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FINAL ENGINEERING EVALUATION COST ANALYSIS FOR A NON TIME CRITICAL
INTERIM REMOVAL ACTION UNEXPLODED ORDNANCE 15 (UXO 15) PHOTO IDENTIFIED
9 (PI 9) EAST AND ADJACENT UNEXPLODED ORDNANCE 16 (UXO 16) ENCRUSTED
MUNITIONS ATLANTIC FLEET WEAPONS TRAINING AREA FORMER VIEQUES NAVAL
TRAINING RANGE VIEQUES ISLAND PUERTO RICO

07/01/2015
CH2M HILL

Final

**Engineering Evaluation/Cost Analysis
for a Non-Time Critical Interim Removal Action
UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions**

**Atlantic Fleet Weapons Training Area—Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico**

Contract Task Order 019

July 2015

Prepared for

**Department of the Navy
Naval Facilities Engineering Command
Atlantic**

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**NAVFAC CLEAN 8012 Program
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Prepared by



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Executive Summary

This Engineering Evaluation/Cost Analysis (EE/CA) report presents the evaluation of interim removal action alternatives for a non-time critical removal action (NTCRA) to reduce the explosive hazard associated with encrusted potential munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) identified at Photo Identified (PI) 9 East in UXO 15 and within UXO 16 immediately adjacent to PI-9 East, located at the former Vieques Naval Training Range (VNTR), Vieques, Puerto Rico. This NTCRA will reduce the explosive hazard associated with the encrusted items in the near-term, and ultimately support the final remedy selection for the site via the full Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The following removal action alternatives were evaluated in this EE/CA:

- Alternative 1 – No Action

Alternative 1 consists of performing no interim removal action and serves only as a baseline to which to compare to the other alternative; it is not a viable option considered for the site.

- Alternative 2 – Recovery and Disposal

Alternative 2 consists primarily of physical removal of the encrusted items (either manually or through remotely operated equipment) and transport to a location to be demilitarized. This alternative includes a pre-removal inspection to evaluate the conditions of the encrusted items and to determine whether manually moving or dislodging the items is safe, and also a biological evaluation to determine what, if any, impacts there may be to sea life as a result of the NTCRA.

This EE/CA includes detailed descriptions, evaluations, and comparative analysis of the alternatives listed above. Based on the evaluation process, Alternative 2 – Recovery and Disposal is recommended as the removal action alternative. Since this NTCRA is only an interim removal action for UXOs 15 and 16, the full CERCLA process will continue to evaluate the nature and extent of contamination, potential risks to human health and the environment, and develop and evaluate site-wide remedial alternatives to mitigate unacceptable risks and explosive hazards, if present.

NOTE: THIS SUMMARY IS PRESENTED IN ENGLISH AND SPANISH FOR THE CONVENIENCE OF THE READER. EVERY EFFORT HAS BEEN MADE FOR THE TRANSLATIONS TO BE AS ACCURATE AS REASONABLY POSSIBLE. HOWEVER, READERS SHOULD BE AWARE THAT THE ENGLISH VERSION OF THE TEXT IS THE OFFICIAL VERSION.

NOTA: ESTE RESUMEN SE PRESENTA EN INGLÉS Y EN ESPAÑOL PARA LA CONVENIENCIA DEL LECTOR. SE HAN HECHO TODOS LOS ESFUERZOS PARA QUE LA TRADUCCIÓN SEA PRECISA EN LO MÁS RAZONABLEMENTE POSIBLE. SIN EMBARGO, LOS LECTORES DEBEN ESTAR AL TANTO QUE EL TEXTO EN INGLÉS ES LA VERSIÓN OFICIAL.

Resumen Ejecutivo

Este reporte de Evaluación de Ingeniería/Análisis de Costos (EE/CA, por sus siglas en inglés) presenta la evaluación de las alternativas de acción de remoción interinas para una acción de remoción de tiempo no-critico (NTCRA por sus siglas en inglés) con el propósito de reducir el peligro de explosión asociado con municiones potenciales incrustadas y explosivos de preocupación (MEC, por sus siglas en inglés)/material que potencialmente presenta peligro de explosión (MPPEH, por sus siglas en inglés) identificados en Foto Identificado (PI, por sus siglas en inglés) 9 Este en UXO 15 y dentro de UXO 16 inmediatamente adyacente a PI-9 Este, localizado en el antiguo Campo de Adiestramiento Naval de Vieques (VNTR, por sus siglas en inglés), Vieques, Puerto Rico. Este NTCRA reducirá el peligro de explosión asociado con los artículos incrustados a corto plazo, y últimamente apoyará la selección del remedio final para el sitio a través del proceso completo de la Ley de Respuesta, Compensación y Responsabilidad Ambiental (CERCLA).

Las siguientes alternativas de acción de remoción fueron evaluadas en este EE/CA:

- Alternativa 1 – Ninguna Acción

La Alternativa 1 consiste en no llevar a cabo una acción de remoción interina y sirve solamente como base para comparar las otras alternativas; no se considera una opción viable para el sitio.

- Alternativa 2 – Recuperación y Disposición

La Alternativa 2 consiste primordialmente de la remoción física de los artículos incrustados (ya sea manualmente o a través de equipo manejado remotamente) y su transportación a otra localización para ser desmilitarizados. Esta alternativa incluye una inspección pre-remoción para evaluar las condiciones de los artículos incrustados y para determinar si es seguro mover manualmente o desalojar los artículos, y también una evaluación biológica para determinar cuáles impactos, si alguno, habrían a la vida marina como resultado del NTCRA.

Este EE/CA incluye descripciones, evaluaciones y análisis comparativos detallados de las alternativas mencionadas arriba. Basado en el proceso de evaluación, la Alternativa 2 – Recuperación y Disposición es recomendada como la alternativa de acción de remoción. Ya que este NTCRA es solamente una acción de remoción interina para los UXOs 15 y 16, el proceso completo de CERCLA continuará para evaluar la naturaleza y la extensión de la contaminación, riesgos potenciales a la salud humana y del ambiente, y desarrollar y evaluar alternativas de remediación para todo el sitio para mitigar riesgos inaceptables y riesgos de explosión, si estuvieran presentes.

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- 2-4 Coral Cover in Puerto Ferro
- 2-5 Extent of Encrusted Items

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Acronyms and Abbreviations

ac	acre
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	control of erosion and sediment
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action—Navy
CTO	Contract Task Order
cy	cubic yard
dba	decibels
DNER	Puerto Rico Department of Natural and Environmental Resources
DOI	Department of the Interior
EA	each
ECA	Eastern Conservation Area
EE/CA	Engineering Evaluation/Cost Analysis
EMA	Eastern Maneuver Area
EPA	Environmental Protection Agency
ERA/SI	Expanded Range Assessment/Site Inspection
ERP	Environmental Restoration Program
ft	feet/foot
ft ²	square feet
hr	hour
IC	institutional control
IRP	Installation Restoration Program
LIA	Live Impact Area
LS	lump sum
LUC	land use control
m	meter
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
MSL	mean sea level
NASD	Naval Ammunition Support Detachment
NAVFAC	Naval Facilities Engineering Command, Atlantic Division
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NCP	National Contingency Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NTCRA	non-time critical removal action
OP	operational procedure
PI	Photo Identified
PREQB	Puerto Rico Environmental Quality Board

RAO	removal action objective
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROV	remotely operated vehicle
SARA	Superfund Amendments and Reauthorization Act
SIA	Surface Impact Area
US	United States
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
VNTR	Vieques Naval Training Range

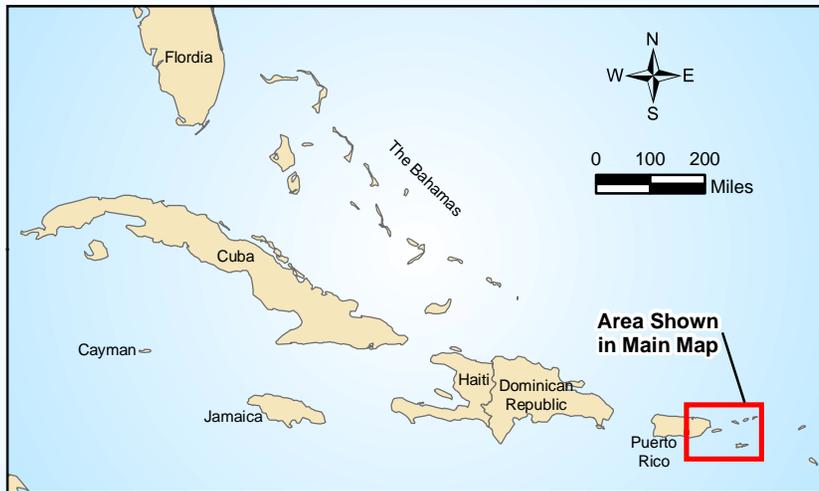
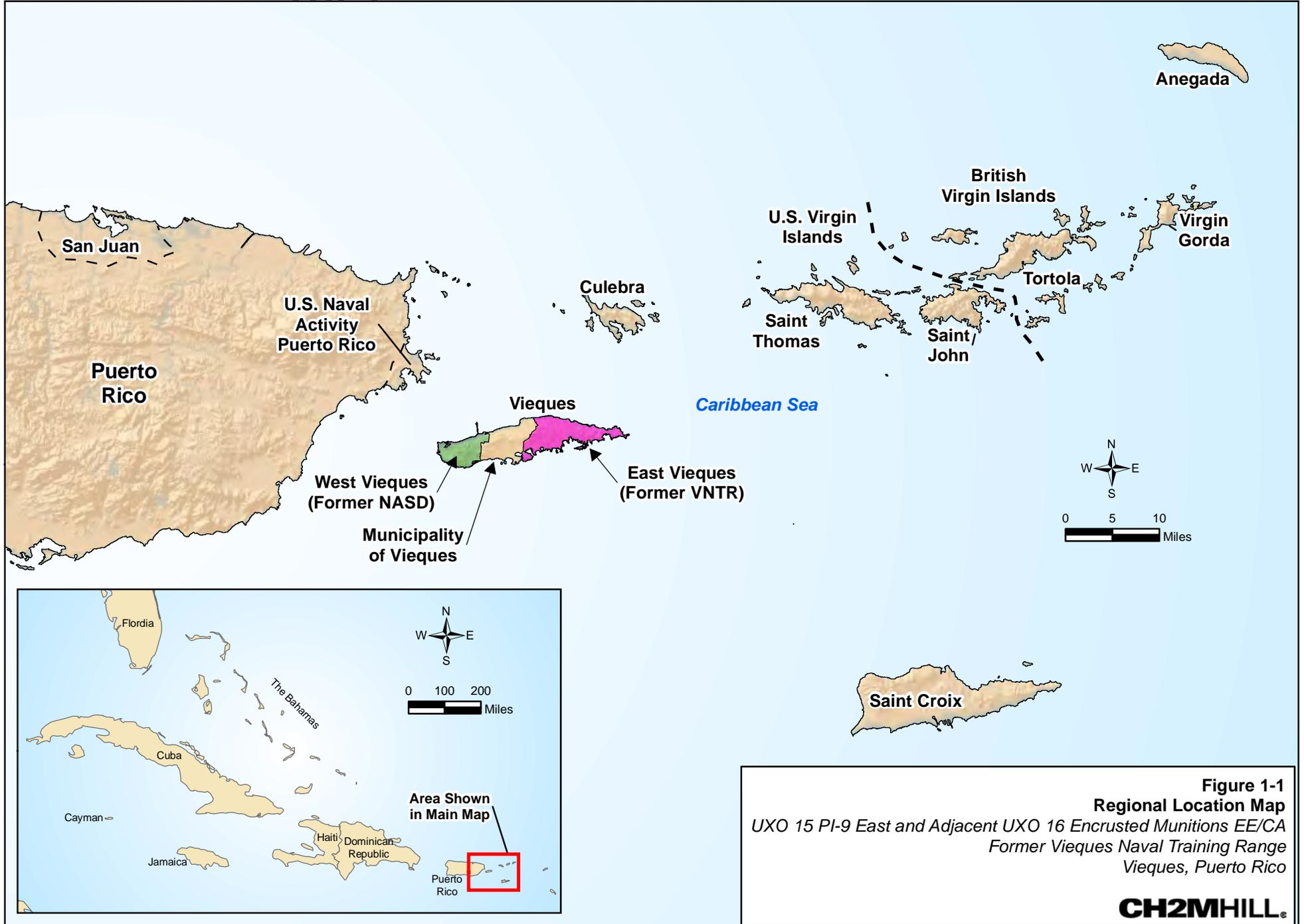
SECTION 1

Introduction

This Engineering Evaluation/Cost Analysis (EE/CA) report presents the evaluation of interim removal action alternatives for a non-time critical removal action (NTCRA) to reduce the explosive hazard associated with encrusted potential munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) identified at Photo Identified (PI)-9 East in UXO 15 and within UXO 16 immediately adjacent to PI-9 East, located at the former Vieques Naval Training Range (VNTR), Vieques, Puerto Rico (**Figures 1-1 and 1-2**). This NTCRA will reduce the explosive hazard associated with the encrusted items in the near-term, and ultimately support the final remedy selection for the site via the full Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

This document was prepared under the Naval Facilities Engineering Command, Atlantic Division (NAVFAC), Comprehensive Long-term Environmental Action—Department of the Navy (Navy) (CLEAN) 8012 Contract N62470-11-D8012, Contract Task Order (CTO) 005, for submittal to NAVFAC, the United States (US) Environmental Protection Agency (EPA) Region 2, the Commonwealth of Puerto Rico Environmental Quality Board (PREQB), the United States Fish and Wildlife Service (USFWS), and the Puerto Rico Department of Natural and Environmental Resources (DNER). NAVFAC, EPA, PREQB, USFWS, and DNER work jointly as the Vieques CERCLA Environmental Restoration Program (ERP) Technical Subcommittee. In addition, since UXO 16 includes the offshore areas of Vieques, the National Oceanographic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS) are included in the consideration of interim removal alternatives.

This document was prepared following EPA's guidance provided in document 540/R93/057 *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993). Submittal of this document fulfills the requirements for an NTCRA defined by CERCLA, Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substance Pollution Contingency Plan (National Contingency Plan) (NCP). This document was prepared to ensure it contains the information pertinent to an EE/CA, but in a format that facilitates an expedited review process and allows for the expedited mitigation of the potential explosive hazard associated with the potential MEC/MPPEH items.





UXO 15 Boundary

PI-9 West

PI-9 East

Main Access Road

PI-13

Encrusted Munitions

Lighthouse Area

- Legend**
- PI Areas
 - UXO 15

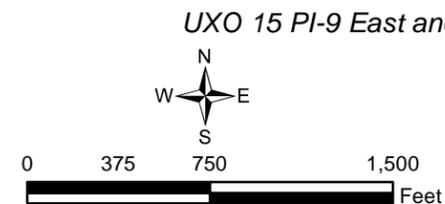


Figure 1-2
UXO 15 Site Features
 UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
 Former Vieques Naval Training Range
 Vieques, Puerto Rico

Site Characterization

2.1 Site Description and Background

- Vieques is located in the Caribbean Sea and, other than mainland Puerto Rico, it is the largest island of the Commonwealth of Puerto Rico; it is approximately 20 miles long and 4.5 miles wide (**Figure 1-1**).
- The former VNTR is situated in the eastern half of Vieques and is bordered on the west by the community of Isabel Segunda, to the north by Vieques Sound, and to the south by the Caribbean Sea. The former VNTR consists of approximately 14,500 acres that were divided operationally into four Munitions Response Areas that (from west to east) comprise: the 10,673-acre Eastern Maneuver Area (EMA); the 2,500-acre Surface Impact Area (SIA); the 900-acre Live Impact Area (LIA), and the 200-acre Eastern Conservation Area (ECA) on the easternmost tip of Vieques (CH2M HILL, 2010) (**Figure 1-2** inset).
- The EMA, which includes UXO 15, was established in 1947 and provided maneuvering areas and ranges for the training by Marine amphibious units and battalion landing teams in exercises that included amphibious landings, small-arms fire, artillery and tank fire, shore fire control, and combat engineering tasks.
- UXO 15 is approximately 535 acres, located in the western portion of the EMA, and includes PI Sites 9 (East and West) and 13 (**Figure 1-2**). PI-9 was likely used for ammunition storage and possibly ammunition disposal based on historical information and aerial photographs. PI-13 may have been the firing point from which long-range artillery was launched to the LIA/SIA, but recent investigations have found no evidence of this use.
- UXO 16 is approximately 11,500 acres and includes the underwater areas adjacent to the range and operational areas on East and West Vieques that are known or suspected to have been impacted by MEC. This NTCRA only addresses the encrusted items immediately adjacent to PI-9 East.
- The former VNTR was transferred to the Department of the Interior (DOI) in 2003 to be operated and managed by the USFWS as a National Wildlife Refuge. The terrestrial areas are currently managed and protected as a wildlife refuge by USFWS and access to the restricted areas is discouraged by fences, landscape features (i.e., dense vegetation) and/or signage. The public is currently restricted from accessing the entirety of UXO 15, but an NTCRA was recently conducted along the main road leading through the site and the historic lighthouse and adjacent beach to facilitate near-term public access to these areas.

2.2 Physical Characteristics

2.2.1 UXO 15

- Most of UXO 15 is characterized as rocky land where rock outcrops of limestone and dolomite occur in the topographically elevated areas (**Figure 2-1**). Loose stones with very shallow soil are found between the outcrops. PI-9 additionally contains tidal flats and a tidal swamp. The tidal flats are slightly above sea level, are affected by sea water at high tide, and likely have a high salt concentration. The tidal swamp is covered with thick mangroves and immersed in salt water the majority of the year.
- The vegetative communities across much of UXO 15 consist of dense evergreen scrub and dry scrub forest, as well as areas of mixed native/naturalized and invasive vegetation, with entirely invasive vegetation occurring in areas of historic habitat disturbance. There is also an extensive area of exposed limestone/dolomite with scarce vegetation. At lower elevations along the north and west sides of the peninsula there are extensive areas of mangrove forest and pockets of secondary growth forest.

- Surface water bodies bound three sides of UXO 15. Puerto Mosquito is located to the west and Puerto Ferro to the east. The ocean is to the south. There is also a small lagoon between the two PI-9 areas, a small lagoon in the southwest portion of UXO 15, and a small lagoon in the northern portion of the site (**Figure 1-2**).
- Groundwater likely exists primarily in bedrock and discharges to the large lagoons to the east and west and ocean to the south.

2.2.2 UXO 16

- The circulation patterns in the Greater Antilles region are dominated by the westward-directed North Equatorial Current. Nearshore currents are variable, with flood and ebb tidal currents varying in speed and directions in different areas. These currents are also influenced by the prevailing northeasterly trade winds and tidal flow (Bauer et al., 2008).
- The tides of the Caribbean Sea are mostly mixed, with two unequal occurrences of high and low water in each tidal day. Some areas exhibit primarily semi-diurnal tides and other areas are dominated by diurnal tides. At Isabel Segunda on the north side of the island, the mean tidal range is 0.25 meters (m) and the diurnal tide range is 0.38 m. Esperanza on the south side of Vieques exhibits a mean tidal range of 0.21 m and a diurnal range of 0.22 m.
- The wave climate around Vieques consists of easterly 1 to 2 m high waves with periods in the range of five to ten seconds, generated by the predominant trade winds. As these waves approach the coast they are transformed due to the proximity of the bottom, refracting and gradually aligning their fronts with the depth contours, and shoaling and breaking in shallow water.
- Puerto Ferro is a natural, generally shallow (2 to 3 m mean sea level [MSL]) deep bay, featuring a low shoreline consisting of mangroves. It is connected to the sea through an approximately 850 m long, 250 m wide natural channel, oriented in a northwest-southeast direction. The channel is sided by rocky shores with few sandy pockets on each side which slope up to 20 m and 30 m high headlands to the east and west, respectively. Just offshore Puerto Ferro, the bottom is approximately 8 m MSL deep, and gently slopes up to a 3 m MSL deep shoal midway in the channel, to then drop into a 4 to 5 m MSL deep depression in the center the bay. In the area of the encrusted items, water depths are less than about 1 m (**Figure 2-2**). Water visibility in the area is generally clear, but can be affected by sea conditions.
- NOAA conducted benthic habitat mapping of the waters surrounding Vieques in 2009 (Bauer and Kendall, 2010). Seagrass is the dominant biological cover type in the underwater area adjacent to PI-9 East (90-100 percent), with coral present in less than ten percent of the seafloor cover in the area (**Figures 2-3 and 2-4**). The proximity of coral to the encrusted items is not documented, but the potential association between the munitions and coral is accounted for in the alternatives evaluation and will be appropriately addressed as part of the interim action.

2.3 Previous Investigations and Nature and Extent of MEC Contamination

Several investigations relevant to PI-9 East and UXO 16 immediately adjacent to PI-9 East have taken place. The investigations include:

- A Preliminary Range Assessment of the former VNTR (CH2M HILL, 2003) identified PI-9 as a potential munitions response site based on aerial photograph analysis (ERI, 2000).
- The Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report recommended PI-9 for further evaluation under the Munitions Response Program (MRP) (CH2M HILL, 2004).
- The Expanded Range Assessment/Site Inspection (ERA/SI) identified munitions-related items encrusted in the rock in the eastern portion of PI-9. The ERA/SI recommended further investigation of the encrusted munitions-related items.

- An underwater investigation of the encrusted items adjacent to PI-9 East was conducted in June 2010 to evaluate the lateral extent of the items. The investigation was conducted using a remotely operated vehicle (ROV) equipped with a live-feed video camera that followed transects throughout an approximate 0.7 acre-area adjacent to approximately 300 feet of the shoreline that extended approximately 100 feet into Puerto Ferro (**Figure 2-5**). The ROV survey results indicated that the encrusted items are limited to the immediate vicinity of where they are proud of the water surface during low tide (approximately 2,600 square feet [ft²] or 0.06 acres) (USAE, 2010).
- A Remedial Investigation (RI) was initiated in 2012 that included, among other tasks, characterizing the extent of the encrusted munitions-related items in PI-9 East, which was determined to be approximately 0.25 acres (**Figure 2-5**).

2.4 Evaluation of Risk

- MEC/MPPEH pose a potential explosive hazard to potential human receptors within the NTCRA area, from activities such as refuge management activities by USFWS, trespassing, swimming/snorkeling/diving, boating, and fishing. The potential explosive hazard presented by the MEC/MPPEH to ecological receptors is negligible; however, impacts of the NTCRA activities to threatened and endangered species, habitats, and sea life will be considered and mitigated as necessary, in accordance with a biological assessment and associated biological opinion, or alternative approach deemed acceptable by USFWS, DNER, and/or NMFS, that will be developed to support this NTCRA.



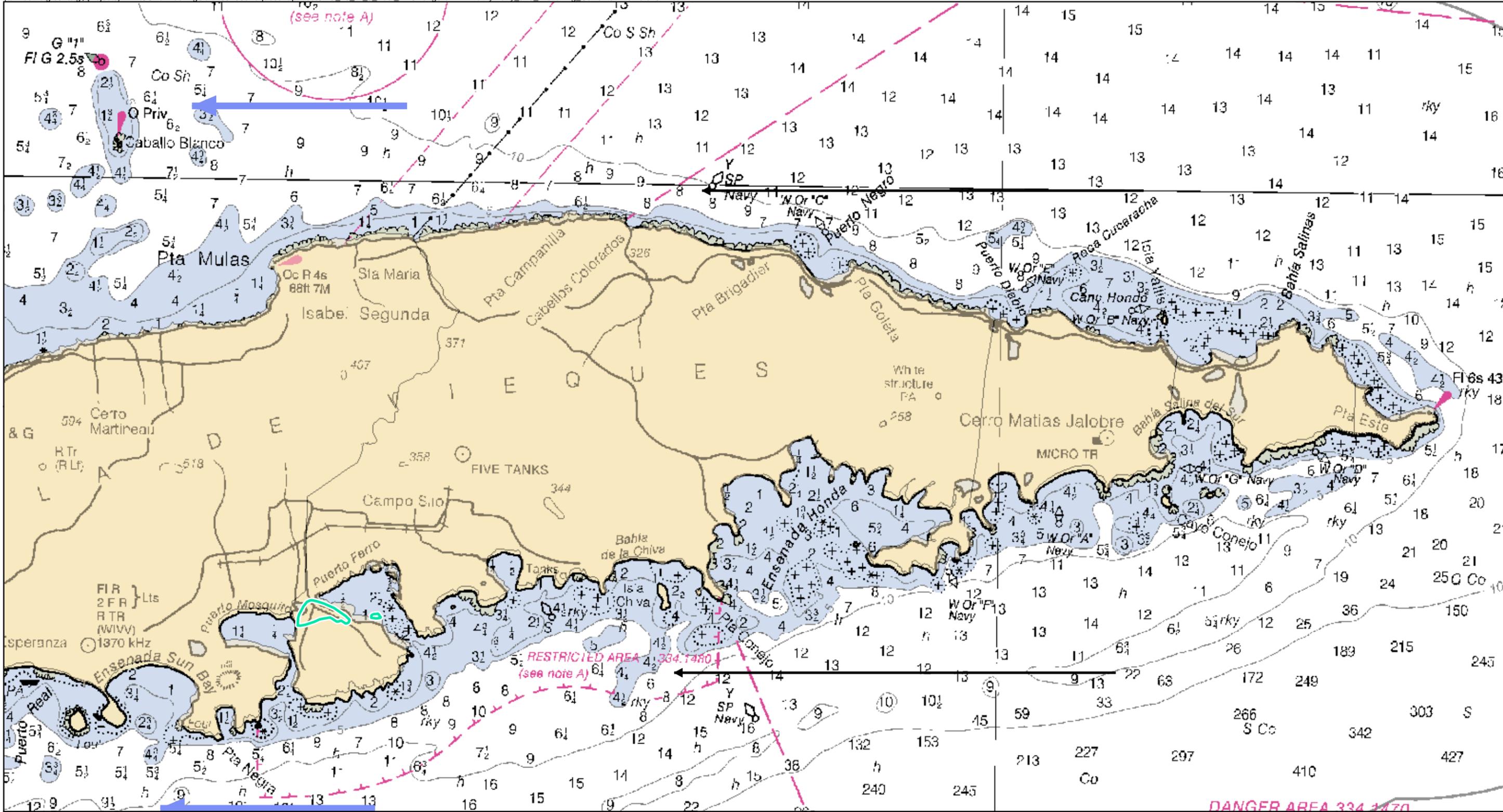
Legend

- Topographic Contours (5 Meter)
- Orange Outline UXO 15
- Yellow Outline PI Site

Notes:
 Topographic Conours from USGS.
 USGS contours are mean sea level.



Figure 2-1
UXO 15 Topographic Map
 UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
 Former Vieques Naval Training Range
 Vieques, Puerto Rico



- Legend**
- Prevailing Winds
 - Prevailing Currents
 - PI 09

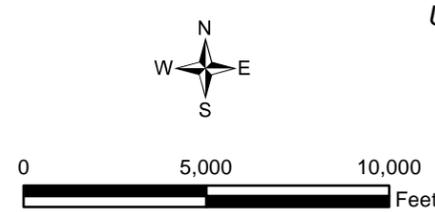


Figure 2-2
Bathymetry and Prevailing Currents
 UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
 Former Vieques Naval Training Range
 Vieques, Puerto Rico

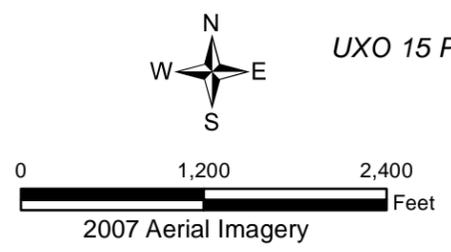
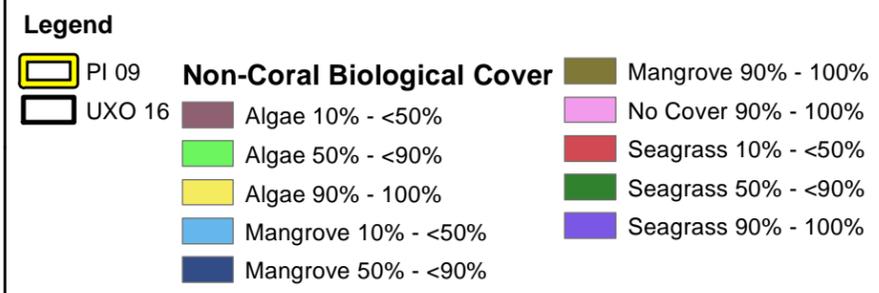
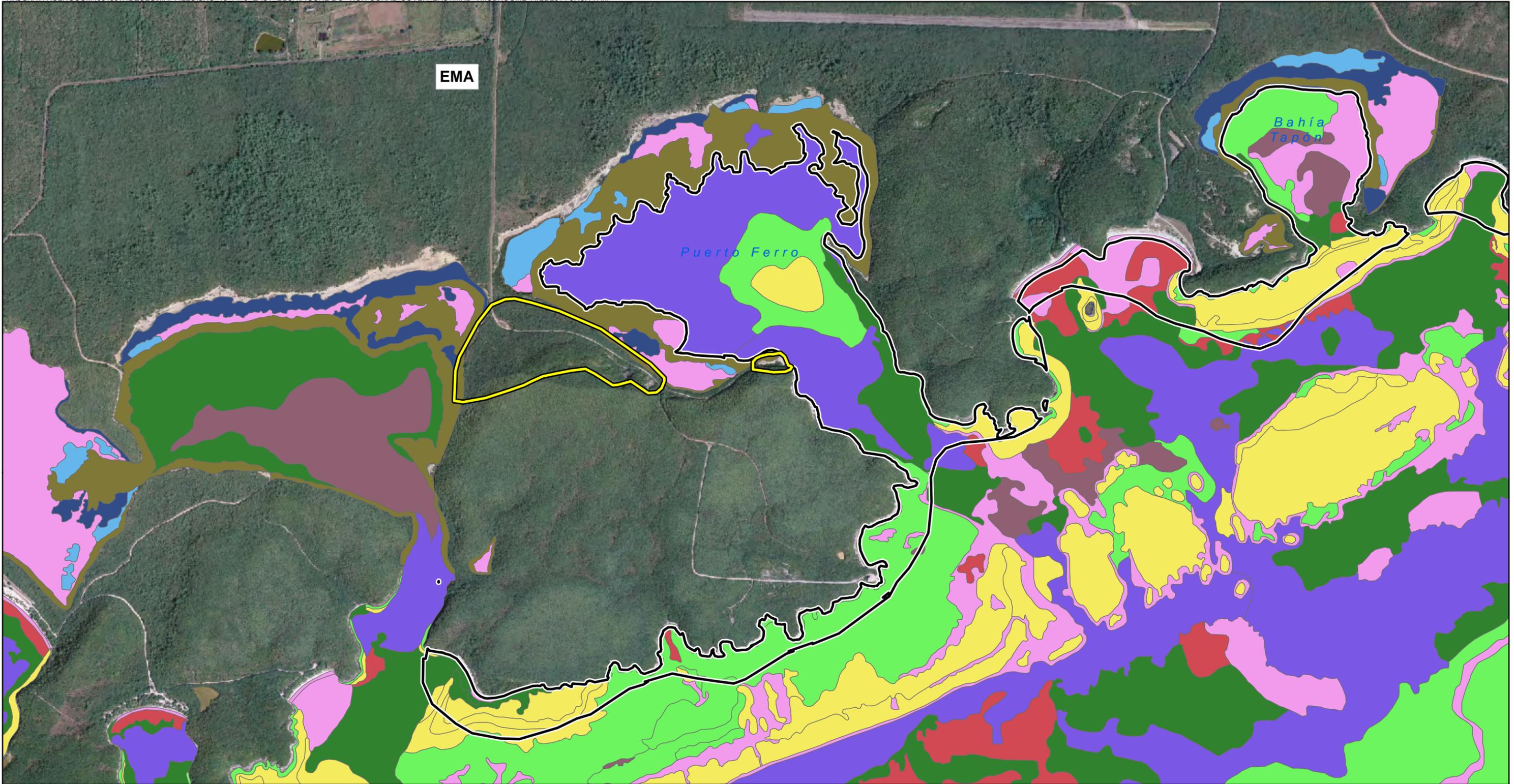


Figure 2-3
Non-Coral Biological Cover in Puerto Ferro
 UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
 Former Vieques Naval Training Range
 Vieques, Puerto Rico

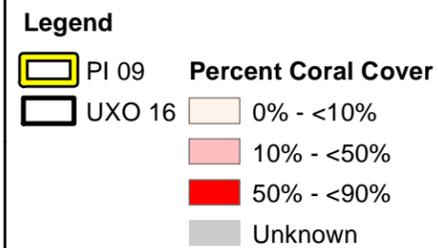
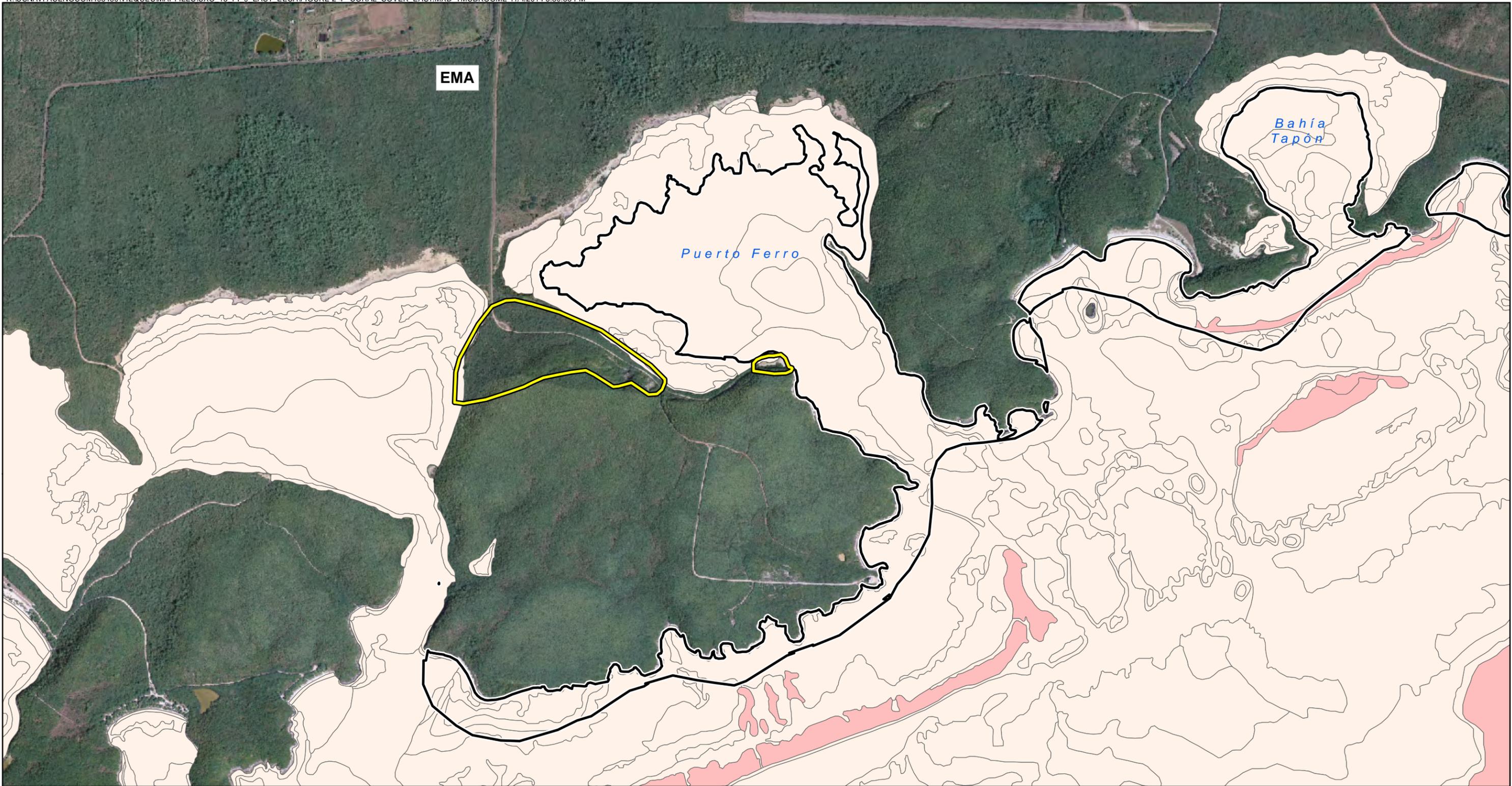
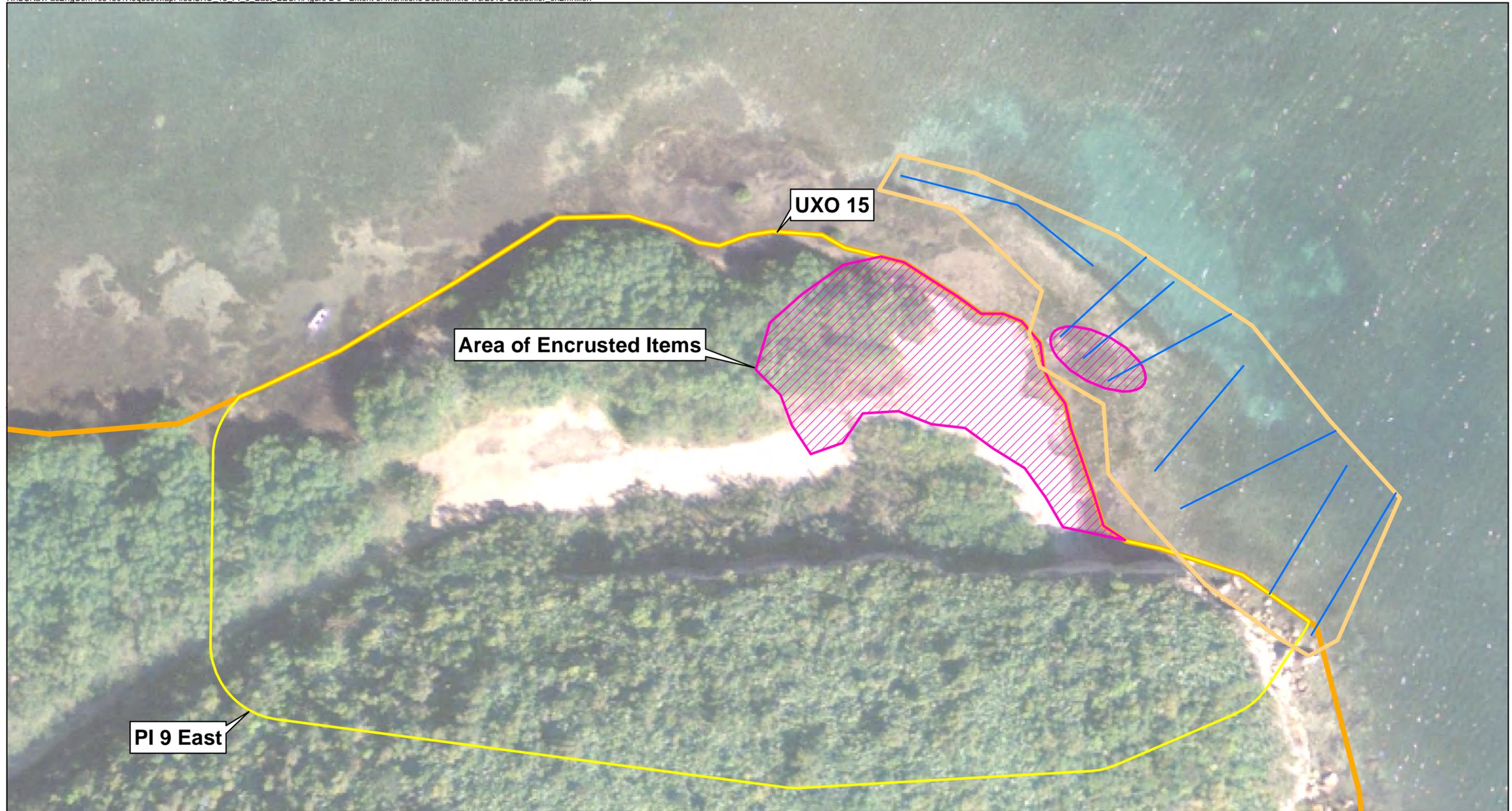


Figure 2-4
Coral Cover in Puerto Ferro
 UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
 Former Vieques Naval Training Range
 Vieques, Puerto Rico



- Legend**
- Transects
 - Surveyed Area
 - Extent of Encrusted Items
 - PI Site
 - UXO15

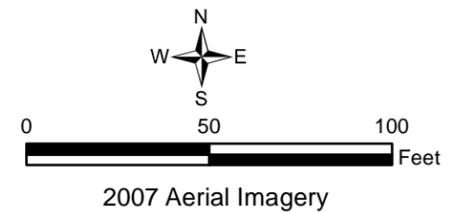


Figure 2-5
Extent of Encrusted Items
UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA
Former Vieques Naval Training Range
Vieques, Puerto Rico

Removal Action Objectives and Scope

3.1 Statutory Limits on Removal Actions

This removal action will not be EPA fund-financed. The Navy/Marine Corps Installation Restoration Program (IRP) Manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives.

3.2 Applicable or Relevant and Appropriate Requirements

The selected removal action will comply with applicable or relevant and appropriate requirement (ARARs) under federal and Puerto Rico laws. **Appendix A** contains the ARAR tables and provides a summary of each potentially related environmental and munitions regulation. Other federal and Puerto Rico advisories, criteria, or guidance will be considered, as appropriate, in formulating the removal action.

3.3 Removal Action Objective and Scope

The goal of this EE/CA and subsequent interim removal action is to accelerate the process through which the explosive hazard associated with potential MEC/MPPEH at PI-9 East and UXO 16 immediately adjacent to PI-9 East is reduced while the sites as a whole continue through the full CERCLA process. The site-specific removal action objective (RAO) for this NTCRA is:

- Reduce the potential explosive hazard associated with potential MEC/MPPEH encrusted at PI-9 East and in UXO 16 immediately adjacent to PI-9 East (**Figure 2-5**).

3.4 Determination of Removal Action Schedule

The EE/CA will be placed in the Administrative Record and notice of its availability for public review along with a brief summary will be published in the local newspaper. The EE/CA will then be available for a 45-day public comment period. Following the public comment period, a Responsiveness Summary will be prepared (if substantive comments are received) that summarizes responses to substantive comments that will also be included in the Administrative Record. Since this removal action has been designated non-time-critical, the start date will be initiated following the resolution of the comments.

The total project period is anticipated to require a few months, including preparation and implementation of the selected interim removal action. The interim removal action is anticipated to begin in mid-2016 and be completed by the end of the calendar year. However, the actual start date and duration will be dependent on a number of factors, including preparation and approval of the interim removal action work plan, completion of the biological survey and biological assessment (or other approved method), weather, and availability of resources. Critical milestone periods related to the EE/CA are summarized below:

- EE/CA Public Comment Period—45 days
- Material procurement and site preparation—less than one month
- NTCRA — approximately one to two months

Identification and Detailed Analysis of Removal Action Alternatives

4.1 Removal Action Alternatives Description

Based on the information provided in Section 2 and RAO presented in Section 3, the following removal action alternatives have been considered for detailed evaluation:

1. No Action
2. Recovery and Disposal

A description of each of these alternatives is provided below. During preparation of the EE/CA, the Technical Subcommittee, comprising representatives from the Navy and regulatory agencies, discussed the various alternatives to consider. Because the munitions items may be readily accessible by the public (especially those just offshore) an alternative solely consisting of land use controls (LUCs) and institutional controls (ICs) would not meet the interim removal action RAO. Similarly, an alternative consisting of encapsulating the encrusted items in concrete was considered but ultimately rejected for further evaluation, as that would result in a relatively wide-scale permanent remedy requiring public input (encapsulation has been evaluated as part of addressing individual items but not for large areas); the Technical Subcommittee concurred that encapsulation of the area with encrusted items would not be included in the evaluation and, if in the execution of this NTCRA, an item cannot be excavated or detonated then the item will be left in place to be addressed as part of the final remedy for the impacted areas.

Alternative 2 includes a pre-NTCRA inspection to evaluate the condition of the encrusted items. As possible, the unexploded ordnance (UXO) team will inspect all of the encrusted items to determine whether manually moving or dislodging the items is safe. In addition, the UXO team will inspect the seafloor in the immediate vicinity of the UXO 16 encrusted items identified on **Figure 2-5** with underwater metal detectors to confirm the extent of the items. In addition, prior to any removal activities, a biological assessment (or other process deemed appropriate by NMFS, USFWS, and/or DNER) will be conducted in the project area to determine what, if any, impacts there will be to sea life as a result of the NTCRA. The details of the biological assessment (or other approved process) and associated mitigation measures will be included in the associated Interim Removal Action Work Plan, which will be prepared following completion of the EE/CA. The impact mitigation approaches identified in the biological assessment (or other process as identified above) will be employed during the NTCRA.

Because the items are encrusted together in masses, the alternative selected for the items in the land and in the water will be applied to all items in that media. For example, if recovery and disposal is selected for the terrestrial munitions items, it will be applied to all terrestrial munitions items. Likewise, if recovery and disposal is selected for the offshore munitions items, it will be applied to all offshore munitions items.

4.1.1 Alternative 1—No Action

The no action alternative consists of leaving the site as it currently is, with no LUCs.

4.1.2 Alternative 2—Recovery and Disposal

Alternative 2 would consist of MEC removal and disposal following approaches similar to those used for the MEC removal actions throughout the former VNTR and Naval Ammunition Support Detachment (NASD), including mobilization and demobilization, biological evaluations, vegetation clearance, MEC removal to an estimated depth of 1 foot below ground surface (bgs), and demilitarization of recovered MEC items.

The encrusted items at the site would be removed, manually or through remotely operated equipment, from their current location and transported to a (terrestrial) location for destruction. Because the items are encrusted and relatively immobile, it is assumed that the items can only be freed from their current locations through physically chipping away the materials holding them in place or otherwise applying force to dislodge them from

the surrounding media/larger mass of items. The details of the removal (e.g., path through which the items will be transported and the location where they will be destroyed) will be presented in the Interim Removal Action Work Plan, which will be prepared following completion of the EE/CA process. The removed items would be destroyed/demilitarized using the practices currently followed for the terrestrial munitions response activities on Vieques. Erosion control measures may comprise/include those assumed as part of this EE/CA for cost estimating purposes, but ultimately will be determined during preparation of the NTCRA Work Plan.

The major components and assumptions for Alternative 2 are:

- Vegetation clearance with anomaly avoidance support conducted to establish the NTCRA area and provide sufficient access to the ground surface to investigate and remove munitions items/anomalies. The vegetative community within the investigation area primarily consists of mangroves (red mangrove [*Rhizophora mangle*], white mangrove [*Laguncularia racemosa*], and black mangrove [*Avicennia germinans*]), buttonwood (*Conocarpus erectus*), and portia tree (*Thespesia populnea*). The cut vegetation will be managed in a manner similar to how vegetation is managed for other removal actions conducted at the former VNTR. The extent practicable, the cut vegetation will be spread and not left in piles
- A technology-aided MEC removal would be conducted to remove potential MEC/MPPEH from the ground surface and up to an assumed depth of 1 foot bgs in the subsurface. This depth is assumed due to the proximity to the ocean; however, the actual depth will be actual depth of munitions items encountered.
- Site restoration of the terrestrial area will consist of re-grading to eliminate fall hazards following the MEC removal activities; terrestrial areas will not be subject to any active planting or other restoration by the Navy. Threatened or endangered resources or associated critical habitats damaged during the interim removal action will be restored, as appropriate, in accordance with the biological assessment (or other process deemed acceptable by the associated agencies). In wetland areas, lower branches of mangroves will be pruned as necessary to allow for investigation and potential removal of anomalies; mature mangroves that are necessarily cut to ground or removed will be replaced onsite.
- A biological survey will be conducted, and an archaeological survey may need to be completed within the NTCRA area prior to vegetation clearance and MEC removal activities. As necessary, the surveys will be conducted to protect sensitive or threatened and endangered flora and fauna and to ensure that the work does not negatively impact cultural resources.

4.2 Analysis of Removal Action Alternatives

The alternatives were evaluated using the NCP evaluation criteria (40CFR300.430(e)(9)). Evaluation summaries of the alternatives are presented in **Table 4-1**. Cost estimates of the removal alternative elements associated with Alternative 2 is provided in Tables 4-2. In addition, Table 4-2 has been divided into **Tables 4-2a** and **4-2b** that estimate the costs to perform the removal/disposal manually and through employing remotely operated equipment, respectively. The alternative cost estimates are in 2014 dollars, based on RS Means and engineer's estimates for similar projects.

The cost estimates presented in **Tables 4-2a** and **4-2b** have been developed strictly for comparing the removal alternatives. The final costs of the project and the resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, the implementation schedule, and other variables. Therefore, final project costs may vary from the cost estimates.

The cost estimates are order-of-magnitude estimates having an intended accuracy range of +50 to -30 percent. The range applies only to the alternatives as they are defined herein and does not account for changes in the scope of the alternatives.

TABLE 4-1

Detailed Evaluation of Removal Action Alternatives*NTCRA for Encrusted Munitions at UXO 15 PI-9 East and Adjacent UXO 16 EE/CA*

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Recovery and Disposal
Overall Protection to Human Health and the Environment		
Reduce the potential explosive hazard associated with potential MEC/MPPEH located at PI-9 East within UXO 15 and immediately offshore within UXO 16.	Will not meet the RAO for UXO 16. No reduction in risk of exposure to potential MEC/MPPEH or the explosive hazard posed by the potential MEC/MPPEH to boaters accessing Puerto Ferro.	This alternative will meet the RAO because it removes potential MEC/MPPEH in an area known to be used by recreational users and trespassers and for intended future land use.
Compliance with ARARs		
Location-specific ARARs	Complies with ARARs	Complies with ARARs
Action-specific ARARs	Not applicable	Complies with ARARs
Chemical-specific ARARs	Not applicable	Complies with ARARs
Long-Term Effectiveness and Permanence		
Magnitude of residual risks	No significant change in explosive hazard because no action would be taken; therefore, it is not effective or permanent.	Elimination of explosive hazard
Adequacy and reliability of controls	Access to the encrusted items in UXO 16 is unrestricted.	Controls not necessary for items because they will be eliminated.
Reduction of Toxicity, Mobility, or Volume through Treatment		
Reduction of toxicity, mobility, or volume through treatment	Not applicable	Reduction of MEC toxicity, mobility, and volume through disposal
Short-Term Effectiveness		
Protection of workers during removal action	Not applicable	MEC evaluation and removal would follow health and safety plan and procedures, including specialty training/procedures for underwater work.

TABLE 4-1

Detailed Evaluation of Removal Action Alternatives

NTCRA for Encrusted Munitions at UXO 15 PI-9 East and Adjacent UXO 16 EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Recovery and Disposal
Short-term risk that might be posed to the community during implementation	Not applicable	Potential impacts to the community, including boaters and trespassers, while performing the NTCRA will be minimized by restricting access to UXO 15 and to Puerto Ferro.
Potential environmental impacts of remedial action and effectiveness and reliability of mitigation measures during implementation	Not applicable	Potential damage/destruction to seagrass beds or coral from physical removal of potential MEC/MPPEH. Temporary disturbance of the area immediately around the potential MEC/MPPEH as the items are evaluated and removed. Mitigation measures will be implemented, as necessary, in accordance with the biological assessment or other approved processes.
Time until protection is achieved	Not applicable	Approximately 2-3 months to complete removal of MEC/MPPEH
Implementability		
Technical feasibility	No action is technically feasible	Services and materials are available due to ongoing MEC removal actions at the former VNTR.
Administrative feasibility	Agency approval unlikely	Feasible (would require coordination with USFWS, NMFS, and DNER to protect marine species via biological assessment followed by a biological opinion [or other approved method]).
Availability of services, equipment, and materials	Not applicable	Available
Cost		
Cost (See Tables 4-2a and 4-2b for Cost Breakdown)	\$0	\$844,000-\$1,076,000

TABLE 4-2a

Alternative 2 - Manual Recovery and Disposal of Encrusted Items Cost Estimate
 NTCRA for Encrusted Munitions at UXO 15 PI-9 East and Adjacent UXO 16 EE/CA
 Atlantic Fleet Weapons Training Area—Vieques
 Former Vieques Naval Training Range
 Vieques, Puerto Rico

Site: UXO 15 PI-9 East and Adjacent UXO 16 Area, Former Vieques Naval Training Range Base Year: 2015
 Location: Vieques, Puerto Rico Date: January 2015
 Phase: EE/CA

Alternative Description:

- Pre-NTCRA evaluation of potential MEC/MPPEH
- Biological assessment of underwater area near potential MEC/MPPEH
- Removal (by hand) and disposal, as appropriate, of encrusted items
- Post-demolition sampling

Description	Quantity	Unit	\$/Unit	Total Cost	Notes
(1) Mobilization/Demobilization and Work Planning					
1.1 Work Plan	1	EA	\$30,000	\$30,000	Estimate
1.2 ESS Revision to Address Work Approaches	1	EA	\$10,000	\$10,000	Estimate
1.3 Dive Plan	1	EA	\$15,000	\$15,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.4 UXO Dive Team Mobilization (survey + removal)	2	EA	\$13,200	\$26,400	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.5 UXO Dive Team Demobilization (survey + removal)	2	EA	\$13,200	\$26,400	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.6 Evaluation of Items to Determine if Safe to Move and Safe to Dislodge	1	LS	\$20,000	\$20,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006; assume UXO dive team will be able to evaluate both terrestrial and underwater items; assume 1 day for inspection
1.7 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Work Plan	1	EA	\$30,000	\$30,000	Cost based on FP for CLEAN 8012 CTO 006
1.8 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Fieldwork	1	LS	\$43,458	\$43,458	Cost based on previous costs incurred; Subcontract work on CLEAN 8012 CTO 006 in late 2011; \$25,000 mobilization/demobilization; \$5,315/day labor; daily rates escalated by 5% per year; estimate up to 3 days on site
1.9 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Reporting	1	EA	\$35,000	\$35,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.10 Archeological Survey of NTCRA Area	1	EA	\$7,500	\$7,500	Site work - Assume 40 hours labor for one archaeologist at \$100/hr (including travel labor); travel costs estimated \$1,500; assume on-site UXO tech to provide UXO escort, no additional UXO escort cost included. Reporting - assume 20 hours labor for one archaeologist at \$100/hr
Subtotal 1				\$243,758	
(2) Terrestrial MEC/MPPEH Removal					
2.1 Manual Vegetation Removal/Reduction, Surface MEC removal, and Mag-and-Dig to 1 ft bgs	22	Day	\$5,400	\$118,800	Average cost calculated to be approximately \$675/person/day, inclusive of indirect and direct costs; assume team consists of 8 personnel; assume production rate of approximately 0.01 ac/day due to items being encrusted and difficult to remove (estimate approximately 1 month to complete removal [22 working days/month])
2.2 Boat Support to Maintain Exclusion Zone	22	Day	\$1,350	\$29,700	Assume 1 boat per day to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019; assumed that surface MEC clearance will take 2 days and subsurface MEC clearance will take 3 days (5 days total)
2.3 Erosion and Sediment Controls (AquaDams installed around excavation area during excavation)	300	ft	\$268	\$80,406	Cost based on 2010 vendor literature for purchase (\$70/ft), escalated 5% per year and 300% for delivery to Vieques; assumes approximately 400 ft of dams needed to block off terrestrial work areas; assumes using 5 ft tall x 13 ft wide AquaDams
2.4 Pump to Lower Water Level within Excavation Area	22	Day	\$400	\$8,800	Daily cost includes pump and hose rental (\$250/day), assumes fuel costs (\$50/day) and labor to keep pump running (\$100/day)
Subtotal 2				\$237,706	
(3) Underwater MEC/MPPEH Removal					
3.1 Retrieval of Underwater Encrusted Items	6	Day	\$20,000	\$120,000	Assumes divers will be needed for portion of work; includes movement of MEC/MPPEH to terrestrial disposal location; Cost based on previous costs incurred on CLEAN 8012 CTO 006; assume production rate of approximately 0.01 ac/day due to items being encrusted and difficult to remove.
3.2 Boat Support to Maintain Exclusion Zone and Support Dive Operations	12	Day	\$1,350	\$16,200	Assume 2 boats per day; one to serve as dive support, one to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019
Subtotal 3				\$136,200	
(4) MEC/MPPEH Destruction					
4.1 Boat Support to Maintain Exclusion Zone	2	Day	\$1,300	\$1,350	Assume 1 boat per day to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019
4.2 Guards for Explosives Storage Magazine	5	Day	\$342	\$1,710	Assume up to 2 weeks of guard services needed based on delivery date of donor charges; costs based on subcontract security guard costs incurred on CLEAN 8012 CTO 019
4.3 Demolition/Explosive Venting	2	Event	\$11,160	\$22,320	Assume 2 demo events to address MEC/MPPEH; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013
Subtotal 4				\$25,380	
Subtotal for Tasks 1, 2, 3, and 4				\$643,044	
CONTINGENCY	20%		\$643,044	\$129,000	EPA July 2000 guidance
SUBTOTAL - CONSTRUCTION COST				\$773,000	

Site: UXO 15 PI-9 East and Adjacent UXO 16 Area, Former Vieques Naval Training Range

Base Year: 2015

Location: Vieques, Puerto Rico

Date: January 2015

Phase: EE/CA

Alternative Description:

- Pre-NTCRA evaluation of potential MEC/MPPEH
- Biological assessment of underwater area near potential MEC/MPPEH
- Removal (by hand) and disposal, as appropriate, of encrusted items
- Post-demolition sampling

Description	Quantity	Unit	\$/Unit	Total Cost	Notes
<u>(5) DESIGN&CM&PM</u>					
Project Management	5%		\$773,000	\$38,650	EPA July 2000 guidance page 5-13
Construction Management	6%		\$773,000	\$46,380	EPA July 2000 guidance page 5-13
General&Administration (G&A)	9.2%		\$773,000	\$71,116	RSMeans 5% to 15%
Pollution Liability Insurance	2%		\$773,000	\$15,460	market price
Payment & Performance Bond	1.25%		\$773,000	\$9,663	market price
Fee	8%		\$844,116	\$67,529	
Tax	7%		\$773,000	\$54,110	Puerto Rico tax
TOTAL - Design &CM&PM				\$303,000	
TOTAL Capital Cost				\$1,076,000	

Note:

This estimate has been developed and provided as an Order of Magnitude Estimate (ROM)/Budgetary Estimate and as such is suitable for the purpose of budget development and/or planning only. This estimate is offered as an opinion of cost to perform the work and is not an offer to contract for construction services, procure and/or provide such services. (Cost Accuracy Range: +50% / -30%)

Acronyms and Abbreviations

AC - acres

EA - each

LS - lump sum

TABLE 4-2b

Alternative 2 - Recovery and Disposal of Encrusted Items using Remote Controlled Equipment Cost Estimate

NTCRA for Encrusted Munitions at UXO 15 PI-9 East and Adjacent UXO 16 EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Site: UXO 15 PI-9 East and Adjacent UXO 16 Area, Former Vieques Naval Training Range

Base Year: 2015

Location: Vieques, Puerto Rico

Date: January 2015

Phase: EE/CA

Alternative Description:

- Pre-NTCRA evaluation of potential MEC/MPPEH

- Biological assessment of underwater area near potential MEC/MPPEH

- Removal using remote control equipment and disposal, as appropriate, of encrusted items

- Post-demolition sampling

Description	Quantity	Unit	\$/Unit	Total Cost	Notes
(1) Mobilization/Demobilization and Work Planning					
1.1 Work Plan	1	EA	\$30,000	\$30,000	Estimate
1.2 ESS Revision to Address Work Approaches	1	EA	\$10,000	\$10,000	Estimate
1.3 Dive Plan	1	EA	\$15,000	\$15,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.4 UXO Dive Team Mobilization (survey + removal)	2	EA	\$13,200	\$26,400	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.5 UXO Dive Team Demobilization (survey + removal)	2	EA	\$13,200	\$26,400	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.6 Evaluation of Items to Determine if Safe to Move and Safe to Dislodge	1	LS	\$20,000	\$20,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006; assume UXO dive team will be able to evaluate both terrestrial and underwater items; assume 1 day for inspection
1.7 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Work Plan	1	EA	\$30,000	\$30,000	Cost based on FP for CLEAN 8012 CTO 006
1.8 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Fieldwork	1	LS	\$43,458	\$43,458	Cost based on previous costs incurred; Subcontract work on CLEAN 8012 CTO 006 in late 2011; \$25,000 mobilization/demobilization; \$5,315/day labor; daily rates escalated by 5% per year; estimate up to 3 days on site
1.9 Biological Assessment of Area Containing Encrusted Items (Terrestrial and Underwater) - Reporting	1	EA	\$35,000	\$35,000	Cost based on previous costs incurred on CLEAN 8012 CTO 006
1.10 Archeological Survey of NTCRA Area	1	EA	\$7,500	\$7,500	Site work - Assume 40 hours labor for one archaeologist at \$100/hr (including travel labor); travel costs estimated \$1,500; assume on-site UXO tech to provide UXO escort, no additional UXO escort cost included. Reporting - assume 20 hours labor for one archaeologist at \$100/hr
Subtotal 1				\$243,758	
(2) Terrestrial MEC/MPPEH Removal					
2.1 Vegetation Removal and Removal of Terrestrial Items with Remote Controlled Excavator (to a depth of 1 ft bgs)	5	Day	\$10,000	\$50,000	Assumed vegetation removal will take approximately 0.5 days; assume volume of soil to be excavated is 400 cubic yards [cy] (0.25 acres, 1 ft deep); assumed excavation rate and screening with bucket of 150 cy per day (3 days); 1 day to backfill with excavator; backfill compaction will be incidental to placement and limited to using tracks of excavator
2.2 UXO Team Inspection of Excavation Spoils and Floor of Excavation	5	Day	\$5,400	\$27,000	Average cost calculated to be approximately \$675/person/day, inclusive of indirect and direct costs; assume team consists of 8 personnel; assume team will be onsite throughout excavation activities
2.3 Boat Support to Maintain Exclusion Zone	5	Day	\$1,350	\$6,750	Assume 1 boat per day to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019
2.4 Erosion and Sediment Controls (AquaDams installed around excavation area during excavation)	450	Ft	\$268	\$120,609	Cost based on 2010 vendor literature for purchase (\$70/ft), escalated 5% per year and 300% for delivery to Vieques; assumes approximately 450 ft of dams needed to block off terrestrial and underwater work areas; assumes using 5 ft tall x 13 ft wide AquaDams (assume water depth of 36")
2.5 Pump to Lower Water Level within Excavation Area	6	Day	\$400	\$2,400	Daily cost includes pump and hose rental (\$250/day), assumes fuel costs (\$50/day) and labor to keep pump running (\$100/day)
Subtotal 2				\$206,759	
(3) Underwater MEC/MPPEH Removal					
3.1 Excavation/Mud Mats to Support Excavator	4	EA	\$3,000	\$12,000	Assumed excavation mats will be necessary to help reach the furthest extent of items; cost is estimated; assume mats will need to be rented of for over a month due to work taking place on Vieques; estimated \$100/day, 30 days/month
3.2 Removal of Underwater Items with Remote Controlled Excavator	1	Day	\$10,000	\$10,000	Assumed area with items (0.03 ac; 2,300 ft2) can be excavated in 1 day.
3.3 UXO Team Inspection of Excavation Spoils	1	Day	\$5,400	\$5,400	Average cost calculated to be approximately \$675/person/day, inclusive of indirect and direct costs; assume team consists of 8 personnel; assume team will be onsite throughout excavation activities.
3.4 Boat Support to Maintain Exclusion Zone	1	Day	\$1,350	\$1,350	Assume 1 boat per day to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019
Subtotal 3				\$28,750	

Site: UXO 15 PI-9 East and Adjacent UXO 16 Area, Former Vieques Naval Training Range Base Year: 2015
 Location: Vieques, Puerto Rico Date: January 2015
 Phase: EE/CA
 Alternative Description:
 - Pre-NTCRA evaluation of potential MEC/MPPEH
 - Biological assessment of underwater area near potential MEC/MPPEH
 - Removal using remote control equipment and disposal, as appropriate, of encrusted items
 - Post-demolition sampling

Description	Quantity	Unit	\$/Unit	Total Cost	Notes
(4) MEC/MPPEH Destruction					
4.1 Boat Support to Maintain Exclusion Zone	2	Day	\$1,300	\$1,350	Assume 1 boat per day to patrol Puerto Ferro/block access to the bay; costs based on subcontract boat support costs incurred on CLEAN 8012 CTO 019
4.2 Guards for Explosives Storage Magazine	5	Day	\$342	\$1,710	Assume up to 2 weeks of guard services needed based on delivery date of donor charges; costs based on subcontract security guard costs incurred on CLEAN 8012 CTO 019
4.3 Demolition/Explosive Venting	2	Event	\$11,160	\$22,320	Assume 2 demo events to address MEC/MPPEH; Cost estimate is based on average demolition costs for USAE on VT004 through October 2013
Subtotal 4				\$25,380	
Subtotal for Tasks 1, 2, 3, and 4				\$504,647	
CONTINGENCY	20%		\$504,647	\$101,000	EPA July 2000 guidance
SUBTOTAL - CONSTRUCTION COST				\$606,000	
(5) DESIGN&CM&PM					
Project Management	5%		\$606,000	\$30,300	EPA July 2000 guidance page 5-13
Construction Management	6%		\$606,000	\$36,360	EPA July 2000 guidance page 5-13
General&Administration (G&A)	9.2%		\$606,000	\$55,752	RSMeans 5% to 15%
Pollution Liability Insurance	2%		\$606,000	\$12,120	market price
Payment & Performance Bond	1.25%		\$606,000	\$7,575	market price
Fee	8%		\$661,752	\$52,940	
Tax	7%		\$606,000	\$42,420	Puerto Rico tax
TOTAL - Design & CM&PM				\$238,000	
TOTAL Capital Cost				\$844,000	

Note:
 This estimate has been developed and provided as an Order of Magnitude Estimate (ROM)/Budgetary Estimate and as such is suitable for the purpose of budget development and/or planning only. This estimate is offered as an opinion of cost to perform the work and is not an offer to contract for construction services, procure and/or provide such services.
 (Cost Accuracy Range: +50% / -30%)

Acronyms and Abbreviations
 EA - each
 LS - lump sum

Comparative Analysis of Removal Action Alternatives

A summary of the relative comparative analysis is provided in **Table 5-1**.

5.1 Overall Protection of Human Health and the Environment

- Alternative 2 is protective of human health and the environment because it either eliminates the MEC/MPPEH or eliminates the potential exposure pathway to MEC/MPPEH, respectively.
- Alternative 1 is protective of human health and the environment in the terrestrial portions of the NTCRA due to activities completed as portions of other NTCRAs; however, it is not protective for the items found within UXO 16.

5.2 Compliance with ARARs

- **Attachment A** presents a compilation and evaluation of state (Commonwealth) and federal chemical-specific, location-specific, and action-specific ARARs. All of the removal alternatives meet the ARARs.

5.3 Long-Term Effectiveness and Permanence

- Alternative 2 provides long-term effectiveness through elimination of the explosive hazard.
- Alternative 1 does not provide any long-term effectiveness.

5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

- Reduction of mobility and volume through treatment would be accomplished through Alternative 2 by removal and, as applicable, destruction of MEC/MPPEH through detonation.
- There is no reduction in toxicity, mobility, and volume associated with Alternative 1.

5.5 Short-Term Effectiveness

- Because there would be no physical removal activities associated with Alternative 1, it has the least short-term impacts.
- Alternative 2 will present potential short-term impacts to workers at the site, but these can be managed through MEC health and safety practices and, as applicable, enforcement of exclusion zones. Access restrictions to Puerto Ferro will result in short-term impacts to the general public throughout the execution of the NTCRA.
- The following manageable safety concerns for workers will exist during the execution of the NTCRA:
 - Working in an area with potentially live munitions is the main hazard to workers associated with Alternative 2. All personnel involved with the removal actions will have the proper training and demonstrated experience for project roles and will receive site-specific training, including munitions awareness training (often referred to as Recognize, Retreat, Report [3R] Training) as appropriate. Exclusion zones will be maintained throughout the removal action and only authorized personnel will be allowed in the exclusion zone. In addition, if warranted, remotely operated equipment may be utilized to reduce the explosive hazard to workers.
 - Because of the location for this NTCRA, Alternative 2 may result in workers diving at the site and spending extended periods of time underwater. Proper planning, training, equipment, and task- and site-appropriate personal protective equipment can mitigate the health and safety concerns associated with diving and working with potential underwater MEC/MPPEH.

- Potential impacts to the environment are associated with the activities related to the evaluation, removal, and or destruction of the potential MEC/MPPEH. To minimize these impacts, a biological assessment will be prepared for which a biological opinion will be issued (or an alternate process approved by NMFS, USFWS, and/or DNER) to identify ways to plan for and mitigate impacts to threatened or endangered species.
- The timeframe to achieve the NTCRA RAO is the anticipated duration of the NTCRA, which is a maximum of two to three months.

5.6 Implementability

- Alternative 2 is technically and administratively feasible. The potential damage to marine threatened and endangered species may put constraints on the execution of these alternatives; however, mitigation measures may be appropriate, which will be determined in the biological assessment (or other approved process).
- Since Alternative 1 is the No Action alternative and does not meet the RAO, it would be difficult to obtain administrative approval for this alternative.

5.7 Cost

- Alternative 1 is the most cost effective as there is no cost associated with it; however, this alternative does not meet the RAO. The estimated cost of Alternative 2 anticipated to range from \$844,000 - \$1,076,000, depending on whether the removal is conducted by hand or using remote controlled equipment.

TABLE 5-1

Comparative Analysis of Removal Alternatives

NTCRA for Encrusted Munitions at UXO 15 PI-9 East and Adjacent UXO 16 EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Vieques Naval Training Range

Vieques, Puerto Rico

Criterion	Alternative 1	Alternative 2
	No Action	Recovery and Disposal
<i>Threshold Criterion</i>		
Overall protection of human health and the environment	✘	✓
Compliance with ARARs	✓	✓
Compliance with Chemical-Specific ARARs	Not Applicable	✓
Compliance with Action-Specific ARARs	Not Applicable	✓
Compliance with Location-Specific ARARs	✓	✓
<i>Balancing Criterion</i>		
Long-term effectiveness and permanence	○	●
Magnitude of Residual Risk	○	●
Adequacy and Reliability of Controls	○	●
Reduction of toxicity, mobility, or volume through treatment	Not Applicable	●
Treatment Process Used and Materials Treated	Not Applicable	●
Amount of Hazardous Materials Destroyed or Treated	Not Applicable	●
Degree of Expected Reductions in Toxicity, Mobility, and Volume	Not Applicable	●
Degree to Which Treatment is Irreversible	Not Applicable	●
Type and Quantity of Residual Remaining After Treatment	Not Applicable	●
Short-term effectiveness	Not Applicable	◐
Short-term Risks to Community During Removal Action	Not Applicable	●
Short-term Risks to Workers During Removal Action	Not Applicable	●
Environmental Impacts	Not Applicable	◐
Time Until Remedial Action Objectives are Achieved	Not Applicable	●
Implementability	◐	●
Technical Feasibility	●	●
Administrative Feasibility	○	●
Availability of Services, Equipment, and Materials	Not Applicable	●
Cost (Total Present Value)	\$ -	\$844,000 - \$1,076,000

Individual criterion scores: ○ not met ◐ poor ◑ satisfactory ◒ good ● excellent

SECTION 6

Recommended Interim Removal Action Alternative

Alternative 2 provides acceptable reduction in risk associated with access to the NTCRA area and provides a more permanent solution through removal of potential MEC/MPPEH. Therefore, Alternative 2 (Recovery and Disposal) is the recommended removal alternative unless the biological assessment and associated opinion (or other process deemed acceptable by the applicable agencies) indicate any potential damage to threatened and endangered species (if present) cannot be acceptably mitigated.

SECTION 7

References

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Appendix A
Applicable or Relevant and Appropriate
Requirements

TABLE A-1(a)

Federal Chemical-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
No Federal Chemical-Specific ARARs apply.						

TABLE A-1(b)

Puerto Rico Chemical-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Media	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Surface Water						
Surface Water	The protection of the uses assigned to the classifications of the coastal, surface, estuarine, wetlands, and ground waters of the Commonwealth of Puerto Rico.	Activity taking place in a coastal, surface, estuarine, wetlands, and ground waters of the Commonwealth of Puerto Rico.	Rule 1303C, 1303.1A, B, D, E, and H	2	Applicable	Applicable to activities taking place within surface water associated with removal and/or encapsulating of items under investigation. However, neither of the removal alternatives will cause degradation to the surrounding surface water.

TABLE A-1(c)

Federal Location-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Coastal Zone						
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the area that will affect maximum extent practicable, State coastal zone management programs. Federal agencies must supply the State with a consistency determination.	Activity taking place in a wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone.	15 CFR 930.33(a)(1), (a)(2), (b); .35(a), (b); .36(a)	2	Applicable	Activities at UXO 15 and 16 that will affect Puerto Rico's coastal zone will be consistent to the maximum extent practicable with Puerto Rico's enforceable policies. Activities performed on-site and in compliance with CERCLA are not subject to administrative review; however, the substantive requirements of making a consistency determination will be met.
Migratory Flyway						
Migratory bird area	Protects almost all species of native birds in the United States from unregulated taking.	Presence of migratory birds.	<i>Migratory Bird Treaty Act</i> , 16 USC 703	2	Applicable	The site is located in the Atlantic Americas Migratory Flyway. Any terrestrial-based consolidated detonations will be done in an area that will not destroy the birds, nests, or eggs.

TABLE A-1(d)

Puerto Rico Location-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
No Puerto Rico Location-Specific ARARs apply.						

TABLE A-1(e)

Federal Action-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Waste Management						
Management of non-hazardous solid waste onsite in containers or in piles.	Non-hazardous solid waste staged onsite must not create a hazard or public nuisance.	Generation of non-hazardous solid waste that is managed onsite in containers or in piles.	40 CFR 273.3-1(a); 3-3; 3-4(a); 3-7(a); 3-8(d)	2	Applicable	It is anticipated that non-hazardous solid wastes (i.e., material documented as safe [MDAS]) will be generated during the implementation of Alternative 2. The MDAS will be managed as scrap metal.
Management of military munitions	Specifies management requirements for those military munitions that are no longer exempt from the definition of solid waste.	Management of unused military munitions that have been disposed of or fired/used military munitions that have been removed from the range.	40 CFR 266.202(b) and (c) ; 205 (a) and (b)	2	Applicable	Munitions items discovered will be managed in accordance with OP-5 guidance.
Taking of endangered species						
Underwater detonations and/or encapsulation	Actions that involve the incidental taking of threatened or endangered species or the destruction of the critical habitat of threatened or endangered species are generally prohibited.	The presence of threatened or endangered species and their critical habitat in an area where underwater detonations may result in incidental taking. Take means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any protected species.	16 USC 1538	2	Applicable	Several endangered species and critical habitats have been identified within UXO-15 and 16. Onsite CERCLA actions are exempt from permitting; endangered species will be addressed during project planning associated with the removal action.
Underwater detonations	Actions that involve the incidental taking of marine mammals are generally prohibited. Such actions are allowable only when it will have a negligible impact.	The presence of marine mammals in an area where underwater detonations may result in incidental taking. Take means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any protected species.	16 USC 1361	2	Applicable	The underwater destruction of munitions and explosives of concern may cause the incidental taking of marine mammals. Onsite CERCLA actions are exempt from permitting; protected species will be addressed during project planning associated with the removal action.

TABLE A-1(f)

Puerto Rico Action-Specific ARARs

UXO 15 PI-9 East and Adjacent UXO 16 Encrusted Munitions EE/CA

Atlantic Fleet Weapons Training Area—Vieques

Former Naval Ammunition Support Detachment

Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	Alternative	ARAR Determination	Comment
Construction Activities						
Performing construction activities that generate noise	No construction activity may be performed at night or in such a way that vibrations are produced that can be felt beyond the property boundary. If equipment used in construction is not manufactured in accordance with USEPA standards for newly manufactured equipment then it may not produce noise that exceeds 70 dBA.	Construction activity including earthwork.	Puerto Rico Regulation 3418.3.1.5(A),(C);3.1.10; 3.1.13; and 4.1	2	Applicable	The site is considered to be in Zone II (Commercial) for noise production. Noise pollution during MEC clearance and demolition, will be appropriately addressed.
Land disturbance	A Control of Erosion and Sediment (CES) Plan and a Work Plan must be prepared for any activities that involve the alteration of ground or soil conditions that have not been specifically excluded.	Disturbance of more than 40 cubic meters of soil during construction activity.	Puerto Rico Regulation 5754.1230(B), (C)	2	Applicable	Remedial alternatives involve the disturbance of more than 40 cubic meters of soil. A CES and Work Plan will be prepared for this activity.
Production of Fugitive Dust	Dust control measures must be implemented during construction activities to prevent emissions beyond the property boundary. These include, but are not limited to, the use of water or other chemicals on road ways to control dust, covering haul trucks, and cleaning tracked soil off of paved roads.	Construction activity causing particulate matter to become airborne.	Puerto Rico Regulation 5300.404(A)(2), (4), (7); (B)	2	Applicable	Applicable to activities that produce fugitive dust. Dust control measures will be implemented.
Waste Management						
Management of non-hazardous solid waste onsite in containers and piles	Non-hazardous solid waste staged onsite must not create a hazard or public nuisance.	Generation of non-hazardous solid waste that is managed onsite in containers or in piles.	Puerto Rico Non-Hazardous Solid Waste Regulation 531.H	2	Applicable	It is anticipated that non-hazardous solid wastes (i.e., material documented as safe [MDAS]) will be generated during the implementation of these alternatives. The MDAS will be managed as scrap metal.