FINAL REPORT
FOR
MILITARY MUNITIONS RESPONSE PROGRAM (MMRP)
REMEDIAL INVESTIGATION
Culebra Island Site
MRS 02 – Cerro Balcon and Adjacent Cays
MRS 04 – Flamenco Lagoon Maneuver Area
MRS 05 – Mortar and Combat Range Area
MRS 07 – Culebrita Artillery Impact Area

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Prepared For:
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February 2013

CULEBRA ISLAND SITE

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Remedial Investigation Final Report

Military Munitions Response Program

Culebra Island Site

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ACRONYMS

°F	Degrees Fahrenheit
%	percent
µg/kg	Micrograms per kilogram
APP	Accident Prevention Plan
ARARs	Applicable or Relevant and Appropriate Requirements
ASR	Archive Search Report
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
cm^2	centimeters squared
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
DGM	Digital Geophysical Mapping
DID	Data Item Description
DMM	Discarded Military Munitions
DNER	Department of Natural and Environmental Resources
DoD	Department of Defense
DQO	Data Quality Objective
EcoSSL	Ecological Soil Screening Level
ECSM	Ecological Conceptual Site Model
EE/CA	Engineering Evaluation and Cost Analysis
EHE	Explosive Hazard Evaluation
Ellis	Ellis Environmental Group, LC
EM	Engineer Manual
EM CX	Environmental and Munitions Center of Expertise
EOTI/ARCADIS	Explosive Ordnance Technologies, Inc. and ARCADIS/Malcolm Pirnie
EP	Engineer Pamphlet
EPC	Exposure Point Concentrations

ESE	Environmental Science and Engineering, Inc.
ESL	Ecological Screening Level
ESP	Explosives Site Plan
EZ	Exclusion Zone
FLEX	Fleet Landing Exercise
FS	Feasibility Study
FUDS	Formerly Used Defense Site
GP	Guided Projectile
GPO	Geophysical Prove Out
GPS	Global Positioning System
HA	Hazard Assessment
HE	High-Explosive
HEI	High-Explosive Incendiary
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HRR	Historical Records Review
INPR	Inventory Project Report
lbs	pounds
LANL	Los Alamos National Laboratory
LTM	Long Term Management
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram of body weight per day
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MQL	Method Quantitation Limits
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol

MSD	Minimum Separation Distance
MS/MSD	Matrix spike / Matrix Spike Duplicate
NA	Not Applicable
NCP	National Contingency Plan
OB/OD	Open Burn/Open Detonation
OSHA	Occupational Safety and Health Administration
PAOs	Preliminary Action Objectives
PEL	Probable Effects Level
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation/Feasibility Study
RSL	Regional Screening Level
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SLRA	Screening Level Risk Assessment
SUXOS	Senior Unexploded Ordnance Supervisor
SWPP	Storm Water Pollution Prevention Plan
TBC	To Be Considered
TEL	Threshold Effects Levels
TPP	Technical Project Plan
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
U.S.	United States
USC	United States Code
USAEC	United States Army Environmental Command
USAESCH	United States Army Engineering Support Center, Huntsville
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist

UXOSO	Unexploded Ordnance Safety Officer

ES.0 EXECUTIVE SUMMARY

ES.1 OBJECTIVE

ES.1.1 On behalf of the United States (U.S.) Army, U.S. Army Corps of Engineers (USACE) Jacksonville District and the U.S. Army Engineering and Support Center, Explosive Ordnance Technologies, Inc. (EOTI) and ARCADIS/Malcolm Pirnie (EOTI/ARCADIS) have performed a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation / Feasibility Study (RI) at Cerro Balcon and Adjacent Cays (Munitions Response Site [MRS] 02), Flamenco Lagoon Maneuver Area (MRS 04), Mortar and Combat Range Area (MRS 05), and Culebrita Artillery Impact Area (MRS 07) at the Culebra Island Formerly Used Defense Site (FUDS) under the Military Munitions Response Program (MMRP). An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800. A Site Inspection (SI) was conducted and the 2007 Final SI Report recommended all four MRSs proceed to RI for further evaluation of munitions and explosives of concern (MEC) and munitions constituents (MC). This Report has been developed to provide a description of the MMRP tasks that have been conducted by EOTI/ARCADIS under this RI. The objective of the project is to characterize the nature and extent of contamination within MRSs 02, 04, 05, and 07 meeting the requirements of ER 200-3-1 and Environmental and Munitions Center of Expertise (EM CX) Interim Guidance 06-04.

ES.2 REMEDIAL INVESTIGATION (RI) FIELD WORK SUMMARY

ES.2.1 RI fieldwork was conducted from 11 October 2010 to 25 March 2011, in accordance with the approved Final MMRP Work Plan (EOTI, 2010) and decisions made during technical project planning (TPP) sessions. The fieldwork included geophysical investigations, during which surface and subsurface metallic anomalies were investigated along predefined transects throughout MRS 04, MRS 05, and MRS 07. The transects covered approximately 24 miles (123,000 ft) across the MRSs. In addition, four 25 x 25 foot mini-grids were investigated in areas where indicators of MEC were discovered along the transects. One grid was located in MRS 04 and three were located in MRS 05. No investigations were conducted in MRS 02 due to the lack of rights-of-entry (ROE) in the Cerro Balcon area and the inability of field teams to access the cays, which comprise the remainder of MRS 02. The cays are difficult to access due to steep terrain and inadequate landing areas. The field teams attempted access to the cays but were deterred by rough seas. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible than the other cays by recreational users (trespassers). Portions of MRS 04 and 05 were not investigated by the field teams due to lack of ROEs, and in some cases, due to access issues caused by heavy vegetation and terrain.

ES.2.2 In total, 466 anomalies were intrusively investigated across MRS 04, MRS 05, and MRS 07. During the investigation, 49 pieces of munitions debris (MD) (items without an explosive hazard) were found, totaling 43 pounds. MD included items associated with mortars, 3-inch projectiles, 20mm projectiles, flares, fuzes, small arms ammunition, and unidentifiable fragments. The investigation confirmed that MD and metal scrap (non-munitons related metal) were located on the surface and in the subsurface at MRS 04, MRS 05, and MRS 07. During the investigation, MEC associated with a Mk 5 Mod 0 rocket and a Mk 8 demolition hose was found within MRS 07. No MEC was found in MRS 04 or MRS 05. The remainder of the 466 anomalies were identified as either non-munitions-related metallic debris, such as barb wire and small arms ammunition not related to military use, or geologic anomalies. Table ES-1 summarizes the MEC investigation results for each MRS.

ES.2.3 A total of 28 soil samples and 7 sediment samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for munitions constituents (MC), including explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc). Based on the phased approach established for MC sampling no subsurface soil, surface water, or groundwater samples were collected. No samples were collected from MRS 02 due to lack of a ROE and inaccessibility issues for the Cays. Explosives were not detected in any of the field samples; however, 1,3,5-TNB and 4-NT were found at very low levels in one split sample at MRS 05 collected for quality assurance purposes. Both analytes were well below the US Environmental Protection Agency's (USEPA) Residential Screening Levels (RSL) and were not evaluated as part of the human health or ecological risk assessments. While detected metals concentrations in the RI surface soil samples from MRS 04, MRS 05, and MRS 07 were, for the most part, greater than the range of concentrations in background soil samples, they were less than the USEPA RSLs for Resident Soil. No background sediment data were available; however, detected metals concentrations in sediment samples from MRS 04, MRS 05, and MRS 07 were also less than the USEPA RSLs for Resident Soil. Detected metals concentrations in soil and sediment samples from MRS 04, MRS 05, and MRS 07 were greater than ecological screening values.

ES.3 RI RISK ASSESSMENT RESULTS

ES.3.1 A human health risk assessment and screening-level ecological risk assessment were conducted for each MRS. The risk assessments were based on soil and sediment data collected in 2007 as part of the Site Inspection (SI) in addition to the data collected as part of this effort. As no soil or sediment samples were collected during the SI or RI at MRS 02, the risk assessments for MRS 02 were based on the analytical results of ten pre-detonation surface soil samples collected during the 2006 clearance activities at Cerro Balcon and Cayo Lobo, as reported in the Final SI Report. In the human health risk assessment, no chemicals of potential concern (COPCs) were identified in surface soil or sediment from any of the MRSs. No soil remediation on the basis of human health risk is warranted.

ES.3.2 The screening level ecological risk assessment determined that the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (cays), MRS 04, and MRS 07 is negligible, and the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (Cerro Balcon) and MRS 05 is low. No soil remediation on the basis of ecological risk is warranted. Based on evaluation of the available sediment data from MRS 04, MRS 05, and MRS 07, there is a potential for adverse health effects in aquatic receptors, and further ecological evaluation of MC in sediment may be warranted. However, given the conservative nature of the toxicity reference values (TRV) used to screen the sediment data, the potential for ecological risk is qualified as low. No soil or sediment remediation on the basis of ecological risk is warranted.

ES.4 Munitions Response Site Prioritization Protocol (MRSPP) AND Conceptual Site Model (CSM) AND MEC Hazard Assessment (HA) RESULTS

ES.4.1 The Munitions Response Site Prioritization Protocol (MRSPP) and Conceptual Site Model (CSM) for the MRSs, as presented in the 2007 Final SI Report, were updated based on the RI fieldwork results. The revised CSM reflects incomplete exposure pathways for all human and ecological receptors of MEC at the surface for MRS 02 – Cerro Balcon and Cayo Lobo, where surface clearances have been conducted. Complete pathways exist for receptors of MEC in the subsurface at MRS 02 - Cerro Balcon and Cayo Lobo, because MEC is confirmed on site, and no subsurface clearance was conducted. Complete pathways also exist for MEC in both the surface and subsurface at MRS 07 due to the presence of MEC found during previous investigations and during the RI. Potentially complete pathways exist on the surface and subsurface for all other cays and MRS 04 and 05. While data is available to suggest low MEC density, data gaps remain for these sites based on lack of ROEs and inaccessibility issues. Based on the results of the risk assessment, all MC pathways are incomplete for all MRSs for the media investigated. Data gaps exist for the environmental media not investigated (i.e., subsurface soil, groundwater and lagoons) and it is not known whether exposure pathways are potentially complete for these areas and media.

ES.4.2 The MRSPP for each MRS was updated to include the types of munitions encountered during the RI, as well as the results of MC sampling conducted. A baseline MEC Hazard Assessment (MEC HA) was also completed for the each

MRS using the MEC HA guidance and accompanying automated scoring worksheets. Table ES-1 displays the summary of the RI results and hazard analysis. A description of the MRSPP, the MEC HA and an explanation of the scoring process is included in Section 5. The MEC HA categorized all sites as high risk except for the Cays, which are moderate risk. Based on a review of previous data and the RI data, along with current land use, MEC risk is qualitatively considered as: moderate for Cerro Balcon (subsurface only), low for the cays (subsurface only for Cayo Lobo), low for MRS 04 and MRS 05 and moderate-to-high for MRS 07.

ES.5 MRS Recommendations

MRS 02: MRS 02 includes Cerro Balcon and the Cays. Cerro Balcon is landlocked within MRS 05 with different access and receptors than the remainder of the cays. The Cays also have varied accessibility. While access to all cays is restricted, Cayo Lobo and Yerba are known to be frequented by recreational users, while the other cays are less accessible or frequented. Based on this information, it is recommended that MRS 02 be split into three areas for further evaluation in the feasibility study:

- Cerro Balcon MRS
- Cayo Lobo and Cayo Yerba MRS
- Remaining Cays MRS (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

MRS 04 and MRS 05: MRS 04 and MRS 05 are adjacent MRSs at Culebra. U.S. Fish and Wildlife own a contiguous portion of each MRS. Receptors and land use varies in this area when compared to the remainder of MRS 04 and 05. Thus, it is recommended that the U.S. Fish and Wildlife Areas from each MRS be combined into a separate MRS. The remainder of each MRS 04 and MRS 05 will remain as separate MRSs. Thus, the following will result:

- U.S. Fish and Wildlife Area MRS
- MRS 04 (remaining area)
- MRS 05 (remaining area)

MRS 07: No changes to MRS boundaries are recommended for MRS 07 based on the RI results.

Table ES- 1: Culebra Island MRS Summary

MRS	MD	MEC	MC	HHRA	SLERA	MRSPP Score[1]	Baseline MEC HA Score[2]	Data Gaps
02 - Cerro Balcon (28 acres)	No field activities conducted during the RI (lack of ROE). MD identified during previous investigations.	**RI** No field activities conducted during the RI (lack of ROE). **Previous Investigations** • 3 inch common MK3, MOD 7 (3) • Fuze, model 1898, 15 second PTTF (2) • 81mm mortar (2) A surface clearance has been conducted over the entire area.	- No field activities conducted at MRS 02 during the RI (lack of ROE). - No explosives detected in previously collected soil samples. - All metals detected below USEPA RSLs in previously collected soil samples.	- No chemical of potential concern (COPCs) identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	3	2	MEC: No subsurface investigation during RI or previous investigations to gather data on subsurface MEC density. MC: None
02 – Cays (88 acres)	No field activities conducted during the RI due to inaccessibility. MD identified during previous investigations at several cays.	**RI** No field activities conducted at MRS 02 during the RI. **Previous Investigations** • 500 lb bomb (2) • MK 27 Torpedo (1) • MK 76 Practice Bomb (2) • 76 mm projectile (1) • Fuze, M151 (1) • Practice bomb (32) • 5-inch/54 MK 41 (1) A surface clearance was conducted on Cayo Lobo (2006).	- No field activities conducted at MRS 02 during the RI. - No explosives detected in previously collected soil samples. - All metals detected below USEPA RSLs in previously collected soil samples.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted in the adjacent cays.	3	3	MEC: Some of the smaller cays have not had MEC investigations conducted due to access restrictions. MC: No sampling data for cays other than Cayo Lobo. Cays were inaccessible to the field teams during the SI and RI based on rough seas.
04 (550 acres)	Fragmentation identified during the RI.	None during the RI. One MEC item found on Flamenco Beach during 2008 NTCRA (5-inch projectile)	- No explosives detected. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	4	2	MEC: Portions of MRS 04 were not investigated due to a lack of ROEs or accessibility (steep terrain / vegetation). Data was not collected in portions of the USFWS area as a result of changes to the CSM/DOQs. MC: None

05 (2842 acres)	- Fragmentation (9) - 30 caliber cartridges (2) - 81mm mortar (3) - 4.2" mortar base	No MEC finds during the RI or previous investigations.	- 1,3,5-TNB and 4-4-NT detected at very low levels below USEPA RSLs in one split sample. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	4	2	MEC: Portions of MRS 05 were not investigated due to a lack of ROEs or accessibility (steep terrain / vegetation). Data was not collected in portions of the USFWS area as a result of changes to the CSM/DQQs. MC: None
07 (375 acres)	- Expended flare - 20 mm projectile - Partial rotating band - Powder Train Time Fuze - Brass fragmentation (9) - Partial fuze body - Shotgun shell - 3'"projectile fragmentation	**RI** • MK 5 Mod 0 Rocket (1) • Mk 8 Demo hose (1) **Previous Investigations** • practice bombs (18) • 6" Naval Gunfire • Spotting charge • 20 mm Projectile (39)	- No explosives detected. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	3	2	MEC: Portions of MRS 07 were not investigated due changes to the CSM/DQOs. The investigation was focused outside of the areas with MEC clearances conducted (beaches). MC: None.

[1] The MRSPP is a method for assigning a relative priority for response actions to defense sites containing military munitions. Priority 1 indicates the highest potential hazard and Priority 8 indicates the lowest potential hazard.
[2] The MEC HA is a baseline hazard analysis for MEC based on current site conditions. There are four hazard levels (1–4), with 1 indicating the highest potential explosive hazard condition and 4 the lowest potential explosive hazard condition.

Note: When MEC and MC investigations were not feasible and historical data was available, the historical data was used to develop human health and risk assessments.

1 INTRODUCTION

1.1 PURPOSE

1.1.1 This Remedial Investigation (RI) Report has been prepared on behalf of the United States Army Corps of Engineers (USACE) to further remedial activities under the Military Munitions Response Program (MMRP) in Culebra, Puerto Rico. This RI Report has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (1988) and the *Munitions Response Remedial Investigation/Feasibility Study Guidance* [United States Army Corps of Engineers (USACE) & United States Army Environmental Command (USAEC), 2009d]. All work was conducted in accordance with the field investigation procedures further developed in the Final MMRP Work Plan, (EOTI, 2010).

1.1.2 An Inventory Project Report (INPR) was signed on 24 December 1991, establishing Culebra as a Formerly Used Defense Site (FUDS), defining a site boundary, and assigning FUDS Project Number I02PR006800. Culebra was subsequently investigated during a Site Inspection (SI) in 2007. The Final SI Report recommended a RI for munitions and explosives of concern (MEC) and munitions constituents (MC) to be conducted at Cerro Balcon and Adjacent Cays (Munitions Response Site [MRS] 02), Flamenco Lagoon Maneuver Area (MRS 04), Mortar and Combat Range Area (MRS 05), and Culebrita Artillery Impact Area (MRS 07), which prompted this RI.

1.1.3 The objective of the project is to characterize the nature and extent of contamination within MRSs 02, 04, 05, and 07 meeting the requirements of ER 200-3-1 and the Environmental and Munitions Center of Expertise (EM CX) Interim Guidance 06-04.

1.2 PROPERTY DESCRIPTION AND PROBLEM IDENTIFICATION

1.2.1 The Culebra is approximately seventeen miles east of San Juan, Puerto Rico and nine miles north of Vieques (Figure 1-1). The Vieques Sound separates Culebra from Puerto Rico. The Caribbean Sea lies to the south, and the Atlantic Ocean is to the north. The total land area of Culebra and its outlying cays is approximately 8,430 acres, are owned by the United States Fish and Wildlife Service (USFWS), Puerto Rico Department of Natural and Environmental Resources (DNER), the Municipality of Culebra, and private.

1.2.2 Culebra has sandy beaches, irregular rugged coastlines, lagoons, coastal wetlands, steep hills and narrow valleys. Ninety percent of the island is hilly, with the residential population concentrated in the flatlands. Mount Resaca is the highest point on the island, approximately 630 feet above mean sea level. The island has a limited variety of soil types due to its volcanic origin, limited size, rugged terrain, and moderately uniform climate. Most soils, except along the slopes and on the beaches, are the result of weathering bedrock. The Desculabrado series is found on slopes of 20 to 40 percent and on over 75 percent of Culebra Island. The soils are well-drained, runoff is rapid, and permeability is moderate. Vegetation is moderately to extremely dense on undeveloped portions of Culebra and Culebrita. However, vegetation is sparse or absent on many of the smaller cays, as most are rocky with very little soil.

1.2.3 Surface water is scarce, and creeks and streams are intermittent and seasonal. Normally, they are dry and collect and drain runoff only during rainstorms. There are approximately twelve natural springs and seeps, but they are charged only during particularly wet seasons and are not used for domestic purposes.

1.2.4 Fresh water is scarce. There are some shallow (10 to 20 feet deep) wells in areas away from coastal seepage, but the groundwater is high in chloride concentrations and salinity. Due to the shallow bedrock and impermeability of the lava and overlying soil, the potential for groundwater as a source of potable water is virtually nonexistent. No aquifers are on Culebra and the adjacent cays which are used for potable water. Potable water is supplied by a desalination plant built by the Navy and a water line from Puerto Rico.

1.2.5 Currently Culebra has schools, residential areas, a medical clinic, an airport, restaurants, hotels, shops and a few industrial companies. There are two main commercial areas: the town of Dewey, located on the west side of the Great Harbor, and the area surrounding the airport. Most residential development is on the northwest end of Great Harbor; however, residences are scattered throughout the island. Lower Town, Flamenco Point, Mount Resaca, Northwest Peninsula, and all of the beaches are managed by the USFWS or DNER for wildlife conservation and recreational use. It is anticipated that land use on the island will remain the same, and development for similar purposes will likely continue.

1.2.6 The U.S. Census Bureau's (USCB) Census 2000 provided the general demographics of the Municipality of Culebra. Of the 1868 residents 51.9% were male and 48.1% were female with both groups reporting a median age of 36. Resident under 5 Years of age (138 or 7.4%), residents 18 Years of age and over (1,351 or 72.3%), and residents 65 Years of age and Over (237 or 12.4%).

1.3 CULEBRA ISLAND HISTORICAL INFORMATION

1.3.1 In 1898, the Spanish American War concluded, and the Kingdom of Spain ceded all public lands of Puerto Rico to the U.S. Culebra and the Cays are part of Puerto Rico. Shortly after, in 1900, President Theodore Roosevelt placed Culebra under the jurisdiction of the Department of the Navy. In 1903, the Navy acquired approximately 4,200 acres of land by transfer and purchase; further donations, transfers, and leases between 1939 and 1965 brought the total land acquired to approximately 4,800 acres. Although portions of the site were never formally acquired, military use included the entire Island of Culebra and all of the surrounding cays. The Navy retained 87.5 acres near Flamenco Point that are not eligible for FUDS. The 2005 revised Findings and Determination of Eligibility report states that the site, except for 87.5 acres recently transferred from the control of the Navy, has been determined to be formerly used by the Department of Defense (DoD).

1.3.2 Although reconnaissance trips, development of a base, and placement of guns began as early as 1902, the first maneuvers at Culebra did not begin until January 1914, with the Marines first Advance Base Expedition establishing several encampments and 3-inch and 5-inch gun batteries at the mouth of Great Harbor. The Marines' use of the island continued over several more decades. In 1922, an exercise was conducted firing 7-inch, 8-inch, 3-inch, 155-millimeter (mm), 75mm, and 37mm guns. In 1924, maneuvers included establishment of ammunitions dumps throughout the island, firing of 75mm and 155mm guns, and mine placement in several water areas around Culebra.

1.3.3 In 1934, the Navy and Marines organized to carry out the first Fleet Landing Exercise (FLEX), Fleet Problem XV. Weapons used during this exercise included .30-caliber machine guns, 3-inch anti-aircraft guns, 6-inch gun batteries, 75mm batteries, and 6-inch naval guns. Six more FLEXs were conducted on Culebra Island between 1935 and 1941. Photographic accounts document additional Marine landing exercises in 1946 and 1947. Marine training at Culebra is believed to have continued until the late 1950s. The Navy used Culebra and the surrounding cays for bombing and gunnery training from 1935 through 1975. Naval exercises included aerial bombardment, submarine torpedo fire, and naval gunfire directed at the Northwest Peninsula and many cays. All military use of the island was terminated in 1975. In summary, the Island of Culebra, nearby cays, and surrounding water were used between 1902 and 1975 for training and live fire of bombs, mortars, rockets, torpedoes, projectiles, and small arms.

1.3.4 Beginning in 1978, all of the land acquired by the military on Culebra and the surrounding cays were excessed to the Department of the Interior or transferred to the government of Puerto Rico by quitclaim deed. These lands are currently managed by USFWS, DNER, or the Municipality of Culebra. No official lease or transfer documents have been identified for the remainder of the privately owned land; however, any portion of the island may have been used by the military during its long history of training on Culebra.

1.3.5 The Culebra FUDS consists of 13 MRSs, totaling 9,460 acres (8,430 land acres and 1,030 acres of water). This RI covers 4 of the 13 MRSs: Cerro Balcon and

Adjacent Cays (MRS 02), Flamenco Lagoon Maneuver Area (MRS 04), Mortar and Combat Range Area (MRS 05), and Culebrita Artillery Impact Area (MRS 07), as illustrated in Figure 1. Below is a description of each MRS including historical military use, property acquisitions and excesses, known munitions use and present ownership.

1.4 Munitions Response Sites

1.4.1 MRS 02 – Cerro Balcon and Adjacent Cays

1.4.1.1 For this investigation, MRS 02 includes Cerro Balcon, Cayo Ballena, Cayo Lobo (also known as Cross Cay), Cayo Lobito, Cayo Del Agua (also known as Water Key), Cayo Yerba, Cayo Raton, Los Gemelos (also known as Twin Rock), Cayo Geniqui (also known as Palada Cay), and Cayo Sombrerito (Figure 1-1). The Northwest Peninsula of Culebra is also part of MRS 02 but was excluded from the investigation in accordance with Public Law 93-166. Cerro Balcon is a former 28-acre mortar range in the center of MRS 5. The adjacent Cays consist of approximately 88 acres. All cays are considered conservation priority areas for Culebra.

1.4.1.2 The Navy conducted fleet maneuvers and FLEX on MRS 02 (Cays) between 1923 and 1941. During these exercises, the surrounding cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds. Training continued through the 1950s and 1960s, and in the early 1960s aerial bombardment was expanded from Northwest Peninsula, Los Gemelos, and Alcarazza to most of the cays on the east and west side of Culebra. Training continued until 1975. Cerro Balcon, in the center of Culebra MRS 5, was used as a mortar range target. Records show that the property near Cerro Balcon was leased beginning in 1924 to around 1939.

1.4.1.3 In 1975, the Navy issued a report of excess for the land associated with the Navy's original 1900 holdings. In 1980, the General Services Administration transferred 776 acres to the USFWS to establish the Culebra National Wildlife Refuge. The remaining 936 acres were accepted in a quitclaim deed from the Secretary of the Interior by the Governor of Puerto Rico in 1982. Currently, the USFWS manages the cays associated with MRS 02.

1.4.2 MRS 04 – Flamenco Lagoon Maneuver Area

The 550-acre MRS 04 includes Flamenco Lagoon and the hillside east of the lagoon (Figure 1-2). Records show that Combat Range #2, located on the south side of Flamenco Beach, was used for direct and indirect fire of small arms and 81mm mortars from firing positions on the hillside within MRS 04 during FLEX #4 in 1938. Firing positions for 75mm projectiles used during FLEX #5 in 1939 were also located in MRS 04. There are no records for lease or excess of this property; the majority of the MRS is currently under private ownership. DNER manages the property along the beaches on the northeastern side of the site. Portions of the MRS include dense vegetation and steep terrain that restricts certain access and activity. Figure 1-5 shows areas within the MRS with potentially restrictive terrain and vegetation.

1.4.3 MRS 05 – Mortar and Combat Range Area

MRS 05, the largest MRS, includes most of the landmass between Resaca Beach and Carenero Point, totaling approximately 2,842 acres (Figure 1-3). Historical training records indicate that many of the hills in this area may have been used for direct fire. Cerro Balcon Mortar Range, which is part of MRS 02, is surrounded by MRS 05. Unexploded ordnance (UXO) has been identified near Cerro Balcon on portions of the MRS 05 property. MRS 05 includes two 1936 combat training areas leased for combat, target, and sweep-of-fire range training. Small arms and 81mm mortars may have been used at Combat Range #1 in 1937. A 1924 standing barrage training area is also included in the MRS. Historical records indicate that land within MRS 05 was leased in 1924 from Mr. A. Lugo for gun emplacements and other possible camp sites. The property was returned to Mr. A. Lugo in November 1939. Most of MRS 05 is privately owned; however, USFWS manages a large portion of the property surrounding Mount Resaca and DNER manages the property along the beaches on the northeastern side of the site. Portions of the MRS include dense vegetation and steep terrain that restricts certain access and activity. Figure 1-5 shows areas within the MRS with potentially restrictive terrain and vegetation.

1.4.4 MRS 07 – Culebrita Artillery Impact Area

MRS 07 includes the northern portion of Culebrita as well as Cayo Botella (a.ka. Ladrone Cay) (Figure 1-4). The Marines used this 375-acre area as an artillery impact area between 1936 and the late 1940s. The United States and the United Kingdom used Cayo Botella for an aircraft bombing/rocket target in 1969. Munitions included 20mm projectiles, flares, live and practice bombs up to 500 pounds, and 2.75-inch rockets as well as British bombs and rockets. Culebrita beaches and trails are used recreationally, and many boats visit the island each year. Culebrita was part of the land designated for use by the Department of the Navy in 1900; it was reported excess in 1972. This MRS is managed by the USFWS.

1.5 PREVIOUS INVESTIGATIONS

1.5.1 The following previous investigations are summarized for Culebra. For additional detail, please see the specific report referenced. These investigations cover all of Culebra including MRSs not covered in this RI; in each case the applicable data is specified. Table 1-1 includes a summary of previous MEC found at only the MRSs and areas covered within this RI.

1.5.2 1991 Inventory Project Report (INPR)

An INPR was signed on 24 December 1991, establishing the Culebra as a FUDS, defining a site boundary, and assigning FUDS Project Number I02PR006800 (USACE, 1991). The Findings and Determination of Eligibility concluded that “the site, except for 87.5 acres still under control of the Navy, has been determined to be formerly used by the Department of Defense. It is therefore eligible for the Defense Environmental Restoration Program (DERP)."

1.5.3 1995 Archives Search Report

The Archives Search Report (ASR) was completed by the USACE Rock Island District in February 1995 (USACE, 1995) after reviewing available records, photographs, and reports that documented the history of the site. As part of the ASR, a site visit was conducted in October 1994, during which the team identified munitions debris (MD) on Cayo Botella, Cayos Geniqui and Cayo del Agua. In addition, MD was identified on Flamenco Beach, Flamenco Peninsula, and the hillside near Cerro Balcon. The ASR listed several ordnance items verified on site by either explosive ordnance disposal personnel or the ASR field team.

1.5.4 1995 Interim Remedial Action

In 1995 MTA, Inc. completed an interim remedial action on 3.66 acres of the Flamenco Bay Campground near Flamenco Beach to dispose of unexploded ordnance within 2 feet of the ground surface at the campground. Work was conducted on the site between 12 May and 26 May 1995. MTA found 11 items of MEC and MD**.** While part of Flamenco Beach falls within MRS 04, the area covered in this interim removal action is outside the MRS boundary.

1.5.5 1997 Final Engineering Evaluation / Cost Analysis

In April 1997, Environmental Science and Engineering, Inc. (ESE) submitted the final engineering evaluation and cost analysis (EE/CA) for Culebra. The EE/CA investigation included surface and subsurface sample grids on Flamenco Peninsula, Isla Culebrita (MRS 07), Cayo Botella (MRS 07), Cayo del Agua (MRS 02), Cayo Lobo (MRS 02), and Cerro Balcon (MRS 02). MEC were found in all areas except Cayo Lobo and Cerro Balcon, where only MD was identified.

1.5.6 2004 Unexploded Ordnance (UXO) Construction Support

In June 2004, Ellis Environmental Group, LC (Ellis) submitted the *Site-Specific Final Report, UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico* (Ellis, 2004a). The report documented clearance efforts conducted by Ellis on Northwest Peninsula. The Northwest Peninsula is part of MRS 02, but this portion of MRS 02 was not included in this RI. Ellis performed four phases of clearance from January 2001 to February 2004. Phase I consisted of construction support by clearing roadways, a wind generator foundation, a desalination plant foundation and re-grading the site. Phase II of the construction support was not exercised due to a stop in funding for the construction project. Phase III included surface clearance of 70 acres of bird nesting area and 4-foot-depth subsurface clearance of roadways, firebreaks and an observation post. Phase IV consisted of demilitarization of MD, construction of a fence and information kiosk, and development of public awareness information. The public awareness information included a video, safety posters and brochures.

1.5.7 2004 Archives Search Report Supplement

The ASR Supplement was completed by the USACE Rock Island District as an addition to the 1995 ASR (USACE, 2004). This report provides details of aerial training conducted by the Navy between 1935 and 1975 and identifies the following range areas.

- Mortar Range: This area is also called Cerro Balcon and is part of MRS 02 (located within MRS 05). The following munitions may have been used in this area: 3" mortars and 4.2" mortars.
- Shark Rock: Part of MRS 02, also known as Cayo Tiburon, this area was used as a target for aerial gunnery with bombs and rockets. Suspected ordnance includes 500-pound bombs and 5-inch rockets. Cayo Tiburon is not included within the scope of this RI because it was determined to be inaccessible during the project scoping process.
- Palada Cay: Part of MRS 02, also known as Cayos Geniqui, this area was used as a target for aerial gunnery with bombs and rockets. Suspected ordnance includes 500-pound bombs and 5-inch rockets.
- Ladrone Cay: Part of MRS 02, also known as Cayo Botella (MRS 7), this area was used as a target for aerial gunnery with bombs and rockets. Suspected ordnance includes 500-pound bombs and 5-inch rockets.
- Culebrita Strafing Range: This strafing range target was on the north side of Culebrita and is part of MRS 07. Suspected munitions include small arms, and 20 mm high-explosive incendiary (HEI) rounds.
- Culebrita Torpedo Range: Firing at this range from the water north of Culebrita targeted the sheer cliffs of Cayos Geniqui, part of MRS 02. Suspected munitions include the Navy's general torpedo.
- Twin Rocks: This area, also known as Los Gemelos, is part of MRS 02. These cays were used as targets for aerial bombs and rockets. Munitions included bombs, 5-inch rockets and 5-inch practice rockets.
- Fungy Bowl: This area, also known as Alcarazza, is part of the original MRS 02 but not included within the scope of this RI because it was determined to be inaccessible during the project scoping process. This large rock was used as a target for aerial bombs and rockets. Suspected munitions include bombs and 5-inch rockets.
- Cross Cay: This area, also known as Cayo Lobo, is part of MRS 02 and was used as a strafing and bombing target. Munitions included small arms, bombs, and 20 mm high-explosive incendiary.
- Agua Cay: This area, also known as Water Key, is part of MRS 02 and was used as a target for bombing and rocket fire. Munitions include general purpose bombs and 2.75-inch rockets.
- Air-to-Ground North: This target, at the northern tip of Northwest Peninsula, is part of the original MRS 02 but not included in the scope of

this RI because it was determined to be inaccessible during the project scoping process. Munitions used include small arms, 500-pound bombs, 2.75-inch rockets, and 11.75-inch Tiny Tim rockets.

- Air-to-Ground South: This target was located at the northern tip of Northwest Peninsula and is part of the original MRS 02 but not included in the scope of this RI because it was determined to be inaccessible during the project scoping process. Munitions used include small arms, 500-pound bombs, 2.75-inch rockets, and 11.75-inch rockets.
- Rifle Range South: This small arms range is believed to be located on undeveloped land near the southern tip of the island in MRS 09, which is not included in this RI. This range has not been confirmed; however, munitions used at this range would have included only small arms.

1.5.8 2005 Revised Inventory Project Report

A Revised INPR was completed in June 2005 (USACE, 2005a). The Revised INPR further clarified the military use of the Island of Culebra and divided the original site, Property No I02PR0068, into 14 separate MRSs. One hazardous and toxic waste project was identified and assigned the number 00, and 13 MMRP project areas were identified and assigned Risk Assessment Code scores. MRS 01 was not defined.

1.5.9 2005 Supplemental Archives Search Report

The Supplemental ASR was completed by the USACE St. Louis District in 2005 as an addition to the 1995 ASR (USACE, 2005c). The Supplemental ASR is the source of most of the historical information pertaining to site operations and identifies the key areas of focus for the SI. This document provided a detailed summary of military activities conducted on Culebra and the surrounding cays. The document summarizes planned and/or executed maneuvers and training conducted at the site, including specific time periods, locations, and munitions used.

1.5.10 2006 Non Time-Critical Removal Action

Ellis Environmental Group, under contract to USACE, completed a non-time-critical removal action on portions of Culebra. The surface clearance included Cerro Balcon, Culebrita, and the adjacent cays (Cayo Botella, Cayo Tiburon, Los Gemelos, Cayo del Agua, Cayo Genequi, Cayo Lobo and Cayo Alcarraza). Soil samples were collected at Cayo Lobo and Cerro Balcon.

1.5.11 2007 Site Inspection (SI)

Parsons conducted a SI to determine if further investigation under the MMRP were warrented. Due to the presence of MEC and MD observed during previous investigations and during the SI field visit, a RI was recommended at 12 of the 13 MRSs. No MEC was identified during the SI; however, MD was identified on MRS 02, MRS 05, and MRS 07. No MD was found at MRS 04. At MRS 02, MD was identified on Cayo Del Agua only. The Cays were only observed from a boat since they were inaccessible due to wave action, steep terrain and rocky cliffs.

1.5.12 2008 Non Time-Critical Removal Action

USA Environmental conducted a non time-critical removal action on Flamenco Beach (a portion of which is within MRS 04) and within selected beach areas at Isla Culebrita (MRS 07). The scope included Digital Geophysical Mapping (DGM) and the removal and disposal of all explosive hazards within the selected beach areas at Isla Culebrita and Culebra. MEC and MD were identified on Flamenco Beach and the Culebrita Beaches.

Table 1-1: MEC Items Previously Identified for MRS 02, 04, 05 and 07

Item	Quantity	MRS	Reference	Location	Date
500 pound Bomb	1	2	ASR	West of Cayo Ballena	1983
500 pound Bomb	2	2	ASR	West of Cayo Geniqui (60 feet of water)	1983
Torpedo	1	2	ASR	East of Cayo Geniqui (60 feet of water)	1983
Practice Bomb with spotting charge	11	2	EE/CA	Cayo del Agua AQ-1	1997
Practice Bomb, with spotting charge	5	2	EE/CA	Cayo del Agua AQ-1	1997
76 mm Projectile	1	2	EE/CA	Cayo del Agua AQ-1	1997
Practice Bomb, with spotting charge	2	7	EE/CA	Cayo del Botella BO-1	1997
Practice Bomb with spotting charge	4	7	EE/CA	Cayo del Botella BO-1	1997
6 inch Naval Gunfire	1	7	EE/CA	Cayo del Botella BO-1	1997
Practice Bomb with spotting charge	6	7	EE/CA	Cayo del Botella BO-2	1997
Practice Bomb, practice with spotting charge	3	7	EE/CA	Cayo del Botella BO-2	1997

Item	Quantity	MRS	Reference	Location	Date
Practice Bomb with spotting charge	3	7	EE/CA	Cayo del Botella BO-2	1997
Spotting charge	1	7	EE/CA	Cayo del Botella BO-2	1997
20 mm Projectile	5	7	EE/CA	Culebrita IC-4	1997
20 mm Projectile	2	7	EE/CA	Culebrita IC-5	1997
20 mm Projectile	3	7	EE/CA	Culebrita IC-5	1997
20 mm Projectile	23	7	EE/CA	Culebrita IC-6	1997
20 mm Projectile	2	7	EE/CA	Culebrita IC-6	1997
20 mm Projectile	4	7	EE/CA	Culebrita IC-6	1997
Fuze, M151	1	2	Ellis NTCRA	Cayo Lobo	2006
25 Pound Practice	28	2	Ellis NTCRA	Cayo Lobo	2006
5 pound Practice Bomb	4	2	Ellis NTCRA	Cayo Lobo	2006
5 inch Projectile	1	2	Ellis NTCRA	Cayo Lobo	2006
3 inch Projectile	1	2	Ellis NTCRA	Cerro Balcon	2006
Powder Train Time Fuze (PTTF)	2	2	Ellis NTCRA	Cerro Balcon	2006
3 inch Projectile	2	2	Ellis NTCRA	Cerro Balcon	2006
81 mm Mortar	2	2	Ellis NTCRA	Cerro Balcon	2006
20 mm Projectile	6	7	USAE NTCRA	Culebrita (NW beach)	2008
5 inch Projectile	1	4	USAE NTCRA	Flamenco Beach	2008

Note: Only MEC items reported within the MRS boundaries included in this RI report are included.

Culebra Munitions Site
Culebra, Puerto Rico

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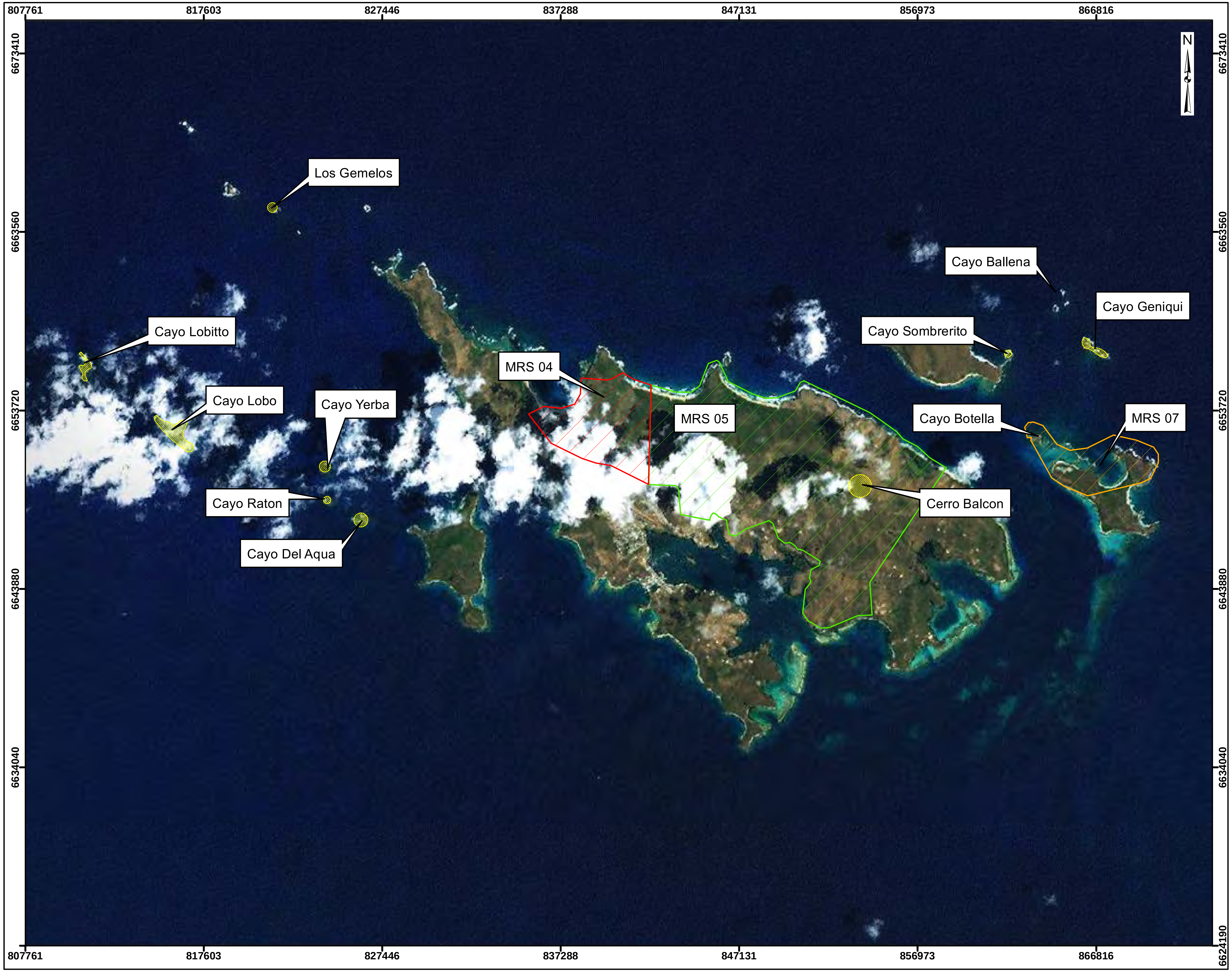
Figure 1-1
Munitions Response Site Overview



Legend

- MRS 02 – Cerro Balcon and Adjacent Cays
- MRS 04 – Flamenco Lagoon Maneuver Area
- MRS 05 – Mortar and Combat Range Area
- MRS 07 – Culebrita Artillery Impact Area

0 1,500 3,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

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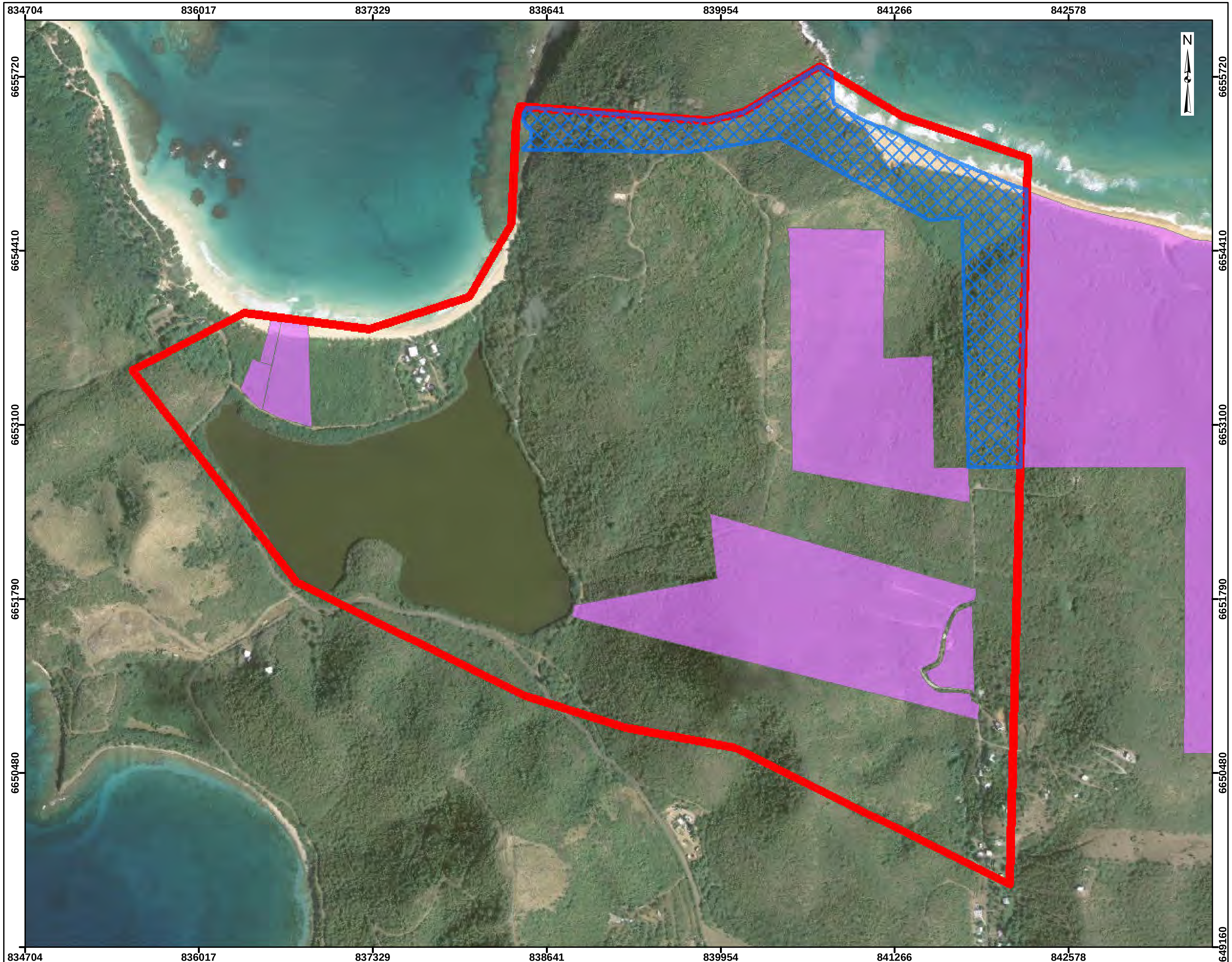

Figure 1-2
MRS 04 – Flamenco Lagoon Maneuver Area

Legend

MRS 04 Boundary
MRS 04 Fish & Wildlife Area
Right of Entry (ROE) Received

0 200 400 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

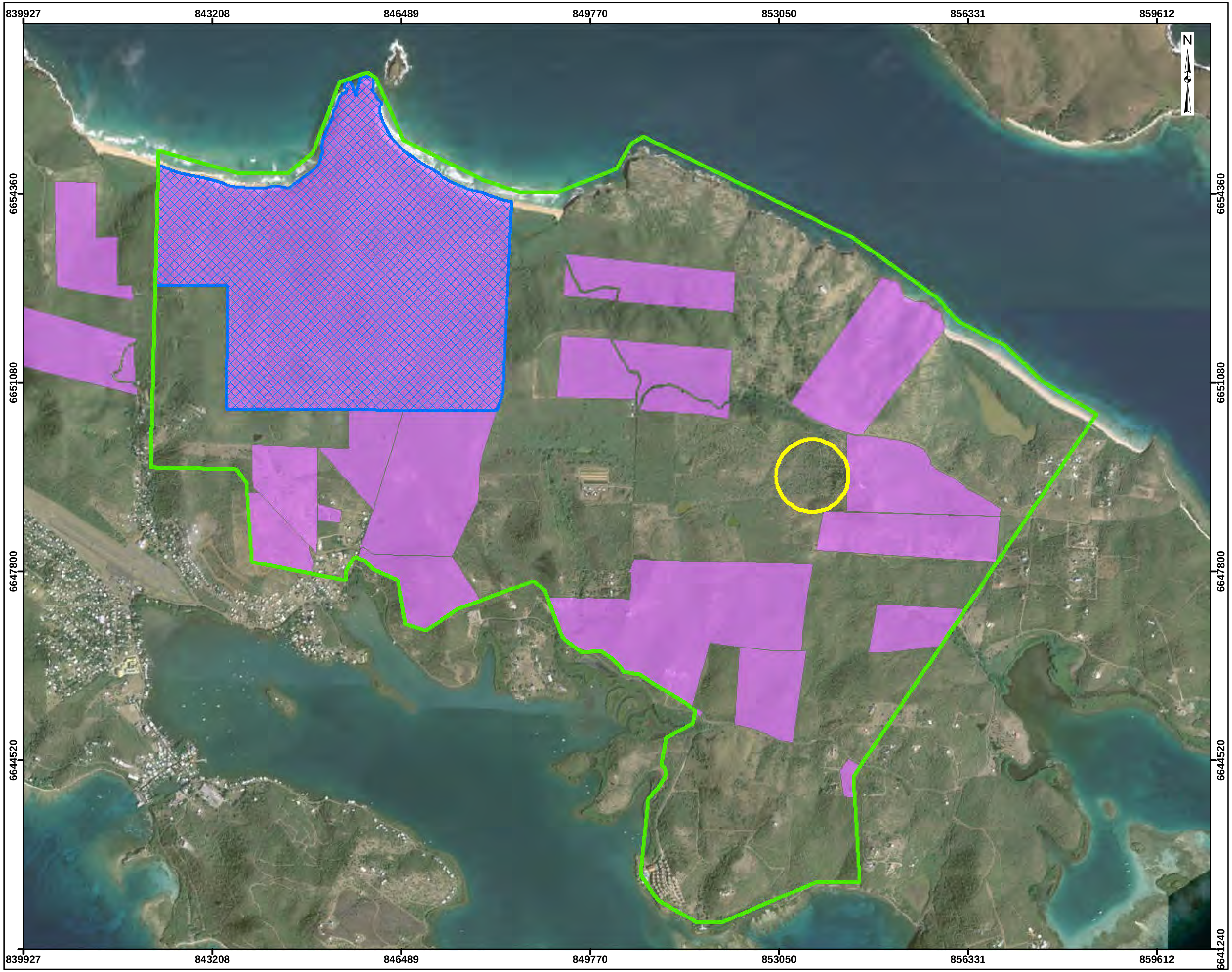

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Figure 1-3
MRS 05 – Mortar and Combat Range Area

Legend

- MRS 05 Boundary
- MRS 02 Boundary
- MRS 05 Fish & Wildlife Area
- Right of Entry (ROE) Received

0 500 1,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

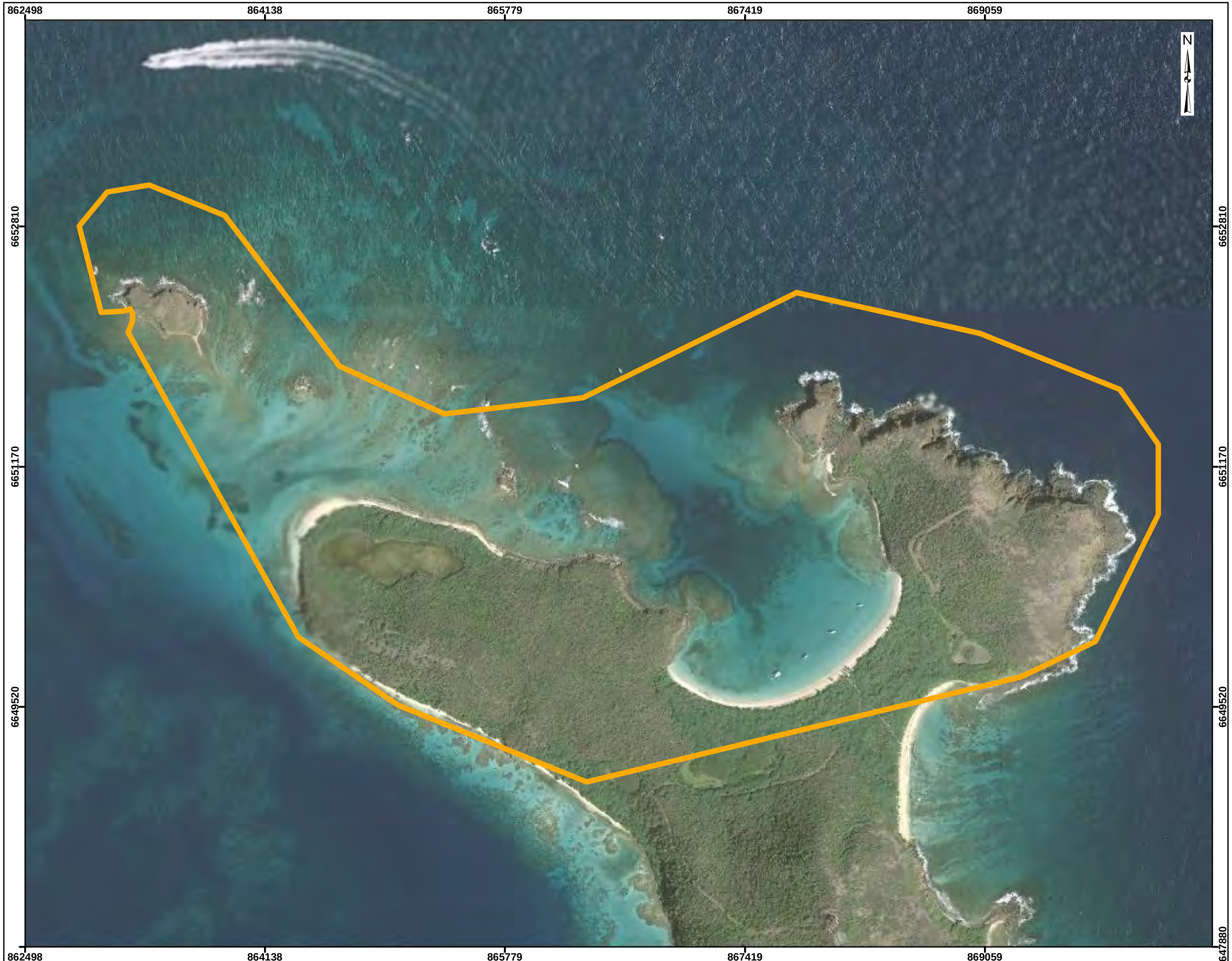

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Figure1-4
MRS 07 – Culebrita Artillery Impact Area

Legend

MRS 07 Boundary

0 200 400 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

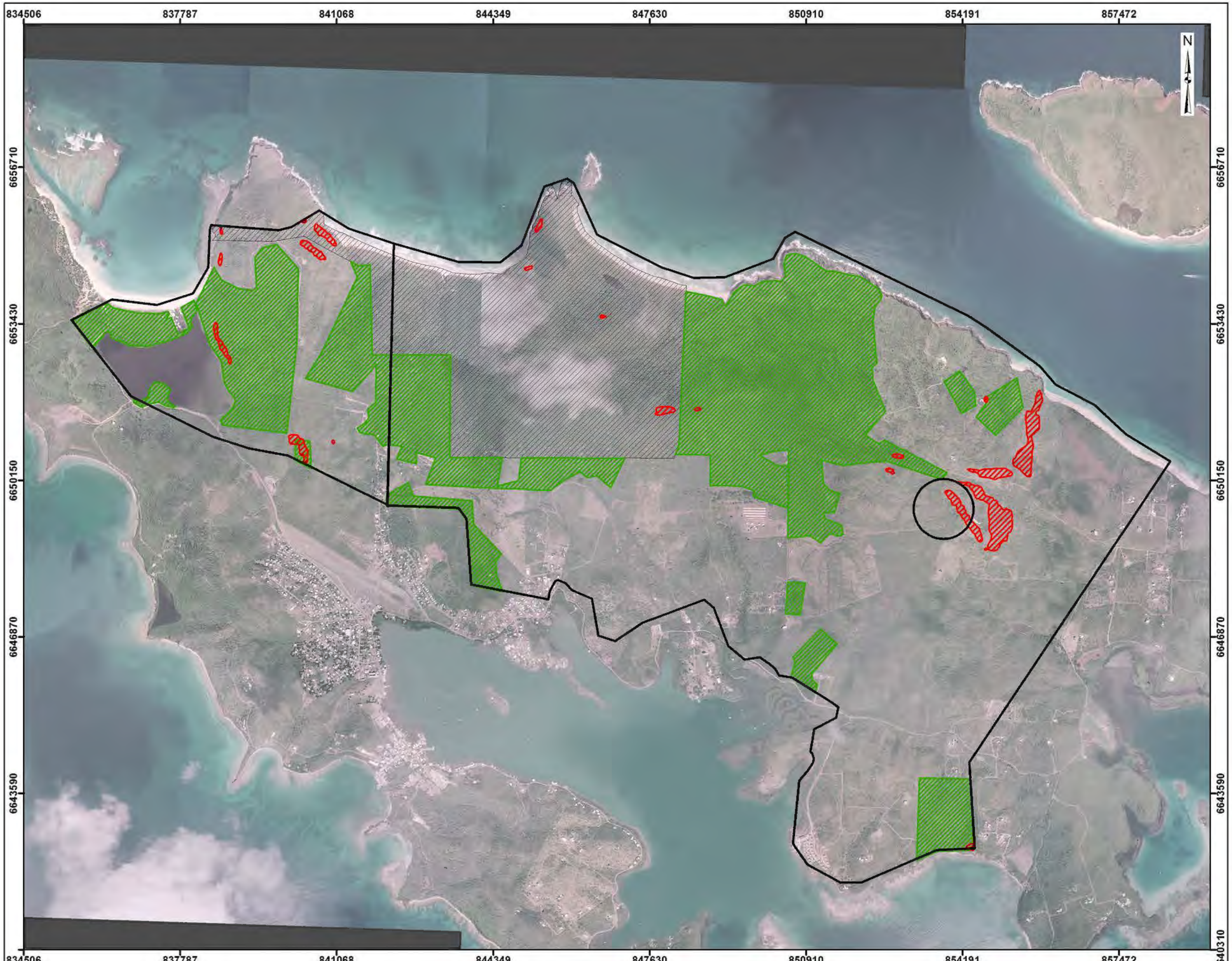

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Figure 1-5
Potentially Restrictive Terrain / Vegetation

Legend

- MRS Area
- +30 Degree Slope
- Potentially Restrictive Vegetation
- MRS 05 & 04 Fish & Wildlife Area

Note: This map shows areas within the remaining lands of MRS 04 and MRS 05 with potentially restrictive vegetation and terrain.

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

2 PROJECT REMEDIAL INVESTIGATION OBJECTIVES

2.1 CONCEPTUAL SITE MODEL (CSM) AND PROJECT APPROACH

2.1.1 Project Approach

2.1.1.1 All RI tasks were performed in accordance with the Final MMRP Work Plan (EOTI, 2010). The Work Plan, which includes the Sampling and Analysis Plan, was approved by the Corps of Engineers on 23 September 2010. The following summarizes the key elements of the RI for the sites investigated on Culebra.

<u>Explosives Site Plan (ESP)</u> – An ESP was prepared by the Army in accordance with Data Item Description (DID) MMRP-09-003 (Safety Submissions) and Engineer Manual (EM) 1110-1-4009 (USACE, 2007b). The ESP is a stand-alone document that provided specifics on the minimum separation distance (MSD) and engineering controls that were enforced during intrusive operations. The Final ESP was approved on 15 October 2010.

<u>RI Final MMRP Work Plan</u> – The RI Final MMRP Work Plan provided a detailed approach for MEC and MC RI activities. The Final MMRP Work Plan was approved by the Army, USEPA, and Puerto Rico Environmental Quality Board (PREQB) and is dated March 2010.

<u>RI Fieldwork</u> – Fieldwork included the following tasks to meet the objectives of the RI: Geophysical Prove-Out (GPO), intrusive investigation of subsurface anomalies, MC sampling and analysis. Field work was conducted within portions of MRS 04, 05, and 07. RI field work was not conducted in MRS 2.

<u>GPO</u> – A GPO was conducted to test the proposed equipment and methodologies in a site specific environment. However, analog methods were utilized in the field rather than DGM and as such the GPO results were not utilized. The decision to utilize analog geophysical methods was based on limited access to areas where the DGM methods are most appropriate. Limited rights of entry significantly reduced access to planned transect locations. Additionally, terrain and vegetation in much of the area with rights of entry reduced the effectiveness of DGM methods. The Final GPO Report is included as Appendix A.

<u>Intrusive Investigation</u> – An intrusive investigation along transects and grids was conducted at MRS 04, MRS 05, and MRS 07. This task included intrusive investigation of anomalies, suspected MEC/Material Potentially Presenting an Explosive Hazard (MPPEH) destruction; MEC/MPPEH accountability and anomaly count; final disposal of MPPEH, MD, and range scrap; and MPPEH inspection.

<u>MC Sampling and Analysis -</u> Surface soil and sediment samples were collected from MRS 04, MRS 05 and MRS 07 and analyzed for explosives and select metals.

RI Report – This report is submitted in accordance with the USEPA document Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)(1988) and the MMRP Center of Expertise Technical Update. The RI Report is also submitted in accordance with the U.S. Army Munitions Response Remedial Investigation / Feasibility Study Guidance (USACE & USAEC, 2009d.

2.1.2 Initial CSM

2.1.2.1 The following presents the initial CSM for the Culebra MRSs based on the SI data and data presented during the TPP process. No updates have been made to this CSM, which is considered the baseline. The updated CSM with explosive pathway analysis using results from the field work is presented in Section 4.0.

2.1.2.1.1 Site Profile

Conceptual Site Model Information Profiles – Site Profile	
Information Needs	**Current/Preliminary Information**
FUDS Location	Culebra, Puerto Rico
FUDS Name	Culebra Island - Former Used Defense Sites
FUDS Location	Culebra is located approximately seventeen miles east of Puerto Rico, twelve miles west of St. Thomas and nine miles north of Vieques. Its coordinates are Latitude 18.33º N and Longitude: 65.33º W
Culebra Island Military History	In 1898 Spain ceded public lands in Culebra and its adjacent cays to the U.S. In 1900, President Theodore Roosevelt placed Culebra under the jurisdiction of the Department of the Navy which through additional donations, transfers, and leases brought the total land controlled to approximately 4,800 acres. While portions of the Island were never formally acquired, military use included the entire Island of Culebra and all surrounding cays. While some advanced activities occurred as early as 1902, the first maneuvers at Culebra did not begin until January 1914, with the Marines First Advance Base Expedition establishing several encampments and 3- inch and 5-inch gun batteries at the mouth of Great Harbor. The Marines' use of the island continued with exercises involving the firing of a range of artillery including 37mm, 75mm, 3-inch, 155-mm, 7- inch, and 8-inch projectiles. In 1924, maneuvers included establishment of ammunitions dumps throughout the island, firing of 75mm and 155mm guns, and mine placement in several water areas around Culebra. The Navy and Marines began organizing joint exercises in 1934, referred to as the first Fleet Landing Exercise (FLEX), Fleet Problem XV. The exercises continued through 1941 and included the use of

Conceptual Site Model Information Profiles – Site Profile	
Information Needs	**Current/Preliminary Information**
	.30 - caliber machine guns, 75mm batteries, 3-inch anti-aircraft guns, 6-inch gun batteries, and 6-inch naval guns. The operational history documents additional Marine landing exercises in 1946 and 1947 but training exercises are believed to have continued until the late 1950s. From 1935 through 1975 the Navy used Culebra Island and surrounding cays for exercises involving aerial bombardment, submarine torpedo fire, and naval gunfire directed at Northwest Peninsula and many cays. All military use of the island was terminated in 1975. In 1971 the people of Culebra began protests, known as the Navy-Culebra protests, for the removal of the US Navy from Culebra. Four years later, in 1975, the use of Culebra as a gunnery range ceased and all operations were moved to Vieques. Beginning in 1978, all of the land acquired by the military on Culebra and the surrounding cays were transferred to the Department of the Interior or transferred to the government of Puerto Rico by quitclaim deed. These lands are currently managed by USFWS, DNER, or the Municipality of Culebra.
Culebra Island Layout	Culebra (Snake Island) is an island municipality of Puerto Rico. It is also known as "Isla Chiquita" (Small Island) and "Ultima Virgen" (Last Virgin). Its total area including surrounding Cays is 7,000 acres. It is an archipelago consisting of the main island and twenty-three smaller islands that lie off its coast. The largest of these cays are: Culebrita to the east, Cayo Norte to the northeast, and Cayo Luis Peña and Cayo Lobo to the west. It is divided in five wards: Dewey (capital), Flamenco, Fraile, Playa Sardinas 1, Playa Sardinas 2 and San Isidrio. Culebra is characterized by an irregular topography and is approximately 7 by 5 miles. The coast is marked by cliffs, sandy coral beaches and mangrove forests. Inland, the tallest point on the island is Mount Resaca, with an elevation of 650 feet. According to the U.S. Army Corps the Island of Culebra and surrounding cays were divided into 13 MRSs based on the islands geography and historic military use totaling 9,460 acres (8,430 land acres and 1,030 acres of water).
Former Used Military and Current Island Structures	Facilities constructed by the Navy included a desalination plant, an airfield, barracks, helicopter pads, range instrumentation facilities, gun sites (for the defense of the islands), observation points, and impact ranges for aerial bombs and rockets, missiles, mortars, and naval ordnance.

Conceptual Site Model Information Profiles – Site Profile	
Information Needs	**Current/Preliminary Information**
	Currently the island has schools, residential areas, a clinic, an airport, restaurants, hotels, shops, and a few industrial companies. Water is provided by a desalination plant, built by the Navy, located on DNER land near the USFWS and DNER offices. The surrounding cays have no structures except Cayo Norte, which has a few full-time residents, and Culebrita, where the oldest operating lighthouse in the Caribbean is still maintained. Only Culebra and Cayo Norte have full-time residents.
MRS Boundaries and Landowners	Culebra Island and the adjacent cays have sandy beaches, irregular rugged coastlines, lagoons, coastal wetlands, steep mountains, and narrow valleys. Ninety percent of the island is mountainous, with population concentrations in the flatlands. The highest point on the Island is Monte Resaca, which is approximately 630 feet above mean sea level. The second highest point is Cerro Balcon at 511 feet above mean sea level. Below is a description of each MRS included in this Task Order and information about present ownership of the land comprising the MRS. **MRS-02 – Northwest Peninsula, Cerro Balcon, and Adjacent Cayos** This MRS includes Northwest Peninsula, Cerro Balcon, Cayo Lobo, Cayo Lobito, El Mono, Cayo Del Agua, Cayo Yerba, Cayo Raton, Alcarraza, Los Gemelos, Piedra Stevens, Cayo Tiburon, Cayos Geniqui, and Cayo Sombrerito, encompassing approximately 660 acres. In 1980, the General Services Administration (GSA) transferred 776 acres to the USFWS to establish the Culebra National Wildlife Refuge. The remaining 936 acres were accepted in a quitclaim deed from the Secretary of the Interior by the Governor of Puerto Rico in 1982. As part of this quitclaim deed, the governor agreed to the provisions of Section 204 of Public Law 93-166 stating that Northwest Peninsula was accepted in its present condition, having been used as a bombardment area by the Navy. It also stated that the grantor will hold no responsibility for decontamination nor any claims of damage or loss of property or persons associated with use or presence on the property. In accordance with Public Law 93-166, data were not collected on Northwest Peninsula. Currently, the DNER manages the southern half of Northwest Peninsula and the USFWS manages the northern half of Northwest Peninsula and the cays associated with MRS-02. **MRS-04 – Flamenco Lagoon Maneuver Area**

Conceptual Site Model Information Profiles – Site Profile	
Information Needs	**Current/Preliminary Information**
	The 550-acre MRS-04 includes Flamenco Lagoon and the hillside east of the lagoon. There are no records for lease or excess of this property; it is currently under private ownership. **MRS-05 – Mortar and Combat Range Area** MRS-05, the largest MRS on Culebra Island, includes most of the landmass between Resaca Beach and Carenero Point, totaling approximately 2,842 acres. Historical records indicate that 1,500 acres of land within MRS-05 and part of MRS 06 were leased in 1924 from Mr. A. Lugo for gun emplacements and other possible camp sites. The property was returned to Mr. A Lugo in November 1939. Most of MRS-05 is privately owned; however, USFWS manages a large portion of the property surrounding Mount Resaca and DNER manages the property along the beaches on the northeastern side of the site. **MRS-07 – Culebrita Artillery Impact Area** MRS-07 includes the northern portion of Culebrita as well as Cayo Botella. Culebrita beaches are used recreationally, and many boats visit the island each year. This MRS is managed by the USFWS.

2.1.2.1.2 Munitions / Release Profile

Conceptual Site Model Information Profiles – Munitions/Release Profile	
Information Needs	**Preliminary Information**
Release Profiles for Culebra Island MRSs	Culebra Island and adjacent cays were used as an impact range for aerial bombs and rockets, missiles, mortars, and naval projectiles and torpedoes from 1903 until 1975. Munitions and Explosives of Concern, to include UXO, and Munition Constitutes (MC) can exist at these MRSs in a number of physical states that may create risk from exposure to explosive and chemical hazards. MEC may occur at the MRSs from either being abandoned or discarded at the site or from fired munitions that failed to function as designed. MC can be released from fully intact munitions through corrosion and breaching of the casing or the development of cracks, or from dissolved filler leaking through screw threads on the munition casing, or exposed filler that resulted from incomplete detonation. This explosive filler may be scattered over the MRS or partially encased in the remains of the munition casing. **MRS-02 – Northwest Peninsula, Cerro Balcon, and Adjacent Cayos** The Navy conducted fleet maneuvers and FLEXs on MRS-02 between 1923 and 1941. During these exercises, Northwest Peninsula and the surrounding cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds. Training continued through the 1950s and 1960s, and in the early 1960s aerial bombardment was

Conceptual Site Model Information Profiles – Munitions/Release Profile	
Information Needs	**Preliminary Information**
	expanded from Northwest Peninsula, Los Gemelos, and Alcarazza to most of the cays on the east and west side of Culebra. Training continued until 1975. Cerro Balcon, in the center of Culebra, was used as a mortar range target. **MRS-04 – Flamenco Lagoon Maneuver Area** Records show that Combat Range No. 2, located on the south side of Flamenco Beach, was used for direct and indirect fire of small arms and 81mm mortars from firing positions on the hillside within MRS-04 during FLEX No. 4 in 1938. Firing positions for 75mm projectiles used during FLEX No. 5 in 1939 were also located in MRS-04. **MRS-05 – Mortar and Combat Range Area** MRS-05, the largest MRS on Culebra Island, includes most of the landmass between Resaca Beach and Carenero Point, totaling approximately 2,842 acres. Historical training records indicate that many of the hills in this area may have been used for direct fire. Cerro Balcon Mortar Range, which is part of MRS-02, is surrounded by MRS-05. Unexploded ordnance (UXO) has been identified near Cerro Balcon on portions of the MRS-05 property. MRS-05 includes two 1936 combat training areas leased for combat, target, and sweep-of-fire range training. Small arms and 81mm mortars may have been used at Combat Range No. 1 in 1937 during FLEX No. 4. A 1924 standing barrage training area is also included in the MRS. **MRS-07 – Culebrita Artillery Impact Area** MRS-07 includes the northern portion of Culebrita as well as Cayo Botella. The Marines used this 375-acre area as an artillery impact area between 1936 and the late 1940s. The United States and the United Kingdom used Cayo Botella for an aircraft bombing/rocket target in 1969. Munitions included 20mm projectiles, Mk 44 and Mk 45 flares, live and practice bombs up to 500 pounds, and 2.75-inch rockets as well as British bombs and rockets.
Types of Munitions Used at Each MRS	<u>**MRS-02**</u> – **Bombs:** GP: Mk 81; Mk 82; Mk 83; Mk 84 GP Practice Bomb: MK 76, 100 lb. bomb, **Rocket:** 5-inch Zuni; 5-inch; Tiny Tim 11.75-inch Mk 1 mod 0; general rockets Practice Rocket: Mk 8, 2.75- inch **Projectiles:** HEI Projectile: 20mm; 76mm; 105mm HE Projectile: M1; 155mm; 75mm; 37mm AP: 8-inch Mk 21; 16-inch Mk 5; 7-inch; 8-inch; 3-inch; 6- inch; 12-inch shell; 3-inch shell 5-inch Flat Nose; 5-inch common; 5-inch HE; 5-inch Naval ; 6-inch; 4-inch shrapnel; 3-inch HE; 3-inch shrapnel; 14- inch projectile; 12-inch **Mortar**: 81mm HE and practice; 3-inch, HE MK1; 4.2-inch HE M329A1**Torpedo**: General Navy **Aircraft flares** <u>**MRS-04**</u> **- Mortar:** 81mm HE and practice; 75mm shrapnel <u>**MRS-05**</u> - **Mortar:** 81mm HE and practice; 75mm practice <u>**MRS-07**</u> - **Bombs:** GP Bomb: Mk 82, 500-pound **Rocket:** 5-inch

Conceptual Site Model Information Profiles – Munitions/Release Profile	
Information Needs	**Preliminary Information**
	Zuni; **Projectile:** 75mm; 20mm HEI MkI; 75mm, 2.75-inch
Period of Use	At varying levels from 1902 until 1975
Munition Locations Based on Operational History	**MRS-02 –Northwest Peninsula, Cerro Balcon, and Adjacent Cayos** Several previous investigations at this MRS have confirmed the presence of MEC and MD items. MRS-02 is a very diverse site that includes the smaller cays surrounding Culebra Island, Northwest Peninsula, and portions of Cerro Balcon. As shown above in the Types of Munitions section, MRS-02 has a large and diverse population of MEC items most of which were found on the Northwest Peninsula and Flamenco Beach, but MEC items have also been identified on Cayo Del Agua, Cayo Botella, Cayo Lobo, and Cerro Balcon. **MRS-04 – Flamenco Lagoon Maneuver Area** Previous investigations have not identified MEC or MD within MRS-04; however, due to its close proximity to portions of MRS-02, it is possible that MEC are present on site. **MRS-05 – Mortar and Combat Range Area** Previous investigations at MRS-05 have confirmed the presence of MEC and MD items within this MRS to include MD within MRS-05 near Cerro Balcon. **MRS-07 – Culebrita Artillery Impact Area** Previous investigations at MRS-07 have confirmed the presence of MEC and MD items within this MRS to include MD on the northeastern lobe of Culebrita.
MEC Density Based on Previous Site Activities	Density will be described for each MRS associated with this task order based on site reconnaissance completed during a recent Site Inspection conducted at each MRS and from historical investigation and removals efforts completed on a limited number of MRSs. **MRS-02**: Reconnaissance efforts encountered MK 80 series bomb body (1) MK 76 practice bomb body (25+), and Aircraft flares (2). Previous efforts at MRS-02 encountered: Bomb, 500 pound (3)Torpedo, MK 27(1) Candle- illumination, from 5-inch 38 naval projectile (13) Bomb, practice, 25 pound, MK76/BDU-33 (47) Projectile, 40mm, M81A1 TP-T (3) Projectile, 3 inch, 50 HE (6), 3-inch common MK3, MOD 7(1) Projectile Fuze, BD, from 5-inch 38 projectile (2) Projectile, 40mm, Bofors(1) Rocket, 5-inch, HVAR(1) Bomb, practice, MK 23(1) Projectile, 20mm HEI(1) Mortar, 81mm(1) Naval Projectile, 5 inch (9) , 5-inch/ 54 MK 41(1) Naval Projectile, 6 inch(3) Grenade, w/o fuze(1) Mortar, 81mm(4) Fuze, projectile base(1) Projectile, 37mm HE(1) Warhead, rocket, 5-inch(1)

Conceptual Site Model Information Profiles – Munitions/Release Profile	
Information Needs	**Preliminary Information**
	Projectile, 76mm (1) Bomb, 100 pound(1) Bomb, 1,000 pound(1) Fuze, M151(1), Fuze, model 1898, (2) Bomb, practice, 5 pound,MK106 (4). **MRS-04:** No MEC or MD was encountered during the site reconnaissance and there is no record of MEC/MD being encountered at this MRS during previous investigative/removal efforts despite its operational history. **MRS-05:** Reconnaissance efforts encountered 4.2-inch mortar round/base (1) .30-caliber cartridge (4) .30-caliber bullet (1). There is no record of additional MEC/MD being encountered at this MRS during previous investigative/removal efforts. **MRS-07:** Reconnaissance efforts encountered a single Mechanical time fuze. Previous efforts at MRS-07 encountered Bomb, practice, MK 76 w/MK 4 spotting charge (18) with (1) additional MK 4spotting charge, Naval Projectile, 6-inch (1) Projectile, 20mm HEI (39).
Munitions Debris	Munitions debris is expected to be present at each of the four MRSs based upon their operational history, however; no MD was encountered at MRS-04 during the recent site reconnaissance. MRS-02, MRS-05, and MRS-07 all reported some level of MD thought to be associated with the operational history involving military munitions.
Associated Munitions Constituents (MC)	At the four MRSs previous efforts have included the collection and analysis of soil samples for explosives using Method SW8321A and for select metals using EPA SW-846 Methods 6010B or 6020, and Methods 7470A and 7471A for mercury. A summary of the results from that sampling effort is as follows: **MRS-2:** Explosive compounds were not detected in previously collected samples, but metals were detected in each of the samples. Chromium and zinc were the two metals reported to be present in elevated concentrations in some areas of MRS-02 thus were recommended during previous efforts to be retained for use in Screening Level Risk Assessments. **MRS-04:** Laboratory analysis of a single soil sample previously collected at MRS-04 detected several metals but no explosive compounds. The maximum detected concentration of each metal was compared to selected background concentrations however none of the soil analytes were recommended to be retained for consideration in a SLRA. **MRS-05:** Laboratory analysis of the six soil samples detected

Conceptual Site Model Information Profiles – Munitions/Release Profile	
Information Needs	**Preliminary Information**
	several metals but no explosive compounds. The maximum detected concentration of each metal was compared to selected background concentrations and four of the soil analytes (barium, chromium, copper, and zinc) were recommended to be retained for consideration in a SLRA. **MRS-07:** Laboratory analysis of a single soil sample previously collected at MRS-07 detected several metals but no explosive compounds. The maximum detected concentration of each metal was compared to selected background concentrations and three of the soil analytes (barium, copper, and zinc) were recommended to be retained for consideration in the SLRA.
Migration Routes / Release Mechanisms	Migration of MEC on the surface may occur naturally through soil erosion or a storm event, or by human activities such as farming, ranching, construction, or maintenance at the site. Migration of MEC in the subsurface may occur naturally through surface soil erosion or by human activities such as intrusive activities such as farming or ranching techniques, construction, excavation, and/or maintenance at the site. Migration of MEC within near-shore marine environments and impounded water bodies is possible due to a storm event, potential dredging, and recreational activities such as crabbing, claiming, boating and diving. Migration of MC may occur naturally through surface soil erosion, plant or animal uptake, or by human activities such as maintenance and site work. If soil erosion and subsequent surface runoff carries MC into inland impounded water bodies, migration of MC through surface water and sediment contact, or indirect or direct ingestion can occur as well. Migration of MC may occur through groundwater.

2.1.2.1.3 Physical Profile

Conceptual Site Model Information Profiles – Physical Profile	
Information Needs	**Preliminary Information**
Climate	The weather at Culebra Island is generally warm year round due to its tropical marine climate. Average rainfall is approximately 36 inches, with the heaviest rain in May, October, September, and November. The months of August through November are considered the wet season, and the driest months are January through April. Daily temperatures average 80°F year round with an average maximum of 86°F and an average low of 74°F. Winds are generally from the east-northeast during November through January and from the east during February through October. Winds speeds average 8 knots. Hurricane season is from June through November, and severe hurricanes hit Culebra every 10 to 20 years.
Topography	Culebra Island and the adjacent cays have sandy beaches, irregular rugged coastlines, lagoons, coastal wetlands, steep mountains, and narrow valleys. Ninety percent of the island is mountainous, with population concentrations in the flatlands. The highest point on Culebra Island is Monte Resaca, which is approximately 630 feet above mean sea level. The second highest point is Cerro Balcon at 511 feet above mean sea level. The island has a limited variety of soil types, due to its volcanic origin, limited size, rugged terrain, and moderately uniform climate. Most soils, except along the slopes, are the result of weathering bedrock. The soils are well-drained and runoff is rapid.
Geology	Culebra Island and the surrounding cays are part of the Culebra Archipelago. The rocks are predominantly intrusive or extrusive volcanic rocks consisting of andesite lava and tuff. The rocks in the north-central portion of Culebra and on the east side of Cayo Luis Pena contain diorite porphyry inclusions and have little to no porosity due to compaction and quartz and calcite growth in the pore space. Puerto Rico and its outlying islands are part of an island arc that largely consists of faulted and folded vulcaniclastic and sedimentary rock, locally intruded by igneous rock. These rocks range from Cretaceous to Eocene in age (USGS 1999).
Soil	Soils are generally shallow and rocky and consist mostly of silts and clays. Loamy organic-rich soils are found in areas of dense vegetation and grasses, while sandy soils are found on tidal flats or areas near the beach. Many of the beaches on Culebra and the surrounding cays have clean white to tan sand, while other beaches are rocky with a mix of cobbles and pieces of dead coral

Conceptual Site Model Information Profiles – Physical Profile	
Information Needs	**Preliminary Information**
	reef.
Hydrogeology	Due to the shallow bedrock and impermeability of the lava and overlying soil, the potential for use of groundwater as potable domestic, municipal, or commercial water source is nonexistent. No aquifers are on Culebra Island and the adjacent cays which are suitable for supplying potable water.
Hydrology	Fresh water is scarce on the island, and it is high in chloride and saline. Most residents get their water from a desalination plant installed by the Navy at the lower camp and from a water line from the Island of Puerto Rico. There are some shallow (10 to 20 feet deep) wells in areas away from coastal seepage, but these wells are high in chloride concentrations and salinity. Surface water is also scarce, and creeks and streams are intermittent and seasonal. Normally they are dry and only collect and drain runoff water during rainstorms. Approximately 12 natural springs and seeps exist, but they are charged only during particularly wet seasons (USACE-RI 1995).
Vegetation	Vegetation is moderately to extremely dense on undeveloped portions of Culebra, Luis Pena Cay, Northeast Cay, and Culebrita; however, vegetation is sparse or absent on many of the smaller cays as most are rocky with very little soil. Hazardous vegetation include the Mesquite acacia or thorny brush, which may be present on Culebra and all of the surrounding cays, and the poisonous Manchineel tree (also called Manzanillo Tree on Culebra), which is known to be present on Northwest peninsula and near Flamenco Lagoon.
Near Shore Marine Environment	The National Oceanic and Atmospheric Administration (NOAA) estimates that water depths average approximately 70 to 90 feet in the areas adjacent Culebra Island; however, some areas west of Flamenco Peninsula and east of Cayos Geniqui are more than 130 feet deep. Localcharts show “Caution UXO [unexploded ordnance]” in the northern and western areas. Tidal data for Culebra Island indicates that tides are chiefly diurnal. The height difference between mean higher high water and mean lower low water is 1.1 feet. The mean tide level is 0.6 foot

2.1.2.1.4 Land Use and Exposure Profile

Conceptual Site Model Information Profiles – Land Use and Exposure Profile	
Information Needs	**Preliminary Information**
Current Land Use	There are two main commercial areas on Culebra: the town of Dewey, located on the west side of Great Harbor, and the area surrounding the airport. Most of the residential development is on the northwest end of Great Harbor; however, residents are scattered throughout the island. Two houses are present on Cerro Balcon and it is reported that land has been cleared for development on the southeast side of Cerro Balcon; therefore, future residential development is expected in this area. Lower Town, Flamenco Point, Mount Resaca, Northwest Peninsula, and all of the beaches are managed by the USFWS or DNER for wildlife conservation and recreational use. Specifically MRS-02 is currently a Wildlife refuge with protected areas for several species. MRS-04 is privately owned and developed for tourist/recreational use. MRS-05 is a combination of Wildlife Refuge and some privately owned land used for cattle grazing. MRS-07 is designated as a Wildlife Refuge.
Current Human Receptors	Depending on the location within Culebra, potential current human receptors include a wide variety of people to include residents, outdoor site workers, construction/utility workers, recreational users/visitors, and trespassers.
Current Activities (frequency, nature of activity)	MRS-02 is designated as a Wildlife Refuge and is inaccessible to the public but is visited by FWS employees and researchers. MRS-04 is accessible to the public and used for recreation at the beach. MRS-05 is wildlife refuge and privately owned and used for cattle grazing and is accessible to the public. MRS-07 is controlled by FWS and inaccessible to the public.
Potential Future Land Use	It is anticipated that the land use will remain the same and that development for similar purposes will likely continue on site.
Potential Future Human Receptors	Same as current receptors.
Potential Future Land Use Related Activities	Same as current activities
Land Use Restrictions	MRS-02 and MRS-07 are inaccessible to the public and MRS-04 and MRS-05 are accessible. Some institutional controls in the form of signage have been placed at some locations on Culebra Island.

Conceptual Site Model Information Profiles – Land Use and Exposure Profile	
Information Needs	**Preliminary Information**
Beneficial Resources	According to the National Wildlife Refuge System (NWRS), portions of Culebra Island and 22 of the associated cays are considered National Wildlife Refuge area. The three largest cayos are Culebrita, Cayo Norte, and Luis Pena. These resemble Culebra in that they all have sandy beaches, rugged coastline, and gentle to steep hills. Vegetation ranges from moderate to extremely dense. The smaller cays are primarily solid rock with sparse or no vegetation. A few of the smaller cays have small beaches; however, most are rugged rock all around
Demographics/ Zoning	The island is inhabited at an average density of 71.8 persons per square mile even though the population is concentrated near the town of Dewey and the Airport. Of the four MRSs only MRS-04, with 389, and MRS-05, with 553, have any residents within ¼ of a mile of the site. Residents living ¼ to ½ miles from the MRSs are as follows: MRS-02 (11), MRS-04 (378), MRS-05 (475), and MRS-07 (0). Residents living 1/2 to 1 mile from the MRSs are as follows: MRS-02 (29), MRS-04 (777), MRS-05 (783), and MRS-07 (18). There are no known zoning requirements enforced on Culebra.

2.1.2.1.5 Ecological Profile

Conceptual Site Model Information Profiles – Ecological Profile	
Information Needs	**Preliminary Information**
Flora and Fauna	The main island of Puerto Rico and its associated islands support 75 federally listed threatened and endangered species consisting of 26 animals and 49 plants. Among this diverse group of fauna and flora are multiple species that are known to exist, potentially exist, or temporarily use areas within the Culebra Island, such as migratory birds. Of the 75 federally listed species, nine are known or are suspected to occupy Culebra Island and/or the associated cays. In addition to the federally listed species, 13 state-listed species are known to occupy Culebra Island and/or the associated cays. The federally and state-listed species includes both terrestrial and marine life. The federally listed species of most concern for the wildlife refuge are the Culebra Island giant anole, Virgin Islands tree boa, roseate tern, brown pelican, green sea turtle, hawksbill sea turtle, leatherback sea turtle, loggerhead sea turtle, Leptocereus grantianus (cactus), and Wheeler’s peperomia. Due to declining populations, the elkhorn and staghorn corals in the surrounding waters are proposed to be federally listed threatened and endangered species.

Conceptual Site Model Information Profiles – Ecological Profile	
Information Needs	**Preliminary Information**
Cultural Resources	According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there is only one registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however, the lighthouse is ocated outside of the MRS boundary. The lighthouse is not open to the public due to building deterioration. According to the Puerto Rico State Historic Preservation Office (SHPO), there are no known architectural resources within the boundaries of the Culebra Island site; however, an architectural survey has not yet been conducted for Culebra. An archeological survey performed at Lower Camp in 1992 found evidence of prehistoric and historic inhabitants distributed over a half-acre area within the Lower Camp site.

2.2 PRELIMINARY REMEDIATION GOALS AND REMEDIAL ACTION OBJECTIVES

2.2.1 The RI was conducted to adequately characterize MRSs 02, 04, 05 and 07 for the purpose of developing and evaluating effective remedial alternatives. The characterization was designed to find the nature and extent risks related to MEC and MC within each MRS. The primary goal of the RI is to determine the following:

- Nature and extent of contamination, evaluate risk, and determine if a remedial action may be warranted

2.2.2 To achieve the objectives of this RI, the MRSs required sufficient characterization of the presence of MEC and MD. MEC and MD were to be characterized in these areas based on analog transects and intrusive data collected during the RI. The MEC characterization goals included:

- Determining the nature and extent of the MEC and MD on the surface by conducting analog transects across MRS 04, 05, and 07 within accessible areas;
- Digging anomalies along analog transects to characterize subsurface MEC risk;
- Documenting the intrusive findings; and
- Removing and destroying identified MEC.

2.2.3 The preliminary action objectives (PAOs) for all of the MRSs is to limit interaction between residual MEC and persons accessing the MRSs.

2.2.4 MC was assessed through a sampling program for explosives and metals at locations where MEC and selected MD was found and at specific locations determined by the technical project planning (TPP) team. The analytical MC of concern was selected on the basis of the MEC and MD items recovered at the site. The standard analytical methods include USEPA Method 6010B for antimony, barium, chromium, copper, lead, and zinc; USEPA Method 7471A for mercury; and USEPA Method 8330B-modified for explosives. The MC characterization goals include the following:

- Collecting soil and sediment samples to characterize the nature and extent of MC;
- Collecting background samples for comparison to sample results;
- Conducting a human and ecological risk assessment with the MC results.

2.2.5 While data gaps exist due to the inaccessibility of portions of the MRSs being investigated, each of the MRSs were adequately investigated to characterize the general nature and extent of MEC and MC contamination.

2.3 PRELIMINARY IDENTIFICATION OF POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND "TO BE CONSIDERED" INFORMATION

2.3.1 Definition of Applicable or Relevant and Appropriate Requirements (ARAR)

According to 40 CFR 300.5, applicable requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not ''applicable'' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

2.3.1.1 Response actions under FUDS must identify and attain or formally waive ARARs under Federal and State laws (ER 200-3-1). Although the RI is not considered a response action, preliminary identification of chemical-specific and location-specific applicable or relevant and appropriate requirements (ARARs) is conducted during RI site characterization. ARARs are used as a "starting point" to determining the protectiveness of a site remedy. When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories, and guidance referred to as To Be Considered (TBC) are useful in designing and selecting a remedial alternative.

2.3.1.2 As the RI/FS process continues, the list of ARARs and TBCs will be updated, particularly as guidance is issued by commonwealth and federal agencies. ARARs and TBCs will be used as a guide to establish the appropriate extent of site cleanup; to aid in scoping, formulating, and selecting proposed treatment technologies; and to govern the implementation and operation of the selected remedial alternative. As part of the FS, primary consideration should be given to remedial alternatives that attain or exceed the requirements of the identified ARARs and TBCs. Throughout the RI/FS phase, ARARs and TBCs are identified and used by taking into account the following:

- Contaminants suspected or identified to be at the site;
- Chemical analysis performed, or scheduled to be performed;
- Types of media (air, soil, ground water, surface water, and sediment);
- Geology and other site characteristics;
- Use of site resources and media;
- Potential contaminant transport mechanisms;
- Purpose and application of potential ARARs and TBCs; and
- Remedial alternatives considered for site cleanup.

2.3.1.3 **Chemical-Specific.** Chemical-specific requirements define acceptable exposure levels for specific hazardous substances and, therefore, may be used as a basis for establishing preliminary remediation goals and cleanup levels for chemicals of concern in the designated media. Chemical-specific ARARs and TBCs are also used to determine treatment and disposal requirements for remedial actions. In the event a chemical has more than one requirement, the more stringent of the two requirements will be used.

2.3.1.4 **Location-Specific.** Location-specific requirements set restrictions on the types of remedial actions that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on federal and state laws for hazardous waste facilities or proximity to wetlands, floodplains or man-made features, such as existing landfills, disposal areas, and local historic landmarks or buildings.

2.3.1.5 **Action-Specific.** Action-specific requirements set controls or restrictions on the design, implementation, and performance of remedial actions. They are triggered by the particular types of treatment or remedial actions that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs and TBCs that specify remedial action performance levels, as well as specific contaminant levels for discharge of media or residual chemical levels for media left in place, are used as a basis for assessing the feasibility and effectiveness of the remedial action.

Potential ARARs and TBCs at Culebra

Chemical- Specific TBCs	Target Cleanup Levels
Chemical-Specific ARARs and TBCs	• Puerto Rico Water Quality Standard Regulation • EPA Regional Screening Levels for Soil, Sediment, and Surface Water
Location-Specific ARARs and TBCs	• Substantive requirements of the Endangered Species Act 16 U.S.C Sections 1538 and 1540 • Coastal Zone Management Act
Action-Specific ARARs and TBCs	• Substantive requirements of the Migratory Bird Treaty Act (16 USC 703) • RCRA Subpart X

Note: Substantial requirements of RCRA Subpart X are potential ARARs if consolidated shots are anticipated. Demolition activities alone which do not include consolidated shots do not trigger Subpart X requirements.

2.4 INSTITUTIONAL ANALYSIS

2.4.1 Institutional analyses are prepared to support the development of institutional control strategies and plans of action as a munitions response alternative. These strategies rely on existing powers and authorities of government agencies to protect the public at large from MEC risks.

2.4.2 A review of government institutions and private entities that exercise jurisdiction and ownership of the areas indicates that the property encompassing Culebra is under the jurisdiction of several private landowners and agencies including the US Fish and Wildlife Service. The U.S. Army does not own or control any property on Culebra and cannot implement, maintain, or enforce land use controls (LUCs). Before any alternative containing a LUC component can be selected, there needs to be documented commitment from the current landowners that they will implement, maintain, and enforce the LUCs.

2.5 DATA NEEDS AND DATA QUALITY OBJECTIVES

2.5.1 Data Needs

2.5.1.1 Technical Project Planning (TPP) meetings were periodically held with USACE, USEPA and PREQB during the field work planning and Final MMRP Work Plan development stage of the RI. Site characterization goals were discussed and agreed upon through the TPP process and review of the Final MMRP Work Plan.

Table 2-1 provides a summary of agreed-upon MEC and MC field activities for the RI at MRS 02, MRS 04, MRS 05, and MRS 07. Changes from the Final Work Plan were discussed at the March 2011 TPP Session.

Table 2-1: Summary of RI Field Activity Decisions

MRS	RI Activities		
	MEC Activity	MC Activity	Purpose
02	No MEC or MC field activities for MRS 02 during the RI.		- Due to the lack of rights-of-entry in the Cerro Balcon area and because the outlying cays were inaccessible, no MEC or MC field activities could be conducted during the RI. This was discussed at the March 2011 TPP session. - Future remedial actions will be based upon historical data and current / future land use.
04	Investigation of metallic anomalies along transects. Transects will be limited to accessible areas based on ROEs, vegetation, sensitive habitats and terrain.	- Collection of surface soil samples near MEC and MD - Collection of sediment samples from lagoons and streams	- Characterize explosive safety hazards, including MEC and MPPEH on the surface and in the subsurface in accessible areas. - Investigate and characterize MC in the surface soil and sediment. - Collect data to support a MEC Hazard Assessment (HA). - Collect data to support site remedial action decisions.
05	Investigation of metallic anomalies along transects. Transects will be limited to accessible areas based on ROEs, vegetation, sensitive habitats and terrain.	- Collection of surface soil samples near MEC and MD - Collection of sediment samples from lagoons and streams	- Characterize explosive safety hazards, including MEC and MPPEH on the surface and in the subsurface. - Investigate and characterize MC in the surface soil and sediment. - Collect data to support a MEC HA. - Collect data to support site remedial action decisions.
07	Investigation of metallic anomalies along transects. Transects will be limited to accessible areas based on ROEs, vegetation, sensitive habitats and terrain.	- Collection of surface soil samples near MEC and MD - Collection of sediment samples from lagoons and streams	- Characterize explosive safety hazards, including MEC and MPPEH on the surface and in the subsurface. - Investigate and characterize MC in the surface soil and sediment. - Collect data to support a MEC HA. - Collect data to support site remedial action decisions.

2.5.2 Data Quality Objectives

2.5.2.1 The use of Data Quality Objectives (DQOs) is a systematic approach for establishing the quality and quantity of data needed to support project decisions. To establish DQOs, the intended use of the data, possible consequences of incorrect decisions attributed to inadequate or invalid data, and an acceptable level of uncertainty must be considered. Guidelines followed in the preparation of DQOs are set out in EM 1110-1-4009, *Engineering and Design – Military Munitions Response Actions* and *Guidance on Systematic Planning Using the Data Quality Objectives Process, USEPA QA/G-4* (USEPA, 2007b). The DQO process is fully outlined in the Final MMRP Work Plan.

2.5.2.2 Based on the DQO process outlined in the Final MMRP Work Plan and the TPP process, the following project DQOs were established for the RI.

2.5.3 Data Quality Objectives for MEC Investigation

2.5.3.1 DQOs for MEC are summarized in the following tables. The DQOs presented in the Final Work Plan were modified during the March 2011 TPP session. DQOs were modified based on the identification of inaccessible areas (due to terrain, vegetation, and sensitive habitats) and the lack of ROEs achieved for the MRSs. DQOs were revised to focus on collecting information in accessible areas frequented by human receptors.

Table 2-2: MEC Data Quality Objectives for Cerro Balcon Area at MRS 02

DQO Step	MRS 2 – Cerro Balcon Area
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.

Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC.
	• Observations:
	  o Visual field MEC confirmation
	  o Type(s)/location(s) of MEC
	• Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.)
	• Accessibility of the site
	• The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC

DQO Step	MRS 2 – Cerro Balcon Area
	type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors). • Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. • Rights of Entry
Develop a Decision Rule	Data will be collected along meandering transects using one of two methods, depending on terrain, vegetation, and other factors. • Qualitative Reconnaissance - meandering transects divided into 200' segments that are investigated with analog geophysical techniques. The team will count "hits" and keep a log of the "hits" per segment. Detected anomalies will be investigated by UXO technicians as they are detected. Once the segment is characterized by a MPPEH item or three or more indicators of MEC, no additional intrusive investigation will be conducted on the segment. The investigation will be conducted as a typical "mag and dig" on the meandering transect segments. • Digital geophysical mapping along meandering transects with 250 feet separation with no more than 25 feet or 10% deviation from course (for heavy vegetation or lack of ROE).
Specify Tolerable Limits of Detection Error	If all the inputs to the decision rule were performed to the standard of Quality Control/Quality Assurance (QC/QA) procedures as specified in the QAPP and the Work Plan, then the error is within tolerable limits.
Optimize the Design for Obtaining Data	Meandering transects will be utilized to establish a contamination boundary and possibly reduce the area of interest.

Table 2-3: MEC Data Quality Objectives for Adjacent Cays at MRS 02

DQO Step	MRS 2 – Adjacent Cays
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC. • Observations: • Accessibility of the site • The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs used to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors).
Develop a Decision Rule	Based on access controls and access limitations due to adequate beaching areas, terrain and vegetation exposure to receptors is very limited. The expected future land use area is limited to wildlife management with no development and limited access. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented without violating ARARs, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

Table 2-4: MEC Data Quality Objectives for MRS 04

DQO Step	MRS 4 – Flamingo Lagoon Area
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.

Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC.
	• Observations:
	  o Visual field MEC confirmation
	  o Type(s)/location(s) of MEC
	• Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.)
	• Accessibility of the site
	• The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.)
	• Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data.
	• Present and/or future land use considerations.
	• Statistical analysis tools.

Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors). • Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. • Rights of Entry
Develop a Decision Rule	Data will be collected along meandering transects using one of two methods, depending on terrain, vegetation, and other factors. • Qualitative Reconnaissance - meandering transects divided into 200' segments that are investigated with analog

DQO Step	MRS 4 – Flamingo Lagoon Area
	geophysical techniques. The team will count "hits" and keep a log of the "hits" per segment. Detected anomalies will be investigated by UXO technicians as they are detected. Once the segment is characterized by a MPPEH item or three or more indicators of MEC, no additional intrusive investigation will be conducted on the segment. The investigation will be conducted as a typical "mag and dig" on the meandering transect segments. • Digital geophysical mapping along meandering transects with 250 feet separation with no more than 25 feet or 10% deviation from course (for heavy vegetation or lack of ROE).
Specify Tolerable Limits of Detection Error	If all the inputs to the decision rule were performed to the standard of Quality Control/Quality Assurance (QC/QA) procedures as specified in the QAPP and the Work Plan, then the error is within tolerable limits.
Optimize the Design for Obtaining Data	Meandering transects will be utilized to establish a contamination boundary and possibly reduce the area of interest.

Table 2-5: MEC Data Quality Objectives for Private Parcels at MRS 05

DQO Step	MRS 5 – Private Parcels
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC. • Observations: o Visual field MEC confirmation o Type(s)/location(s) of MEC • Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) • Accessibility of the site • The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC

DQO Step	MRS 5 – Private Parcels
	type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors). • Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. • Rights of Entry
Develop a Decision Rule	Data will be collected along meandering transects using one of two methods, depending on terrain, vegetation, and other factors. • Qualitative Reconnaissance - meandering transects divided into 200' segments that are investigated with analog geophysical techniques. The team will count "hits" and keep a log of the "hits" per segment. Detected anomalies will be investigated by UXO technicians as they are detected. Once the segment is characterized by a MPPEH item or three or more indicators of MEC, no additional intrusive investigation will be conducted on the segment. The investigation will be conducted as a typical "mag and dig" on the meandering transect segments. • Digital geophysical mapping along meandering transects with 250 feet separation with no more than 25 feet or 10% deviation from course (for heavy vegetation or lack of ROE).
Specify Tolerable Limits of Detection Error	If all the inputs to the decision rule were performed to the standard of Quality Control/Quality Assurance (QC/QA) procedures as specified in the QAPP and the Work Plan, then the error is within tolerable limits.
Optimize the Design for Obtaining Data	Meandering transects will be utilized to establish a contamination boundary and possibly reduce the area of interest.

Table 2-6: MEC Data Quality Objectives for Wildlife Refuge at MRS 05

DQO Step	MRS 5 – Wildlife Refuge
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC. • Observations: o Accessibility of the site • The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors).
Develop a Decision Rule	Based on access controls and access limitations due to terrain and vegetation exposure to receptors is very limited. The expected future land use area is limited to wildlife management with no development and limited access. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented without violating ARARs, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

Table 2-7: MEC Data Quality Objectives for Beaches/Trails at MRS 07

DQO Step	MRS 7 – Beaches and Trails
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC. • Observations: o Visual field MEC confirmation o Type(s)/location(s) of MEC • Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) • Accessibility of the site • The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors). • Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. • Rights of Entry
Develop a Decision Rule	Data will be collected along meandering transects using one of two methods, depending on terrain, vegetation, and other factors. • Qualitative Reconnaissance - meandering transects divided

DQO Step	MRS 7 – Beaches and Trails
	into 200' segments that are investigated with analog geophysical techniques. The team will count "hits" and keep a log of the "hits" per segment. Detected anomalies will be investigated by UXO technicians as they are detected. Once the segment is characterized by a MPPEH item or three or more indicators of MEC, no additional intrusive investigation will be conducted on the segment. The investigation will be conducted as a typical "mag and dig" on the meandering transect segments. • Digital geophysical mapping along meandering transects with 150 feet separation with no more than 25 feet or 10% deviation from course (for heavy vegetation or lack of ROE).
Specify Tolerable Limits of Detection Error	If all the inputs to the decision rule were performed to the standard of Quality Control/Quality Assurance (QC/QA) procedures as specified in the QAPP and the Work Plan, then the error is within tolerable limits.
Optimize the Design for Obtaining Data	Meandering transects will be utilized to establish a contamination boundary and possibly reduce the area of interest.

Table 2-8: MEC Data Quality Objectives for Vegetated Areas at MRS 07

DQO Step	MRS 7 – Vegetated Areas
State the Problem	Define the nature and extent of MEC contamination within the area of interest that may pose a potential threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MEC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information (e.g., ASR, field notes, aerial photos, maps) regarding potential MEC. • Observations: o Accessibility of the site • The Conceptual Site Model (i.e. historical information {ASR, field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) • Statistically calculated MEC densities based on historical use

DQO Step	MRS 7 – Vegetated Areas
	of area, previous MEC investigation and removals, and current field sampling data. • Present and/or future land use considerations. • Statistical analysis tools.
Define Boundaries of Study	• Established MRSs will be utilized to subdivide investigation areas. • Limited to the ground surface and near surface. • Exclusive of inaccessible areas (due to vegetation / terrain). • Time frame for collection (including ecological factors).
Develop a Decision Rule	Based on access controls and access limitations due to terrain and vegetation exposure to receptors is very limited. The expected future land use area is limited to wildlife management with no development and limited access. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented without violating ARARs, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

2.5.4 Data Quality Objectives for MC Investigation

2.5.4.1 DQOs for MC sampling and analysis were developed following the same guidelines previously described for the MEC investigation and are summarized in the following tables. The DQOs presented in the Final Work Plan were modified during the March 2011 TPP session. DQOs were modified based on the identification of inaccessible areas (due to terrain, vegetation, and sensitive habitats) and the lack of ROEs achieved for the MRSs. DQOs were revised to focus on filling data gaps, where possible.

Table 2-9: MC Data Quality Objectives for Cerro Balcon Area at MRS 02

DQO Step	MRS 2 – Cerro Balcon
State the Problem	Define the nature and extent of MC contamination within the Cerro Balcon area of MRS 2 that may pose a potential threat to human health and the environment, relative to potential receptors and their activity, for the purpose of developing and evaluating viable remedial alternatives, if required.

DQO Step	MRS 2 – Cerro Balcon
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and MD identified in previous investigations at the Cerro Balcon Area • Location of MEC, MD, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field • Compare soil metals detections in biased samples to site-specific background concentrations • Compare soil and sediment metal and explosive detections to USEPA residential Regional Screening Levels (RSL) (if required) • Screening-level ecological risk assessment (if required)

Define Boundaries of Study	• Overall Cerro Balcon Area boundary; MRS boundaries
	• Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat)
	• Sampling locations based on documentation of previous use and previous investigations/removals
	  o MC may be present in the known impact areas (especially areas with visible ground scarring or impact craters)
	  o MC may be present in areas of previous removal actions and potentially areas outside the impact areas due to migration
	• Sampling locations limited to MEC investigation areas
	• Sampling locations based on the intrinsic geophysical MEC investigation in fixed range locations
	  o MC may be present in front of and behind the firing lines, in target areas, and in other identified impact areas
	  o Surface soil from areas within the fixed ranges with identified MEC will also be sampled for MC
	• Rights of Entry.

Develop a Decision Rule	• Compare biased metals results to site-specific background concentrations to determine if there are differences • If soil and sediment samples results exceed site-specific background concentrations, results will be compared to USEPA residential RSLs and ecological screening levels

DQO Step	MRS 2 – Cerro Balcon
	• If there are exceedances of the assessment levels, additional samples will be collected to delineate the soil to the appropriate assessment levels • If vertical delineation is necessary, a more extensive subsurface investigation will be conducted
Specify Tolerable Limits of Detection Error	• Two possible decision errors for this project: o Concluding that the suspect medium (surface soil) within the boundaries of the study is contaminated when it is really not (Type I error) o Concluding that the soil within the boundaries of the study is not contaminated when it really is (Type II error) • Type I error is more tolerable; minimize Type II errors
Optimize the Design for Obtaining Data	• Employ judgmental sampling – focus sampling locations at areas most likely to contain residual MC (firing points, target areas, impact areas) • Analyze at method quantitation limits (MQLs) that are equal to or lower than screening levels to minimize Type II errors

Table 2-10: MC Data Quality Objectives for Adjacent Cays at MRS 02

DQO Step	MRS 2 – Adjacent Cays
State the Problem	Define the nature and extent of MC contamination within the portion of MRS 2 consisting of the surrounding cays, which may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and MD identified in previous investigations at the adjacent cays • Location of MEC, MD, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field

DQO Step	MRS 2 – Adjacent Cays
Define Boundaries of Study	• Overall adjacent cays boundary; MRS boundaries • Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat) • Rights of Entry
Develop a Decision Rule	Based on access restrictions and due to inadequate beaching areas and steep cliffs on many of the cays, exposure to receptors is very limited. The expected future land use area is limited to wildlife management with no development and limited access. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

Table 2-11: MC Data Quality Objectives for MRS 04

DQO Step	MRS 4 – Flamenco Lagoon Area
State the Problem	Define the nature and extent of MC contamination within MRS 4 that may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and MD identified in previous investigations at the Flamenco Lagoon Area • Location of MEC, MD, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field • Compare soil metals detections in biased samples to site-specific background concentrations • Compare soil and sediment metal and explosive detections to USEPA residential RSL (if required) • Screening-level ecological risk assessment (if required)

DQO Step	MRS 4 – Flamenco Lagoon Area

Define Boundaries of Study	• Overall Flamenco Lagoon Area boundary; MRS boundaries
	• Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat)
	• Sampling locations based on documentation of previous use and previous investigations/removals
	  o MC may be present in the known impact areas (especially areas with visible ground scarring or impact craters)
	  o MC may be present in areas of previous removal actions and potentially areas outside the impact areas due to migration
	• Sampling locations limited to MEC investigation areas
	• Sampling locations based on the intrinsic geophysical MEC investigation in fixed range locations
	  o MC may be present in front of and behind the firing lines, in target areas, and in other identified impact areas
	  o Surface soil from areas within the fixed ranges with identified MEC will also be sampled for MC
	• Rights of Entry

Develop a Decision Rule	• Compare biased metals results to site-specific background concentrations • If soil and sediment samples results exceed site-specific background concentrations, results will be compared to USEPA residential RSLs and ecological screening levels • If there are exceedances of the assessment levels, additional samples will be collected to delineate the soil to the appropriate assessment levels • If vertical delineation is necessary, a more extensive subsurface investigation will be conducted

Specify Tolerable Limits of Detection Error	• Two possible decision errors for this project:
	  o Concluding that the suspect medium (surface soil) within the boundaries of the study is contaminated when it is really not (Type I error)
	  o Concluding that the soil within the boundaries of the study is not contaminated when it really is (Type II error)
	• Type I error is more tolerable; minimize Type II errors

DQO Step	MRS 4 – Flamenco Lagoon Area
Optimize the Design for Obtaining Data	• Employ judgmental sampling – focus sampling locations at areas most likely to contain residual MC (firing points, target areas, impact areas) • Analyze at MQLs that are equal to or lower than screening levels to minimize Type II errors

Table 2-12: MC Data Quality Objectives for Private Parcels at MRS 05

DQO Step	MRS 5 – Mortar and Combat Range Area
State the Problem	Define the nature and extent of MC contamination within the portion of MRS 5 consisting of privately owned parcels, which may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and MD identified in previous investigations at the private parcels • Location of MEC, MD, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field • Compare soil metals detections in biased samples to site-specific background concentrations to determine if there are differences • Compare soil and sediment metal and explosive detections to USEPA RSLs (if required) • Screening-level ecological risk assessment (if required)

Define Boundaries of Study	• Overall private parcels boundary; MRS boundaries
	• Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat)
	• Sampling locations based on documentation of previous use and previous investigations/removals
	  ○ MC may be present in the known impact areas (especially areas with visible ground scarring or impact craters)
	  ○ MC may be present in areas of previous removal actions and potentially areas outside the impact

DQO Step	MRS 5 – Mortar and Combat Range Area

	areas due to migration
	• Sampling locations limited to MEC investigation areas
	• Sampling locations based on the intrinsic geophysical MEC investigation in fixed range locations
	  ○ MC may be present in front of and behind the firing lines, in target areas, and in other identified impact areas
	  ○ Surface soil from areas within the fixed ranges with identified MEC will also be sampled for MC
	• Rights of Entry

Develop a Decision Rule	• Compare biased metals results to site-specific background concentrations • If soil and sediment samples results exceed site-specific background concentrations, results will be compared to USEPA residential RSLs and ecological screening levels • If there are exceedances of the assessment levels, additional samples will be collected to delineate the soil to the appropriate assessment levels • If vertical delineation is necessary, a more extensive subsurface investigation will be conducted

Specify Tolerable Limits of Detection Error	• Two possible decision errors for this project:
	  ○ Concluding that the suspect medium (surface soil) within the boundaries of the study is contaminated when it is really not (Type I error)
	  ○ Concluding that the soil within the boundaries of the study is not contaminated when it really is (Type II error)
	• Type I error is more tolerable; minimize Type II errors

Optimize the Design for Obtaining Data	• Employ judgmental sampling – focus sampling locations at areas most likely to contain residual MC (firing points, target areas, impact areas) • Analyze at MQLs that are equal to or lower than screening levels to minimize Type II errors

Table 2-13: MC Data Quality Objectives for Wildlife Refuge at MRS 05

DQO Step	MRS 5 – Wildlife Refuge
State the Problem	Define the nature and extent of MC contamination within the portion of MRS 5 consisting of designated Wildlife Refuge, which may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and munitions debris identified in previous investigations at the Wildlife Refuge • Location of MEC, munitions debris, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field
Define Boundaries of Study	• Overall Wildlife Refuge boundary; MRS boundaries • Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat) • Rights of Entry
Develop a Decision Rule	The expected future land use area is limited to wildlife management with no development and limited access. USFWS personnel will access the site to complete wildlife management. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

Table 2-14: MC Data Quality Objectives for Beaches and Trail at MRS 07

DQO Step	MRS 7 – Beaches and Trails
State the Problem	Define the nature and extent of MC contamination within readily accessible portions of MRS 7 that may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and munitions debris identified in previous investigations at the beaches and trails • Location of MEC, munitions debris, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field • Compare soil metals detections in biased samples to site-specific background concentrations • Compare soil and sediment metal and explosive detections to United States Environmental Protection Agency (USEPA) residential Regional Screening Levels (RSL) (if required) • Screening-level ecological risk assessment (if required)

Define Boundaries of Study	• Overall beaches and trails boundary; MRS boundaries
	• Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat)
	• Sampling locations based on documentation of previous use and previous investigations/removals
	  o MC may be present in the known impact areas (especially areas with visible ground scarring or impact craters)
	  o MC may be present in areas of previous removal actions and potentially areas outside the impact areas due to migration
	• Sampling locations limited to MEC investigation areas
	• Sampling locations based on the intrinsic geophysical MEC investigation in fixed range locations
	  o MC may be present in front of and behind the firing lines, in target areas, and in other identified impact areas

DQO Step	MRS 7 – Beaches and Trails
	○ Surface soil from areas within the fixed ranges with identified MEC will also be sampled for MC • Rights of Entry
Develop a Decision Rule	• Compare biased metals results to site-specific background concentrations • If soil and sediment samples results exceed site-specific background concentrations, results will be compared to USEPA residential RSLs and • ecological screening levels • If there are exceedances of the assessment levels, additional samples will be collected to delineate the soil to the appropriate assessment levels • If vertical delineation is necessary, a more extensive subsurface investigation will be conducted
Specify Tolerable Limits of Detection Error	• Two possible decision errors for this project: ○ Concluding that the suspect medium (surface soil) within the boundaries of the study is contaminated when it is really not (Type I error) ○ Concluding that the soil within the boundaries of the study is not contaminated when it really is (Type II error) • Type I error is more tolerable; minimize Type II errors
Optimize the Design for Obtaining Data	• Employ judgmental sampling – focus sampling locations at areas most likely to contain residual MC (firing points, target areas, impact areas) • Analyze at method quantitation limits (MQLs) that are equal to or lower than screening levels to minimize Type II errors

Table 2-15: MC Data Quality Objectives for Vegetated Areas at MRS 07

DQO Step	MRS 7 – Vegetated Areas
State the Problem	Define the nature and extent of MC contamination within heavily vegetated portions of MRS 7 that may pose a potential threat to human health and the environment, relative to potential receptors and their activities, for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine where MC contamination poses an unacceptable risk to human health and the environment and may require further investigation to develop and evaluate potential remedial response alternatives or support a recommendation of no further action is necessary.

DQO Step	MRS 7 – Vegetated Areas
Identify Inputs	• Historical information from previous uses of the site • Location of MEC and munitions debris identified in previous investigations at the vegetated areas • Location of MEC, munitions debris, range structures, and other evidence of munitions based on MEC characterization/geophysical investigations to be completed in the field
Define Boundaries of Study	• Overall vegetative areas boundary; MRS boundaries • Exclusive of inaccessible areas (due to vegetation / terrain / sensitive species and habitat) • Rights of Entry
Develop a Decision Rule	The expected future land use area is limited to wildlife management with no development and limited access. USFWS personnel will access the site to complete wildlife management. The CSM indicates limited completed exposure pathways and the sensitive habitat limits potential remedial alternatives. Therefore existing data, from historical records is sufficient to make the decision.
Specify Tolerable Limits of Detection Error	Based on limited exposure pathways identified in the CSM and the limited remedial alternatives that can be implemented, existing data is sufficient to make the decision.
Optimize the Design for Obtaining Data	Existing, historical data will be used to make decisions since there is limited access and limited potential remedial alternatives.

2.5.4.2 All QA / QC procedures outlined in the Final MMRP Work Plan were followed closely. These procedures and the overall design of the investigation were created initially to assure that all of the DQOs were met. The QA/QC procedures followed are outlined in detail in Section 3 of the Final MMRP Work Plan. Based upon the design of the investigation, the revised DQOs outlined above for this RI were met for the accessible areas of the MRSs. Portions of each MRS were not accessible for the RI field work.

3 CHARACTIZATION OF MEC AND MC

3.1 RI FIELD ACTIVITIES OVERVIEW

3.1.1 RI field activities at the MRSs began in October 2010 and continued through March 2011. The MEC field investigation team consisted of a SUXOS, a dual UXO Safety Officer (UXOSO) / UXO Quality Control Specialist (UXOQCS), and UXO Technician IIIs, UXO Technician IIs, and UXO Technician Is. RI field activities were completed on 24 March 2011. The following sections discuss the various portions of the MEC field investigation and results in detail.

3.1.2 The following major tasks were performed to meet the project objectives:

- Geophysical Prove Out (GPO);
- Brush cutting and surface sweep;
- Analog transects and mini-grids
- Intrusive investigation and identification of anomalies
- Proper disposal of all recovered MEC, MD and non-MD material in accordance with federal, state and local regulations:
- MC sampling.

3.1.3 The primary analog instrument identified in the Final Work Plan was the White Eagle Spectrum XLT. This instrument was tested in the test-strip and its performance was compared to that of the Schonstedt GA-52Cx. The Schonstedt proved to be able to locate items at a greater depth; however, due to the geology it was not effective in many areas. The project team mobilized the White Model DFX-300. This instrument proved more effective at eliminating geological effects than the White XLT but was inferior to the Mine Lab F3. CEHNC provided Mine Labs F3 for the teams to use for the duration of the project. One was provided starting 15 February 2011 and a second was provided on 23 February 2011.

3.1.4 Before engaging in any activities on site, all personnel reviewed the ESP, RI Work Plan and the Accident Prevention Plan (APP). A Daily Safety Meeting was completed every morning before the commencement of the day’s activities.

3.2 MEC CHARACTERIZATION

3.2.1 Geophysical Prove-Out

3.2.1.1 It was determined in the field that qualitative reconnaissance, using analog equipment would be utilized for all MRSs based on the site conditions. However, the team determined that it was advantageous to test the digital geophysical equipment, even if it was not used during the RI data collection. The GPO was performed to evaluate the geophysical sensor and navigational instruments. The results can be used to make future decisions about the most appropriate equipment to use during future activities on Culebra.

3.2.1.2 The GPO was design to test the capabilities of geophysical equipment. Various size seed items used to simulate expected MEC were buried at various depths based on expected penetration depths and theoretical equipment detection depths. EOTI used data published in Table 7.3 of the 23 June 2000 version of EM 1110-1-4009 as a guide to estimate potential penetration depth. Although subsequent version do not include the table, the information remains useful in designing geophysical test plots. Details on the GPO can be found in the Final GPO Report (Appendix A).

3.2.2 De-Vegetation and Surface Clearance

3.2.2.1 UXO technicians performed a 100% surface clearance along each transect prior to the brush cutting and intrusive investigation. A de-vegetation and surface clearance team, comprised of UXO technicians and local brush cutters, performed a technology-aided surface removal and vegetation removal along all transects.

3.2.2.2 Natural debris (e.g., fallen trees) was moved from the areas to be cleared, and small trees and brush were cut to grade with no disturbance to the roots or ground surface (Photograph 3-3). All brush and natural debris were spread thinly into the surrounding areas. A biologist familiar with the local flora and fauna was present during brush clearing activities to monitor the field crew and ensure no sensitive habitats were destroyed.

Photograph 3-1: Brush clearing at MRS 07

3.2.3 MEC Field Work Results

3.2.3.1 Approximately 23.5 miles of analog transects were collected from MRS 04, 05, and 07. No investigation took place at MRS 02 due to access issues (Cays) and lack of ROEs (Cerro Balcon). Several attempts to access the cays via boat were made; however, they were unsuccessful based on sea conditions and inadequate landing areas. According to the local population, weather conditions typically prohibit access to the cays during that time of year. Once it was determined that access to the cays was not feasible, it was determined that historical data available for the cays provide adequate information for risk characterization.

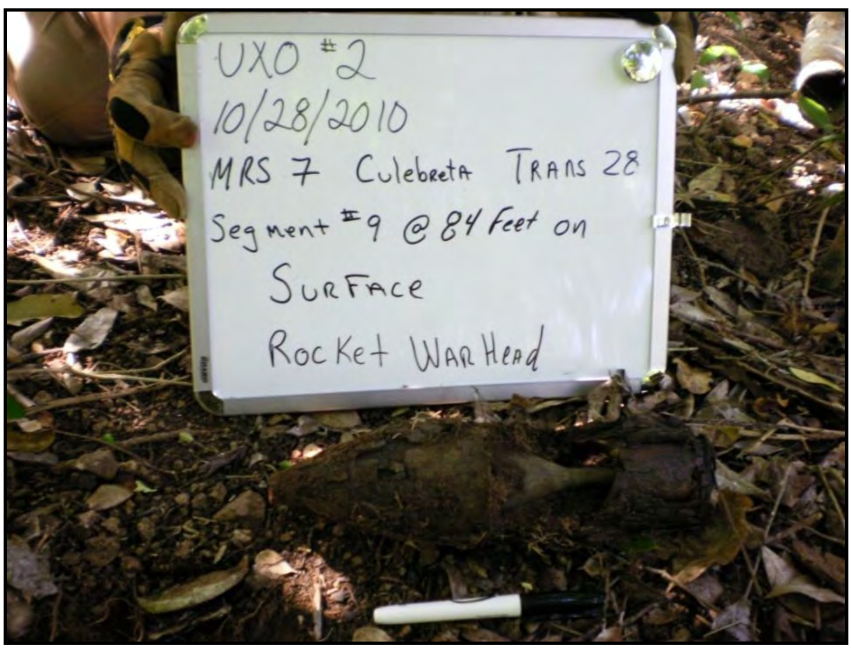
3.2.3.2 A total of 466 anomalies were intrusively investigated across the MRSs (38 in MRS 04, 406 in MRS 05, and 22 in MRS 07). During the investigation, two (2) MEC items were discovered; both in MRS 07. The MEC items in MRS 07 were discovered in the northwest portion of the MRS along transect 28A on the ground surface. The location of MEC items were recorded using hand-held GPS equipment. The location of MD was recorded by the UXO teams based on the measured distance from start point of the transect segment. Table 3-1 summarizes the MEC investigation for each MRS. Table 3-2 provides a summary of all MEC and MD items identified with specified depths. The majority of MD was found on or near to the surface, with the exception of MD on MRS 5, which was located about 12 inches bgs. Figures 3-2, 3-4, and 3-6 show the intrusive results for MRS 04, MRS 05, and MRS 07, respectively. All excavation holes were backfilled to their prior condition.

3.2.3.3 At the conclusion of all intrusive activities, approximately 43 pounds (lbs) of MD items were identified and removed from the investigated area. The majority of the MD was found in MRS 05 (18 MD items) and MRS 07 (22 MD items), and the remainder of the anomalies uncovered non-munitions-related metal waste such as barbed wire or nails.

3.2.3.4 Based on the intrusive results, one 25 x 25 foot mini-grid was established and investigated in MRS 04 north of Flamenco Lagoon and three mini-grids were investigated in MRS 05 on 7 and 8 March 2011. Grids were placed along transects in areas where there were indicators of potential MEC. The initial locations of the grids were proposed during a TPP meeting. Based on discussion at the meeting an additional grid was placed in MRS 04. The decision not to place grids in MRS 07 was based on the revised CSM and DQOs. No MEC or MD was observed in any of the grids.

Table 3-1: Summary of RI MEC Investigation

MRS	Completed Transects (miles)	Investigated Anomalies	MEC	MD
02	No MEC investigation activities were conducted at MRS 02 during the RI due to accessibility issues (Cays) and lack of ROEs (Cerro Balcon), as discussed upon at the March 2011 TPP.			
04	2.03	38	None	- Fragments
05	19.42	406	None	- Fragments (9) - 30 caliber cartridges (2) - 81mm mortar (3) - 4.2" mortar base - Small arms ammunition debris
07	2.04	22	- MK5 Mod 0 Rocket - MK8 Demo Hose	- Expended flare - 20 mm - Partial rotating band - Powder train time fuze (PTTF) - Brass frag (9) - Partial fuze body - Shotgun shell - 3'"projectile fragments - Lead bullet



Photograph 3-2: Mk5 Mod 0 Rocket in MRS 07

Photograph 3-5: Mk8 Demolition Hose in MRS 07

Table 3-2: MEC and MD Locations - RI Investigation

Transect	MRS	Anomaly Type	Description	Depth (inches)
17a	4	MD	Fragment	2
23b-2	5	MD	Fragment	8
24A-5	5	MD	30 caliber cartridge	0.5
24A-5	5	MD	30 caliber cartridge	0.5
26c-7	5	MD	Fragment	7
29A-10	5	MD	81mm Mortar	0
29c-10	5	MD	Fragment	8
29c-12	5	MD	Fragment	8
29c-12	5	MD	Fragment	6
29c-12	5	MD	Fragment	10
29c-12	5	MD	Fragment	12
29c-12	5	MD	Fragment	8
31c-1	5	MD	4.2" mortar base	0
31c-2	5	MD	mortar frag	0
32c-3	5	MD	81 mm mortar fragments/ tailboom	0.5
35B-9	5	MD	81mm mortar fragments, (5 Pounds)	0
41b-4	5	MD	Fragment	8
42b-2	5	MD	Fragment	8
43b-2	5	MD	81mm mortar fragment	14
4A-3	7	MD	PTTF Fuze, expended	0
3A-1	7	MD	Partial Rotating band	1

Transect	MRS	Anomaly Type	Description	Depth (inches)
12A-4	7	MD	Expended Flare	0
28A-9	7	MD	20mm projectile	0
4A-5	7	MD	Brass Fragment	0
4A-5	7	MD	Brass Fragment	0
4A-5	7	MD	Brass Fragment	0
4A-6	7	MD	Brass Fragment	0
4A-6	7	MD	Brass Fragment	0
4A-6	7	MD	Brass Fragment	0
4A-6	7	MD	lead bullet	0
4A-6	7	MD	Brass Fragment	0
4A-6	7	MD	Brass Fragment	0
4A-7	7	MD	Brass Fragment	0
4A-7	7	MD	Partial Fuze body	0
4A-8	7	MD	Shotgun shell	0
8A-1	7	MD	Partial Fuze body	0
8A-4	7	MD	Fragment from 3" Projectile	0.5
8A-5	7	MD	Fragment from 3" Projectile	0.5
8A-6	7	MD	Lead bullet	0.5
28A-9	7	MEC	MK 5 Mod 0 Rocket	0
28A-9	7	MEC	Mk 8 Demo hose	0

3.2.4 Demolition and Disposal Operations

All demolition and disposal was conducted in accordance with the Final Approved Explosive Siting Plan (ESP) and Final MMRP Work Plan. Onsite destruction of all MEC/MPPEH was conducted on 21 March 2011. One demolition shot took place on the northwestern portion of MRS 7 near where the MEC were found. The demolition hole was inspected; the debris was removed, and the hole was then backfilled. After the demolition was completed, the items were inspected to confirm final classification (*i.e.*, MEC). No post-demolition MC soil samples were collected.

3.2.5 MEC Results Summary

3.2.5.1 A Mk 5 Mod 0 rocket and a MK 8 demolition hose were identified on the surface in the northwestern portion of MRS 07. During the investigation, 49 MD were found, totaling 43 lbs, and included items associated with mortars, 3-inch projectiles, 20 mm projectiles, flares, fuzes, small arms ammunition, and unidentifiable fragments. The investigation confirmed that MD and metal scrap (non-munitions related metal) were located on the surface and in the subsurface at MRS 04, MRS 05, and MRS 07. The remainder of the anomalies were identified as either non-munitions-related metallic debris, such as barbed wire and small arms ammunition not related to military use or geologic anomalies.

3.2.5.2 The results of MEC and MC RI field activities are shown on Figures at the end of this section. Approximately 24 miles (123,000 feet) were investigated during the RI. A complete risk characterization for MEC within the studied MRSs in Culebra is included in Section 4.

3.3 MC CHARACTERIZATION

3.3.1 Environmental samples were collected in MRS 04, MRS, 05, and MRS 07 March 21-23, 2011. No environmental samples were collected in MRS 02 due to a lack of rights-of-entry in the Cerro Balcon area and adverse site conditions and the inaccessibility of the adjacent cays. Surface soil and sediment samples were collected where munitions or munitions debris was found. The samples were analyzed for explosives and metals found in munitions or their breakdown products. Based on the phased approach established for MC sampling no subsurface soil, surface water, or groundwater samples were collected.

Table 3-3: Sampling Design

<table>
<tr><th>MRS</th><th>Surface Soil Samples</th><th>Sediment Samples</th><th>Background Soil Samples</th><th>QA/QC Soil Samples</th><th>Analytes Sampled</th><th>Sampling Design</th></tr>
<tr><td>02</td><td colspan="6">MC sampling was not conducted in MRS 02 due to the lack of rights-of-entry in the Cerro Balcon area and because the adjacent cays could not be accessed due to site conditions.</td></tr>
<tr><td>04</td><td>6</td><td>3</td><td>3</td><td>5</td><td rowspan="3">Selected metals (antimony, barium, chromium, copper, lead, mercury, and zinc) and explosive suite</td><td rowspan="3">Surface soil samples were collected near locations where MEC and MD were found along the cleared transects. Sediment locations were limited due to dry conditions. Sediment samples were collected from lagoons and streams. Sampling locations are shown on Figures 3-1, 3-3, and 3-5.</td></tr>
<tr><td>05</td><td>14</td><td>2</td><td>4</td><td>10</td></tr>
<tr><td>07</td><td>8</td><td>2</td><td>3</td><td>5</td></tr>
</table>

3.3.2 Twenty-eight surface soil samples, plus QA/QC samples, were taken at MRS 04, MRS 05, and MRS 07 at biased locations near where MEC and MD were found. Nine surface soil samples were collected at the MRSs (one in MRS 04, six in MRS 05, and two in MRS 07) during the 2006 SI fieldwork at Culebra Island and used in the evaluation of human and ecological risk discussed in Section 6. Soil sample locations are shown on Figures 3-1 to 3-5.

3.3.3 Ten background soil samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for metals listed in Table 3-3. The three samples collected from

MRS 07 were collected outside of the MRS, south of the southern MRS boundary directly south of a trail used by visitors to Culebrita. The background samples collected at MRS 04 and MRS 05 were taken within the MRS boundary since there are no locations on Culebra which are not part of a MRS. Samples collected from MRS 04 and MRS 05 were biased to locations were no MEC or MD was found during previous MEC investigations in an effort to collect soil unaffected by historic munitions use in on the island. Background soil sample locations are shown on Figures 3-1 to 3-5.

3.3.4 A total of seven sediment samples were taken at MRS 04, MRS 05, and MRS 07 at random locations from lagoons and streams (Figures 3-1, 3-3, 3-5). Four sediment samples were collected at the MRSs (two in MRS 04, one in MRS 05, and one in MRS 07) during the 2006 SI fieldwork at Culebra Island and used in the evaluation of human and ecological risk discussed in Section 6. Sediment sample locations are shown on Figures 3-1 to 3-5.

3.3.5 Ten surface soil samples were collected before and after the detonation of ordnance in the Cerro Balcon area of MRS 02 in 2001 by Ellis during construction support activities. These samples were used in the qualitative analysis of MC that will be developed for MRS 02. This data was used in the evaluation of human and ecological risk discussed in Section 6 as no samples were collected in MRS 02 during the RI.

3.4 Field Sampling Methods

3.4.1 Surface soil samples were composite samples collected using the Cold Regions Research and Engineering Laboratory (CRREL) 7-sample wheel approach. Sample design and locations are described in Table 3-3. Each of the surface soil samples was collected from a depth of 0 to 2 inches bgs using disposable sampling equipment. Each sampling location was cleared of surface vegetation prior to sample collection. New sterile sampling equipment and new gloves were used at each sampling location. Soil characteristics for each soil sample were logged on a sampling log form (Appendix C). The remaining soil was disposed of on the ground surface at the sampling locations from which they were collected.

3.4.2 Sediment samples were discrete samples collected from available surface water bodies such as lagoons and streams. Each of the sediment samples was collected from a depth of 0 to 6 inches bgs using disposable sampling equipment avoiding the collection of rocks, twigs, leaves and other debris. Each sample container was filled to zero headspace. New sterile sampling equipment and new gloves were used at each sampling location.

3.4.3 Soil and sediment sampling locations were recorded in the sampling logs as sampling was completed. When possible, distances to reference points were given. Surface sampling locations were recorded using a handheld Global

Positioning System (GPS). Photographs were taken of each of the sampling areas (Appendix D). MEC / Multiple Anomaly Discovery Logs were not completed because no MEC or MD discoveries occurred during soil sampling.

3.5 Chemistry Analyses

3.5.1 The analytical MC of concern were selected on the basis of the MEC and MD items recovered at the site and agreed upon during the TPP process. The standard analytical methods include USEPA Method 6010B for antimony, barium, chromium, copper, lead, and zinc; USEPA Method 7471A for mercury; and USEPA Method 8330B-modified for explosives.

3.5.2 Project-specific DQOs (Section 2) were met for sampling and analysis and the QA/QC objectives by collecting the proper quantities and types of samples, using the correct analytical methodologies, implementing field and laboratory QA/QC procedures, and using various data validation and evaluation processes. The DQOs for each analytical method are provided in the QAPP. Laboratory requirements for the analytical methods used for this project are provided in the Work Plan and QAPP.

3.5.3 As described in the Data Validation Reports in Appendix C, the analytical data was found to be valid and acceptable and met the comprehensive data level for risk assessments being conducted for the site.

3.6 Munitions and Explosives of Concern Avoidance Procedures

Anomaly avoidance techniques were used during the MC sampling event strictly to ensure the safety of field sampling personnel. All surface soil samples were collected from previously cleared transects and sediment sample locations were cleared by the UXO Technician prior to sample collection. The UXO Technician had direct field responsibility for MEC avoidance, and no MEC or MD was identified during the MC field effort.

3.7 MC Results Summary

A total of 28 soil and 7 sediment samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for MC, including explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc). Explosives were not detected in any of the field samples. One split sample detected very low levels of 1,3,5-TNB and 4-NT, but both were well below the USEPA RSLs for Resident Soil. All detected metals concentrations were below the USEPA RSLs but greater than ecological screening values. Tables 3-5 through 3-10 show the sample results. All sample results are provided in Appendix C. A complete discussion of MC findings and the MC risk assessment is included in Section 5.

3.8 Investigative-Derived Wastes

Soil and excess sample material were returned to the sample location immediately after completion of sampling. Used gloves and any other disposable sampling equipment or personal protective equipment were double bagged and disposed of in a designated trash bin at the field office. Reusable sample equipment was not used therefore no decontamination rinse or decontamination fluid was collected.

3.9 DEVIATIONS FROM THE FINAL MMRP WORK PLAN

Field conditions dictated deviations from the Work Plan; these changes are presented in Table 3-4. All changes were presented to the stakeholders for concurrence prior to implementation.

Table 3-4: Deviations from the Work Plan

Change	Rationale
A portion of the originally planned transects were not completed.	Some rights-of-entry were not received for the MRSs. The team also could not access the cays due to terrain. Some of the transects planned in US Fish and Wild Life managed areas were not completed because of changes in DQOs that specify data would be focused in areas of high receptor use vs. undeveloped areas. Portions of the wildlife management areas are also inaccessible due to terrain and vegetation. Concern was noted over disturbance of specie status species and habitats in these areas. These changes were discussed in the March 2011 TPP session.
MC sample numbers and locations were modified based on MRS access and MEC and MD locations, as well as field conditions.	Portions of MRSs were either inaccessible or a right-of-entry was not granted for a specific property. Revised sample locations were presented during the March 2011 TPP session.
MRS 04 and 05 were divided into separate areas for investigation and characterization. The Work Plan DQOs did not divide the MRS into subareas.	MRS 04 and MRS 05 are adjacent MRSs at Culebra. USFWS own a contiguous portion of each MRS. Receptors and land use varies in this area when compared to the remainder of MRS 04 and 05 that is privately owned. Thus, it is recommended that USFWS areas from each MRS be combined into a separate MRS. The remainder of each MRS 04 and MRS 05 will remain as separate MRSs. Thus, the following will result: • U.S. Fish and Wildlife Area MRS • MRS 04 (remaining area) • MRS 05 (remaining area)
MRS 07 was divided into separate areas for investigation and characterization. The Work Plan DQOs did not divide the MRS into subareas.	Due to differences in potential receptors and prior surface clearances along the beaches at MRS 07 the DQOs were adjusted and separate DQOs were established for the beaches and trails at MRS 07 and the vegetated areas where no clearances have

Change	Rationale
	been conducted and receptors are less likely to access.
No MEC or MC activities were conducted in MRS 02.	A right-of-entry was not granted for Cerro Balcon and the adjacent cays were not accessible due to rough seas and the absence of suitable access points during the time of year the field teams were present. While access to all cays is prohibited, Cayo Lobo and Cayo Yerba are frequented by recreational users. These cays have small beaches that allow access during good weather in certain times of the year. The Work Plan DQOs called for meandering transects, DGM, and anomaly investigations which were not feasible during the RI (for various reasons) field work and the DQOs were adjusted accordingly for Cerro Balcon and the cays. It was agreed upon at the TPP meeting in March 2011 that historical data would be sufficient to make future action decisions for these areas.

3.10 QUALITY CONTROL

The QC Plan for this project established the methods and procedures that were used to evaluate the project's process and to address QC inspection, audit, and reporting requirements. Throughout site operations, the field crew performed quality control inspections, which consisted of daily observations by the UXOQCS of operational activities and formal inspections of completed work. Daily inspections included checks of maintenance and calibration procedures, as well as monitoring for compliance with the Work Plan. Daily magnetometer checks were performed. Throughout all site operations the SUXOS completed a daily report detailing all site operations, man-hours and equipment used each day, and operating issues. The overall effectiveness of the QC program for this project was dependent on the RI activities being conducted in accordance with the Final MMRP Work Plan, which were developed to ensure the project met the requirements of the established DQOs. To ensure an effective QC program, the Project Manager, SUXOS, and UXOQCS worked closely together during all aspects of the fieldwork, to monitor and document the procedures conducted in support of the RI in accordance with the Final MMRP Work Plan. QC data and records are located within Appendix B.

Table 3-5: Soil Sampling Results at MRS 04

Analytic Method	Chemical Name	Report Result Unit	CI-MRS04-SS-01 3/23/2011		CI-MRS04-SS-02 3/23/2011		CI-MRS04-SS-03 3/23/2011		CI-MRS04-SS-04 3/23/2011		CI-MRS04-SS-05 3/23/2011		CI-MRS04-SS-06 3/23/2011	
				DVQ		DVQ		DVQ		DVQ		DVQ		DVQ
	Percent Solids	%	96		79.9		94.1		91.4		97.2		94	
SW846 3050B	Antimony, Total	mg/kg	1.03 UN	UJ	1.23 UN	UJ	0.357 BN	UJ	1.02 UN	UJ	0.471 BN	UJ	0.984 UN	UJ
SW846 3050B	Barium, Total	mg/kg	218 N	J	216 N	J	129 N	J	17.6 N	J	12.4 N	J	12.3 N	J
SW846 3050B	Chromium, Total	mg/kg	4.42		2.83		14.7		9.34		8.29		8.18	
SW846 3050B	Copper, Total	mg/kg	41.2		33		61.8	J	6.16		3.05		3.78	
SW846 3050B	Lead, Total	mg/kg	9.92		10.3		9.66		10.2 U		9.76 U		9.84 U	
SW846 7471A Prep	Mercury, Total	mg/kg	0.0139 B	J	0.0286 B	J	0.0218 B	J	0.0312 B	J	0.00558 B	J	0.0186 B	J
SW846 3050B	Zinc, Total	mg/kg	60.6		65.3		117	J	11.1		5.22		6.67	
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 QU		500 QU		500 QU		500 QU		500 QU		500 QU	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-6: Sediment Sampling Results at MRS 04

Analytic Method	Chemical Name	Report Result Unit	CI-MRS04-SD-01 3/23/2011		CI-MRS04-SD-02 3/23/2011		CI-MRS04-SD-03 3/23/2011	
				DVQ		DVQ		DVQ
	Percent Solids	%	74.3		68.8		63.6	
SW846 3050B	Antimony, Total	mg/kg	2.54 BN	UJ	0.594 BN	UJ	1.57 UN	UJ
SW846 3050B	Barium, Total	mg/kg	65.9 N	J	21.2 N	J	24.5 N	J
SW846 3050B	Chromium, Total	mg/kg	12.1		8.14		8.7	
SW846 3050B	Copper, Total	mg/kg	120		2.94		5.9	
SW846 3050B	Lead, Total	mg/kg	159		13.1 U		15.7 U	
SW846 7471A Prep	Mercury, Total	mg/kg	0.227 B	J	0.0159 UB	J	0.0172 UB	J
SW846 3050B	Zinc, Total	mg/kg	95.5		3.65		6.11	
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 QU		500 QU		500 QU	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-7: Soil Sampling Results at MRS 05

Analytic Method	Chemical Name	Report Result Unit	CI-MRS05-SS-01 3/22/2011		CI-MRS05-SS-02 3/22/2011		CI-MRS05-SS-03 3/22/2011		CI-MRS05-SS-04 3/22/2011		CI-MRS05-SS-05 3/22/2011		CI-MRS05-SS-06 3/22/2011		CI-MRS05-SS-07 3/22/2011	
				DVQ		DVQ		DVQ		DVQ		DVQ		DVQ		DVQ
	Percent Solids	%	94.7		92.3		90.9		90.5		89.7		91.6		91.2	
SW846 3050B	Antimony, Total	mg/kg	1.04 UN	UJ	3.46 BN	UJ	5.25 UN	UJ	5.44 UN	UJ	0.662 BN	UJ	1.77 BN	UJ	1.1 UN	UJ
SW846 3050B	Barium, Total	mg/kg	100 N	J	65 N	J	35.1 N	J	37.3 N	J	56.4 N	J	46.5 N	J	616 N	J
SW846 3050B	Chromium, Total	mg/kg	15.9 N	J	13.9 N	J	12.3 N	J	8.62 N	J	60.5 N	J	23.7 N	J	13.5 N	J
SW846 3050B	Copper, Total	mg/kg	77 N	J	63.5 N	J	76.8 N	J	84.6 N	J	89.5 N	J	77 N	J	138 N	J
SW846 3050B	Lead, Total	mg/kg	3.19 N	J	5.53		2.36 B		2.36 B		2.31 B		4.53 B		6.06	
SW846 7471A Prep	Mercury, Total	mg/kg	0.00741 B	J	0.0333 B		0.0309 B		0.0363 B		0.0305 B		0.0302 B		0.0313 B	
SW846 3050B	Zinc, Total	mg/kg	68.8 N	J	90.1 N	J	91.8 N	J	93.5 N	J	74.9 N	J	76.9 N	J	103 N	J
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	µg/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	HMX	µg/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	µg/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 U		500 QU		500 QU		500 QU		500 QU		500 QU		500 QU	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-7: Soil Sampling Results at MRS 05 (continued)

Analytic Method	Chemical Name	Report Result Unit	CI-MRS05-SS-08 3/22/2011		CI-MRS05-SS-09 3/22/2011		CI-MRS05-SS-10 3/22/2011		CI-MRS05-SS-11 3/22/2011		CI-MRS05-SS-12 3/22/2011		CI-MRS05-SS-13 3/22/2011		CI-MRS05-SS-14 3/22/2011	
				DVQ		DVQ		DVQ		DVQ		DVQ		DVQ		DVQ
	Percent Solids	%	60.6		93.8		94		90.4		92.3		88.8		91	
SW846 3050B	Antimony, Total	mg/kg	7.57 UN	UJ	2.82 BN	UJ	4.88 UN	UJ	5.53 UN	UJ	1.06 UN	UJ	5.43 UN	UJ	4.83 UN	UJ
SW846 3050B	Barium, Total	mg/kg	958 N	J	36.8 N	J	44.8 N	J	407 N	J	262 N	J	626 N	J	543 N	J
SW846 3050B	Chromium, Total	mg/kg	12.8 N	J	8.19 N	J	8.76 N	J	26.9 N	J	14.6 N	J	23.5 N	J	10.8 N	J
SW846 3050B	Copper, Total	mg/kg	171 N	J	75.3 N	J	85.1 N	J	165 N	J	115 N	J	121 N	J	87 N	J
SW846 3050B	Lead, Total	mg/kg	17.3	J	3.13 B		3.45 B		9.98		7.1		12.6		9.31	
SW846 7471A Prep	Mercury, Total	mg/kg	0.0167 B		0.0234 B		0.0346 B		0.0335 B		0.0434 B		0.0316 B		0.0414 B	
SW846 3050B	Zinc, Total	mg/kg	105 N	J	67.6 N	J	68 N	J	88.6 N	J	58.4 N	J	127 N	J	88.6 N	J
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 QU		500 QU		500 QU		500 QU		500 QU		500 QU		500 QU	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-8: Sediment Sampling Results at MRS 05

Analytic Method	Chemical Name	Report Result Unit	CI-MRS05-SD-01 3/22/2011	DVQ	CI-MRS05-SD-02 3/22/2011	DVQ
	Percent Solids	%	50.7		60.4	
SW846 3050B	Antimony, Total	mg/kg	0.577 UN	UJ	0.529 UN	UJ
SW846 3050B	Barium, Total	mg/kg	196 N	J	175 N	J
SW846 3050B	Chromium, Total	mg/kg	14.3 N	J	13.3 N	J
SW846 3050B	Copper, Total	mg/kg	149 N	J	130 N	J
SW846 3050B	Lead, Total	mg/kg	6.29		5.56	
SW846 7471A Prep	Mercury, Total	mg/kg	0.00818 B		0.0129 B	
SW846 3050B	Zinc, Total	mg/kg	68.7 N	J	73.3 N	J
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 QU		1000 QU	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 QU		500 QU	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-9: Soil Sampling Results at MRS 07

Analytic Method	Chemical Name	Report Result Unit	CI-MRS07-SS-01 3/21/2011		CI-MRS07-SS-02 3/21/2011		CI-MRS07-SS-03 3/21/2011		CI-MRS07-SS-04 3/21/2011		CI-MRS07-SS-05 3/21/2011		CI-MRS07-SS-06 3/21/2011		CI-MRS07-SS-07 3/21/2011		CI-MRS07-SS-08 3/21/2011	
				DVQ		DVQ		DVQ		DVQ		DVQ		DVQ		DVQ		
	Percent Solids	%	58.8		93		92.8		92.8		94.9		91.1		91.4		88.8	
SW846 3050B	Antimony, Total	mg/kg	1.7 UN	UJ	5.37 UN	UJ	5.3 UN	UJ	5.29 UN	UJ	5.26 UN	UJ	5.49 UN	UJ	0.489 BN	UJ	5.15 UN	UJ
SW846 3050B	Barium, Total	mg/kg	132 N	J	260 N	J	29.6 N	J	118 N	J	134 N	J	129 N	J	317 N	J	272 N	J
SW846 3050B	Chromium, Total	mg/kg	17.8 N	J	17 N	J	11.4 N	J	10.9 N	J	12.2 N	J	22.5 N	J	15.5 N	J	18.8 N	J
SW846 3050B	Copper, Total	mg/kg	173 N	J	170 N	J	193 N	J	124 N	J	109 N	J	143 N	J	194 N	J	225 N	J
SW846 3050B	Lead, Total	mg/kg	8.79 N	J	9.66 N	J	3.4 BN	J	7.05 N	J	4.24 BN	J	7.45 N	J	22.8 N	J	15.3 N	J
SW846 7471A Prep	Mercury, Total	mg/kg	0.0101 B	J	0.0276 B	J	0.0113 UB	UJ	0.041 B	J	0.0321 B	J	0.0379 B	J	0.0436 B	J	0.0517 B	J
SW846 3050B	Zinc, Total	mg/kg	51.7 N	J	88.5 N	J	66.8 N	J	76.8 N	J	74.6 N	J	61.7 N	J	116 N	J	143 N	J
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU		1000 QU	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U		500 U		500 U		500 U		500 U		500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-10: Sediment Sampling Results at MRS 07

Analytic Method	Chemical Name	Report Result Unit	CI-MRS07-SD-01 3/21/2011		CI-MRS07-SD-02 3/21/2011	
				DVQ		DVQ
	Percent Solids	%	32.6		75.3	
SW846 3050B	Antimony, Total	mg/kg	1.97 BN	UJ	0.592 BN	UJ
SW846 3050B	Barium, Total	mg/kg	369 N	J	24.1 N	J
SW846 3050B	Chromium, Total	mg/kg	12.6 N	J	2.69 N	J
SW846 3050B	Copper, Total	mg/kg	151 N	J	11.8 N	J
SW846 3050B	Lead, Total	mg/kg	20.1 N	J	11.7 UN	UJ
SW846 7471A Prep	Mercury, Total	mg/kg	0.0338 UB	UJ	0.0768 UB	UJ
SW846 3050B	Zinc, Total	mg/kg	115 N	J	6.2 N	J
SW846 8330B (no MIS)	1,3,5-Trinitrobenzene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,4,6-Trinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,4-Dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2,6-Dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	2-Amino-4,6-dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	3,5-Dinitroaniline	ug/kg	1000 U		1000 U	
SW846 8330B (no MIS)	4-Amino-2,6-dinitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	HMX	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	Nitroglycerin	ug/kg	1000 U		1000 U	
SW846 8330B (no MIS)	PETN	ug/kg	1000 QU		1000 QU	
SW846 8330B (no MIS)	RDX	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	Tetryl	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	m-Dinitrobenzene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	m-Nitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	o-Nitrotoluene	ug/kg	500 U		500 U	
SW846 8330B (no MIS)	p-Nitrotoluene	ug/kg	500 U		500 U	

Notes

U – indicates the target analyte was analyzed for but not detected above the detection limit.
J – indicates an estimated value.
B – Target analyte was detected in the sample as well as the associated blank
N – Spiked sample recovery not within control limits
Q – LCS recovery not within control limits

Table 3-11: Background Soil Sampling Results at MRS 04 and MRS 07

Analytic Method	Chemical Name	Report Result Unit	CI-MRS04-BKG-01 3/23/2011		CI-MRS04-BKG-02 3/23/2011		CI-MRS04-BKG-03 3/23/2011		CI-MRS07-BKG-01 3/21/2011		CI-MRS07-BKG-02 3/21/2011		CI-MRS07-BKG-03 3/21/2011	
				DVQ		DVQ		DVQ		DVQ		DVQ		DVQ
	Percent Solids	%	95.3		95.8		94.1		92.3		90.5		90.3	
SW846 3050B	Antimony, Total	mg/kg	0.338 UN	UJ	0.337 UN	UJ	0.349 BN	UJ	2.8 BN	UJ	1.78 UN	UJ	2.15 BN	UJ
SW846 3050B	Barium, Total	mg/kg	111 N	J	124 N	J	257 N	J	130 N	J	118 N	J	125 N	J
SW846 3050B	Chromium, Total	mg/kg	2.75	J	2.74	J	14.2	J	15.9 N	J	12.9 N	J	13.8 N	J
SW846 3050B	Copper, Total	mg/kg	51.9	J	39.7	J	60.3	J	130 N	J	125 N	J	136 N	J
SW846 3050B	Lead, Total	mg/kg	15.1	J	3.21	J	3.89	J	5.19 N	J	4.57 BN	J	5.35 N	J
SW846 7471A Prep	Mercury, Total	mg/kg	0.0353 B	J	0.017 B	J	0.0305 B	UJ	0.0296 B	J	0.0255 B	J	0.0314 B	J
SW846 3050B	Zinc, Total	mg/kg	71.9	J	33	J	65.2	J	60 N	J	68.5 N	J	77.6 N	J

Table 3-12: Background Soil Sampling Results at MRS 05

Analytic Method	Chemical Name	Report Result Unit	CI-MRS05-BKG-01 3/23/2011		CI-MRS05-BKG-02 3/23/2011		CI-MRS05-BKG-03 3/23/2011		CI-MRS05-BKG-04 3/23/2011	
				DVQ		DVQ		DVQ		DVQ
	Percent Solids	%	91.4		91.4		93.7		92.3	
SW846 3050B	Antimony, Total	mg/kg	1.78 UN	UJ	0.339 UN	UJ	0.315 UN	UJ	0337 UN	UJ
SW846 3050B	Barium, Total	mg/kg	262 N	J	255 N	J	421 N	J	236 N	J
SW846 3050B	Chromium, Total	mg/kg	14.3	J	13.4	J	11.5	J	12.6	J
SW846 3050B	Copper, Total	mg/kg	148	J	140	J	135	J	152	J
SW846 3050B	Lead, Total	mg/kg	9.77	J	5.39	J	9.83	J	5.08	J
SW846 7471A Prep	Mercury, Total	mg/kg	0.0113 BB	J	0.0357 B	J	0.0246 B	UJ	0.0317 B	J
SW846 3050B	Zinc, Total	mg/kg	164	J	78.3	J	71.3	J	60.3	J

3.10.1 Employee Process Training Program

3.10.1.1 All site personnel received the applicable training as specified in the APP. In addition, UXO-qualified personnel met the qualification standards for personnel conducting MEC operations, as set forth in Department of Defense Explosives Safety Board Technical Paper 18 *Minimum Qualifications for UXO Technicians and Personnel* (2004).

3.10.1.2 Documentation of training requirements for each UXO Technician was reviewed by the SUXOS/UXOSO and filed in on-site project files before personnel were allowed to enter the Exclusion Zone (EZ). No one was permitted to work in an EZ without the appropriate training and medical clearances.

3.10.2 Munitions and Explosives of Concern Quality Assurance / Quality Control Methods Used

3.10.2.1 A three-phase control system was used in the implementation of the QC program to ensure that all project work conformed to project DQOs, with the phases being Preparatory, Initial, and Follow-up. The Preparatory Phase included familiarization by project personnel with established DQOs and incorporation of any required follow-up work to ensure the process would pass QC. The Initial Phase was the start of the QC checks on the project process. The Follow-Up Phase included checks conducted after the initial QC check to ensure any discrepancies discovered during the initial QC checks were corrected.

3.10.2.2 All of the areas in which surface and subsurface investigations were completed were subjected to a QC analysis by the UXOQCS. All of the investigated areas passed QC inspection.

3.10.3 Munitions and Explosives of Concern QC Results

3.10.3.1 The following QC/QC failure criteria were documented in the Work Plan:

3.10.3.2 The quality failure criteria will be no MEC item equal to or smaller than the (audible or digital) response of a 20mm projectile, as established within the guidelines of the GPO process at the project start. The Team Leader will notify the SUXOS and / or UXOQCS as soon as the grid or transect segment is completed. The SUXOS will immediately notify the USAESCH on-site representative so that QC and QA checks can be scheduled and completed as soon as possible.

3.10.3.3 During field work, the project team revised the QC failure criteria to correct an error in the Work Plan and to provide a better standard of quality control. Formal changes to the Work Plan were submitted on 8 February 2011. The criteria were specifically revised to "…no metal that produces a signal response equivalent to or greater than the response of a 20mm projectile…"

3.10.3.4 Within the field the project team identified four transects where the quality of work was questionable based on the outlined failure criteria. Each of these transects were reworked. As a result of the rework, additional items were located; however none were MEC or MD. A portion of the transect segments received a quality assurance check by the CEHNC on-site OE Safety Specialist and none failed. There were no QA failures recorded as a result of the RI field effort.

3.10.4 Munitions Constituents Quality Assurance / Quality Control Samples

QA and QC procedures for the MC investigation are documented in the QAPP. Samples were analyzed for the purpose of assessing the quality of the sampling effort and the analytical data.

3.10.4.1 QC Samples

3.10.4.1.1 QC for analytical samples was provided through the use of temperature blanks, matrix spike / matrix spike duplicates (MS/MSDs) and field splits samples. The QC samples were handled as regular samples. QC for the analytical samples was provided through the use of field split samples.

3.10.4.1.2 The following QC samples were collected for analytical samples (Table 3-11):

- MSs: Samples were collected to be split in the laboratory and run as MS/MSDs in an amount equal to at least 10% of the field samples for laboratory analysis for soil.
- Field Splits: Field splits were collected at eight locations over MRS 04, MRS 05, and MRS 07. Field split samples were collected as a single sample that was divided into equal parts before being sent for laboratory analysis. These samples were collected in a quantity equal to at least 20% of the field samples for soil.

Table 3-13: Quantities of Analyses

Field Samples	Spikes	Field Splits	Total Number of Analyses
28	4	8	40

3.10.4.2 Quality Assurance Samples

3.10.4.2.1 Eight QA split samples were collected during the sampling effort, as identified in the approved Work Plan. These samples were sent to a separate QA lab, and were validated separately from the primary samples.

3.10.4.3 Data Quality Controls

3.10.4.3.1 An independent third party conducted analytical data validation for this project and Data Validation Reports are provided in Appendix C. Objectives for this review are in accordance with the QA/QC objectives stated in the QAPP. Outlying data were flagged, as appropriate, in accordance with laboratory Standard Operating Procedures.

3.10.4.3.2 Validation activities were performed in accordance using the “USEPA National Functional Guidelines (NFG) for Inorganic Data Review, October 2004 (EPA 540-R-04-004)”, “USEPA Contract Laboratory Program NFG for Superfund Organic Methods Data Review, June 2008 (EPA 540-R-08-01)” and “HPLC SOP HW-16 Revision 2 (2006)” as guidance, as per the QAPP.

3.11 DATA GAPS

Due to site specific conditions and unanticipated circumstances, the RI contains data gaps. The most significant data gaps are identified below and further discussed in greater detail throughout the RI in relation to their effect on meeting established DQOs and the ability of the project team to adequately characterize the nature and extent of contamination at Culebra. In some cases, historical data was used to fill these gaps or data collected during the RI was extrapolated to assist in site characterization.

MRS 02 – Cerro Balcon: No subsurface MEC investigation was conducted during the RI or previous investigation at the site; therefore, no data exists concerning subsurface MEC density at the site. Data could not be collected because ROEs were not granted for Cerro Balcon.

MRS 02 – Adjacent Cays: No MEC investigations have been conducted at any of the cays except for Cayo Lobo; therefore, no data exists concerning surface or subsurface MEC density at this portion of the site. Investigations were not conducted during the RI on the cays due to the inaccessibility of the cays (no beaches, steep cliffs, and rough seas). A full MEC surface clearance was conducted previously at Cayo Lobo.

MRS 02 – Adjacent Cays: Mo MC sampling data exists for any of the cays except for Cayo Lobo. Investigations were not conducted during the RI on the cays due to the inaccessibility of the cays (no beaches, steep cliffs, and rough seas).

MRS 04: Portions of the MRS were not investigated for MEC or MC due to either a lack of ROEs or due to the rough terrain (steep inaccessible terrain and/or dense vegetation).

MRS 05: Portions of the MRS were not investigated for MEC or MC due to either a lack of ROEs or due to the rough terrain (steep inaccessible hills and/or dense vegetation).

The most significant data gaps resulted from a lack of ROEs for privately owned parcels within MRS 05, MRS 04 and Cerro Balcon. The USACE Real Estate Office in San Juan attempted to obtain ROEs by visiting property owners and through phone calls prior to mobilization. Additional efforts were made when the field team identified property owners potentially willing to grant access.

Culebra Munitions Site
Culebra, Puerto Rico

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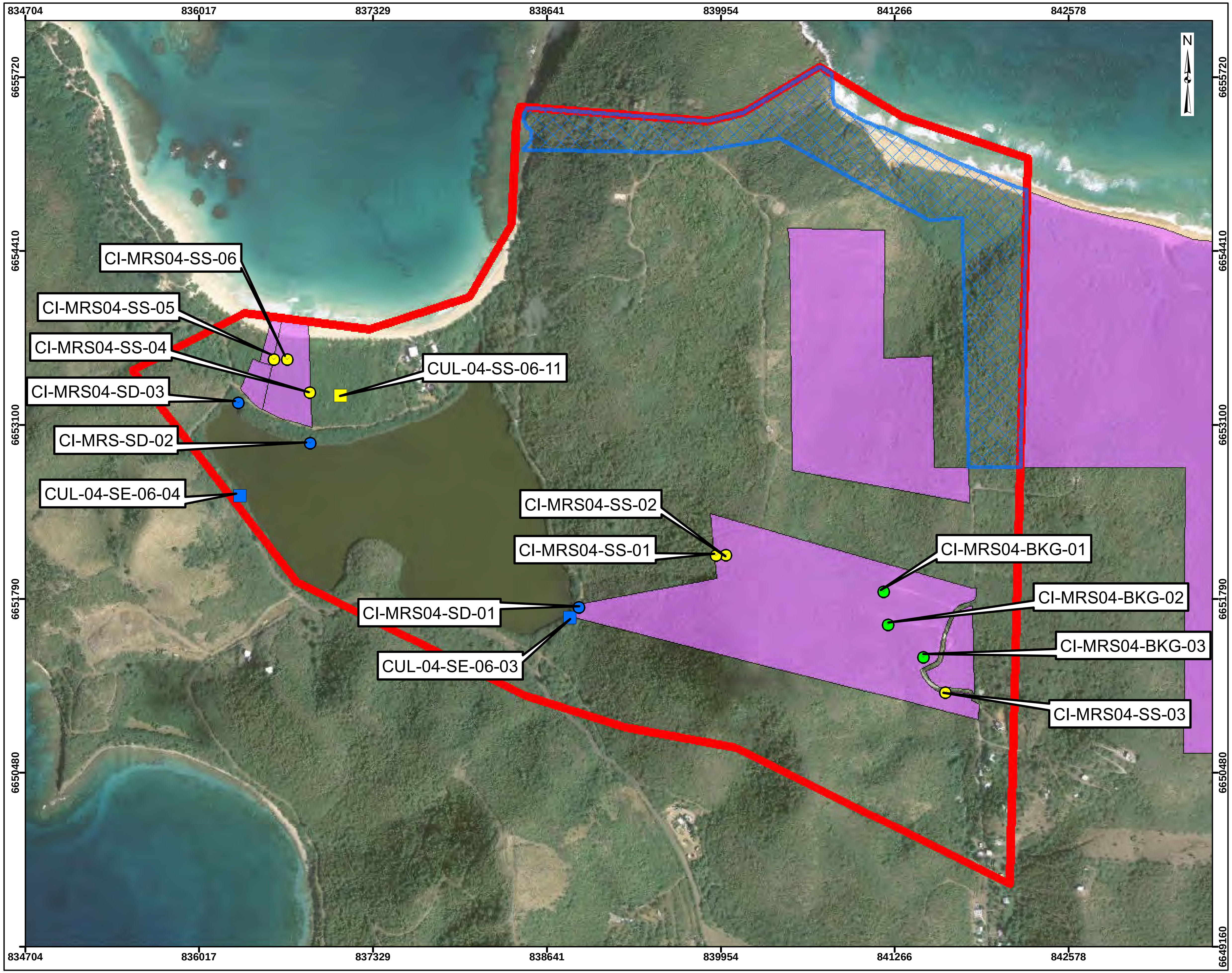
Figure 3-1
MRS 04 – Flamenco Lagoon Maneuver Area
Munitions Constituents Data



Legend

MRS 04 Boundary
MRS 04 Fish & Wildlife Area
Right of Entry (ROE) Received

RI Sample Locations

RI Background Sample Location
RI Sediment Sample Location
RI Soil Sample Location

SI Sample Locations

SI Sediment Sample Location
SI Soil Sample Location

0 200 400 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

Culebra Munitions Site
Culebra, Puerto Rico

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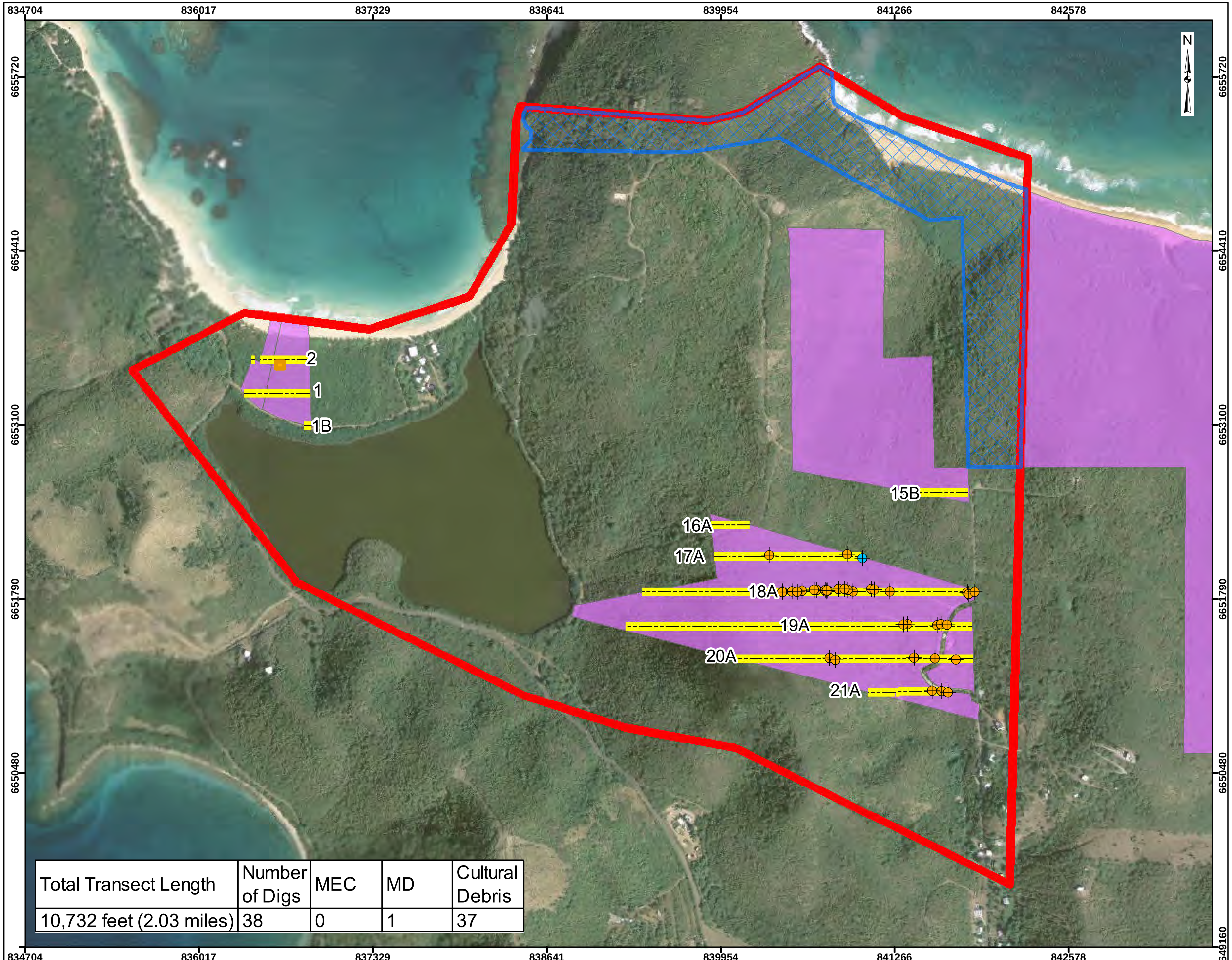
Figure 3-2
MRS 04 – Flamenco Lagoon Maneuver Area
Munitions Explosives of Concern



Total Transect Length	Number of Digs	MEC	MD	Cultural Debris
10,732 feet (2.03 miles)	38	0	1	37

Legend

- MRS 04 Boundary
- MRS 04 Fish & Wildlife Area
- Right of Entry (ROE) Received
- Investigated Transects
- Approximate Grid Location (25 ft by 25 ft)

RI Intrusive Results

- Cultural Debris Item
- Munitions Debris Item

0 200 400 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

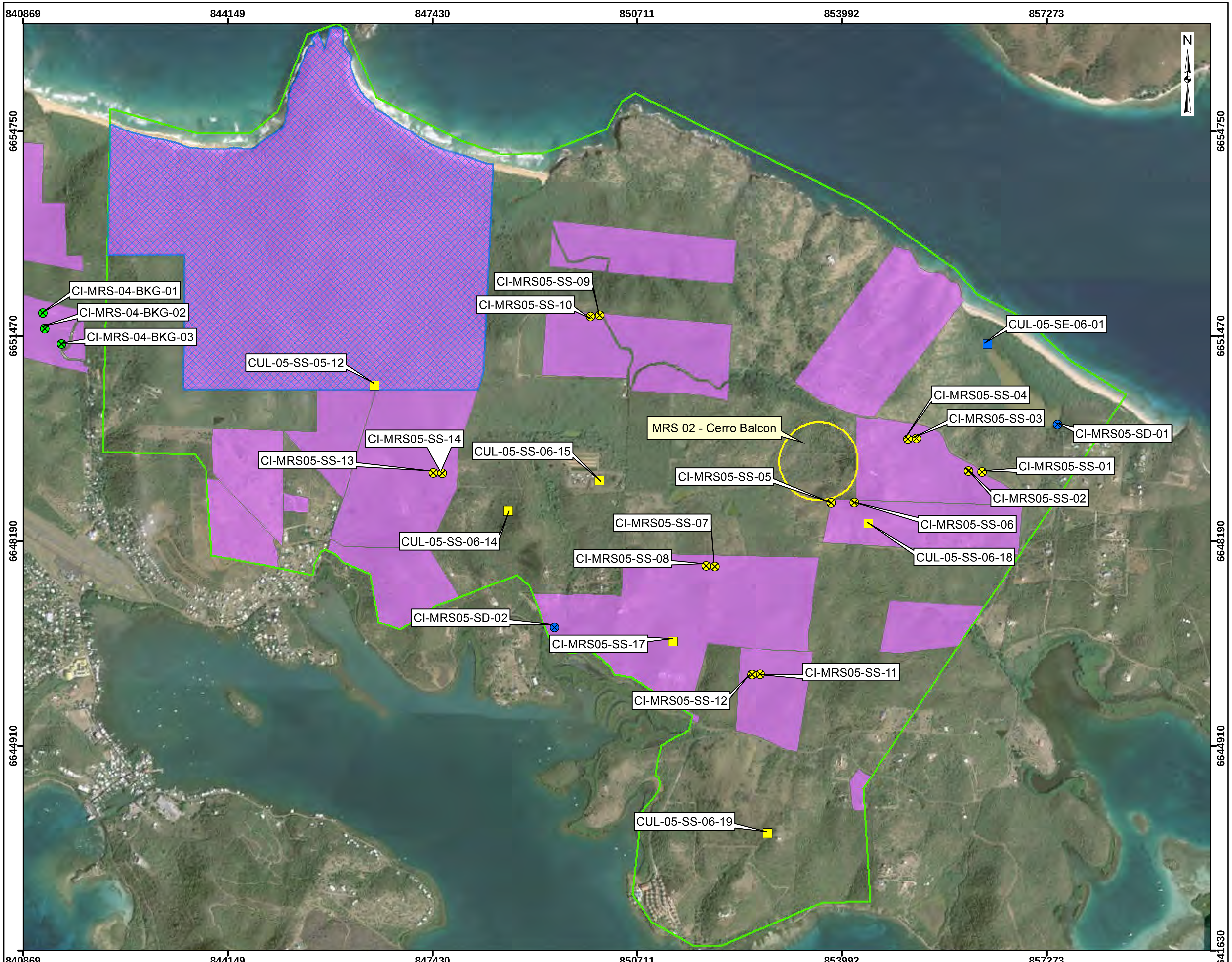


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Figure 3-3
MRS 05 – Mortar and Combat Range Area
Munitions Constituents

Legend

- MRS 05 Boundary
- MRS 02 Boundary
- MRS 05 Fish & Wildlife Area
- Right of Entry (ROE) Received

RI Sample Locations

- Background Sample Location
- Sediment Sample Location
- Soil Sample Location

SI Sample Locations

- SI Sediment Sample Location
- SI Soil Sample Location

0 500 1,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

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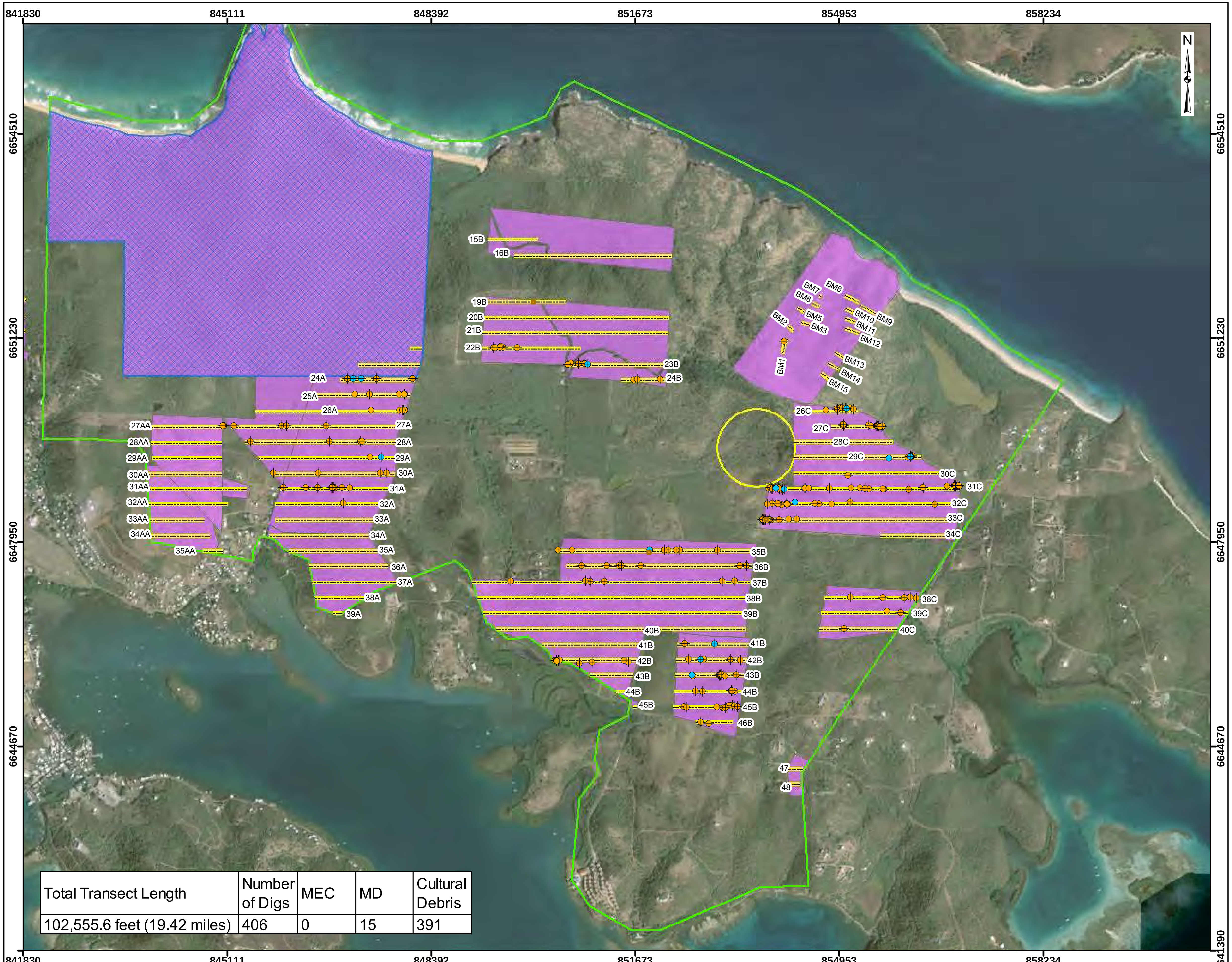
Figure 3-4
MRS 05 – Mortar and Combat Range Area
Munitions Explosives of Concern



Total Transect Length	Number of Digs	MEC	MD	Cultural Debris
102,555.6 feet (19.42 miles)	406	0	15	391

Legend

- MRS 05 Boundary
- MRS 02 Boundary
- MRS 05 Fish & Wildlife Area
- Right of Entry (ROE) Received
- Investigated Transect
- Approximate Grid Location (25 ft by 25 ft)

RI Intrusive Results

- Munitions Debris Item
- Cultural Debris Item

0 500 1,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

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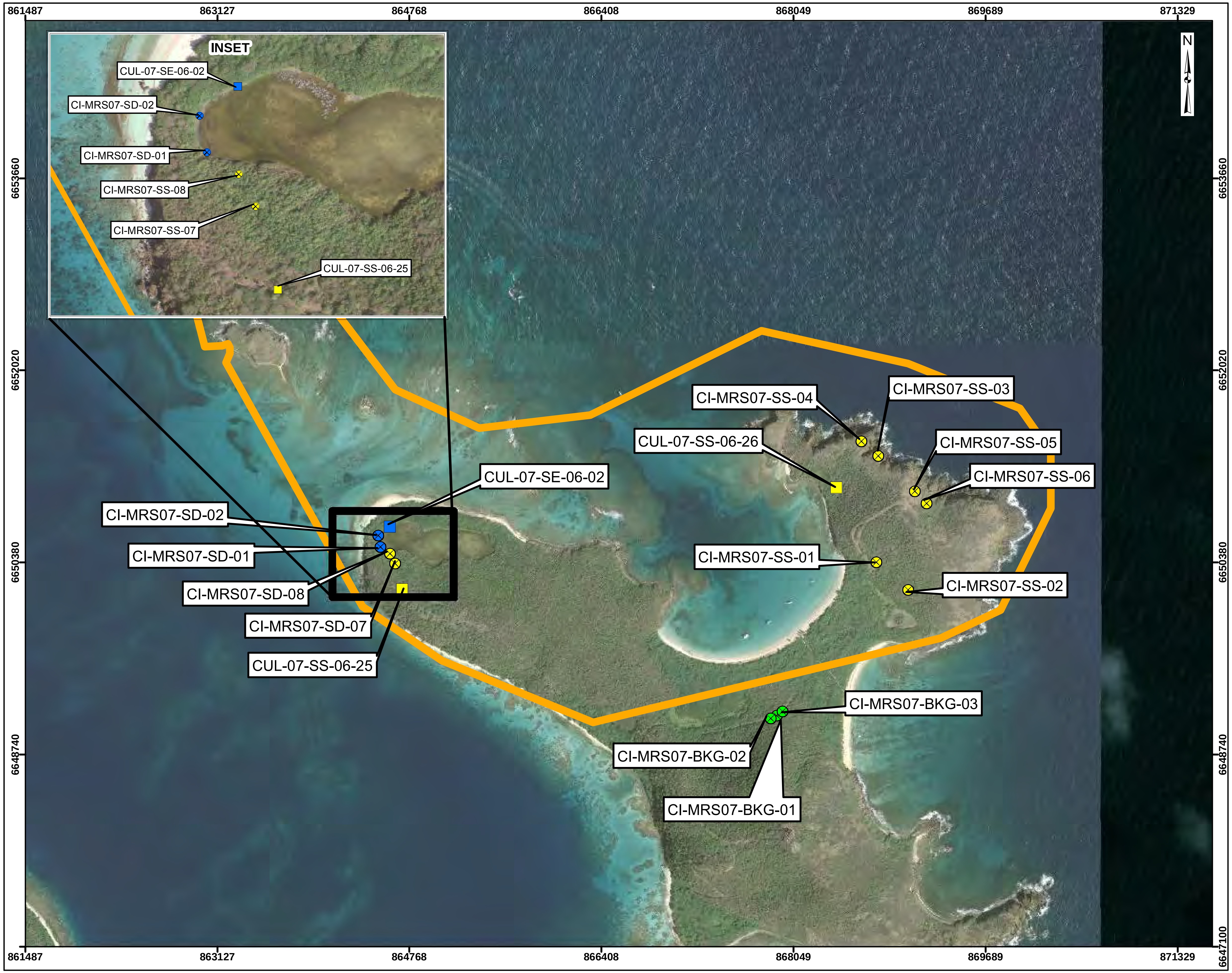
Figure 3-5
MRS 07 – Culebrita Artillery Impact Area
Munitions Constituents



Legend

MRS 07 Boundary

RI Sample Locations

Background Sample Location

Sediment Sample Location

Soil Sample Location

SI Sample Locations

SI Sediment Sample Location

SI Soil Sample Location

0 200 400 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

Culebra Munitions Site
Culebra. Puerto Rico

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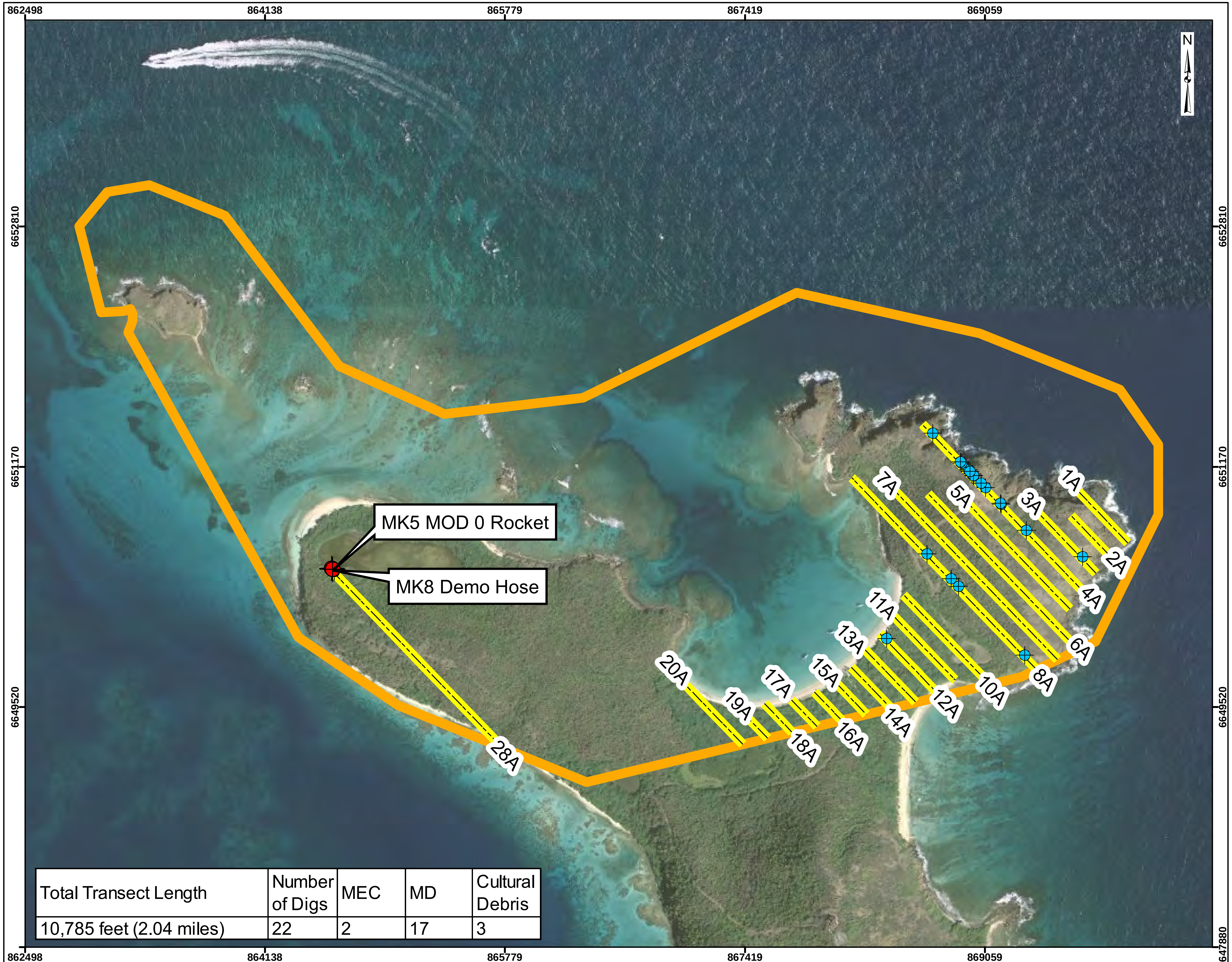
Figure 3-6
MRS 07 – Culebrita Artillery Impact Area
Munitions Explosives of Concern



Total Transect Length	Number of Digs	MEC	MD	Cultural Debris
10,785 feet (2.04 miles)	22	2	17	3

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

4 REVISED CONCEPTUAL SITE MODEL AND RI RESULTS

RI fieldwork for Culebra Island was conducted from October 2010 to March 2011. A revised CSM has been created based on the results of the RI fieldwork and risk assessment conducted for each MRS. The starting point for this effort was the CSM established during the Historical Records Review/SI and presented at the TPP meetings. The following presents the amended CSM for MRS 02, MRS, 04, MRS 05, and MRS 07 at Culebra Island. Historical use of the sites was presented in Section 1. The physical profile for Culebra Island can be found in Section 2, which remains unchanged. Figures 4-1, 4-2, 4-3, and 4-4 present the 3D graphical CSMs for each MRS, which visually illustrate receptors, source, and land use activities for each MRS.

4.1 MEC AND MC PROFILE FOR MRS 02, 04, 05, AND 07

Table 4-1: Munitions and MC Release Profile Culebra Island MRSs

Information Type	Summary Information
Types of Munitions Historically Used	**MRS 02 (Cerro Balcon) - Mortar:** 81mm HE and practice; 75mm practice
	MRS 02 (Cays) – **Bombs:** Guided Projectile (GP): Mk 81; Mk 82; Mk 83; Mk 84 GP Practice Bomb: MK 76, 100 lb. bomb, **Rocket:** 5-inch Zuni; 5-inch; Tiny Tim 11.75-inch Mk 1 mod 0; general rockets Practice Rocket: Mk 8, 2.75- inch; **Projectiles:** HEI Projectile: 20mm; 76mm; 105mm HE Projectile: M1; 155mm; 75mm; 37mm AP: 8-inch Mk 21; 16-inch Mk 5; 7-inch; 8-inch; 3-inch; 6- inch; 12-inch shell; 3-inch shell 5-inch Flat Nose; 5-inch common; 5-inch HE; 5-inch Naval ; 6-inch; 4-inch shrapnel; 3-inch HE; 3-inch shrapnel; 14-inch projectile; 12-inch; **Mortar**: 81mm HE and practice; 3-inch, HE MK1; 4.2-inch HE M329A1; **Torpedo**: General Navy Aircraft flares
	MRS 04 - Mortar: 81mm HE and practice; 75mm projectiles
	MRS 05 - **Mortar:** 81mm HE and practice; 75mm projectiles
	MRS 07 - **Bombs:** GP Bomb: Mk 44, 45, 82, 500-pound; **Rocket:** 2.75-inch; **Projectile:** 75mm; 20mm HE
Identified MEC and MD (Previous Investigations and RI)	**MRS 02 – Cerro Balcon** • 1995 ASR: Munitions debris identified (fragments of mortars) • 1997 EE/CA: Munitions debris • 2006 NTCRA: MEC and MD, 3-inch common MK3, MOD 7, 81 mm mortars, fuzes • 2007 SI: No data collected

Information Type	Summary Information
	• 2011 RI: No data collected
	MRS 02 – Cays • 1995 ASR: Munitions debris found on Cayos Geniqui (MK 80 series bomb) and Cayo Agua (MK 76 practice bomb). 500-lb bombs identified west of Cayo Ballena and Cayo Geniqui in the water (MEC). Torpedo reported east of Cayo Geniqui in the water (MEC). • 1997 EE/CA: MK 76 practice bombs and 76mm projectile at Cayo Agua; munitions debris found on Cayo Lobo • 2006 NTCRA: fuzes, 5-lb and 25-lb practice bombs, 5-inch 54 MK 41 found on Cayo Lobo • 2007 SI: munitions debris from MK 80 series bomb and MK 76 practice bombs at Cayo Agua. • 2011 RI: No data collected
	MRS 04 – Flamenco Lagoon Maneuver Area • 1995 ASR: MD found on Flamenco Beach • 2007 SI: No MEC or MD • 2008 NTCRA: MEC 5-inch projectile • 2011 RI: no MEC; frag identified
	MRS 05 – Mortar and Combat Range Area • 1995 ASR: MD from a 3-inch stokes mortar • 2007 SI: MD from a 4.2-inch mortar base and .30 cal catridges • 2011 RI: no MEC; MD included frag, .30 cal cartridges, 81 mm mortar, 4.2-inch mortar base, SAA debris.
	MRS 07 – Culebrita Artillery Impact Area • 1995 ASR: MD from MK 76 / MK 80 practice bombs and HE bomb fragments found on Cayo Botella • 1997 EE/CA: MEC and MD including MK 76 practice bombs and 6-inch naval gun at Cayo Botella; 20 mm HEI projectiles at Culebrita • 2007 SI: MD including mechanical time fuze • 2008 NTCRA: MEC 20-mm projectiles; MD • 2011 RI: MEC included MK5 Mod 0 Rocket and MK8 demo hose; MD included expended flare, 20mm, rotating band, PTTF, brass frag, fuze body, 3-inch projectile
MEC Density	**MRS 02 – Cerro Balcon**

Information Type	Summary Information
	MEC has been previously identified; however, a removal action has been completed. As such MEC density is considered negligible at the surface. Subsurface MEC density is unknown due to lack of ROEs.
	MRS 02 – Cays MEC has been identified on Cayo Agua and Cayo Lobo. The rest of the cays are inaccessible to confirm MEC presence or density. A surface clearance has been conducted at Cayo Lobo. MEC density is considered moderate for all of the cays outside of removal areas based on previous investigations. Table 1-1 shows quantities of MEC at MRS 2.
	MRS 04 – Flamenco Lagoon Maneuver Area One MEC item was identified at Flamenco Beach during the NTCRA in 2008. Due to the removal action completed, Flamenco Beach is considered low density. No other MEC has been found on MRS 4 during previous investigations or this RI. As such, the MEC density is considered to be low.
	MRS 05 – Mortar and Combat Range Area No MEC items have been found at MRS 5, during previous investigations or the RI. As such, MEC density is considered to be low.
	MRS 07 – Culebrita Artillery Impact Area Significant quantities of MEC have been identified at MRS 7 during the EE/CA (see table 1-1). MEC was also found during the NW beach removal action in 2008 and the RI. As such, MEC density is considered to be moderate except in locations that have a removal action completed, which are low density.
Associated MC	**MRS 02 – Cerro Balcon** HHRA: No COPCs were identified. SLERA: COPECs include antimony, barium, chromium, copper, mercury and zinc.
	MRS 02 – Cays HHRA: No COPCs were identified. SLERA: COPECs include antimony, barium, chromium, copper, mercury, and zinc.
	MRS 04 – Flamenco Lagoon Maneuver Area HHRA: No COPCs were identified. SLERA: COPECs include chromium, copper, lead, mercury.
	MRS 05 – Mortar and Combat Range Area HHRA: No COPCs were identified. SLERA: COPECs include barium, chromium, mercury, lead and copper.

Information Type	Summary Information
	MRS 07 – Culebrita Artillery Impact Area HHRA: No COPCs were identified. SLERA: COPECs include barium, chromium, copper, lead, and zinc.

4.2 Land Use and Exposure Profile

Table 4-2: Human Receptors – Culebra Island MRSs

Potential Human Receptor Population	MRS02		MRS04	MRS05	MRS07
	Cerro Balcon	Adjacent Cays	Flamenco Lagoon Artillery Impact Area	Mortar and Combat Range Area	Culebrita Artillery Impact Area
Current Exposure Scenario					
Residents	Y	N	Y	Y	N
Outdoor Site Workers	Y	Y	Y	Y	Y
Construction/Utility Workers	Y	N	Y	Y	N
Recreationists/Visitors/Tourists	Y	N*	Y	Y	Y
Trespassers	Y	Y	Y	Y	Not applicable
Future Exposure Scenario					
Residents	Y	N	Y	Y	N
Construction Workers	Y	N	Y	Y	N
Outdoor Site Workers	Y	Y	Y	Y	Y
Construction/Utility Workers	Y	N	Y	Y	N
Recreationists/Visitors/Tourists	Y	N*	Y	Y	Y
Trespassers	Y	Y	Y	Y	Not applicable

Y - indicates receptor population was identified for this MRS
N - indicates receptor population is not present at this MRS
* Recreational users present at the Cays are considered trespassers

Notes:

Outdoor site workers include contractors and refuge workers.

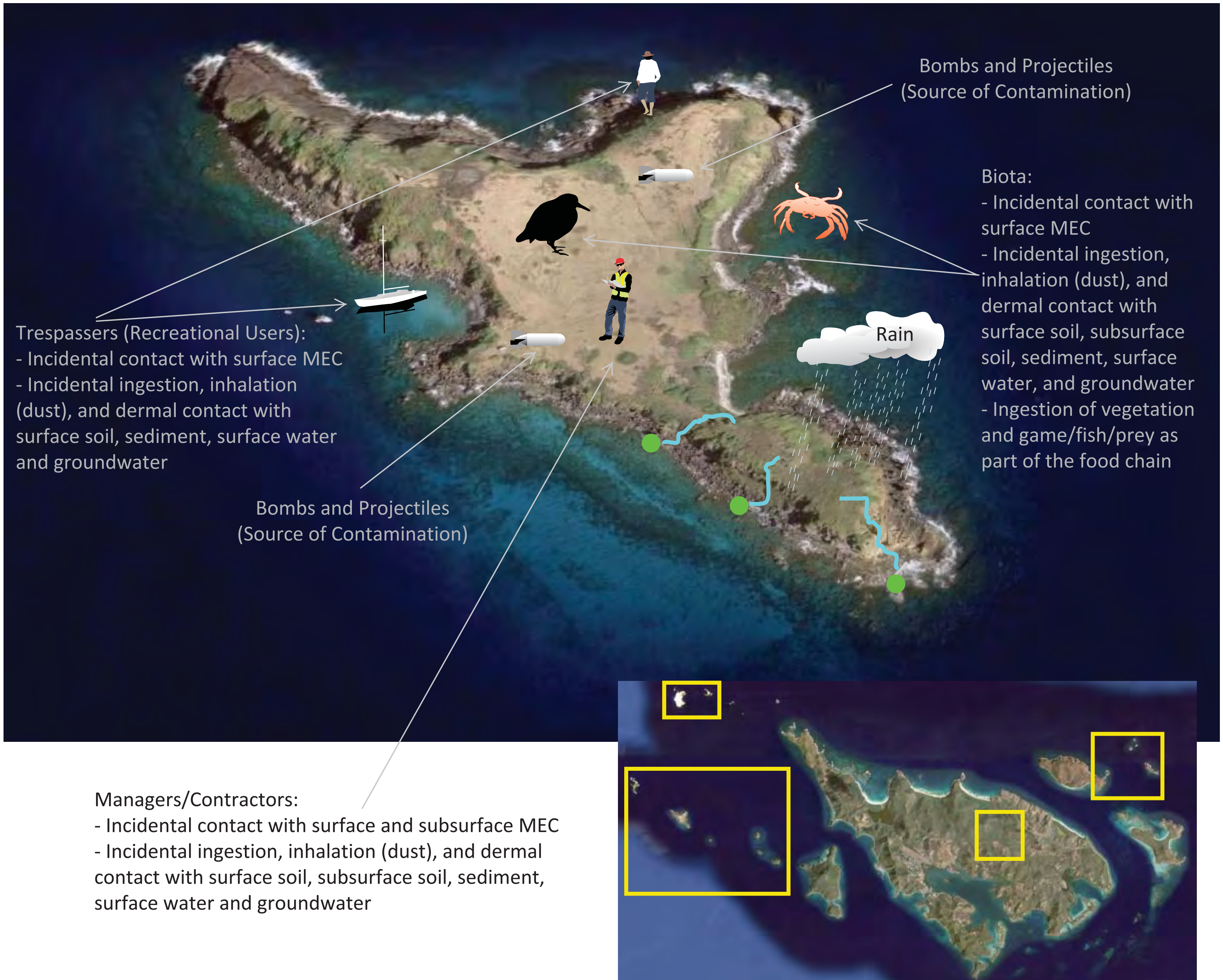
Indoor site workers/visitors were not included as potential human receptor populations, because their exposure is expected to be less than that of outdoor site workers. Evaluation of outdoor site workers is considered protective of indoor workers/visitors as well.

Table 4-3: Land Use and Exposure Profile – Culebra Island MRSs

Information Needs	Preliminary Information
Current Land Use / Activities	**MRS 02 – Cerro Balcon:** Residential; undeveloped
	MRS 02 – Cays: USFW (protected species areas); trespassers for recreational use. Public use restricted other than USFWS workers. Signs indicating no trespassing were posted several years ago but have not been maintained or replaced as needed. The condition or number of remaining signs has not been verified. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible by recreational users (trespassers). These cays are slightly larger than the others on which small beaches facilitate access during low tide and good weather conditions.
	MRS 04 – Flamenco Lagoon Maneuver Area: Tourist / recreational use (beach); undeveloped land (wildlife area); residential; construction activities
	MRS 05 – Mortar and Combat Range Area: Residential; wildlife refuge; recreational; cattle crazing; construction activities
	MRS 07 – Culebrita Artillery Impact Area: USFWS area; limited accessibility but recreational activities permitted on trails and beaches.
Potential Future Land Use / Activities	It is anticipated that the land use will remain the same for MRS 02 – Cays, and MRS 07. Additional residential development is likely for MRS 4 and 5. There is also potential commercial development for MRS 4.
Land Use Restrictions	MRS 02 – Cays, MRS 07, and the wildlife refuges on MRS 04 and MRS 05 are managed by USFWS and have restricted access. Public access is not permitted at the Cays. Although not permitted, some of the Cays are frequented by recreational users (primarily Cay Lobo and Cay Yerba).
Beneficial Resources	MRS 02 – Cays, MRS 07, and portions of MRS 04 and 05 are National Wildlife Refuge areas. Sensitive habitats exist in these areas.
Demographics/ Zoning	The island is inhabited at an average density of 71.8 persons per square mile even though the population is concentrated near the town of Dewey and the Airport. Of the four MRSs only MRS 04, with 389, and MRS 05, with 553, has any residents within ¼ of a mile of the site. Residents living ¼ to ½ miles from the MRSs are as follows: MRS 02 (11), MRS 04 (378), MRS 05 (475), and MRS 07 (0). Residents living 1/2 to 1 mile from the MRSs are as follows: MRS

Information Needs	Preliminary Information
	02 (29), MRS 04 (777), MRS 05 (783), and MRS 07 (18).
Flora and Fauna	See section 6.1.2.3
Cultural Resources	According to the National Register Information System, National Historic Landmarks list, National Heritage Areas list, and National Park Service there is only one registered cultural resource within the boundaries of the Culebra Island site. On Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas. The lighthouse is not open to the public due to building deterioration. According to the Puerto Rico State Historic Preservation Office there are no known architectural resources within the boundaries of the Culebra Island site; however, an architectural survey has not yet been conducted for Culebra.

Insert graphical CSMs – Figures 4-1 to 4-4



Map Image By Google/ SIO, NOAA, U.S. Navy,NGA GEBCO Image U.S. Geological Survey

Figure 4-1

Remedial Action/Feasibility Study

Adjacent Cays

MRS-2

3D Graphical Conceptual Site Model

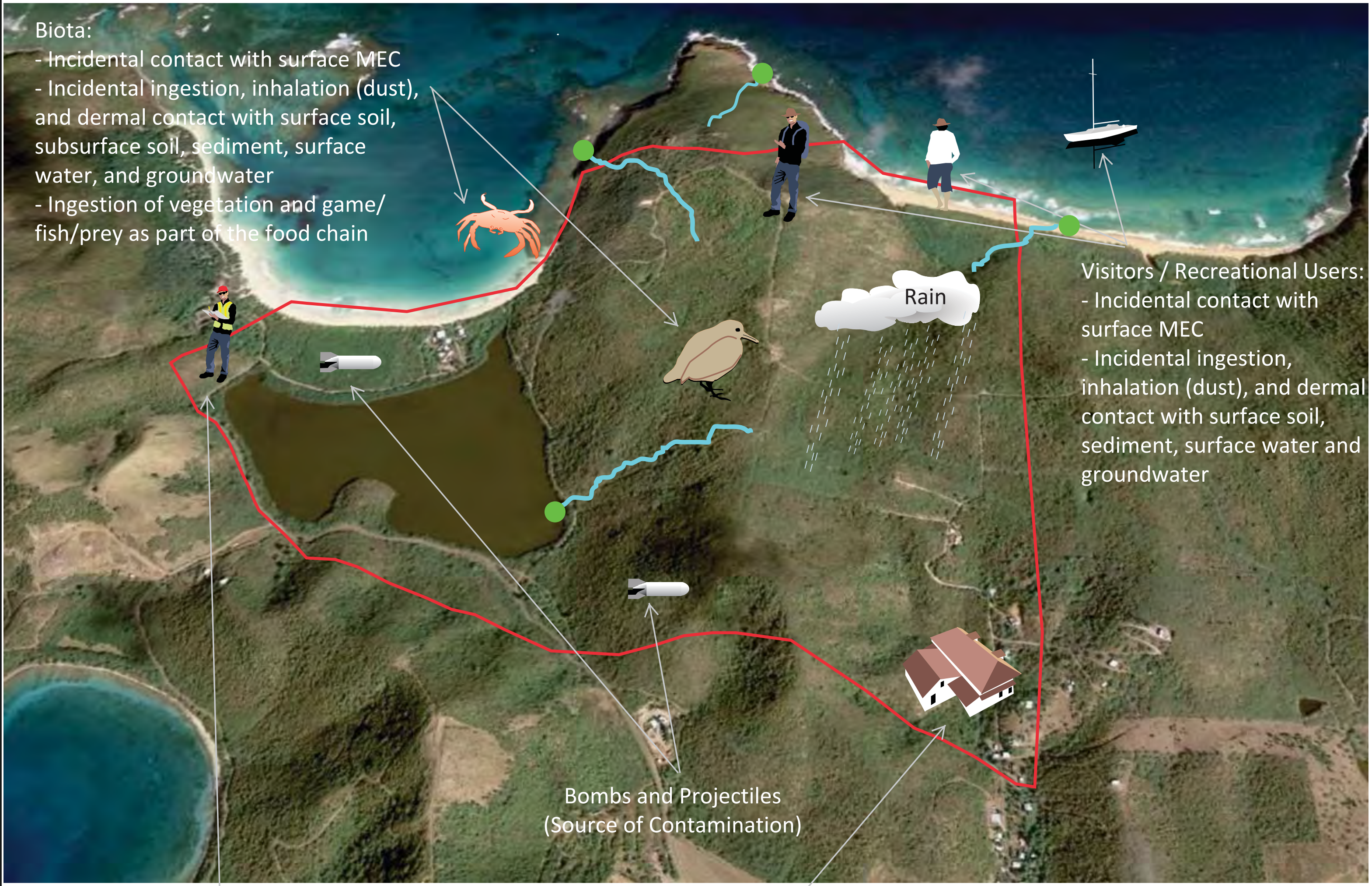
Culebra Island, Puerto Rico

Ephemeral Streams

Depositional Areas

Notes:

1. Based on access controls and access limitations due to adequate beaching areas, terrain and vegetation, exposure to receptors is very limited.
2. The pathways and potential receptors depicted in this model are consistent with all the adjacent cays encompassed by MRS 2 but not depicted in here.



Managers/Contractors:
- Incidental contact with surface and subsurface MEC
- Incidental ingestion, inhalation (dust), and dermal contact with surface soil, subsurface soil, sediment, surface water and groundwater

Residents:
- Incidental contact with surface and subsurface MEC
- Incidental ingestion, inhalation (dust), and dermal contact with surface soil, subsurface soil, sediment, surface water and groundwater
- Ingestion of vegetation and game/fish/prey as part of the food chain

Map Image By Google/ SIO, NOAA, U.S. Navy,NGA GEBCO Image U.S. Geological Survey

Figure 4-2

Remedial Action/Feasibility Study

Flamingo Lagoon

MRS-4

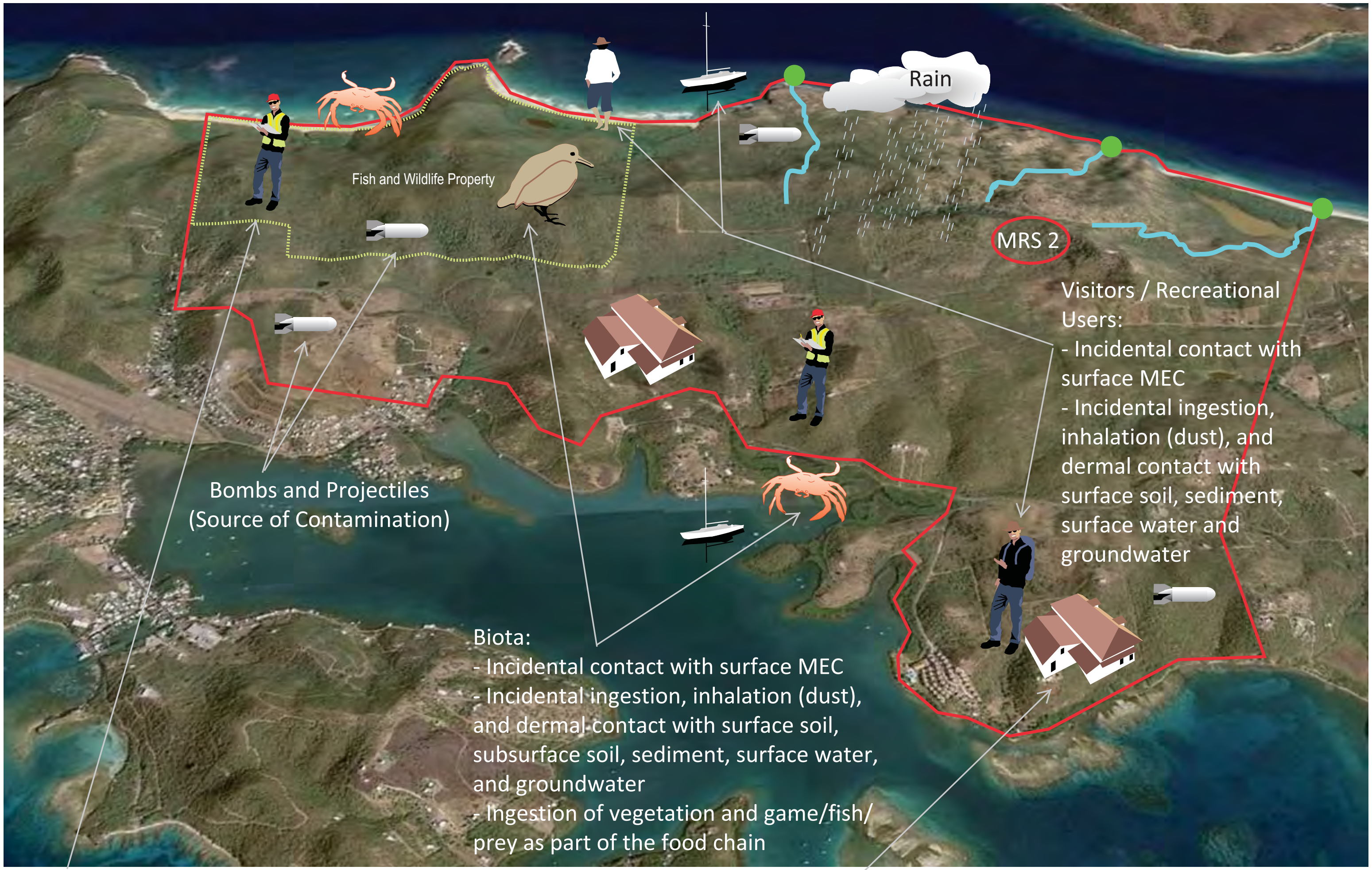
3D Graphical Conceptual Site Model

Culebra Island, Puerto Rico

Ephemeral Streams

Depositional Areas

MRS Boundary



Managers/Contractors:
- Incidental contact with surface and subsurface MEC
- Incidental ingestion, inhalation (dust), and dermal contact with surface soil, subsurface soil, sediment, surface water and groundwater

Residents:
- Incidental contact with surface and subsurface MEC
- Incidental ingestion, inhalation (dust), and dermal contact with surface soil, subsurface soil, sediment, surface water and groundwater
- Ingestion of vegetation and game/fish/prey as part of the food chain

Map Image By Google/ SIO, NOAA, U.S. Navy,NGA GEBCO Image U.S. Geological Survey

Note: The pathways and potential receptors depicted for the private properties in MRS 5 are the same for the portion of MRS 2 with the boundaries of MRS 5.

Remedial Action/Feasibility Study

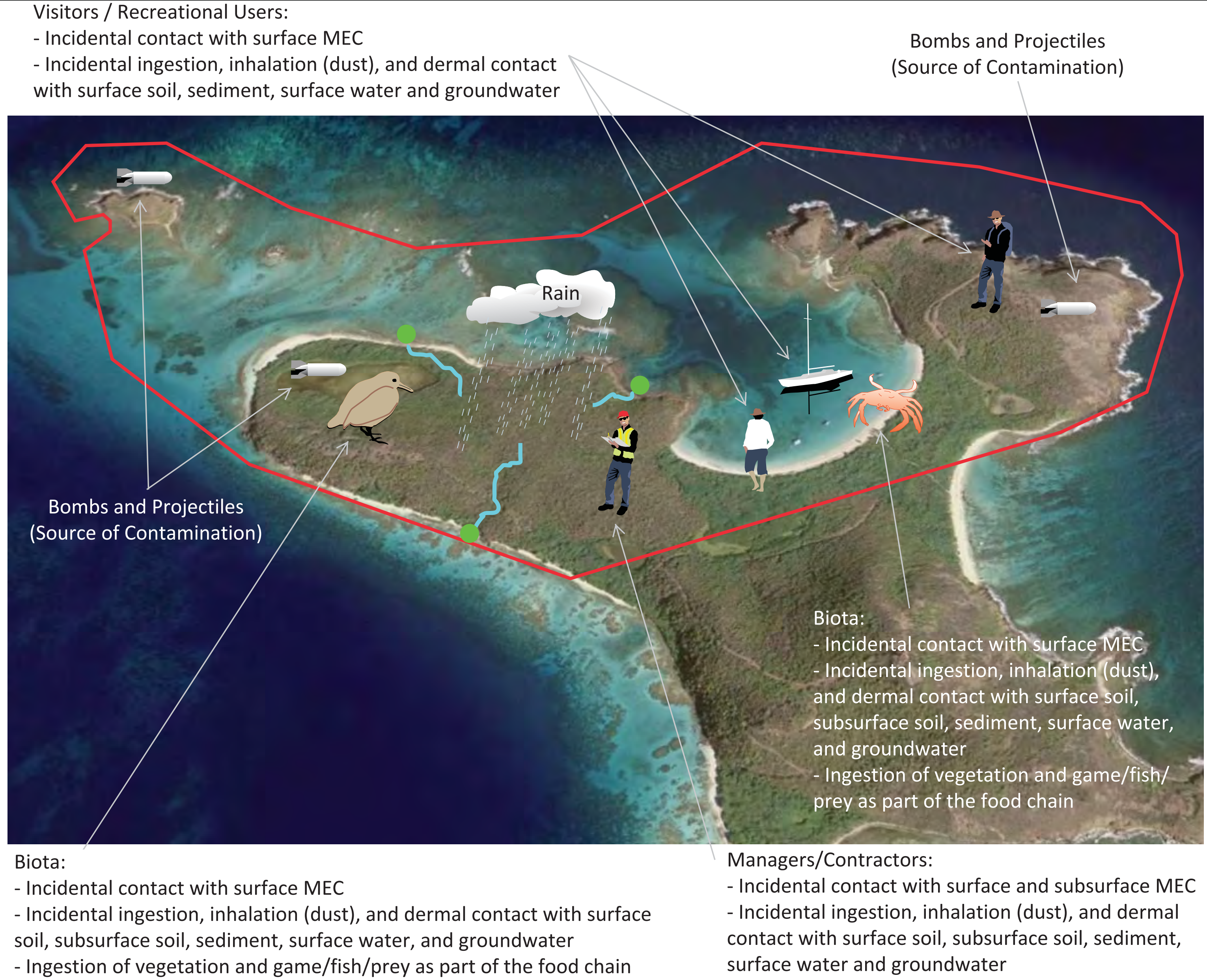
Figure 4-3

MRS-5

3D Graphical Conceptual Site Model

Culebra Island, Puerto Rico

Ephemeral Streams
Depositional Areas
MRS Boundary
Fish and Wildlife Refuge Boundary



Map Image By Google/ SIO, NOAA, U.S. Navy,NGA GEBCO Image U.S. Geological Survey

Figure 4-4

Remedial Action/Feasibility Study

MRS-7

3D Graphical Conceptual Site Model

Culebra Island, Puerto Rico

Ephemeral Streams

Depositional Areas

MRS Boundary

Note: Based on access controls and access limitations due to adequate beaching areas, terrain and vegetation, exposure to receptors is very limited to the beaches and hiking trails.

5 CONTAMINANT FATE AND TRANSPORT FOR MEC AND MC

5.1 Contaminant Fate and Transport Pathway Analysis for MEC and MC

5.1.1 The following sections include a discussion of exposure pathways for MEC and MC based on historical information, previous investigations, and RI field activities. Exposure pathways diagrams based on the results of the RI (and previous investigations) showing incomplete, complete, or potentially complete pathways are presented in the sections below for MEC and MC, respectively.

5.1.2 Three types of exposures pathways are considered for each receptor of MEC and/or MC: incomplete, complete, and potentially complete. An exposure pathway consists of four elements: 1) a source and mechanism of chemical release, 2) a retention or transport mechanism, 3) a point of potential human contact with the contaminated medium, and 4) an exposure route at the contact point (USEPA, 1989). If any one of these elements is missing, the exposure pathway is incomplete. An incomplete pathway indicates that no receptor pathway exists, or there is evidence that MEC or MC does not exist. A complete pathway indicates a receptor has an available exposure route to be exposed to MEC or MC. A potentially complete pathway indicates that there is a data gap within information (it is uncertain whether or not a receptor can come into contact with MEC or MC or whether MEC or MC exists).

5.1.2.1 MEC Pathway Analyses

5.1.2.1.1 MRS 02 – Cerro Balcon and Adjacent Cays

The pathway analysis for MRS 02 has been separated for Cerro Balcon and the Cays because the areas have different land uses and receptors. Cerro Balcon is located within and is completely surrounded by MRS 05 and includes residential and undeveloped areas. The adjacent cays, which are part of MRS 02, are managed by the USFWS and public access is restricted. While visiting the adjacent cays is difficult, due to the rough terrain and lack of access locations, and prohibited by USFWS, recreational users are known to trespass on the cays. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible by recreational users (trespassers). These cays are slightly larger than the others on which small beaches facilitate access during low tide and good weather conditions.

5.1.2.1.2 Cerro Balcon

The MEC pathway analysis for Cerro Balcon, Figure 5-1, shows that there are incomplete pathways for all human and ecological receptors of MEC on the surface based on the surface clearance activities that have been conducted (2006). Because a subsurface clearance has not been completed for this area and MEC has been found during previous investigations, complete exposure pathways exist in the subsurface soil for human receptors, such as contractors who may need to access underground utilities in the subsurface soil or may perform intrusive work during future construction activities, and residents and visitors who may disturb subsurface soil. The subsurface pathway is also complete for biota that may nest or burrow at the MRS.

5.1.2.1.3 Adjacent Cays

The MEC pathway analysis for the adjacent cays, Figure 5-2, shows that there are potentially complete pathways for all human and ecological receptors of MEC on all of the cays with the exception of Cayo Lobo, where a surface clearance has been conducted. This represents a data gap; due to inaccessibility, very little field work has been conducted on the majority of the cays. MEC is suspected in all of the cays. For Cayo Lobo, subsurface pathways to MEC are complete since MEC has been confirmed but no subsurface clearance has been conducted. Cayo Lobo and Cayo Yerba are the two cays suspected to be frequented by recreational users (trespassers).

5.1.2.1.4 MRS 04 – Flamenco Lagoon Maneuver Area

The MEC pathway analysis for MRS 04, Figure 5-3, shows that there are potentially complete pathways for all human and ecological receptors of MEC based on the results of previous investigations, this RI, and existence of data gaps. Because large portions of this MRS could not be investigated due to lack of ROEs, MEC characterization could not be completed in these areas. Munitions debris has been found in MRS 4 suggesting that MEC could be present. No MEC was found during the RI or previous investigations other than at Flamenco beach during the removal action. Exposure pathways include receptors for handle/treads underfoot contact (surface), as well as surface intrusive work that may be conducted. Potentially complete exposure pathways also exist in the subsurface soil for human receptors, such as contractors who may need to access underground utilities in the subsurface soil or may perform intrusive work during future construction activities, and residents and recreational visitors who may disturb subsurface soil. The subsurface pathway is also potentially complete for biota that may nest or burrow at the MRS.

5.1.2.1.5 MRS 05 – Mortar and Combat Range Area

The MEC pathway analysis for MRS 05, Figure 5-4, shows that there are potentially complete pathways for all human and ecological receptors of MEC based on the results of previous investigations, the RI and existing data gaps. Because large portions of this MRS could not be investigated due to lack of ROEs, MEC characterization could not be completed in these areas. Munitions debris has been found in MRS 5 suggesting that MEC could be present. No MEC was found during the RI or previous investigations. Exposure pathways include receptors for handle/treads underfoot contact (surface), as well as surface intrusive work that may be conducted. Potentially complete exposure pathways also exist in the subsurface soil for human receptors, such as contractors who may need to access underground utilities in the subsurface soil or may perform intrusive work during future construction activities, and residents and recreational visitors who may disturb subsurface soil. The subsurface pathway is also potentially complete for biota that may nest or burrow at the MRS.

5.1.2.1.6 MRS 07 – Culebrita Artillery Impact Area

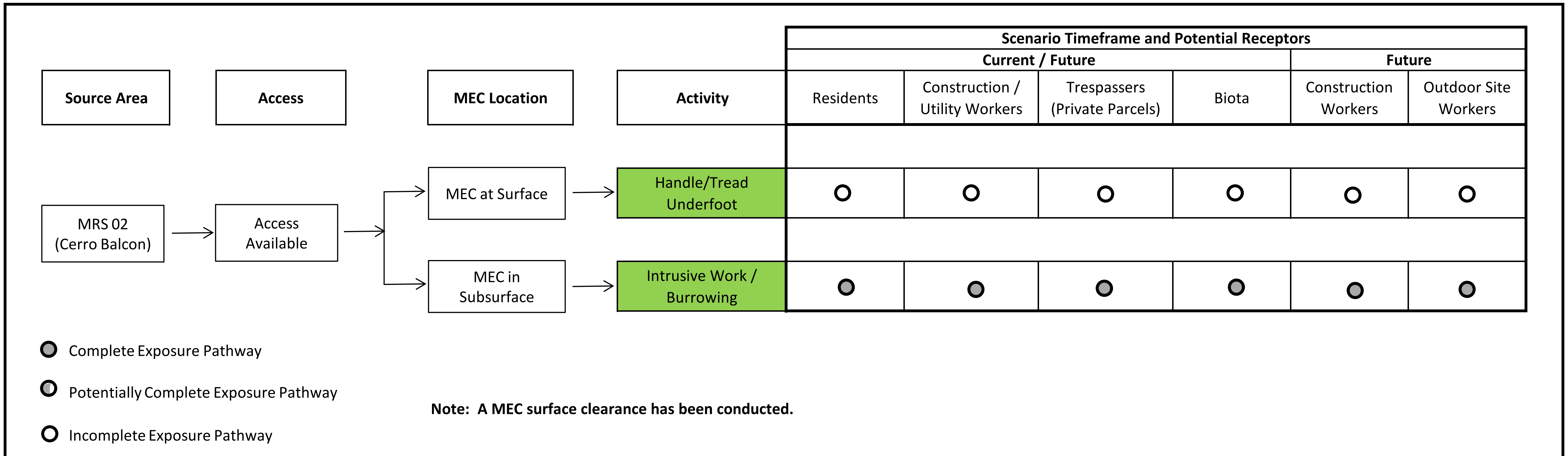
The MEC pathway analysis for MRS 07, Figure 5-5, shows that there are complete pathways for all human and ecological receptors of MEC based on the results of the RI field work and previous investigations. MEC was identified on MRS 7. This includes receptors for handle/treads underfoot contact (surface), as well as surface intrusive work that may be conducted. Complete exposure pathways also exist in the subsurface soil for human receptors, such as outdoor site workers who may perform intrusive work and recreational visitors who may visit the site and disturb subsurface soil. The subsurface pathway is also complete for biota that may nest or burrow at the MRS.

5.2 MC Pathways Analysis

5.2.1 Due to the nature of historical military activities at the Site, MC can exist at an MRS and may present a risk of adverse health effects, if human exposure occurs. MC can be released from fully intact munitions through corrosion and breaching of the casing or the development of cracks, or from dissolved filler leaking through screw threads on the munitions casing, or exposed filler that resulted from incomplete detonation. This explosive filler may be scattered over the MRS or partially encased in the remains of the munitions casing. Migration of MC may occur naturally through surface soil erosion, plant or animal uptake, or by human activities such as maintenance and site work. MC in surface soil may migrate to the subsurface with infiltrating water. If soil erosion and subsequent surface runoff carries MC into inland impounded water bodies, migration of MC through surface water and sediment may occur as well. MC in soil/sediment may also migrate through leaching to groundwater; however, shallow groundwater is not a source of potable water at Culebra.

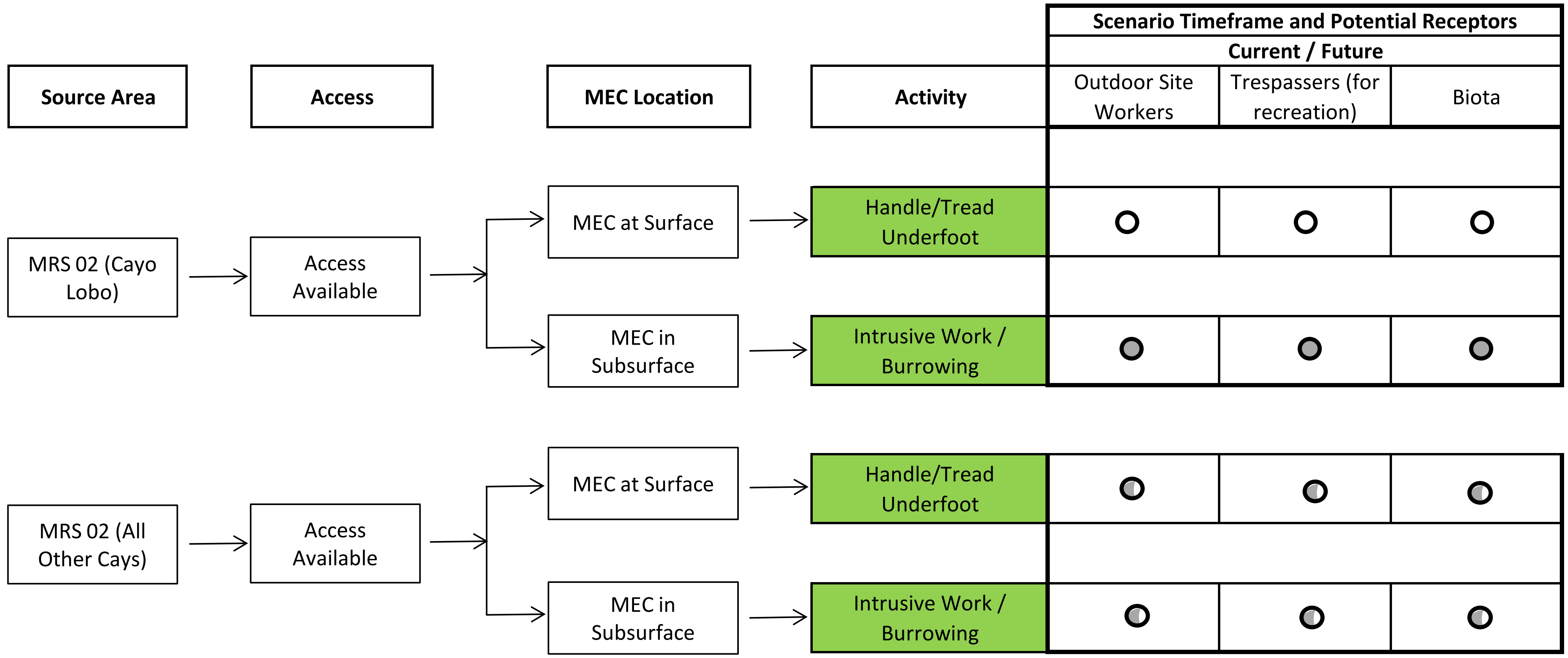
5.2.2 Based on sampling data from previous investigations and the RI combined, a HHRA and SLERA were conducted for each MRS (presented in Section 6). The results of the HHRA indicate that no COPCs exist for any MRS included in this RI. As such, the exposure pathways are all incomplete for human receptors of MC. Figures 5-6 to 5-10 illustrate the incomplete pathways to human receptors.

5.2.3 The SLERA identified COPECs for all of the MRSs. However, the conclusion of the SLERA is that the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (adjacent cays), MRS 04, and MRS 07 is negligible, and the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (Cerro Balcon) and MRS 05 is low based on the hazard quotient for chromium. Based on the evaluation of the sediment data, a potential for risk of adverse health effects in aquatic receptors is indicated. However, given the conservative nature of the toxicity reference values (TRV) used to screen the sediment data, the potential for ecological risk is qualified as low. No sediment remediation on the basis of ecological risk is warranted. No soil or sediment remediation on the basis of ecological risk is warranted. As such, all exposure pathways are incomplete for ecological receptors of MC.



EXPOSURE PATHWAY ANALYSIS FOR MEC - MRS 02 (Cerro Balcon)
Remedial Investigation
Culebra Island Site, Puerto Rico

FIGURE 5-1



Complete Exposure Pathway

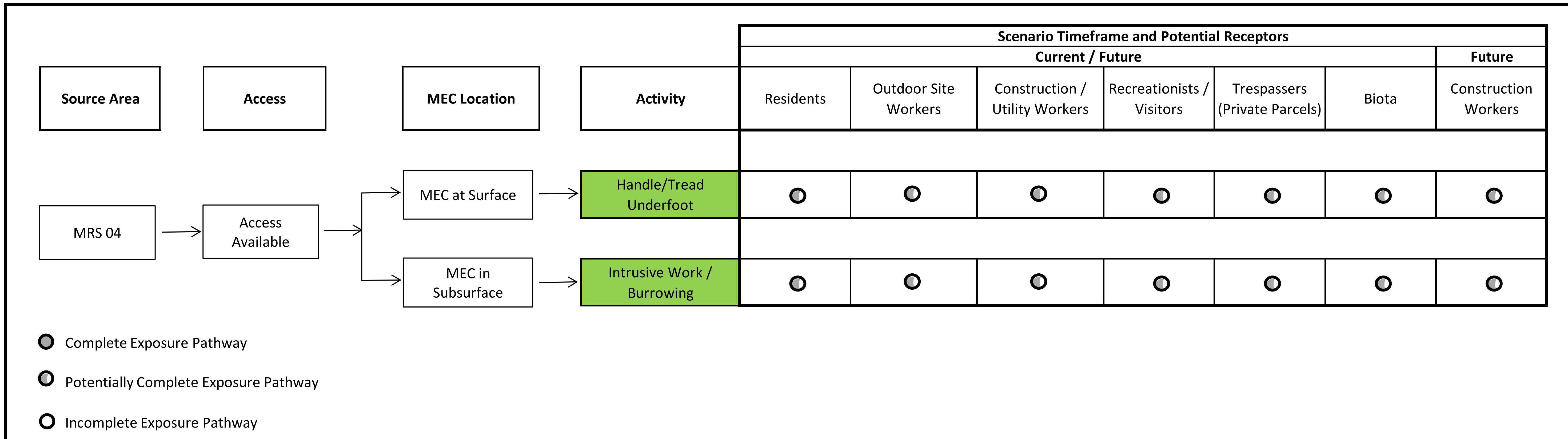
Potentially Complete Exposure Pathway

Incomplete Exposure Pathway

Note: A MEC surface clearance was conducted on Cayo Lobo. Acess to all cays is prohibited, but trespassers (for recreation) visit the cays as weather permits, in particular Cayo Lobo and Cayo Yerba which are the more accessible cays.

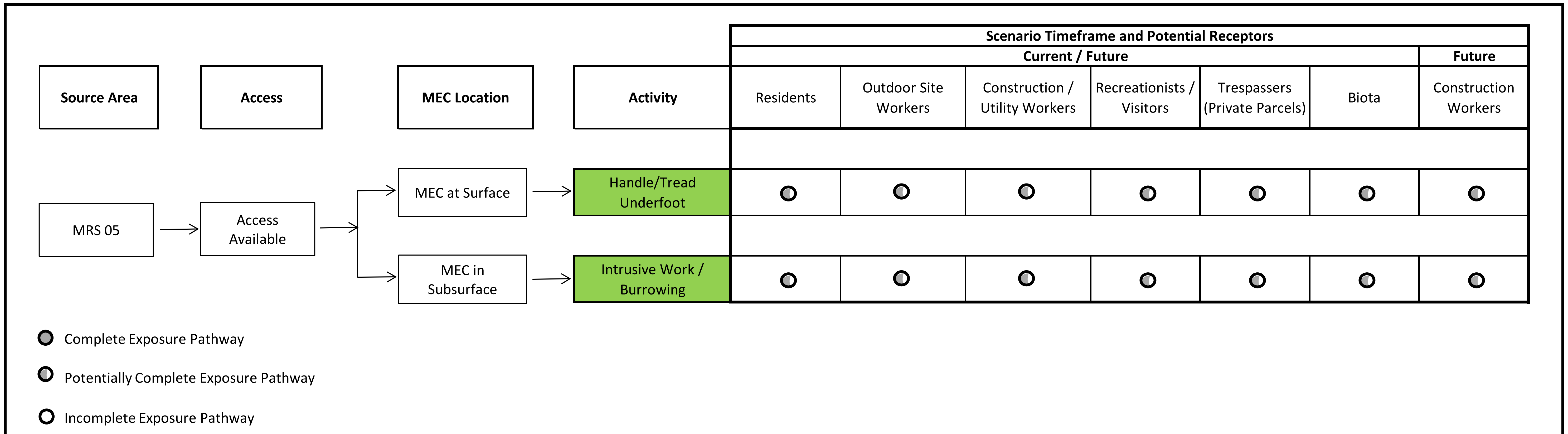
EXPOSURE PATHWAY ANALYSIS FOR MEC - MRS 02 (Cays)
Remedial Investigation
Culebra Island Site, Puerto Rico

FIGURE 5-2



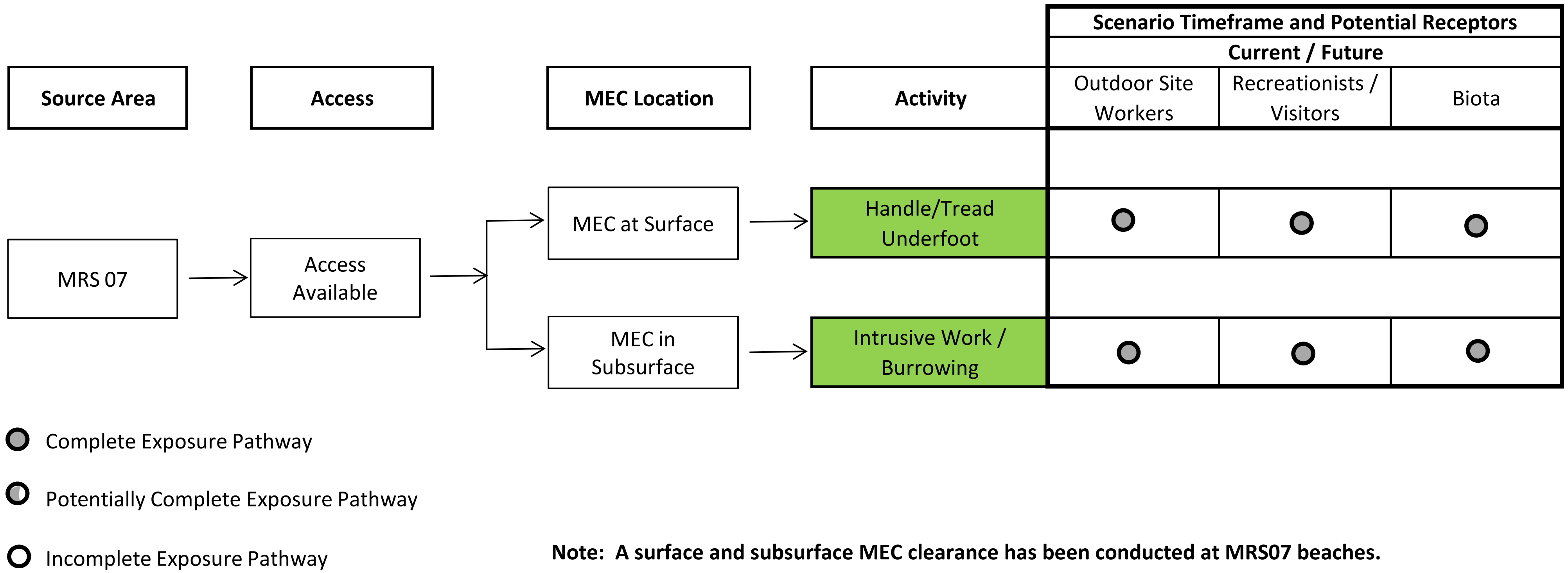
EXPOSURE PATHWAY ANALYSIS FOR MEC - MRS 04
Remedial Investigation
Culebra Island Site, Puerto Rico

FIGURE 5-3



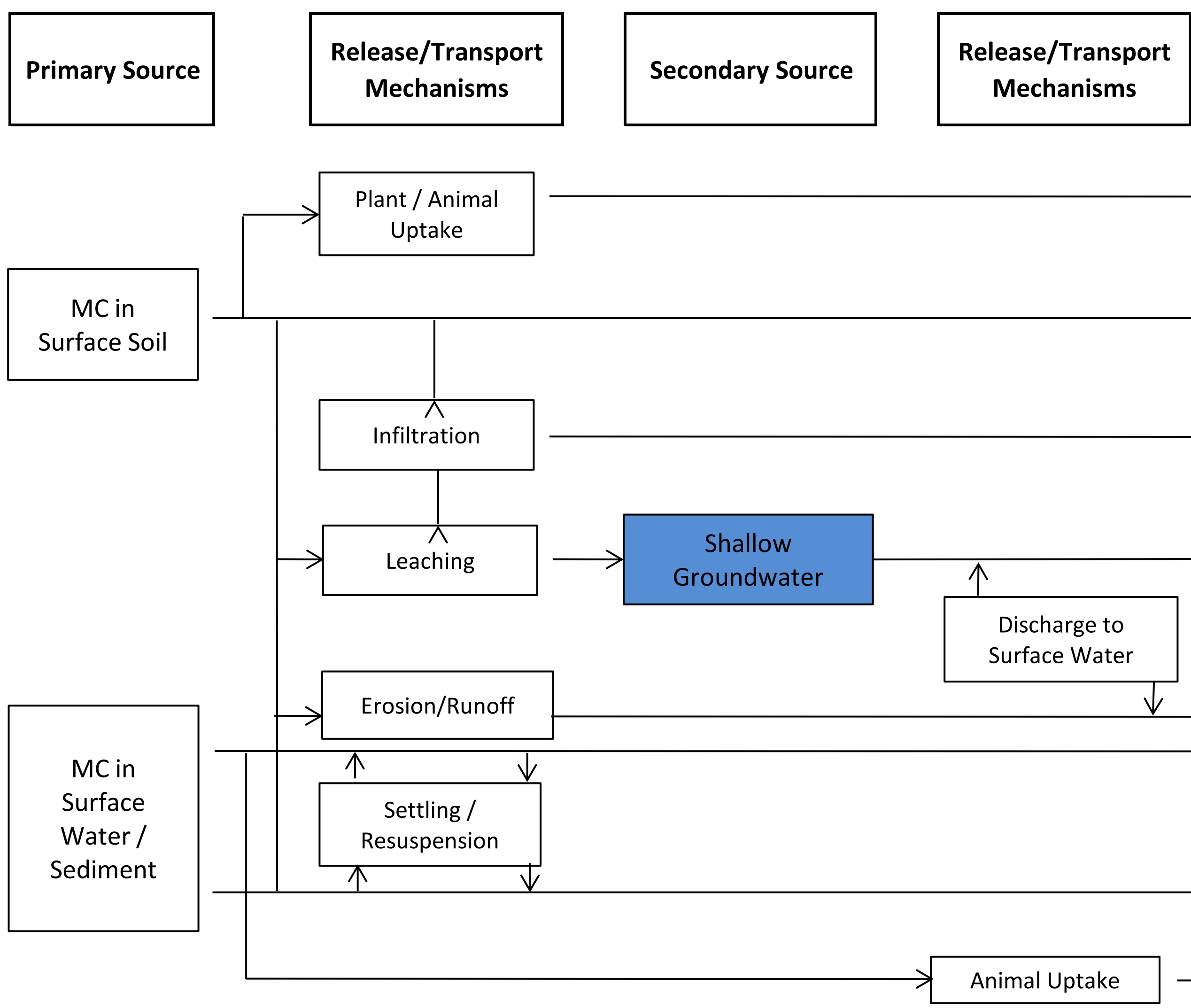
EXPOSURE PATHWAY ANALYSIS FOR MEC - MRS 05
Remedial Investigation
Culebra Island Site, Puerto Rico

FIGURE 5-4



EXPOSURE PATHWAY ANALYSIS FOR MEC - MRS 07
Remedial Investigation
Culebra Island Site, Puerto Rico

FIGURE 5-5



Exposure Media	Exposure Routes	Scenario Timeframe and Potential Human Receptor Populations				
		Current / Future			Future	
		Residents	Construction / Utility Workers	Trespassers (Private Parcels)	Construction Workers	Outdoor Site Workers
Vegetation	Ingestion	O				
Domestic Animals/Game	Ingestion	O		O		
Surface Soil	Ingestion	O	O	O	O	O
	Dermal Contact	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O
Subsurface Soil	Ingestion	O	O		O	O
	Dermal Contact	O	O		O	O
	Inhalation (Dust)	O	O		O	O
Shallow Groundwater	Ingestion					
	Dermal Contact		O			
Surface Water	Ingestion					
	Dermal Contact	O	O	O	O	O
Sediment	Ingestion	O	O	O	O	O
	Dermal Contact	O	O	O	O	O
Fish	Ingestion					

● Complete Exposure Pathway

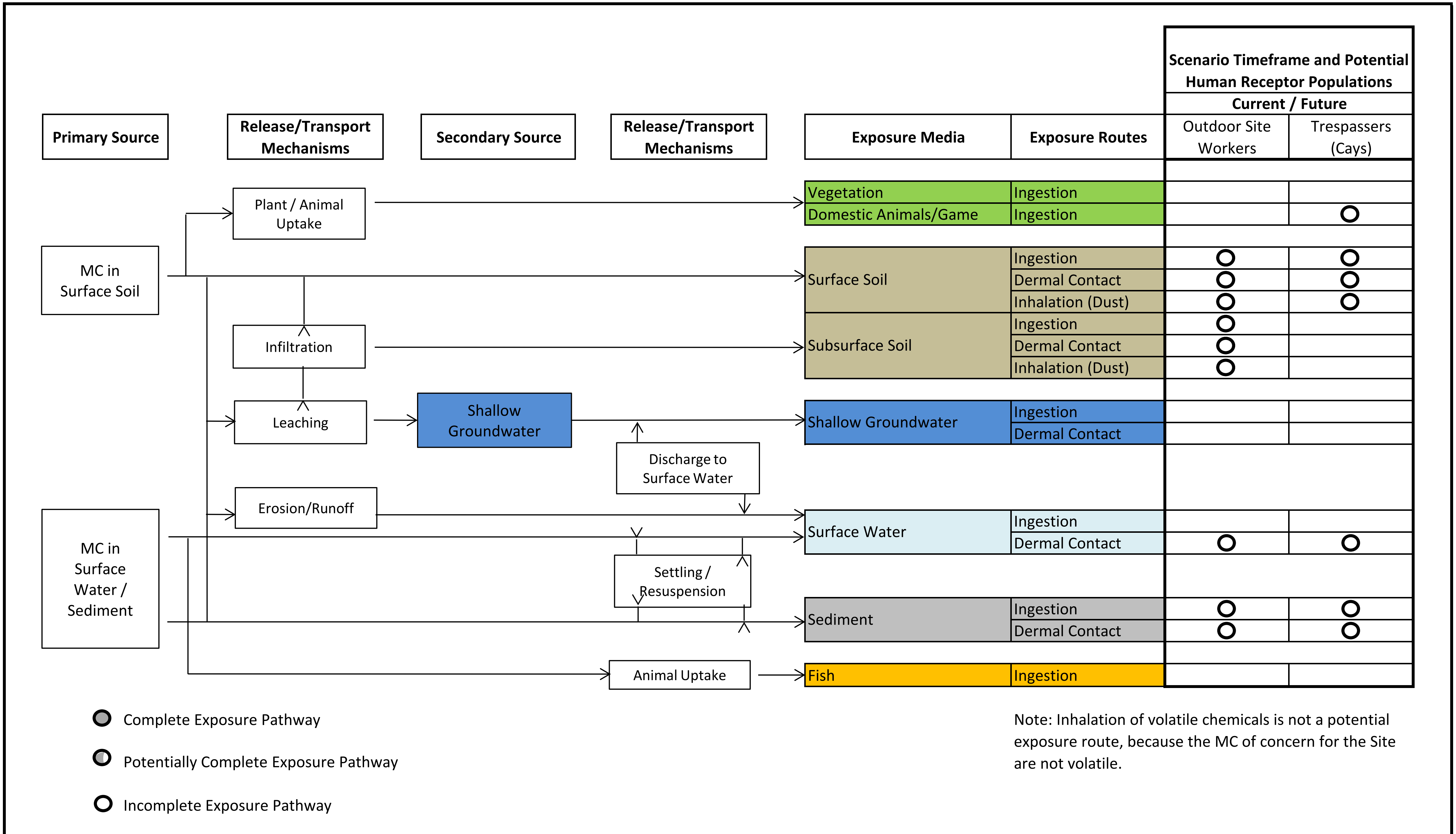
◐ Potentially Complete Exposure Pathway

O Incomplete Exposure Pathway

Note: Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

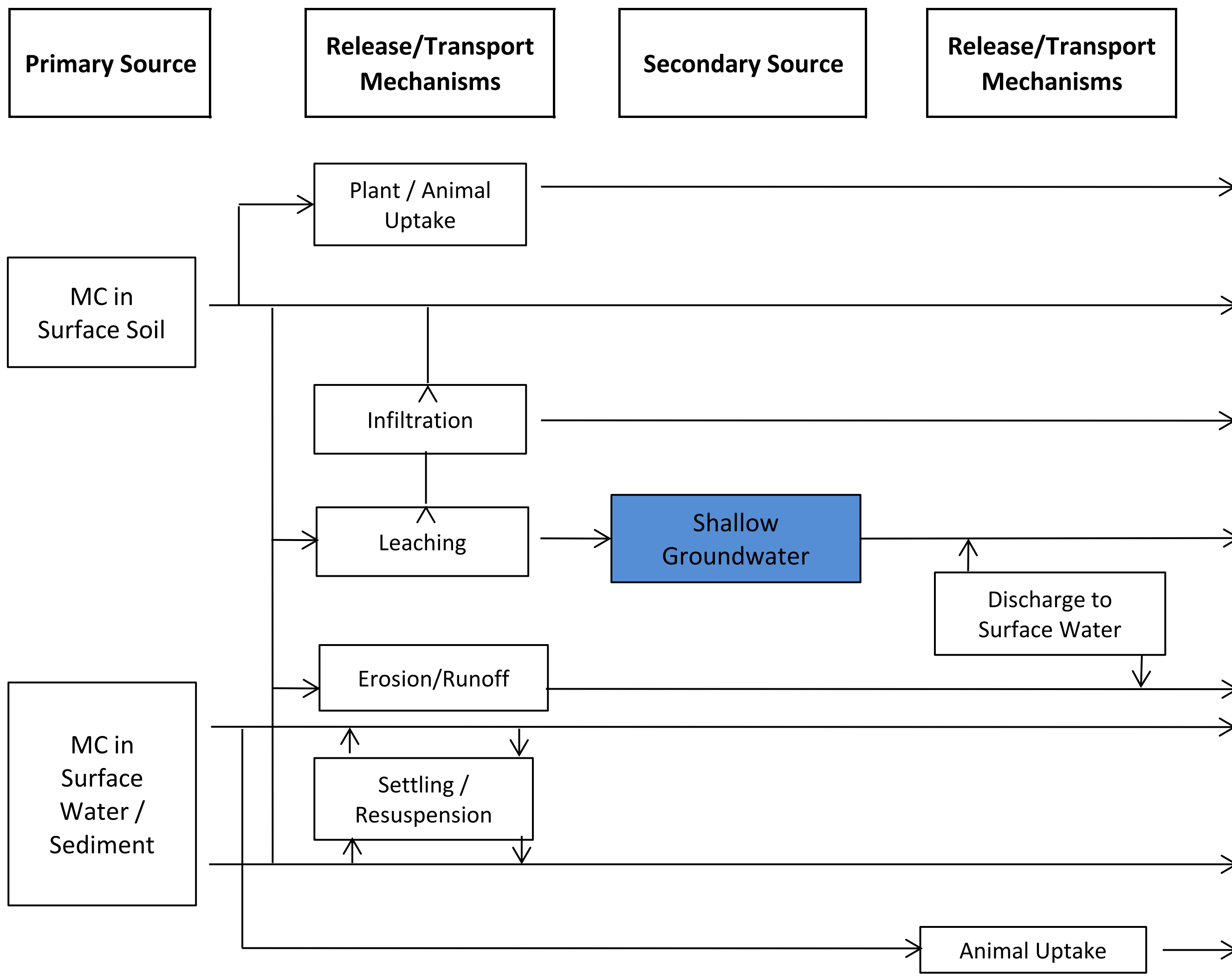
EXPOSURE PATHWAY ANALYSIS FOR MC- MRS 02 (Cerro Balcon)
Culebra Island Site, Puerto Rico

FIGURE 5-6



EXPOSURE PATHWAY ANALYSIS FOR MC - MRS 02 (Cays)
Culebra Island Site, Puerto Rico

FIGURE 5-7



		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors	Trespassers (Private Parcels)	Construction Workers
Vegetation	Ingestion	○					
Domestic Animals/Game	Ingestion	○				○	
Surface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Subsurface Soil	Ingestion	○	○	○			○
	Dermal Contact	○	○	○			○
	Inhalation (Dust)	○	○	○			○
Shallow Groundwater	Ingestion						
	Dermal Contact			○			
Surface Water	Ingestion	○			○	○	
	Dermal Contact	○	○	○	○	○	○
Sediment	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
Fish	Ingestion	○			○	○	

● Complete Exposure Pathway

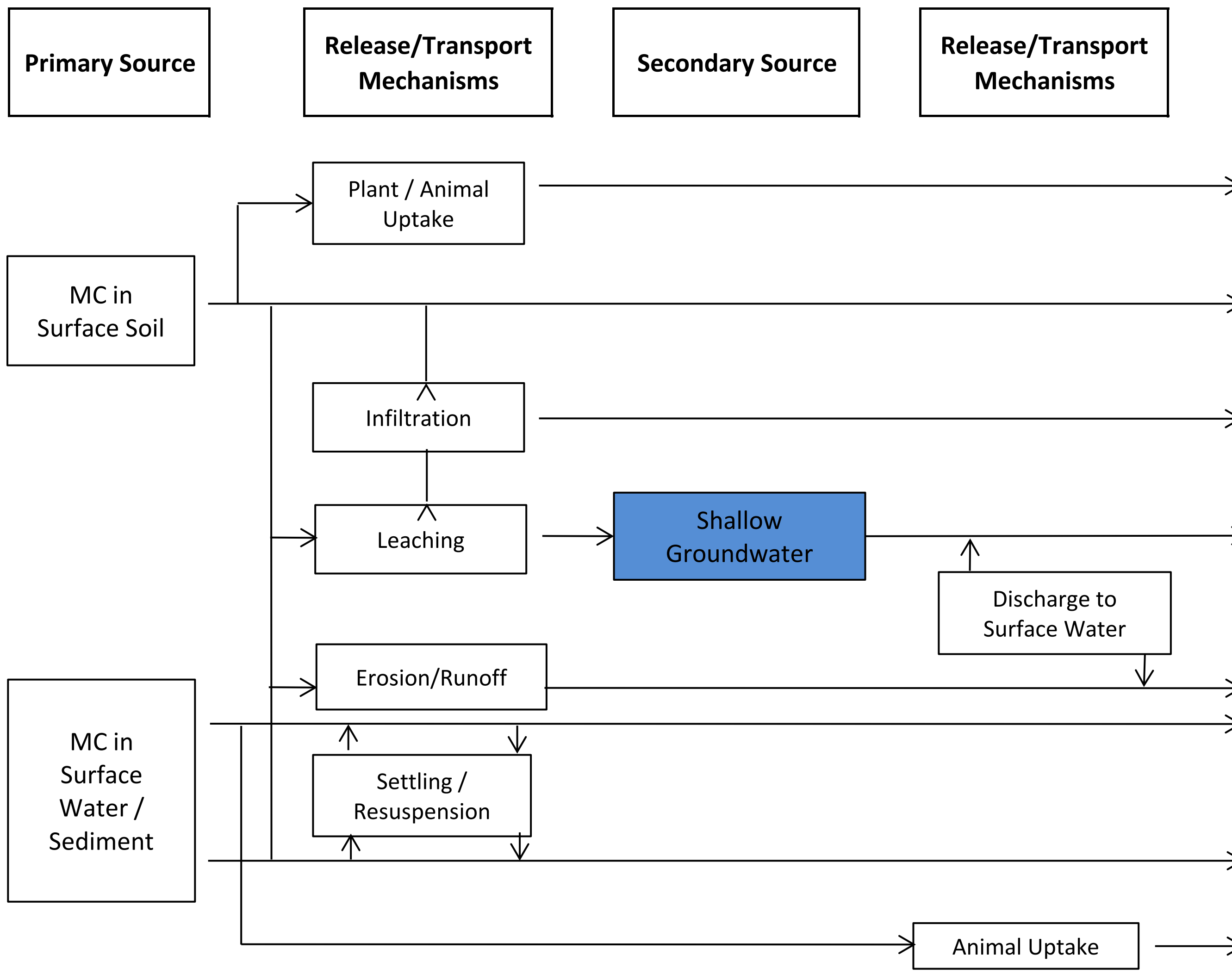
◐ Potentially Complete Exposure Pathway

○ Incomplete Exposure Pathway

Note: Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

EXPOSURE PATHWAY ANALYSIS FOR MC- MRS 04
Culebra Island Site, Puerto Rico

FIGURE 5-8



		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors	Trespassers (Private Parcels)	Construction Workers
Vegetation	Ingestion	○					
Domestic Animals/Game	Ingestion	○				○	
Surface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Subsurface Soil	Ingestion	○	○	○			○
	Dermal Contact	○	○	○			○
	Inhalation (Dust)	○	○	○			○
Shallow Groundwater	Ingestion						
	Dermal Contact			○			
Surface Water	Ingestion	○			○	○	
	Dermal Contact	○	○	○	○	○	○
Sediment	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
Fish	Ingestion	○			○	○	

● Complete Exposure Pathway

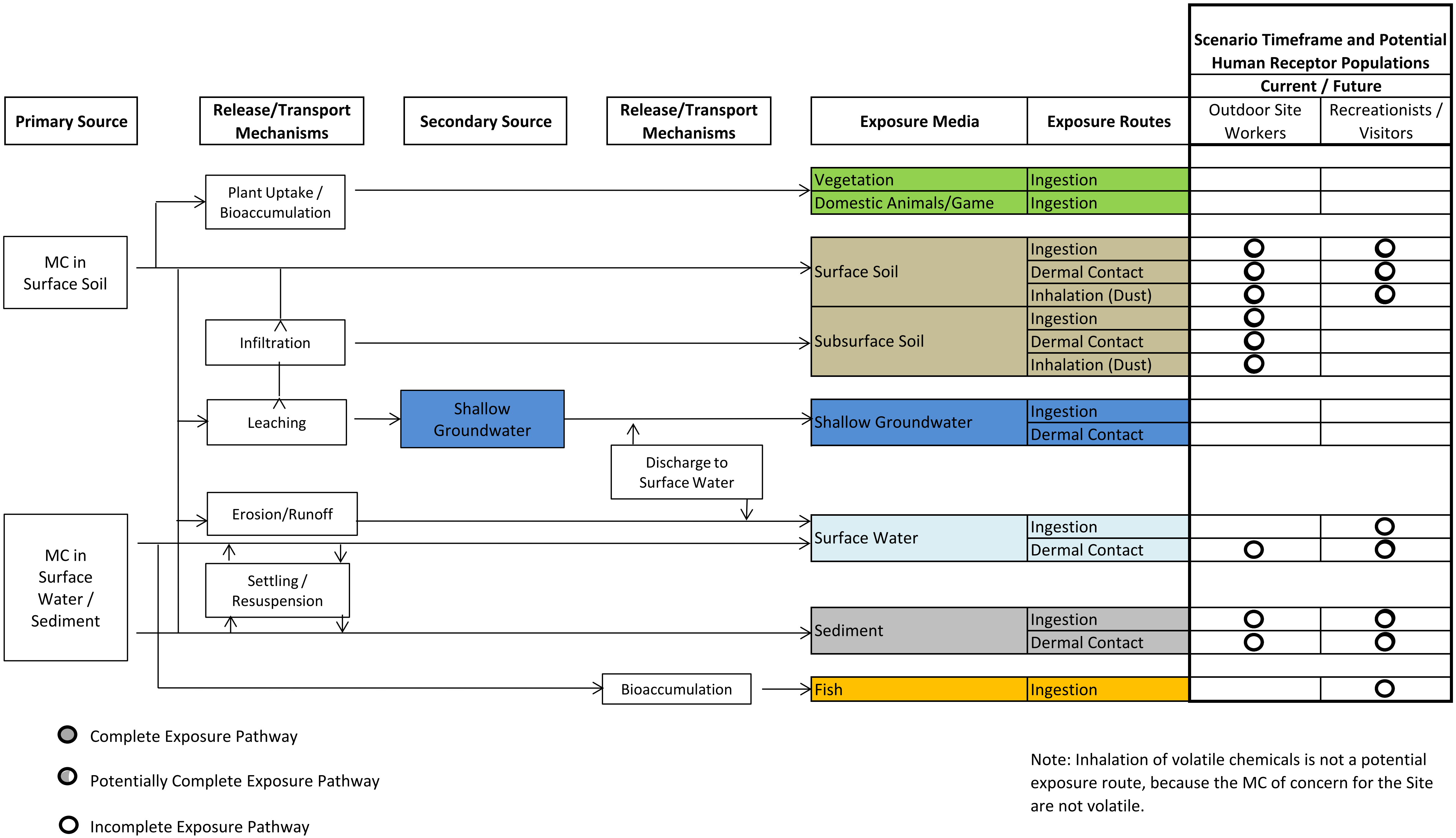
◐ Potentially Complete Exposure Pathway

○ Incomplete Exposure Pathway

Note: Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

EXPOSURE PATHWAY ANALYSIS FOR MC - MRS 05
Culebra Island Site, Puerto Rico

FIGURE 5-9



EXPOSURE PATHWAY ANALYSIS FOR MC - MRS 07
Culebra Island Site, Puerto Rico

FIGURE 5-10

6 BASELINE RISK ASSESSMENT FOR MC AND HAZARD ASSESSMENT FOR MEC

6.1 BASELINE RISK ASSESSMENT FOR MC

This section presents an assessment of potential human health and ecological risks associated with exposure to MC in surface soil and sediment at MRSs 02, 04, 05, and 07. The risk assessment is based on the analytical results of 48 surface soil and 11 sediment samples collected at MRSs 04, 05, and 07 during the SI in October 2006 and the RI in March 2011. For MRS 02, the risk assessment is based on the results of 10 surface soil samples collected by Ellis Environmental and reported in the Final SI Report (Parsons, 2007).

6.1.1 The objectives of the risk assessment are to:

- Assess potential human health risks, currently and in the future, in the absence of any major action to control or mitigate soil or sediment contamination.
- Evaluate the potential for adverse ecological health effects, currently and in the future, in the absence of any major action to control or mitigate soil or sediment contamination.
- Assist in determining the need for and extent of soil or sediment remediation.
- Provide a basis for comparing various remedial alternatives and determining which of them will meet the goals of protection of human health and the environment, as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR Part 300.5).

6.1.2 The human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA) are presented below.

6.2.1 HUMAN HEALTH RISK ASSESSMENT (HHRA)

6.2.1.1 The HHRA addresses the potential for adverse human health effects associated with exposure to MC in surface soil and sediment at MRSs 02, 04, 05, and 07. The HHRA methodology conforms to the USEPA's *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual Part A* (USEPA, 1989). The goal of the Superfund HHRA process is to provide a framework for developing the risk information necessary to assist in determination of possible remedial actions at a site. Risk assessment is a tool used to characterize and assess the toxicity of contaminants, evaluate the potential pathways and routes through which an individual may be exposed to contaminated environmental media, and characterize the cancer risks and non-cancer hazards at a site (USEPA, 1989).

6.2.1.2 There are four components to the HHRA process: data evaluation, exposure assessment, toxicity assessment, and risk characterization. The data evaluation focuses on the identification of chemicals of potential concern (COPC) at a site. In the exposure assessment, assumptions about the potential for human exposure to COPCs originating at a site are established. Representative exposure point concentrations (EPC) for each COPC are derived from the relevant data sets and used to model human exposure, in the form of chemical intakes and dermally absorbed doses. The likelihood and magnitude of adverse human health effects are expressed as incremental lifetime cancer risks and non-cancer hazard quotients, which are estimated in the risk characterization by combining chemical intakes/doses with chemical-specific toxicity information. Sources of uncertainty associated with the HHRA process and the extent to which human health risks may be over- or under-estimated are also discussed.

6.2.2.1 MC Data Summary

6.2.2.1.1 This section presents the usable MC data and identifies COPCs in soil and sediment samples collected at MRSs 02, 04, 05, and 07. As stated previously, each MRS was treated as a separate exposure unit in this HHRA. Therefore, the analytical data for each MRS were summarized and evaluated separately.

6.2.2.1.2 Table 6-1 summarizes the surface soil and sediment samples available for each MRS. As shown, a total of 10 composite surface soil samples (including 3 background samples) and 5 discrete sediment samples are available for MRS 04 from the SI in October 2006 and RI in March 2011. Twenty-four composite surface soil samples (including four background samples) and three discrete sediment samples are available from the SI and RI at MRS 05. Fourteen composite surface soil samples (including four background samples) and three discrete sediment samples are available from the SI and RI at MRS 07. Due to difficulties accessing the outlying cays and access restrictions at Cerro Balcon, no soil or sediment samples were collected during the SI or RI at MRS 02. Therefore, the risk assessment for MRS 02 relies on 10 discrete pre-detonation surface soil samples collected by Ellis during 2006 clearance activities at Cerro Balcon and Cayo Lobo.

Table 6-1: Summary of Analytical Data Available for Each MRS

	MRS02	MRS04	MRS05	MRS07
	Cerro Balcon and Cayo Lobo	Flamenco Lagoon Maneuver Area	Mortar and Combat Range Area	Culebrita Artillery Impact Area
Ellis 2006 NTCRA Samples	*Discrete Surface Soil Samples (sample depth unknown)*			
	C08005	Not Applicable	Not Applicable	Not Applicable
	B08001			
	B07002			
	C08001			
	B08002			
	D04001			
	D04002			
	C05001			

	MRS02	**MRS04**	**MRS05**	**MRS07**
	Cerro Balcon and Cayo Lobo	Flamenco Lagoon Maneuver Area	Mortar and Combat Range Area	Culebrita Artillery Impact Area
	C04001			
	B05001			
Site Investigation (SI) Samples - October 2006	*Composite Surface Soil Samples (2-6 inches bgs)*			
	None	CUL-04-SS-06-11*	CUL-05-SS-06-12	CUL-07-SS-06-25*
			CUL-05-SS-06-14	CUL-07-SS-06-26
			CUL-05-SS-06-15	
			CUL-05-SS-06-17*	
			CUL-05-SS-06-18	
			CUL-05-SS-06-19	
	Discrete Sediment Samples (sample depth unknown)			
	None	CUL-04-SE-06-03	CUL-05-SE-06-01	CUL-07-SE-06-02
		CUL-04-SE-06-04		
	Composite Background Surface Soil Samples (2-6 inches bgs)			
	None	None	None	CUL-07-SS-06-22
Remedial Investigation (RI) Samples - March 2011	*Composite Surface Soil Samples (0-2 inches bgs)*			
	None	CI-MRS04-SS-01	CI-MRS05-SS-01*	CI-MRS07-SS-01*
		CI-MRS04-SS-02*	CI-MRS05-SS-02	CI-MRS07-SS-02
		CI-MRS04-SS-03*	CI-MRS05-SS-03	CI-MRS07-SS-03
		CI-MRS04-SS-04	CI-MRS05-SS-04	CI-MRS07-SS-04
		CI-MRS04-SS-05	CI-MRS05-SS-05*	CI-MRS07-SS-05
		CI-MRS04-SS-06	CI-MRS05-SS-06	CI-MRS07-SS-06
			CI-MRS05-SS-07	CI-MRS07-SS-07*
			CI-MRS05-SS-08*	CI-MRS07-SS-08
			CI-MRS05-SS-09*	
			CI-MRS05-SS-10	
			CI-MRS05-SS-11	
			CI-MRS05-SS-12	
			CI-MRS05-SS-13	
			CI-MRS05-SS-14	
	Discrete Sediment Samples (0-6 inches bgs, in about 6 inches surface water)			
	None	CI-MRS04-SD-01	CI-MRS05-SD-01	CI-MRS07-SD-01
		CI-MRS04-SD-02	CI-MRS05-SD-02	CI-MRS07-SD-02
		CI-MRS04-SD-03		
	Background Composite Surface Soil Samples (0-2 inches bgs)			
	None	CI-MRS04-BKG-01	CI-MRS05-BKG-01	CI-MRS07-BKG-01
		CI-MRS04-BKG-02	CI-MRS05-BKG-02	CI-MRS07-BKG-02
		CI-MRS04-BKG-03	CI-MRS05-BKG-03	CI-MRS07-BKG-03

	MRS02	MRS04	MRS05	MRS07
	Cerro Balcon and Cayo Lobo	Flamenco Lagoon Maneuver Area	Mortar and Combat Range Area	Culebrita Artillery Impact Area
			CI-MRS05-BKG-04	
Total No. Samples:	10 surface soil samples	7 surface soil samples; 5 sediment samples; 3 background soil samples	20 surface soil samples; 3 sediment samples; 4 background soil samples	10 surface soil samples; 3 sediment samples; 4 background soil samples

Notes
bgs - below ground surface
*Duplicate sample was collected.
- Ellis samples were pre-detonation samples analyzed for explosives and metals.
- SI samples were analyzed for explosives and metals.
- RI samples were analyzed for explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc).

6.2.2.1.3 Fieldwork and environmental sampling for the RI were conducted in accordance with the EOTI Performance Work Statement (PWS), with field investigation procedures further developed in the RI work plan (EOTI, 2010). Laboratory analytical methods and data validation procedures were selected to meet the data quality objectives identified in the QAPP. The SI sample data were identified as "validated analytical results" in Tables 5.1 and 5.2 of the SI Report(Parsons, 2007), but the validation procedures were not indicated. It is unlikely the analytical data from soil samples collected by Ellis were independently validated; these data are presented in Table 5.4 of the SI Report (Parsons, 2007).

6.2.2.2 Surface Soil

6.2.2.2.1 Figures 3-1, 3-3 and 3-5 depict the locations of surface soil samples collected during the SI and RI at MRSs 04, 05, and 07. The SI soil samples "were collected at locations selected to represent areas with the highest likelihood for the presence of MEC or MC contamination" (Parsons, 2007). The RI soil samples were collected near locations where MEC or MD was found during the RI MEC fieldwork. The single exception to this is CI-MRS04-SS-03, which was collected to better characterize an area of MRS 04 where no other samples were collected. Background soil samples at MRS 04 and MRS 05 were collected at locations presumed to be un-impacted by military activities based on the RI MEC investigation. Background soil samples at MRS 07 were collected near the Culebrita lighthouse and at locations known to be un-impacted by historical activities.

6.2.2.2.2 Surface soil samples for both the SI and RI were collected using the CRREL 7-sample wheel approach. The SI samples were collected at depths of two to six inches bgs and were analyzed for explosives and metals (Parsons, 2007). The RI samples were collected at depths of zero to two inches bgs and were analyzed for the MC of concern listed in Table 5-1 of the RI work plan (EOTI, 2010). These MC include explosives and the following metals: antimony, barium, chromium, copper, lead, mercury, and zinc. As described in Section 3.3.2.1, these metals were selected based on the munitions types historically used at Culebra.

6.2.2.2.3 Tables 6-2 to 6-5 present summaries of the available surface soil data for each MRS, with the frequency of detection and range of detected concentrations for each detected chemical. No explosives were detected in any of the field surface soil samples; however, 1,3,5-TNB and 4-NT were found at very low levels in one split sample (CI-MRS05-SS-08B) collected for quality assurance purposes. Both analytes were well below the USEPA RSLs and are not evaluated as part of the HHRA. The SI data for only the select metals noted above were included in these data summaries, as the list of MC of concern was narrowed based on the use of military munitions during training activities from 1942-1946.

6.2.2.2.4 The decision process for the identification of COPCs is dictated by relevant USEPA (1989) guidance. A risk-based screen of detected MC concentrations was implemented, using the USEPA (2011a) RSLs for resident soil as screening toxicity values. [Note: The USEPA RSL table has been updated since May 2011; however, RSLs presented in this RI Report are still current as of November 2012.] The RSLs are chemical- and medium-specific concentrations derived to be protective of adverse health effects from ingestion, dermal contact, and inhalation exposures. Depending on the toxic effect, RSLs are based on either a cancer risk of one-in-a-million (i.e., 10^{-6} or 1E-06) or a non-cancer hazard quotient (HQ) of 1. In this HHRA, RSLs based on non-cancer health effects were reduced by one-tenth to represent a target HQ of 0.1 and thereby account for additive health effects. Chemicals with maximum detected concentrations greater than the RSLs were selected as COPCs. However, if the maximum concentration of a metal was less than or within the range of site-specific background concentrations, the metal was not selected as a COPC regardless of comparison to the RSL.

The following sections note the COPCs identified in surface soil at each MRS.

6.2.2.2.5 MRS 02 – Cerro Balcon and Adjacent Cays

Table 6-2 presents a data summary for the metals detected in surface soil samples collected by Ellis at MRS 02. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentration of each detected metal is less than the USEPA RSL. Therefore, no COPCs were identified in surface soil at MRS 02.

6.2.2.2.6 MRS 04 – Flamenco Lagoon Maneuver Area

Table 6-3 presents data summaries for the metals detected in surface soil samples collected during the SI and RI at MRS 04. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of the detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in surface soil at MRS 04.

6.2.2.2.7 MRS 05 – Mortar and Combat Range Area

Table 6-4 presents data summaries for the metals detected in surface soil samples collected during the SI and RI at MRS 05. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of the detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in surface soil at MRS 05.

6.2.2.2.8 MRS 07 – Culebrita Artillery Impact Area

Table 6-5 presents data summaries for the metals detected in surface soil samples collected during the SI and RI at MRS 07. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of all detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in surface soil at MRS 07.

Table 6-2: Summary of MRS 02 Surface Soil Data and Identification of COPCs

Detected Chemicals	Ellis Pre-Detonation Surface Soil Samples [1]		USEPA RSL for Resident Soil [2]		COPC? [3]
	Frequency of Detection	Range of Detected Concentrations			
		(mg/kg)	(mg/kg)	basis	[Y/N]
Antimony	9 / 10	0.79 B - 2 B	3.1	n	N
Barium	10 / 10	28 - 60	1,500	n	N
Chromium[2]	10 / 10	19 - 110	12,000	nm	N
Copper	10 / 10	58 - 110	310	n	N
Lead	10 / 10	2.1 - 9	400	n	N
Mercury[2]	9 / 10	0.0087 B - 0.047	2.3	n	N
Zinc	10 / 10	43 - 150	2,300	n	N

Notes

[1] Surface soil samples were collected by Ellis Environmental during clearance activities at Cayo Lobo and Cerro Balcon. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007) and are summarized herein. Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[2] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[3] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil.

B - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

Table 6-3: Summary of MRS 04 Surface Soil Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006: Frequency of Detection	SI Samples - October 2006: Range of Detected Concentrations	RI Samples - March 2011: Frequency of Detection	RI Samples - March 2011: Range of Detected Concentrations	USEPA RSL for Resident Soil [1]		COPC? [2]	Background Surface Soil Samples [3]: Range of Detected Concentrations
		(mg/kg)		(mg/kg)	(mg/kg)	basis	[Y/N]	(mg/kg)
Barium	1 / 1	12	6 / 6	12.3 J - 218 J	1,500	n	N	111 J - 257 J
Chromium	1 / 1	10	6 / 6	2.83 - 14.7	12,000	nm	N	2.74 - 14.2
Copper	1 / 1	3.6 J	6 / 6	3.05 - 61.8 J	310	n	N	39.7 - 60.3
Lead	1 / 1	1.2	3 / 6	9.66 - 10.3	400	n	N	3.21 - 15.1
Mercury	1 / 1	0.029 J	6 / 6	0.00558 J - 0.0312 J	2.3	n	N	0.017 J - 0.0353 J
Zinc	1 / 1	5.3 J	6 / 6	5.22 - 117 J	2,300	n	N	33 - 71.9

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil and is also greater than the range of detected concentrations in background surface soil samples.

[3] Represents combined SI and RI background soil sample data.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

Table 6-4: Summary of MRS 05 Surface Soil Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006: Frequency of Detection	SI Samples - October 2006: Range of Detected Concentrations (mg/kg)	RI Samples - March 2011: Frequency of Detection	RI Samples - March 2011: Range of Detected Concentrations (mg/kg)	USEPA RSL for Resident Soil [1] (mg/kg)	USEPA RSL for Resident Soil [1] basis	COPC? [2] [Y/N]	Background Surface Soil Samples [3]: Range of Detected Concentrations (mg/kg)
Barium	6 / 6	59 - 1,300	14 / 14	35.1 J - 958 J	1,500	n	N	236 J - 421 J
Chromium	6 / 6	2.8 - 150	14 / 14	8.19 J - 60.5 J	12,000	nm	N	11.5 - 14.3
Copper	6 / 6	18 J - 170 J	14 / 14	63.5 J - 171 J	310	n	N	135 - 152
Lead	6 / 6	2.7 - 9.4	14 / 14	2.36 - 17.3 J	400	n	N	5.08 - 9.83
Mercury	6 / 6	0.0097 J - 0.059	14 / 14	0.007 J - 0.0434	2.3	n	N	0.0113 J - 0.0357 J
Zinc	6 / 6	62 J - 120	14 / 14	58.4 J - 127 J	2,300	n	N	60.3 - 164

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected except for1,3,5-TNB and 4-NT, which were detected in one split sample collected from MRS 05 (CI-MRS05-SS-08B) for quality assurance purposes only. Detected concentrations of 1,3,5-TNB (0.16 mg/kg) and 4-NT (0.16 mg/kg) were less than chemical-specific RSLs.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil and is also greater than the range of detected concentrations in background surface soil samples.

[3] Represents combined SI and RI background soil sample data.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

Table 6-5: Summary of MRS 07 Surface Soil Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006 Frequency of Detection	SI Samples - October 2006 Range of Detected Concentrations (mg/kg)	RI Samples - March 2011 Frequency of Detection	RI Samples - March 2011 Range of Detected Concentrations (mg/kg)	USEPA RSL for Resident Soil [1] (mg/kg)	USEPA RSL basis	COPC? [2] [Y/N]	Background Surface Soil Samples [3] Range of Detected Concentrations (mg/kg)
Barium	2 / 2	180 - 480	8 / 8	29.6 J - 317 J	1,500	n	N	118 J - 130 J
Chromium	2 / 2	8.0 J - 9.9	8 / 8	10.9 J - 22.5 J	12,000	nm	N	12.9 J - 15.9 J
Copper	2 / 2	110 - 200 J	8 / 8	109 J - 225 J	310	n	N	125 J - 136 J
Lead	2 / 2	37 - 69 J	8 / 8	3.4 J - 22.8 J	400	n	N	4.57 J - 5.35 J
Mercury	2 / 2	0.032 J - 0.048	7 / 8	0.0101 J - 0.052 J	2.3	n	N	0.0255 J - 0.0314 J
Zinc	2 / 2	67 J - 190 J	8 / 8	51.7 J - 143 J	2,300	n	N	60 J - 77.6 J

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil and is also greater than the range of detected concentrations in background surface soil samples.

[3] Represents combined SI and RI background soil sample data.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

6.2.2.3 Sediment

6.2.2.3.1 Figures 3-1, 3-3 and 3-5 show the locations of sediment samples collected during the SI and RI at MRSs 04, 05, and 07. As with surface soil, the SI sediment sample locations were biased toward "areas with the highest likelihood for the presence of MEC or MC contamination" (Parsons, 2007). The RI sediment sample locations were randomly selected. Sediment samples during the RI at MRS 04 and MRS 07 were collected from lagoon sediments. One sediment sample collected during the RI at MRS 05 was from the shore of a lagoon, while the other was collected from a perennial stream. No sediment samples were collected at MRS 02. No background sediment samples were collected during the SI or RI.

6.2.2.3.2 Sediment samples for both the SI and RI were grab/discrete samples. The SI Report does not indicate sediment sample depth, but the samples were analyzed for explosives and metals (Parsons, 2007). The RI sediment samples were collected at depths of 0-6 inches bgs, in about 6 inches of surface water, and were analyzed for the MC of concern listed in Table 5-1 of the RI work plan (EOTI, 2010). These MC include explosives and the following metals: antimony, barium, chromium, copper, lead, mercury, and zinc.

6.2.2.3.3 Tables 6-6 to 6-8 present summaries of the available sediment data, with the frequency of detection and range of detected concentrations for each detected chemical. No explosives were detected in the sediment samples. The SI data for only the select metals noted above were included in these data summaries.

6.2.2.3.4 The decision process for the identification of COPCs is as described above for surface soil. The USEPA RSLs for resident soil were used as screening toxicity values. While human exposure to sediment is expected to be less (in exposure frequency and duration) than to soil in a residential setting, the RSLs for resident soil were used as a conservative screen of detected concentrations in sediment. The following sections note the COPCs identified in sediment.

6.2.2.3.5 *MRS 04 – Flamenco Lagoon Maneuver Area*

Table 6-6 presents data summaries for the metals detected in sediment samples collected during the SI and RI at MRS 04. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of the detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in sediment at MRS 04.

6.2.2.3.6 *MRS 05 – Mortar and Combat Range Area*

Table 6-7 presents data summaries for the metals detected in sediment samples collected during the SI and RI at MRS 05. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of the detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in sediment at MRS 05.

6.2.2.3.7 *MRS 07 – Culebrita Artillery Impact Area*

Table 6-8 presents data summaries for the metals detected in sediment samples collected during the SI and RI at MRS 07. The USEPA RSL for resident soil, its basis, and whether the chemical was identified as a COPC is indicated. As shown, the maximum concentrations of the detected metals are less than the USEPA RSLs. Therefore, no COPCs were identified in sediment at MRS 07.

6.2.2.4 Exposure Assessment

6.2.2.4.1 The objective of the exposure assessment is to estimate the type and magnitude of human exposure to the COPCs in surface soil and sediment at MRSs 02, 04, 05, and 07. Assumptions regarding the potential for human exposure (e.g., exposed populations, exposure frequency, etc.) are established. Representative EPCs for each COPC are calculated and used to model human exposure in the form of daily chemical intakes. These intakes are then combined in the Risk Characterization with COPC-specific toxicity values to calculate incremental lifetime cancer risks and non-cancer hazards.

6.2.2.4.2 In this HHRA, no COPCs were identified in surface soil or sediment from MRSs 02, 04, 05, and 07. Therefore, human exposure was not modeled. A CSM and associated MC exposure pathway analysis figure for each MRS are presented in Section 4 and 5. In the event future environmental sampling occurs at MRSs 02, 04, 05, and 07, and COPCs are identified based on those future data, the CSM describes potentially relevant human exposure pathways.

Table 6-6: Summary of MRS 04 Sediment Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006: Frequency of Detection	SI Samples - October 2006: Range of Detected Concentrations	RI Samples - March 2011: Frequency of Detection	RI Samples - March 2011: Range of Detected Concentrations	USEPA RSL for Resident Soil [1]		COPC? [2]
		(mg/kg)		(mg/kg)	(mg/kg)	basis	[Y/N]
Barium	2 / 2	60 - 81	3 / 3	21.2 J - 65.9 J	1,500	n	N
Chromium	2 / 2	5.8 - 9.9	3 / 3	8.14 - 12.1	12,000	nm	N
Copper	2 / 2	75 J - 93 J	3 / 3	2.94 - 120	310	n	N
Lead	2 / 2	5.8 - 12	1 / 3	159	400	n	N
Mercury	2 / 2	0.013 J - 0.04 J	1 / 3	0.227 J	2.3	n	N
Zinc	2 / 2	53 J - 74 J	3 / 3	3.65 - 95.5	2,300	n	N

Notes

Sediment samples were also analyzed for explosives, but no explosive compounds were detected.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

Table 6-7: Summary of MRS 05 Sediment Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006 Frequency of Detection	SI Samples - October 2006 Range of Detected Concentrations (mg/kg)	RI Samples - March 2011 Frequency of Detection	RI Samples - March 2011 Range of Detected Concentrations (mg/kg)	USEPA RSL for Resident Soil [1] (mg/kg)	basis	COPC? [2] [Y/N]
Barium	1 / 1	29	2 / 2	175 J - 196 J	1,500	n	N
Chromium	1 / 1	7.7	2 / 2	13.3 J - 14.3 J	12,000	nm	N
Copper	1 / 1	22	2 / 2	130 J - 149 J	310	n	N
Lead	1 / 1	2.5	2 / 2	5.56 - 6.29	400	n	N
Mercury	1 / 1	0.013 J	2 / 2	0.00818 - 0.0129	2.3	n	N
Zinc	1 / 1	32 J	2 / 2	68.7 J - 73.3 J	2,300	n	N

Notes

Sediment samples were also analyzed for explosives, but no explosive compounds were detected.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III. RSL for mercury applies to mercuric chloride.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

Table 6-8: Summary of MRS 07 Sediment Data and Identification of COPCs

Detected Chemicals	SI Samples - October 2006 Frequency of Detection	SI Samples - October 2006 Range of Detected Concentrations	RI Samples - March 2011 Frequency of Detection	RI Samples - March 2011 Range of Detected Concentrations	USEPA RSL for Resident Soil [1]		COPC? [2]
		(mg/kg)		(mg/kg)	(mg/kg)	basis	[Y/N]
Barium	1 / 1	16	2 / 2	24.1 J - 369 J	1,500	n	N
Chromium	1 / 1	3.0	2 / 2	2.69 J - 12.6 J	12,000	nm	N
Copper	1 / 1	6.7	2 / 2	11.8 J - 151 J	310	n	N
Lead	1 / 1	1.9	1 / 2	20.1 J	400	n	N
Zinc	1 / 1	5.0 J	2 / 2	6.2 J - 115 J	2,300	n	N

Notes

Sediment samples were also analyzed for explosives, but no explosive compounds were detected.

[1] With the exception of lead, USEPA RSLs (May 2011) for resident soil are based on a non-cancer (n) hazard quotient of 0.1. RSL for chromium applies to Chromium III.

[2] A chemical is identified as a COPC where the maximum detected concentration in either the SI or RI data set is greater than the USEPA RSL for resident soil.

J - estimated

n - indicates USEPA RSL for resident soil is based on a non-cancer hazard quotient of 0.1.

m - concentration exceeds theoretical ceiling limit of 10^5 mg/kg, which is equivalent to a chemical representing 10% by weight of the soil sample

6.2.2.5 Consideration of Uncertainty

6.2.2.5.1 A basic assumption underlying this HHRA is that the available surface soil and sediment data adequately characterize environmental conditions and the potential for MC to be present at each MRS. However, there are always some uncertainties associated with environmental sampling and analysis. Uncertainty associated with environmental sampling is generally related to limitations in terms of the number and distribution of samples, while uncertainty associated with the analysis of samples is generally associated with systematic or random errors (i.e., false positive or negative results). Efforts to minimize uncertainty were made by collecting and analyzing the RI samples in accordance with the QAPP and by independently validating the analytical data.

6.2.2.5.2 Composite surface soil samples were collected in an effort to characterize a greater areal extent and thereby obtain representative estimates of MC concentrations at each selected location. Discrete soil samples, in contrast, tend to underestimate mean MC concentrations at munitions response sites due to the heterogeneous distribution of particles of energetic residues (USEPA, 2012). However, even the 7-point wheel composite sampling approach used in this RI may underestimate MC concentrations and contribute to decision uncertainty, because a relatively small area within each MRS was sampled (USACE, 2008). In addition, the combined soil sample may mask the presence of relatively elevated concentrations in a single aliquot. While pre-processing or mixing composite samples prior to laboratory analysis introduces uncertainty in volatile chemical analyses, the explosives and metals analyzed for in this RI are not volatile.

6.2.2.5.3 Sediment sample locations for the RI were randomly selected, while the RI surface soil sample locations were biased toward areas where MEC or MD were found. While the latter approach increased the likelihood of finding MC at elevated concentrations, dense vegetation throughout the upland areas of each MRS limited field investigations for both MEC and MC. The extent to which MC is present at elevated concentrations in the areas of each MRS that were not accessible by the field team is an area of uncertainty, and the potential for human exposure and adverse health effects may be understated to an unknown degree.

6.2.2.5.4 Due to difficulties accessing the outlying cays and access restrictions at Cerro Balcon, no soil or sediment samples were collected during the RI at MRS 02. The risk evaluation for MRS 02 is instead based on ten pre-detonation surface soil samples collected by Ellis during clearance activities in 2006 at Cerro Balcon and Cayo Lobo. The sample collection methods and quality control procedures used are not known. It is not likely the analytical data were independently validated. No post-detonation surface soil samples were collected. The extent to which the Ellis surface soil data are reliable indicators of MC presence and concentrations in soil at MRS 02 is uncertain, and the potential for exposure and adverse health effects may be understated to an unknown degree. In addition, the lack of sediment data for MRS 02 does not allow for a determination of the potential for adverse health effects from human exposure to potential MC in sediment.

6.2.2.5.5 Non-detect chemicals are not evaluated as COPCs, as their presence and concentration in soil or sediment has not been confirmed. Explosives and metals that were analyzed for but not detected in soil or sediment samples may be present at an unknown concentration somewhere between the sample reporting limit and zero. Reporting limits for non-detect results were therefore compared to USEPA RSLs for resident soil to evaluate whether non-detect chemicals may be present at concentrations that pose human health risks and hazards. Of the soil and sediment samples collected for this RI, reporting limits for non-detect lead and mercury results were less than chemical-specific RSLs used to select COPCs in this HHRA. Antimony was not detected in any soil or sediment sample collected for this RI, and reporting limits in a few soil samples collected from MRS 05 and MRS 07 were greater than the RSL used in this HHRA (3.1 mg/kg). However, this RSL is based on a noncancer HQ of 0.1; all antimony reporting limits were less than the RSL based on a target HQ of 1 (31 mg/kg). Similarly, explosives were not detected in any soil or sediment sample collected for this RI. Reporting limits for nitroglycerin (1 mg/kg), m-dinitrobenzene (5 mg/kg), and m-nitrotoluene (5 mg/kg) were greater than RSLs based on a noncancer HQ of 0.1 (0.61 mg/kg for all) but less than RSLs based on a target HQ of 1 (6.1 mg/kg for all). The only chemical that was considered non-detect at a reporting limit greater than a chemical-specific RSL was o-nitrotoluene (RL = 5 mg/kg compared to RSL of 2.9 mg/kg, based on a target cancer risk of 10^{-6}). This is a source of uncertainty in the HHRA, as o-nitrotoluene may be present at concentrations in soil or sediment that pose human health risks.

6.2.2.5.6 Additional sources of uncertainty are associated with the equations, exposure factors, and toxicity values used to derive the RSLs. Standard USEPA exposure equations and default parameter values representing reasonable maximum exposure were used (2011a). The toxicity values can result in over-estimates or under-estimates of the potential for adverse health effects. In most cases, toxicity values are derived by extrapolating from laboratory animal data to humans. Uncertainty factors are usually applied to avoid under-estimating the potential for adverse human health effects.

6.2.2.5.7 Lastly, the RSL for Cr III was used to evaluate total chromium data, and the RSL for mercuric chloride was used to evaluate total mercury data, rather than the more conservative RSLs for hexavalent chromium (0.29 mg/kg based on cancer risk of 10^{-6}) and methylmercury (0.78 mg/kg based on HQ = 0.1). Samples to speciate chromium and mercury data were not collected; therefore the actual speciation of chromium and mercury in the soil and sediment at each MRS is unknown. However, it is likely the majority of total chromium is Cr III and the majority of total mercury is inorganic, divalent mercury (e.g., mercuric chloride). The presence of Cr VI in the environment is usually associated with its use in specific industries (e.g., leather tanning, cement, textiles, etc.). Except for soils containing chromate waste from such industries, chromium in most soils is predominantly present as Cr III (ATSDR, 2012). In addition, organic matter in soil and sediment will reduce Cr VI to Cr III (ATSDR, 2012). The presence of methylmercury in soil and sediment is largely due to its formation by micro-organisms, which may occur under aerobic or anaerobic conditions. Methylmercury is not associated with former munitions, but the degree to which methylation of mercury in the environment may have occurred is unknown. Regardless, total mercury concentrations detected in soil and sediment samples were also less than the RSL for methylmercury; therefore, this potential source of uncertainty has no impact on the HHRA conclusions.

6.2.3 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

This SLERA evaluates the potential for adverse health effects in ecological receptors from exposure to MC in surface soil and sediment at MRSs 02, 04, 05, and 07 at the Culebra Island Site. The SLERA was conducted following methodology in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997) and *Guidelines for Ecological Risk Assessment* (USEPA, 1998).

6.2.3.1 The SLERA consists of the following:

- Ecological Setting – describes the predominant vegetation and potential wildlife habitat on the Culebra Island Site.
- Problem Formulation – presents an exposure pathway analysis and ecological conceptual site model (ECSM) and identifies appropriate assessment and measurement endpoints for each MRS.
- Ecological Effects Evaluation – presents chemical-specific ecological screening values and identifies chemicals of potential ecological concern (COPEC) in surface soil and sediment samples from each MRS.
- Risk Characterization – presents HQs for each COPEC and qualifies the potential for adverse health effects; discusses potential sources of uncertainty associated with assessing ecological risks; and draws conclusions regarding the need to perform further ecological evaluation.

6.2.3.1.1 Ecological Setting

As described above, Culebra is an archipelago consisting of the main island and 22 smaller cays. Culebra has a tropical marine climate with a year-round average daily temperature of 80 ^{0}F. The average rainfall is 36 inches, and the average humidity is 73%. The majority of rainfall occurs between April and November, with a dry season between January and April. Prevailing winds are from the east-northeast in November through January and from the east the rest of the year. The average wind speed is 9.2 miles per hour. The hurricane season is from June through November, with most storms occurring July through September. Severe hurricanes occur through this area every 15 to 33 years.

6.2.3.1.2 Potential Ecological Habitat and Receptors

Culebra supports subtropical fauna and flora and contains a diversity of habitats, including subtropical dry forest, mangroves, and grasslands (USFWS, 2011). The largest remaining forest on the island is a unique habitat known as a boulder forest, located on Mount Resaca within MRS 05 (USFWS, 2011). The forest is characterized by boulder-covered areas, rock-strewn ravines, and a canopy of cupey and jaguey (wild fig) trees that support bromeliads and succulent herbaceous plants.

6.2.3.1.2.1 The majority of undeveloped portions of MRS 02 (Cerro Balcon), MRS 04, and MRS 05 are densely vegetated with low-growing shrubs and grasses. Human disturbance on Culebra Island has led to the proliferation of invasive plants, such as the sweet acacia, mesquite acacia, and guinea grass. Native plants include the fiddlewood, Puerto Rico box, and Turk's head cactus. The poisonous manzanillo tree is known to be present near Flamenco Lagoon within MRS 04.

6.2.3.1.2.2 Culebrita is similar to Culebra in that it is characterized by sandy beaches, a rocky coastline, and gentle to steep hills with moderate to dense vegetation. Vegetation is sparse or absent on many of the smaller cays (including Cayo Botella), as most are rocky with very little soil (USACE, 1995).

6.2.3.1.2.3 Surface water is scarce, and creeks and streams are intermittent and seasonal. Normally they are dry and collect and drain runoff only during rainstorms. Permanent surface water bodies on Culebra are limited to coastal lagoons and brackish ponds.

6.2.3.1.2.4 Appendix G contains maps of federally-recognized wetlands within MRSs 04, 05, and 07. These maps were generated using the online National Wetlands Inventory mapping tool, Wetlands Mapper. The maps show coastal wetlands, lagoons, and freshwater ponds occur within MRS 04 and MRS 05. The lagoons from which sediment samples were collected during the SI and RI have the following classification:

- E1AB3/UB2L – estuarine, subtidal, aquatic bed, rooted vascular/unconsolidated bottom, sand, subtidal

6.2.3.1.2.5 In addition, these lagoons are surrounded by wetlands with the following classifications:

- E2FO3N (MRS 04) – estuarine, intertidal, forested, broad-leaved evergreen, regularly flooded
- E2FO3M (MRS 05) – estuarine, intertidal, forested, broad-leaved evergreen, irregularly exposed

6.2.3.1.2.6 Coastal wetlands and a lagoon are present within MRS 07 (i.e., on Culebrita). The lagoon from which sediment samples were collected during the SI and RI at MRS 07 has the following Cowardin (1979) classification:

- E2US2M – estuarine, intertidal, unconsolidated shore, sand, irregularly exposed

6.2.3.1.2.7 In addition, the lagoon within MRS 07 is surrounded by a wetland with the following Cowardin (1979) classification:

- E2FO3P – estuarine, intertidal, forested, broad-leaved evergreen, irregularly flooded

6.2.3.1.2.8 Potential terrestrial ecological receptors that may be found in the upland areas of Culebra Island [i.e., MRS 2 (Cerro Balcon), MRS 04, and MRS 05] and Culebrita (MRS 07) include soil invertebrates, terrestrial plants, birds (e.g., cattle egret, songbirds), reptiles and amphibians (e.g., snakes, iguanas, anoles, and toads), and small mammals (e.g., rodents and bats). Large mammals (i.e., white-tailed deer) are present on Culebra Island but are not potential ecological receptors for Culebrita. The brackish lagoons within MRS 04, MRS 05, and MRS 07 provide habitat for benthic invertebrates, aquatic plants (e.g., mangroves), fish, wading birds and shorebirds (e.g., greater yellowlegs) (Heatwole et al., 1963). Aquatic beds in the lagoons within MRSs 04 and 05 likely provide spawning habitat for fish. Coastal areas support important rookeries for seabirds (e.g., laughing gulls, bridled terns, sooty terns, roseate terns, and brown boobies). Culebra beaches are used as nesting sites by leatherback and hawksbill sea turtles (USFWS, 2011).

6.2.3.1.2.9 The diversity of potential ecological receptors at MRS 02 (cays) is considerably less, as most cays are rocky with very little soil or vegetation. The only potential terrestrial receptors identified for the cays within MRS 02 are seabirds.

6.2.3.1.3 Sensitive Habitats and Threatened or Endangered Species

6.2.3.1.3.1 A survey for the presence of sensitive habitats and threatened or endangered species at each MRS was not conducted for this RI. However, the following summary of information on threatened or endangered species on Puerto Rico and Culebra was originally presented in the SI Report (Parsons, 2007) and supplemented through a review of the USFWS Southeast Region online resource (http://www.fws.gov/caribbean/es/Endangered-Main.html). Additional resources reviewed for threatened and endangered species included the: *USACE Archives Search Report, 1995*; *Environmental and Cultural Resource Surveys for Isla Culebrita, 2006*; and the *Environmental and Cultural Resource Surveys for Cerro Balcon NTCRA, 2006*.

6.2.3.1.3.2 The main island of Puerto Rico and its associated islands support 75 federally listed threatened and endangered species consisting of 26 animals and 49 plants. Among this diverse group of fauna and flora are multiple species that are known to exist, potentially exist, or temporarily use areas within the Culebra Island, such as migratory birds. The following are considered by the Puerto Rico Natural Heritage Program to be conservation-priority areas: Culebra National Wildlife Refuge, Mount Resaca, all of the lagoons and beaches on Culebra, and all cays around Culebra (Parsons, 2007). It should be noted the cays within MRS 02, portions of MRS 04 and MRS 05, and all of MRS 07 (Culebrita and Cayo Botella), are managed by the USFWS as part of the Culebra National Wildlife Refuge. The particular areas within MRS 04 and MRS 05 are depicted on Figure 1-2 (MRS 04) and Figure 1-3 (MRS 05) as "Fish & Wildlife Area." On Culebrita, all beachfront areas from mean high tide inland to a point 150 meters from shore have been designated critical habitat for hawksbill sea turtles. The sea turtle nesting season varies with locality, but in most locations nesting occurs sometime between April and November. Table 6-9 is a summary of the threatened/endangered species and critical habitats for Culebra (USFWS, 2011).

Table 6-9: Culebra Federal Threatened and Endangered Species (USFWS, 2011)

Scientific Name	Common Name	Group	Status	Distribution
Anolis roosevelti	Culebra Giant Anole	Reptile	E, CH	Forested Areas
Caretta caretta	Loggerhead Sea Turtle	Reptile	T	Coastal Zones
Chelonia mydas	Green Sea Turtle	Reptile	T, CH	Coastal Zones
Dermochelys coriacea	Leatherback Sea Turtle	Reptile	E, CH	Coastal Zones
Epicrates monensis granti	Virgin Islands Tree Boa	Reptile	E	Forested Areas
Eretmochelys imbricata	Hawksbill Sea Turtle	Reptile	E, CH	Coastal Zones
Leptocereus grantianus	No Common Name	Plant	E	Punta Melones
Pelecanus occidentalis	Brown Pelican	Bird	D, MP	Coastal Zone, No Nesting
Peperomia wheeleri	Wheeler's Peperomia	Plant	E	Monte Resaca, Playa Brava
Sterna dougallii	Roseate Tern	Bird	T	Coastal Areas and Offshore Cays, Nesting
Trichechus manatus manatus	Antillean Manatee	Mammal	E	Coastal Zones
Acropora palmata	Elkhorn Coral	Coral	T	Coastal Zones
Acropora cervicornis	Staghorn Coral	Coral	T	Coastal Zones

Notes:
E=Endangered
T=Threatened
CH=Critical Habitat
D=Delisted due to Recovery
MP= Monitoring Plan

6.2.3.1.4 Problem Formulation

Problem formulation establishes the goals, breadth, and focus of the SLERA (USEPA, 1997). It is based on the current understanding of potential ecological habitat and receptors at each MRS and information collected during environmental investigations. In this section, potential exposure pathways between MC originating in soil and sediment and ecological receptors are described and illustrated in an ECSM. Lastly, appropriate assessment and measurement endpoints for this SLERA are identified.

6.2.3.1.5 Assessment and Measurement Endpoints

6.2.3.1.5.1 Assessment endpoints refer to the valued ecological resources to be protected from potential adverse health effects caused by exposure to site-related COPECs. For most potential receptors of concern, USEPA (1997) guidance recommends the appropriate level of protection to be provided by any action that may be required is protection of the population or community of plants and/or animals present at a site. For this SLERA, the assessment endpoints are any adverse health effects (e.g., reduced vigor, population decline) on the terrestrial and aquatic communities that may be present at each MRS. Because it is often difficult to measure effects on entire communities or individual populations to verify if risk predictions are accurate, adverse effects on individual organisms, representative of the entire population, are usually substituted in practice.

6.2.3.1.5.2 Measurement endpoints can be measures of effect (e.g., changes in community structure) or measures of exposure (e.g., concentrations in affected environmental media) used to infer the potential for adverse health effects in communities and the ecosystem in question (USEPA, 1997). In this SLERA, measures of exposure were compared to conservative risk-based toxicity reference values (TRV) protective of adverse effects on organisms.

6.2.3.1.5.3 To evaluate the potential for adverse health effects in terrestrial plants and soil invertebrates, detected MC concentrations in surface soil were compared to TRVs protective of direct toxicity to terrestrial plants and soil invertebrates. Chemicals with maximum concentrations greater than the applicable screening values were identified as COPECs. The following hierarchy of sources of soil screening values was used:

- USEPA Ecological Soil Screening Levels (EcoSSL) (USEPA, 2011b). Separate EcoSSLs are derived for plants and soil invertebrates. However, EcoSSLs are not always available for both plants and soil invertebrates, and EcoSSLs are not available for all of the detected metals in surface soil.
- USEPA Region 5 Ecological Screening Levels (ESL) for Soil (USEPA Region 5, 2003).
- Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Plants (Efroymson et al., 1997).

6.2.3.1.5.4 To evaluate the potential for adverse health effects in terrestrial wildlife, detected chemical concentrations in surface soil were compared to TRVs protective of such effects in birds and mammals. These screening values were derived using food chain bioaccumulation models and toxicity values based on no-observed-adverse-effect-levels. They consider direct exposure to chemicals in soil through feeding and nesting activities and exposure to bio-accumulated chemicals in food/prey items. The following hierarchy of sources of soil screening values was used:

- USEPA EcoSSL (USEPA, 2011b). Separate EcoSSLs are derived for birds and mammals.
- USEPA Region 5 ESLs for Soil (USEPA Region 5, 2003). However, no soil ESLs based on exposure to birds or mammals were available for the MC lacking applicable EcoSSLs.

6.2.3.1.5.5 To evaluate the potential for adverse health effects in aquatic receptors, detected chemical concentrations in sediment were compared to TRVs indicative of the potential for such effects in sediment-associated biota. Chemical-specific threshold effects levels (TEL) represent concentration levels below which adverse effects are not expected, while probable effects levels (PEL) are concentration levels above which adverse effects are likely to occur (Long and MacDonald, 1998). As a conservative screen, COPECs in sediment were identified where the maximum detected concentration was greater than the TEL. However, both the TEL and PEL for a given chemical were presented (where available) to effectively bound the potential for adverse health effects.

6.2.3.1.6 Ecological Effects Evaluation

6.2.3.1.6.1 The ecological effects evaluation serves to focus the SLERA on those chemicals detected in surface soil and sediment that, if exposed to, may result in adverse health effects. This is achieved by comparing detected chemical concentrations to the applicable TRVs and selecting COPECs. A chemical was identified as a COPEC where the maximum detected concentration was greater than the TRV or where no applicable TRV was available. This is a conservative screening approach that assumes ecological receptors are continuously exposed to chemical concentrations equivalent to maximum detected concentrations at each MRS and that chemicals in soil and sediment are 100% bioavailable. In addition, exceedance of a TRV is not a predictor of adverse ecological effects, especially on sites where background metals concentrations are greater than TRVs or where ecological communities are diverse and thriving (Efroymson, et al., 1997). For detected metals in surface soil, if the maximum concentration was less than or within the range of site-specific background concentrations, it was not selected as a COPEC regardless of the comparison to or availability of the TRV.

6.2.3.1.6.2 The available surface soil and sediment samples are as described above for the HHRA. Table 6-1 summarizes the surface soil and sediment samples available for each MRS. As shown, a total of ten surface soil samples (including three background samples) and five sediment samples are available for MRS 04 from the SI in October 2006 and the RI in March 2011. Twenty-four surface soil samples (including four background samples) and three sediment samples are available from the SI and RI at MRS 05. Fourteen surface soil samples (including four background samples) and three sediment samples are available from the SI and RI at MRS 07. Due to difficulties accessing the outlying cays and access restrictions at Cerro Balcon, no soil or sediment samples were collected during the SI or RI at MRS 02. Therefore, the SLERA relies on ten pre-detonation surface soil samples collected by Ellis during clearance activities at Cerro Balcon and Cayo Lobo. Due to differences in potential ecological receptors and the geographic distance between them, soil data from Cerro Balcon and Cayo Lobo were summarized separately, and COPECs were identified for MRS 02 (Cerro Balcon) and MRS 02 (cays).

6.2.3.1.7 Selection of COPECs in Surface Soil

6.2.3.1.7.1 Tables 6-10A to 6-14 present a surface soil data summary and the selection of COPECs for each MRS. Separate tables (e.g., Table 6-10A and Table 6-10B) were prepared to show COPECs identified based on comparison to TRVs for terrestrial plants and soil invertebrates vs. TRVs for birds and mammals. The following summarizes the COPECs identified in surface soil at each MRS.

6.2.3.1.7.2 *MRS 02 – Cerro Balcon*

As shown in Table 6-10A, the following MC were identified as COPECs in surface soil at MRS 02 (Cerro Balcon), because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in terrestrial plants and soil invertebrates: chromium, copper, and zinc.

6.2.3.1.7.3 Table 6-10B shows the following MC were identified as COPECs in surface soil because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in birds and mammals: antimony, chromium, copper, and zinc. In addition, antimony, barium, and mercury were identified as COPECs based on the lack of applicable TRVs for one or both categories of receptors.

6.2.3.1.7.4 *MRS 02 – Cayo Lobo*

As shown in Table 6-11A, the following MC were identified as COPECs in surface soil at MRS 02 (Cayo Labo), because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in terrestrial plants and soil invertebrates: chromium, copper, and zinc.

6.2.3.1.7.5 Table 6-11B shows the following MC were identified as COPECs in surface soil because their maximum detected concentrations are greater than the TRVs protective of adverse health effects in birds: chromium, copper, and zinc. In addition, antimony, barium, and mercury were identified as COPECs based on the lack of applicable TRVs.

6.2.3.1.7.6 *MRS 04 – Flamenco Lagoon Maneuver Area*
As shown in Table 6-12A, chromium was identified as a COPEC in surface soil at MRS 04, because the maximum detected concentration is greater than both TRVs protective of adverse health effects in terrestrial plants and soil invertebrates.

6.2.3.1.7.7 Table 6-12B shows the following MC were identified as COPECs in surface soil because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in birds and mammals: copper and zinc. While there are no TRVs for barium (birds) and mercury (birds and mammals), these metals were not identified as COPECs because their maximum detected concentrations were within the range of detected concentrations in background surface soil samples.

6.2.3.1.7.8 *MRS 05 – Mortar and Combat Range Area*
As shown in Table 6-13A, the following MC were identified as COPECs in surface soil at MRS 05, because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in terrestrial plants and soil invertebrates: barium, chromium, and copper. While the maximum zinc concentration is also greater than TRVs for plants and soil invertebrates, it was within the range of detected concentrations in background surface soil samples. Therefore, zinc was not identified as a COPEC in Table 6-13A.

6.2.3.1.7.9 Table 6-13B shows the following MC were identified as COPECs in surface soil because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in birds and mammals: chromium, copper, and lead. In addition, barium and mercury were identified as COPECs based on the lack of applicable TRVs for one or both categories of receptors. While the maximum zinc concentration is also greater than TRVs for birds and mammals, it was within the range of detected concentrations in background surface soil samples. Therefore, zinc was not identified as a COPEC in Table 6-13B.

6.2.3.1.7.10 *MRS 07 – Culebrita Artillery Impact Area*
As shown in Table 6-14A, the following MC were identified as COPECs in surface soil at MRS 07, because their maximum detected concentrations are greater

than one or both of the TRVs protective of adverse health effects in terrestrial plants and soil invertebrates: barium, chromium, copper, and zinc.

6.2.3.1.7.11 Table 6-14B shows the following MC were identified as COPECs in surface soil because their maximum detected concentrations are greater than one or both of the TRVs protective of adverse health effects in birds and mammals: copper, lead, and zinc. In addition, barium and mercury were identified as COPECs based on the lack of applicable TRVs for one or both categories of receptors.

Table 6-10A: Selection of COPECs in MRS 02 (Cerro Balcon) Surface Soil: Plants and Soil Invertebrates

Detected Chemicals	Ellis Pre-Detonation Surface Soil Samples [1] Frequency of Detection	Range of Detected Concentrations (mg/kg)	TRV [2] Terrestrial Plants (mg/kg)	basis	Soil Invertebrates (mg/kg)	basis	COPEC? [3] [Y/N]
Antimony	5 / 5	1 B - 2 B	5	c	78	a	N
Barium	5 / 5	45 - 60	500	c	330	a	N
Chromium [4]	5 / 5	40 - 110	1	c	0.4	b	Y
Copper	5 / 5	91 - 110	70	a	80	a	Y
Lead	5 / 5	2.9 - 5.8	120	a	1,700	a	N
Mercury [5]	5 / 5	0.028 - 0.047	0.3	c	0.1	b	N
Zinc	5 / 5	52 J - 130 J	160	a	120	a	Y

Notes

[1] Surface soil samples were collected by Ellis Environmental during clearance activities at Cerro Balcon. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007) and are summarized herein. Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[2] TRVs were selected from the following hierarchy of sources:

a - USEPA (2011b) Ecological Soil Screening Levels

b - USEPA Region 5 (2003) ESL for soil

c - ORNL Toxicological Benchmarks for Plants (Efroymson, et al., 1997)

[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs.

[4] TRV applies to total chromium.

[5] ONRL benchmark applies to elemental mercury. USEPA Region 5 ESL applies to total mercury.

J, B - estimated

Table 6-10B: Selection of COPECs in MRS 02 (Cerro Balcon) Surface Soil: Birds and Mammals

Detected Chemicals	Ellis Pre-Detonation Surface Soil Samples [1] Frequency of Detection	Ellis Pre-Detonation Surface Soil Samples [1] Range of Detected Concentrations (mg/kg)	Bioaccumulative [2]	TRV [3] Birds (mg/kg)	TRV [3] Birds basis	TRV [3] Mammals (mg/kg)	TRV [3] Mammals basis	COPEC? [4] [Y/N]
Antimony	5 / 5	1 B - 2 B	N	NA		0.27	a	Y
Barium	5 / 5	45 - 60	N	NA		2,000	a	Y
Chromium [5]	5 / 5	40 - 110	Cr VI	26	a	34	a	Y
Copper	5 / 5	91 - 110	Y	28	a	49	a	Y
Lead	5 / 5	2.9 - 5.8	Y	11	a	56	a	N
Mercury	5 / 5	0.028 - 0.047	MHg	NA		NA		Y
Zinc	5 / 5	52 J - 130 J	Y	46	a	79	a	Y

Notes

[1] Surface soil samples were collected by Ellis Environmental during clearance activities at Cerro Balcon. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007) and are summarized herein. Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[2] Chemicals considered bioaccumulative are those listed in Table 4-2, Important Bioaccumulative Compounds in USEPA, 2000.

[3] TRVs were selected from the following hierarchy of sources:
- a - USEPA (2011b) Ecological Soil Screening Levels
- b - USEPA Region 5 (2003) ESL for soil

[4] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs.

[5] USEPA EcoSSL applies to trivalent chromium (Cr III).

Cr VI - indicates only hexavalent chromium (Cr VI) is bioaccumulative

MHg - indicates only methylmercury is bioaccumulative

J, B - estimated

NA - Not Available

Table 6-11A: Selection of COPECs in MRS 02 (Cayo Lobo) Surface Soil: Terrestrial Plants and Soil Invertebrates

Detected Chemicals	Ellis Pre-Detonation Surface Soil Samples [1]		TRV [2]				COPEC? [3]
	Frequency of Detection	Range of Detected Concentrations	Terrestrial Plants		Soil Invertebrates		
		(mg/kg)	(mg/kg)	basis	(mg/kg)	basis	[Y/N]
Antimony	4 / 5	0.79 B - 1.7 B	5	c	78	a	N
Barium	5 / 5	28 - 52	500	c	330	a	N
Chromium [4]	5 / 5	19 - 30	1	c	0.4	b	Y
Copper	5 / 5	58 - 83	70	a	80	a	Y
Lead	5 / 5	2.1 - 4.2	120	a	1,700	a	N
Mercury [5]	4 / 5	0.0087 B - 0.021 B	0.3	c	0.1	b	N
Zinc	5 / 5	43 - 150	160	a	120	a	Y

Notes

[1] Surface soil samples were collected by Ellis Environmental during clearance activities at Cayo Lobo. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007) and are summarized herein. Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[2] TRVs were selected from the following hierarchy of sources:
- a - USEPA (2011b) Ecological Soil Screening Levels
- b - USEPA Region 5 (2003) ESL for soil
- c - ORNL Toxicological Benchmarks for Plants (Efroymson, et al., 1997)

[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs.

[4] TRV applies to total chromium.

[5] ONRL benchmark applies to elemental mercury. USEPA Region 5 ESL applies to total mercury.

B - estimated

Table 6-11B: Selection of COPECs in MRS 02 (cays) Surface Soil: Birds

Detected Chemicals	Ellis Pre-Detonation Surface Soil Samples [1] Frequency of Detection	Range of Detected Concentrations (mg/kg)	Bioaccumulative [2]	TRV [3] Birds (mg/kg)	basis	COPEC? [4] [Y/N]
Antimony	4 / 5	0.79 B - 1.7 B	N	NA		Y
Barium	5 / 5	28 - 52	N	NA		Y
Chromium [5]	5 / 5	19 - 30	Cr VI	26	a	Y
Copper	5 / 5	58 - 83	Y	28	a	Y
Lead	5 / 5	2.1 - 4.2	Y	11	a	N
Mercury	4 / 5	0.0087 B - 0.021 B	MHg	NA		Y
Zinc	5 / 5	43 - 150	Y	46	a	Y

Notes

[1] Surface soil samples were collected by Ellis Environmental during clearance activities at Cayo Lobo. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007) and are summarized herein. Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[2] Chemicals considered bioaccumulative are those listed in Table 4-2, Important Bioaccumulative Compounds in USEPA, 2000.

[3] TRVs were selected from the following hierarchy of sources:
- a - USEPA (2011b) Ecological Soil Screening Levels
- b - USEPA Region 5 (2003) ESL for soil

[4] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs.

[5] USEPA EcoSSL applies to trivalent chromium (Cr III).

B - estimated

Cr VI - indicates only hexavalent chromium (Cr VI) is bioaccumulative

MHg - indicates only methylmercury is bioaccumulative

NA - Not Available

Table 6-12A: Selection of COPECs in MRS 04 Surface Soil: Plants and Soil Invertebrates

Detected Chemicals	Surface Soil Data Summary [1]		TRV [2]				COPEC? [3]	Rationale	Background Surface Soil Samples [4]
	Frequency of Detection	Range of Detected Concentrations	Terrestrial Plants		Soil Invertebrates				Range of Detected Concentrations
		(mg/kg)	(mg/kg)	basis	(mg/kg)	basis	[Y/N]		(mg/kg)
Barium	7 / 7	12 - 218 J	500	c	330	a	N	Max < TRVs	111 J - 257 J
Chromium [5]	7 / 7	2.83 - 14.7	1	c	0.4	b	Y	Max > TRVs, BG	2.74 - 14.2
Copper	7 / 7	3.05 - 61.8 J	70	a	80	a	N	Max < TRVs	39.7 - 60.3
Lead	4 / 7	1.2 - 10.3	120	a	1,700	a	N	Max < TRVs	3.21 - 15.1
Mercury [6]	7 / 7	0.00558 J - 0.0312 J	0.3	c	0.1	b	N	Max < TRVs	0.017 J - 0.0353 J
Zinc	7 / 7	5.22 - 117 J	160	a	120	a	N	Max < TRVs	33 - 71.9

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] TRVs were selected from the following hierarchy of sources:

a - USEPA (2011b) Ecological Soil Screening Levels

b - USEPA Region 5 (2003) Ecological Screening Levels (ESL) for soil

c - Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Plants (Efroymson, et al., 1997)

[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is also greater than the range of detected concentrations in background surface soil samples.

[4] Represents combined SI and RI background soil sample data.

[5] TRV applies to total chromium.

[6] ONRL benchmark applies to elemental mercury. USEPA Region 5 ESL applies to total mercury.

J - estimated

Max - maximum detected concentration

BG - range of detected concentrations in background surface soil samples

Table 6-12B: Selection of COPECs in MRS 04 Surface Soil: Birds and Mammals

Detected Chemicals	Surface Soil Data Summary [1] Frequency of Detection	Surface Soil Data Summary [1] Range of Detected Concentrations (mg/kg)	Bioaccumulative [2]	TRV [3] Birds (mg/kg)	TRV [3] Birds basis	TRV [3] Mammals (mg/kg)	TRV [3] Mammals basis	COPEC? [4] [Y/N]	Rationale	Background Surface Soil Samples [5] Range of Detected Concentrations (mg/kg)
Barium	7 / 7	12 - 218 J	N	NA		2,000	a	N	Max < TRV, BG	111 J - 257 J
Chromium [6]	7 / 7	2.83 - 14.7	Cr VI	26	a	34	a	N	Max < TRVs	2.74 - 14.2
Copper	7 / 7	3.05 - 61.8 J	Y	28	a	49	a	Y	Max > TRVs, BG	39.7 - 60.3
Lead	4 / 7	1.2 - 10.3	Y	11	a	56	a	N	Max < TRVs	3.21 - 15.1
Mercury	7 / 7	0.00558 J - 0.0312 J	MHg	NA		NA		N	Max < BG	0.017 J - 0.0353 J
Zinc	7 / 7	5.22 - 117 J	Y	46	a	79	a	Y	Max > TRVs, BG	33 - 71.9

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] Chemicals considered bioaccumulative are those listed in Table 4-2, Important Bioaccumulative Compounds in USEPA, 2000.

[3] TRVs were selected from the following hierarchy of sources:

a - USEPA (2011b) Ecological Soil Screening Levels

b - USEPA Region 5 (2003) Ecological Screening Levels (ESL) for soil

[4] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is also greater than the range of detected concentrations in background surface soil samples.

[5] Represents combined SI and RI background soil sample data.

[6] USEPA EcoSSL applies to trivalent chromium (Cr III).

J - estimated

Cr VI - indicates only hexavalent chromium (Cr VI) is bioaccumulative

MHg - indicates only methylmercury is bioaccumulative

NA - Not Available

Max - maximum detected concentration

BG - range of detected concentrations in background surface soil samples

Table 6-13A: Selection of COPECs in MRS 05 Surface Soil: Plants and Soil Invertebrates

Detected Chemicals	Surface Soil Data Summary [1] Frequency of Detection	Surface Soil Data Summary [1] Range of Detected Concentrations (mg/kg)	TRV [2] Terrestrial Plants (mg/kg)	basis	TRV [2] Soil Invertebrates (mg/kg)	basis	COPEC? [3] [Y/N]	Rationale	Background Surface Soil Samples [4] Range of Detected Concentrations (mg/kg)
Barium	20 / 20	35.1 J - 1,300	500	c	330	a	Y	Max > TRVs, BG	236 J - 421 J
Chromium [5]	20 / 20	2.8 - 150	1	c	0.4	b	Y	Max > TRVs, BG	11.5 - 14.3
Copper	20 / 20	18 J - 170 J	70	a	80	a	Y	Max > TRVs, BG	135 - 152
Lead	20 / 20	2.36 - 17.3 J	120	a	1,700	a	N	Max < TRVs	5.08 - 9.83
Mercury [6]	20 / 20	0.0097 J - 0.059	0.3	c	0.1	b	N	Max < TRVs	0.0113 J - 0.0357 J
Zinc	20 / 20	58.4 J - 127 J	160	a	120	a	N	Max < BG	60.3 - 164

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected except for1,3,5-TNB and 4-NT, which were detected in one split sample collected from MRS 05 (CI-MRS05-SS-08B) for quality assurance purposes only.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] TRVs were selected from the following hierarchy of sources:

a - USEPA (2011b) Ecological Soil Screening Levels

b - USEPA Region 5 (2003) Ecological Screening Levels (ESL) for soil

c - Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Plants (Efroymson, et al., 1997)

[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is also greater than the range of detected concentrations in background surface soil samples.

[4] Represents combined SI and RI background soil sample data.

[5] TRV applies to total chromium.

[6] ONRL benchmark applies to elemental mercury. USEPA Region 5 ESL applies to total mercury.

J - estimated

Max - maximum detected concentration

BG - range of detected concentrations in background surface soil samples

Table 6-13B: Selection of COPECs in MRS 05 Surface Soil: Birds and Mammals

Detected Chemicals	Surface Soil Data Summary [1] Frequency of Detection	Surface Soil Data Summary [1] Range of Detected Concentrations (mg/kg)	Bioaccumulative [2]	TRV [3] Birds (mg/kg)	TRV [3] Birds basis	TRV [3] Mammals (mg/kg)	TRV [3] Mammals basis	COPEC? [4] [Y/N]	Rationale	Background Surface Soil Samples [5] Range of Detected Concentrations (mg/kg)
Barium	20 / 20	35.1 J - 1,300	N	NA		2,000	a	Y	No TRV, Max > BG	236 J - 421 J
Chromium [6]	20 / 20	2.8 - 150	Cr VI	26	a	34	a	Y	Max > TRVs, BG	11.5 - 14.3
Copper	20 / 20	18 J - 170 J	Y	28	a	49	a	Y	Max > TRVs, BG	135 - 152
Lead	20 / 20	2.36 - 17.3 J	Y	11	a	56	a	Y	Max > TRV, BG	5.08 - 9.83
Mercury	20 / 20	0.0097 J - 0.059	MHg	NA		NA		Y	No TRV, Max > BG	0.0113 J - 0.0357 J
Zinc	20 / 20	58.4 J - 127 J	Y	46	a	79	a	N	Max < BG	60.3 - 164

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected except for1,3,5-TNB and 4-NT, which were detected in one split sample collected from MRS 05 (CI-MRS05-SS-08B) for quality assurance purposes only.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] Chemicals considered bioaccumulative are those listed in Table 4-2, Important Bioaccumulative Compounds in USEPA, 2000.

[3] TRVs were selected from the following hierarchy of sources:
- a - USEPA (2011b) Ecological Soil Screening Levels
- b - USEPA Region 5 (2003) Ecological Screening Levels (ESL) for soil

[4] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is greater than the range of detected concentrations in background surface soil samples.

[5] Represents combined SI and RI background soil sample data.

[6] USEPA EcoSSL applies to trivalent chromium (Cr III).

J - estimated
Cr VI - indicates only hexavalent chromium (Cr VI) is bioaccumulative
MHg - indicates only methylmercury is bioaccumulative
NA - Not Available
Max - maximum detected concentration
BG - range of detected concentrations in background surface soil samples

Table 6-14A: Selection of COPECs in MRS 07 Surface Soil: Plants and Soil Invertebrates

Detected Chemicals	Surface Soil Data Summary [1]		TRV [2]				COPEC? [3]	Rationale	Background Surface Soil Samples [4]
	Frequency of Detection	Range of Detected Concentrations	Terrestrial Plants		Soil Invertebrates				Range of Detected Concentrations
		(mg/kg)	(mg/kg)	basis	(mg/kg)	basis	[Y/N]		(mg/kg)
Barium	10 / 10	29.6 J - 480	500	c	330	a	Y	Max > TRV, BG	118 J - 130 J
Chromium [5]	10 / 10	8.0 J - 22.5 J	1	c	0.4	b	Y	Max > TRVs, BG	12.9 J - 15.9 J
Copper	10 / 10	109 J - 225 J	70	a	80	a	Y	Max > TRVs, BG	125 J - 136 J
Lead	10 / 10	3.4 J - 69 J	120	a	1,700	a	N	Max < TRVs	4.57 J - 5.35 J
Mercury [6]	9 / 10	0.0101 J - 0.052 J	0.3	c	0.1	b	N	Max < TRVs	0.0255 J - 0.0314 J
Zinc	10 / 10	51.7 J - 190 J	160	a	120	a	Y	Max > TRVs, BG	60 J - 77.6 J

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] TRVs were selected from the following hierarchy of sources:

- a - USEPA (2011b) Ecological Soil Screening Levels
- b - USEPA Region 5 (2003) Ecological Screening Levels (ESL) for soil
- c - Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Plants (Efroymson, et al., 1997)

[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is also greater than the range of detected concentrations in background surface soil samples.

[4] Represents combined SI and RI background soil sample data.

[5] TRV applies to total chromium.

[6] ONRL benchmark applies to elemental mercury. USEPA Region 5 ESL applies to total mercury.

J - estimated

Max - maximum detected concentration

BG - range of detected concentrations in background surface soil samples

Table 6-14B: Selection of COPECs in MRS 07 Surface Soil: Birds and Mammals

Detected Chemicals	Surface Soil Data Summary [1] Frequency of Detection	Surface Soil Data Summary [1] Range of Detected Concentrations (mg/kg)	Bioaccumulative [2]	TRV [3] Birds (mg/kg)	TRV [3] Birds basis	TRV [3] Mammals (mg/kg)	TRV [3] Mammals basis	COPEC? [4] [Y/N]	Rationale	Background Surface Soil Samples [5] Range of Detected Concentrations (mg/kg)
Barium	10 / 10	29.6 J - 480	N	NA		2,000	a	Y	No TRV, Max> BG	118 J - 130 J
Chromium [6]	10 / 10	8.0 J - 22.5 J	Cr VI	26	a	34	a	N	Max < TRVs	12.9 J - 15.9 J
Copper	10 / 10	109 J - 225 J	Y	28	a	49	a	Y	Max > TRVs, BG	125 J - 136 J
Lead	10 / 10	3.4 J - 69 J	Y	11	a	56	a	Y	Max > TRVs, BG	4.57 J - 5.35 J
Mercury	9 / 10	0.0101 J - 0.052 J	MHg	NA		NA		Y	No TRV, Max > BG	0.0255 J - 0.0314 J
Zinc	10 / 10	51.7 J - 190 J	Y	46	a	79	a	Y	Max > TRVs, BG	60 J - 77.6 J

Notes

Surface soil samples were also analyzed for explosives, but no explosive compounds were detected.

[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) surface soil data.

[2] Chemicals considered bioaccumulative are those listed in Table 4-2, Important Bioaccumulative Compounds in USEPA, 2000.

[3] TRVs were selected from the following hierarchy of sources:

a - USEPA (2011b) Ecological Soil Screening Levels

[4] A chemical is identified as a COPEC where the maximum detected concentration is greater than one or both TRVs and is also greater than the range of detected concentrations in background surface soil samples.

[5] Represents combined SI and RI background soil sample data.

[6] USEPA EcoSSL applies to trivalent chromium (Cr III).

J - estimated

Cr VI - indicates only hexavalent chromium (Cr VI) is bioaccumulative

MHg - indicates only methylmercury is bioaccumulative

Max - maximum detected concentration

BG - range of detected concentrations in background surface soil samples

NA - Not Available

6.2.3.1.8 Selection of COPECs in Sediment

6.2.3.1.8.1 Tables 6-15 to 6-17 present a sediment data summary and the selection of COPECs for MRSs 04, 05, and 07. The following summarizes the COPECs identified in sediment at each MRS.

6.2.3.1.8.2 *MRS 04 – Flamenco Lagoon Maneuver Area*
As shown in Table 6-15, the following MC were identified as COPECs in sediment at MRS 04, because their maximum detected concentrations are greater than chemical-specific TELs: copper, lead, and mercury.

6.2.3.1.8.3 *MRS 05 – Mortar and Combat Range Area*
Table 6-16 presents the data from the two lagoon sediment samples separately from the single sediment sample from the perennial stream. The following MC were identified as COPECs in lagoon sediments at MRS 05, because their maximum detected concentrations are greater than chemical-specific TELs: barium and copper. Copper was also identified as a COPEC in the stream sediment samples from MRS 05, because the maximum concentration is greater than the chemical-specific TEL. Barium was also identified as a COPEC in the stream sediment sample from MRS 05, based on the lack of applicable freshwater sediment TRVs.

6.2.3.1.8.4 *MRS 07 – Culebrita Artillery Impact Area*
As shown in Table 6-17, the following MC were identified as COPECs in sediment at MRS 07, because their maximum detected concentrations are greater than chemical-specific TELs: barium and copper.

Table 6-15: Summary of MRS 04 Sediment Data and Identification of COPECs

	Lagoon Sediment Data Summary [1]		TRV [2]		COPEC? [3]
Detected Chemicals	Frequency of Detection	Range of Detected Concentrations	TEL	PEL	
		(mg/kg)	(mg/kg)	(mg/kg)	[Y/N]
Barium	4 / 5	21.2 J - 81	130	NA	N
Chromium	4 / 5	5.8 - 12.1	52	160	N
Copper	4 / 5	2.94 - 120	19	108	Y
Lead	2 / 5	5.8 - 159	30	112	Y
Mercury	2 / 5	0.013 J - 0.227 J	0.1	0.7	Y
Zinc	4 / 5	3.65 - 95.5	124	271	N

Notes
Sediment samples were also analyzed for explosives, but no explosive compounds were detected.
[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) sediment data.
[2] TRVs are threshold effects levels (TEL) and probable effects levels (PEL) for marine sediments (Buchman, M.F., 2008).
[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than the TEL.
J - estimated
NA - not available

Table 6-16: Summary of MRS 05 Sediment Data and Identification of COPECs

Detected Chemicals	Lagoon Sediment Data Summary [1] Frequency of Detection	Range of Detected Concentrations	TRV [2] TEL	PEL	COPEC? [3]
		(mg/kg)	(mg/kg)	(mg/kg)	[Y/N]
Barium	2 / 2	29 - 196 J	130	NA	Y
Chromium	2 / 2	7.7 - 14.3 J	52	160	N
Copper	2 / 2	22 - 149 J	19	108	Y
Lead	2 / 2	2.5 - 6.29	30	112	N
Mercury	2 / 2	0.00818 - 0.013 J	0.1	0.7	N
Zinc	2 / 2	32 J - 68.7 J	124	271	N

Detected Chemicals	Stream Sediment Data Summary [1] Frequency of Detection	Range of Detected Concentrations	Freshwater Sediment TRV [2] TEL	PEL	COPEC? [3]
		(mg/kg)	(mg/kg)	(mg/kg)	[Y/N]
Barium	1 / 1	175 J	NA	NA	Y
Chromium	1 / 1	13.3 J	37.3	90	N
Copper	1 / 1	130 J	35.7	197	Y
Lead	1 / 1	5.56	35	91.3	N
Mercury	1 / 1	0.0129	0.174	0.486	N
Zinc	1 / 1	73.3 J	123	315	N

Notes

Sediment samples were also analyzed for explosives, but no explosive compounds were detected.
[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) sediment data.
[2] TRVs for lagoon sediments are threshold effects levels (TEL) and probable effects levels (PEL) for marine sediments. TRVs for stream sediments are TELs and PELs for freshwater sediments. (Buchman, M.F., 2008).
[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than the TEL or ERL.
J - estimated
NA - not available

Table 6-17: Summary of MRS 07 Sediment Data and Identification of COPECs

Detected Chemicals	Lagoon Sediment Data Summary [1] Frequency of Detection	Range of Detected Concentrations	TRV [2] TEL	PEL	COPEC? [3]
		(mg/kg)	(mg/kg)	(mg/kg)	[Y/N]
Barium	3 / 3	16 - 369 J	130	NA	Y
Chromium	3 / 3	2.69 J - 12.6 J	52	160	N
Copper	3 / 3	6.7 - 151 J	19	108	Y
Lead	2 / 3	1.9 - 20.1 J	30	112	N
Zinc	3 / 3	5.0 J - 115 J	124	271	N

Notes
Sediment samples were also analyzed for explosives, but no explosive compounds were detected.
[1] Represents combined summary of Site Investigation (SI) and Remedial Investigation (RI) sediment data.
[2] TRVs are threshold effects levels (TEL) and probable effects levels (PEL) for marine sediments (Buchman, M.F., 2008).
[3] A chemical is identified as a COPEC where the maximum detected concentration is greater than the TEL.
J - estimated
NA - not available

6.2.3.1.9 Risk Characterization

Risk characterization involves risk estimation and risk description. Exposure and effects information are integrated to evaluate the potential for adverse health effects associated with exposure to the identified COPECs. The risk characterization notes some of the assumptions used in this SLERA, as well as sources of uncertainty, because the SLERA process relies on certain assumptions that warrant documentation.

6.2.3.1.10 Screening-Level Risk Calculations for COPECs in Surface Soil

6.2.3.1.10.1 The potential for adverse health effects from exposure to the COPECs identified in surface soil is characterized by calculating an ecological HQ, which is the ratio of the estimated exposure (i.e., soil concentration) to the corresponding chemical-specific TRV. In this SLERA, maximum detected concentrations were used as conservative estimates of exposure; it is not likely that MC would be present across an MRS at concentrations equivalent to the maximum detected concentration. An HQ greater than 1 indicates a potential for adverse health effects from exposure to that COPEC. According to the USEPA (1997), an HQ less than 1 does not indicate the absence of ecological risk. Rather, the potential for ecological risk "should be interpreted based on the severity of the effect reported and the magnitude of the calculated quotient" (USEPA, 1997).

6.2.3.1.10.2 Tables 6-18 to 6-22 present the HQs calculated for the COPECs identified in surface soil at each MRS. As shown, most of the HQs are between 1 and 10, indicating the maximum detected MC concentrations are typically within an order of magnitude of the TRVs used to indicate the potential for adverse health effects in terrestrial receptors.

6.2.3.1.10.3 Chromium is the only COPEC in surface soil with consistently elevated HQs relative to 1. The HQs for chromium calculated using TRVs protective of adverse health effects in terrestrial plants and soil invertebrates are particularly elevated (i.e., greater than 10), which may be a function of the low TRVs (i.e., 1 mg/kg for plants and 0.4 mg/kg for invertebrates). In fact, a potential for adverse health effects in terrestrial plants and soil invertebrates would be indicated using even the minimum chromium concentration detected in background soil samples from each MRS as the exposure estimate in the HQ calculation. This reflects the conservative nature of the TRVs used in screening-level assessments and reinforces the concept that HQs are indicative of the potential for, but are not predictors of, adverse health effects.

6.2.3.1.10.4 At MRS 02 (Cerro Balcon), chromium concentrations in the soil samples collected by Ellis were 40, 42, 49, 53, and 110 mg/kg; all were greater than TRVs for plants, soil invertebrates, birds (26 mg/kg), and mammals (34 mg/kg). Antimony concentrations in the five soil samples ranged from 1-2 mg/kg, demonstrating little variability in concentration, yet all were greater than the TRV for mammals (0.27 mg/kg). Copper concentrations ranged from 91-110 mg/kg, also demonstrating little variability, yet all were greater than the TRVs for plants (70 mg/kg), soil invertebrates (80 mg/kg), birds (28 mg/kg) and mammals (49 mg/kg). Four of the five detected zinc concentrations ranged from 52-68 mg/kg, and the greatest concentration was 130 mg/kg. All zinc concentrations were greater than the TRV for birds (46 mg/kg) but less than the TRV for plants (160 mg/kg). The geospatial distribution of the Ellis soil samples, the reliability of the analytical data, and background metals concentrations at MRS 02 (Cerro Balcon) are unknown. The potential for ecological risk is indicated by the calculated HQs for antimony, chromium, copper, and zinc. Relatively elevated concentrations of chromium and zinc may be present in isolated areas. However, as there is little variability in most detected metals concentrations, MRS 02 (Cerro Balcon) soil samples may largely reflect background conditions.

6.2.3.1.10.5 There is also little variability in concentrations of chromium and copper detected in the five soil samples collected by Ellis at MRS 02 (Cayo Lobo). Yet all chromium concentrations (19-30 mg/kg) were greater than the TRVs for plants and soil invertebrates, and three of the five concentrations were greater than the TRV for birds. All copper concentrations (58-83 mg/kg) were greater than the TRVs for birds and mammals, three of the five were greater than the TRV for plants, but only one was greater than the TRV for soil invertebrates. Four of the five zinc concentrations ranged from 43-83 mg/kg, and the greatest concentration was 150 mg/kg. Three of these zinc concentrations were greater than the TRV for birds, but all were less than the TRV for plants. The geospatial distribution of the Ellis soil samples, the reliability of the analytical data, and background metals concentrations at MRS 02 (Cayo Lobo) are unknown. The potential for ecological risk is indicated by the calculated HQs for chromium, copper, and zinc. Relatively elevated concentrations of zinc may be present in isolated areas. However, as there is little variability in most of the detected metals concentrations, the MRS 02 (Cayo Lobo) soil samples may also reflect background conditions.

6.2.3.1.10.6 At MRS 04, the range of chromium concentrations detected in surface soil (2.83-14.7 mg/kg) is similar to that found in background soil samples (2.74-14.2 mg/kg). Detected copper concentrations (3.05-61.8 mg/kg) were also less than or similar to background concentrations (39.7-60.3 mg/kg). Zinc concentrations in six of the seven samples were less than or within background concentrations (33-71.9 mg/kg), and only one concentration (117 mg/kg) was greater than the maximum background concentration and the TRVs for birds and mammals. The potential for ecological risk is indicated by the calculated HQs for chromium, copper, and zinc. However, detected metals concentrations in surface soil at MRS 04 are not likely attributable to historic munitions and may instead reflect background conditions.

6.2.3.1.10.7 At MRS 05, chromium concentrations in five of the six soil samples collected during the SI ranged from 2.8-18 mg/kg, with the greatest concentration (150 mg/kg) detected in sample CUL-05-SS-06-18. Chromium concentrations in the RI soil samples ranged from 8.26-63.6 mg/kg, with the maximum concentration detected in CI-MRS05-SS-05. The next three highest concentrations were only slightly elevated relative to the range of background concentrations (11.5-14.3 mg/kg) and were detected in the following samples: CI-MRS05-SS-11 (26.9 mg/kg), CI-MRS05-SS-06 (23.7 mg/kg), and CI-MRS05-SS-13 (23.5 mg/kg). Three of the five aforementioned samples were collected at locations just southeast of Cerro Balcon. The other two samples (CI-MRS05-SS-11 and CI-MRS05-SS-13) were collected in the south and west of the MRS, respectively. Overall, the majority of chromium concentrations were within or near the range of background, but elevated concentrations may be present at sporadic locations across the MRS. Similar observations can be made for barium, copper, and lead. While a few relatively elevated concentrations of these metals were detected in MRS 05 surface soil, 15 of 20 detected concentrations of barium and copper, and 16 of 20 detected lead concentrations, were within or less than the range of background concentrations.

6.2.3.1.10.8 At MRS 07, the maximum chromium concentration (22.5 mg/kg) detected in surface soil was only slightly elevated relative to the range of concentrations in background samples (12.9-15.9 mg/kg), while seven of ten chromium concentrations were within the range of background. Only one (480 mg/kg) barium concentration exceeded any of the TRVs (330 mg/kg for soil invertebrates). While the range of copper concentrations (109-225 mg/kg) was greater than all TRVs, there was little variability in concentrations, and background concentrations ranged from 125-136 mg/kg. Lead concentrations were also generally greater than background, yet only four of ten were greater than the TRV for birds (11 mg/kg), only one was greater than the TRV for mammals (56 mg/kg), and none was greater than the TRVs for plants or soil invertebrates. Six of ten zinc concentrations were within the range of background; all were greater than the TRV for birds but only one (190 mg/kg) was greater than the TRV for plants.

Table 6-18: Calculation of Hazard Quotients for COPECs in MRS 02 (Cerro Balcon) Surface Soil

Detected Chemicals	Hazard Quotient (HQ) [1]			
	Terrestrial Plants	Soil Invertebrates	Birds	Mammals
Antimony	--	--	NA	7
Barium	--	--	NA	--
Chromium [2]	110	275	4	3
Copper	2	1	4	2
Lead	--	--	--	--
Mercury	--	--	NA	NA
Zinc	--	1	3	2

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the chemical-specific TRV.
[2] HQ was calculated using the TRV for total chromium (plants and soil invertebrates) or trivalent chromium (Cr III) (birds and mammals).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - chemical-specific TRV was not available for this COPEC

Table 6-19: Calculation of Hazard Quotients for COPECs in MRS 02 (cays) Surface Soil

Detected Chemicals	Hazard Quotient (HQ) [1]		
	Terrestrial Plants	Soil Invertebrates	Birds
Antimony	--	--	NA
Barium	--	--	NA
Chromium [2]	30	75	1
Copper	1	1	3
Lead	--	--	--
Mercury	--	--	NA
Zinc	--	1	3

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the chemical-specific TRV.
[2] HQ was calculated using the TRV for total chromium (plants and soil invertebrates) or trivalent chromium (Cr III) (birds).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - chemical-specific TRV was not available for this COPEC

Table 6-20: Calculation of Hazard Quotients for COPECs in MRS 04

Detected Chemicals	Hazard Quotient (HQ) [1]			
	Terrestrial Plants	Soil Invertebrates	Birds	Mammals
Barium	--	--	NA	--
Chromium [2]	15	37	--	--
Copper	--	--	2	1
Lead	--	--	--	--
Mercury	--	--	NA	NA
Zinc	--	--	3	1

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the chemical-specific TRV.
[2] HQ was calculated using the TRV for total chromium (plants and soil invertebrates) or trivalent chromium (Cr III) (birds and mammals).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - chemical-specific TRV was not available for this COPEC

Table 6-21: Calculation of Hazard Quotients for COPECs in MRS 05

Detected Chemicals	Hazard Quotient (HQ) [1]			
	Terrestrial Plants	Soil Invertebrates	Birds	Mammals
Barium	3	4	NA	--
Chromium [2]	150	375	6	4
Copper	2	2	6	3
Lead	--	--	1	--
Mercury	--	--	NA	NA
Zinc	--	--	--	--

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the chemical-specific (TRV).
[2] HQ was calculated using the TRV for total chromium (plants and soil invertebrates) or trivalent chromium (Cr III) (birds and mammals).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - chemical-specific TRV was not available for this COPEC

Table 6-22: Calculation of Hazard Quotients for COPECs in MRS 07

Detected Chemicals	Hazard Quotient (HQ) [1]			
	Terrestrial Plants	Soil Invertebrates	Birds	Mammals
Barium	--	1	NA	--
Chromium [2]	23	56	--	--
Copper	3	3	8	5
Lead	--	--	6	1
Mercury	--	--	NA	NA
Zinc	1	2	4	2

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the chemical-specific (TRV).
[2] HQ was calculated using the TRV for total chromium (plants and soil invertebrates) or trivalent chromium (Cr III) (birds and mammals).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - chemical-specific TRV was not available for this COPEC

6.2.3.1.11 Screening-Level Risk Calculations for COPECs in Sediment

6.2.3.1.11.1 Tables 6-23 to 6-25 present the HQs calculated for the COPECs identified in sediment at MRSs 04, 05, and 07. HQs were calculated as the ratio of the maximum detected concentration to the corresponding TEL and PEL. As stated above, adverse health effects in sediment-associated biota are not expected from exposure to concentrations less than the TEL, while PELs are concentration levels above which adverse health effects are likely to occur (Long and MacDonald, 1998).

6.2.3.1.11.2 As shown in Tables 6-23 to 6-25, HQs calculated using the TELs as the more conservative TRVs are greater than 1 but less than 10. HQs calculated using the PELs are 1, indicating a potential for risk of adverse health effects in aquatic receptors.

6.2.3.1.11.3 At MRS 04, three of the five detected copper concentrations were greater than the TEL but only one was greater than the PEL. Lead was detected in three of the five sediment samples, but only one concentration was greater than the TEL or PEL. Mercury was also detected in three of the five sediment samples, and only one concentration was greater than the TEL, but this concentration was less than the PEL. The greatest copper, lead, and mercury concentrations were detected in sample CI-MRS04-SD-01, indicating this area may contain elevated MC concentrations but that other areas sampled are less likely to contain MC at concentrations that would result in adverse ecological effects. No background sediment data are available for comparison.

6.2.3.1.11.4 At MRS 05, barium and copper concentrations exceeded the TRVs in only one of the two samples collected from lagoon sediments. Detected barium and copper concentrations in the RI sample (CI-MRS05-SD-01) were approximately seven times greater than those detected in the SI sample (CUL-05-SE-06-01), indicating this area may contain elevated MC concentrations. However, the MRS 05 sediment data evaluation is limited by the number of samples, and no background sediment data are available for comparison. The detected copper concentration in the single sediment sample from the perennial stream was greater than the TEL but less than the PEL. No freshwater sediment TRVs were available to evaluate barium concentrations.

6.2.3.1.11.5 At MRS 07, barium and copper concentrations exceeded the TRVs in only one of the three samples collected from lagoon sediments. Detected barium and copper concentrations in this sample (CI-MRS07-SD-01) were an order of magnitude greater than concentrations detected in the other two samples, indicating this area may contain elevated MC concentrations. However, the sediment data evaluation is limited by the number of samples, and no background sediment data are available for comparison.

Table 6-23: Calculation of Hazard Quotients for COPECs in MRS 04 Sediment

Detected Chemicals	Lagoon Sediment Hazard Quotient (HQ) [1] TEL-based	PEL-based
Barium	--	--
Chromium	--	--
Copper	6	1
Lead	5	1
Mercury	2	--
Zinc	--	--

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the threshold effects level (TEL) or probable effects level (PEL).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor

Table 6-24: Calculation of Hazard Quotients for COPECs in MRS 05 Sediment

Detected Chemicals	Lagoon Sediment Hazard Quotient (HQ) [1] TEL-based	PEL-based
Barium	2	NA
Chromium	--	--
Copper	8	1
Lead	--	--
Mercury	--	--
Zinc	--	--

Detected Chemicals	Stream Sediment HQs [1] TEL-based	PEL-based
Barium	NA	NA
Chromium	--	--
Copper	4	--
Lead	--	--
Mercury	--	--
Zinc	--	--

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the threshold effects level (TEL) or probable effects level (PEL).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - PEL not available

Table 6-25: Calculation of Hazard Quotients for COPECs in MRS 07 Sediment

Detected Chemicals	Lagoon Sediment Hazard Quotient (HQ) [1] TEL-based	PEL-based
Barium	3	NA
Chromium	--	--
Copper	8	1
Lead	--	--
Zinc	--	--

Notes
[1] The HQ was calculated as the ratio of the maximum detected concentration to the threshold effects level (TEL) or probable effects level (PEL).
COPEC - chemical of potential ecological concern
-- not a COPEC for this receptor
NA - PEL not available

6.2.3.1.12 Uncertainty Evaluation

6.2.3.1.12.1 Uncertainties in the SLERA process are related to environmental sampling, assumptions regarding the potential exposure of ecological receptors, and the TRVs used to select COPECs and calculate HQs.

6.2.3.1.12.2 A basic assumption underlying this SLERA is that the available surface soil and sediment data adequately characterize environmental conditions and the potential for MC to be present at each MRS. However, there are always some uncertainties associated with environmental sampling and analysis. Sources of uncertainty specific to this RI (e.g., composite soil sampling method, data gaps due to access restrictions, the use of Ellis samples to represent MRS 02 soil, and the lack of sediment samples from MRS 02) are noted in Section 6.2.2.5. The extent to which the MC sampling represents exposure conditions is not known, and the potential for adverse ecological effects may be over- or understated to an unknown degree.

6.2.3.1.12.3 Non-detect chemicals were not evaluated as COPECs in this SLERA, as their presence and concentration in soil or sediment has not been confirmed. Explosive compounds that were analyzed for but not detected in soil or sediment samples may be present at an unknown concentration somewhere between the sample reporting limit and zero. Reporting limits for non-detect explosives were therefore compared to TRVs, as available, to evaluate whether non-detect explosives may be present at concentrations that pose ecological health risks. Of the soil and sediment samples collected for this RI, reporting limits for most explosives were 5 mg/kg, while reporting limits for 3,5-dinitroaniline, nitroglycerin, and PETN were 1 mg/kg. The ORNL (2012) ecological benchmark search tool revealed the only readily-available sources of TRVs for any non-detect explosives are USEPA Region 5 ESLs for soil and sediment and USEPA Region 3 freshwater sediment screening benchmarks (USEPA, 2006). At least one TRV (i.e., for soil or sediment from either source) was available for seven of the sixteen total non-detect explosives. In all cases, reporting limits were greater than available TRVs. However, TRVs for explosives are also available from Los Alamos National Laboratory (LANL) EcoRisk Database, Release 3.1 (LANL, 2012). TRVS are available for fourteen of the sixteen non-detect explosives. For all but four of these fourteen, reporting limits were less than the lowest available no effect-based TRV. Reporting limits for 2,4-dinitrotoluene, 2,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, and tetryl were greater than the lowest no effect-based TRV but less than the greatest no effect-based TRV. This is a source of uncertainty in the SLERA, as in most cases, explosives are likely either non-detect or present at concentrations less than no-effect based TRVs, but some explosives may be present at concentrations in soil or sediment that pose ecological health risks.

6.2.3.1.12.4 For chemicals identified as COPECs, the SLERA necessarily overestimates the potential for risk of adverse health effects by making conservative assumptions about the potential for ecological exposure. These assumptions include:

- Ecological receptors forage exclusively within the immediate MRS vicinity and are exposed to the COPEC present in surface soil/sediment on a daily basis. This is an especially conservative assumption for evaluating receptors with large home ranges.
- Each COPEC is present at a concentration equal to its maximum detected concentration. This is unlikely because the COPECs are not likely present across each MRS at concentrations equivalent to the maximum detected concentrations.
- The COPECs are 100% bioavailable in soil and sediment.

6.2.3.1.12.5 The potential for adverse health effects was not specifically evaluated for fish or aquatic/semi-aquatic birds and mammals that may be exposed to MC in sediment. The TELs used to identify COPECs in sediment are protective of adverse effects in sediment-associated biota and do not consider effects on upper trophic level receptors. This contributes to decision uncertainty in the SLERA, as the potential for adverse health effects from exposure to bioaccumulative metals detected in sediment was not evaluated.

6.2.3.1.12.6 Sources of uncertainty in the TRVs used to select COPECs and calculate HQs stem mostly from differences in their derivation. In some cases, the TRVs were derived using clinical dose-response trials with laboratory animals under controlled environmental conditions. Differences in toxicity may exist between laboratory animals and wildlife. Additionally, toxicity values from various sources can differ by orders of magnitude for the same chemical, depending on the test species used and the type of trial conducted. The use of TRVs from multiple sources, depending on their availability, may limit the comparability of HQs for a single receptor. The usefulness of TRVs as indicators of potential ecological risk is limited in cases where TRVs are exceeded by background concentrations. Lastly, the lack of TRVs for some detected chemicals contributes to immeasurable uncertainty in either direction.

6.2.3.1.12.7 TRVs were not available to evaluate the potential for ecological risk from exposure to mercury in surface soil. Therefore, the potential for adverse effects in terrestrial wildlife from exposure to mercury in soil was not quantitatively evaluated in this SLERA. The following sections provide a brief summary of information on the environmental transport and potential ecotoxicity of mercury.

6.2.3.1.12.8 *Mercury*

Inorganic mercury can be methylated by microorganisms indigenous to soils, fresh water, and salt water. Two transformation processes of mercury in surface waters are biotransformation and bioaccumulation. Methylmercury in surface waters is rapidly accumulated by aquatic organisms.

6.2.3.1.12.9 Mercury compounds in soils may undergo the same chemical and biological transformations described for surface waters. Mercuric mercury usually forms complexes with chloride and hydroxide ions in soils, the specific complexes formed being dependent on the pH, salt content, and composition of the soil solution.

6.2.3.1.12.10 Numerous animal studies have determined the health effects from breathing and ingesting mercury. Effects from breathing metallic mercury range from lung, kidney, heart, stomach, liver damage, and possible damage to brain tissue in rabbits, to lung and liver disease in rabbits, decrease in number of fertile female rats over time, and shakiness, and temporary learning disability in rats. Effects from drinking inorganic mercury range from death in both young rats and developing young in pregnant hamsters, to weight loss, possible lowering of immune system, behavioral changes in mice, and kidney disease in rats.

6.2.3.1.12.11 From eating and drinking organic mercury, long-term health effects in animals include kidney disease in rats, brain damage and weakness in kittens, and liver damage in the developing young of pregnant rats. Studies have shown that short-term effects from drinking organic mercury include behavior problems in offspring of exposed mothers in rats, male infertility, and brain cell death in rabbits.

6.2.3.1.13 SLERA Conclusions

6.2.3.1.13.1 USEPA (1997) guidance indicates that following the screening-level risk calculation, a decision point is reached where it is determined which of these three statements applies:

- The potential for adverse health effects in ecological receptors is negligible and there is no need for remediation on the basis of ecological risk.
- There is inadequate information and the ecological risk assessment process should continue.
- There is the potential for adverse ecological effects and a more thorough assessment is warranted.

6.2.3.1.13.2 Based on the evaluation presented herein and considering the magnitude of the calculated HQs, the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (cays), MRS 04, and MRS 07 is negligible; no soil remediation on the basis of ecological risk is warranted.

6.2.3.1.13.3 The potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (Cerro Balcon) and MRS 05 is low. Specifically, the HQs for chromium, calculated using TRVs protective of adverse health effects in terrestrial plants and soil invertebrates, were particularly elevated (i.e., greater than 10). Further evaluation of the MRS 02 data indicated relatively elevated concentrations of chromium and zinc may be present in isolated areas. However, as there is little variability in most detected metals concentrations, MRS 02 (Cerro Balcon) soil samples may largely reflect background conditions. Similarly, elevated metals concentrations may be present at sporadic locations in surface soil across MRS 05, but the majority of detected concentrations likely reflect background conditions.

6.2.3.1.13.4 Regardless of the possible distribution of chromium at each MRS, the potential for risk of adverse health effects was qualified “low” considering that the TRVs for terrestrial plants and soil invertebrates are exceptionally low, such that a potential for risk would also be indicated using the minimum detected background concentrations in surface soil. The HQs are not predictors of adverse health effects but are meant to indicate the potential for adverse health effects. The actual toxicity of a metal is a function of its bioavailability, its chemical form, and the exposure time of the receptor, among other factors. This SLERA assumes the MC are 100% bioavailable and necessarily overestimates exposure by using the maximum detected concentration as the exposure concentration. It is more likely that MC are present across each MRS at concentrations reflective of background. Therefore, no soil remediation on the basis of ecological risk is warranted.

6.2.3.1.13.5 Based on evaluation of the available sediment data from MRSs 04, 05, and 07, a potential for risk of adverse health effects in aquatic receptors is indicated. HQs based on comparison of maximum concentrations to TELs, and assuming 100% bioavailability, are greater than 1 for barium, copper, lead, and mercury in sediment of least one MRS. HQs based on comparison of maximum concentrations to PELs are equal to 1. Given the limited data sets used to evaluate sediment conditions at MRS 04, MRS 05, and MRS 07, the lack of sediment data from MRS 02, and uncertainty associated with limiting the sediment data evaluation to effects on sediment-associated biota, further ecological evaluation of sediment may be warranted in the future. However, there is no conclusive evidence that suggests a current impact or threat to health of aquatic receptors. At this time remediation on the basis of ecological risk is not recommended.

6.3 HAZARD ASSESSMENT FOR MEC

6.3.1 Munitions Response Site Prioritization Protocol

6.3.1.1 The Munitions Response Site Prioritization Protocol (MRSPP) is a method for assigning a relative priority for response actions to defense sites containing military munitions. It was developed in three modules to evaluate the unique hazards posed by UXO, Discarded Military Munitions (DMM), and MC.

- The Explosive Hazard Evaluation (EHE) Module provides a single approach to evaluate explosive hazards. This module is used when there is a known or suspected presence of an explosive hazard. The module considers data elements relative to three factors — explosive hazard, accessibility and potential effects on people.
- The Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE) Module evaluates the chemical hazards associated with the physiological effects of chemical warfare materiel. The CHE module is used only when chemical warfare materiel is known or suspected of being present at a MRS. This module considers data elements related to three factors — chemical warfare materiel hazard, accessibility and potential effects on people.
- The Health Hazard Evaluation (HHE) Module approach evaluates relative risk to human health and the environment posed by MC and other non-munitions-related incidental contaminants. The module considers three factors — contamination hazard factor, potential effects on people, other living things and the environment, and migration pathway.

6.3.1.2 Each of the modules is assigned a rating from G (lowest) to A (highest). Besides the ratings, there are three other possible outcomes of scoring for each module – evaluation pending (insufficient data are available to conduct the scoring), no longer required (a response has already been conducted and completed), or no known or suspected hazard. Based on the results of scoring the three modules, each MRS is assigned one of eight priorities, where Priority 1 indicates the highest potential hazard and Priority 8 indicates the lowest potential hazard.

6.3.1.3 An MRSPP was prepared for MRSs in Culebra as part of the 2007 MMRP SI. Since additional data were collected, the MRSPP provided in the SI Report was re-evaluated and updated in this RI Report to reflect the current understanding of site conditions. For the HHE module RI sampling results were utilized in conjunction with SI surface soil and sediment sampling results for MRS 04, MRS 05, and MRS 07. Surface soil sampling results from 2006 pre-detonation surface soils samples taken during removal action activities at Cerro Balcon and Cayo Lobo were used in the HHE module for MRS 02. The latest version of the MRSPP worksheets was utilized. Table 6-26 provides a summary of the revised MRSPP results for MRS 02, MRS 04, MRS 05, and MRS 07. The MRSPPs for the MRSs is provided in Appendix F.

Table 6-26: Summary of Revised MRSPP

MRS	EHE Rating	CHE Rating	HHE Rating	Overall Site Rating/Priority
02	B	No known or suspected CWM hazard	G	3
04	C	No known or suspected CWM hazard	G	4
05	C	No known or suspected CWM hazard	G	4
07	B	No known or suspected CWM hazard	G	3

Note: CHE – Chemical Hazard Evaluation
EHE – Explosive Hazard Evaluation
HHE – Health Hazard Evaluation

6.3.2 Baseline Munitions and Explosives of Concern Hazard Assessment

A baseline MEC HA was completed for MRS 02, MRS 04, MRS 05, and MRS 07 using the MEC HA guidance and accompanying automated scoring worksheets (Appendix E). The MEC HA presents a number of input factors that are scored based on current site conditions (baseline) and rescored based on proposed remedial alternatives. Based on the input factors for each MRS, the scoring worksheets generate a score for the site based on a sum of the scores determined for each input factor. The sum of the input factor scores falls within one of four hazard levels (1–4). The following description of each hazard level is summarized from the Interim MEC HA Methodology:

6.3.2.1 Hazard Level Descriptions

6.3.2.1.1 **Hazard Level 1**

This category identifies sites with the highest potential explosive hazard conditions. There may be instances where there is an imminent threat to human health from MEC. This hazard may be so obvious that an emergency response is appropriate without calculating a MEC HA.

6.3.2.1.2 Typical characteristics of a Hazard Level 1 site condition include a combination of the following:

- HE-filled UXO, usually "Sensitive UXO" on the surface;
- A former target area or Open Burn/Open Detonation (OB/OD) area;
- An MRS with full or moderate accessibility;
- Has the presence of additional human receptors inside the MRS or Explosive Safety Quantity Distance;
- May include subsurface MEC with intrusive activities to the depth of subsurface MEC; and
- An MRS that has not undergone a cleanup.

6.3.2.1.3 **Hazard Level 2**

This Hazard Level identifies MRS with high potential explosive hazard conditions. Typical characteristics of a Hazard Level 2 MRS include the following:

- Former target area, OB/OD area, function test range, or maneuver area;
- UXO, or Fuzed Sensitive DMM on the surface, or intrusive activities that overlap with minimum depths of UXO or Fuzed Sensitive DMM located only subsurface; and
- Has full or moderate accessibility to people who will engage in intrusive activities.

6.3.2.1.4 **Hazard Level 3**

This Hazard level identifies MRS with moderate potential explosive hazard conditions. Typical characteristics of a Hazard Level 3 MRS include the following:

- DMM on the surface, or intrusive activities that overlap with minimum depths of DMM located only subsurface;
- Former target area, OB/OD area, function test range, or maneuver area that has undergone a surface cleanup; and
- An MRS with moderate or limited accessibility, and a low number of contact hours.

6.3.2.1.5 **Hazard Level 4**

This Hazard Level identifies MRS with low potential explosive hazard conditions. The presence of MEC at an MRS means that an explosive hazard may exist.

Therefore, MEC may still pose a hazard at a Hazard Level 4 MRS. Typical characteristics of an MRS in Hazard Level 4 include the following:

- A MEC cleanup was performed or MEC is only located subsurface, below the depth of receptor intrusive activities;
- Energetic Material Type is propellant, spotting charge, or incendiary; and
- Accessibility is Limited or Very Limited, and contact hours are few or very few. This may be the result of LUCs.

6.3.2.1.6 LUCs may be required to reduce the MEC hazard level to support the reasonably anticipated land use. As an example, a MRS may be a Hazard Level 3 without LUCs but a Hazard Level 4 with LUCs.

6.3.2.2 Baseline Scoring Results

A baseline MEC HA was prepared for each MRS based on current site conditions and anticipated future activities. MEC finds from RI activities as well as previous investigations (Table 1-1) were used in the development of the MEC HAs. The MEC HA workbooks are included as Appendix E. The table below provides a summary of the MEC HA results for MRS 02, MRS 04, MRS 05, and MRS 07.

Table 6-27: Summary of Baseline MEC HA

MRS	Score	Hazard Level Category
02 Cerro Balcon	775	2
02 Adjacent Cays	680	3
04	755	2
05	795	2
07	765	2

6.3.2.3 MRS 02 – Cerro Balcon

Based upon current site conditions following the RI field effort, the Cerro Balcon portion of MRS 02 scored a 775, which corresponds to a Hazard Level 2. A Hazard Level of 2 identifies the MRS with high potential explosive hazard conditions. It is not an indication of MEC density. Major drivers for the MEC HA score include the historical range type, MEC type, and the current land use (residential). The surface clearance in this area did not significantly affect the score due to the potential for subsurface MEC within areas that have intrusive activities (residents and site workers during construction activities).

6.3.2.4 MRS 02 –Adjacent Cays

Based upon current site conditions following the RI field effort, the adjacent cays of MRS 02 scored a 680, which corresponds to a Hazard Level 3. A Hazard Level of 3 identifies the MRS with moderate potential explosive hazard conditions. It is not an indication of MEC density. Major drivers for the MEC HA score include the historical range type and the MEC finds during previous investigations.

6.3.2.5 MRS 04 – Flamenco Lagoon Maneuver Area

Based upon current site conditions following the RI field effort, MRS 04 scored a 755, which corresponds to a Hazard Level 2. A Hazard Level of 2 identifies the MRS with high potential explosive hazard conditions. It is not an indication of MEC density. Major drivers for the MEC HA score include the historical range type, MEC type, and location of MEC (surface and subsurface) and the current land use (residential).

6.3.2.6 MRS 05 – Mortar and Combat Range Area

Based upon current site conditions following the RI field effort, MRS 02 scored a 795, which corresponds to a Hazard Level 2. A Hazard Level of 2 identifies the MRS with high potential explosive hazard conditions. It is not an indication of MEC density. Major drivers for the MEC HA score include the historical range type, MEC type, and location of MEC (surface and subsurface) and the current land use (residential).

6.3.2.7 MRS 07 – Culebrita Artillery Impact Area

Based upon current site conditions following the RI field effort, MRS 07 scored a 765, which corresponds to a Hazard Level 2. A Hazard Level of 2 identifies the MRS with high potential explosive hazard conditions, which is driven primarily by the types of MEC found at the site. It is not an indication of MEC density. Major drivers for the MEC HA score include the historical range type, MEC type, and location of MEC (surface and subsurface).

6.3.3 MEC Qualitative Risk Discussion

6.3.3.1 MRS 02

6.3.3.1.1 Cerro Balcon

No MEC investigation was completed at MRS 02 Cerro Balcon during the RI due to lack of ROEs. Previous investigations in this former mortar range include the 1995 ASR (identified munitions debris), 1997 EE/CA (identified munitions debris), and the 2006 NTCRA. During the NTCRA, a full surface clearance was conducted over this site and seven munitions were identified (Table 1-1). MEC included: 3-inch projectiles, fuze with black powder, and 81 mm mortars. The 2007 SI did not conduct any activities in this area. Overall, this entire area has been surface cleared; as such, there is negligible risk for receptor interaction with MEC at the surface. Due to the limited subsurface investigation in this area and the documented presence of surface MEC and subsurface MD, in conjunction with the range type (mortar firing), MEC is likely present in the subsurface. Sufficient subsurface characterization has not been met to verify this due to the lack of ROEs at the RI phase. However, since no MEC was found during the EE/CA (surface and subsurface), or noted to date by residents of the area, it is likely that MEC is low density in the subsurface. The subsurface is considered moderate risk for receptors that engage in subsurface activities to encounter MEC, such as residents and site workers during construction.

6.3.3.1.2 Adjacent Cays

No MEC investigation was completed for any of the Cays during the RI due to accessibility issues. Multiple attempts were made to access the cays via boat, but rough seas deterred the field team's efforts. The Cays are generally difficult to access based on steep terrain and lack of landing points, as well as rough seas. As such, previous data is evaluated to consider MEC risk. Previous investigations include the 1995 ASR (identified MEC within the water and munitions debris on land), 1997 EE/CA (identified MEC and munitions debris on several cays), 2006 NTCRA at Cayo Lobo (identified surface MEC and munitions debris) and the 2007 SI (munitions debris observed from a boat along several cays). Cays at which MEC and/or MD have been identified include: Cayo Lobo, Cayo Ballena, Cayo Geniqui, and Cayo del Agua. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible by recreational users (trespassers). These cays are slightly larger than the others on which small beaches facilitate access during low tide and good weather conditions. Due to the surface clearance conducted at Cayo Lobo, risk for receptors encountering MEC at the surface is considered negligible. A data gap exists because subsurface MEC characterization is incomplete. MEC likely exists in both the surface and the subsurface based on historical use and surface data available, but there are relatively few receptors at this MRS, due to lack of accessibility. Trespassers are not anticipated to frequently engage in subsurface activities. No residents or structures are located on any of the cays. Subsurface confirmation of MEC has not been conducted. With the limited accessibility, the risk for receptors to encounter MEC on the cays is considered low.

6.3.3.1.3 MRS 04 – Flamenco Lagoon Maneuver Area

6.3.3.1.3.1 Approximately 2 miles of transects and 38 anomalies were investigated during the RI field work at MRS 04. No MEC was identified at MRS 04 during the RI; munition fragments were found at one location at a depth of 2 inches.

Previous investigations have been conducted at MRS 04 including the 1995 ASR (MD found on the surface of Flamenco Beach), 2007 SI (no MEC or MD identified), and the 2008 NTCRA at Flamenco Beach. Only one munition has been found at MRS 04, located during the 2008 NTCRA on Flamenco Beach at a depth of 2 inches.

6.3.3.1.3.2 There are large data gaps for this MRS based on lack of ROEs, and conditions related to vegetation clearing. Figure 3-2 displays the location of the RI transects and areas that ROEs were received. There is no pattern or concentration to the data to be observed; only one anomaly was characterized as MD. Although MEC has only been found on Flamenco Beach, there is not enough data collected to characterize all areas of the MRS. Overall, the data suggests that very limited MEC and/or MD are present at MRS 04. MEC risk is negligible for Flamenco Beach where the NTCRA occurred. Based on the site history, current land use and most likely future land use (although future land use is not guaranteed), and previous investigations including the RI, there is a low risk for encounters with MEC at the remainder of MRS 04.

6.3.3.1.4 MRS 05 – Mortar and Combat Range Area

6.3.3.1.4.1 Approximately 19 miles of transects and 406 anomalies were investigated during the RI field work at MRS 05. No MEC was identified during the RI; MD was found within several transects scattered throughout MRS 5. Previous investigations have been conducted at MRS 05 including the 1995 ASR (MD identified) and the 2007 SI (MD identified). No other intrusive work has been conducted at MRS 05 outside of the current RI. No MEC has ever been found or reported within this MRS.

6.3.3.1.4.2 There are data gaps for this MRS based on lack of ROEs and conditions related to vegetation clearing. Figure 3-4 displays the location of the RI transects and areas that ROEs were received. As noted by the figure, the transects for the RI were scattered over several areas of the MRS 05. There is not a specific pattern for the presence of MD; it appears to be located within most areas investigated in this RI but no high concentrations were found. Overall the data suggests that very limited MEC and/or MD are present at MRS 05. MEC presence cannot be completely discounted based on the locations of MD and lack of full characterization in areas without a ROE or that were inaccessible. Based on the site history, the current and most likely future land use (although future land use is not guaranteed), previous investigations, and RI results, there is a low risk for encounters with MEC at MRS 05.

6.3.3.1.5 MRS 07 – Culebrita Artillery Impact Area

Two munitions were found on the surface, and MD was identified at MRS 07 during the RI (figure 3-6). Additionally, MEC and MD have been found on Culebrita and Cayo Botella (Table 1-1) during previous investigations. During the 1997 EE/CA, 20 munitions were found at Cayo Botella either on the surface or within the first three inches bgs. On Culebrita, 39 munitions were found; most were found on the surface although some were found down to four inches bgs. A NTCRA (surface and subsurface) has been conducted on the beaches of MRS 07 (see figure 6-1). Twelve munitions were found on the northwest beach of Culebrita; all were located near the surface. Within these beach areas, MEC has been removed from the surface and subsurface and the risk to receptors to encounter MEC is negligible. Within the rest of Culebrita, including Cayo Botella, MEC exists on the surface and near the surface (first 4 inches). Human receptors are limited to occasional use (recreational or site work); there are no residents on MRS 07. Areas of specific use include the beaches and trails that cut through MRS 07. As such, the risk of recreational users or site workers to encounter MEC (outside of the beaches) is considered moderate to high.

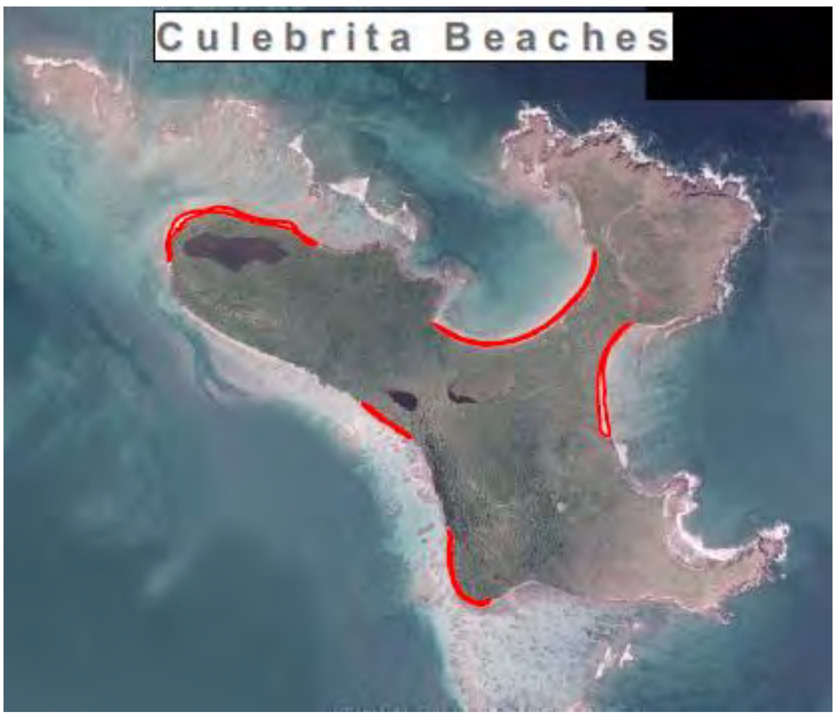


Figure 6-1: Location of NTCRA on MRS 07 during 2008

7 SUMMARY OF RESULTS

This section summarizes the results of the RI for the MRS 02, MRS 04, MRS 05, and MRS 07 and presents the conclusions based on these results.

7.1 RI FIELD WORK SUMMARY

7.1.1 RI fieldwork was conducted from 11 October 2010 to 25 March 2011, in accordance with the approved Final MMRP Work Plan (EOTI, 2010). No investigations were conducted in MRS 02 due to the lack of rights-of-entry in the Cerro Balcon area and the inability of field teams to access the cays due to steep terrain and inadequate landing points. Portions of MRS04 and MRS 05 planned for investigation were not accessible due to right-of-entry issues. As a result of changes to the CSM and DQOs, data was not collected along all originally planned transects within the USFWS areas of MRS 04, MRS 05, and MRS 07.The fieldwork included mag and dig investigations, during which surface and subsurface metallic anomalies were investigated along predefined transects throughout MRS 04, MRS 05, and MRS 07. The transects covered approximately 24 miles (123,000 ft) across the MRSs with magnetometers. In addition, four 25 x 25 foot mini-grids were investigated. One grid was located in MRS 04 and three were located in MRS 05. In total, 466 anomalies were intrusively investigated across MRS 04, MRS 05, and MRS 07.

7.1.2 A total of 28 soil samples and seven sediment samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for MC, including explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc).

7.2 MEC Conclusions

7.2.1 MRS 02 - Cerro Balcon

No MEC investigation was completed at MRS 02 Cerro Balcon during the RI due to lack of ROEs. Previous investigations in this former mortar range include the 1995 ASR (identified munitions debris), 1997 EE/CA (identified munitions debris), and the 2006 NTCRA. During the NTCRA, a full surface clearance was conducted over this site and 7 MEC items were identified. The 2007 SI did not conduct any activities in this area. Overall, this entire area has been surface cleared; as such, there is negligible risk for receptor interaction with MEC at the surface. Due to the limited subsurface investigation in this area and the documented presence of surface MEC and subsurface MD, in conjunction with the range type (mortar firing), MEC is likely present in the subsurface. Sufficient subsurface characterization has not been met to verify this due to the lack of ROE at the RI phase. However, since no MEC was found during the EE/CA (surface and subsurface), or reported to date by residents of the area, it is likely that MEC is low density in the subsurface. The MEC HA categorized this site as high risk. However, due to the completed surface clearance and likely low MEC density in the subsurface, it is a conclusion of this RI that Cerro Balcon exhibits moderate MEC risk based on receptor types, such as residents and site workers that engage in subsurface activities. Cerro Balcon should be considered separate from the Adjacent Cays based on the different receptor groups and current activities.

7.2.2 MRS 02 - Adjacent Cays

No MEC investigation was completed for any of the Cays during the RI due to accessibility issues. The Cays are difficult to access based on steep terrain and lack of boat landing points, as well as rough seas. As such, previous data is evaluated to consider MEC risk. Previous investigations include the 1995 ASR (identified MEC within the water and munitions debris on land), 1997 EE/CA (identified MEC and munitions debris on several cays), 2006 NTCRA at Cayo Lobo (identified surface MEC and munitions debris) and the 2007 SI (munitions debris observed from a boat along several cays). Cays at which MEC and/or MD have been identified include: Cayo Lobo, Cayo Ballena, Cayo Geniqui, and Cayo del Agua. Due to the surface clearance conducted at Cayo Lobo, risk for receptors encountering MEC at the surface is considered negligible. Subsurface MEC characterization is incomplete and an existing data gap for all cays. Surface characterization is also lacking for some cays. MEC likely exists in both the surface (outside of Cayo Lobo) and the subsurface for all cays based on historical use and surface data available. However, there are very few receptors at this MSR due to accessibility issues; potential exposure is extremely limited. No residents or structures are located on the cays. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible by recreational users (trespassers). These cays are slightly larger than the others on which small beaches facilitate access during low tide and good weather conditions. The MEC HA assigned a moderate risk to the Cays based on potential for access and presence of MEC. With the limited accessibility, it is a conclusion of this RI that the risk for receptors to encounter MEC on most of the cays is considered low. The risk for receptors to encounter MEC at Cayo Lobo and Yerba is considered moderate based on increased accessibility of these cays.

7.2.3 MRS 04 – Flamenco Lagoon Maneuver Area

No MEC was identified at MRS 04 during the RI; fragments were found at one location at a depth of 2 inches. Previous investigations have been conducted at MRS 04 including the 1995 ASR (MD found on the surface of Flamenco Beach), 2007 SI (no MEC or MD identified), and the 2008 NTCRA at Flamenco Beach. Only one MEC item has been found at MRS 04, located during the 2008 NTCA on Flamenco Beach at a depth of 2 inches. There are large data gaps for this MRS based on lack of ROEs, and areas of thick vegetation with steep terrain that created inaccessible areas. From the data collected, there is no pattern or concentration to the data; only one anomaly was characterized as MD. Although MEC has only been found on Flamenco Beach, there is not enough data collected to characterize all areas of the MRS, in locations that were not accessible. Overall the data suggests that very limited MEC and/or MD are present at MRS 04. MEC risk is negligible for Flamenco Beach where the NTCRA occurred. The MEC HA assigned a high risk to this MRS. This was primarily because of the one MEC item and munitions debris that was an input, as well as the range type; however, the score in not based on

MEC density. The score is also considered high because of the number of residents in this area, although population density is also not considered. Based on the site history, current land use, and previous investigations including the RI, a conclusion of this RI is that there is a low risk for encounters with MEC at MRS 04 in both the surface and the subsurface.

7.2.4 MRS 05 – Mortar and Combat Range Area

No MEC was identified during the RI; MD was found within several transects scattered throughout MRS 5. Previous investigations have been conducted at MRS 05 including the 1995 ASR (MD identified) and the 2007 SI (MD identified). No other intrusive work has been conducted at MRS 05 outside of the current RI. No MEC has ever been found or reported within this MRS. There are large data gaps for this MRS due to lack of access / ROEs. The transects for the RI were scattered over several accessible areas of the MRS 05 providing adequate sampling for MEC density. There is not a specific pattern noted for the presence of MD; it appears to be located at a low density within most areas investigated in this RI. No high concentrations of MD were found. Overall the data suggests that very limited MEC or MD are present at MRS 05. MEC presence cannot be completely discounted based on the locations of MD (which are possible indicators of MEC) and lack of full characterization in areas that did not receive an ROE or were considered inaccessible. The MEC HA assigned a high risk to this MRS. This was primarily because of the munitions debris that was an input, as well as the range type; however, the score in not based on MEC density. The score is also considered high because of the number of residents in this area, although population density is also not considered. Based on the site history, current land use, and previous investigations including the RI, a conclusion of this RI is that there is a low risk for encounters with MEC at MRS 05 in both the surface and the subsurface.

7.2.5 MRS 07 – Culebrita Artillery Impact Area

Two MEC items and MD were identified at MRS 07 during the RI. Both of these items were found on the surface. In addition, MEC and MD have historically been found on Culebrita and Cayo Botella during previous investigations. During the 1997 EE/CA, 20 MEC items were found at Cayo Botella either on the surface or within the first 3 inches bgs. On Culebrita, 39 MEC items were found; most were found on the surface and some items were found down to 4 inches bgs. A NTCRA (surface and subsurface) has been conducted on the beaches of MRS 07. 12 MEC items were found on the northwest beach of Culebrita; all were received within the first inch bgs. Within these beach areas, MEC has been removed from the surface and subsurface and the risk to receptors to encounter MEC is negligible. Within the rest of Culebrita, including Cayo Botella, MEC exists on the surface and within the near subsurface (first 4 inches). Human receptors are limited to occasional use (recreational or USFWS site work); there are no residents on MRS 07. Areas of specific use include the beaches and trails that cut through MRS 07. As such, the risk of recreational users or site workers to encounter MEC (outside of the beaches) is considered moderate to high. This corresponds with the MEC HA which assigned a risk of high to MRS 07.

7.3 MC Conclusions

7.3.1 Explosives were not detected in any of the field samples; however, 1,3,5-TNB and 4-NT were found at very low levels in one split sample at MRS 05 collected for quality assurance purposes. Both analytes were well below the USEPA RSL. All metals were detected at levels below the USEPA RSLs. Table 3-5 through 3-10 show the field sample results. All sample results are provided Appendix C. Based on the human health risk assessment, no COPCs were identified in surface soil or sediment in any of the MRSs.

7.3.2 The SLERA determined the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (adjacent cays), MRS 04, and MRS 07 is negligible and the potential for adverse health effects in terrestrial receptors from exposure to MC in surface soil at MRS 02 (Cerro Balcon) and MRS 05 is low based on the hazard quotient for chromium. Based on the evaluation of the sediment data, a potential for risk of adverse health effects in aquatic receptors is indicated. However, given the conservative nature of the TRVs used to screen the sediment data, the potential for ecological risk may be qualified low. The revised CSM for MC reflects incomplete exposure pathways for all human and ecological receptors of MC at all MRS 04 and MRS 05 based on the absence of COPCs.

7.3.3 Due to difficulties accessing the outlying cays and access restrictions at Cerro Balcon, no soil or sediment samples were collected at MRS 02 during the RI. The risk evaluation for MRS 02 is based on ten surface soil samples collected by Ellis during clearance activities in 2006 at Cerro Balcon and Cayo Lobo. The extent to which the Ellis data at Cayo Lobo are reliable indicators of MC presence and concentrations at the remainder of the cays is uncertain. However, samples results both at Cerro Balcon and Cayo Lobo are consistent in the negligible risk to receptors. In addition, receptors are extremely limited at the Cays based on access issues. As such, a conclusion of this RI is that for all MRSs included in this RI, there is no risk to human or ecological receptors and no remediation is necessary for MC.

7.4 MRS Delineation Recommendations

7.4.1 Based on the results of the RI fieldwork and review of existing data from previous investigations, the following recommendations have been made on Culebra MRS delineation.

7.4.2 ***MRS 02:*** MRS 02 includes Cerro Balcon and the Cays. Cerro Balcon is landlocked within MRS 05 with different access and receptors than the remainder of the cays. The Cays also have varied accessibility. While access to all cays is restricted, Cayo Lobo and Yerba are known to be frequented by recreational users, while the other cays are less accessible or frequented. Based on this information, it is recommended that MRS 02 be split into three areas for further evaluation in the feasibility study:

- Cerro Balcon MRS
- Cayo Lobo and Cayo Yerba MRS
- Remaining Cays MRS (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

7.4.3 ***MRS 04 and MRS 05:*** MRS 04 and MRS 05 are adjacent MRSs at Culebra. U.S. Fish and Wildlife own a contiguous portion of each MRS. Receptors and land use varies in this area when compared to the remainder of MRS 04 and 05. Thus, it is recommended that the U.S. Fish and Wildlife Areas from each MRS be combined into a separate MRS. The remainder of each MRS 04 and MRS 05 will remain as separate MRSs. Thus, the following will result:

- U.S. Fish and Wildlife Area MRS
- MRS 04 (remaining area)
- MRS 05 (remaining area)

7.4.4 ***MRS 07:*** No changes to MRS boundaries are recommended for MRS 07 based on the RI results.

7-1: MRSPP Scores for Revised MRS Delineations

MRS	MRSPP Score
MRS 02 – Cerro Balcon	3
MRS 02 – Cayo Lobo and Cayo Yerba	3
MRS 02 – Remaining Cays	3
U.S. Fish and Wildlife Area	4
MRS 04	4
MRS 05	4
MRS 07	3

7-2: Culebra Island MRS Summary

MRS	MD	MEC	MC	HHRA	SLERA	MRSPP Score[1]	Baseline MEC HA Score[2]	Data Gaps
02 - Cerro Balcon	No MEC field activities conducted at MRS 02 during the RI due to lack of ROE. MD identified during previous investigations.	**RI** No MEC field activities conducted at MRS 02 during the RI. **Previous Investigations** • 3 inch common MK3, MOD 7 (3) • Fuze, model 1898, 15 second PTTF (2) • 81mm mortar (2) A surface clearance has been conducted.	- No MC field activities conducted at MRS 02 during the RI (lack of ROE). - No explosives detected in previously collected soil samples. - All metals detected below USEPA RSLs in previously collected soil samples.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted in either Cerro Balcon.	3	2	MEC: No subsurface investigation during RI or previous investigations to gather data on subsurface MEC density. No ROE could be obtained during the SI or RI. MC: None
02 - Cays	No MEC field activities conducted at MRS 02 during the RI due to inaccessibility. MD identified during previous investigations at several cays.	**RI** No MEC field activities conducted at MRS 02 during the RI. **Previous Investigations** • 500 lb bomb (2) • MK 27 Torpedo (1) • MK 76 Practice Bomb (2) • 76 mm projectile (1) • Fuze, M151 (1) • Practice bomb (32) • 5-inch/54 MK 41 (1) A surface clearance was conducted on Cayo Lobo (2006).	- No MC field activities conducted at MRS 02 during the RI. - No explosives detected in previously collected soil samples. - All metals detected below USEPA RSLs in previously collected soil samples.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted in the adjacent cays.	3	3	MEC: Some of the smaller cays have not had MEC investigations conducted due to access restrictions. MC: No sampling data for cays other than Cayo Lobo. Cays were inaccessible during the SI and RI.
04	Frag identified during the RI.	None during the RI. One MEC item found on Flamenco Beach during 2008 NTCRA (5-inch projectile)	- No explosives detected. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	4	2	MEC: Portions of MRS 04 were not investigated due to ROE or accessibility issues (steep terrain / vegetation). MC: None
05	- Frag (9) - 30 cal cartridges (2) - 81mm mortar (3) - 4.2" mortar base	No MEC finds during the RI or previous investigations.	- 1,3,5-TNB and 4-4-NT detected at very low levels below USEPA RSLs in one split sample. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	4	2	MEC: Portions of MRS 05 were not investigated due to ROE or accessibility issues (steep terrain / vegetation). MC: None

07	- Expended flare - 20 mm - Partial rotating band - PTTF fuze - Brass frag (9) - Partial fuze body - Shotgun shell - 3'"projectile frag	**RI** • MK5 Mod 0 rocket (1) • MK8 Demo Hose (1) **Previous Investigations** • MK 76 /Mk4 practice bomb (18) • Naval gun fire, 6 inch • Spotting charge, MK 4 • Projectile, 20mm HEI (39)	- No explosives detected. - All metals detected below USEPA RSLs.	- No COPCs identified. No risk to human receptors.	- No soil or sediment remediation on the basis of ecological risk is warranted.	3	2	MEC: None MC: None

[1] The MRSPP is a method for assigning a relative priority for response actions to defense sites containing military munitions. Priority 1 indicates the highest potential hazard and Priority 8 indicates the lowest potential hazard.
[2] The MEC HA is a baseline hazard analysis for MEC based on current site conditions. There are four hazard levels (1–4), with 1 indicating the highest potential explosive hazard condition and 4 the lowest potential explosive hazard condition

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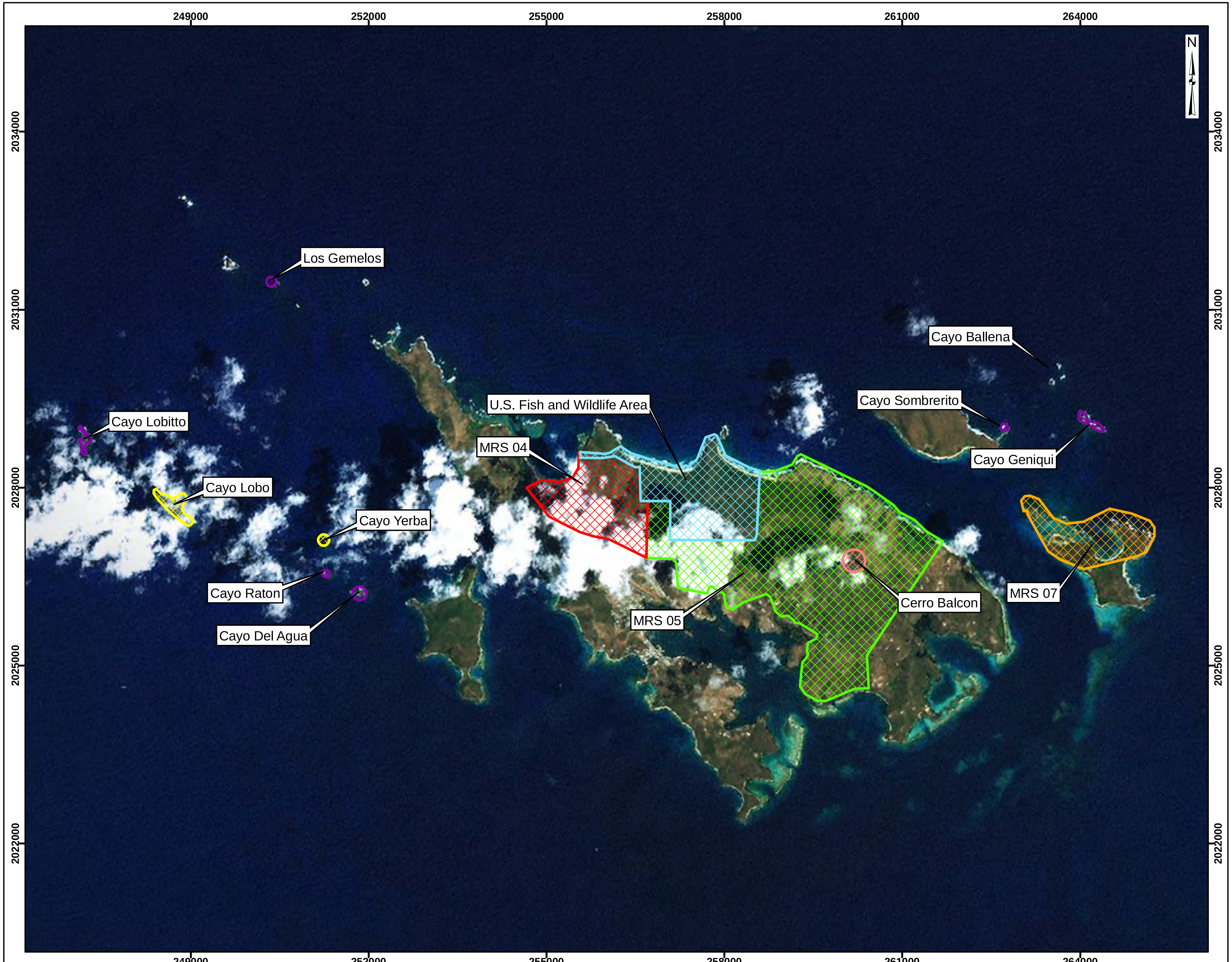
Figure 7-1
MRS Delineation Recommendations



Legend

- MRS 02 - Cayo Lobo and Cayo Yerba
- MRS 02 - Cerro Balcon
- MRS 02 - Remaining Cays
- MRS 04
- MRS 05
- MRS 07
- U.S. Fish and Wildlife Area

0 1,500 3,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM Zone 20N
Datum: NAD83
Units: Meters

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Appendix A: GPO Letter Report

FINAL GEOPHYSICAL PROVE-OUT
FOR

REMEDIAL INVESTIGATION / FEASBILITY STUDY
AT THE CULEBRA ISLAND SITE
PUERTO RICO

CONTRACT NO. W912DY-04-D-0009

TASK ORDER NO. 0013

Prepared For:

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February 03, 2010
Revision 1

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ACRONYM LIST

ARM	ARM Geophysics
cm	Centimeter
DGM	Digital Geophysical Mapping
DID	Data Item Description
DMM	Discarded Military Munitions
DoD	Department of Defense
DQO	Data Quality Objective
EM61	Geonics EM61-MKII Electromagnetic Sensor
EOTI	Explosive Ordnance Technologies, Inc.
FTP	File Transfer Protocol
ft	Foot
GDB, GX, GRD	Geosoft Data Base, Geosoft Executable, Geosoft Grid files
GPO	Geophysical Prove-Out
GPS	Global Positioning System
Hz	Hertz (cycles per second)
MEC	Munitions and Explosives of Concern
m	Meter
mm	Millimeter
mV	Millivolt
MRS	Munitions Response Site
PDOP	Positional Dilution Of Precision
QC	Quality Control
RI/FS	Remedial Investigation / Feasibility Study
RTK-DGPS	Real-Time Kinematic Differential Global Positioning System
SOP	Standard Operating Procedure
SOW	Statement of Work
TDEM	Time Domain Electromagnetic
WP	Work Plan

1.0 INTRODUCTION

1.1 PROJECT SCOPE

1.1.1 Project Objectives

The objectives of the Culebra project, as defined in the Work Plan (WP), are to perform digital geophysical mapping (DGM) techniques to capture and document anomaly distributions, utilizing the Geonics EM61 MK2 (EM61) time domain electromagnetic (TDEM) system at a number of Munitions Response Sites (MRS) at Culebra Island, in support of a Remedial Investigation / Feasibility Study (RI/FS) document.

1.1.2 GPO Reporting Requirements as Related to Project Scope

As part of the scoped work, a Geophysical Prove Out (GPO) was required to test the proposed equipment and methodologies in a site specific environment. This GPO Report is to serve as a comprehensive summary for the completion of all activities associated with the GPO. Brief summaries of the activities conducted during all tasks are provided, but the primary focus will be on detailing the GPO results and the quality control (QC) performed.

1.2 BACKGROUND

1.2.1 Site and Office Locations

All field work related to the GPO was conducted on Culebra Island, Puerto Rico. Data processing and analysis was conducted by ARM personnel at its home office in Hershey, Pennsylvania and at a satellite office in Australia.

1.2.2 Site Surface Topography, Vegetation, & Geology Conditions

1.2.2.1 Culebra Island Site Location and Conditions

Culebra Island, Puerto Rico is located in the Caribbean, 17 miles east of the Island of Puerto Rico, separated by the Vieques Sound with the Caribbean Sea to the south and the Atlantic Ocean to the north. It consists of a main island, of approximately 598 acres, and 24 adjacent cays. The climate of Culebra is tropical maritime and the terrain hilly with a mix of rugged and sandy coastlines. More information regarding the terrain and climate of Culebra can be found in the Work Plan under Section 1.

1.2.2.2 Site Geology

The geology of Culebra Island is composed of both intrusive and extrusive volcanic rock of the Upper Cretaceous Age, mainly andesite and andesitic tuffs with the bedrock consisting of andesite and andesite breccia. The geology exhibits strong magnetic properties that can affect magnetometer (and, to a lesser extent, electro-magnetometer) readings. The island has a small variety of soil types due to its volcanic origin, limited size, rugged terrain, and moderately uniform climate. Most soils, except along the slopes, are the result of weathering bedrock. More information regarding the geology of Culebra can be found in the Work Plan under Sections 1.3.2 and 1.3.4.

1.2.2.3 Site History

From 1903 through 1975, US Navy and NATO forces used Culebra as a training facility with the island and adjacent cays used, amongst other purposes, as an impact range for aerial bombs and rockets, missiles, mortars, and naval projectiles. More information regarding the historical and military use of Culebra can be found in the Work Plan under Section 1.4.

2.0 GEOPHYSICAL PROVE OUT AND METHOLOGY

2.1 GEOPHYSICAL PROVE OUT PLAN AND REPORT

2.1.1 Objective

The objective of the GPO was to evaluate the geophysical sensor and navigational instruments proposed for use in the main part of the project, to recommend the system of choice and to propose a set of decision parameters for target picking based on the response of seeded item in the GPO.

2.1.2 GPO Specific Data Quality Objectives

Data Quality Objectives (DQO‟s) were outlined in the work plan and included the following:

1. Demonstrate that the geophysical investigation system/equipment is operating properly.
2. Provide a set of isolated objects (e.g., single inert target items or target surrogates). The sensor signatures from these items will be used to determine the equipment limitations in this geologic setting.
3. Assess the operators performance and update related procedures
4. Establish a baseline of performance capabilities for the selected instruments.
5. Establish decision parameters for target selection by the site geophysicists.
6. Evaluate navigational/position systems for positional accuracy
7. Instrument latency will be corrected using an appropriate correction routine that accounts for instrument latency time and sensor velocity.

Additionally, specified objectives, related to positioning systems and data collection variables, included:

8. Positioning Systems:

   EOTI will utilize a Leica 500, 1200 or comparable RTK Differential Global Positioning System (DGPS) to integrate location data with the EM data. The GPS system employed will have centimeter accuracy and will utilize a base station established at a known monument/control point. EOTI will also evaluate man-portable EM61 with fiducial positioning if transects and/or grids in canopied areas are needed.

9. Down-Line Sampling Rate:

   Sampling rates of the EM61 will be approximately 10-12 Hz for DGPS and once every 10cm for wheel mode fiducials. For DGPS, down-line sample separation will be 0.2m or less, 95% of the time. Sampling rates on the GPS will once per second.

10. Across-Line Sampling:

Grid data will be collected in lanes 0.6m apart based on the known presence of 25 mm projectiles at the Culebra Island

Note: Due to anticipated vegetation coverage documented after the first site-specific visits during project startup, the proposed navigation system was changed between the writing of the Work Plan and performance of the GPO. Due to the pervasive canopy in the areas considered for data collection, the DGPS was ruled out as a primary navigation method, in favor of the (more canopy-tolerant) sub-meter GPS and fiducial methods which were to be evaluated during this GPO. Additionally, due to the positioning instrumentation change and transect swath vegetation removal limitations (which also limited the positioning systems of choice), the across sampling metric was changed to be bound by a maximum of one coil size, or 1 meter (~ 3.3 feet). As such, the GPO passes have a nominal design lane spacing of 0.75 meters (2.5 feet) with a proposed coverage swath up to one coil width in order to accurately demonstrate transect detection rates while maneuvering within the tight transect paths.

2.2 SITE SPECIFIC GEOPHYSICAL PROVE OUT

2.2.1 GPO Location

A location for the GPO was selected by EOTI and brush-cut to allow surveying with the instrument. Some trees and brush remained however due to restrictions on brush cutting outlined in the work plan (See Figure 1, below). Following the background survey (see 3.1.2) the grid was further brush-cut to allow emplacement of seed items with a backhoe.

2.2.2 GPO Construction

After initial brush cutting had been completed, a 100ft x 100ft (~30.5m x 30.5m) GPO grid was laid out with measuring tapes and the positions of the corners recorded with the sub-meter GPS. As mentioned above, an amount of trees and brush with moderate canopy remained within the grid, impacting on the path of the surveys and having, as it would under real, production surveying conditions, a detrimental effect on the GPS coverage. As can be seen in Figure 1, tall brush and scrub surrounded the GPO on all sides, also preventing a full view of the sky and impacting GPS coverage. The sub-meter system was deemed to be the best GPS suited for the conditions due to the technological advances of correction methods and acceptance tolerances relative to the canopy limitations. The system chosen (see section 2.3.2) was considered the best trade-off as use of alternate GPS systems would have resulted in larger positional offsets from either accepting „looser" fits or attempting and failing to achieve „tighter" fits.

Figure 1 – GPO, View from NW Corner towards NE corner (Left) and SW corner (Right)

2.2.3 GPO Seeds

Of the 25 seeds initially planned, only eight were able to be emplaced due to the inherent responsiveness of the chosen GPO, as found following the background survey (see section 3.1.2). The GPO area was limited to the current location, firstly due to issues relating to rights of property access prevented moving to another, prospectively cleaner, location and, secondly, due to time constraints in locating and preparing another area for survey that would likely have contained similar issues. The main issue to overcome with the current grid was the quantity and distribution of responses in the grid limiting the areas in which seeds could be emplaced, such that the seed response would not be masked by the background response. In order to demonstrate the minimum response criteria, a small suite of inert items were seeded (see Table 1) at the worse-case orientation: Horizontal and as perpendicular as possible to the line path).

Table 1 – List of Seeds

Seed ID	Item	Diameter (m)	Depth (ft)	Depth (Diameter)	Orientation	Bearing
1-1	20mm	0.020	0.7	10.67	horizontal	90
1-2	37mm	0.037	1.2	9.88	horizontal	60
1-3	grenade	0.057	1.0	5.35	horizontal	45
2-1	105mm	0.105	3.0	8.71	horizontal	120
2-2	155mm	0.155	4.0	7.87	horizontal	80
3-1	60mm	0.060	2.0	10.16	horizontal	135
4-1	81mm	0.081	2.5	9.41	horizontal	100
5-1	2.75" rocket	0.070	2.5	10.89	horizontal	345

Table 1 lists the seed items emplaced in the GPO grid, along with their type and burial depths, both as a function of distance and in multiples of their diameter. The seeded items were all simulants used to approximate the response to items listed in Table 1. Photos of simulants used in the GPO test plot are included in Appendix B. Individual depths for seeded items were selected based on the combined practical information contained in documents EM 1110-1-4009 (Table 7.3 – Ordnance Penetration / Detection) and NRL/MR/6110--08-9155 (Standardized EM61 response curve Tables). The important excerpts of these documents are provided as exhibits A-1 and A-2 of Appendix A, respectively, for reference. The responses tables have been focused into the region between the seed depth (highlighted in purple) and the maximum theoretical depth cross-referenced from Table 7.3 Ordnance Detection Depth Table (highlighted in yellow).
As can be seen from Table 1, the Table of Ordnance Penetration/Detection (exhibit A-1), and the Response Tables (exhibit A-2), the majority of the items were seeded close to the maximum emplacement depth, with the exception of the 155mm (Seed 2-2) which was buried at the anticipated maximum project excavation depth of 4 feet. All items were seeded at their worst case orientation to the extent possible while maintaining anomaly avoidance. Appendix B contains the simulant item photos as gathered by EOTI during the GPO seeding process.

Figure 2, an „As-Built Drawing", shows the locations of the seed items within the GPO.

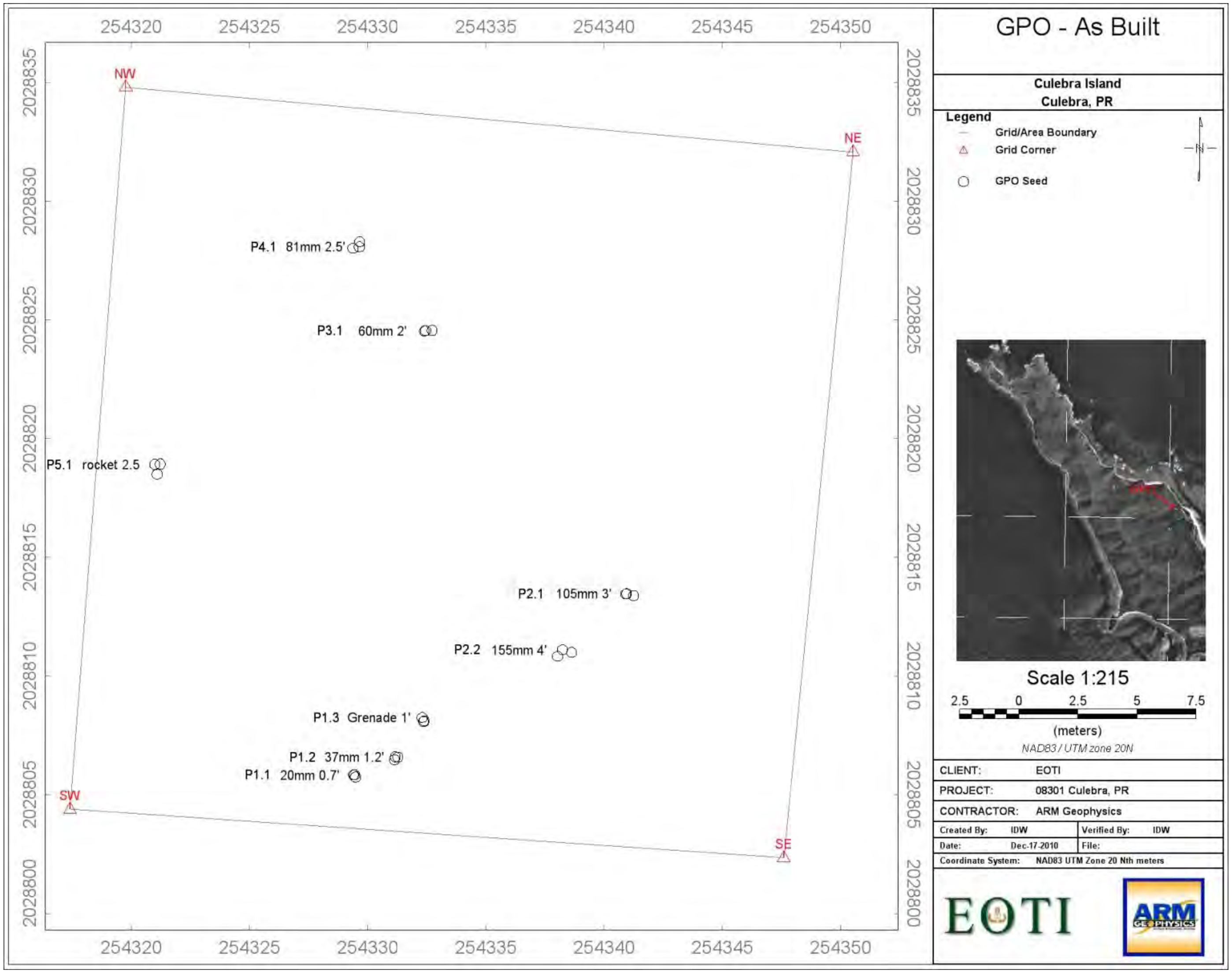


Figure 2 – 'As Built' Diagram of GPO

2.3 GEOPHYSICAL AND POSITIONING SURVEY EQUIPMENT

2.3.1 Surveying

The Geonics EM61 MK2 time domain EM system (EM61) was selected as the digital geophysical mapping (DGM) instrument of choice for the project. An additional instrument, a hand-held analogue EM detector to be used in terrain not conducive to the operation of the EM61, is discussed in Section 3.4.2.

The EM61 was operated in two modes – two person „litter‟ carried mode and two person push/pull wheeled mode, with the preferred mode being „litter‟ to avoid complications arising from uneven / rough ground or residual vegetation.

2.3.2 Positioning

Three positioning methods were trialed during the GPO, one GPS and two fiducial:

2.3.2.1 GPS

The GPS method (see Figure 3, below) involved streaming positions from a Trimble ProXRS Sub-Meter GPS to the field computer of the EM61 where they were integrated with the EM readings in real time. The anticipated canopy of the project was not conducive to use of a centimeter accuracy real time kinematic differential GPS (RTK-DGPS) and the use of the sub-meter GPS was approved prior to mobilization for the GPO. Positioning accuracy of the sub-meter GPS was increased through use of the subscription DGPS service, Omnistar as the primary set of corrections. A secondary correction service – Coast Guard Beacon positioning corrections – was used as a backup in case the Omnistar services were not operating adequately according to digital readouts on the display screen of the GPS unit controller.

Figure 3 – Time Fiducials in Two-Person, 'Litter' Carried Mode

2.3.2.2 Fiducial Method 1 – Wheel Fiducials

The first fiducial method trialed was wheel-based fiducials. The Geonics EM61 counting wheel, factory modified, records one value (on each of four channels) for every 0.1m of wheel movement. A marker value is then input to the data at any point through the use of the „fiducial marker button", with these marks used to convey the location of start/endpoints and other survey control lines within the grid. The start/end point marks in the data are then used to position the data in DAT61 and the in-grid control line marks are used to correct for any positioning errors accumulated between control points.

2.3.2.3 Fiducial method 2 – Time Fiducials

The second fiducial method used over the GPO was time fiducials. With this method, data is recorded in the EM61 at its set rate (15Hz) and marks emplaced in the data through use of the „fiducial marker button" and these start/end and in-grid control point marks subsequently used to set the data positions in DAT61.

3.0 GEOPHYSICAL SURVEY

3.1 PRE SURVEY TESTS

3.1.1 Instrument Standardization

QC Tests were performed in accordance with the required equipment tests and frequency of testing, summarized in Table 2.

Table 2 - Quality Control Measures and Associated Frequencies

Test #	Test Description	Specific detector	Power on	Beginning of Day	Beginning and End of Day	1st Day of Project	Per Grid or Dataset
1	Equipment Warm-up		X				
2	Personnel Test			X			
3	Vibration Test (Cable Shake)			X			
4	Static Background and Static Spike				X		
5	6 Line Test					X	
6	2 Line Test			X			
7	Dynamic Repeatability						X
8	Positioning Device Check			X			

The following tests were conducted**:**

3.1.1.1 Equipment/Electronics Warm-up

The purpose of Equipment/Electronics Warm-up is to minimize sensor drift. Most instruments require some time for the electronics to warm up to operating temperature before data collection begins. The EM61 equipment was given, typically, 5 to 15 minutes to warm up at the beginning of the day and after it had been switched off for an extended period of time.

3.1.1.2 Personnel Test

The purpose of personnel testing is to ensure survey personnel have removed all potential interference sources from about their person Common interference sources can include steel-toed boots, boots with metal shanks, or large metallic belt buckles, which can produce data anomalies similar to MEC targets. All personnel who came within close proximity to the sensor during survey operations were tested for metallic response by approaching the sensor and have a second person monitor and record the results. Acceptance criterion for the EM61 was no response greater than +/- 2.5mV on channel 3 without being an isolated incident with an adequately documented and resolved cause. An example of a personnel test from December 16th is provided below as Figure 4. As can clearly be seen, no spikes, bumps, or responses are exhibited above the 2.5 mV threshold.

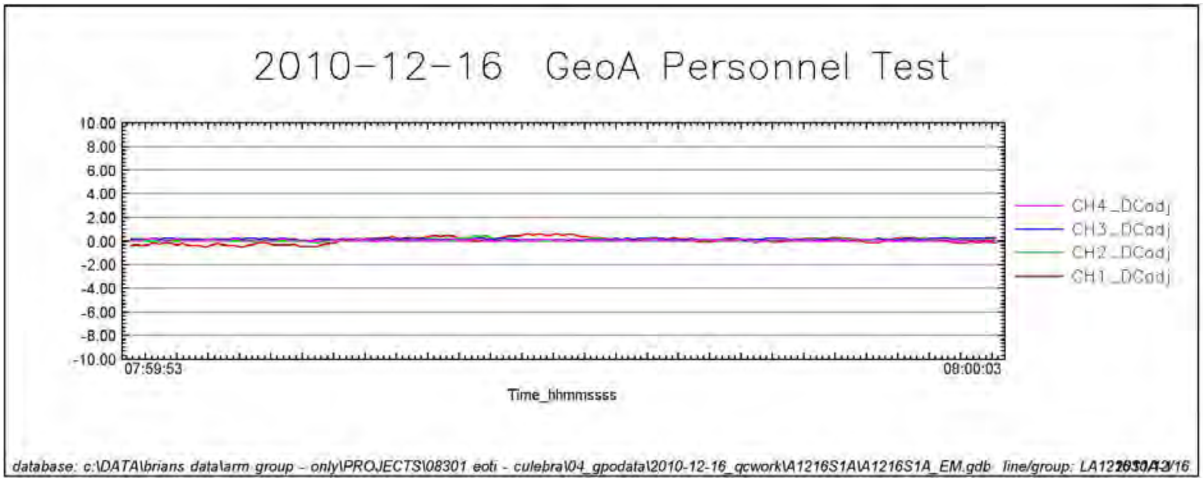


Figure 4 – Personnel Test Example (December 16th, 2010)

3.1.1.3 Record Relative Sensor Positions

The purpose of the record relative sensor positions test is to document relative navigation and sensor offsets, detector separation, and detector heights above the ground surface. This will ensure that detector offset corrections can be done correctly and that the surveys are repeatable. As the surveys were conducted using a single coil, this was achieved by ensuring that (1) the GPS antenna was located directly over the center of the coil through use of a stable antenna tripod and that (2) a constant coil height of 16 inches above ground surface was maintained within the acceptance criterion of +/- one inch. The height was measured by rotating the coil around a fixed point while measuring corner heights and adjusting the setup until the platform was within operational specifications.

3.1.1.4 Vibration Test (Cable Shake)

The purpose of the vibration test is to identify and replace any shorting cables or broken pin-outs on connectors causing noise or spikes to appear in the data. With the instrument held in a static position and collecting data, an assistant carefully shook all cables to test for shorts and broken pin-outs while the readings were observed for any changes (spikes) in instrument response. The acceptance criterion was a data profile that did not exhibit data spike responses +/- 2.5mV on channel 3. An example of a vibration (cable shake) test from December 16th is provided below as Figure 5. As can clearly be seen, no spikes, bumps, or responses are exhibited above the 2.5 mV threshold.

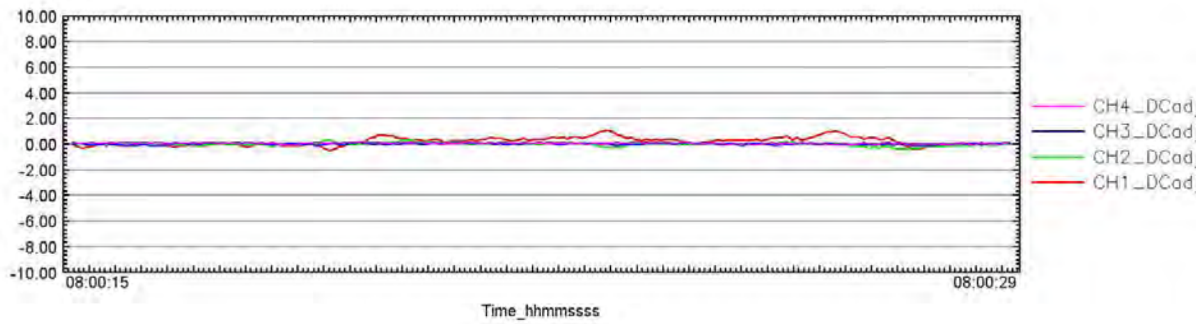


Figure 5 – Cable Shake Test Example (December 16th, 2010)

3.1.1.5 Static Background and Static Standard Response (Spike) Test

The purpose of this test was to quantify instrument background readings, repeatability of the instrument to a standard test item (test jig) and locate any potential sources of interference in the time domain. Improper instrument function and the presence of local sources of ambient noise (such as EM transmissions from high-voltage electric lines or electrical storms) are potential causes of inconsistent, non-repeatable readings. In humid environments and in tidal or wave affected areas, interference can sometimes also be seen from condensation in connections and movement of saline water within the subsurface. A minimum of 3 minutes static background collection, after instrument warm-up, followed by a 1-minute standard (spike) test followed by a 1-minute static background data was performed both before and after data collection. The acceptance criterion was as follows: Static Background Test: EM61 +/- 2.5 mV on channel 3, Spike Test: EM61 +/- 10% of standard item response, after background correction. An example of an acceptable static background / static response test from December 16th is provided below in Figure 6. As can clearly be seen, no spikes, bumps, or responses are exhibited above the 2.5 mV threshold and responses are within the percent range for repeatability. Table 3 summarizes the static tests results between days of operation. Based on the evaluating the static responses during the GPO and the static responses from previous projects using the same test jig, ARM has determined that the static response baseline values for the upcoming work should be 140 mV on channel 3, the same channel evaluated for spikes discussed above and dynamic response evaluations to follow in order to maintain consistency. If the test item (due to loss or replacement) and/or test item response changes appreciably, ARM will notify USAESCH Geophysicist as soon as possible.

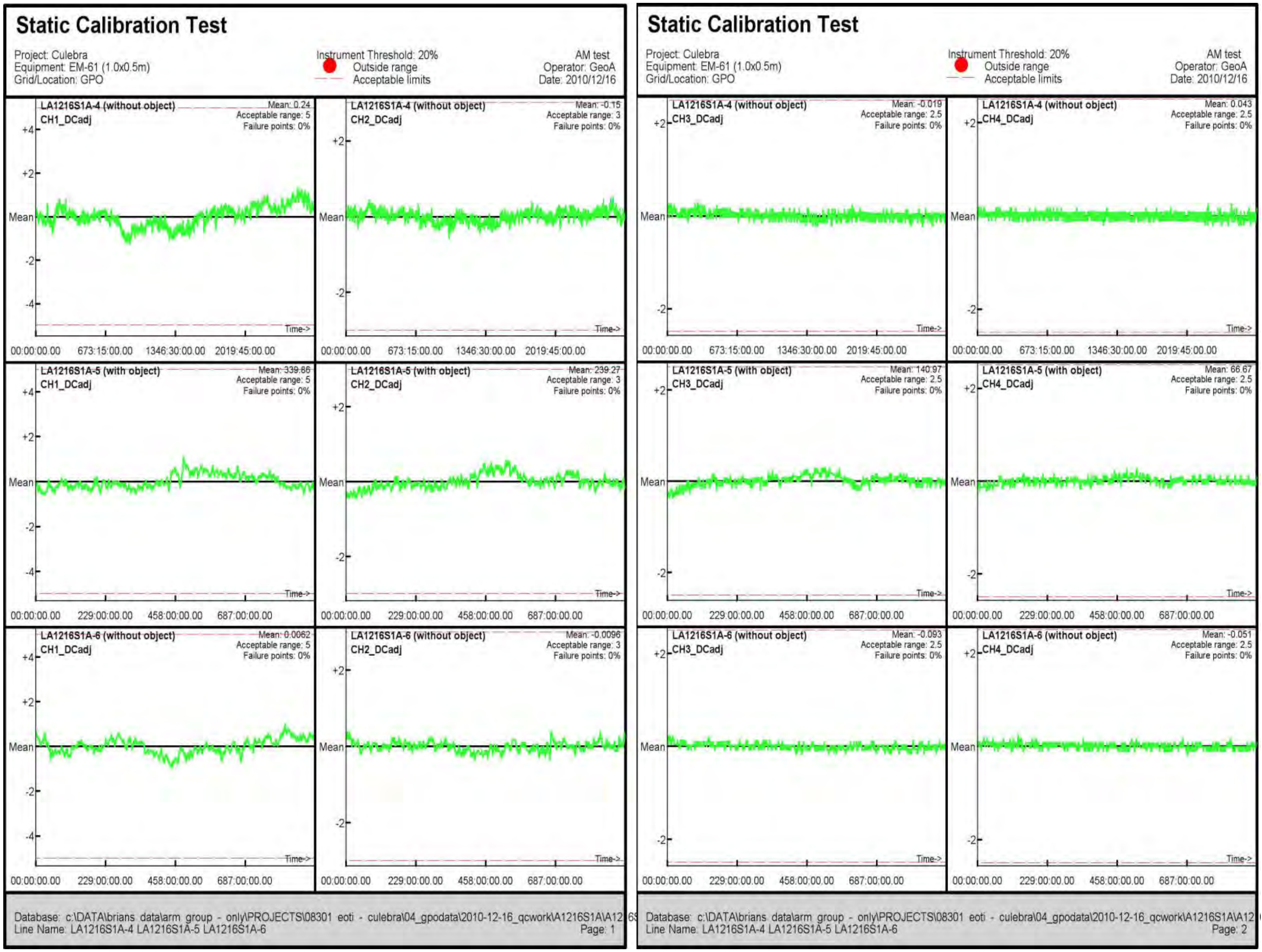


Figure 6 – Static Test Example (AM Test, December 16th, 2010)

Table 3 – Static-Spike Test Summary

	% Difference Between AM and PM Spike				% Difference Between First Day's AM Spike				% Difference Between First Day's PM Spike			
Date	Ch1	Ch2	Ch3	Ch4	Ch1	Ch2	Ch3	Ch4	Ch1	Ch2	Ch3	Ch4
12/14/2010	1.81	1.39	0.92	0.65	n/a	-	-	-	n/a	-	-	-
12/16/2010	0.86	0.68	0.38	0.62	1.15	0.73	0.23	-0.32	0.20	0.02	-0.31	-0.35

3.1.1.6 Six Line Test

The purpose of this test was to document latency and repeatability of response amplitude, and to demonstrate that instrument latency is not variable across the normal range of survey speeds. The following procedure was followed after a 50 ft tape was laid out:

1. A line of data collected in one direction at normal survey speed
2. Line collected in reverse direction at normal survey speed
3. Target (test jig) placed at the midpoint of the tape (25 feet) and line of data collected at normal survey speed
4. Line collected in reverse direction at normal survey speed with target
5. Line collected in reverse direction at faster than normal survey speed with target
6. Line collected in reverse direction at slower than normal survey speed with target

An example of an acceptable six-line test, from December 14th, is provided below as Figure 7. As can clearly be seen, once the correction is applied all of the peaks line up accordingly regardless of (moderate, slow, or fast) walking pace.

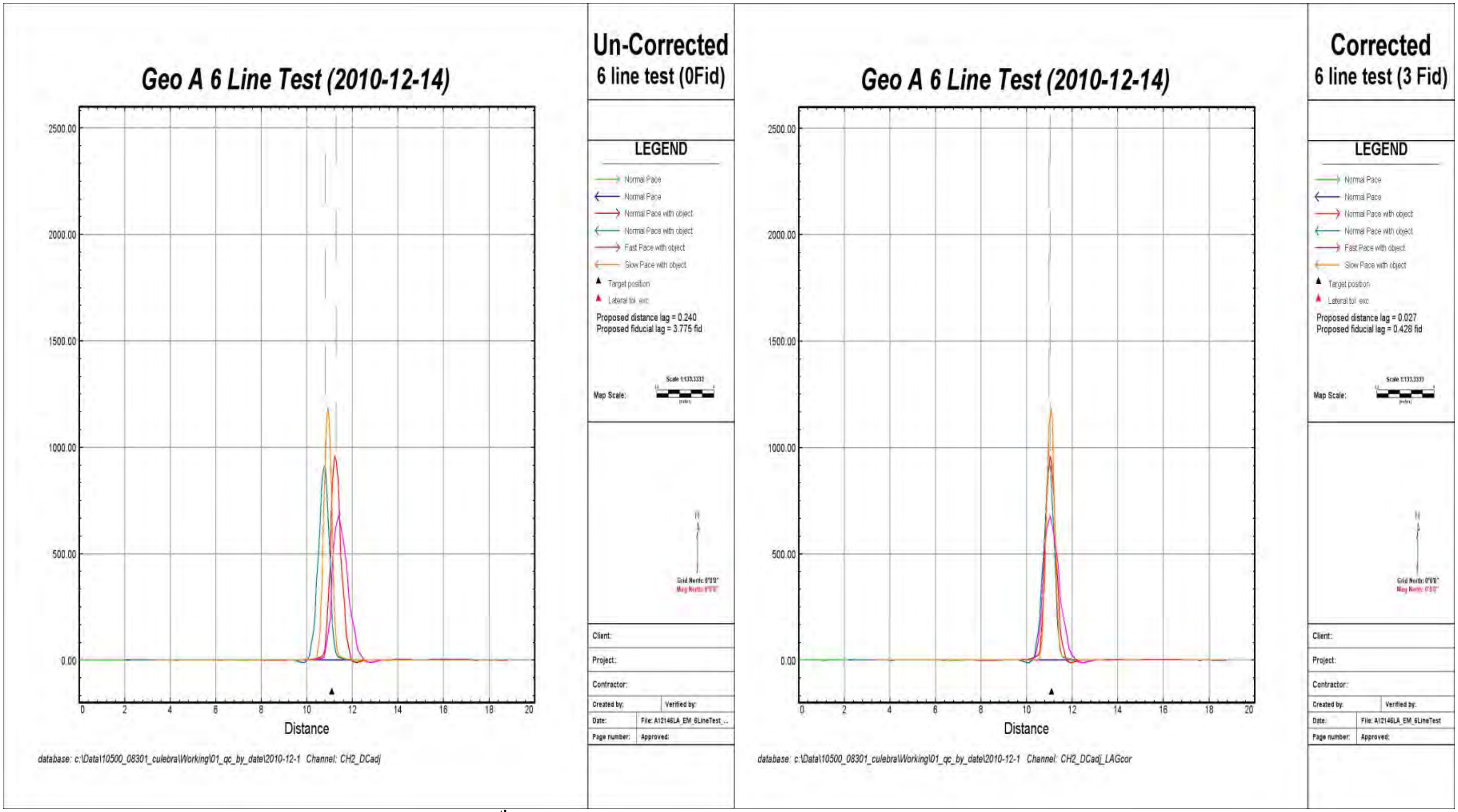


Figure 7 – Six-Line Test (14th December, 2010). Left image shows data prior to lag correction, right image shows data after application of a 3 fiducial lag correction.

3.1.1.7 Two Line Test

The purpose of this test was to (daily) test and document the latency adjustment required to correct the data. The test consisted of running the equivalent of lines 3 and 4 of the 6-Line Test and viewing the results in profile and map view (in cases where the line was not oriented N/S or E/W). An example of an acceptable two-line test from December 14th is provided below as Figure 8. As can clearly be seen, once the correction is applied all of the peaks line up with similar peak response ranges.

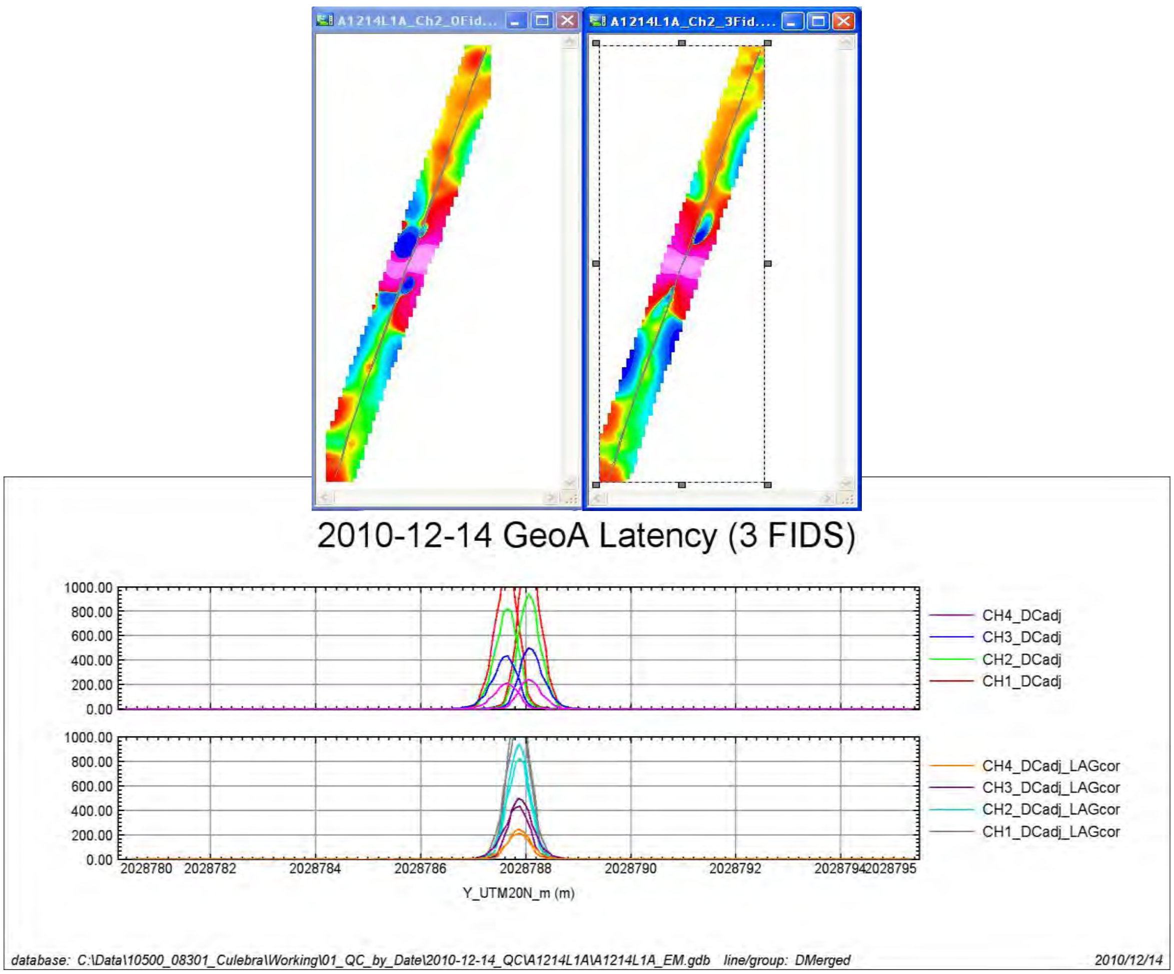


Figure 8 – 2-Line Test Example (December 14th, 2010)

3.1.1.8 Dynamic Repeatability Test

The purpose of this test was to document that data quality was consistent and sufficient for detection of the MEC items of interest, being a replacement for the previously used 2% repeat line test. A standard test item (e.g. a small, flat plate, response less than 500 units) was to be placed within the grid and then the grid was to be surveyed as per normal with the location of the dynamic repeatability item noted and its response determined during processing. Test item anomaly characteristics (peak response and size) shall be repeatable with an allowable variation of +/-25%. This test should be performed once per grid or dataset, or group of data, usually twice per day depending on field production.

Two dynamic repeatability tests were run on December 16th, 2010. However, they were not collected as part of the GPO grid itself because the background response was too high and all available clear areas in the GPO had been seeded with items. Instead, the tests were collected as stand-alone „mini grids", but in the manner of a regular dynamic repeatability test. The results of the tests are shown in Table 4:

Table 4 – Dynamic Repeatability Tests, December 16th, 2010

Dynamic Response			
Test 1 Filename:	A1216K1A	**Test 2 Filename:**	A1216K2A
CH1 Response:	1460.40	**CH1 Response:**	1270.60
CH2 Response:	950.70	**CH2 Response:**	828.00
CH3 Response:	490.40	**CH3 Response:**	440.30
CH4 Response:	224.60	**CH4 Response:**	198.50
CH1 % Change:	0.00%	**CH1 % Change:**	-13.00%
CH2 % Change:	0.00%	**CH2 % Change:**	-12.91%
CH3 % Change:	0.00%	**CH3 % Change:**	-10.22%
CH4 % Change:	0.00%	**CH4 % Change:**	-11.62%

Based on the evaluating the dynamic responses during the GPO and from prior projects using the same test item, ARM has determined that the dynamic response baseline value for the upcoming work should be 440 mV on channel 3, the same channel evaluated for static background and spike response evaluations in order to maintain consistency. If the test item (due to loss or replacement) and/or test item response changes appreciably, ARM will notify USAESCH Geophysicist as soon as possible.

3.1.1.9 Data Position Check

At the beginning of each day, a known local survey point was to have its position recorded and compared to the location of the known point to ensure survey positioning is within the tolerance of the navigation system (Acceptance criterion: 4 inches or

10.12cm). However, because RTK-DGPS was not used for this GPO survey, a sub-meter GPS unit was used in its place. For the purposes of a positional check, the four corners of the GPO were recorded to file on three separate occasions. Table 5 shows the combined offsets of position checks 1 and 2 as compared with position check 3:

Table 5 – Position Checks and Offsets

Corner	Check 1 Easting (m)	Check 1 Northing (m)	Check 3 Easting (m)	Check 3 Northing (m)	Easting Offset (m)	Northing Offset (m)	Combined Offset
SE	254347.58	2028802.08	254347.57	2028802.35	0.01	-0.27	0.27
SW	254317.21	2028804.51	254317.41	2028804.40	-0.20	0.11	0.23
NW	254320.97	2028834.27	254319.76	2028834.80	1.21	-0.53	1.32
NE	254350.60	2028832.01	254350.51	2028832.08	0.09	-0.07	0.11
Corner	**Check 2 Easting (m)**	**Check 2 Northing (m)**	**Check 3 Easting (m)**	**Check 3 Northing (m)**	**Easting Offset (m)**	**Northing Offset (m)**	**Combined Offset**
SE	254347.82	2028801.79	254347.57	2028802.35	0.25	-0.57	0.62
SW	254317.42	2028805.04	254317.41	2028804.40	0.01	0.64	0.64
NW	254320.43	2028834.63	254319.76	2028834.80	0.66	-0.18	0.69
NE	254350.66	2028831.88	254350.51	2028832.08	0.14	-0.20	0.25

As can be seen from Table 5**,** the combined offsets (offsets in a straight line) are all in the region of +/-0.6m or less (within the acceptable bounds for the instrument) with the exception of one measurement of the NW corner which is 1.3m offset. As noted previously, the GPO was surrounded on all four sides with tall vegetation with vegetation remaining within the grid and it is likely that this one measurement can be considered an isolated occurrence as this magnitude of offset was not repeated on any of the other days or occupation time frames.

3.1.2 Background survey

Following brush cutting and layout of the GPO, a background survey was conducted in order to determine the extent of any pre-existing response in the grid and to locate clear areas in which to seed the items. The background survey was performed using the EM61 in wheeled mode with GPS positioning. Coverage of the grid was not 100% complete due to residual vegetation (some of which was later removed in order to emplace seed items with a backhoe), which caused both physical gaps and gaps due to poor GPS signal from residual canopy. This anticipated to be typical for parts of the production transects areas, where there is tall vegetation either side of the transect. Further discussion of the background survey can be found in Section 3.3.1.

3.1.3 Seeded Surveys

Following seeding of the GPO on December 15th, 2010, surveys of the GPO were conducted using all three of the instrument-navigational-method combinations: Litter mode GPS, litter mode time fiducials and wheeled mode wheel fiducials.

Data was collected in parallel lines of alternating direction, at the modified design lane spacing of 2.5 feet apart. As discussed in Section 2.1.2, the deviation from the work plan arose from the practical limitations of vegetation removal determined during the TPP process. Once the 2.5 foot spacing surveys were completed, ARM planned to collect an additional run at 2.0 foot spacing to ensure all items were detected, but due to the inclement weather and required travel logistics during the afternoon of December 16th and the morning of December 17th, another pass could not be completed. As the seeded GPO results will show in Section 3.3.2, the additional pass would not have been necessary as all items were sufficiently detectable at the revised design lane spacing of 2.5 feet.

Because of the numerous responses of unknown source scattered across the grid, only the anomalies due to the seeded items were selected for evaluation.

3.2 DATA DOWNLOAD AND PROCESSING

Data was collected using both EM61MK2A and NAV61 software on the Allegro field computer. File conversion was performed in DAT61 and Trackmaker61, with all other processing being done in Geosoft Oasis Montaj.

3.2.1 File Naming Conventions

Raw files were named according to the following convention:

<System/Team><Month and Day><Survey/QC File Type>, where, for QC files, the following names are observed:

S1A – AM Static Test, Attempt 1 (additional attempts labeled B, C…)

S2A – PM Static Test, Attempt 1 (additional attempts labeled B, C…)

L1A – Latency Test, Attempt 1 (additional attempts labeled B, C.., additional tests 2, 3)

P1A – Positional Test, Attempt 1 (additional attempts labeled B, C., additional tests 2, 3)

K1A – Standalone Kinematic Test No. 1, Attempt 1 (additional attempts labeled B, C…)

6LA – Six Line Test

e.g. A1216S1A is the AM static file for Team/System A on December 16th

Production Files are generally named according to <Grid/Transect><Subsection of Grid/Transect><Attempt>

e.g. 3rd Grid of the day, 2nd subsection (e.g. switched operators), restarted due to line path error would be named "C2B"

3.2.2 *Importing and Positioning of the Data*

Raw data files (*.P61 and *.R61) were copied from the Allegro to a CF card and from there to a field laptop, from where they were transferred to the ARM FTP site for backup and transfer to the offsite data processor. At all times through the GPO activities, backups of the data were retained on the Allegro, the field laptop and the ARM FTP site.

3.2.2.1 GPS Data Collected in NAV61

Raw GPS Data, collected in NAV61 (*.P61), were converted to ASCII format using Trackmaker61. The resulting *.XYZ files, with integral GPS positioning, were then imported into Geosoft using a script to consistently name the database columns and set the Eastings and Northings to NAD83 UTM Zone 20th meters.

3.2.2.2 GPS Data Collected in EM61MK2A

A number of QC files with GPS positioning were collected in EM61MK2A. These *.R61 files were converted to *.M61, each reading positioned with respect to the integral 1Hz GPS string and then exported to ASCII format *.XYZ file in DAT61. The *.XYZ files were then imported into Geosoft for further processing

3.2.2.3 Wheel and Time Fiducials Collected in EM61MK2A

Fiducial data, though collected by different methods, were treated in the same manner. The raw data files were converted and opened in DAT61 and the markers in the data (start/end points of the line and control points where the fiducial marker button had been pressed) positioned with respect to the field notes, ensuring that the length and direction of each line segment was correct. Once the positioning of each file had been checked, the data was exported to ASCII *.XYZ format and imported into Geosoft for further processing.

3.2.3 Filtering and/or DC Adjusting of the Data

Upon import to Geosoft, the data for each survey was viewed in profile mode to check for noise, drift and overall response. Filtering to remove instrument drift was achieved by means of a non-linear drift filter, the settings of which were dependant on the data. Typical settings, depending on the aggressiveness of the filter required and the amount of anomalous response in the profile, were either Low: 0, High: 65 and Window 250 or Low: 0, High: 80 and Window 500.

3.2.4 Lag Correction of the Data

The daily 2-line QC test was used to determine the amount of correction needed to fix any „chevronning" in the data due to time delays between sampling the response and recording the data to file. This correction value was then applied to the data in Geosoft and its effect assessed in mapview and adjusted if necessary. Lag values applied to the data were +3 fiducials (data points) for the GPS data and +6 fiducials for both fiducially positioned files.

3.2.5 Overlap Removal within the Data

Overlap removal was performed, as necessary, in the GPS positioned data. No overlap removal was required for the fiducially positioned data.

3.2.6 Warping of the Data

Because of the nature of fiducially-positioned navigation, both the time fiducial and wheel fiducial data had to be warped to real-world coordinates. The positions were translated using a 4-point warp consisting of the recorded GPO corners. Because of the residual canopy in the grid affecting the accuracy of the GPS-positioned pass, it was also found to be necessary to warp the GPS pass. In this case, the data was warped by means of the anomalies corresponding to the corner pins and the recorded locations of the GPO corners.

3.2.7 Gridding of the data

Grids of the drift-filtered and lag-corrected data were made using the minimum curvature method with a cell size of 0.104m and a blanking distance of 0.52m. The grids were displayed in color-contoured map form and a color scale selected to highlight the anomalies of interest.

3.2.8 Additional Data Analyses

3.2.8.1 Target Selection

On the three seeded GPO passes, targets were selected using the UX-Detect add-on package in Oasis Montaj. Because of the extent of the pre-existing responses, only the anomalies corresponding to the buried seeds were picked as targets. Targets were manually selected using the Blakely method and the target properties (SNR, Signal Strength and Size) calculated. Targets were then exported to ASCII *.XYZ and dig sheets generated for each of the three GPO passes.

3.3 DISCUSSION OF THE GPO RESULTS

3.3.1 Background Pass

The grid of the background GPO pass can be seen in Figure 9:

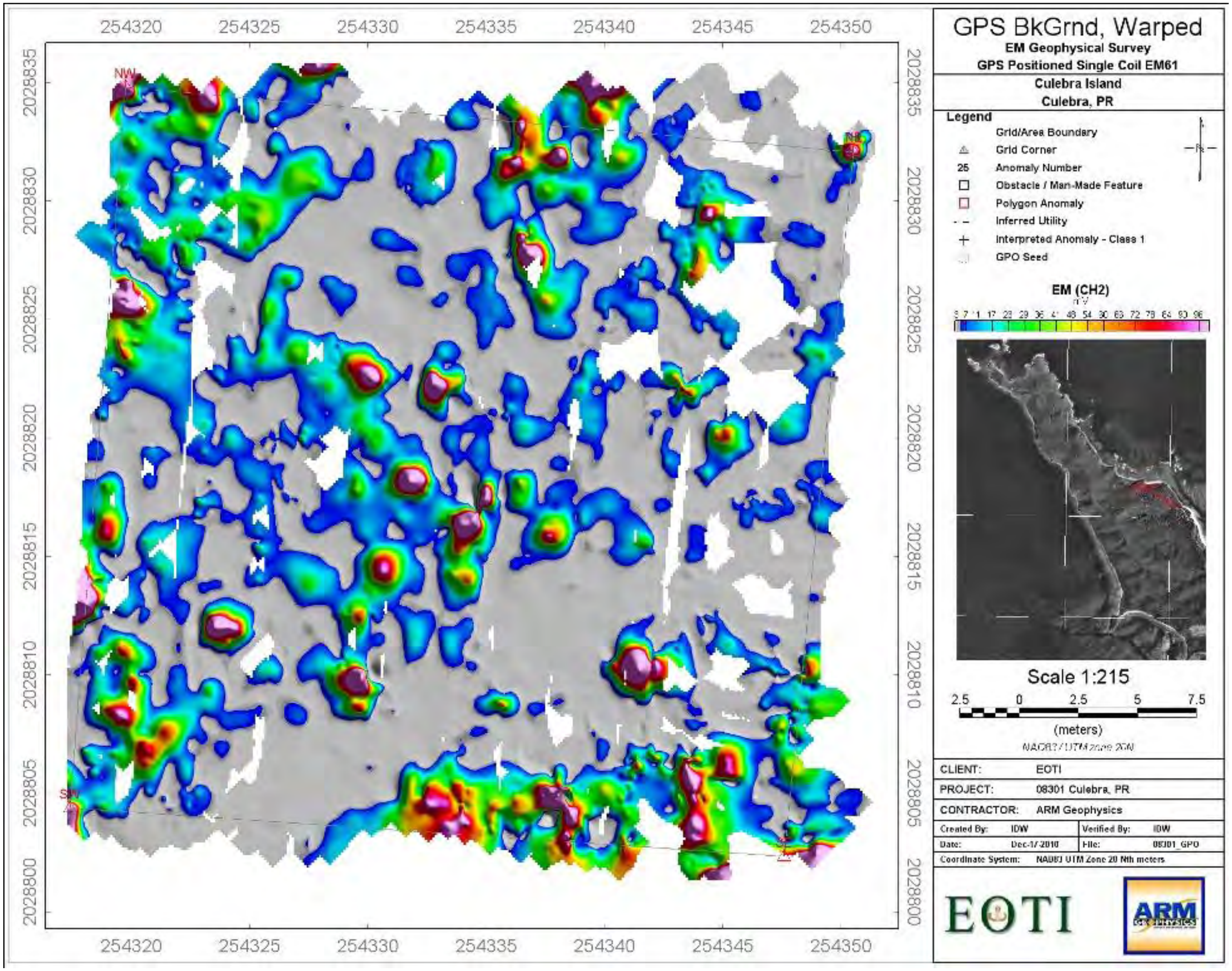


Figure 9 – GPO Background Survey

As can be seen, the grid was relatively noisy and the full seeding plan could not be implemented. Due to logistical considerations, the GPO could not be re-located during this mobilization; however, enough clear, response-free area was in the GPO grid to allow seeding of eight items. Five clear or relatively clear, areas were selected for seeding and the coordinates of the corners of these areas transferred to the field crew and staked out to facilitate seeding.

3.3.2 Seeded Passes

To aid in target picking, the color-contoured grid of the background survey was displayed in semi-transparent mode over the top of each seeded survey. An example of this comparison can be seen in
Figure **10**.

Figure 11 to
Figure 13 shows the three seeded GPO passes with target and seed locations displayed:

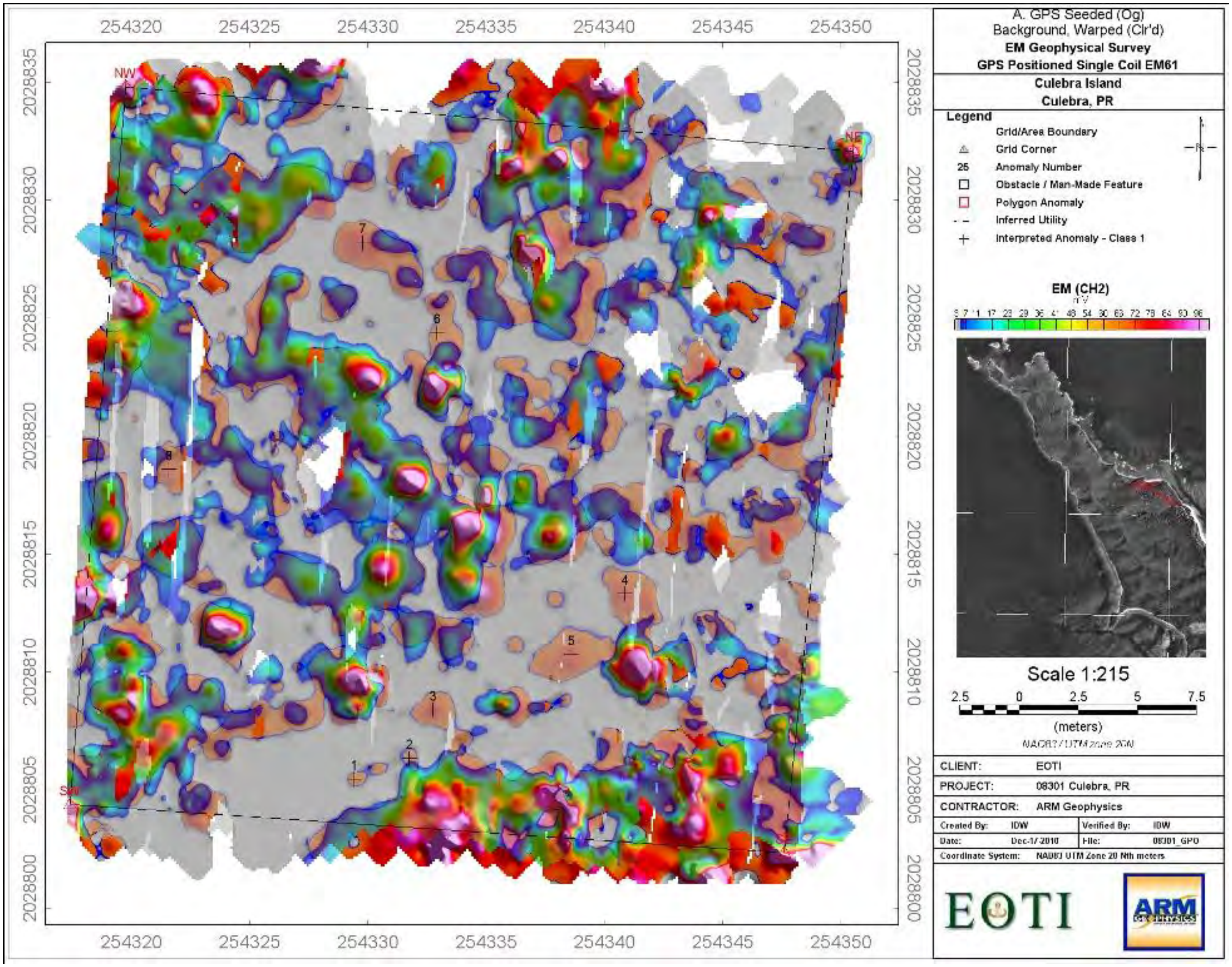


Figure 10 – GPO Background (Colored, Semi-Transparent) Displayed Over Seeded GPS Pass (Orange)

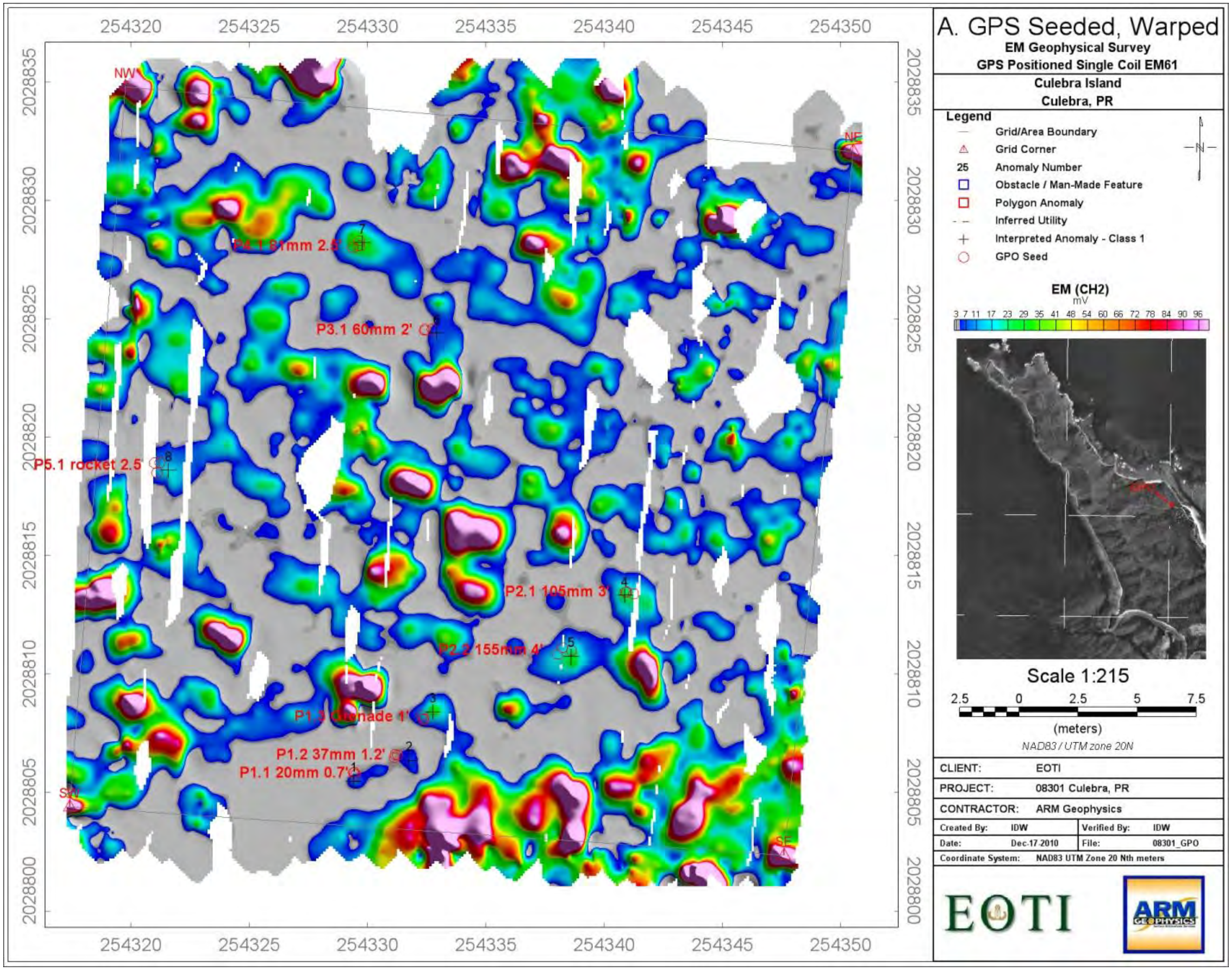


Figure 11 – Seeded GPO; GPS, Litter Mode

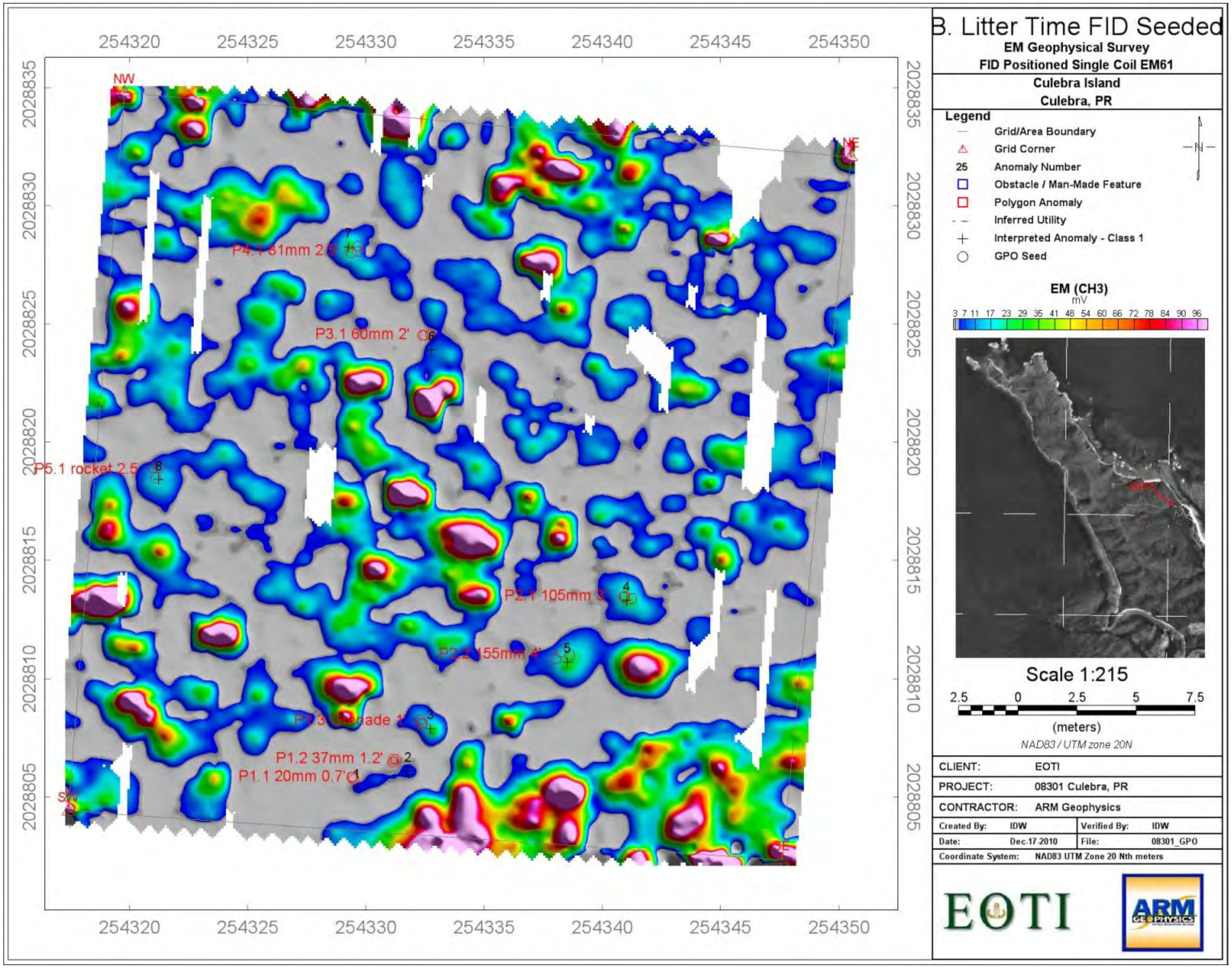


Figure 12 – Seeded GPO; Time Fiducial, Litter Mode

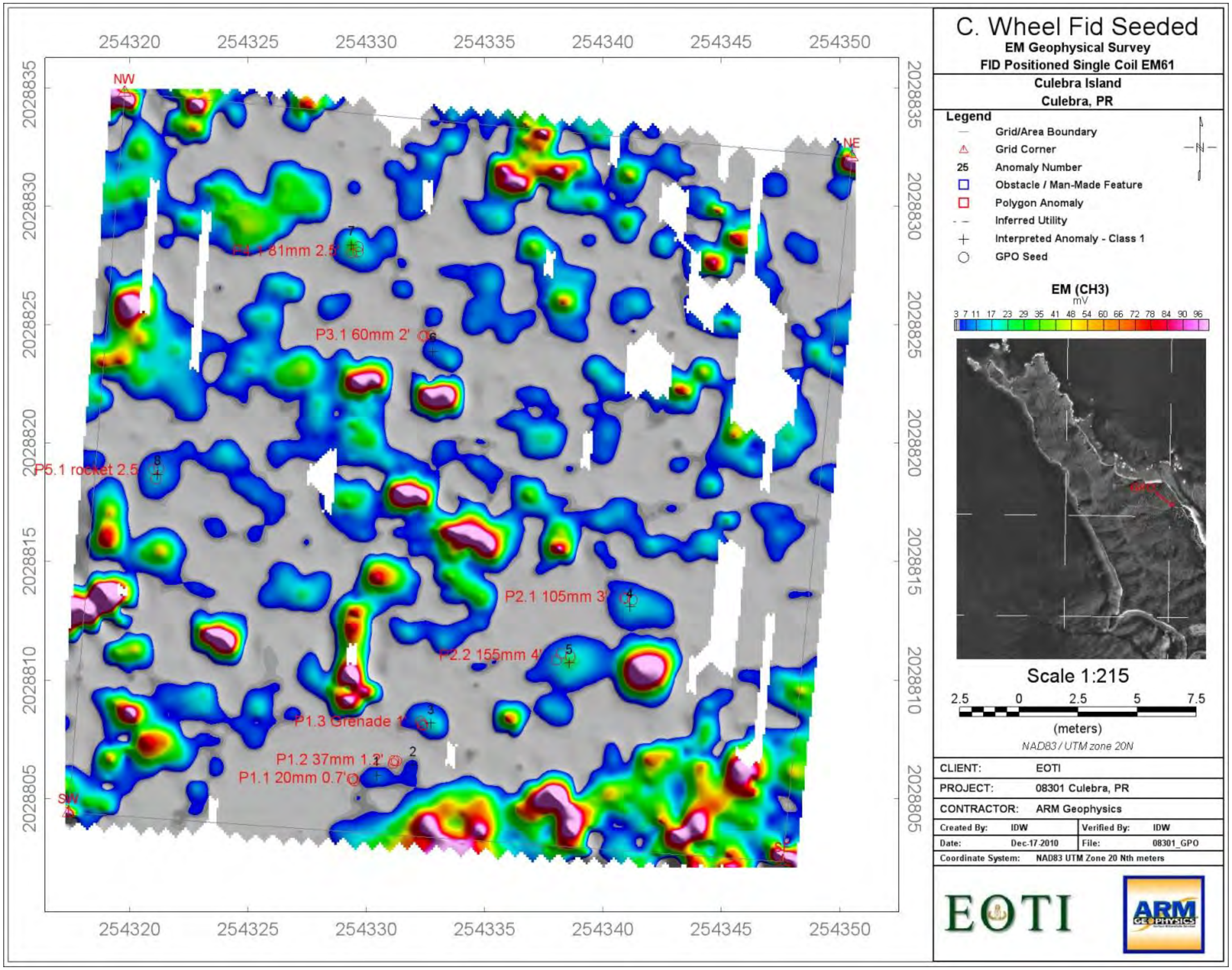


Figure 13 – Seeded GPO; Wheel Fiducial

3.3.2.1 Threshold Value Analysis

All seeds were successfully detected at amplitude levels appropriate to target selection in production data, as can be seen in Table 6:

Table 6 – Seed Responses, Sorted by GPO Pass

	Seed	Item	Depth (ft)	Ch1 (mV)	Ch2 (mV)	Ch3 (mV)	Ch4 (mV)
GPS	1-1	20mm	0.7	14.99	9.91	4.97	2.48
	1-2	37mm	1.2	11.34	6.96	3.67	1.63
	1-3	grenade	1.0	46.43	28.87	13.48	5.15
	2-1	105mm	3.0	38.46	24.43	12.28	5.72
	2-2	155mm	4.0	34.5	24.6	13.73	7.29
	3-1	60mm	2.0	11.8	8.2	4.72	2.43
	4-1	81mm	2.5	42.02	28.73	15.93	7.11
	5-1	2.75" rocket	2.5	28.7	19.07	10.4	4.9
Time FID	1-1	20mm	0.7	8.97	6.27	3.22	1.36
	1-2	37mm	1.2	10.89	6.56	3.51	1.62
	1-3	grenade	1.0	39.93	24.64	12.21	4.77
	2-1	105mm	3.0	37.37	24.62	13.06	6.27
	2-2	155mm	4.0	37.15	25.75	14.57	7.13
	3-1	60mm	2.0	13.78	9.56	5.48	2.9
	4-1	81mm	2.5	35.43	23.73	12.36	5.29
	5-1	2.75" rocket	2.5	25.53	17.25	9.72	4.73
Wheel FID	1-1	20mm	0.7	15.67	10.69	5.44	2.48
	1-2	37mm	1.2	9.14	6.09	3.14	1.41
	1-3	grenade	1.0	28.91	18.78	9.72	4.09
	2-1	105mm	3.0	28.17	18.51	10.03	4.73
	2-2	155mm	4.0	34.71	23.69	13.2	6.26
	3-1	60mm	2.0	15.94	10.86	6.24	3.06
	4-1	81mm	2.5	38.67	25.77	13.36	5.59
	5-1	2.75" rocket	2.5	21.34	14.52	7.98	4.07

Ch2 was selected as the channel to report due to the lack of external noise evident in the data. Ch2 results are summarized in Table 7.

Table 7 - Ch2 Results by Seed and GPO Pass

GPO\Seed	1.1	1.2	1.3	2.1	2.2	3.1	4.1	5.1
GPS	9.91	6.96	28.87	24.43	24.6	8.2	28.73	19.07
Time FID	6.27	6.56	24.64	24.62	25.75	9.56	23.73	17.25
Wheel FID	10.69	6.09	18.78	18.51	23.69	10.86	25.77	14.52

Due to the tight constraints on seeding and the relative inaccuracy of the sub-meter GPS used to stake out the seeding locations, seed 3.1 was inadvertently located close to a pre-existing anomaly. The response of this seed was somewhat masked by this anomaly, however, as can be seen from

Figure **10**, the post seeding anomaly is both a different shape and larger than the pre-seed anomaly and the response of the combined anomaly was such that it would have been selected were this a production grid.

As can be seen from Table 7, the lowest response for a seeded item was 6.09mV on Ch2 for the 37mm at 1.2 feet. Because of this and the consistency in results across the three surveys, ARM is confident in recommending a 5.0mV cutoff for selection of anomalies on Ch2. This threshold, with a built-in 1.0mV buffer, will allow selection of all targets within the GPO and, by extension, allow selection of items down to 20mm and 37mm in their least detectable orientation at or close to maximum depth in production areas.

Because all items were seeded horizontally and close to maximum depth, this recommended threshold is significantly lower than it would have been, were all items in their vertical position. By extension, and considering the responses present in the background GPO pass, there will likely be a large number of targets selected in production areas corresponding to geology or other items „not-of-interest". Should the anticipated depth of the smaller items (20mm, 37mm) be revised upwards, the picking threshold would be able to be raised in-line with the measured curves for ordnance items as all items in the GPO were buried in their least favorable orientation (horizontal).

3.3.2.2 Tau Value Analysis

Analysis of seed item Tau (time constant) values has also been performed, both internally, against an unsorted threshold pick of one of the data sets, and against the modeled data [Tabulated Results; EM61-MK2 Response to Standard Munitions Items (NRL/MR/6110-08-9155)] for items corresponding to seeded items in this GPO. Note: The modeled responses for the 20mm were not tabulated in this dataset. Figure 14 shows the results of this analysis for Tau Ch1-3 plotted against Tau 2-3; the modeled results being for a "D" Mode rather than a "4-Channel" Mode EM61 precluded a comparison of Tau values involving Ch4. As can be seen, the measured values for the horizontal seeded items (worst-case orientation) fall in a relatively restricted area, offering the potential for discrimination against the blind, threshold-only picks (Blakely test, 5.0mV threshold, no sorting). However, when the modeled best-case (vertical) and worst-case (horizontal) values are plotted, the potential tau value range is seen to increase significantly.

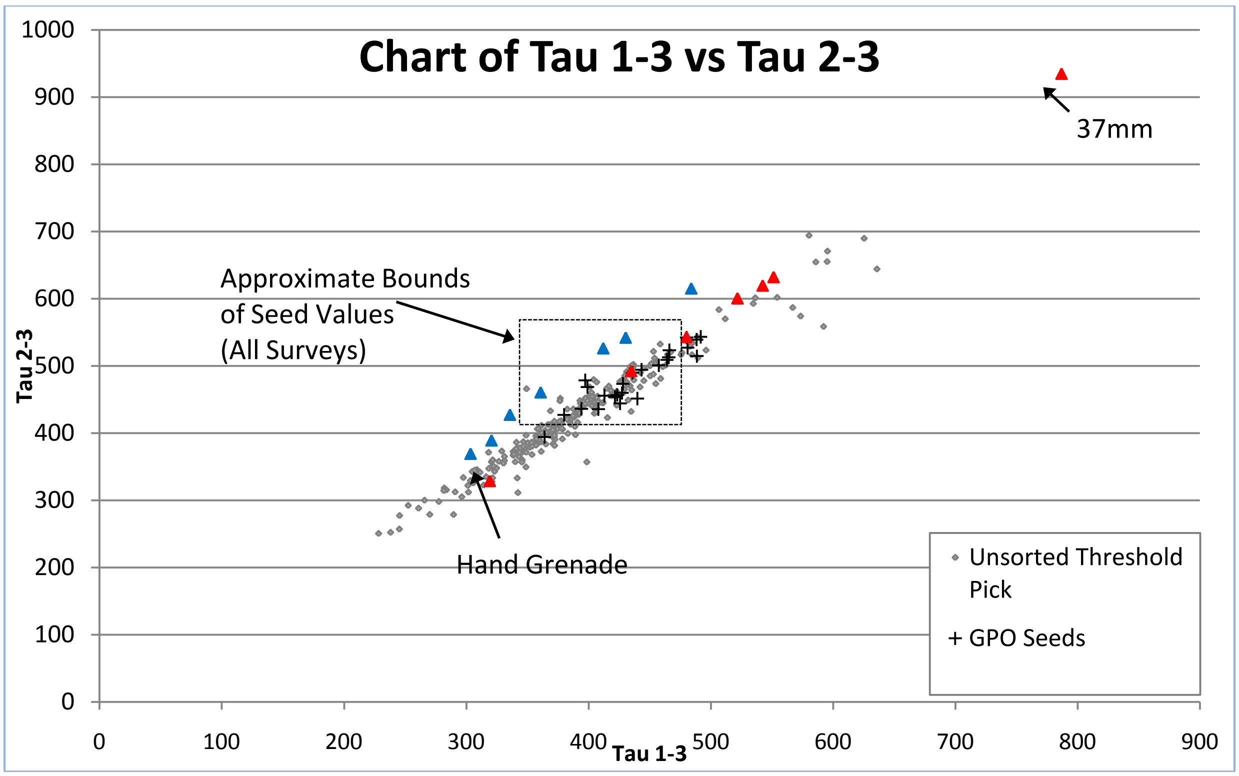


Figure 14 – Chart of Tau 1-3 against Tau 2-3

As clearly demonstrated in Figure 14, if the range suggested by the GPO results were used to restrict items on the digsheets, it would be likely that certain real items, particularly 37mm, would be excluded. The limitations, particularly related to small-sized (and generally small response) ordnance items, is a common problem that has been documented over time and as recently as the results from the trials at Camp Butner. However, in an attempt to utilize as much available information as possible without limiting the results, ARM recommends a four class system to prioritize the intrusive investigations as follows:

Class 1 – above threshold, within boundaries of Tau Range 1;

Class 2 – above threshold, within boundaries Tau Range 2;

Class 3 – between 5mV and 300mV and within boundaries of Tau Range 3; and

Class 4 – all remaining above threshold residual targets.

Class 1 captures all of the items seeded within the GPO while Class 2 captures all the items modeled from the NRL tables, with the exception of a single isolated example (37mm, horizontal). Class 3 extends the range to include the 37mm outlier while limiting the amplitude range to the maximum modeled for the 37mm (vertical) at ground surface to restrict the potential inclusion of larger amplitude clutter. Class 4 includes all remaining anomalies above the amplitude threshold that do not fall into Class 1-3. All of the classes" tau ranges are represented visually in Figure 15 shown below:

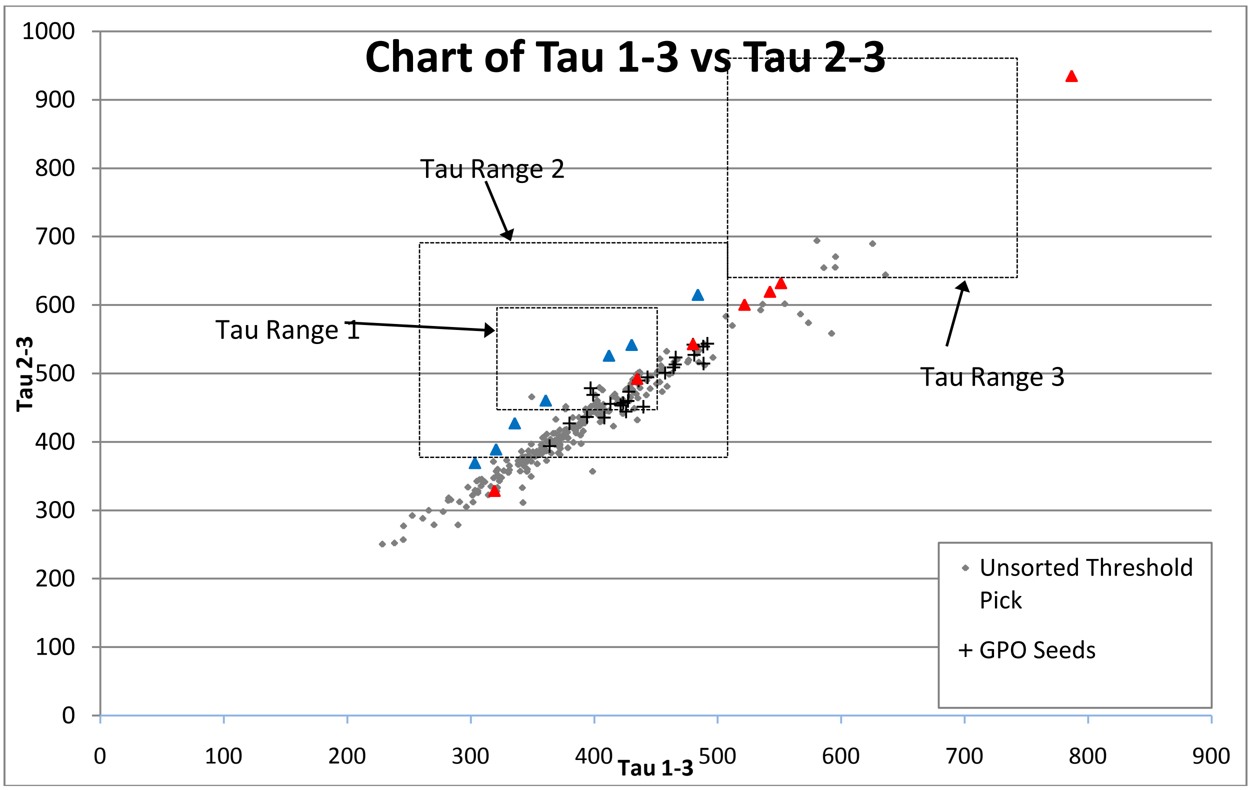


Figure 15 – Tau Value Ranges for Classification

The Tau ranges, as graphically shown in Figure 15, are numerically defined as follows:

<u>Tau Range 1:</u> Tau 1-3: 360 to 495 and Tau 2-3; 390 to 545 (Rounded up/down to nearest 5);

<u>Tau Range 2:</u> Tau 1-3: 290 to 555 and Tau 2-3; 310 to 650 (Buffer of +/- 15); and

Tau Range 3: Tau 1-3: 555 to 800 and Tau 2-3; 600 to 950 (Buffer of +/- 15).

3.3.3 Production-Area Geophysics Recommendations

All three methods implemented were successful in identifying the seeded items. However, because of the anticipated vegetation and canopy in the production areas, the fiducial methods are likely to prove more accurate and useful as long as transect stakes are located accurately (within the accuracy of the GPS system) and the real-world positions are known, in order to both warp the data to the project coordinate system (NAD83 UTM Zone 20m) and to overlay the data on a large-scale map. Due to the extensive canopy cover, reacquisition operations will have to employ the system of measuring distances between transect stakes, particularly in areas of extreme canopy coverage whereby consistent GPS coverage is not realistic along the entire transect. Additionally, of the two fiducial methods, wheel fiducials are generally considered to be more accurate than time fiducials as they are not dependant on constant velocity being maintained between control points. This increased accuracy needs to be weighed against the greater ease of collection over rough terrain afforded by the two-person litter carried mode.

For open-sky situations, where GPS coverage is good, but assuming rough terrain, the systems should be ranked in order of preference as follows:

1. GPS, 2-person litter mode
2. Time Fiducials, two-person litter mode / Wheel Fiducials (depending on severity of terrain)

For areas where canopy is an issue, fiducials should be considered as the navigation method of choice; however, the recommended carrying mode would be dependent on the the terrain.

3.4 Discussion of the Instrument-Aided Reacquisition Results

3.4.1 Digital Instrument Recorded Response Checking

After the items were seeded in the GPO, ARM checked the seed locations (by sweeping the immediate area surrounding the known seed locations) for the peak responses in order to validate EM61 response-depth relationships as compared to the expected values as catalogued in the NRL report (and as compared to the GPO surveys). The peak responses were captured for the primary interpretation channel in order to simulate reacquisition activities for areas where analogue instruments could be hindered. Table 8 compares the average GPO survey response (derived from Table 7) to the re-occupied instrument response.

Table 8 - GPO CH2 Response versus Instrument CH2 Response for each seed.

GPO\Seed	1.1	1.2	1.3	2.1	2.2	3.1	4.1	5.1
GPO Resp.	9	7	24	23	25	10	26	17
INST. Resp.	9	6	18	20	20	5	20	20
Item Type	20mm	37mm	grenade	105mm	155mm	60mm	81mm	2.75"
Depth (ft)	0.7	1.2	1.0	3.0	4.0	2.0	2.5	2.5

As can be seen from Table 8, there are a few discrepancies (between the two sets of responses) but nothing out of the ordinary given the site conditions. As a matter of practicality, however, the EM61 is expected to be a secondary reacquire instrument and the analogue instruments are expected to be the primary reacquire instrument due to both the inherent flexibility of analogue system and greater ease of mobility for the operators across the site. The EM61 can be used to supplement reacquire activities or sort out any confusing areas. The analog instruments, discussed next, are also expected to be used in areas where terrain or other features may not safely allow the use of the EM61 instrumentation for data acquisition. Residual areas will be documented accordingly.

3.4.2 Analogue Instrument Audible Response Checking

After the items were seeded in the GPO, EOTI checked the seed locations for the peak responses in order to validate analog instruments audibility (and inferred detection) in order to validate the utilization of tested instruments for use as either a primary instrument or a supplementary instrument during data acquisition and reacquire operations. EOTI evaluated two different analog instruments, which included a White‟s XLT and a White‟s DFX 300. The White‟s XLT operates at a single frequency of 6.5 Khz, while the White‟s DFX 300 transmits at two frequencies – 3 KHz and 15KHz. The instruments were evaluated in the GPO and in a separate geophysical test strip. The test strip, shown in Figure 16, is 6 ft by 15ft.

Table 9 provides the size, position, and depth of each seed item included in the geophysical test strip. Location shown in the table (x,y) are given in inches and are measured from the Southwest corner of the test strip. All items are oriented horizontally with the top of the item at the depth shown in the table. The test strip is located in the same general area as the magazine and the GPO and the coordinates for its corners are:

SW – 665613.03N 834829.21E NW – 6656024.89N 834820.54E

SE – 6656017.79N 834832.97E SW – 6656028.07N 834823.44E

Table 9 – List of Seeds – Geophysical Test Strip

Seed #	Seed Description	Size (inches)	X (inches)	Y (inches)	Z (inches)
1	Pipe	4.5 x 12	33	132	36
2	Rotating Band from 3" Projectile	3/4 x 9.5	50	84	6
3	Pipe	1 x 4	18	48	5
4	Pipe	1 1/4 x 4	48	24	4
5	Pipe	2 1/4 x 8	14	168	9
6	81mm (body only)	3 1/5 x 8	12	96	8
7	76mm Projo Nose with partial nose fuze	3 x 1 1/2	36	72	6
8	120mm Mortar piece	4 1/2 x 7	48	156	14

Figure 16 – Geophysical Test Strip used to Evaluate Analog instruments

Both instruments were able to detect all but the first (and deepest) seed item in the Geophysical Test Strip. The two analog instruments were also tested on the GPO and were able to clearly and consistently detect the seed items buried at one foot and shallower. Deeper anomalies were not detected by either analog instrument.

4.0 CONCLUSIONS

In conclusion, ARM mobilized two qualified geophysicists to Culebra Island between December 13th and December 17th, 2010 to conduct GPO activities in association with EOTI. One background (pre-seeding) survey was completed on December 14th followed by GPO seeding on December 15th and finally three post-seeded surveys were completed on December 16th. The post-seed surveys utilized the mobilized crew of two geophysicists to complete litter mode and wheeled mode surveys with GPS and fiducial positioning methods. Regardless of positioning method demonstrated, the EM61 sensor data acquisition at the revised design lane spacing of 2.5 feet was proven to adequately capture and detect all items seeded within the confines of the GPO grid at the worse-case seeded orientation and depth.

For maximum efficiency in variable-canopied terrain, if all of the transect areas are to be digitally sampled, ARM recommends the use of fiducial methods over GPS. If, however, large and connected transect sections are available with unencumbered view of the sky, a mix of GPS and fiducial methods should be employed. For accuracy of position, Wheel fiducials are to be preferred over Time fiducials, however, the ease of movement over very rough terrain with the EM61 in two-person „litter‟ carried mode should not be discounted.

Finally, ARM recommends that the interpretation of the acquired data begin with a starting threshold of 5.0 mV on channel 2 and increase this threshold, if feasible, based on the preliminary intrusive investigation results, once a catalogue of items is available to supplement the current GPO results. ARM also recommends the use of four categories of classification system based on a combination of threshold and Tau value analysis to further prioritize anomalies for intrusive investigation. During preliminary investigations, all locations may have to be intrusively investigated until the results of the GPO are validated by intrusive investigation results in the field. Once validated, however, ARM plans to weight the first two priorities higher than the last two.

Although the analog instruments proved less effective at locating anomalies deep (near 11 times diameter) at the most challenging orientation (horizontal), they can be effective in collecting the data required along the transects. The primary purpose of the transect data is to identify the location of previous targets or impact areas. These areas are reasonably expected to have high concentration of MD, most of which is expected between the surface and the maximum penetration depth of the munitions. It is therefore expected that a significant amount of MD would be detected near the surface with the analog instruments in these areas of concern. An added advantage to using a "mag and dig" technique with analog instruments is the elimination of the reacquisition step. Many of the transect segments will be collected in the fiducial mode and the transect paths change directionality often in order to avoid restrictive terrain or vegetation marked by the biologist. This will make it very challenging and time consuming to accurately reacquire selected anomalies.

Lastly, all of the raw, preliminarily processed, and final processed data were posted to EOTI"s FTP site on Monday December 20th, 2010, prior to subsequent review by the USAESCH. The databases associated with the deliverables will be made available on EOTI"s FTP site once completed.

APPENDIX A:
Reference Tables

Exhibit A-1:
Table of Ordnance Penetration/Detection
(Excerpted from USACE Guidance Document)

Table 7.3
Ordnance Penetration/Detection

Ordnance Item	Depth of Penetration (ft)[1,2]			Typical Max Detection Depth[4] (ft)	
	Sand	Loam	Clay	Magnetometry	TDEM[5]
14.5 mm Trainer/Spotter, M1813A1	0.2	0.3	0.4	0.3	0.5
20mm, M56A4	2.3	3.0	4.6	0.4	0.7
22 mm Subcal for 81 mm mortar	1.4	1.9	2.8	0.5	0.8
35 mm Subcal M73	0.5	0.7	1.0	0.9	1.3
37 mm, M63	3.9	5.2	7.9	1.0	1.3
40 mm, M822 (AA)	2.3	3.0	4.5	1.1	1.4
40 mm, M677 (Mk 19)	0.2	0.3	0.4	1.1	1.4
40 mm, M381 (M203/M79)	0.2	0.3	0.4	1.1	1.4
Mk 118 Bomblet	1.9	2.4	3.7	1.5	1.8
Mk 23 3 lb. Practice Bomb	2.7	3.5	5.4	1.7	2.0
57 mm, M306A1	2.7	3.6	5.5	1.7	2.0
M9 Rifle Grenade	0.1	0.2	0.2	1.7	2.0
2.25" Rocket, Mk 4	4.0	5.2	8.0	1.7	2.0
60 mm, M49A1 (charge 4)	1.1	1.5	2.3	1.9	2.2
2.36" Rocket, M6A1	0.4	0.5	0.8	1.9	2.2
66 mm, M72 LAW	0.9	1.2	1.8	2.1	2.4
66 mm TPA, M74	0.7	0.9	1.4	2.1	2.4
BLU-3/B,-27/B,-28/B	2.2	2.9	4.4	2.3	2.5
2.75" Rocket, Practice	8.1	10.7	16.3	2.3	2.5
6 lb. Incendiary Bomb	3.4	4.4	6.7	2.4	2.6
75 mm, M48	4.9	6.4	9.8	2.5	2.7
75 mm, M310	3.9	5.1	7.8	2.5	2.7
81 mm, M43A1 (charge 8)	2.7	3.5	5.4	2.8	2.9
83 mm SMAW Mk 3	2.8	3.6	5.6	2.9	3.0

Table 7.3
Ordnance Penetration/Detection
(Continued)

Ordnance Item	Depth of Penetration (ft)[1,2]			Typical Max Detection Depth[4] (ft)	
	Sand	Loam	Clay	Magnetometry	TDEM[5]
84 mm, M136 (AT4)	2.5	3.7	5.0	2.9	3.0
3.5" Rocket, M28	0.8	1.1	1.7	3.2	3.2
90 mm, M371A1	2.0	2.7	4.1	3.2	3.2
25 lb. Frag Bomb[3]	2.1	2.8	4.3	3.2	3.2
AN-M41A1 20 lb. Practice Bomb	5.0	6.6	10.0	3.3	3.3
105 mm, M1 (charge 7)	7.7	10.1	15.4	4.0	3.8
106 mm, M344A1	6.5	8.5	13.0	4.0	3.8
4.2" Mortar, M3 (max charge)	4.1	5.4	8.3	4.1	3.9
Dragon Guided Missile	0.9	1.1	1.7	4.3	4.0
155 mm, M107	14.0	16.4	28.0	6.7	5.6
8", M106 (charge 8)	16.4	24.2	36.9	9.7	7.3
M38A2 100 lb. Practice Bomb	8.6	11.3	15.2	9.9	7.4

[1]Penetration depths include the following "worst-case" conditions assumptions: impact velocity is equal to maximum velocity of round; impact is perpendicular to ground surface; munition decelerates subsurface in a straight line; munition does not deform upon impact. Typical penetration depth for any individual item will usually be significantly less.

[2]Actual detection depth may vary based on field conditions and be either lower or deeper.

[3]All bombs are assumed to have an impact velocity of 1135 feet per second.

[4]Maximum depth of penetration assuming a velocity of 500 fps.

[5]Time Domain Electromagnetics
Rev 1-5/11/99

Exhibit A-2:
Tables of EM61 Response as a Function of Depth Below EM61 Coil
(Excerpted from NRL Report)

Predicted EM61-MK2 Response to a Small Surrogate

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	378.3	43.6	263.3	24.2	155.1	10.8	72.9	3.8
43	350.7	40.4	244.1	22.4	143.8	10.0	67.6	3.5
44	325.2	37.5	226.3	20.8	133.3	9.3	62.7	3.3
45	301.8	34.8	210.0	19.3	123.7	8.6	58.2	3.0
46	280.1	32.3	194.9	17.9	114.8	8.0	54.0	2.8
47	260.1	30.0	181.0	16.6	106.7	7.4	50.1	2.6
48	241.7	27.9	168.2	15.4	99.1	6.9	46.6	2.4
49	224.7	25.9	156.4	14.4	92.1	6.4	43.3	2.3
50	208.9	24.1	145.4	13.4	85.7	6.0	40.3	2.1
51	194.4	22.4	135.3	12.4	79.7	5.5	37.5	2.0
52	181.0	20.9	126.0	11.6	74.2	5.2	34.9	1.8
53	168.6	19.4	117.3	10.8	69.1	4.8	32.5	1.7
54	157.1	18.1	109.3	10.0	64.4	4.5	30.3	1.6
55	146.4	16.9	101.9	9.4	60.0	4.2	28.2	1.5
56	136.6	15.8	95.1	8.7	56.0	3.9	26.3	1.4
57	127.5	14.7	88.7	8.1	52.3	3.6	24.6	1.3
58	119.0	13.7	82.8	7.6	48.8	3.4	22.9	1.2
59	111.2	12.8	77.4	7.1	45.6	3.2	21.4	1.1
60	103.9	12.0	72.3	6.6	42.6	3.0	20.0	1.0
61	97.2	11.2	67.6	6.2	39.8	2.8	18.7	1.0
62	90.9	10.5	63.3	5.8	37.3	2.6	17.5	0.9
63	85.1	9.8	59.2	5.4	34.9	2.4	16.4	0.9
64	79.7	9.2	55.5	5.1	32.7	2.3	15.4	0.8
65	74.7	8.6	52.0	4.8	30.6	2.1	14.4	0.8
66	70.0	8.1	48.7	4.5	28.7	2.0	13.5	0.7
67	65.6	7.6	45.7	4.2	26.9	1.9	12.7	0.7
68	61.6	7.1	42.9	3.9	25.2	1.8	11.9	0.6
69	57.8	6.7	40.2	3.7	23.7	1.6	11.1	0.6
70	54.3	6.3	37.8	3.5	22.3	1.5	10.5	0.6
71	51.0	5.9	35.5	3.3	20.9	1.5	9.8	0.5
72	47.9	5.5	33.4	3.1	19.7	1.4	9.2	0.5
73	45.1	5.2	31.4	2.9	18.5	1.3	8.7	0.5
74	42.4	4.9	29.5	2.7	17.4	1.2	8.2	0.4
75	39.9	4.6	27.8	2.6	16.4	1.1	7.7	0.4
76	37.6	4.3	26.2	2.4	15.4	1.1	7.3	0.4
77	35.4	4.1	24.7	2.3	14.5	1.0	6.8	0.4
78	33.4	3.9	23.2	2.1	13.7	1.0	6.4	0.3
79	31.5	3.6	21.9	2.0	12.9	0.9	6.1	0.3

Predicted EM61-MK2 Response to a 37-mm Projectile

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	287.3	77.4	223.5	41.1	162.1	19.0	168.4	22.9
43	266.3	71.7	207.2	38.1	150.3	17.6	157.0	21.4
44	247.0	66.5	192.1	35.3	139.4	16.3	146.6	19.9
45	229.2	61.7	178.3	32.7	129.3	15.2	136.8	18.6
46	212.7	57.3	165.5	30.4	120.1	14.1	127.8	17.4
47	197.6	53.2	153.7	28.2	111.5	13.1	119.4	16.2
48	183.6	49.4	142.8	26.2	103.6	12.1	111.7	15.2
49	170.6	46.0	132.7	24.4	96.3	11.3	104.5	14.2
50	158.7	42.7	123.4	22.7	89.6	10.5	97.7	13.3
51	147.7	39.8	114.9	21.1	83.3	9.8	91.5	12.4
52	137.5	37.0	106.9	19.6	77.6	9.1	85.7	11.7
53	128.0	34.5	99.6	18.3	72.3	8.5	80.3	10.9
54	119.3	32.1	92.8	17.0	67.3	7.9	75.3	10.2
55	111.2	30.0	86.5	15.9	62.8	7.4	70.6	9.6
56	103.7	27.9	80.7	14.8	58.5	6.9	66.3	9.0
57	96.8	26.1	75.3	13.8	54.6	6.4	62.2	8.5
58	90.4	24.3	70.3	12.9	51.0	6.0	58.5	8.0
59	84.4	22.7	65.7	12.1	47.7	5.6	54.9	7.5
60	78.9	21.3	61.4	11.3	44.5	5.2	51.7	7.0
61	73.8	19.9	57.4	10.5	41.6	4.9	48.6	6.6
62	69.0	18.6	53.7	9.9	39.0	4.6	45.7	6.2
63	64.6	17.4	50.3	9.2	36.5	4.3	43.0	5.8
64	60.5	16.3	47.1	8.6	34.2	4.0	40.5	5.5
65	56.7	15.3	44.1	8.1	32.0	3.7	38.2	5.2
66	53.1	14.3	41.3	7.6	30.0	3.5	36.0	4.9
67	49.8	13.4	38.8	7.1	28.1	3.3	34.0	4.6
68	46.8	12.6	36.4	6.7	26.4	3.1	32.0	4.4
69	43.9	11.8	34.1	6.3	24.8	2.9	30.2	4.1
70	41.2	11.1	32.1	5.9	23.3	2.7	28.6	3.9
71	38.7	10.4	30.1	5.5	21.9	2.6	27.0	3.7
72	36.4	9.8	28.3	5.2	20.6	2.4	25.5	3.5
73	34.2	9.2	26.6	4.9	19.3	2.3	24.1	3.3
74	32.2	8.7	25.1	4.6	18.2	2.1	22.8	3.1
75	30.3	8.2	23.6	4.3	17.1	2.0	21.6	2.9
76	28.6	7.7	22.2	4.1	16.1	1.9	20.4	2.8
77	26.9	7.2	20.9	3.8	15.2	1.8	19.3	2.6
78	25.4	6.8	19.7	3.6	14.3	1.7	18.3	2.5
79	23.9	6.4	18.6	3.4	13.5	1.6	17.4	2.4
80	22.6	6.1	17.6	3.2	12.7	1.5	16.5	2.2
81	21.3	5.7	16.6	3.0	12.0	1.4	15.6	2.1

Predicted EM61-MK2 Response to a Hand Grenade

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	271.8	75.4	165.3	38.5	66.4	17.1	68.9	20.6
43	251.9	69.9	153.2	35.7	61.5	15.9	64.3	19.2
44	233.6	64.9	142.1	33.1	57.1	14.7	60.0	17.9
45	216.8	60.2	131.8	30.7	52.9	13.6	56.0	16.8
46	201.2	55.9	122.4	28.5	49.1	12.7	52.3	15.7
47	186.9	51.9	113.7	26.5	45.6	11.8	48.9	14.6
48	173.6	48.2	105.6	24.6	42.4	10.9	45.7	13.7
49	161.4	44.8	98.2	22.9	39.4	10.2	42.8	12.8
50	150.1	41.7	91.3	21.3	36.7	9.5	40.0	12.0
51	139.7	38.8	84.9	19.8	34.1	8.8	37.5	11.2
52	130.0	36.1	79.1	18.4	31.8	8.2	35.1	10.5
53	121.1	33.6	73.7	17.2	29.6	7.6	32.9	9.8
54	112.8	31.3	68.6	16.0	27.6	7.1	30.8	9.2
55	105.2	29.2	64.0	14.9	25.7	6.6	28.9	8.6
56	98.1	27.2	59.7	13.9	24.0	6.2	27.1	8.1
57	91.6	25.4	55.7	13.0	22.4	5.8	25.5	7.6
58	85.5	23.7	52.0	12.1	20.9	5.4	23.9	7.2
59	79.9	22.2	48.6	11.3	19.5	5.0	22.5	6.7
60	74.7	20.7	45.4	10.6	18.2	4.7	21.1	6.3
61	69.8	19.4	42.5	9.9	17.0	4.4	19.9	6.0
62	65.3	18.1	39.7	9.3	15.9	4.1	18.7	5.6
63	61.1	17.0	37.2	8.7	14.9	3.8	17.6	5.3
64	57.2	15.9	34.8	8.1	14.0	3.6	16.6	5.0
65	53.6	14.9	32.6	7.6	13.1	3.4	15.6	4.7
66	50.3	14.0	30.6	7.1	12.3	3.2	14.7	4.4
67	47.1	13.1	28.7	6.7	11.5	3.0	13.9	4.2
68	44.2	12.3	26.9	6.3	10.8	2.8	13.1	3.9
69	41.5	11.5	25.3	5.9	10.1	2.6	12.4	3.7
70	39.0	10.8	23.7	5.5	9.5	2.5	11.7	3.5
71	36.6	10.2	22.3	5.2	9.0	2.3	11.0	3.3
72	34.4	9.6	21.0	4.9	8.4	2.2	10.4	3.1
73	32.4	9.0	19.7	4.6	7.9	2.0	9.9	3.0
74	30.5	8.5	18.5	4.3	7.4	1.9	9.3	2.8
75	28.7	8.0	17.5	4.1	7.0	1.8	8.8	2.6
76	27.0	7.5	16.4	3.8	6.6	1.7	8.4	2.5
77	25.5	7.1	15.5	3.6	6.2	1.6	7.9	2.4
78	24.0	6.7	14.6	3.4	5.9	1.5	7.5	2.2
79	22.6	6.3	13.8	3.2	5.5	1.4	7.1	2.1
80	21.4	5.9	13.0	3.0	5.2	1.3	6.7	2.0
81	20.2	5.6	12.3	2.9	4.9	1.3	6.4	1.9

Predicted EM61-MK2 Response to a 105-mm Projectile

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
132	39.7	21.0	28.2	12.9	17.5	7.4	27.6	13.5
133	38.1	20.2	27.1	12.3	16.8	7.1	26.5	13.0
134	36.6	19.4	26.0	11.9	16.2	6.8	25.6	12.5
135	35.2	18.6	25.0	11.4	15.5	6.6	24.6	12.0
136	33.8	17.9	24.0	10.9	14.9	6.3	23.7	11.6
137	32.5	17.2	23.1	10.5	14.4	6.0	22.9	11.2
138	31.2	16.5	22.2	10.1	13.8	5.8	22.1	10.8
139	30.0	15.9	21.3	9.7	13.3	5.6	21.3	10.4
140	28.9	15.3	20.5	9.4	12.8	5.4	20.5	10.0
141	27.8	14.7	19.7	9.0	12.3	5.2	19.8	9.7
142	26.7	14.2	19.0	8.7	11.8	5.0	19.1	9.3
143	25.7	13.6	18.3	8.3	11.4	4.8	18.4	9.0
144	24.8	13.1	17.6	8.0	11.0	4.6	17.8	8.7
145	23.8	12.6	16.9	7.7	10.5	4.4	17.2	8.4
146	23.0	12.2	16.3	7.4	10.2	4.3	16.6	8.1
147	22.1	11.7	15.7	7.2	9.8	4.1	16.0	7.8
148	21.3	11.3	15.1	6.9	9.4	4.0	15.4	7.6
149	20.5	10.9	14.6	6.7	9.1	3.8	14.9	7.3
150	19.8	10.5	14.1	6.4	8.8	3.7	14.4	7.0
151	19.1	10.1	13.6	6.2	8.4	3.6	13.9	6.8
152	18.4	9.8	13.1	6.0	8.1	3.4	13.5	6.6
153	17.8	9.4	12.6	5.8	7.9	3.3	13.0	6.4
154	17.1	9.1	12.2	5.5	7.6	3.2	12.6	6.2
155	16.5	8.8	11.7	5.4	7.3	3.1	12.2	6.0
156	16.0	8.5	11.3	5.2	7.1	3.0	11.8	5.8
157	15.4	8.2	10.9	5.0	6.8	2.9	11.4	5.6
158	14.9	7.9	10.6	4.8	6.6	2.8	11.0	5.4
159	14.4	7.6	10.2	4.7	6.4	2.7	10.7	5.2
160	13.9	7.4	9.9	4.5	6.1	2.6	10.3	5.0
161	13.4	7.1	9.5	4.3	5.9	2.5	10.0	4.9
162	12.9	6.9	9.2	4.2	5.7	2.4	9.7	4.7
163	12.5	6.6	8.9	4.1	5.5	2.3	9.4	4.6
164	12.1	6.4	8.6	3.9	5.3	2.3	9.1	4.4
165	11.7	6.2	8.3	3.8	5.2	2.2	8.8	4.3
166	11.3	6.0	8.0	3.7	5.0	2.1	8.5	4.2
167	10.9	5.8	7.8	3.5	4.8	2.0	8.3	4.0
168	10.6	5.6	7.5	3.4	4.7	2.0	8.0	3.9
169	10.2	5.4	7.3	3.3	4.5	1.9	7.8	3.8
170	9.9	5.2	7.0	3.2	4.4	1.8	7.5	3.7
171	9.6	5.1	6.8	3.1	4.2	1.8	7.3	3.6
172	9.3	4.9	6.6	3.0	4.1	1.7	7.1	3.5
173	9.0	4.8	6.4	2.9	4.0	1.7	6.9	3.4
174	8.7	4.6	6.2	2.8	3.8	1.6	6.7	3.3
175	8.4	4.5	6.0	2.7	3.7	1.6	6.5	3.2
176	8.1	4.3	5.8	2.6	3.6	1.5	6.3	3.1

Predicted EM61-MK2 Response to a 155-mm Projectile

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
132	91.6	62.5	64.8	40.2	39.9	24.7	62.8	45.0
133	87.9	60.0	62.2	38.6	38.3	23.7	60.4	43.3
134	84.4	57.6	59.8	37.0	36.8	22.7	58.2	41.7
135	81.1	55.4	57.4	35.6	35.4	21.8	56.1	40.2
136	78.0	53.2	55.2	34.2	34.0	21.0	54.0	38.7
137	74.9	51.1	53.0	32.9	32.7	20.2	52.1	37.3
138	72.0	49.2	51.0	31.6	31.4	19.4	50.2	36.0
139	69.3	47.3	49.0	30.4	30.2	18.7	48.4	34.7
140	66.6	45.5	47.2	29.2	29.1	17.9	46.7	33.4
141	64.1	43.8	45.4	28.1	28.0	17.3	45.0	32.3
142	61.7	42.1	43.7	27.1	26.9	16.6	43.4	31.1
143	59.4	40.5	42.0	26.0	25.9	16.0	41.9	30.0
144	57.2	39.0	40.5	25.1	24.9	15.4	40.5	29.0
145	55.0	37.6	39.0	24.1	24.0	14.8	39.1	28.0
146	53.0	36.2	37.5	23.2	23.1	14.3	37.7	27.0
147	51.1	34.9	36.1	22.4	22.3	13.7	36.4	26.1
148	49.2	33.6	34.8	21.6	21.5	13.3	35.2	25.2
149	47.4	32.4	33.6	20.8	20.7	12.8	34.0	24.3
150	45.7	31.2	32.3	20.0	19.9	12.3	32.8	23.5
151	44.1	30.1	31.2	19.3	19.2	11.9	31.7	22.7
152	42.5	29.0	30.1	18.6	18.5	11.4	30.7	22.0
153	41.0	28.0	29.0	18.0	17.9	11.0	29.6	21.2
154	39.5	27.0	28.0	17.3	17.2	10.7	28.7	20.5
155	38.2	26.0	27.0	16.7	16.6	10.3	27.7	19.9
156	36.8	25.1	26.1	16.1	16.1	9.9	26.8	19.2
157	35.5	24.3	25.2	15.6	15.5	9.6	25.9	18.6
158	34.3	23.4	24.3	15.0	15.0	9.2	25.1	18.0
159	33.1	22.6	23.5	14.5	14.5	8.9	24.3	17.4
160	32.0	21.8	22.7	14.0	14.0	8.6	23.5	16.8
161	30.9	21.1	21.9	13.6	13.5	8.3	22.8	16.3
162	29.9	20.4	21.1	13.1	13.0	8.0	22.0	15.8
163	28.9	19.7	20.4	12.7	12.6	7.8	21.3	15.3
164	27.9	19.0	19.7	12.2	12.2	7.5	20.7	14.8
165	27.0	18.4	19.1	11.8	11.8	7.3	20.0	14.3
166	26.1	17.8	18.5	11.4	11.4	7.0	19.4	13.9
167	25.2	17.2	17.9	11.1	11.0	6.8	18.8	13.5
168	24.4	16.7	17.3	10.7	10.6	6.6	18.2	13.1
169	23.6	16.1	16.7	10.3	10.3	6.4	17.7	12.7
170	22.8	15.6	16.2	10.0	10.0	6.2	17.1	12.3
171	22.1	15.1	15.6	9.7	9.6	5.9	16.6	11.9
172	21.4	14.6	15.1	9.4	9.3	5.8	16.1	11.5
173	20.7	14.1	14.7	9.1	9.0	5.6	15.6	11.2
174	20.0	13.7	14.2	8.8	8.7	5.4	15.1	10.9
175	19.4	13.2	13.7	8.5	8.5	5.2	14.7	10.5
176	18.8	12.8	13.3	8.2	8.2	5.1	14.3	10.2

Predicted EM61-MK2 Response to a 155-mm Projectile

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
177	18.2	12.4	12.9	8.0	7.9	4.9	13.8	9.9
178	17.6	12.0	12.5	7.7	7.7	4.7	13.4	9.6
179	17.1	11.7	12.1	7.5	7.5	4.6	13.0	9.3
180	16.6	11.3	11.7	7.3	7.2	4.5	12.7	9.1
181	16.1	11.0	11.4	7.0	7.0	4.3	12.3	8.8
182	15.6	10.6	11.0	6.8	6.8	4.2	11.9	8.6
183	15.1	10.3	10.7	6.6	6.6	4.1	11.6	8.3
184	14.6	10.0	10.4	6.4	6.4	3.9	11.3	8.1
185	14.2	9.7	10.0	6.2	6.2	3.8	10.9	7.8
186	13.8	9.4	9.7	6.0	6.0	3.7	10.6	7.6
187	13.4	9.1	9.5	5.9	5.8	3.6	10.3	7.4
188	13.0	8.8	9.2	5.7	5.7	3.5	10.0	7.2
189	12.6	8.6	8.9	5.5	5.5	3.4	9.8	7.0
190	12.2	8.3	8.6	5.3	5.3	3.3	9.5	6.8
191	11.9	8.1	8.4	5.2	5.2	3.2	9.2	6.6
192	11.5	7.9	8.1	5.0	5.0	3.1	9.0	6.4
193	11.2	7.6	7.9	4.9	4.9	3.0	8.7	6.2
194	10.8	7.4	7.7	4.8	4.7	2.9	8.5	6.1
195	10.5	7.2	7.5	4.6	4.6	2.8	8.3	5.9
196	10.2	7.0	7.2	4.5	4.5	2.8	8.0	5.8
197	9.9	6.8	7.0	4.4	4.3	2.7	7.8	5.6
198	9.7	6.6	6.8	4.2	4.2	2.6	7.6	5.4
199	9.4	6.4	6.6	4.1	4.1	2.5	7.4	5.3
200	9.1	6.2	6.5	4.0	4.0	2.5	7.2	5.2
201	8.9	6.1	6.3	3.9	3.9	2.4	7.0	5.0
202	8.6	5.9	6.1	3.8	3.8	2.3	6.8	4.9
203	8.4	5.7	5.9	3.7	3.7	2.3	6.7	4.8
204	8.2	5.6	5.8	3.6	3.6	2.2	6.5	4.6
205	7.9	5.4	5.6	3.5	3.5	2.1	6.3	4.5
206	7.7	5.3	5.5	3.4	3.4	2.1	6.1	4.4
207	7.5	5.1	5.3	3.3	3.3	2.0	6.0	4.3
208	7.3	5.0	5.2	3.2	3.2	2.0	5.8	4.2
209	7.1	4.8	5.0	3.1	3.1	1.9	5.7	4.1
210	6.9	4.7	4.9	3.0	3.0	1.9	5.5	4.0
211	6.7	4.6	4.8	2.9	2.9	1.8	5.4	3.9
212	6.5	4.5	4.6	2.9	2.9	1.8	5.3	3.8
213	6.4	4.3	4.5	2.8	2.8	1.7	5.1	3.7
214	6.2	4.2	4.4	2.7	2.7	1.7	5.0	3.6
215	6.0	4.1	4.3	2.6	2.6	1.6	4.9	3.5
216	5.9	4.0	4.2	2.6	2.6	1.6	4.8	3.4
217	5.7	3.9	4.1	2.5	2.5	1.5	4.6	3.3
218	5.6	3.8	3.9	2.4	2.4	1.5	4.5	3.2
219	5.4	3.7	3.8	2.4	2.4	1.5	4.4	3.1
220	5.3	3.6	3.7	2.3	2.3	1.4	4.3	3.1
221	5.2	3.5	3.7	2.3	2.3	1.4	4.2	3.0

Predicted EM61-MK2 Response to a 60-mm Mortar

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
84	84.7	22.6	58.9	13.4	35.7	7.6	47.1	11.6
85	80.1	21.3	55.7	12.7	33.8	7.2	44.7	11.0
86	75.7	20.2	52.7	12.0	32.0	6.8	42.5	10.4
87	71.6	19.1	49.8	11.3	30.2	6.4	40.4	9.9
88	67.8	18.1	47.2	10.7	28.6	6.1	38.4	9.4
89	64.2	17.1	44.7	10.2	27.1	5.7	36.5	9.0
90	60.8	16.2	42.3	9.6	25.7	5.4	34.8	8.5
91	57.7	15.4	40.1	9.1	24.3	5.2	33.1	8.1
92	54.7	14.6	38.0	8.6	23.1	4.9	31.5	7.7
93	51.8	13.8	36.1	8.2	21.9	4.6	30.0	7.4
94	49.2	13.1	34.2	7.8	20.8	4.4	28.6	7.0
95	46.7	12.4	32.5	7.4	19.7	4.2	27.3	6.7
96	44.3	11.8	30.8	7.0	18.7	4.0	26.0	6.4
97	42.1	11.2	29.3	6.7	17.8	3.8	24.8	6.1
98	40.0	10.7	27.8	6.3	16.9	3.6	23.7	5.8
99	38.0	10.1	26.5	6.0	16.1	3.4	22.6	5.6
100	36.2	9.6	25.2	5.7	15.3	3.2	21.6	5.3
101	34.4	9.2	23.9	5.4	14.5	3.1	20.6	5.1
102	32.7	8.7	22.8	5.2	13.8	2.9	19.7	4.8
103	31.2	8.3	21.7	4.9	13.2	2.8	18.8	4.6
104	29.7	7.9	20.6	4.7	12.5	2.7	18.0	4.4
105	28.3	7.5	19.7	4.5	11.9	2.5	17.2	4.2
106	26.9	7.2	18.7	4.3	11.4	2.4	16.4	4.0
107	25.7	6.8	17.9	4.1	10.8	2.3	15.7	3.9
108	24.5	6.5	17.0	3.9	10.3	2.2	15.0	3.7
109	23.3	6.2	16.2	3.7	9.9	2.1	14.4	3.5
110	22.3	5.9	15.5	3.5	9.4	2.0	13.8	3.4
111	21.3	5.7	14.8	3.4	9.0	1.9	13.2	3.2
112	20.3	5.4	14.1	3.2	8.6	1.8	12.6	3.1
113	19.4	5.2	13.5	3.1	8.2	1.7	12.1	3.0
114	18.5	4.9	12.9	2.9	7.8	1.7	11.6	2.9
115	17.7	4.7	12.3	2.8	7.5	1.6	11.1	2.7
116	16.9	4.5	11.8	2.7	7.1	1.5	10.7	2.6
117	16.2	4.3	11.2	2.6	6.8	1.4	10.2	2.5
118	15.5	4.1	10.8	2.4	6.5	1.4	9.8	2.4
119	14.8	3.9	10.3	2.3	6.2	1.3	9.4	2.3
120	14.2	3.8	9.8	2.2	6.0	1.3	9.1	2.2
121	13.5	3.6	9.4	2.1	5.7	1.2	8.7	2.1
122	13.0	3.5	9.0	2.1	5.5	1.2	8.4	2.1
123	12.4	3.3	8.6	2.0	5.2	1.1	8.0	2.0
124	11.9	3.2	8.3	1.9	5.0	1.1	7.7	1.9
125	11.4	3.0	7.9	1.8	4.8	1.0	7.4	1.8

Predicted EM61-MK2 Response to a 81-mm Mortar

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
84	283.7	29.9	185.3	16.4	100.8	8.6	132.8	13.1
85	268.2	28.2	175.2	15.6	95.3	8.1	126.1	12.5
86	253.7	26.7	165.7	14.7	90.1	7.7	119.8	11.8
87	240.1	25.3	156.8	13.9	85.3	7.3	113.9	11.2
88	227.2	23.9	148.4	13.2	80.7	6.9	108.3	10.7
89	215.2	22.6	140.6	12.5	76.4	6.5	103.0	10.2
90	203.8	21.5	133.2	11.8	72.4	6.2	98.0	9.7
91	193.2	20.3	126.2	11.2	68.6	5.8	93.3	9.2
92	183.2	19.3	119.6	10.6	65.1	5.5	88.8	8.8
93	173.7	18.3	113.5	10.1	61.7	5.3	84.6	8.4
94	164.8	17.4	107.7	9.6	58.5	5.0	80.6	8.0
95	156.4	16.5	102.2	9.1	55.6	4.7	76.9	7.6
96	148.5	15.6	97.0	8.6	52.8	4.5	73.3	7.2
97	141.1	14.9	92.2	8.2	50.1	4.3	69.9	6.9
98	134.1	14.1	87.6	7.8	47.6	4.0	66.7	6.6
99	127.4	13.4	83.2	7.4	45.3	3.9	63.6	6.3
100	121.2	12.8	79.1	7.0	43.0	3.7	60.8	6.0
101	115.3	12.1	75.3	6.7	40.9	3.5	58.0	5.7
102	109.7	11.5	71.6	6.4	39.0	3.3	55.4	5.5
103	104.4	11.0	68.2	6.0	37.1	3.2	53.0	5.2
104	99.4	10.5	64.9	5.8	35.3	3.0	50.6	5.0
105	94.7	10.0	61.8	5.5	33.6	2.9	48.4	4.8
106	90.2	9.5	58.9	5.2	32.0	2.7	46.3	4.6
107	86.0	9.1	56.2	5.0	30.5	2.6	44.3	4.4
108	82.0	8.6	53.6	4.7	29.1	2.5	42.4	4.2
109	78.2	8.2	51.1	4.5	27.8	2.4	40.6	4.0
110	74.6	7.9	48.7	4.3	26.5	2.3	38.8	3.8
111	71.2	7.5	46.5	4.1	25.3	2.1	37.2	3.7
112	68.0	7.2	44.4	3.9	24.1	2.1	35.6	3.5
113	64.9	6.8	42.4	3.8	23.1	2.0	34.2	3.4
114	62.0	6.5	40.5	3.6	22.0	1.9	32.7	3.2
115	59.2	6.2	38.7	3.4	21.0	1.8	31.4	3.1
116	56.6	6.0	37.0	3.3	20.1	1.7	30.1	3.0
117	54.1	5.7	35.4	3.1	19.2	1.6	28.9	2.9
118	51.8	5.5	33.8	3.0	18.4	1.6	27.7	2.7
119	49.5	5.2	32.4	2.9	17.6	1.5	26.6	2.6
120	47.4	5.0	31.0	2.8	16.8	1.4	25.5	2.5
121	45.4	4.8	29.6	2.6	16.1	1.4	24.5	2.4
122	43.5	4.6	28.4	2.5	15.4	1.3	23.6	2.3
123	41.6	4.4	27.2	2.4	14.8	1.3	22.6	2.2
124	39.9	4.2	26.0	2.3	14.2	1.2	21.7	2.1
125	38.2	4.0	25.0	2.2	13.6	1.2	20.9	2.1

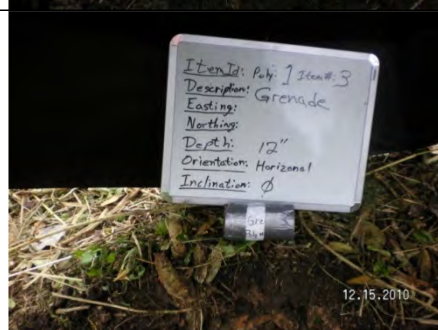
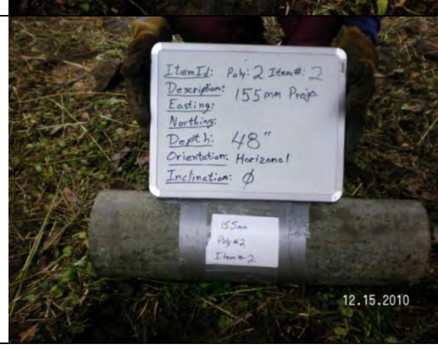
Predicted EM61-MK2 Response to a 81-mm Mortar

Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
126	36.6	3.9	23.9	2.1	13.0	1.1	20.1	2.0
127	35.1	3.7	22.9	2.0	12.5	1.1	19.3	1.9
128	33.7	3.5	22.0	1.9	12.0	1.0	18.6	1.8
129	32.3	3.4	21.1	1.9	11.5	1.0	17.9	1.8
130	31.0	3.3	20.2	1.8	11.0	0.9	17.2	1.7
131	29.7	3.1	19.4	1.7	10.6	0.9	16.6	1.6
132	28.6	3.0	18.7	1.7	10.1	0.9	15.9	1.6
133	27.4	2.9	17.9	1.6	9.7	0.8	15.4	1.5
134	26.3	2.8	17.2	1.5	9.4	0.8	14.8	1.5
135	25.3	2.7	16.5	1.5	9.0	0.8	14.2	1.4
136	24.3	2.6	15.9	1.4	8.6	0.7	13.7	1.4
137	23.4	2.5	15.3	1.4	8.3	0.7	13.2	1.3
138	22.5	2.4	14.7	1.3	8.0	0.7	12.8	1.3
139	21.6	2.3	14.1	1.3	7.7	0.7	12.3	1.2
140	20.8	2.2	13.6	1.2	7.4	0.6	11.9	1.2
141	20.0	2.1	13.1	1.2	7.1	0.6	11.4	1.1
142	19.2	2.0	12.6	1.1	6.8	0.6	11.0	1.1
143	18.5	1.9	12.1	1.1	6.6	0.6	10.6	1.0
144	17.8	1.9	11.6	1.0	6.3	0.5	10.3	1.0
145	17.2	1.8	11.2	1.0	6.1	0.5	9.9	1.0
146	16.5	1.7	10.8	1.0	5.9	0.5	9.6	0.9
147	15.9	1.7	10.4	0.9	5.7	0.5	9.3	0.9
148	15.3	1.6	10.0	0.9	5.5	0.5	8.9	0.9
149	14.8	1.6	9.7	0.9	5.3	0.5	8.6	0.9
150	14.3	1.5	9.3	0.8	5.1	0.4	8.3	0.8
151	13.7	1.4	9.0	0.8	4.9	0.4	8.1	0.8
152	13.3	1.4	8.7	0.8	4.7	0.4	7.8	0.8
153	12.8	1.3	8.4	0.7	4.5	0.4	7.5	0.7
154	12.3	1.3	8.1	0.7	4.4	0.4	7.3	0.7
155	11.9	1.3	7.8	0.7	4.2	0.4	7.0	0.7
156	11.5	1.2	7.5	0.7	4.1	0.3	6.8	0.7
157	11.1	1.2	7.2	0.6	3.9	0.3	6.6	0.6
158	10.7	1.1	7.0	0.6	3.8	0.3	6.4	0.6
159	10.3	1.1	6.8	0.6	3.7	0.3	6.2	0.6
160	10.0	1.1	6.5	0.6	3.5	0.3	6.0	0.6
161	9.6	1.0	6.3	0.6	3.4	0.3	5.8	0.6
162	9.3	1.0	6.1	0.5	3.3	0.3	5.6	0.6
163	9.0	0.9	5.9	0.5	3.2	0.3	5.4	0.5
164	8.7	0.9	5.7	0.5	3.1	0.3	5.3	0.5
165	8.4	0.9	5.5	0.5	3.0	0.3	5.1	0.5
166	8.1	0.9	5.3	0.5	2.9	0.2	4.9	0.5
167	7.9	0.8	5.1	0.5	2.8	0.2	4.8	0.5

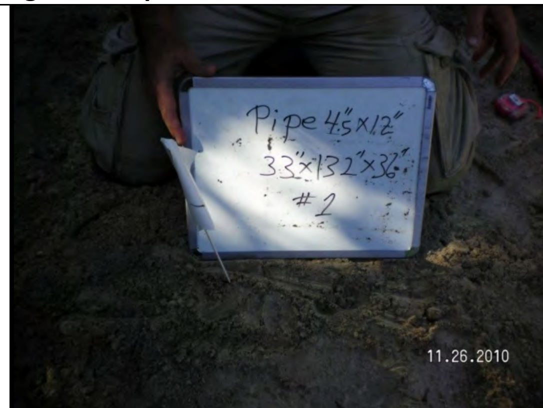
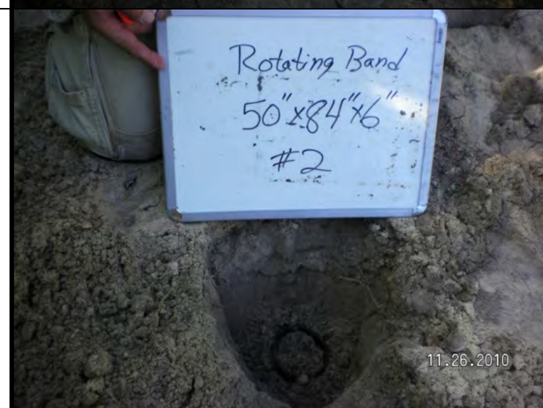
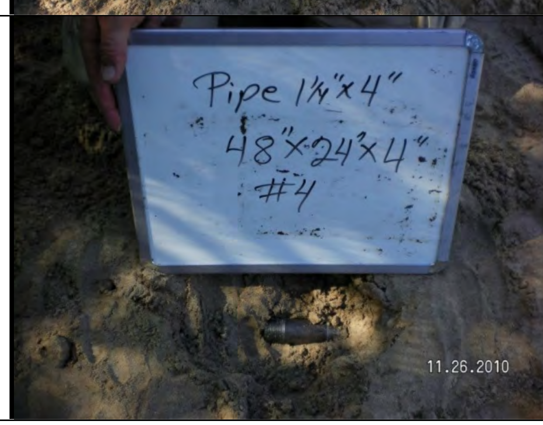
Predicted EM61-MK2 Response to a 2.75-in Rocket Warhead

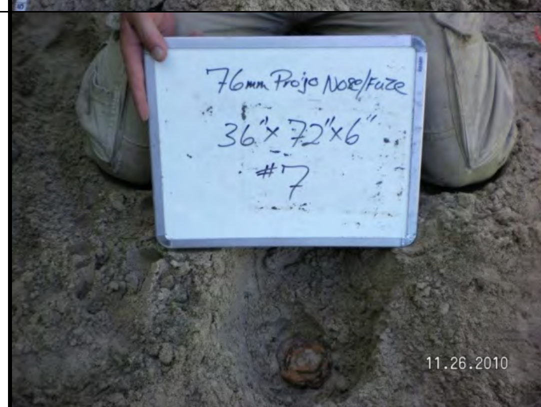
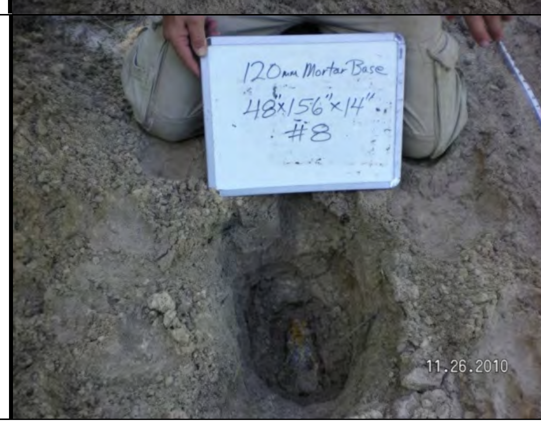
Distance of Target Center Below Lower Coil (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 [D] (mV)	
	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
84	406.6	32.9	276.6	17.3	159.2	8.6	209.7	13.1
85	384.4	31.1	261.5	16.4	150.5	8.1	199.2	12.5
86	363.6	29.4	247.4	15.5	142.4	7.7	189.3	11.9
87	344.0	27.8	234.1	14.7	134.7	7.3	179.9	11.3
88	325.6	26.3	221.6	13.9	127.5	6.9	171.1	10.7
89	308.4	24.9	209.8	13.2	120.8	6.5	162.7	10.2
90	292.1	23.6	198.8	12.5	114.4	6.2	154.9	9.7
91	276.8	22.4	188.4	11.8	108.4	5.9	147.4	9.2
92	262.5	21.2	178.6	11.2	102.8	5.6	140.4	8.8
93	248.9	20.1	169.4	10.6	97.5	5.3	133.7	8.4
94	236.2	19.1	160.7	10.1	92.5	5.0	127.4	8.0
95	224.2	18.1	152.5	9.6	87.8	4.7	121.4	7.6
96	212.8	17.2	144.8	9.1	83.4	4.5	115.8	7.3
97	202.2	16.3	137.6	8.6	79.2	4.3	110.4	6.9
98	192.1	15.5	130.7	8.2	75.2	4.1	105.4	6.6
99	182.6	14.8	124.2	7.8	71.5	3.9	100.5	6.3
100	173.6	14.0	118.1	7.4	68.0	3.7	96.0	6.0
101	165.2	13.4	112.4	7.0	64.7	3.5	91.7	5.7
102	157.2	12.7	106.9	6.7	61.5	3.3	87.6	5.5
103	149.6	12.1	101.8	6.4	58.6	3.2	83.7	5.2
104	142.4	11.5	96.9	6.1	55.8	3.0	80.0	5.0
105	135.7	11.0	92.3	5.8	53.1	2.9	76.5	4.8
106	129.3	10.5	88.0	5.5	50.6	2.7	73.1	4.6
107	123.2	10.0	83.8	5.3	48.3	2.6	70.0	4.4
108	117.5	9.5	79.9	5.0	46.0	2.5	67.0	4.2
109	112.1	9.1	76.2	4.8	43.9	2.4	64.1	4.0
110	106.9	8.6	72.7	4.6	41.9	2.3	61.4	3.8
111	102.0	8.2	69.4	4.4	40.0	2.2	58.8	3.7
112	97.4	7.9	66.3	4.2	38.1	2.1	56.3	3.5
113	93.0	7.5	63.3	4.0	36.4	2.0	54.0	3.4
114	88.9	7.2	60.5	3.8	34.8	1.9	51.7	3.2
115	84.9	6.9	57.8	3.6	33.3	1.8	49.6	3.1
116	81.2	6.6	55.2	3.5	31.8	1.7	47.6	3.0
117	77.6	6.3	52.8	3.3	30.4	1.6	45.6	2.9
118	74.2	6.0	50.5	3.2	29.1	1.6	43.8	2.7
119	71.0	5.7	48.3	3.0	27.8	1.5	42.0	2.6
120	67.9	5.5	46.2	2.9	26.6	1.4	40.3	2.5
121	65.0	5.3	44.2	2.8	25.5	1.4	38.7	2.4
122	62.3	5.0	42.4	2.7	24.4	1.3	37.2	2.3
123	59.6	4.8	40.6	2.5	23.4	1.3	35.7	2.2
124	57.1	4.6	38.9	2.4	22.4	1.2	34.3	2.2
125	54.7	4.4	37.2	2.3	21.4	1.2	33.0	2.1

APPENDIX B:
Photos

Table B-1 GPO Seed Items		
Seed ID – 1-1 Nominal Diameter – 20mm Depth – 7.5 inches EM61 – 9mV White's XLT – Detect White's DFX 300 – Detect		
Seed ID – 1-2 Nominal Diameter – 37mm Depth – 14.5 inches EM61 – 6mV White's XLT – N/D White's DFX 300 – N/D		
Seed ID – 1-3 Nominal Diameter – 57mm Depth – 12 inches EM61 – 18mV White's XLT – Detect White's DFX 300 – Detect		
Seed ID – 2-1 Nominal Diameter – 105mm Depth – 36 inches EM61 – 20mV White's XLT – N/D White's DFX 300 – N/D		
Seed ID – 2-2 Nominal Diameter – 155mm Depth – 48 inches EM61 – 20mV White's XLT – N/D White's DFX 300 –N/D		

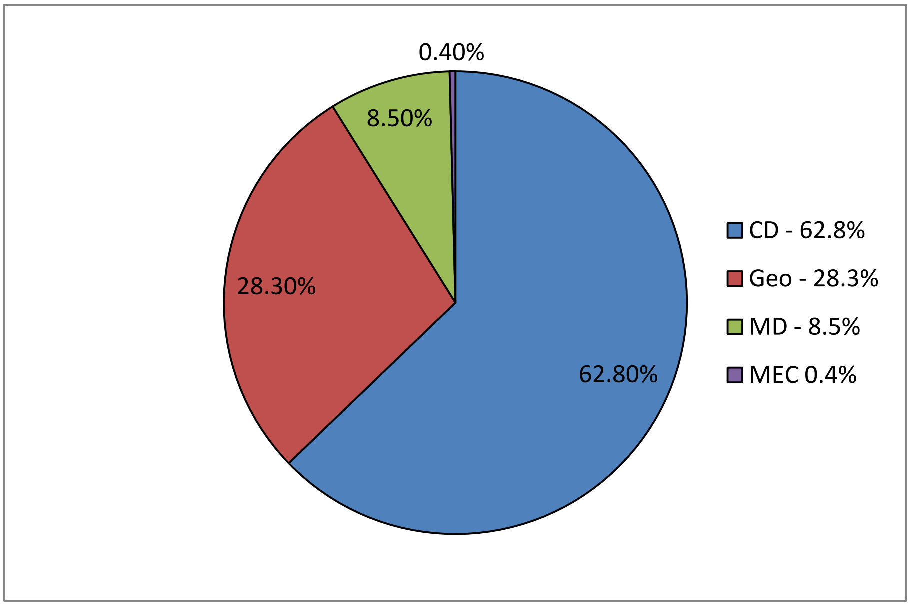
Seed ID – 3-1 Nominal Diameter – 60mm Depth – 24 inches EM61 – 5mV White's XLT – N/D White's DFX 300 – N/D		
Seed ID – 4-1 Nominal Diameter – 81mm Depth – 30 inches EM61 – 20mV White's XLT – N/D White's DFX 300 –N/D		
Seed ID – 5-1 Nominal Diameter – 70mm Depth – 30 inches EM61 – 20mV White's XLT – N/D White's DFX 300 –N/D		

Table B-2 Analog Test Strip Seed Items		
Seed ID – 1 Description – Pipe Size – 4.5in x 12in Depth – 36 inches White's XLT – N/D White's DFX 300 – N/D		
Seed ID – 2 Description – 3in Projectile Rotating Band Size – 0.75in x 9.5in Depth – 6 inches White's XLT – Detect White's DFX 300 – Detect		
Seed ID – 3 Description – Pipe Size – 1in x 4in Depth – 5 inches White's XLT – Detect White's DFX 300 – Detect		
Seed ID – 4 Description – Pipe Size – 1.25in x 4in Depth – 4 inches White's XLT – Detect White's DFX 300 – Detect		

Seed ID – 5 Description – Pipe Size – 2.25in x 8in Depth – 9 inches White's XLT – Detect White's DFX 300 – Detect			
Seed ID – 6 Description – 81mm Mortar Size – 3.2in x 8in Depth – 8 inches White's XLT – Detect White's DFX 300 – Detect			
Seed ID – 7 Description – 76mm Projectile Nose Size – 3in x 1.5in Depth – 6 inches White's XLT – Detect White's DFX 300 – Detect			
Seed ID – 8 Description – 120mm Base Size – 4.5in x 7in Depth – 14 inches White's XLT – Detect White's DFX 300 – Detect			

Appendix B: MEC Investigation Data

The table included in this appendix provides detailed results of geophysical anomaly investigations. The data include: anomaly location, depth, type, and description. Data is organized by Anomaly Type, which include: Cultural Debris (CD); Effect of Geology (GEO); Munitions Debris (MD); and Munitions and Explosives of Concern (MEC). A summary of the results is shown in the graph below.



Target_ID	Location	MRS_ID	Dig_team	Dig_date	Anomaly_Type	Description	Depth	Final_X	Final_Y
17a-3-4	17a	4	1	25-Feb-11	CD	smallarms	6	840320.4751	6652118.796
17a-7-3	17a	4	1	25-Feb-11	CD	barbed wire	0	840907.2713	6652125.594
18a-9-13	18a	4	1	25-Feb-11	CD	55 gal drum	0	840843.4559	6651862.656
18a-9-16	18a	4	1	25-Feb-11	CD	barbed wire	10	840950.6612	6651843.922
18a-9-15	18a	4	1	25-Feb-11	CD	scrapmetal	8	840913.2839	6651855.959
18a-9-14	18a	4	1	25-Feb-11	CD	s rapmetal	8	840889.3969	6651864.738
18a-8-9	18a	4	1	25-Feb-11	CD	scrap metal	6	840749.3817	6651845.198
18a-8-8	18a	4	1	25-Feb-11	CD	scrap pit	12	840676.4814	6651855.869
18a-8-12	18a	4	1	25-Feb-11	CD	scrapmetal	11	840760.0612	6651852.873
18a-8-11	18a	4	1	25-Feb-11	CD	s rapmetal	6	840741.1024	6651853.537
18a-8-10	18a	4	1	25-Feb-11	CD	smallarms	10	840753.9126	6651851.377
18a-7-7	18a	4	1	25-Feb-11	CD	barbed wire pit	6	840656.7047	6651855.877
18a-7-6	18a	4	1	25-Feb-11	CD	scrapmetal	8	840567.5542	6651848.227
18a-7-3	18a	4	1	25-Feb-11	CD	barbed wire	6	840492.962	6651844.025
18a-7-2	18a	4	1	25-Feb-11	CD	scrapmetal	6	840420.8633	6651844.938
18a-7-1	18a	4	1	25-Feb-11	CD	scrap metal	8	840418.3575	6651838.855
18a-13-22	18a	4	1	25-Feb-11	CD	small pieces barbed wire pit start	6	841815.0292	6651837.104
18a-13-21	18a	4	1	25-Feb-11	CD	small pieces barbed wire pit end	6	841825.2871	6651825.168
18a-7-5	18a	4	1	25-Feb-11	CD	scrapmetal	6	840529.9994	6651841.679
18a-13-20	18a	4	1	25-Feb-11	CD	grounding rod	4	841868.9742	6651841.084
18a-11-18	18a	4	1	25-Feb-11	CD	trashpit end	0	841228.4215	6651845.311
18a-10-17	18a	4	1	25-Feb-11	CD	scrap metal pile	0	841089.9391	6651864.622
18a-10-18	18a	4	1	25-Feb-11	CD	trashpit start goes for approx.100feet	0	841113.9109	6651857.961
19a-4-4	19a	4	1	28-Feb-11	CD	nailbed	3	841362.9669	6651597.058
19a-5-3	19a	4	1	28-Feb-11	CD	barbedwire	6	841587.1887	6651589.984
19a-5-2	19a	4	1	28-Feb-11	CD	rebar	2	841615.7377	6651597.736
19a-4-5	19a	4	1	28-Feb-11	CD	trashpit	6	841331.4331	6651595.641
19a-5-1	19a	4	1	28-Feb-11	CD	trashpit	6	841661.1213	6651592.319
20a-4-2	20a	4	1	28-Feb-11	CD	barbed wire fence	0	841570.1041	6651341.046
20a-5-1	20a	4	1	28-Feb-11	CD	horse	4	841728.0015	6651329.604
20a-4-3	20a	4	1	28-Feb-11	CD	barbed wire fence	0	841414.0945	6651346.289
20a-1-6	20a	4	1	28-Feb-11	CD	barbed wire fence	0	840774.4165	6651342.395
20b-1-5	20b	4	1	28-Feb-11	CD	barbed wire	1	840817.5506	6651328.287
21a-3-2	21a	4	1	28-Feb-11	CD	old barbed wire fence line end	2	841621.0855	6651092.338
21a-3-3	21a	4	1	28-Feb-11	CD	oldfence line start	2	841547.9166	6651095.564
21a-3-1	21a	4	1	28-Feb-11	CD	barbed wire/trashpit	0	841667.2238	6651082.551
22b-1-7	22b-1	5	1	18-Feb-11	CD	smallarms	8	849392.0006	6651069.326
22b-2-3	22b-2	5	1	18-Feb-11	CD	small arms	7	849544.4278	6651073.654
22b-2-4	22b-2	5	1	18-Feb-11	CD	small arms	8	849509.0709	6651090.141
22b-2-5	22b-2	5	1	18-Feb-11	CD	small arms	8	849494.4568	6651072.948
22b-2-6	22b-2	5	1	18-Feb-11	CD	smallarms	7	849418.0945	6651070.453
22b-3-1	22b-3	5	1	18-Feb-11	CD	small arms	6	849771.5431	6651071.477
23b-1-3	23b-1	5	1	18-Feb-11	CD	barbed wire fence	3	850617.0942	6650808.844
23b-1-4	23b-1	5	1	18-Feb-11	CD	cable left in place	6	850634.3184	6650822.07
23b-1-8	23b-1	5	1	18-Feb-11	CD	smallarms	8	850758.8192	6650812.824
23b-1-1	23b-1	5	1	18-Feb-11	CD	barbed wire fence	2	850590.4866	6650799.005
23b-2-9	23b-2	5	1	18-Feb-11	CD	small metal scrap pit	6	850841.9524	6650824.984
23b-2-11	23b-2	5	1	18-Feb-11	CD	decorative metal	7	850858.052	6650817.639
23b-2-10	23b-2	5	1	18-Feb-11	CD	pipe fitting	10	850858.9635	6650816.537
24A-1-001	24A-1	5	1	22-Nov-10	CD	Barbed Wire	0	848092.078	6650572.171
24A-4-001	24A-4	5	1	22-Nov-10	CD	Steel Bar	0.127	847507.4172	6650571.311
24A-6-001	24A-6	5	1	22-Nov-10	CD	Barbed Wire	0.1524	847045.1751	6650572.718
24b-1-3	24b-1	5	1	18-Feb-11	CD	barbed wire fence	1	851649.8365	6650555.511
24b-2-2	24b-2	5	1	18-Feb-11	CD	steel rod	8	851703.2968	6650562.412
24b-4-1	24b-4	5	1	18-Feb-11	CD	shotgun shells (3)	3	852072.2792	6650561.621
25A-1-001	25A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0762	847963.2246	6650322.924
25A-1-002	25A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0508	847960.5218	6650322.586
25A-1-003	25A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0762	847954.2715	6650321.741
25A-1-004	25A-1	5	1	19-Nov-10	CD	Metal Plate	0.1016	847871.6343	6650322.772
25A-5-001	25A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0508	847162.1189	6650322.759
25A-4-001	25A-4	5	1	19-Nov-10	CD	Metal Plate	0.0254	847399.6356	6650321.75
25A-4-002	25A-4	5	1	19-Nov-10	CD	Barbed Wire	0.0254	847393.9164	6650322.423
26A-1-006	26A-1	5	1	19-Nov-10	CD	Barbed Wire		847944.9119	6650066.854
26A-1-007	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0508	847961.7801	6650065.383
26A-1-005	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.127	847951.4781	6650065.496
26A-1-004	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0762	847955.8933	6650066.628
26A-1-003	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.1016	847968.4595	6650065.949
26A-1-002	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0254	847965.9802	6650065.849

26A-1-001	26A-1	5	1	19-Nov-10	CD	Barbed Wire	0.0254	847882.735	6650065.51
26A-1-008	26A-1	5	1	19-Nov-10	CD	Barbed Wire		847928.9494	6650065.835
26A-3-001	26A-3	5	1	19-Nov-10	CD	Pull Tab	0.0508	847419.6977	6650067.065
26c-5-1	26c-5	5	1	15-Feb-11	CD	small arms projectile	10	854737.9579	6650068.081
26c-6-2	26c-6	5	1	15-Feb-11	CD	pepsi can	4	854908.8328	6650086.421
26c-6-3	26c-6	5	1	15-Feb-11	CD	aluminum madalia can	12	854923.9064	6650075.577
26c-6-5	26c-6	5	1	15-Feb-11	CD	rebar	13	854976.0072	6650108.048
26c-6-6	26c-6	5	1	15-Feb-11	CD	bolt/small arms projectile	8	855004.3641	6650105.153
26c-7-9	26c-7	5	1	15-Feb-11	CD	scrap metal	6	855119.1587	6650101.183
26c-7-10	26c-7	5	1	15-Feb-11	CD	screw	6	855177.8545	6650082.713
26c-7-11	26c-7	5	1	15-Feb-11	CD	nail	7	855181.0308	6650082.371
26c-7-7	26c-7	5	1	15-Feb-11	CD	rebar	6	855050.7751	6650098.582
27A-06-001	27A-06	5	1	11-Nov-10	CD	Barbed Wire	0.0508	846700.5106	6649816.592
27A-10-002	27A-10	5	1	11-Nov-10	CD	Barbed Wire	0.0254	845985.1656	6649815.572
27A-10-001	27A-10	5	1	11-Nov-10	CD	Barbed Wire	0.0254	846059.7933	6649816.116
27A-14-001	27A-14	5	1	11-Nov-10	CD	Vehicle Filter	0.1016	845216.9712	6649815.754
27A-15-001	27A-15	5	1	11-Nov-10	CD	Barbed Wire	0.127	845059.1421	6649815.732
27A-15-002	27A-15	5	1	11-Nov-10	CD	Barbed Wire	0.0508	845052.0125	6649816.151
27A-15-003	27A-15	5	1	11-Nov-10	CD	Barbed Wire	0.1524	845039.8503	6649816.571
27c-8-18	27c-8	5	1	15-Feb-11	CD	barbed wire	5	855025.8804	6649821.772
27c-8-19	27c-8	5	1	15-Feb-11	CD	scrap metal	6	855026.3003	6649827.64
27c-8-21	27c-8	5	1	15-Feb-11	CD	barbed wire	9	855010.4623	6649842.126
27c-8-17	27c-8	5	1	15-Feb-11	CD	scrapmetal	6	855019.6757	6649815.734
27c-8-16	27c-8	5	1	15-Feb-11	CD	horse shoe	10	855421.5978	6649827.026
27c-8-20	27c-8	5	1	15-Feb-11	CD	small arms	8	855020.4301	6649834.554
27c-9-15	27c-9	5	1	15-Feb-11	CD	barbed wire fence	0	855456.5325	6649818.297
27c-9-5	27c-9	5	1	15-Feb-11	CD	horseshoe	10	855618.5037	6649799.514
27c-9-6	27c-9	5	1	15-Feb-11	CD	scrapmetal	9	855607.5513	6649802.314
27c-9-3	27c-9	5	1	15-Feb-11	CD	scrap metal	8	855637.2997	6649795.042
27c-9-2	27c-9	5	1	15-Feb-11	CD	small arms cartridge casing	9	855634.4518	6649803.191
27c-9-14	27c-9	5	1	15-Feb-11	CD	nail	8	855550.269	6649818.222
27c-9-13	27c-9	5	1	15-Feb-11	CD	nail	6	855560.6416	6649810.646
27c-9-12	27c-9	5	1	15-Feb-11	CD	iron	7	855564.7834	6649808.9
27c-9-11	27c-9	5	1	15-Feb-11	CD	scrap metal	11	855581.8412	6649808.809
27c-9-1	27c-9	5	1	15-Feb-11	CD	scrap metal	8	855649.212	6649809.001
27c-9-10	27c-9	5	1	15-Feb-11	CD	scrap metal	9	855590.8359	6649802.037
27c-9-8	27c-9	5	1	15-Feb-11	CD	scrap metal	10	855599.4306	6649804.958
27c-9-7	27c-9	5	1	15-Feb-11	CD	scrapmetal	7	855607.3171	6649802.075
28A-12-001	28A-12	5	1	13-Dec-10	CD	Barbed Wire	0	845483.7428	6649567.372
28A-3-002	28A-3	5	1	13-Dec-10	CD	Steel Piece	0.0254	847251.7929	6649565.459
28A-3-001	28A-3	5	1	13-Dec-10	CD	Alum Can	0.0762	847279.9179	6649566.241
28A-6-001	28A-6	5	1	13-Dec-10	CD	Debris Pile	0	846753.8763	6649564.938
29A-9-001	29A-9	5	1	03-Nov-10	CD	Chain (12")	0.127	847404.3813	6649313.377
29c-11-4	29c-11	5	1	14-Feb-11	CD	scrap metal	9	856051.7192	6649308.496
29c-12-11	29c-12	5	1	14-Feb-11	CD	scrap metal	10	856108.6645	6649325.953
29c-13-13	29c-13	5	1	14-Feb-11	CD	scrap metal	8	856118.2752	6649326.863
29c-13-14	29c-13	5	1	14-Feb-11	CD	scrap metal	7	856125.2337	6649333.073
30A-1-001	30A-1	5	1	02-Nov-10	CD	Wire	0.0254	847673.7724	6649058.671
30A-10-001	30A-10	5	1	05-Nov-10	CD	Rebar and Fence Post	0	845849.8804	6649059.145
30A-2-001	30A-2	5	1	02-Nov-10	CD	Alum Can	0.0762	847571.2081	6649058.197
30A-7-001	30A-7	5	1	05-Nov-10	CD	Alum Can	0.0254	846574.4629	6649059.145
30c-7-1	30C-7	5	1	02-Mar-11	CD	Barbed Wire Fence		855088.5464	6649020.03
31A-1-001	31A-1	5	1	05-Nov-10	CD	Sheet Metal	0.0508	846007.73	6648822.606
31A-3-001	31A-3	5	1	05-Nov-10	CD	Sheet Metal	0	846559.9303	6648822.137
31A-3-002	31A-3	5	1	05-Nov-10	CD	Alum Wire	0	846375.0052	6648821.435
31A-5-006	31A-5	5	1	05-Nov-10	CD	Pipe (fixed)	0	846785.1176	6648822.372
31A-5-001	31A-5	5	1	05-Nov-10	CD	Alum Can	0.0508	846954.3592	6648821.435
31A-5-002	31A-5	5	1	05-Nov-10	CD	Sheet Metal	0.0508	846845.0427	6648821.201
31A-5-003	31A-5	5	1	05-Nov-10	CD	Sheet Metal	0.0254	846817.1869	6648822.137
31A-5-004	31A-5	5	1	05-Nov-10	CD	Sheet Metal	0.0762	846801.9715	6648822.606
31A-5-005	31A-5	5	1	05-Nov-10	CD	Steel Bar	0.0762	846798.2262	6648823.074
31A-6-001	31A-6	5	1	05-Nov-10	CD	Sheet Metal	0.0762	847077.9547	6648820.967
31c-1-3	31c-1	5	1	11-Feb-11	CD	barbed wire	0.1524	853864.6979	6648807.841
31c-1-13	31c-1	5	1	11-Feb-11	CD	smallarms	0.2032	853977.5725	6648816.669
31c-1-1	31c-1	5	1	11-Feb-11	CD	polestaple	0.2032	853818.5954	6648816.044
31c-1-7	31c-1	5	1	11-Feb-11	CD	smallarms	0.1778	853928.238	6648820.734
31c-1-2	31c-1	5	1	11-Feb-11	CD	small arms	0.1778	853844.8643	6648821.893
31c-1-6	31c-1	5	1	11-Feb-11	CD	small arms	0.2032	853916.5604	6648811.737
31c-1-4	31c-1	5	1	11-Feb-11	CD	small arms	0.2032	853879.0572	6648804.635
31c-11-37	31c-11	5	1	11-Feb-11	CD	barbed wire	0.127	855669.9146	6648796.171

31c-11-36	31c-11	5	1	11-Feb-11	CD	barbed wire fence.debris field end	0	855653.2726	6648804.313
31c-12-38	31c-12	5	1	11-Feb-11	CD	barbed wire fence/debris field end	0	856065.1804	6648795.021
31c-13-44	31c-13	5	1	11-Feb-11	CD	barbed wire	0.1778	856301.7844	6648820.784
31c-13-42	31c-13	5	1	11-Feb-11	CD	barbed wire pit	0.2794	856298.7681	6648824.696
31c-15-15	31c-15	5	1	10-Feb-11	CD	scrap metal pile covers approx 10'x10'area across	0	856684.7334	6648849.878
31c-15-9	31c-15	5	1	10-Feb-11	CD	spike	0.254	856840.6076	6648842.859
31c-15-8	31c-15	5	1	10-Feb-11	CD	Scrap metal	0.2286	856846.8047	6648843.63
31c-15-7	31c-15	5	1	10-Feb-11	CD	masterlock	0.2032	856838.3406	6648841.918
31c-15-6	31c-15	5	1	10-Feb-11	CD	scrap metal	0.1778	856854.4562	6648854.433
31c-15-5	31c-15	5	1	10-Feb-11	CD	sheet metal	0.0762	856860.4551	6648857.87
31c-15-2	31c-15	5	1	10-Feb-11	CD	nail	0.1524	856873.9036	6648851.165
31c-15-13	31c-15	5	1	10-Feb-11	CD	bottlecap	0.1016	856796.6337	6648854.847
31c-15-11a	31c-15	5	1	10-Feb-11	CD	scrap metal	0.254	856801.9943	6648853.449
31c-15-10	31c-15	5	1	10-Feb-11	CD	small arms cartridgecasing	0.1778	856821.0828	6648853.878
31c-15-1	31c-15	5	1	10-Feb-11	CD	hook	0.1524	856883.8627	6648842.868
31c-15-3	31c-15	5	1	10-Feb-11	CD	bottlecap	0.1778	856873.9419	6648854.252
31c-2-34	31c-2	5	1	08-Feb-11	CD	barbed wire	0.254	854405.1708	6648813.468
31c-2-20	31c-2	5	1	11-Feb-11	CD	small arms	0.3556	854037.2077	6648789.952
31c-2-15	31c-2	5	1	11-Feb-11	CD	small arms	0.2032	853989.4096	6648796.662
31c-2-16	31c-2	5	1	11-Feb-11	CD	smallarms	0.1524	853983.2845	6648815.629
31c-2-14a	31c-2	5	1	11-Feb-11	CD	barbedwire	0.1524	853983.4045	6648811.329
31c-3-3a	31c-3	5	1	08-Feb-11	CD	fence staple	0.1524	854395.1757	6648814.198
31c-3-32	31c-3	5	1	08-Feb-11	CD	small arms	0.1524	854398.18	6648813.979
31c-4-40	31c-4	5	1	08-Feb-11	CD	post nails(3)	0.254	854460.0253	6648811.514
31c-4-42	31c-4	5	1	08-Feb-11	CD	small arms carrridge casing	0.127	854794.1736	6648812.99
31c-5-43	31c-5	5	1	08-Feb-11	CD	barbed wire pit	0.0508	853721.0002	6648306.552
31c-7-32	31c-7	5	1	11-Feb-11	CD	barbed wire fence	0	855139.2518	6648819.175
31c-8-36	31c-8	5	1	11-Feb-11	CD	barbed wirefence debris field start	0.0254	855426.7192	6648805.613
31c-8-33	31c-8	5	1	11-Feb-11	CD	barbed wire fence start	0	855285.2763	6648819.903
31c-8-35	31c-8	5	1	11-Feb-11	CD	barbed wire fence stop	0	855365.7751	6648810.79
32A-4-002	32A-4	5	1	05-Nov-10	CD	Scrap Metal	0.0762	846977.0289	6648572.934
32A-4-001	32A-4	5	1	05-Nov-10	CD	Alum Can	0.0254	846977.2463	6648571.63
32c-1-6	32c-1	5	1	09-Feb-11	CD	barbed wire	0.3048	853871.1701	6648565.879
32c-1-5	32c-1	5	1	09-Feb-11	CD	smallarms	0.1524	853948.0273	6648570.796
32c-1-7	32c-1	5	1	09-Feb-11	CD	barbed wire fence left in place	0.3302	853793.4892	6648559.823
32c-13-14	32c-13	5	1	10-Feb-11	CD	shotgun shell	0.2032	854624.2512	6648562.138
32c-14-15	32c-14	5	1	10-Feb-11	CD	barbed wire fence	0	856488.4998	6648554.245
32c-2-17	32c-2	5	1	09-Feb-11	CD	nail	0.3048	854123.7757	6648557.529
32c-2-14	32c-2	5	1	09-Feb-11	CD	nail	0.2032	854111.028	6648564.771
32c-2-13	32c-2	5	1	09-Feb-11	CD	nail	0.1524	854110.0758	6648562.603
32c-2-12a	32c-2	5	1	09-Feb-11	CD	nail	0.2032	854096.1247	6648561.445
32c-2-12	32c-2	5	1	09-Feb-11	CD	chain fence left in pkace	0	854097.0881	6648559.859
32c-2-10	32c-2	5	1	09-Feb-11	CD	barbed wire	0.3302	854026.7523	6648549.23
32c-2-2	32c-2	5	1	09-Feb-11	CD	rebar	0.2032	853980.7549	6648561.246
32c-2-16	32c-2	5	1	09-Feb-11	CD	metal fence post left in place	0.4572	854108.5371	6648559.777
32c-2-3	32c-2	5	1	09-Feb-11	CD	small arms	0.254	853964.9747	6648561.805
32c-2-15	32c-2	5	1	09-Feb-11	CD	canlid	0.1778	854112.5806	6648559.424
32c-4-8	32c-4	5	1	10-Feb-11	CD	fencepole left in place and rebar	0	854560.3389	6648568.264
32c-6-9	32c-6	5	1	10-Feb-11	CD	fencepole	0	854829.199	6648560.32
32c-7-12	32c-7	5	1	10-Feb-11	CD	small arms	0.1524	855126.9019	6648593.189
33c-1-3	33c-1	5	1	09-Feb-11	CD	nail	0.2032	853719.657	6648310.141
33c-1-17	33c-1	5	1	09-Feb-11	CD	nails	0.2032	853984.3099	6648307.877
33c-1-4	33c-1	5	1	09-Feb-11	CD	(5) digs construction debris	0.2032	853726.9451	6648305.631
33c-1-5	33c-1	5	1	09-Feb-11	CD	(7) digs nails	0.2032	853735.4317	6648304.496
33c-1-15	33c-1	5	1	09-Feb-11	CD	small arms cartridgecasing	0.1778	853849.9198	6648303.495
33c-1-14	33c-1	5	1	09-Feb-11	CD	nail	0.1524	853834.2753	6648301.025
33c-1-13	33c-1	5	1	09-Feb-11	CD	small arms cartridge casing	0.1524	853832.8999	6648306.673
33c-1-6	33c-1	5	1	09-Feb-11	CD	nail	0.1778	853751.4201	6648306.719
33c-1-12	33c-1	5	1	09-Feb-11	CD	tape measure piece	0.1016	853821.5884	6648308.509
33c-1-11	33c-1	5	1	09-Feb-11	CD	small arms cartridge casing	0.2032	853819.256	6648306.964

33c-1-10	33c-1	5	1	09-Feb-11	CD	small arms cartridge casing	0.1524	853807.005	6648307.662
33c-1-2	33c-1	5	1	09-Feb-11	CD	bottlecap	0.1778	853713.3637	6648310.946
33c-1-1	33c-1	5	1	09-Feb-11	CD	nail	0.2032	853719.0345	6648311.239
33c-1-7	33c-1	5	1	09-Feb-11	CD	nails(2)	0.1524	853764.4654	6648304.8
33c-1-8	33c-1	5	1	09-Feb-11	CD	rebar left in place	0.3048	853767.1229	6648304.586
33c-1-9a	33c-1	5	1	09-Feb-11	CD	small arms cartridge casing	0.1778	853789.4825	6648302.975
33c-2-17	33c-2	5	1	09-Feb-11	CD	budweiser beer can	0.1524	854139.6691	6648315.086
33c-3-18	33c-3	5	1	09-Feb-11	CD	(2)small arms cartridge casing	0.3048	854265.1699	6648316.128
35B-1-001	35B-1	5	1	14-Jan-11	CD	Horseshoe	0.0508	852992.6848	6647822.342
35B-15-001	35B-15	5	1	14-Jan-11	CD	Small Arms	0.0254	850653.5869	6647820.261
35B-16-001	35B-16	5	1	14-Jan-11	CD	Barbed Wire	0.0762	850429.813	6647820.952
35B-7-001	35B-7	5	1	14-Jan-11	CD	Barbed Wire	0.0508	852383.9596	6647820.974
35B-7-002	35B-7	5	1	14-Jan-11	CD	Barbed Wire Fence	0	852328.8499	6647822.758
35B-8-001	35B-8	5	1	14-Jan-11	CD	Small Arms	0.0508	852198.6555	6647821.509
35B-8-002	35B-8	5	1	14-Jan-11	CD	Small Arms	0.0254	852138.5521	6647823.115
36B-1-001	36B-1	5	1	13-Jan-11	CD	Barbed Wire	0.0254	853459.4467	6647570.858
36B-10-001	36B-10	5	1	13-Jan-11	CD	Barbed Wire Fence	0	851762.1612	6647572.99
36B-11-002	36B-11	5	1	14-Jan-11	CD	Barbed Wire	0.0508	851411.4766	6647572.279
36B-11-001	36B-11	5	1	14-Jan-11	CD	Barbed Wire	0.1016	851450.2047	6647569.792
36B-12-001	36B-12	5	1	14-Jan-11	CD	Scrap Metal	0.0254	851211.4406	6647572.279
36B-14-001	36B-14	5	1	14-Jan-11	CD	Small Arms	0.0254	850810.3028	6647572.279
36B-2-001	36B-2	5	1	13-Jan-11	CD	Small Arms	0.0254	853350.7238	6647571.924
37B-10-001	37B-10	5	1		CD	Barbed Wire Fence	0	850945.0298	6647316.369
37B-11-001	37B-11	5	1	13-Jan-11	CD	Barbed Wire Fence	0	851170.3842	6647317.138
37B-20-001	37B-20	5	1	13-Jan-11	CD	Nail	0.0508	853068.9764	6647319.061
37B-21-001	37B-21	5	1	13-Jan-11	CD	Barbed Wire	0.0127	853268.9496	6647322.907
37B-3-001	37B-3	5	1	12-Jan-11	CD	Bed Frame & Sheet Metal	0	849669.0466	6647320.984
37B-9-001	37B-9	5	1	13-Jan-11	CD	Barbed Wire	0.0254	850869.2707	6647322.907
37B-9-002	37B-9	5	1	13-Jan-11	CD	Barbed Wire	0.0254	850869.2707	6647322.907
38c-2-1	38c-2	5	1	08-Mar-11	CD	barbed wire fence	0	855129.2136	6647066.495
38c-4-2	38c-4	5	1	08-Mar-11	CD	nailpit	2	855652.979	6647052.846
38c-6-3	38c-6	5	1	08-Mar-11	CD	barved wire fenceline	0	855996.4336	6647053.305
38c-7-4	38c-7	5	1	08-Mar-11	CD	horseshoe	12	856094.8479	6647061.71
38c-7-5	38c-7	5	1	08-Mar-11	CD	barbed wire fenceline	0	856189.346	6647048.126
39c-6-1	39c-6	5	1	10-Mar-11	CD	barbed wire	0	855722.092	6646839.108
39c-6-2	39c-6	5	1	10-Mar-11	CD	barbed wire fenceline	0	855941.9397	6646814.159
40c-2-1	40c-2	5	1	09-Mar-11	CD	barbed wire pit	5	855027.4668	6646557.175
41b-1-5	41b-1	5	1	17-Feb-11	CD	small arms	8	852465.3632	6646316.117
42 b-1-7	42 b-1	5	1	15-Feb-11	CD	nail	8	850435.8774	6646044.888
42b-1-2	42b-1	5	1	15-Feb-11	CD	bottle opener	9	850380.5996	6646045.579
42b-1-3	42b-1	5	1	15-Feb-11	CD	nail	8	850399.5134	6646045.827
42b-1-4	42b-1	5	1	15-Feb-11	CD	nail	8	850402.9865	6646046.087
42b-1-5	42b-1	5	1	15-Feb-11	CD	nail	9	850402.9725	6646040.335
42b-1-6	42b-1	5	1	15-Feb-11	CD	steel band	10	850409.0438	6646040.259
42b-1-7	42b-1	5	1	15-Feb-11	CD	scrapmetal ornamental	8	850434.3601	6646048.419
42b-1-9	42b-1	5	1	15-Feb-11	CD	nail	10	850454.9474	6646053.006
42b-1-1	42b-1	5	1	15-Feb-11	CD	small armscartridge casing/stove burner grate part	9	850408.026	6646037.487
42b-2-2	42b-2	5	1	17-Feb-11	CD	small arms	8	852529.0186	6646068.9
42b-3-12	42b-3	5	1	15-Feb-11	CD	datacable	0	850772.4396	6645997.454
42b-3-4	42b-3	5	1	17-Feb-11	CD	small arms cartridge casing	7	852772.2131	6646065.567
42b-4-15	42b-4	5	1	15-Feb-11	CD	screw	10	850979.0879	6646012.795
42b-5-6	42b-5	5	1	17-Feb-11	CD	small arms cartridge casing	7	853201.9973	6646059.851
42b-6-7	42b-6	5	1	17-Feb-11	CD	small arms projectile	8	853359.7271	6646052.619
42b-7-17	42b-7	5	1	15-Feb-11	CD	rebar	0	851559.6775	6646019.413
42b-7-16	42b-7	5	1	15-Feb-11	CD	scrapmetal	6	851488.723	6646047.544
43b-2-9	43b-2	5	1	17-Feb-11	CD	small arms	8	852598.4778	6645795.456
43b-3-7	43b-3	5	1	17-Feb-11	CD	smallarms	8	853016.6973	6645803.626
43b-3-6	43b-3	5	1	17-Feb-11	CD	smallarms	7	853025.626	6645805.452
43b-3-5	43b-3	5	1	17-Feb-11	CD	small arms	6	853026.9526	6645814.457
43b-4-5	43b-4	5	1	17-Feb-11	CD	small arms	6	853036.7688	6645813.245
43b-4-1	43b-4	5	1	17-Feb-11	CD	small arms	8	853084.438	6645809.927
43b-4-2	43b-4	5	1	17-Feb-11	CD	smallarms	8	853065.9651	6645812.579
43b-4-4	43b-4	5	1	17-Feb-11	CD	smallarms	8	853044.7724	6645815.083
43b-4-3	43b-4	5	1	17-Feb-11	CD	smallarms	6	853057.6548	6645818.616
43b-5-2	43b-5	5	1	16-Feb-11	CD	small arms (2)	8	853117.112	6645795.958

43b-5-1	43b-5	5	1	16-Feb-11	CD	smallarms	6	853294.4325	6645815.425
44b-2-1	44b-2	5	1	16-Feb-11	CD	barbed wire	0	852639.0308	6645555.187
44b-3-2	44b-3	5	1	16-Feb-11	CD	scrap metal	6	852751.6486	6645547.548
44b-5-9	44b-5	5	1	16-Feb-11	CD	small arms	8	853218.9374	6645557.894
44b-5-8	44b-5	5	1	16-Feb-11	CD	small arms	7	853213.1726	6645559.358
44b-5-16	44b-5	5	1	16-Feb-11	CD	small arms	6	853272.521	6645551.172
44b-5-14	44b-5	5	1	16-Feb-11	CD	smallarms	8	853228.514	6645556.019
44b-5-15	44b-5	5	1	16-Feb-11	CD	small arms	9	853228.6063	6645554.141
44b-5-10	44b-5	5	1	16-Feb-11	CD	small arms	7	853219.5089	6645557.342
44b-5-11	44b-5	5	1	16-Feb-11	CD	smallarms	8	853217.4454	6645558.821
44b-5-13	44b-5	5	1	16-Feb-11	CD	smallarms	7	853227.9217	6645559.538
45b-2-29	45b-2	5	1	16-Feb-11	CD	barbed wiire pit	12	852454.6601	6645304.22
45b-2-28	45b-2	5	1	16-Feb-11	CD	small arms	7	852496.4059	6645294.255
45b-3-23	45b-3	5	1	16-Feb-11	CD	smallarms	6	853080.0384	6645284.805
45b-3-27	45b-3	5	1	16-Feb-11	CD	horse shoe	5	852982.9043	6645300.545
45b-3-22	45b-3	5	1	16-Feb-11	CD	smallarms	8	853095.8659	6645283.336
45b-4-10	45b-4	5	1	16-Feb-11	CD	small arms	10	853228.3317	6645327.702
45b-4-9	45b-4	5	1	16-Feb-11	CD	small arms	9	853232.4009	6645324.745
45b-4-17	45b-4	5	1	16-Feb-11	CD	hotrock	12	853176.6297	6645318.355
45b-4-21	45b-4	5	1	16-Feb-11	CD	smallarms	10	853120.3708	6645286.724
45b-4-5	45b-4	5	1	16-Feb-11	CD	smalll arms	12	853267.4813	6645313.591
45b-4-1	45b-4	5	1	16-Feb-11	CD	smallarms	8	853313.5676	6645303.875
46b-1-2	46b-1	5	1	16-Feb-11	CD	barbed wire fence	0	852725.695	6645047.215
46b-1-1	46b-1	5	1	16-Feb-11	CD	can	8	852719.8947	6645059.76
46b-2-4	46b-2	5	1	16-Feb-11	CD	cable	12	852855.0288	6645035.069
BM-1-001	BM-1	5	1	28-Feb-11	CD		0.3048	854060.0214	6651171.128
17a-7-2	17a	4	1	25-Feb-11	Geo	hotsoil	6	840947.3616	6652108.617
22b-1-8	22b-1	5	1	18-Feb-11	Geo	hotrock	10	849348.8923	6651053.276
22b-1-9	22b-1	5	1	18-Feb-11	Geo	hotrock	9	849306.7706	6651055.983
22b-2-2	22b-2	5	1	18-Feb-11	Geo	hotrock	8	849579.09	6651075.581
23b-1-7	23b-1	5	1	18-Feb-11	Geo	hotrock	7	850755.9931	6650822.668
23b-1-6	23b-1	5	1	18-Feb-11	Geo	hotrock	8	850740.9405	6650825.884
23b-1-5	23b-1	5	1	18-Feb-11	Geo	hotrock	8	850730.2007	6650817.905
23b-1-2	23b-1	5	1	18-Feb-11	Geo	hotrock	8	850600.0655	6650806.635
23b-2-12	23b-2	5	1	18-Feb-11	Geo	hotrock	6	850880.3609	6650788.903
24b-1-6	24b-1	5	1	18-Feb-11	Geo	hotrock	12	851523.2916	6650558.544
28c-10-1	28c-10	5	1	14-Feb-11	Geo	hotrock	6	855746.5457	6649544.478
28c-8-5	28c-8	5	1	14-Feb-11	Geo	hotrock	8	855340.2406	6649562.18
28c-9-4	28c-9	5	1	14-Feb-11	Geo	hotrock	0	855400.9536	6649566.39
28c-9-3	28c-9	5	1	14-Feb-11	Geo	hotsoil	8	855414.6647	6649562.224
29c-11-2	29c-11	5	1	14-Feb-11	Geo	hotrock	8	855719.0513	6649300.214
29c-9-1	29c-9	5	1	14-Feb-11	Geo	hotsoil	12	855511.1659	6649291.232
31c-1-12	31c-1	5	1	11-Feb-11	Geo	hotrock	0.2286	853948.6172	6648817.998
31c-1-10	31c-1	5	1	11-Feb-11	Geo	hotrock	0.3048	853935.0519	6648810.659
31c-1-13a	31c-1	5	1	11-Feb-11	Geo	hotrock	0.1778	853977.0753	6648813.89
31c-1-5	31c-1	5	1	11-Feb-11	Geo	hotrock	0.254	853895.3118	6648818.964
31c-1-8	31c-1	5	1	11-Feb-11	Geo	hotrock	0.254	853927.8108	6648804.997
31c-13-39	31c-13	5	1	11-Feb-11	Geo	hotrock	0.3048	856170.7563	6648807.576
31c-13-40	31c-13	5	1	11-Feb-11	Geo	hotrock	0.254	856203.9759	6648814.368
31c-13-41	31c-13	5	1	11-Feb-11	Geo	hotrock	0.2032	856213.54	6648811.525
31c-13-45	31c-13	5	1	11-Feb-11	Geo	hotrock	0.3302	856353.9362	6648824.738
31c-13-48	31c-13	5	1	11-Feb-11	Geo	hotrock	0.254	856392.3881	6648838.429
31c-13-46	31c-13	5	1	11-Feb-11	Geo	hotdirt	0.3048	856387.3998	6648827.895
31c-14-49	31c-14	5	1	11-Feb-11	Geo	hotrock	0.254	856493.1054	6648836.937
31c-15-11	31c-15	5	1	10-Feb-11	Geo	hotrock	0.2286	856814.7385	6648850.566
31c-2-10	31c-2	5	1	08-Feb-11	Geo	hot rocks	0.254	854345.407	6648815.906
31c-2-13	31c-2	5	1	08-Feb-11	Geo	hotrock	0.3302	854352.9431	6648817.387
31c-2-14	31c-2	5	1	11-Feb-11	Geo	hotrock	0.254	853976.7082	6648816.922
31c-2-17	31c-2	5	1	11-Feb-11	Geo	hotrock	0.254	853999.1808	6648810.466
31c-2-18	31c-2	5	1	11-Feb-11	Geo	hotdirt	0.3302	854010.9884	6648802.025
31c-2-19	31c-2	5	1	11-Feb-11	Geo	hotdirt	0.381	854021.3572	6648794.146
31c-2-21	31c-2	5	1	11-Feb-11	Geo	hotdirt	0.3048	854048.9889	6648797.979
31c-2-23	31c-2	5	1	11-Feb-11	Geo	hotrock	0.254	854048.584	6648793.322
31c-2-26	31c-2	5	1	11-Feb-11	Geo	hotrock	0.2286	854140.0038	6648802.114
31c-2-27	31c-2	5	1	11-Feb-11	Geo	hotdirt	0.3048	854142.5385	6648792.032
31c-2-28	31c-2	5	1	11-Feb-11	Geo	hotrock	0.254	854178.5185	6648811.504
31c-2-29	31c-2	5	1	11-Feb-11	Geo	hotrock	0.2286	854181.8887	6648817.456
31c-2-24	31c-2	5	1	11-Feb-11	Geo	hot rocks (5)	0.2286	854061.1375	6648793.711
31c-3-21	31c-3	5	1	08-Feb-11	Geo	hotrocks	0.254	854369.6534	6648812.578
31c-3-34a	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854399.1696	6648809.849
31c-3-23a	31c-3	5	1	08-Feb-11	Geo	hotrock	0.3048	854377.2983	6648813.512
31c-3-25	31c-3	5	1	08-Feb-11	Geo	hotroock	0.1524	854379.102	6648814.397
31c-3-25a	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854382.8796	6648811.263

31c-3-27	31c-3	5	1	08-Feb-11	Geo	hotrock	0.254	854382.502	6648813.447
31c-3-28	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1778	854382.1986	6648812.3
31c-3-28a	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854387.0202	6648814.057
31c-3-29	31c-3	5	1	08-Feb-11	Geo	hoock	0.3302	854389.8143	6648815.536
31c-3-3	31c-3	5	1	08-Feb-11	Geo	hor rocks	0.2032	854277.7435	6648810.875
31c-3-30a	31c-3	5	1	08-Feb-11	Geo	hotrock	0.0254	854395.1763	6648809.596
31c-3-23	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.2794	854374.3691	6648815.122
31c-3-34	31c-3	5	1	08-Feb-11	Geo	hotrock	0.2032	854401.5614	6648816.177
31c-3-24	31c-3	5	1	08-Feb-11	Geo	hotrock	0.3048	854377.7405	6648811.871
31c-3-35	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1778	854408.8006	6648812.393
31c-3-36	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854421.3675	6648809.21
31c-3-4	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.3048	854290.6163	6648813.682
31c-3-4a	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.254	854284.3567	6648812.549
31c-3-5	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854287.0104	6648812.031
31c-3-5a	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.1778	854289.8205	6648819.444
31c-3-6	31c-3	5	1	08-Feb-11	Geo	hotrocks	0.1778	854297.6724	6648813.776
31c-3-8	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.1524	854331.2796	6648814.508
31c-3-9	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.3048	854343.5109	6648812.237
31c-3-33	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1016	854400.5979	6648813.101
31c-3-11	31c-3	5	1	08-Feb-11	Geo	hot rock	0.2032	854347.9	6648816.42
31c-3-20	31c-3	5	1	08-Feb-11	Geo	hotrock	0.2032	854371.1791	6648809.713
31c-3-2	31c-3	5	1	08-Feb-11	Geo	hot rock	0.1524	854280.633	6648810.718
31c-3-1	31c-3	5	1	08-Feb-11	Geo	hot soil	0.2032	854273.2336	6648810.931
31c-3-19	31c-3	5	1	08-Feb-11	Geo	hotrock	0.3048	854367.5758	6648817.568
31c-3-22	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.1524	854371.4429	6648816.975
31c-3-18	31c-3	5	1	08-Feb-11	Geo	hot rock	0.1524	854366.1025	6648815.346
31c-3-17	31c-3	5	1	08-Feb-11	Geo	hot rock	0.3556	854364.7322	6648816.756
31c-3-16	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1778	854360.4799	6648818.928
31c-3-15	31c-3	5	1	08-Feb-11	Geo	hotrock	0.1524	854358.8527	6648818.282
31c-3-14	31c-3	5	1	08-Feb-11	Geo	hot rocks	0.2032	854355.1381	6648821.84
31c-3-12	31c-3	5	1	08-Feb-11	Geo	hot rock	0.1524	854349.8891	6648813.61
31c-3-31	31c-3	5	1	11-Feb-11	Geo	hotdirt	0.3048	854228.0161	6648811.252
31c-3-30	31c-3	5	1	11-Feb-11	Geo	hotrock	0.1778	854194.4181	6648815.908
31c-4-38	31c-4	5	1	08-Feb-11	Geo	hotrock	0.2032	854452.7868	6648815.358
31c-4-37	31c-4	5	1	08-Feb-11	Geo	hotrock	0.2032	854439.1413	6648810.866
31c-4-41	31c-4	5	1	08-Feb-11	Geo	hotrock	0.1524	854499.0477	6648805.943
31c-4-39	31c-4	5	1	08-Feb-11	Geo	hotrock	0.2286	854455.4639	6648821.379
31c-8-35a	31c-8	5	1	11-Feb-11	Geo	hotrock	0.254	855402.8701	6648812.993
32c-1-6a	32c-1	5	1	09-Feb-11	Geo	hotrock	0.3048	853844.7716	6648568.206
32c-1-8	32c-1	5	1	09-Feb-11	Geo	hotdirt	0.508	853784.0701	6648565.026
32c-1-9	32c-1	5	1	09-Feb-11	Geo	hot dirt	0.5588	853769.9531	6648564.475
32c-10-12	32c-10	5	1	10-Feb-11	Geo	hotrock	0.254	855911.7612	6648566.609
32c-13-15	32c-13	5	1	10-Feb-11	Geo	hotrock	0.3048	856336.4499	6648561.944
32c-2-1	32c-2	5	1	09-Feb-11	Geo	hotrock	0.1524	854000.2579	6648557.794
32c-2-4	32c-2	5	1	09-Feb-11	Geo	hotrock	0.254	853964.495	6648565.081
32c-2-2a	32c-2	5	1	10-Feb-11	Geo	hotrock	0.2032	854236.8999	6648586.394
32c-3-11	32c-3	5	1	09-Feb-11	Geo	hotdirt	0.4572	854077.7137	6648550.412
32c-3-1	32c-3	5	1	10-Feb-11	Geo	hotrock	0.254	854213.6161	6648588.076
32c-3-5	32c-3	5	1	10-Feb-11	Geo	hotrock	0.254	854214.9256	6648586.425
32c-3-6	32c-3	5	1	10-Feb-11	Geo	hotrock	0.254	854287.5652	6648600.961
32c-3-7	32c-3	5	1	10-Feb-11	Geo	hotrock	0.254	854445.9845	6648593.905
32c-3-2	32c-3	5	1	10-Feb-11	Geo	hotrock	0.254	854243.2923	6648584.256
32c-4-6	32c-4	5	1	10-Feb-11	Geo	hotrock	0.254	854366.9664	6648568.671
32c-7-11	32c-7	5	1	10-Feb-11	Geo	hotrock	0.254	855111.9975	6648599.066
32c-7-10	32c-7	5	1	10-Feb-11	Geo	hotrock	0.2032	854994.6419	6648574.005
33c-1-9	33c-1	5	1	09-Feb-11	Geo	hotrock	0.254	853773.4126	6648308.14
33c-1-6a	33c-1	5	1	09-Feb-11	Geo	hot rocks (2)	0.1524	853746.3913	6648306.902
33c-1-16	33c-1	5	1	09-Feb-11	Geo	hotrock	0.3048	853872.1053	6648306.488
41b-1-6	41b-1	5	1	17-Feb-11	Geo	hotrock	7	852407.4053	6646296.617
41b-5-3	41b-5	5	1	17-Feb-11	Geo	hot soil	10	852688.4542	6646296.02
42b-1-10	42b-1	5	1	15-Feb-11	Geo	hotrock	8	850473.7122	6646041.328
42b-4-14	42b-4	5	1	15-Feb-11	Geo	hotrock	6	850866.3391	6645991.377
44b-3-3	44b-3	5	1	16-Feb-11	Geo	hotrock	10	852900.9535	6645569.543
44b-4-6	44b-4	5	1	16-Feb-11	Geo	hotrock	10	853039.8997	6645558.489
44b-4-5	44b-4	5	1	16-Feb-11	Geo	hotrock	9	853015.9344	6645561.269
44b-5-7	44b-5	5	1	16-Feb-11	Geo	hotrock	7	853195.7562	6645563.268
45b-2-25	45b-2	5	1	16-Feb-11	Geo	hotrocks (3)	7	853061.1356	6645280.802
45b-3-28	45b-3	5	1	16-Feb-11	Geo	hotrock	8	852947.5443	6645307.827
45b-3-29	45b-3	5	1	16-Feb-11	Geo	hotrock	8	852848.415	6645325.894
45b-3-26	45b-3	5	1	16-Feb-11	Geo	hotsoil	12	853044.7599	6645298.625
45b-4-12	45b-4	5	1	16-Feb-11	Geo	hotrock	10	853209.5989	6645332.718
45b-4-7	45b-4	5	1	16-Feb-11	Geo	hotrock	9	853254.9743	6645312.355
45b-4-6	45b-4	5	1	16-Feb-11	Geo	hotrock	8	853244.403	6645304.01

45b-4-4	45b-4	5	1	16-Feb-11	Geo	hoock	8	853286.6803	6645290.284
45b-4-20	45b-4	5	1	16-Feb-11	Geo	hotrock	10	853128.3581	6645291.892
45b-4-2	45b-4	5	1	16-Feb-11	Geo	hotrock	9	853290.9464	6645307.79
45b-4-18	45b-4	5	1	16-Feb-11	Geo	hotrock	11	853152.6509	6645306.121
45b-4-16	45b-4	5	1	16-Feb-11	Geo	hotrock	10	853203.9789	6645331.88
45b-4-15	45b-4	5	1	16-Feb-11	Geo	hoock	11	853198.9061	6645328.552
45b-4-11	45b-4	5	1	16-Feb-11	Geo	hotrock	9	853222.259	6645332.318
45b-4-13	45b-4	5	1	16-Feb-11	Geo	hotrock	8	853206.0964	6645330.098
45b-4-14	45b-4	5	1	16-Feb-11	Geo	hotrock	9	853202.4373	6645333.473
46b-1-3	46b-1	5	1	16-Feb-11	Geo	hotrock	8	852716.8492	6645052.048
12A-4-001	12A-4	7	1	24-Nov-10	MD	Expended Flare	0.01	868388.0144	6649991.454
17a-7-1	17a	4	1	25-Feb-11	MD	frag	2	841023.2306	6652094.942
23b-2-13	23b-2	5	1	18-Feb-11	MD	frag	8	850903.36	6650801.512
24A-5-001	24A-5	5	2	22-Nov-10	MD	30 cal carts	0.5	847261.7986	6650572.547
24A-5-002	24A-5	5	2	22-Nov-10	MD	30 cal carts	0.5	847134.3892	6650572.547
26c-7-8	26c-7	5	1	15-Feb-11	MD	frag	7	855071.5181	6650092.572
28A-9-001	28A-9	7	1	28-Oct-10	MD	20mm	0	864612.1109	6650451.68
29A-10-001	29A-10	5	1	04-Nov-10	MD	81mm Mortar	0	847584.5835	6649313.573
29c-10-3	29c-10	5	1	14-Feb-11	MD	frag	8	855750.4699	6649292.377
29c-12-10	29c-12	5	1	14-Feb-11	MD	frag	8	856102.9014	6649322.876
29c-12-7	29c-12	5	1	14-Feb-11	MD	frag	6	856098.285	6649328.322
29c-12-9	29c-12	5	1	14-Feb-11	MD	frag	10	856099.3408	6649329.52
29c-12-8	29c-12	5	1	14-Feb-11	MD	fRag	12	856099.4301	6649327.399
29c-12-6	29c-12	5	1	14-Feb-11	MD	frag	8	856095.174	6649319.945
31c-1-11	31c-1	5	1	11-Feb-11	MD	4.2" mortar base	0.2032	853936.3885	6648811.187
31c-2-25	31c-2	5	1	11-Feb-11	MD	mortar frag	0.2032	854065.6167	6648795.835
32c-3-4	32c-3	5	1	10-Feb-11	MD	81mm mortar frag/tailboom	0.3048	854241.859	6648589.905
35B-9-001	35B-9	5	1	14-Jan-11	MD	81mm Frag (5) Pounds	0.1524	851903.5595	6647821.19
3A-1-001	3A-1	7	1	18-Nov-10	MD	Partial Rotating band	0.75	869726.6609	6650549.81
41b-4-1	41b-4	5	1	17-Feb-11	MD	frag	8	852948.3433	6646309.856
42b-2-3	42b-2	5	1	17-Feb-11	MD	frag	8	852724.0443	6646061.263
43b-2-10	43b-2	5	1	17-Feb-11	MD	81mm mortar frag	14	852581.3603	6645809.413
4A-3-001	4A-3	7	1	18-Nov-10	MD	PTTF Fuze expended	0	869343.3246	6650731.464
4A-5-001	4A-5	7	1	18-Nov-10	MD	Brass Frag	0	869169.9599	6650910.354
4A-5-002	4A-5	7	1	18-Nov-10	MD	Brass Frag	0	869165.125	6650917.261
4A-5-003	4A-5	7	1	18-Nov-10	MD	Brass Frag	0	869062.902	6651022.937
4A-6-004	4A-6	7	1	18-Nov-10	MD	Brass Frag	0	868971.0394	6651116.872
4A-6-005	4A-6	7	1	18-Nov-10	MD	Brass Frag	0	868983.4719	6651103.749
4A-6-003	4A-6	7	1	18-Nov-10	MD	Brass Frag	0	868980.7091	6651106.512
4A-6-002	4A-6	7	1	18-Nov-10	MD	lead bullet	0	868946.865	6651143.809
4A-6-001	4A-6	7	1	18-Nov-10	MD	Brass Frag	0	869033.202	6651052.637
4A-6-006	4A-6	7	1	18-Nov-10	MD	Brass Frag	0	868956.5348	6651134.139
4A-7-001	4A-7	7	1	24-Nov-10	MD	Brass Frag	0.0508	868901.2791	6651190.086
4A-7-002	4A-7	7	1	24-Nov-10	MD	Partial Fuze body	0.0508	868892.3	6651198.374
4A-8-001	4A-8	7	1	18-Nov-10	MD	Shotgun shell	0.0508	868703.0493	6651395.222
8A-1-001	8A-1	7	1	18-Nov-10	MD	Partial Fuze body	0.0508	869332.1144	6649878.549
8A-4-001	8A-4	7	1	24-Nov-10	MD	Frag from 3" Projectile	0.381	868878.1528	6650348.832
8A-5-001	8A-5	7	1	24-Nov-10	MD	Frag from 3" Projectile	0.381	868829.6251	6650399.761
8A-6-001	8A-6	7	1	24-Nov-10	MD	Lead bullet	0.381	868664.5697	6650570.521
28A-9-003	28A-9	7	1	28-Oct-10	MEC	warhead (HEAT) live, rocket nose	0	864593.6833	6650471.274
28A-9-002	28A-9	7	1	28-Oct-10	MEC	Mk 8 Demo hose	0	864601.3809	6650463.11
43b-4-na	43b-4	5	1	16-Feb-11	na	stoppoint	0	853093.2767	6645799.887
27AA-1-001	27AA-1	5	1	22-Nov-10	O		0.3048	843918.5865	6649817.299
27AA-1-003	27AA-1	5	1	22-Nov-10	O		0.0762	844026.7502	6649816.312
27AA-1-002	27AA-1	5	1	22-Nov-10	O		0.3048	843929.9	6649816.653
37B-7-001	37B-7	5	1	12-Jan-11	O	Hot Dirt	0.3048	850505.8577	6647321.753
41B-9-001	41B-9	5	1	10-Dec-10	O	Hot Rock		850276.3929	6646321.288

Appendix C: MC Investigation Data

MC Data included in Electronic Format on
The Enclosed CD

Appendix D: Photo Log

Photograph 1: MC Sample MRS04 SS 01

Photograph 2: MC Sample MS04 SS 02

Photograph 3: MC Sample MS04 SS 03

Photograph 4: MC Sample MS04 SS 04

Photograph 5: MC Sample MRS04 SS 05


Photograph 6: MC Sample MRS04 SD 01

Photograph 7: MC Sample MRS04 SD 03

Photograph 8: MC Sample MRS04 BKG 01

Photograph 9: MC Sample MRS04 BKG 02

Photograph 10: MC Sample MRS04 BKG 03

Photograph 11: MC Sample MRS05 SS 01

Photograph 12: MC Sample MRS05 SS 03

Photograph 13: MC Sample MRS05 SS 04

Photograph 14: MC Sample MRS05 SS 05

Photograph 15: MC Sample MRS05 SS 06

Photograph 16: MC Sample MRS05 SS 07

Photograph 17: MC Sample MRS05 SS 08

Photograph 18: MC Sample MRS05 SS 09

Photograph 19: MC Sample MRS05 SS 11

Photograph 20 MC Sample MRS05 SS 12

Photograph 21: MC Sample MRS05 SS 13

Photograph 22 MC Sample MRS05 SD 01

Photograph 23 MC Sample MRS05 SD 02

Photograph 24: MC Sample MRS05 BKG 01

Photograph 25: MC Sample MRS05 BKG 02

Photograph 26: MC Sample MRS05 BKG 03

Photograph 27: MC Sample MRS05 BKG 04

Photograph 28: MC Sample MRS07 SS 01

Photograph 29: MC Sample MRS07 SS 02

Photograph 30: MC Sample MRS07 SS 03

Photograph 31: MC Sample MRS07 SS 04

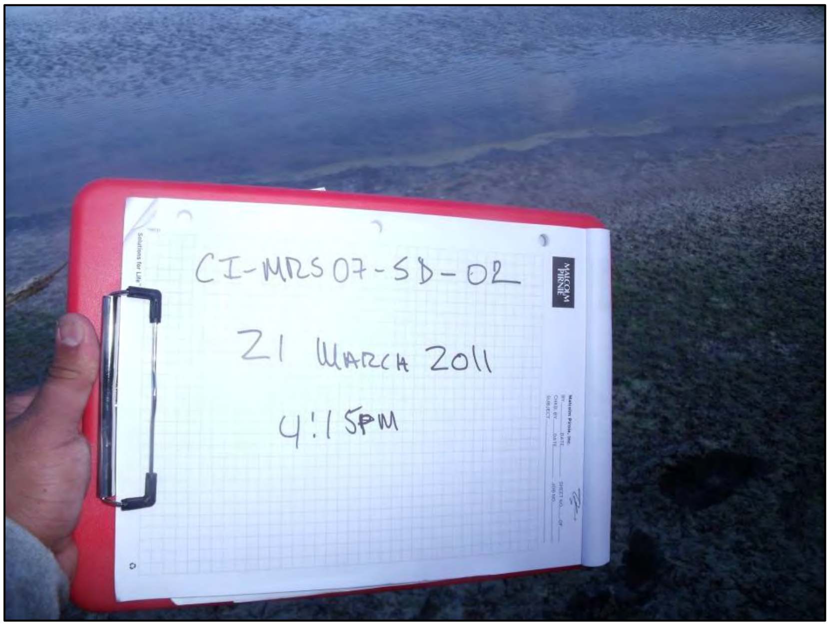
Photograph 32: MC Sample MRS07 SS 05

Photograph 33: MC Sample MRS07 SS 06

Photograph 34: MC Sample MRS07 SS 07

Photograph 35: MC Sample MRS07 SS 08

Photograph 36: MC Sample MRS07 SD 01



Photograph 37: MC Sample MRS07 SD 02

Photograph 38: MC Sample MRS07 BKG 01

Photograph 39: MC Sample MRS07 BKG 02

Photograph 40: MC Sample MRS07 BKG 03

Photograph 41: Transect in MRS 07 during MC sampling

Photograph 42: View of the beach and the western portion of MRS 07 on Culebrita

Photograph 43: View of Cayo Botella (right) from Culebrita (MRS 07)

Photograph 44: Recreational trail looking west near the southern boundary of MRS 07

Photograph 45: Lagoon in western portion of MRS 07 near sediment sampling locations looking east

Photograph 46: Transect in MRS 05 during MC sampling


Photograph 47: Flamenco Beach in MRS 04 looking east


Photograph 48: Transect in MRS 04 during MC sampling

Photograph 49: View south from MRS 05

Photograph 50: View of the southwestern face of Cayo Lobo (MRS 02)

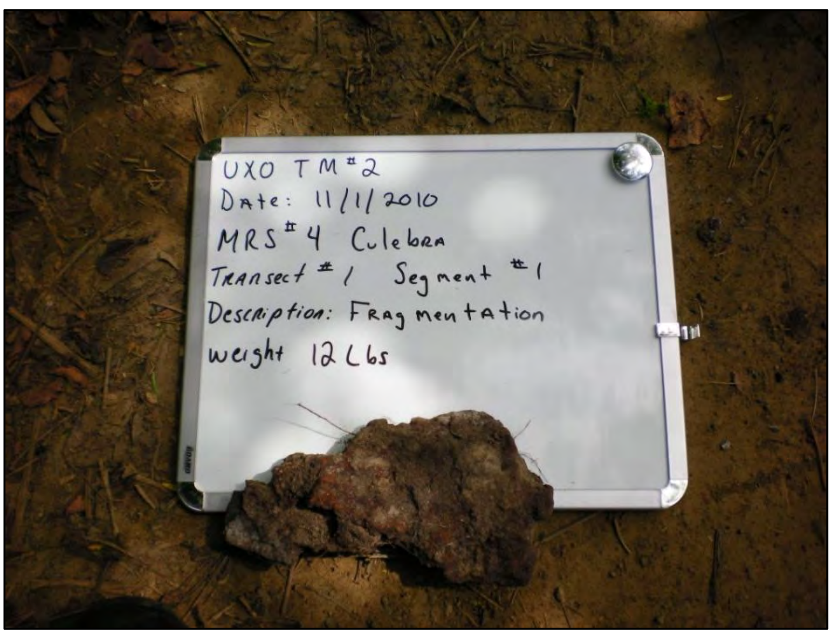
Photograph 51: MD found along transect 05A in MRS 07

Photograph 52: Brush cutting in MRS 07

Photograph 53: Transect in MRS 07 recently cleared of brush

Photograph 54: Mk8 Demolition Hose (MEC) found along transect 29A

Photograph 55: Mk5 MOD 0 Rocket Nose (MEC) found along transect 29A in MRS 07



Photograph 56: MD found along transect 1 in MRS 04

Photograph 57: MD found along transect 2 in MRS 04

Photograph 58: Beginning of transect 1 in MRS 04

Photograph 59: Field crew member conducting daily magnetometer check

Photograph 60: Cleared GPO location

Photograph 61: DGM equipment in DPO

Photograph 62: Beginning of transect 27A in MRS 05

Photograph 63: Cultural debris found along transect 27A in MRS 05

Photograph 64: Tank located near transect 28A of MRS 07 is consistent with historical military activity

Photograph 65: View along transect 46B in MRS 05

Appendix E: MEC HA

MEC HA Summary Information

Comments

Site ID: MRS 02 (Cays)
Date: 9/9/2011

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

The Cays

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
2	Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010
3	Site Specific Final Report. UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico, 2004.
4	Final FUDS Inventory Project Report. 1991.
5	
6	
7	
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 39.5 acres
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Undeveloped, tresspassers (recreation), USFW workers

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800 (USACE, 1991).

6. How certain are the site boundaries?

The boundaries are fairly certain.

Reference(s) for Part B:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011

[redacted]

C. Historical Clearances

1. Have there been any historical clearances at the site? Yes, surface clearance
2. If a clearance occurred:
   a. What year was the clearance performed? 200

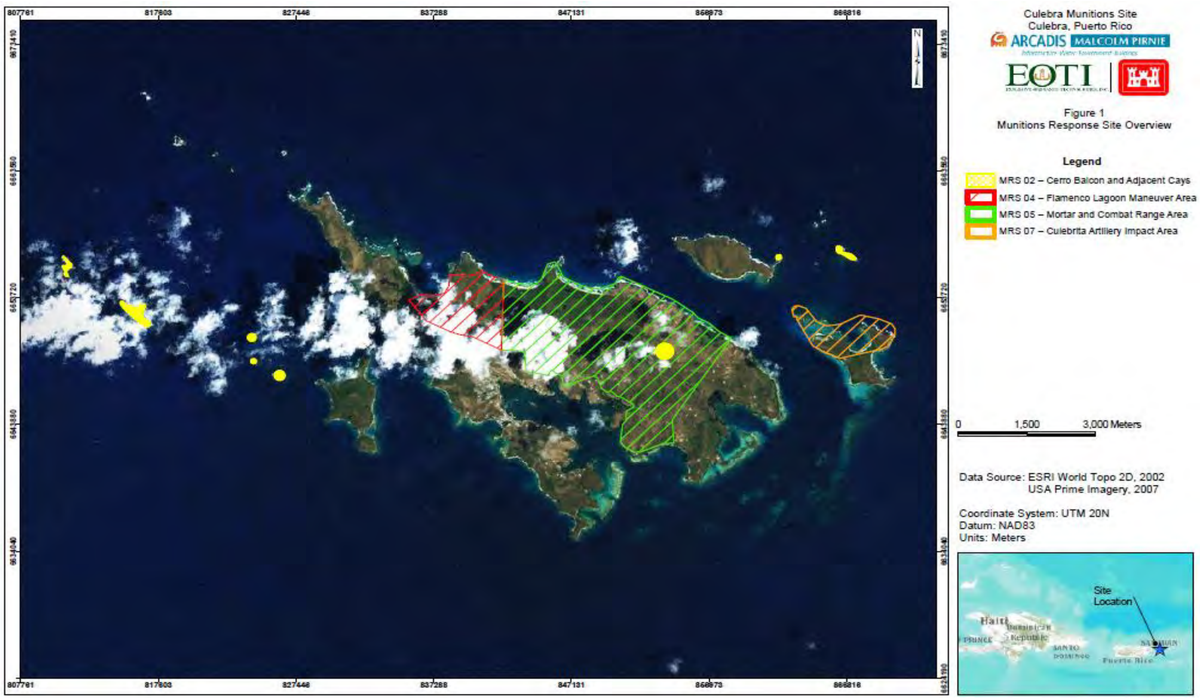
   b. Provide a description of the clearance activity (e.g., extent, depth, amount of munitions-related items removed, types and sizes of removed items, and whether metal detectors were used):

Surface clearance conducted on 100% of Cayo Lobo in 2006.

Reference(s) for Part C:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)



Site ID: **MRS 02 (Cays)**
Date: **9/9/2011**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Bombs	500	lb		High Explosive				0	Subsurface Only	one West of Cayo Ballena, two West of Cayo Geniqui
2	Torpedoes			MK 27					0	Subsurface Only	East of Cayo Geniqui
3	Bombs			MK 76	Spotting Charge				0	Surface and Subsurface	Cayo del Agua
4	Artillery	76	mm		Low Explosive Filler in a fragmenting round				0	Surface and Subsurface	Cayo del Agua
5	Bombs	100	lb		Spotting Charge	Yes		Armed	0	Surface and Subsurface	
6	Bombs	1000	lb			Yes		Armed	0	Surface and Subsurface	
7	Mortars	81	mm		High Explosive	Yes		Armed	0	Surface and Subsurface	
8	Fuzes			M151					0.5	Surface and Subsurface	Cayo Lobo
9	Bombs	25	lb		Spotting Charge				0.5	Surface and Subsurface	Cayo Lobo
10	Bombs	5	lb		Spotting Charge				0.5	Surface and Subsurface	Cayo Lobo
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **MRS 02 (Cays)**
Date: **9/9/2011**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Undeveloped	0	0	**0**	0	
2	Site workers	5	40	**200**	1	
3	Recreational users (trespassers)	75	20	**1,500**	0	
4						
5						
6						
7						
8						
9						
10						
11						
12						
	Total Potential Contact Time (receptor hrs/yr):			**1,700**		
	Maximum intrusive depth at site (ft):				**1**	

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Site ID: **MRS 02 (Cays)**
Date: **9/9/2011**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1						
2						
3						
4						
5						
6						

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed against current land uses.

Reference(s) for table above:
Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

[redacted]

Site ID: **MRS 02 (Cays)**
Date: **9/9/2011**

Energetic Material Type Input Factor Categories

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

	Score
Baseline Conditions:	**100**
Surface Cleanup:	**100**
Subsurface Cleanup:	**100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 3882 feet

2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? No

3. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for current use activities

Item #4. Artillery (76mm)
Item #6. Bombs (1000lb)

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Outside of the ESQD arc', based on Question 2.'

	Score
Baseline Conditions:	**0**
Surface Cleanup:	**0**
Subsurface Cleanup:	**0**

5. Are there future plans to locate or construct features or facilities where people may congregate within the MRS, or within the ESQD arc?

6. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for future use activities

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (future use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

7. Please answer Question 5 above to determine the scores.

	Score
Baseline Conditions:	
Surface Cleanup:	
Subsurface Cleanup:	

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities ***Score***

Select the category that best describes the site accessibility under the current use scenario:

Limited Accessibility

Baseline Conditions:	**15**
Surface Cleanup:	**15**
Subsurface Cleanup:	**15**

Future Use Activities

Select the category that best describes the site accessibility under the future use scenario:

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Reference(s) for above information:
After Action Report Remedial Investigation Field Work, Sierra Army Depot MRS, Sierra Army Depot (SIAD), Herlong California, December 2011

Response Alternative No. 1:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities :

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **1,700** receptor hrs/yr
Based on the table above, this corresponds to a input factor score for baseline conditions of: **15** Score

Future Use Activities :

Input factors are only determined for baseline conditions for future use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: receptor hrs/yr
Based on the table above, this corresponds to a input factor score of: Score

Response Alternative No. 1:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 4:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 5:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 6:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

	Score
Baseline Conditions:	**180**
Surface Cleanup:	**120**
Subsurface Cleanup:	**30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft

The deepest intrusive depth: **1** ft

The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95

Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Future Use Activities

Deepest intrusive depth: **1** ft

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.'. For 'Future Use Activities', only Baseline Conditions are considered. **240** ***Score***

Response Alternative No. 1:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 5:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? Yes

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

wave action, erosion

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Possible.' ***Score***

Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**10**

Reference(s) for above information:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: No

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

At least one item listed in the 'Munitions, Bulk Explosive Info' Worksheet was identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO'.	*Score*
Baseline Conditions:	110
Surface Cleanup:	110
Subsurface Cleanup:	110

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Small

	Score
Baseline Conditions:	40
Surface Cleanup:	40
Subsurface Cleanup:	40

Scoring Summary

Site ID:	MRS 02 (Cays)	a. Scoring Summary for Current Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Outside of the ESQD arc	0
III. Site Accessibility		Limited Accessibility	15
IV. Potential Contact Hours		<10,000 receptor-hrs/yr	15
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	730
		Hazard Level Category	3

Site ID:	MRS 02 (Cays)	b. Scoring Summary for Future Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors			
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	700
		Hazard Level Category	3

MEC HA Hazard Level Determination		
Site ID: MRS 02 (Cays)		
Date: 9/9/2011		
	Hazard Level Category	**Score**
a. Current Use Activities	3	730
b. Future Use Activities	N/A	N/A
c. Response Alternative 1:		
d. Response Alternative 2:		
e. Response Alternative 3:		
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		

Characteristics of the MRS	
Is critical infrastructure located within the MRS or within the ESQD arc?	No
Are cultural resources located within the MRS or within the ESQD arc?	No
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes

MEC HA Summary Information

Comments

Site ID: MRS 02 (Cerro Balcon)
Date: 9/9/2011

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Cerro Balcon

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Site, Puerto Rico, September 2011
2	Study at the Culebra Island Site, Puerto Rico, February
3	Final SI Report, Parsons, September 2007
4	Final FUDS Inventory Project Report. 1991.
5	
6	
7	
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 30 acres
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Residential, Undeveloped, Construction

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800 (USACE, 1991).

6. How certain are the site boundaries?

The boundaries are fairly certain.

Reference(s) for Part B:
Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

C. Historical Clearances

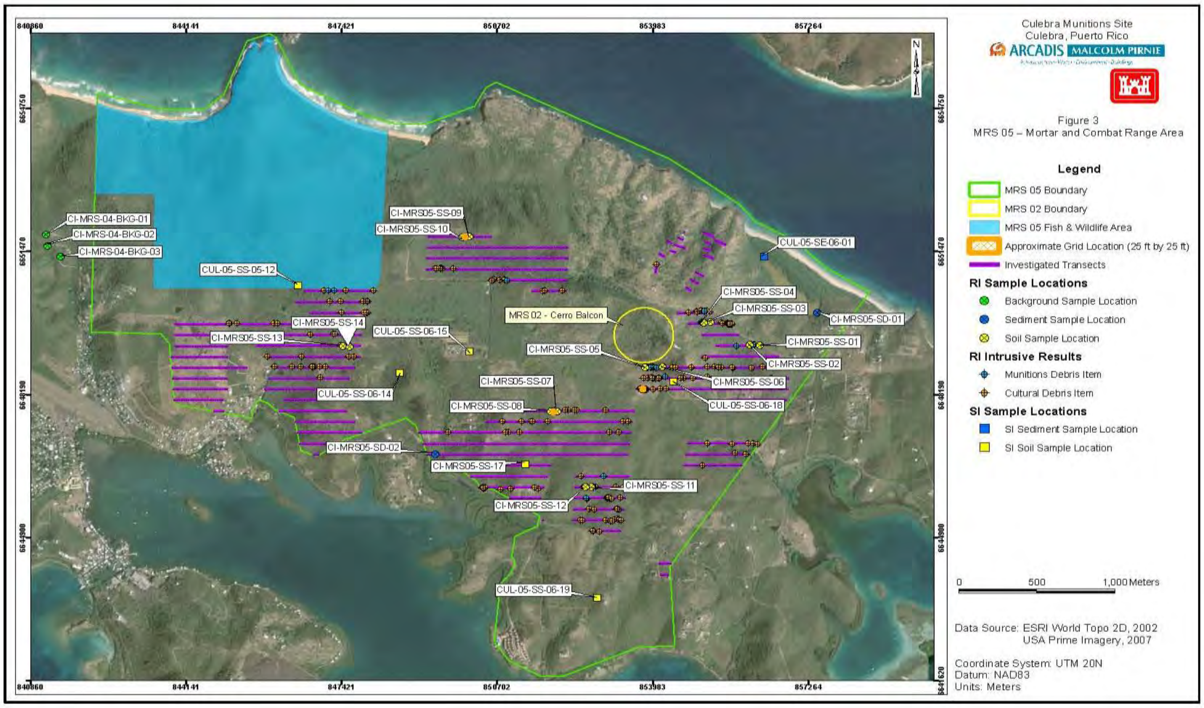
1. Have there been any historical clearances at the site? Yes, surface clearance
2. If a clearance occurred:
   a. What year was the clearance performed? 2006

   b. Provide a description of the clearance activity (e.g., extent, depth, amount of munitions-related items removed, types and sizes of removed items, and whether metal detectors were used):

   Full surface clearance of the MRS. 7 MEC items we removed including 3-inch common MK3, MOD 7s, Fuze model 1898, and 81mm mortars

Reference(s) for Part C:
Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)



Site ID: **MRS 02 (Cerro Balcon)**
Date: **9/9/2011**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Artillery	3	inches	MK 3, MOD 7	High Explosive	Yes			0.5	Subsurface Only	From Ellis 2006 NTCRA, Cerro Balcon. Location is set at subsurface since a surface removal has been conducted.
2	Fuzes			1898	High Explosive	Yes			0.5	Subsurface Only	From Ellis 2006 NTCRA, Cerro Balcon. Location is set at subsurface since a surface removal has been conducted.
3	Mortars	81	mm	M43	High Explosive	No			0.5	Subsurface Only	From Ellis 2006 NTCRA, Cerro Balcon. Location is set at subsurface since a surface removal has been conducted.
4											
5											

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **MRS 02 (Cerro Balcon)**
Date: **9/9/2011**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Residential	50	5,840	**292,000**	1	
2	Undeveloped	0	0	**0**	0	
3	Construction Development	10	200	**2,000**	2	
4						
5						
6					Contract No. W912DY-04-D-0009	
7					Task Order No. 0013	
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr): **294,000**
Maximum intrusive depth at site (ft): **2**

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Activities Planned for the Future at the Site (If any are planned: see 'Summary Info' Worksheet, Question 4)

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr):

Maximum intrusive depth at site (ft):

Reference(s) for table above:

Site ID: **MRS 02 (Cerro Balcon)**
Date: **9/9/2011**

Energetic Material Type Input Factor Categories

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

Score

Baseline Conditions: **100**
Surface Cleanup: **100**
Subsurface Cleanup: **100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 1617 feet
2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes
3. Please describe the facility or feature.

Residential houses

MEC Item(s) used to calculate the ESQD for current use activities
Item #1. Artillery (3inches, High Explosive)
Item #3. Mortars (81mm, Low Explosive Filler in a fragmenting round)

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

Score

Baseline Conditions: **30**
Surface Cleanup: **30**
Subsurface Cleanup: **30**

5. Are there future plans to locate or construct features or facilities where people may congregate within the MRS, or within the ESQD arc?
6. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for future use activities

The following table is used to determine scores associated with the location of additional human receptors (future use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

7. Please answer Question 5 above to determine the scores. *Score*
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities — *Score*

Select the category that best describes the site accessibility under the current use scenario:

Full Accessibility

Baseline Conditions: **80**
Surface Cleanup: **80**
Subsurface Cleanup: **80**

Future Use Activities

Select the category that best describes the site accessibility under the future use scenario:

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Reference(s) for above information:

[redacted]

Response Alternative No. 1:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities :

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **294,000** receptor hrs/yr
Based on the table above, this corresponds to a input factor score for baseline conditions of: **70** Score

Future Use Activities :

Input factors are only determined for baseline conditions for future use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: receptor hrs/yr
Based on the table above, this corresponds to a input factor score of: Score

Response Alternative No. 1:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

	Score
Based on the table above, this corresponds to input factor scores of:	
Baseline Conditions:	
Surface Cleanup:	
Subsurface Cleanup:	

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

Baseline Conditions: **180**
Surface Cleanup: **120**
Subsurface Cleanup: **30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0.5** ft
The deepest intrusive depth: **2** ft
The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95

Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located only subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.' For 'Current Use Activities', only Baseline Conditions are considered. **150** ***Score***

Future Use Activities
Deepest intrusive depth: ft
Not enough information has been entered to determine the input factor category. ***Score***

Response Alternative No. 1:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? No

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Unlikely.' ***Score***

Baseline Conditions:	**10**
Surface Cleanup:	**10**
Subsurface Cleanup:	**10**

Reference(s) for above information:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: Yes

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

At least one item listed in the 'Munitions, Bulk Explosive Info' Worksheet was identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO Special Case	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO Special Case'.

	Score
Baseline Conditions:	**180**
Surface Cleanup:	**180**
Subsurface Cleanup:	**180**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Large

	Score
Baseline Conditions:	**0**
Surface Cleanup:	**0**
Subsurface Cleanup:	**0**

Scoring Summary

Site ID: MRS 02 (Cerro Balcon)	a. Scoring Summary for Current Use Activities	
Date: 9/9/2011	Response Action Cleanup:	No Response Action
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	30
III. Site Accessibility	Full Accessibility	80
IV. Potential Contact Hours	100,000 to 999,999 receptor hrs/yr	70
V. Amount of MEC	Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth	#NAME?	#NAME?
VII. Migration Potential	Unlikely	10
VIII. MEC Classification	UXO Special Case	180
IX. MEC Size	Large	0
	Total Score	**#NAME?**
	Hazard Level Category	**#NAME?**

Site ID: MRS 02 (Cerro Balcon)	b. Scoring Summary for Future Use Activities	
Date: 9/9/2011	Response Action Cleanup:	No Response Action
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		
III. Site Accessibility		
IV. Potential Contact Hours		
V. Amount of MEC	Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		
VII. Migration Potential	Unlikely	10
VIII. MEC Classification	UXO Special Case	180
IX. MEC Size	Large	0
	Total Score	**470**
	Hazard Level Category	**4**

Site ID: MRS 02 (Cerro Balcon)	c. Scoring Summary for Response Alternative 1:	
Date: 9/9/2011	Response Action Cleanup:	
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	
III. Site Accessibility		
IV. Potential Contact Hours		
V. Amount of MEC	Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth	#NAME?	
VII. Migration Potential	Unlikely	
VIII. MEC Classification	UXO Special Case	
IX. MEC Size	Large	
	Total Score	
	Hazard Level Category	

Site ID:	MRS 02 (Cerro Balcon)	d. Scoring Summary for Response Alternative 2:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		#NAME?	
VII. Migration Potential		Unlikely	
VIII. MEC Classification		UXO Special Case	
IX. MEC Size		Large	
		Total Score	
		Hazard Level Category	

Site ID:	MRS 02 (Cerro Balcon)	e. Scoring Summary for Response Alternative 3:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		#NAME?	
VII. Migration Potential		Unlikely	
VIII. MEC Classification		UXO Special Case	
IX. MEC Size		Large	
		Total Score	
		Hazard Level Category	

Site ID:	MRS 02 (Cerro Balcon)	f. Scoring Summary for Response Alternative 4:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		#NAME?	
VII. Migration Potential		Unlikely	
VIII. MEC Classification		UXO Special Case	
IX. MEC Size		Large	
		Total Score	
		Hazard Level Category	

Site ID:	MRS 02 (Cerro Balcon)	g. Scoring Summary for Response Alternative 5:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		#NAME?	
VII. Migration Potential		Unlikely	
VIII. MEC Classification		UXO Special Case	
IX. MEC Size		Large	
		Total Score	
		Hazard Level Category	

Site ID:	MRS 02 (Cerro Balcon)	h. Scoring Summary for Response Alternative 6:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		#NAME?	
VII. Migration Potential		Unlikely	
VIII. MEC Classification		UXO Special Case	
IX. MEC Size		Large	
		Total Score	
		Hazard Level Category	

MEC HA Hazard Level Determination		
Site ID: **MRS 02 (Cerro Balcon)**		
Date: **9/9/2011**		
	Hazard Level Category	**Score**
a. Current Use Activities	**2**	**775**
b. Future Use Activities		
c. Response Alternative 1:		
d. Response Alternative 2:		
e. Response Alternative 3:		
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		

Characteristics of the MRS	
Is critical infrastructure located within the MRS or within the ESQD arc?	Yes
Are cultural resources located within the MRS or within the ESQD arc?	No
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes

MEC HA Summary Information

Comments

Site ID: MRS 04
Date: 9/9/2011

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Flamingo Lagoon Manuever Area

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
2	Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010
3	Site Specific Final Report. UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico, 2004.
4	Final FUDS Inventory Project Report. 1991.
5	
6	
7	
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 550 acres
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Undeveloped, residential, recreational, site workers

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800 (USACE, 1991).

6. How certain are the site boundaries?

The boundaries are fairly certain.

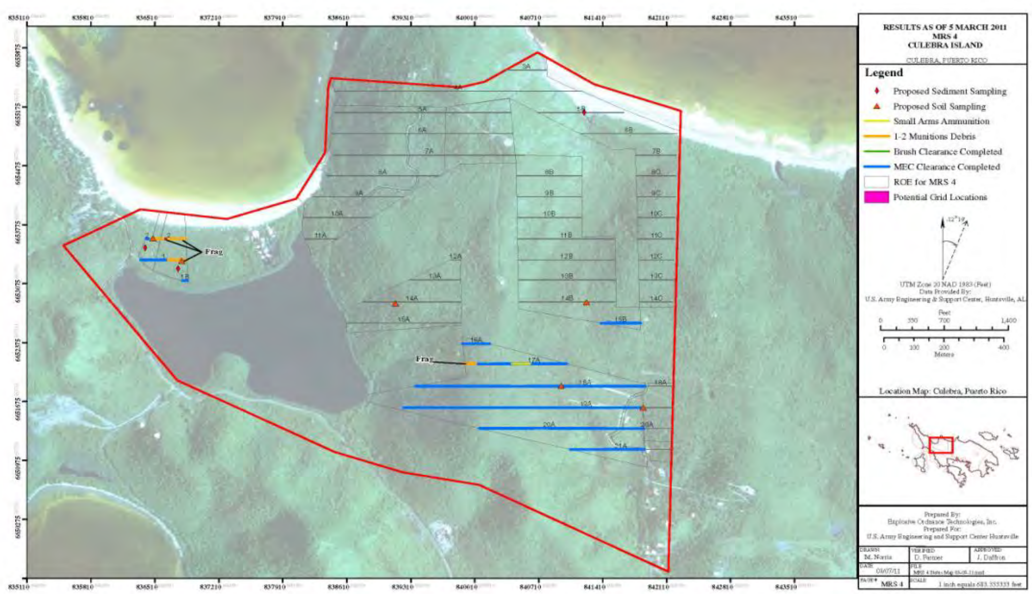
Reference(s) for Part B:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

C. Historical Clearances

1. Have there been any historical clearances at the site? Yes, surface clearance
2. If a clearance occurred:

[redacted]


RESULTS AS OF 5 MARCH 2011
MRS 4
CULEBRA ISLAND
CULEBRA, PUERTO RICO
Legend
Proposed Sediment Sampling
Proposed Soil Sampling
Small Arms Ammunition
1-2 Munitions Debris
Brush Clearance Completed
MEC Clearance Completed
ROE for MRS 4
Potential Grid Locations
UTM Zone 20 NAD 1983 (Feet)
Data Provided By:
U.S. Army Engineering & Support Center, Huntsville, AL
Feet
0 350 700 1,400
0 100 200 400
Meters
Location Map: Culebra, Puerto Rico
Prepared By:
Explosive Ordnance Technologies, Inc.
Prepared For:
U.S. Army Engineering and Support Center Huntsville
DRAWN M. Norris
VERIFIED D. Parmer
APPROVED J. Daffron
DATE 03/07/11
PAGE# MRS 4
SCALE 1 inch equals 683.333333 feet
Frag

Site ID: **MRS 04**
Date: **9/9/2011**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Artillery	5	inches		High Explosive				0.2	Subsurface Only	No MEC identified during the RI or previous investigations. Only MD - included here as indication of MEC.
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Reference(s) for table above:

[redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments	
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

[redacted]

Site ID: **MRS 04**
Date: **9/9/2011**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Undeveloped	0	0	**0**	0	
2	Recreational	50,000	16	**800,000**	0	
3	Residential	50	8,760	**438,000**	2	Estimated based on typical residential use.
4	Site Workers	25	40	**1,000**	0	
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr): **1,239,000**
Maximum intrusive depth at site (ft): **2**

Reference(s) for table above:
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010 [redacted]

Activities Planned for the Future at the Site (If any are planned: see 'Summary Info' Worksheet, Question 4)

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr):

Maximum intrusive depth at site (ft):

Reference(s) for table above:

Site ID: **MRS 04**
Date: **9/9/2011**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1						
2						
3						
4						
5						
6						

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed against current land uses.

Reference(s) for table above:
Draft Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, June 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

[redacted]

Site ID: **MRS 04**
Date: **9/9/2011**

Energetic Material Type Input Factor Categories

Comments

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

	Score
Baseline Conditions:	**100**
Surface Cleanup:	**100**
Subsurface Cleanup:	**100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 2370 feet

2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes

3. Please describe the facility or feature.

Residents

MEC Item(s) used to calculate the ESQD for current use activities

[redacted]

5-inch 54 Mk41

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

	Score
Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**30**

5. Are there future plans to locate or construct features or facilities where people may congregate within the MRS, or within the ESQD arc?

6. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for future use activities

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (future use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities ***Score***

Select the category that best describes the site accessibility under the current use scenario:

Full Accessibility

Baseline Conditions:	**80**
Surface Cleanup:	**80**
Subsurface Cleanup:	**80**

Future Use Activities

Select the category that best describes the site accessibility under the future use scenario:

Moderate Accessibility

Baseline Conditions:	**55**
Surface Cleanup:	**55**
Subsurface Cleanup:	**55**

Reference(s) for above information:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

Response Alternative No. 1:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities:

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **1,239,000** receptor hrs/yr
Based on the table above, this corresponds to a input factor score for baseline conditions of: **120** Score

Future Use Activities:

Input factors are only determined for baseline conditions for future use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: receptor hrs/yr
Based on the table above, this corresponds to a input factor score of: Score

Response Alternative No. 1:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: **Score**
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time
Based on the table above, this corresponds to input factor scores of: **Score**
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

Baseline Conditions:	**180**
Surface Cleanup:	**120**
Subsurface Cleanup:	**30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft
The deepest intrusive depth: **2** ft
The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located only subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.' For 'Current Use Activities', only Baseline Conditions are considered. **150** ***Score***

Future Use Activities

Deepest intrusive depth: **1** ft

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located only subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.'. For 'Future Use Activities', only Baseline Conditions are considered. **150** ***Score***

Response Alternative No. 1:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

	Score
Baseline Conditions:	
Surface Cleanup:	
Subsurface Cleanup:	

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? No

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Unlikely.'

	Score
Baseline Conditions:	**10**
Surface Cleanup:	**10**
Subsurface Cleanup:	**10**

Reference(s) for above information:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010 [redacted]

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: No

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

None of the items listed in the 'Munitions, Bulk Explosive Info' Worksheet were identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO'.

	Score
Baseline Conditions:	**110**
Surface Cleanup:	**110**
Subsurface Cleanup:	**110**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is:	Large
	Score
Baseline Conditions:	**0**
Surface Cleanup:	**0**
Subsurface Cleanup:	**0**

Scoring Summary

Site ID:	MRS 04	a. Scoring Summary for Current Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Full Accessibility	80
IV. Potential Contact Hours		≥1,000,000 receptor-hrs/yr	120
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150
VII. Migration Potential		Unlikely	10
VIII. MEC Classification		UXO	110
IX. MEC Size		Large	0
		Total Score	780
		Hazard Level Category	2

Site ID:	MRS 04	b. Scoring Summary for Future Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		#NAME?	#NAME?
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150
VII. Migration Potential		Unlikely	10
VIII. MEC Classification		UXO	110
IX. MEC Size		Large	0
		Total Score	#NAME?
		Hazard Level Category	#NAME?

MEC HA Hazard Level Determination		
Site ID: **MRS 04**		
Date: **9/9/2011**		
	Hazard Level Category	**Score**
a. Current Activities	**2**	**780**
b. Future Use Activities	**N/A**	**N/A**
c. Response Alternative 1:		**0**
d. Response Alternative 2:		
e. Response Alternative 3:		
f. Response Alternative 4:		

Characteristics of the MRS	
Is critical infrastructure located within the MRS or within the ESQD arc?	Yes
Are cultural resources located within the MRS or within the ESQD arc?	No
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes

MEC HA Summary Information

Comments

Site ID: MRS 05
Date: 9/9/2011

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Mortar and Combat Range Area

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
2	Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010
3	Site Specific Final Report. UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico, 2004.
4	Final FUDS Inventory Project Report. 1991.
5	
6	
7	
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 2,842 acres
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Undeveloped, residential, recreational, USFWS area, construction

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800 (USACE, 1991).

6. How certain are the site boundaries?

The boundaries are fairly certain.

Reference(s) for Part B:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

C. Historical Clearances

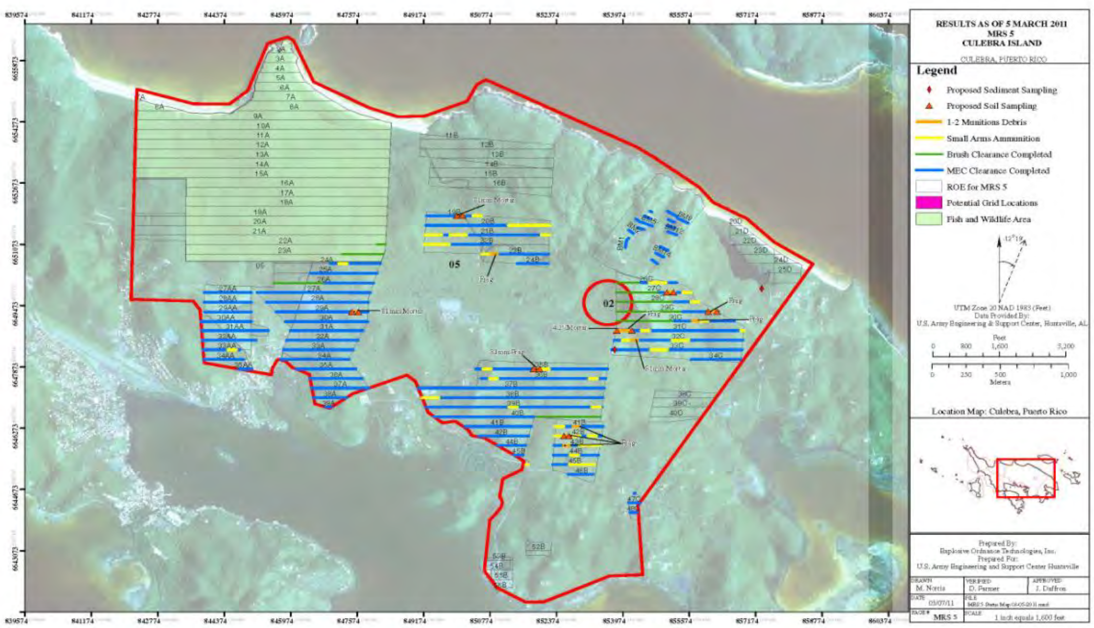
1. Have there been any historical clearances at the site? No, none
2. If a clearance occurred:
   a. What year was the clearance performed?

   b. Provide a description of the clearance activity (e.g., extent, depth, amount of munitions-related items removed, types and sizes of removed items, and whether metal detectors were used):

Reference(s) for Part C:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010 [redacted]

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)



Site ID: **MRS 05**
Date: **9/9/2011**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Mortars	3	inches		High Explosive				0	Surface and Subsurface	No MEC identified during the RI or previous investigations. Only MD - included here as indication of MEC.
2	Mortars	4.2	inches		High Explosive				0	Surface and Subsurface	
3	Mortars	81	mm		High Explosive				0	Surface and Subsurface	
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **MRS 05**
Date: **9/9/2011**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Undeveloped	0	0	**0**	0	
2	Recreational	25,000	16	**400,000**	0	
3	Residential	25	8,760	**219,000**	2	
4	Site Workers	25	40	**1,000**	2	
5						
6						
7						
8						
9						
10						
11						
12						
	Total Potential Contact Time (receptor hrs/yr):			**620,000**		
	Maximum intrusive depth at site (ft):				**2**	

Reference(s) for table above:
Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

[redacted]

Activities Planned for the Future at the Site (If any are planned: see 'Summary Info' Worksheet, Question 4)

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr):

Maximum intrusive depth at site (ft):

Reference(s) for table above:

[redacted]

Site ID: **MRS 05**
Date: **9/9/2011**

Energetic Material Type Input Factor Categories

Comments

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

	Score
Baseline Conditions:	**100**
Surface Cleanup:	**100**
Subsurface Cleanup:	**100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 1617 feet

2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes

3. Please describe the facility or feature.

residents

MEC Item(s) used to calculate the ESQD for current use activities

[redacted]

4.2-inch

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

	Score
Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**30**

5. Are there future plans to locate or construct features or facilities where people may congregate within the MRS, or within the ESQD arc?

6. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for future use activities

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (future use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

7. Please answer Question 5 above to determine the scores.

	Score
Baseline Conditions:	
Surface Cleanup:	
Subsurface Cleanup:	

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities	***Score***
Select the category that best describes the site accessibility under the current use scenario:	
Full Accessibility	
Baseline Conditions:	**80**
Surface Cleanup:	**80**
Subsurface Cleanup:	**80**

Future Use Activities	
Select the category that best describes the site accessibility under the future use scenario:	
Moderate Accessibility	
Baseline Conditions:	**55**
Surface Cleanup:	**55**
Subsurface Cleanup:	**55**

Reference(s) for above information:
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010 [redacted]

Response Alternative No. 1:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:
Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities :

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **620,000** receptor hrs/yr

Based on the table above, this corresponds to a input factor score for baseline conditions of: **70** Score

Future Use Activities :

Input factors are only determined for baseline conditions for future use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: receptor hrs/yr

Based on the table above, this corresponds to a input factor score of: Score

Response Alternative No. 1:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 2:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 3:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 4:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 5:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 6:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

	Score
Baseline Conditions:	**180**
Surface Cleanup:	**120**
Subsurface Cleanup:	**30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft

The deepest intrusive depth: **2** ft

The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Future Use Activities

Deepest intrusive depth: **1** ft

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.'. For 'Future Use Activities', only Baseline Conditions are considered. **240** ***Score***

Response Alternative No. 1:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? No

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Unlikely.' ***Score***

Baseline Conditions:	**10**
Surface Cleanup:	**10**
Subsurface Cleanup:	**10**

Reference(s) for above information:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: No

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

None of the items listed in the 'Munitions, Bulk Explosive Info' Worksheet were identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO'. ***Score***

Baseline Conditions:	**110**
Surface Cleanup:	**110**
Subsurface Cleanup:	**110**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40

Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Large

	Score
Baseline Conditions:	**0**
Surface Cleanup:	**0**
Subsurface Cleanup:	**0**

Scoring Summary

Site ID:	MRS 05	a. Scoring Summary for Current Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Full Accessibility	80
IV. Potential Contact Hours		100,000 to 999,999 receptor hrs/yr	70
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Unlikely	10
VIII. MEC Classification		UXO	110
IX. MEC Size		Large	0
		Total Score	820
		Hazard Level Category	2

Site ID:	MRS 05	b. Scoring Summary for Future Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors			
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Unlikely	10
VIII. MEC Classification		UXO	110
IX. MEC Size		Large	0
		Total Score	695
		Hazard Level Category	3

MEC HA Hazard Level Determination		
Site ID: MRS 05		
Date: 9/9/2011		
	Hazard Level Category	Score
a. Current Use Activites	2	820
b. Future Use Activities	N/A	N/A
c. Response Alternative 1:		
d. Response Alternative 2:		
e. Response Alternative 3:		
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		
Characteristics of the MRS		
Is critical infrastructure located within the MRS or within the ESQD arc?	No	
Are cultural resources located within the MRS or within the ESQD arc?	No	
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes	

MEC HA Summary Information

Comments

Site ID:	MRS 07
Date:	9/9/2011

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Culebrita Artillery Impact Area

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
2	Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010
3	Site Specific Final Report. UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico, 2004.
4	Final FUDS Inventory Project Report. 1991.
5	
6	
7	
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 375 acres
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Undeveloped, recreation, USFWA

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800 (USACE, 1991).

6. How certain are the site boundaries?

The boundaries are fairly certain.

Reference(s) for Part B:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

C. Historical Clearances

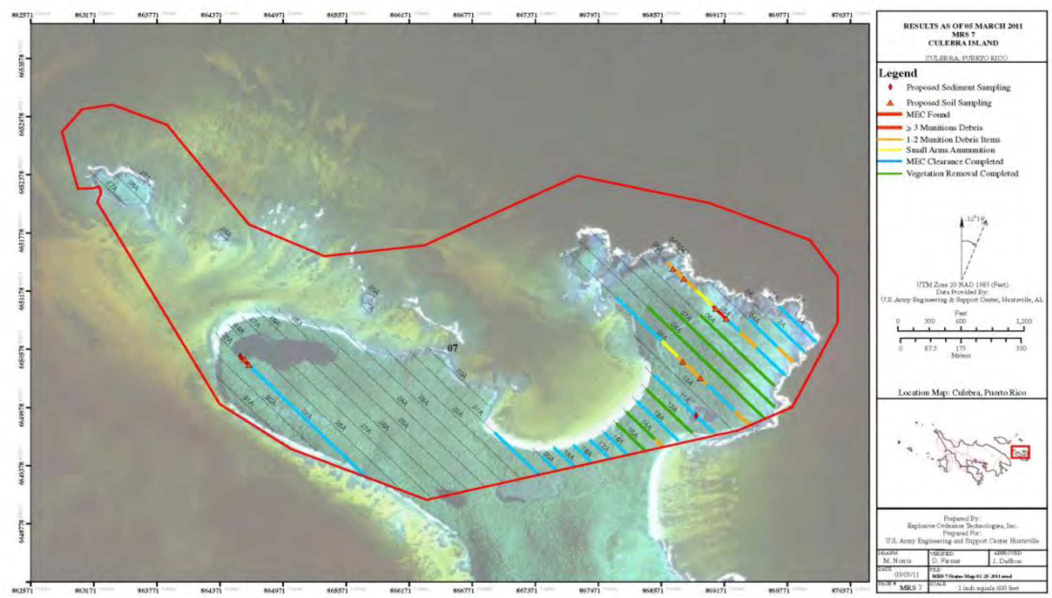
1. Have there been any historical clearances at the site? No, none
2. If a clearance occurred:
   a. What year was the clearance performed?

   b. Provide a description of the clearance activity (e.g., extent, depth, amount of munitions-related items removed, types and sizes of removed items, and whether metal detectors were used):

Reference(s) for Part C:
Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

[redacted]

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)



Site ID: **MRS 07**
Date: **9/9/2011**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Demolition Charges			Mk 8 Demo hose	High Explosive	UNK	UNK	UNK	0	Surface and Subsurface	RI field work
2	Rockets			warhead (HEAT) live, rocket nose	High Explosive	Yes	UNK	Armed	0	Surface and Subsurface	RI field work
3	Bombs			MK76	High Explosive					Surface and Subsurface	EE/CA, Cayo Botella
4	Artillery	6	inches							Surface and Subsurface	EE/CA, Cayo Botella
5	Pyrotechnic			Spotting charge, MK 4						Surface and Subsurface	EE/CA, Cayo Botella
6	Artillery	20	mm	HEI	High Explosive					Surface and Subsurface	EE/CA, NTCRA
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **MRS 07**
Date: **9/9/2011**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Undeveloped	0	0	**0**	0	
2	Recreational	10,000	16	**160,000**	0	
3	Site Workers	25	40	**1,000**	0	
4						
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr): **161,000**
Maximum intrusive depth at site (ft): **0**

Reference(s) for table above:

Draft Remedial Investigation at the Culebra Island Site, Puerto Rico, September 2011 [redacted]

Activities Planned for the Future at the Site (If any are planned: see 'Summary Info' Worksheet, Question 4)

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Total Potential Contact Time (receptor hrs/yr):

Maximum intrusive depth at site (ft):

Reference(s) for table above:

EOTI

Site ID: **MRS 07**
Date: **9/9/2011**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1						
2						
3						
4						
5						
6						

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed against current land uses.

Reference(s) for table above:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, Februar

Site ID: **MRS 07**
Date: **9/9/2011**

Energetic Material Type Input Factor Categories

Comments

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

	Score
Baseline Conditions:	**100**
Surface Cleanup:	**100**
Subsurface Cleanup:	**100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 2510 feet

2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes

3. Please describe the facility or feature.

Recreational users can congregate on and/or near the beach.

MEC Item(s) used to calculate the ESQD for current use activities

Item #1. Demolition Charges (High Explosive)
Item #2. Rockets (High Explosive)
Item #6. Artillery (20mm, High Explosive)

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

	Score
Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**30**

5. Are there future plans to locate or construct features or facilities where people may congregate within the MRS, or within the ESQD arc?

6. Please describe the facility or feature.

MEC Item(s) used to calculate the ESQD for future use activities

[redacted]

The following table is used to determine scores associated with the location of additional human receptors (future use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

7. Please answer Question 5 above to determine the scores.

	Score
Baseline Conditions:	
Surface Cleanup:	
Subsurface Cleanup:	

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities ***Score***

Select the category that best describes the site accessibility under the current use scenario:

Limited Accessibility

Baseline Conditions:	**15**
Surface Cleanup:	**15**
Subsurface Cleanup:	**15**

Future Use Activities

Select the category that best describes the site accessibility under the future use scenario:

Moderate Accessibility

Baseline Conditions:	**55**
Surface Cleanup:	**55**
Subsurface Cleanup:	**55**

Reference(s) for above information:

Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

Response Alternative No. 1:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:

Please enter site accessibility information in the 'Planned Remedial or Removal Actions' Worksheet to continue.

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities :

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **161,000** receptor hrs/yr

Based on the table above, this corresponds to a input factor score for baseline conditions of: **70** Score

Future Use Activities :

Input factors are only determined for baseline conditions for future use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: receptor hrs/yr

Based on the table above, this corresponds to a input factor score of: Score

Response Alternative No. 1:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 2:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 3:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 4:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 5:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Response Alternative No. 6:

Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Total Potential Contact Time

Based on the table above, this corresponds to input factor scores of: **Score**

Baseline Conditions:

Surface Cleanup:

Subsurface Cleanup:

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

Baseline Conditions:	**180**
Surface Cleanup:	**120**
Subsurface Cleanup:	**30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft

The deepest intrusive depth: **0** ft

The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Future Use Activities
Deepest intrusive depth: **1** ft
Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.'. For 'Future Use Activities', only Baseline Conditions are considered. **240** ***Score***

Response Alternative No. 1:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 4:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 5:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.
Score
Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 6:
Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): ft
Not enough information has been entered in the 'Planned Remedial or Removal Actions' Worksheet. Please complete the table before returning to this section.

Maximum Intrusive Depth ft

Not enough information has been entered to calculate this input factor.

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup:

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? Yes

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

MRS contains low-lying beaches which are succeptible to erosion.

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Possible.' ***Score***

Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**10**

Reference(s) for above information:
Final Work Plan, Remedial Investigation / Feasibility Study at the Culebra Island Site, Puerto Rico, February 2010

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: No

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

At least one item listed in the 'Munitions, Bulk Explosive Info' Worksheet was identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO'. ***Score***

Baseline Conditions:	**110**
Surface Cleanup:	**110**
Subsurface Cleanup:	**110**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Small

	Score
Baseline Conditions:	**40**
Surface Cleanup:	**40**
Subsurface Cleanup:	**40**

Scoring Summary

Site ID:	MRS 07	a. Scoring Summary for Current Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Limited Accessibility	15
IV. Potential Contact Hours		100,000 to 999,999 receptor hrs/yr	70
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	815
		Hazard Level Category	2

Site ID:	MRS 07	b. Scoring Summary for Future Use Activities	
Date:	9/9/2011	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors			
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	755
		Hazard Level Category	2

Site ID:	MRS 07	c. Scoring Summary for Response Alternative 1:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth			
VII. Migration Potential		Possible	
VIII. MEC Classification		UXO	
IX. MEC Size		Small	
		Total Score	
		Hazard Level Category	

Site ID: MRS 07	d. Scoring Summary for Response Alternative 2:	
Date: 9/9/2011	Response Action Cleanup:	
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	
III. Site Accessibility		
IV. Potential Contact Hours		
V. Amount of MEC	Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		
VII. Migration Potential	Possible	
VIII. MEC Classification	UXO	
IX. MEC Size	Small	
	Total Score	
	Hazard Level Category	

Site ID: MRS 07	e. Scoring Summary for Response Alternative 3:	
Date: 9/9/2011	Response Action Cleanup:	
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	
III. Site Accessibility		
IV. Potential Contact Hours		
V. Amount of MEC	Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		
VII. Migration Potential	Possible	
VIII. MEC Classification	UXO	
IX. MEC Size	Small	
	Total Score	
	Hazard Level Category	

Site ID: MRS 07	f. Scoring Summary for Response Alternative 4:	
Date: 9/9/2011	Response Action Cleanup:	
Input Factor	**Input Factor Category**	**Score**
I. Energetic Material Type	High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	
III. Site Accessibility		
IV. Potential Contact Hours		
V. Amount of MEC	Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		
VII. Migration Potential	Possible	
VIII. MEC Classification	UXO	
IX. MEC Size	Small	
	Total Score	
	Hazard Level Category	

Site ID:	MRS 07	g. Scoring Summary for Response Alternative 5:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		**Input Factor Category**	**Score**
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth			
VII. Migration Potential		Possible	
VIII. MEC Classification		UXO	
IX. MEC Size		Small	
		Total Score	
		Hazard Level Category	

Site ID:	MRS 07	h. Scoring Summary for Response Alternative 6:	
Date:	9/9/2011	Response Action Cleanup:	
Input Factor		**Input Factor Category**	**Score**
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	
III. Site Accessibility			
IV. Potential Contact Hours			
V. Amount of MEC		Target Area	
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth			
VII. Migration Potential		Possible	
VIII. MEC Classification		UXO	
IX. MEC Size		Small	
		Total Score	
		Hazard Level Category	

MEC HA Hazard Level Determination		
Site ID: MRS 07		
Date: 9/9/2011		
	Hazard Level Category	Score
a. Current Activities	2	815
b. Future Use Activities	N/A	N/A
c. Response Alternative 1:		
d. Response Alternative 2:		
e. Response Alternative 3:		
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		
Characteristics of the MRS		
Is critical infrastructure located within the MRS or within the ESQD arc?	No	
Are cultural resources located within the MRS or within the ESQD arc?	No	
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes	

Appendix F: MRSPP

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 02 – Cayo Lobo and Cayo Yerba

Component: U.S. Army

Installation/Property Name: Culebra Island Site

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island Site **PRDF/FRMD**:____________________

Date Information Entered/Updated: 19 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):

❑ Groundwater	❑ Sediment (human receptor)
✓ Surface soil	❑ Surface Water (ecological receptor)
❑ Sediment (ecological receptor)	❑ Surface Water (human receptor)

Note: Pre-detonation surface soil samples collected by Ellis during a 2006 clearance at Cayo Lobo were used for the MC evaluation.

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The MRS includes, Cayo Lobo and Cayo Yerba. The two cays consist of approximately 46 acres. The Navy conducted fleet maneuvers and fleet landing exercises (FLEX) between 1923 and 1941. During these exercises, the cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for outdoor site workers, trespassers, and biota for MEC in the surface and subsurface on the cays. Potentially complete pathways exist for outdoor site workers and trespassers for MC in the surface water and sediment through ingestion or dermal contact on the cays.

Description of Receptors (Human and Ecological): The current human receptors at the site are trespassers and onsite workers on the cays. Ecological receptors include a variety of species at the site.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellants	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Based on historic uses of the sites, the types of Munitions used at the MRS include: **Bombs:** GP: Mk 81; Mk 82; Mk 83; Mk 84 GP, **Practice Bomb**: MK 76, 100 lb. bomb, **Rocket:** 5-inch Zuni; 5-inch; Tiny Tim 11.75-inch Mk 1 mod 0; general rockets **Practice Rocket:** Mk 8, 2.75- inch **Projectiles:** HEI Projectile: 20mm; 76mm; 105mm HE Projectile: M1; 155mm; 75mm; 37mm AP: 8-inch Mk 21; 16-inch Mk 5; 7-inch; 8-inch; 3-inch; 6- inch; 12-inch shell; 3-inch shell 5-inch Flat Nose; 5-inch common; 5-inch HE; 5-inch Naval ; 6-inch; 4-inch shrapnel; 3-inch HE; 3-inch shrapnel; 14- inch projectile; 12-inch **Mortar**: 81mm HE and practice; 3-inch, HE MK1; 4.2-inch HE M329A1, **Torpedo**: General Navy **Aircraft flares.** (RI Report Section 2.1.2)

Table 2
EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.
Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

The Navy conducted fleet maneuvers and fleet landing exercises (FLEX) between 1923 and 1941. During these exercises, the cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 25).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

Several previous investigations at this MRS have confirmed the presence of MEC and MD items. Numerous MEC items were found on Cayo Lobo during a 2006 NTCRA on the surface and in the subsurface. (RI Report Section 2.1.2)

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Access to the cays is prohibited by USFWS however trespassers have been known to gain access for recreational use. (RI Report Section 2.1.2)

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	$\boxed{5}$
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The majority of the site is currently a wildlife refuge with protected areas for several species. (RI Report Section 2.1.2)

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. The cays are not populated. (RI Report Section 2.1.2)

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

Cayo Lobo and Cayo Yerba are uninhabited. There are very few inhabited structures on the southern coast of Culebra within 2 miles of either Cayo Lobo or Cayo Yerba. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	4

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The land use on the Cayo Lobo and Cayo Yerba is undeveloped; however, .there are recreational activities conducted on Culebra within 2 miles of the cays. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	40
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	9
Population Near Hazard	Table 7	1	
Types of Activities/Structures	Table 8	4	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			84

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	$\boxed{B}$
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	B

Table 11
CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at MRS 02 – Cayo Lobo and Cayo Yerba. (RI Report Section 2.1.2)

Tables 12-19

No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No groundwater samples were collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
No surface water samples were collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No sediment samples were collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No surface water samples were collected.			

CHF Scale	CHF Value	Sum the Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No sediment samples were collected.			

CHF Scale	CHF Value	Sum the Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ❑

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	3.1	22	0.141
Barium	52	15,000	0.003
Chromium	30	100,000	0.000
Copper	83	3,100	0.027
CHF Scale	**CHF Value**	**Sum the Ratios**	0.190
CHF > 100	**H (High)**	$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	$\boxed{L}$
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	$\boxed{L}$
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard ❑

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Surface Soil	Lead	4.2	400	0.011
Surface Soil	Mercury	0.021	23	0.001
Surface Soil	Zinc	150	23,000	0.007
Note: Surface soil samples were collected by Ellis Environmental during clearance activities at Cayo Lobo. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007).				

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	--	--	--	--	--
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	--	--	--	--	--
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING: G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	**1**		
A	**2**	**B**	**2**	**A**	**2**
B	3	**C**	**3**	**B**	**3**
C	**4**	**D**	**4**	**C**	**4**
D	**5**	**E**	**5**	**D**	**5**
E	**6**	**F**	**6**	**E**	**6**
F	**7**	**G**	**7**	**F**	**7**
G	**8**			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**3**	

Table A

MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 02 – Cerro Balcon

Component: U.S. Army

Installation/Property Name: Culebra Island Site

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island Site **PRDF/FRMD**:__________________

Date Information Entered/Updated: 19 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):

❑ Groundwater	❑ Sediment (human receptor)
✓ Surface soil	❑ Surface Water (ecological receptor)
❑ Sediment (ecological receptor	❑ Surface Water (human receptor)

Note: Pre-detonation surface soil samples collected by Ellis during a 2006 clearance at Cerro Balcon were used for the MC evaluation.

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The MRS includes Cerro Balcon located within MRS 05 on Culebra. Cerro Balcon is a 38 acre former mortar range.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for residents, construction/utility workers, trespassers, outdoor site workers, and biota for MEC in the surface and subsurface at Cerro Balcon. Potentially complete pathways exist for residents, construction/utility workers, trespassers, and outdoor site workers for MC in the surface water and sediment through ingestion or dermal contact at Cerro Balcon.

Description of Receptors (Human and Ecological): The current human receptors at the site are residents, construction/utility workers, trespassers, outdoor site workers at Cerro Balcon. Ecological receptors include a variety of species at the site.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered “sensitive.” ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Cerro Balcon was historically used as a mortar range target. (RI Report Section 2.1.2)

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

Cerro Balcon was used as a mortar range. (RI Report Section 2.1.2)

Table 3
EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	$\boxed{25}$
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	$\boxed{15}$
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	$\boxed{10}$
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	$\boxed{5}$
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

Previous investigations at Cerro Balcon have confirmed the presence of MEC and MD items. Numerous MEC items were found during a 2006 NTCRA on the surface and in the subsurface. (RI Report Section 2.1.2)

Table 4
EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.
Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	$\boxed{10}$
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Cerro Balcon contains residential and undeveloped properties. (RI Report Section 2.1.2)

Table 5
EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The majority of Cerro Balcon is residential land and undeveloped land. (RI Report Section 2.1.2)

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. (RI Report Section 2.1.2)

Table 7
EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures within two miles of Cerro Balcon. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The land use on Cerro Balcon is residential and undeveloped land. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

There are no known threatened or endangered species at Cerro Balcon..(RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	40
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	11
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	0	
EHE MODULE TOTAL			86

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	$\boxed{B}$
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	B

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at Cerro Balcon. (RI Report Section 2.1.2)

Tables 12-19
No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20

Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No groundwater samples were collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ☐

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
No surface water samples were collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No sediment samples were collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No surface water samples were collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

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Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No sediment samples were collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ❑

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

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Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	2	22	0.091
Barium	60	15,000	0.004
Chromium	110	100,000	0.001
Copper	110	3,100	0.035
CHF Scale	**CHF Value**	**Sum the Ratios**	0.166
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard	✓

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Surface Soil	Lead	9	400	0.026
Surface Soil	Mercury	0.047	23	0.002
Surface Soil	Zinc	150	23,000	0.007
Note: Surface soil samples were collected by Ellis Environmental during clearance activities at Cerro Balcon. The surface soil data are presented in Table 5.4 of the Final Site Inspection Report (Parsons, 2007).				

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	--	--	--	--	--
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	--	--	--	--	--
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING: G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	$\boxed{G}$
Alternative Module Ratings	Evaluation Pending
	No Longer Required

		No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**3**	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 02 – Remaining Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Agua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

Component: U.S. Army

Installation/Property Name: Culebra Island Site

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island Site **PRDF/FRMD**:___________________

Date Information Entered/Updated: 19 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):

❑ Groundwater	❑ Sediment (human receptor)
❑ Surface soil	❑ Surface Water (ecological receptor)
❑ Sediment (ecological receptor)	❑ Surface Water (human receptor)

Note: No sampling was conducted at the remaining cays during the RI or during previous studies. Due to the lack of sampling data, the HHE Module is marked as "Evaluation Pending".

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The MRS includes, Cayo Ballena, Cayo Lobito, Cayo Del Agua (a.k.a. Water Key), Cayo Raton, Los Gemelos (a.k.a. Twin Rock), Cayos Geniqui (a.k.a. Palada Cay), and Cayo Sombrerito. The remaining cays consist of approximately 43 acres. The Navy conducted fleet maneuvers and fleet landing exercises (FLEX) between 1923 and 1941. During these exercises, the cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds.

Description of Pathways for Human and Ecological Receptors:

Table A

MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Potentially complete pathways exist for outdoor site workers, trespassers, and biota for MEC in the surface and subsurface on the cays. Potentially complete pathways exist for outdoor site workers and trespassers for MC in the surface water and sediment through ingestion or dermal contact on the cays.

Description of Receptors (Human and Ecological): The current human receptors at the site are trespassers and onsite workers on the cays. Ecological receptors include a variety of species at the site.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Based on historic uses of the sites, the types of Munitions used at the MRS include: **Bombs:** GP: Mk 81; Mk 82; Mk 83; Mk 84 GP, **Practice Bomb**: MK 76, 100 lb. bomb, **Rocket:** 5-inch Zuni; 5-inch; Tiny Tim 11.75-inch Mk 1 mod 0; general rockets **Practice Rocket:** Mk 8, 2.75- inch **Projectiles:** HEI Projectile: 20mm; 76mm; 105mm HE Projectile: M1; 155mm; 75mm; 37mm AP: 8-inch Mk 21; 16-inch Mk 5; 7-inch; 8-inch; 3-inch; 6- inch; 12-inch shell; 3-inch shell 5-inch Flat Nose; 5-inch common; 5-inch HE; 5-inch Naval ; 6-inch; 4-inch shrapnel; 3-inch HE; 3-inch shrapnel; 14- inch projectile; 12-inch **Mortar**: 81mm HE and practice; 3-inch, HE MK1; 4.2-inch HE M329A1, **Torpedo**: General Navy **Aircraft flares.** (RI Report Section 2.1.2)

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

The Navy conducted fleet maneuvers and fleet landing exercises (FLEX) between 1923 and 1941. During these exercises, the cays were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

Several previous investigations at this MRS have confirmed the presence of MEC and MD items. Numerous MEC items were found on Cayo del Agua during a 1997 EE/CA on the surface and in the subsurface. (RI Report Section 2.1.2)

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Access to the cays is prohibited by USFWS however trespassers have been known to gain access for recreational use. (RI Report Section 2.1.2)

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The majority of the MRS is currently a wildlife refuge with protected areas for several species. (RI Report Section 2.1.2)

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	$\boxed{1}$
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. The cays are not populated. (RI Report Section 2.1.2)

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures on the northern portion of Culebra which are within two miles of Cayo Sombreritto. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The land use on the remaining cays is undeveloped; however, .there are residential, recreational and commercial activities conducted on Culebra and Culebrita within 2 miles of the remaining cays. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	40
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	14
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			89

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	$\boxed{B}$
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	B

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at MRS 02 - Remaining Cays. (RI Report Section 2.1.2)

Tables 12-19
No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Tables 21-27

No environmental media (groundwater, surface water, sediment, or surface soil) samples were collected or analyzed from MRS 02 – Remaining Cays. As a result, the HHE Module has not been evaluated. Tables 21 through 27 have therefore been intentionally omitted and the HHE score will remain "Evaluation Pending" until analytical data becomes available.

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	--	--	--	--	--
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	--	--	--	--	--
Surface Soil (Table 26)	--	--	--	--	--

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	--

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	**Evaluation Pending**
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	**1**		
A	**2**	**B**	**2**	**A**	**2**
B	**3**	**C**	**3**	**B**	**3**
C	**4**	**D**	**4**	**C**	**4**
D	**5**	**E**	**5**	**D**	**5**
E	**6**	**F**	**6**	**E**	**6**
F	**7**	**G**	**7**	**F**	**7**
G	**8**			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**3**	

Table A

MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 04 - Flamingo Lagoon Maneuver Area

Component: U.S. Army

Installation/Property Name: Culebra Island

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island **PRDF/FRMD:**___________________

Date Information Entered/Updated: 20 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):

❑ Groundwater	✓ Sediment (human receptor)
✓ Surface Soil	❑ Surface Water (ecological recep o)
✓ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The 505-acre MRS 04 includes Flamingo Lagoon and the hillside east of the lagoon. Records show that Combat Range #2, located on the south side of Flamingo Beach, was used for direct and indirect fire of small arms and 81mm mortars from firing positions on the hillside within MRS 04 during FLEX #4 in 1938. Firing positions for 75mm projectiles used during FLEX #5 in 1939 were also located.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for residents, construction/utility workers, trespassers, outdoor site workers, recreationists/visitors, and biota for MEC in the surface and subsurface. Incomplete pathways exist for all human and ecological receptors for MC.

Table A **MRS Background Information**
DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.
Description of Receptors (Human and Ecological): The current human receptors include residents, construction/utility workers, trespassers, outdoor site workers, and recreationists/visitors. Ecological receptors include a variety of species.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided

Historically, 81mm HE and practice mortars and 75mm shrapnel mortars were used at MRS 04. During the RI/FS fieldwork, only unidentified frag and small arms were found at the site. No MEC was found during the RI/FS field work. (RI Report Section 2.1.2)

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

The 550-acre MRS 04 includes Flamingo Lagoon and the hillside east of the lagoon. Records show that Combat Range #2, located on the south side of Flamingo Beach, was used for direct and indirect fire of small arms and 81mm mortars from firing positions on the hillside within MRS 04 during FLEX #4 in 1938. Firing positions for 75mm projectiles used during FLEX #5 in 1939 were also located. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

MD was found within MRS 04 during the RI/FS. A 5 inch projectile was found along Flamenco Beach in MRS 04 during the 2008 NTCRA. (RI Report Section 2.1.2)

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

MRS 04 contains private property and beaches accessible to the public. (RI Report Section 2.1.2)

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

No portion of MRS 4 is under DoD control. It is either privately owned or property managed either by DNER. (RI Report Section 2.1.2)

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. (RI Report Section 2.1.2)

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures within two miles of MRS 04. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The land use on MRS 04 is mainly residential, recreational, and undeveloped land. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10

Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	40
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	13
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			88

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	$\boxed{B}$
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	B

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at MRS 04. (RI Report Section 2.1.2)

Tables 12-19

No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20

Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No groundwater samples were collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
No surface water samples were collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	2.54	22	0.115
Barium	65.9	15,000	0.004
Chromium	12.1	100,000	0.000
Copper	120	3,100	0.039
CHF Scale	**CHF Value**	**Sum The Ratios**	0.570
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	$\boxed{L}$
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	$\boxed{L}$
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No surface water samples were collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table. .

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	2.54	22	0.115
Barium	65.9	15,000	0.004
Chromium	12.1	100,000	0.000
Copper	120	3,100	0.039
CHF Scale	**CHF Value**	**Sum the Ratios**	0.570
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.	✓

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	4.97	22	0.225
Barium	218	15,000	0.015
Chromium	18.7	100,000	0.000
Copper	95.8	3,100	0.031
CHF Scale	**CHF Value**	**Sum the Ratios**	0.308
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard	✓

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Sediment	Lead	159	400	0.398
Sediment	Mercury	0.227	23	0.010
Sediment	Zinc	95.5	23,000	0.004
Surface Soil	Lead	10.5	400	0.026
Surface Soil	Mercury	0.0312	23	0.001
Surface Soil	Zinc	230	23,000	0.010

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	G
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	L	L	L	LLL	G
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G

Alternative Module Ratings	
	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				3	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 05 - Mortar and Combat Range Area
Component: U.S. Army

Installation/Property Name: Culebra Island

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island **PRDF/FRMD**:____________________

Date Information Entered/Updated: 21 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑ FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):.

❑ Groundwater	✓ Sediment (human receptor)
✓ Surface soil	❑ Surface Water (ecological receptor)
✓ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The MRS includes most of the landmass between Resaca Beach and Carenero Point, totaling approximately 2,317 acres. Historical training records indicate that many of the hills in this area may have been used for direct fire. MRS 05 includes two 1936 combat training areas leased for combat, target, and sweep-of-fire range training. Small arms and 81mm mortars may have been used at Combat Range #1 in 1937 during FLEX #4. A 1924 standing barrage training area is also included in the MRS.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for residents, construction/utility workers, trespassers, outdoor site workers, recreationists/visitors, and biota for MEC in the surface and subsurface. Incomplete pathways exist for all human and ecological receptors for MC.

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Description of Receptors (Human and Ecological): The current human receptors include residents, construction/utility workers, trespassers, outdoor site workers, and recreationists/visitors. Ecological receptors include a variety of species.

Table 1
EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	$\boxed{25}$
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	$\boxed{15}$
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	$\boxed{5}$
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	$\boxed{2}$
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Historical munitions used at MRS 05 include 81mm HE and practice mortars and 75mm practice mortars. Frag from 81mm mortars and other unidentified sources were found during the RI/FS field work. Small arms casings were also found. No MEC was found during the RI/FS field work. (RI Report Section 2.1.2)

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

Historical training records indicate that many of the hills in this area may have been used for direct fire. MRS 05 includes two 1936 combat training areas leased for combat, target, and sweep-of-fire range training. Small arms and 81mm mortars may have been used at Combat Range #1 in 1937 during FLEX #4. A 1924 standing barrage training area is also included in the MRS. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	$\boxed{10}$
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

MD was found within MRS 05 during the RI/FS. No MEC was found during the RI or previous investigations. (RI Report Section 2.1.2)

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

MRS 05 is primarily privately owned land. It is accessible to the public. (RI Report Section 2.1.2)

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	• The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. • The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

Most of MRS 05 is privately owned. DNER manages the property along the beaches on the northeastern side of the site. No property is under DoD control. (RI Report Section 2.1.2)

Table 6
EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.
Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	$\boxed{1}$
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. (RI Report Section 2.1.2)

Table 7
EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures within 2 miles of MRS 05. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The main land uses on MRS 05 is residential, recreational, and undeveloped. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	25
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	14
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			74

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	C

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at MRS 05. (RI Report Section 2.1.2)

Tables 12-19

No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Groundwater samples were not collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

<u>Contaminant Hazard Factor (CHF)</u>

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Surface water samples were not collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **<u>the CHF Value</u>** from above in the box to the right (maximum value = H).		

<u>Migratory Pathway Factor</u>

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **<u>the single highest value</u>** from above in the box to the right (maximum value = H).	

<u>Receptor Factor</u>

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **<u>the single highest value</u>** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Barium	196	15,000	0.013
Chromium	14.3	100,000	0.000
Copper	149	3,100	0.048
Lead	6.29	400	0.016
CHF Scale	**CHF Value**	**Sum The Ratios**	0.080
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Sediment (Human Endpoint) MC Hazard

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment. ✓

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Surface water samples were not collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Barium	196	15,000	0.013
Chromium	14.3	100,000	0.000
Copper	149	3,100	0.048
Lead	6.29	400	0.016
CHF Scale	**CHF Value**	**Sum the Ratios**	0.080
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment. ✓

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	7.57	22	0.344
Barium	958	15,000	0.063
Chromium	66.7	100,000	0.000
Copper	171	3,100	0.055
CHF Scale	**CHF Value**	**Sum the Ratios**	0.512
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment. ✓

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

<u>Contaminant Hazard Factor (CHF)</u>

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Sediment	Mercury	0.0129	23	0.000
Sediment	Zinc	73.3	23,000	0.003
Surface Soil	Lead	17.3	400	0.043
Surface Soil	Mercury	0.0434	23	0.002
Surface Soil	Zinc	127	23,000	0.005

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	G
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	L	L	L	LLL	G
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	E

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G

Alternative Module Ratings	
	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29

MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**4**	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 7 - Culebrita Artillery Impact Area
Component: U.S. Army
Installation/Property Name: Culebra Island
Location (City, County, State): Culebra Island, Puerto Rico
Site Name/Project Name (Project No.): Culebra Island **PRDF/FRMD**:___________________

Date Information Entered/Updated: 21 December 2011?February 2013
Point of Contact (Name/Phone): Layne Young (410.332.4806)
Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑ FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):.

❑ Groundwater	✓ Sediment (human receptor)
✓ Surface soil	❑ Surface Water (ecological receptor)
✓ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:
MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

MRS 07 includes the northern portion of Culebrita as well as Cayo Botella (a.ka. Ladrone Cay). The Marines used this 375-acre area as an artillery impact area between 1936 and the late 1940s. The United States and the United Kingdom used Cayo Botella for an aircraft bombing/rocket target in 1969. Munitions included 20mm projectiles, Mk 44 and Mk 45 flares, live and practice bombs up to 500 pounds, and 2.75-inch rockets as well as British bombs and rockets.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for outdoor site workers, recreationists/visitors, and biota for MEC in the surface and subsurface. Potentially complete pathways exist for outdoor site workers and recreationists/visitors for MC in the surface and subsurface soil through ingestion, dermal contact, and inhalation.

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Description of Receptors (Human and Ecological): The current human receptors at the installation are limited to outdoor site workers and recreationists/visitors. Ecological receptors include a variety of species at the site.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Based on historical research the following munitions were used at this MRS: **Bombs:** GP Bomb: Mk 82, 500-pound **Rocket:** 5-inch Zuni; **Projectile:** 75mm; 20mm HEI MkI; 75mm. Two MEC items were found during RI/FS field work: MK5 MOD O Rocket nose and Mk8 demo hose. Various frag and small arms also were found at the site during the RI/FS field work. (RI Report Section 2.1.2)

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

The Marines used this 375-acre area as an artillery impact area between 1936 and the late 1940s. The United States and the United Kingdom used Cayo Botella for an aircraft bombing/rocket target in 1969. Munitions included 20mm projectiles, Mk 44 and Mk 45 flares, live and practice bombs up to 500 pounds, and 2.75-inch rockets as well as British bombs and rockets. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 25).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

Two MEC items were found during RI/FS field work: MK5 MOD O Rocket nose and Mk8 demo hose. Various frag and small arms also were found at the site during the RI/FS field work. Historically additional MEC has been found on both Culebrita and Cayo Botella. (RI Report Section 2.1.2)

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

There is no barrier to access the site; however, the site is only accessible by boat. (RI Report Section 2.1.2)

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

This MRS is managed by the USFWS. (RI Report Section 2.1.2)

Table 6
EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.
Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. Culebrita and Cayo Botella are uninhabited. (RI Report Section 2.1.2)

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	$\boxed{5}$
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures within 2 miles of MRS 07 located on Culebra. Culebrita and Cayo Botella are uninhabited. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	4

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

Culebrita beaches and trails are used recreationally and many boats visit the island each year. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. The Culebrita Lighthouse (dedicated as a Historical Monument of the United States) is located on Culebrita but outside of the MRS boundary. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	40
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	14
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	3	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			89

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	$\boxed{B}$
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	B

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at MRS 07. (RI Report Section 2.1.2)

Tables 12-19

No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No groundwater sampling was conducted.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No surface water sampling was conducted.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	1.97	22	0.089
Barium	369	15,000	0.025
Chromium	12.6	100,000	0.000
Copper	151	3,100	0.048
CHF Scale	**CHF Value**	**Sum The Ratios**	0.220
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	$\boxed{L}$
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	$\boxed{L}$
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No Known or Suspected Sediment (Human Endpoint) MC Hazard			
Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.			✓

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
No surface water sampling was conducted.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	1.97	22	0.089
Barium	369	15,000	0.025
Chromium	12.6	100,000	0.000
Copper	151	3,100	0.048
CHF Scale	**CHF Value**	**Sum the Ratios**	0.220
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
No Known or Suspected Sediment (Ecological Endpoint) MC Hazard Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.			✓

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	7.02	22	0.319
Barium	870	15,000	0.058
Chromium	22.5	100,000	0.000
Copper	225	3,100	0.072
CHF Scale	**CHF Value**	**Sum the Ratios**	0.0514
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	$\boxed{L}$
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	$\boxed{L}$
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
		No Known or Suspected Surface Soil MC Hazard	
Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.			✓

DRAFT

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

<u>**Contaminant Hazard Factor (CHF)**</u>

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Sediment	Lead	20.1	400	0.050
Sediment	Mercury	0.0768	23	0.003
Sediment	Zinc	115	23,000	0.005
Surface Soil	Lead	22.8	400	0.057
Surface Soil	Mercury	0.0517	23	0.002
Surface Soil	Zinc	149	23,000	0.006

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	G
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	L	L	L	LLL	G
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				3	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: U.S. Fish and Wildlife Area
Component: U.S. Army

Installation/Property Name: Culebra Island

Location (City, County, State): Culebra Island, Puerto Rico

Site Name/Project Name (Project No.): Culebra Island **PRDF/FRMD**:____________________

Date Information Entered/Updated: 19 December 2011/February 2013

Point of Contact (Name/Phone): Layne Young (410.332.4806)

Project Phase (check only one): RI

❑ PA	❑ SI	✓ RI	❑ FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Note: This Draft MRSPP was created in coordination with the U.S. Army Corps of Engineers and additional project stakeholders (e.g., U.S. Environmental Protection Agency, Puerto Rico Environmental Quality Board). Prior to being finalized the MRSPP will be included in a public notice and will be available for public review.

Media Evaluated (check all that apply):.

❑ Groundwater	❑ Sediment (human receptor)
✓ Surface soil	❑ Surface Water (ecological receptor)
✓ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:
MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The U.S. Fish and Wildlife Area includes contiguous portion of MRS 04 and MRS 05 in the north central portion of Culebra and covers approximately 631. Historical training records indicate that many of the hills in this area may have been used for direct fire.

Description of Pathways for Human and Ecological Receptors:
Potentially complete pathways exist for construction/utility workers, outdoor site workers, recreationists/visitors, and biota for MEC in the surface and subsurface. Incomplete pathways exist for all human and ecological receptors for MC.

Description of Receptors (Human and Ecological): The current human receptors include construction/utility workers, outdoor site workers, and recreationists/visitors. Ecological receptors include a variety of species.

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	25

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Historical munitions used at the U.S> Fish and Wildlife Area include 81mm HE and practice mortars and 75mm practice mortars. No MEC was found during the RI/FS field work. (RI Report Section 2.1.2)

Table 2
EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.
Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	$\boxed{10}$
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

Historical training records indicate that many of the hills in this area may have been used for direct fire. (RI Report Section 2.1.2)

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

Limited MEC investigations were conducted in the US Fish and Wildlife Area during the RI; however, MD was found just south of the U.S. Fish and Wildlife Area in MRS 05 during the RI. No MEC was found during the RI or previous investigations. (RI Report Section 2.1.2)

Table 4
EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	10

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

The US Fish and Wildlife Area is a designated wildlife refuge. It is accessible to the public. (RI Report Section 2.1.2)

Table 5
EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The USFWS and DNER manage the U.S. Fish and Wildlife Area. No property is under DoD control. (RI Report Section 2.1.2)

Table 6
EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The island of Culebra has a population density of 62.4 persons per square mile. (RI Report Section 2.1.2)

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

There are greater than 26 inhabited structures within 2 miles of the U.S. Fish and Wildlife Area. (RI Report Section 2.1.2)

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The main land uses on and surrounding the U.S. Fish and Wildlife Area are residential, recreational, and undeveloped. (RI Report Section 2.1.2)

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Protected species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. (RI Report Table 6-9)

According to the National Register Information System (NRIS), National Historic Landmarks (NHL) list, National Heritage Areas (NHA) list, and National Park Service (NPS), there are no registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita (MRS 07) is an historic lighthouse called Faro Isla de Culebritas; however the lighthouse is outside of the MRS 07 boundaries. (RI Report Section 2.1.2)

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	25
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	14
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			74

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	C

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

No evidence of CWM has been found at the U.S. Fish and Wildlife Area. (RI Report Section 2.1.2)

Tables 12-19

No known or suspected CWM hazard is expected at this site. Therefore, Tables 12 through 19 have been intentionally omitted according to Active Army Guidance.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	--	
Accessibility Factor Data Elements			
Location of CWM	Table 13	--	--
Ease of Access	Table 14	--	
Status of Property	Table 15	--	
Receptor Factor Data Elements			
Population Density	Table 16	--	--
Population Near Hazard	Table 17	--	
Types of Activities/Structures	Table 18	--	
Ecological and/or Cultural Resources	Table 19	--	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	NO KNOWN OR SUSPECTED CWM HAZARD

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Groundwater samples were not collected.			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ❑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Surface water samples were not collected.			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard	✓

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Barium	196	15,000	0.013
Chromium	14.3	100,000	0.000
Copper	149	3,100	0.048
Lead	6.29	400	0.016
CHF Scale	**CHF Value**	**Sum The Ratios**	0.080
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	$\boxed{L}$
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	$\boxed{L}$
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Sediment (Human Endpoint) MC Hazard ✓

Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Surface water samples were not collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ❑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Barium	196	15,000	0.013
Chromium	14.3	100,000	0.000
Copper	149	3,100	0.048
Lead	6.29	400	0.016
CHF Scale	**CHF Value**	**Sum the Ratios**	0.080
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
		No Known or Suspected Sediment (Ecological Endpoint) MC Hazard	
Note: A value of L was selected for the MPF and the RF due to the extremely low concentrations of metals detected during the soils sampling event and the low potential for receptors to encounter these metals due to current and future land use. See Sections 5 and 6 of the RI for fate and transport and the baseline risk assessment.			✓

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Surface soil samples were not collected.			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Soil MC Hazard ❑

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	--	--	--	--	--
Surface Water/Human Endpoint (Table 22)	--	--	--	--	--
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	G
Surface Water/Ecological Endpoint (Table 24)	--	--	--	--	--
Sediment/Ecological Endpoint (Table 25)	L	L	L	LLL	G
Surface Soil (Table 26)	--	--	--	--	--

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	$\boxed{G}$
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				4	

Appendix G: Federally Recognized Wetlands

U.S. Fish and Wildlife Service

National Wetlands Inventory

MRS 04

Jun 9, 2011

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Status

- Digital
- Scan
- Non-Digital
- No Data

User Remarks:

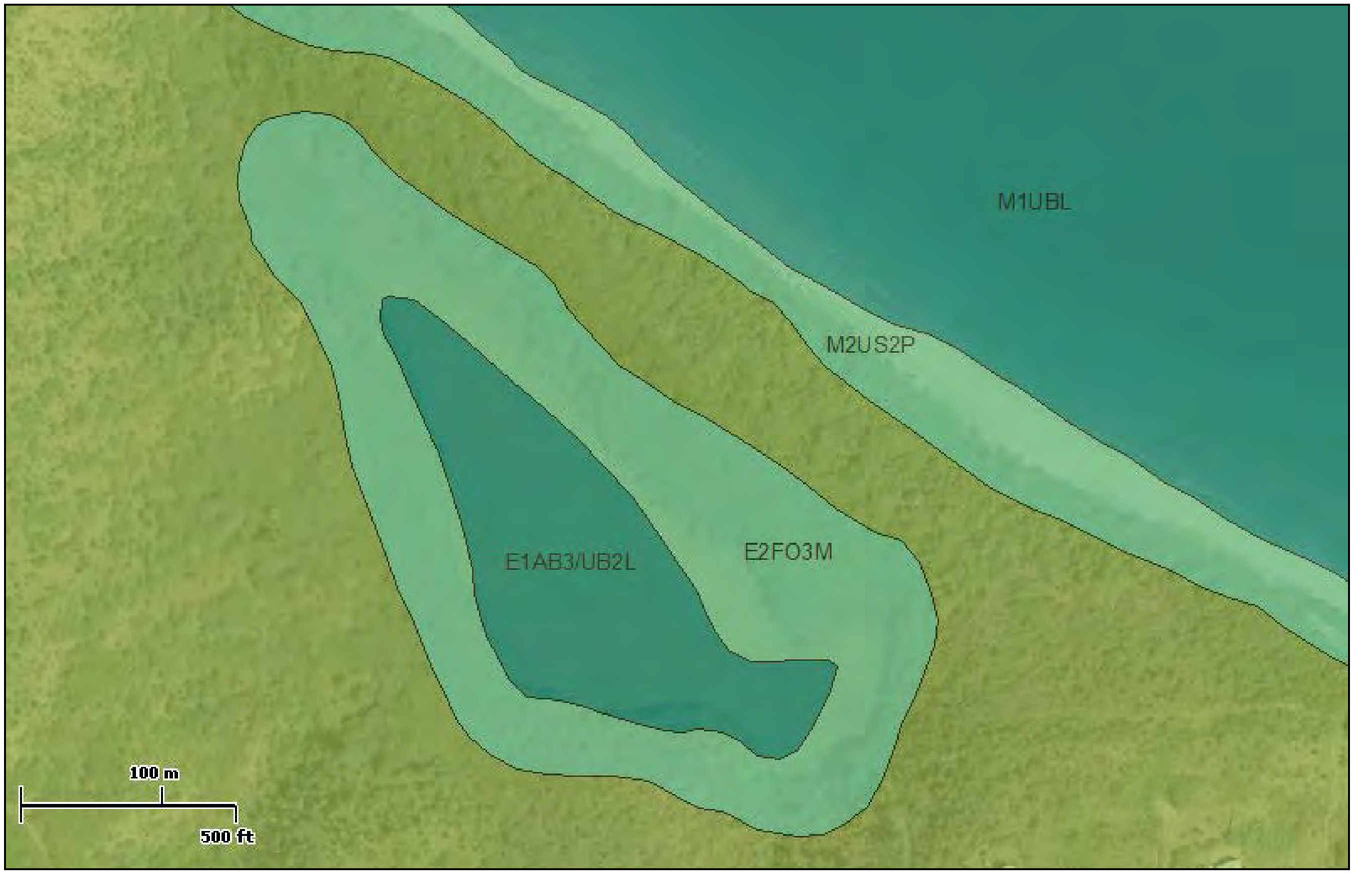
National Wetlands Inventory Map

U.S. Fish and Wildlife Service

National Wetlands Inventory

Lagoon MRS 05

Jun 9, 2011



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Status

- Digital
- Scan
- Non-Digital
- No Data

User Remarks:

National Wetlands Inventory Map

U.S. Fish and Wildlife Service

National Wetlands Inventory

MRS 05

Jun 9, 2011

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Status

- Digital
- Scan
- Non-Digital
- No Data

User Remarks:

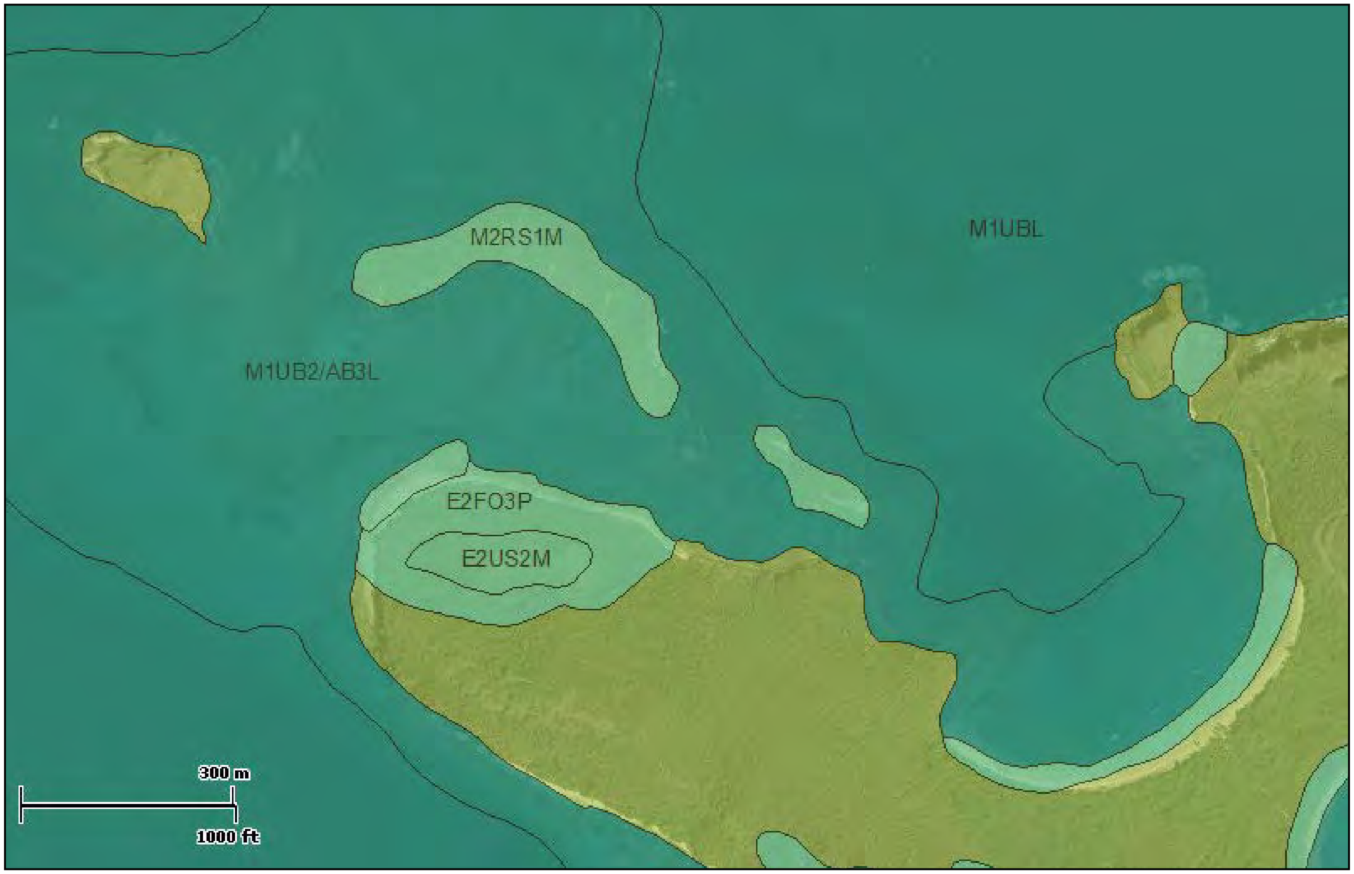
National Wetlands Inventory Map

U.S. Fish and Wildlife Service

National Wetlands Inventory

MRS 07

Jun 9, 2011



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Status

- Digital
- Scan
- Non-Digital
- No Data

User Remarks:

National Wetlands Inventory Map

Appendix H: GIS Data

GIS Data included in Electronic Format on
The Enclosed CD (Appendix H Folder)

Appendix I: TPP Meeting Minutes

January 15, 2009 Culebra-004

US Army Engineering & Support Center
ATTN: CEHNC-OE-DC (Brendan Slater)
4820 University Square
Huntsville, AL 35816-1822

RE: TPP Meeting #1, Culebra Island, Contract No. W912DY-04-D-0009; Task Order 0013

This Letter Report details the events of the TPP meeting regarding the Remedial Investigation / Feasibility Study (RI/FS) on Culebra Island at the U.S. Army Corps of Engineers (USACE) in San Juan, Puerto Rico on 20 November 2008. The purpose of the TPP meeting was to determine data needs and data collection options.

Attendance List

Name	Title	Company	Phone	E-Mail
Kathy Rollow	Project Manager	EOTI	865-220-8668	krollow@eoti.net
Bill Veith	OE Safety Specialist	USACE, Huntsville EM-CX	256-895-1592	William.d.veith@usace.army.mil
Kathleen Hamrick	Scientist	Malcolm Pirnie	843-853-7140 Ext. 11	khamrick@pirnie.com
Richard Henry	P.M.	USFWS	732-906-6987	Richard.henry@fws.gov
Ana M Roman	Culebra NWR Refuse Manager	USFWS	787-306-1389	Ana_roman@fws.gov
James J. Oland	Planner	FWS Contractor	740-980-7996	vjoland@att.net
Brenda Cruz	Administrator	ACDEC-Culebra	787-742-3880	bmcruz@prtc.net
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Felix Lopez	USFWS	USFWS		Felix.lopez@fws.com
Lisamarie Carrubba	Ecologist	NMFS	878-851-3700	Lisamarie.Carrubba@noaa.gov
Rolando Soler		PRWA	787-220-1185	
Rose A. Ortiz	Planning Analyst	Puerto Rico Planning Board	787-723-6200 Ext. 2020	Ortiz_r@jp.gobierno.pr

Materials and Documentation Discussed/Reviewed During TPP

The following documents were discussed during the TPP in order to provide the attendees with a familiarity of the site and a source of background information:

- Aerial Depictions of the Area Designated for Characterization
- Draft Conceptual Site Model

Handouts

The following handouts were distributed to the attendees of the TPP meeting.

- Attendee Sign-In Sheet
- At the conclusion of the TPP meeting copies of the invitee list were made available to attendees.

Changes/Deletions/Modifications

No significant changes, deletions, or modifications to the TPP materials were suggested among parties in attendance.

Discussion Items

Bill Veith, USACE Huntsville, gave the presentation and led the discussions that arose throughout. The following is a breakdown of the major discussion topics associated with the Culebra Island RI/FS:

I. A brief discussion on the different areas was held regarding access and rights of entry (ROE).

Concern #1: How to access cayos and Culebra's beaches.

- The contractor needs to have the latest version of the Standard Operating Procedures (SOPs) Revision 8 November 2008 and that it needs to be followed thoroughly.
- Cayo Norte is not included in the SOPs, therefore the contractor will need to coordinate access through NMFS.
- Use of a jet boat to access cayos and beaches was suggested without opposition.
- Nelson Colon has been assigned as the USACE project biologist.

- During the winter season it will be hard to get to the cayos.
    - Most of the cayos do not have beaches, except Culebrita, Cano Luis Pena and Cayo Norte.
- NMFS expressed concern over what would happen if a large UXO was discovered on a small cayo (e.g., 500 pound bomb on ½ mile cayo).

Concern #2: Plan for distributing and reviewing documents.

- Daniel Rodriguiz, EPA, will be reviewing documents for the PREQC.
- The review period for project documentation will be 60 days.
- Upon approval by USACE Huntsville, the contractor will submit documents to the USACE Antilles office for distribution to regulators/stakeholders.

Concern #3: How to coordinate and obtain ROE.

- Dan Shelly, the owner of the Puerto del Rey Marina in Fajardo, Puerto Rico, is the current owner of Cayo Norte and plans to develop this land.
    - The land was previously owned by a consortium of families and a ROE could not be obtained.
    - A ROE may be obtainable from this new owner.
- At the Cerro Balcon area, there has only been a ROE issue with one owner, Mrs. Gonzalez.
- Educating the land owners in regards to what will be occurring and for what reason will be needed, in order to obtain ROEs.
- Cayo Luis Pena is not included in the project.

<u>II. Project Discussion by MRS</u>

<u>MRS-04: Flamenco Lagoon Maneuver Area</u>

- There are many land owners in this area (more than 12) and heavy vegetation.
- Proposed approach:
    - Doing transects going from east to west.
    - The transects should be as straight as the vegetation allows.
    - Detectors will be used to look for elevated anomaly counts.

Concern #4: Heavy vegetation hides everything, so how will the contractor minimize clearing without compromising DQOs?

Existing paths will not be characterized.

- A plan will be laid out and then altered according to vegetation, natural circumstances and ROE.

Concern #5: No targets have been identified in this area in previous studies.

- The goal is to characterize the whole site.
- The team does not know if all of the fans have been found.
- The whole island is a Munitions Response Site (MRS).
- There was not a large volume of firing and not discrete targets.

Concern #6: Subdividing MRS.

- Additional development may occur, therefore, the MRS will not be subdivided into the areas that are developed and undeveloped.
- The transect locations will be based on prior military use, not land use.

Concern #7: Vegetation removal.

- There are not limitations on grass removal.

- The project biologist and land owner will be consulted regarding removal of trees or bushes.
  - The contractor needs a copy of the procedures for boa habitats.

Concern #8: DQO.

- The amount of negative data required to accept MEC is not a risk factor needs to be determined.
- Proposed approach:
  - Transects with 250 feet separation apart with no more than 25 feet or 10% deviation from course (for heavy vegetation or lack of ROE).
  - Transects will be 3ft wide.
  - 25ft by 25ft Grids will be placed based on areas of high anomaly count.
  - Vegetation will be removed from grids.

Concern #9: Finding background soil in the island will be very difficult.

- Separate background sample for each MRS are needed.
- Addition background samples may be needed if previous background samples are not really background (based on the findings).

Concern #10: Amount of samples for statistical robustness.

- Multi Incremental Sampling (MIS) will help with statistical robustness because more than 30 samples will be collected to create one MIS.

<u>MRS-07: Culebrita Artillery Impact Area</u>

- 20 mm and 75 mm found in this area are evidence of targets.
- Some beaches were included because of what might have shifted or come in with storms.
- South portion of the Culebrita has no range fans, therefore is not included in the study area.
  - The portion where the lighthouse and observation tower are located will not be included in the investigation.
- A previously conducted geophysical study and prepared maps will be provided to the contractor.
- Cayo Botella is less than half an acre, non-vegetated rock and can be investigated in a day.

Concern 11: Possible UXO on Cayo Botella.

- There is the belief that a 500 pound bomb is on this cayo.
- There are two lagoons in Culebrita, which are usually dry in February

Concern 12: Dangerous vegetation on peninsula.

- The vegetation is very heavy with vines, spines and mangroves.
- Clearance of plants will be coordinated with FWS and DNER because of endangered plant species.
- The biologist will be classified as essential personnel in order to accompany the field crew to identify endangered species.

Concern 13: Direction of fire.

- There seems to be a discrepancy between what has been reported in the past and what has been seen in the field.
  - Cleared area from old targets are still visible.
- Proposed Approach:

  - o Transects 250 feet apart; however portions may be as close as 150 feet.
  - o Transects perpendicular to range fan.

MRS-02: Cerro Balcon and Adjacent Cayos

- There were bombing targets in this area.
- Name of MRS has been updated to Cerro Balcon and Accessible Cayos
- Contractor will coordinate access to cayos.
- The contractor will be provided a map with all cayos identified (show names and planned access route).
- The contractor will be provided data from a previously conducted surface removal on Cayo Lobo in order to get a boundary to the south.
- Contractor may have to go back to all removal points to look in the subsurface.

Concern #14: Cayos not to be accessed by FWS guidance.

- Cayos not to be accessed by FWS guidance will not be investigated.

Concern #15: Nesting Seabirds.

- SOPs do not address nesting seabirds, therefore, the contractor will be provided separate documentation regarding avoiding nesting seasons.

Concern #16: Vegetation.

- There is thick grass and mulch.
- Best approach may be using the Schonstedt even though there may be some false hits due to hot rock

Concern #17 Spacing of transects:

- Proposed approach:
  - o Qualitative Reconnaissance.
  - o Transects with 250 feet separation.

MRS-05: Mortar and Combat Range Area

- There is no data of MEC in this zone.
- Access to the area is difficult.

Concern #17: DQOs:

- During the SI, several meandering paths were walked with no resulting anomalies.
- Proposed approach:
  - o Qualitative Reconnaissance.
  - o Contractor should fill in the gaps from the SI, except do transects north of MRS 2 (with magnetometer and EM).
  - o Transects will have to be meandering digging subsurface anomalies as the path progresses.

Concern #18: Endangered Species (Lizard)

- There is an endangered species, but it hasn't been seen since 1935.

MC Collection/Analysis

Concern # 19: Sampling and analytes.

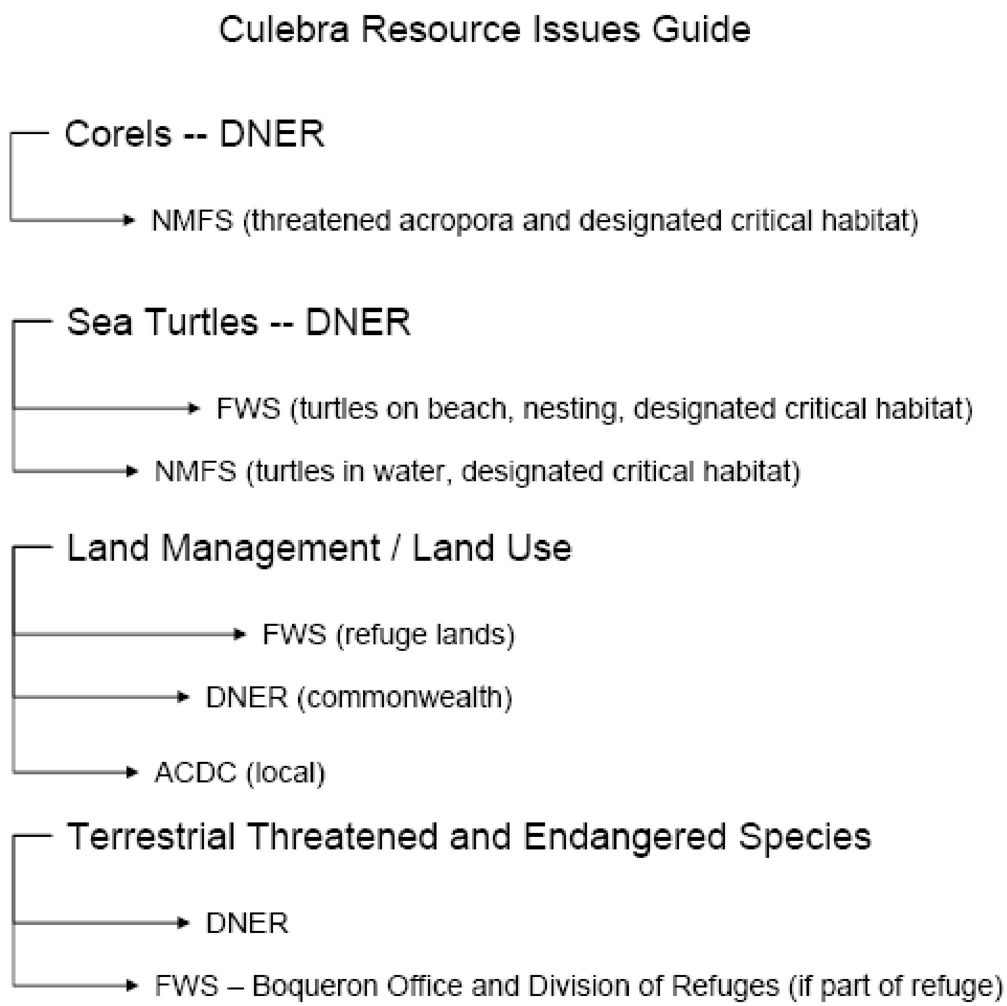
- Sampling analytes are based on what we are looking for metals and explosives.
- According to conceptual sampling model, no surface water will be sampled, just sediment from lagoons.
- Groundwater sampling may be needed because of future potential use.

- Receptors were identified for surface water but not for groundwater in the CSM.
- Concern was also expressed over lack of surface water samples.

Concern #20: Sampling Method – Sampling depth

- Grab sampling – 0”-6”
- Incremental sampling – 0’-2’
- Sample should not include organic layer.
- Removal or inclusion of vegetation was discussed, but not decided on.
- It was proposed that a sampling depth of 0-2” be adopted
    - However EPA has been sampling to 2 feet or until bedrock is encountered.
    - Because of grasses, soil layers are being added on top and contamination may now be lower.
    - The team agreed to consider deeper samples

Members of the TPP Team prepared the following diagram as guidance regarding resource issues:



The next TPP meeting is scheduled for April 2009. At that time the draft-final version of the Work Plan will be reviewed.

Action Items

The following list represents items that require follow-on actions or need resolution:

- The contractor will be provided the latest version of the Standard Operating Procedures (SOPs) dated 8 November 2008.
- Specific procedures will be developed regarding large UXO discovered on a small cayo (e.g., 500 pound bomb on ½ mile cayo).
- Clarification is needed regarding why Cayo Luis Pena not included in the project.
- The procedures for Boa Habitats will be provided to the contractor.
- The amount of negative data required to accept MEC is not a risk factor needs to be determined.
- A previously conducted geophysical study and prepared maps for the Culebrita Artillery Impact Area will be provided to the contractor.
- The contractor will be provided a map with all cayos identified (show names and planned access route).
- The contractor will be provided data from a previously conducted surface removal on Cayo Lobo in order to get a boundary to the south.
- The contractor will be provided separate documentation/letter regarding avoiding nesting seabirds.
- A decision is required regarding the need for groundwater and surface water sampling.
- A decision is required regarding the removal or inclusion of vegetation and sampling depth for soil sampling.

Sincerely,

Explosive Ordnance Technologies, Inc.

Kathy Rollow, M.B.A.
Project Manager

cc: USACE Jacksonville (12 copies)

July 29, 2010 Culebra-009Rev1

US Army Engineering & Support Center
ATTN: CEHNC-OE-DC (Spencer O'Neil)
4820 University Square
Huntsville, AL 35816-1822

RE: TPP Meeting #2, Culebra Island, Contract No. W912DY-04-D-0009; Task Order 0013

The second Technical Project Planning meeting for the subject Remedial Investigation / Feasibility Study (RI/FS) on Culebra Island at the U.S. Army Corps of Engineers (USACE) in San Juan, Puerto Rico took place on 7 July 2010. The purpose of the TPP meeting was to finalize the data collection plan and address any remaining concerns with the Work Plan. Participants in the meeting included the following personnel.

Attendance List

Name	Title	Company	Phone	E-Mail
Spencer O'Neil	Project Manager	CEHNC	256-895-1574	Spencer.d.oneal@usace.army.mil
Jim Daffron	Project Manager	EOTI	865-220-8668	jdaffron@eoti.net
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Ana M Roman	Culebra NWR Refuse Manager	USFWS	787-742-0115	Ana_roman@fws.gov
Kelly Enriques	Geophysicist	CEHNC	256-895-1373	kelly.d.enriquez@usace.army.mil
Jose Mendez	Project Manager	USACE Antilles	787-370-8928	Jose.M.Mendez@usace.army.mil
Daniel Rodriguez	PRM	USEPA	787-741-5201	Rodriquez.daniel@epa.gov
Wilmarie Rivera	PREQB-RPM	PREQB	787-365-8873	wilmarierivera@jca.gobierno.pr
Susan Silander	Project Lead	USFWS	787-851-7258 ext. 306	Susan_silander@fws.gov
Katarina Rutkowski	PREQB Consultant	TRC	860-298-6202	krutkowski@trcsolutions.com

Each participant was provided a handout that included the TPP meeting slides, a draft proposed schedule for field work and the minutes from the last TPP meeting. Discussion included: a review of the CERCLA process and project status; the Final Work Plan (including SAP/QAPP); Task Order PWS; and schedule for field work. The following is a summary of the issues and discussions.

Discussion Items

The presentation used to facilitate the discussion included:

- CERCLA Process review – with a focus on the RI/FS included in the EOTI PWS and the TPP process
- Project review
    - Milestones completed to date from contract award on 27 Jun 2008 trough the TPP meeting on 7 Jul 10
    - Review of the four MRSs included in the EOTI PWS

  MRS 02 – Cerro Balcon and Adjacent Accessible Cayos
  MRS 04 – Flamenco Lagoon Maneuver Area
  MRS 05 – Mortar and Combat Range
  MRS 07 – Culebrita Artillery Impact Area
    - Status of efforts to obtain rights of entry – MRS 02 and MRS 07 are largely Government owned properties; however the lack of ROE to private property in MRS 04 and MRS 05will impact the originally planned data collection plan
    - Data collected during previous clearance efforts and studies will be used as appropriate to meet data needs
- Plan for RI field work
    - The field team will consist of a UXO team supported by a SUXOS, UXOQCS/UXOSO, Biologist, and a Site Geophysicist. A geologist will mobilize later during the planned field work to support the MC sampling effort.
    - Geophysical data will be collected using a combination of digital and analog techniques. The most appropriate method will be determined in the field by the SUXOS, in coordination with the site geophysicist and biologist. Consideration when determining the most appropriate method and equipment, include: effectiveness of the technology for the specific terrain and geology, as well as the potential environmental and other effects of brush clearing. Geophysical data will be collected along meandering transects and small grids.
    - Anomalies detected along transects and in grids will be investigated until the segment of transect or grid is characterized as described in the Work Plan
    - Surface soil and sediment samples will be collected and analyzed to determine if MC related to military training are present in the MRS. Initial proposed sample locations are based on data obtained from previous removal efforts and analysis of previous military activity. The final location of the samples may be adjusted based on the results of the geophysical investigation. Composite samples will be collected using the CRREL 7-sample wheel approach. Each MC sample will be analyzed for explosives and metals listed in the SAP.
- Potential Challenges
    - Limited ROE – the greatest impact is in MRS 04 and MRS 05 – recommend beginning work in areas with fewer ROE restrictions while continuing to work to obtain ROE to other areas. Initial results may help to focus the efforts to obtain additional ROE
    - Need for accurate parcel boundary and ownership information

  - Environmental consideration along the beaches – mitigated and controlled through the use of existing data from recently completed beach clearance efforts and monitoring by the team biologist
  - Environmental considerations limit access to three of the cayos included in MRS 02 – Cayo Lobo; Cayo Del Agua; and Cayo Geniqui – work is scheduled to minimize impact to migratory sea birds
  - DDESB must approve the ESP before field work before starting field work.
- Project Schedule – The field work is expected to take three to four months; however the duration could be shortened by adding resources. Approval of the ESP is the only remaining critical task that must be completed prior to beginning field work. If the ESP is approved quickly field work could begin in August 2010.

A summary of the key points of discussion from the meeting are as follows:

- Lack of Rights of Entry – as described above the lack of rights of entry may affect the ability to collect the planned data, especially in MRS 04 and MRS 05.
  - USACE Real Estate office has been and continues to work to gain access where required
  - Will have to talk to people during field event – the Real Estate Office has best results when on site contacting the property owners in person
  - The Real Estate Office will have a representative on the ground during the field work to continue to obtain ROE and to coordinate with private property owners to gain access to property when required
- RI Report
  - PREQB wanted to ensure that historical information being used will be incorporated into RI
- Summarize and include references for reports and other sources of data used MEC/MC Investigation Logistics
  - Schedule of events following approval of ESP
  - EOTI will hire a local biologist who is familiar with local plant and animal species to accompany the MEC geophysical investigation team and will coordinate with FWS prior to the investigation
  - Investigation and sampling on Cayo Lobo, Cayo Del Agua, and Cayo Geniqui must be conducted during period between active migratory bird nesting
- Final MC Sample Locations
  - Request was made for PREQB, EPA, and FWS to review final sample locations prior to sample event
    - USACE agrees to allow a maximum of 5 days to review and finalize prior to sampling event in MRS 04, MRS 05 and MRS 07.

        - MRS02 Cayos are an exception since it is unknown if enough soil will be present and the plan is to access the cayos one time to collect all required MEC data. The soil samples collected on the cayos will be taken at the planned locations at the same time that geophysical data is collected. Adjustments to the location on the cayos may be made based on the availability of soil or the identification of high concentrations of MEC.
        - Team members should be familiar with topography, historical data, the preliminary CSM, and future land uses so that when combined with new data collected during the geophysical investigation, concurrence with sample location can be achieved quickly.
        - A meeting or conference call will be scheduled to discuss proposed MC locations and obtain concurrence
    - Background metals samples are intended for use across the MRS. Because metal concentrations can vary with soil type, if the field geologist determines a change in geology across the MRS at the time of the sampling it will be noted. Additional samples may be required to determine background levels in an MRS with varying geology.
    - SOP for collection of soil samples is in the Final Work Plan Appendix E, Section 5.2.2. All personnel involved in the collection of MC samples will be trained on these procedures. As stated during the TPP meeting and described in the work plan, soil samples will be collected from the top two inches.
    - Samples will be analyzed for the MC of concern listed in the Final Work Plan Appendix E, Table 5-1 and as stated in Section 5.2.1.4
- Responses to comments
    - PREQB was not given the final version of the Culebra Island Work Plan
    - Agree with Responses to Comments submitted 21 June 2010 with one exception:
        - *TRC/PREQB requests a track change version of the Response to Comments be submitted with clarification of Item 1 to include text to say that samples will also be analyzed for explosives and reference Table 5-1 in Work Plan*
    - PREQB requested clarification on the decision process and purpose of comparing site background data to regional data. Clarification on the data that will be selected (i.e., site background or regional background) based on this comparison is based on the PREQB WP comment on 7 October. The comment stated "Typically, metals concentrations detected in soil samples are compared to background to determine if metals concentrations in site samples are within the range of background concentrations."

In agreement with this comment, USACE will be using regional metal concentrations as a screening tool to determine if the concentrations are within the same range. These site-specific metal concentrations will be used for comparison purposes with the surface soil and sediment samples collected for delineation.

- Groundwater and Subsurface sampling – Ground water sampling is not included in the current EOTI contract and the contract cannot be modified to include new tasks - Issue Tabled
- PREQB discussed the need for subsurface soil and possibly groundwater sampling to evaluate the nature and extent of contamination and to conduct baseline risk assessments. Discussion concerning the fate and transport of explosives occurred, and the agencies noted that explosives are transported with water, and can impact groundwater, surface water and sediments, where sediments may be a repository for explosives constituents. It was also noted that although explosives degrade, degradation products are also considered contaminants and may be present. If delineation sample results are found to exceed regulatory assessment levels, then a more extensive subsurface investigation may be conducted at a later date. Based on a review of the geology following the TPP meeting, it is determined that there are no significant aquifers on Culebra Island or adjacent cays. Additionally, shallow bedrock and the impermeability of lava and overlying soil prevent the transport of MC to the groundwater. The potential use of groundwater as a potable domestic, municipal, or commercial water source is virtually nonexistent.
- Lagoons and beaches within MRS 04 and MRS 05 were identified as areas potentially requiring further evaluation. EOTI intends to use existing data for previous beach clearance projects. In addition to the planned sediment samples planned for the lagoons, EOTI will use data from previous sampling. PREQB noted that sediment sampling is used on Vieques Island to evaluate potential MC impacts to ecological receptors such as nesting turtles. No geophysical transects are currently planned in water covered portions of the lagoon. If insufficient data is available to evaluate these areas within MRS 04 and MRS 05, the team will discuss the path forward at the TPP meeting tentatively scheduled to occur following the RI report.
- Human activity on cayos – USFWS personnel perform restoration activities that should be considered when assessing human health risk.
- Project Schedule
  - Field work associated with the RI could start in August or September depending on the approval of the ESP.
  - During the time of year that field activities are currently scheduled the sea condition may limit ability to access cayos. Field crews will take advantage of favorable sea condition, when they exist, to access the cayos and Culebrita as early in the schedule as possible.

Action Items

The following list represents items that require follow-on actions or need resolution:

- CEHNC prepares and gains DDESB approval of the ESP, in coordination with EOTI
- EOTI establishes a secured project collaboration website to facilitate the sharing of field data with team members
- EOTI identifies a qualified, local biologist to support field efforts
- CESAJ provides PREQB Final Work Plan, dated 24 Mar 2010
- USACE provides PREQB with a map showing all MRSs on Culebra and identifying which are included in one of the two ongoing RI/FS projects
- After receiving the Final WP, PREQB back-checks RTC dated 21 June 2010

Sincerely,

Explosive Ordnance Technologies, Inc.

James Y. Daffron, PE
Project Manager

March 9, 2011 Culebra-019

US Army Engineering & Support Center
ATTN: CEHNC-OE-DC (Spencer O'Neil)
4820 University Square
Huntsville, AL 35816-1822

RE: TPP Memorandum, Culebra Island, Contract No. W912DY-04-D-0009; Task Order 0013

The third Technical Project Planning meeting for the subject Remedial Investigation / Feasibility Study (RI/FS) on Culebra Island at the U.S. Army Corps of Engineers (USACE) in San Juan, Puerto Rico took place on 3 March 2011. The purpose of the TPP meeting was to review the progress of the RI field work and the revised CSM/DQOs in order to obtain concurrence with the PDT before completing the RI/FS. Participants in the meeting included the following personnel.

Attendance List

Name	Title	Company	Phone	E-Mail
Spencer O'Neil	Project Manager	CEHNC	256-895-1574	Spencer.d.oneal@usace.army.mil
Jim Daffron	Project Manager	EOTI	865-220-8668	jdaffron@eoti.net
Teresa Carpenter	Technical Manager	USACE	256-895-1569	teresa.m.carpenter@usace.army.mil
Layne Young	Env. Scientist	ARCADIS/MP	410-332-4806	layne.young@arcadis-us.com
Richard Henry	Project Manager	USFWS	732-906-6987	richard_henry@fws.gov
Kelly Enriques	Geophysicist	CEHNC	256-895-1373	kelly.d.enriquez@usace.army.mil
Jose Mendez	Project Manager	USACE Antilles	787-370-8928	Jose.M.Mendez@usace.army.mil
Felix Lopez	Ecologist	USFWS	787-510-5208	felix_lopez@fws.gov
Wilmarie Rivera	PREQB-RPM	PREQB	787-365-8873	wilmarierivera@jca.gobierno.pr
Susan Silander	Project Lead	USFWS	787-851-7258 ext. 306	Susan_silander@fws.gov
Diane Wehner	Regional Resource Coordinator	NOAA/NOS	240.338.3411	diane.wehner@noaa.gov
Jim Pastoric	Consultant	UXOPro (PREQB)	703.548.5300	jim@uxopro.com
Katarina Rutkowski	PREQB Consultant	TRC	860-298-6202	krutkowski@trcsolutions.com
Tom Freeman (by phone)	Project Manager	USACE - SAJ		

Name	Title	Company	Phone	E-Mail
Julio F. Vázquez (by phone)		U.S. EPA - Region 2		Vazquez.Julio@epamail.epa.gov

Each participant was provided a handout that included the TPP meeting slides, maps showing progress in each MRS, revised DQOs, and the minutes from the last TPP meetings. Discussion included: a review of the project, a summary of the current status of the field work, and the plan for preparing the RI/FS Report. The following is a summary of the issues and discussions.

Discussion Items

The presentation used to facilitate the discussion included:

- Project review
  - Review of the four MRSs included in the EOTI PWS

    MRS 02 – Cerro Balcon and Adjacent Accessible Cayos
    MRS 04 – Flamenco Lagoon Maneuver Area
    MRS 05 – Mortar and Combat Range
    MRS 07 – Culebrita Artillery Impact Area
  - Discussion of revised CSM for MRSs following the completion of most field work based on the reasonably expected future land used and exposure to potential receptors based on their expected activities.
    - MRS-02 - Two reasonably anticipated future land uses – Wildlife management on Cays, with limited/controlled access and activities and private development/residential use in Cerro Balcon area. Data will primarily come from historical records and previously completed projects.
    - MRS-04 - Two reasonably anticipated future land uses – Wildlife management within the Culebra Wildlife Refuge Area and private development/residential use. Data is derived from historical records and field investigation completed during the RI.
    - MRS-05 - Two reasonably anticipated future land uses – Wildlife management within the Culebra Wildlife Refuge Area with limited access and private development/residential use. Data is derived from historical records and field investigation completed during the RI.
    - MRS-07 - Culebrita is managed by US Fish and Wildlife but is visited by tourist/residents that use the beaches and established trails. Vegetation and terrain is very restrictive in other areas. Data is derived from historical records and field investigation completed during the RI.

    The Revised CSM was presented with a graphical representation and a flowchart that showed the potentially complete pathways with receptors and MEC/MC
- Current status of the RI field work. EOTI provided a summary of the results of the field work through 25 February 2011 in each MRS. These results of field work as of 25 February 2011 are given below:

- MRS-02 – None completed as of 25 Feb.
- MRS-04 –
    - Transects complete – 2,512 FT
    - Anomalies investigated – 54
    - Munitions debris items located -3
    - MEC items located - 0

  Field work in this MRS is on-going with priority in the eastern portion where historic records indicate potential target locations.
- MRS-05 –
    - Transects complete – 105,433 FT
    - Anomalies investigated – 742
    - Munitions debris items located – 123 (109 SAA related debris)
    - MEC items located - 0

Field work in this MRS is on-going.

- MRS-07 –
    - Transects complete – 9,557 FT
    - Anomalies investigated – 944
    - Munitions debris items located – 19 (2 SAA related debris)
    - MEC items located – 2 (live fuze from 2.75“ HEAT round, Mk 8 Demo hose).

MC Sampling will be completed during the week of 21 March 2011. Sampling will be completed using the CRREL 7-sample wheel approach (USACE CRREL, 1996) at the approximate locations indicated on the attached maps, which were selected based on the results of the geophysical investigation. Based on field conditions during the sampling event sample locations may be revised. If this is necessary the same methodology for location selection will be used.

Key Points of Discussion

A summary of the key points of discussion from the meeting are as follows:

General

- PREQB and other stakeholders need a copy of the FINAL Work Plan. It was agreed that the plan would be posted on the EOTI website and directions for download will be provided. The plan was loaded on the EOTI ftp site and directions for accessing the site were sent to the Corps PM.
- There have been multiple issues with ROEs at the site. This has affected the properties that could be investigated and will be discussed in the RI/FS report.

MEC Characterization

- USFWS suggests environmental restoration/revegetation is an option for sensitive areas that require vegetation clearance as part of a potential remedial response.
- PREQB (UXOPro) voiced concern regarding making decisions not to collect field data in certain MRSs or portions of MRSs during the RI based on future anticipated land use.

- Flamenco Lagoon within MRS 4 is sometimes completely dry or dry around the edges during the dry season. According to USFWS, visitors go into the lagoon when it is dry and metallic anomalies are visible.
- Procedures for MEC disposal were discussed. The BIP of the two items located within MRS 07 will involve a net explosive weight of less than one pound and involve a consolidated shot with an EZ of 300 feet. Notification will be made in accordance with the Work Plan and may include DNR, Culebra Police Department, USFW, Culebra Fire Department, and US Coast Guard.

MC Characterization

- The USACE Risk Assessor (Monique Nixon) may be in the field during the MC sampling effort.
- USACE requested confirmation of the selected laboratory's accreditation.
- It was agreed the seven point "wagon wheel" composite sampling procedure will be used for soil sampling. Sediment samples will be discreet.
- Locations of potential background samples were discussed. Samples will potentially be taken in an area of MRS 4 that appears to have had limited military use based on the ASR and/or in areas where no MEC or MD was found during the geophysical investigation within the MRS. Background samples on Culebrita will be taken south of the lighthouse where the property was not used for military purposes.
- There are three major soil types on the island (rock, sand, and coastal soil). Background samples will need to be taken from soil types which are similar to the soil samples collected. There will be a minimum of 10 background samples taken.
- If analytical results from the background samples are statistically similar from the different soil types they can be combined for a single set of background values.
- It was agreed background samples will be analyzed for explosives as well as metals to ensure the sample is "clean" since they will be taken from within the MRS.
- There is a 2007 background study for the island of Vieques that can be used for soil type background values. The study can be obtained from PREQB.
- It was suggested sediment screening criteria from a 2010 study (Pascoe) be used. The study was provided.
- MC sampling locations will be reviewed based on updated MEC investigation results and access limitations. Sampling locations will be biased to areas where MEC and MD were found. Updated sample locations will be provided to USACE for review and comment (see attached).
- Two soil samples will be taken along each transect selected for sampling based on the discovery of MEC and/or MC.
- Method 8330B will be used for explosive analysis.
- The Flamenco Lagoon and mangrove marsh are owned by USFWS and will be the location of two sediment sample locations in MRS 4.

RI/FS Report

- PREQB requests that documentation of ROE refusal be maintained and included in the RI/FS report.
- According the USFWS the adjacent cays are closed to the public; however, people do visit. For the purposes of the CSM trespassers need to be considered potential receptors.
- In the CSM, need to specifically include "Construction Workers" and differentiate between "Visitors" and "Trespassers" for the purposes of the risk assessment.
- For the risk assessment, the conservative assumption of "residential" future land use should be used for currently undeveloped areas which are not part of a Wildlife Refuge.
- USACE may "realign" MRSs as a result of the RI/FS report.
- The RI and FS will be submitted as one document for review.
- The DRAFT RI/FS report will be submitted NLT the end of April, pending receipt of MC sampling analytical results in time for evaluation and inclusion in the report.
- ROE and TES issues which limited access for the investigation need to be fully documented in the RI/FS report.
- The MEC CSMs need to be revised to show a potentially complete pathway for biota in the surface and subsurface due to the activities of burrowing animals.
- The Cerro Balcon MC CSM needs to be adjusted to show potentially complete pathway for biota through domestic animals.
- If there is a data gap (e.g. adjacent cays) for MEC or MC the CSM should show a potentially complete pathway as appropriate and this data gap should be explained in the RI/FS report.
- The MRS 4 MC CSM needs to be adjusted to show potentially complete pathway for visitors through game/fish/prey because visitors fish in the lagoon and collect land crabs.
- The MRS 5 MEC CSM needs to be adjusted to show potentially complete pathway for visitors through non-intrusive surface MEC and for managers/contractors through intrusive subsurface MEC.
- In MC CSMs there should be a potentially complete pathway for all residents through groundwater as appropriate for current and future land use as PR treats all groundwater as potentially potable.
- Need to re-evaluate MEC CSMs for visitors in wildlife refuge areas as there are no access controls and people can potentially enter the area even though the vegetation appears limiting.
- Need to adjust the MC CSMs for MRS 4 and 5 to include a potentially complete pathway for residents, managers/contractors, and visitors through the ingestion of surface water/sediment.
- Any investigation "data gaps" (MEC and/or MC) need to be discussed in detail in the RI/FS report.
- Mr. Vazquez pointed out that five year reviews are required by law if any contaminant is left in place. They become part of each alternative that is not unrestricted, but never by itself. Therefore, it cannot be considered an alternative.

<u>Action Items</u>

The following list represents items that require follow-on actions or need resolution:

- EOTI provides a map of proposed sample locations superimposed on a map of the geophysical investigation results.
- EOTI confirms accreditation of the laboratory selected to analyze the soil samples
- EOTI posts the Final Work Plan on an ftp site and provides instruction for accessing it to the Corps of Engineers.
- PREQB provides the 2007 background study from Vieques.

Sincerely,

Explosive Ordnance Technologies, Inc.

James Y. Daffron, PE
Project Manager