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DRAFT FINAL CLOSURE PLAN OPEN BURN/OPEN DETONATION SITE FORMER ATLANTIC FLEET WEAPONS TRAINING FACILITY VIEQUES ISLAND PUERTO RICO
(DRAFT FINAL ACTING AS FINAL VERSION)
07/01/2004
CH2M HILL

Draft Final

Closure Plan
Open Burn/Open Detonation Site
Former Atlantic Fleet Weapons Training Facility
Vieques, Puerto Rico

Prepared for

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Naval Facilities Engineering Command
Norfolk, Virginia

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Prepared by

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Abbreviations and Acronyms

AFWTF	Atlantic Fleet Weapons Training Facility
amsl	above mean sea level
ASTM	American Society of Testing and Materials
ATG	Air-to-Ground
ATV	All Terrain Vehicle
BD	Base Detonating
bgs	Below Ground Surface
BIP	Blow-in-Place
CAP	Corrective Action Plan
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chain of Custody
COPC	Contaminant of Potential Concern
COMLANTFLT	Commander, U.S. Atlantic Fleet
CSM	Conceptual Model
CWM	Chemical Warfare Material
DDESB	Department of Defense Explosive Safety Board
DO	Dissolved Oxygen
DoD	Department of Defense
DOI	Department of Interior
DQO	Data Quality Objectives
ECA	Eastern Conservation Area
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Disposal
EQB	Environmental Quality Board
ERA	Ecological Risk Assessment
EZ	Exclusion Zone
°F	Degrees Fahrenheit
GIS	Geographic Information System
GPS	Global Positioning System
HSM	Health and Safety Manager
IDW	Investigation Derived Waste
LANTDIV	Atlantic Division
LCS	Laboratory Confirmation Sample
LIA	Live Impact Area

MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NSRR	Naval Station Roosevelt Roads
NASD	Naval Ammunitions Support Detachment
NATO	North Atlantic Treaty Organization
NEW	Net Explosive Weight
NGF	Naval Gunfire
NGFS	Naval Gunfire Support
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NTU	Nephelometric Turbidity Unit
OB	Open Burn
OD	Open Detonation
OE	Ordnance and Explosives
OP	Observation Post
ORS	Ordnance Related Scrap
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PPE	Personal Protective Equipment
PRASA	Puerto Rico Aqueduct and Sewer Authority
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
PZ	Piezoelectric
QA	Quality Assurance
QAPP	Quality Assurance Project Plans
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RGO	Remedial Goal Option
RL	Reporting Limit
SIA	Surface Impact Area
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SUXOS	Senior Unexploded Ordnance Supervisor
TEF	Toxicity Equivalency Factor
TO	Technical Order

UCL	Upper Confidence Limit
USCS	United Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UTL	Upper Tolerance Limit
UTS	Universal Treatment Standard
UXO	Unexploded Ordnance
UXOSO	Unexploded Ordnance Safety Officer
UXOQCS	Unexploded Ordnance Quality Control Supervisor
VNTR	Vieques Naval Training Range
VOC	Volatile Organic Compound

SECTION 1

1 Introduction

This closure plan identifies the procedures to achieve closure of the Open Burn/Open Detonation (OB/OD) site at the U.S. Navy's former Atlantic Fleet Weapons Training Facility (AFWTF), also known as the Vieques Naval Training Range, located in Vieques, Puerto Rico. The closure of the site refers to the process by which the site is closed to prevent or minimize future impacts to human health or the environment.

The OB/OD site was operated under interim status of the Resource Conservation and Recovery Act (RCRA) in accordance with the Part B Hazardous Waste Facility Operations Permit Application submitted by the U.S. Navy to USEPA in 1988. A Closure Plan for the OB/OD site was submitted by the U.S. Navy in June 1993. Comments on this Closure Plan were received from USEPA on October 21, 1999. Based on laws passed by Congress there has been some uncertainty of the anticipated use of the site until it was decided to close the entire Vieques Naval Training Facility in 2003. This Closure Plan for the OB/OD site amends the June 1999 Closure Plan for site closure and addresses USEPA's comments from October 21, 1999.

The OB/OD site is located on property currently owned by the Department of Interior; however, the U.S. Navy is responsible for the environmental cleanup of the property. Copies of this closure plan will be maintained by both the Department of Interior (DOI) and the Atlantic Division of the U.S. Navy (LANTDIV) until closure is completed. Upon completion of closure, LANTDIV will submit to USEPA and Puerto Rico's Environmental Quality Board (EQB) a certification, by an independent registered professional engineer, that the facility has been closed in accordance with the specifications in the approved closure plan. This plan will be updated as necessary by issuing either page changes or new copies, as appropriate, to all plan addressees.

There are two approaches to closure of the OB/OD site under RCRA: 1) closure by removal (clean closure) and 2) in-place closure. Clean closure occurs when any associated contamination at the facility is removed to the extent that laboratory analysis shows the contaminants remaining are either below background levels or if it can be determined that any contamination remaining in place at the site poses no unacceptable risk to human health and the environment through the use of risk-based cleanup levels. In-place closure occurs when contamination associated with the site remains in place, either in the soil or groundwater or both. Under this option, post closure monitoring will be conducted to ensure there are no impacts to downgradient receptors.

The objectives of this Closure Plan are to: 1) provide the procedures for completing a site characterization to delineate the nature and extent of contamination, if any, associated with the OB/OD areas; 2) present the approach for determining if the site will be closed as a clean closure or as an in-place closure; and 3) should the site be found to pose an unacceptable risk to human health and the environment, identify the procedures for completing final closure of the site. An Interim Closure Report will present the results of the site characterization and provide a revised closure plan that will include a more detailed description of the process for closing the facility, based on the results of the site characterization.

SECTION 2

2 Facility Description

2.1 Facility Location

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of the island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin Islands. It is approximately 20 miles long and 3 miles wide, and has an area of approximately 33,088 acres (51 square miles). Figure 2-1 shows the location of Vieques and the former AFWTF. The former AFWTF is situated in the eastern third of Vieques Island, and is bordered to the west by the community of Isabel Segunda, to the north by the Vieques Sound, and to the south by the Caribbean Sea.

2.2 Facility Operation

The former AFWTF is located on the eastern one-third of Vieques Island and was under the command of the Commander, U.S. Atlantic Fleet (COMLANTFLT). The AFWTF provided facilities to train Atlantic Fleet and North Atlantic Treaty Organization (NATO) ships, air wings, and smaller air units from other allied nations in naval gunfire support and air-to-ground ordnance delivery. The AFWTF included the following operational areas extending from east to west: the Eastern Conservation Area (ECA), comprised of an area of 200 acres; the Live Impact Area (LIA), comprised of 900 acres; the Surface Impact Area (SIA), comprised of 2,500 acres; and the adjacent and wholly contiguous Eastern Maneuver Area (EMA), comprised of around 11,070 acres. The locations of these areas are shown on Figure 2-2. The U.S. Navy utilized these areas as impact areas for COMLANTFLT training in the operational areas of Naval Gunfire Support (NGFS) or ship-to-shore firing; air-to-ground (ATG) ordnance delivery; ground forces artillery/tank firing/small arms firing; and amphibious operations landings(U.S. Navy, 1979).

The area that had the largest ordnance usage is the LIA, encompassing an area of 900 acres. This area was established by the U.S. Navy in 1964 when a gunnery range was constructed. This range consisted of point and area targets for ships to practice NGFS. In 1965, the LIA added an air impact area where numerous mock-ups such as old tanks and vehicles were used as targets for aerial bombing and strafing with live and inert ordnance. The locations of these targets and the OB/OD units are shown in Figure 2-3. The activity at the LIA increased significantly after July 1975 when training activities stopped on nearby Culebra Island. From 1974 through 1998, an average of more than 7,600 rounds per year of naval gunfire (NGF) was directed at the LIA. The naval gunfire munitions of explosive concern (MEC) typically ranged from 3-inch/50 to 5-inch/54 type projectiles each weighting from 13 to 70 pounds. For the same period of time, the ATG MEC expended averaged more than 3,000 rounds per year. The ATG MEC typically ranged from MK-24s (parachute flares) through MK-84 bombs (2,000 pound bombs) (U.S. Navy, 1979).

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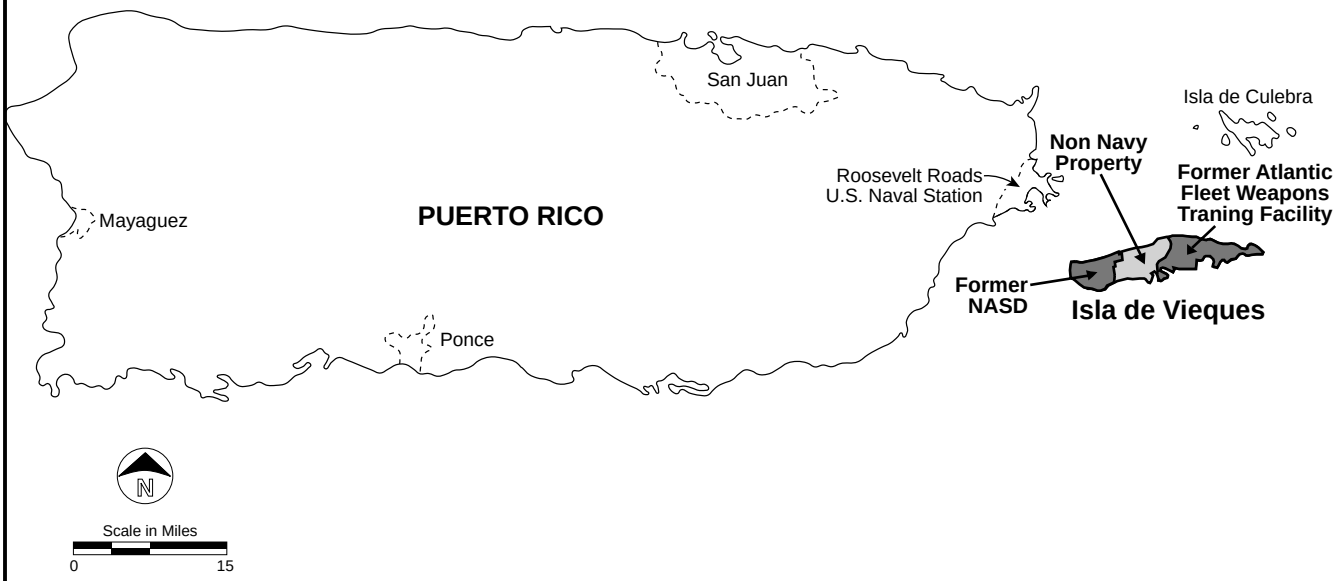
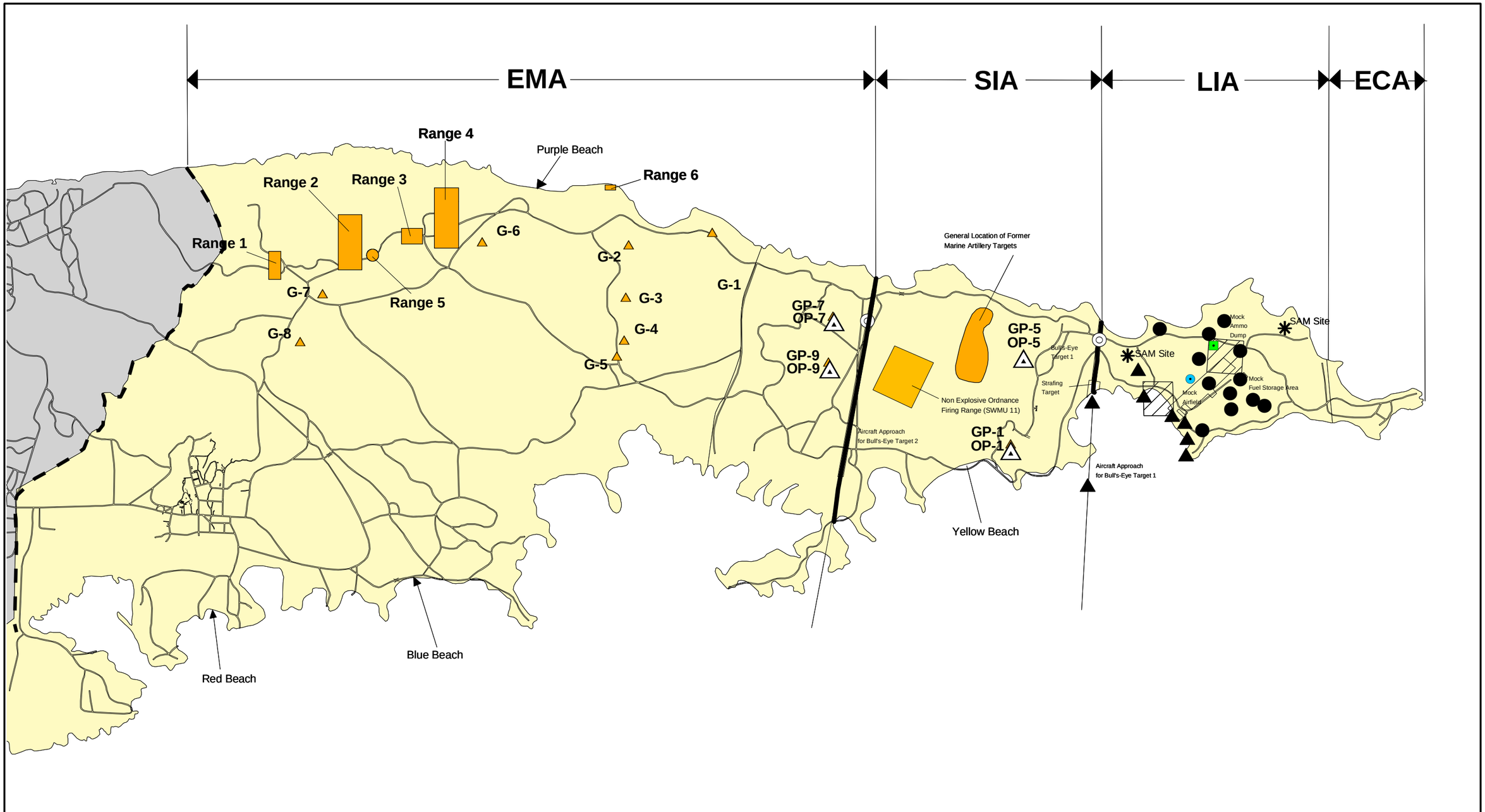


Figure 2-1
Site Location Map
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico



LEGEND

- Naval Gunfire Support (NGFS)
- Area Target
- Navy Property
- Non-Navy Property
- Air-To-Ground (ATG) Target
- Naval Gunfire Support (NGFS) Target
- Open Detonation Unit
- Open Burning Unit
- Property Line
- Small Arms/Artillery Ranges
- General Location of Marine Artillery Targets
- Observation Point
- Gun Position

ECA - Eastern Conservation Area
EMA - Eastern Maneuver Area
LIA - Live Impact Area
SIA - Surface Impact Area

2,400 0 2,400 Feet

Figure 2-2
AFTWTF Operational Areas
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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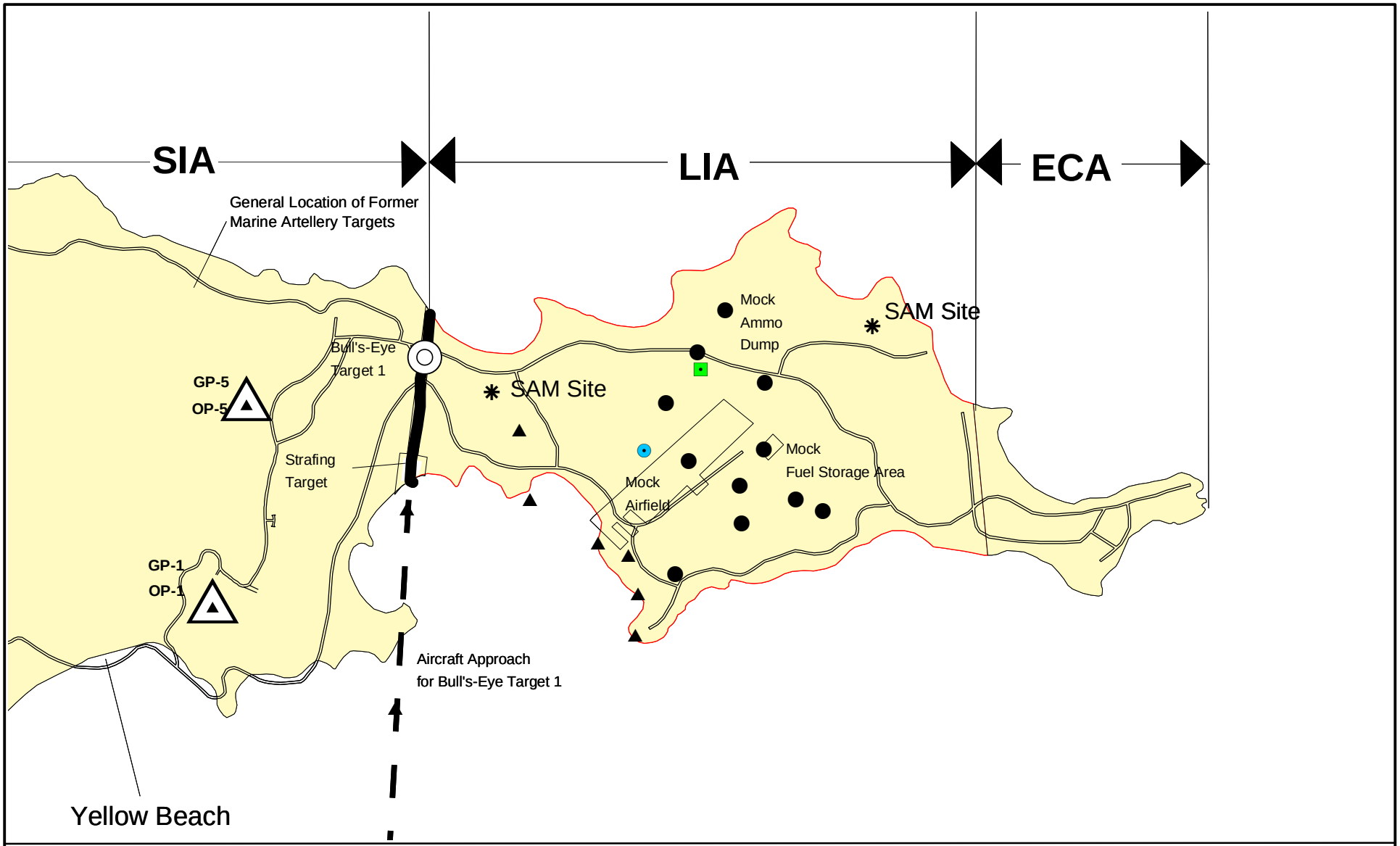

ECA - Eastern Conservation Area
LIA - Live Impact Area
SIA - Surface Impact Area

Open Detonation Unit
Open Burning Unit
Air-To-Ground (ATG) Target
Naval Gunfire Support (NGFS) Target

1,500 0 1,500 Feet

Figure 2-3
Location of OB/OD Units and Target Areas
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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In the late 1970s the amphibious training in the EMA declined and Camp Garcia was closed in 1978. Also at that time, use of the SIA for live fire was discontinued and live artillery fire afterwards was directed to the northwest portion of the LIA. After 1978, ATG activities declined and were terminated in 2003.

From April 2000 until April 2003, when the former Naval facility was closed, all the ordnance fired on Vieques was limited to inert ordnance. This was a result of a Congressional law. Following termination of training operations on Vieques, AFWTF ownership was transferred to the jurisdiction of the Secretary of the Interior.

2.3 OB/OD Site Description

Within the AFTWF's LIA, two separate locations were designated for treatment of retrograde (unserviceable) ordnance through OB/OD. The retrograde munitions also included the expired ammunition stored at the former Naval Ammunitions Support Detachment located in western Vieques. The location of the site is shown on Figure 2-3. The OB/OD facility was operated under interim status of RCRA in accordance with the Part B Hazardous Waste Facility Operations Permit Application submitted in 1988. Two separate operation locations were identified, a open detonation area and an open burn area, as shown on Figures 2-3 and 2-4. Operation of the facility continued until April 30, 2003 when the Naval facilities on eastern Vieques were closed and the property was transferred to the DOI.

In the open detonation area, retrograde munitions were detonated with high explosives in excavated earthen pits. Detonation events at the OD area occurred once or twice per year when the Navy Explosive Ordnance Detachment (EOD) cleared paths to target areas within the LIA so that the target areas could be repaired (U.S. Navy, 1993). During each detonation event, a single pit was excavated in which the waste ordnance was placed for detonation. The pits were circular with approximately a 30 to 50-foot radius; and generally excavated to a depth of 6 to 8 feet. Cover materials were likely used to cover ordnance prior to detonation. Waste ordnance was transported from the Naval Ammunitions Support Detachment (NASD) to the LIA via water and, within the LIA, transported via motor vehicle to the OD unit, where high explosives were placed in direct contact with the waste ordnance to maintain explosive continuity.

Although high explosives were used to supplement open detonation, they were not technically a fuel, but an initiating mechanism. No supplemental fuels were used for detonation operations. Following each detonation, EOD personnel carefully searched the surrounding grounds for unexploded ammunition or explosives. Explosives or unfuzed ammunition were picked up and prepared for the next detonation. Fused ammunition or items with potentially damaged internal components were generally detonated in-place.

No more than one detonation occurred per day during the detonation events that occurred once or twice per year (U.S. Navy, 1993). No sound or shock barriers were utilized since personnel evacuate to Observation Point-1 (OP-l) prior to detonation; OP-1 is located approximately 1.8 miles from the unit (see Figure 2-2). Department of Defense (DoD) policy and the facility standard operating procedure (SOP) states that a minimum 5,000-foot buffer

is required between personnel and the detonation site; therefore, no protective bunkers were utilized at the unit. Such devices would be destroyed during Naval training activities.

The boundaries of the OD area were not well delineated in the Permit Application. However, analysis of historical aerial photography (Environmental Research, Inc., 2003 and December 2003) indicated that the site consisted of a series of adjoining detonation pits over a 3-acre area, as shown on Figure 2-4. Ten pits and a bermed area within the OB/OD site were identified from the 1994 aerial photo. An access road leads through the center of the site with the pits and bermed area lying on either side of the access road (seven pits along the eastern side of the road and the bermed area and three pits along the western side of the road). Three of the larger pits along the eastern side of the road contained debris. An access road also leads into the OB/OD site from the west. During a site visit by the U.S. Navy and CH2M HILL on November 18, 2003 the site was observed to be approximately the same size as was present in the 1994 aerial photo. A total of nine detonation pits were visually identified and a number of munitions items were found on the surface. Based on the aerial photo analysis completed, no detonation pits were noted on the 1985 and 1983 photographs in this area.

The open burn area was designated in the Permit Application for open burning of waste propellants and pyrotechnics. EOD Officer Todd Enders and environmental staff from Naval Station Roosevelt Roads (NSRR), who have both been involved in EOD operations at Vieques since the mid 1980s, indicated that the OD site was the only designated detonation area and there were no open burn areas within the LIA. However, the RCRA Part B Hazardous Waste Facilities Operations Permit Application (Department of the Navy, 1993) indicates that "no treatment operations have been conducted at this facility since 1987," implying that treatment operations occurred at that facility prior to that date.

An analysis of historical aerial photos for the period of 1970 to 1994 identified a "dark circular pit" in the 1970 aerial photo that corresponds to the location of the burn pit identified in the Part B Permit Application (Environmental Research, Inc., 2004). The pit is approximately 50 feet in diameter. On the 1983 and 1985 aerial photos vegetation surrounded the pit and an overgrown access road was evident on the west side of the pit, indicating the area was not in use at the time. On the 1994 aerial photo vegetation growth was visible within the pit.

The area where the OB/OD site is located is in the vicinity of targets that were used for target practice for ATG bombing and naval gunfire training. The LIA was bombed with the same types of ordnance which were treated at the OB/OD units.

The entire LIA, including the OB/OD site is required by Section 1049 of the Nation Defense Authorization Act for Fiscal Year 2002 to be managed by DOI as part of the National Wildlife Refuge System. The area must be managed as a wilderness area and public access must be excluded (Public Law 106–398; Public Law 107–107).

Legend

- Open Detonation Area
- Open Detonation Pits
- Open Burn Area

N
W E
S

125 0 125 Feet

Figure 2-4
Aerial Photographic Analysis Findings
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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2.4 Waste Treated at OB/OD Site

In accordance with 40 CFR 265.112(b)(3) a closure plan needs to provide an estimate of the maximum waste inventory from the facility. The maximum inventory of hazardous waste at the OB/OD site was assumed to be the maximum single day disposal since that is the maximum waste ever on site. Only the amount that was to be treated that day would be on location which was 5,000 pounds net explosive weight (NEW) of explosives per detonation and 5,000 pounds of explosive per burn. This is the maximum quantity of explosives allowed under the U.S. Navy explosive safety rules to be treated at the OB/OD site in a single event. RCRA reporting requirements only required that the total annual NEW for each explosive category be reported. Table 2-1 lists the NEW of waste munitions, by explosive category, that was treated at the OB/OD facility between 1992 and 1999. The types of explosives used is listed in Table 2-2. A representative listing of the types and quantities of munitions that have been treated on-site are reflected in a listing of the munitions treated during the 1998 and 1996 detonation events, listed in Tables 2-3 and 2-4.

2.5 Environmental Setting

2.5.1 Climate

The climate of Vieques is tropical-marine. Temperatures are nearly constant, with an annual average of approximately 79 degrees Fahrenheit (°F). August is the warmest month (82°F) and February the coolest (76°F). Vieques lies directly in the path of the prevailing easterly trade winds that regulate the climate of Puerto Rico. The trade winds result in a rainfall pattern characterized by a dry season from December through July and a rainy season from August to November. Heavy precipitation may be induced by tropical storms from June to November. Average annual rainfall in Vieques averages 36 inches with extremes of 25 inches on the eastern end and 45-50 inches on the western end (PREQB, 1995)

2.5.2 Topography

The terrain at the Site is varied, with partially flat and partially hilly portions. The LIA is mostly flat with elevations ranging from 0 to approximately 50 feet above mean sea level (amsl). The SIA and EMA are mostly hilly with a maximum elevation of 450 feet amsl at OP-1. The coastal plain is generally narrow at the Site, however mangrove swamps extend into the interior of the island forming relatively large expanses of tidally inundated lowlands, especially along the southern coast (see Figure 2-5).

2.5.3 Surface Water

Vieques does not have any perennial surface drainage, most of the streams are intermittent where streamflow only occurs during major precipitation events. Surface water deposits occur primarily in coastal lagoons and intermittent streams, known locally as arroyos and quebradas that channel water downward from hills during rain events.

TABLE 2-1
Annual Net Explosive Weight (NEW) of Waste Munitions Treated at OB/OD Facility

Year	Total NEW (lbs.)	Explosive A (lbs.)	Explosives B (lbs.)	Explosives C (lbs.)
1992	854	427	427	0
1993	3813	3754	23	36
1994	777	702	6	69
1995	3285.3	1655	105.3	1515
1996*	755	600	145	10
1997	62890.2	59566.5	2306.7	1017
1998*	87	60	15	12
1999	15812			

Explosives A - Detonating explosives (High explosive filled munitions [bomb, mortars, projectiles]; demolition explosives, [C4 or TNT])

Explosives B - Burning explosives (Liquid/solid propellants, smokeless powder, pyrotechnics)

Explosives C - Manufactured items containing limited quantities of Explosives A or B (or both). For example: small arms ammunition, spotting charges for practice munitions.

* Explosive weights are estimated based on types of explosives recorded to have been treated for that year (Tables 2-3 and 2-4). No records of exact explosives weights were available.

TABLE 2-2
Types of Explosives used at OB/OD Facility (U.S. Navy, 1993)

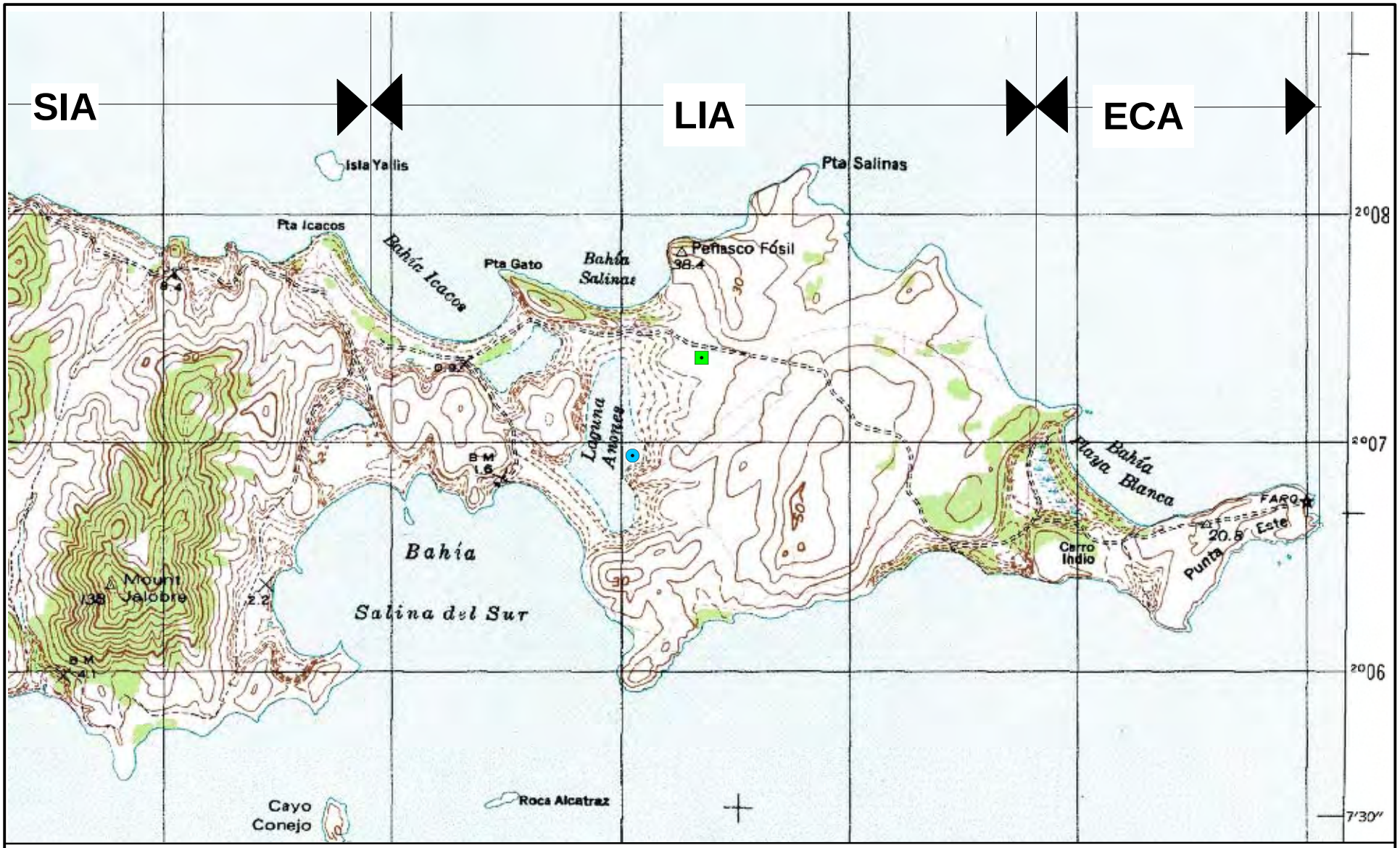
Black powder	H6 (RDX/TNT/aluminum mixtures)	mercury fulminate
TNT (trinitrotoluene)	Tritonal (TNT I aluminum mixture)	tetracene
Explosive D (ammonium picrate)	D BX (TNT IRD XI ammonium nitratel aluminum mixture)	DDNP (diazodinitrophenol)
PETN (pentaerythritol tetranitrate)	Torpex (RDX/TNT/aluminum mixture)	smokeless powder
tetry I (N -tetranitro- N –methy laniline)	Comp D-2 (desensitizing wax mixture)	solid propellant
RDX compositions (cyclotrimethylene trinitramine with other explosives and materials) cyclotols (RDX/TNT mixtures)	PBX (explosives/plastics mixture)	pentataerylthritol
HMX (cyclotetramethylene tetranitromine)	lead azide	pyrotechnics
octols (HMX/TNT mixtures)	lead styphnate	
HBXs (RDX/TNT/aluminum mixtures)		

TABLE 2-3
Types and Quantities of Munitions Treated at OB/OD Site in 1998

Type Of Munitions	NAL Code	Number of Items Treated	Type Of Munitions	NAL Code	Number of Items Treated
PCU46/B	4W69	150	Signal, SE1 124	L283	13
Cartridge, 12 Gauge	A011	102	Signal, SMK GR M128	L324	1
Cartridge, 5.56MM M855	A059	2	Marker, LOC 25-3	L554	1
Cartridge, 5.56MM M193	A071	200	Marker 58	L580	2
Cartridge, 7.62BALL	A102	60	Simulator M177	L596	7
Cartridge, 7.62 MSG	A130	840	Flare, 28	LW38	4
Cartridge, 50 LINKED	A578	3500	Flare Kit	LY 15	1
Cartridge, 20MM LINKED	A672	178	Cartridge, Imp., MK19	M012	36
Cartridge 20MM PGU-27	A678	76	Cartridge Impulse	M016	20
Cartridge, 20MM DUMMY	A807	412	Charge, DM 1/2 LB	M031	15
Cartridge, 20MM M55A2	A891	324	Cartridge CCU-45/B	M065	38
Cartridge 25MM HEI-T	A981	39	Cartridge Imp, CU44/B	M066	24
Prop. Assembly	DW53	6	Cartridge Fire Ex.	M162	4
Bomb, Practice	E957	1	Cartridge A/S Fire Ex	M179	21
Bomb, BDU-48/B	E982	3	Cartridge Impulse 2-1	M190	1
Bomb, PR BDU-45/B	F017	1	Cartridge A/C Fire Ext	M193	4
Cartridge, SIG CXU4AB	F534	2	Cartridge MK124	M383	23
Fuze, M904EZ	F881	25	Cartridge, IMP, MK-45	M516	13
Delay ELUM M9	G217	157	Dynamite, AN 40%	M585	12
Hand Grenade, Inc.	G900	2	Init. M99	M648	27
Hand Grenade, Off	G911	12	Thruster M13	M651	4
Hand Grenade, Smoke	G930	32	Cap, Blasting	M855	90
Switch 122	GW03	36	Cartridge, MK-107-1	M943	1
Igniter 173	H413	15	Init, JAU-20A	MF47	8
Signal, Kit	L118	5	Init., JAU-22/B	MF84	4858
Signal, Illum./80	L258	61	Can. Scent Kit	MN01	1
Prop. Assy	TA78	3	Cartridge Assy	MW19	2

TABLE 2-4
Types and Quantities of Munitions Treated at OB/OD Site in 1996

Type Of Munitions	NAL Code	Number of Items Treated	Type Of Munitions	NAL Code	Number of Items Treated
Cartridge, 5.56MM M193	A071	3	Cartridge, Impulse MK23	M161	1
Cartridge, small arms, blanks	A112	94	Impulse Cartridge	M232	1
Cartridge, 7.62 LINKED	A165	56	Impulse Cartridge	M397	1
Cartridge, 50 BALL	A605	1	Cutter, Cable MK 3	M485	33
Inert	AWAA	1	Cartridge, Impulse	M506	1
Cartridge 40mm White Star Cluster M585	B536	13	Cartridge, IMP, MK-45	M516	1
Prop. Assembly	DW53		Cartridge, Impulse	M643	2
Bomb GP 500lb MK 82 Thermal Protected	E488	2	Cartridge, Impulse	M644	13
Explosive Bomb	E510	1	Cartridge, Impulse	M783	4
Grenade, Hand, Smoke	G945	1	Ctg Impulse CCU-45	MD65	49
Rocket Motor	H341	2	Cartridge, Mortar	MF64	8
Signal, Smoke and Illum	L275	1	Guided Missile	PV15	1
Flare, A/C, Parachute	L411	1		T674	2
Signal, Illumination	L596	435	Blasting Caps	UNK	12
Flare, Decoy, MK-46	LW60	2		YW33	624
Electric Blasting Cap #8 Delay	M118	282			



ECA - Eastern Conservation Area
LIA - Live Impact Area
SIA - Surface Impact Area

- Open Detonation Unit
- Open Burning Unit

1,200 0 1,200 Feet

Figure 2-5
Topograhic Map
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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Surface water features are less prominent on the eastern side of the island than they are on the western side, and exist primarily very close to the coast as lagoons. Some rainwater does pool for some time in low-lying areas following storm events, but these features dissipate within a few days. In the vicinity of the OB/OD unit, flooding has been observed following significant rain events and the observed flood waters persisted for extended periods. The surface water bodies nearest the OB/OD units are the Caribbean Sea and Laguna Anones, which is approximately 1/8th-mile from the OB /OD site (see Figure 2-5). Runoff from the site drains into this lagoon.

2.5.4 Geology

The geology of Vieques is characterized by volcanic rocks generally overlain by alluvial deposits and patches of limestone. The upland areas contain three rock types consisting of sedimentary rocks composed of limestone and volcanic rocks composed of granodiorite and diorite.

Limestone bedrock is found exposed in the upland areas in the LIA. The limestone, which is locally known as the Puerto Ferro limestone and is of Tertiary-Miocene age, ranges from 125 to 140 feet thick on the south coast and 160 to 175 feet on the eastern tip of the island. On the south coast, the limestone rests on granodiorite basement rock. Quaternary age deposits are found in the valleys and coastal areas and include beach, swamp, and alluvial deposits. Deposits of sand, swamp, and salt mud occur in the coastal areas and floodplains. The limestone is generally soft, yellowish, and well-indurated where exposed to the atmosphere.

Most soils on Vieques are residual in nature. Because of the tropical wet and dry type climate and the relatively impermeable intact rock, soil development has been severely limited on the eastern portion of the island, resulting in a very shallow soil profile. Generally, the soils on the eastern end of the island are fine-grained with a high clay content.

Alluvial deposits are found in the valleys and coastal areas and include beach, swamp and alluvial deposits. Deposits of sand, swamp, and salt mud occur in the coastal areas and floodplains. A recent investigation of the eastern end of Vieques indicated that the alluvial deposits on the eastern end of Vieques range from 5 to 50 feet in thickness (Baker, 1999).

Soils on Vieques Island are primarily residual, due to both climatic and subsurface rock conditions. They typically are classified into five groups and range from rock land soils where bedrock is exposed to deep, well drained soils within the alluvial deposits to shallow soils (U.S. Department of Agriculture, 1977).

2.5.5 Groundwater

Two types of aquifers are present in eastern Vieques. The first type of aquifer is found in the upper portion of the bedrock in the EMA. At the east end of Vieques, a groundwater divide occurs near the center of the island. From this location, the groundwater flow is toward the northeast and the southwest (Baker, 1999). The second type of aquifer is within the alluvial deposits found below the hills in the low flat valleys along the coast. Groundwater flow in these aquifers is also downhill and generally towards the sea. The more productive aquifer is an alluvial aquifer within Esperanza Valley, the largest alluvial valley in Vieques. The groundwater within the Valle de Esperanza aquifer is located beneath the southern portion

of the island near Camp Garcia. Approximately 5 percent of the annual precipitation infiltrates through the ground and supplies the aquifers. A more detailed discussion of the groundwater conditions within VNTR is provided in the Environmental Baseline Survey and the U.S. Geological Survey of the area (U.S. Geological Survey, 1995)

Prior to the installation of the water line from the main island of Puerto Rico in 1978, the Valle de Esperanza aquifer supplied most of the potable water for the island. The Puerto Rico Aqueduct and Sewer Authority (PRASA) well field, which is located in Esperanza, is currently not in use. In 1985, the U.S. Geological Survey completed a 2-year study of groundwater resources in Vieques. Because of high sodium levels, untreated groundwater used for irrigation on a long-term basis would result in the accumulation of salts in the soils. The relatively high concentrations of chloride recorded in 1977 in groundwater from the Valle de Esperanza aquifer have been attributed to saltwater intrusion as a result of excessive groundwater withdrawals, and to the accumulation of salts from infiltration of sea spray. The quality of any shallow groundwater underlying the OB/OD units has not been investigated. Groundwater is no longer used as a drinking water supply; potable water is piped from Puerto Rico for this purpose. In response to the September 29, 1999 3008 (h) order for installation restoration work at the Inner Range at Vieques, the U.S. Navy is conducting a western perimeter “baseline” groundwater investigation. The purpose of this investigation is to establish baseline groundwater quality, regional groundwater flow patterns along the western perimeter of the former U.S. Navy facility, and to assess whether activities at the facility have impacted groundwater at the western perimeter.

SECTION 3

3 Closure Plan Approach

In accordance with 40 CFR 270.14(b)(13), 270.23(a)(2), and 265.112(a)(1) and (2) this closure plan identifies the procedures necessary to achieve closure of the OB/OD Site at the former AFWTF. Copies of the plan will be maintained by LANTDIV and DOI until closure is completed, certified by the Navy, and signed by an independent professional engineer licensed in Puerto Rico. This plan will be updated as necessary by issuing either page changes or new copies, as appropriate, to all plan addressees.

3.1 Closure Performance Standard

RCRA closure performance standards(40 CFR 265.111) are intended to protect human health and the environment as well as to minimize the need for post-closure maintenance. These goals can be achieved through either:

Clean Closure—closure to established risk-based screening levels or quantified risk-based cleanup levels based on land use, accomplished by removing hazardous wastes and hazardous waste residues from the unit that exceed these levels, or

In-Place Closure—closure where wastes remain in place and specific post-closure care is performed in order to monitor waste containment. This closure option may be subject to landfill closure requirements of RCRA or CERCLA.

For clean closure, if any contamination in the form of hazardous wastes or constituents contained in soils or groundwater is determined to be the direct result of past operations of the OB/OD site or is shown to be present in concentrations above cleanup goals, background concentrations, or other standards or guidance levels, further study will be done to determine the nature and extent of this contamination and what remediation requirements are needed. If warranted, an appropriate Corrective Action Plan (CAP) will be prepared and submitted to USEPA for approval. Upon approval and modification of the closure plan, the CAP will then be implemented to remedy any identified contamination in soils and/or groundwater.

Clean closure of the OB/OD site is preferred, but unrecoverable past releases of ordnance and contaminated soils from within the LIA and OB/OD area may make clean closure technically impractical. Therefore, if data from the closure sampling indicates clean-closure is not a practicable alternative at this juncture, the OB/OD site will be closed as an in-place closure where the waste will remain in place and post closure care will be performed to monitor and evaluate any contamination left in place, in accordance with the end use of the property. The closure activities are discussed in Section 3.3.

3.2 Partial Closure and Final Closure Activities

Because the site is no longer an operating facility, partial closure requirements under RCRA [40 CFR 265.112(b)(1) through (b)(7)] do not apply to the site. For the purposes of determining the maximum extent of operations during the life of the facility, the area of closure will be defined as the OB/OD Site described in Section 2. This will include those areas that may have been impacted by past thermal treatment and/or disposal operations. Because closure will be performed for the entire OB/OD site none of it will remain open.

3.3 Closure Activities

The following section provides a general description of the activities to be conducted during closure as required under RCRA (40 CFR 265.112 and 265.114) and the rationale for the selection of these activities. Field work will not be initiated until all UXO safety issues are addressed with an Explosive Safety Submission that is approved by the Department of Defense Explosive Safety Board (DDESB). Details of the procedures to implement these activities are included in Section 5 of this closure plan.

To determine the nature and extent of past releases, and to assess whether the site will be closed as a clean closure or in-place closure, the activities described in the following section are to be completed. Upon completion of the initial closure activities, the final closure procedures will be established.

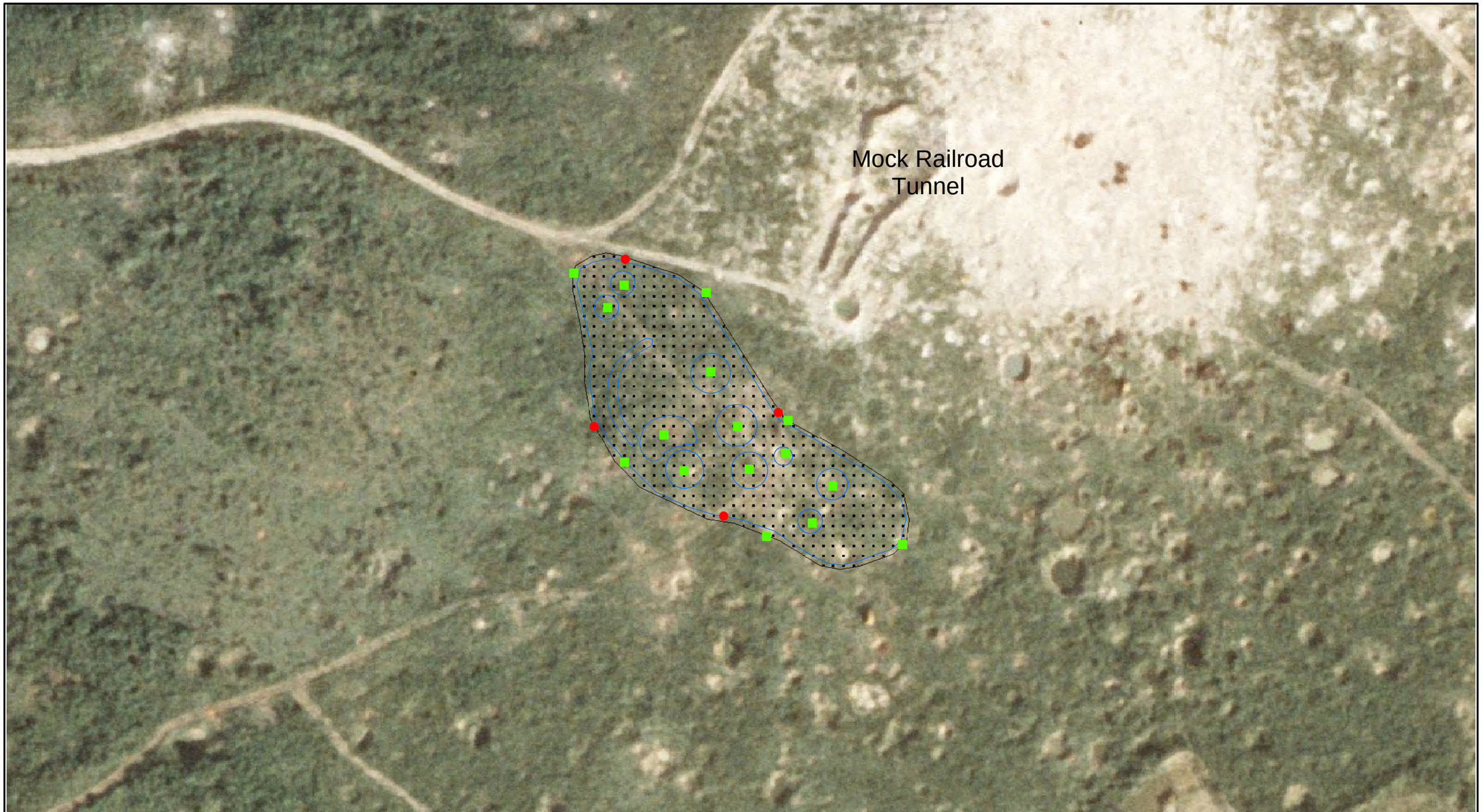
3.3.1 Topographic Survey

The locations of the units within the OB/OD site used to treat munitions have not been precisely identified or mapped. However, an analysis of aerial photographs from 1994 show that the site consisted of ten separate pits that were utilized for the detonation of munitions. The size and condition of these pits may have been altered since 1994 by subsequent detonations. To further delineate the locations of these pits a field survey will be completed to establish the current size and dimensions of the detonation pits such that the optimum soil sampling locations can be identified. An updated topographic site map will be prepared showing the precise locations of the open detonation pits and any modifications to the proposed sampling locations.

3.3.2 Geophysical Survey

To estimate the amount and extent of subsurface munitions, or munition fragments, that remain at the OB/OD site a geophysical survey will be conducted. The survey will also be used to protect soil and groundwater sampling teams from encountering any unexploded ordnance (UXO).

This geophysical survey will be conducted using EM-61 electromagnetic geophysical equipment over the 3-acre area shown on Figure 3-1. The equipment will be traversed across the site by a two-person geophysics team along transects that are spaced 3 feet apart. Digital geophysical readings of subsurface metallic anomalies, indicative of buried munitions, will be collected continuously along each transect. Precise locations of the geophysical anomalies, using the latitude and longitude coordinate system, will be established using a global positioning system (GPS). Items identified by the survey team will be flagged for removal by follow-on UXO removal teams. The procedures for completing the geophysical survey are detailed in Section 5 of this closure plan.



Legend

- Proposed Monitoring Well
- Proposed Soil Boring
- Open Detonation Area
- Open Detonation Pits

N
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80 0 80 Feet

Figure 3-1
Proposed Sampling Locations, Open Detonation Area
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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3.3.3 Surface Clearance of MEC

Prior to conducting the geophysical survey and environmental sampling, an UXO contractor will carefully inspect the site with the aid of an appropriate geophysical instrument (e.g., Schonstedt GA-52CX magnetometer) for evidence of munitions on the ground surface.

The surface clearance will remove munitions, munitions debris consisting of metal fragments and inert munitions casings lying on the surface that could interfere with the geophysical survey. If the munitions items are safe to move they will be relocated to a designated location for treatment and disposal. However, should the munitions items exhibit a high explosive hazard, the UXO contractor will treat these items using blow-in-place (BIP) methods by destroying the item with an explosive charge that will be detonated. The BIP events will be carried out in accordance with 40 CFR 266.206. Additionally, USEPA Region II will be notified in a timely manner of all BIP events.

The UXO Technicians will provide a detailed description of the types of munitions encountered, including any identified explosive hazards, and establish their location in the field with a GPS system.

Non-UXO-qualified personnel will be instructed to avoid working in designated hazard areas. If ordnance and explosives (OE) are discovered on the surface, subsurface activities will not be allowed unless the 3-acre OB/OD area can first be effectively swept of all surface OE.

3.3.4 Subsurface Removal of Munitions

Within the boundaries of the 3-acre site identified on Figure 3-1, selected geophysical anomalies will be excavated and removed to provide a safe working environment for the field sampling personnel. An UXO contractor will locate the geophysical anomalies with the aid of an appropriate geophysical instrument (e.g., Schonstedt GA-52CX magnetometer). Excavation of anomalies will be performed by a two-person team of UXO Technicians using hand excavation tools such as shovels, spades, trowels, and pry bars. The excavation activities will be limited to a maximum depth that will provide for a safe working environment for the investigation crew by eliminating the subsurface explosive hazard in accordance with the procedures described in Section 5.0 of this plan.

If the munitions items are safe to move they will be relocated to one of the pits within the OD area for treatment by detonation. A RCRA permit will not be required (as described in Section 5.1), however; the treatment will meet all the requirements of RCRA, including treating the material within 90 days of generating the waste. Should the munitions items exhibit an explosive hazard, the UXO contractor will treat these items using BIP methods as described in Sections 3.3.3 and 5.1. The UXO Technicians will also provide a detailed description of the types of munitions encountered, including any identified explosive hazards, and establish their location in the field with a GPS system.

3.3.5 Treatment and Disposal of Munitions

Each munitions item removed from the surface during clearance and subsurface removal activities will be inspected by UXO personnel in accordance with Technical Order (TO) 11A-1-60, “Inspection of Reusable Munitions Containers and Scrap Material Generated from

Items Exposed to, or Containing Explosives." Based on the inspection, items determined to be inert will be certified, collected, stockpiled and transported offsite for further disposition at a metals recycling facility, when the final closure protocol for this activity is established.

Any munitions or munitions fragments suspected to still contain explosives, or items that are fuzed, will either be BIP or treated at a designated detonation pit in the vicinity of the OB/OD site. Treatment of the munitions items within the detonation pit will be conducted by countercharging the items with an explosive donor charge and detonating the charge. Prior to detonation, the munitions will be covered with sand to control the kick-out of explosives and fragments. The munitions detonations will be performed under the direction and supervision of an on-site Senior UXO Supervisor (SUXOS). During these operations, an on-site UXO Site Safety Officer (UXOSO) will closely monitor these operations, strictly enforce safety and adherence to procedures, and ensure that the exclusion area is appropriately evacuated of non-essential personnel.

3.3.6 Soil and Groundwater Sampling

Once the proposed soil and groundwater sampling locations are cleared of scrap metal and UXO, soil and groundwater samples can be safely collected for analysis.

Soil and groundwater sampling will be conducted as part of this closure plan to establish the extent of surface and subsurface soil contamination within the solid waste management unit due to past operations. The results of the sampling will be used to establish cleanup requirements and make the determination of either clean closure or in-place closure.

Site-specific sampling locations, quantities, sample collection and analytical methods, and quality assurance/quality control (QA/QC) issues are addressed below.

3.3.6.1 Monitoring Well Installation

Four monitoring wells will be installed to establish groundwater flow direction and characterize the groundwater quality upgradient and downgradient of the OD area. Additionally, three monitoring wells will be installed around the perimeter of the OB area. All well elevations will be surveyed in accordance with the Surveying SOP included in the Final Master Work Plan, AFWTF, Vieques, Puerto Rico (CH2M HILL, June 2003). The monitoring wells will be installed using either hollow stem auger or rotary methods in accordance with the procedures described in Section 5 of this closure plan.

The proposed locations for these monitoring wells are illustrated in Figure 3-1 and Figure 3-2. The analytical data from the groundwater samples collected from the monitoring wells will be assessed to determine if either the OB area or the OD area have had an impact on groundwater quality. Based on a review of the groundwater elevation data and groundwater quality data the need for additional monitoring wells will be evaluated.

The depth of the wells will be determined in the field and based on the depth of the groundwater encountered during drilling. The wells will be constructed with a 10-foot long well screen with 2 feet of the screen extending above the level where groundwater is encountered.

Legend

- Proposed Monitoring Well
- Proposed Soil Boring
- Open Burn Area

N
W E
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50 0 50 Feet

Figure 3-2
Proposed Sampling Locations
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

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3.3.6.2 Groundwater Sampling and Analysis

The seven installed monitoring wells will be sampled for RCRA Appendix IX VOCs, SVOCs, pesticides, PCBs, explosives, perchlorate, total and dissolved metals.

Groundwater sampling will be conducted in accordance with the techniques described in the Final Master Work Plan for AFWTF, Vieques, Puerto Rico (CH2M HILL, June 2003). Prior to sampling, a round of water level measurements will be collected from all of the wells. Afterwards, the wells will be purged and sampled using USEPA Region II low-flow sampling techniques to minimize turbidity of the samples. Table 3-1 presents the number of groundwater samples to be collected as part of this evaluation, including QA/QC samples. Section 5 presents details regarding the required containers, preservatives, and holding times for groundwater samples.

TABLE 3-1
Groundwater Sample Parameters, Methods, and Quantities

Parameter	Method	No. of Samples	Equipment Blanks*	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Samples
Appendix IX Pesticides	SW-846 Method 3550B/ 8081A	7	2	1	1	1	12
Appendix IX PCBs	SW-846 Method 3550B/ 8082	7	2	1	1	1	12
Appendix IX Total Metals	SW-846 Method 3550B/ 6010B/7000 series	7	2	1	1	1	12
Appendix IX Dissolved Metals	SW-846 Method 3550B/ 6010B/7000 series	7	2	1	1	1	12
Appendix IX VOCs	SW-846 Method 5035/ 8260B	7	2	1	1	1	12
Appendix IX SVOCs	SW-846 Method 3550B/ 8270C	7	2	1	1	1	12
Explosives	SW846 8330	7	2	1	1	1	12
Perchlorate	EPA 314.0	7	2	1	1	1	12

Equipment blanks – one per day
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent.

Groundwater quality parameters to be measured and logged in the field include temperature, pH, dissolved oxygen (DO), redox potential, conductivity, salinity, and turbidity.

3.3.6.3 Soil Sampling and Analysis

Surface soil and subsurface soil samples will be collected to define the horizontal and vertical extent of soil contamination within the limits of the OB area and the OD area. Figures 3-1 and 3-2 present the proposed soil sampling locations. The locations may be slightly modified based on the results of the topographic survey. The following sampling rationale is proposed.

- Ten soil borings will be completed through the bottom of the detonation pits with, one of the ten borings completed through the lowest point of each pit. Two analytical soil samples will be collected from each soil boring. One of the samples collected will be a surface soil sample which will be collected from a depth of 0-6 inches below ground surface (bgs). The second sample will be collected over a 2-foot interval from a minimum depth of 2 ft to a maximum depth defined by the extent of disturbed soil or 8 ft bgs, whichever is greater. The soil column interval of sample collection will be determined by indications of contamination from either visual observations or PID screening levels. If no contamination is apparent in the field the sample will be collected from a depth of 6 to 8 ft if the disturbed soils extend to a depth of less than two feet. The "rim" (which is projected to be the original grade) of the pits will be used as the surface reference point. This will allow for the collection of samples at the maximum estimated depth of each pit. The soil samples will be analyzed for the Appendix IX analytes listed in Table 3-2, explosives, and perchlorate to assess the nature of the contaminants present at each of the OD pits. The initial location of the pits are shown in Figure 3-1, however, the pit locations will be further refined with the proposed topographic survey. As a result, the proposed locations of the borings shown on Figure 3-1 may vary slightly depending on the results of the site topographic survey.
- Six soil borings will be completed around the perimeter of the OD pits as shown on Figure 3-1. Two analytical soil samples will be collected from each soil boring. One of the samples collected will be a surface soil sample which will be collected from a depth of 0-6 inches bgs. The second sample will be collected over a 2-foot interval from a minimum depth of 2 ft to a maximum depth defined by the extent of disturbed soil or 8 ft bgs, whichever is greater. The soil column interval of sample collection will be determined by indications of contamination from either visual observations or PID screening levels. If no contamination is apparent in the field the sample will be collected from a depth of 6 to 8 ft if the disturbed soils extend to a depth of less than two feet. Six to 8 ft bgs is the maximum estimated depth of the OD pits. The samples will be analyzed for the analyte list shown in Table 3-2, explosives, and perchlorate to assess the extent of contaminants present at the OD area.
- Five soil borings will be completed within the OB area as shown on Figure 3-2. Two analytical soil samples will be collected from each soil boring. One of the samples collected will be a surface soil sample which will be collected from a depth of 0-6 inches bgs. The second sample will be collected over a 2-foot interval from a minimum depth of 2 ft to a maximum depth defined by the extent of disturbed soil or 8 ft bgs, whichever is greater. The soil column interval of sample collection will be determined by indications of contamination from either visual observations or PID screening levels. If no contamination is apparent in the field the sample will be collected from a depth of 6 to 8 ft if the disturbed soils extend to a depth of less than two feet. The soil samples will be analyzed for the Appendix IX analytes listed in Table 3-2, explosives, and perchlorate to assess the nature of the contaminants present at the OB area.

Sampling techniques that will be employed for surface soil and subsurface sampling are described in Section 5 of this closure plan. Table 3-2 provides a listing of soil sample parameters and methods and includes the number of analytical soil samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required

containers, preservatives, and holding times for groundwater and soil samples are presented in Section 5 of this closure plan.

TABLE 3-2
Soil Sample Parameters, Methods, and Quantities

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Samples
Pesticides/ Herbicides	SW-846 Methods 3550B/ 8081A/8051A	42	4	4	5	3	58
PCBs	SW-846 Methods 3550B/8082	42	4	4	5	3	58
SVOCs	SW-846 Methods 3550B/8270C	42	4	4	5	3	58
Metals	SW-846 Methods 3550B/6010B 7000 series	42	4	4	5	3	58
Explosives	SW-846 Method 8330	42	4	4	5	3	58
Perchlorate	EPA 314.0	42	4	4	5	3	58
VOCs	SW-846 Methods 5035/8260B	42	4	4	5	3	58

Equipment blanks – one per matrix per day; Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

3.3.7 Closure Cleanup Goals

The analytical results of the closure sampling will be compared to USEPA Region IX risk-based Preliminary Remediation Goals (PRGs). Each constituent that exceeds its respective PRG will be considered as a Contaminant of Potential Concern (COPC). The COPCs will be compared to background concentrations at AFWTF. A Draft Work Plan for Soil and Groundwater Background Investigation, AFWTF, Vieques (CH2M HILL, December 2003) has been developed. The implementation of the final version of this work plan will provide the background concentrations required to make this comparison. The background data and PRGs will be evaluated to establish the clean closure requirements for the site. For COPCs identified exceeding background levels site specific risk-based cleanup levels may be developed as described in Section 5 of this closure plan.

If the closure investigation results indicate the site poses an unacceptable risk to human health and the environment, an evaluation of remedial alternatives will be completed. The evaluation will assess selected alternative against the nine CERCLA Feasibility Study criteria to select the most appropriate remedial action for the site. In-place closure options would be considered including: installation of a soil cover, installation of a RCRA cap, and in-situ remedial technologies.

3.3.8 Interim Closure Report/Revised Closure Plan

Following the completion of the geophysical survey, the soil and groundwater investigations and the determination of cleanup goals, an Interim Closure Report will be

prepared. The purpose of this report is to provide the investigation results and present the recommended approach for closing the site as either a clean closure or as an in-place closure. In addition, the report will identify the additional closure activities that will be required to complete closure at the site.

Specific information to be provided in the Interim Closure Report will include:

- A description of the site conditions including: soil types and groundwater conditions, physical and chemical descriptions of any contamination encountered, the types of munitions identified along with their explosive hazards;
- A detailed site topographic map showing the configuration of the detonation pits and the final soil boring locations;
- A geophysical map showing the locations of the buried metallic anomalies;
- A munitions map showing the locations and types of munitions identified at the site;
- A map showing the soil analytical results exceeding background and risk-based PRG levels;
- A groundwater flow map;
- A map showing the groundwater analytical results exceeding background and risked-base PRGs;
- An estimate of the amount of munitions remaining on site;
- An estimate of the volume of contaminated soil remaining on-site;
- The results of a human health risk assessment for the site;
- The results of an ecological risk assessment for the site;
- An evaluation of remedial alternatives including an assessment of each of the alternatives based on the nine criteria identified in the CERCLA Feasibility process;
- A detailed plan for the completion of final closure activities for clean closure or in-place closure including, if required: the estimated volume of waste to be removed, the waste removal procedures, the waste disposal procedures, and the specifications of the RCRA cap (if required) and verification sampling; and
- Planned post closure activities, if required, including all planned monitoring and maintenance activities along with their respective frequencies.

More detailed information on the procedures for completing the site investigations and risk assessments is provided in Section 5 of this Closure Plan

3.3.9 Site Cleanup, Inventory Removal, and Disposal of Decontamination Equipment

As required under 40 CFR 265.112(b)(e) and 265.114 the closure plan is to provide the procedures for the site cleanup, inventory of removal, and disposal of decontamination equipment. The waste inventory consists of (1) munitions scrap left at the surface of the pits

from treatment activities; (2) untreated surface UXO; and (3) soil cuttings, decontamination fluid, and other investigation derived waste (IDW). UXO and contaminated scrap will be treated as described in Section 5. IDW will be managed in accordance with Section 5. All visible waste and debris contained within the 3-acre site will be physically removed. A bermed decontamination pad constructed of 30 mil plastic will be used to contain all wash water.

Following decontamination, rinseate samples will be analyzed for Toxic Characteristic Leaching Procedure metals and explosive compounds to verify their cleanliness. Once the treatment structures are certified clean, they will be either transported to OP-1 to be stored until contracted for disposal/recycling or disposed of directly. All waste generated from the decontamination process will be containerized in drums for characterization and disposal/ recycling.

All contaminated debris identified as treatment residue, solid IDW, and decontamination fluids and rinseates will be placed in DOT 17E and 17H drums, as previously described. Should sampling analysis determine these to be contaminated, each container will be closed and transported to a hazardous waste disposal facility. Remaining containers will be decontaminated and removed from the facility.

3.3.10 Final Closure Report and Closure Certification

Within 60 days of the completion of closure the U.S. Navy will submit in writing (by certified mail) a closure certification to the USEPA Regional Administrator (40 CFR 265.115 and 265.116). The certification will verify that the site was closed in accordance with the specifications outlined in the closure plan, including the completion of all required corrective action measures. The certification will be signed by an authorized official of the U.S. Navy and an independent professional engineer. Documentation supporting the professional engineer's certification will be furnished upon request.

The closure certification will include a final report demonstrating that the OB/OD site has been closed in accordance with the approved closure plan. This report should include all inspection summary reports, problem identification and corrective measure reports, inspection data sheets, photographic reporting data sheets, acceptance reports, deviations from design and materials specifications (with justifying documentation), and as-built drawings. The final report should also include manifests, decontamination, sampling and analysis results if the approved closure plan specifies these actions. The closure activities must be documented by an independent registered professional engineer and included as part of the Certification of Closure documentation.

No later than the submission of closure certification, the U.S. Navy will also submit to the USEPA Regional Administrator a survey plat indicating the location and dimensions of the facility with respect to permanently surveyed benchmarks. The plat will be prepared and certified by a professional land surveyor.

3.3.11 Closure Cost Estimate

the OB/OD site is a federal government facility, owned by the DOI and remediated by the U.S. Navy and is exempt from the requirements (40 CFR 265.142) for closure cost estimates.

However, cost estimates for the various alternatives evaluated will be considered as a criteria in remedy selection and will be provided in the Interim Closure Report.

3.3.12 Financial Assurance Mechanism for Closure

In accordance with 40 CFR 265.143, "Financial Assurance for Closure," federal facilities are exempt from the requirements for financial assurance.

3.3.13 Post-Closure Plan

Should an in-place closure be implemented, RCRA requires that the in-place closed facility be monitored in accordance with a post closure plan [40 CFR 265.14(b)(13), 270.23(a), 265.118, and 265.603]. The post closure plan identifies all necessary activities to be implemented following in-place closure of the OB/OD site. Post-closure care will include all planned monitoring and maintenance activities, as required, along with their respective frequencies. The post-closure plan will be based on the general requirements of 40 CFR 265.118 and the post-closure care requirements of 40 CFR 265.603. Because the need for the post-closure plan will be dependant on the results of the closure site investigation activities, the determination of the need for this plan will be completed following the closure activities.

3.3.14 Post-Closure Use of Property

The post-closure use of property following final closure will not be allowed if such use results in a disturbance of the area. This may endanger personnel entering the area or may result in disturbance or damage to the facility's monitoring and/or remediation systems (i.e., groundwater wells) that exist at the site. The Navy will maintain the fences, gates and monitoring devices.

3.3.15 Post-Closure Care

The post-closure care period for the site will begin after the completion of closure of the OB/OD units, including all required corrective action measures, and will continue for a period of time that is dependent on whether the facility can be clean closed [40 CFR 270.23(a)(3) and 265.603]. This determination cannot be made until closure activities are completed.

3.3.16 Post-Closure Security

In accordance with RCRA the facility owner is to provide appropriate security [40 CFR 265.117(b)]. Public access to the site is currently prohibited by Federal legislation. In addition, security is maintained with locked gates and fencing across all the roads into the site. Beaches and roadways are clearly signed indicating the hazards present and restrictions to access. The current security measures will be re-assessed during the evaluation of remedial alternatives as part of the Interim Closure Report.

3.3.17 Post-Closure Contact

Post-closure contact should be with USEPA until the post-closure care period is completed [40 CFR 265.118(b)(3)], certified by the permittee, and signed by an independent professional engineer.

3.3.18 Monitoring Plan

Should it be determined that the site will be closed as an in-place closure, groundwater monitoring will be conducted [40 CFR 265.118(b)(1)] at the site during the post-closure care period (and during the closure period as well) to determine whether any remaining contamination could originate from the site (e.g., hazardous wastes or hazardous constituents from any contaminated soils that might remain in place following closure) and impact groundwater quality. Details of the post-closure monitoring will be established following completion of the closure activities.

3.3.19 Post-Closure Notices

If any wastes (determined to be hazardous) remain in place following the completion of closure activities, a record of their type, location, and quantity will be submitted to the authority with jurisdiction over local land use, and to the USEPA Regional Administrator no later than 60 days following closure [40 CFR 265.116 and 265.119]. Additionally, a survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the OB /OD site will be filed with the authority with jurisdiction over local land use and with the USEPA Regional Administrator. The plat will state the U.S. Navy's obligation to restrict disturbance of the hazardous waste disposal unit area in accordance with applicable 40 CFR Part 265 Subpart G regulations.

SECTION 4

4 Closure Schedule

4.1 Schedule for Closure

An estimated closure schedule, required by RCRA [40 CFR 265.112(b)(6)], that includes the time needed to complete all required closure activities is provided in Figure 4-1. The extent of requirements to fully close the site will not be known until closure activities reveal the nature and extent of any contamination in soils and groundwater. Based on this information a determination of whether the site will be closed as a clean closure or in-place closure will be made. The closure schedule may be modified based on this determination. Should the site be closed as an in-place closure the schedule will also include all other activities necessary to complete final closure, including post-closure monitoring. The time frames shown in Figure 4-1 are consistent with other RCRA related activities on Vieques including: those completed under the RCRA 2008 Consent Order between the U.S. Navy and USEPA, and previous RCRA related publics reviews. These timeframes include the following assumptions:

- A 30-day period for the USEPA and PREQB to prepare and publish a public notice for review the Draft Final Closure Plan prepared by the U.S. Navy;
- The development and approval of the Explosives Safety Submission within the duration that this Closure Plan is reviewed by USEPA and the public;
- A 30-day public review and comment period following the release of the closure plan to the public;
- A 60-day period for review and approval of the Interim Closure Report by USEPA and PREQB; and
- The completion of the final closure activities within 180 days from USEPA approval of the Interim Closure Report.

The timeframes presented in Figure 4-1 are attributed to several subtasks that need to be completed under the main tasks. The subtasks associated with the main tasks include the following:

- Draft Closure Plan: funding appropriation, review of site history, conduct site visit, and perform aerial photograph analysis.
- Closure Plan Review by USEPA and EQB: contracting environmental subcontractors, conducting review, and preparation of written comments to the U.S. Navy.
- Navy Revision of Draft Closure Plan: schedule meeting of EPA, EQB, DOI and the Navy to discuss comments, prepare draft responses to comments, obtain concurrence on responses, and incorporate responses into a draft final report.

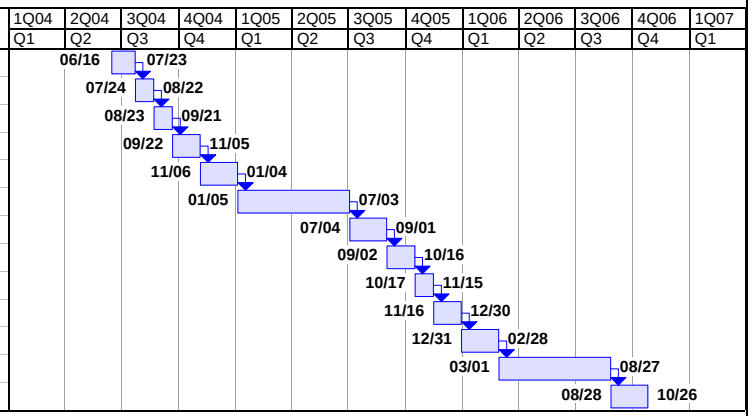
- Public Review of Draft final Closure Plan: prepare and publish public notice, hold public meeting, compile comments from the community, and prepare written comments to USEPA and the U.S. Navy.
- Closure Investigation/Interim Closure Report: conduct topographic survey, complete surface clearance of UXO, conduct soil and groundwater sampling, conduct sample analysis and validation, complete Interim Closure Report which will include results of investigation and the procedures for the final closure activities.
- Final Closure Activities (if required): complete removal of remaining UXO, remove remaining contaminated soil, installation of soil cover, complete verification sampling.

4.2 Extensions for Closure Time

If for any reason closure activities cannot be completed within the specified time frame outlined in the closure schedule, RCRA [40 CFR 265.113(a) and (b)] allows a request or petition for an extension of the closure time to be submitted to the USEPA and EQB. This petition will identify the need for the extension, the status of the facility, and the actions required to prevent threats to human health or the environment during the extension period. The written request will include a copy of the amended closure plan.

Figure 4-1
Schedule for Site Closure
OB/OD Site Closure Plan
Former AFWTF, Vieques, Puerto Rico

ID	Task Name	Duration	Start	Finish
1	**Navy Revision Of Draft Final Closure Plan**	**38 days**	**Wed 06/16/04**	**Fri 07/23/04**
2	**EPA Preparation and Publishing of Public Notice**	**30 days**	**Sat 07/24/04**	**Sun 08/22/04**
3	**Pubic Review Of Draft Final Closure Plan**	**30 days**	**Mon 08/23/04**	**Tue 09/21/04**
4	**Navy Revision Of Draft Final Closure Plan**	**45 days**	**Wed 09/22/04**	**Fri 11/05/04**
5	**EPA/EQB Approval Of Draft Final Closure Plan**	**60 days**	**Sat 11/06/04**	**Tue 01/04/05**
6	**Field Investigatons/ Interim Closure Report/ Final Closure Plan**	**180 days**	**Wed 01/05/05**	**Sun 07/03/05**
7	**EPA /EQB Review Interim Report/Final Closure Plan**	**60 days**	**Mon 07/04/05**	**Thu 09/01/05**
8	**Navy Revision Of Interim Closure Report/Revised Closure Plan**	**45 days**	**Fri 09/02/05**	**Sun 10/16/05**
9	**Pubic Review Of Interim Closure Report/Revised Closure Plan**	**30 days**	**Mon 10/17/05**	**Tue 11/15/05**
10	**Navy Revision Of Interim Report/Revised Closure Plan**	**45 days**	**Wed 11/16/05**	**Fri 12/30/05**
11	**EPA/EQB Approval Of Interim Report /Revised Closure Plan**	**60 days**	**Sat 12/31/05**	**Tue 02/28/06**
12	**Completion Of Closure Activities**	**180 days**	**Wed 03/01/06**	**Sun 08/27/06**
13	**Closue Certification/Closure Report**	**60 days**	**Mon 08/28/06**	**Thu 10/26/06**



Project: East Vieques OB OD Site Clo
Date: Mon 08/02/04

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		External Milestone	
Milestone		Rolled Up Milestone		External Tasks		Deadline	

SECTION 5

5 Closure Procedures

In accordance with RCRA requirements 40 CFR 265.112 and 265.114 the following section provides a description of the procedures that will be implemented during closure of the OB/OD site. Additional information on the field procedures for the environmental investigations can be obtained from the following documents: Phase I RCRA Facility Investigation, AFWTF Vieques, Puerto Rico (CH2M HILL, 2003) and the Final Master Work Plan for AFWTF (CH2M HILL, June 2003).

5.1 Surface Clearance of MEC and Setting Up Staging Area

Prior to conducting the geophysical survey and environmental sampling, the UXO contractor will carefully inspect the OB and OD areas with the aid of an appropriate geophysical instrument (e.g., Schonstedt GA-52CX magnetometers or equivalent) for evidence of OE/MEC partially or fully exposed on the ground surface. An MEC clearance will remove munitions, munitions debris consisting of metal fragments and inert munitions casings lying on the surface that could interfere with the geophysical survey. If the munitions items are safe to move they will be relocated to one of the existing detonation pits for treatment by detonation. However, should the munitions items exhibit a high explosive hazard, the UXO contractor will treat these items using blow-in-place (BIP) methods by destroying the item with an explosive charge that will be detonated. USEPA Region II will be notified in a timely manner of all BIP events.

The BIP events are anticipated to be carried out in accordance with 40 CFR 266.204, which exempts the action from normal permit requirements. All MEC operations will be performed under the direction and supervision of an on-site SUXOS. During these operations, an on-site UXOSO will closely monitor these operations, strictly enforce safety and adherence to procedures, and ensure that the exclusion area is appropriately evacuated. The UXO Technicians will mark any OE/MEC or other hazards by encircling the hazard with flagging tape. Non-UXO-qualified personnel will be instructed to avoid working in designated hazard areas. If OE/MEC is discovered on the surface, mechanical equipment will not be used unless the area can first be effectively swept of all surface OE/MEC.

5.2 Surveying of Grids for Geophysics

Where practical, positional data will be collected from an Esthete Z-FX Surveyor RTK (Real Time Kinematics) GPS. A GPS base station (also utilizing an Esthete Z-FX receiver) will be set up on an established control point, and real time corrections broadcast to the roving GPS unit via a radio link. The roving GPS antenna may be mounted in the center of the coils to track the EM-61 or, in areas where limited coverage exists due to terrain or vegetation, the rover may be used to locate survey cell corners for data conversions and interpolation from a local coordinate system. From these control points wooden hubs or stakes will be set on a grid spacing throughout the area of investigation. Using the employed control points, the

geophysical crew will establish a grid for data collection. In areas that exhibit inadequate GPS coverage, highly accurate data positioning will be maintained through the use of an instrument survey (e.g., "staff and rod" surveying from control points). This method will serve as a backup to GPS and be used when GPS technology is adversely affected by local vegetation or topographic conditions. Appendix C contains the geophysical investigation plan.

5.3 Geophysical Survey

The objectives of the geophysical work are 1) geophysical instrument prove-out and evaluation, 2) geophysical data collection, which includes anomaly reacquisition (utilizing the same geophysical instrumentation and temporary markers [i.e., pin flag, paint, or other semi-permanent markers]), geophysical data analysis, and the creation of target maps and dig-sheets. Appendix C contains the geophysical investigation plan.

5.3.1 Geophysical Prove Out

The initial phase of the investigation will be an evaluation of the proposed geophysical instrumentation. An established "prove-out" area, consistent with the local site conditions (geological, topographical, and vegetation conditions), will be seeded with known items (similar to those discovered during surface clearance) at various depths from just below ground surface to 3 feet bgs, and used by the geophysical contractor for the evaluation. An inductively coupled metal detector (EM-61) followed by a cesium-vapor total field magnetometer (Sinter Smartmag SM-4), in conjunction with a base station magnetometer, will be evaluated across the entire prove-out area using the same survey techniques determined to be suitable for the investigation.

The GPO will be established to identify the most optimum and accurate sensor, sensor platform, positioning methods, data density and data processing techniques. The optimum geophysical data collection method will be based primarily on the detection depth capabilities and false alarm rate. The GPO will also allow for evaluation of the operators and functionality of the geophysical sensors.

The GPO test plot will be established with 20 to 30 seeded items (targets) representative of those items expected to be found at the site. The depths and orientations of the items will be varied to effectively evaluate the instrumentation and operators.

Specifics regarding the GPO, instrumentation, and operators will be given in the Closure Report.

5.3.2 Geophysical Data Collection

5.3.2.1 Anomaly Reacquisition

Target anomalies will be re-acquired by the geophysical contractor using the GPS system where appropriate. Coordinate locations of each targeted anomaly will be uploaded into the rover, which will be used to navigate or re-occupy the point where a temporary mark will be placed. Reacquisition of target locations where no GPS coverage exists will be conducted using tape measures pulled from corner stakes to locate the interpreted local x,y coordinate position listed for each target on the dig sheet. Each reacquired target location will be

marked with a pin flag labeled with the anomaly's identifying number as specified on the dig sheet.

Using the same geophysical equipment as was originally used, the reacquisition crew will then refine the location of the anomaly. This will be accomplished by collecting readings in continuous mode while slowly maneuvering the instrument over the anomaly, searching for the peak response. The pin flag will be moved to the refined location and the offset will be documented.

The geophysical contractor will also provide, a grid map, which contains the following:

1. Grid identification
2. Grid corner locations and coordinates
3. Contoured data
4. Anomaly locations with unique identification numbers

As soon as practical after collection, the geophysical field data shall be provided in delineated fields as x, y, z, v (1), v (2), etc., for delivery. Maps that display the geophysical anomalies with annotated, interpreted and identified physical features shall be delivered in MicroStation (.dgn) and Geosoft compatible format.

5.3.2.2 Geophysical Data Analysis

The raw data is displayed on the screen as a color contour image with the track plot overlaid on the map. The purpose of this initial exercise is to assess the positioning and density of the data.

Geophysical data processing will include the following procedures:

1. Conversion of local grid coordinates to Puerto Rico State Plane coordinates
2. Diurnal Drift Correction (magnetics)
3. Heading corrections
4. Lag corrections
5. Normalization or leveling (removal of background)
6. Gridding of data
7. Digital filtering and enhancement
8. Calculating the 3D analytic signal from the magnetic data
9. Gridding of analytic signal
10. Selection of anomaly picks (above an appropriate threshold)
11. Preparation of geophysical maps and target maps

5.3.2.3 Geophysical Dig Sheets

The geophysical contractor will, using a qualified geophysicist, analyze the geophysical data for each geophysical grid, identify anomalies that may represent buried UXO, and prepare anomaly lists containing the following information:

1. Project site
2. Geophysical contractor
3. Responsible geophysicist
4. Grid identification

5. Grid corner locations and coordinates
6. Unique anomaly identification numbers
7. Predicted anomaly easting & northing in State Plane coordinates
8. Instrument peak value at each anomaly location

The dig-sheets will be prioritized and anomalies deemed more likely to be UXO, will be ranked higher than anomalies less likely to be UXO. The criteria for selecting and locating anomalies for the anomaly (or target) list include the following items:

1. The maximum amplitude of the response with respect to local background conditions
2. The lateral extent (width) of the response
3. The 3-dimensional shape of the response
4. The location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid
5. The shape and amplitude of the response with respect to the response of known targets buried in the geophysical prove-out test plot
6. The shape and amplitude of the response with respect to relevant anomalies encountered in previous OE removal grids
7. The apparent depth of the anomaly
8. Potential distortions in the response due to interference from nearby cultural features; any instrument or grid survey QC that could affect the analysis

5.4 Removal Of Subsurface Metallic Items

For each specific site, all metallic anomalies evaluated as potential UXO will be selected for intrusive investigation to a depth deemed necessary to provide safe working conditions for the environmental sampling efforts. The targets will be reacquired using tape measures and/or calibrated ropes in conjunction with an appropriate reacquisition instrument, and excavated by hand. The personnel, vehicles, equipment, and mobilization/ demobilization tasks required for completion of the intrusive aspect of the field investigation are described in the following subsections.

A restricted/exclusion zone (EZ) shall be established around the area where intrusive activities are conducted, in accordance with Section 6 of this plan. Initially, a 300-ft EZ will be established at each location where intrusive activities are being conducted. If UXO is located during excavation, the EZ will be adjusted to 1,250 feet for non-fragmenting explosive materials; 2,500 feet for fragmenting explosive materials; or 4,000 feet for bombs and projectiles of caliber 5-inch and greater. While UXO removal operations are in progress, only those personnel necessary for the operation will be allowed within the EZ. If nonessential personnel enter the area, all UXO removal operations will cease.

During anomaly validation actions, the UXO Technician III will assign UXO Technicians one or more anomalies to investigate. Validation of anomalies will be performed by a two-person team of UXO Technicians using hand excavation tools to a maximum depth of 3 feet

to eliminate any potential explosive hazards to the investigation crew. If removal of items at depths of greater than 3 feet is necessary mechanical means will be employed.

5.4.1 Hand Excavation

Small hand tools such as shovels, spades, trowels, and pry bars will be used to access potential UXO. The hand excavation activities will be limited to a necessary for safe work area access. Hand tools will be used for the majority of items, which generally are found near the surface. The following basic technique will be used for anomaly excavation:

1. The UXO Technician will relocate the anomaly with an appropriate geophysical instrument.
2. Until the anomaly is identified otherwise, it is assumed the anomaly is UXO. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue down until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument, or until the maximum depth of excavation required by the work plan is reached.
3. Using progressively smaller and more delicate tools to carefully remove the soil, the excavation team will expand the sidewall to expose the metallic item in the wall of the excavation for inspection and identification without moving or disturbing the item.
4. Once the item is exposed for inspection, the excavation team will determine whether it is a munitions item.
5. If the item is a munitions item, the procedures of Section 5.4.2, Munitions Identification, will apply.
6. If the item is not a munitions item, it will be removed and the area will be rechecked with the magnetometer to assess if munitions are hidden beneath it. The excavation team will then annotate the results of the excavation on the anomaly tracking sheet and move on to the next marked subsurface anomaly.

5.4.2 Munitions Identification

When an item is positively identified as munitions, the UXO Technician III, SUXOS, and UXOSO will be notified along with the NSRR OE/MEC Safety Representative. An OE/MEC Information Form (Form 2-1) will be filled out for each munitions item identified. The UXO Technician will carefully remove enough soil, without disturbing the munitions item, to facilitate positive identification or to obtain identification features. UXO Technicians will make every effort to identify munitions through visual examination of the item for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the fuze condition can be ascertained. If the condition is questionable, the fuze will be considered armed. The SUXOS and the UXOSO will agree on the positive identification of the item and the disposition of the item before implementing any disposal operations.

When OE that cannot be moved safely is discovered, and the area can withstand a high-order detonation, then the item will be blown in place (BIP) by countercharging the item with an explosive donor charge and detonating the donor charge. All explosive disposal

operations will be performed under the direction and supervision of the UXO subcontractor on-site SUXOS. During these operations, the contractor's on-site UXOSO will closely monitor these operations, strictly enforce safety and adherence to procedures, and ensure that the exclusion area is appropriately evacuated. Engineering controls or protective measures will be employed where required to minimize the damage from BIP operations. These controls may consist of earthen works, sandbags, trenching, buttressing, taping of glass, mounding, flooding, and venting to reduce the effects of detonation.

5.4.3 Disposal of Recovered Scrap

Ordnance related scrap (ORS) materials that have been in direct contact with energetic materials of the ordnance (e.g., expended rocket motors, shell casings, and warhead fragments) will be visually inspected by at least two MEC personnel, and will be certified free of energetic materials that would pose an explosive safety hazard, if appropriate. Certified safe ORS will be containerized and disposed of in an approved landfill or at an approved recycling facility. Materials that cannot be certified as safe from explosive hazards will be handled for further processing by explosives personnel.

Metal debris that is not ordnance-related (e.g., rebar, angle iron, and sheet metal) is not classified as hazardous waste and will be consolidated at the site in a separate container.

5.4.4 Processing of Inert MEC Items

Inert ordnance items will be demilitarized in accordance with DoD 4160.21-M, Defense Reutilization and Marketing Manual, and DoD 4160.21-M-1, DoD Demilitarization Manual. In general, treatment of all MEC will be performed using standard demolition practices. All disposal operations will be performed under the direction and supervision of an on-site SUXOS and UXOSO. Operations will be closely monitored, safety strictly enforced, procedures will be adhered to, and an exclusion zone will be maintained with only essential personnel present.

5.5 Surface Soil Sampling

Sampling techniques that may be employed for surface soil sampling include stainless steel trowel sampling and stainless steel hand auger sampling, depending on the nature of the material to be sampled. A stainless steel trowel will typically be used to collect samples of loosely packed materials and a stainless steel hand auger for densely packed materials. Surface soil samples will be obtained from a depth of 0 to 6 inches bgs and typically be used to investigate leaks and spills on the ground surface. Samples collected from beneath paved or gravel surfaces are not considered surface samples. Table 5-1 lists the required containers, preservatives, and holding times for soil samples.

TABLE 5-1
Required Containers, Preservatives, and Holding Times for Soil

Analysis	Analytical Preparation/ Method Number	No. of Containers	Sample Container	Preservative	Holding Time	Volume of Sample
VOCs	SW-846 Method 5035/ 8260B	3 to 4	3-4 each 5-g En Core sampler	4°C	48 hours to extraction and 14 days from extraction to analysis	Fill completely with no air bubbles
SVOCs	SW-846 Method 3550B/ 8270C	1	8-oz. Glass jar [1]	4°C	14 days to extraction and 40 days from extraction to analysis	Fill completely
Pest/PCBs	SW-846 Methods 3550B/ 8081A/ and 3550B/8082	1	8-oz. Glass jar [1]	4°C	14 days to extraction and 40 days from extraction to analysis	Fill completely
Pesticides	SW-846 Method 3550B/ 8081A	1	8-oz. Glass jar [1]	4°C	14 days to extraction and 40 days from extraction to analysis	Fill completely
Metals	SW-846 Methods 3050B/ 6010B 7000 series	1	4-oz. Glass jar [1]	4°C	6 months, 28 days for mercury	Fill to shoulder
Cyanide	SW-846 Methods 9010B and 9012A series	1	8-oz plastic or glass bottle	Cool to 4ºC	14 days	Fill completely
Explosives	SW-846 Methods 8330	1	4-oz. Glass jar [1]	4°C	7 days to extraction and 14 days from extraction to analysis	Fill completely
Lead/Arsenic/ Explosives	SW-846 Methods 3050B/ 7421 and 3050B/7061 A	1	8-oz plastic or glass bottle	Cool to 4ºC	6 months	Fill to shoulder
Total Organic Carbon	EPA Method 9060	1	8-oz plastic or glass bottle	Cool to 4ºC	28 days	Fill completely
Grain Size	ASTM 0421-58/0422-63	1	Quart size plastic bag	Cool to 4ºC	--	Approximately 1/3rd full
TCLP VOCs	SW846 Method 1311 SW-5030B/8260B	2	2 each 25 gram En Core sampler	Cool to 4ºC	14 days to extraction/14 days to analysis	Fill completely
TCLP SVOCs, Pesticides, Metals	SW846 Method 1311 SW-3510C/8270C/ 8081A SW-3010A/6010B SW-7471A for mercury	1	8-oz glass bottle with Teflon-lined cap	Cool to 4ºC	14 days to extraction/40 to SVOC and Pest analysis; 28 days to mercury analysis; 180 days to metals analysis, 7 days extraction	Fill completely
Reactivity	SW-846 Sections 7.3, 3.2/ 7.3, 4.2	1	8-oz plastic or glass bottle	Cool to 4ºC	48 hours	Fill completely
Corrosivity	SW-846 Section 7.2	1	8-oz plastic or glass bottle	Cool to 4ºC	28 days	Fill completely
Ignitability	SW 846 Method 1010/1020A	1	8-oz plastic or glass bottle	Cool to 4ºC	ASAP	Fill completely

[1] Teflon-lined cap.

5.6 Soil Borings

Before soil borings (or well borings) are initiated, the location will be cleared of munitions by the UXO Contractor Borings will be advanced using one of the following methods: a truck-mounted drill rig, an all-terrain vehicle (ATV) drill rig, using a split-spoon sampler or a hand auger. A magnetometer with down-hole monitoring capabilities will be used for all borings greater than 4 feet in depth. The OE team will direct the beginning of the borehole, which will be started with a hand held portable auger. At not more than a 2-foot depth, the auger will be withdrawn and the magnetometer will be lowered into the borehole. This procedure will be used to insure that smaller items of UXO, undetectable from the surface, can be detected. If no magnetic anomalies are found, the procedure will be repeated at 2-foot intervals to the maximum depth of the auger, but no less than 4 feet. If the proposed borehole site is free of magnetic anomalies, the drilling equipment may be brought on site and utilized. Borehole monitoring with the magnetometer shall continue at 2-foot intervals, until the sampling is completed.

If physical access to areas is restricted due to the presence of UXO, soil borings may be advanced using a hand auger or a tripod-mounted sampling device. The locations and total depth of hand-augured boreholes will be determined in the field based upon subsurface soil conditions and site-specific sampling objectives.

The soil borings performed for this investigation will typically be sampled continuously (every 2 feet) to a depth of 8 feet for lithologic and/or chemical characterization. Soil samples collected continuously at 2-foot intervals. A geologist will observe the drilling and sampling operations. The soil will be classified according to the Unified Soil Classification System (USCS). Field observations of lithology, moisture content, discoloration, odors, and other visible features will be described and recorded in the field logbook and on a soil boring log provided in the Field Sampling Plan. During advancement of the boring, a photoionization detector (PID) will be used to measure volatile organic contamination in the soil cuttings and split spoon samples. Subsurface soil samples may be analyzed from all or selected boreholes.

Upon completion, each boring will be backfilled with a bentonite-cement grout mixture. A labeled stake will be placed at the ground surface near the borehole for future reference for soil borings. Auger cuttings will be containerized in a roll-off, or drums. If significant contamination is present, either visually or by measurement from a PID, the soil will be drummed separately from the roll-off box, labeled with the appropriate boring number, and placed on a wooden pallet at the site.

5.7 Subsurface Soil Sampling

The densities and the presence of UXO will dictate subsurface soil sampling methodologies. Split spoon sampling techniques will be the preferred method used at locations where samples are being collected from depths greater than 3 feet bgs. However, hand augers may be used to collect samples where the terrain or the presence of UXO prohibit the use of hollow stem augers. The subsurface soil sample collection approach is described below and in Section 3.3.6.3 of this report.

Where a drill rig can be used a 3-¼-inch hollow stem augers will be advanced to the top of the desired sampling interval. A stainless steel split-spoon sampler will be attached to the proper length of drilling rod and inserted through the hollow stem augers. A 150-pound hammer will be used to advance the split-spoon sampler up to 2 feet below the auger or until refusal, as required for sample collection. The split-spoon sampler will then be retrieved and the sample handled in accordance with site-specific SOPs. Direct-push methods will obtain the sample from the desired depth by pushing the sampling tube directly to that depth.

The soil borings will be completed within the OB and OD areas as shown on Figure 3-1 and 3-2. Two soil samples will be collected from each soil boring. One of the samples collected will be a surface soil sample the second sample will be collected over a 2-foot interval from a depth of 2 ft bgs to a maximum depth defined by the extent of disturbed soils or 8 ft bgs, whichever is greater. The soil column interval of sample collection will be determined by indications of contamination from either visual observations or PID screening levels. If no contamination is apparent in the field the sample will be collected from a depth of 6-8 ft if the disturbed soils extend to a depth of less than two feet. The soil samples will be analyzed for the Appendix IX analytes listed in Table 3-2, explosives and perchlorate to assess the nature of the contaminants present at the OB area.

UXO clearance of subsurface soil borings will be conducted as described in Section 5.6.

5.8 Monitoring Well Installation

Boreholes drilled for monitoring well installation will be lithologically logged by the Field Geologist as described in Section 5.6. Well locations are described in Section 3.3.5 and are shown on Figures 3-1 and 3-2. The proposed well locations provide groundwater sampling locations at the site boundary immediately downgradient and therefore, provide a characterization of the groundwater quality migrating from the site. This approach is consistent with the approach used for the groundwater sampling in the RCRA Facility Investigation.

Monitoring well borings will usually be installed using hollow stem augers, unless field conditions require the use of a rotary or sonic method. The rotary method will utilize the addition of drilling water, not drilling mud. At locations where permanent wells are not required or well installation cannot be completed using a truck-mounted or ATV drilling rig, drive points may be installed. Drive points are 2-inch-diameter, stainless steel monitoring wells with short screens, and are installed by driving the well point into the ground. These will be installed in wet areas where the weight of a drilling rig cannot be supported, or because of steep slopes or dense forest. Drive points may also be installed in an open borehole.

5.8.1 Monitoring Well Construction

Monitoring wells will be constructed of 2-inch inside diameter (I.D.), Schedule 40 polyvinyl chloride (PVC) risers and screen, with flush joint threads. Wells will be completed with 10-foot-long No. 10 slot size screens with 2 feet of the well screen extending above the top of the water bearing zone. A typical well construction diagram is provided Final Master Work

Plan (CH2M HILL, June 2003). Permanent water level measurement notches will be made on the northern side of the riser casing to keep water level gauging events consistent.

A sand pack will be placed around the screened interval to 1 to 2 feet above the top of the screen. A minimum of 2 feet of bentonite will be placed above the sand pack. If above the water table, bentonite will be hydrated with potable water prior to grouting. Grout will be placed via a side-discharging tremie pipe above the bentonite pellets to within 1 foot of the ground surface.

Wells will be constructed to have 2 to 3 feet of "stickup" above ground surface. A steel protective casing will be placed over the riser and cemented into a 4-foot x 4-foot x 4-inch concrete pad. The pad will be sloped away from the well to prevent surface water infiltration.

Some wells may require that a surface casing be installed to prevent potential contamination from migrating between water-bearing units separated by low-permeability materials. Surface casings will consist of either PVC or steel. The casings will be set into low-permeability material separating the water-bearing units and will be grouted in place.

UXO clearance of monitoring well borings will be conducted as described in Section 5.6.

5.8.2 Monitoring Well Development

Monitoring wells will be developed prior to groundwater sampling by removing water from each well using a submersible pump. The development water will be discharged into 55-gallon drums or other storage containers (e.g., tankers). A surge block also will be used to aid in development. If dedicated sampling equipment is not used, equipment will be decontaminated between wells.

Well development will be performed after the grout used to construct the well has been allowed to adequately set at least 24 hours. The groundwater levels will be measured to the nearest 0.01 foot from the top of the PVC casing. Development will consist of removing at least three borehole volumes of water, plus the amount of water added during the drilling or installation process. Development will continue until groundwater turbidity levels reach 50 nephelometric turbidity units (NTUs), or until 6 hours of development has passed, whichever comes first. The goal of 50 NTUs was developed due to the nature of geology on Vieques and the persistence of wells going dry during purging activities. Water clarity will be measured with a Hach™ NTU meter or equivalent. Development information, including water clarity, pH, specific conductivity, and temperature, will be recorded in the field logbook.

5.9 Groundwater Sampling from Monitoring Wells

Monitoring wells will not be sampled for at least 2 weeks after the well has been developed. This will allow an adequate amount of time for the well to recover. Prior to sampling, groundwater will be purged from each well. Purging will be performed until at least three borehole volumes have been removed and the temperature, specific conductance, and pH have stabilized to within 10 percent for three consecutive readings. The borehole volume will be calculated using values for the depth of the well, the depth to water, and the well diameter. Purging will be accomplished using low flow pumps or bailers. Well purging data

will be recorded in the field logbook. The IDW Management Plan of the Final Master Work Plan (CH2M HILL, June 2003) discusses treatment and disposal of purge water.

Samples will be collected after the field parameter measurements have stabilized using EPA Region 2 low flow sampling procedures. Wells that are pumped dry during purging will be allowed to recover before sampling; the sample will be obtained as soon as a sufficient volume of groundwater to fill all sample containers has entered the well. VOC will be collected as described in the Final Master Work Plan (CH2M HILL, June 2003) to minimize agitation of the groundwater and minimize volatilization of VOCs.

Purging activities will be conducted in a manner which minimizes agitation of groundwater in the wells, and at a pumping rate not to exceed one liter per minute. Variable speed submersible environmental pumps (Grundfos or equivalent) will be utilized for purging. Bladder pumps were ruled out for use at ATWTF for purging because of the difficulty in obtaining compressed gasses on the island. All down-hole and effluent tubing will be Teflon-lined or Teflon.

Groundwater samples will be collected from the discharge hose of the purge pump into properly-labeled, laboratory-prepared sampling containers filled and/or preserved as appropriate; cooled to approximately 4 °C; and shipped to the analytical laboratory under appropriate chain of custody (COC) documentation procedures. The pump rate shall be maintained between 0.2 and 0.5 L liter per minute in accordance with EPA Region 2 low flow guidance. Clean, double check valve bailers may be used for sampling as a last resort in wells in which the depth to water or other extenuating circumstances preclude the collection of non-turbid samples through the pump. In this case, care will be taken when lowering the bailer not to agitate the water surface. Table 5-2 shows the required containers, preservatives, and holding times for water samples.

5.10 Sampling Equipment Decontamination Procedures

All field sampling equipment will be precleaned prior to arrival on-site and decontaminated in accordance with the procedures detailed in the Final Master Work Plan (CH2M HILL, June 2003). A decontamination area will be established and maintained on-site for all decontamination activities. The site will be selected by the sampling team based on the location's ability to isolate the decontamination area and assist in preventing cross-contamination of sampling equipment.

5.11 IDW Management

All wastes generated from field sampling and decontamination activities will be treated as contaminated media until data are available to determine their actual characteristics. This material will be drummed and stored in the OP-1 facility pending the outcome of sampling analysis. Specifics such as date, time, equipment being decontaminated, and the associated sample identification number for the equipment being decontaminated will be recorded in a field logbook. Liquids will be drummed separately from solids, and the drums will be properly labeled. It is anticipated that IDW will consist of decontamination fluids and rinseates, contaminated personal protective equipment (PPE), and soil cuttings.

Segregation, minimization, handling, and labeling of IDW will be performed. Solid IDW will be placed in DOT 17H drums. All groundwater, decontamination fluids, and rinseates will be placed in DOT 17E drums. Each drum will be clearly labeled and dated the day it is filled using indelible ink and have the following source identification:

TABLE 5-2
Required Containers, Preservatives, and Holding Times for Water Samples

Analysis	Analytical Preparation/ Method Number	No. of Containers	Sample Container	Preservative	Holding Time	Volume of Sample
VOCs	SW-846 Method 5030B/8260B, 8015	3	Three 40-ml glass vials w/Teflon-lined cap	HCl to pH <2; Cool to 4ºC	14 days	Fill completely; no air bubbles
SVOCs	SW-846 Method 3510C/8270C	2	Two 1-liter bottles	Cool to 4ºC	7 days extraction/40 days to analysis	Fill to shoulder
Pesticides/ PCBs	SW-846 Methods 3510C/ 8081A and 3510C/8082	2	Two 1-liter bottles	Cool to 4ºC	7 days extraction/40 days to analysis	Fill to shoulder
Metals	SW-846 Methods 3010A/ 6010B and 3010A/7000 series	1	1-liter polyethylene bottle	HNO_3 to pH <2; Cool to 4ºC	6 months (28 days for mercury)	Fill to shoulder
Cyanide	SW-846 Methods 9010B and 9012A series	1	1-liter polyethylene bottle	NaOH to pH >12; Cool to 4ºC	14 days	Fill to shoulder
Lead and Arsenic	SW-846 Methods 3010A/7421 and 3010A/7061A	1	1-liter polyethylene bottle	HNO_3 to pH <2; Cool to 4ºC	6 months	Fill to shoulder
Explosives	SW-846 Method 8330	1	1-Liter Amber	Cool to 4ºC	14 days/ extraction/40 days to analysis	Fill to shoulder
Total Organic Carbon	EPA Method 9060	1	500-ml amber glass	H_2SO_4 or HNO_3 to pH<2; Cool to 4ºC	28 Days	Fill completely, no air bubbles
TCLP VOCs	SW-1311/5030B/ 8260B	3	40-ml glass vials w/Teflon-lined cap	Cool to 4ºC	14 days to filter/14 days to analysis	Fill completely; no air bubbles
TCLP SVOCs, Pesticides, Metals	SW-1311 SW-3510C/ 8270C/8081A SW-3010A/6010B SW-7470A for mercury	2	1-liter bottles	Cool to 4ºC	14 days to extraction /7 days to SVOC and Pest analysis; 28 days to mercury analysis; 180 days to metals analysis	Fill to shoulder
Total Suspended Solids (TSS)	EPA Method 160.2	1	500 ml bottle	Cool to 4ºC	7 days	Fill to shoulder

TABLE 5-2
Required Containers, Preservatives, and Holding Times for Water Samples

Analysis	Analytical Preparation/ Method Number	No. of Containers	Sample Container	Preservative	Holding Time	Volume of Sample
Total Dissolved Solids (TDS)	EPA Method 160.1	1	250 ml bottle	Cool to 4ºC	7 days	Fill to shoulder
Alkalinity	EPA Method 310.1	1	250 ml bottle	Cool to 4ºC	14 days	Fill to shoulder
Hardness	EPA Method130.2	1	250 ml bottle	HNO_3 to pH <2; Cool to 4ºC	6 months	Fill to shoulder
Acrolein/ Acrylonitrile	SW846 5030B/8260B/8015	1	40 ml glass vial w/Teflon lined cap	HCL to pH 4-5 cool to 4ºC or unpreserved	14 days preserved or 7 days unpreserved	Fill completely no air bubbles
Reactivity	SW7.3.3.2	1	1-liter polyethylene bottle	Cool to 4ºC NaOH	48 hours	Fill to shoulder

Contaminated media will be managed in accordance with the current federal hazardous waste rules. For instance, if concentrations of samples collected from decontamination/ rinseate fluids exceed the Universal Treatment Standards (UTS) of 40 CFR 268.40 or the maximum contaminant levels (MCLs), whichever is higher, the drummed waste will be considered a hazardous waste and will be managed accordingly. All soils with hazardous constituent concentrations exceeding the UTS or the soil screening levels (SSLs) (i.e., cleanup goals), whichever is lower, are considered hazardous waste and similarly managed. Wastes determined to be hazardous will be picked up by a contractor for transport to a permitted disposal facility.

If the results indicate none of the UTS or SSL/MCL concentrations have been exceeded, wastewater and/or soils are not considered hazardous waste and will be managed in accordance with the procedures in the Final Master Work Plan for AFWTF (CH2M HILL, June 2003).

All sanitary trash and uncontaminated PPE will be discarded in accordance with applicable solid waste regulations.

5.12 Sample Analysis and Validation

5.12.1 Sample Analysis

All analyses of soil and groundwater will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and SW 846. The laboratory must follow the scope of work prepared by the project team. A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with SW 846. All analyses will be performed following the highest level of USEPA guidance. Analyses will include the proper ratio of field QC samples recommended by USEPA guidance for the data quality objectives (DQOs).

This task includes checking the data from the laboratory and converting it into an electronic format that can be readily incorporated into the GIS Data Management system for AFWTF.

5.12.2 Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. The Quality Assurance Project Plans (QAPP) (CH2M HILL, June 2003) provides details with regard to the number and frequency of field QC samples to be collected during the investigation and are given in Tables 3-1 and 3-2.

5.12.2.1 Blanks

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. American Society for Testing and Materials (ASTM) Type II water will be used for blanks. Four types of blanks can be generated during sampling activities: trip blanks, field blanks, equipment rinseate blanks, and temperature blanks.

One trip blank will be included in each cooler used for the daily shipment of VOC samples. If more than one cooler is being sent on a given day, all of the VOC samples should be placed in one cooler, if possible, to minimize the number of trip blanks needed. The trip blanks will be prepared before each sampling event, shipped or transported to the field with the sampling bottles, and returned unopened for analysis. Trip blanks will indicate if there is contamination during shipment to the field, from storage in the field, or from shipment from the field to the analytical laboratory.

One field blank will be collected per sampling event. If sampling events extend beyond 1 week (5 working days) or for windy and dusty field conditions, the number of field blanks should be increased. Field blanks are used to determine the chemical quality of water used for such procedures as decontamination and blank collection.

One equipment blank per sample medium will be obtained for each day of sampling. Equipment blanks will give an indication of the efficiency of decontamination procedures.

USEPA has recently requested that a temperature blank be included in each cooler containing samples for analyses so that the laboratory can record the temperature without disturbing the samples. The temperature blank will be labeled, but will not be given a sample number nor will it be listed as a sample on the COC form.

5.12.2.2 Duplicates

Field duplicate samples will be collected at a frequency of one field duplicate per 10 field samples per matrix. The locations from which the duplicates are taken will be selected randomly. Each duplicate sample will be split evenly into two sample containers and submitted for analysis as two independent samples.

5.12.2.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 MS/MSD for every 20 field samples collected. Analytical results of these samples indicate the impact of the matrix (water, soil, sediment) on extracting the analyte for analysis. MS/MSD samples give an indication of the laboratory's analytical accuracy and precision within the sample matrix. Data validators will use these results to evaluate the accuracy of the analytical data.

5.12.3 Data Validation

Analytical results will be validated by an independent subcontractor approved by the U.S. Navy. Data validators will mostly use USEPA Region II guidance (*Functional Guidelines*), but other validation guidelines may be used with prior USEPA approval. Data validation will be pursuant to the requirements of Section X of the January 2000 Consent Order, and all deviations from that have been, or will be, approved in writing by USEPA.

The hardcopy data packages will be reviewed by the subcontractor chemists using the process outlined in USEPA's *Functional Guidelines for Evaluating Data* (USEPA, September 1999). Areas of review will include (when applicable to the method): holding time compliance, calibration verification, blank results, mass spectrometer precision and accuracy, method accuracy as demonstrated by laboratory confirmation samples (LCSs), field duplicate results, surrogate recoveries, internal standard performance, and interference

checks. A data review worksheet will be completed for each of these data packages and any non-conformance will be documented. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes.

Data that are not within the acceptance limits will be appended with a qualifying flag, which consists of a single or double-letter abbreviation that reflects a problem with the data. The following flags will be used in the evaluation:

- U, undetected. Analyte was analyzed for but not detected above the method detection limit (MDL).
- UJ, detection limit estimated. Analyte was analyzed for, and qualified as not detected. The result is estimated.
- J, estimated. The analyte was present, but the reported value may not be accurate or precise.
- R, rejected. The data are unusable. (Note: Analyte/compound may or may not be present.)

Numerical sample results that are greater than the MDL but less than the laboratory reporting limit (RL) are qualified with a "J" for estimated as required by USEPA's *Functional Guidelines* (USEPA, 1999).

5.13 Health and Safety Procedures

The following section outlines the tasks associated with MEC and environmental investigations, associated hazards and hazard controls that need to be implemented during the completion of the closure plan activities. A detailed Explosives Safety Submission is currently being prepared for submittal to DDESB and will be approved by DDESB prior to initiating any field activities. In addition, a Site Health and Safety Plan will be prepared prior to initiating any field activities.

Personnel performing sampling will use appropriate PPE deemed necessary to accomplish sampling tasks. The PPE to be used will be specified in the closure Health and Safety Plan. Sampling personnel will be properly trained in hazardous waste sampling procedures and will have appropriate medical monitoring and certification. Sampling personnel will also be briefed by the UXO safety officer on the hazards of sampling in a potential explosively contaminated environment. A detailed description of the hazard controls for general hazards (fire hazards, material handling, heat stress, IDW handling, vegetation and insect hazards) are provided in detail within the Health and Safety Plan provided in the Final Master Work Plan (CH2M HILL, June 2003).

5.13.1.1 Hazwoper-Regulated Tasks

- Site Layout
- Surface geophysical surveys
  - Magnetic
  - Electromagnetic
- Vegetation removal
- Anomaly reacquisition

5.13.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.

5.14 MEC Hazard Analysis for Unexploded Ordnance Activities

For closure activities where there is a potential for exposure to MEC and UXO, Table 5-3 provides a list of MEC related activities, the potential hazards associated with each activity and recommended controls. Table 5-4 shows inspection requirements for equipment that will be utilized in the field during MEC investigations.

TABLE 5-3
Hazards Analysis

Principal Steps	Potential Hazards	Recommended Controls
Transportation of explosive materials [1]	Accidental detonation of explosives	Explosives will be transported in accordance with the 49, CFR, Parts 100-199.
		Explosives will be transported in closed vehicles whenever possible.
		When using an open vehicle, explosives will be covered with a flame resistant tarpaulin.
		Motor vehicles will be shut off when loading/unloading explosives.
		Beds of vehicles will have either a nonconductive bed liner, dunnage, or sand bags to protect the explosives from contact with the metal bed and fittings.
		Initiating explosives, such as blasting caps, will remain separated at all times.
		Each vehicle used for the transport of OE will be outfitted with a fire extinguisher and first aid kit.
		Do not fuel trucks when loaded with OE.
	Unqualified Drivers	Drivers operating outside the boundaries of any federal installation will be licensed in accordance with federal, state, and local regulations.
	Vehicle operations	Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
		Vehicles transporting explosives offroad will not exceed 15 miles per hour (mph).
		Chock wheels when loading or unloading OE-related materials.

TABLE 5-3
Hazards Analysis

Principal Steps	Potential Hazards	Recommended Controls
Storage of explosive materials [1]	Accidental detonation of explosives	Materials will be stored in accordance with federal, state and local regulations. Refer to the SOP for the Storage of Explosive Materials.
Surveying and establishing boundaries and grids	Accidental detonation of explosives	Personnel involved will attend a site-specific OE/MEC recognition class prior to the commencement of any site activities. MEC personnel will escort non-MEC personnel at all times. Mark and avoid MEC. Only MEC personnel will handle OE waste. Check location with magnetometer prior to driving stakes.
	Wildlife, slips, trips, falls, insects, poisonous plants, use of hand tools	Refer to the Activity Hazard Analysis for section of this SSHP.
Clearing and grubbing	Accidental detonation of explosives	Personnel involved will attend a site-specific OE/MEC recognition class prior to the commencement of any site activities. Be alert and mark all OE located. Only clear and grub to within 4 inches of the ground surface. MEC trained personnel will escort non-MEC personnel at all times. Surface sweeps will be conducted with magnetometers or other suitable geophysical instrumentation to identify potential OE.
Transportation of OE waste [1]	Accidental detonation of explosives	No personnel allowed in OE cargo department of vehicle.
	Accidental detonation of explosives	No OE allowed in passenger compartment of vehicle. Block, brace, secure OE. No smoking in vehicles used for transport of OE/MEC waste.
	Vehicle operations	Placard vehicle in accordance with U.S. Department of Transportation (DOT) regulations. Vehicles transporting explosives offroad will not exceed 15 mph. Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
MEC disposal operations [1]	Accidental detonation of explosives	Observe procedures outlined in EODB 60A-1-1-31.

TABLE 5-3
Hazards Analysis

Principal Steps	Potential Hazards	Recommended Controls
OE-related scrap demilitarization	Accidental detonation of explosives	Only MEC technicians will perform explosive demilitarization of OE-related scrap.
	Shredder Operations	Stay clear of moving mechanical parts.
		Ensure that only inspected scrap is fed into shredder.
Inspection/ certification of ORS	Accidental detonation of explosives	Only MEC technicians will inspect OE-related scrap.
		Personnel in the immediate vicinity of OE-related scrap inspections will be kept to the minimum necessary for safe operations but no less than two MEC technicians.
		Observe requirements of DoD 4160.21-M-1.
Anomaly reacquisition	Accidental detonation	Only MEC technicians will excavate or handle MEC.
		Personnel in the immediate vicinity of MEC operations will be kept to the minimum necessary for safe operations, but no less than two MEC technicians.
		Do not subject MEC to heat, shock, or friction.
		Only hand excavation permitted when within 1 ft of MEC.
		Magnetometers will be used frequently to pinpoint the location of MEC.
	Non-MEC personnel	Establish exclusion zone (EZ); post warning signs, maintain site control.
		Stop all MEC operations when non-MEC trained personnel are within the EZ.
Clearing and Grubbing of vegetation	Cutting tools, chain saws, weed cutters	Eye, hand, foot, and hearing protection, (Level D). Face shield and chaps will be worn by chain saw operations. Personnel using chain saws, cutting tools, and weed cutters must provide safe distance between workers and be cautious of tools.

[1] Only the MEC subcontractor or NSRR EOD personnel will transport OE/MEC material and explosives.

5.15 MEC Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. Contractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. The main physical or safety hazards posed to personnel during project activities are described below.

A restricted/EZ shall be established around the area where intrusive activities are conducted. Initially, a 300-foot EZ will be established at each location where intrusive

activities are being conducted. If OE/MEC is located during excavation, the EZ will be adjusted to 1,250 feet for non-fragmenting explosive materials; 2,500 feet for fragmenting explosive materials; or 4,000 ft for bombs and projectiles of caliber 5-inch and greater. While MEC operations are in progress, only those personnel necessary for the operation will be allowed within the EZ. If nonessential personnel enter the area, all MEC operations will cease.

OE includes MEC, OE-contaminated soils and groundwater, range maintenance and ordnance demilitarization (Demil). Sites potentially contaminated with OE/MEC will be screened by the MEC contractor with qualified MEC Technicians prior to and during field activities.

TABLE 5-4
Inspection Requirements

Equipment To Be Used	Inspection Requirements	Training Requirements
Vehicles	Daily preventive maintenance and operational checks	40-hour qualification per 29 CFR 1910.120
Fire extinguishers	First aid kits	8-hour refresher
First aid kits	Calibration of geophysical instrumentation	MEC personnel EOD trained
Demolition materials		Tailgate safety meetings
Explosives		Site-specific orientation
Blocking, bracing, and cushioning materials		Lead awareness training
Manual hand tools		Poison oak awareness training
Mechanized equipment		
EMM		
Geophysical instrumentation		
Global Positioning System instrumentation		
PPE		
Communications equipment		

On-site personnel who are potentially exposed to hazards associated with OE activities shall follow the requirements described in this section regardless of the company performing the OE operation.

- Only qualified MEC Technicians or EOD personnel will locate, identify, handle, remove, transport, store, or dispose of OE/MEC items.
- The preferred and safest method for disposal of OE/MEC is to destroy it in its original position by demolition (BIP) whenever circumstances permit. By this method, both the ordnance and the hazard it poses are eliminated in one operation.
- Munitions that have been determined to be “safe to move” by an authorized MEC Technician can be transported to an approved holding area or disposal site.

- One person acting alone should never conduct operations involving contact with OE/MEC.
- OE/MEC must not be moved or disturbed in any way unless it has been determined to be safe to do so by a qualified MEC technician. Operations in the vicinity of OE/MEC should only be conducted after a complete work plan, including emergency procedures, has been established.
- Electronic equipment capable of emitting electromagnetic radiation (such as radios or cellular phones) shall not be activated in the vicinity of known or suspected electrically initiated ordnance.
- Munitions having no color-coding, incomplete color-coding, or improper color-coding are not uncommon, so color coding should not be relied on as a positive identification of ordnance.
- Inhalation of, and skin contact with, smoke, fumes, and vapors of explosives and related hazardous materials shall be avoided.
- OE/MEC that has been exposed to fire or detonation must be considered extremely hazardous. Chemical and physical changes may have occurred to the contents, which render it more sensitive than when in its original state.
- When encountered, attempts should be made to positively identify OE/MEC items. The item shall be carefully examined for markings and other identifying features such as shape, size, and external fittings. The item should not be moved prior to inspection.
- Ordnance shall be approached from the side because munitions may contain an ejection hazard, shaped charge explosive jet hazard, rocket motor, or fuzing sensitive to movement.
- Unnecessary personnel must not remain in the vicinity of OE or MEC.
- Ordnance items must be considered armed and dangerous.
- Fired ammunition or ordnance should not be considered safe.
- MEC items shall not be removed from the site by unauthorized personnel.
- Ordnance items larger than .50 caliber are considered MEC and may contain high explosives.

5.16 Approach For Establishing Cleanup Goals

The following documentation discusses the general approach for establishing cleanup goals for closure at the OB/OD site. Risk assessment will use methods recommended by the USEPA guidance.

A risk assessment will be conducted and include the following major components in the evaluation process:

- Identification of COPCs;
- Exposure assessment;

- Toxicity assessment;
- Risk characterization and uncertainty evaluation; and
- Site versus background concentrations and risks.

A conceptual site model (CSM) will be developed for an overview of site conditions, potential migration pathways, receptors, and exposure routes identification purposes. This will serve as the basis for the exposure pathway evaluations in the human health (and ecological) risk assessments.

As appropriate, a discussion of remedial goal options (RGOs) will be included for the sites presenting excess risk or hazard, for risk management decision purposes.

5.16.1 Identification of Contaminants of Potential Concern

Existing analytical data from each of the closure activities will be evaluated for a quantitative risk assessment by identifying chemicals that are above screening levels. The screening criteria will use the latest updated PRG values from USEPA Region 9, MCLs from USEPA, website, and the latest available ecological criteria for surface water and sediments at the time of the closure report preparation. The current version of this criteria is included in Appendix G of the Final Master Work Plan (CH2M HILL, June 2003). Soil will be evaluated using criteria provided in USEPA Region IV, Draft Ecological Screening Levels for Soil from *"Memorandum – Amended Guidance on Ecological Risk Assessment at Military Bases; Process Considerations, Timing of Activities, and Inclusion of Stakeholders,"* June 23, 2000.

Data are obtained in electronic format and these data will be ensured to have been through a DQE process. The COPC that represent site conditions will be selected using the monitoring data from each site. The selection process will include chemicals that are a direct exposure concern.

The groundwater data from unfiltered samples will be used for quantitative risk assessment. Analytical data from filtered samples will be used to assess the quality of the data of unfiltered groundwater samples. If there is a significant discrepancy between the filtered and unfiltered data, the filtered data may be used for the risk assessment in accordance with EPA Guidance.

5.16.2 Exposure Assessment

An exposure assessment will evaluate the potential exposure to the site media and identify the potential receptor population for the site. The exposure assessment will be conducted to identify potential exposure pathways for human and ecological receptors, assess the potential routes of exposure, and document the behavior of the assumed receptor into exposure factors for quantitation of the potential exposure. The specific assumptions will be discussed with the risk assessors from reviewing agencies prior to inclusion in the quantitative risk assessment. A CSM will be developed to identify the source, migration pathways, and the potential receptors at the OB/OD site.

Land use assumptions for current and future land uses at the site and surrounding areas will be discussed. If additional information from DOI regarding future land use plans for property is available, it will be used in the exposure assessment. In addition the USEPA guidance document "Land Use in the CERCLA Remedy Selection Process" will be

consulted. Additionally, current exposure scenarios will include a site-specific most likely use scenario and will be evaluated for the site, as appropriate. Fate and transport of the COPC identified for each media will be evaluated and discussions will be provided.

The dose (chronic daily intakes [CDIs]) will be estimated using exposure point concentrations for each receptor and exposure route for the identified complete exposure pathways. Exposure pathways for risk assessment will be selected based on the site activities and surrounding area and the site conceptual model developed prior to risk assessment. Exposure pathways to be quantified will be determined based on USEPA guidance and will include the direct exposure pathways to soil and groundwater as appropriate. Appropriate representative exposure pathways will be included for quantitative analysis and other potentially complete, less–conservative pathways will be discussed qualitatively, as appropriate.

The exposure point concentrations will be the upper 95% confidence limit estimates on the mean concentrations (UCL95%). The non-detect samples will be included at half the detection limit levels in these UCL95% estimates. These estimations will be performed using the underlying data distributions (normal versus log-normal), according to the USEPA guidance. The lower of the maximum detected concentration and the UCL95% estimated will be selected as the exposure point concentrations.

Both surface and subsurface soils will be evaluated for human health exposure. Subsurface soils within the uppermost 6 feet will be evaluated for direct exposure during excavation.

A fate and transport evaluation will include discussion of environmental behavior of the COPC identified during the nature and extent investigations in the surface and subsurface soils and potential impacts to site groundwater. The behavior of the chemicals shall be determined by both individual chemical properties, as well as by facility characteristics including water flow velocity, soil permeability, infiltration, temperature, and presence of conditions that support microbial population. Potential pathways shall be assessed based on site-specific information and chemical properties. Fate and transport evaluation will include potential offsite impacts from the site contaminants by evaluating the site COPC and their potential for offsite migration through groundwater or surface runoff. The groundwater monitoring data will serve as the indicator for quantitative assessment of the potential migration. No quantitative modeling will be performed as part of this fate and transport evaluation.

5.16.3 Toxicity Assessment

The human health evaluation will include a toxicity assessment section that compiles the toxicity criteria for risk and hazard index estimates. The toxicity criteria will be obtained from the USEPA toxicity databases (e.g., IRIS, and HEAST). Any interim values from USEPA available through other sources (e.g., USEPA Region IX PRG tables) will be used in the absence of a value in the USEPA toxicity databases. Uncertainties associated with the toxicity criteria estimations will be discussed. The target organs for the selected toxicity factors will be selected from the existing toxicity databases, as suggested by USEPA. The toxicity equivalency factors (TEFs) will be used for polycyclic aromatic hydrocarbons (PAHs) as appropriate.

5.16.4 Risk Characterization

The exposure and toxicity information from the previous sections will be integrated in this section to estimate the potential risks and health indices (HIs). The estimated risks and HIs represent the site (area) being investigated for site-specific risk management decisions. The cumulative risks and HIs will be compared against the acceptable risk ranges. Where necessary, cleanup goals for each COPC will be calculated based on acceptable risk ranges. Summary and conclusions will be provided for each of the receptor populations. Risks will be totaled by medium and combined risks across media and pathways will be presented as appropriate.

5.16.5 Background Analysis

A Draft Work Plan For Soil and Groundwater Background Investigations at AFWTF has been submitted to EPA (CH2M HILL, May 2004). The analytical results from the implementation of this work plan will be integrated into this closure plan. Any background levels for inorganic chemicals that exceed risk-based cleanup goals will be used as the goals for achieving clean closure. Where background levels exceed the acceptable risk-based levels the calculated 95% Upper Tolerance Limit (UTL95%) of the background concentration will be established as the clean closure goal.

5.17 Ecological Risk Assessment Approach

An ecological risk assessment (ERA) will be conducted to document any potential adverse effects to the environment resulting from of contamination present at the OB/OD Site. The USEPA's program guidance for ERAs will be the primary ERA guidance (USEPA, 1997). The stepwise process outlined in this guidance will serve as the basic framework for the ERA portion of the Interim Closure Report. The initial data collected during the closure investigation will be used to assess ecological risks following existing USEPA guidance. The ecological risk assessment will consist of the screening-level baseline ERA described in Steps 1 through 3A of EPA guidance. Conservative thresholds for adverse ecological effects, or screening ecotoxicity values, will be presented for contaminants detected in surface soil. The soil ecotoxicity values will be obtained from USEPA Region IV, Draft Ecological Screening Levels for Soil from *"Memorandum – Amended Guidance on Ecological Risk Assessment at Military Bases; Process Considerations, Timing of Activities, and Inclusion of Stakeholders,"* June 23, 2000.

5.18 Evaluation Of Remedial Alternatives

For areas where contaminant levels exceed acceptable risk levels and background concentrations, remedial alternatives will be developed. Each alternative will be evaluated against the nine criteria outlined in CERCLA, which include:

- Overall protection of human health and the environment
- Compliance with ARARs, including DoD 6055.9 STD, CERCLA and RCRA
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness

- Implementability
- Cost
- State/support agency acceptance
- Community acceptance

Alternatives to be considered may include: no further action, soil/waste excavation and off-site disposal, installation of soil cover, installation of a RCRA cap, in-situ treatment technologies or other appropriate remedial measures.

Details of each of these criteria for the selected alternative will be evaluated and included in the Interim Closure Report.

SECTION 6

6 References

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Appendix A
UXO Avoidance Survey Procedures

Ordnance Explosives (OE)
Standard of Practice HSE-91

1.0 Applicability and Scope

1.1 Applicability
This Standard of Practice (SOP) applies to: (1) CH2M HILL employees who enter areas known or suspected of having Ordnance Explosives (OE) and (2) CH2M HILL Safety Coordinators (SCs) and CH2M HILL Ordnance Explosives Safety Officers (OESO)/Ordnance Explosives Quality Control Managers (OEQCM) who may be responsible for providing oversight of a subcontractors OE operations. OE operations may be conducted on active, inactive, closed, transferring, or transferred ranges; former battlefields; disposal sites; or munitions manufacturing and storage sites.

1.2 Scope
This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with OE operations. OE hazards addressed in this SOP include exposure to Unexploded Ordnance (UXO), Chemical Warfare Material (CWM), Ordnance Demilitarization operations, explosives contaminated soil and groundwater, and the hazards associated with operations to locate, identify, remove, and dispose of OE. CH2M HILL employees who enter OE areas must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, responsibilities for health, safety and environment (HS&E) are expressly defined through the subcontract terms and conditions, and CH2M HILL's HS&E practices in the field are determined based on these defined responsibilities. Consistent with HSE-55, the subcontractor must determine how to operate safely and in compliance with applicable HS&E regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of OE operations nor direct the details of corrective actions.

1.3 Regulatory Review
OE projects are often complex and have a myriad of regulatory requirements to ensure safety. Support for determining the governing laws and regulations for any specific OE project must be reviewed by the OESO, OEQCM, or the OE Market Segment Team Leader to ensure compliance and safety.

Department of Defense (DOD) Ammunition and Explosives Safety Standards, DOD 6055.9-STD, establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, demilitarization, and disposal.

The U.S. Environmental Protection Agency (EPA) regulates the disposal of military munitions and waste containing military munitions through the Military Munitions Rule (RCRA; 40 CFR part 266, subpart M). The rule (1) identifies when conventional and chemical military munitions

become a solid waste and (2) provides criteria for storage and transportation of such waste, including a conditional exemption if the munitions are managed under DOD rules.

The United States Army Corps of Engineers, Engineering Support Center, Huntsville, has published accepted guidelines and requirements for OE operations. These requirements are incorporated by reference into this document and are generally considered to be industry standards in the same manner as Voluntary Consensus Standards such as NFPA and NIOSH.

2.0 Project Planning

2.1 Training Requirements

CH2M HILL employees and subcontractors who work on projects that involve OE must complete the following training:

- 40-hour hazardous waste comprehensive course with training in hazard recognition and basic health and safety issues, as required by the occupational safety and health regulations contained in 29 CFR 1910.120(e)
- Annual 8-hour hazardous waste refresher course
- Hazardous waste supervisory training as specified in 29 CFR 1910.120(e) [only required for management and supervisors]
- All UXO personnel will be graduates of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal AL; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course

The OESO, OEQCM, or OE Market Segment Team Leader must provide assistance in reviewing subcontractor personnel qualifications.

2.2 Medical Surveillance Requirements

All CH2M HILL employees who work on OE sites must be on a medical surveillance program consisting of a baseline health assessment that includes a medical and occupational history review, blood and urine tests for contaminants of interest, electrocardiogram, slit-lamp corneal examination, pulmonary function tests, chest x-ray, respiratory fit test, and a general physical examination that includes hearing and vision.

Employees who terminate employment and who have worked at OE project sites may be required to undergo an exit examination equivalent to the baseline health assessment.

Subcontractors are responsible for ensuring that their employees receive medical surveillance as required.

2.3 Drug Abuse Surveillance Requirements

CH2M HILL employees who perform OE operations and oversight are subject to the provisions contained in HSE-76.

Subcontractors are responsible for ensuring that their employees who perform OE operations on CH2M HILL projects are on a drug abuse surveillance program that meet the requirements contained in HSE-76.

2.4 Competent Person Requirements

OE/UXO subcontractors are responsible for providing a competent person to oversee OE operations. A competent person may be a Senior UXO Supervisor, UXO Safety Officer, UXO Quality Control Specialist, or a UXO Technician III. The competent person must meet the following minimum qualification requirements:

- Be a graduate of either of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal Alabama; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course
- Have at least 10 years of combined active duty military EOD and contractor UXO experience
- Have experience in OE operations and supervising personnel

CH2M HILL competent person requirements are the same as for a subcontractor.

2.5 Safety Equipment

OE subcontractors are responsible for providing all personal protective equipment (PPE) necessary for their employees. CH2M HILL will provide PPE only for its own employees. Other safety equipment will be provided as delineated in the subcontract and referenced documents. The OESO, OEQCM, or OE Market Segment Team Leader must review subcontractor work plans and health and safety plans to ensure that appropriate safety equipment has been included to meet the scope of work requirements.

2.6 Subcontractor Selection

OE subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55. The "Subcontractor Safety Procedure Criteria—OE Operations" found in Attachment 1 provides the minimum criteria for OE operations. Additional criteria may be developed dependent upon the specific OE scope of work requirements for the subcontractor. These criteria shall be used by the CH2M HILL OESO or the OE Market Segment Business Leader to review subcontractor OE procedures submitted when oversight is required by HSE-55.

2.7 Planning Activities

Assistance for planning OE operations is available from the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader for planning and executing OE support for Hazardous Toxic Radiological Waste (HTRW) support activities, construction support activities, OE response actions, CWM activities, explosive contaminated soils, and ordnance demilitarization. The following types of support may be needed for OE operations:

- On site visits with known or suspect OE an Abbreviated Site Specific Health and Safety Plan must be prepared. This SSHP is to be used only for non-intrusive site visits and it must be approved by the OESO, OEQCM, or the OE Market Segment Team Leader prior to the start of the field visit. All team members must read, and comply with the SSHP, and attend the safety briefings. The SSHO shall ensure the Safety Briefing Checklist and the plan acceptance forms are filled out prior to the start of the site visit.

- On a HTRW site with known or suspected OE, UXO support refers to the anomaly avoidance techniques implemented to avoid any potential surface UXO and any subsurface anomalies.
- On a construction site with known or suspected OE, UXO support is provided by qualified UXO personnel during construction activities. The level of UXO support required is dependent on the probability of encountering UXO, as determined on a project-by-project basis.
- OE response actions in which location, identification, excavation, removal, and disposal of UXO is accomplished require qualified UXO personnel, including a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist to provide oversight for UXO Teams performing operations.
- On an OE site that has OE contamination of soils and/or groundwater, UXO support may include both anomaly avoidance techniques and OE construction support for excavation and/or treatment of OE contaminated soil and groundwater.
- On ordnance demilitarization projects, OE support is required for identification, handling, disassembly, processing, certification, transportation, and treatment or disposal of munition components.
- On projects where OE waste (OEW) is transported or disposed off-range, the OE and Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.
- On projects where Ordnance Related Scrap (ORS)/Material that Presents Potential Explosive Hazard (MPPEH) or inert ordnance is recovered and processed for disposal as scrap, UXO and ECC support may determine if treatment and certification is required, along with any permitting requirements.
- Drilling activities at Potential OE Sites; if the project site is suspected of OE contamination, the UXO team will conduct a reconnaissance and OE avoidance to provide clear access routes to each site prior to drilling crews entering the area. The procedures listed in HSE-35 apply and will be implemented.
- Excavation activities at Potential OE Sites; If the project site is suspected of OE contamination, the UXO team will conduct a reconnaissance and OE avoidance to provide clear access routes to each site prior to excavation crews entering the area. The procedures listed in HSE-32 apply and will be implemented.

The CH2M HILL OESO or OEQCM will verify subcontractor training, personnel qualification, and current medical examinations prior to the start of field operations. Any identified shortfalls in qualifications should be report to the OE Market Segment Leader for resolution.

3.0 Definitions (See Attachment 4)

4.0 Project Execution

4.1 Safe Work Practices

The requirements of this section are to be followed by CH2M HILL employees who enter OE exclusion zones, regardless of the company performing OE operations. These requirements also pertain to OE subcontractor personnel.

4.2 Regulations/Industry Standards

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, CH2M HILL's project OESO or OEQCM may be required to provide oversight of an OE subcontractor. OE subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements. The following subsections provide the minimum regulatory and industry standard requirements pertaining to OE operations.

4.2.1 General Safety Concerns and Procedures

(a) OE operations including OE site visits will not be conducted until a complete plan for the site is prepared and approved by the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader. These plans will be based upon limiting exposure to the minimum number of personnel, for the minimum amount of time, to the least amount of OE consistent with safe and efficient operations.

(b) Only UXO qualified personnel will perform OE procedures. Non-UXO personnel may be used to perform OE-related procedures when supervised by a UXO Technician III. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or a Senior UXO Supervisor.

(c) Personnel who will be handling OE items will not wear outer or inner garments having static electricity-generating characteristics. Materials made of 100 percent polyester, nylon, silk, and wool are highly static producing.

(d) UXO Technicians are required to wear hard hats when an overhead hazard exist and/or when specified in the H&S plan (except when investigating suspect UXO). Hard hats may create an unsafe condition by falling off of the head of a UXO technician at a critical moment. In the event of the accidental detonation of a UXO (the worst case accident scenario), the hard hat will not protect the UXO technician from fragments and may worsen the injury by reflecting fragments into the head of the technician. This is consistent with safety guidance from the U.S. Army Corps of Engineers OE Center of Excellence. Also, protective shoes worn by personnel performing UXO operations should be constructed of nonferrous materials (e.g., fiberglass) to prevent interference with sensitive geophysical instruments.

(e) Prior to any action being performed on an ordnance item, all fuzing will be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/sheared, etc.

4.2.2 OE Safety Precautions

(a) Every effort will be made to identify a suspect OE item. Under no circumstances will any OE be moved in an attempt to make a positive identification. The OE item will be visually examined for markings and other external features such as shape, size, and external fittings. If an unknown OE item is encountered, the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader will be notified immediately. The following are additional considerations for the safe handling of OE items:

(1) Projectiles containing base detonating (BD) fuzes are to be considered armed if the round

is fired.

(2) Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.

(3) Do not depress plungers, turn vanes, rotate spindles, levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.

(4) Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE items unless the item is included in the scope of work (SOW).

(5) UXO personnel are not authorized to inert any OE items found onsite unless it is a part of the SOW.

(6) OE/UXO items will not be taken from the site as souvenirs/training aids.

(7) Civil War ordnance will be treated as any other OE.

(b) Prior to entering U.S. Army-controlled areas/ranges contaminated with Improved Conventional Munitions (ICM), an approved Department of the Army (DA) wavier must be obtained.

(c) Any time suspect chemical warfare material (CWM) is encountered during conventional OE site activities; all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of two personnel will secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the Work Plan will be immediately notified.

(d) Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.

(e) Consider OE items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than their original state.

(f) Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

(g) Avoid approaching the forward area of an OE item until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped charge munitions contain piezoelectric (PZ) fuzing system until identified. PZ is extremely sensitive. It can function at the slightest physical change and can remain hazardous for an indefinite period of time.

(h) Approach an unfired rocket motor from the side at a 45-degree angle. Accidental ignition can cause a missile hazard and hot exhaust.

(i) Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources.

(j) Consider an emplaced landmine armed until proven otherwise. It may be intentionally boobytrapped to deceive.

(k) Assume that practice OE contains a live charge until it can be determined otherwise. Expended pyrotechnic and practice devices can contain red or white phosphorous residue. Due to incomplete combustion, the phosphorous may reignite if the crust is broken and exposed to air.

(l) Do not approach a smoking white phosphorous (WP) munition. Burning WP may detonate the explosive burster charge at anytime.

(m) Foreign ordnance was returned to the United States for exploitation and subsequent disposal. Every effort must be made to research the applicable documentation and publications prior to commencement of a project.

4.2.3 OE Storage

(a) During OE projects, explosive storage falls into two categories, on-DOD installations and off-DOD installations.

(b) For On-DOD installations the provisions of DOD 6055.9-STD will be followed.

(c) In the event the installation does not have an existing storage facility, the provisions of DOD 6055.9-STD will apply.

(d) For Off-DOD installations, establish a temporary explosive storage area that will meet all local, state, and 27 CFR, Bureau of Alcohol Tobacco, and Firearms (BATF) requirements and as much of DOD 6055.9-STD as is practical to implement. The establishment of a temporary explosive storage area must meet the following requirements:

(1) The area will, if possible, meet the inhabited building and public traffic route distances specified in DOD 6055.9-STD. If the distances are less than required by the DOD guidance, a proposed barricading plan to protect the public from accidental detonation must be developed and reviewed by the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader.

(2) Magazines must meet the requirements of the BATF regulations, and each magazine must have a Net Explosive Weight (NEW) established for the explosives to be stored.

(3) Each magazine must be grounded as specified in NFPA 780 and must meet the intermagazine distances as defined in the DOD guidance.

(4) A physical security survey will be conducted to determine if fencing or guards are required. This survey will be coordinated through the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader and local law enforcement agencies.

(5) A fire plan for either on- or off-installation explosive storage areas will be prepared and coordinated through the CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader and the local fire department. All magazines will have placards.

(e) OE Waste (OEW) may be stored: (1) in RCRA regulated units (i.e., tanks, containers, containment buildings, etc.) as described in HSE-80; (2) in military magazines conforming to DDESB standards (as described above); or (3) under the MMR conditional exemption (40 CFR

266.205). The MMR conditional exemption applies to military non-chemical munitions, and the following procedures must be met:

(1) Follow DDESB requirements for storage.

(2) Notify EPA of the location of the unit within 90 days of when storage unit first is used for waste munitions storage.

(3) Notify EPA within 24 hours of any loss or theft of munitions from the storage area.

(4) Inventory wastes annually, conduct inspections quarterly and keep records for at least three years.

(5) Limit access to the area to appropriately trained and authorized personnel.

4.2.4 OE Transportation

In the event that OE items must be transported offsite, the provisions of 49 CFR, DA Pam 385-64 state and local laws must be followed. These additional considerations are provided for the safe transport of OE items:

(a) Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

(b) If loose pyrotechnic, tracer, flare, or similar mixtures are to be transported, they will be placed in #10 mineral oil or equivalent to minimize the fire and explosion hazards.

(c) Incendiary loaded munitions should be placed on a bed of sand and covered with sand to help control the burn if a fire should start.

(d) If a base-ejection projectile must be transported to a disposal area, the base will be oriented in the vehicle so that it is parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

(e) OE with exposed hazardous fillers such as high explosives (HE), will be placed in appropriate containers with packing materials to prevent migration of the hazardous fillers. Padding should be added to protect the exposed filler from heat, shock, and friction.

4.2.5 OE Exclusion Zone Operations

On OE project sites, it is the responsibility of the UXOSO to establish the exclusion zone for each UXO team. This exclusion zone should not be confused with the safe separation distance that is maintained between teams.

(a) The purpose of the exclusion zone is for the protection of nonessential project personnel and the public from blast overpressure and fragmentation hazards. There are two criteria for calculating exclusion zones:

(1) Intentional Detonations. When destroying ordnance, both the hazards from fragmentation and overpressure must be considered. The minimum separation distances in DOD 6055.9-STD will also be used unless otherwise stated.

(2) Unintentional Detonations. If the identification of OE on an OE site is unknown, the

minimum separation specified in DOD 6055.9-STD, Chapter 5, Paragraph C5.5.4, will be used to establish the exclusion zones.

(b) When multiple teams are working onsite, a safe separation distance will be established. The minimum distance maintained between teams will never be less than 200 feet or the K50 overpressure distance. The one that is greater will be used.

(c) While OE operations are being conducted, only personnel essential for the operation will be allowed in the exclusion zone. When nonessential personnel enter the exclusion zone, all OE operations will cease. In addition to this work stoppage, the following actions will be accomplished:

(1) The individuals must receive a safety briefing and sign the visitors' log prior to entering the zone.

(2) The individuals will be escorted by a UXO qualified individual.

(3) All OE operations will cease within the radius of the exclusion zone for the areas to be visited.

(d) All personnel working within the exclusion zone must comply with the following:

(1) There will be no smoking within the exclusion zone, except in areas designated by the UXOSO.

(2) There will be no open fires for heating or cooking within the exclusion zone, except where authorized by the UXOSO.

(3) During magnetometer operations, workers will have no metal parts in or on their shoes that would cause the magnetometer to present false indications.

4.2.6 OE Excavation Operations

(a) Hand excavation is the most reliable method for uncovering OE, provided the item is near the surface. Hand excavation exposes personnel to the hazard of detonation for longer periods of time than any other method. Taking this into consideration, only UXO qualified personnel will be used to accomplish this task.

(b) Earth-Moving Machinery (EMM) may be used to excavate overburden from suspected OE. EMM will not be used to excavate within 12 inches of a suspected OE. Once the EMM is within 12 inches of the OE, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate EMM only when supervised by a UXO Technician III.

(1) If more than one EMM is to be used onsite, the same minimum separation distances required for multiple work teams applies.

(2) EMM operations will be conducted within the guidelines of HSE-32 "Excavations."

(c) Excavation operations, whether by hand or EMM, will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over the suspected OE.

4.2.7 OE Disposal Operations

To avoid MMR regulation, all demolition operations will be conducted on-range in accordance with TM/EODB 60A 1-1-31. Any deviation from this policy must be approved by the OESO and ECC. The following are on-range disposal procedures.

(a) As a general rule, all demolition operations will be accomplished by use of shock tubing or electrical means to assure maximum safety. There are exceptions to this requirement in situations where static electricity of EMR hazards are present.

(b) The only acceptable disposal method is the one stated in the appropriate TM/EODB 60-series manual for specific ordnance types. Any commercial explosives being used will be equivalent to the military explosive required for the disposal operation.

(c) If a situation dictates, protective measures to reduce shock, blast overpressure, and fragmentation will be taken. The CH2M HILL OESO, OEQCM, or the OE Market Segment Team Leader will assist in any design work and must review and approve all proposed protective works. As a minimum requirement, all demolition shots will be tamped with clean earth or sand. In accordance with DOD 6055.9-STD the following separation distances will be observed unless otherwise directed:

(1) Minimum separation distance for nonfragmenting explosive materials will be no less than 1,250 feet.

(2) Minimum separation distance for fragmenting explosive ordnance will be no less than 2,500 feet. For bombs and projectiles with a diameter of 5 inches or greater, use a minimum distance of 4,000 feet.

(3) Ordnance items with lifting lugs, strong backs, base plates, etc., will be oriented away from personnel, as fragments from these items tends to travel farther than normal.

(d) Once demolition operations are completed, a thorough search of the demolition area will be conducted with a magnetometer to ensure a complete disposal was accomplished.

(e) Inert ordnance will not be disposed of for scrap until the internal fillers/voids have been exposed and unconfined. Heat generated during the reclamation process can cause the inert fillers, moisture, or air to expand and burst the sealed casings. In this situation, Oil Well Perforators can be used for venting these ordnance items that require demilitarization.

(f) Inert ordnance to be disposed of as scrap may require certification by the UXOSO and a government representative. This may require further treatment by operation of a portable incinerator, depending on local requirements and acceptance criteria. The UXOSO and ECC will determine if certification and incineration is necessary, along with any permitting requirements during project planning.

4.2.8 Donovan Blast Chamber (DBC) Operations

Donovan Blast Chamber (DBC). A controlled detonation chamber capable of repeated controlled detonations of a suite of energetic materials that are currently demilitarized by Open Burn/Open Detonation (OB/OD). This offers the Department of Defense (DoD) an alternative to OB/OD while at the same time increasing throughput, efficiencies, safety,

and controlling air, soil, water, and noise pollution. The Donovan Blast Chamber system meets all State and Federal air discharge regulations. DBC operations are found in attachment 3.

4.2.9 OEW Disposal

When the used or fired munition is managed off-range (i.e., transported off-range and stored, reclaimed, treated or disposed) or disposed of on-range (i.e., buried without treatment), it is subject to regulation as a solid waste under RCRA. This means it may also be subject to regulation as a hazardous waste. Also, munitions that land off-range, and that are not promptly retrieved, are solid wastes. Table 4-1 describes how solid wastes may be characterized as hazardous in these situations. All characterization must be based on field observations by the OESO, OEQCM, or OE Market Segment OE Team Leader who is trained in the proper identification of waste ordnance items and meet the requirements for an "emergency response expert" under RCRA. In the event the OEW is regulated as hazardous waste, refer to the Hazardous Waste Management SOP, HSE-80 for RCRA hazardous waste management requirements. Attachment 6 provides guidance for Ordnance Related Scrap (ORS) Metal Collection and Inspection Procedures.

Table 4-1. Waste Characterization

Item	Characterization	Waste Code
Uncontaminated Metal Debris	If visual inspection determines if item does not contain waste residue, waste is non-hazardous scrap metal, excluded from RCRA regulation under 40 CFR 261.6(a)(3). Waste may be subject to further incineration and certification requirements.	None
Contaminated Metal Debris	If visual inspection determines item contains hazardous waste residue, manage as potential hazardous waste.	Potential D003 and/or D008
Ordnance Items Less than 0.50 Caliber	Small-arms ammunition is not considered reactive hazardous waste in accordance with EPA policy (November 30, 1984 Memorandum, John Skinner, OSWER Director).	None
Ordnance Items Greater than 0.50 Caliber	Untreated UXO presumed to be reactive hazardous waste using generator knowledge under 40 CFR 261.23.	D003
Ordnance Items Greater than 0.50 Caliber with Lead Projectiles[BR1]	Ordnance containing lead projectiles will be presumed to be toxic hazardous waste under 40 CFR 261.24.	D008

4.2.10 Forms/Permits

(a) **Type-33 User of High Explosives License/Permit** issued by the Bureau of Alcohol Tabacco and Firearms (ATF) is required for the purchase, storage, and use of high explosives (HE) in support of OE operations, construction projects, and demolition and disposal (D&D) projects. Written authorization designating the individuals who can purchase, store, or use explosives must be included in the site-specific work plans. Authorization is provided by the OE Market Segment Team Leader.

(b) **Type-20 Manufacturer of High Explosives License/Permit** issued by the ATF is required for on-site use of binary explosives in support of OE operations, construction projects, and demolition and disposal (D&D) projects. Written authorization designating the individuals who can use binary explosives must be included in the site-specific work plans. Authorization is provided by the OE Market Segment Team Leader.

(c) **State and Local Explosive Permits** may be required for the purchase, storage, and use of HE in support of OE operations, construction projects, and D&D projects.

4.2.11 Self-Assessment Checklists

The "HS&E Self-Assessment Checklist—OE Operations" found in Attachment 2 is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to OE operations. CH2M HILL's project OESO/ OESO OEQCM shall use this checklist when: (1) CH2M HILL employees are potentially exposed to hazards associated with OE operations, and/or (2) CH2M HILL oversight of an OE subcontractor is required. The OESO or OEQCM shall specify the frequency in which this checklist shall be completed and provide this information in the project's written safety plan. Completed checklists shall be sent to the OESO or OEQCM for review. The OESO shall assist the Site UXOSO in resolving any deficiencies identified during the self-assessment.
CH2M HILL Regional Safety Directors may periodically assist the OESO with safety audits and the "HS&E Self-Assessment Checklist—OE Operations".

Attachments

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations
Attachment 2: HS&E Self-Assessment Checklist for OE Operations
Attachment 3: Donovan Blast Chamber (DBC) Operations
Attachment 4: HS&E Self-Assessment Checklist for DBC Operations
Attachment 5: HS&E Glossary and Abbreviations for OE Operations
Attachment 6: Ordnance Related Scrap (ORS) Metal Collection and Inspection Procedures
Attachment 7: Abbreviated Site Safety and Health Plan (ASSHP)

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Ordnance Explosives (OE)
Standard of Practice HSE-91

Attachment 2: HS&E Self-Assessment Checklist—OE Operations

HS&E Self-Assessment Checklist - ORDANCE EXPLOSIVES (OE)

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI. The Safety Coordinator (SC) position must be filled by a qualified UXO technician to provide field assessment of OE activities.

This checklist is to be used at locations where: 1) CH2M HILL employees are involved with OE activities (complete entire checklist). 2) CH2M HILL oversight of an OE subcontractor is required (complete entire checklist).

UXOSO's may consult with OE subcontractors when completing this checklist, but shall not direct the means and methods of OE operations nor direct the details of corrective actions. OE subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Appendix B
Risk Assessment Screening Criteria

Method and Target List	Reporting	Limit	Laboratory Specific MDLs		Screening Criteria			
Semivolatiles CLP OLMO4.2, LL-LOCO3.2	**ug/Kg**	**ug/L**	**Solid mg/kg**	**Aqueous ug/L**	**Soil mg/kg**	**Sediment mg/Kg**	**Groundwater ug/L**	**Surfacewater ug/L**
1,1'-Biphenyl	330	5	0.0022	1.03	35		30.42	
Acenaphthene	330	5	0.0019	0.28	20	0.016	36.50	
Acenaphthylene	330	5	0.0022	0.24				
Acetophenone	330	5	0.0031	0.848				
Anthracene	330	5	0.0021	0.34	10,000		182.50	
Atrazine	330	5	0.0037	0.646	7.8		0.30	
Benzaldehyde	330	5	0.0048	0.919	6156		365.00	
Benzo(a)anthracene	330	5	0.0026	0.24	2.1		0.09	
Benzo(a)pyrene	330	5	0.0021	0.22	0.21	0.43	0.01	
Benzo(b)fluoranthene	330	5	0.0016	0.24	2.1		0.09	
Benzo(g,h,i)perylene	330	5	0.0019	0.26				
Benzo(k)fluoranthene	330	5	0.0017	0.38	21.1		0.92	
bis(2-Chloroethoxy) methane	330	5	0.0026	0.36				
bis(2-Chloroethyl)ether	330	5	0.0033	0.34	0.55		0.01	
bis(2-Chloroisopropyl)ether	330	5	0.0033	0.22	7.4		0.27	
bis(2-Ethylhexyl)phthalate	330	5	0.0031	5.99	123		4.80	
Bromophenyl phenyl ether, 4-	330	5	0.0028	0.26				
Butyl benzyl phthalate	330	5	0.006	0.65	10,000		729.99	
Caprolactam	330	5	0.011	0.295	10,000		1824.97	
Carbazole	330	5	0.003	0.25	86.2		3.36	
Chloro-3-methylphenol, 4- (p-Chloro-m-cresol)	330	5	0.0031	0.82				
Chloroaniline, 4-	330	5	0.0025	0.35	246		14.60	
Chloronaphthalene, 2-	330	5	0.0022	0.42			48.67	
Chlorophenol, 2-	330	5	0.0027	0.31	23.6		3.04	
Chlorophenyl-phenyl ether, 4-	330	5	0.0022	0.36				
Chrysene	330	5	0.002	0.31	211		9.21	
Dibenz(a,h)anthracene	330	5	0.0029	0.56	0.21		0.01	
Dibenzofuran	330	5	0.002	0.22	313		2.43	
Dichlorobenzidine, 3,3'-	670	5	0.0041	1.22	3.8		0.15	
Dichlorophenol, 2,4-	330	5	0.0036	0.3	185		10.95	
Diethyl phthalate	330	5	0.002	0.38	100		2919.91	
Dimethyl phthalate	330	5	0.002	0.34	10,000		36486.68	
Dimethylphenol, 2,4-	330	5	0.0027	0.44	1231		73.00	
Di-n-butyl phthalate (Dibutyl phthalate)	330	5	0.0017	0.26	200		365.00	
Dinitro-2-methylphenol, 4,6-	990	20	0.052	0.81				
Dinitrophenol, 2,4-	990	20	0.0047	1.27	20		7.30	
Dinitrotoluene, 2,4-	330	5	0.0035	0.7	123		7.30	
Dinitrotoluene, 2,6-	330	5	0.0084	0.81	61.6		3.65	
Di-n-octyl phthalate	330	5	0.0017	3	2462		146.00	
Fluoranthene	330	5	0.0018	0.22	2200	0.6	146.00	
Fluorene	330	5	0.0018	0.36	2628		24.33	
Hexachlorobenzene	330	5	0.0029	0.38	1.1		0.04	
Hexachlorobutadiene	330	5	0.0033	1.1	22.1		0.86	
Hexachlorocyclopentadiene	330	5	0.0022	0.49	10		21.90	
Hexachloroethane	330	5	0.0035	1	123		4.80	
Indeno(1,2,3-cd)pyrene	330	5	0.0034	0.26	2.1		0.09	
Isophorone	330	5	0.0029	1.2	1814		70.77	
Methylnaphthalene, 2-	330	5	0.0027	0.28				

Method and Target List	Reporting	Limit		Laboratory Specific MDLs			Screening Criteria			
Methylphenol, 2- (o cresol)	330	5		0.0033	0.72		3078		182.50	
Methylphenol, 4- (p cresol)	330	5		0.0032	0.28		308		18.25	
Naphthalene	330	5		0.0029	0.25		18.8	0.16	0.62	
Nitroaniline, 2- (o-)	990	20		0.0019	0.3		1.8		0.10	
Nitroaniline, 3- (m-)	990	20		0.0025	0.45					
Nitroaniline, 4- (p-)	990	20		0.0018	0.46					
Nitrobenzene	330	5		0.0022	0.34		10.3		0.34	
Nitrophenol, 2-	330	5		0.0024	0.7					
Nitrophenol, 4-	990	20		0.0077	3.73		7			
Nitrosodiphenylamine, n-	330	5		0.0025	0.34		352		13.72	
n-Nitroso-di-n-propylamine	330	5		0.0022	0.28		0.25		0.01	
Pentachlorophenol	990	20		0.0031	1.32		3		0.56	7.9
Phenanthrene	330	5		0.0017	0.26			0.24		
Phenol	330	5		0.0031	0.25		30		2189.95	
Pyrene	330	5		0.0022	0.54		2913	0.66	18.25	
Trichlorophenol, 2,4,5-	990	20		0.0028	0.39		9		365.00	
Trichlorophenol, 2,4,6-	330	5		0.0039	0.57		4		0.36	
Volatiles - CLP SOW (OLMO4.2)	**Soil ug/kg**	**Water ug/L**								
1,1,1-Trichloroethane (1,1,1-TCA)	10	0.5		0.000067	0.26		120		317.17	
1,1,2,2-Tetrachloroethane	10	0.5		0.000047	0.17		0.93		0.06	
1,1,2-Trichloro-1,2,2-trifluoroethane	10	0.5		0.000089	0.27					
1,1,2-Trichloroethane (1,1,2-TCA)	10	0.5		0.000054	0.22		1.6		0.20	
1,1-Dichloroethane (1,1-DCA)	10	0.5		0.000069	0.14		174		81.11	
1,1-Dichloroethylene (1,1-DCE)	10	0.5		0.000077	0.22		41.3		33.88	
1,2,4-Trichlorobenzene	10	0.5		0.000062	0.14		20		19.44	
1,2-Dibromo-3-chloropropane	10	0.5		0.000061	0.36		2		0.05	
1,2-Dibromoethane	10	0.5		0.000072	0.21		0.028		0.00	
1,2-Dichlorobenzene	10	0.5		0.000053	0.14		37		37.01	
1,2-Dichloroethane (1,2-DCA)	10	0.5		0.000041	0.21		0.6		0.12	
1,2-Dichloropropane	10	0.5		0.000049	0.16		0.74		0.16	
1,3-Dichlorobenzene	10	0.5		0.00006	0.17		6.3		0.55	
1,4-Dichlorobenzene	10	0.5		0.000051	0.15		7.9		0.50	
2-Butanone (MEK)	10	5		0.00027	1		2710			
2-Hexanone	10	5		0.00012	0.31					
4-Methyl-2-pentanone (MBK)	10	5		0.00013	0.42		284			
Acetone	10	5		0.00028	1.9		604		60.83	
Benzene	10	0.5		0.000058	0.14		1.3		0.34	
Bromodichloromethane	10	0.5		0.000058	0.15		1.8		0.18	
Bromoform	10	0.5		0.000061	0.16		218		8.51	
Bromomethane	10	0.5		0.000077	0.44		1.3		0.87	
Carbon disulfide	10	0.5		0.000065	0.28		72		104.29	
Carbon tetrachloride	10	0.5		0.00008	0.22		0.55		0.17	
Chlorobenzene	10	0.5		0.000044	0.14		40		10.61	
Chloroethane	10	0.5		0.000058	0.35		6.5		4.64	
Chloroform	10	0.5		0.000055	0.13		11.7		6.17	
Chloromethane	10	0.5		0.000056	0.17		2.6		1.51	
cis-1,2-Dichloroethene	10	0.5		0.000077	0.18		14.6			
cis-1,3-Dichloropropene	10	0.5		0.000048	0.19					
Cyclohexane	10	0.5		0.000069	0.19		14		3467.50	

Method and Target List	Reporting	Limit	Laboratory Specific MDLs		Screening Criteria			
Dibromochloromethane	10	0.5	0.000041	0.24	2.6		0.13	
Dichlorodifluoromethane	10	0.5	0.000071	0.23	30.8		39.46	
Ethylbenzene	10	0.5	0.000055	0.15	19.5		2.91	
Isopropylbenzene	10	0.5	0.00007	0.12				
Methyl acetate	10	0.5	0.00012	0.24	9153		608.33	
Methyl tert-Butyl ether	10	0.5	0.000058	0.18	157		13.31	
Methylcyclohexane	10	0.5	0.000066	0.19			521.72	
Methylene chloride	10	0.5	0.00008	0.13	20.5		4.28	
Styrene	10	0.5	0.000044	0.16	170		164.11	
Tetrachloroethylene (PCE)	10	0.5	0.000086	0.22	3.4		0.66	
Toluene	10	0.5	0.000051	0.11	52		72.34	
Total xylenes	10	0.5	0.00015	0.31	42		21.00	
trans-1,2-Dichloroethene	10	0.5	0.000063	0.14	23.5			
trans-1,3-Dichloropropene	10	0.5	0.000043	0.17				
Trichloroethene (TCE)	10	0.5	0.000057	0.21	0.11			
Trichlorofluoromethane	10	0.5	0.00008	0.28	200		128.82	
Vinyl Chloride	10	0.5	0.000071	0.19	0.75		0.02	
Pesticides and PCB's - CLP SOW (OLMO4.2)	**Soil ug/kg**	**Water ug/L**						
4,4'-DDD	3.3	0.02	0.00013	0.04	10		0.28	
4,4'-DDE	3.3	0.02	0.000054	0.056	7		0.20	
4,4'-DDT	3.3	0.02	0.00019	0.044	7	0.0016	0.20	0.001
Aldrin	1.7	0.01	0.0001	0.02	0.1		0.00	
alpha-BHC	1.7	0.01	0.00011	0.012	0.36			
alpha-Chlordane	1.7	0.01	0.00011	0.022				0.004
Aroclor-1016	33	1	0.0011	0.02	21.2		0.96	0.014
Aroclor-1221	67	0.2	0.001	0.43	0.74		0.03	0.014
Aroclor-1232	33	0.4	0.0013	0.3	0.74		0.03	0.014
Aroclor-1242	33	0.2	0.00065	0.38	0.74		0.03	0.014
Aroclor-1248	33	0.2	0.00045	0.27	0.74		0.03	0.014
Aroclor-1254	33	0.2	0.00042	0.15	0.74		0.03	0.014
Aroclor-1260	33	0.2	0.00048	0.02	0.74		0.03	0.014
beta-BHC	1.7	0.01	0.00006	0.018	1.3			
delta-BHC	1.7	0.01	0.000072	0.058				
Dieldrin	3.3	0.02	0.000036	0.038	0.11		0.00	0.0019
Endosulfan I	1.7	0.01	0.000069	0.043	369			0.0087
Endosulfan II	3.3	0.02	0.000047	0.018				0.0087
Endosulfan sulfate	3.3	0.02	0.00025	0.022				
Endrin	3.3	0.02	0.000088	0.044	18.5		1.09	0.0023
Endrin aldehyde	3.3	0.02	0.00018	0.051				
Endrin ketone	3.3	0.02	0.00019	0.034				
gamma-BHC (Lindane)	1.7	0.01	0.00011	0.019	1.7			
gamma-Chlordane	1.7	0.01	0.00011	0.025	6.5			0.004
Heptachlor	1.7	0.01	0.0001	0.022	0.38		0.01	0.0036
Heptachlor epoxide	1.7	0.01	0.000078	0.025	0.19		0.01	0.0036
Methoxychlor	17	0.1	0.00026	0.03	308		3.65	0.03
PCBs - Total			0.0013	0.43	0.371	0.023	0.034	
Toxaphene	170	0.01	0.00056	0.31	1.6			0.0002
Explosives - SW846 8330	**Soil ug/kg**	**Water ug/L**						

Method and Target List	Reporting	Limit	Laboratory Specific MDLs		Screening Criteria			
1,3,5-Trinitrobenzene	250	5	0.12	0.11	1847			
1,3-Dinitrobenzene	250	5	0.064	0.13	6.2			
2,4,6-Trinitrotoluene	250	5	0.088	0.18	57.5			
2,4-Dinitrotoluene	250	5	0.12	0.59	2.5			
2,6-Dinitrotoluene	250	5	0.099	0.73	2.5			
2-Nitrotoluene	250	5	0.11	0.49	100			
3-Nitrotoluene	250	5	0.071	1	100			
4-Nitrotoluene	250	5	0.068	0.56	100			
Hexahydro-1,3,5-trinitro-1,3,5-triazine	250	5	0.058	0.32			0.61	
Methyl-2,4,6-trinitrophenylnitramine	250	5	0.14	0.63				
Nitrobenzene	250	5	0.13	0.26	10.3		0.34	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	250	5	0.08	0.69			182.50	
Perchlorates (EPA 314.0 and 314.0M)	100	20			102		3.65	
Metals - CLP SOW (ILMO5.2)	**Soil ug/kg**	**Water ug/L**						
Aluminum	40	200	3.75	14.6	10,000		3649.87	
Antimony (RL may be lower for 7041 method)	12	60	0.104	1.97	5		1.46	
Arsenic	2	10	0.162	0.855	1.6	8.2	0.04	36
Barium	40	200	0.027	0.191	283		255.50	
Beryllium	1	5	0.0165	0.158	10		7.30	
Cadmium	1	5	0.0156	0.228	4	1.2	1.82	0.25
Calcium	1000	5000	4.47	25.5				
Chromium	2	10	0.037	0.566	0.4	81		74
Cobalt	10	50	0.0551	0.577	20		73.00	
Copper	5	25	0.157	0.74	60	34	146.00	3.1
Iron	20	100	3.13	14	10,000		1094.99	1000
Lead	0.6	3	0.146	1.43	40.5	47	0.00	2.5
Magnesium	1000	5000	4.51	7.62				
Manganese	3	15	0.0447	0.274	1946		87.60	
Mercury	0.04	0.2	0.00211	0.0162	0.00051	0.15	1.09	0.77
Nickel	8	40	0.0561	0.651	30	21	73.00	8.2
Potassium	1000	5000	5.04	55.2				
Selenium	1	5	0.286	2	0.21		18.25	5
Silver	2	10	0.0677	0.325	2		18.25	
Sodium	1000	5000	2.73	9.1				
Thallium	2	10	0.133	2.9	1		0.24	
Vanadium	10	50	0.0242	1.26	2		25.55	
Zinc	4	20	0.276	2.52	8.5	150	1094.99	81
General Chemistry		**Water ug/L**						
Anions by EPA 300.0								
Sulfate		1		500				
Chloride		1		200				
Nitrate		1		50			1000.00	
Nitrite		1		50			100.00	
Orthophosphate		1		20				
Alkalinity by EPA 310.1				1000				20,000
Bicarbonate		5		calculation				

Method and Target List	Reporting	Limit		Laboratory Specific MDLs			Screening Criteria			
Carbonate		5			calculation					
Hydroxide		5			calculation					
Soil and Groundwater Screening Criteria										
from EPA Region 9 October 2002 PRG (HI 0.1)										
Surface Water - National Recommended Water										
Quality Criteria: 2002 USEPA Office of Water										
November 2002, EPA-822-R-02-047										
Sediment - Long, E.R., D.D. MacDonald, S.L. Smith										
and F.D. Calder, 1995 Incidence of Adverse										
Biological Effects Within Ranges of Chemical										
Concentrations in Marine and Estuarine										
Sediments. Environmental Management 19 (1): 81-97										
Low Level Organic CLP SOW - OLCO3.2										

Appendix C
Geophysical Investigation Plan

APPENDIX C

Geophysical Investigation Plan

C.1 Geophysical Plan

This document details the geophysical plan in support of OE detection activities for the area identified as OB/OD Site Former AFWTF on the island of Vieques in Puerto Rico. This action is authorized by the U.S. Navy (Navy Clean Prime Contract N62470-95-D-6007) and CH2M HILL.

C.2 Personnel Qualifications

Data acquisition will be conducted by a well-trained, experienced two-person crew led by a qualified geophysicist. All geophysical support subcontractor personnel onsite will have documentation of 40-hour OSHA certification, any necessary re-certification (8-hour refresher), and OSHA-compliant medical monitoring physical exams. Throughout operations, the geophysical support subcontractor will strictly adhere to the following general practice. All work to be conducted is non-intrusive. Personnel will practice avoidance in the unlikely event that MEC is encountered.

C.3 Geophysical Investigation Plan Outline

The objectives of the geophysical work are 1) geophysical instrument prove-out and evaluation, 2) geophysical mapping of 25 acres, which includes the creation of target maps and dig-sheets and, 3) anomaly reacquisition utilizing the same geophysical instrumentation and temporary markers (i.e. pin flag, paint, or other semi-permanent markers).

C.3.1 Geophysical Prove Out

The initial phase of the investigation will be an evaluation of the proposed geophysical instrumentation. An established "prove-out" area, consistent with the local site conditions, will be seeded with known items and used by the geophysical support subcontractor for the evaluation. The qualified two-person geophysical team will separately employ an inductively coupled metal detector (EM-61) followed by a cesium-vapor total field magnetometer (Scintrex Smartmag SM-4), in conjunction with a base station magnetometer, across the entire prove-out area using the same survey techniques to be exercised for the investigation. Upon evaluation of the data, including the terrain and target item responsiveness, the best-suited instrument will be selected for the investigation.

C.3.2 Geophysical Mapping

The area to be investigated is described as having a dense shrub canopy that will be removed using mechanized de-vegetation techniques. The areas of concern (AOC) will be established as individual 200-foot by 200-foot grids cells to cover approximately 25 acres

(1 acre=200 ft x 200 ft). Immediate surface culture (i.e., metallic debris, obstructions, etc…) will be removed prior to the start of the geophysical investigation.

C.3.3 Anomaly Reacquisition

Target anomalies will be re-acquired by the geophysical contractor using the GPS system where appropriate. Coordinate locations of each targeted anomaly will be uploaded into the rover, which will be used to navigate or re-occupy the point where a temporary mark will be placed. Reacquisition of target locations where no GPS coverage exists will be conducted using tape measures pulled from corner stakes to locate the interpreted local x,y coordinate position listed for each target on the dig sheet. Each reacquired target location will be marked with a pin flag labeled with the anomaly's identifying number as specified on the dig sheet.

Using the same geophysical equipment as was originally used, the reacquisition crew will then refine the location of the anomaly. This will be accomplished by collecting readings in continuous mode while slowly maneuvering the instrument over the anomaly, searching for the peak response. The pin flag will be moved to the refined location and the offset will be documented.

C.4 Geophysical Instrumentation

C.4.1 Electromagnetics

The Geonics EM61 metal detector is a time domain instrument that detects both ferrous and non-ferrous metallic objects. A transmitter current pulse in a 1meter by ½ meter transmitter coil 40 cm above the ground generates a primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field that is measured by sampling induced voltages in two receiver coils (bottom coil co-planar with transmitter, and top coil 40cm higher). The measured responses are recorded in an integrated data logger. The EM61 coil dimensions are newly designed from the original square meter by meter coils to reportedly increase the sensitivity to smaller metallic items.

C.4.2 Total Field Magnetics

The Scintrex cesium vapor magnetometer is well suited for the detection of ferrous munitions. The magnetic method measures variations in the earth's magnetic field. Localized variations or distortions in the magnetic field can be identified and interpreted as subsurface ferro-magnetic objects. A Scintrex Envimag proton precession magnetometer (or equivalent) will be operated as a base-station to measure diurnal changes in the earth's magnetic field during times of field data acquisition. The base station instrument will remain stationary while recording continuous readings at five-second intervals. Diurnal variation observed in the base station data during total field magnetic data acquisition is removed with Geosoft's Magbase software, which is used to match the time stamps of the two magnetometers and subtract the base value.

A review of all raw data and initial editing procedures will be performed in the field using appropriate software. Once satisfied with the data quality (i.e. line path coverage, data

density, positioning, etc…), it will then be electronically transferred to a workstation for final processing and interpretation using Geosoft® Oasis Montaj software.

C.5 Location Surveying, Mapping, and Navigation

Wooden hubs or stakes will be set on 200-foot corners throughout the area of investigation to serve as control. Using the emplaced control points, the geophysical crew will establish a grid for data collection. Where practical, positional data will be collected from an Ashtech Z-FX Surveyor RTK (Real Time Kinematic) GPS system. A GPS base station (also utilizing an Ashtech Z-FX receiver) will be set up on an established control point, and real time corrections broadcast to the roving GPS unit via a radio link. This system provides positional updates at a rate of 1 Hz, with an accuracy of 3-cm horizontal, 5-cm vertical, when no less than 5 satellites are available. The roving GPS antenna may be mounted in the center of the coils to track the EM-61 or, in areas where limited coverage exists due to terrain or vegetation, the rover may be used to locate survey cell corners for data conversions and interpolation from a local coordinate system. In areas that exhibit inadequate GPS coverage, highly accurate data positioning will be maintained through the use of color-coded ropes placed across the area of investigation to assist in straight-line profiling, and for the placement of fiducial marks within the data sets. This method will serve as a backup to GPS and be used when GPS technology is adversely affected by local vegetation or topographic conditions.

C.6 Instrument Standardization/Quality Control

Geophysical instruments will be field tested daily to ensure that they are operating properly. If the standard response cannot be attained, the instrument will be re-calibrated, repaired, or replaced. The following procedures will be conducted each day:

1. The instruments will be positioned at the same location each morning, and readings will be collected for no less than one minute. The data from this "static test" will be evaluated for consistency and repeatability. A uniform target item will be placed on the ground surface, in the center of the EM-61 coil, or directly under the magnetometer sensor. The instrument response to the item will be checked against the previous daily static tests to ensure that the instruments are functioning properly, as evidenced by a consistent response.

2. Upon completion of the static test, the selected geophysical instrument will be used to measure and record at least one standard calibration test line (located in pre-existing prove-out) over known inert OE items each morning prior to use. The same test line will be re-surveyed upon completion of the daily data acquisition. Peak anomalous readings over the OE items will be evaluated for consistency immediately after the data is collected.

3. Additionally, data collection over at least 4 percent of each survey cell will be repeated for direct comparison of amplitude response and positioning. If consistent response or positioning cannot be attained, the instrument will be re-calibrated, repaired, or replaced.

C.7 Data Processing and Analysis

The raw data is gridded and displayed on the screen as a color contour image with the track plot overlaid on the map. The purpose of this initial exercise is to assess the positioning and density of the data.

Geophysical data processing will include the following procedures:

1. Conversion of local grid coordinates to Puerto Rico State Plane coordinates
2. Diurnal Drift Correction (magnetics)
3. Heading corrections
4. Lag corrections
5. Normalization or leveling (removal of background)
6. Gridding of data
7. Digital filtering and enhancement
8. Calculating the 3D analytic signal from the magnetic data
9. Gridding of analytic signal
10. Selection of anomaly picks (above an appropriate threshold)
11. Preparation of geophysical maps and target maps

C.7.1 Quantitative Interpretation and Dig Sheet Development

Geophysical anomalies (or targets) will be identified from the processed data. For each grid, the geophysical subcontractor will assess each of the following factors prior to selecting anomalies (or targets):

1. The local background (terrain noise) conditions
2. An evaluation of data completeness and accuracy
3. An assessment of data quality based on the survey and grid QC data
4. The grid boundary conditions, utilities and/or other cultural features present, and unsurveyable areas (trees, buildings, etc.)
5. A delineation of the extent and boundaries of pits and trenches (anomaly lists will not be generated for extensively large areas of anomalous response).

C.7.2 Dig Sheets

The geophysical contractor will, using a qualified geophysicist, analyze the geophysical data for each OE removal grid, identify anomalies that may represent buried MEC, and prepare anomaly lists containing the following information:

1. Project site

2. Geophysical contractor
3. Responsible geophysicist
4. Grid identification
5. Grid corner locations and coordinates
6. Unique anomaly identification numbers
7. Predicted anomaly easting & northing in State Plane coordinates
8. Instrument peak value at each anomaly location

The dig-sheets will be prioritized and anomalies deemed more likely to be MEC, will be ranked higher than anomalies less likely to be MEC. The criteria for selecting and locating anomalies for the anomaly (or target) list include the following items:

1. The maximum amplitude of the response with respect to local background conditions
2. The lateral extent (width) of the response
3. The 3-dimensional shape of the response
4. The location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid
5. The shape and amplitude of the response with respect to the response of known targets buried in the geophysical prove-out test plot
6. The shape and amplitude of the response with respect to relevant anomalies encountered in previous OE removal grids
7. The apparent depth of the anomaly
8. Potential distortions in the response due to interference from nearby cultural features; any instrument or grid survey QC that could affect the analysis.

C.7.3 Grid Maps

The geophysical contractor will also provide, with each dig sheet, a grid map, which contains the following:

1. Grid identification
2. Grid corner locations and coordinates
3. Contoured data
4. Anomaly locations with unique identification numbers

C.7.4 Records Management

All files will be available for quality and/or control processing during the investigation to assure the field and data processing procedures are properly implemented. All raw data

files, final processed data files, hard copies, and field notes will be maintained for the duration of the project and then turned over to CH2M HILL.

C.7.5 Final Reports and Maps, Geophysical Mapping Data

As soon as practical after collection, the geophysical field data shall be provided in delineated fields as x, y, z, v (1), v (2), etc., for delivery to CH2M HILL. After completion of survey and processing activities, all final maps and supporting geophysical interpretations shall be provided for delivery to CH2M HILL. Maps that display the geophysical anomalies with annotated, interpreted and identified physical features shall be delivered in MicroStation (.dgn) compatible format.

ATTACHMENT:

SOP
GEOPHYSICAL SURVEY

STANDARD OPERATING PROCEDURE
GEOPHYSICAL SURVEY

U.S. NAVY AMMUNITION SUPPORT DETACHMENT
UNEXPLODED ORDNANCE INVESTIGATION
OB/OD SITE FORMER AFWTF
N62470-95-D-6007

VIEQUES, PUERTO RICO

REVISION 1

CH2M HILL

SUPERVISORS STATEMENT

I have read and understand this SOP and have no doubt the operation can be performed efficiently and safely using these procedures.

I understand this SOP is a guide and not meant to address every situation. It is my responsibility to exercise good judgment and decision making to carry out my duties. If a situation arises where I do not have sufficient knowledge or information to make an informed decision, I will contact my supervisor for further direction.

NAME	SIGNATURE	DATE

OPERATORS STATEMENT

I have read and understand this SOP and have no doubt the operation can be performed efficiently and safely using these procedures.

I understand this SOP is a guide and not meant to address every situation. I will follow this SOP and direction of my supervisor.

NAME	SIGNATURE	DATE

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2. DATAQUALITY OBJECTIVES
3. DEFINITIONS
4. PROCEDURES
5. TRAINING

ATTACHMENT 1
EQUIPMENT GEOPHYSICAL PROVE OUT (GPO) CERTIFICATION/ DOCUMENT/ CHECKLIST

PURPOSE

This document details the Standard Operating Procedure (SOP) for conducting a geophysical survey in support of ordnance and explosives (OE) detection activities for the area identified as OB/OD Site Former AFWTF on the island of Vieques in Puerto Rico. The objectives of the geophysical work are 1) conduct geophysical instrument prove-outs to demonstrate that the geophysical equipment can meet the data quality objectives, 2) geophysical mapping of 25 acres, which includes the identification of subsurface anomalies that may be indicative of OE items, and the development of target maps and dig-sheets and, 3) anomaly reacquisition utilizing the same geophysical instrumentation and temporary markers (i.e. pin flag, paint, or other semi-permanent markers) to verify potential OE locations.

Data Quality objectives

The data quality objectives (DQOs)of the geophysical survey reflect the information that is required to meet the goals identified above and include the following:

- Assess the horizontal extent of OE items at OB/OD Site Former AFWTF
    - Demonstrate the effectiveness of the geophysical equipment using a geophysical prove-out that provides a 85% probability of detection with a confidence level of 90%
    - Detection of the MPM/OE to the depths of burial
    - Determine the location of each anomaly such that the locations identified from the geophysics are within 2.5-ft. of its actual location.

DEFINITIONS

Deficiency – An identified condition or activity that does not meet standards or requirements and does not effect the overall quality of the finished product.

Nonconformance – Product, procedure, system process or activity that does not meet requirements and effects overall quality of the product. A nonconformance must be corrected prior to delivery of the finished product.

Surveillance – Continual monitoring and verification of the status of an entity and analysis of records to ensure specified requirements are being fulfilled.

PROCEDURES

Maintenance

The Project Quality Control Manager (QCM) is responsible for the maintenance of all procedures including:

- Resolving on-site quality issues concerning the GPO and the geophysical survey
- Providing QC oversight to assigned project QC staff
- Maintaining the GPO and ECA test areas

Suggested improvements or changes to this SOP will be approved by the QCM and the Program QC Supervisor.

Geophysical Prove-Out

Objectives

Prior to initiating the geophysical survey a geophysical "prove-out" (GPO) will be completed to provide an evaluation of the proposed geophysical instrumentation. The purpose of the geophysical prove-out is to establish and validate the ability of the system, people and equipment, to attain the contract required Probability of Detection (PD) and Confidence Level (CL) prior to starting fieldwork. System certification is required prior to beginning fieldwork or when an uncertified person is assigned to the team and will be operating geophysical equipment, a change in geophysical equipment, or at the request of the QC Manager randomly or for cause. A system, for GPO purposes, is the personnel and equipment used in the detection and reacquisition of subsurface anomalies. The GPO effectively evaluates the ability of the system to detect, identify, and reacquire anomalies. It also assesses the ability of the process to process EM and DGPS data, manage information, and track and handle data.

The GPO will be repeated weekly during the survey and any time there is a change in either the equipment or the geophysical personnel. The CH2MHILL Project Quality Control Manager will be responsible for implementing this procedure and observe the geophysical

team throughout the GPO. An established prove-out area, consistent with the local site conditions, will be seeded with known items and identified by the geophysical contractor.

The number of targets to be emplaced in the GPO is determined by calculating the number of seeded targets necessary to demonstrate the DQO requirement of 85% probability of detection (Pd) and 90% confidence level (Cl). For purposes of this GPO, the Reliability Computer developed by the Naval Explosive Ordnance Disposal Technology Division was used.

Acceptable geophysical results will demonstrate the ability to acquire at least 46 out of the 48 targets will be graded as having both a Pd of greater than 0.85 and a CL greater than 90%.

Site Characteristics

OB/OD Site Former AFWTF is relatively flat and heavily vegetated. However, the vegetation is being completely removed (with the exception of large trees), eliminating the vegetation as an obstacle to the geophysical survey, and there are some steep ravines (quebradas) that traverse the site. The GPO site, therefore, can be any relatively flat to rolling area within or adjacent to OB/OD Site Former AFWTF that has been cleared of vegetation. The locations of the seeded OE in the GPO will be kept in strict confidence and will not be known to the personnel being tested.

Procedures

A qualified two-person geophysical team will separately employ an inductively coupled metal detector (EM-61) across the entire prove-out area using the following procedures:

1. Forty-Eight (48) targets will be buried within the GPO grid. The targets will be buried in random order at various depths, attitudes, and locations.
2. A Differential Global Positioning System (DGPS) will be used to record target locations (X,Y), providing an Easting and Northing for each seeded target. The location, attitude, and depth of each target will be recorded and used for the field validation process. All target markings in the GPO grid will be removed and the grid will be returned as near as possible to its natural condition. Information on the seeded target's location will not be released to the test participants.
3. Since a subcontractor is doing the geophysical data gathering, handling and processing, the construction of the GPO will be done by the (CH2M Hill) OE/UXO Quality Control manager and (CH2M Hill) Senior UXO Supervisor. These two persons will emplace each seeded OE and record the emplacement data.
4. All targets will be marked with pin flags and additional pin flags will be placed within the grid (GPO) area. Geophysical teams will conduct their search of the GPO grid as they would during collection of data throughout the site. The number of targets is not known to the geophysical equipment operators.

5. Prior to starting the prove-out an Equipment Check will be conducted by the geophysical team outside the prove-out area. This will allow the team to adjust their equipment to site conditions and ensure their equipment is functioning properly before entering the prove-out area. Specific information on target location and item type placed in Equipment Check Area (ECA) will be provided to the geophysics team.

6. Ensure flags marking the centerline of the GPO route are visible throughout the course and in good condition. Flags should be located to ensure teams can closely follow the designated route. It is important that each team follow the same path as closely as possible.

7. When team conducts the GPO, they will follow procedures as outlined in Section 6.2 for Geophysical Survey operation.

7) When the team has completed the geophysical survey, they will continue with the process until all data files, photocopies of logbook entries, and way point/track maps are submitted to the Data Manager for initial processing and transmission.

8) The Data Manager will download files from data logger and PC cards.

New/repaired equipment certification

When new/repaired geophysical survey equipment is being processed through the GPO, by a person already certified in the GPO process, it will not be necessary to perform the requisition operation using a UXO team. The reason for this is the anomalies identified by the geophysical survey and post processing of data can be compared with known target locations to determine effectiveness of equipment.

When new/repaired requisition equipment is being processed through the GPO, by a person already certified in the GPO process, the certification may be completed using a dig package from a previous GPO operation.

Geophysical survey

The area to be investigated is described as having a dense shrub canopy that will be removed using mechanized de-vegetation techniques. The areas of concern (AOC) will be established as individual 200-foot by 200-foot grids cells to cover approximately 25 acres (1acre=200ftx200ft). Immediate surface culture (i.e. metallic debris, obstructions, etc…) will be removed prior to the start of the geophysical investigation.

Instrument Standardization/Quality Control

Geophysical instruments will be field tested daily to ensure that they are operating properly. If the standard response cannot be attained, the instrument will be re-calibrated, repaired, or replaced. The following procedures will be conducted each day:

1.) The instruments will be positioned at the same location each morning, and readings will be collected for no less than one minute. The data from this “static test” will be evaluated for consistency and repeatability. A uniform target item will be

placed on the ground surface, in the center of the EM-61 coil .The instrument response to the item will be checked against the previous daily static tests to ensure that the instruments are functioning properly, as evidenced by a consistent response.

2.) Upon completion of the static test, the selected geophysical instrument will be used to measure and record at least one standard calibration test line (located in pre-existing prove-out) over known inert OE items each morning prior to use. The same test line will be re-surveyed upon completion of the daily data acquisition. Peak anomalous readings over the OE items will be evaluated for consistency immediately after the data is collected.

3.) Additionally, data collection over at least 4% of each survey cell will be repeated for direct comparison of amplitude response and positioning. If consistent response or positioning cannot be attained, the instrument will be re-calibrated, repaired, or replaced.

Location Surveying, Mapping, and Navigation

Wooden hubs or stakes will be set on 200-foot corners throughout the area of investigation to serve as control. Using the emplaced control points, the geophysical crew will establish a grid for data collection. Where practical, positional data will be collected from an Ashtech Z-FX Surveyor RTK (Real Time Kinematic) GPS system. A GPS base station (also utilizing an Ashtech Z-FX receiver) will be set up on an established control point, and real time corrections broadcast to the roving GPS unit via a radio link. This system provides positional updates at a rate of 1 Hz, with an accuracy of 3-cm horizontal, 5-cm vertical, when no less than 5 satellites are available. The roving GPS antenna may be mounted in the center of the coils to track the EM-61 or, in areas where limited coverage exists due to terrain or vegetation, the rover may be used to locate survey cell corners for data conversions and interpolation from a local coordinate system. In areas that exhibit inadequate GPS coverage, highly accurate data positioning will be maintained through the use of color-coded ropes placed across the area of investigation to assist in straight-line profiling, and for the placement of fiducial marks within the data sets. This method will serve as a backup to GPS and be used when GPS technology is adversely affected by local vegetation or topographic conditions.

Anomaly Reacquisition

Target anomalies will be re-acquired by the geophysical contractor using the GPS system where appropriate. Coordinate locations of each targeted anomaly will be uploaded into the rover, which will be used to navigate or re-occupy the point where a temporary mark will be placed. Reacquisition of target locations where no GPS coverage exists will be conducted using tape measures pulled from corner stakes to locate the interpreted local x,y coordinate position listed for each target on the dig sheet. Each reacquired target location

will be marked with a pin flag labeled with the anomaly's identifying number as specified on the dig sheet.

Using the same geophysical equipment as was originally used, the reacquisition crew will then refine the location of the anomaly. This will be accomplished by collecting readings in continuous mode while slowly maneuvering the instrument over the anomaly, searching for the peak response. The pin flag will be moved to the refined location and the offset will be documented. The actual location identified by the UXO team shall be within 2-1/2 feet of the anomaly identified by the geophysical survey.

Data Processing and Analysis

The raw data is gridded and displayed on the screen as a color contour image with the track plot overlaid on the map. The purpose of this initial exercise is to assess the positioning and density of the data.

Geophysical data processing will include the following procedures:

1. Conversion of local grid coordinates to Puerto Rico State Plane coordinates
2. Diurnal Drift Correction (magnetics)
3. Heading corrections
4. Lag corrections
5. Normalization or leveling (removal of background)
6. Gridding of data
7. Digital filtering and enhancement
8. Calculating the 3D analytic signal from the magnetic data
9. Gridding of analytic signal
10. Selection of anomaly picks (above an appropriate threshold)
11. Preparation of geophysical maps and target maps

Quantitative Interpretation and Dig Sheet Development

Geophysical anomalies (or targets) will be identified from the processed data. For each grid, the geophysical subcontractor will assess each of the following factors prior to selecting anomalies (or targets):

1. The local background (terrain noise) conditions
2. An evaluation of data completeness and accuracy
3. An assessment of data quality based on the survey and grid QC data

4. The grid boundary conditions, utilities and/or other cultural features present, and unsurveyable areas (trees, buildings, etc.)
5. A delineation of the extent and boundaries of pits and trenches (anomaly lists will not be generated for extensively large areas of anomalous response).

Dig Sheets

The geophysical contractor will, using a qualified geophysicist, analyze the geophysical data for each OE removal grid, identify anomalies that may represent buried UXO, and prepare anomaly lists containing the following information:

1. Project site
2. Geophysical contractor
3. Responsible geophysicist
4. Grid identification
5. Grid corner locations and coordinates
6. Unique anomaly identification numbers
7. Predicted anomaly easting & northing in State Plane coordinates
8. Instrument peak value at each anomaly location

The dig-sheets will be prioritized and anomalies deemed more likely to be UXO, will be ranked higher than anomalies less likely to be UXO. The criteria for selecting and locating anomalies for the anomaly (or target) list include the following items:

1. The maximum amplitude of the response with respect to local background conditions
2. The lateral extent (width) of the response
3. The 3-dimensional shape of the response
4. The location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid
5. The shape and amplitude of the response with respect to the response of known targets buried in the geophysical prove-out test plot

6. The shape and amplitude of the response with respect to relevant anomalies encountered in previous OE removal grids
7. The apparent depth of the anomaly
8. Potential distortions in the response due to interference from nearby cultural features; any instrument or grid survey QC that could affect the analysis.

Grid Maps

The geophysical contractor will also provide, with each dig sheet, a grid map, which contains the following:

1. Grid identification
2. Grid corner locations and coordinates
3. Contoured data
4. Anomaly locations with unique identification numbers

Records Management

The files will be available for quality and/or control processing during the investigation to assure the field and data processing procedures are properly implemented. All raw data files, final processed data files, hard copies, and field notes will be maintained by the geophysical contractor for the duration of the field survey and then turned over to CH2M Hill.

Final Reports and Maps, Geophysical Mapping Data

As soon as practical after collection, the geophysical field data shall be provided in delineated fields as x, y, z, v (1), v (2), etc., for delivery to CH2M Hill. After completion of survey and processing activities, all final maps and supporting geophysical interpretations shall be provided for delivery to CH2M Hill. Maps that display the geophysical anomalies with annotated, interpreted and identified physical features shall be delivered in MicroStation (.dgn) compatible format.

TRAINING

All project Quality Control personnel involved in conducting surveillances, and completing surveillance forms/reports will be trained in this procedure by the QCM or his designee through OJT. Determination of the adequacy of the level of training of assigned QC staff to carry out surveillance activities is the responsibility of the QCM.

Geophysical data acquisition will be conducted by a well-trained, experienced two-person crew led by a qualified geophysicist. All personnel on-site will have documentation of 40-hour OSHA certification, any necessary re-certification (8-hour refresher), and OSHA-compliant medical monitoring physical exams. Throughout operations, the geophysical staff will strictly adhere to the following general practice. All work to be conducted is non-intrusive. Personnel will practice avoidance in the unlikely event that UXO is encountered.

Section 1 - Team Information

TEAM:	LOCATION:	DATE:

TEAM MEMBERS

NAME	Company	Position

Section 2 - Equipment Serial Numbers

EQUIPMENT ITEM	Serial #	Equipment Item	Serial #

Section 3 - Checklist

Item	Ref.	Inspection Point	Yes	No	N/A	Comments
1	GPO PLAN	EQUIPMENT CHECK PERFORMED IN ECA?				
2	GPO PLAN	DATA COLLECTED IAW SOP?				
3	GPO PLAN	WAS PAPERWORK COMPLETED PROPERLY?				
4	GPO PLAN	OBTAIN COPY OF LOGBOOK ENTRIES FROM GEO AND UXO TEAMS.				
5	GPO PLAN	DID TEAM EXPERIENCE ANY PROBLEMS WHILE COMPLETING PROVE OUT COURSE?				

Section 4 - Punch list Items

ITEM #	DESCRIPTION

Conducted by: _____

Project QC Manager: _____

Appendix D
Form 2-1

FORM 2-1

UXO INFORMATION FORM

DATE/TIME: _____ **IDENTIFICATION# (ID):** _____
LOCATION: _____

1. **ITEM REMOVED FROM SITE (YES/NO)**

2. **WHO REMOVED THE ITEM?**
   Name:_____ **Organization:** _____

3. **IF ITEM WAS REMOVED, WHERE WAS IT TAKEN?** _____
   _____

4. **ITEM DESTROYED ONSITE (YES/NO)**

5. **WHO DESTROYED ITEM?**
   Name: _____ **Organization:** _____
   Time of Detonation:_____ **UXO Down Time:**_____

6. **ORDNANCE ITEM ENCOUNTERED:**

Type	Reference Information Location*	Condition	Disposition

***Identify location where records regarding information on this item are located (e.g., field book # and date, electronic file name and location, paper form ID and location) or record parameters listed below in comments section.**

- The site vegetation, topography and soil/bedrock type
- Transect locations (for Inland MRS)
- Geographic location
- MEC size
- Qualitative magnitude of geophysical sensor response for subsurface anomaly
- Orientation of surface items
- The condition of the MEC (whether or not expended)
- Disposal method if item is removed
- Disposal date if applicable
- Whether or not he MEC is fuzed and contains explosive filler

7. **US NAVY NOTIFIED AT (TIME):** _____ **REP:** _____

8. **CH2MHILL PERSONNEL NOTIFIED AT (TIME):** _____ **REP:** _____

9. **COMMENTS (Significant events or findings):** _____
   _____
   _____
   _____

_____ _____
CH2MHILL UXO Representative (Signature) **CH2MHILL UXO Representative (Print Name)**

CHECKED BY _____	APPROVED BY _____

Appendix E
ORS Metal Collection and Inspection Procedures

Ordnance Related Scrap (ORS) Metal Collection and Inspection Procedures

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1.0 Purpose

This SOP is intended to guide MEC Technicians in the safe and efficient handling and disposal of ordnance related scrap metal found at CH2M HILL project sites. The inherently dangerous characteristics of AEDA dictate that special precaution be taken to ensure that demilitarization is performed only by properly trained and technically qualified personnel.

2.0 Background

During investigation operations, MEC Technicians will encounter the following types of metallic contamination: MEC items; ordnance related scrap that is contaminated with explosives or other hazardous materials; non-hazardous ordnance related scrap metal; and general metallic debris. Because the metal scrap recovered will ultimately be disposed of offsite, it is imperative that procedures be established to preclude live ordnance or hazardous materials from becoming intermingled with other non-hazardous metal scrap.

Current and past practices have only required the inspection of ordnance related scrap and a certification by a qualified EOD/MEC technician that it is safe to the best of their knowledge. There are several pitfalls with this approach depending on the type of ordnance being inspected. The following paragraphs provide guidance for avoiding these pitfalls.

References:

DoD 4160.21-M: Department of Defense Reutilization and Marketing Manual

DoD 4160.21-M-1: Department of Defense Demilitarization Manual

TB 700-4: Department of the Army Technical Bulletin - Decontamination of Facilities and Equipment

3.0 Collection Procedures

A systematic approach for collecting and inspecting metal scrap will be used. The approach is designed to ensure that the materials undergo a continual evaluation/inspection process from the time acquired until finally removed from the site.

At the operating site, we will preposition scrap metal containers. Which will be marked "Non-ordnance Scrap Metal" and will be used to collect general metal debris. The other container(s) will be marked "Ordnance Related Scrap Metal" and will be used to collect non-hazardous ordnance related scrap metal (i.e. Metal components that <u>do not</u> contain any explosives or other hazardous materials).

Collection procedures begin at the time the metal item is discovered by the MEC Technician. At this point the MEC Technician makes a preliminary determination as to the classification of the item. If the item is identified as non-ordnance related scrap it is placed in a temporary Non-ordnance scrap pile located within the current operating area. If the item is identified as ordnance related scrap it is placed in a temporary ordnance related scrap pile, again this pile is located within the current operating area.

Upon completion of operations within an area, the MEC Supervisor for the team that cleared the area will inspect each of the scrap piles and direct movement of the scrap into the appropriate site collection container. To preclude migration of the material from one pile to the other during movement to the scrap containers, each pile will be moved as a distinct and separate vehicle load.

4.0 Removal of Scrap Metal/Range Residue

The MEC Team will collect the scrap piles deposited at the operational area by the MEC Clearance Team, perform an inspection to confirm that segregation of the ordnance related scrap had been done correctly and that no live MEC has been placed in the ordnance related scrap pile. The ordnance related scrap will be inspected and divided into two groups: 1) ordnance related scrap requiring further demilitarization; and 2) ordnance related scrap that does not require further demilitarization. **Figure 1** is a Logic Diagram for the Collection and Disposition of ORS.

4.1 Segregation of Scrap Metal/Range Residue

For purposes of disposal, it shall be segregated and defined as either Group 1a, Group1b, or Group 2.

4.1.1 Group 1 Scrap Metal/Range Residue

Group 1 includes property that previously contained explosives or that does not contain items of a dangerous nature and can be certified inert and/or free of explosives or other dangerous materials such as targets, certain expended ordnance, etc.

4.1.1.1 Group 1a Scrap Metal/Range Residue

Group 1a includes firing range expended small arms cartridge and inert metals gleaned from range clean up. Metals gleaned include material for which the only use is for its basic material content (e.g. clean shrapnel, target metal, etc.) And does not include material with any residual utility or capability or that is considered to be MLI or CCLI. Such material is eligible under the Resource Recovery and Recycling Program for disposition by a QRP in accordance with DODI 7514.1, Pollution Prevention. DOD Components may exercise direct sale authority for firing range expended small arms cartridge cases provided that it is crushed, shredded or otherwise destroyed prior to release from DOD control.

4.1.1.2 Group 1b Scrap Metal/Range Residue

Group 1b includes any certifiable material or item not meeting the criteria in 1a above. A determination shall be made as to whether the material/item requires demilitarization. Damaged sustained does not necessarily constitute demilitarization. Destruction shall, at a minimum, satisfy the provisions of DOD 4160.21-M-1. This material is not eligible for a QRP.

4.1.2 Group 2 Scrap Metal/Range Residue

Group 2 includes inherently dangerous items that may potentially contain munitions residue and cannot be certified as inert, such as practice bombs (that is, Aduds,≅ unexploded ordnance (MEC), BDU-33, MK-106, etc.)

5.0 Disposition of Munitions List Items (MLI)

Demilitarization should be accomplished by the most cost effective method consistent with adequate security and surveillance as economically as practical in accordance with existing environmental standards, safety and operational regulations, to the point of assuring freedom from explosives, toxic or incendiary materials, smoke content or design hazards by one of the following methods:

a) By a sales contractor, as a condition of sale. Unless otherwise authorized, property to be demilitarized by this manual must be demilitarized prior to transfer of title to a purchaser.

b) By the DRMO, generating activity, designated Military Service/Defense Agency or contractor personnel (having qualified MEC personnel).

c) Under a service/performance contract.

5.1 Assignment of Demilitarization Codes

The proper procedure requires that ordnance scrap be assigned a demilitarization code and that code determines the type of processing required. For almost all ordnance scrap the assigned code should be AG≅. Assignment of this code is the responsibility of the generating activity (for range maintenance contracts such as Fort Irwin it is the National Training Command; for base realignment and closure (BRAC) removal actions it is the BRAC office; and for formerly used defense sites (FUDS) it is the Corp of Engineers). CH2M HILL as the contractor and expert in MEC should assist the generating activity in determining the demilitarization code to be assigned and the method and degree of demilitarization required.

Definition of Demilitarization Code AG≅:

AG≅ MLI -- Demilitarization required - AEDA, Demilitarization, and if required, declassification and/or removal of sensitive markings or information, will be accomplished prior to physical transfer to a recycling facility. This code will be used for all ADEA items, including those which also require declassification and/or removal of sensitive marking or information. [When in doubt assign Demilitarization Code AG≅ for all recovered ordnance related scrap.]

5.2 Demilitarization Requirements

Demilitarization and decontamination of ordnance scrap is based on a system that assigns decontamination levels commensurate with the post treatment use. For metal that is being released to the public as recyclable, 5X is the acceptable degree of decontamination.

Past practices for recovery and certification of ordnance scrap from range maintenance contracts, BRAC and FUDS removal actions have improperly certified ordnance scrap as safe for turn-in to DRMO for recycling based on inspection and certification by MEC/EOD technicians. In most cases this achieves a 3X level of decontamination by de facto. This is not sufficient for resale to the public. Three X=s indicate the equipment or facilities (in this case ordnance scrap) have been examined and decontaminated by approved procedures and no

contamination can be detected by appropriate instrumentation, test solutions, or by visual inspections on easily accessible surfaces or in concealed housings, etc. and are considered safe for the intended use. Items decontaminated to this degree can not be furnished to qualified DOD or Industry users or subjected directly to open flame cutting, welding, high temperature heating devices), or operations which generate extreme heat, such as drilling and machining. Newly implemented certification procedures require two signatures for certification of which only one signature may be from a government contractor.

The only acceptable way to get to 5X decontamination is by partial or complete removal, neutralization, or destruction of explosives/explosive residue by flashing, steaming, neutralization, or other approved desensitizing methods such as shredding. This is often expensive and nullifies the value of the scrap. However to leave ordnance scrap on a range site increases the possibility of residues such as RDX, HBX, and TNT entering the ground water and causing a more expensive problem.

Technical instructions issued by the Defense Agency or Military Service having procurement responsibility for the item involved and/or instructions provided through the DOD demilitarization Bulletin Board System, will determine and identify the method of demilitarization and the degree to which additional demilitarization is necessary to meet the requirements in their respective areas. For additional information contact the following:

a) For ammunition procured by the Department of the Army, technical instructions relating to ballistic missiles, and large rockets, will be furnished by the Commander, U.S. Army Aviation and Missile Command (AMCOM), Attn: AMSAM-DSA-WO, Redstone Arsenal, AL 35898-5239

b) For conventional, chemical, and all other types of ammunition excluding lethal chemical agents and waste munitions, technical instructions will be provided by the U.S. Army Industrial Operations Command, Attn: AMSIO-SMK, Rock Island, IL 61299-6000

c) For lethal chemical agents including vesicants and nerve agents and their carriers, technical instructions will be furnished by the U.S. Army Armament Material Readiness Command Program Manager for the demilitarization of Chemical Material, Edgewood Arsenal, Aberdeen proving Ground, Maryland 21010

d) For ammunition procured by the Department of the Navy, technical instructions will be issued by the Commander, Naval Sea Systems Commander or by the Commander Naval Air Systems Command, department of the Navy, Washington, D.C.

e) For ammunition procured by the Department of the Air Force, technical instructions will be issued by the Engineering and Reliability Branch (MMWR), Ogden Air Logistics Center, Ogden, UT 84056-5609.

The following paragraphs provide guidance for the method and degree of required demilitarization for most types of ordnance items:

5.2.1 Category III. Ammunition - Method and Degree of Required Demilitarization

a) **Artillery/Mortar Ammunition Components and Similar Items of All Types** including but not limited to high explosive, practice, inert loaded, incendiary, and smoke fillers.

Remove explosive filler from projectile (wash out, burn out, etc.). Remove rotating band and deform fuse cavity threads or score or deform bourrelet or gas check band. Burn propellant unless otherwise instructed to retain for sale or other purposes. Deform fin assembly threads or fin blades. Cartridge cases will be deformed by off-center punch-out of primer or split case neck or puncture the lower sidewall with a minimum of 3/4 inch hole or deform lower sidewall, which will prevent chambering, or crush or press. Burn out smoke mixture or detonate smoke canister.

b) **Inert Loaded Ammunition, Projectiles, and Similar Items of All Types** loaded with inert filler to simulate service item. Remove rotating band from artillery projectiles and open the closure of the projectile body to expose the inert filler. On items without rotating bands, open the body closure to expose the inert filler and damage the closure surface to prevent reloading or resealing.

NOTE: For inert loaded items (concrete, sand, plaster) a potential explosive safety hazard exists when the internal filler is not exposed or unconfined during burning. Melting, or cutting. Heat generated from a demilitarization process can cause the filler, moisture and air to expand and burst sealed casings. For this reason, DRMOs will not accept inert loaded items unless the internal filler is exposed and unconfined. The internal filler may be exposed by removal of the fuse well from the cavity, removal of base plates, or by puncturing/drilling holes I the bomb casing.

c) **Ammunition and Components Which Have Been Fired or Expended, Range Residue and Other Non-Explosive Items.** All items will be rendered free of energetic materials prior to accomplishment of demilitarization. Range residue will be processed in accordance with the defense Material Disposition Manual, DOD 4160.21-M, Chapter 4, paragraph B.3, after all required demilitarization is accomplished.

1. **Artillery/Mortar Ammunition Components and Similar Items of All Types.** Remove rotating band and deform fuse cavity threads or score or deform bourrelet or gas check band. Score practice round with a torch, displacing a minimum of one cubic inch of metal or shear into two pieces. Deform fin assembly threads and fin blades.

2. **Inert Loaded Ammunition, Projectiles, and Similar Items of All Types** loaded with inert filler to simulate service item. Remove rotating band from artillery projectiles and open the enclosure of the projectile body to expose the inert filler. On items without rotating bands, open the body closure to expose the inert filler and damage the closure surface to prevent relocating or resealing. **NOTE:** For inert loaded items (concrete, sand, plaster) a potential explosive safety hazard exists when the internal filler is not exposed or unconfined during burning, melting, or cutting. Heat generated from a demilitarization process can cause the filler, moisture and air to expand and burst sealed casings. For this reason, DRMOs will not accept inert loaded items unless the internal filler is exposed and unconfined. The internal filler may be exposed by removal of the fuse well from the cavity, removal of base plates, or by puncturing/drilling holes I the bomb casing.

3. **Other Nonexplosive Filled Items** which perform a major function essential to the basic mission of the end item. Cut, crush, or process through a deactivation furnace. Burn or

cut cartridge case lines and propelling charge bags. Cut, burn, or crush aircraft and ground signal cases. Crush or detonate piezoelectric (lucky) elements.

d) **Technical data** will be demilitarized by burning, shredding, or pulping.

5.2.2 Category V. Military Explosives, Solid and Liquid Propellants, Bombs, Mines, Incendiary Agents, and their Constituents - Method and Degree of Required Demilitarization

a) **Artillery/Mortar Ammunition Components and Similar Items of All Types** including but not limited to high explosive, practice, inert loaded, incendiary, and smoke fillers. Remove explosive filler from projectile (wash out, burn out, etc.). Remove rotating band and deform fuse cavity threads or score or deform bourrelet or gas check band. Burn propellant unless otherwise instructed to retain for sale or other purposes. Deform fin assembly threads or fin blades. Cartridge cases will be deformed by off-center punch-out of primer or split case neck or puncture the lower sidewall with a minimum of 3/4 inch hole or deform lower sidewall, which will prevent chambering, or crush or press. Burn out smoke mixture or detonate smoke canister.

b) **Inert Loaded Projectiles, Warheads and Similar Items of All Types** loaded with inert filler to simulate service item. Remove fuse and/or spotting charge, where applicable, and burn or detonate. Remove rotating band from artillery projectiles and open the enclosure of the projectile body to expose inert filler. On items without rotating bands, open the body closure to expose the inert filler and damage the closure surface to prevent reloading or resealing.

c) **Bombs and Similar Items of All Types,** including but not limited to high explosive, practice, inert loaded, incendiary and photo flash fillers, military explosive excavating devices, demolition blocks, and grenades. Demilitarization will be accomplished by removal of explosive filler in an approved manner (e.g., wash-out, burn-out, etc.) And by deforming fuse cavity threads or removing base plate by other than normal disassembly (such as sawing) or by detonation. Grenades will be demilitarized by cutting or crushing (a minimum of 75% compression) the grenade body after item has been defused and explosive removed or by detonation.

d) **Small Explosive Items**, including but not limited to fuses, boosters, primers, detonators, firing devices, ignition cartridges, blasting caps, grenade cartridges, tracer assemblies, and similar components. Demilitarization can be accomplished by processing through a deactivation furnace at settings of 1150 degrees at burner end and 450 to 500 degrees at stack end or by mutilation. Incendiary projectiles will normally be decored to expose and assist in the compete burning of the incendiary composition. Where decoring of projectile is not necessary, processing through the deactivation furnace is adequate. Burn out 20mm HE projectiles by processing through the deactivation furnace or detonate. Processing complete small arms ammunition cartridges, all caliber's, through the deactivation furnace at controlled temperatures will result in adequate demilitarization. Fuses and boosters can be disposed of by disassembly and cutting, drilling, or punching to deform metal parts. Explosive components generated through disassembly are to be burned or detonated. Fuses may also be processed through a deactivation furnace as a complete item when disassembly is not feasible. For grenades demilitarization may be

accomplished by removal of explosive components by crushing, cutting, breaking, melting, burning, or otherwise to fully preclude their rehabilitation or further use as grenade components. Demilitarization may also be accomplished by detonation or burning as appropriate for the particular item involved.

e) **Rocket Motors, Warheads, Components and Similar Items of All Types,** including high explosive, inert, loaded, practice and smoke. Wash out or burn out rocket warhead filler and mutilate casing by crushing or cutting by torch and deforming threaded area. Disassemble and remove or burn out rocket motor propellant and cut or crush case, and deform threaded area of cases. Rocket motors and warheads may also be detonated.

f) **Mines, Anti-Personnel/Anti-Tank Explosive, Components and Similar Items of All Types** including high explosive, practice, inert loaded associated explosive components. Wash out or burn out filler and mutilate by crushing, cutting by torch, deforming threaded area or detonate. Process mine fuses, activators, and firing devices through a deactivation furnace, burn in a cage or detonate. Mine firing such as the M56 or M61 types should be crushed, cut, or burned.

g) **Ammunition and Components Which Have Been Fired or Expended, Range Residue and Other Non-Explosive Items.** All items will be rendered free of energetic materials prior to accomplishment of demilitarization. Range residue will be processed in accordance with the defense Material Disposition Manual, DOD 4160.21-M, Chapter 4, paragraph B.3, after all required demilitarization is accomplished.

1. **Artillery/Mortar Ammunition Components and Similar Items of All Types** including but not limited to high explosive, practice, inert loaded, incendiary, and smoke fillers. Remove explosive filler from projectile (wash out, burn out, etc.). Remove rotating band and deform fuse cavity threads or score or deform bourrelet or gas check band. Score practice round with a torch, displacing a minimum of one cubic inch of metal or shear into two pieces. Deform fin assembly threads and fin blades. Defective cartridge cases will be deformed by off-center punch-out of primer or split case neck or puncture the lower sidewall with a minimum of ¾ inch hole or deform lower sidewall, which will prevent chambering, or crush or press. Burn out smoke mixture or detonate smoke canister.

2. **Inert Loaded Ammunition, Projectiles, and Similar Items of All Types** loaded with inert filler to simulate service item. Remove rotating band from artillery projectiles and open the enclosure of the projectile body to expose the inert filler. On items without rotating bands, open the body closure to expose the inert filler and damage the closure surface to prevent relocating or resealing. **NOTE:** For inert loaded items (concrete, sand, plaster) a potential explosive safety hazard exists when the internal filler is not exposed or unconfined during burning, melting, or cutting. Heat generated from a demilitarization process can cause the filler, moisture and air to expand and burst sealed casings. For this reason, DRMOs will not accept inert loaded items unless the internal filler is exposed and unconfined. The internal filler may be exposed by removal of the fuse well from the cavity, removal of base plates, or by puncturing/drilling holes I the bomb casing.

3. **Bombs and Similar Items of All Types**, including but not limited to high explosive, practice, inert loaded, incendiary and photoflash fillers, military explosive excavating devices, demolition blocks and grenades. Demilitarization will be accomplished by deforming fuse cavity threads or removing base plate by other than normal disassembly (such as sawing) or by detonation. Grenades will be demilitarized by cutting or crushing (a minimum of 75% compression) the grenade body after item has been defused and explosive removed or by detonation.

4. **Rocket Motors, warheads, Components and Similar Items of All Types**, including high explosive, inert loaded, practice and smoke. Demilitarize casing by crushing or cutting by torch or deforming threaded area. Cut, crush case, or deform threaded area of rocket motor cases.

5. **Mines, Anti-Personnel/Anti-Tank, and Similar Items of All Types** including high explosive, practice, inert loaded and associated components. Demilitarize casing by crushing, or cutting by torch, and deforming threaded area or detonate. Mine firing devices such as the M56 or M61 types should be crushed, cut, or burned.

h) Instructions For Specific Ordnance Items:

1. BDU-50 Practice Bomb:

(a) Each bomb must be inspected by qualified EOD/MEC personnel to ensure that bombs are BDU-50s and that the bomb is expended. If the EOD/MEC personnel cannot verify both fuse wells, or absence thereof, it must be op-opened remotely by detonation.

(b) A 1/4 inch hole will be punched in each of the two spanner wrench receptacles, fracturing the metal to a depth in excess of 1/10 inch into the concrete filler material.

(c) A 1/4 inch punch will be utilized to further damage the threads of the nose plate, ensuring that the plate cannot be removed and replaced.

(d) Fins will be deformed or broken and paint will then be used to place a mark of contrasting color on the bomb or near the nose.

i) **Technical data** will be demilitarized by burning, shredding, or pulping.

5.2.3 Venting of Ordnance-Related Scrap

Prior and current practices have taken this to mean that if the MEC item is intact and resembles a piece of military ordnance, such as a 105mm HEAT (Practice) projectile, it should have a hole punched through the side to expose the filler as non-explosive. This is typically accomplished through the use of a shape charge attack. The explosively created hole exposes the filler and disfigures the projectile so that it could not be used again. For a 105 mm HEAT (Practice) round this approach is sufficient because the projectile never contained any explosives or energetic material used as a spotting charge. For a MK- 82 LDGP Bomb (Practice) this approach may not be sufficient because the bomb can contain various types of explosively activated spotting charges that have the capability to cause injury or death if exposed to the right elements such as flame from a cutting torch. And their is always the possibility that a shape charge attack may punch a hole in an explosive ordnance item

exposing the filler but not causing a detonation. Because some explosive fillers look like inert fillers the possibility for misidentification and improper certification is real.

MEC known or suspected to be inert (filled with an inert substance to simulate the weight of an explosive filler) will be explosively vented with conical-shaped charges. For the purpose of determining the fragmentation hazard area for explosive venting, it will be assumed that the MEC has an explosive filler and that a high-order detonation will occur. Venting will be considered successful when the inert filler is exposed. The vented inert ordnance item can be treated and disposed as scrap after the venting and demilitarization process is complete.

6.0 Certification/Disposal of Scrap Metal

The generating activity will ensure that the quantities of demilitarized property turned in to the recycling facility are accurate and that these quantities are readily verifiable by the facility. Recycling facilities will not accept any property unless the DD Form 1348-1A contains the demilitarization code or clear text statement of the demilitarization required. An example of the DD Form 1348-1A is included as Form 2-5. The generating activity is responsible for issuing a letter specifying who is authorized to sign the statement of inert certification. This letter will be kept in the project files and with the generating activity. It must be update as needed.

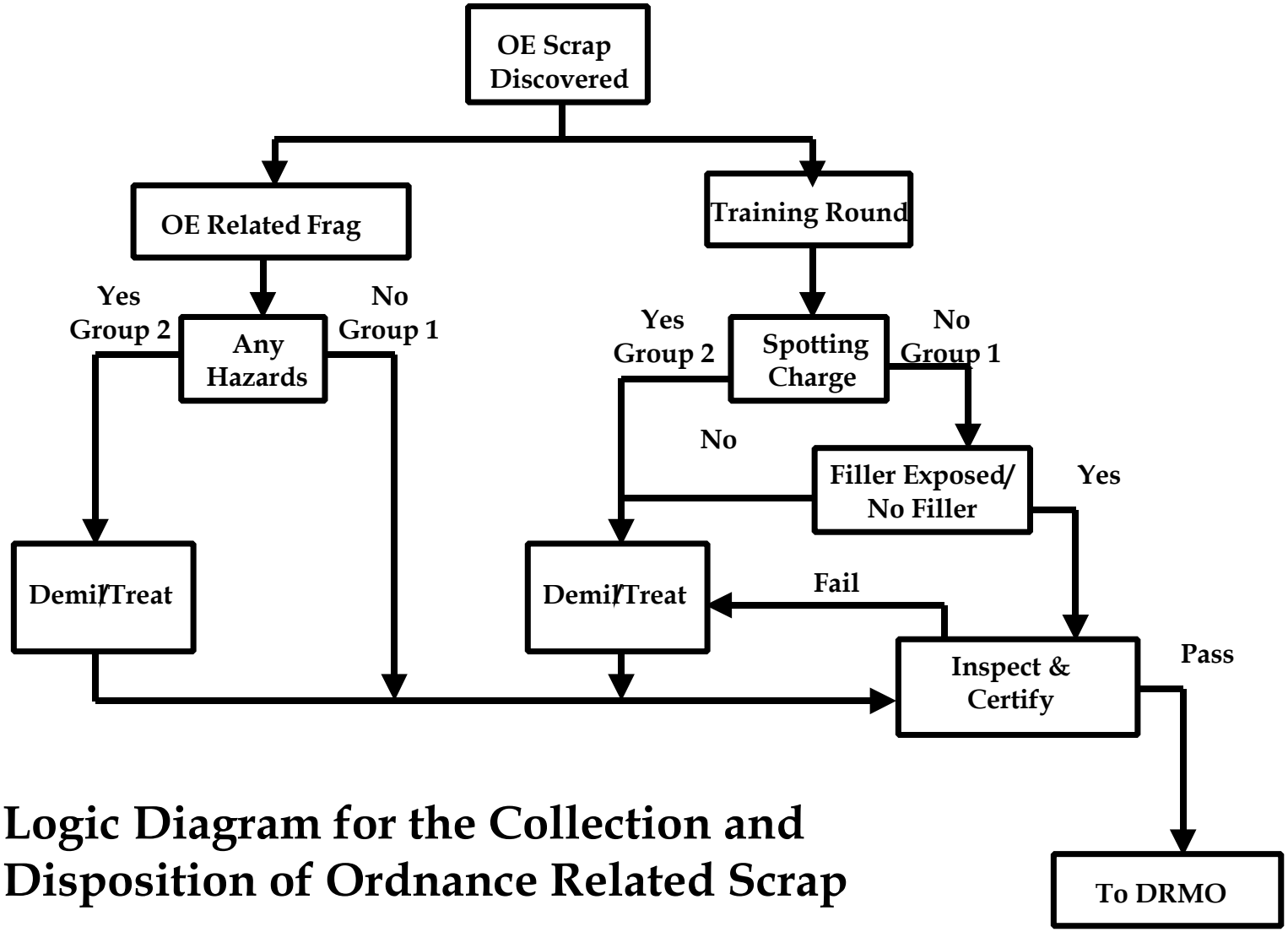
All material generated from the firing and/or demilitarization of AEDA will be rendered **free from explosives** before being referred to a recycling facility for sale. All scrap metal, generated at the site, will be disposed of at an approved scrap metal dealer, and will be transferred using DD Form 1348-1A. Prior to release of the material, the Senior MEC Supervisor will physically inspect the material in the containers to ensure that they are free of dangerous items or conduct demilitarization operations. The Senior MEC Supervisor will sign the certificate, typed on the DD Form 1348-1A, which states:

> "This certifies and verifies that the AEDA residue, Range Residue, and/or explosive contaminated property listed, has been 100 percent properly inspected, and to the best of our knowledge and belief, are inert and/or free of explosives or related materials."

The certification will be verified (countersigned) by a technically qualified U.S. government representative (U.S. citizen) designated by the responsible commander/generating activity.

Scrap will be segregated into like metals (mainly steel, aluminum, and mixed metal) and placed into palletized wooden shipping boxes. Each item placed into an inert-certified box will be inspected. The boxes will be filled, the covers will be nailed on, and a lead seal will be affixed. A Statement of Inert Certification will then be attached to the box. The box can then be picked up by a local scrap yard for disposal or recycling.

Using these procedures ensures that the collected scrap metal is properly inspected and classified. Our method includes three distinct inspections which are performed by persons of increasing levels of responsibility. The first inspection is performed at the operating grid by a qualified MEC Technician, the second is performed by the supervisor responsible for the operating grid, and the final inspection is performed by the Senior MEC Supervisor who is vested with overall responsibility.



Logic Diagram for the Collection and Disposition of Ordnance Related Scrap

Figure 1

FORM 2-5

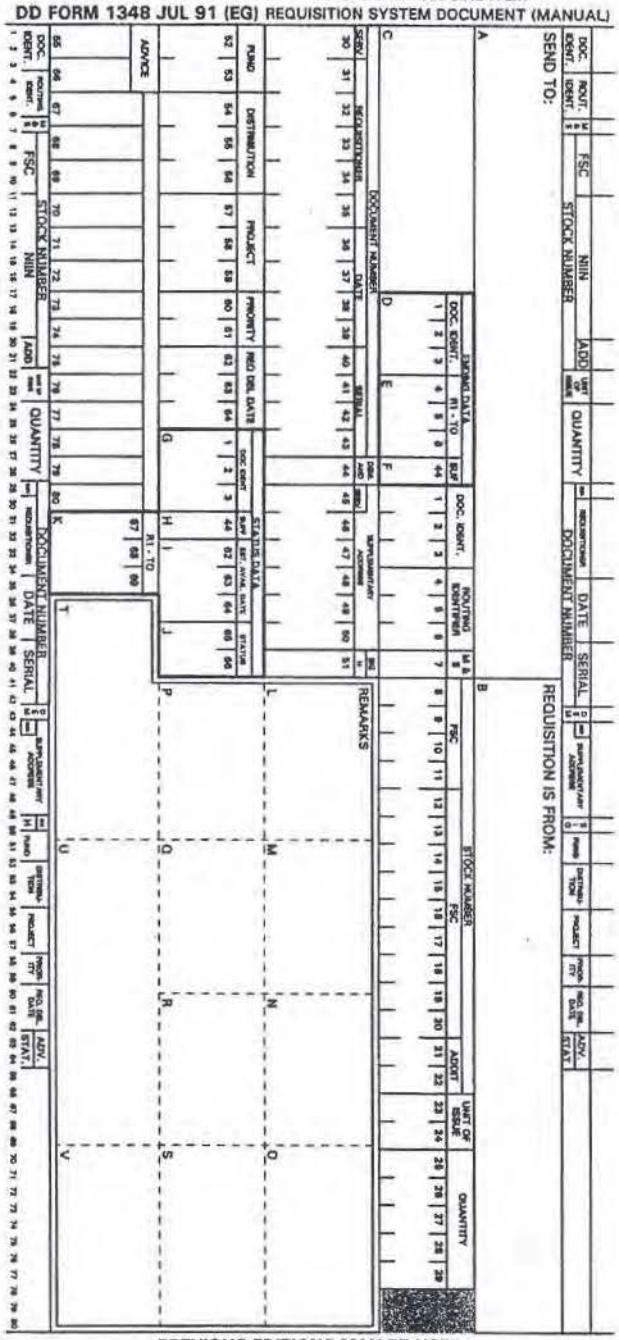
SCRAP CERTIFICATION FORM

USE [ ] TYPEWRITER OR BALL POINT PRESS HERE [ ] PEN

TO ASSURE LEGIBILITY ON ALL COPIES

D O D SINGLE LINE ITEM

DD FORM 1348 JUL 91 (EG) REQUISITION SYSTEM DOCUMENT (MANUAL)



PREVIOUS EDITIONS MAY BE USED