



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

CEHNC-EMM

4 March 2016

MEMORANDUM FOR US Army Technical Center for Explosives Safety, Explosives Safety Knowledge, OE and Chemical Division, (ATCL-ACE)/ Mr. Jimmy Langley), Building 35, 1C Tree Road, McAlester, OK 74501-9053.

SUBJECT: Explosives Site Plan (ESP), Remedial Investigation Munitions, Response Site (MRS 07, Culebrita Artillery Impact Area Water Acreage and all Cayos of MRS 02 Water Acreage, Island of Culebra, Puerto Rico (PR), Formerly Used Defense Site (FUDS) Project Number I02PR0068, March 2016

1. References:

- a. ER 385-1-95, Safety and Health Concerns for Munitions and Explosives of Concern (MEC) Projects, March 2007.
- b. DOD 6055.09-M, Ammunition and Explosives Safety Standards, February 2008.

2. This ESP is submitted to address the appropriate safety criteria and munitions response actions for MRS 07 and MRS 02 Remedial Investigation Island of Culebra Island, Puerto Rico.

3. This memorandum constitutes Direct Reporting Unit approval for U.S. Army Corps of Engineers participation per reference 1a.

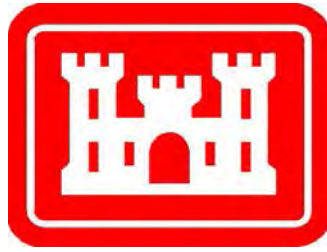
4. If you have any questions, please contact Walt Zange at (256) 895-1586 or Mr. Jeff Barker at (256) 895-1513.

Encl



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Explosives Site Plan

Remedial Investigation
Munitions Response Site (MRS) 07
Culebrita Artillery Impact Area Water Acreage and all
Cayos of MRS 02 Water Acreage
Island of Culebra, Puerto Rico (PR)
Formerly Used Defense Site (FUDS)
Project Number I02PR0068

March 2016

Prepared for

U.S. ARMY CORPS OF ENGINEERS
Engineering and Support Center, Huntsville

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1.0 SITE

- a. Name: Culebra Island (see Appendix A, Figure 1)
- b. State: Commonwealth of Puerto Rico
- c. This underwater Remedial Investigation (RI) is being performed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and is part of the overall Remedial Action Process. Subsequent removal responses may be dictated in the future during the remainder of the remedial response process, as determined by action memoranda or other decision documents. Based on the results of this characterization and subsequent decision document, an Explosives Safety Submission (ESS) will be submitted in accordance with Department of Defense (DoD) 6055.09-M.

2.0 ANTICIPATED START DATE

15 May 2016

3.0 PURPOSE

- a. The underwater RI is intended to adequately characterize the nature and extent of munitions and explosives of concern (MEC) and contamination; to assess the risk to human health, safety, and the environment; to collect information needed to design the required munitions response; and to prepare, as appropriate, an ESS for the selected response.
- b. Unexploded Ordnance (UXO) personnel qualified in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18 will perform all MEC activities at the site.

4.0 SITE BACKGROUND AND CURRENT CONDITIONS

4.1 BACKGROUND

- a. The project location is Culebra Island, PR. Culebra is located approximately 17 miles east of the main island of Puerto Rico and also includes surrounding islands.
- b. Culebra came under Navy control in 1901; the Navy built a small base that same year and an airfield about 20 years later. The Culebra Island Archipelago was used for training purposes by the U.S. Navy and U.S. Marines, and was later used by the North Atlantic Treaty Organization (NATO). The U.S. Marines used portions of Culebra Island as a training facility from 1902 through 1941. Culebra Island was used as a bombing and gunnery range from 1935 through 1975. To support the increased training needs during Viet Nam operations, the Navy acquired additional training areas on cayos east and west of Culebra Island for use as air-to-ground ranges. Live ordnance operations reached their peak in 1969 as the fleet was training pilots for Viet Nam. Aircraft bombing and strafing of the Flamenco Peninsula ended around 1970, while the use of live rounds for naval gunfire support training ended in 1971. Subsequent naval support training was conducted using puff rounds until use of ordnance was terminated on September 30, 1975. Between 1975 and 1982, the facilities were turned over to the General Services Administration (GSA).

4.2 CURRENT CONDITIONS

RI Field Activities addressed under this Explosives Site Plan (ESP) include: MRS 02 – Culebra Cayos (water acreage) and MRS 07 – Culebrita Artillery Impact Area (water acreage). The MRS's consist of a series of small cayos which are ecologically significant as seabird nesting sites and sea turtle egg laying sites and they are populated with corals that are protected by both the Commonwealth of Puerto Rico and under the Endangered Species Act. In addition, numerous marine mammals use the waters surrounding the cayos as their breeding and feeding grounds.

- a. MRS 02, Culebra Cayos include the following: Cayo Del Agua, Cayo Geniqui, Cayo Lobito, Cayo Lobo, Cayo Raton, Cayo Yerba, Cayo Sombrerito, Los Gemelos, El Mono, Cayo Alcarraza, Piedra Stevens, and Cayo Tiburon. MRS 02 Cayos consist of approximately 384.7 total acres, of which 285.7 are water acres. The Navy conducted fleet maneuvers and Fleet Landing Exercises (FLEXs) on MRS 02 between 1923 and 1941. During these exercises, the cayos were heavily bombarded with high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds. Training continued through the 1950s and 1960s and, in the early 1960s, aerial bombardment was expanded from Los Gemelos and Alcarraza to most of the cayos on the east and west side of Culebra. Training continued until 1975.
1. Cayo del Agua: The Archives Search Report (ASR) Team observed Mk 76 series practice bombs and fragments with suspension lugs from HE bombs. During the Site Inspection (SI), Mk 80 series bomb debris and aircraft flare trays were observed. During the 1996 Engineering Evaluation and Cost Analysis (EE/CA) investigation, one 76mm projectile (mark/model number not specified) and sixteen MK76 practice bombs were discovered as UXO.
 2. Cayo Geniqui: The ASR Team observed Mk 80 series bomb tail fins. The 2005 ASR Supplement states that two 500-lb bombs and a MK 27 HE torpedo were discovered by Explosive Ordnance Disposal (EOD) divers west of the Cayo in 1983. According to the 1994 ASR, the suspected Munitions and Explosives of Concern (MEC) for this site are Mk 82 Mod 1 500-lb Bomb, 5-inch Zuni rockets, and MK 14-3A/MK 16-6/MK 16-7/MK 27-4/MK 28-3/MK 15 Torpedoes.
 3. Cayo Lobito: During the Culebra RI for MRS's 02, 04, 05, 07 (field work was concluded on November 2015 a 12 inch MK 16 Projectile. No other historical information is available indicating the types of MEC used on Cayo Lobito.
 4. Cayo Lobo: According to the 2004 ASR Supplement, Cayo Lobo was used as a strafing and bombing target. Munitions included general small arms, .50-caliber small arms, Mk80 series general purpose bombs, and Mk I 20mm HEI. There have been no findings of any Mk80 series bombs. The largest item found/confirmed at Cayo Lobo (during the 2009 removal action) was the 5-inch 54 Mk 41.
 5. Cayo Raton: Cayo Raton has no mention of any previous MEC found on the cayo. However, local divers have indicated the possibility of underwater ordnance near the cayo. The ASR Team observed Mk 76 series practice bombs, and fragments with suspension lugs from HE bombs. The Cayo is located within the boundary of the ASR-delineated Bombing Range, and without further investigation information, the munitions assumed to have been used are based on the history of the cayos in this area (Cayos Yerba and del Agua).
 6. Cayo Yerba: The ASR reported findings of Mk 76 series practice bombs, and fragments with suspension lugs from HE bombs on Cayo Yerba. The Cayo is located within the boundary of the ASR delineated Bombing Range, and without further investigation information, the munitions assumed to have been used are based on the history of the cayos in this area (Cayos Raton and del Agua).
 7. Cayo Sombrerito: No historical data could be found for Cayo Sombrerito. Cayo Sombrerito is located within the MRS boundary of the same bombing ranges of Cayos Tiburon, Geniqui, and Botella. In addition, the 2005 ASR Supplement states that two 500- lb bombs were discovered by Explosive Ordnance Disposal (EOD) divers between cayos Geniqui and Sombrerito in 1983.
 8. Los Gemelos: Los Gemelos (aka Twin Rocks) were used as targets for aerial bombs and rockets. Munitions included Mk80 series general purpose bombs, 5-inch Zuni Rockets, and Mk8 5-inch practice rockets.
 9. El Mono: The ASR reported that El Mono was used as a target for 75mm and 155mm howitzers (nomenclature was not specified in historical documents; however, an explosive

weight of 15.4 pounds of TNT was provided in the EE/CA, dated March 1997). The M102 155 Projectile best represents the description provided in the EE/CA.

10. Cayo Alcarraza (aka Fungy Bowl): The ASR reported Cayo Alcarraza was used as a target for aerial bombs and rockets. Munitions included Mk80 series general purpose bombs, 5-inch Zuni Rockets, and Mk8 5-inch practice rockets. The largest ordnance item reported in the ASR was the MK 83 1,000-lb HE bomb.
 11. Piedra Stevens: Piedra Stevens may have been used for DoD munitions training; however, there is no historical evidence. As it is near Los Gemelos, the assumed munitions use of Los Gemelos are proposed as the munitions potentially present on Piedra Stevens.
 12. Cayo Tiburon: The ASR reported that Cayo Tiburon was used as a bombing and artillery target. MK 82 500-pound general purpose bomb, 5-inch Zuni Rockets, 75mm and 155mm howitzers (nomenclature was not specified in historical documents; however, an explosive weight of 15.4 pounds of TNT was provided in the EE/CA, dated March 1997). The M102 155 Projectile best represents the description provided in the EE/CA.
- b. MRS 07, Culebrita Artillery Impact Area, includes the northern portion of Culebrita as well as Cayo Botella. MRS 07 consists of approximately 514.5 total acres, of which 244.7 are water acres. The Marines used MRS 07 site as an artillery impact area between 1936 and the late 1940s. In addition, the U.S. and the United Kingdom used Cayo Botella as an aircraft bombing/rocket target in 1969. The history of munitions included 20mm projectiles, Mk44 and Mk45 flares, live and practice bombs up to 500 pounds and 2.75-inch rockets as well as British bombs and rockets (of unknown size and type) and MK 14-3A/MK 16-6/MK 16-7/MK 27-4/MK 28-3/MK 15 Torpedoes (Torpedoes were used on the eastern shore of Culebrita's Marc Point). Culebrita is managed by the U.S. Fish and Wildlife Service (USFWS) and is used recreationally. Many boats visit the island each year. During the 2008 Non-Time Critical Removal Action (NTCRA), 20mm and 75mm UXO and munitions debris (MD) was discovered on Culebrita.
- c. For the purposes of this action only, the geographical locations of the MRS 02 Cayos and MRS 07 support the grouping of the individual Cayos into two groups – Group 1 for the cayos located on the western side of Culebra Island and Group 2 for the cayos located on the eastern side (see Figure 1 in Appendix A). The groupings will allow for the transport of MEC, deemed acceptable to move, between the cayos within each group to mitigate potential impacts to ecologically sensitive species and essential habitats from demolition activities. The following cayos make up each of the Island Groups:
- i. Island Group 1 (Western Cayos): Cayo Del Agua, Cayo Lobito, Cayo Lobo, Cayo Raton, Cayo Yerba, Los Gemelos, El Mono, Cayo Alcarraza, and Piedra Stevens.
 - ii. Island Group 2 (Eastern Cayos): Cayo Geniqui, Cayo Sombrerito, Cayo Botella, Culebrita and Cayo Tiburon.

5.0 EXECUTING AGENCIES

- U.S. Army Engineering and Support Center, Huntsville
- U.S. Army Corps of Engineers, Jacksonville District
- Contractor - Parsons, Peachtree Corners, GA

6.0 SCOPE OF REMEDIAL INVESTIGATION

6.1 OBJECTIVE

Conduct a RI, Feasibility Study (FS), and all necessary activities required to accomplish this objective. Obtain acceptance of a Decision Document meeting the requirements of ER 200-3-1 and EM CX Interim Guidance 06-04, EP 1110-1-18, Munitions Response Process.

- a. Underwater operations within the MRS 02 Cayos and MRS 07 boundaries will be completed during three phases of work:
 - Phase 1: Environmental Baseline Survey (EBS) with EBS Report (completed in June 2013)
 - Phase 2: Underwater Geophysical Survey [23.3 miles of Electromagnetic (EM)-61 underwater transects were completed in August 2015 by floating the EM coil above the ocean floor or by using a remotely operated vehicle (ROV) with the EM coil attached]
 - Phase 3: Underwater Intrusive Investigations and Environmental Sampling
- b. Phase 3 will utilize the following systems/equipment and consist of the listed actions:
 - UXO Divers with Self-Contained Underwater Breathing Apparatus (SCUBA)
 - VideoRay Underwater ROV
 - Underwater Geophysics (underwater analog metal detectors)
 - Snorkel operations
 - Dive vessel with support boat
 - Remote lifting of MEC and towing of the MEC item to be remotely pulled up onto a suitable beach for disposal (or to relocate MEC remotely away from listed threatened or endangered species to a suitable underwater site for underwater disposal).
 - MEC/Material Potentially Presenting an Explosive Hazard (MPPEH) underwater disposal operations
 - MEC disposal by detonations will take place within the boundaries of the Culebra site. Remote towing/transport of MEC is permitted between the Culebra site Cayos/MRSs.
- c. SCUBA dives will be conducted in order to complete the following RI/FS tasks:
 - Visual and detector assisted surveys of the seafloor
 - Excavation of chosen subsurface anomalies
 - Explosive disposal operations of underwater MEC/MPPEH items
 - Collection of marine sediment samples
- d. Manual Intrusive Investigations will be conducted in unconsolidated sediment areas only. Subsurface (not to exceed 24 inches) investigative action is required to fully characterize the site to determine the vertical extent and boundaries of contamination in those areas, and identify possible future remedial actions. UXO SCUBA divers will perform intrusive investigations by hand.
- e. Small boats will be used during Phase 3 as a SCUBA diving platform, exclusion area security, and lifting balloon tow vehicle
- f. Table 6-1 identifies the acreage of the MRS to be investigated.
- g. Mechanized MEC Processing Operations such as towing a munition with a lifting balloon via the tow boat may be considered high or low input operations (refer to DoDM 6055.09-M-V7), depending on the risk assessment. If the MEC item is considered unacceptable to move and is moved remotely by lifting balloon, this will be considered a high input operation due to a higher level of risk. If a MEC item is considered acceptable to move and on-site transport by lifting balloon is being performed due to the MEC's size and weight, this is considered a low input operation. To mitigate the risk, essential and non-essential personnel will follow the safety criteria guidance in Section 7.0.

Table 6-1: RI/FS MRS Acreage

Site	Type of Investigation	Total Land Acreage	Water Acreage	Total Acreage
MRS 02 Cayos	RI/FS Intrusive investigation of DGM anomalies in the water area	99.0	285.7	384.7
MRS) 07 Culebrita Artillery Impact Area	RI/FS Intrusive investigation of DGM anomalies in the water area	269.9	244.7	514.6
Totals		368.9	530.4	899.3

7.0 SAFETY CRITERIA

- a. The Minimum Separation Distance (MSD) restrictions from MEC areas to non-essential personnel will be applied during all MEC operations. The MSDs identified for Island Group 1 and Island Group 2 are presented in Table 7-1. Preliminary site work such as surveying, laying grid lanes, and anomaly detection do not require the establishment of an MSD for Quantity-Distance (Q-D) purposes. Essential personnel are defined as USACE and contractor project personnel necessary for the safe and efficient completion of field operations conducted in an exclusion zone (EZ). This is limited to: contractor work team members including the UXOSO, UXOQCS, SUXOS, and a USACE OESS. The outer boundaries of the MSD arcs are depicted on the Q-D maps in Appendix A. The team separation distance for land operations at this site will be the K40 overpressure distance shown in Table 7-1. Positive control of the EZ based on the MSD will be maintained at all times that MEC operations are being conducted. Prior to beginning MEC operations, the contractor will ensure that there are no non-essential personnel within the EZ and the contractor will ensure that the EZ remains clear of non-essential personnel throughout the MEC operations. MEC items will be investigated and detonated within the specific group assigned in Section 4.2.c. As discussed in Section 4.2, MRS 02 and MRS 07 contain significant natural resource concerns. Therefore, Soldado Point Mortar and Bombing Area (MRS 09) has been designated as an alternate demolition location for both of the island groups. Soldado Point Mortar and Bombing Area, in some instances, may be more protective of the environment for MEC treatment through detonations. When transporting MEC between cayos or to Soldado Point Mortar and Bombing Area, the HFD will be used as the EZ. Any occupied buildings or public roadways/waterways in the MSD areas during MEC operations will be evacuated and/or roadways/waterways blocked to prevent non-essential personnel from entering during the conduct of MEC operations. Alternatively, engineering controls may be used (for those munitions listed in Table 7-1 that have EZs for these engineering controls only) as follows: Sandbag Mitigation or Water Mitigation for disposal operations (see notes in Table 7-1 for appropriate reports governing the use of these engineering controls). The appropriate reports will be available on site for all engineering controls used. If a MEC item is found that is not in the Fragmentation Database, Sandbag Mitigation or Water Mitigation will not be used without a munition specific calculation.
- b. The Army will establish underwater QD criteria.
- c. Per EM 385-1-97, Errata Sheet 3, Section P, Table 7-1 has been included in this ESP in the recommended format. The distances and the engineering controls listed in the table are specific to unintentional and intentional detonations that occur on land only and do not apply to underwater demolition operations.
- d. Tamping (single or multiple items) may be used in accordance with DDESB TP 16 and the BEM version 6.3.3. These reports will be available on site for all mitigation methods used.
- e. During the course of this investigation, if a MEC item with a greater fragmentation distance is encountered, the MSD will be adjusted in accordance with DDESB TP 16; operations will continue and an amendment to this ESP submitted expeditiously for approval. QD arcs will be adjusted accordingly.

- f. MPPEH procedures will be In Accordance With (IAW) DoDI 4140.62 and EM 200-1-15. All MPPEH processing procedures will be assessed and its explosives safety status determined and documented prior to transfer with the DoD control. Prior to release to the public, MPPEH will be documented by authorized and technically qualified personnel as Material Documented as Safe (MDAS) after a 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosives safety perspective.
- g. Parsons will notify the following agencies at least 36 hours in advance of performing any demolition operations. These agencies will also be used to assist in securing the area, as appropriate, where the item presenting an explosive hazard is located until demolition operations have occurred.
- USCG, Mr. Efrain Lopez, Marine Information Specialist (787) 289-2097, efrain.lopez1@uscg.mil, USCG Sector San Juan and, CWO Anthony Cassisa, (787) 289-2073, anthony.j.cassisa@uscg.mil. Warning broadcast to mariners over VHF for a scheduled demolition shot (Notice to Mariners [NOTMAR]).
 - FAA Coordination Facility (787) 253-8664, Mr. Felipe Fraticelli, for a Notice to Airmen on flight restriction above the demolition area. Additional points of contact include Mr. Hector Plaza, (787) 525-6070, and Mr. Hector Rivera, FAA Office (404) 520-4241.
 - Municipal Police (787) 742-0106 for any activity on Flamenco Beach. The Parsons Senior UXO Supervisor (SUXOS) or UXO Safety Officer (UXOSO) will coordinate directly with the police department to overcome any language difficulties on demolition operations.
 - Puerto Rican State Police (787) 742-3501, for any activities on Culebra. The Parsons SUXOS or UXOSO will coordinate directly with the police department to overcome any language difficulties on demolition operations.
- h. Parsons will request assistance from the local authorities on Culebra to notify residents at least 36 hours prior to performing intrusive operations on an MRS. Areas within EZs will require evacuations during intrusive investigations and demolition operations due to the proximity of popular beaches. If for any reason beaches and the surrounding waters cannot be secured, Parsons will notify the USACE Project Manager for resolution. Parsons will coordinate with USACE for notification of the local population and appropriate regulatory agencies before a demolition event.
- i. Parsons will coordinate with the USACE to evacuate the public during the demolition of a UXO item if all other engineering controls are not adequate. Parsons will conduct demolition operations only after all personnel protective measures have been completed and reported to the SUXOS. Personnel will be permitted to re-enter the area only after the demolition point has been inspected and the "all clear" has been given by the SUXOS. There are five demolition land sites proposed for this project, two within Island Group 1: Cayo Lobo and Cayo del Agua; two within Island Group 2: Cayo Botella and Culebrita; and Soldado Point Mortar and Bombing Area (MRS 09). Only munitions that are acceptable to move or can be moved remotely while maintaining MSDs will be moved to one of these locations for disposal. The potential for UXO larger than the munitions identified in the historical files for Cayo Lobo exists as it is the only proposed site for detonations that allows the MSD for the larger munitions to be detonated without requiring the evacuation of occupied buildings or roadways. MRS 09 - Soldado Point provides a detonation site that will not have a potential impact to seabirds (See the demolition site Q-D maps in Appendix A.

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Table 7-1 Minimum Separation Distance (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⁾
Island Group 1	MK 84 2000-lb Bomb	437 ⁽³⁾	963 ^{(4) (7)}	4021	N/A	N/A
	12-inch MK 16 Projectile	147	479 ⁽⁷⁾	4473 ⁽⁵⁾	N/A	N/A
Island Group 2	MK 82 500-lb Bomb	257	686 ⁽⁷⁾	3074	N/A	N/A
Soldado Point Mortar and Bombing area ⁽⁶⁾	MK 82 500-lb Bomb	257	686 ⁽⁷⁾	3074	N/A	N/A

Notes:

1. See Appendix B for calculation sheets and documentation of MSD.
2. See Appendix B 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. Team separation distance for Island Group 1
4. HFD for Island Group 1
5. MFD for Island Group 1
6. Soldado Point Mortar and Bombing Area demolition site will be restricted to not exceed the MSD of a Mk 82 500-lb Bomb.
7. Mechanized MEC Processing Operations: When towing a MEC item from its discovered location to an alternate location for detonation, HFD will be used.

8.0 METHODS OF DISPOSAL

- a. Disposal activities will be performed only by qualified UXO personnel. All explosive operations will follow the procedures outlined in the site work plan, SOPs, and EM 385-1-97, (Explosives Safety and Health Requirements Manual).
- b. Sandbags [HNC-ED-CS-S-98-7, Amendment 1; HNC-ED-CS-S-00-3, HNC safety advisory dated 07 November 2011; and DDESB Memo dated May 22, 2014 (*Revision of DDESB Approval for Use of Sandbags for Mitigation of Fragmentation and Blast Effects Resulting from the Intentional Detonation of Munitions*)] or Water Mitigation (HNC-ED-CS-S-00-3) may be used to reduce the intentional detonation MSD. Tamping (single or multiple items) may be used in accordance with DDESB TP 16 and the BEM, version 6.3.3. These reports will be available on site for all mitigation methods used. In addition, double sandbag mitigation may be used for Non-robust and Robust items up to and including 81mm in diameter, which have a net explosive weight (NEW) not exceeding 1.39 lb TNT equivalent. For items using double sandbag mitigation, the minimum separation distance is 12.5 ft.
- c. The Minimum Separation Distances for the MGF for intentional and unintentional detonations on land are shown in Table 7-1. Explosive Safety Quantity Distance (ESQD) Arcs can be found in Appendix B. If an ordnance item is encountered underwater, the SUXOS and UXOSO will determine if the item is acceptable or unacceptable to move; the minimum safe separation distances for underwater unintentional and intentional detonations can be found in Section 7.0 of this ESP.
- d. The MGF for MRS 02 and 07 is shown in Table 7-1. Items with smaller fragmentation distances may be found. Demolition of these items may be completed using the item-specific MSDs and engineering controls in accordance with DDESB-TP 16, Fragmentation Database. For items not in the DDESB TP 16 Fragmentation Database the maximum fragment distance may be calculated through the use of Tables 4-7A or 4-8A in DDESB TP 16 or by using the Generic Equations Calculator in DDESB TP 16. [Note: The Generic Equation Calculator (GEQ) is available on the DDESB's secure website at [HTTP://www.ddesb.pentagon.mil/](http://www.ddesb.pentagon.mil/)].
- e. When an ordnance item is found in water, guarding the munitions will not be required due to the following:
 - The locations of the ordnance items will be known only by the survey team; the public will not be aware of their presence.
 - All MEC items requiring disposal will be disposed of at the end of the intrusive phase due to the length of time of coordination between state and federal agencies.
 - Severe environmental conditions (violent winds, extremely high surf conditions, thunderstorms, etc.) may last for long periods of time and would expose security personnel to needless safety risks caused by turbulent climatic situations.
- f. MEC that is acceptable to move but which will cause an unacceptable risk to the divers due to the size and weight of the MEC will be moved remotely by the use of a lifting balloon after the completion of the intrusive investigation. MEC determined to be unacceptable to move will be moved remotely by balloon after the intrusion phase of work. MEC that does not impose hazards to listed threatened or endangered species will be detonated in place.
- g. The handling of munitions to include relocation and detonation operations will require extensive coordination with state and Federal agencies to ensure public safety. All relocation and detonation operations will occur once the field investigation has been completed; this approach allows time for the required coordination and minimizes the impact to the community, beach, and surrounding waters recreational users by reducing the number of evacuations.
- h. A single item of UXO that poses a public hazard in its current location and is deemed acceptable to move by the SUXOS and UXOSO may be relocated to the closest suitable site within the MRS. A suitable site is one that is within the general vicinity of discovery, which reduces or eliminates

the public hazard, and consists of a flat sand bottom in which the UXO will be placed for destruction.

- i. Collection points are those areas used to temporarily accumulate MEC determined acceptable to move by the SUXOS and UXOSO pending destruction at the end of the day using consolidated shots. MEC items at collection points must be laid out as shown in "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites". The maximum net explosive weight (NEW) at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the HFD for the area. Consolidating multiple MEC is anticipated for this project.
- j. If determined acceptable to move by the SUXOS and UXOSO, consolidating multiple MEC may be anticipated for this project. US Army Engineering and Support Center, Huntsville (USAESCH) publication "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites," dated March 2000, will be used and a copy of this report will be available on site. The maximum net explosive weight (NEW) for a consolidated shot will be limited such that the K328 overpressure distance for the total NEW (including donor charges) does not exceed the MSD for the intentional detonation.
- k. Explosives will be provided by a local vendor (Alba Explosives, PR) on an as-needed basis.
- l. On-call explosives delivery will be used for any MEC items recovered during operations. Explosives will be provided by a local vendor on an "as-needed" basis. Should it be necessary to store explosives as a result of adverse weather conditions or other factors, one magazine with attached cap box, will be located at the designated explosives storage facility location 18°2⁰'04.56"N; 65°1⁹'26.79"W (see Appendix A: Figure 2). The magazine is owned by USA Environmental, Inc. A Standard Operating Procedure is in place for accountability and security. The magazine is an unbarricaded Alcohol, Tobacco and Firearms (ATF) Type II magazine. The total maximum net explosive weight (NEW) stored in the magazine will not exceed a total of 31 lb. DOD 6055.09-M determines that there will be a 200 foot Inhabited Building Distance (IBD) and a 120 foot Public Traffic Route Distance (PTRD) for the intended maximum NEW of 31 lb. These commercial explosives will have assigned DOD hazard division/storage compatibility groups (HD/SCG) and will be stored in accordance with DOD 6055.09-M, DA Pam 385-64, and any local regulations. The magazine is positioned in accordance with EP1110-1-18 and Section 55.206 of ATFP 5400.7, Alcohol, Tobacco, and Firearms (ATF) Explosives Law and Regulations. A notification (dated August 22, 2014) of intent to store explosives under the provisions of this contract has been forwarded to the Bureau of Alcohol, Tobacco, Firearms, and Explosives field office in Tampa, FL. The Amendment 1 Explosives Site Plan, Munitions Response Sites, 02, 04, 05, and 07, Culebra Island Site, Culebra, Puerto Rico demonstrated the intended use and siting of the USA Environmental, Inc. magazine in which approval by Department of Defense Explosive Safety Board (DDESB) was awarded on November 10, 2014 (DDESB 2014).
- m. Munitions to be relocated will be moved remotely by raising the munition off the sea floor with a lifting balloon. The required MFD-H, or Blast Withdrawal Distance, whichever is greater, will be maintained during the lifting and towing of each munition. When attached to the inflated balloon, the munition must remain submerged at a depth sufficient to clear all bottom obstructions but still provide significant tamp to protect the UXO Technicians in the towing vessel from an unplanned detonation. The depth of the ordnance item being towed will be pre-calculated (see Section 7.0) and the lifting balloon bridle will be configured to ensure the proper depth is maintained below the lifting balloon. The munition will have a witness buoy attached to it in case the balloon is separated from the munition during the raise or tow.
- n. Upon the successful detonation of a MEC item, a 5-minute wait time will be observed. A verification dive will be made to ensure the munition has been disposed of and to recover any MD left on the site. If explosives remain on the detonation site, they will be disposed of via counter charge of the remaining explosives.

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APPENDIX A. MAPS

This appendix contains the following maps for use on this project:

- Figure 1 - Regional Location Map
- Figure 2 - Magazine ESQD Map
- Figure 3 – Island Group 1 (Western Cayos) ESQD Map
- Figure 4 – Island Group 2 (Eastern Cayos) ESQD Map
- Figure 5 - MRS 09 Demo Location ESQD Map
- Figure 6 – Travel Route ESQD Map

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N

Scale Varies

Data is projected to the State Plane Coordinate System:
NAD 1983 StatePlane Puerto Rico Virgin Islands FIPS 5200

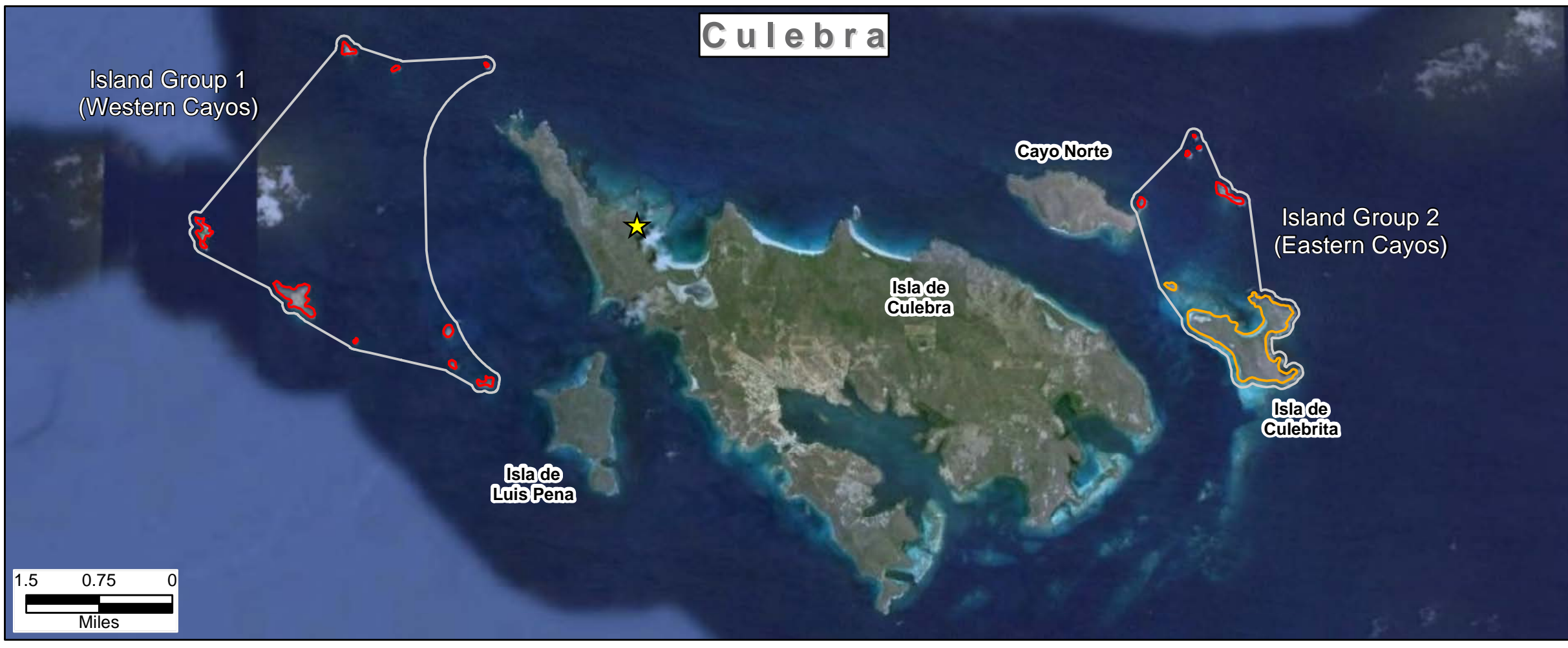
Remedial Action/ Feasibility Study

Figure 1

Regional Location Map

MRS 2 and 7

Culebra Island Site, Puerto Rico



Legend

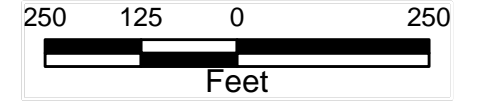
- ★ Magazine Location
- Island Groups

MRS Locations

- MRS 02
- MRS 07

PARSONS		US Army Engineering And Support Center Huntsville, Alabama	
Drawn By: JAL	Scale: Varies	Rev:	
Checked By:	Date Drawn: 11-19-2015		
Submitted By: MT	Revision Date:		
	Path: S:\Culebra1\Culebra MRS 2 and 7\MXD\ESP\02-26-16\Fig1 Regional Location map.mxd		

UTM Zone 20N; NAD83; Meters
Easting: 254425.606365
Northing: 2028774.91043



*Data is projected to the UTM Coordinate System:
Zone 20 North, NAD83, Units in Meters.*

Remedial Investigation/ Feasibility Study

Figure 2

Magazine ESQD Map

Culebra Island Site, Puerto Rico

Legend

- ★ Magazine Location
- 120-ft PTRD
- 200-ft IBD

PARSONS

US Army Engineering
And Support Center
Huntsville, Alabama

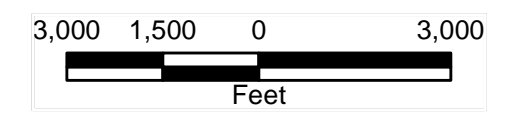
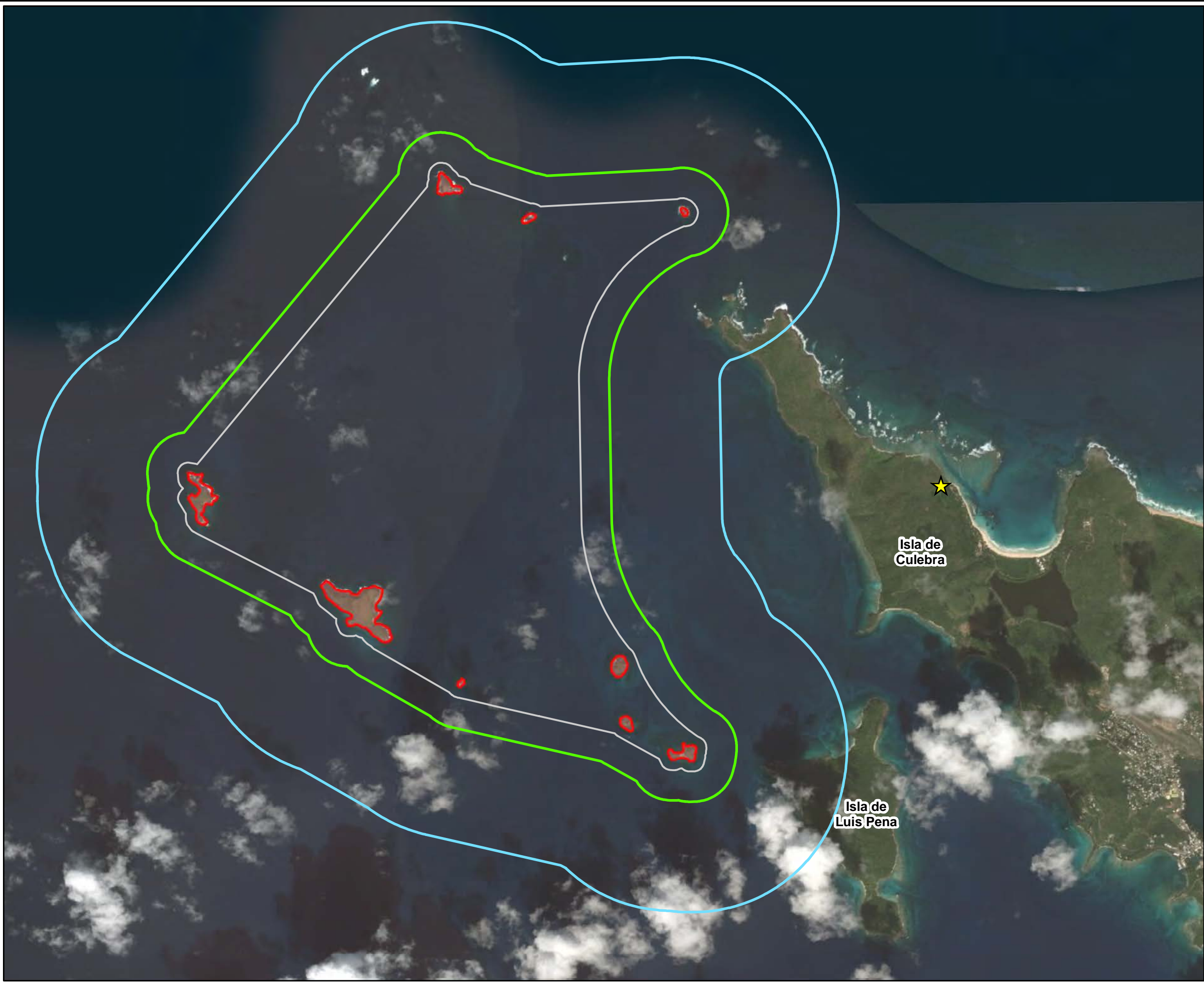
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Checked By:	TB	Date Drawn:	11-19-2015		
Submitted By:	PB	Revision Date:			



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7\MXD\ESP\02-26-16\Fig2 Magazine
ESQD Map.mxd



Flamenco Beach



Data is projected to the State Plane Coordinate System:
NAD 1983 StatePlane Puerto Rico Virgin Islands FIPS 5200

Remedial Action/ Feasibility Study

Figure 3
Island Group 1
(Western Cayos)
ESQD Map
MRS 2 and 7
Culebra Island Site, Puerto Rico

Legend

- ★ Magazine Location
- Island Group 1 (Western Cayos)
- MRS Locations**
- MRS 02
- ESQD Arcs: Mk 84 2,000-lb Bomb**
- HFD - 963 feet
- ESQD Arcs: 12-inch Mk 16 Projectile**
- MFD - 4,473 feet

PARSONS

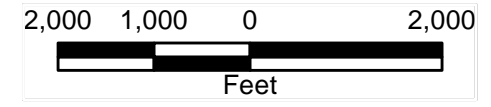
US Army Engineering
And Support Center
Huntsville, Alabama

Drawn By: CLH	Scale: 1 in = 3,000 feet	Rev:
Checked By:	Date Drawn: 03-01-2016	
Submitted By:	Revision Date:	



Path: S:\Culebra1\Culebra MRS 2 and 7\MXD\ESP\02-26-16\Fig3 Island Group 1 ESQD Map.mxd





*Data is projected to the State Plane Coordinate System:
NAD 1983 StatePlane Puerto Rico Virgin Islands FIPS 5200*

Remedial Action/ Feasibility Study

Figure 4
Island Group 2
(Eastern Cayos)
ESQD Map

MRS 2 and 7

Culebra Island Site, Puerto Rico

Legend

- Island Group 2 (Eastern Cayos)
- MRS Locations**
- MRS 02
- MRS 07
- ESQD Arcs: Mk 82 500-lb Bomb**
- HFD - 686 feet
- MFD - 3,074 feet

PARSONS

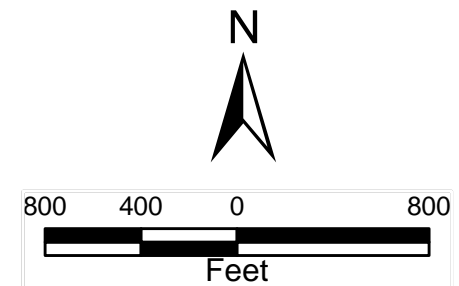
US Army Engineering
And Support Center
Huntsville, Alabama

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Checked By:	Date Drawn: 03-01-2016	
Submitted By:	Revision Date:	



Path: S:\Culebra1\Culebra MRS 2 and 7\MXD\ESP\02-26-16\Fig4 Island Group 2 ESQD Map.mxd





Data is projected to the UTM Coordinate System:
Zone 20 North, NAD83, Units in Meters.

Remedial Investigation/ Feasibility Study

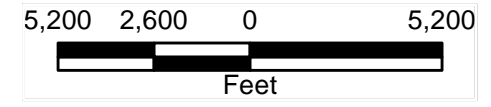
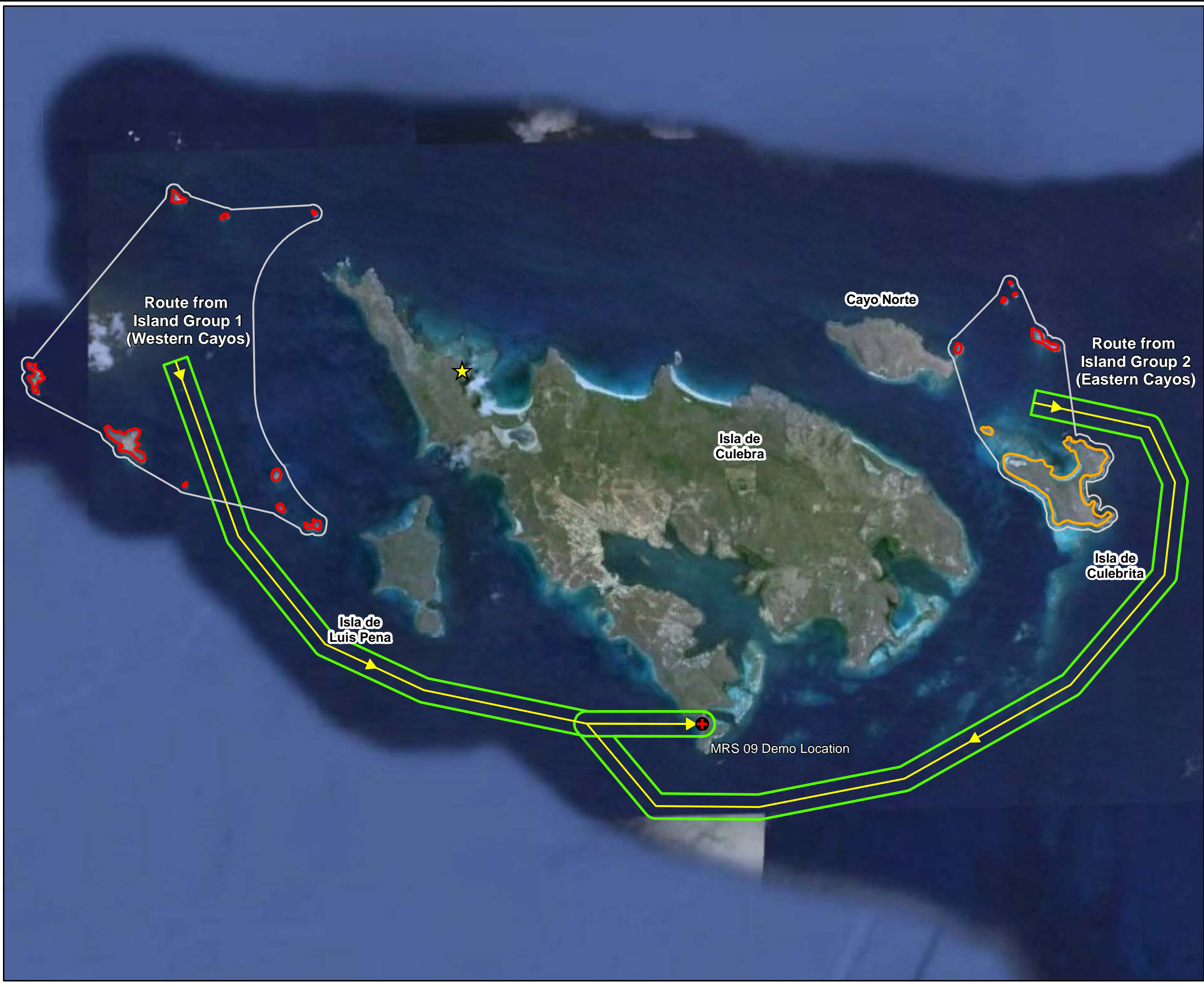
Figure 5
MRS 09
Demo Location
ESQD Map
MRS 2 and 7

Culebra Island Site, Puerto Rico

Legend

- Demo Location
- MRS Boundary
- ESQD Arcs: Mk 82 500-lb Bomb**
- HFD - 686 feet
- MFD - 3,074 feet

PARSONS		US Army Engineering And Support Center Huntsville, Alabama	
Drawn By:	JAL	Scale:	1 in = 800 feet
Checked By:	TB	Date Drawn:	2-3-2016
Submitted By:	PB	Revision Date:	
Path:		S:\Culebra1\Culebra MRS 2 and 7\MXD\ESP\02-26-16\Fig5 MRS 9 Demo ESQD Map.mxd	



Data is projected to the State Plane Coordinate System:
NAD 1983 StatePlane Puerto Rico Virgin Islands FIPS 5200

Remedial Action/ Feasibility Study

Figure 6

Travel Route ESQD Map

MRS 2 and 7

Culebra Island Site, Puerto Rico

Legend

- Demo Location
- Magazine Location
- Island Groups
- Demo Transport Routes
- MRS Locations**
- MRS 02
- MRS 07
- ESQD Arcs: Mk 82 500-lb Bomb**
- HFD - 686 feet

PARSONS

US Army Engineering
And Support Center
Huntsville, Alabama

Drawn By: CLH	Scale: 1 in = 5,200 feet	Rev:
Checked By:	Date Drawn: 03-01-2016	
Submitted By:	Revision Date:	



Path: S:\Culebra1\Culebra MRS 2 and 7\MXD\ESP\02-26-16\Fig6 Travel Route ESQD Map.mxd



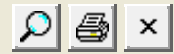
APPENDIX B. FRAGMENTATION DATA SHEETS

This appendix contains the following fragmentation data sheets for use on this project:

- MK 16
- MK 82
- MK 84

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Fragmentation Data Review Form



Database Revision Date 9/22/2015

Category:

Munition:

Case Material:

Fragmentation Method:

Secondary Database Category:

Munition Case Classification:

DODIC:

Date Record Created:

Record Created By:

Last Date Record Updated:

Individual Last Updated Record:

Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type:

Explosive Weight (lb):

Diameter (in):

Cylindrical Case Weight (lb):

Maximum Fragment Weight (Intentional) (lb):

Design Fragment Weight (95% Unintentional) (lb):

Critical Fragment Velocity (fps):

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):

MFD-H [Maximum Fragment Distance, Horizontal] (ft):

MFD-V [Maximum Fragment Distance, Vertical] (ft):

Overpressure Distances

TNT Equivalent (Pressure):

TNT Equivalent Weight - Pressure (lbs):

Unbarricaded Intraline Distance (3.5 psi), K18 Distance:

Public Traffic Route Distance (2.3 psi); K24 Distance:

Inhabited Building Distance (1.2 psi), K40 Distance:

Intentional MSD (0.0655 psi), K328 Distance:

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):

TNT Equivalent Weight - Impulse (lbs):

Kinetic Energy 10⁶ (lb-ft²/s²):

Single Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Double Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Water Mitigation

Minimum Separation Distance (ft):

Water Containment System:

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	<input type="text" value="21.15"/>	<input type="text" value="10.67"/>
Mild Steel:	<input type="text" value="4.06"/>	<input type="text" value="2.03"/>
Hard Steel:	<input type="text" value="3.33"/>	<input type="text" value="1.66"/>
Aluminum:	<input type="text" value="7.41"/>	<input type="text" value="3.87"/>
LEXAN:	<input type="text" value="14.54"/>	<input type="text" value="9.49"/>
Plexi-glass:	<input type="text" value="14.22"/>	<input type="text" value="8.07"/>
Bullet Resist Glass:	<input type="text" value="13.88"/>	<input type="text" value="7.40"/>

Item Notes

Fragmentation Data Review Form



Database Revision Date 9/22/2015

Category:

Munition:

Case Material:

Fragmentation Method:

Secondary Database Category:

Munition Case Classification:

DODIC:

Date Record Created:

Record Created By:

Last Date Record Updated:

Individual Last Updated Record:

Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type:

Explosive Weight (lb):

Diameter (in):

Cylindrical Case Weight (lb):

Maximum Fragment Weight (Intentional) (lb):

Design Fragment Weight (95% (Unintentional) (lb):

Critical Fragment Velocity (fps):

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):

MFD-H [Maximum Fragment Distance, Horizontal] (ft):

MFD-V [Maximum Fragment Distance, Vertical] (ft):

Overpressure Distances

TNT Equivalent (Pressure):

TNT Equivalent Weight - Pressure (lbs):

Unbarricaded Intraline Distance (3.5 psi), K18 Distance:

Public Traffic Route Distance (2.3 psi); K24 Distance:

Inhabited Building Distance (1.2 psi), K40 Distance:

Intentional MSD (0.0655 psi), K328 Distance:

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):

TNT Equivalent Weight - Impulse (lbs):

Kinetic Energy 10⁶ (lb-ft²/s²):

Single Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Double Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Water Mitigation

Minimum Separation Distance (ft):

Water Containment System:

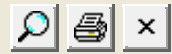
Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	<input type="text" value="29.68"/>	<input type="text" value="11.18"/>
Mild Steel:	<input type="text" value="4.78"/>	<input type="text" value="1.90"/>
Hard Steel:	<input type="text" value="3.92"/>	<input type="text" value="1.56"/>
Aluminum:	<input type="text" value="9.25"/>	<input type="text" value="3.89"/>
LEXAN:	<input type="text" value="14.13"/>	<input type="text" value="8.04"/>
Plexi-glass:	<input type="text" value="13.61"/>	<input type="text" value="6.46"/>
Bullet Resist Glass:	<input type="text" value="12.61"/>	<input type="text" value="5.63"/>

Item Notes

Fragmentation Data Review Form



Database Revision Date 9/22/2015

Category:

Munition:

Case Material:

Fragmentation Method:

Secondary Database Category:

Munition Case Classification:

DODIC:

Date Record Created:

Record Created By:

Last Date Record Updated:

Individual Last Updated Record:

Date Record Retired:

Munition Information and Fragmentation Characteristics

Explosive Type:

Explosive Weight (lb):

Diameter (in):

Cylindrical Case Weight (lb):

Maximum Fragment Weight (Intentional) (lb):

Design Fragment Weight (95% Unintentional) (lb):

Critical Fragment Velocity (fps):

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):

MFD-H [Maximum Fragment Distance, Horizontal] (ft):

MFD-V [Maximum Fragment Distance, Vertical] (ft):

Overpressure Distances

TNT Equivalent (Pressure):

TNT Equivalent Weight - Pressure (lbs):

Unbarricaded Intraline Distance (3.5 psi), K18 Distance:

Public Traffic Route Distance (2.3 psi); K24 Distance:

Inhabited Building Distance (1.2 psi), K40 Distance:

Intentional MSD (0.0655 psi), K328 Distance:

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):

TNT Equivalent Weight - Impulse (lbs):

Kinetic Energy 10⁶ (lb-ft²/s²):

Single Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Double Sandbag Mitigation

Required Wall & Roof Thickness (in):

Expected Max. Throw Distance (ft):

Minimum Separation Distance (ft):

Water Mitigation

Minimum Separation Distance (ft):

Water Containment System:

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	<input type="text" value="50.59"/>	<input type="text" value="18.35"/>
Mild Steel:	<input type="text" value="7.70"/>	<input type="text" value="2.97"/>
Hard Steel:	<input type="text" value="6.32"/>	<input type="text" value="2.44"/>
Aluminum:	<input type="text" value="14.54"/>	<input type="text" value="5.94"/>
LEXAN:	<input type="text" value="18.80"/>	<input type="text" value="10.46"/>
Plexi-glass:	<input type="text" value="19.88"/>	<input type="text" value="9.12"/>
Bullet Resist Glass:	<input type="text" value="19.15"/>	<input type="text" value="8.06"/>

Item Notes