WORK PLAN
ADDENDUM
FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
Cerro Balcon and Accessible Cayos (MRS 02) - Project Number I02PR006802
Flamingo Lagoon Maneuver Area (MRS 04) - Project Number I02PR006804
Mortar and Combat Range Area (MRS 05) – Project Number I02PR006805
Culebrita Artillery Impact Area (MRS 07) – Project Number I02PR006807
CULEBRA ISLAND, PUERTO RICO

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ACRONYM LIST

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
ARAR	Applicable or Relevant and Appropriate Requirements
ASR	Archives Search Report
ATF	Bureau of Alcohol, Tobacco, and Firearms
bgs	Below Ground Surface
BIP	Blow-in-Place
CD	Compact Disk
CEHNC	U.S. States Army Engineering and Support Center, Huntsville
CERCLA	Comprehensive Environmental Reponse, Compensation, and Liability Act
CESAJ	Corps of Engineers, Jacksonville District
CFR	Code of Federal Regulations
CHE	Chemical Warfare Material Hazard Evaluation
cm	Centimeter
CMS	Caribbean Marine Services, Inc.
COPC	Contaminant of Potential Concern
CRREL	Cold Regions Research and Engineering Laboratory
CRP	Community Relations Plan
CSM	Conceptual Site Model
CWM	Chemical Warfare Material
DD	Decision Document
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DFW	Definable Feature of Work
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DID	Data Item Description
DMM	Discarded Military Munitions
DN	Deficiency Notice
DoD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objective
DSQ	Director of Safety and Quality
DVD	Digital Versatile Disc
EcoSSL	Ecological Soil Screening Levels
EE/CA	Engineering Evaluation/Cost Analysis
EHE	Explosive Hazard Evaluation
EM	Electromagnetic; Engineer Manual
EOD	Explosive Ordnance Disposal
EOTI	Environmental Ordnance Technologies, Inc.

EP	Engineer Pamphlet
ESA	Endangered Species Act
ESL	Ecological Screening Leve
ESE	Environmental Science and Engineering, Inc.
ESP	Explosive Site Plan
ESRI	Environmental Systems Research Institute
ESTCP	Environmental Security Technology Certification Program
ESV	Ecological Screening Value
FAA	Federal Aviation Administration
FAR	Federal Acquisitions Regulations
FGDC	Federal Geographic Data Committee
FS	Feasibility Study
FSP	Field Sampling Plan
FTP	File Transfer Protocol
ft	Foot,feet
FUDS	Formerly Used Defense Sites
GIP	Geophysical Investigation Plan
GIS	Geographic Information Systems
GPS	Global Positioning System
GSV	Geophysical System Verification
HA	Hazard Assessment
HDC	Handheld Data Collection
HE	High Explosives
HFD	Hazardous Fragment Distance
HHE	Health Hazard Evaluation
HQ	Hazard Quotient
HTRW	Hazardous, Toxic, and Radioactive Waste
IAW	In Accordance With
IDW	Investigative Derived Waste
IGD	Interim Guidance Document
ISO	Industry Standard Object
IVS	Instrument Verification Strip
lb.	Pound
LLP	Lessons Learned Program
m	Meter
MATOC	Multiple Award Task Order Contract
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MGFD	Munition with the Greatest Fragmentation Distance
mm	Millimeter
MMRP	Military Munitions Response Program

MPH	Miles Per Hour
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objectives
MRS	Munitions Response Sites
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix Spike/Matrix Duplicate
MSD	Minimum Separation Distance
MSDS	Material Safety Data Sheets
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTCRA	Non-Time Critical Removal Action
NRL	Naval Research Laboratory
OE	Ordnance and Explosives
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
PDA	Personal Digital Assistant
PDF	Portable Document Format
PM	Project Manager
PP	Proposed Plan
PP/IP/FP	Preparatory Phase/Initial Phase/Follow-up Phase
PPE	Personal Protective Equipment
PRDNER	Puerto Rico Department of Natural and Environmental Resource
PREQB	Puerto Rico Environmental Quality Board
PSV	Preliminary Screening Values
PWS	Performance Work Statement
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QD	Quantity Distance
RAGS	Risk Assessment Guidance
RCWM	Recovered Chemical Warfare Material
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROE	Rights of Entry
RSL	Regional Screening Levels
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDSFIE	Spatial Data Standard for Facilities, Infrastructure, and Environment
SI	Site Inspection
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan

SUXOS	Senior Unexploded Ordnance Supervisor
TBC	To Be Considered
TES	Timberline Environmental Services
TMP	Technical Management Plan
TNT	Trinitrotoluene
TP	Technical Paper
TPP	Technical Project Planning
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plans
USACE	United States Army Corps of Engineers
USACE-RI	United States Army Corps of Engineers, Rock Island District
USAE	USA Environmental Inc.
USAESCH	United States Army Engineering and Support Center, Huntsville
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
UXOT	Unexploded Ordnance Technician
VHF	Very High Frequency
VSP	Visual Sampling Plan
WAAS	Wide Area Augmentation System
WERS	Worldwide Environmental Remediation Services
WP	Work Plan

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CHAPTER 1. INTRODUCTION

1.0.1 This Work Plan (WP) Addendum describes the additional field investigation activities, goals, methods, procedures, and personnel to fill in data gaps identified in the original Remedial Investigation (RI) Report due to the lack of Rights of Entry (ROE) for the Munition Response Sites (MRS):

- Cerro Balcon and Accessible Cayos (MRS 02) - Project Number I02PR006802 (Cerro Balcon 22.9 acres/Adjacent Cays 88 acres)
- Flamingo Lagoon Maneuver Area (MRS 04) - Project Number I02PR006804 (562.5 acres)
- Mortar and Combat Range Area (MRS 05) – Project Number I02PR006805 (2867.1 acres)

1.0.2 RI activities and collected data will be consolidated with the previous site data into a RI Report, FS Report, Proposed Plan (PP) and to prepare a Decision Document (DD) for stakeholder concurrence. This effort is to determine the extent of hazards posed by Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC).

1.0.3 Culebrita Artillery Impact Area (MRS 07) – Project Number I02PR006807 (375 acres) will not require additional field activities. EOTI RI findings and recommendations for MRS 07 was determined acceptable by the U. S. Army Corps of Engineers (USACE) and therefore MRS 07 will not undergo any additional fieldwork. Data provided within the EOTI RI report will be included with the above mentioned MRS's Feasibility Study (FS). The project location can be found in Figure 1-1.

1.0.4 This WP Addendum is provided in addition to the EOTI WP (EOTI February 2010). Sections of the EOTI WP that remain applicable are referenced for applicable WP Sections.

1.1 PROJECT AUTHORIZATION

1.1.1 On 23 September 2013, USA Environmental, Inc. (USAE) was awarded Worldwide Environmental Remediation Services (WERS) Multiple Award Task Order Contract (MATOC), Contract No. W912DY-10-D-0026, to complete portions of the EOTI work that could not be completed by EOTI due to the lack of ROE from private land owners.

1.1.2 The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing MEC or MC. Under the MMRP, the United States Army Corps of Engineers (USACE) is conducting environmental response activities at Formerly Used Defense Sites (FUDS) for the Army, DoD's executive agent for the FUDS program. The Culebra Island site falls under the boundary of the USACE Jacksonville District (CESAJ).

1.2 PURPOSE AND SCOPE

1.3 WP ADDENDUM

1.3.0.1 This WP Addendum is to serve as a comprehensive plan for the completion of field investigation, RI Report, FS Report, and DD for MRS 02, 04, and 05 on Culebra. MEC was discovered in MRS 07 during the previous investigations which identifies that MEC is present in the MRS and soil and sediment samples were also collected in which there were no exceedances in metals detected and no explosives were detected. Therefore MRS 07 will not undergo any additional field work (see Appendix B: Figures B-5 and B-6). This task involves compiling data and information from previous investigations conducted as well as collecting new information. Details about the execution of field activities and the secured disposition of any MEC or munitions debris (MD) encountered are included in this WP Addendum. This WP Addendum provides a basis for consistent project objectives and uniformity of methods, procedures, and quality objectives throughout the Remedial Investigation/Feasibility Study (RI/FS) process.

1.3.0.2 This WP follows the directions of (Interim Guidance) Engineer Manual (EM) EM 200-1-15 and Data Item Description (DIDs) listed in Table 1-1.

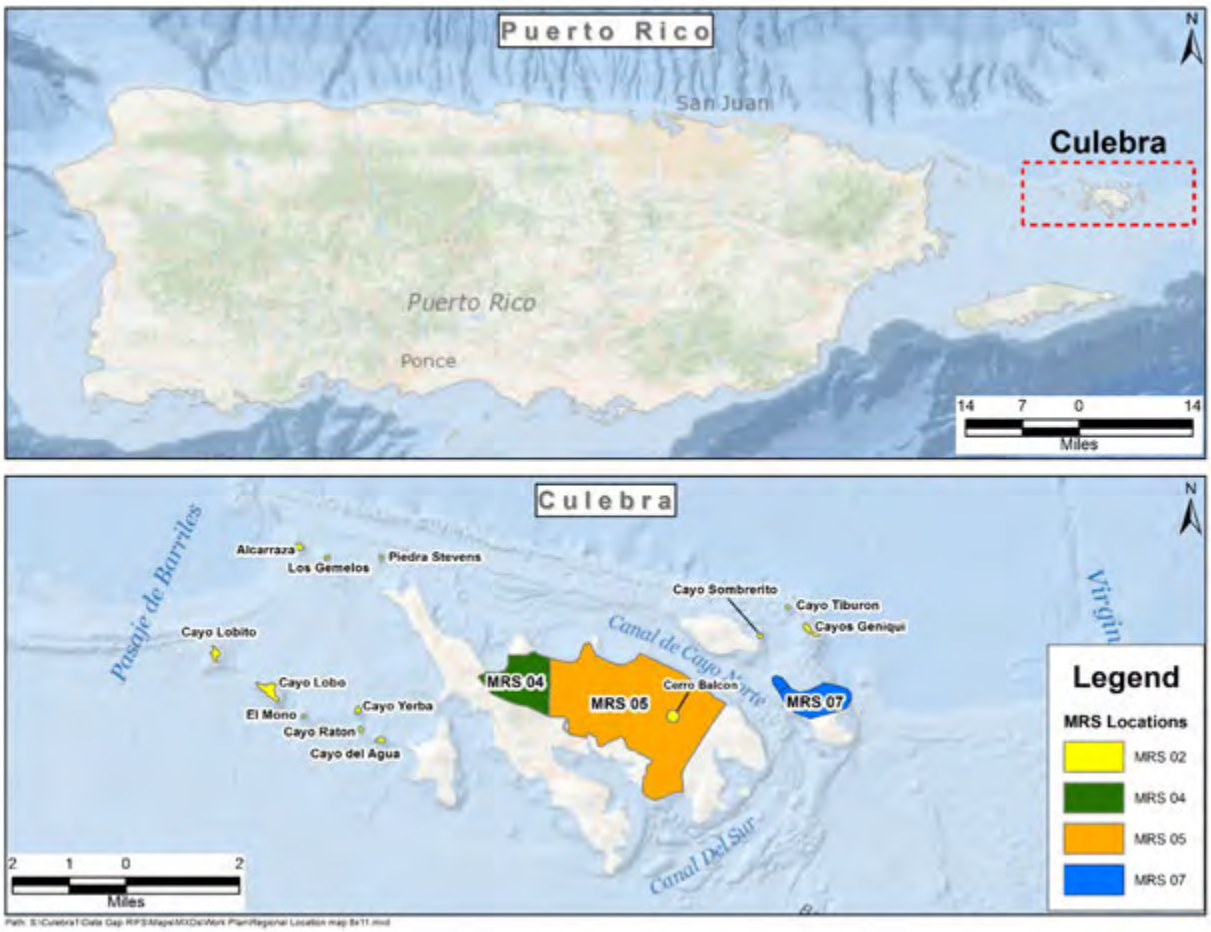

Figure 1-1: Project Location Map

Table 1-1: Data Item Descriptions

DID	DID Title
WERS-001.01	Work Plans
WERS-002.01	Explosives Management Plan
WERS-003.01	Safety Submissions
WERS-004.01	Geophysics
WERS-005.01	Accident Prevention Plan
WERS-007.01	Geospatial Information and Electronic Submittals
WERS-009.01	MC Chemical Data Quality Deliverables
WERS-011.01	Accident/Incident Reports
WERS-012.01	Personnel Qualifications Certification Letter
WERS-014.01	Reports/Minutes, Record of Meeting
WERS-015.01	Telephone Conversations/Correspondence Records
WERS-016.02	Periodic Status Report

1.3.1 WP Organization

1.3.1.1 This WP has been divided into Chapters 1 through 10 with associated documents provided either as appendices herein or as standalone documents. Together, the WP and associated documents present the project history, work elements, and requirements in an organized manner. Table 1-2 describes the general structure and organization of this WP. References are frequently made between various sections in the WP and the associated documents.

Table 1-2: WP Structure

Chapter Number	Descriptor	Information
1	Introduction	A statement of the project objectives, project authorization, purpose and scope; summary of WP organization, project location, and site descriptions.
2	Technical Management Plan (TMP)	Summary of project objectives, project organization, communication and reporting, project deliverables, project schedule, public relations support, subcontractor management, and management of field operations.
3	Field Investigation Plan	Describes the approach and procedures that will be followed in performing the geophysical survey of transects and the intrusive investigation, and reporting activities, and includes discussion of project goals, data quality objectives (DQO).
4	Quality Control Plan (QCP)	Describes the standard processes that will be used to monitor, inspect, and control daily field activities to ensure quality performance, processes to correct quality issues, quality control (QC) of contract deliverables, and QC reporting requirements.
5	Explosives Management Plan	The Explosives Management Plan will be used to provide details for management of explosives in accordance with applicable regulations.
6	Environmental Protection Plan	Describes the approach, methods and operational procedures that will be employed during onsite activities to protect the natural environment.
7	Property Management Plan	This chapter is not used. The Property Management Plan is not required for this Task Order.
8	Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel	This chapter is not used. The Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel is not required for this Task Order.
9	Physical Security Plan for Recovered Chemical Warfare Sites	This chapter is not used. The Physical Security Plan for Recovered Chemical Warfare Sites is not required for this Task Order.
10	References	Citation of documents referenced within this WP.

1.3.1.2 This WP covers work to be completed in accordance with the performance work statement (PWS) dated 7 August 2013. The PWS is provided in Appendix A. The WP Addendum is written in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund amendments and Reauthorization Act of 1986 (SARA), and is part of the overall Remedial Action Process. Activities involving work in areas potentially containing MEC hazards will be conducted in accordance with the USACE - Huntsville Center (CEHNC), Department of the Army, and DoD requirements regarding personnel, equipment, and procedures.

1.3.1.3 The WP Addendum addresses the USAE 2013 PWS. USAE RI technical approach will complete MEC and MC investigation in the areas where data gaps have been identified by EOTI in their RI Report

(EOTI February 2013). Most of the data gaps were the result from the lack of receiving Right of Entry (ROE). USAE PWS has the additional tasks to characterize groundwater and include and investigation in the lagoons on MRS 04 and MRS 05. The groundwater investigation will include a groundwater survey of existing wells, and installation of at least one well and groundwater sampling if a source of MC is confirmed. The investigation of the lagoons in MRS 04 and MRS 05 will include a limited MEC investigation and MC water sampling. USAE will also evaluate MEC and MC for 5 cays of MRS 2 and use existing data from the Cayo Lobo Non-Time Critical Removal Action (NTCRA) and the Underwater RI for MRS 2 awarded to Parsons for the remaining 7 cays (totaling 12 cays) to complete the RI Report.

1.4 SITE DESCRIPTION

Site Description can be found in Section 1 of the EOTI WP (EOTI February 2010)

1.5 SITE HISTORY

A Site History can be found in Section 1 of the EOTI WP (EOTI February 2010) (see Appendix M) additional Site History has been provided below that captures EOTI RI 2011 field work.

1.5.1 EOTI Areas Investigated During 2011 RI

1.5.1.1 Appendix B Figure B-1 through B-6 depicts the completed investigation for MRS's 04, 05, 07 and 02 (Cerro Balcon) during the EOTI RI. Investigation of many areas was not possible due to ROEs that were not obtained and these areas are referred to as the non-ROE areas in sections below.

1.5.1.2 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.

1.5.1.3 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 (MK5 Mod 0 Rocket, Charge, Demolition, Flex Linear, MK8). The MEC items in MRS 07 were discovered in the northwest portion of the MRS.

1.5.1.4 At the conclusion of all intrusive activities, approximately 43 pounds (lb.) of MD items were identified and removed from the investigated area. The majority of the MD was found in MRS 05 (15 MD items) and MRS 07 (17 MD items), and the remainder of the anomalies uncovered non-munitions-related metal waste such as barbed wire or nails. Suspected military munitions identified by the MD items (MRS 4 did not produce any MD that could be associated with a specific munition or munition type):

- MRS 5: 81-mm mortar, small arms ammunition, 4.2 inch mortars
- MRS 7: 20-mm projectile, small arms ammunition, 3 inch projectile, MK5 Mod 0 Rocket, Charge, Demolition, Flex Linear, MK8

1.5.1.5 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) Regional 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.

1.6 INITIAL SUMMARY OF RISK FROM MEC

Table 1-3 lists the munitions with the greatest fragmentation distance for each MRS within the project site. This list was compiled utilizing historical data.

1.7 INITIAL SUMMARY OF SUSPECTED MC

Appendix N: Chemical Composition of Munitions Known or Suspected for Culebra MRS's, lists the munitions and their munition constituents suspected to have been used on Culebra during the DoD's use for training and exercises documented in the historical findings.

Table 1-3: Minimum Separation Distances (MSD)

Area	MEC	MSD (ft)[1]				
		For Unintentional Detonations		For Intentional Detonations		
		Team Separation Distance (K40)	Hazardous Fragment Distance (HFD)	Without Engineering Controls	Using Sandbag Mitigation[2]	Using Water Mitigation[2]
MRS 02						
Cerro Balcon	4.2-inch M3A1	81	316	1,670	200	275
	4.2-inch M329	79	311	1,641	200	275
Cayo del Agua	MK84 2000-lb. High Explosives (HE) Bomb	437	963	4021	N/A	N/A
Cayos Geniqui	MK82 500-lb. HE Bomb	257	692	3028	N/A	N/A
Cayo Lobito	5-inch 54 MK41	74	359	2377	220	275
Cayo Lobo	5-inch 54 MK41	74	359	2377	220	275
Cayo Yerba	MK84 2000-lb HE Bomb	437	963	4021	N/A	N/A
MRS 04						
Flamenco Lagoon Maneuver Area	5-inch 54 MK41	74	359	2377	220	275
MRS 05						
Mortar and Combat Range Area	4.2-inch M3A1	81	316	1,670	200	275
	4.2-inch M329	79	311	1,641	200	275

Notes:
1. See Explosive Site Plan (ESP) for calculation sheets and documentation of MSD.
2. See ESP for required sandbag thickness in accordance with (IAW) HNC-ED-CS-98-7, Amendment 1, HNC-ED-CS-S-00-3, HNC safety advisory dated 07 November 2011, and Department of Defense Explosives Safety Board (DDESB) memo dated 29 November 2010 (Clarification regarding use of sandbags for mitigation of fragmentation and blast effects due to intentional detonation of munitions).

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CHAPTER 2. TECHNICAL MANAGEMENT PLAN

The TMP describes the investigation in detail including the approach, methods and procedures to be implemented within the WP Addendum by USAE.

2.1 PROJECT OBJECTIVES

The purpose of the RI/FS project is to characterize the nature and extent of contamination within MRSs 02, 04, and 05 for the purpose of developing and evaluating effective remedial alternatives, including the assessment of risks to human health, safety, and the environment.

2.2 PROJECT ORGANIZATION

Close coordination and cooperation between the stakeholders, community, regulators, and technical support personnel will ensure successful project completion. Table 2-1 depicts the key project entities and the roles these organizations occupy in the project.

Table 2-1: Key Project Organizations

Organization	Responsibility Category
CESAJ	Project Management, Geographical District
United States Army Engineering and Support Center, Huntsville (USAESCH)	Technical Management
USAE, and Subcontractors	Project Management, Contractor
Puerto Rico Environmental Quality Board (PREQB)	Lead Regulator/Review and concurrence of WP and reports
United States Environmental Protection Agency (USEPA)	Regulator/Review and concurrence of WP and reports
National Marine Fisheries Service (NMFS)	Stakeholder/Review of WP and reports
National Oceanic and Atmospheric Administration (NOAA)	Stakeholder/Review of WP and reports
United States Fish and Wildlife Service (USFWS)	Stakeholder/Review of WP and reports
Puerto Rico Department of Natural and Environmental Resource (PRDNER)	Stakeholder/Review of WP and reports

2.2.1 CESAJ

CESAJ is the overall Project Manager (PM) for the RI/FS project. CESAJ's responsibilities include the review of project plans and documents, obtaining ROE to properties in the work area, working with the news media and the public, and coordinating with federal, state, and local stakeholders on issues pertaining to implementation of this project and protection of ecological and cultural resources.

2.2.2 USAESCH

USAESCH, the implementing agency for execution of the project, provides technical expertise for MEC and MC activities, and serves as the Task Order Manager and Technical Lead for conducting the RI/FS. USAESCH responsibilities include procurement and direction of the prime contractor and the coordination of document reviews and approvals. CEHNC is also responsible for quality assurance (QA) of the contractor's adherence to the PWS and controlling the budget and schedule.

2.2.3 USAE

USAE is the prime contractor to USAESCH for this project. USAE will provide staff to perform all aspects of fieldwork and provide oversight of field sampling activities. USAE will assign project personnel based on management and technical experience and abilities. USAE will prepare and submit data reports IAW relevant USACE guidance and applicable DIDs.

2.2.3.1 Subcontractor Management

Subcontractors will report to the appropriate line of authority per the tasks assigned. The USAE PM will maintain the senior level of responsibility for the management of USAE's subcontractors. The following subcontractors and their roles follow.

- Parsons will provide assistance to USAE with the WP update [Sampling and Analysis Plan (SAP) and QAPP], assume the lead with the Risk Assessment WP, MC Sampling and risk assessment; and will provide assistance with report preparation.
- Caribbean Marine Services, Inc., (CMS) who is local to Culebra provides the team with logistical, marine services, ROE support and vegetation removal teams.

2.2.4 Project Regulators/Stakeholders

2.2.4.1 The stakeholders are the individuals and organizations directly impacted by the survey activities and the utilization of the resulting RI Report data. Stakeholders include (but are not limited to):

- USEPA
- PRDNER
- PREQB
- USFWS
- NOAA
- NMFS

2.2.4.2 Those listed above participate in the Technical Project Planning (TPP) process.

2.2.5 Contractor Management Team

2.2.5.1 USAE Project Manager

The PM (Mr. Thomas Bourque) is responsible for monitoring overall progress of the Task Order, reviewing monthly progress reports, and ensuring that resources are available. The PM maintains close communication with USAESCH to assess USAESCH satisfaction with USAE performance on this Task Order.

2.2.5.2 USAE Director of Safety and Quality

The Director of Safety and Quality (DSQ) (Mr. Robert Crownover) is responsible for reviewing and updating the Quality Control Plan and verifying compliance with the plan. Compliance with the QCP is accomplished by; auditing project activities; instituting corrective actions; and developing and coordinating the Accident Prevention Plan (APP). The DSQ is the contact for regulatory agencies on matters of health and safety.

2.2.5.3 USAE Project Engineer

The Project Engineer (Ms. Margaret Zaice) provides logistical support for all field activities, in addition to providing technical and report writing support to ensure the technical quality of deliverables to USAESCH.

2.2.5.4 USAE Geographic Information Systems (GIS) Manager

The GIS Manager (Mr. Jeff Lewis) is responsible for management and control of the project GIS. The GIS Manager will direct GIS operations occurring locally and remotely, and is responsible for control of data included in and used as part of the project GIS.

2.2.5.5 USAE Project Geophysicist

The Project Geophysicist (Mr. Al Crandall) is responsible for the overall technical direction for Digital Geophysical Mapping (DGM) surveys, to include the following:

- Provide overall technical direction for DGM surveys.
- Supervise data processing and interpretation.
- Coordinate with the Site Geophysicist to verify the accuracy and completeness of; project DGM documentation and target lists, instrument verification strip (IVS) testing results, QC results, and related DGM project documentation.

2.2.6 Field Management Team

The Field Management Team is responsible for the efficient and safe execution of the daily site activities. The Field Management Team will maintain field logs, provide daily input into the reporting and Access Data Base project files. All Unexploded Ordnance (UXO) Technicians and team members will meet, or exceed the requirements in DDESB TP 18 for the positions they hold. The organizational chart below shows the key project positions and personnel and the relationships between them and other team members (see Figure 2-1). The following is the Field Management Team and their responsibilities:

2.2.6.1 Senior Unexploded Ordnance Supervisor (SUXOS)

The SUXOS supervises all field activities while on the work site. The SUXOS ensures conformance with the RI/FS WP and all its associated plans. The SUXOS will report administratively and operationally to the PM.

- Identification of personnel and equipment requirements.
- Supervision of all daily field team activities.
- Early detection and identification of potential problem areas and institution of corrective measures.
- Assisting with the preparation of all project reports.
- Preparation of a daily report, which will include man-hours expended, areas cleared, explosives expended, and any other information required by the Project Manager.
- Providing on-the-job training for selected UXO Supervisor(s) who may be called upon to temporarily perform SUXOS duties during his absence from the site.
- Supervision of UXO Technicians; and
- Scheduling and executing a daily safety meeting, scheduling and coordinating subcontractor field team activities, and oversight of all field activities.
- Be responsible for ensuring work and QCP's specify the procedures and responsibilities for processing Material Potentially Presenting an Explosive Hazard (MPPEH) for final disposition as Material Document as Safe (MDAS) or range-related debris.
- Ensuring applicable Standard Operating Procedure (SOP) are adhered to (see Appendix K).

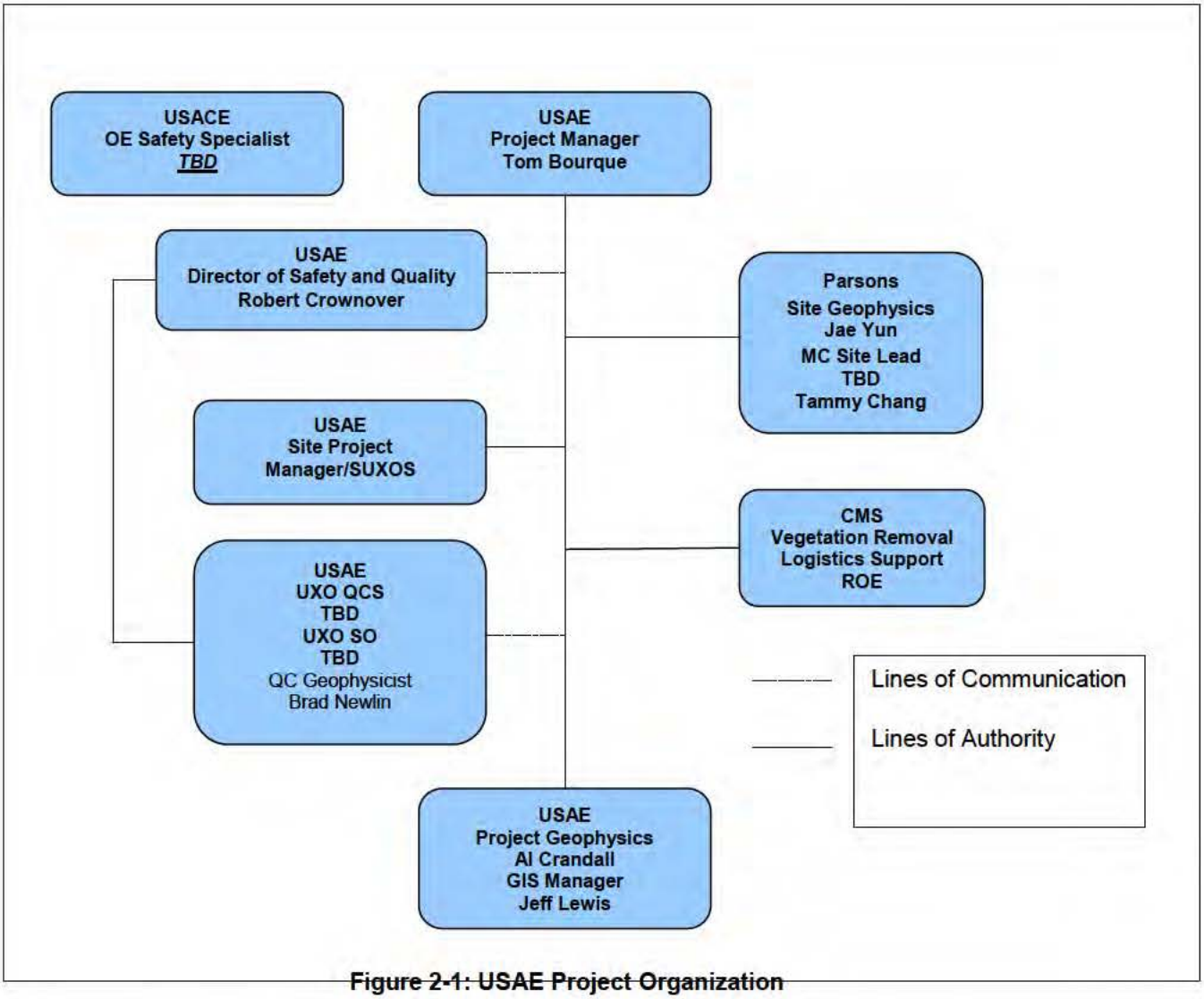

Figure 2-1: USAE Project Organization

2.2.6.2 Unexploded Ordnance Safety Officer (UXOSO)

The UXOSO has responsibility for enforcement of the overall safety aspects of the RI fieldwork. The UXOSO will provide daily safety briefs, and will conduct safety audits of all activities of the project. The UXOSO is responsible to the USAE Director of Safety and Quality for all safety related issues. The UXOSO has stop work authority in any matter related to the safety of personnel and equipment involved with the project. Specific duties include:

- Daily Safety Brief
- Daily Safety Inspections
- Weekly Safety Audit
- Conducting initial site safety orientation training
- Periodic safety training on relevant safety subjects
- Complete appropriate Accident Investigation and Accident/Incident Reports, as required
- Acting in an advisory capacity with the PM on safety related issues

- Working directly with the SUXOS to ensure safe completion of operational tasks.
- Ensure the specific procedures and responsibilities for processing MPPEH for certification as MDAS or range-related debris specified in the WP are being followed.
- All procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

- Submission of Float Plan to include all personnel, destination, approx. departure and return times when ever boat operations are to take place.

2.2.6.3 Unexploded Ordnance Quality Control Specialist (UXOQCS)

The UXOQCS is responsible for overseeing the site QCP in all field operations. The UXOSO/UXOQCS will be trained in QC techniques methodology and be qualified as a UXO Technician (UXOT) III . The UXOQCS coordinates with the PM for daily operations, and maintains a direct line of communication to the PM and Field Team.

- Conducts daily audits of the DGM teams, equipment and procedures
- Conduct daily audits of the UXO teams, equipment and procedures
- Perform and document random sampling (by pieces, volume or area) of all MPPEH collected from the various teams to ensure no items with explosive hazards, engine fluids, illuminating dials and other visible liquid Hazardous, Toxic, and Radioactive Waste (HTRW) materials are identified as MD or range-related debris as required for completion of the Requisition and Turn-in Document, DD Form 1348-1A

2.2.6.4 Parsons Site Geophysicist

The Site Geophysicist is provided by Parsons. The Site Geophysicist is responsible for the following:

- Coordination and communication with USAE's Site Manger and Project Geophysicist
- Overall site geophysical support, and DGM equipment maintenance and operation
- IVS setup and processing
- Production DGM management, collection, archiving, processing, analysis, and delivery to USAE's Project Geophysicist
- Digital and Analog Geophysics Access database development, maintenance, and weekly delivery to USAE's Project Geophysicist
- Drafts the submission of the Geophysical System Verification (GSV) report.

2.3 PROJECT COMMUNICATION AND REPORTING

2.3.1 Project Communication

Communications for this project will flow along the lines established by the organization depicted previously in Figure 2-2. All communications between USAE and the USAESCH will primarily be directed through the respective USAESCH PM or Contracting Officer. Communication directly between USAE and other government entities associated with this project will only occur with USAESCH concurrence.

2.3.2 Field Communications

During field operations, cell phones and hand-held radios will be utilized for internal communications between teams and key personnel. This allows for communication, between the Field Management Team, team leaders and the Ordnance and Explosives Safety Specialist (OESS).

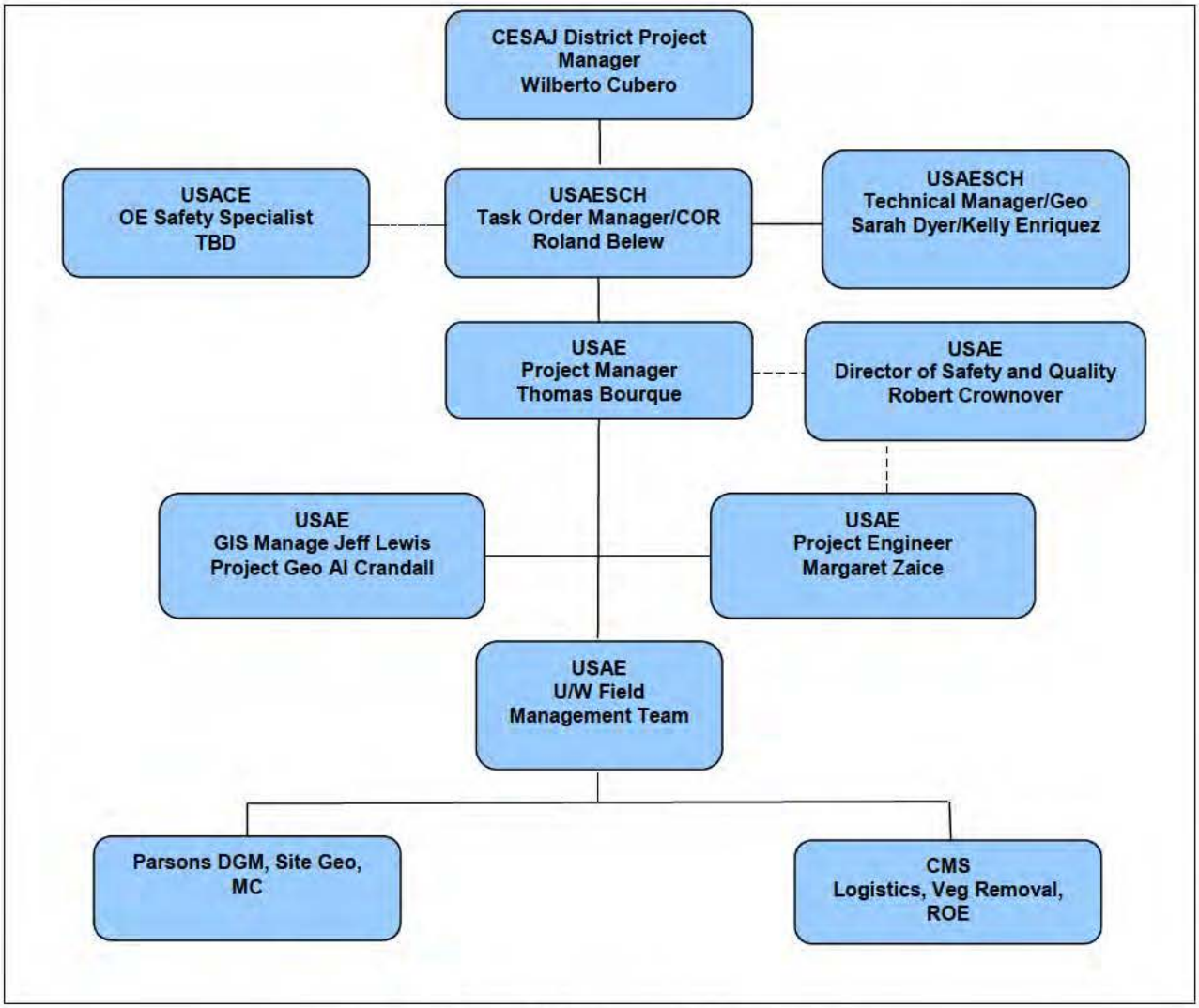

Figure 2-2: Project Management Organization

2.4 PROJECT DELIVERABLES

2.4.1 Project deliverables will meet the schedule requirements of the project and will be prepared in accordance with the applicable DID format. Deliverables will undergo internal review prior to submittal. A detailed description of project deliverables is provided in the current version of the PWS (Appendix A). Deliverable data will be submitted to USAESCH and CESAJ no later than the close of the business day indicated in the project schedule. Electronic data will be submitted in formats consistent with USAESCH software and systems, as defined in the PWS. Geophysical data deliverables will meet DID WERS-004.01 delivery schedule.

2.4.2 Additional report requirements follow:

- RI Report:
  - Address each MRS in separate chapters in a sequential manner in the document.
  - Data will be incorporated from the 2013 EOTI RI Report and previous Site Inspections (SI) (Parsons, 2007), Engineering Evaluation/Cost Analysis (EE/CA) and NTCRA, and historical documents.

  - A baseline risk assessment for MC and MEC will also be included. The ecological and human health risk assessment will be performed IAW the USEPA [Risk Assessment Guidance (RAGS)], USACE EM 200-1-4, Volumes I and II, and the approved Risk Assessment WP appended to the project WP.
  - The RI Report will include recommended revisions, as required, in the delineation of MRS boundaries based on RI findings.
  - An appendix to the report will include a determination of the MRS priority for each MRS using Munitions Response Site Prioritization Protocol (MRSPP) worksheets updated with RI results.
  - The RI Report will be submitted with the FS as one document.
- MEC Hazard Assessment (HA)
  - The MEC HA provides a method of risk assessment that allows the project team to evaluate the potential explosive hazard associated with an MRS, given current conditions and under various cleanup, land use activities, and land use control alternatives. The MEC HA is intended to fit into MMRP activities and the regulatory structure under CERCLA. It addresses the NCP direction to conduct site-specific risk assessments for threats to human health and the environment. The MEC HA addresses human health and safety concerns associated with potential exposure to MEC at MRS. As part of the USAE RI, a MEC HA will be performed for each MRS in accordance with the methods described in the USEPA October 2008 Interim MEC HA Methodology Document.
- FS
  - An FS will be prepared following USEPA CERCLA guidance and conform, as appropriate, with EP 1110-1-18, EM-CX Interim Guidance 06-04, and Army RI/FS guidance (per PWS for USAE). The FS will document the remedial options that are available to address MEC that was discovered and not removed as part of the previous site work. The FS Report will include documentation of the evaluation of the alternatives listed in paragraph 4-4.3.7 of ER 200-3-1. Following CERCLA guidance, the FS will not select a preferred remedy but instead will present the advantages and disadvantages of each alternative evaluated against the nine USEPA Superfund evaluation criteria. In accordance with the PWS, the FS will include potential risk reductions and cost estimates for alternatives and will be submitted with the RI report as one document.
- Proposed Plan (PP)
  - A PP document will be prepared covering all MRSs (MRS 02, MRS 04, MRS 05, and MRS 07) outlining the response action alternatives preferred for this site as a result of the RI/FS process. The PP (per PWS for USAE) will be prepared in accordance with ER 200-3-1, EP 1110-1-18, EM-CX Interim Guidance 06-04, and CERCLA, as amended, and will undergo a required 30-day public review. The PP will summarize the alternatives studied in the FS and will specify the preferred alternative. The PP will be written in clear, non-technical language so that the public can easily understand the reasons for the choice of the preferred alternative.
- DD
  - DD will be prepared for each delineated MRS resulting from the RI, in accordance with ER 200-3-1, EP 1110-1-18, attachment C, USEPA 540-R-98-031, and CERCLA, as amended. A DD is similar to a Record of Decision (ROD) in a CERCLA project. This document will contain information similar to that in the PP, but will contain greater technical detail as it becomes the basis for future actions, if any. The DD will include the responses to any comments that were offered during the PP public review process.

2.5 PROJECT SCHEDULE

The project schedule (Appendix J) provides the sequence of tasks, deliverable due dates, and anticipated number of days to complete each task. The schedule will be updated monthly and will be included in the Monthly Progress Status reports prepared in accordance with the applicable DID.

2.6 COSTING AND BILLING

Invoicing will be submitted throughout the project as milestones are successfully completed.

2.7 PROJECT PUBLIC RELATIONS SUPPORT

USAE will assist in the coordination of community relations with the local community, updating the Government approved Community Relations Plan (CRP). The primary objectives are building and maintain a positive relationship with the community, establishing communications as quickly as possible and continuing to provide public information regarding ongoing activities and MEC safety. USAE will provide the USACE with community relations support for two public meetings conducted on the Island of Culebra. The meetings will be attended by the PM and Technical Director; each of these individuals are familiar with the details of the project and ER 200-3-1 requirements and each is experienced in planning and conducting public meetings. USAE will provide meeting support including preparing bilingual presentations, producing posters and maps and other graphics as identified, obtaining meeting locations, providing sound equipment as needed, performing public notification, and participating in question and answer sessions. USAE will obtain USACE approval of materials presented to the public and will provide a summary of the meeting to USACE within 7 days.

2.8 CONCEPTUAL SITE MODEL (CSM)

The original CSM Site can be found in Appendix I TPP of the EOTI WP (EOTI February 2010). The CSM was updated in Section 2 of the EOTI RI Report (EOTI February 2013). The WP Addendum has provided an additional update to the CSM and can be found in Appendix G.

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CHAPTER 3. FIELD INVESTIGATION PLAN

3.1 OVERALL APPROACH TO MUNITIONS RESPONSE ACTIVITIES – MEC CHARACTERIZATION

3.1.1 MEC Site Characterization Goals

The primary goal of the RI/FS MEC investigation at Culebra Island is to characterize the nature and extent of MEC and MD. MEC has previously been recovered from several areas on the former military property and may remain on the site as a result of activities conducted by the DoD during operations at Culebra Island and may pose a threat to human health. An intrinsic geophysical investigation and MEC sampling will be conducted to determine the presence and characteristics of MEC. This will be combined with previous MEC investigation and removal data to complete an RI and FS.

3.1.2 Data Quality Objectives for MEC Investigation

3.1.2.1 DQOs (refer to Table 3-1)are established for this project to incorporate the data needs of the RI Report and FS Report. The RI Report will be provide results of the MEC characterization investigations. The RI Report will be prepared after the conclusion of field activities. The document will include a logical conclusion to the status of MEC at the site based on information gathered in the field. The RI Report will contain maps showing the search grids and records of MEC, and MD found at the site by grid number, type, and quantity. The RI Report will be submitted with the FS Report as one document.

3.1.2.2 The use of 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 200-1-15, Engineering and Design - Military Munitions Response Actions, and the Guidance for the DQO Process USEPA QA/G-4, Final Guidance (USEPA, 2000).

Table 3-1: DQO's

MRS 2 – Cerro Balcon Area MEC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 2 – Cerro Balcon Area is confirmed to have been used for DoD training operations using munitions with an explosive potential. No subsurface investigation has been conducted in the Cerro Balcon Area. The RI needs to define the nature and extent of MEC contamination within the MRS that may pose a threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine how investigative transects will be placed to characterize the presence of a target area with a 95% confidence level, while protecting ecological resources and adequately consider the safety of field teams. Establish which anomalies identified in the geophysical/analog investigation will be intrusively investigated. Determine a level of MEC density which will be considered high density, for decisions on grid placement. Determine what methods and standards will be used to delineate the estimated extent of contamination identified.

Identify Inputs	Historical information [e.g., Supplemental Archives Search Report (ASR) (USACE, 2004), Culebra SI Report (Parsons, 2007), field notes, aerial photos, maps] regarding potential MEC. EOTI Remedial Investigation Report <u>Observations:</u> Visual field MEC confirmation and indicators of MEC Type(s)/location(s) of MEC Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) Accessibility of the site The CSM (i.e. historical information [Supplemental ASR (USACE, 2004), field notes, aerial photographs, maps], anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.) Output from Visual Sampling Plan (VSP) Statistical analysis tools to include transect design, 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.
Define Boundaries of Study	Cerro Balcon area of MRS 2 investigative data will be collected using DGM or analog instruments to investigate along .08 acres of transects. Transect width is 1m and spacing is 422-ft for Cerro Balcon MRS. If the site conditions warrant, field teams may deviate from the transect design; however, the field team will return to the original transect design when conditions requiring the deviation no longer exist. Existing MEC information, as well as adjacent MRS05 transect data will be used to generate the anomaly density map. VSP post-analysis will be used to define high-density areas by using the data from the geophysical investigation. With concurrence from the Project Development Team (PDT), a 50-ft by 50-ft grid will be placed in the high-density areas which have been identified and selected for further investigation. The grid will be investigated with full coverage. If indicators of MEC are found, radial grids will be placed around the high density grid. If indicators of MEC are found in the radial grids, 4 radial transects extending 250-ft and radiating inward toward the MEC target area will be placed to determine extent. These transects will be intrusively investigated from the outer areas working in toward the MEC target area until MD is found. Vertical extent: ground surface to depth of instrument detection or bedrock, whichever is encountered first. Should the SUXOS, UXOQCS, and OE Safety Specialist determine that a high-density area is the result of Cultural Debris or trash pits, the investigation of the high-density area will cease. MRS Boundaries will be compared to past historical clearance operations for Cerro Balcon such as the 2006 NTCRA and the results of the RI. Recommendation to relocate MRS Boundaries in the RI Report will be provided if applicable. No ponds or lagoons have been identified in MRS 02 – Cerro Balcon. Exclusive of inaccessible areas. Inaccessible areas include: Slopes steeper than 33 degrees; the presence of Listed Threatened or Endangered Species or Critical Habitat (the Team Biologist will be present to identify Listed Species or Critical Habitat as the transects are established); rock and boulder outcroppings that pose a hazard to the field teams if traversed; areas of vegetation that if vegetation is removed the removal will be in violation of the USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015); areas that pose an unacceptable risk of injury to the field team if traversed. Time frame for collection (including ecological factors). Approved ROE

Develop a Decision Rule	If the anomalies found are not MEC-related, then the area will be considered unimpacted by MEC. If anomalies are identified as UXO or MD then the area will be considered potentially contaminated by MEC, and the hazard present will be evaluated in an assessment supported with data from a MEC HA, historical data, and professional judgment. Discovery of indicators of MEC in the high density grid will trigger 4 radial grids (approximately 20-ft x 200-ft) around the high density grid. If indicators of MEC are discovered in the radial grids, four additional radial transects, each 250-ft long, will be mapped and investigated to further refine the extent of MEC contamination. Cerro Balcon is already presumed to be a target area and will be analyzed to determine whether the target boundary is accurate. Geophysical targets will be excavated by using hand tools. If the anomaly cannot be excavated by hand (such as when the anomaly is situated underneath bedrock, or during excavation groundwater is encountered preventing the anomaly from being safely investigated and identified), the anomaly will be noted and excavation will be halted.
Specify Tolerable Limits of Detection Error	All geophysical activities will achieve applicable Measurement Quality Objectives (MQO) as stated in Chapter 3 Field Investigation Plan and confirmed/modified by the IVS, unless MQO failures can be adequately explained or justified.
Optimize the Design for Obtaining Data	The design for data collection was conducted to collect the most reliable information with consideration to terrain, safety of field teams, and protection of the environment. Data collection procedures and associated QC measurements are included in the Field Investigation Plan in Chapter 3. A total of .08 acres of transects in areas where obtaining ROEs is anticipated. Terrestrial extent transect/grid (.30 acres) will be placed in a high density area per VSP. Transect width is 1 m. Grid size may vary between a 25-ft by 25-ft area to a 50-ft by 50-ft area.

MRS 2 – Adjacent Cayos MEC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, the areas that comprise MRS 2 – Adjacent Cayos are confirmed to have been used for DoD training operations using munitions with an explosive potential. The RI needs to define the nature and extent of MEC contamination within the MRS areas that may pose a threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	The areas in the Adjacent Cays of MRS 2 present unique challenges due to their remoteness and environmental conditions limiting access. This includes rugged terrain and an access/egress requiring transition from small craft to shore. • Determine how investigative transects will be placed to characterize the presence of a target area with the maximum data possible, while protecting ecological resources and adequately consider the safety of field teams. • Establish which anomalies identified in the analog investigation will be intrusively investigated. • Determine what methods and standards will be used to delineate the estimated extent of contamination identified.
Identify Inputs	Historical information (e.g., Supplemental ASR (USACE, 2004), Culebra SI Report (Parsons 2007), field notes, aerial photos, maps) regarding potential MEC. EOTI Remedial Investigation Report Observations: Visual field MEC confirmation and indicators of MEC Type(s)/location(s) of MEC

	Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) Accessibility of the site The CSM [i.e. historical information (Supplemental ASR (USACE, 2004), field notes, aerial photographs, maps}, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.). Geophysical transects were manually designed to maximize coverage, based on land area and safe access. Present and/or future land use considerations.
Define Boundaries of Study	Standard Analog (Mag and Dig) operations will intrusively investigate 100% of anomalies detected. In areas of no soil, a visual inspection will be conducted. Horizontal extent includes land portions only Vertical extent: ground surface to depth of instrument detection or bedrock, whichever is encountered first. No ponds or lagoons have been identified in the MRS 02 – Adjacent Cayos. Exclusive of inaccessible areas. Inaccessible areas include: Slopes steeper than 33 degrees; the presence of Listed Threatened or Endangered Species or Critical Habitat (the Team Biologist will be present to identify Listed Species or Critical Habitat as the transects are established); rock and boulder outcroppings that pose a hazard to the field teams if traversed; areas of vegetation that if vegetation is removed the removal will be in violation of the USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015); areas that pose an unacceptable risk of injury to the field team if traversed. Time frame for collection (including ecological factors).
Develop a Decision Rule	If the anomalies found are not MEC-related, then the Cayo will be considered un-impacted by MEC. If anomalies are identified as UXO or MD, then the Cayo will be considered potentially contaminated by MEC, and the hazard present will be evaluated in an assessment supported with data from a MEC HA, historical data, and professional judgment. Analog targets will be excavated by using hand tools. If the anomaly cannot be excavated by hand (such as when the anomaly is situated underneath bedrock, or during excavation groundwater is encountered, preventing the anomaly from being safely investigated and identified), the anomaly will be noted and the excavation will be halted. Previously collected data will be utilized to determine the presence of MEC on cayos that will not be investigated during this RI data gap.
Specify Tolerable Limits of Detection Error	All geophysical activities will achieve applicable MQOs as stated in Chapter 3 Field Investigation Plan and confirmed/modified by the IVS, unless MQO failures can be adequately explained or justified.
Optimize the Design for Obtaining Data	The design for data collection was conducted to collect the most reliable information with consideration to terrain, access which requires a transition from a small craft to the shore, safety of field teams, and protection of the environment. Data collection procedures and associated QC measurements are included in the Field Investigation Plan in Chapter 3. For the five cays to be investigated a total of .27 acres is anticipated. Transects have been placed along the long axis of the cay when possible and in areas deemed safe for field work. Transect width is 1 m. If the site conditions warrants, field teams may deviate from the transect design however the field team will return to the original transect design when conditions requiring the deviation no longer exists. For the remaining cays, no investigation will be conducted in this RI, and data will be used from the ongoing water born RI for MRS 02 and 07 awarded in a separate contract.

MRS 4 – Flamenco Lagoon Maneuver Area MEC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 4 – Flamenco Lagoon Maneuver Area is suspected to have been used for DoD training operations using munitions with explosives. The RI needs to define the nature and extent of MEC contamination within the MRS that may pose a threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine how investigative transects will be placed to characterize the presence of a target area with a 95% confidence level, while protecting ecological resources and adequately consider the safety of field teams. Establish which anomalies identified in the geophysical/analog investigation will be intrusively investigated. Determine a level of MEC density which will be considered high density, for decisions on grid placement. Determine what methods and standards will be used to delineate the estimated extent of contamination identified.
Identify Inputs	Historical information (e.g., Supplemental ASR (USACE 2004), Culebra SI Report (Parsons 2007), field notes, aerial photos, maps) regarding potential MEC. EOTI RI Report <u>Observations:</u> • Visual field MEC confirmation and indicators of MEC • Type(s)/location(s) of MEC Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) Accessibility of the site The CSM [i.e., historical information (Supplemental ASR USACE 2004), field notes, aerial photographs, maps], anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries]. Output from VSP Statistical analysis tools to include transect design and 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.
Define Boundaries of Study	MRS 4 – Flamenco Lagoon Maneuver Area investigative data will be collected using DGM or analog instruments to investigate along .87 acres (terrestrial) and .34 acres (lagoon) of transects designed in VSP to detect a target area of 300 anomalies/acre above background of 10 anomalies/acre at 95% CL, based on the anticipated presence of the 81-mm mortar. Transect width is 1m and spacing is 797-ft. If the site conditions warrants, field teams may deviate from the transect design; however, the field team will return to the original transect design when conditions requiring the deviation no longer exist. VSP post analysis will be used to define high-density areas by using the data from the geophysical investigation. With concurrence from the PDT a 50-ft by 50-ft grid will be placed in the high-density areas which have been identified and selected for further investigation. The grid will be investigated with full coverage. If MEC is found, radial grids will be placed around the high density grid. If MEC is found in any of the radial grids, 4 radial transects extending 250-ft and radiating inward toward the MEC target area will be placed to determine extent. These transects will be intrusively investigated from the outer areas working in toward the MEC target area until MD is found. Lagoons: High density areas around the perimeter of the lagoons will be investigated with radial transects, if portions of the lagoon dries up and allows for intrusive investigation, analog transects may be added. For work in lagoons, an EM61 floating platform will be used. Intrusive investigations in the shallow water will not be accomplished due to safety concerns for the UXOT.

	Vertical extent - ground surface to depth of instrument detection or bedrock, whichever is encountered first. Should the SUXOS, UXOQCS, and OE Safety Specialist determine that a high-density area is the result of Cultural Debris or trash pits, the investigation of the high-density area will cease. Exclusive of inaccessible areas. Inaccessible areas include: slopes steeper than 33 degrees; the presence of Listed Threatened or Endangered Species or Critical Habitat (the Team Biologist will be present to identify Listed Species or Critical Habitat as the transects are established); rock and boulder outcroppings that pose a hazard to the field teams if traversed; areas of vegetation that if vegetation is removed the removal will be in violation of the USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015); areas that pose an unacceptable risk of injury to the field team if traversed. Time frame for collection (including ecological factors). Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. Approved ROE
Develop a Decision Rule	If the anomalies found are not MEC-related, then the area will be considered unimpacted by MEC. If anomalies are identified as UXO or MD, then the area will be considered potentially contaminated by MEC, and the hazard present will be evaluated in an assessment supported with data from a MEC HA, historical data, and professional judgment. Geophysical targets will be excavated by using hand tools. If the anomaly cannot be excavated by hand (such as if the anomaly is situated underneath bedrock, or during excavation groundwater is encountered, preventing the anomaly from being safely investigated and identified), the anomaly will be noted and excavation will be halted.
Specify Tolerable Limits of Detection Error	All geophysical activities will achieve applicable MQOs as stated in Chapter 3 Field Investigation Plan and confirmed/modified by the IVS, unless MQO failures can be adequately explained or justified.
Optimize the Design for Obtaining Data	The design for data collection was conducted to collect the most reliable information with consideration to terrain, safety of field teams, and protection of the environment. Data collection procedures and associated QC measurements are included in the Field Investigation Plan in Chapter 3. A total of .87 acres (terrestrial) and .34 acres (lagoon) of transects in areas where obtaining ROEs is anticipated. Terrestrial extent transect/grid (.30 acres) will be placed in a high density area per VSP. Transect width is 1 m. Grid size may vary between 25-ft by 25-ft area to a 50-ft by 50-ft area.

MRS 5 – Mortar and Combat Range Area MEC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 5 – Mortar and Combat Range Area is confirmed to have been used for DoD training operations using munitions with an explosive potential. The RI needs to define the nature and extent of MEC contamination within the MRS that may pose a threat to human health and the environment for the purpose of developing and evaluating viable remedial alternatives, if required.
Identify the Decision	Determine how investigative transects will be placed to characterize the presence of a target area with a 95% confidence level, while protecting ecological resources and adequately consider the safety of field teams. Establish which anomalies identified in the geophysical/analog investigation will be intrusively investigated.

	Determine a level of MEC density which will be considered high density, for decisions on grid placement. Determine what methods and standards will be used to delineate the estimated extent of contamination identified.
Identify Inputs	Historical information [e.g., Supplemental ASR (USACE 2004), Culebra SI Report (Parsons 2007), field notes, aerial photos, maps] regarding potential MEC. EOTI Remedial Investigation Report Observations: • Visual field MEC confirmation and indicators of MEC • Type(s)/location(s) of MEC Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.) Accessibility of the site The CSM [i.e. historical information Supplemental ASR (USACE 2004), field notes, aerial photographs, maps, anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.] Output from VSP Statistical analysis tools to include transect design, 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.
Define Boundaries of Study	The beach areas of MRS 5 – Mortar and Combat Range Area will not be investigated in the RI. The data from the Culebra SI Report (Parsons 2007) will be used to characterize the beach areas. For the inland areas of MRS 5 – Mortar and Combat Range Area investigative data will be collected using DGM or Analog Instruments to investigate along 3.36 acres (terrestrial) and .05 acres (lagoon) of transects designed in VSP to detect a target area of 300 anomalies/acre above background of 10 anomalies/acre at 95% CL, based on the anticipated presence of the 81-mm mortar. Transect width is 1m and spacing is 797-ft. If the site conditions warrants, field teams may deviate from the transect design; however, the field team will return to the original transect design when conditions requiring the deviation no longer exist. Terrestrial: VSP post analysis will be used to define high density areas by using the data from the geophysical investigation. With concurrence from the PDT, a 50-ft by 50-ft grid will be placed in the high density areas which have been identified and selected for further investigation. The grid will be investigated with full coverage. If indicators of MEC are found, radial grids will be placed around the high density grid. If MEC is found in the radial grids, 4 radial transects extending 250-ft and radiating inward toward the MEC target area will be placed to determine extent. These transects will be intrusively investigated from the outer areas working in toward the MEC target area until MD is found. Lagoons: High density areas around the perimeter of the lagoons will be investigated with radial transects, if portions of the lagoon dries up and allows for intrusive investigation, analog transects may be added. For work in lagoons, an EM61 floating platform will be used. Intrusive investigations in the shallow water will not be accomplished due to safety concerns for the UXOT. Vertical extent- ground surface to depth of instrument detection or bedrock, whichever is encountered first. Should the SUXOS, UXOQCS, and OE Safety Specialist determine that a high density area is the result of cultural debris or trash pits the investigation of the high density area will cease. Exclusive of inaccessible areas. Inaccessible areas include: slopes steeper than 33 degrees; the presence of Listed Threatened or Endangered Species or Critical Habitat (The team biologist will be present to identify listed species or critical habitat as the transects are established); rock and boulder outcroppings that pose a hazard to the field teams if

	traversed; areas of vegetation that, if vegetation is removed, the removal will be in violation of the USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015); areas that pose an unacceptable risk of injury to the field team if traversed. Time frame for collection (including ecological factors). Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions. Approved ROE
Develop a Decision Rule	If the anomalies found are not MEC-related, then the area will be considered unimpacted by MEC. If anomalies are identified as UXO or MD then the area will be considered potentially contaminated by MEC, and the hazard present will be evaluated in an assessment supported with data from a MEC HA, historical data, and professional judgment. Discovery of indicators of MEC in the high density grid will trigger four radial grids (approximately 20-ft x 200-ft) around the high density grid. If indicators of MEC are discovered in the radial grids, four additional radial transects, each 250-ft long, will be mapped and investigated to further refine the extent of MEC contamination. Geophysical targets will be excavated by using hand tools. If the anomaly cannot be excavated by hand (such as when the anomaly is situated underneath bedrock, or during excavation groundwater is encountered, preventing the anomaly from being safely investigated and identified), the anomaly will be noted and the excavation will be halted.
Specify Tolerable Limits of Detection Error	All geophysical activities will achieve applicable MQOs as stated in Chapter 3 Field Investigation Plan and confirmed/modified by the IVS, unless MQO failures can be adequately explained or justified.
Optimize the Design for Obtaining Data	The design for data collection was conducted to collect the most reliable information with consideration to terrain, safety of field teams, and protection of the environment. Data collection procedures and associated QC measurements are included in the Field Investigation Plan in Chapter 3. A total of 3.36 acres (terrestrial) and .05 acres (lagoon) of transects in areas where obtaining ROEs is anticipated. Terrestrial extent transect/grid (.30 acres) will be placed in a high density area per VSP. Transect width is 1 m. Grid size may vary between a 25-ft by 25-ft area to a 50-ft by 50-ft area.

MRS 2 – Cerro Balcon Area MC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 2 – Cerro Balcon Area is confirmed to have been used for DoD training operations using munitions with an explosive potential. No subsurface investigation has been conducted in the Cerro Balcon Area. The RI is intended to define the nature and extent of MC contamination associated with MEC found within the MRS that may pose a threat to human health and the environment 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. Establish presence/absence of MC contamination of surface soil and groundwater within MRS 2 – Cerro Balcon Area (if present) characterize nature and extent of MC contamination. Determine what receptors are present Determine the number of samples and locations where samples will be collected. Determine what analytes will be evaluated

	Determine what background values and screening values will be used to identify Contaminant of Potential Concern (COPC) for risk assessment. Determine if levels of detected MC present an unacceptable a risk to human or ecological receptors in a baseline risk assessment. Determine how the extent of any contamination from MC determined to present an unacceptable risk to human or ecological receptors will be delineated.
Identify Inputs	To establish presence/absence (nature and extent if present) MC contamination. The list of MC analytes are developed from the types of munitions identified as used at the MRS and include MC metals (aluminum, antimony, barium, chromium, copper, mercury, lead, and zinc), and explosives, picrate and perchlorate, nitrate/nitrites, and chlorides (groundwater only). The preliminary screening values (PSV) for soil for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (USEPA Regional Screening Levels (RSL) for residential soil) and Ecological Screening Value (ESV) [USEPA Ecological Soil Screening Levels (EcoSSL)], or USEPA Region 4 ESV, USEPA Region 5 Ecological Screening Level (ESL), or LANL EcoRisk Database value in the absence of a USEPA EcoSSL); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. Noncarcinogenic RSLs will be divided by 10 to reflect a Hazard Quotient (HQ) of 0.1 to account for potential cumulative effects. The background levels for metals in soil will be obtained from values established in the previous RIs conducted on Culebra, and will be from a similar soil type. Values are presented in the Uniform Federal Policy – Quality Assurance Project Plans (UFP-QAPP) and Risk Assessment WP. The human health screening values for groundwater are the USEPA RSLs for Tap water. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects. Ecological receptors are not exposed to groundwater, so ESVs for groundwater are not necessary. United States Geological Survey (USGS) Water Wells on Isla de Culebra, Puerto Rico (Cherry, 1995).
Define Boundaries of Study	The RI investigation for MC within MRS 2 – Cerro Balcon Area includes surface soil and subsurface soil (if needed to vertically delineate exceedances in surface soil), and groundwater.
Develop a Decision Rule	If no MEC or MD is encountered, no MC sampling will be conducted in any media (including groundwater), as there is no source. MC samples will be collected at MEC locations, including MEC step-outs, as needed. Soil samples will be collected at locations where MEC is found in the subsurface. These samples will be collected 0”-6” below the item found in the subsurface. If an MC analyte is undetected or is detected at concentrations less than the selected PSVs as established in the MC UFP-QAPP, then the area will be considered uncontaminated by that MC analyte and it will not be investigated further. In areas where MC analytes are detected at concentrations greater than the selected PSVs as established in the MC UFP-QAPP, the analyte will be considered a COPC and retained for consideration in a baseline risk assessment. Any detection of explosives will be considered a COPC. If the baseline risk assessment determines the exceedance does not pose an unacceptable risk to human or ecological health there will be no further investigation. If the baseline risk assessment determines an unacceptable risk to human health or ecological receptors then the TPP team will evaluate the magnitude of the unacceptable risk and further step-out sampling may be planned.

Specify Tolerable Limits of Detection Error	All sampling and analysis will achieve the MQOs outlined in the UFP-QAPP, unless MQO failures can be adequately explained and/or justified.
Optimize the Design for Obtaining Data	Soil Two surface soil samples to be collected by Cold Regions Research and Engineering Laboratory (CRREL) 7-pt wheel composite method at select MEC and MD locations within the target area. Additional step-out surface soil samples and subsurface soil samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Subsurface soil samples will be collected from 6 in. to 24 in. below ground surface (depending on site conditions) using a hand auger. Groundwater One groundwater sample to be collected from a well identified in the Groundwater Well Survey and located within or at a suitable distance downgradient from potential source areas. The detailed sampling plan for field procedures and laboratory analysis are outlined in Appendix E, the SAP and UFP-QAPP.

MRS 2 – Adjacent Cayos MC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, the areas that comprise MRS 2 – Adjacent Cayos are confirmed to have been used for DoD training operations using munitions with an explosive potential. The RI is intended to define the nature and extent of MC contamination associated with MEC found within the MRS that may pose a threat to human health and the environment 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. Establish presence/absence of MC contamination of soil, surface water and sediment within MRS 2 – Adjacent Cayos; if present, characterize nature and extent of MC contamination. Determine what receptors are present Determine the number of samples and locations where samples will be collected. Determine what analytes will be evaluated Determine what background values and screening values will be used to identify COPCs for risk assessment. Determine if levels of detected MC present an unacceptable a risk to human or ecological receptors in a baseline risk assessment. Determine how the extent of any contamination from MC determined to present an unacceptable risk to human or ecological receptors will be delineated.
Identify Inputs	To establish presence/absence (nature and extent if present) MC contamination: The list of MC analytes are developed from the types of munitions identified as used at the MRS and include MC metals (aluminum, antimony, barium, chromium, copper, mercury, lead, and zinc), explosives, and ammonium picrate. The PSVs for soil for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (USEPA RSLs for residential soil) and ESVs (USEPA EcoSSLs, or USEPA Region 4 ESV, USEPA Region 5 ESL, or LANL EcoRisk Database value in the absence of a USEPA EcoSSL); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the

	two will be selected as the PSV. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects. The PSVs for sediment for this RI will be selected using a two-step process: a) First, the most conservative screening value will be determined from the applicable human health screening values((USEPA RSLs for residential soil) and ESVs (Pascoe et. al. 2010; Buchman, 2008; or Long et. al. 1995 [see Section 4.4]); b) Second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. The PSVs for surface water for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (PREQB Water Quality Standards for Class SB surface water supplemented with USEPA National Recommended Water Quality Criteria for Human Health for the Consumption of Organism Only and USEPA RSLs for tap water) and ESVs (PREQB Water Quality Standards for Class SB surface water supplemented with values from the following sources: USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Saltwater CCC (chronic); Nipper et. al. 2001; or Buchman, 2008 [see Section 4.4]); b) second, this screening value was compared to the applicable surface water background value, and the greater of the two was selected as the PSV. The background levels for metals in soil and surface water will be obtained from values established in the previous RIs conducted on Culebra. Values are presented in the UFP-QAPP and Risk Assessment WP.
Define Boundaries of Study	The RI investigation for MC within MRS 2 – Adjacent Cayos includes surface soil and subsurface soil (if needed to vertically delineate exceedances in surface soil), surface water, and sediments.
Develop a Decision Rule	If no MEC or MD is encountered, no MC sampling will be conducted in any media (including groundwater), as there is no source. MC samples will be collected at MEC locations, including MEC step-outs, as needed. Soil samples will be collected at locations where MEC is found in the subsurface. These samples will be collected 0”-6” below the item found in the subsurface. If an MC analyte is undetected or is detected at concentrations less than the selected PSVs as established in the MC UFP-QAPP, then the area will be considered uncontaminated by that MC analyte and it will not be investigated further. In areas where MC analytes are detected at concentrations greater than the selected PSVs as established in the MC UFP-QAPP, the analyte will be considered a COPC and retained for consideration in a baseline risk assessment. Any detection of explosives will be considered a COPC. If the baseline risk assessment determines the exceedance does not pose an unacceptable risk to human or ecological health there will be no further investigation. If the baseline risk assessment determines an unacceptable risk to human health or ecological receptors then the TPP team will evaluate the magnitude of the unacceptable risk and further step-out sampling may be planned.
Specify Tolerable Limits of Detection Error	All sampling and analysis will achieve the MQOs outlined in the UFP-QAPP, unless MQO failures can be adequately explained and/or justified.
Optimize the Design for Obtaining Data	Soil Six surface soil samples to be collected by the CRREL 7-pt wheel composite method at select MEC and MD locations within target area or at areas suspected of munition use, to be distributed as follows: • Cayo Geniqui - 2 • Cayo Yerba - 1 • Cayo Lobito - 1 • Cayo del Agua - 1 • Cayo Lobo - 1.

	Additional step-out surface soil samples, and subsurface soil samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Subsurface soil samples will be collected from 6 inches to 24 inches below ground surface (depending on site conditions) using a hand auger. Post demolition samples will be collected by the CRREL 7-pt wheel composite method at locations of demolition shots. Surface Water/Sediment: Four Surface Water/ Sediment pairs to be co-located at along the shore of lagoons located within the MRS. Additional step-out samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Groundwater: No groundwater samples will be collected. The detailed sampling plan for field procedures and laboratory analysis are outlined in Appendix E, the SAP and UFP-QAPP.

MRS 4 – Flamenco Lagoon Maneuver Area MC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 4 – Flamenco Lagoon Maneuver Area, is confirmed to have been used for DoD training operations using munitions with explosives. The RI is intended to define the nature and extent of MC contamination associated with MEC found within the MRS that may pose a threat to human health and the environment 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. Establish presence/absence of MC contamination of soil, surface water, sediment, and groundwater within MRS 4– Flamenco Lagoon Maneuver Area; if present, characterize nature and extent of MC contamination. Determine what receptors are present Determine the number of samples and locations where samples will be collected. Determine what analytes will be evaluated Determine what background values and screening values will be used to identify COPCs for risk assessment. Determine if levels of detected MC present an unacceptable a risk to human or ecological receptors in a baseline risk assessment. Determine how the extent of any contamination from MC determined to present an unacceptable risk to human or ecological receptors will be delineated.
Identify Inputs	To establish presence/absence (nature and extent if present) of MC contamination: The list of MC analytes are developed from the types of munitions identified as used at the MRS and include MC metals (aluminum, antimony, barium, chromium, copper, mercury, lead, and zinc), explosives, and picrate, and perchlorate, nitrate/nitrites, and chlorides (groundwater only) The PSVs for soil for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (USEPA RSLs for residential soil) and ESVs (USEPA EcoSSLs, or USEPA Region 4 ESV, USEPA Region 5 ESL, or LANL EcoRisk Database value in the absence of a USEPA EcoSSL); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects.

	The PSVs for sediment for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (USEPA RSLs for residential soil) and ESVs (Pascoe et. al. 2010; Buchman, 2008; or Long et. al. 1995 [see Section 4.4]); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. The PSVs for surface water for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (PREQB Water Quality Standards for Class SB surface water supplemented with USEPA National Recommended Water Quality Criteria for Human Health for the Consumption of Organism Only and USEPA RSLs for tap water) and ESVs (PREQB Water Quality Standards for Class SB surface water supplemented with values from the following sources: USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Saltwater CCC (chronic); Nipper et. al. 2001; or Buchman, 2008 [see Section 4.4]); b) second, this screening value was compared to the applicable surface water background value, and the greater of the two was selected as the PSV. The human health screening values for groundwater are the USEPA RSLs for tap water. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects. Ecological receptors are not exposed to groundwater, so ESVs for groundwater are not necessary. The background levels for metals in soil and surface water will be obtained from values established in the previous RIs conducted on Culebra. Values are presented in the UFP-QAPP and Risk Assessment WP.
Define Boundaries of Study	The RI investigation for MC within MRS 4– Flamenco Lagoon Maneuver Area includes surface soil and subsurface soil (if needed to vertically delineate exceedances in surface soil), surface water and sediments, and groundwater.
Develop a Decision Rule	If no MEC or MD is encountered, no MC sampling will be conducted in any media (including groundwater), as there is no source. MC samples will be collected at MEC locations, including MEC step-outs, as needed. Soil samples will be collected at locations where MEC is found in the subsurface. These samples will be collected 0”-6” below the item found in the subsurface. If an MC analyte is undetected or is detected at concentrations less than the selected PSVs as established in the MC UFP-QAPP, then the area will be considered uncontaminated by that MC analyte and it will not be investigated further. In areas where MC analytes are detected at concentrations greater than the selected PSVs as established in the MC UFP-QAPP, the analyte will be considered a COPC and retained for consideration in a baseline risk assessment. Any detection of explosives will be considered a COPC. If the baseline risk assessment determines the exceedance does not pose an unacceptable risk to human or ecological health there will be no further investigation. If the baseline risk assessment determines an unacceptable risk to human health or ecological receptors then the TPP team will evaluate the magnitude of the unacceptable risk and further step-out sampling may be planned.
Specify Tolerable Limits of Detection Error	All sampling and analysis will achieve the MQOs outlined in the UFP-QAPP, unless MQO failures can be adequately explained and/or justified.
Optimize the Design for Obtaining Data	The detailed sampling plan for field procedures and laboratory analysis are outlined in Appendix E, the SAP and UFP-QAPP. Soil Eight surface soil samples to be collected by the CRREL 7-pt wheel composite method at select MEC and MD locations within the target area or at areas suspected of munition use within areas of the MRS where ROE was not obtained in previous work.

	Additional step-out surface soil samples, and subsurface soil samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Subsurface soil samples will be collected from 6 in. to 24 in. below ground surface (depending on site conditions) using a hand auger. Surface Water/Sediment: Four Surface Water/ Sediment pairs to be co-located at locations along the shore of lagoons located within the MRS. Additional step-out samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Groundwater A total of four groundwater samples to be collected from wells identified in the Groundwater Well Survey and located within or at a suitable distance downgradient from potential source areas: Two to be collected from areas where ROE was previously not obtained, and two from the remaining area of the MRS.

MRS 5 – Mortar and Combat Range Area MC DQOs

State the Problem	Based on historical data, previous investigations, and documented incidents of UXO findings, MRS 5 – Mortar and Combat Range Area is confirmed to have been used for DoD training operations using munitions with explosives. The RI is intended to define the nature and extent of MC contamination associated with MEC found within the MRS that may pose a threat to human health and the environment 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. Establish presence/absence of MC contamination of soil, surface water, sediment, and groundwater within MRS 5 – Mortar and Combat Range Area; if present, characterize nature and extent of MC contamination. Determine what receptors are present. Determine the number of samples and locations where samples will be collected. Determine what analytes will be evaluated. Determine what background values and screening values will be used to identify COPCs for risk assessment. Determine if levels of detected MC present an unacceptable a risk to human or ecological receptors in a baseline risk assessment. Determine how the extent of any contamination from MC determined to present an unacceptable risk to human or ecological receptors will be delineated.
Identify Inputs	To establish presence/absence (nature and extent if present) MC contamination: The list of MC analytes are developed from the types of munitions identified as used at the MRS and include MC metals (aluminum, antimony, barium, chromium, copper, mercury, lead, and zinc), explosives, and picrate, and perchlorate nitrate/nitrites, and chlorides (groundwater only). The PSVs for soil for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (USEPA RSLs for residential soil) and ESVs (USEPA EcoSSLs, or USEPA Region 4 ESV, USEPA Region 5 ESL, or LANL EcoRisk Database value in the absence of a USEPA EcoSSL); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects. The PSVs for sediment for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health

	screening values (USEPA RSLs for residential soil) and ESVs (Pascoe et. al. 2010; Buchman, 2008; or Long et. al. 1995 [see Section 4.4]); b) second, this screening value will be compared to the applicable site-specific, soil type-specific background concentration, and the greater of the two will be selected as the PSV. The PSVs for surface water for this RI will be selected using a two-step process: a) first, the most conservative screening value will be determined from the applicable human health screening values (PREQB Water Quality Standards for Class SB surface water supplemented with USEPA National Recommended Water Quality Criteria for Human Health for the Consumption of Organism Only and USEPA RSLs for tap water) and ESVs (PREQB Water Quality Standards for Class SB surface water supplemented with values from the following sources: USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Saltwater CCC (chronic); Nipper et. al. 2001; or Buchman, 2008 [see Section 4.4]); b) second, this screening value was compared to the applicable surface water background value, and the greater of the two was selected as the PSV. The human health screening values for groundwater are the USEPA RSLs for tap water. Noncarcinogenic RSLs will be divided by 10 to reflect a HQ of 0.1 to account for potential cumulative effects. Ecological receptors are not exposed to groundwater, so ESVs for groundwater are not necessary. The background levels for metals in soil and surface water will be obtained from values established in the previous RIs conducted on Culebra. Values are presented in the UFP-QAPP and Risk Assessment WP.
Define Boundaries of Study	The RI investigation for MC within MRS 5 – Mortar and Combat Range Area; includes surface soil and subsurface soil (if needed to vertically delineate exceedances in surface soil), surface water and sediments, and groundwater.
Develop a Decision Rule	If no MEC or MD is encountered, no MC sampling will be conducted in any media (including groundwater), as there is no source. MC samples will be collected at MEC locations, including MEC step-outs, as needed. Soil samples will be collected at locations where MEC is found in the subsurface. These samples will be collected 0”-6” below the item found in the subsurface. If an MC analyte is undetected or is detected at concentrations less than the selected PSVs as established in the MC UFP-QAPP, then the area will be considered uncontaminated by that MC analyte and it will not be investigated further. In areas where MC analytes are detected at concentrations greater than the selected PSVs as established in the MC UFP-QAPP, the analyte will be considered a COPC and retained for consideration in a baseline risk assessment. Any detection of explosives will be considered a COPC. If the baseline risk assessment determines the exceedance does not pose an unacceptable risk to human or ecological health there will be no further investigation. If the baseline risk assessment determines an unacceptable risk to human health or ecological receptors then the TPP team will evaluate the magnitude of the unacceptable risk and further step-out sampling may be planned.
Specify Tolerable Limits of Detection Error	All sampling and analysis will achieve the MQOs outlined in the UFP-QAPP, unless MQO failures can be adequately explained and/or justified.
Optimize the Design for Obtaining Data	Soil Ten surface soil samples to be collected by the CRREL 7-pt wheel composite method at select MEC and MD locations within target area or at areas suspected of munition use within areas of the MRS where ROE was not obtained in previous work. Additional step-out surface soil samples, and subsurface soil samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Subsurface soil samples will be collected from 6 in. to 24 in. below ground surface (depending on site conditions) using a hand auger.

	Post demolition samples will be collected by the CRREL 7-pt wheel composite method at locations of demolition shots. Surface Water/Sediment: Four Surface Water/ Sediment pairs to be co-located at along the shore of lagoons located within the MRS. Additional step-out samples at locations of exceedances to be determined by project team based on level of unacceptable risk present. Groundwater: A total of five groundwater samples to be collected from wells located within or at a suitable distance downgradient from potential source areas as follows: From the area where ROE was previously not obtained: two wells identified from the groundwater survey. From the remaining area of the MRS 5, two from wells identified from the groundwater survey and one from a newly installed well. The detailed sampling plan for field procedures and laboratory analysis are outlined in Appendix E, the SAP and UFP-QAPP.

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3.2 DATA INCORPORATED INTO RI AND FS REPORTS

3.2.1 Historical data as well as previous investigation data concerning the presence of MEC will be incorporated into the RI Report as both site history and RI data. Multiple investigations and clearance activities have been conducted at the Culebra Island Sites. This information will be useful for MEC characterization activities for the overall site. Historical and previous investigation data will also be incorporated into the RI Report to describe the rationale for MC sampling locations.

3.2.2 Data from the geophysical investigations with intrusive anomaly investigations will be incorporated in the RI Report as supplied by the field team. Any MEC/MD found at the site will be documented in field logs/dig sheets and locations will be logged using GPS. This information will be brought together in GIS and displayed on maps that summarize the results of the field activities. Information recorded on field logs and dig sheets will be written into text summarizing the location, size, and description of any MEC/MD at the site. Additional information will be added by the Daily SUXOS reports that include any valid information about site conditions.

3.2.3 Data collected as part of the MC sampling investigation will be incorporated into the RI Report as supplied by the laboratory following a data quality review. Previous investigation data concerning the presence of MC will be incorporated into the RI Report as both site history and RI data.

3.2.4 The background values established by the EOTI WP (EOTI February 2010) will be used and may be augmented with other site specific values if from similar soil types. Surface water, sediment and groundwater has been included in this WP Addendum.

3.2.5 Detections will be summarized and exceedances will be mapped using GIS. Samples will be collected and analyzed to determine whether MC of concern have been released to the surface soil as a result of historical military activities at the Culebra Island. Metals detections will be compared to site-specific background concentrations. Metals that exceed the site-specific background values and all detected explosives will be compared to USEPA residential RSL's and ecological assessment levels. Analytical data will be used to summarize path forward recommendations for the Culebra Island Sites. If there are exceedances of USEPA residential RSLs and/or ecological assessment, a recommendation will be made in the RI requesting the collection of additional samples to delineate the media to the appropriate screening standard.

3.2.6 Data collected as part of the RI field activities will be used to produce a FS for the Culebra Island Sites. The FS will evaluate options for the site including no further action and various clearance activities with institutional controls.

3.3 SITE SPECIFIC TRAINING

3.3.1 The USAE Field Management Team will familiarize field personnel, including subcontractors, with the site and will evaluate boat launching points, IVS site, USAE magazine location, supporting and storage sites, survey control points, vessel layout and safety equipment and procedures for firefighting on the vessel.

3.3.2 The UXOSO will give a project specific brief on hazards that may be encountered, discuss emergency procedures and provide directions to the nearest emergency care facility. The UXO Dive Supervisor will discuss safe boating. Briefings will be conducted covering the project WP and its appendices. Additional focus will be provided for Appendix K USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015), Safety Equipment, man-overboard procedures, emergency contact phone numbers, review of the Accident Prevention Plan (APP) and Activity Hazard Analysis (AHA)s. All project personnel will be required to read and sign the project WP, APP, AHA, and SOPs.

3.3.3 The primary methods for communications will be covered during the site specific training. Primary method for communications will be Very High Frequency (VHF) with alternate communications is cell

phones. All project team members will be provided a handout with call signs and the team's cell phone number along with all the emergency phone numbers.

3.4 GEOPHYSICAL SYSTEM VERIFICATION PLAN AND REPORT

3.4.1 GSV

3.4.1.1 A GSV process will be implemented at Culebra Area MRSs to demonstrate that the instrument and data collection strategies selected for the site function as intended for the duration of the field investigation. Within this process, an IVS will be used to verify the proper functioning of the EM61-MK2 sensor used during the project. The IVS is an area containing various buried "industry standard objects" (ISO) that have well documented EM61-MK2 responses to which the measured values can be compared. Also, a blind seeding program will be used to provide dynamic monitoring of geophysical data collection, data processing, and target selection procedures. The general GSV approach was developed by the Environmental Security Technology Certification Program (ESTCP) with input from state and federal regulators and the National Association of Ordnance and Explosive Waste Contractors (ESTCP, 2009). The Naval Research Laboratory (NRL) performed tests over ISOs (NRL, 2009) and common munitions items (NRL, 2008).

3.4.1.3 In accordance with GSV process guidelines, pre-determined instrument response curves for buried ISOs will be used to verify the proper functioning of each EM61-MK2 at the Culebra Area MRSs.

3.4.2 IVS Report

Following initial IVS testing using the instruments and techniques proposed for the project, the collected data will be submitted (IVS Report) by the Site Geophysicist and submitted to the Project Geophysicist for review approval and submission to the government. If the initial IVS results do not require changes to MQOs or procedures production data collection will begin immediately without Army review of the IVS results.

3.4.3 IVS and Noise Strip

3.4.3.1 Under the direction of the Site Geophysicist, an IVS will be constructed in the vicinity of the Site office or near where the DGM equipment will be stored and will consist of one straight, well-defined lane. Prior to the construction of the IVS pre-survey of the proposed location will be conducted to ensure there are no anomalies already present that would interfere with the constructed IVS. Should anomalies be found, the survey will be expanded. If the expanded survey still finds existing anomalies, an alternate location will be chosen and pre-surveyed until a suitable location is found.

3.4.3.2 The IVS will be seeded with two small ISOs buried at depths of 3 and 7 times the object diameter. The ISOs will be oriented horizontally, parallel to the IVS. The center point of each ISO will be surveyed using either Trimble Pro-XRT, or equivalent, Global Positioning System (GPS) unit capable of sub-meter accuracy or survey tapes. When installing the IVS, the team will use an EM61-MK2 to check for anomalies before item placement and will relocate seed locations to avoid any detected anomalies.

3.4.3.3 A "noise strip" located adjacent to the IVS will be used to determine the background noise level of the EM61-MK2 sensors. The noise strip will contain no discreet anomalies or buried ISOs and will consist of a straight, well-defined lane equal in length to the adjacent IVS strip. The noise level will be defined as the standard deviation of the sensor readings recorded along the noise strip. The noise level along the test strip will be compared to the proposed anomaly selection threshold. In general, a signal to noise ratio (SNR) of 5 is required for reliable detection of subsurface metal. The anomaly selection threshold may be raised as necessary to achieve an SNR of 5 or above to prevent a significant number of false positives during the project.

3.4.3.4 Data will be collected over the IVS and noise strip twice daily with each geophysical instrument , positioned with the appropriate system (e.g., Differential Global Positioning System (DGPS) for DGM transects, and Line/Station/Fiducials for DGM grids) During this test the instrument operator will make a

single pass over both the IVS and the adjacent noise strip. The travel path over each strip will be well marked to ensure that the instrument passes directly over the center of each ISO and that background data is collected in a consistent a manner from day to day. When the IVS is established, five lines of data will be collected over the IVS to establish the baseline expected responses of the ISOs. This data will be positioned with Line/Station/Fiducials, as this is the positioning techniques that will be used in all DGM grids.

3.4.3.5 The responses recorded twice daily over each ISO item will be compared to the baseline responses to confirm that the instrument readings are consistent with expectations (i.e., at least 75% of the expected value). The noise level will also be recorded each day and compared with previous day's values to confirm that the noise level is consistent.

3.4.3.6 Daily IVS check results are captured and reported in the DGM Access database.

3.4.4 Analog Test Strip

3.4.4.1 As the IVS will not sufficiently test the functionality of the analog systems that will be used on the project (all metals detector), a small analog test strip will also be constructed for the purpose of performing QC tests on these systems. The analog test strip will be established either near the field office or at a location that allows for project efficiency such as a location in route to the MRSs. The analog test strip will be built under the supervision of the Site Geophysicist (or UXOQCS if the Site Geophysicist is not available) prior to the field teams using analog instruments in the MRSs. This test strip will include at least 2 small ISOs, buried 7 x diameter, or to bedrock (9.2 in. measured from ground surface to object center), one horizontal and one vertical, and at least two medium ISOs, buried 7 x diameter, or to bedrock (16.6 in. measured from ground surface to object center), one horizontal and one vertical. Each UXO analog operator will be certified using an analog test strip to ensure the instrument and operator are working properly and that project detection requirements are being met. As long as the operator is able to detect the seed items buried in the test strip, the equipment and operator will be considered to be in working order. A Test Strip memorandum that describes the test strip design, location, photos, and ISO positioning data will be drafted by the Site Geophysicist and submitted to the Project Geophysicist for review approval and submission to the government.

3.4.4.2 When Analog instruments are being used in the field the equipment and operators will process through the test strip as a daily QC check.

3.4.4.3 Analog instruments will be checked on the test strip daily and after any repairs. They will be required to demonstrate a consistent detection rate for all seed items and any identified background anomalies.

3.4.4.4 In addition to the analog test strip an analog function check area will be set up on each Cays to confirm function after the transition from boat to shore. The function check will consist of the analog instrument being passed over a small ISO to ensure that during the boat transit and transition from the boat to the shore the instrument wasn't damaged.

3.4.4.5 The results of analog instrument checks are captured and reported in the Analog Access database.

3.4.5 Transect Design

The VSP Reports for MRS 04 & 05 have been provided in Appendix O: VSP. The investigation transects were designed in VSP to detect areas of elevated anomaly densities. The VSP anomaly density values were based on available data from previous investigations. Intrusive investigation would then determine whether these areas of higher anomaly densities corresponded to MEC-contaminated areas.

The VSP transect design for Cerro Balcon was performed separate from MRSs 04 & 05; however, the VSP transect design was abandoned because of its small size and previous investigation results. Therefore, two transects through the MRS, irrespective of VSP, were designed. Based on the site terrain, site access, and previous site MMRP work, the anomaly densities associated with these two transects along with supporting results from the NTCRA, EE/CA, and previous RI field work, will be used to assess the Cerro Balcon site boundary.

Inputs into the original VSP for MRS 04 and 05 are as followed. An EM-61 coil width is 1 meter; therefore, the transect width of 1 meter was selected. A circular target was chosen to better represent multiple firing points. A target area radius of 442 ft. was chosen based on the ordnance expected at MRSs 04 and 05 (81mm mortars). A background density of 10 anomalies per acre and an expected target area density of 300 anomalies per acre above background was chosen based on historical ordnance reported within this MRS (mortars). These VSP inputs resulted in an 800 ft. (244m) transect spacing. This provides a 95% probability of traversing and detecting any 442 ft radius potential MEC contaminated area. This is the basis for the MRS04 and 05 proposed transects.

3.4.6 Geophysical MQO

MQOs have been established for the project to verify the quality of geophysical data collected during the investigation at the Culebra Area MRSs. Table 3-2 describes each geophysical MQO for the project, including the method and frequency of verification, and the minimum criteria to be achieved.

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Table 3-2: Geophysics MQO

Requirement	Test Method	Frequency of Test, Check, or Review	Criteria for MQO to be Achieved	Consequence of MQO Failure
DGM Survey-Specific MQO				
Along Line Measurement Spacing	Evaluate each dataset using Geosoft Sample Separation QC tool.	Each day after data collection.	98% ≤ 0.25-m along line.	That day's submittal fails.
Velocity	Evaluate each dataset using Geosoft Velocity Calculation QC tool.	Each day after data collection.	95% ≤ 3.4 miles per hour (mph) (or maximum velocity demonstrated during IVS).	That day's submittal fails unless blind-seeded test item is mapped with repeatable characteristics and Along Line Measurement Spacing MQO passes.
Grid Coverage	Evaluate each dataset using Geosoft Coverage Calculation QC tool.	Each day after data collection.	Area covered with Geosoft Footprint Coverage QC tool should be >90% of the intended coverage (i.e. at least 2250 square feet for a 50x50-ft grid) at project design line spacing of 0.6-m.	That day's submittal fails unless data gaps filled by collection of additional data or sufficient additional data collected adjacent to grid to meet coverage requirement.
IVS Data Collection	Collect data over IVS with each instrument to be used.	Twice daily per instrument (prior to and following data collection)	Measured responses are at least +25% of the responses measured during the initial IVS surveys (1). Along line offset from known to anomaly locations will be established at the IVS for each positioning system used for that day's work.	Day's data fails unless root cause analysis indicates that failure was based on operator error and not equipment malfunction. (1)
GSV Blind Seeding	Blind seed items to be placed in DGM grids.	As ISO locations are mapped; goal that one ISO should be mapped per day, per team. (2)	Blind seeds detected with a response above 75% of the minimum expected response at maximum horizontal offset. Offset from picked to known item position within 0.75-m for GPS located data and within 0.90-m for fiducially located data.	Submittal fails.

Requirement	Test Method	Frequency of Test, Check, or Review	Criteria for MQO to be Achieved	Consequence of MQO Failure
Target Selection	Targets retained in the project's target database meet project requirements for each data set.	As data sets are processed before submittal.	All targets meeting target classification criteria have been selected.	Submittal fails.
Anomaly Resolution (3)	The UXOQCS will check a subset of all targets investigated to ensure they have been adequately resolved. Subset size to be determined using the number of anomalies investigated in each area of higher or lower anomaly density and the Acceptance Sampling Table in DID WERS 004.01.	As intrusive investigation of areas of higher/lower anomaly density is completed.	If MEC: 70% confidence <10% unresolved anomalies If no MEC: 90% confidence <5% unresolved anomalies. Accept on zero. Lot sizes are defined as per grid for MRS 4, 5, and 2 (Cerro Balcon) and per Cayo for MRS 2 (Cayo's)	Intrusive results unreliable for that area.
Geodetic Equipment Functionality	Place GPS antenna directly over known location test point to measure location repeatability daily.	Once daily per instrument as GPS equipment is used without accompanying blind seeding program (i.e., requisition, grid corner location, other debris mapping, and etc.).	Compare measured coordinates with known coordinates to confirm that the offset is: • <1m for Pro-XRT • <2m for Geo-XT • <10-m for handheld GPS	Affected work fails.
Geodetic Internal Consistency	Measure the distance between two grid corners for all grids collected with Fiducial methods.	Per Grid	Confirm that the distance between points is within 30cm of the intended distance.	Grid must be reestablished
Analog Dynamic Repeatability for Transects with Digging	Repeat a segment of transect	2% per lot (transect)	Extra flags/digs not greater than the greater of 20% or 8 flags/digs, or within range of adjacent segments.	Redo transect
Analog Repeatability (instrument functionality)	Each operator and instrument cover analog test strip.	Once daily per instrument and operator (before surveys performed).	All items in test strip detected (trains ear daily to items of interest).	Operator or instrument fails.

Requirement	Test Method	Frequency of Test, Check, or Review	Criteria for MQO to be Achieved	Consequence of MQO Failure

1) Root cause analysis will consider such things as other IVS data collected that day, GSV seed items mapped during that day's data collection, and any problems and/or fixes noted for the equipment between the AM and PM IVS tests.

2) It is intended that at least one GSV seed item be mapped per team per day, and the number of seeds placed during the project will be determined with this in mind. However, equipment problems, weather, and/or survey progress may result in days during which no seed items are crossed. Submittals will not be failed if a GSV seed item is not crossed. The results of that day's IVS data collection and previous and subsequent days' GSV seed item results will be considered in determining the acceptability of the data in question.

3) Resolved is defined as 1) no geophysical signal remains at the flagged/selected location, or 2) signal remains but it is too low or too small to be associated with UXO, or 3) signal remains but is associated with fixed or surface material which when moved results in low, or no signal at the interpreted location, or 4) signal remains and a complete rationale for its presence exists.

3.4.7 Database

Information pertaining to all transects and grids collected during DGM and Analog surveys will be stored in a Microsoft Access database or databases in accordance with DID WERS 004.01. The database(s) will be maintained throughout the duration of the project and will contain records of all instrument standardization tests conducted each day as well as the results of QC checks made on all processed data. The database will be submitted weekly for review by the Project Geophysicist and PM. The PM will submit to the USACE once any corrections or updates have been completed.

3.4.8 Site Preparation

3.4.7.1 Brush cutting will be required to ensure effective surface clearance in portions of the designated areas. Clearance of plants, trees and brush will be coordinated with USFWS and DNER because of endangered plant species. The project biologist will be classified as essential personnel in order to accompany the field crew to identify endangered species.

3.4.7.2 Due to the potential for encountering sensitive species and habitat, vegetation clearance will be minimized. Heavy vegetation can significantly limit the effectiveness of DGM. When necessary due to potential environmental impacts due to vegetation removal, the team will implement analog transects. Because of the terrain or site conditions, the field team is allowed to deviate from the transect design. However, the field team must make all efforts to return to the original transect design as soon as the condition that forced the deviation is no longer a factor. The field team will use a White Eagle Spectrum XLT or other equivalent metal detector proven effective in locating potential MEC on site. Underbrush and trees may be pruned to a height of 12 inches from the ground surface or less to allow full instrument coverage underneath the trees. Grids requiring wheel fiducials (e.g. canopied areas), will have vegetation removal to 6 inches. The quality of vegetation removal will have to be such that reliable and smooth wheel fiducials can be collected. Overhead vegetation will be removed to at least 6-ft above the ground, but not more than 10-ft.

3.4.7.3 To the extent possible, native trees greater than 2 inches in diameter must be left in place; however, they may be lightly pruned as required to allow full coverage of the ground with the geophysical sensors. In cases where MEC is found embedded in a native tree, USFWS and DNER will be notified prior to removal. Invasive plants such as mesquite can be removed. All protected native trees which should not be pruned or removed as part the removal action will be flagged.

3.4.7.4 Shrubs, trees, and limbs will not be cut without prior approval from the Project Biologist. Vegetation removal will be conducted with handheld weed eaters and chainsaws. Vegetation will be removed, or left in place according to the landowner or their agents prior to gaining access.

3.4.7.5 No sea grapes or other larger plants will be cut within designated critical habitat boundaries; however, these plants may be lightly pruned as necessary to gain access to characterize the site.

3.4.7.6 The brush clearance team(s) will be structured to safely and efficiently clear each of the designated areas. The SUXOS will designate team personnel and equipment, based on the size of the area, type of brush, terrain, MPPEH, etc. Brush cutting teams will consist of no less than two personnel and will include a minimum of one UXO qualified personnel (UXO Technician II or above).

3.4.7.7 Surface metal removal entails the visual inspection of each transect for metal ordnance- related items. This activity helps ensure that only subsurface anomalies are investigated during subsequent geophysical survey operations. The same crew performing the geophysical investigation will also perform the surface metal removal. If possible, large surface items that cannot be moved will be avoided, and the transect survey lines moved away from/directed around the items. Any MEC or MD will be logged as a surface item on the dig sheet and, if possible, coordinate recorded (coordinates for MEC must be sub meter accurate).

3.4.7.8 Section 6 of the WP Addendum and Appendix K (USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015) –See the SOP's Appendix A pages 5 – 9 and Appendix B Section 3.1.1 – 3.1.3) will be followed during all brush cutting.

3.4.7.9 The Project Biologist will maintain a log of all activities that involve the execution of Appendix K USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015) Appendix B Section 3.1.3.

3.4.9 Location Surveying

3.4.8.1 USAE will establish the required amount of survey control points by using a PLS registered in Puerto Rico. The survey team will be escorted by a UXOTII while performing their field work. As necessary, USAE will self-perform civil surveys to stake out transect points, grid corners, and measure analog anomaly locations. Trimble Pro-XRT or handheld GPS units will be used for civil surveys and to position DGM data. USAE's Site Geophysicist will certify the survey team on Culebra using the established survey control points. Civil surveys will be IAW (Interim Guidance) EM 200-1-15 and DID WERS-007.01

3.4.8.2 All coordinates will be in Universal Transverse Mercator (UTM) 20N meters, NAD 1983 coordinates. Grid surveys will be positioned with line/station/fiducials. Grid corners will be roughed in with the DGPS and may be adjusted in the field to accommodate terrain, critical habitat, and threatened and endangered species. Once the corners are established, they will be checked for internal consistency by measuring any leg or diagonal is within 30 cm (11.81 in.). Surveying of seed item locations will be performed by USAE for the DGM grids will be established with survey tapes from two corners.

3.4.8.3 The Trimble Pro-XRT DGPS or handheld GPS will be used with the EM61-MK2 to navigate and position the DGM transect data.

3.4.10 Site Utilities

Based on what is currently known about the site, geophysical surveys are not expected to cross a significant number of utility lines.

3.4.11 Shoreline and Sea Critical Habitat

Section 6 of the WP will be followed during RI field work phases for beach areas and MRS 02 Cays. When investigating the MRS 02 Cays some cays were identified as inaccessible. Through coordination with the

TPP Team and the USACE and incorporated in the Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015); this is included in Appendix K of this WP and will not be investigated. To ensure the protection of critical habitat, the Cays being investigated will follow the access requirements identified in the above mentioned SOP. In addition when accessing the Cays, no intrusive work will be conducted on the beaches or disposal actions that may affect turtle nests that may be present without further coordination with the Natural Resource Agencies.

3.5 GEOPHYSICAL INVESTIGATION PLAN

The Geophysical Investigation Plan (GIP) is delineated into the following six subject categories, based on guidelines from USACE provided within DID WERS-004.01:

- UXO Safety;
- Personnel Qualifications;
- Geophysical Investigation Plan Outline;
- Geophysical Investigation Performance Goals;
- Geophysical Mapping Data; and
- Geophysical Investigation Plan Summary and Conclusions.

3.5.1 UXO Safety

Areas of new DGM will be surface-cleared by USAE prior to DGM activities.

3.5.2 Personnel Qualifications

3.5.2.1 The geophysical investigation will be managed and performed by qualified geophysicists meeting the qualification requirements. Qualifications overviews of selected key personnel are provided below.

3.5.2.2 The anticipated Project Geophysicist, Al Crandall, has over eight years of experience as a geophysicist, including five years of continuous on-site UXO geophysics project experience. He has trained, educated, and managed a diversified staff of geophysicists and UXO Technicians in data collection, processing, interpretation, and reacquisition procedures. As a geophysicist, he has successfully completed projects for USAESCH, Department of Energy, U.S. Navy, and U.S. Air Force customers.

3.5.2.3 The anticipated Site Geophysicist, Jae Yun (Parsons), has over fifteen years of experience performing geophysical surveys on UXO projects. Jae Yun has collected and processed geophysical data with a wide range of geophysical tools, which include: the EM61 MK2 proposed for this project.

3.5.3 GIP Outline

3.5.3.0.1 The GIP Outline is delineated into the following 11 subject categories, based on guidelines from USACE provided within the DID WERS-004.01:

- Site Description.
- Geophysical Investigation.
- Instrument Standardization.
- Data Processing, Corrections, and Analysis.
- Dig Sheet Development.
- Feed-Back Process.
- QC.
- Corrective Measures.
- Records Management.

- Interim Reporting; and
- Map Format.

3.5.3.0.2 Accordingly, the current specifications pertaining to performing GIP-related activities after the mobilization is completed to Culebra Island will be discussed in order of appearance as listed above.

3.5.3.1 Site Description

Site Description can be found in Section 1 and Section 3.9.4.2 of the EOTI WP (EOTI February 2010). Sensitive Environments has been updated in this Addendum.

3.5.3.1.1 Sensitive Environments

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. General description of the listed species that have the potential to occur in the project area is provided in Appendix K. The federally listed species of most concern for the project are:

- *Anolis roosevelti* (Culebra Island Giant Anole),
- *Epicrates monensis granti* (Virgin Islands Tree Boa),
- *Sterna dougallii* (Roseate Tern),
- *Leptocereus grantianus* (Cactus),
- *Peperomia wheeleri* (Wheeler's Peperomia),
- *Trichechusmanatus mantus* (Antillean Manatee)
- *Caretta Caretta* (Loggerhead Sea Turtle)
- *Cheloniamydas* (Green Sea Turtle)
- *Dermochelyscoriacea* (Leatherback Sea Turtle)
- *Eretmochelys imbricate* (Hawksbill Sea Turtle)
- *Magapteranovaiangliae* (Humpback Whale)
- *Balaenopteraphysalus* (Finback Whale)
- *Balaenoptera* I (Sei Whale)
- *Physetermacrocephalus* (Sperm Whale)
- *Balaenopteramusculus* (Blue Whale)
- *Acropora palmate* (Elkhorn Coral)
- *Acropora cervicornis* (Staghorn Coral)
- *Mecetophyllia ferox*
- *Dendrogyra cylindrus*
- *Orbicella annularis*
- *Orbicella faveolata*
- *Orbicella ftanksi.*

3.5.3.2 Geophysical Investigation

The Geophysical Investigation portion of the GIP is delineated into the following six subject categories, based on guidelines from USACE provided within the DID MR-005-05.01: (a) survey type; (b) equipment; (c) procedures; (d) personnel; (e) production rates; and (f) data spatial density.

3.5.3.2.1 Survey Type

3.5.3.2.1.1 USAE will perform surveys in areas determined during the respective TPP process. Survey types expected to be man-portable transects and small grids located over areas of interest identified during the transect collection. Because of the rugged (dangerous) and steep terrain and the need to avoid listed as threatened or endangered species and their critical habitats, survey teams may deviate from the transect design when required. The field team should make all efforts to return the survey to the original transect design as soon as the condition that forced the deviation is no longer a factor. Data collection will not stop because of deviation and will be collected along the new route. DGM in all cases, except for the MRS 02 Cayos, is the primary means (with analog established as a secondary method) in which the transects and grids will be surveyed. Recommendations to switch from DGM survey to analog survey will be made on site by the field team managers. The reason for such a request:

- To complete gaps in transects that could not be completed by DGM
- To complete full length transects in which the DGM equipment cannot gain access to the transect due to terrain, or safety concerns
- If it is determined that analog should be the preferred survey method replacing DGM to ensure field work meets the DQOs.

The recommendation will be promptly evaluated by USAE Management and if USAE Management agrees with the recommendation it will be forwarded to the PDT for concurrence in the form of a Field Change Request. The FCR will have COR final concurrence prior to the equipment being instituted.

3.5.3.2.1.2 Analog geophysical methods and techniques will be implemented as required to meet DQOs when canopy, vegetation, potential environmental impacts, or terrain prevent the use of digital methods.

3.5.3.2.1.3 In all areas except the cays and deeper than 24 inches in the lagoons, survey type is planned to be DGM transects and grids. Analog investigation is planned in MRS 02 Adjacent Cayos due to the rugged terrain, in consideration of personnel safety, and equipment operability while making the transition from small craft to shore. Underwater Whites or Minelabs will be used to avoid any problems with the marine environment. Analog transects (Mag and Dig) may be used as an alternate to DGM transects if terrain, vegetation or other factors should it be deemed necessary.

3.5.3.2.1.4 The Vegetation Removal Team will precede the DGM team. During the vegetation removal, the vegetation removal team will also note the tree canopy and if it interferes with the GPS signal, identify potential environmental impacts, and terrain conditions that might impact the DGM Survey. In situations in which the transects move through a thick canopy of vegetation or rugged terrain. A Reconnaissance Team may be used to mark the transect route for the Vegetation Removal Team The DGM team will mobilize with a clear understanding of the location and amount of DGM to be conducted. MRS 04 transects may be aligned with a new unimproved road that was built in April 2014 by the land owner. If the unimproved road construction is used, DGM will be used down the center of the road and the spoils on both sides of the road will be investigated by analog instruments.

3.5.3.2.1.5 DGM and/or Analog transects will be tracked using GPS whenever possible. If satellite service is not available due to canopy, the team will maintain a heading using a compass. Compass bearing and distances will be recorded in the team leaders log until satellite service is restored. During short time periods in which satellite service is not available, the DGM data processor will interpolate between GPS drop outs and will jump to the next point in which the satellite signal is received and captured in the GPS track log. If satellite service is lost, the GIS Manager will evaluate the transect routes recorded by both methods and will ensure the most accurate results selected for that transect segment. Each transect will

be divided into 200 ft segments. Each segment will be named with a unique identifier. The team will maintain a log with an anomaly count for each segment if analog is used. The transect segment anomaly counts, for every 200 ft, along with all DGM transect targets, will be used to create the anomaly density maps. High density areas or areas with indicators of MEC (as determined by the Project Geophysicist and approved by the USACE Project Manager) will be recommended for intrusive investigation in targeted grids. In the event that vegetation is very heavy and GPS technology rendered ineffective, analog methods and/or the EM61 deployed in wheel fiducial mode will be used.

3.5.3.2.1.6 The reconnaissance team (when required) will mark the transects for the vegetation clearance teams. The reconnaissance team includes three personnel, of which at least two will be UXO Technician IIs or higher. One team member will be primarily responsible for navigation and record keeping. One will be primarily responsible for operating the analog instrument and detecting anomalies. The third member will conduct minor brush clearing and intrusive investigations along the transects. A UXO Technician III will supervise the work of two reconnaissance teams (six personnel total). The reconnaissance teams will be supported by a SUXOS, UXOQCS, UXOSO and a Biologist. The biologist will brief teams on potential sensitive species and habitat in the areas where the teams are working and will be available to answer questions as they arise.

3.5.3.2.2 Equipment

The geophysical survey equipment utilized will be the same for all DGM tasks. The survey platform consists of a man-portable EM61 MK2 system (0.5-m x 1.0-m coil), preferably in wheeled configuration. For areas requiring fiducial positioning (e.g. canopied areas), wheel mode must be employed due to the inaccuracies involved with utilizing time fiducials. As such, terrain over which data can be collected shall be restricted to that which can be safely traversed by a two person team (one with the pack, pushing the EM61 and one pulling the EM61 by means of rope or harness). Platform height off the ground surface will be maintained at the standard 16 inches due to the use of standard Geonics wheels. Regular DGM is anticipated to utilize EM61 MK2 sensors in conjunction with a DGPS or handheld GPS (e.g. Trimble Geo-XT, Garmin or Etrex) positioning unit. Tasks involving GPS will set the collection rates at once per second for the GPS and at 10-12 times per second for the EM61. For wheel fiducials, sample separation shall be set to one sample every 0.1 m

3.5.3.2.3 Planned DGM Survey

3.5.3.2.3.1 The following list describes the anticipated type of geophysical investigation agreed upon during the kick off meeting. The methods and techniques implemented will be determined on site as required to meet the DQOs:

3.5.3.2.3.2 The MEC investigation will be conducted in MRS 02, MRS 04, and MRS 05 as described below. MRS 07 will not be investigated for MEC per guidance provided by USACE. All data collected from past investigations will be incorporated into the RI/FS Reports.

- MRS 02 – Cerro Balcon: Data will be collected along transects (deviation from the transect design is allowed but the survey team should make all efforts to return the survey to the original transect design as soon as the condition that forced the deviation is no longer a factor) using one of two methods, depending on terrain, vegetation, and other factors.
  - Analog Geophysics - transects that are investigated with analog geophysical techniques. Detected anomalies will be located with DGPS as they are detected. Analog transect anomaly locations will be used, along with DGM transect anomalies, historical MEC finds, and adjacent MRS 05 transect anomalies, to generate an MRS anomaly density map. Analog geophysics will be used if canopy, vegetation, potential environmental impacts, or terrain prevent the use of digital methods
  - USAE used VSP software to plan reconnaissance transects in order to detect target area with an average density of 300 anomalies per acre above a background density of 10

anomalies per acre, at a 95% confidence level. The transects for MRS 02 (Cerro Balcon) were based on the 3-inch Stokes Mortar.

- The MRS will be investigated by DGM along transects using the EM61. Plans for MRS 02 Cerro Balcon call for 0.08-acres of transect geophysics using DGM to establish anomaly density. Transects will be 1m wide and spacing has been established in VSP at 423-ft (129-m).
- A Trimble Pro-XRT DGPS or handheld GPS will be used to lay out all reconnaissance transects.
- MEC teams will conduct initial clearance of surface debris, MD, MEC, target related debris, and vegetation. Locations of all MD, MEC, and any remaining range structures will be recorded with GPS.
- Following the MEC/vegetation team, a DGM team investigates each transect. Transect DGM anomalies will be uploaded into the GIS Database and the Access Database per DID WERS-007.01 and DID WERS-004.01. The GIS information will then be used to generate an anomaly density map. Analog anomalies, if any, will be assigned a specific anomaly identification number by segment and will be included in the project database.
- High density areas will be investigated with DGM survey of 50-ft x 50-ft grids (or equivalent size) to establish the nature and extent of MEC contamination. The grids will be intrusively investigated for MEC and MD.
- Grid locations will be determined from analysis of transect anomaly density data as well as the previous RI data if applicable. Cerro Balcon underwent a TCRA and all available data from that clearance operation will also be utilized. The high density grid will have 100% anomaly resolution. All anomaly data will be collected via personal digital assistant (PDA) and uploaded into the project GIS Database and the Access Database per DID WERS-007.01.
- If only non-munitions related debris is discovered no additional grids will be required.
- If indicators of a MEC target area are discovered, the high density grid will be bounded by four (4) additional grids to further refine MEC extent.

  The four (4) additional radial grids (20-ft x 200-ft) will be intrusively investigated. Additional radial transects (3-ft x 250-ft long) may be used to further determine the extent of contamination should the radial extent grids produce indicators of MEC near their outer boundary. The radial transects will extend 250-ft and radiate inward towards the grid in which the MEC items were discovered to determine the extent of the contamination. Five grids will be investigated for one high density area. One high density area for Cerro Balcon is anticipated.

- MRS 02 Adjacent Cayos
  - It is anticipated access can be obtained to five of the Cays. Five Cayos are planned for the Investigation (Cayo Yerba, Cayo Lobito, Cayo Lobo, Cayo Del Agua, and Cayos Geniqui). Appendix B Figures B-10 through B-13 demonstrate the planned investigation for the Cayos. The remainder of the cays data will be collected from the water born RI for MRS 02 and 07.
  - The MRS 02 Adjacent Cays provide unique challenges due to their remoteness and the environmental conditions potentially limiting access. USAE will gain access to the Cays via small boat. Boats will be used to gain access to the Cays and monitor exclusion zones thereby preventing visitors to the islands when MEC intrusive or demolition operations are being conducted. While conducting RI field operations in MRS 04 or 05, the UXOSO will monitor the weather forecast and if mild and favorable weather conditions exist, the SUXOS may choose to move one or more field teams to work on the Cays as the weather allows.
  - Once ashore on the Cays the following will be completed:
    - Transects on the MRS 02 Cays will be characterized using analog detectors and immediate intrusive investigation. To avoid any problems with water intrusion for non-

water proof instruments Waterproof Whites, Minelab or a suitable substitute will be used. Visual detection will be used where there is no soil. The placement of transects will be based on accessible terrain in which it will be safe for the investigation teams to transit. Transects will be 1-m wide. Deviations in transects is allowed to avoid dangerous terrain or impassable land features.

- For the five cays to be investigated a total of 0.27 acres is anticipated. Transects have been placed along the long axis of the cay when possible and in areas deemed safe for field work. Transect width is 1 m.
- Following the MEC team, an analog and flag team flags all subsurface anomalies. Flag locations are recorded on the Trimble Pro-XRT DGPS, Geo-XT or if handheld GPS without a PDA function are used then flag locations will be captured in the field log and transferred to dig sheets.
- Transects are placed where access is deemed safe for the investigating teams and along the longest axis of the Cays if possible based upon terrain. Terrain prohibits the Cayo Lobo transect from placement along the longest axis.
- Analog transects will undergo intrusive investigations using standard Mag and Dig practices. If there is no soil present visual transect investigation will be performed.
- All anomalies will be excavated using hand tools.
- 100% of Anomalies within the transect will be investigated. Anomaly data will be collected via PDA and uploaded into the project GIS Database and the Access Database per DID WERS-007.01.
- When investigating the MRS 02 Cays, some cays were identified as inaccessible through coordination with the TPP Team and the USACE and incorporated in the Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015) included in Appendix K of this WP and will not be investigated. To ensure the protection of critical habitat, the Cays that will be investigated will follow the access requirements identified in the above mentioned SOP. In addition when accessing the Cays, no intrusive work will be conducted on the beaches or disposal actions that may affect turtle nests that may be present without further coordination with the Natural Resource Agencies

- MRS 04 - Flamenco Lagoon Maneuver Area and MRS 05 - Mortar and Combat Range Area – Terrestrial. Data will be collected along transects using one of two methods, depending on terrain, vegetation, and other factors (deviation from the transect design is allowed but the survey team should make all efforts to return the survey to the original transect design as soon as the condition that forced the deviation is no longer a factor).
  - Qualitative Reconnaissance - transects divided into segments that are investigated with analog geophysical techniques. 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 transect segments.
  - Due to no ROE, these areas were not fully investigated during the EOTI RI. EOTI work accomplished in these areas is shown in Appendix B Figure B-1 and B-4. The MRS 05 Beaches will be characterized using the Culebra SI Report and results (See Appendix B Figure B-14. Planned USAE work is shown in Appendix B Figure B-8 and B-9. MEC investigation of Lagoons is discussed in the following bullet. MRS 04 transects may be aligned with a new unimproved road that was built in April 2014 by the land owner. If the unimproved road construction is used, DGM will be used down the center of the road and the spoils on both sides of the road will be investigated by analog instruments.

- USAE used VSP software to plan transects to detect a target area with an average density of 300 anomalies per acre above a background density of 10 anomalies per acre, at a 95% confidence level. The transects for both MRS 04 and MRS 05 are based on the 81-mm mortar. Transects will be 1m wide and spacing has been established at 797-ft (243 m) for the investigations.
- The MRS's will be investigated by DGM along transects using the EM61. Both MRSs will be investigated by DGM using the EM61. A Trimble Pro-XRT DGPS or handheld GPS will be used to lay out all reconnaissance transects.
- The following acreages of transects will be investigated in each MRS.
  - MRS 04 0.87 acres of terrestrial transects.
  - MRS 05 3.36 acres of terrestrial transects.
- MEC teams conduct initial clearance of surface debris, MD, MEC, range related debris, and vegetation. Locations of all MD, MEC, and range related debris are recorded in the Trimble Pro-XRT DGPS or field logs if handheld GPS's without a PDA function are used.
- Following MEC/vegetation team, a DGM team investigates each transect. DGM anomalies will be uploaded into the project GIS Database and the Access Database per DID WERS-007.01 and DID WERS 004.01. The GIS information will be used to generate an anomaly density map for each MRS. Analog anomalies, if any, will be assigned a specific anomaly identification number by segment and will be included in the project database.
- High density areas will be investigated with DGM survey of 50-ft x 50-ft grids (or equivalent size) to establish the nature and extent of MEC contamination. The grids will be intrusively investigated for MEC and MD.
- Grid locations will be determined from analysis of transect anomaly density data as well as the previous RI data if applicable. The high density grid will have 100% anomaly resolution. All anomaly data will be collected via PDA and uploaded into the project GIS Database and the Access Database per DID WERS-007.01.
- If only non-munitions related debris is discovered, no additional grids will be required.
- If a MEC target area is discovered these grids will be bounded by four (4) additional grids to further refine MEC extent.
- The four (4) additional radial grids will be intrusively investigated. Additional radial transects may be used to further determine the extent of contamination should the radial extent grids produce MEC near their outer boundary. The radial transects will extend 250-ft and radiate inward towards the grid in which the MEC items were discovered to determine the extent of the contamination. One high density area is anticipated to be discovered in MRS 04 and one in MRS 05. A total of 10 grids are anticipated for placement.

- MRS 04 - Flamenco Lagoon Maneuver Area and MRS 05 - Mortar and Combat Range Area – Lagoons.
  - Lagoons were not investigated by EOTI. Proposed locations of transects are presented in Appendix B Figures B-8 and B-9.
  - The approach for this task is based on the depth of the water within the lagoons. The following DGM configuration is planned for water depth 24 inches or less.
  - USAE used VSP software to plan transects to detect a target area with an average density of 300 anomalies per acre above a background density of 10 anomalies per acre, at a 95% confidence level. The lagoon transects for both MRS 04 and MRS 05 are based on the 81-mm mortar. Transects will be 1m wide and spacing has been established at 797-ft (243-m) for the investigations.
  - The following acreages will be investigated by DGM to establish anomaly density.
    - MRS 04: 0.34 acres of lagoon transects.

  - MRS 05: 0.05 acres of lagoon transects.
- Approach
- A light-weight, plastic, two-person pontoon boat powered by two electric propellers in the rear will provide the means of transportation for the DGM sensor. The motors are connected to the main radio control unit and computer located in an aluminum box located just forward of the middle section of the boat. The boat can be remotely operated or can run autonomously with preloaded coordinates and paths. The boat was designed for both Bathymetric and DGM surveys. The boat will pull a submersible platform with the sensor attached. A Bathymetric survey maybe conducted using a single beam system to determine the lagoon depth, but shallow depths are assumed for the lagoons. The bathymetry system will be modified to low power for shallow depths. If a bathymetric can be conducted, the sensor offsets from the platform will be adjusted.
- Sensors
- For the lagoons, the team will evaluate the Geonics EM61S which is a submersible EM61-MK2 sensor without the top coil. The EM61S will be mounted on a PVC platform to float on the surface of the lagoon. After the bathymetry survey, the depths of the lagoons will be evaluated and the platform design will be modified to provide maximum detection.
- Positioning Systems

  USAE will utilize a Trimble Pro-XRT DGPS to integrate location data with the EM61-S. The GPS system employed will provide sub-meter accuracy through the lagoon. A Go Pro underwater camera will also be attached to the boat to provide video data time stamped to the DGM data if the lagoons have enough underwater visibility to benefit from digital video.
- Sampling Rate

  Sampling rates of the EM61-S will be approximately 10-12 Hz for DGPS. For DGPS, downline sample separation will be 0.25m or less, 98% of the time. Sampling rates on the GPS will once per second.
- DGM Processing

  High density areas detected from the lagoons will be identified; Intrusive investigation in the muddy shallow water is considered a high safety risk for UXOT's. To wade in waters in which the UXOT can't see where they are stepping or excavating anomalies that they can't identify due to low visibility is considered high risk and will be avoided. Intrusive investigation will be limited to areas of the lagoons that have dried or land areas immediate adjacent to the high density areas. Institutional controls may be a consideration for the lagoons if they can't be adequately investigated for MEC due to the high risk for the MEC teams.

3.5.3.3 Instrument Standardization

The following QC measures are to be implemented prior to conducting and/or during daily field operations (see Table 3-2).

3.5.3.3.1 Blind Detection QC Seed Item Recovery

Small ISOs buried horizontally at a depth of 10 cm will be used as blind seed items. Prior to ISO installation an analog instrument will be used to ensure the location for the ISO to be buried is free of anomalies. MEC avoidance procedures will be used. These items will be buried in grids at a frequency to allow one to be detected during each day of grid data collection. Blind seed items will not be placed along transects due to the uncertain paths and high likelihood that the transect would not pass close enough to the seed items to detect them.

3.5.3.3.2 IVS

Data will be collected over the IVS and noise strip twice daily with each geophysical instrument. During this test the instrument operator will make a single pass over both the IVS and the adjacent noise strip. The travel path over each strip will be well marked to ensure that the instrument passes directly over the center of each ISO and that background data is collected in a consistent a manner from day to day. When the IVS is established, five lines of data will be collected over the IVS to establish the baseline expected responses of the ISOs

3.5.3.4 Data Processing, Corrections and Analysis

For the DGM tasks, the processing system will utilize computers installed with Geonics DAT61, Geosoft Oasis Montaj base package with UX-Detect extension module, and a mixture of other (off-the-shelf and proprietary) programs in order to process the data.

3.5.3.4.1 Initial Field Processing

Data file QC review and correction of the following will be performed:

- Grid name and location
- Line numbers, survey direction, start and end points.
- Removal of data drop-outs, spikes and physical feature interference sources.

3.5.3.4.2 Standard Data Analysis

The following corrections where appropriate will be applied:

- Positional offset correction
- Sensor bias, background leveling and/or standardization adjustment
- Sensor drift correction
- Latency correction.

3.5.3.4.3 Advanced Data Processing, Digital Filtering and Enhancement

During DGM tasks, advanced processing steps and analyses steps are not planned but enhancements to DGM targets such as decay and half width could be incorporated for priority purposes.

3.5.3.4.4 Anomaly Selection and Decision Criteria

Anomaly selection and decision criteria will follow the recommendations in the Final IVS report. Nominally the anomaly selection threshold will follow the GSV guidance that a SNR of 5 is required for reliable detection, based on the dynamic noise measured along the IVS background (noise) line. As background noise levels may change over different portions of the MRSs, the anomaly selection threshold may be adjusted, if necessary. These parameters will be discussed with USACE prior to beginning production geophysics.

3.5.3.4.5 Maps

Colored maps will be constructed in accordance with Attachment D, DID WERS-004.01, Geophysics Map Deliverable Format.

3.5.3.5 Dig Sheet Development

Dig sheets will be constructed in accordance with Attachment B, DID WERS-004.01.

3.5.3.5.1 Reacquisition

3.5.3.5.1.1 Reacquisition of geophysical target anomalies identified as priority targets on the dig sheets for excavation and utilize a precision surveying method to identify the location. For the DGM survey, a “dig

sheet" listing all selected anomalies with their respective local and UTM coordinates, response amplitude, decay constant, and other pertinent information will be prepared for the site. Rather than an actual sheet, the anomaly information may be tracked in a Microsoft SQL Server database backend with a Microsoft Access database frontend. Anomalies from this list selected for intrusive investigation will be transferred to reacquisition and dig teams via PDAs or GPS units loaded with a program capable of tracking reacquisition and intrusive information (i.e., Terrsync, Google DoForms, or similar).

3.5.3.5.1.2 The EM61 MK2 or Analog instrument will be used during reacquisition activities. Using the anomaly local coordinates, and the established (0, 0) grid corner and the proper Y direction used during data acquisition, the Reacquisition Teams will mark the location of each identified anomaly shown on the dig sheet with a non-metallic pin flag to within 3 feet of the calculated location and then confirm presence of anomaly with the EM61 or Analog Instrument.

3.5.3.5.1.3 In areas were EM61 grid data is collected using wheel fiducial mode, targets will be reacquired using distances from corner stakes (e.g. 5.75 meters from the south west corner stake in the x direction and 10 meters from the south west corner in the y direction). Each reacquired anomaly location will be marked using a non-metallic pin flag, with anomaly sequence number marked on the flag in indelible ink.

3.5.3.5.1.4 The reacquisition surveys will be performed in accordance with DID WERS-004.01 and the Geophysical Investigations for Buried Munitions Operational Procedures and QC Manual.

3.5.3.5.2 Field Procedures

Field procedures will begin and end each day with the QC tests (equipment checkout at the IVS and GPS checks at a known or measured point). In between the QC tests, all of the production activities such as DGM activities with their associated procedures will be completed. DGM will involve a three-person team collecting GPS integrated and/or wheel fiducial EM61 data in transects and grid patterns. Digital data will be recorded to the field PC (Allegro) and manual data, such as grid maps and pertinent QC information, will be recorded in production forms provided in Appendix F for each set of transects or grid(s) surveyed. More details are provided in the QC, Reacquire, and DGM sections.

3.5.3.5.3 Data Spatial Density

Data spatial density for grids is to be in the order of 0.6 meters across-track for 90% or greater coverage and 2% less than or equal to 0.25 meters along-track for grids where DGM mapping is used to detect anomalies. Down line data density is restricted by the fiducial separation for wheel fiducial data.

3.5.3.6 Feed-Back Process

The site geophysicist will review the reacquisition and intrusive results and compare what was found by the intrusive teams with the geophysical anomalies selected from the DGM data to determine whether the stated source is representative of the original anomaly. Anomalies with peak responses more than twice the anomaly selection threshold and a reacquisition value below 75 percent of the picked value or with a "no contact" intrusive result will be investigated by the site geophysicist and may be reassigned to a reacquisition team for verification. The project and/or site geophysicists may also reassign any anomaly for which they consider the stated source not to be representative of the identified anomaly.

3.5.3.7 QC

3.5.3.7.1 Geosoft USACE Oasis Montaj UXO QC and Quality Assurance System Software will be used to QC geophysical data where applicable. The instrument standardization tests related to QC procedures are described by their methods, frequency, and task-specific applications in Table 3-2.

3.5.3.7.2 If an instrument does not meet the standard set in Table 3-2, it will be re-calibrated, repaired or replaced. Operational and test procedures will conform to manufacturer's standard instructions. All geophysical instruments and equipment used to gather and generate field data are calibrated with sufficient

frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

3.5.3.7.3 All raw data from field measurements (including both the required Intrusive Investigation Dig Sheets and optional DGM DID WERS-004.01, Attachment A, field forms) will be appropriately recorded during each day and scanned digitally each night. During the subsequent days, the information will be transcribed digitally to the files by an administrative assistant with the Site Geophysicist/SUXOS reviewing the final product prior to delivering to USACE. Data reduction and analysis methodologies will be dependent upon those geophysical methods selected.

3.5.3.8 Corrective Measures

Problems noticed during daily QC test monitoring, intrusive investigation, or intrusive verification activities such as equipment or human operation errors that are noticed during subsequent cause-effect data review will be documented with a root-cause analysis to follow. Once the analysis is complete, a solution will also be documented and implemented as a corrective measure in order to solve the problem. Examples may include changing out faulty equipment or possibly changing field procedures in order more effectively complete tasks.

3.5.3.9 Records Management

3.5.3.9.1 Field data sheets shall be maintained in accordance with DID WERS-004.01. Project documentation will be collected and managed on-site during the field portion of the geophysical investigation for inspection by client personnel. Geophysical data is recorded digitally and downloaded daily to a field computer for processing or transfer to the processing center. In addition to the copy of data placed on the field computer's hard drive, a copy of the data will be written to CD, DVD or an external hard drive, for backup before the data is erased from the equipment.

3.5.3.9.2 As an additional means of ensuring data availability, all data will be transferred to the geophysical data processing center on a daily basis. This off-site storage of data will further reduce the likelihood that data will be lost. Transfer may be accomplished by e- mail attachment, file transfer protocol (FTP), or overnight delivery of CD or DVD. If possible, copies of field data collection forms and appropriate field logbooks will be scanned weekly.

3.5.3.9.3 The Project Geophysicist will review the uploaded geophysical data to verify that the transfer system is functioning on a daily basis. This review will also serve to double- check the field data review for QA/QC purposes. The review will verify that the data is valid and useable for the intended purpose.

3.5.3.9.4 All digital data stored at the geophysical data processing center will be backed up on a regular basis. All data, reports, memorandums, spreadsheets, etc., should be maintained in a designated client/site subdirectory and transferred to the central GIS/database system.

3.5.3.10 Interim Reporting

Periodic Status Reports will be prepared IAW WERS-016.02. This report will be submitted monthly when fieldwork is not being performed, and daily when fieldwork is underway. When MC sampling is being conducted daily reports will be submitted per WERS-009.01 paragraph 1.3.2. The Project Access Data Base will be submitted weekly to the USACE PM.

3.5.3.11 Map Format

USAE will generate a map format that will follow the guidelines of DID WERS-004.01, Attachment D using Geosoft Oasis Montaj software. For the required intrusive investigation tasks, USAE will tabulate the data and then provide/display the data using a combination of Microsoft Excel, Microsoft Access, and Environmental Systems Research Institute (ESRI) software packages.

3.5.4 Geophysical Investigation Performance Goals

3.5.4.0.1 The Geophysical Investigation Performance Goals are delineated into the following three subject categories, based on guidelines from USACE provided within the DID WERS-004.01:

- Detection of MEC or other munitions;
- Horizontal Accuracy; and
- False Positives.

3.5.4.0.2 Accordingly, the current specifications pertaining to performing GIP-related activities after the mobilization is completed to Culebra Island, will be discussed in order of appearance as listed above.

3.5.4.1 Detection of MEC

Successful performance will be measured by detection of ordnance-related items of interest down to depths of 11 times the ordnance item diameter (or width) within the designated investigation areas. .

3.5.4.2 Horizontal Accuracy

Horizontal accuracy requirements have been established and are required to be met during the lifetime of the project.

- 95 percent of all reacquired anomaly locations must lie within a 1-meter radius of their original surface location as marked on the dig sheet.
- 95 percent of all excavated items must lie within a 35-centimeter radius of their mapped surface location as marked in the field after reacquisition. The first metric requires that all significant peak anomaly positions that are marked during the reacquire interrogation sweep process must lie within one meter, or roughly to the nearest line of data, of the starting-point (centroid) reacquire location. The second metric requires that all significant post-peak- adjusted end-point reacquire locations must have metal pieces found within a roughly 1/3 meter (35 centimeter) of the end-point reacquire locations. If a pattern of offsets are noticed while evaluating the results of either the first metric (DGM to reacquire difference) or the second metric (reacquire to intrusive difference), corrective measures will be discussed and provided to USACE by USAE.

3.5.4.3 False Positives

If there are more than 15 percent “false positives,” a re-evaluation of the data, detection methods being utilized and overall project QC shall be performed. False positives are defined as anomalies reacquired that result in no detectable metallic material recovered during excavations, calculated as a running average for the sector.

3.5.5 Geophysical Mapping Data

The Geophysical Mapping Data is delineated into the following three subject categories, based on guidelines from USACE provided within DID WERS-004.01:

- Sensor and Navigational Data Correlation.
- Geophysical Data Analysis and Reporting.
- Anomaly Excavation and Reporting.

3.5.5.1 Sensor and Navigational Data Correlation

3.5.5.1.1 The man-portable sensor and navigational equipment for DGM activities is the Geonics EM61 MK2 in man-portable wheeled mode in conjunction with GPS and/or wheel fiducials. The EM61 MK2 will be sampled at least 10 times per second while the GPS will be updated once per second. Wheel fiducial data will have a sample rate set at one reading every 0.1-m.

3.5.5.1.2 DGM sensor data shall be pre-processed for sensor lag, drift, and additional corrections as needed. All pre-processing and advanced processing steps will be completed and digital deliverables of raw, processed, final, and interpretation results for individual grids in the standard Geosoft XYZ ASCII format. Geonics DAT61, Geosoft Oasis Montaj with UX-Detect module, and other proprietary software packages to complete all processing, visual display, and deliverables preparation activities will be used.

3.5.5.2 Geophysical Data Analysis, Field Reacquisition, and Reporting

As an overview, USAE will primarily utilize Geosoft Oasis Montaj for all data analysis techniques that may include (but are not limited to) the following: amplitude analysis, depth/size estimations, threshold area estimations, and decay curve analyses. The final data analysis and subsequent anomaly prioritizations for future DGM data collection are highly dependent on the feedback process during the upcoming intrusive operations. At this time, USAE expects some techniques to be more effective at the site than others. Thus, not necessarily all of the previously outlined analysis methods may be implemented. The reporting of anomaly prioritizations for intrusive investigation will occur either within individual Attachment C style dig sheets or database equivalent as stated in the DID.

3.5.5.3 Anomaly Excavation Reporting

As required by the DID, USAE will excavate all anomalies marked in the field with unique identified PVC pin-flags. The intrusive information, recorded on the dig sheet, will include details such as depth, orientation, size, offset, and additional required reporting information as listed in DID WERS-004.01, Attachment B. The Site Geophysicist will review the intrusive records to qualitatively verify that the metal removed was enough to generate the response characteristics calculated during processing of DGM data. Any noticeable patterns in ordnance, non-ordnance, clutter or no-finds that are specifically related to reported data analysis patterns (time gate, area, depth, etc.) that were utilized during the original prioritization decision-making process will be documented. The documented patterns will be used in a feed-back process in order to improve future DGM, reacquisition, and intrusive operations.

3.5.6 GIP Summary and Conclusions

Since the GIP have been discussed according to their subject categories provided within the DID, this portion of the WP is complete.

3.6 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

The USAE GIS team will build upon existing historical information.

3.6.1 Accuracy

GIS data developed for the field activities for this project is subject to accuracy restraints dictated by the GPS accuracy used to reacquire the Geophysical anomalies. During surface activities, results will be collected using a handheld data collection (HDC) system. The system will utilize the Trimble Geo-XT GPS unit. The accuracy of this GPS model is sub-foot during data collection; furthermore, the unit will utilize the Federal Aviation Administration (FAA) and the Department of Transportation (DOT) Wide Area Augmentation System (WAAS). WAAS corrects for GPS signal errors caused by ionosphere disturbances, timing, and satellite orbit errors. This eliminates need for GPS base station, in turn reducing cost and vital field time during the duration of field activities.

3.6.2 Computer Files & Digital Data Sets

3.6.2.1 USAE utilizes ESRI ArcGIS in development of comprehensive and accurate geospatial data. USAE proposes to submit the most current GIS as part of any report submitted to the CEHNC. This will include ArcGIS project files and metadata for the geospatial data that is referenced in the project files.

3.6.2.2 The GIS will be updated on a daily basis throughout the project life cycle. Updating on a routine basis will facilitate project planning efforts and Government progress tracking of clearance and or

investigation efforts. The Government and other stakeholders will have the ability to view progress and project data in a map-based environment and to view the tabular data associated with the GIS vector data. Collected data will be incorporated into the GIS and conform to the UTM projection, a datum of GCS North America 1983 (NAD83), and with linear unit of measure in Meters.

3.6.2.3 The GIS staff will produce updated maps and provide to the government on a weekly basis. The maps will document the work efforts that were conducted from the prior week. Digital Portable Document Format (PDF) copies of the maps will be uploaded to the project collaboration website and made available to the Government. All GIS data and ArcGIS projects will be developed and incorporated in to the ESRI Geodatabase format. All GIS project and layout files will be in the (ArcGIS.mxd) file format and submitted with the final report. All spatial imagery during the life of the project will be transferred into LizardTech MrSID format to help in reducing image file size unless stated otherwise by the Government.

3.6.2.4 All MEC items that are discovered during the investigation and are determined or suspected of containing energetic material will be documented with the GIS. Coordinates for the individual items and will be collected with the Trimble Pro-XRT or Geo-XT GPS unit prior to blow-in-place (BIP), consolidation, or removal operations beginning.

3.6.2.5 External tabular data that is not integrated within the Geodatabase will be provided to the Government in Microsoft Access at the completion of the project. All supporting databases will be complete and single entities, with no relations or joined connections to others.

3.6.2.6 All geospatial data developed by USAE will be incorporated into the project specific GIS and will conform to the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) standards and the USAESCH and CEHNC data standards to give all spatial datasets more compatibility with other Government GIS programs. Federal Geographic Data Committee (FGDC) metadata will be developed for core MEC-GIS data layers. It is assumed that spatial data retrieved from other sources such as GIS clearinghouses, previous site investigations, etc., will contain previously developed metadata created by the originator.

3.6.2.7 The project specific Geodatabase will be delivered on DVD media. The Geodatabase that will accompany the weekly submittals to the CEHNC will either be delivered by e-mail or if file sizes are to immense for e-mail then the Geodatabase will be either uploaded to the project collaboration-site hosted by USAE or will be uploaded to a password protected FTP site for download.

3.6.2.8 GIS data will be available throughout the projects life on the Secure Project collaboration website. Access to the website will be limited to the Team, CEHNC project personnel, and others authorized by CEHNC. Spatial data created for the project will be developed and managed in ESRI-compliant formats (Shape files or Geodatabases) throughout the life of the project. All project data and project related documents will be incorporated into the project specific GIS and will be available on-line to the government and invested parties through the secure project specific collaboration/Web-GIS throughout the projects life cycle.

3.6.2.9 USAE will establish a geospatial database to be maintained by the GIS Manager IAW DID WERS-007.01, EM 200-1-2, EM 200-1-15, and applicable Interim Guidance Documents (IGD).

3.7 INTRUSIVE INVESTIGATIONS

3.7.1 DGM Target Intrusive Investigation

3.7.1.1. Subsurface investigations will be performed on all anomalies selected by the Site Geophysicist and approved by the USACE Geophysicist. Intrusive investigation teams, consisting of at least two UXO-qualified individuals and equipped with analog metal detectors (Whites or Minelab) or EM61 (depending on the initial investigation method used), GPS, field computer and hand digging implements will conduct excavations.

3.7.1.2 UXO personnel will excavate subsurface geophysical targets identified, as a result of the geophysical mapping and data evaluation effort, and picked for excavation using the RI/FS DQO methodology and model.

3.7.1.3 Geophysical targets will be excavated by using hand tools. If the anomaly cannot be excavated by hand (such as the anomaly is situated underneath bedrock or during excavation groundwater is encountered, preventing the anomaly from being safely investigated and identified), the anomaly will be noted and excavation will be halted. A visual and electronic search of the excavation will be made until the anomaly is located. If the subsurface target is unable to be located, the data for undiscovered anomalies will be reviewed by the project geophysicist and the MEC team supervisor(s). Upon excavation, the intrusive investigation team will record the location, identification, and attributes of the excavated item (either manually on a dig sheet or electronically in a field computer).

3.7.2 Analog Mag and Dig Transect with Intrusive Investigation

3.7.2.1. The team leader and UXOQCS will observe each operator to ensure that proper sensor sweep procedures for search speed, sensor overlap, and sensor height are followed. All anomalies will be excavated using hand tools. If the anomaly can't be excavated by hand (such as the anomaly is situated underneath bedrock or during excavation groundwater is encountered preventing the anomaly from being safely investigated and identified), the anomaly will be noted and excavation will be halted.

3.7.2.2 Using a Trimble Pro-XRT DGPS or Geo-XT (or other handheld GPS), the MEC Intrusive team leader will record positioning data. Upon excavation, the intrusive investigation team will record the location, identification, and attributes of the excavated item (either manually on a dig sheet or electronically in a field computer). Intrusive results will then be uploaded to the project FTP site where they will be incorporated into the project GIS Database and the Analog Access Database per the DID WERS-007.01 and DID WERS-004.01, respectively. All location data gathered during the surface and subsurface activities will be used to develop MEC density maps of the MRS. Maintaining the Analog Access Data Base will be the responsibility of the Site Geophysicist (SUXOS will maintain the Analog Access Data Base in lieu of the Site Geophysicist if the Site Geophysicist is not on site).

3.7.2.3 The analog anomaly locations will be used along with the DGM transect anomalies to calculate the MRS Anomaly Density. The anomaly densities will be provided to the Project Geophysicist by the Site Geophysicist as required.

3.7.3 MEC

MEC located during the subsurface search will be reported to the SUXOS. A description of all MEC, MD, and non-munitions debris recovered will be recorded and incorporated into the project database. Recorded data will include, where possible, size, estimated weight, orientation, depth bgs, and description of the item excavated. If acceptable to move, suspected or known MEC will be consolidated for destruction. Site Utilities will be identified and the positioning data provided if they have the potential to be impacted by the disposal of MEC.

3.7.3.1 Accountability and MEC Records Management

3.7.3.1.1 A detailed accounting will be made of all MEC items encountered during the RI activities. This accounting will include the nomenclature (if applicable) type, approximate weight, depth, orientation, condition, and location of the item indicated. The UXO Technician III (team leader) will record specific details regarding the material found, including (but not limited to), the following: specific nomenclature, type of fusing, condition, and external markings. The X, Y, and Z coordinates and disposition of the item also will be recorded.

3.7.3.1.2 Each suspected MEC item encountered will be entered on the MEC Accountability Log. The SUXOS will prepare and submit the MEC Accountability Log using the Daily Report and/or disposal record. The SUXOS will provide copies of the MEC Log to the PM. The intrusive investigation data will be compiled

on a weekly basis and sent to the PM for review. Excavated anomaly attributes will also be added to the project GIS database.

3.7.3.1.3 The inventory count of MEC items will be conducted by the SUXOS and UXOQCS on a weekly basis and any discrepancies with the project database will be reported immediately to the CEHNC OESS and USAE PM.

3.7.3.2 MEC Sampling Procedures

3.7.3.2.1 Subsurface MEC Investigation

A geophysical reacquisition team will use tape measures to determine the location of the anomaly based on the local target coordinates reported on the field computer dig sheet. Reacquisition teams will search a 1-m radius to delineate the exact location of the anomaly peak, using an analog all metals detector. Due to the rough terrain and the difficulty accessing different grids, the EM61-MK2 will not be used for anomaly resolution. If the anomaly is found, a pin flag will be placed at the actual anomaly location (all anomaly sources within a 1-m radius will be flagged). The signal response, offset distance, and direction from the re-acquired location will be noted in the field computer. If the anomaly is not found, a probable source for the reacquisition failure will be examined. A Geophysicist will review 100% of the intrusive results to help ensure that the selected anomaly was investigated. In addition to the reported anomaly source, the Geophysicist will assess the anomaly offset and ensure object(s) is within 1-m. Any intrusive result ambiguity will be rechecked, prior to QC. The UXOQCS will check a percentage of the DGM targets in each grid.

3.7.3.2.2 Near-Surface Anomalies

Near-surface anomaly sources are those that are partially exposed or suspected to be within .3-m (1-ft) of the surface and that can be excavated using hand tools. These anomalies will be excavated by carefully removing the earth overburden using a hand shovel/trowel or other small digging implement. Throughout the excavation, the UXO Technicians will use Whites metal detectors to check and verify the proximity of the anomaly source.

3.7.3.2.3 Subsurface Anomalies

Subsurface anomalies are those caused by sources that are more deeply buried > .3-m (1-ft) bgs. Mechanical methods may be used to excavate all subsurface anomalies to within one foot of the anomaly source. Mechanical excavation will be done in lifts. After each lift, the anomaly location will be redefined with the White. This process will continue until the source of the anomaly has been uncovered and identified.

3.7.3.3 MEC Disposal

Disposal and handling of MEC will be in accordance with the Explosive Site Plan (Explosive Site Plan is a separate document from this WP Addendum) and Appendix K.

3.7.4 MPPEH

All MPPEH recovered during this project will be handled and processed in accordance with Chapter 14, Corps of Engineers Contractors MPPEH Inspection, Certification, and Final Disposition Procedures of EM 200-1-15, dated 15 June 2007. USAE will follow the SOP for OPS 13 - MPPEH Management found in Appendix K.

3.7.5 Munitions Documented as Safe

MD will be inspected, certified as free of reactive constituents, and reclassified as MDAS. USAE will follow the SOP for OPS 13 - MPPEH Management (found in Appendix K) which identifies the procedures for classifying and shipping MD as MDAS.

3.7.6 Munition with the Greatest Fragmentation Distance/Minimum Separation Distances

See Table 3-3 for a complete list of munition with the greatest fragmentation distance (MGFD) and MSD for each area of concern.

Table 3-3: MGFD and MSD

Area	MEC	MSD (ft)[1]				
		For Unintentional Detonations		For Intentional Detonations		
		Team Separation Distance (K40)	HFD	Without Engineering Controls	Using Sandbag Mitigation[2]	Using Water Mitigation[2]
MRS 02						
Cerro Balcon	4.2-inch M3A1	81	316	1,670	200	275
	4.2-inch M329	79	311	1,641	200	275
Cayo del Agua	MK84 2000-lb HE Bomb	437	963	4021	N/A	N/A
Cayos Geniqui	MK82 500-lb HE Bomb	257	692	3028	N/A	N/A
Cayo Lobito	5-inch 54 MK41	74	359	2377	220	275
Cayo Lobo	5-inch 54 MK41	74	359	2377	220	275
Cayo Yerba	MK84 2000-lb HE Bomb	437	963	4021	N/A	N/A
MRS 04						
Flamenco Lagoon Maneuver Area	5-inch 54 MK41	74	359	2377	220	275
MRS 05						
Mortar and Combat Range Area	4.2-inch M3A1	81	316	1,670	200	275
	4.2-inch M329	79	311	1,641	200	275

Notes:

1. See ESP for calculation sheets and documentation of MSD.
2. See ESP for required sandbag thickness IAW HNC-ED-CS-98-7, Amendment 1, HNC-ED-CS-S-00-3, HNC safety advisory dated 07 November 2011, and DDESB memo dated 29 November 2010 (Clarification regarding use of sandbags for mitigation of fragmentation and blast effects due to intentional detonation of munitions).

3.8 UXO PERSONNEL QUALIFICATIONS

As required by the specific task, all USAE personnel and its subcontractors (as applicable) will complete the Occupational Safety and Health Administration (OSHA) 40-hour training course for hazardous waste site workers and an 8-hour refresher course as appropriate. Management and supervisory personnel will also complete supervisory training and refresher training as required by Code of Federal Regulations (CFR) 1910.120 e (4) & (8). Additional site-specific training, in accordance with 29 CFR 1910.120, EM 385-1-1 (USACE Safety and Health Requirements Manual), and ER 385-1-92 (Safety and Occupational Health

Document Requirements for HTRW Activities) will be provided to all personnel upon their initial mobilization. A Medical Surveillance Program is in place with the latest examination within the last 12 months. CPR training will be required for USAE personnel and subcontractors that are participating in field operations.

3.8.1 UXO Personnel Qualifications

UXO personnel must meet the requirements set forth in DDESB Technical Paper (TP) 18, Personnel/Work Standards. UXO personnel will be U.S. citizens and be graduates of the either the U.S. Naval Explosive Ordnance Disposal (EOD) School, Eglin AFB, Florida; the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, Maryland; the U.S. Naval EOD School, Indian Head, Maryland; the EOD Assistants Course, Redstone Arsenal, Alabama; the EOD Assistants Course, Eglin AFB, FL or a DoD-Certified equivalent course. Credit for the EOD experience while assigned to the National Guard or Reserve will be based on the actual documented time spent on active duty, not on the total time of service. The qualifications for these personnel are appended to the WP in Appendix H, Personnel Resumes.

3.9 FIELD TEAM COMPOSITIONS

The below team compositions will not be fielded concurrently but will be made up of personnel mobilized onto the work site. The SUXOS, UXOSO and UXOQCS will maintain field management per their required job functions.

3.9.1 Civil Survey Team (1 Team)

- Site Geophysicist (1 ea)
- UXO Technician III (1 ea)
- UXO Technician I (1 ea)

3.9.2 Vegetation Removal Team (2 Teams)

- UXO Technician III (1 ea – team lead will supervise up to two Vegetation Removal Teams)
- UXO Technician II (1 ea.)
- Brush Cutters (2 ea.)
- Team Biologist (The team Biologist will move between teams as required)

3.9.3 DGM Team (1 Team)

- Site Geophysicist (1 ea)
- UXO Technician II (2 ea)
- Optional: UXO Technician I (1 ea) (May be added to the team to assist in the transporting of the EM61)

3.9.4 Analog Transect Geophysical Team (1 team)

- Optional: Site Geophysicist (if required)
- UXO Technician III (1 ea)
- UXO Technician II (2 ea)
- UXO Technician I (2 ea)

3.9.5 MEC Team (1 Team)

- UXO Technician III (1 ea)
- UXO Technician II (2 ea)
- UXO Technician I (2 ea)
- Team Biologist (1 ea.)

3.10 ENVIRONMENTAL SAMPLING

3.10.1 Specify Tolerable Limits on Decision Errors

All sampling and analysis will achieve the MQOs outlined in the UFP-QAPP, unless MQO failures can be adequately explained and/or justified.

3.10.2 Optimize the Design for Obtaining Data

The detailed sampling plan for field procedures and laboratory analysis are outlined in Appendix E, the SAP and UFP-QAPP. Table 3-4 and Table 3-5 demonstrate the proposed samples and the analytes to be sampled for.

Table 3-4: Proposed Samples for RI/FS

MRS	Matrix				
	Soil	Post Detonation Soil	Sediment	Surface Water (Lagoons)	Groundwater
MRS 02 Cerro Balcon	2		-	-	1 existing
MRS 02 Cayos	6	1	4	4	-
MRS 04	8		4	4	4 existing
MRS 05	10	1	4	4	4 existing/1 new
MRS 07					
Subtotal	***26***	***2***	***12***	***12***	***10***
QA/QC					
Duplicates[1]	2	1	1	1	1
QA Splits[2]	2	1	1	1	1
MS/MSD[3]	2	1	1	1	1
Subtotal	**6**	**3**	**3**	**3**	**3**
IDW Characterization					2
Total	***32***	***5***	***15***	***15***	***15***

Notes:
QA/QC – quality assurance/quality control
MS/MSD – matrix spike/matrix duplicate
IDW – investigative derived waste

1. *Field duplicates for this project are collected at 5% per analytical group (i.e., two groups), per matrix, per sampling procedure, per sampling team.*
2. *QA split samples will be collected at 10% per analytical group, per matrix same media source sampling procedure, homogenized, and split into separate containers.*
3. *One MS/MSD per inorganic sample delivery group, per analytical group (i.e., two groups), per matrix.*

Table 3-5: Proposed Analytes[1] and Analytical Methods

Explosives (SW8330B)	Metals (SW6020A/7470A/7471B)
2-Amino-4,6-dinitrotoluene	Aluminum
4-Amino-2,6-dinitrotoluene	Antimony

Explosives (SW8330B)	**Metals (SW6020A/7470A/7471B)**
1,3-Dinitrobenzene	Barium
2,4-Dinitrotoluene	Chromium
2,6-Dinitrotoluene	Copper
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Mercury
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	Lead
Nitrobenzene	Zinc
Nitroglycerin	
2-Nitrotoluene	
3-Nitrotoluene	
4-Nitrotoluene	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	
Pentaerythritol tetranitrate (PETN)	
1,3,5-Trinitrobenzene	
2,4,6-Trinitrotoluene	
Ammonium Picrate (SW8321)	
Groundwater only	**Groundwater/Surface Water**
Nitrate/Nitrite as N (E353.2)	Perchlorate (SW6850)
Chlorides (E300.0)	
1. Target analytes/contaminants of concern for explosives and metals have been identified based on research of munitions used at the site (see Appendix N) and the current Culebra RI/FS efforts.	

3.11 IDW PLAN

3.11.1 IDW generated as part of the field investigation will be properly collected, labeled, profiled, manifested, transported, and disposed of, if necessary, at a facility licensed to handle these materials.

3.11.2 IDW from the MEC investigation will include drums of MDAS and will be packaged, sealed, and shipped to Timberline Environmental Services (TES) for final disposal. TES will provide USAE and USACE with signed copies of receipt documents and will provide certificates of destruction when the material is completely processed. The Certificates of Destruction will be included in the RI report.

3.11.3 IDW from the well installation will include soil and water. The IDW will be tested and evaluated and if considered free of contaminates it will be disposed of locally. If it is determined to not be suitable for local disposal USAE will contract a certified Subcontractor to package and ship to a certified and approved disposal facility.

3.11.4 IDW from the MC investigation will include purge water, used sterile soil/sediment sampling scoops, and personal protective equipment (PPE). The details concerning containerizing, sampling, and disposal are further discussed in Appendix E, Sampling and Analysis Plan (SAP), Chapter 8, IDW Waste Management Plan

3.12 RISK CHARACTERIZATION AND ANALYSIS

3.12.1 A detailed risk characterization and analysis following the MEC HA methodology will be completed as part of the RI/FS. This risk assessment requires information about the presence of MEC at the Culebra Island Sites for completion. MEC has been found and removed from various areas across the site. Further

MEC investigation activities (geophysical study) will be conducted as part of this RI which will involve anomaly identification and investigation. Pertinent information that will be gathered about MEC during the geophysical investigation. Information regarding site characteristics, site accessibility, site stability, human factors, site activities, and population will also be gathered during the MEC and MC investigations to ensure a complete risk assessment. It should be noted that the risk assessment activity may not be necessary for areas where there is no evidence of MEC presence. However, the exception to this would be the presence of MC in the surface soil in an area suspected to have been impacted by training activities.

3.12.2 Human health and ecological risk due to potential exposure to MC will be evaluated using the methodology outlined in by the USEPA RAGS and USACE guidance EM 200-1-4, Volumes I and II. The primary methodology for evaluating human health risk will be comparison of environmental sampling analytical data to the appropriate screening levels. A Screening-Level Ecological Risk Assessment (SLERA) may also be required as MRS 05 and 07 contain wildlife refuge areas. The human health and SLERA will be developed in accordance with USACE guidance EM 200-1-4, EM 1110-1-1200, as appropriate, USEPA Risk Assessment Guidance for Superfund. The results will be provided in the RI Report and will factor into potential removal/remediation measures during the FS phase.

3.12.3 The details of the risk characterization and analysis are outlined in the Risk Assessment WP found in Appendix G.

3.13 MRSPP

3.13.1 In 2001, Congress directed that the DoD identify and then prioritize their MRSs. The protocol was published as a rule on 5 October 2005 (35 Code of Federal Regulations Part 179). The protocol was designed to:

1) Maximize use of the latest MRS-specific data

2) Be applied early in the munitions response process

3.13.2 The protocol assigns a relative priority to each location in the DoD's inventory of defense sites known or suspected of containing UXO, Discarded Military Munitions (DMM), or MC, and prescribes procedures for prioritizing the defense sites and general component responsibilities. The site priority ranking is based on the risk posed by potential hazards captured in data entered for three hazard evaluation modules of the MRSPP, explosive hazard evaluation (EHE) module, chemical warfare material hazard evaluation (CHE) module, and the health hazard evaluation (HHE) module. Separate MRSPP tables (EHE Tables 1 through 10, CHE Tables 11 and 20, HHE Tables 21 through 28, MRS Priority Table 29, and MRS Background Information, Table A) will be completed for each MRS in the RI Report.

3.14 ANALYSIS OF LAND USE CONTROLS

3.14.1 USAE will conduct an Institutional Analysis in accordance with EP 1110-1-24 as part of the RI/FS. As Institutional Controls rely on existing powers and authorities of various government agencies to protect the public from MEC risks, government agencies having jurisdiction over properties containing MEC will be identified and their appropriateness, capability, and willingness to assert controls will be assessed.

3.14.2 For each institution selected for review, USAE will collect the following information:

- Name of Agency
- Origin of Institution
- Basis of Authority
- Sunset Provisions
- Geographic Jurisdiction
- Public Safety Function
- Land Use Control Function

- Financial Capability
- Desire to participate in the Institutional Control Program
- Constraints to Institutional Effectiveness.

3.14.3 An Institutional Analysis Report will be prepared to document feasible local initiatives that will be used to support development of alternative plans of action. The report will identify and analyze the institutional framework that supports the development of institutional controls for the site. The report will address local initiative strategies available to control or limit access to different areas within the project site, or strategies to implement public safety awareness actions regarding the site. The Institutional Analysis will include discussions with state and local agencies, and with private parties having interests in the sites.

3.14.4 Following the Institutional Analysis and preparation of the Institutional Analysis Report, a draft Institutional Control Plan will be included in the draft RI Report detailing the Institutional Control Alternatives recommended based on their apparent ability to satisfy project objectives.

3.15 USE OF TIME-CRITICAL REMOVAL ACTIONS DURING THE RI/FS PROCESS

Time Critical Removal Actions can be found in Section 3.4 of the EOTI WP (EOTI February 2010).

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CHAPTER 4. QUALITY CONTROL PLAN

4.1 INTRODUCTION

4.1.1 The USAE QC process provides a permanent and workable system that allows each employee to understand the job performance expected within the assigned task. The USAE QC and improvement process ensures that the training, actions, procedures, and tools support every employee according to requirements, and in such a manner that we protect the environment and minimize the impact of project activities. Checklists have been developed to ensure critical elements are addressed and that QC checks are documented for compliance with the WP, SOPs, policies and procedures. By promoting teamwork and by focusing attention on the solutions, the quality of work is increased and assured throughout the project.

4.1.2 This QCP provides the procedures and methods to be used for the field activities within the selected work areas. This plan addresses organization and responsibilities; DQOs, QC test methods, audit procedures and pass/fail criteria, digital geophysical operations, anomaly acquisition and reacquisition, field operations, equipment testing, maintenance and calibration, QC inspections, and reporting procedures. The QCP outlines procedures to ensure all personnel meet the qualification requirements and receive the site-specific training to perform the duties of the job for which they will be hired, and site-specific training requirements for visitors. The QCP also describes how lessons learned are captured, documented and submitted to the Government.

4.2 QUALITY MANAGEMENT STRUCTURE

The following paragraphs describe the organizational structure of the USAE Quality Management Team during operations at the project site. Names and qualifications of site personnel will be provided prior to mobilization.

4.2.1 USAE Director of Safety and Quality

The DSQ (Mr. Robert Crownover) is responsible for reviewing and updating the QCP and verifying compliance with the plan. The Director of Safety and Quality verifies compliance with the QCP by auditing project activities and instituting corrective actions; and develops and coordinates the APP. The DSQ is the contact for regulatory agencies on matters of health and safety and has the following responsibilities:

- Preparation of USAE QC policies and procedures
- Ensuring timely submission of contract deliverables
- Providing training and assistance to the site project UXOSO/UXOQCS
- Reviewing employee qualification records to ensure accuracy
- Conducting periodic field audits of sites, programs, and projects project activities to ensure QC compliance.

4.2.2 PM

The PM is responsible for overall performance during this project. The PM will develop and implement the site WP and also has the following responsibilities:

- Serves as primary point of contract with the USACE PM
- Monitors project performance, safety, quality, cost, and schedule
- Ensures timely submission of contract deliverables
- Reports directly to the Program Manager

4.2.3 USAE Project Geophysicist

The Project Geophysicist (Mr. Al Crandall) is responsible for the overall technical direction for DGM surveys to include the following:

- Provide overall technical direction for DGM surveys
- Supervise data processing and interpretation.
- Coordinate with the Site Geophysicist to verify the accuracy and completeness of project DGM documentation and target lists, IVS testing results, QC results and related DGM project documentation
- Review all DGM and Analog data, confirm that DGM performance metrics are being maintained, and provide notification to USAESCH when data are available for their review.

4.2.4 USAE SUXOS

The SUXOS is responsible for the day-to-day field operations at the project site. The SUXOS reports directly to the USAE PM and has the following responsibilities:

- Implementation of WP and QC policies and procedures
- Reporting to the PM on effectiveness, adequacy, and status of the project
- Ensuring the timely submission of contract deliverables
- Coordinating with project personnel for site tasking and schedules
- Reviewing any failures and implementing corrective actions
- Implementing additional guidelines used to assist in the development of site and task specific policies and procedures.

4.2.5 UXOQCS

The UXOQCS is responsible for overseeing the site QCP in all field operations. The UXOQCS will be trained in QC techniques methodology and be qualified as prescribed by DDESB TP 18. The UXOQCS coordinates with the PM for daily operations and maintains a direct line of communication to the PM and SUXOS. The UXOQCS will have at his disposal the appropriate SME disciplines in support of specific QC activities as prescribed by Table 4-1. The UXOQCS reports directly to the DSQ and has the following responsibilities:

- Reviewing, implementing, and enforcing the QCP
- Coordinating with the DSQ to ensure QC procedures are appropriate for demonstrating validity sufficient to meet QC objectives
- Performing periodic audits of USAE's performance under the contract.
- Assisting the DSQ in Root Cause Analysis
- Recommending to the PM actions to be taken in the event of a QC failure
- Maintaining a Lessons Learned log
- STOP WORK authority for issues regarding QC at the project site.
- Conducting QC inspections of documents, work in progress, work performed, and monitoring. The UXOQCS records and reports the results to the appropriate personnel.
- Ensuring classification of MEC-related items
- Recommending to the DSQ actions to be taken in the event of a QC failure
- Advising the Field Team Leader and Survey Teams on all QC-related site matters
- Reporting non-compliance with QC criteria to project management personnel

4.2.6 QC Geophysicist

A QC geophysicist (Mr. Brad Newlin) will be assigned to the project on a part-time basis to monitor QC tests and documentation in compliance with the QC requirements described in the PWS and DQO's. The QC geophysicist will monitor the QC test data, acquired geophysical data, database documentation, and deliverables. The UXOQCS will serve as the QC geophysicist's on-site representative in the management of seeding required ISO's during the expected geophysics grid survey area to confirm dynamic detection and positioning repeatability.

4.3 DATA QUALITY OBJECTIVES

4.3.1 The data obtained during field operations will provide the informational basis to prepare the RI report. The data obtained and the subsequent inspections findings will assist in developing a hazard analysis, by evaluating and vertically delineating the nature and extent of potential hazards to human health and the environment. The groundwater investigation will include a groundwater survey of existing wells, installation of at least one well and groundwater sampling. The data will be used to assess the nature and extent of the hazards or potential hazards presented by MEC or MC at the identified sites in order to support recommendations for proposed MEC remedies.

4.3.2 The investigation of the lagoons in MRS 04 and MRS 05 will include a limited MEC investigation and MC water sampling. The report will then document the findings of the data collections efforts and field inspections. MEC and MC for 5 cays of MRS 2 and use existing data from the Cayo Lobo NTCRA and the Underwater RI for MRS 2 awarded to Parsons for the remaining 6 cays (totaling 12 cays) to complete the RI Report.

4.3.3 This data will provide a basis for determining whether the sites (or portions of the sites) can be NDAI or warrants a move forward to the FS for analysis of further response actions. The project DQOs are presented in Table 3-1.

4.4 QUALITY CONTROL TEST METHODS AND AUDIT PROCEDURES

This section discusses QC methods and procedures to be used during project operations.

4.4.1 Inspections

4.4.1.0.1 USAE will conduct inspections to verify whether quality-related activities comply with this QCP. A list of the audit procedures based on the Definable Feature of Work (DFW) is provided in Table 4-1. Internal inspections will address activities performed by the project team. External inspections will address activities performed by project subcontractors, laboratories, and equipment and material suppliers.

4.4.1.0.2 The UXOQCS will implement the three-phase control process for each of the Definable DFWs in Table 4-1 to audit/inspect the subtasks for compliance with the approved WP, SOPs and DQOs. The three-phase control process includes the preparatory, initial and follow-up phase audits/inspections. The inspections are documented using the QC Surveillance Forms prepared for each DFW (located in Appendix F).

4.4.1.1 Preparatory Phase

A preparatory phase inspection is performed prior to the beginning of work on each DFW. The UXOQCS will review the DFW scope and applicable specifications and verify that the necessary resources, controls and conditions are in place and compliant with the WP before the work activities begin.

4.4.1.2 Initial Phase

The UXOQCS performs an initial phase inspection for each DFW once a representative sample of the work has been completed. The purpose of this inspection is to check the preliminary work for compliance with procedures and contract specifications, to verify through inspection and testing the acceptable level of

workmanship. The UXOQCS will review the minutes of the preparatory phase to check for omissions and resolve any differences of interpretation by project personnel and the contract requirements.

4.4.1.3 Follow-up Phase

4.4.1.3.1 The UXOQCS performs a follow-up phase inspection periodically while work progresses for each DFW. The frequency of the follow-up phase is specified in Table 4-1 by DFW. The purpose of the inspection is to ensure continuous compliance and an acceptable level of workmanship. The UXOQCS will observe the same activities as under the initial inspection and ensure that discrepancies between site practices and approved specifications are identified and resolved. Corrective actions for unsatisfactory conditions or practices will be verified by the UXOQCS prior to continuing work on the affected DFW.

4.4.1.3.2 The inspection program is established to provide the following:

- An objective and independent evaluation of compliance with established policies and procedures (WP, SOPs, AHAs, etc.)
- A mechanism for verifying and implementing the corrective actions recommended as the result of inspections.

4.4.1.3.3 Personnel performing QC inspections are knowledgeable about, and have received training in, QC techniques and methodologies, this QCP and applicable regulations. They will also be technically knowledgeable of the processes being inspected. Inspections will be performed in accordance with written procedures or checklists. Personnel performing QC inspections will not have direct responsibilities in the areas they are assessing.

4.4.1.3.4 System and performance inspections will be undertaken. System inspections will evaluate the components of the QC system, including evaluating items such as approach and adequacy of the preparation step, inspection of the schedules and plan delivery dates, and tracking systems for QC activities. Performance inspections evaluate actual QC activities, such as design control, on-site data gathering, calibration and control, inspection and testing activities, and documentation.

4.4.1.3.5 Inspecting QC personnel will document inspection results, which will be reviewed by the Project Manager. When unsatisfactory or nonconforming conditions or items are found, the responsible organization will implement corrective actions in a timely manner. Previously unsatisfactory areas will be re-inspected to ensure satisfactory corrective actions have been completed. The results of the inspections will be shared with the team with regard to needed rework and lessons learned.

4.4.1.3.6 Records of all inspections will be maintained and controlled as QC records.

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Table 4-1: Definable Features of Work Audit Procedures

Note: QC audits/inspections for each DFW are documented using the QC Surveillance Forms located in Appendix F.

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Mobilization & Site Specific Training	WP Sec-2.2.6.1; 2.2.6.2; 3.3; 4.8.1; 4.8.2; Form Personnel Qualification Verification Form; MEC Training Documentation Form	Visual Observation and Document Review	Preparatory Phase/Initial Phase/Follow-up Phase (PP/IP/ FP)	Once, and follow-up as required	All personnel required for the work activities have been identified, are available, and meet the requirements and qualifications for the positions have been obtained.	Document deficiency and report to SUXOS and PM for resolution, follow-up to verify compliance before personnel are assigned project tasks
	WP and APP	Document Review	PP/IP/ FP	Once, and follow-up as required	All field personnel have reviewed the WP and APP.	Document deficiency and report to UXOQCS and SUXOS for resolution, follow-up to verify compliance before personnel commence assigned project tasks
	APP Form Safety Meeting Attendance Log	Document Review	PP/IP/ FP	Once, and follow-up as required	All personnel have signed the Employee Sign-off Forms for the Site Safety and Health Plan (SSHP), the Certificate of PPE training and all AHAs have been completed.	Document deficiency and report to UXOQCS and SUXOS for resolution, follow-up to verify compliance before personnel commence assigned project tasks
	APP	Document Review	PP/IP/ FP	Once, and follow-up as Material is Introduced to Project	Material Safety Data Sheets (MSDSs) are available on-site for all hazardous materials used or encountered onsite	Document deficiency and report to UXOQCS and SUXOS for resolution, follow-up to verify compliance before personnel are exposed to the hazardous material of concern

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
	App K USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015)	Visual Observation and Document Review	PP/IP/ FP	Once and Follow-up as Required	All field personnel have received a review of the SOP from the team biologist or other qualified (USFWS, NOAA specialists, etc.)	Document deficiency and report to SM/SUXOS for resolution prior to initiating project tasks
	WP Appendix J Project Schedule	Visual Observation and Document Review	PP/IP/ FP	Once and Follow-up as Required	All equipment is received on island as needed to support the project schedule.	Document deficiency and report to SUXOS for resolution
	WP Sec- 2.2	Document Review	PP/IP/ FP	Once	Coordination is performed with personnel on Culebra, USFWS, DNER, PREQB, the U.S. Coast Guard, FAA and USAESCH.	Document deficiency and report to SUXOS for resolution prior to initiating project tasks
	Appendix F: Forms: Mobilization and Site Prep SOP	Document Review	PP/IP/ FP	Once and Follow-up as Required	Coordination with support facilities has been conducted.	Document deficiency and report to SUXOS for resolution prior to initiating project tasks

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
	SSHP	Visual Observation and Document Review	PP/IP/ FP	Daily	Work zones and exclusion zones are properly established.	Document deficiency and report to SUXOS for resolution prior to initiating project tasks
	WP Sec- 4.8.2	Visual Observation and Document Review	PP/IP/ FP	Once, and follow-up as required	All personnel are properly trained and certified to operate equipment and machinery.	Document deficiency and report to SM/SUXOS for resolution, follow-up to verify compliance before personnel operate equipment and machinery
IVS Installation	WP Sec 3.4.3	Visual Observation and Document Review	PP/IP/ FP	Each Occurrence	Proper site selection for the IVS for the DGM Platform and IVS installed as designed.	Document deficiency and report to SM/SUXOS/Project Geophysicist for resolution. DGM survey will not be initiated until the deficiency has been resolved.
IVS Certification	WP Table 3-1; Sec- 3.4.1; 3.4.3 Appendix F: Forms Operator and Geophysical Instrument Checkout	Visual observation	PP/IP/ FP	Daily as required	GPS checked at a known location and indicates accurate position, and IVS MQOs, listed in Table 3-2, for seed item response and location accuracy are met	Deficiency will be reported to SUXOS and personnel/equipment will undergo remedial training and certification

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Analog Test Strip	WP Table 3-1; Sec- 3.4.4;	Visual observation	PP/IP/ FP	Daily as required	Analog Instruments checked at a known location and indicates equipment and operator working per WP	Deficiency will be reported to SUXOS and personnel/equipment will undergo remedial training and certification OR equipment repair or replacement
DGM Survey	WP Table 3-1 and Table 3-2 WP Sec 3.4.5 Appendix F: Forms DGM Prep Initial and Follow-up	Visual Observation and Document Review	PP/IP/ FP	Daily as Required	Pre-operations checks performed on detection equipment and production MQOs (Along Line Measurement Spacing, Velocity, Grid Coverage, BSI Detection, DGM Target Selection), detailed in Table 3-2, are met	Deficiency will be reported to SUXOS and personnel/equipment will undergo remedial training and certification. If required, equipment may be repaired or replaced. Data may be re-collected depending on the results of the RCA
	WP Table 3-1 and Table 3-2 WP Sec 3.4.5 Appendix F: Forms DGM Prep Initial and Follow-up Appendix K. SOP's	Document Review	IP/FP	Daily as required	Locations of suspected MEC recorded and reported to USACE	Deficiency will be reported to SUXOS. UXOQC will verify resolution procedure Data may be re-collected depending on the results of the RCA

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Intrusive Investigation	WP Table 3-1 and Table 3-2. WP Sec 3.5.3; 3.5.4.2; 3.5.5; 3.7 Appendix F: Forms Intrusive Prep Initial and Follow-up and MEC accountability log. Appendix K WP Sec 7	Visual Observation and Document Review	PP/IP/ FP	Daily as Required	Pre-operations checks performed on detection equipment Target Anomaly Investigated per WP Proper documentation in field logs and reporting of MEC Additional intrusive transects investigated; Threatened and Endangered Species Identified around MEC	Deficiency will be reported to SUXOS and personnel/equipment will undergo remedial training and certification or equipment may be repaired or replaced
Small Boat Operations	WP Sec- 3.5.3.2.3; Sec 7, App. K	Visual Observation	IP/FP	Daily as Required	Vessel operating in a manner to protect natural resources but remains functional in field operations	Deficiency will be reported to SUXOS and boat operator will perform remedial training and certification.
Demolition Operations	WP Table 3-1; Sec- 3.5.3.2.3; 3.7.3; 3.7.3.1; 3.7.3.3 App. K; Explosive Site Plan: Explosive Demolition Review Checklist; Explosive Usage Record Form; Explosive Vehicle On Site Inspection	Visual Observation and Document Review	PP/IP/ FP	Upon each occurrence	Coordination and notification requirements have been complete; MD inspected and removed for further processing Threatened and Endangered Species were identified and protected per the WP Proper explosive and disposal documentation has been completed	Deficiency will be documented and reported to SUXOS. UXOQC will verify resolution procedure

DFW	Reference	Audit Procedures	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
MPPEH Management	WP Sec- 3.7.4; App K: MPPEH SOP	Visual Observation and Document Review	IP/FP	Daily as required	MPPEH items properly recorded, contained, and stored	Deficiency will be documented reported to SUXOS. UXOQC will verify resolution procedure
MDAS Management	WP Sec- 3.7.5 App F; Form MDAS Accumulation Form	Visual Observation and Document Review	IP/FP	Daily as required	MDAS items properly recorded, contained, and stored	Deficiency will be documented reported to SUXOS. UXOQC will verify resolution procedure
Weekly Magazine Inspection (when explosives have been stored in the magazine)	WP Sec – 5.7.2	Visual Observation and Document Review	PP/IP/ FP	Upon the initial storage of explosives and then weekly.	Explosives properly recorded, contained, and stored	Deficiency in packaging or storage will be documented reported to SUXOS. UXOQC will verify resolution procedure. If deficiency in the inventory immediate reporting to the USACE Contracting Officer, OESS and USAE Explosive Manager is required.

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4.4.2 Deficiency Management

All deficiencies or nonconforming conditions (as defined in the pass/fail criteria in Table 4-1) discovered during inspections or other QC functions will be noted on a Deficiency Notice (DN) form. The DN will identify, at a minimum, any corrective action required, the individuals reviewing and approving the actions, and the actions taken to prevent recurrence. A DN Log will be maintained to document and track corrective actions to closure, and will be included in the RI Report. The UXOQCS will be responsible for tracking deficiencies to closure and reporting their status on daily reports and log forms (see Appendix F for the DN and DN Log forms).

4.4.2.1 Root Cause Analysis

4.4.2.1.1 If a requirement failure occurs, a root cause analysis will be performed by the UXOQCS or if it is DGM Data Related the Project Geophysicist, who will then present the findings to the PM and DSQ with suggested or required corrective actions. Once approved by management, the team will implement the corrective actions. The Root Cause Analysis and corrective actions will be attached to the weekly QC report. All target reacquisition, DGM metrics and requirements, and intrusive QC measures will be documented, with copies sent to the appropriate personnel for review and inclusion in other documents as deemed necessary.

4.4.2.1.2 Figure 4-1 illustrates the flow of the root cause and effect process that the UXOQCS will use to determine failure causes.

Figure 4-1: Cause and Effect Process

4.4.2.2 Corrective Actions

4.4.2.2.1 Following the root cause analysis and approval of corrective actions by management, project personnel will implement these actions to correct the problem. Potential remedies to be considered may include the following:

- Supplemental training of personnel
- Changes of equipment or modification to equipment currently in use
- Acquisition of supplemental equipment
- Implementation of new procedures or modification to existing procedures
- Changes in QC procedures.

4.4.2.2.2 The UXOQCS will document the application of the corrective actions on the DN. Through follow-up phase surveillance, the UXOQCS will verify that the corrective action implemented has rectified the deficient condition and is sufficient to prevent recurrence.

4.5 FIELD QUALITY CONTROL INSPECTIONS, AUDITS AND REPORTS

The UXOQCS is responsible for verifying that site personnel perform operational checks of instruments and equipment prior to using them on-site. The UXOQCS will periodically check the project logbooks listed below to ensure the log entries are complete and accurate. Inspections will be performed daily at random, with unscheduled checks of the site in general to ensure personnel accomplish all work as specified in the WP. The UXOQCS will utilize the process outlined in Figure 4-2 and Table 4-1 , to ensure all field tasks meet quality standards prior to submittal for the Quality Assurance process. The UXOQCS will submit a report to the SUXOS detailing the results of these checks.

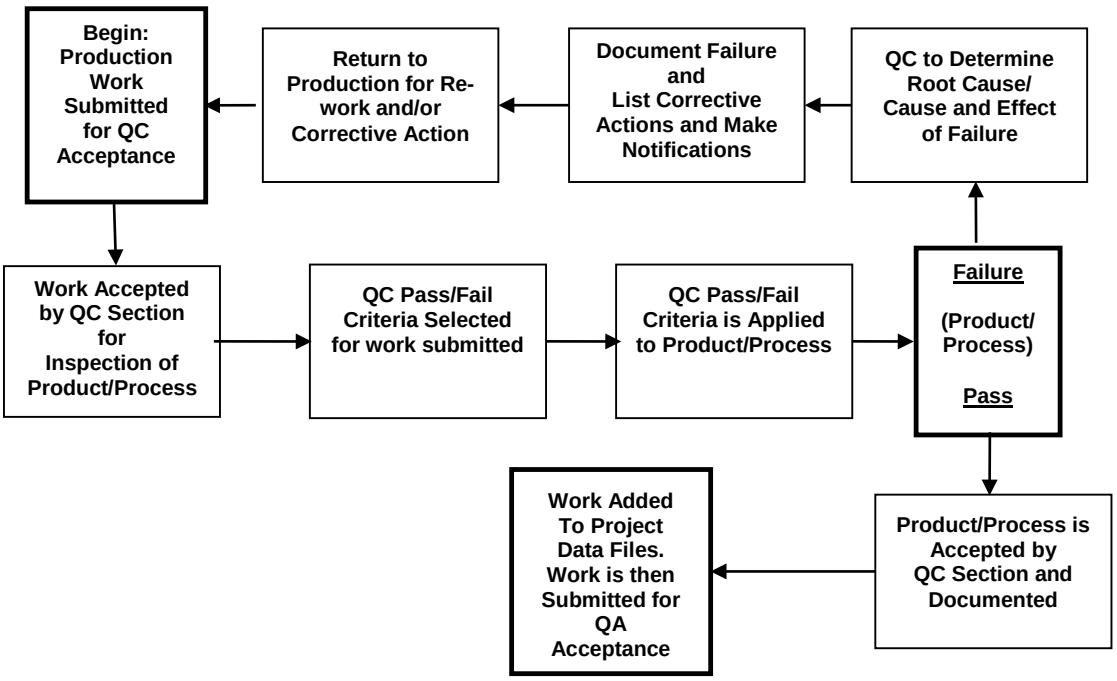

Figure 4-2: QC Process

4.5.1 Equipment Testing Procedures and Frequency

Instruments and equipment, and data analysis and transfer systems, used to gather and generate site specific data, e.g. GPS, Geophysical data (results of geophysical tests will be recorded in the Access Database) to support the field activities, will be tested with sufficient frequency and in such a manner as to ensure that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Instruments or equipment failing to meet the standard will be repaired, recalibrated, or replaced. Replaced instruments or equipment must meet the same specifications for accuracy and precision as the item removed from service. Operator proficiency will also be evaluated regularly for proper instrument set-up, operation, survey technique, and data transfer. Items such as cellular telephones and radios will be tested for serviceability at the start of each workday. Results of these tests will be recorded in the Daily Log. Items failing these tests will be repaired or replaced prior to operations commencing.

4.5.2 Calibration

4.5.2.1 The UXOQCS will coordinate with the Site Geophysicist to check and ensure that DGM equipment is calibrated or recalibrated in accordance with the applicable SOPs and manufacturer's recommendation, or owner's manual. Calibrations will be completed on a prescribed schedule and the calibration results recorded in the daily field logbook.

4.5.2.2 Recalibration will be performed as necessary, with the reason for the recalibration and the results recorded in the daily field logbook.

4.5.3 Maintenance

4.5.3.1 The UXOQCS will check field logbooks to ensure that maintenance of vehicles and equipment are performed on a regular schedule and in accordance with the manufacturer recommendations or owner's manual for equipment requiring regular upkeep.

4.5.3.2 USAE and its subcontractors will coordinate scheduled maintenance of the following equipment in accordance with manufacturer recommendations or the owner's manual.

- Vehicles
- Vessels (Boats)
- Sensor and Data Acquisition Systems
- Personal Protective Equipment
- Communications Equipment
- GPS Equipment, and Personal Digital Assistant
- Emergency Equipment.

4.5.3.3 Replacement equipment will meet the same specifications for accuracy and sensitivity as the equipment removed from service. Geophysical instruments will be checked on the test strip daily and after any repairs. They will be required to demonstrate a consistent detection rate for all seed items and any identified background anomalies. Repair or replacement of parts will meet the manufacturer specifications and recommendations. The UXOQCS will document and maintain records pertaining to the testing, repair, and/or replacement of equipment on site.

4.5.3.4 Repair or replacement parts will meet the manufacturer requirements and be installed by personnel authorized to replace parts or make repairs. Records pertaining to the testing, repair, or replacement of instruments and equipment will be maintained on-site by the UXOQCS.

4.5.4 Logs and Records

Activity Logs will be maintained daily, as applicable; all entries will be in ink. Logbooks will be bound and pages consecutively numbered. Logbooks and records may be supplemented by the use of preprinted forms (e.g., safety inspection forms, safety briefings, etc.). These forms help to ensure uniformity of

activities being conducted, inspected, and reviewed. Forms are located in Appendix F of the WP. The following logbooks and records will be maintained on-site and are subject to inspection by the UXOQCS.

4.5.5 UXO QC Report

The UXOQCS will prepare daily QC Reports and a weekly QC Report (See the report forms located in Appendix F, Daily QC Report, and Weekly QC Report forms). These documents will be kept on-site. The weekly QC report will be submitted to the PM for distribution to the appropriate personnel. This report will include the following information:

- The periodic assessments of work performed
- Significant QA/QC problems and corrective actions taken
- Conformance or non-compliance issues
- Work progress
- Lessons learned, and change recommendations
- Signature of the UXOQCS.

4.5.5.1 Daily Journal

The Daily Journal will be maintained by the SUXOS; this journal provides a summary of all operations conducted on-site, to include:

- Date and recorder of information
- Start and end time of work activities
- Work stoppage
- Visitors and escorts
- Weather conditions
- Changes to the WP, SSHP, policies or procedures
- Injuries and /or illnesses
- Safety briefings
- MEC encountered
- Relevant events and training
- Signature of the SUXOS.

4.5.5.2 Field Logbooks

The Field Logbooks are maintained by the Supervisory Personnel. These logbooks are used to record site activities and field data. Logbooks are maintained in a neat and legible manner and provide an historic record of site activities, to include:

- Date and team location
- Personnel and work performed
- Equipment and instrument checks
- Injuries and/or illnesses
- Changes to work instructions
- Work stoppage
- Visitors
- Other relevant events
- Signature of Supervisor.

4.5.5.3 Safety Logbook

The site UXOSO will maintain the Safety Logbook. This logbook is used to record all safety matters associated with the project site, including:

- Safety briefings and/or meetings
- Training
- Safety inspections and audits performed
- Work stoppage due to safety issues
- Visitors
- Accidents, incidents, and near misses with corrective action taken
- Site control measures
- Other relevant events
- Date and teams checked
- Signature of the UXOSO.

4.5.5.4 QC Logbook

The QC Logbook will be maintained by the UXOQCS. This logbook is used to record all QC matters associated with the project site, including:

- Equipment testing and results
- QC inspections performed
- Work stoppage due to QC issues
- Equipment monitoring results
- Non-conformance reporting
- Other relevant events
- Date and teams checked
- Signature of UXOQCS.

4.5.5.5 Training Records

Training records will be maintained on-site and monitored by the PM as necessary. These records contain any licenses, permits, certificates, or other qualifying data, to include:

- Date and nature of training
- Personnel attending and instructor(s)
- Visitor training and briefings
- Signature of instructor and SUXOS, UXOSO or UXOQCS.

4.5.5.6 Underwater MEC and Anomaly Records

The underwater MEC and anomaly records are individually prepared records for each operating team. These records are prepared by the SUXOS, and are used to record data on anomaly and MEC encountered. These records also include:

- Date and target identifier
- Identification of item(s) located
- Classification
- Distance from marked target location and depth encountered

- Type, condition, depth, and location of any MEC encountered
- Disposition of MEC
- Other relevant data
- Signature of Supervisor.

4.5.5.7 Photographic Logbook

The Photographic Logbook will be maintained by the SUXOS. This logbook is used to record all photographs taken on the project site. These photographs are used to document MEC encountered, and before, during, and after work, and/or site conditions. Photographs will include:

- Date and time taken
- Unique identifying number(s) relating to the Photographic Logbook
- Location photograph was taken
- Brief description of the subject matter.

4.5.6 Daily Review of Field Data

During daily field activities, or at least once daily, the UXOQCS will review field data. UXOQCS will ensure the following: The Daily Observer Log is being maintained, DGM Data is being collected and submitted to the Project Geophysicist daily, the Site Geophysicist and UXOSO are maintaining a daily logs, Daily safety briefs and inspections are being completed per the Accident Prevention Plan (APP).

4.6 CONTRACT SUBMITTAL QUALITY CONTROL PROCESS

4.6.1 Documents required under this contract will be developed and maintained by a project team consisting of the USAE PM, Project Engineer, Project Geophysicist, GIS Manager, and DSQ. These team members will contribute their corporate knowledge and experience to the documents to ensure technical quality.

- The PM will take the lead in the development of contract documents, and will schedule a peer review and a QC review in sufficient time to meet project milestones for delivery of submittals.
- The Project Engineer will provide technical writing support to develop the documents, and will review completed documents to ensure accuracy and completeness.
- The PM will review and supply information and documents to ensure accuracy and completeness of procedures and reports.
- The Project Geophysicist will ensure a technically sound approach to fieldwork, and accuracy and completeness of reporting on geophysical data.
- The GIS Manager will develop digital database and maps, overlays of beaches and exclusion zones, and other spatial data. The GIS Manager will prepare all drawings or maps needed for submittals, and will perform QC of civil survey data.

4.6.2 After the project team has performed a review of documents, the DSQ and UXOQCS will perform a QC review to ensure overall quality and completeness.

4.6.3 Comments on submitted documents will be directed by project personnel to the appropriate subject matter expert for resolution.

4.6.4 Changes to final WPs will be submitted to the PM immediately upon approval. The PM will be responsible for ensuring that the changes are posted to the hard copy on file and that all field personnel are made aware of the changes.

4.7 FIELD QUALITY CONTROL INSPECTIONS, AUDITS, AND REPORTS

The UXOQCS is responsible for the accomplishment of operational checks of instruments and equipment by site personnel. The appropriate log entries will be made. Inspections will be performed daily at random, with unscheduled checks of the site in general, to ensure personnel accomplish all work as specified in the WP. The UXOQCS will utilize the process outlined in Figure 4-2 and Table 4-1 to ensure all field tasks meet quality standards prior to submittal for the Quality Assurance process. The UXOQCS will submit a report to the Site Manager detailing the results of these checks.

4.7.1 Classification of MEC-Related Items

4.7.1.1 The MEC accountability will be conducted in accordance with DID WERS-007.01. This accounting will include the amounts of UXO, DMM, and MD, item nomenclature and condition, location and depth of the UXO, DMM, and MD, and disposition. USAE will keep an account of all demolition materials used on site. In addition, the team will take digital photographs of UXO and DMM and examples of MD found during the investigation. The RI Report will contain tables that reflect all UXO, DMM, MD, range related debris, and cultural debris that have been excavated, and will include photographs of all UXO and DMM and examples of MD.

4.7.1.2 To ensure accurate classification of MEC-related items (with respect to their explosive hazard), as the information is used to make decisions about the response action, USAE will inspect suspect MEC and classify these items in accordance with Table 4-2. The list is not all inclusive, but reflects the types of MEC related material that may be encountered at the project site. The numbers in the table refer to footnotes that are found below the Table. It is important to read the footnotes, as they provide additional information of importance to understanding.

Table 4-2: Classifications of MEC-Related Items

	Classification Following Inspection:					
	Presents Explosive Hazards			Does Not Present Explosive Hazards		
	MEC					
Type of Material	UXO	DMM (1)	MC (2)	MC (3)	MD	Other
Used military munitions, on a range, fired	X				X	
Unused military munitions, on a range, apparently discarded		X			X	
Used military munitions, in a burial pit, on a former range	X(4)				X	
Unused military munitions, in a burial pit on a former range		X(4)			X	
Explosives in the soil			X(5)	X		
Target from a range (other than small arms range)	X(6)	X(6)	X(6)			X(7)
Remnants of munitions from a former range	X(8)	X(8)	X(8)		X(9)	

Footnotes:

(1) DMM: Munitions generally considered as DMM include: buried munitions; un-recovered kick-outs from open detonations; munitions left behind or discarded accidentally during munitions-related activities; munitions intentionally disposed of without authorization during munitions-related activities. Munitions removed from storage for the purpose of disposal that are awaiting disposal are not DMM.

(2) MC: MC is both (a) an explosive; and (b) present in sufficient concentrations to present explosive hazards.

(3) This is MC that is either (a) not an explosive (e.g., lead, beryllium, and cadmium); or (b) an explosive not present in sufficient concentrations to present explosive hazards.

(4) Although military munitions in a burial pit will normally be DMM, some may be UXO. For explosives safety reasons, munitions in a burial pit should be approached as UXO until assessed by technically qualified personnel (e.g., EOD personnel, UXO-qualified personnel) have determined that they are not UXO or that they do not present explosive hazards similar to UXO.

(5) Explosive soil is typically found in sumps and settling lagoons for explosives-laden wastewater, and in and around drainage ditches and pipes that carry the wastewater to such sumps and lagoons.

(6) A target is a type of range-related debris. Although a target is not MEC, it may contain UXO, DMM, or MC. Prior to its release from DoD control, its explosives safety status must be documented.

(7) A target's explosives safety status must be documented and any demilitarization required to remove its military characteristics must be performed prior to its release from DoD control.

(8) UXO, DMM, or MC may be found on operational ranges and on former ranges (previously referred to as closed, transferring or transferred ranges). An inspection of the material will determine into which category this material falls. For example, if a projectile breaks apart on impact, one could find (a) a sheared-off fuze, which would be UXO or (b) explosive filler, which would be MC that broke away from the projectile's open body. If, during an open detonation of an unserviceable munitions that is conducted on an operational range, the donor charge detonates but the munitions being destroyed breaks up but does not detonate, the remnants of the munitions would be DMM or, if explosive residue (e.g., clumps of trinitrotoluene (TNT), MC.

(9) Fragments, while MD, may be evidence of High Explosive (HE) usage at the site. For such fragments, USAE will indicate evidence of HE in its classification. After determination of its explosives safety status, scrap metal from used munitions on a range that is documented as safe would, after any demilitarization required to remove its military characteristics, be available for release from DoD control. In additions to these DoD requirements, other regulatory criteria may apply.

4.8 QUALIFICATIONS AND TRAINING

4.8.1 Employee Qualifications

The PM will maintain personnel files on each employee at the project site. These files include copies of necessary licenses, permits, training records, certificates of qualifications, and resumes that support the employee's placement and position. Prior to an employee's initial assignment, or before any change in duties or assignment, the PM will review the employee's files to ensure necessary qualifications are met. All site records and documentation are subject to inspection and review by the UXOQCS.

- Site UXO personnel must meet the minimal qualifications as outlined in DDESB TP-18, dated 20 December 2004.

4.8.2 Employee Training and Site Specific Requirements

4.8.2.1 USAE ensures that only qualified and properly trained personnel are assigned to positions on project sites. Prior to mobilization of personnel, USAE ensures that training required by USA, OSHA 29 CFR 1910.120, and the EM 385-1-1 has been completed for all personnel assigned to the project as shown in Table 4-3 below.

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Table 4-3: Training

Training Course	Personnel Attending
40-Hour HAZWOPER Training	All personnel who have not previously received this training or who do not qualify for certification through documented experience or training equivalent to that in paragraphs (e)(1) through (e)(4) of 29 CFR 1910.120.
8-Hour Supervisor Course	All USAE management and supervisory personnel. This includes the SUXOS, UXOSO, UXOQCS, and UXO Technicians III.
8-Hour Refresher Course	All site personnel, except those who have completed their initial 40-Hour HAZWOPER training within the past year.
First Aid and Cardiopulmonary Resuscitation (CPR) Training	CPR training will be required for USAE personnel and subcontractors that are participating in field operations
30-Hour OSHA Construction Safety Course	Training Requirement for UXOSO IAW with EM 385-1-1, Section 01.A.17

4.8.2.2 In addition, prior to the start of operations all personnel will receive the following as a minimum:

- Familiarization with the WP and its policies and procedures
- APP/SSHP/AHA/SOP orientation
- Emergency Response Plan training
- PPE training
- Environmental considerations peculiar to the operations on the project site
- Instruction and training on equipment usage and safe work practices
- Daily safety training outlining the day's activities.

4.8.2.3 Visitors to the site will be provided with a site orientation and safety briefing prior to entering the exclusion area (while on-site, visitors will be escorted at all times by a UXO Technician).

4.8.2.4 Training is conducted by the SUXOS, UXOQCS, or other designated personnel and records of attendance are maintained on-site. Certificates of Training are issued when applicable.

4.9 LESSONS LEARNED PROGRAM

As required by ER 1110-1-12, USAE will develop a Lessons Learned Program (LLP) to provide for the exchange of information regarding problems that may occur during the response RI activities on this project site.

4.9.1 Lessons Learned Objective

The objective of the LLP is to capture and share experience or recognized potential problems or better business practices to:

- Prevent the recurrence of repetitive design/execution deficiency
- Clarify interpretation of regulations or standards
- Reduce the potential for mistakes in high risk/probability areas of concern

- Pass on information specific to an installation or project
- Promote a good work practice that should be ingrained for repeat application
- Promote efficient and cost-effective business practice.

4.9.2 Team Responsibilities

The USAE project team will be responsible for identifying and submitting lessons learned for review and approval. Throughout this MEC response activity, USAE project team members will consider how their experiences might be appropriate for the LLP.

4.9.3 Project Management Responsibility

The PM will review and approve all lessons learned for submittal to the Corps PM for potential discussion with the project development team during After Action Reviews.

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CHAPTER 5. EXPLOSIVES MANAGEMENT PLAN

5.1 GENERAL

This plan outlines the procedures USAE will use to complete the Culebra RI/FS MRS 02, 04, 05, and 07 fieldwork. The procedures are in accordance with the following regulations:

- DoD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives
- DoD 6055.9-M, DoD Ammunition and Explosives Safety Standards
- Applicable Sections of the DOT, 49 CFR Parts 100-199
- Army Regulation (AR) 385-64, Ammunition and Explosives Safety
- AR 190-11, Physical Security of Arms, Ammunition and Explosives
- Engineer Manual (EM) 200-1-15 Engineer Manual, Ordnance and Explosives (OE)
- EP 1110-1-18 Engineer Pamphlet, Ordnance and Explosives Response
- Explosive Law for Commonwealth of Puerto Rico
- USACE EM 385-1-97, Explosives Safety and Health Requirements Manual
- USACE EM 385-1-1, Safety and Health Requirements Manual
- Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATF) Publication 5400.7, Federal Explosives Laws and Regulations.

5.2 ACQUISITION

USAE will use commercial explosives obtained through a local explosives supplier for disposal and venting of MEC. USAE has a Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) permit (see Appendix L) to purchase, store, and use explosives and will supply commercial demolition material for disposal and venting operations. USAE personnel have a letter of clearance from the ATF for the use of explosives. As required by the Commonwealth of Puerto Rico, USAE will have a Blaster's License issued for the RI/FS. USAE will provide the explosives distributor a certified statement of the intended use of the explosive material. The ATF permit will be posted on-site and will be available for Federal, state, or local inspection.

5.2.1 Description and Estimated Quantities

USAE will store explosives on-site in the Type II magazine approved ESP dated November 2013. USAE will store less than 100 pounds of bulk and initiating explosives on-site.

5.2.2 Acquisition Source

USAE will purchase explosives from licensed commercial suppliers such as Professional Rock Crushing Corp., Dorado, Puerto Rico. The SUXOS will be authorized, in writing, to request and receive explosives from the commercial suppliers.

5.2.3 Listing of Proposed Explosives

Table 5-1 lists the types and quantities of explosives that may be used.

Table 5-1: Typical Explosives and Quantities for RI/FS

Type of Explosive	Descriptions	Quantity
1-lb.	Booster Black Cap	20 ea.
Electric Caps	Rock Star Detonators	100 ea.
Detonating Cord	80 Grain	1 roll 500-ft
Perforators	19.5-gram Shaped Charges	50-ea.

5.3 INITIAL RECEIPT

Shipments of explosives will be by commercial carrier from the explosives supplier. The explosive supplier is responsible for all permits and documentation required by Federal, Commonwealth of Puerto Rico, and local regulations for movement of explosives to the air terminal or to Fajardo (if transport by vessel). USAE will coordinate with the Mayor's Office and the Puerto Rico State Police to receive and transport the explosives to the Type II magazine.

5.3.1 Procedures for Receipt of Explosives

Upon receipt, the type, quantity, and lot number of each explosive item will be checked against the shipping manifest and recorded on the USAE Explosives Usage Form and the Daily Operations Journal (see Appendix F, USAE Forms).

5.3.2 Procedures for Reconciling Discrepancies in Quantities Shipped and Received

The SUXOS will reconcile the delivery shipping documentation with the requested amounts ordered and received. The SUXOS will not sign for or accept shipments with shortages or overages until the discrepancies are corrected.

5.4 STORAGE

On-site storage of explosives is anticipated.

5.4.1 Establishment of Storage Facilities

5.4.1.1. USAE will store explosives in the existing ATF Type II magazine, previously sited on Culebra (Figure 5-1). USAE will comply with BATF, Federal, and local storage and compatibility criteria and procedures, including the required USAESCH approved ESP.

5.4.1.2 USAE will maintain the magazine in compliance with the magazine criteria and quantity distance (QD) requirements established in ATF Regulation ATF P 5400.7 and DoD 6055.09-M, DoD Ammunition and Explosives Safety Standards.

Figure 5-1: Site of Type II Magazine

5.4.2 Physical Security of Storage Facilities

The Type II magazine and the blasting cap box that is mounted on the side of the Type II magazine will be locked with high security padlocks (2) meeting ATFP 5400.7 Section 55.208 (a) and will be enclosed by a chain link fence, IAW 6055-9 M, and EM 200-1-15. The magazine and cap box will remain locked except when receipts and issues are being made. The two locks on both the magazine and cap box will require two different keys. One key will be kept by the SUXOS and the second key will be kept by the UXOQCS. The SUXOS will maintain the key to the fence enclosing the magazine. The magazine storage area will be inspected each work week by the SUXOS and UXOQCS to ensure the integrity of the enclosure.

5.5 TRANSPORTATION

Transportation of MEC and explosives will comply with all Federal, state, and local regulations. Permits are not required under CERCLA for on-site or on Federal installations for transportation of explosives or conventional military munitions. USAE will request permission from the Mayor's Office to use the docks at DNER or the Ferry Dock in the City of Dewey, Culebra, PR. Coordination will be made with the Puerto Rican State Police to provide an escort during transport of any explosives to or from the magazine to each MRS on the island, or to the docks on the island. USAE plans to transport newly purchased explosives to the island of Culebra using helicopters or via boat contracted by USAE. If a vessel is used to transport

explosives the vessel will meet USCG requirements for the size of vessel. USAE will coordinate a Police boat escort from Fajardo to Culebra.

5.5.1 Procedures for Transportation from Storage to Disposal Location

5.5.1.1 IAW with DOT regulations, USAE will transport explosives in IME-22 containers for transportation to the disposal sites. USAE will comply with the following:

- Initiating explosives, such as blasting caps, will remain separated at all times. Blasting caps may be transported in the same vehicle as long as they are in a separate IME-22 container (49 CFR 173.63) and secured away from other items.
- Compatibility requirements will be observed.
- Only UXOTIIIs and above may be issued with and can transport explosive materials. The receiving party will sign the receipt documents for accountability.
- Operators transporting Hazard Division (49 CFR 173.50) 1.1 explosives will have a valid driver's license or US Coast Guard Captains License.
- Drivers will comply with posted speed limits but will not exceed a safe and reasonable speed for conditions. Vehicles transporting explosives off-road will not exceed 25 miles per hour (MPH).

5.5.1.2 Personnel will not ride in the cargo compartment with explosives or MEC.

5.5.2 Explosive Transportation Vehicle Requirements

Explosives will be transported in closed containers in the beds of vehicles/vessels whenever possible. The load will be well braced and, except when in closed vehicles, covered with a fire-resistant tarpaulin or placed in an appropriate shipping container.

- Initiating explosives, such as blasting caps, will remain separated at all times. Blasting caps may be transported in the same vehicle as long as they are in a separate container and secured away from other items.
- Compatibility requirements will be observed.
- Only UXO Technicians III and above may be issued explosive materials and may transport them. The receiving party will sign the receipt documents for accountability;
- Operators transporting explosives will have a valid driver's license or when transported by vessel will have a US Coast Guard Captains License;
- Drivers will comply with posted speed limits but will not exceed a safe and reasonable speed for conditions. Vehicles transporting explosives off-road will not exceed 25 MPH.
- Personnel will not ride in the cargo compartment with explosives or MEC.
- Vehicles transporting explosives or MEC will be inspected prior to load-out using the Motor Vehicle Inspection form DD FORM 626 (Appendix F), and will be properly placarded. Vessels will fly the code bravo flag.
- Vehicle engine will not be running and the wheels will be chocked when personnel are loading/unloading explosives.
- Beds of vehicles will have a bed liner, dunnage, or sand bags to protect the explosives from contact with the metal bed and fittings.
- Vehicles transporting explosives will have a First Aid kit, two 10-BC rated fire extinguishers, and a means of communications.

5.5.3 Transportation by Vessel

5.5.3.1 Transport of explosives by waterborne vessel requires adhering to the applicable sections contained in 49 CFR (DOT) and U.S. Coast Guard directives.

5.5.3.2 Specifics, such as safety requirements, placarding, stowage, security, personnel, and emergency procedures are detailed in the SOP Explosives Transportation – Open Water Vessels, contained in Appendix K.

5.6 RECEIPT PROCEDURES

The SUXOS will strictly control access to all explosives. All receipts, issues, and usage of explosives will be properly documented and verified through physical count by the UXOQCS.

5.6.1 Records Management and Accountability

Upon receipt, the type, quantity, and lot number of each explosive item will be checked against the manifest and recorded on the Explosives Usage Form (Appendix F). The original receipt documents and an inventory will be maintained on file by the SUXOS. All original explosive records will be forwarded to USAE Oldsmar for archive in accordance with ATF regulations and requirements. ATF requires USAE to maintain explosive records for commercial purchases for a period of 5 years. Copies of all records will be maintained on-site by the SUXOS and be available for inspection by authorized agencies. Their respective lot number will track explosive items until the item is expended or transferred to Government control and accountability.

5.6.2 Authorized Individuals

USAE is required to provide commercial suppliers with documentation of individuals authorized to request and receive explosives. The individual authorized to receive and issue explosives is the USAE SUXOS and in some cases, if the SUXOS is not available, the UXOQCS. On site, the SUXOS will designate, in writing, the individual who is authorized to transport and use explosives.

5.6.3 Certification

The SUXOS and UXO Technician III team leader performing demolition will sign and date the explosives usage form certifying that the explosives were used for their intended purpose.

5.6.4 Procedures for Reconciling Receipt Documents

The SUXOS and UXOQCS will be responsible for performing a review of the explosives usage record. If there is a discrepancy between the amount received and the amount of explosives consumed, then these individuals will review the receipt documentation to see if the records are correct. If the records review does not reconcile the discrepancy, then it will be reported to the Contracting Officer and USA-Oldsmar for investigation.

5.7 INVENTORY SCHEDULING

Explosives will be inventoried at least weekly by the SUXOS (or approved designee), the UXOQCS, and a Team Leader. Complete inventories will also be conducted after any issues/turn-ins of demolition material.

5.7.1 Storage Facility Physical Inventory Procedures

5.7.1.1 The SUXOS will strictly control access to all explosives. All issues and turn-ins of explosives will be properly documented and verified through physical count by the SUXOS or his approved designee. On receipt, the type, quantity, and lot number of each explosive item is recorded on the Magazine Data Card (see Appendix F).

5.7.1.2 The SUXOS will review all requests for explosives from the individual operating sites and only sufficient explosives for the day's operations will be requested and issued. Issues of explosives will be recorded on Explosives Usage Records, deducted from the Magazine Data Cards, and annotated in the daily journal. This procedure will ensure that the issued explosives are accounted for while they are in the possession of individual users. The end user of explosives will certify on the Explosives Usage Record that the explosives were used for their intended purpose. Entries made on the Explosives Usage Records and

Magazine Data Cards will be verified through physical count by the UXOTIII when drawing or turning-in the explosives and will be verified by the UXOQCS.

- At the end of each disposal operation the UXOQCS and the Demolition Team UXOTIII will reconcile the entries on each Explosives Usage Record, and will turn these records over to the SUXOS. The record of ordnance items destroyed with the explosives consumed will be kept in the SUXOS daily log.
- Entries made on the Explosives Usage Records and Magazine Data Cards will be verified through physical count by the Demolition Team UXOTIII when drawing or turning in the explosives, and the UXOQCS will verify the record.

5.7.2 Procedures for Reconciling Inventory Discrepancies

The SUXOS, UXOQCS, and a UXOTIII will be responsible for performing a weekly inventory of the explosives within the magazine. If there is a discrepancy between the inventory and the volume of explosives within the magazine, then they will review the Magazine Data Card and Explosives Usage Record to see if the inventory records are current. If the records review does not reconcile the discrepancy, then it will be reported to the USACE OESS, Contracting Officer, and USAE PM for investigation.

5.7.3 Inventory Scheduling

SUXOS, UXOQCS, and a UXOTIII will perform weekly inventories of the explosives within the magazine.

5.7.4 Reporting Loss or Theft of Explosive Materials

If it is confirmed that ordnance or explosives are missing, then the SUXOS will contact the Contracting Officer immediately by telephone and in writing within 24 hours. The USACE OESS and USA-Oldsmar will be notified following the notification of the Contracting Officer. USA-Oldsmar will notify ATF and immediately begin an investigation.

5.7.5 Procedures for Return to Storage of Explosives Not Expended

Explosives that were issued for use but were not expended will be returned daily to the magazines at the completion of disposal operations. The Demolition Team UXOTIII will return the unused explosives to the storage magazine and record the items on the Magazine Data Card and Explosives Use Record.

5.8 DISPOSAL OF REMAINING EXPLOSIVES

ATF requires an accounting of all explosives purchased and used; therefore, at project completion all unused explosives still in the sealed containers will either be disposed of by detonation, or by transferring custody and accountability to an incoming contractor, a Government agency, or returned to the distributor.

5.9 ECONOMIC ANALYSIS

Because of ATF requirements and prohibition for returning used open packaging, these explosives will be consumed at the site. An economic analysis of the explosives disposal alternatives will not be required.

5.10 FORMS

USAE will use internal USAE forms Magazine Data Card and Explosives Usage Record for explosives receipt, issue, inventory, and DD Form 626 for vehicle inspections. These forms are in Appendix F.

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CHAPTER 6. ENVIRONMENTAL PROTECTION PLAN

6.1 IDENTIFICATION OF ENVIRONMENTAL CONCERNS

6.1.1 This chapter of the WP Addendum describes updates to Section 7.0 of the EOTI WP. Unless indicated below Section 7.0 of the EOTI WP will remain in effect. This section in conjunction with the EOTI WP Section 7.0 describes environmental concerns and describes methods used during site activities designed to minimize pollution, protect and preserve natural resources, restore damage, and control noise and dust within reasonable limits. Appendix K includes the SOP for USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015). This document contains a series of SOPs to avoid or minimize impacts to threatened and endangered species listed pursuant to the Endangered Species Act (ESA) during work on Culebra and adjacent cays and in the surrounding waters and was updated in 2014.

6.1.2 Appendix K also contains other documents relevant to the ecology of the site including:

- Interim Guidelines for UXO Investigation, Identification, and Removal Activity Taking Place at Culebra National Wildlife Refuge.
- Protected Species and Habitat Protocols.
- Vessel Strike Avoidance Measures and Reporting for Mariners.
- Floral & Faunal Survey of Cerro Balcon Project Site.
- Floral & Faunal Survey of Cayo Lobo DERP-FUDS Clean Up.
- Acropora ESA 4(d) Rule.

6.1.3 Prior to the initiation of field activities, team members will receive site specific training to include SOPs found in Appendix K.

6.2 ENDANGERED/THREATENED SPECIES WITHIN THE PROJECT SITE

6.2.1 Endangered and threatened plant and animal species inhabit specific areas of the Culebra. It is essential that site personnel maintain close coordination with the responsible environmental resources agencies to avoid disturbing any of these species.

6.2.2 In the event that a threatened or endangered species is harmed as a result of clearance activities, USAE will notify the CESAJ PM, Task Order Manager and contracting officer at the first possible opportunity.

6.2.3 Access to the cays will be conducted in accordance with the SOPs and coordinated with the responsible environmental resources agencies.

6.2.4 The main island of Puerto Rico and its associated islands support 82 federally listed threatened and endangered species consisting of 33 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 82 federally listed species, 16 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 project are:

- *Anolis roosevelti* (Culebra Island Giant Anole),
- *Epicrates monensis granti* (Virgin Islands Tree Boa),
- *Sterna dougallii* (Roseate Tern),
- *Leptocereus grantianus* (Cactus),

- *Peperomia wheeleri* (Wheeler's Peperomia),
- *Trichechusmanatus mantus* (Antillean Manatee)
- *Caretta Caretta* (Loggerhead Sea Turtle)
- *Cheloniamydas* (Green Sea Turtle)
- *Dermochelyscoriacea* (Leatherback Sea Turtle)
- *Eretmochelys imbricate* (Hawksbill Sea Turtle)
- *Magapteranovaiangliae* (Humpback Whale)
- *Balaenopteraphysalus* (Finback Whale)
- *Balaenoptera borealis* (Sei Whale)
- *Physetermacrocephalus* (Sperm Whale)
- *Balaenopteramusculus* (Blue Whale)
- *Acropora palmate* (Elkhorn Coral)
- *Acroporacervicornis* (Staghorn Coral)
- *Epinephelus striatus* (Nassau grouper) – Commonwealth of PR listing
- *Epinephelus itajara* (Goliath grouper) – Commonwealth of PR listing
- *Hippocampus spp*. (Sea horses) – Commonwealth of PR listing
- On September 10, 2014 the NMFS published a final rule in the Federal Register (79 FR 53851) to implement a final determination to list 20 coral species as threatened, under the Endangered Species Act (ESA) of 1973, as amended (effective date listed as October 10, 2014). Five of these species are known to occur in Puerto Rico including:
    - *Dendrogyra cylindrus*, (pillar coral)
    - *Mycetophyllia ferox*, (rough cactus coral)
    - *Orbicella annularis*,(lobed star coral)
    - *Orbicella faveolata* (mountainous star coral)
    - *Orbicella franksi* (genus *Orbicella* sp. formerly known as *Montastrea* sp.) (boulder star coral)
- On September 2, 2014 NMFS published a final rule in the Federal Register (79 FR 38213) to list the Central and Southwest (SW) Atlantic Distinct Population Segment (DPS) of scalloped hammerhead shark (*Sphyrna lewini*) as threatened species under the ESA. NMFS is also considering critical habitat for the Central & SW Atlantic DPSs.
- The Nassau grouper (*Epinephelus striatus*) is a candidate for the US Endangered Species List. There has been a complete ban on the fishing of Nassau grouper in the US federal waters since 1990. This includes federal waters around Puerto Rico and the U.S. Virgin Islands. There is also a ban on U.S. state waters.

  MRSs 02 contains live specimens of the staghorn, elkhorn, *Orbicella franksi* formerly known as *Montastrea sp* (boulder star coral) and pillar corals, areas of MRS 02 is designated critical habitat (CH) for elkhorn and staghorn corals as well as for the green sea turtle.

6.2.5 The cays surrounding Culebra are known nesting areas for shorebirds, seabirds, and sea turtles. Although seabirds may be present on the cays year round, the majority of shorebird and seabird nesting occurs during the spring and summer months. Critical times that MEC should not be detonated because of seabird activity is between the months of April through September; this would also be applicable of most sea turtle nesting. All work schedules will be coordinated with the responsible natural resource agencies to avoid or mitigate possible disturbance of sensitive species during nesting seasons.

6.2.6 The Roseate Tern (*Sterna dougallii*) is listed as threatened and the Brown Pelican (*Pelecanus occidentalis*) was delisted due to recovery but is being monitored. A complete list of seabirds that occur in the project area is included in Appendix K the SOP for USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015). Within this SOP Appendix D Lists the following seabirds found in Table 6-1 and Table 6-2 that visit Culebra and the Cayos of MRS 02:

Table 6-1: Culebra Archipelago Seabirds

Species Name	Nesting?	Species Name	Nesting?
Audubon's Shearwater	Yes	Least Tern	Yes
Masked Booby	Yes	Great Shearwater	No
Brown Booby	Yes	Manx Shearwater	No
Red-footed Booby	Yes	Wilson's Storm-Petrel	No
White-tailed Tropicbird	Yes	Leach's Storm-Petrel	No
Red-billed Tropicbird	Yes	Double-crested Cormorant	No
Laughing Gull	Yes	Common Tern	No
Royal Tern	Yes	Arctic Tern	No
Sandwich Tern	Yes	Pomarine Skua	No
Cayenne Tern	Yes	Black Noddy	No
Roseate Tern	Yes	Herald's Petrel	No
Bridled Tern	Yes	Brown Pelican	Yes
Sooty Tern	Yes	Magnificent Frigatebirds	No*
Brown Noddy	Yes		

*Need to be confirmed; potential areas for nesting occur.

Table 6-2: Seabird Areas on Culebra Archipelago

Seabird areas on Culebra Archipelago	Bird Name	Observed or Nesting	Nesting Period	Resident or Migratory
Flamenco Peninsula	Sooty Tern	nesting	March to September	Migratory
Luis Peña Cay	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	nesting	February to September	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
Del Agua Cay	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	nesting	February to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
Ratón Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory

Seabird areas on Culebra Archipelago	Bird Name	Observed or Nesting	Nesting Period	Resident or Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
Yerba Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Lobo Cay	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	observed	February to September	Migratory
	Red-billed Tropicbird	observed	May to September	Migratory
Lobito Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Laughing Gull	nesting	April to September	Migratory
	Royal Tern	nesting	May to July (Sept to April)	Migratory
	Sandwich Tern	nesting	May to July (Sept to April)	Migratory
	Cayenne Tern	nesting	May to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
Noroeste Cay	White-tailed Tropicbird	nesting	February to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Molinos Cay	White-tailed Tropicbird	nesting	February to September	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Alcarraza Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Masked Booby	nesting	Throughout the year	Resident
	Brown Booby	nesting	Throughout the year	Resident
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory

Seabird areas on Culebra Archipelago	Bird Name	Observed or Nesting	Nesting Period	Resident or Migratory
Matojo Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Royal Tern	nesting	May to July (Sept to April)	Migratory
	Laughing Gull	nesting	April to September	Migratory
	Sandwich Tern	nesting	May to July (Sept to April)	Migratory
Geniquí Cays	Red-billed Tropicbird	nesting	May to September	Migratory
	Brown Booby	nesting	Throughout the year	Resident
	Laughing Gull	nesting	April to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
	Red-footed Booby	nesting	Throughout the year	Resident
Culebrita Island	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	observed	February to September	Migratory

6.2.7 Seabirds are pelagic birds. This means that they just come to land to nest and after that, they pass the rest of the time flying over the ocean looking for food. The nesting season of seabirds consists of the period of time that birds are present or near lands doing courtships, nesting area selections, nesting periods, etc. This period is finished when fledglings or juveniles abandon the colony area. The most critical months in Culebra Island for seabirds are from February to August. During this period, the seabirds, and depending on the species, are in the process of courtship, selection of nesting areas, laying eggs, feeding their chicks, and protecting their fledglings from predators. Areas more used by birds in the Culebra Archipelago are Yerba, Molinos, Alcarraza, Geniqui, Lobito, Agua, Raton and Matojo cays, and Flamenco Peninsula.

6.2.8 The most common and dangerous perturbations in the seabirds colonies are predators and human disturbances. In the Culebra offshore cays, introduced predators such as cats and rats, can eat eggs and chicks. Also, other predators (i.e., goats and deer) in the cays can manipulate and change the nesting habitat by grazing. Human disturbances as loud noise made by jet skis, boats, and other sources, or just the presence of one or more persons near the colony (ies) may cause abandonment of nests by adults which may cause eggs overheat and predated by ants, rats, or cats. It is very important not to disturb the colonies during nesting season. Any work or activity necessary to do near or in colony areas should be completed outside of nesting period.

6.2.9 Field work will be implemented on the Cays outside of nesting season. During field operations the team biologist will assess each cay for the presence of nesting seabirds to determine if the scheduled field operation can be conducted. In addition prior to a munition disposal by detonation, a qualified observer will check the beach and adjacent waters surrounding the cay for the presence of protected and listed seabird species by scanning the area with 10 X 50 binoculars. The qualified observer (team biologist) will also survey the beaches for signs of bird nesting. If bird nests are found within the detonation site and/or blast impact area, no detonation will be conducted in that area. If any protected bird species are within 200 meters of the detonation site, the MEC detonation will be delayed until after the animal(s) leave the area. In addition, if blast impacts will extend into nearshore waters, a qualified observer for sea turtles and marine mammals shall be required. If these species are observed the detonation shall be postponed until the animal has left the impact zone or more than 30 minutes have elapsed since it was last sighted.

6.2.10 All on-site project personnel will be instructed during site orientation training of the potential threatened and endangered species in the area and of the need to avoid harming these plants and animals. On-site personnel will be instructed that civil and criminal penalties exist for harming, harassing, or killing

birds, manatees, sea turtles, dolphins, or whales, which are protected under the Marine Mammal Protection Act of 1972, the ESA of 1973, and PRDNER Regulation Number 6766 for the preservation of vulnerable species and species in danger of extinction (February 11, 2004).

6.3 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND "TO BE CONSIDERED" INFORMATION

6.3.1 As amended, the 1986 SARA, Section 121(d)(2) of the CERCLA requires that on-site remedial actions attain (or waive) Federal and more stringent State ARARs of environmental laws upon completion of the remedial action. The revised National Oil and Hazardous Substances Pollution Contingency Plan (NCP) of 1990 requires compliance with ARARs during remedial actions as well as at completion, and compels attainment of ARARs during removal actions to the extent practicable, considering the specifics of the situation.

6.3.2 The "Applicable" portion of the term is defined as:

- Cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable.

6.3.3 The "Relevant and Appropriate" portion of the ARAR term is defined as:

- Cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or state environmental or facility citing 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. Only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

6.3.4 Although compliance is not required, in order to incorporate guidance and other information into the alternatives developed, some remedial actions identify "To Be Considered (TBC)"criteria, which are defined as:

- Non-promulgated advisories, criteria, and guidance are not ARARs, but may sometimes be useful in developing a CERCLA remedy. When this is the case, at the discretion of the lead agency, they can be specified as TBC criteria. TBC criteria can be taken into consideration during evaluation of remedial alternatives, but unlike ARARs, identification of TBCs is not mandatory, nor is compliance with TBCs a selection criterion for a remedial action.

6.3.5 The documents that are TBC are incorporated as appropriate into the RI and FS Reports and are not called out in a table, to avoid confusion with the ARARs. Compliance with these documents is not required under CERCLA or the NCP, and therefore, no tabulation is provided.

6.3.6 Any substantive environmental or facility siting requirement has the potential to be an ARAR. To assist in identification, ARARs are divided into three categories: chemical-specific ARARs, location-specific ARARs, and action-specific ARARs. These three categories are defined as follows:

- Chemical-specific ARARs are promulgated health-based or risk-based numerical values that establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Where more than requirement addressing a contaminant is determined to be an ARAR, the most stringent requirement should be used. Risk-based screening levels (for example, USEPA RSL) are not considered chemical-specific ARARs because they are not promulgated.

- Location-specific ARARs generally are restrictions placed on the concentration of a hazardous substance or the conduction of activities solely because they are in special locations. Requirements addressing cultural resources, historic places, floodplains, wetlands, or sensitive ecosystems and habitats are potential location-specific ARARs.
- Action-specific ARARs are usually technology or activity-based requirements or limitations placed on actions taken with respect to remedial/removal actions, or requirements to conduct certain actions to address particular circumstances at a site. Regulations that dictate the design, construction and operating characteristics of air stripping units, incinerators, landfills or other waste management facilities are examples of action-specific ARARs. No action-specific ARARs have been identified for this site.

6.3.7 ARARs are identified during the response process prior to issuance of the ROD/DD, and they may continue to evolve over time. The NCP requires the lead agency to formally request ARARs from support agencies at completion of the RI. For an alternative to pass into the detailed analysis stage of the RI/FS, and thus become eligible for selection, it must comply with its ARARs or a waiver should be identified and the justification provided for invoking it. An alternative that cannot comply with ARARs, or for which a waiver cannot be justified, should be eliminated from consideration for further discussion as a potential alternative. Updates to ARARs are then requested during development of the FS as details of remedial alternatives become known. Thus, potential ARARs are initially identified on a broad basis, refined to specific requirements during the FS, and finalized at signature of the DD.

6.3.8 As the RI/FS process continues, the list of ARARs will be updated, particularly as the response actions are selected and reviewed by state and federal agencies. ARARs will be used 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. Throughout the RI/FS, ARARs 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, groundwater, surface water, and sediment)
- Geology and other site-specific characteristics
- Use of site resources and media
- Potential contaminant transport mechanisms
- Purpose and application of potential ARARs
- Remedial alternatives considered for site cleanup.

6.3.9 The potential ARARs identified for the RI are presented in Table 6-3

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Table 6-3: Potential ARARs

Requirement	Status /Synopsis of Requirement	Action to be Taken to Attain Requirement
ESA (USC Title 16 chapter 35§1538)	Relevant and Appropriate - Location-Specific /The ESA protects federally listed species (fish, wildlife, and plants) which are either endangered or threatened and preserves critical habitat. The substantive requirement within the Act prohibits the "taking" of listed species [reference: 16 USC 1538; 50 CFR 17.95; 50 CFR 226.208)]	When evaluating remedial alternatives, consideration must be given to avoiding impacts to the endangered species and its habitat. USACE in coordination with NOAA, NMFS, USFWS and DNER authored the: USACE Final Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat with Addendum 1, DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (CESAJ, February 2015). The processes identified in the above-listed SOP provide procedures that allow for the RI to be completed and avoid impact to endangered species. A remedial alternative which "takes" an endangered species or destroys its habitat does not qualify as a suitable remedial alternative because the ESA ARAR would not be satisfied. Either a different alternative which does not impact the endangered species should be pursued or an exception allowing the taking of the species is needed, or a waiver of the ARAR is required.

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CHAPTER 7. PROPERTY MANAGEMENT PLAN

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CHAPTER 8. INTERIM HOLDING FACILITY

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CHAPTER 9. PHYSICAL SECURITY PLAN FOR RECOVERED CHEMICAL WARFARE MATERIAL (RCWM) PROJECT SITES

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CHAPTER 10. REFERENCES

- 29 CFR 1910
- 49 CFR Series
- 50 Code of Federal Regulations (CFR) Subpart I, Section 17.95: Critical Habitat – Fish and Wildlife.
- Acropora Biological Review Team (Acropora BRT), 2005. "Atlantic Acropora Status Review Document." Report to National Marine Fisheries Service, Southeast Regional Office, April 3, 2005 (152 pp + App).
- AR 385-64 U. S. Army Explosives Safety Program
- ATF Publication 5400.7 Federal Explosives Laws
- Boulon, R.H., P.H. Dutton, and D.L. McDonald, 1996. "Leatherback Turtles (Dermochelys coriacea) on St. Croix, U.S. Virgin Islands: Fifteen Years of Conservation." International Journal of Turtle and Tortoise Research, Volume 2, Number 2.
- CEHNC-OE-CX Interim Guidance 02-03
- DDESB TP 16 Methods for Calculating Primary Fragment Characteristic
- DDESB TP-18 Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel
- DoD 4160.21-M-1 Defense Demilitarization Manual
- DoD 6055.9-STD DoD Ammunition and Explosives Safety Standards
- Ellis Environmental Group, LC. 2004a. Site Specific Final Report: UXO Construction Support, Culebra Island National Wildlife Refuge, Culebra Island, Puerto Rico. June.
- Ellis Environmental Group, LC. 2004b. Final Field Sampling and Analysis Report: Construction Support Phase Ib, Culebra Island National Wildlife Refuge, Puerto Rico. June.
- Ellis Environmental Group (EEG), 2006). Final WP, Non-Time Critical Removal Action at the Municipality of Culebra, Puerto Rico, United States Army Corps of Engineers, Huntsville Center, Contract No. W912DY-05-D-0007.
- Environmental Science & Engineering, Inc. (ESE) 1997. Final Engineering Evaluation/Cost Analysis: Former Culebra Island Naval Facility, Culebra Island, Puerto Rico. DERP- FUDS Project Number I02PR006802. April.
- EM 200-1-15 Technical Guidance for Military Munitions Response Actions – Interim Guidance Document (October 30, 2013)
- EM 385-1-1 USACE Safety and Health Requirements Manual
- Environmental Science and Engineering (ESE), 1996. Engineering Evaluation/Cost Analysis at the Culebra National Wildlife Refuge, Puerto Rico; United States Army Corps of Engineers, Huntsville Center, Contract No. DACA 87-00-C-0001.
- EOTI Corporate Quality Plan
- EOTI Corporate Safety Plan
- EOTI, 2013. 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, Contract # W912DY-04-D-0009, Task Order #: 0013. Prepared for CESAJ and USAESCH. February.
- EP 1110-1-18 Military Munitions Response Program
- EP 385-1-95a Basic Considerations for Munitions and Explosives of Concern (MEC) Response Actions.

- EP 75-1-2 Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and radioactive Waste (HTRW) and Construction Activities
- ER1110-1-12 Quality Management
- Federal Acquisitions Regulations (FAR)
- Federal Register (FR) Vol. 70, No. 88:24359, May 9, 2005. Endangered and Threatened Species: Proposed Threatened Status for Elkhorn Coral and Staghorn Coral. National Marine Fisheries Service (NMFS), NOAA, Commerce.
- García-Sais, J., R. Appeldoorn, A. Bruckner, C. Caldow, J.D. Christensen, C. Lilyestrom, M.E. Monaco, J. Sabater, E. Williams, and E. Diaz, 2005. "The State of Coral Reef Ecosystems of the Commonwealth of Puerto Rico."
- IME SLP 17 Safety in the Transportation, Storage, Handling, and Use of Explosive Materials
- IME SLP 20 Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Detonators (Blasting Caps)
- Munitions Response (MR) Data Item Descriptions (DIDs)
- MTA, Inc. 1995. Interim Remedial Action, Draft Final Removal Report, Culebra Island National Wildlife Refuge, Puerto Rico. June.
- PARSONS, 2007. Site Inspection Report – Culebra Island Site, Puerto Rico. Prepared for U.S. Army Corps of Engineers Southeast and Pacific IMA Region.
- Ricklefs, R.E., and I.J. Lovette, 1999. "The roles of island area per se and habitat diversity in the species-area relationships of four Lesser Antillean faunal groups." Journal of Animal Ecology 1999, 68, 1142-1160.
- Saliva, J.E., 2005. "La palometa y las áreas de aniadaje de las aves marinas en Puerto Rico." El Bien-te-veo, Vol. 8, No. 2. Sociedad Ornitológica Puertorriqueña, Inc.
- Saliva, J.E., and J. Burger, 1989. "Effect of Experimental Manipulation of Vegetation Density on Nest-Site Selection in Sooty Terns." The Condor, Vol. 91, pp. 689-698.
- Spendelow, J.A., 1995. "Roseate Tern Fact Sheet." United States National Biological Service. United States Army Corps of Engineers, Rock Island District (USACE-RI), 1995. Archives Search Report Findings for Culebra Island National Wildlife Refuge, Culebra Island, Puerto Rico, Project Number I02PR006802.
- TM 60-series Manuals
- U.S. Army Corps of Engineers (USACE-RI). 1995. Archive Search Report Findings for Culebra Island National Wildlife Refuge, Culebra, Puerto Rico. Project No. I02PR006802. Prepared by USACE Rock Island District. February.
- United States Army Corps of Engineers, St. Louis District (USACE), 2004. Supplemental Archives Search Report for Culebra Island National Wildlife Refuge, Culebra Island, Puerto Rico, Project Number I02PR006802.
- United States Army Engineering and Support Center, Huntsville (USAESCH), 2000. Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions, HCN-ED-CS-S-00-3.
- United States Fish and Wildlife Service (USFWS), 1996. Piping Plover (Charadrius melodus) Atlantic Coast Population Revised Recovery Plan.
- United States Geological Survey (USGS), 1999. Groundwater Atlas of the United States Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands; HA 730-N; Puerto Rico and the U.S. Virgin Islands Regional Summary. At URL: http://capp.water.usgs.gov/gwa/ch_n/N- PR_Vitext1.html
- United States Army Corps of Engineers, 1999. Environmental Quality - Risk Assessment Handbook. Volumes I and II. EM 200-1-4.

- EOTI, 2010. Final Site Specific WP – Remedial Investigation/Feasibility Study at the Culebra Island Site Puerto Rico. Prepared for U.S. Army Engineering and Support Center CEHNC-CT
- EOTI, 2013. 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. Prepared for U.S. Army Engineering and Support Center CEHNC-CT
- USACE, 2014. Supplemental Standard Operating Procedures for Endangered Species Conservation and their Critical Habitat

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