaluation and is not considered a viable option for
28 the site.

29 Through analyzing the benefits of Alternatives 2 and 3, Alternative 3, removal of surface
30 detected MEC from select areas within the MRA-SIA was selected as the recommended
31 removal action alternative. This alternative has a high level of efficiency in meeting the
32 remedial action objectives, a relative moderate ease of implementation, and a relatively
33 higher cost. In addition, this alternative lends itself to potential future remedies that would
34 allow U.S. Fish and Wildlife Service (USFWS) to implement several of the recommendations
35 identified in their preferred land use alternative for the wildlife refuge and wilderness area.

Resumen Ejecutivo

1 Este documento presenta una Evaluación de Ingeniería y Análisis de Costo (EE/CA en
2 inglés) para una acción de remoción de tiempo no-crítico (NCTRA en inglés) para áreas
3 seleccionadas dentro del Área de Respuesta de Municiones-Área de Impacto de Superficie
4 (MRA-SIA en inglés) en el Campo de Adiestramiento Naval de Vieques (VNTR en inglés) en
5 Vieques, Puerto Rico. Las áreas identificadas en este documento para la remoción de
6 municiones de superficie y explosivos de preocupación (MEC en inglés) tienen el potencial
7 de que el público ingrese sin autorización por lo que representan un riesgo a la salud
8 humana. El propósito de este documento es el presentar alternativas para una acción de
9 remediación interina para reducir los riesgos a la salud humana asociados con el MEC que
10 existe en el sitio. La reducción de riesgos para la salud humana se conseguiría al minimizar
11 el potencial de contacto por humanos. Esta acción reducirá el riesgo de que personal
12 potencialmente no autorizado entre en contacto con MEC.

13 Esta EE/CA se completará como un NTCRA, tal como lo requiere la Sección 300.415(b)(4)(i)
14 del Plan Nacional de Contingencia de Contaminación de Petróleo y Substancias Peligrosas
15 (NCP; Código de Reglamentos Federales [CFR] 40 Part 300). El envío de este documento
16 completa los requisitos del NTCRA definidos en la Ley de Respuesta, Compensación y
17 Responsabilidad Ambiental del 1980 (CERCLA en inglés) y los Cambios y Re-autorización
18 de la Ley de Superfondo del 1986 (SARA). Este EE/CA ha sido preparado siguiendo las
19 guías generales del documento *Guía Superfund para llevar a cabo Acciones de Remoción de*
20 *Tiempo No-Crítico bajo CERCLA*, PB93-963402 (USEPA, 1993) de la Agencia de Protección
21 Ambiental de los EEUU (USEPA en inglés).

22 Para considerar el riesgo proveniente del MEC, se analizaron alternativas diseñadas para
23 prevenir su exposición. Las tres alternativas consideradas para las áreas seleccionadas son:

- 24 1. No tomar ninguna acción
- 25 2. Implementar controles de Ingeniería para prevenir el acceso de personal no autorizado
- 26 3. La remoción de MEC encontrado en superficie de las áreas dentro del MRA-SIA que
27 tengan un alto potencial de que personas ingresen sin autorización.

28 La alternativa 1 sirve como base para la evaluación y no es considerada una opción viable
29 para este sitio.

30 A través de un análisis de los beneficios de las Alternativas 2 y 3, la remoción del MEC de
31 superficie fue seleccionada como la alternativa de acción recomendada. Esta alternativa
32 tiene un alto grado de eficiencia en cumplir con los objetivos de acción de remediación, una
33 facilidad de implementación relativamente moderada y un costo relativamente más
34 elevado. Adicionalmente, esta alternativa está de acuerdo con las remediaciones futuras
35 potenciales que permitirán que el Servicio de Pesca y Vida Silvestre de EEUU (USFWS en
36 inglés) implemente varias de las recomendaciones identificadas en su alternativa preferida
37 para el uso de los terrenos del refugio de vida silvestre.

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1 Acronyms and Abbreviations

2	AFWTA	Atlantic Fleet Weapons Training Area
3	ARAR	applicable or relevant and appropriate requirement
4	ATG	air-to-ground
5	CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
6	CFR	Code of Federal Regulations
7	CLEAN	Comprehensive Long-term Environmental Action, Navy
8	CSM	conceptual site model
9	CTO	Contract Task Order
10	DOI	Department of the Interior
11	DON	Department of the Navy
12	ECA	Eastern Conservation Area
13	ECHOS	Environmental Cost, Handling, Options, and Solutions
14	EE/CA	Engineering Evaluation/Cost Analysis
15	EIS	Environmental Impact Statement
16	EMA	Eastern Maneuver Area
17	FFA	Federal Facility Agreement
18	FMFLANT	Fleet Marine Force, Atlantic
19	ft	feet/foot
20	HE	high explosive
21	IC	institutional controls
22	IRP	Installation Restoration Program
23	LIA	Live Impact Area
24	LTM	long-term monitoring
25	LUC	land use controls
26	MD	munitions debris
27	MEC	munitions and explosives of concern
28	mm	millimeter
29	MPPEH	material potentially presenting an explosive hazard
30	MRA	Munitions Response Area
31	NASD	Naval Ammunition Support Detachment
32	NATO	North Atlantic Treaty Organization
33	NAVFAC	Naval Facilities Engineering Command, Atlantic Division
34	NCP	National Contingency Plan
35	NGFS	naval gunfire support
36	NRHP	National Register of Historic Places
37	NSRR	Naval Station Roosevelt Roads
38	NTCRA	Non-time-critical Removal Action

1	O&M	operation and maintenance
2	OB/OD	open burn/open detonation
3	OP	observation post
4	PA/SI	Preliminary Assessment/Site Investigation
5	PAOC	potential area of concern
6	PI	photo-identified
7	PRA	Preliminary Range Assessment
8	PRASA	Puerto Rico Aqueduct and Sewer Authority
9	PREQB	Puerto Rico Environmental Quality Board
10	RAO	remedial action objective
11	ROD	Record of Decision
12	SARA	Superfund Amendments and Reauthorization Act
13	SIA	Surface Impact Area
14	SWMU	solid waste management unit
15	U.S.	United States
16	USEPA	United States Environmental Protection Agency
17	USFWS	United States Fish & Wildlife Service
18	USGS	United States Geological Survey
19	UXO	unexploded ordnance
20	VNTR	Vieques Naval Training Range

Introduction

1 This Engineering Evaluation/Cost Analysis (EE/CA) report was prepared by CH2M HILL
2 under the Naval Facilities Engineering Command, Atlantic Division (NAVFAC),
3 Comprehensive Long-term Environmental Action – Navy III (CLEAN III) Contract N62470-
4 02-D-3052, Contract Task Order (CTO) 211. The purpose of the EE/CA is to develop and
5 evaluate remedial action alternatives for removal of surface munitions and explosives of
6 concern (MEC) from areas within the Munitions Response Area-Surface Impact Area
7 (MRA-SIA) at the former Vieques Naval Training Range (VNTR) on east Vieques.

8 This document follows the United States (U.S.) Environmental Protection Agency's
9 (USEPA's) guidance provided in document 540/R93/057 *Guidance on Conducting Non-Time-*
10 *Critical Removal Actions Under CERCLA* (USEPA, 1993). This EE/CA is based on the findings
11 of records reviews and interviews including the Preliminary Range Assessment (PRA)
12 Report (CH2M HILL, 2003), the *Revised Draft Expanded Range Assessment and Phase I Site*
13 *Inspection Report* (CH2M HILL, 2007), and the ongoing expanded range assessment and
14 Phase II site inspection. The EE/CA assumes that no additional site assessment activities
15 will be necessary to determine the appropriate removal action alternative.

1.1 Purpose and Objectives

16 This EE/CA provides the Comprehensive Environmental Response, Compensation, and
17 Liability Act (CERCLA) documentation to support an interim remedial action for areas in
18 the MRA-SIA where the likelihood for access by unauthorized personnel (e.g., trespassers)
19 is significant. The purpose of this EE/CA is to present the Navy's intent to reduce the risks
20 to human health. The chosen interim action will minimize the potential hazards associated
21 with MEC at the areas identified to support current and proposed future use and minimize
22 the potential hazard to unauthorized personnel. This EE/CA presents three removal
23 alternatives for this interim action. The final remedy for these areas will be determined as
24 part of the CERCLA process.

25 Submittal of this document fulfills the requirements for NTCRAs defined by CERCLA,
26 Superfund Amendments and Reauthorization Act (SARA), and the National Oil and
27 Hazardous Substance Pollution Contingency Plan (NCP). This EE/CA has been prepared in
28 accordance with USEPA's guidance document *Guidance on Conducting Non-Time-Critical*
29 *Removal Actions under CERCLA*, PB93-963402 (USEPA, 1993).

1.2 Regulatory Framework

30 This document is issued by the U.S. Department of the Navy (DON), in partnership with the
31 USEPA Region II and the Puerto Rico Environmental Quality Board (PREQB), under Section
32 104 of CERCLA and SARA of 1986.

1 Section (§)104 of CERCLA and SARA allows an authorized agency to remove, or arrange for
2 removal of, and to provide for remedial action relating to hazardous substances, pollutants,
3 or contaminants at any time, or to take any other response measures consistent with the
4 NCP as deemed necessary to protect public health or welfare and the environment.

5 The NCP, 40 Code of Federal Regulations (CFR) 300, provides regulations for implementing
6 CERCLA and SARA, and regulations specific to removal actions. The NCP defines a
7 removal action as the

8 “cleanup or removal of released hazardous substances from
9 the environment, such actions as may be necessary to monitor,
10 assess, and evaluate the threat of release of hazardous
11 substances; the disposal of removed material; or the taking of
12 such other actions as may be necessary to prevent, minimize,
13 or mitigate damage to the public health or welfare or to the
14 environment, which may otherwise result from a release or
15 threat of release.”

16 For Time-critical Removal Actions, activities shall begin as soon as possible to “abate,
17 prevent, minimize, stabilize, mitigate, or eliminate the threat to public health or welfare of
18 the United States or the environment” (40 CFR §300.415[b][3]). The removal action proposed
19 for the MRA-SIA is non-time-critical.

20 Title 40 CFR §300.415 requires the lead agency to conduct an EE/CA when a NTCRA is
21 planned for a site. The goals of an EE/CA are to identify the objectives of the removal action
22 and to analyze the effectiveness, implementability, and cost of various alternatives that may
23 satisfy these objectives. An EE/CA documents the removal action alternatives and
24 evaluation and recommendation process.

25 Community involvement requirements for NTCRAs include making the EE/CA available
26 for public review and comment for a period of 30 days. An announcement of the 30-day
27 public comment period on the EE/CA is required in a local newspaper. Written responses
28 to significant comments will be summarized in an Action Memorandum and will be
29 included in the Administrative Record.

1.3 Organization of the EE/CA

30 This EE/CA includes the following sections:

- 31 • Section 1 – Introduction
- 32 • Section 2 – Site Description and Background
- 33 • Section 3 – Removal Action Objective and Scope
- 34 • Section 4 – Identification and Detailed Analysis of Removal Action Alternatives
- 35 • Section 5 – Comparative Analysis of the Removal Action Alternatives
- 36 • Section 6 – Recommended Removal Action Alternative
- 37 • Section 7 – References

Site Description and Background

1 This section presents the background, history (including military operations), and the
2 physical setting of the MRA-SIA and the former VNTR. The selection of proposed clearance
3 areas within the MRA-SIA is based on observed trespassing events the presence of MEC.
4 The action will reduce risk posed to unauthorized personnel (e.g., trespassers) who frequent
5 the sites.

2.1 Site Location and Description

6 Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of
7 the island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques
8 is the largest offshore island of the Commonwealth of Puerto Rico. It is approximately 20
9 miles long and 4.5 miles wide, and has an area of approximately 33,088 acres (51 square
10 miles). Figure 2-1 shows the regional location of Vieques with respect to the island of Puerto
11 Rico.

2.1.1 Former Vieques Naval Training Range

12 The former VNTR is situated in the eastern half of the Island of Vieques, and is bordered on
13 the west by the community of Isabel Segunda, to the north by Vieques Sound, and to the
14 south by the Caribbean Sea. The former VNTR consists of approximately 14,500 acres and is
15 divided operationally into four MRAs that (from west to east) include: the Eastern
16 Maneuver Area (EMA), an area approximately 10,673 acres; the SIA, approximately 2,500
17 acres; the 900-acre Live Impact Area (LIA), and the 200-acre Eastern Conservation Area
18 (ECA) on the easternmost tip of Vieques (CH2M HILL, 2006). Figure 2-2 presents a site map
19 of former VNTR.

20 The areas to be addressed as part of the EE/CA are present in one of the five MRAs that
21 make up the former VNTR, the MRA-SIA. The description of the MRA-SIA is presented
22 below.

Munitions Response Area-Surface Impact Area (MRA-SIA)

23 The SIA was established in the 1950s, when several Marine targets were constructed there.
24 Marine artillery ranging from 76 millimeter (mm) to 175mm were directed toward these
25 targets from artillery gun positions within the SIA and EMA. During 1969, the construction
26 of bulls-eye targets 1 and 2, established the eastern and western boundaries of the SIA. At
27 that time, a permanent observation post (OP) with a helicopter pad was also constructed on
28 Cerro Matias. In 1971, a strafing target was installed adjacent to one of the targets. The aerial
29 photo analysis identified numerous craters within the eastern two-thirds of the SIA that
30 were caused by mortar and artillery fire, naval gunfire, and aerial bombing. The craters
31 were most visible on the 1962 aerial photographs. In addition, the aerial photo analysis
32 identified several artillery gun positions and OPs within the SIA that may have been used
33 for artillery fire (CH2M HILL, 2006).

1 Sandy beach areas are intermix with rocky beaches along the south marine boundary and
2 predominate along the northern marine boundary of the SIA. Yellow Beach lies within the
3 SIA along its southern coast.

2.1.2 Geology

4 The geology of Vieques Island is characterized on the east side by marine volcanic andesites
5 (generally lava tuff and *tuffaceous breccia*) intruded by a plutonic rock complex. These
6 igneous rocks are generally overlain by alluvial deposits with some patches of limestone.
7 The plutonic intrusive rocks consist of granodiorites and quartz-diorites, and are exposed
8 over a large percentage of the island.

9 The geology of the western side of the island is dominated by the plutonic complex with
10 some overlying alluvial deposits especially near the marine borders. A gradual change in
11 texture from coarse to fine-grained quartz-diorite has been observed from western to
12 eastern Vieques. A saprolite formation occurs at the surface of the plutonic complex in some
13 areas.

14 Limestone occurs in sectors of the island's northern, southern, and eastern parts. The most
15 extensive areas of limestone are found on the southern coastal peninsulas. The limestone is
16 generally soft, yellowish, and well-indurated where exposed to the atmosphere. The alluvial
17 deposits are generally of Quaternary age, consisting of a mixture of sand, silt, and clay that
18 together have an average thickness of 30 feet (ft) in western Vieques and range from 5 to 50
19 ft thick on the eastern end of Vieques. The alluvial materials are beach and dune deposits,
20 and swamp and marsh deposits. The beach and dune sands are composed of calcite, quartz,
21 plutonic rock fragments, and minor magnetite (USGS, 1989).

22 Soils on Vieques Island are primarily residual, due to both climatic and subsurface rock
23 conditions. They typically are classified into five groups and range from rock land soils
24 where bedrock is exposed to deep, well-drained soils within the alluvial deposits to shallow
25 soils (USDA, 1977).

2.1.3 Hydrology

26 The streambeds found on Vieques flow either northerly or southerly until they reach the
27 Caribbean Sea or Atlantic Ocean. Vieques does not have any perennial surface drainage, and
28 receives an island wide long term average of 45 inches of rainfall per year. The eastern side
29 of the island receives approximately 25 inches/year, while the western side around Solid
30 Waste Management Unit (SWMU 4) averages approximately 50 inches per year. Of the total
31 rainfall, approximately 90 percent is lost to evaporation, based on statistics from the U.S.
32 Virgin Islands. Of the remaining 10 percent, approximately 5 percent infiltrates into the
33 groundwater system and 5 percent becomes surface runoff. (USGS, 1989).

Surface Water

34 Surface water deposits in the former VNTR occur primarily in coastal lagoons and
35 intermittent streams, known locally as arroyos and quebradas that channel water
36 downward from hills during rain events. Some of these arroyos and quebradas have
37 standing water year-round, especially in areas abutting the coastline where terrain has
38 leveled sufficiently to allow for standing water. Several mid- to large-sized lagoons are

1 present near the Purple Beach area just east of Puerto Negro and to the south within the
2 Ensonada Honda area, the Bahía de la Chiva area, and the South Coast Bays area.

3 Some rainwater does pool for some time in low-lying areas following storm events, but
4 these features typically dissipate within a few days.

Groundwater

5 The groundwater on Vieques is derived from rainfall. The water flows downhill as
6 intermittent stream runoff or seeps into the soil and underlying deposits. Water in pore
7 space, cracks, and fractures in bedrock eventually flows into alluvial deposits or to the
8 ocean. Yearly variations in island-wide rainfall influence groundwater levels locally.
9 Groundwater levels also exhibit fluctuations near the coastline because of tidal influences.

10 The groundwater on the island is broken up into two aquifers: the Valle de Resolución,
11 located beneath the island's western portion (the only known groundwater aquifer on the
12 former Naval Ammunition Support Detachment (NASD) property that contains potentially
13 potable water), and the Valle de Esperanza located beneath the island's southern portion
14 near Camp Garcia. As discussed above, approximately 5 percent of the annual precipitation
15 infiltrates through the ground and supplies the aquifers. The Valle de Esperanza is the more
16 productive of the two aquifers and, therefore, was used as a source of potable water by the
17 Navy. The Puerto Rico Aqueduct and Sewer Authority (PRASA) managed a series of 16
18 wells which pumped approximately 450,000 gallons of water per day, although these wells
19 are no longer active because of the installation of a water line from the island of Puerto Rico
20 to Vieques in 1978.

21 The U.S. Geological Survey (USGS) performed a groundwater study on Vieques, including
22 tests on the wells near Esperanza. The results indicated that the groundwater contained
23 high concentrations of sodium bicarbonate. Because of its high sodium content, the
24 groundwater on Vieques is not suitable for extended use for irrigation or other potable
25 water use. The high levels of sodium result from sea spray infiltrating into the ground and
26 saltwater entering the groundwater supply through excessive groundwater withdrawal
27 (Vargas, 1995).

2.1.4 Natural Resources

Eastern Vieques

28 The eastern end of Vieques houses a variety of natural resources in the form of wide-
29 ranging plant and wildlife species. A number of conservation zones have been established
30 in the former VNTR to help protect these valuable resources. A final Biological Assessment
31 for the LIA (GMI, 2006) and amendment to the Final BA (GMI, 2007) has been developed
32 and presents the mitigation measures that will be implemented to avoid impacts to
33 threatened/endangered species during investigation and removal action activities. The
34 approach for expanding the biological assessment to the remainder of the former VNTR,
35 including the MRA-SIA, was submitted and agreed to by the U.S. Fish and Wildlife Service
36 (USFWS) and portions of the field effort have been conducted. The identified Conservation
37 Zones are:

- 1 • The Punta Este Conservation zone, which is located on the southeastern end of the LIA
2 and consists primarily of drought-resistant scrub that no longer can be found elsewhere
3 in Puerto Rico except on Navy property in Vieques.
- 4 • The Cayo Conejo Conservation Zone, a small island located southwest of the LIA in the
5 Bahia Salina del Sur area. This area is an important nesting habitat for the endangered
6 brown pelican and one of the last nesting areas for this species in Puerto Rico.
- 7 • The Ensonada Honda Conservation Zone, which lies between Blue and Yellow Beaches
8 on the southern coast of Vieques. This area has the best example of lowland forest
9 growth on Vieques and is also home to a variety of extensive mangrove populations that
10 appear to be healthy and expanding.
- 11 • The South Coast Bays Conservation Zone, located on the southern coastline of Vieques
12 directly south of the Camp Garcia area and western portions of the EMA. Two bays at
13 this location, Bahia Tapon and Puerto Mosquito, have bioluminescent properties and are
14 a valuable tourism resource for the island.

15 The intent of the conservation zones is the preservation of these unique areas as important
16 components of the overall environmental health of Vieques.

17 Sea turtle nesting occurs primarily from February through November. The sea turtles that
18 have been observed on Vieques are the green, leatherback, and hawksbill sea turtles.

2.1.5 Cultural Resources

19 A number of resources exist in the former VNTR that are of interest from a cultural
20 perspective including a number of conservation zones, cultural resources, and prehistoric
21 sites (Indian and Spanish historical sites). A total of up to 300 sites with the potential to
22 contain significant cultural resources exist within Vieques (U.S. Navy, 1999). Seventeen
23 archeological sites and districts on Vieques are currently listed on the National Register of
24 Historic Places (NRHP) based on surveys completed in 1999 by personnel from the Puerto
25 Rico State Preservation Office. One such area is the Puerto Ferro Lighthouse in the EMA,
26 which has been determined to be eligible for the NRHP (TEC, 2002).

27 Seventeen archaeological sites and districts currently are listed on the NRHP system for
28 Vieques with approximately a half dozen on the island's eastern end as shown on a land use
29 map of U.S. Naval facilities on Vieques (GMI, 1996). This information has been confirmed by
30 the review of other cultural resource maps for Vieques recovered during the record search
31 and NRHP web-based searches.

2.2 Site History

2.2.1 General Site History

32 The sugarcane industry was the major economic base of Vieques during the late 19th
33 century and early 20th century. Several sugarcane operations in Vieques were largely
34 discontinued in the early 1940s when the U.S. Navy purchased large portions of the island.
35 The U.S. Navy primarily used this land to conduct activities related to military training. The
36 eastern end of Vieques Island was used for all aspects of naval gunfire training, including

1 air-to-ground (ATG) ordnance delivery and amphibious landings, as well as housing the
2 main base of operations for these activities, Camp Garcia.

3 Although the island of Culebra was the focal point for naval gunfire in the 1960s and early
4 1970s, the development of facilities on the eastern end of Vieques was undertaken in 1964,
5 when a gunnery range was established in the LIA. In 1965, the Navy established the LIA, also
6 known as the Air Impact Area, and began construction of OP 1 on Cerro Matias.

7 By the 1970s, the LIA maintained several targets for aerial bombing including old tanks and
8 vehicles used as mock-ups, two bulls-eye targets and a strafing target. Additionally, several
9 point and area targets for ships to practice naval gunfire support (NGFS) were established in
10 the LIA.

11 The Environmental Impact Statement (EIS) for Vieques (Tippetts et al., 1979) provides a
12 detailed discussion on the development of training facilities in the former VNTR leading up
13 to 1979. The former VNTR provided logistics support, scheduling assistance, and facilities
14 for NGFS and ATG ordnance delivery training for Atlantic Fleet ships, North Atlantic
15 Treaty Organization (NATO) ships, air wings, and smaller air units from other allied
16 nations and the Puerto Rican National Guard. The Fleet Marine Force, Atlantic (FMFLANT),
17 conducted training for Marine amphibious units, battalion landing teams, and combat
18 engineering units in the EMA. Occasionally, naval units of allied nations having a presence
19 in the Caribbean and the Puerto Rican National Guard also utilized the EMA.

20 Adjacent to and west of the MRA-SIA, the 10,673-acre EMA (established in 1947) provided
21 maneuvering space and ranges for the training of Marine amphibious units and battalion
22 landing teams in exercises of amphibious landings, small-arms fire, artillery and tank fire,
23 shore fire control, and combat engineering tasks. It is demarcated by the western property
24 line east to the western front friendly-fire line where the MRA-SIA begins. Portions of the
25 training areas within the EMA were in continuous use since World War II, when the Navy
26 acquired title to the land, until 2003.

27 The Atlantic Fleet's ships, aircraft, and Marine forces carried out training in all aspects of
28 Naval gunfire support, ATG ordnance delivery, air-to-surface mine delivery, amphibious
29 landings, small-arms fire, artillery and tank fire, and combat engineering. As part of normal
30 operations, unexploded ordnance (UXO) was cleared periodically from the LIA and
31 destroyed. The Navy also operated a waste munitions open burn and open detonation
32 (OB/OD) facility under a USEPA interim status Subpart X permit within the LIA.
33 Additionally, unserviceable military munitions were periodically received from Naval
34 Station Roosevelt Roads (NSRR) and from the NASD on the West End of Vieques, for
35 demolition at the OB/OD area in the LIA.

2.2.2 National Priorities List Listing

36 In 2003, the Governor of Puerto Rico requested USEPA to list the former VNTR (and NASD)
37 on the NPL. On May 26, 2004, the President of PREQB sent a letter to the Regional
38 Administrator of USEPA acknowledging that USEPA, PREQB, and the Department of the
39 Interior (DOI) concurred with the designation of the former Naval facilities of eastern and
40 western Vieques as an NPL site. In addition, a clarification of the Atlantic Fleet Weapons
41 Training Area (AFWTA) was provided and stated that initial areas of Preliminary
42 Assessment/Site Inspection (PA/SI) under CERCLA will focus on "agreed areas" in and

1 around Vieques and Culebra where the Navy conducted operations, including “those
2 waters in and around Vieques where contamination has come to be located.” On February 7,
3 2005, Vieques was placed on the NPL.

4 As a result of the NPL listing, a Federal Facility Agreement (FFA) was developed and
5 signed by the Navy, USEPA, PREQB and DOI. The purpose of the FFA is to ensure that
6 potential environmental contamination from past activities are adequately evaluated and
7 appropriate remedial actions are implemented, as necessary, to protect human health and
8 the environment. The FFA will also establish the procedural framework and schedule for
9 implementing these activities. With the listing on the NPL and the creation of an FFA, all
10 future environmental restoration activities on Vieques will be conducted under CERCLA,
11 with USEPA as the lead regulatory agency.

2.3 Current and Future Land Use

12 The former VNTR was transferred to the DOI in 2003 and must be managed by DOI as part
13 of the National Wildlife Refuge System, pursuant to section 1049 of the Nation Defense
14 Authorization Act for Fiscal Year 2002 (Public Law 107-107). In addition, the LIA including
15 the OB/OD Site, must be managed as a wilderness area where public access will be
16 restricted (Public Laws 106-398 and 107-107). A Comprehensive Conservation Plan for the
17 Vieques National Wildlife Refuge has been developed as is done with all other refuges, and
18 outlines its land use plan for managing the refuge. The Department of Interior Fish and
19 Wildlife Service preliminary land use plan for the former VNTR is presented in Figure 2-3.
20 While all military activities have ceased at the former VNTR the U.S. Navy retains
21 responsibility for any MEC and/or environmental concerns that may exist there. Any land
22 use controls (LUCs) such as access restrictions that are planned for the former LIA are
23 expected to be consistent with those established for state and federal wildlife refuges. It is
24 likely that future site activities (particularly intrusive) will require the support of qualified
25 UXO technicians. The level of support required will depend on the probability of
26 encountering MEC. The need for UXO support should be included in the planning for any
27 activities.

2.4 Previous Investigations

2.4.1 Eastern Vieques

Preliminary Range Assessment

28 Nineteen MEC areas were investigated within the former VNTR as part of the Preliminary
29 Range Assessment (CH2M HILL, 2003), an analysis of historical aerial photographs, and
30 interviews of personnel identified 43 additional potential MEC areas within the former
31 VNTR boundaries. These areas include five potential ranges, 32 mortar or artillery gun
32 positions, four observation posts, and two munitions storage areas.

33 The information from the field reconnaissance, archive search and the aerial photo analysis
34 was evaluated to develop the MEC portion of a conceptual site model (CSM) for the former
35 VNTR. The CSM indicated that the entire 900 acres of the LIA had been impacted by MEC
36 from ATG ordnance delivery and naval gunfire. The activities of the LIA have also

1 potentially impacted the 200 acres of the adjacent ECA. The aerial photo analysis identified
2 numerous craters within the entire 2,500 acres of the MRA-SIA which were caused by
3 mortar and artillery fire, naval gunfire and aerial bombing. Safety fans developed for the six
4 ranges and several artillery fans within the EMA were potentially impacted by MEC.

5 The roads and beaches addressed in this EE/CA are those that are located within the MEC
6 impacted areas of MRA-SIA within the former VNTR.

Expanded Range Assessment and Phase I Site Inspection Report

7 An Expanded Range Assessment and Phase I Site Inspection (CH2M HILL, 2007) was
8 conducted to prioritize future munitions response actions. The beaches (Beach Area) within
9 the range fan area and MRSs in the MRA-LIA, MRA-SIA, and MRA-EMA were evaluated to
10 determine potential risks posed by MEC at the sites. A summary of the results of the
11 investigation are presented below. The MRS locations are shown on Figure 2-2.

12 **MRA-SIA Phase I** MRA-SIA MRS 1 was the only MRS inspected in the MRA-SIA as part of
13 the ERA and Phase I SI. A potential for exposure to explosive hazard exists at the MRA-SIA
14 MRS 1 (based on a site inspection of approximately 25 percent of that MRS) based on the
15 high explosive (HE) hazard associated with the surface MEC identified at the MRS.
16 However, access to the areas is limited or very difficult due to very dense vegetation and
17 rough terrain (e.g., steep slopes). The subsurface was evaluated at MRS 1 using handheld
18 magnetometers and a total of 30 subsurface anomalies were located, which is only slightly
19 more than 1 anomaly/acre, which is a low density.

20 **MRA-SIA Phase II** A total of seven MRSs, two photo-identified (PI) Sites, and one potential
21 area of concern (PAOC) site were inspected as part of the Phase II SI. A potential for
22 exposure to explosive hazard exists at the MRA-SIA MRSs 2-7 (based on a transect
23 evaluation of the MRSs) because of the HE hazard associated with the surface MEC
24 identified at the MRSs. As of June 1, 2008, 1,055 projectiles/mortars, 229 bombs, 141
25 flares/pyrotechnics, 6 grenades, 222 MEC components, 137 rockets missiles, and 323
26 munitions debris (MD)/range related debris with an approximate weight of 173, 342 lbs,
27 have been identified in the MRA-SIA. Access to the interior area of the MRA-SIA is limited
28 or very difficult due to dense vegetation and rough terrain (e.g., steep slopes).

2.5 Evaluation of Risk

29 Historical documentation from military operations and recent MEC data collected since
30 those operations ceased indicate that there are a substantial number of MEC items across the
31 MRA-SIA (CH2M HILL, 2007). Numerous MEC items have been located during both the
32 Phase I and ongoing Phase II SI in the MRA-SIA using a transect approach and covering
33 approximately 10 percent of each MRS. Table 2-1 lists the numbers of munitions related
34 items located and projected densities for each MRS. Additionally, Figure 2-4 shows the
35 locations and categories of the MEC items located.

36 A significant number of munitions related items are present at the surface in the MRA-SIA.
37 A brief summary of trends, by item class, observed to date is presented below:

- 1 • Bomb densities are the greatest on the western side of MRS 5, which is immediately
2 adjacent to the MRA-EMA. This can be attributed to a target located in that area and the
3 resulting high density of small practice bombs (e.g., BDU-33).
- 4 • Bomb densities are high along roadways in MRSs 2 and 3. The bomb types in these areas
5 are highly varied, small practice bombs such as the BDU-33 in addition to Mk series
6 bombs.
- 7 • Rockets/ guided missiles are scattered throughout the MRA-SIA with no apparent
8 pattern.
- 9 • Projectiles/ mortars are found throughout the MRA-SIA. The densities are less in MRSs 2
10 and 3.
- 11 • Grenades/ flares-pyrotechnics have been found sporadically across the MRA-SIA.

TABLE 2-1
MRA-SIA Site Inspection Results and Projected Densities

Inspection (items located)				Projected Density (items/acre)			
Bombs	Rockets/ Guided Missiles	Projectiles/ Mortars	Grenades/ Flares- Pyrotechnics	Bombs	Rockets/ Guided Missiles	Projectiles/ Mortars	Grenades/ Flares- Pyrotechnics
222	140	1054	148	3	2	15	2

12 As Figure 2-4 shows, MEC items are located in close proximity to access routes (roads) and
13 beach areas. Throughout the life of the ongoing removal action, trespassing has been
14 observed throughout the former VNTR on numerous occasions. The observed trespassing
15 includes pleasure boaters accessing beaches and areas beyond the beaches, commercial
16 snorkeling trips to the beaches along the northern coast of the former VNTR, horseback
17 riders, organized protest groups, and others. Efforts to curtail the trespassing are often
18 ignored or met with resistance and do not appear to have a lasting effect. Although a
19 majority of trespassing is on the beaches, there has been evidence of people accessing inland
20 portions of the former VNTR; such evidence includes vandalism to contractor property,
21 burned areas from campfires, and trash and other debris. Although the majority of the
22 trespassing to date has been conducted in the MRA-LIA, boaters have been identified along
23 the shoreline of the SIA and horseback trails have been identified throughout the SIA by the
24 SI field teams. The most frequently observed trespassers are vacationers accessing the
25 beaches along the LIA from boats that are anchored in the bays. Project personnel regularly
26 contact the trespassers, explaining the risk and asking them to observe the exclusion zones
27 shown on nautical maps, in attempts to have them leave the project site. The guards hired to
28 patrol the magazines and central processing compound are also present on site during
29 nights, weekends, and holidays, with few exceptions, frequently report boats in the bays
30 and people on shore.

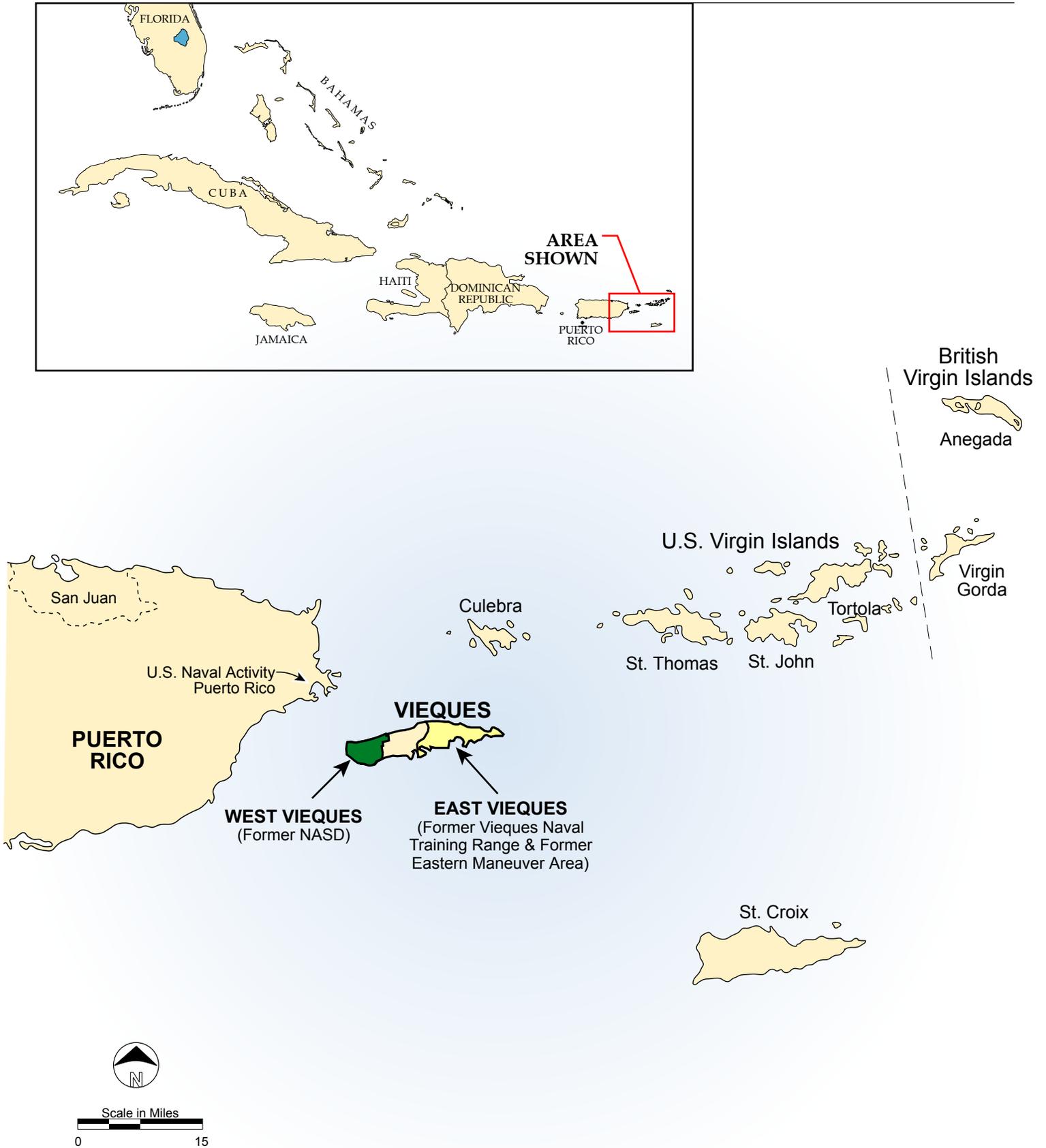


Figure 2-1
Regional Location Map
Former VNTR, Vieques, Puerto Rico



Aerial Photograph of 1994

- Legend**
- MRS Boundary and Number
 - Camp Garcia
 - Parcel Boundary and Designation

Notes :

- MRS Numbers Do Not Signify Priority
- EMA-MRS 43 and SIA-MRS 7 include all terrestrial area within the range fan(s) not designated as other MRSs.

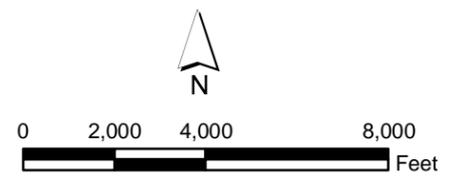


Figure 2-2
Former VNTR Site Map
Former VNTR
Vieques, Puerto Rico

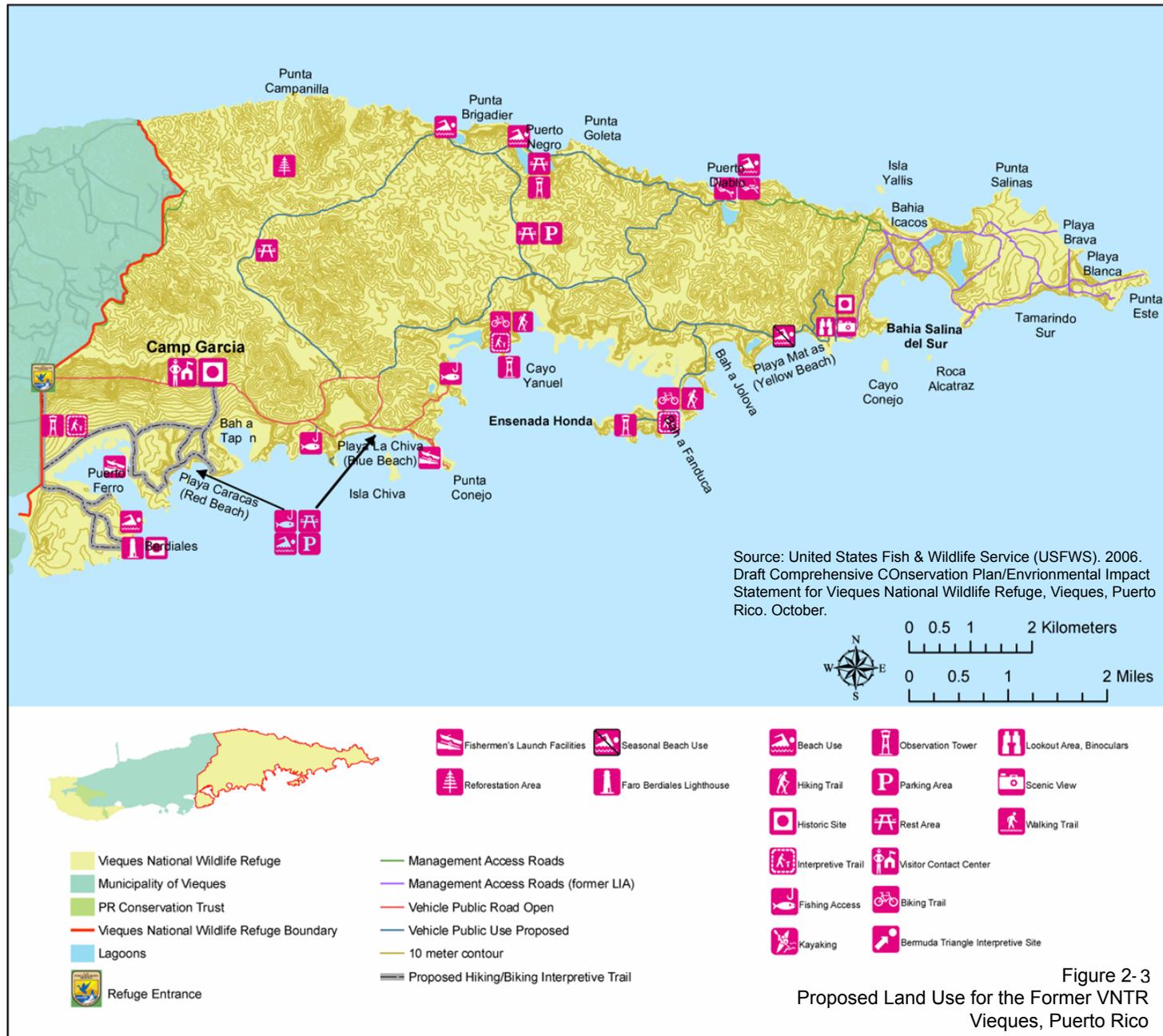
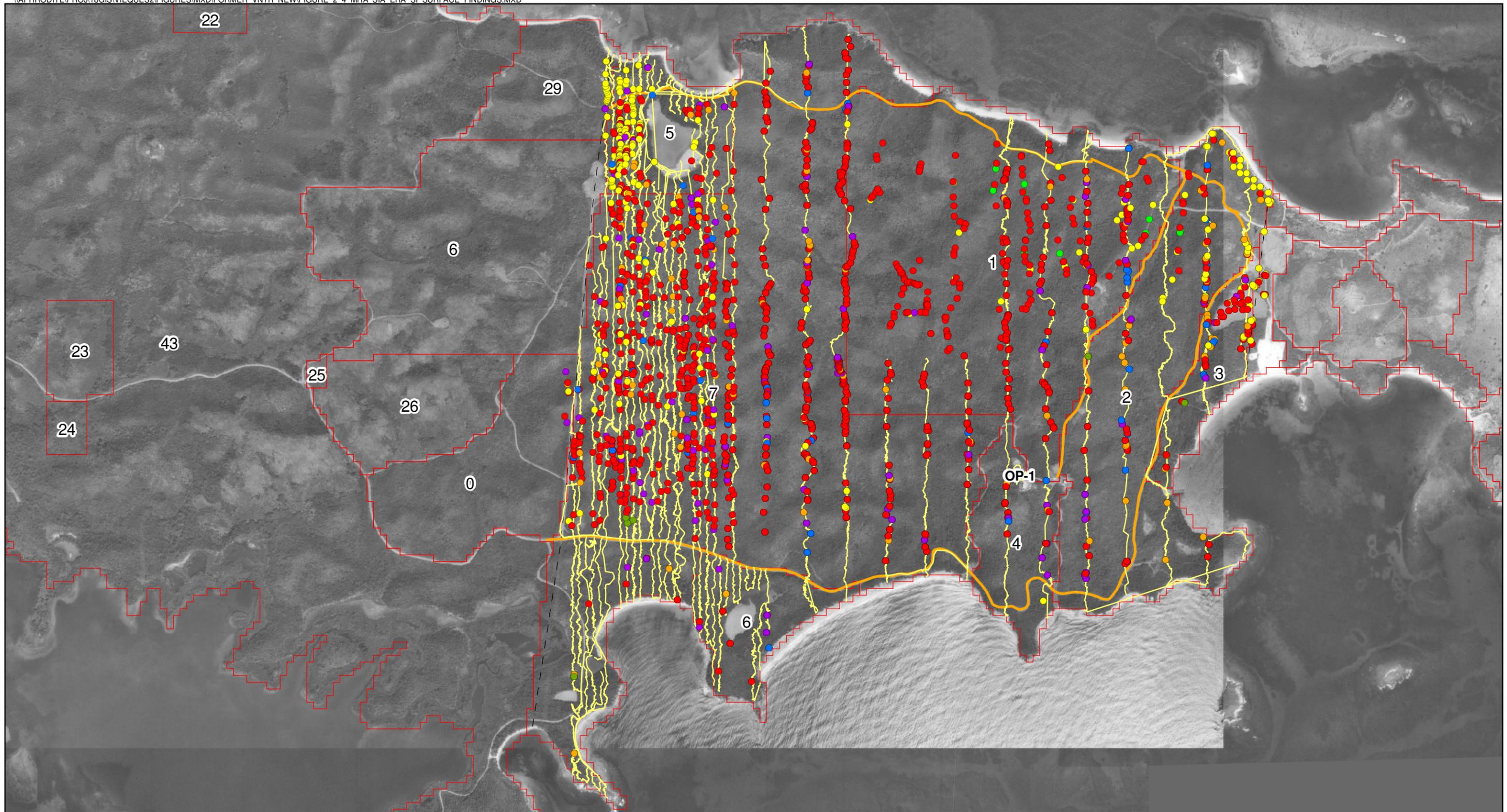


Figure 2-3
Proposed Land Use for the Former VNTR
Vieques, Puerto Rico



- Legend**
- Bombs
 - Flares-Pyrotechnics
 - Grenades
 - MEC Component
 - Projectiles / Mortars
 - Rockets / Guided Missiles
 - ICMS
 - Transects
 - SIA Roads
 - MRS Boundary

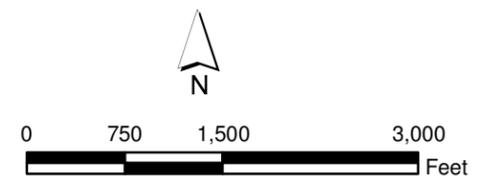


Figure 2-4
MRA-SIA-ERA/SI Surface Findings
Former VNTR
Vieques, Puerto Rico

Removal Action Objective and Scope

1 This section presents information that forms the basis for the site’s removal action objectives
2 (RAOs). This information includes statutory limits on removal actions, the removal action
3 objectives and scope, applicable or relevant and appropriate requirements (ARARs), and a
4 discussion of the selection of cleanup criteria.

3.1 Statutory Limits on Removal Actions

5 The NCP 40 CFR Part 300.415 dictates statutory limits of \$2 million and 12 months of
6 USEPA fund-financed removal actions, with statutory exemptions for emergencies and
7 actions consistent with the remedial action to be taken. This removal action will not be
8 USEPA fund-financed. The Navy/Marine Corps Installation Restoration Program (IRP)
9 Manual does not limit the cost or duration of the removal action; however, cost-effectiveness
10 is a recommended criterion for the evaluation of removal action alternatives.

3.2 Removal Action Objective and Scope

3.2.1 Removal Action Objectives

11 General RAOs are defined by the NCP and as amended by SARA. The NCP requires that
12 the selected remedy meet the following general RAOs:

- 13 • Each selected remedial action shall be protective of human health and the environment.
- 14 • Onsite remedial actions that are selected must attain those ARARs that are identified at
15 the time of the Record of Decision (ROD) signature.
- 16 • Each remedial action selected shall be cost effective; costs shall be proportional to
17 effectiveness.
- 18 • Each remedial action shall use permanent solutions and alternative treatment
19 technologies or resource-recovery technologies to the maximum extent practicable.
20 However in the case of this interim action, future actions may be required as part of the
21 permanent solution.

22 The statutory scope of CERCLA was amended by SARA to include the following general
23 objectives for remedial action at all CERCLA sites:

- 24 • Remedial actions shall attain a degree of cleanup of hazardous substances, pollutants,
25 and contaminants released into the environment and of control of further releases at a
26 minimum, which assures protection of human health and the environment.
- 27 • Remedial actions where treatment that permanently and significantly reduces the
28 volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants
29 as a principal element is preferred.

- 1 • The least favored remedial actions are those that include offsite transport and disposal of
2 hazardous substances or contaminated materials without treatment where practicable
3 treatment technologies are available.
- 4 • The selected remedy must comply with, or attain, the level of any standard,
5 requirement, criteria, or limitation under any federal environmental law or any
6 promulgated standard, requirement, criteria, or limitation under a state environmental
7 or facility citing law that is more stringent than any federal standard, requirement,
8 criteria, or limitation.

9 The site specific proposed RAO is to implement measures along the beaches and roadways
10 of the former VNTR and at SWMU 4 that will isolate, and reduce MEC explosive hazards
11 from energetic materials that pose a potential explosive safety risk to recreational site users,
12 USFWS wildlife refuge site workers, trespassers, and other authorized personnel/workers,
13 based on current and future land use scenarios.

3.2.2 Remedial Action Scope

14 In the preparation of this EE/CA, three removal action alternatives were evaluated that can
15 meet the objectives listed above. The general scope of each removal alternative evaluated is
16 defined in this section.

17 The removal action will address select areas within the MRA-SIA that have a MEC hazard
18 and a potential for access by unauthorized personnel. All evaluated scenarios will meet the
19 objectives above and will consider the following:

- 20 • The selected remedial alternative will limit the potential exposure to MEC (reduce
21 explosive risk) present in the MRA-SIA by unauthorized personnel.
- 22 • Prior to conducting work, measures necessary to protect threatened/endangered flora
23 and fauna (including habitat where warranted) will be implemented in accordance with
24 the Biological Assessment. An approved amendment to the Biological Assessment (GMI,
25 2007) includes the beach area and turtle nesting habitat. The areas within the MRA-SIA
26 identified in the approved approach will be evaluated with respect to
27 threatened/endangered flora and fauna and habitat prior to work being carried out in
28 those areas.

3.3 Determination of Remedial Action Schedule

29 The EE/CA will be placed in the Administrative Record, and notice of its availability for
30 public review along with a brief summary will be published in the local newspaper. The
31 EE/CA is then available for a 30-day public comment period. Following the public comment
32 period, a Responsiveness Summary summarizing responses to significant comments will be
33 prepared and included in the Administrative Record. Since this removal action has been
34 designated non-time-critical, the start date will be initiated following the resolution of the
35 comments.

36 The total project period is anticipated to last less than an estimated 36 to 39 months, from
37 the end of the public comment period through completion of remedial actions. This is an
38 estimated schedule for project completion, should critical milestones not be met, the total

1 project timeframe would also be extended. Critical milestone periods related to the EE/CA
2 are summarized below:

- 3 • EE/CA Public Comment Period – 1 month
- 4 • Contracting – 6 month
- 5 • Preparation – 3 months (includes preparation of work plan[s]), ecological resources
6 surveys and evaluations (if required), submittal reviews, and mobilization
- 7 • Remedial Action – 26 to 29 months

3.4 Applicable or Relevant and Appropriate Requirements

8 The remedial action will, to the extent practicable, comply with ARARs under federal and
9 Puerto Rico laws. Appendix A contains the ARAR tables and provides a summary of each
10 potentially related environmental and munitions regulation. Other federal and Puerto Rico
11 advisories, criteria, or guidance will be considered, as appropriate, in formulating the
12 remedial action. Applicable requirements are those requirements specific to the conditions
13 at the former VNTR and the surrounding vicinity that satisfy all jurisdiction prerequisites of
14 the law or requirements. Relevant and appropriate requirements are those that do not have
15 jurisdiction authority over the particular circumstances at the former VNTR and surrounding
16 vicinity, but are meant to address similar situations, and therefore, are suitable for use at
17 these sites. Federal ARARs are determined by the lead agency. As outlined by 40 CFR
18 300.415(j), the lead agency may consider the urgency of the situation and the scope of the
19 remedial action to be conducted in determining whether compliance with ARARs is
20 practicable.

21 The NCP, 40 CFR 300.400(g)(2), specifies the following factors to consider in determining
22 what requirements of environmental laws are relevant and appropriate:

- 23 • The purpose of the requirement in relation to the purpose of CERCLA.
- 24 • The medium (or media) regulated by the requirement.
- 25 • The substance(s) regulated by the requirement.
- 26 • The actions or activities regulated by the requirement.
- 27 • Variations, waivers, or exemptions of the requirement.
- 28 • The type of place regulated and the type of place affected by the release or CERCLA action.
- 29 • The type and size of the facility or structure regulated by the requirement or affected by
30 the release.
- 31 • Consideration of the use or potential use of affected resources in the requirement.

32 In some circumstances, a requirement may be relevant to the particular site-specific
33 situation but not appropriate because of differences in the purpose of the requirement, the
34 duration of the regulated activity, or the physical size or characteristic of the situation it is

1 intended to address. There is more discretion in the judgment of relevant and appropriate
2 requirements than in the determination of applicable requirements.

3 Three classifications of requirements are defined by USEPA in the ARAR determination
4 process: chemical-specific, location-specific, and action-specific. Each is described below.

5 *Chemical-specific ARARs* are health or risk management-based criteria or methodologies that
6 result in the establishment of numerical values for a given medium that would meet the
7 NCP “threshold criterion” of overall protection of human health and the environment.
8 These requirements generally set protective cleanup concentrations for the chemicals of
9 concern in the designated media, or set safe concentrations of discharge for remedial
10 activity. Any chemical constituents of concern identified at the munitions response sites will
11 be addressed, as a separate munitions response action, following the reduction of the
12 explosive safety risk by the subsurface removal of munitions.

13 *Location-specific ARARs* restrict remedial activities based on the characteristics of the
14 surrounding environments. Location-specific ARARs may include restrictions on remedial
15 actions within wetlands or floodplains, the protection of known endangered species, or
16 restrictions for protected waterways. Federal and Puerto Rico location-specific regulations
17 that have been reviewed are summarized in Appendix A.

18 *Action-specific ARARs* are requirements that define acceptable treatment and disposal
19 procedures for munitions to ensure the protection of public health and safety. Federal and
20 Puerto Rico action-specific ARARs that may affect the development and conceptual
21 arrangement of remedial alternatives are summarized in Appendix A.

Identification and Detailed Analysis of Removal Action Alternatives

4.1 Alternatives Description

1 Based on the analysis of the nature and extent of MEC contamination and the cleanup
2 objectives developed in the previous section, three remedial action alternatives were
3 developed. The following are the remedial action alternatives considered for detailed
4 evaluation at the former VNTR MRA-SIA:

- 5 1. No Action.
- 6 2. Engineering controls (physical barrier) to prevent access to restricted areas.
- 7 3. Removal of surface detected MEC from areas within the MRA-SIA with the highest
8 potential for trespassing.

9 A description of each of these alternatives is provided below.

4.1.1 Alternative 1—No Action

10 The no action alternative implies that no surface MEC remedial work would be completed
11 for the areas with potential unauthorized personnel access within the MRA-SIA.

4.1.2 Alternative 2- Engineering Controls

12 The engineering controls alternative would provide physical barriers and signage to prevent
13 access. As part of this alternative, fencing would be placed along all potential access points
14 and frequent signage would be put in place. The fencing would be constructed of 10 ft high
15 chain link topped with barbed wire. Gates will be put in place at strategic points to allow
16 USFWS and other site worker access. Signs identifying the areas as having an MEC hazard
17 would be placed every 100 ft along the fence line. Intrusive work and limited vegetation
18 clearance would be required during fence installation; therefore, MEC avoidance will be
19 required. The total number of linear feet of fence would be 48,300 ft and 480 signs would be
20 installed. Figure 4-1 presents the proposed fencing and signage locations.

4.1.3 Alternative 3—Removal of Surface MEC from Select areas of the MRA-SIA

21 The removal action alternative would include the removal of all surface MEC from the
22 selected areas. Figure 4-2 and the bullets below present the areas of MEC removal within the
23 MRA-SIA that would be conducted for Alternative 3.

- 24 • The roadways plus 100 meters each side. Because of the steep terrain and dense
25 vegetation in the SIA it is unlikely that unauthorized users will access the central portion
26 of the SIA. Therefore, a 100 meter clearance area along each side of the roads is expected

1 to significantly reduce the explosive risk in areas off the roadways that could reasonably
 2 be accessed by unauthorized personnel/recreational user.

3 • The shoreline inland 100 meters. Because of the steep terrain and dense vegetation in the
 4 central portion of the SIA, it is unlikely that unauthorized users will access this area.
 5 However, several recreational boaters have been documented to trespass in the SIA from
 6 the shoreline. Therefore, a 100 meter clearance inland from the shoreline is expected to
 7 significantly reduce the explosive risk in areas off the beaches that could reasonably be
 8 accessed by unauthorized personnel/recreational users.

9 • From the eastern boundary of the SIA westward to the approximate extent of where HEs
 10 containing bombs are expected to be located based on the ERA/SI data. The eastern
 11 portion of the MRA-SIA transects show a mix of MEC items that are similar to that
 12 found in the MRA-LIA, specifically high explosive bombs. Therefore, this entire area
 13 will be surface cleared to reduce risk. There are also a number of access routes through
 14 this area (e.g., road to OP-1) that present access points for authorized and unauthorized
 15 personnel. The northwestern portion of the MRA-SIA contains a number of practice
 16 bombs (e.g., BDU-33) as shown on Figure 4-2; however, these items do not pose the
 17 same high explosive hazard that the items located in the more eastern portion of the
 18 MRA-SIA do. The BDU 33 type practice bombs are not fitted with a sensitive fuze. If the
 19 BDU 33 failed to function upon impact, it would only contain a few grams of energetic
 20 material.

21 Table 4-1 presents the phases of work for this alternative. A majority of the site will not
 22 require site restoration following the clearance activities; however, some restoration may be
 23 required in beach areas or other sensitive habitat/ecological areas depending on the extent
 24 of removal activities required.

TABLE 4-1
 Alternative 3—Work Phases

Operation	Description
Surface MEC clearance	700 acres of would be cleared of surface MEC in the MRA-SIA. This includes the clearing of vegetation to expose the ground surface and subsequent identification and removal of MEC.
Scrap metal segregation, accumulation, and storage	All scrap metal needing to be removed during the MEC clearance would be collected in an accumulation and storage area for off-site disposal. Estimated quantity is 2100 tons.
MPPEH/MD certification and disposal	All MPPEH/MD would be documented, removed, and stockpiled until inspection. When certified free of explosives, the material will be transferred to a certified recycling facility. Estimated quantity is 1800 tons.
MEC consolidated demolition and demilitarization	All UXO found would be documented and appropriate demolition/venting actions conducted. Estimated quantity is 8500 items.
Revegetation	All revegetation (if required) would be accomplished by allowing the site to revegetate naturally.

Notes:
 MEC = munitions and explosives of concern, MPPEH/MD = Material potentially presenting an explosive hazard/munitions debris, UXO = unexploded ordnance

4.2 Analysis of Removal Action Objectives

- 1 Each alternative was evaluated using the effectiveness, implementability, and cost criteria
- 2 set forth in the NCP and the USEPA guidance for conducting EE/CAs (USEPA, 1993). Each
- 3 evaluation criterion is described in Table 4-2 and sections following the table provide a
- 4 discussion of the pertinent evaluation criteria for each alternative.

TABLE 4-2
Evaluation Criteria

Effectiveness	
Protection of human health and the environment	The assessment describes how the action achieves and maintains protection of human health and the environment and achieves site-specific objectives both during and after implementation.
Compliance with ARARs	An alternative is assessed in terms of its compliance with ARARs, or if a waiver is required, how it is justified.
Short-term effectiveness	An action is assessed in terms of its effectiveness in protecting human health and the environment during the implementation of a remedy before remedial action objectives have been met. The duration of time until the remedial action objectives are met is also factored into this criterion.
Long-term effectiveness and permanence	An action is assessed in terms of its long-term effectiveness in maintaining protection of human health and the environment after remedial action objectives have been met. The magnitude of residual risk and adequacy and reliability of post-remedial site controls are taken into consideration.
Reduction of exposure to explosive hazards	An action is assessed in terms of anticipated performance of the specific remedial technologies it employs. Factors such as volume of MEC removed or destroyed and the degree of expected reductions in exposure to hazards within the remedial area.
Implementability	
Technical feasibility	The ability of the technology to implement the remedy is evaluated.
Administrative feasibility	The administrative feasibility factor evaluates requirements for permits, zoning variances, impacts on adjoining property, and the ability to impose ICs.
Availability of services and materials	The availability of offsite treatment, storage, and disposal capacity, personnel, services and materials, and other resources necessary to implement the alternative will be evaluated.
State and community acceptance	The acceptability of an alternative to the state (commonwealth) agency and the community is evaluated.
Cost	
Direct and indirect capital costs	Includes costs for MEC removal (excavation and site restoration), equipment and materials, munitions storage and services, engineering and design, and permit/licenses.
O&M costs	Includes ongoing monitoring and maintenance for a specific period.

Notes:

ARAR = applicable or relevant and appropriate requirements, IC = institutional control, MEC = munitions and explosives of concern, O&M = operation and maintenance

4.2.1 Effectiveness

1 The *effectiveness* of a technology refers to its capability of removing the specific items in the
2 volumes required, the degree to which the technology achieves the RAO, and the reliability
3 and performance of the technology over time, including protection of human health and the
4 environment, compliance with ARARs to the extent practical, long-term effectiveness and
5 permanence, reduction in explosive safety hazard, and short-term effectiveness.

6 As explained in Section 2, the RAO for the sites is to implement measures that will isolate,
7 reduce, or eliminate MEC hazards which may contain energetic materials that pose a
8 potential explosive safety hazard to human health and the environment based on current
9 and future land use scenarios.

10 Levels of effectiveness were assessed based upon the number of “effectiveness criteria” that
11 would be satisfied by each alternative. The “effectiveness criteria” are described in Table 4-2.

Protection of Human Health and the Environment

12 **Alternative 1—No Action.** Alternative 1 provides no additional protection to human health
13 and the environment. The MEC would remain onsite which would potentially expose
14 trespassers and authorized personnel/workers to explosive safety hazards associated with
15 UXO. In addition this alternative would not protect the environment from future releases of
16 explosive related contaminants. The current concentration of MEC poses a HE safety risk to
17 human health and the environment; this alternative will not reduce that risk.

18 **Alternative 2—Engineering Controls** Alternative 2 provides a limited level of protection to
19 human health and the environment in the MRA-SIA. This alternative would reduce the
20 explosive safety risk to humans by inhibiting access to MEC that would remain in place.
21 Engineering controls can not eliminate the potential for human exposure because of intended
22 or unintended breaches of the installed barrier. No potential environmental benefits are
23 realized from this alternative because munitions items would remain in place.

24 **Alternative 3—Removal of Surface Detected MEC from Select Areas of the MRA-SIA.** Alternative
25 3 provides the highest level of protection to human health and the environment within the
26 MRA-SIA. The surface MEC would be removed from the removal action area and disposed of
27 offsite.

28 An explosive hazard may still exist due to the potential for subsurface MEC and erosion that
29 would expose subsurface items.

Protection of Workers During Implementation

30 **Alternative 1—No Action.** Because Alternative 1 is the ‘No Action’ alternative, this criterion is
31 not applicable.

32 **Alternative 2—Engineering Controls.** As with any MEC site, Alternative 2 does have worker
33 safety issues to address prior to implementation. The main hazard to workers during
34 implementation associated with this alternative is working in areas with live munitions. All
35 personnel working in the area will be lead by UXO personnel who will provide MEC
36 avoidance. Engineering controls will involve intrusive activities during installation. An
37 additional hazard to workers during implementation is working in rough terrain in a

1 tropical climate. Worker safety would be a concern for this alternative, but is a normal,
2 manageable component of MEC related work activities.

3 **Alternative 3—Removal of Surface Detected MEC from Select Areas of the MRA-SIA.** Alternative
4 3 has worker safety issues to address prior to implementation. The main hazard to workers
5 during implementation associated with this alternative is working with potentially live
6 munitions. All personnel involved with the MEC removal will be UXO personnel. All
7 applicable safety requirements will be followed for handling, storage, and
8 demolition/demilitarization. All exclusion areas where removal is taking place will be
9 restricted access exclusion zones for explosive safety purposes. Only authorized personnel
10 will be allowed in the exclusion zone. An additional hazard to workers during
11 implementation is working in rough terrain in a tropical climate. Worker safety would be a
12 concern for this alternative, but is a normal, manageable component of MEC related work
13 activities.

Compliance with Chemical, Action and Location Specific ARARs

14 There are no chemical specific ARARs associated with this EE/CA. All action specific and
15 location specific ARARs are summarized in Appendix A.

Short-term Effectiveness

16 **Alternative 1—No Action.** Alternative 1 does not provide any short term effectiveness at the
17 MRA-SIA.

18 **Alternative 2—Engineering Controls.** Alternative 2 has limited effectiveness in the short term
19 by providing physical barriers and signage for public access to restricted areas, which could
20 be breeched.

21 **Alternative 3—Removal of Surface Detected MEC from Select Areas of the MRA-SIA.** Alternative
22 3 is effective in the short term by reducing the explosive safety risk of MEC by permanently
23 removing the items from the ground surface.

Long-term Effectiveness and Permanence

24 **Alternative 1—No Action.** Alternative 1 does not provide any long-term effectiveness.

25 **Alternative 2—Engineering Controls.** Alternative 2 provides limited long-term effectiveness.
26 Engineering Controls can not eliminate the long term risks to human health. Fencing and
27 signage can be compromised by trespassers, vehicles, and weather, and the public would in
28 turn have access to restricted areas. Alternative 2 does not include the removal of on-site
29 MEC, therefore the risk to human health is high if engineering controls are compromised.
30 Long term and extensive operation and maintenance would be required to maintain fencing
31 and signs in good repair.

32 **Alternative 3—Removal of Surface Detected MEC from Select Areas of the MRA-SIA.** Alternative
33 3 is effective in the long-term by removing on-site MEC. Implementation of this alternative
34 leaves the long-term possibility for circumstances to arise that could affect human health or
35 the environment (e.g., erosion that reveals subsurface MEC), but this is will likely occur over
36 extended periods of time. Long-term operation and maintenance would be required (e.g.,

1 signage) and periodic site evaluations would need to be performed to identify MEC that has
2 migrated to the surface.

4.3 Implementability

3 The *ease of implementation* of a technology refers to the availability of commercial services to
4 support it, the constructability of the technology under specific site conditions, and the
5 acceptability of the technology to all parties involved (regulators, public, owner, etc.),
6 including technical feasibility, administrative feasibility, availability of services, support
7 agency acceptance, and community acceptance. Levels of implementability were assessed
8 based upon the number of “implementability criteria” satisfied by each alternative
9 summarized in Table 4-2.

4.3.1 Alternative 1—No Action

10 Alternative 1 is the ‘No Action’ alternative; therefore, implementability does not apply.

4.3.2 Alternative 2—Engineering Controls

11 Technical feasibility for Alternative 2 is less difficult than Alternative 3. Installation of
12 fencing and performing MEC avoidance can more easily be implemented. This alternative
13 would not include many of the MEC related work phases that Alternative 3 requires.

4.3.3 Alternative 3—Removal of Surface Detected MEC from Select Areas of the MRA-SIA

14 Alternative 3 is technically more difficult to implement than Alternative 2. This is due to
15 Alternative 3 requiring additional MEC related work phases. The implementation of many
16 of the phases requires logistical and equipment considerations due the increased safety
17 requirements when making intentional contact with MEC.

4.4 Cost

18 For the *detailed cost analysis* of alternatives, the expenditures required to complete each
19 alternative were estimated in terms of capital costs, operation and maintenance (O&M)
20 costs, long-term monitoring (LTM) costs, and indirect costs. Capital costs include costs to
21 complete initial remedial activities. O&M costs will be incurred to ensure the integrity of the
22 engineering controls in Alternative 2. Indirect costs include engineering expenses, license or
23 permit costs, and contingency allowances. By combining the different costs associated with
24 each alternative, a present-worth calculation for each alternative can be made for comparison.

25 The costs estimated for this section are provided to an accuracy of +50 percent and -30
26 percent. The alternative cost estimates are in 2007 dollars and are based on information
27 published by R. S. Means *Site Work and Landscape Cost Data* and *Environmental Cost,*
28 *Handling, Options and Solutions (ECHOS)*. When actual costs or real quotes were available or
29 when R. S. Means data are not available or not applicable, quotes, previous costs, or
30 engineering estimates are used for unit pricing. Appendix B contains the preliminary cost
31 estimate for Alternatives 2 and 3. The assumptions are presented below.

4.4.1 Alternative 1—No Action

1 There are no costs associated with this alternative.

4.4.2 Alternative 2—Engineering Controls

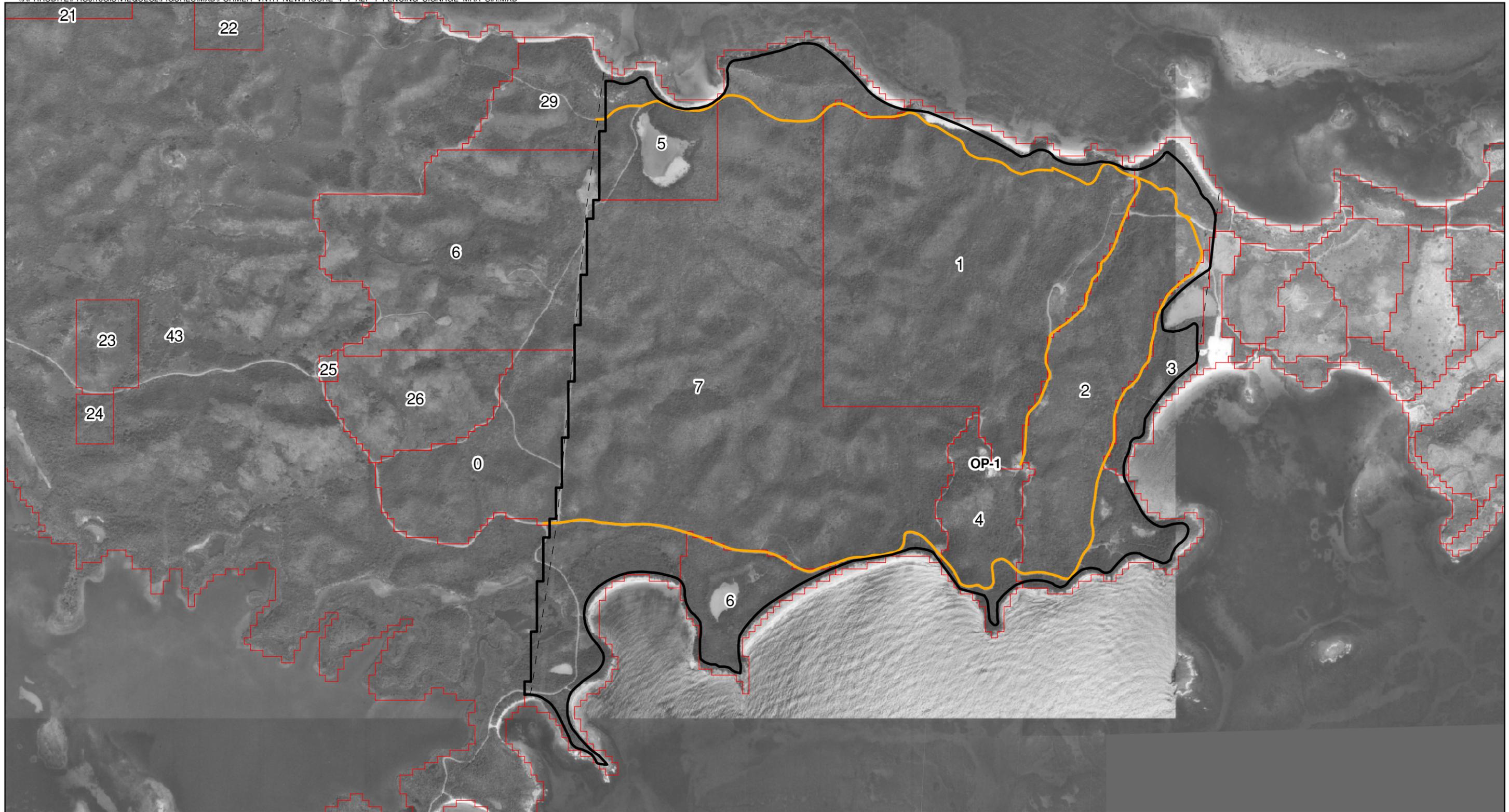
2 The estimated total cost to this alternative is \$18,795,783 Table B-1 in Appendix B contains a
3 preliminary cost estimate for Alternative 2. Assumptions used for this cost estimate are:

- 4 • The entire initial action can be completed with one mobilization for laborers, UXO
5 technicians, and required equipment.
- 6 • Two teams will be working concurrently for the duration of the fence installation effort.
- 7 • No MEC removal will be required, avoidance will be sufficient.
- 8 • The work week will consist of five ten-hour days and will be approximately 80 weeks in
9 duration.
- 10 • Operations and maintenance period of 5 years is assumed.

4.4.3 Alternative 3—Removal of Detected MEC from Select Areas of the MRA-SIA

11 The estimated total cost to complete this alternative is estimated to be \$29,088,446. Table B-2
12 in Appendix B contains a preliminary cost estimate for Alternative 3. Assumptions used for
13 this cost estimate are:

- 14 • The entire removal action can be completed with one mobilization for UXO technicians
15 and required equipment, but will include periodic crew rotations.
- 16 • Three vegetation and surface clearance teams will be working concurrently for the
17 duration of the clearance effort.
- 18 • The work week will consist of five 10-hour days.
- 19 • The surface clearance rate will be 30 acres per month.



- Legend**
- Fence Location
 - SIA Roads
 - MRS Boundary

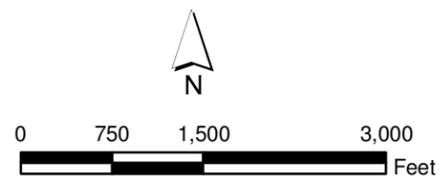
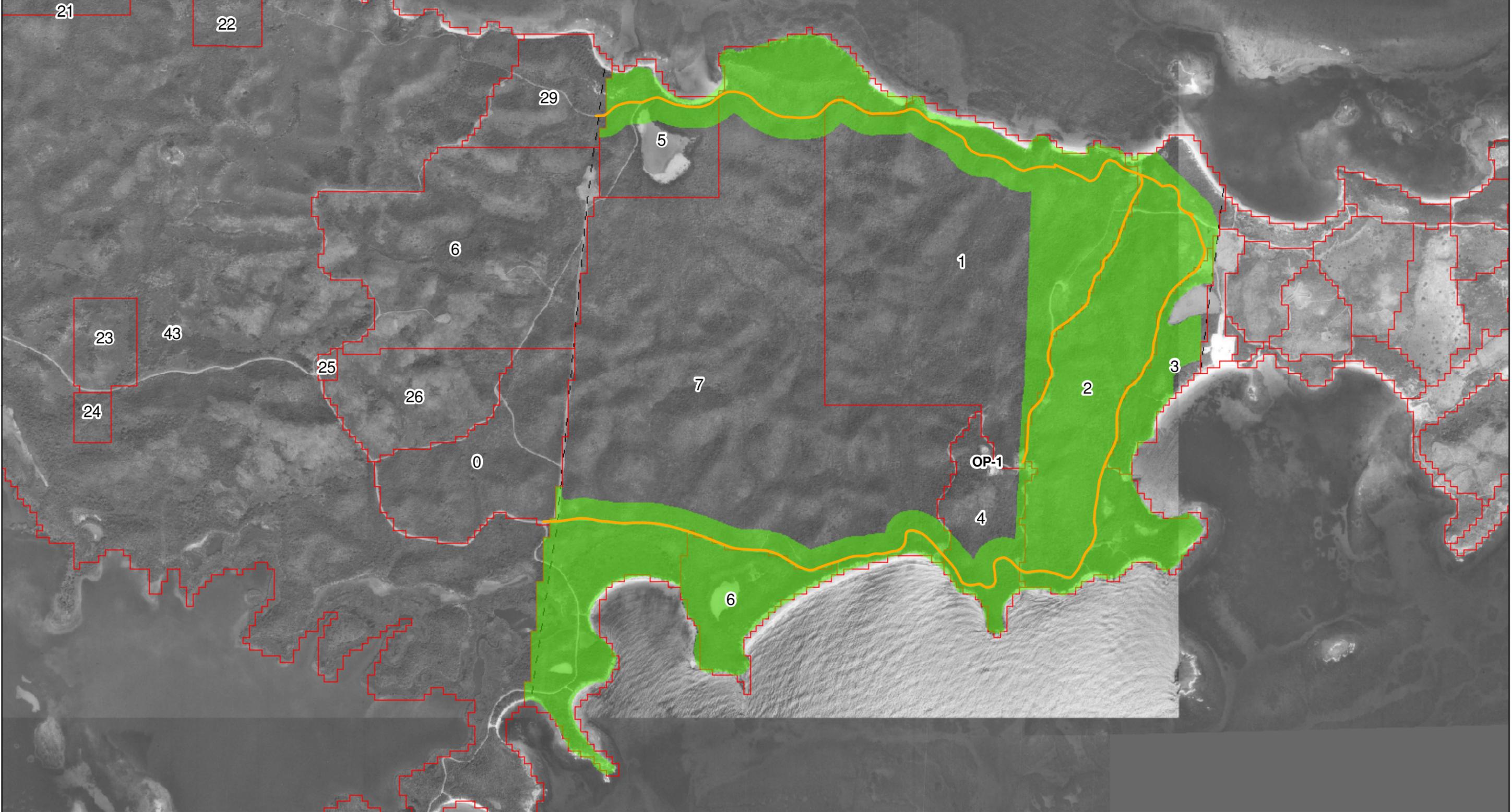


Figure 4-1
Alternative 2- Engineering Controls (Fencing and Signage)
for the MRA-SIA
Former VNTR
Vieques, Puerto Rico

Note: Signs will be placed every 100 ft along entire fenceline.



- Legend**
- SIA Roads
 - Removal Action Area
 - MRS Boundary

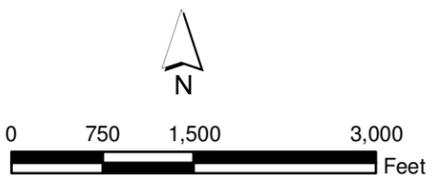


Figure 4-2
Alternative 3- Surface MEC Removal Action
Select Areas within MRA-SIA
Former VNTR
Vieques, Puerto Rico

Comparative Analysis of Removal Action Alternatives

1 This section provides an evaluation of the remedial action alternatives in accordance with
2 the USEPA guidance document *Guidance on Conducting Non-Time Critical Removal Actions*
3 *Under CERCLA* (USEPA/540-R-93-057). The remedial action alternatives are evaluated in
4 terms of effectiveness, implementability, and cost. A summary of the comparative analysis
5 is provided in Table 5-1.

5.1 Effectiveness

6 The overall effectiveness of Alternative 1 is low. The effectiveness of Alternatives 2 is
7 moderate and 3 is high. These levels of effectiveness were assessed based on the number of
8 “effectiveness criteria” that would be satisfied by each alternative. The “effectiveness
9 criteria,” from the USEPA guidance are identified as:

- 10 • Protection of public health
- 11 • Protection of workers during implementation
- 12 • Protection of environment
- 13 • Compliance with ARARs
- 14 • Level of treatment and containment expected
- 15 • Residual effect concerns

16 Alternative 1 does not achieve the RAOs. Alternative 2 and 3 have been developed because
17 they were able to achieve the identified RAOs discussed in Section 3. If the RAO is achieved,
18 then public health is protected.

19 Workers can be protected during implementation of both Alternatives 2 and 3 using
20 standard personal protective equipment and MEC detecting devices and procedures. The
21 explosive safety risk to the public is significantly reduced through the removal of MEC
22 contamination, which, if left in place, could also potentially serve as a source of chemical
23 environmental contaminants. Alternative 3 is more protective of the public health and safety
24 than Alternative 2 because it removes MEC from the site.

25 Both alternatives can comply with the location-specific and action-specific ARARs, which
26 apply to the implementation of the alternatives. The removal action will adhere to all
27 regulations regarding environmentally sensitive locations, excavations, detonations, and
28 explosives transportation, use, and storage.

29 The level of protectiveness varies among all three alternatives, with Alternative 3 being the
30 most complete and more permanent solution. However, Alternative 2 will also provide a
31 level of protection.

5.2 Implementability

1 The implementability evaluation of the alternatives varies from easy to difficult. These
2 levels of implementability were assessed based on the number of “implementability
3 criteria” satisfied by each alternative. The “implementability criteria,” from the USEPA
4 guidance document *Guidance on Conducting Non-Time-Critical Removal Actions Under*
5 *CERCLA* (USEPA/540-R-93-057), are as follows:

- 6 • Construction and operational considerations
- 7 • Demonstrated performance/useful life
- 8 • Adaptable to environment conditions
- 9 • Contributes to remedial performance
- 10 • Can be completed in an acceptable timeframe.
- 11 • Availability of equipment, personnel, and services, outside laboratory testing capacity,
12 and offsite treatment and disposal capacity
- 13 • Permits required
- 14 • Easements or rights-of-way required
- 15 • Impact on adjoining property
- 16 • Ability to impose institutional controls (ICs)

17 Evaluation of implementability is essentially the evaluation of technical and administrative
18 feasibility. The technical feasibility consists of items 1 through 6 above, and administrative
19 feasibility involves items 7 through 10.

20 All of the alternatives are technically feasible. MEC contamination will remain on the
21 surface utilizing Alternative 1 and 2 as no efforts will be expended to remove it.

5.3 Cost

22 The present-worth costs (relative scaling) of each of the alternatives are summarized in
23 Table 5-1. The cost breakdown for each alternative is provided in Appendix B. Alternative 3
24 is the most costly and the most complete solution, Alternative 2 is more cost effective but is
25 less effective with regards to protecting human health and the environment. Alternative 2,
26 although more costly, will more effectively satisfy the RAO in the relative same time frame
27 as Alternative 2 and will be more effective in the long-term.

TABLE 5-1
Relative Remedial Alternative Comparison

Alternative	Effectiveness	Implementation	Cost
THE FORMER VNTR			
Alternative 1—No Action	Not Effective	Easy	No cost
Alternative 2—Engineering Controls	Moderately Effective	Moderate	Moderate
Alternative 3— Removal of Surface MEC from Select Areas of the MRA-SIA	Effective	Moderate	High

Notes:

MEC = munitions and explosives of concern, VNTR = Vieques Naval Training Range

Recommended Removal Action Alternative

1 The EE/CA was performed in accordance with current USEPA and Navy guidance
2 documents for a NTCRA under CERCLA. Three alternatives were analyzed based on
3 evaluation of the effectiveness, implementability, and cost. The effectiveness evaluation
4 included reviewing the protectiveness of the alternative and its ability to meet the RAOs.
5 Implementability included looking at the technical feasibility, availability, and
6 administrative feasibility of the alternative. The evaluation of cost included a review of
7 capital cost, operating cost, and present-worth cost.

8 Alternative 3, Removal of Surface MEC from select areas of the MRA-SIA, is the
9 recommended alternative. Alternative 3 is recommended because it will achieve the
10 remedial action objectives with a higher certainty of success. Based on projected future land
11 use Alternative 3 would be more effective in achieving remedial action needs. Risks from
12 MEC will not be completely eliminated at the sites due to the potential for subsurface
13 contamination, but will significantly reduce the hazard. This alternative would minimize the
14 explosive safety risk to the unauthorized personnel and site workers. Implementation of
15 Alternative 3 is technically feasible and, under the current projected land use, lends itself to
16 future remedies. The cost for implementation of Alternative 3 is estimated to have a present
17 worth of \$29,088,446.

SECTION 7

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Appendix A
Applicable or Relevant and
Appropriate Requirements

Contents

Tables

- A-1 Federal Location-Specific Applicable or Relevant and Appropriate Requirements
- A-2 Puerto Rico Location-Specific Applicable or Relevant and Appropriate Requirements
- A-3 Puerto Rico Action-Specific Applicable or Relevant and Appropriate Requirements
- A-4 Federal Action-Specific Applicable or Relevant and Appropriate Requirements

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**Table A-1
Federal Location-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Protection of Floodplain*					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain (i.e., lowlands and relatively flat areas adjoining inland and coastal waters and other flood-prone areas).	40 CFR Part 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	Removal activities may require compliance with this order. Measures required may include erosion control.
Protection of Wetlands*					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Relevant and Appropriate	Federal or Puerto Rico regulated wetlands are present. Nationwide Permit No. 38 allows for activities in wetlands to contain, stabilize, or remove hazardous or toxic materials. "Notification" is required to the District Engineer and the wetlands on the site should be delineated. Activities undertaken entirely on a CERCLA site by authority of CERCLA, as approved or required by EPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, although the substantive requirements of these permits shall be met. NWP 38 notification will put in place coordination with natural resource and historic resource trustees regarding the potential to adversely affect threatened and endangered species and sites protected under the National Historic Preservation Act.

**Table A-1
Federal Location-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Clean Water Act, Section 404*a					
Wetland	Action to prohibit discharge of dredged or fill material into wetland without permit.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Relevant and Appropriate	Non-time critical removal action may include removal and restoration of wetland sediments. Activities undertaken entirely on a CERCLA site by authority of CERCLA, as approved or required by EPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, although the substantive requirements of these permits shall be met.
Endangered Species Act of 1978*					
Endangered species	Action to ensure that any action is not likely to jeopardize the continued existence of endangered or threatened species or adversely affect its critical habitat.	Applies to actions that affect endangered or threatened species or their habitat.	16 USC 1531 50 CFR Part 402	Relevant and Appropriate	Multiple federally listed or proposed endangered species are known to exist at the former VNTR. A Consultation with US Fish and Wildlife Service as necessary will be completed under this ARAR.
Federal Fish and Wildlife Conservation Act					
Fish and Wildlife	Requires that activities avoid, minimize, or compensate for impacts to fish and wildlife and their habitats.	Applies to actions that affect fish and wildlife and their habitat.	16 USC §662 et seq.	Relevant and Appropriate	Site Restoration at the former VNTR will provide enhanced habitat for fish and wildlife species.

**Table A-1
Federal Location-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Coastal Zone and Management Act					
Coastal Zone	Requires that activities conducted within a coastal zone be consistent with an approved state management program.	Applies to sites located within a coastal zone.	16 USC §1451 et seq.	Relevant and Appropriate	Parts of the former VNTR and surrounding vicinity are located within the coastal zone. Activities will be conducted in accordance with applicable management program(s).
National Historical Preservation Act (NHPA) of 1966 and Archaeological Resources Protection Act of 1979					
Historical Locations and Archaeological Artifacts	Provides for the recovery and preservation of historical and archaeological significant artifacts. Implementing regulations for NHPA (36 CFR Part 65) establish the National Register of Historic Places and provide for preservation of historic properties and minimization of damage to historic landmarks.	Applies to historical properties and landmarks, and archaeological artifacts.	NHPA: 16 USC §470; 36 CFR Part 65. Archaeological Resources Protection Act.	Relevant and Appropriate	Based upon historical site use and filling activities that were conducted in the vicinity, it is not likely that historical landmarks or artifacts exist in the surrounding vicinity.
<p>* Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.</p> <p>ARARs - Applicable or relevant and appropriate requirements CFR - Code of Federal Regulations NWP - Nationwide Permit USC - United States Code</p>					

**Table A-2
Puerto Rico Location-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Water Control Laws and Puerto Rico Wetlands Regulations*					
Coastal Zone Management Act; NOAA Regulations of Federal Consistency with approved State Coastal Zone Management Programs (Natural Patrimony Program Law of Puerto Rico)					
Within coastal zone	Conduct activities within a coastal Management Zone in a manner consistent with local requirements.	Activities conducted at Natural Reserves and Special Areas of Planification	Section 307(c) of 16 USC 1456(c); also see 15 CFR 930 and 923.45	Relevant and Appropriate	Portions of the former VNTR are located in the Coastal Zone, but is not located in areas classified as Natural Reserves or Special Areas of Planification.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

- ARARs - Applicable or relevant and appropriate requirements
- CFR - Code of Federal Regulations
- CWA - Clean Water Act
- NOAA - National Oceanic and Atmospheric Administration
- TBC - To Be Considered
- USACE - United States Army Corps of Engineers
- VAC - Virginia Administrative Code
- VDEQ - Virginia Department of Environmental Quality

**Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Environmental Impact Statement Regulations*					
Environmental Impact Statements	Regulations to establish content requirements and administrative procedures for complying with the Environmental Impact Statement (EIS) procedure required by the Environmental Public Policy A	Determination of whether or not actions will have a significant environmental impact in the normal course of their activities	Regulation on Puerto Rico Environmental Impact Statement	Not Applicable	Proposed removal actions do not trigger the requirement to perform an Environmental Impact Statement at the former VNTR.
Puerto Rico Control of Noise					
Noise Control Requirements	These regulations define requirements for the management and control of noise pollution.	Applicable to any activity which may include site preparation, demolition, removal, or disposal, excavation, occurring on premises, right-of-ways, public or private structures or similar property.	Regulation for the Control of Noise Pollution, Puerto Rico Regulation 3418	Applicable	Applicable to management of noise during MEC removal, detonation/demilitarization, and site restoration activities at the former VNTR.

**Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Hazardous Waste and Non-Hazardous Solid Waste Regulations					
Hazardous Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of hazardous wastes.	Wastes must meet definition of hazardous waste.	Regulation for the Control of Hazardous and Non-Hazardous Solid Waste, Puerto Rico Regulation 2863.	Relevant and Appropriate	Scrap metal and waste excavated during the MEC removal action the former VNTR will be characterized for disposal. Existing data indicate waste will be non-hazardous; however, any identified hazardous waste will be managed accordingly.
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of solid wastes, including the submittal of a Non-Hazardous Solid Waste Operating Plan. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	Regulation for the Control of Hazardous and Non-Hazardous Solid Waste, Puerto Rico Regulation 2863	Applicable	Applicable to management and staging, transportation, and off-site disposal of any debris classified as a solid waste at the former VNTR.
Puerto Rico Solid Waste Management Regulations					
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of solid wastes. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	Regulation for the Management of Non-Hazardous Solid Waste, Puerto Rico Regulation 5717	Applicable	Applicable to management and staging, transportation, and off-site disposal of any debris classified as a solid waste.

**Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Air Pollution Control Regulations*					
Discharge to air	Puerto Rico Ambient Air Quality Standards - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Applicable	Applicable for all site removal activities that may generate air discharges. No discharges to air are anticipated other than fugitive dust.
Discharge of visible emissions and fugitive dust	Fugitive dust/emissions may not be discharged to the atmosphere at amounts in excess of standards.	Any source of fugitive dust/emissions.	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Applicable	Applicable for any site removal activities that generate fugitive dust.
Discharge of toxic pollutants	Toxic pollutants may not be discharged to the atmosphere at amounts in excess of standards.	Any source of toxic pollutants	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Not Applicable	No toxic air pollutants are anticipated as part of this NTCRA.

**Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Regulation for the Control of Erosion and Prevention of Sedimentation					
Erosion / Sediment Control	Regulates erosion / sedimentation control practices and management, including a Control of Erosion and Sediment (CES) Plan and a CES Permit.	Land disturbing activities.	Regulation for the Control of Erosion and Prevention of Sedimentation, Puerto Rico Regulation 5754	Applicable	Applicable for any site removal activities resulting in possible erosion and sedimentation. The NTCRA will include meeting the substantive requirements for erosion and sediment control including a CES Plan and CES Permit.
Explosives	Law of Explosives of Puerto Rico		28 June 1969, Law Number 134	Applicable	
<p>* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific ARARs are addressed in the table below each general heading.</p> <p>ARAR - Applicable or relevant and appropriate requirement</p> <p>CFR - Code of Federal Regulations</p> <p>NTCRA - Non-time critical removal action</p> <p>TBC - To Be Considered</p>					

**Table A-4
Federal Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Explosives and Blasting Agents; Welding and Cutting Activities	Occupational Safety and Health Administration	29 CFR Part 1910 §H.109, and §Q.	Relevant and Appropriate	
Occupational Safety and Health Administration - General Construction Work	Construction work.	29 CFR Part 1926	Applicable	Construction work at the former VNTR will adhere to these regulations.
EPA Final Military Munitions Rule	Remedial actions generate munitions that are subject to RCRA requirements.	40 CFR 260, et al.	Applicable	The remedial actions for the former VNTR will likely generate military munitions waste which may be classified as hazardous.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980	NCP and Hazardous Waste Handling; Military Munitions	40 CFR Parts 266, 300, 370.	Relevant and Appropriate	
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980	EPA Guidance	42 U.S.C. Section 9601	Applicable	
Superfund Amendments and Reauthorization Act (SARA) of 1986	EPA Guidance	42 U.S.C. Section 11001	Applicable	
Handbook on Management of Unexploded Ordnance at Closed, Transferring, and Transferred Ranges	EPA Guidance	March 2000 (Draft)	Applicable	
Resource Conservation and Recovery Act	EPA Guidance	42 U.S.C. Section 6901	Not Applicable	

**Table A-4
Federal Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Hazardous Waste Regulations*	EPA Guidance	Title 126	Applicable	
Emergency Planning & Community Right-to-Know and Contingency Planning Regulations (Reporting Requirements)	EPA Guidance	Title 126		
UXO Technicians and Personnel	Minimum qualifications	DDESB Technical Paper 18	Relevant and Appropriate	
DoD Contractors Safety Manual for Ammunition and Explosives	Department of Defense Guidance	DOD 4145.26M	Applicable	
Defense Demilitarization Manual	Department of Defense Guidance	DOD 4160.21-M-1	Relevant and Appropriate	The former VNTR is not located at a DOD Component. Demilitarization of live ordnance will follow the instructions provided.
Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges Within the United States	Department of Defense Guidance	DOD 4715.11	Applicable	
Ammunition and Explosives Safety Standards	Action involves a transfer of DOD lands.	DOD 6055.9-STD	Relevant and Appropriate	Remedial actions for the former VNTR include a transfer of DOD lands.
Safety and Occupational Health Policy for the Department of Defense	Actions taking place on DOD lands.	DOD Directive 1000.3	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations.
Solid Waste Management – Collection, Disposal, Resource Recovery, and Recycling Program	Actions taking place on DOD lands which include the generation of solid waste.	DOD Directive 4165.6	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations.

**Table A-4
Federal Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Transportation and Traffic Management	Actions taking place on DOD lands which create a significant traffic flow.	DOD Directive 4500.9	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations during construction.
Natural Resource Management Plan	Actions taking place on DOD lands.	DOD Directive 4700.4	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations
Archaeological and Historical Resources Management Plan	Actions taking place on DOD lands.	DOD Directive 4710.1	Applicable	An evaluation of the former VNTR will be conducted as necessary to determine any archeological or historical resources
Protection and Enhancement of Environmental Quality	Actions taking place on DOD lands.	DOD Directive 5100.5	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations
Environmental Effects in the United States of DOD Actions	Actions taking place on DOD lands.	DOD Directive 6050.1	Relevant and Appropriate	Remedial actions for the former VNTR will adhere to these regulations
Safety and Health Requirements for Hazardous, Toxic, and Radioactive Waste and Ordnance and Explosive Waste Activities	Actions which include a HTRW or OE site.	ER 385-1-92	Relevant and Appropriate	The former VNTR is not located on a USACE Command, but the requirements in this regulation for OE safety are relevant to these sites.
Military munitions response program oversight	Department of Defense Guidance	NOSSA 8020.15	Applicable	
Inter-service Responsibilities for Explosive Ordnance Disposal	US Navy and Department of the Army guidance	OPNAVINST 8027.1 AR 75-14	Applicable	
Interim Final Management Principles for Implementing Response Action at Closed, Transferring, and Transferred Ranges	OE Guidance Memoranda	December 19, 2000	Applicable	

**Table A-4
Federal Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Application of the Hazardous Waste Operations and Emergency Response Regulation to Ordnance and Explosives Sites	OE Guidance Memoranda	January 20, 1994	Applicable	
Coordination with the Ordnance and Explosives Center of Expertise (OE CX)	OE Guidance Memoranda	May 7, 1997	Applicable	
Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping	US Navy Guidance	NAVSEA OP 5 Vol 1	Applicable	
Navy Transportation Safety Handbook for Ammunition, Explosives, and Related Hazardous Materials	US Navy Guidance	NAVSEA OP 2165	Applicable	
Motor Vehicle Driver's Handbook, Ammunition, Explosives, and Related Hazardous Materials	US Navy Guidance	NAVSEA OP 2239	Applicable	
Demilitarization and Disposal of Excess, Surplus, and Foreign Excess Ammunition, Explosives and Other Dangerous Articles and Inert Ordnance Material	US Navy Guidance	NAVSEA 4570.1	Applicable	
DOD Ammunition and Explosives Hazard Classification Procedures Joint Technical Bulletin	US Navy Guidance	NAVSEAINST 8020.1H	Applicable	
Operational Risk Management (ORM)	US Navy Guidance	OPNAVINST 3500.39A	Applicable	

**Table A-4
Federal Action-Specific ARARs
For the Former VNTR, Vieques, Puerto Rico**

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Department of the Navy Explosives Safety Policy	US Navy Guidance	OPNAVINST 8020.14	Applicable	
U.S. Navy Explosives Safety Policies, Requirements, and Procedures	US Navy Guidance	OPNAVINST 8023.2	Applicable	
Navy Munitions Disposition Policy	US Navy Guidance	OPNAVINST 8026.2A	Applicable	
Responsibilities for Technical Escort of Dangerous Materials	US Navy Guidance	OPNAVINST 8070.1B	Applicable	
Responsibilities for Issuance and Administration of Waivers and Exemptions from Department of Defense Explosive Safety Standards	US Navy Guidance	SECNAVINST 8023.3C	Applicable	

Appendix B Cost Estimates

Table B-1
Detailed Cost Estimate
Alternative 2
Former VNTR SIA EE/CA
Vieques, Puerto Rico

Item	Quantity	Units	Unit Cost	Adjustment*	Subtotal
1 EXPENSES AND CONSUMABLES					
1.1 Per diem - meals (assuming 14 person team)	582	day	\$57.00	14	\$464,094
1.2 Per diem - lodging	582	day	\$60.00	14	\$488,520
1.3 Transportation	582	day	\$60.00	5	\$174,471
1.4 Schondstet (UXO Support)	4	each	\$1,100.00	1	\$4,400
1.6 Daily Consumables	582	day	\$55.00	1	\$31,986
1.7 Health and Safety Consumables	582	day	\$55.00	1	\$31,986
2 MOBILIZATION/DEMOBILIZATION AND SITE SETUP					
2.1 Mobilization	1	ea	\$65,000.00	1	\$65,000
2.2 Demobilization	1	ea	\$15,000.00	1	\$15,000
2.4 Flora and Avian Habitat Survey	100	ac	\$400.00	1	\$40,000
3 Fencing and Signs					
3.1 10' ft tall fencing (approximately 32,000 linear feet)	48300	foot	\$57.00	1	\$2,753,100
3.2 3 strand barbed wire (approximately 96,000 linear feet)	144900	foot	\$8.00	1	\$1,159,200
3.3 Installation of 30 Road Gates	30	ea	\$2,600.00	1	\$78,000
3.4 Signs	480	ea	\$315.00	1	\$151,200
3.5 Vegetation Clearance	10	ac	\$3,800.00	1	\$38,000
4 UXO Support					
4.1 MEC Avoidance Support	582	day	\$2,300.00	4	\$5,350,457
5 Operations and Maintenance (5 Yr)					
5.1 Per diem - meals (assuming 7 person team)	20	days/yr	\$57.00	35	\$39,900
5.2 Per diem - lodging	20	days/yr	\$60.00	35	\$42,000
5.3 Transportation	20	days/yr	\$60.00	15	\$18,000
5.4 Schondstet (UXO Support)	2	ea/yr	\$1,100.00	5	\$11,000
5.6 Daily Consumables	20	days/yr	\$55.00	5	\$5,500
5.7 Health and Safety Consumables	20	days/yr	\$55.00	5	\$5,500
5.1 Mobilization	1	ea/yr	\$25,000.00	5	\$125,000
5.2 Demobilization	1	ea/yr	\$5,000.00	5	\$25,000
5.1 10' ft tall fencing (approximately 1000 linear feet/year)	1000	ft/yr	\$57.00	5	\$285,000
5.2 3 strand barbed wire (approximately 3000 linear feet/year)	3000	ft/yr	\$8.00	5	\$120,000
5.3 Installation of 5 Road Gates/yr	5	ea/yr	\$2,600.00	5	\$65,000
5.4 Installation of 50 signs/yr	50	ea/yr	\$315.00	5	\$78,750
5.1 MEC Avoidance Support	20	days/yr	\$2,300.00	5	\$230,000
Subtotal					\$11,896,065
Project Management	8%				\$951,685
Remedial Design	15%				\$1,784,410
Construction Management	10%				\$1,189,607
Contingency	25%				\$2,974,016
TOTAL COST					\$ 18,795,783
Upper Limit of Cost Accuracy	150%				\$28,193,675
Lower Limit of Cost Accuracy	70%				\$13,157,048

Table B-2
Detailed Cost Estimate
Alternative 3
Former VNTR SIA EE/CA
Vieques, Puerto Rico

Item	Quantity	Units	Unit Cost	Adjustment*	Subtotal
1 EXPENSES AND CONSUMABLES					
1.1 Per diem - meals (assuming 10 person team)	467	day	\$57.00	30	\$798,000
1.2 Per diem - lodging	467	day	\$60.00	30	\$840,000
1.3 Transportation	467	day	\$60.00	20	\$560,000
1.4 Equipment	93	wk	\$8,000.00	1	\$746,667
2 MOBILIZATION/DEMOBILIZATION AND SITE SETUP					
2.1 Mobilization	1	ea	\$75,000.00	1	\$75,000
2.2 Demobilization	1	ea	\$50,000.00	1	\$50,000
2.3 Crew Rotation	16	ea	\$25,000.00	1	\$400,000
2.4 Flora and Avian Habitat Survey	300	ac	\$400.00	1	\$120,000
3 SURFACE CLEARANCE					
3.1 Surface Clearance	700	ac	\$12,000.00	1	\$8,400,000
3.2 Demilitarization/Venting	49	day	\$9,000.00	1	\$437,143
4 DEMILITARIZATION OF MEC ITEMS					
4.1 MD/RRD Processing	3900	ton	\$1,300.00	1	\$5,070,000
Subtotal					\$17,496,810
Project Management	8%				\$1,399,745
Remedial Design	15%				\$2,624,521
Construction Management	10%				\$1,749,681
Contingency	25%				\$5,817,689
TOTAL COST					\$29,088,446
Upper Limit of Cost Accuracy	150%				\$43,632,669
Lower Limit of Cost Accuracy	70%				\$20,361,912