FINAL

PHASE 2 CONFIRMATORY SAMPLING REPORT

FORT STEWART

HINESVILLE, GEORGIA

SEPTEMBER 2011

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DoD Contract Number: W912DR-09-D-0016

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ARCADIS/Malcolm Pirnie, Inc., prepared this report at the direction of the United States Army Corps of Engineers (USACE). This document should be used only with the approval of the USACE. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

SEPTEMBER 2011

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TABLE OF ACRONYMS

Acronym	Definition
°F	Degrees Fahrenheit
%	percent
3ID(M)	Third Infantry Division (Mechanized)
AAFES	Army and Air Force Exchange Service
AEDB-R	Army Environmental Database-Restoration
amsl	above mean sea level
bgs	below ground surface
BRAC	Base Realignment and Closure
cal	caliber
CMP	Composition
CMS	Corrective Measures Study
CS	Confirmatory Sampling
CSM	Conceptual Site Model
CTC	Cost-to-Complete
CTT	Closed, Transferred and Transferring
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DoD	Department of Defense
DOE	Department of Energy
EOD	Explosive Ordnance Disposal
FTSW	Fort Stewart
FUDS	Formerly Used Defense Site
FY	Fiscal Year
GA	Georgia

TABLE OF ACRONYMS

Acronym	Definition
GPS	Global Positioning System
HE	High Explosive
HEP	High Explosive Plastic
HRR	Historical Records Review
IBCT	Infantry Brigade Combat Team
ID	Infantry Division
ITRC	Interstate Technology and Regulatory Council
m	meters
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
mm	millimeter
MMRP	Military Munitions Response Program
mph	miles per hour
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix Spike / Matrix Spike Duplicate
NFA	No Further Action
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylene trinitramine
RFI	Resource Conservation and Recovery Act Facility Investigation
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
TNT	Trinitrotoluene
TPP	Technical Project Planning

TABLE OF ACRONYMS

Acronym	Definition
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance

GLOSSARY OF TERMS

Closed Range – A military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Department of Defense (DoD) component.

Defense Site – Locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions.

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance (UXO), military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations.

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of UXO and other munitions that have become an imposing danger (for example, by damage or deterioration).

Explosives Safety – A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects of risks of potential mishaps involving military munitions.

Formerly Used Defense Site (FUDS) – A DoD program that focuses on compliance and cleanup efforts at sites that were formerly used by the DoD. A FUDS property is eligible for the Military Munitions Response Program if the release occurred prior to October 17, 1986; the property was transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria.

Military Munitions – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, United States Coast Guard, Department of Energy (DOE), and National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof.

The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 United States Code [U.S.C.] 2011 et seq.) have been completed.

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, includes: UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); and munitions constituents (e.g., trinitrotoluene [TNT], cyclotrimethylenetrinitramine [RDX]) present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC) – Any materials originating from UXO, DMM, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Munitions Debris – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities.

Range – A designated land or water area set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration.

Transferred Range – A range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was used under the terms of an executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. Additionally, property that was previously used by the military as a range, but did not have a formal use agreement, also qualifies as a transferred range.

Transferring Range – A range that is proposed to be leased, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An active range will not be considered a transferring range until the transfer is imminent (generally defined as the transfer date is within 12 months and a receiving entity has been notified).

Unexploded Ordnance (UXO) – Military munitions that (A) have been primed, fused, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in

such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause.

EXECUTIVE SUMMARY

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites with munitions and explosives of concern (MEC) (which include unexploded ordnance [UXO] and discarded military munitions [DMM]) and munitions constituents [MC]). The United States (U.S.) Army's inventory of closed, transferred, and transferring (CTT) military ranges and defense sites has identified sites eligible for action under the MMRP. The MMRP eligible sites include other than operational ranges where MEC are known or suspected. Properties classified as operational ranges, operating storage or manufacturing facilities, or permitted military munitions disposal facilities are not eligible and, therefore, are excluded from the MMRP. This report presents the results of the MMRP Resource Conservation and Recovery Act (RCRA) Phase 2 Confirmatory Sampling (CS) conducted at Fort Stewart (FTSW) in Bryan, Evans, Liberty, Long, and Tattnall counties, Georgia (GA).

An installation-wide MMRP CS Report was completed at FTSW in November 2007 (Pirnie, 2007). FTSW recently has expanded the cantonment area; to accomplish the expansion; an approximately 4,240-acre portion of the operational footprint has been re-designated as other than operational and is no longer excluded from the MMRP. An additional 1,072 acres of the operational footprint were closed within Training Area B-5 on 7 March 2011. This Phase 2 MMRP CS Report is a continuation of the initial 2007 MMRP CS Report and is focused on evaluating the potential presence of historical munitions use on the 4,240-acre re-designated parcel. A Phase 2 Historical Records Review (HRR), completed in June 2010, identified four sites: the Anti-Aircraft Range – 4, Anti-Tank Range 90-MM – 2, Grenade Launcher Range, and Small Arms Range - 2 (Map 1-1). These sites are the basis for this Phase 2 CS Report.

FTSW consists of 279,081 acres and is located north of Hinesville, GA, approximately 40 miles southwest of Savannah, GA. FTSW is the largest Army installation east of the Mississippi River, spanning portions of Bryan, Evans, Liberty, Long, and Tattnall counties. Georgia Highway 119, which runs north to south from Pembroke to Hinesville, and Georgia Highway 144, which runs east to west from Richmond Hill to Glennville, bisect FTSW. Situated south of Interstate 16 and west of Interstate 95, the installation boundaries are roughly defined by the

intersection of Interstate 16 and Interstate 95 and the cities of Richmond Hill, Hinesville, Glennville, Claxton, and Pembroke.

The Phase 2 CS at the MMRP sites at FTSW included both MEC and MC field activities, which were conducted from August 23, 2010 through August 26, 2010.

MEC

MEC field activities included magnetometer-assisted, visual surveys of munitions response sites (MRS) where HRR findings indicated a potential for MEC. The goal of the MEC fieldwork was to conduct a visual survey of the MRSs to identify range features and to determine whether MEC are present on the MRSs. At the Small Arms Range – 2, an all-metals detector was used to identify range features.

In June of 2009, the United States army Corps of Engineers (USACE) Savannah District began construction on the 4th Infantry Brigade Combat Team (IBCT) site that will incorporate over 457 acres of site development on the Anti-Aircraft Range-4 (Appendix J). During the course of construction efforts on this project, site workers encountered munitions debris and MEC items during site grading and during the spreading of soil from two stockpiles amassed during grading activities. The majority of the Explosive Ordnance Disposal (EOD) responses involved M2 training rockets; however, only limited information was received from Range Control. Work in an area where soil had been spread was put on hold 1 December 2010 when a MEC item was discovered by a contractor.

During the period of 14-26 February 2011, the USACE, Baltimore District Explosive Safety Staff conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest within the 4th Infantry Brigade Combat Team construction site to address any remaining munitions debris or MEC (Appendix J). A MEC removal action was also conducted in two construction sites (10th Engineering Battalion and Dog Kennel) which are adjacent to the 4th IBCT construction site. A total of 7 small arms (50-caliber), 16 munitions debris (15 M2 Target Rockets and one 3.5” rocket motor) and one MEC item (Point Detonating Fuze) were recovered as a result of this investigation. Per the results of this investigation the USACE recommended, “That the remaining areas within the construction site undergo a MEC Quality Assurance

Investigation to Depth of Detection in order to ensure that these areas warrant a "low probability" categorization as well."

Following the February 2011 field effort, the USACE Savannah District and FTSW Installation Officials requested that the USACE Baltimore District Explosive Safety Staff conduct a MEC Investigation to Depth of Detection on a five acre site identified as the Army & Air Force Exchange Service (AAFES) Mini Mart Future Construction Site located in close proximity to the 4th Infantry Brigade Combat Team Construction site (Appendix K). This investigation was conducted during the period of 13-21 April 2011. A total of 54 M2 Target Rockets, 19 M2 Target Rocket Motors and two 81 millimeter (mm) Practice Mortars were recovered. All items were identified as munitions debris and turned over to the local EOD unit for disposal. The results of this investigation indicate that construction efforts on the site are safe to continue following "low probability" for encountering MEC protocols.

Based on the explosive hazard probably designations assigned during the investigations performed by USACE Baltimore District Explosive Safety, the Anti-Aircraft Range-4 MRA was divided into two MRSs. This will be instrumental in managing the MRA through future investigations. The first MRS, Anti-Aircraft Range-4-A, includes the construction areas where the investigations and removal activities were conducted; this area was assigned a low probability for encountering MEC designation. The second MRS, Anti-Aircraft Range-4-B, encompasses the undeveloped portion of the site that was assigned a low probability for encountering MEC designation.

MC

MC fieldwork included the collection and analysis of surface soil samples for a select set of metals and explosives, as appropriate based on the HRR findings and agreements made during and after the Technical Project Planning (TPP) meeting. The goal of the MC field activities was to determine the presence or absence of residual MC resulting from activities conducted by the DoD during operation of these sites that may pose a threat to human health and/or the environment. This determination is made by obtaining biased or random surface soil samples and analyzing the samples for MC.

The standard analytical methods include United States Environmental Protection Agency (USEPA) Methods 6010B for metals and USEPA Method 8330B modified for explosives. USEPA Method 6010B was used for the analysis of aluminum, antimony, copper, lead, and zinc. All laboratory method detection and reporting limits were set to achieve screening against the following, in the listed order:

FTSW Inorganic/Metal Background Study (April 2000)

USEPA Regional Screening Levels (RSL) for residential soil

USEPA Region 4 Ecological Screening Values for surface soil

No samples collected showed detections for explosives or exceeded USEPA RSLs for metals. Lead exceeded Region 4 Ecological Screening Values at the Grenade Launcher Range (three of fourteen samples) and the Small Arms Range – 2 (three samples and one duplicate of ten samples). Zinc exceeded Region 4 Ecological Screening Values at the Anti-Tank 90-MM – 2 Range (one of four sample). The concentrations of zinc and lead observed at Grenade Launcher Range and the Anti-Tank Range 90-MM – 2, respectively, were less than an order of magnitude above the established background levels; this is likely indicative of naturally occurring conditions and not evidence of an impact of the former land use.

Table ES-1 summarizes the results of the Phase 2 CS activities and recommendations for each MRS.

Table ES-1: Phase 2 CS Findings and Recommendations

MRS	Phase 2 CS Recommendation	Basis for Recommendation	
		MEC	MC
Anti-Aircraft Range – 4 (FTSW-009-R-01)	RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS)	Based on two historic EOD responses and numerous EOD responses during on-going construction activities, the Anti-Aircraft Range -4 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.
	Split into two MRSs: Anti-Aircraft Range -4-A &Anti-Aircraft Range-4-B	Based on the results of the two MEC investigations conducted by USACE Baltimore District Explosive Safety staff, the constructed area of the MRS was deemed “low probability” for explosive hazard. The remainder of the site remains a medium to high probability for encountering MEC.	None
Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)	RFI/CMS	Based on the discovery of an inert mine, the Anti-Tank Range 90-MM – 2 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

MRS	Phase 2 CS Recommendation	Basis for Recommendation	
		MEC	MC
Grenade Launcher Range (FTSW-011-R-01)	RFI/CMS	Based on range features and observed munitions debris, the Grenade Launcher Range is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.
Small Arms Range – 2 (FTSW-006-R-01)	RFI/CMS	Two unexpected munitions debris items, a 9mm projectile and a 25mm expended cartridge, were found during the visual survey. Based on munitions debris finds and two historic EOD responses, the Small Arms Range – 2 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

ACKNOWLEDGMENTS

The Phase 2 Confirmatory Sampling (CS) field activities were performed at Fort Stewart (FTSW) from August 23, 2010 through August 26, 2010 by ARCADIS/Malcolm Pirnie, Inc., as part of the Military Munitions Response Program (MMRP) for the Department of Defense. The entire Phase 2 CS process began in August 2009 and is scheduled to conclude in September 2011. ARCADIS/Malcolm Pirnie, Inc. would like to acknowledge the following people for their participation and cooperation throughout the Phase 2 CS process:

United States Army Environmental Command — Mary Ellen Maly, Restoration Oversight Manager

United States Army Corps of Engineers — Marc Randrianarivelo, FTSW MMRP Site Inspection Project Manager

Georgia Environmental Protection Division — Amy Potter, Project Manager

FTSW — Algeana Stevenson, Installation Restoration Program Manager

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1 INTRODUCTION

1.1 MILITARY MUNITIONS RESPONSE PROGRAM OVERVIEW

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites with munitions and explosives of concern (MEC) (which include unexploded ordnance [UXO] and discarded military munitions [DMM]) and munitions constituents (MC). The United States (U.S.) Army's inventory of closed, transferred, and transferring (CTT) military ranges and defense sites has identified sites eligible for action under the MMRP. The MMRP eligible sites include other than operational ranges where MEC are known or suspected. Properties classified as operational ranges, operating storage or manufacturing facilities, or permitted military munitions disposal facilities are not eligible and, therefore, are excluded from the MMRP.

An installation-wide MMRP Confirmatory Sampling (CS) Report was completed at Fort Stewart (FTSW) in November 2007; this will be referred to as the Phase I CS Report throughout this document. FTSW recently has expanded the cantonment area; to accomplish the expansion; an approximately 4,240-acre portion of the operational footprint has been re-designated as other than operational and is no longer excluded from the MMRP. An additional 1,072 acres of the operational footprint were closed within Training Area B-5 on 7 March 2011. This Phase 2 MMRP CS Report is a continuation of the initial 2007 MMRP CS Report and is focused on evaluating the potential presence of historical munitions use on the 4,240-acre re-designated parcel. A Phase 2 Historical Records Review, completed in June 2010, identified four Munitions Response Sites (MRS): the Anti-Aircraft Range – 4, Anti-Tank Range 90-MM – 2, Grenade Launcher Range, and Small Arms Range - 2 (Map 1-1).

This report presents the results of the MMRP Resource Conservation and Recovery Act (RCRA) Phase 2 CS conducted at FTSW in Bryan, Evans, Liberty, Long, and Tattnall counties, Georgia (GA), and is intended to meet the requirements of an MMRP Site Inspection report under the Comprehensive Environmental Response, Compensation, and Liability Act. ARCADIS/Malcolm Pirnie is performing the Phase 2 CS on the FTSW installation from August 2009 to September 2011.

The following MRSs (with their associated Army Environmental Database-Restoration [AEDB-R] identification numbers) were investigated as part of this Phase 2 CS:

- Anti-Aircraft Range – 4 (FTSW-009-R-01)
- Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)
- Grenade Launcher Range (FTSW-011-R-01)
- Small Arms Range – 2 (FTSW-006-R-01)

1.2 PURPOSE, SCOPE, AND OBJECTIVES

The primary goal of the Phase 2 CS was to collect a sufficient amount of information necessary to make one of the following decisions: 1) whether a RCRA Facilities Investigation (RFI) / Corrective Measures Study (CMS) is required at a MRS; 2) whether an immediate response is needed; or 3) whether the MRS qualifies for no further action (NFA). The Phase 2 CS at FTSW addressed MEC and MC on four ranges for these MMRP eligible sites. The secondary goal of the Phase 2 CS was to collect information for building the MMRP, including site prioritization for the MMRP eligible sites.

The field activities for the Phase 2 CS were not intended to confirm all types of MEC present, determine MEC density, or define the limits of the MEC impacts. The goal of the field sampling activities is to determine if MEC were present or absent at the MRSs and to determine if the MRSs have been impacted by the MC associated with their historical use. The Phase 2 CS field activities were not intended to delineate the nature and extent of MC contamination.

1.3 PROJECT DRIVERS

The key legislative, administrative, and historical precedents for managing MMRP sites include the following:

Defense Environmental Restoration Program (DERP) Management Guidance (September 2001)

The DERP Management Guidance established an MMRP element for UXO, DMM, and MC defense sites. The history of DERP dates back to the Superfund Amendments and

Reauthorization Act (SARA) of 1986. The scope of the DERP is defined in 10 United States Code (U.S.C.) §2701(b), which states that the:

Goals of the program shall include the following: … (1) The identification, investigation, research and development, and cleanup of contamination from hazardous substances, and pollutants and contaminants. (2) Correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment.

Army DERP Management Guidance for Active Installations (November 2004)

The Army DERP Management Guidance provides guidance for active installations and non-Base Realignment and Closure (BRAC) excess properties on the management of the Army Installation Restoration Program, the MMRP, and the Building Demolition and Debris Removal Program categories that are related to environmental cleanup. The Army DERP Management Guidance does not apply to Army restoration activities overseas, the BRAC Environmental Restoration Program, the Compliance-Related Cleanup Program, or the Formerly Used Defense Sites Restoration Program. The guidance document was provided to implement the Army's DERP in accordance with the DoD Management Guidance for the DERP (September 2001). The Army DERP Management Guidance supplements the roles, responsibilities, and procedures contained in Army Regulation 200-1 and Department of the Army Pamphlet 200-1.

National Defense Authorization Act (Fiscal Year [FY] 02) (Sections 311-312)

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced the DoD's 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to contain MEC or MC. Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with the states and Tribes. Section 312 requires the DoD to create a separate program element to ensure that the DoD can identify and track munitions response funding.

The September 2001 DoD Management Guidance for the DERP and the National Defense Authorization Act of FY02, described above, established the MMRP. The DERP and the

MMRP provide guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, UXO, DMM, or MC.

In December 2008, the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics issued a memorandum outlining an interim policy for DERP eligibility. This memorandum reevaluated policies related to DERP eligibility, which resulted in the inclusion of compliance related cleanup sites under DERP. This interim policy also rescinded the September 30, 2002, MMRP eligibility cutoff date. The previous guidance stated that MMRP eligible sites include other than operational ranges where UXO, DMM, and/or MC are known or suspected and the release occurred prior to September 30, 2002. As a result of this interim guidance, sites meeting eligibility guidelines with releases occurring after September 30, 2002, are MMRP eligible.

Munitions Response Site Prioritization Protocol

The Munitions Response Site Prioritization Protocol (MRSPP) reflects the statement in 10 U.S.C. § 2710(b)(2) that the priority assigned should be based on the overall conditions at each location, taking into consideration various factors relating to safety and environmental hazard potential. As required under 10 U.S.C. § 2710(b)(1), the priority assigned to each MRS will be included with the inventory information made publicly available. The requirement for an inventory of munitions response sites known or suspected of containing UXO, DMM, or MC is found in 10 U.S.C. § 2710(a). The assigned priority will be updated annually to reflect new information that becomes available.

The Department of Defense first published the MRSPP in the Federal Register as a proposed rule on 22 August 2003. The rule was finalized on 05 October 2005 under the authority of Section 311(b) of the National Defense Authorization Act, codified at Section 10 U.S.C. § 2710(b). The tables in Appendix F (Munitions Response Site Prioritization Protocol) reflect the changes incorporated in the final rule, many of which pertained to clarification of terms and definitions based on new statutory definitions promulgated in the National Defense Authorization Act for 2004 and codified at 10 U.S.C. § 101. These tables also include the revised module that evaluates potential health hazards associated with MC. This module now has seven potential

outcomes (i.e., A through G) rather than the three potential outcomes described in the proposed rule (i.e., high, medium, and low).

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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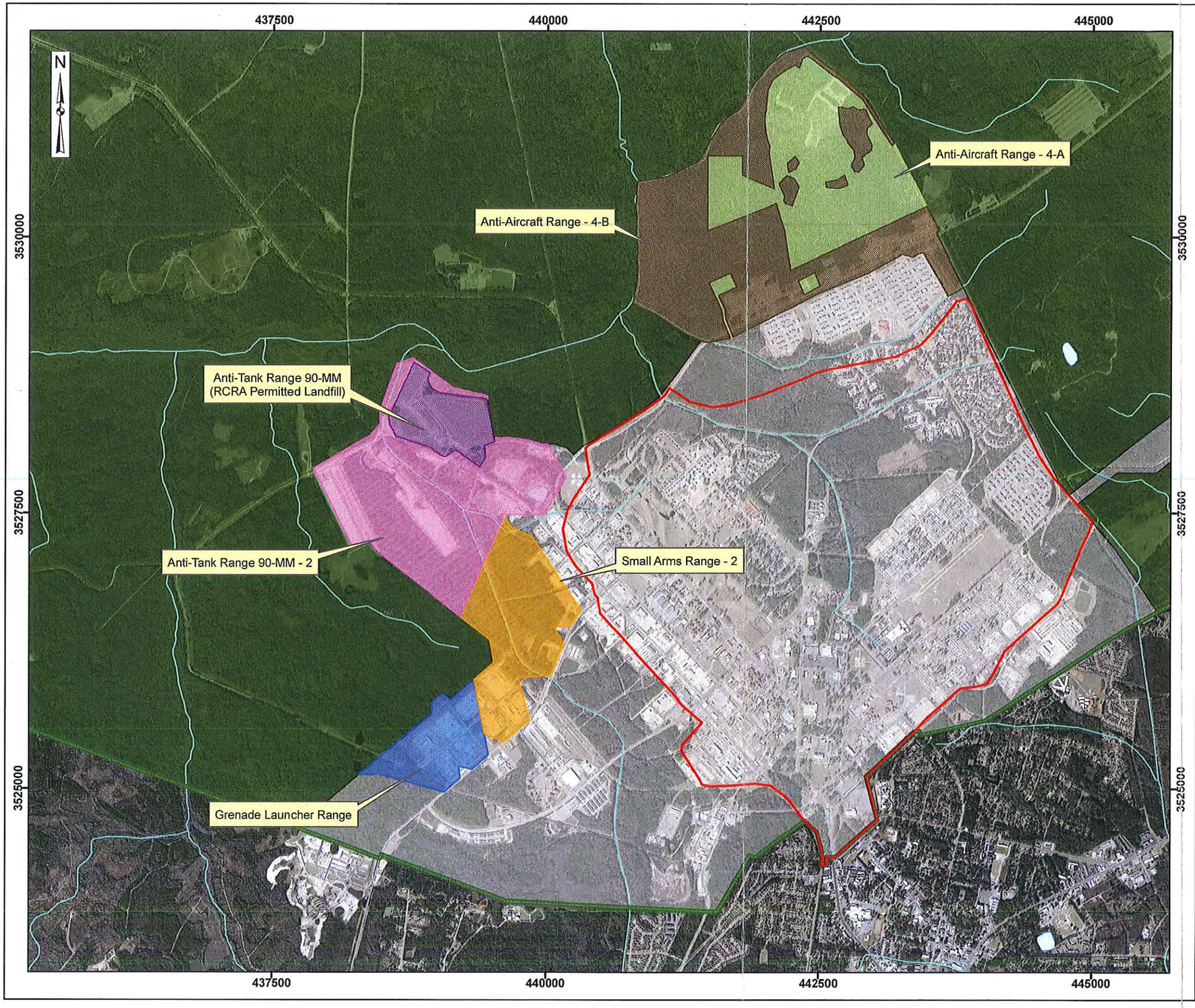
Map 1-1
Overview of MMRP Ranges



Legend

Installation Data
- Installation Boundary
- Other than Operational Area (2006 Boundary)
- Other than Operational Area (March 2011 boundary)
- Operational Area

Phase 2 MRS (Other than Operational Area)
- Small Arms Range - 2
- Anti-Tank Range 90-MM - 2
- Anti-Aircraft Range - 4A
- Anti-Aircraft Range - 4B
- Grenade Launcher Range

Phase 1 MRS
- Anti-Tank Range 90-MM (RCRA Permitted Landfill)

Hydrology
- River/Stream
- Water Body

0 500 1,000 1,500 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0004
Edition: Final
Date: June 2012

2 INSTALLATION OVERVIEW

2.1 INSTALLATION HISTORY

FTSW consists of 279,081 acres and is located north of Hinesville, GA, approximately 40 miles southwest of Savannah, GA. FTSW is the largest Army installation east of the Mississippi River, spanning portions of Bryan, Evans, Liberty, Long, and Tattnall counties. Georgia Highway 119, which runs north to south from Pembroke to Hinesville, and Georgia Highway 144, which runs east to west from Richmond Hill to Glennville, bisect FTSW. Situated south of Interstate 16 and west of Interstate 95, the installation boundaries are roughly defined by the intersection of Interstate 16 and Interstate 95 and the cities of Richmond Hill, Hinesville, Glennville, Claxton, and Pembroke.

Construction of the reservation that was to become FTSW began on September 10, 1940, on what was formerly the Camp Savannah Anti-Aircraft Firing Center. On November 18, 1940, the reservation's name was changed from Camp Savannah to Camp Stewart in honor of the Revolutionary War Brigadier General Daniel Stewart. The reservation was established as an anti-aircraft center with facilities to prepare artillery troops for overseas deployment.

The reservation's mission of training anti-aircraft units ended on November 20, 1944, and all training terminated in December 1944. Army ground forces units were to have departed by April 30, 1945. A prisoner-of-war camp that was operated at the reservation was also closed. The reservation's mission was reestablished as a separation center for redeployed troops from August 6, 1945, until September 2, 1945. On September 30, 1945, Camp Stewart was inactivated, and the reservation became a location for training the Georgia National Guard. From a peak strength of 55,000 soldiers during the spring of 1944, only two officers, 10 enlisted men, and 50 civilian employees remained by the fall of 1945 to maintain the facilities.

With the outbreak of hostilities in Korea in June 1950, Camp Stewart was reactivated on August 9, 1950, and was designated the 3rd Army Anti-Aircraft Artillery Training Center. In 1953, armor and tank training was added to the mission of the reservation. On March 21, 1956, Camp Stewart was re-designated as Fort Stewart and was designated a permanent Army installation. In 1959, FTSW became an armor and artillery firing center. Troop training at FTSW peaked in

1961 and 1962 in response to the Berlin and Cuban crises, respectively. The 1st Armored Division was relocated to the reservation during the Cuban crisis.

In response to a need for more helicopter and light fixed wing aircraft in support of the Vietnam conflict, an element of the U.S. Army Aviation School at Fort Rucker, Alabama, was transferred to FTSW in 1966. Helicopter pilot training and helicopter gunnery courses became the new mission for FTSW.

In 1967, the main mission for FTSW was to train Army aviators. The reservation was also used to maintain readiness for other active duty, Reserve, and National Guard personnel. In 1970, Vietnamese helicopter pilots began training at FTSW. Aviation training at FTSW was phased out in 1973, when all aviation training was consolidated at Fort Rucker. By 1974, FTSW had become a training and maneuver area, providing tank, field artillery, helicopter gunnery, and small arms training for Regular Army and National Guard units. FTSW supported training by providing facilities, conducting training opportunities, and assisting in the mobilization and deployment of troops.

In 1974, the 1st Battalion, 75th Infantry Regiment (Ranger) was reactivated at FTSW. Later that year, the 24th Infantry Division was activated on the reservation.

Currently, the 3rd Infantry Division (Mechanized) (3ID [M]) is the major unit located at FTSW

with the following major units: 1st Brigade, 3ID(M); 2nd Brigade, 3ID(M); 3ID Artillery; 3ID Support Command; 3ID Engineer Brigade; 3/7 Cavalry; 1/3 Air Defense Artillery; 103d Military Intelligence Battalion; 123d Signal Battalion; 3d Military Police Battalion (Provisional); and 24th Corps Support Groups. The 3d Brigade, 3ID (M) operates out of Fort Benning, GA, but often trains at FTSW. Currently, the mission of FTSW is to sustain a quality of life and reservation support at the level necessary for divisions and non-divisional, tenant, and Reserve Component units to accomplish their training missions.

Hunter Army Airfield is a subinstallation to FTSW and is located approximately 45 miles southwest of FTSW. It occupies approximately 5,400 acres and, along with FTSW, acts as a home to the 3ID(M).

2.2 PREVIOUS INVESTIGATIONS

Detailed descriptions of the previous investigations that were conducted at FTSW are presented in the Historical Records Review (HRR). Based on the data repositories reviewed for the Phase 2 CS, the following additional investigations that contain relevant information and supplements information presented in the HRR at FTSW were identified:

- The *Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia, Volume I of III* (April 2000) provided background concentrations for metals at FTSW.
- The *Final Confirmatory Sampling, Fort Stewart, Georgia (October 2007)* provided background information for the surrounding MRSs at FTSW.
- The *Final Preliminary Assessment for the Small Arms Range – 2, Fort Stewart, Georgia (January 2009)* determined that the Small Arms Range – 2 was eligible for MMRP.

Following the CS fieldwork, two MEC investigations were conducted by USACE Baltimore District Explosive Safety due to EOD responses within the 4th Infantry Brigade Combat Team construction site within the footprint of Anti-Aircraft Range-4. These investigations are described in Sections 4.1.1 and 4.1.3.1.

3 CONFIRMATORY SAMPLING OVERVIEW

3.1 CONFIRMATORY SAMPLING TASKS

The FTSW Phase 2 CS included both MEC and MC field activities, which were conducted from August 23, 2010 to August 26, 2010. Field activities included locating surface evidence of MEC and munitions debris through magnetometer-assisted visual surveys and collecting surface soil to analyze for MC of concern (aluminum, antimony, copper, lead, zinc, and explosives, where appropriate). The MC were selected based on the types of munitions known to have been used at the MRSs. The purpose of the field activities was to collect sufficient information to determine whether MEC or MC above selected screening criteria are present at each MRS to support one of the following decisions: 1) whether an RFI/CMS is required at a MRS; 2) whether an immediate response is needed; or 3) whether the MRS qualifies for NFA.

Summaries of both the MEC and MC activities conducted at each of the MRSs are provided in Section 4. The MEC and MC activities conducted at each of the MRSs were selected based on results of the Technical Project Planning (TPP) session held on 29 April 2010, and decisions made and agreed upon after the TPP session. The Work Plan, finalized August 2010, dictated both the MEC and MC sampling/field activities conducted at FTSW.

The goal of the MEC field activities at each MRS was to determine if MEC were present on the surface. Due to the potential hazards associated with the presence of MEC, a UXO Technician escorted the field team members during the reconnaissance activities using MEC avoidance techniques. The locations of munitions debris items encountered were documented using a handheld Global Positioning System (GPS). MEC were not encountered at any of the MRSs on FTSW. Additionally, each munitions training related feature or munitions debris encounter was documented in the field logbook (Appendix A). Observations made during the magnetometer-assisted visual survey were used to determine biased soil sampling locations where possible.

The MEC field activities were conducted at all of the four MRSs:

- Anti-Aircraft Range – 4
- Anti-Tank Range 90-MM – 2
- Grenade Launcher Range
- Small Arms Range – 2

The goal of the MC field activities was to determine if MC was present at levels potentially posing an unacceptable risk at each MRS. As agreed at the 29 April 2010 TPP session and as described in the Final Work Plan dated August 2010, MC field activities were conducted at all MRS. Where possible, samples were collected in biased locations where evidence of munitions related use was observed. An all-metals detector assisted visual survey was conducted to locate remnants of small arms rounds in an attempt to identify biased sample locations and berm locations. Rationale for each soil sample location is provided in the Soil Sample Logs included in Appendix B. MEC Discovery Forms are also included in Appendix B. A hand-held GPS unit was used to record all sample locations. Samples were analyzed for metals, and/or explosives using United States Environmental Protection Agency (USEPA) Methods 6010B (aluminum, antimony, copper, lead, and zinc) and 8330B modified (explosives). Anomaly avoidance techniques were utilized during the MC field sampling activities Table 3-1 and Table 3-2 summarize the TPP decisions that dictated the field activities at FTSW.

Table 3-1: Summary of 29 April 2010 TPP MEC Decisions

MRS	MEC Phase 2 CS Activities	
	Activity	**Purpose**
Anti – Aircraft Range -4 **(FTSW-009-R-01)**	Magnetometer assisted visual survey during sampling activities of 100 percent (%) of the undeveloped acres (20 acres).	Provide additional data to support future RFI/CMS activities for this MRS based on historical evidence of multiple overlapping range fans and multiple explosive ordnance disposal (EOD) responses.
Anti – Tank Range 90-MM – 2 **(FTSW-010-R-01)**	Magnetometer assisted visual survey during sampling activities of 10% of the undeveloped acres (33 acres).	Provide additional data to support future RFI/CMS activities for this MRS based on historical evidence of multiple overlapping range fans.
Grenade Launcher Range **(FTSW-011-R-01)**	Magnetometer assisted visual survey during sampling activities of 10% of the undeveloped acres (4 acres).	Provide additional data to support future RFI/CMS activities for this MRS based on historical evidence of multiple overlapping range fans.
Small Arms Range – 2 **(FTSW-006-R-01)**	No MEC field activities are required because only small arms were used at the MRS.	

Table 3-2: Summary of 29 April 2010 TPP MC Decisions

MRS	MC Phase 2 CS Activities	
	Activity	**Purpose**
Anti – Aircraft Range – 4 **(FTSW-009-R-01)**	Collect 4 discrete surface soil samples. Sample locations will be randomly distributed unless biased locations are identified. Analyze for explosives and metals using USEPA Methods 8330B modified and 6010B.	To provide additional data to support future MC RFI/CMS activities for this MRS. To provide data to complete the MRSPP. To gain a greater understanding of site conditions related to MC to support the next study phase and to complete the cost to complete (CTC). Compare data to: • FTSW Inorganic/Metal Background Study • USEPA Regional Screening Levels (RSL) for Residential Soil • USEPA Region 4 Ecological Screening Values for surface soil

MRS	MC Phase 2 CS Activities	
	Activity	**Purpose**
Anti – Tank Range 90-MM – 2 **(FTSW-010-R-01)**	Collect 4 discrete surface soil samples. A minimum of two samples will be biased and collected from the firing points of the Anti-Tank 90-MM and Anti-Aircraft 40MM ranges. The remaining two contingency samples will be randomly distributed unless biased locations are identified. Analyze for explosives and metals using USEPA Methods 8330B modified and 6010B.	To provide additional data to support future MC RFI/CMS activities for this MRS. To provide data to complete the MRSPP. To gain a greater understanding of site conditions related to MC to support the next study phase and to complete the CTC. Compare data to: • FTSW Inorganic/Metal Background Study • USEPA RSL for Residential Soil • USEPA Region 4 Ecological Screening Values for surface soil

MRS	MC Phase 2 CS Activities	
	Activity	**Purpose**
Grenade Launcher Range **(FTSW-011-R-01)**	Collect 14 discrete surface soil samples. Three samples each will be collected from the location of the berms of Ranges H, B, and A. Additionally, three samples will be collected from the firing point of the 120-MM Anti-Aircraft Range. The remaining two contingency samples will be randomly distributed unless biased locations are identified. Analyze for explosives and metals using USEPA Methods 8330B modified and 6010B.	To provide additional data to support future MC RFI/CMS activities for this MRS. To provide data to complete the MRSPP. To gain a greater understanding of site conditions related to MC to support the next study phase and to complete the CTC. Compare data to: • FTSW Inorganic/Metal Background Study • USEPA RSL for Residential Soil • USEPA Region 4 Ecological Screening Values for surface soil

MRS	MC Phase 2 CS Activities	
	Activity	**Purpose**
Small Arms Range – 2 **(FTSW-006-R-01)**	Collect a total of 10 discrete surface soil samples. Eight of the ten samples will be collected from Range N. Two samples will be collected from each of the four firing positions/berms on Range N. The remaining two samples will be randomly distributed unless biased locations are identified. *Because locations of historic EOD locations are known, collect one sample at each of the two locations. (This takes the place of the biased samples.) Analyze samples for explosives and metals using USEPA Methods 8330B modified and 6010B. Analyze remaining samples for lead by USEPA Method 6010B.	To provide additional data to support future MC RFI/CMS activities for this MRS. To provide data to complete the MRSPP. To gain a greater understanding of site conditions related to MC to support the next study phase and to complete the CTC. Compare data to: • FTSW Inorganic/Metal Background Study • USEPA RSL for Residential Soil • USEPA Region 4 Ecological Screening Values for surface soil

*Task was added after the TPP session.

3.2 DEVIATIONS FROM WORK PLAN

The TPP Meeting Minutes are provided as Appendix H. The details regarding the field sampling procedures are presented in the Final Phase 2 CS Work Plan (August 2010). Deviations from the procedures described in the work plan during the Phase 2 CS field activities are outlined below:

- All duplicate and matrix spike / matrix spike duplicate samples were analyzed for metals and explosives.
- During the magnetometer-assisted visual survey, the transects were not evenly spaced on any of the MRSs due to field conditions.
- Anti-Aircraft Range - 4 –A large portion of the area has been under construction since the last phase of work at this site. Because much of this area is now fenced and inaccessible due to on-going construction, the accessible areas for CS activities were greatly decreased. As agreed in the 29 April 2010 TPP meeting and stated in the Work Plan, samples would only be collected within accessible areas of the MRS. All four planned samples were collected within the accessible areas.
- Anti-Tank Range 90-MM-2 – Portions of the MRS were inaccessible due to flooding or were located in a large borrow pit. This decreased the undeveloped accessible areas of the MRS.
- Small Arms Range – 2 – Five suspected berms were found on Range N, instead of the four previously believed. The eight samples planned for Range N were split between the berms: two from each of the three westernmost berms and one each from the two eastern berms.

3.3 CONFIRMATORY SAMPLING FINDINGS

The results of the Phase 2 CS field activities conducted at FTSW, including MEC and MC findings for each MRS, are discussed in Section 4. The munitions debris items identified, as well as other significant visual observations, were recorded using a Trimble Geoexplorer XH handheld GPS unit. Sampling locations were recorded using the handheld GPS unit and were photo documented; notes regarding each sampling location were written in the Soil Sample Logs. The field notes and observations made during the Phase 2 CS field activities are documented in

Appendix A (Field Notes), Appendix B (Field Forms), and Appendix C (Photographic Log). Analytical results from Katahdin Analytical Services and the quality control verification data are provided as Appendix D. Geographic coordinates of field observations (including MEC items, munitions debris items, and other notable items) and surface soil sampling locations are provided in Appendix E. The MRSPP are included in Appendix F. The Ordnance Technical Data Sheets are provided in Appendix G. The TPP Meeting Minutes are provided as Appendix H. The Record of Environmental Consideration, prepared by FTSW Environmental Division under National Environmental Policy Act guidelines, is provided in Appendix I.

FTSW background levels of metals in soils were used as initial screening criteria for MC results. Analytical data were compared to the following criteria:

- FTSW Inorganic/Metal Background Study (April 2000)
- USEPA Regional Screening Levels (RSLs) for residential soil
- USEPA Region 4 Ecological Screening Values for surface soil

4 CONFIRMATORY SAMPLING DETAILS

This section presents the site-specific information for each MRS at FTSW. Each MRS subsection includes: a site description and historical overview, an overview of the fieldwork activities that occurred on the MRS, the results of the fieldwork, the conceptual site model (CSM), a site summary, and site recommendations. Analytical Tables 4-2, 4-6, 4-10, and 4-14 include the following:

- FTSW inorganic background values,
- regulatory screening criteria,
- method detection limits,
- laboratory reporting limits, and
- analytical results.

4.1 ANTI-AIRCRAFT RANGE – 4 (AEDB-R ID: FTSW-009-R-01)

4.1.1 Site Description and Historical Overview

The Munitions Response Area (MRA) layout, location, and approximate sample points are presented on Map 4-1. This MRA is a 1,128-acre parcel located in the northern portion of the cantonment area and was used for anti-aircraft range training from 1941 to 1964. The MRA is composed of the firing points of a total of three separate/collocated ranges. The combined acreage covered by these three historical ranges is 85,325 acres, 1,128 acres of which are not in the operational range area and, thus, overlap the other than operational area and make up Anti-Aircraft Range–4. The boundary of the MRA was expanded to 661 acres southeast beyond the firing point area to include a currently undeveloped area where an EOD response was documented. The footprint was again increased to 1,128 when the remaining 1,072 acres of the operational footprint were closed within Training Area B-5 on 7 March 2011. Based on historical data reviewed for this HRR, the expected munitions use associated with this MRA includes 40 millimeter (mm) and 90mm anti-aircraft projectiles. The following EOD responses occurred at the site: “40mm” projectile (along the northern boundary of the site), “mortar round” (western central section of the site), “M67” hand grenade (along the southeast boundary) and

"2.75-inch rocket" (southern central section of the site). Additionally, one EOD response [labeled "EOD Response (no information)"] was reported along the southern boundary and northern central section of the site. Details regarding the munitions items encountered were not available.

In June of 2009, the USACE Savannah District began construction on the 4th Infantry Brigade Combat Team (IBCT) site that will incorporate over 457 acres of site development. A MEC removal action was also conducted in two construction sites (10th Engineering Battalion and Dog Kennel) which are adjacent to the 4th IBCT construction site. Construction on the IBCT construction site includes 20 barracks facilities, six company operations facilities, six tactical equipment maintenance facilities, a consolidated Brigade/Battalion Headquarters facility, a large dining facility, a physical fitness center, and a soldier family care clinic. Once complete, the area will house an entire brigade combat team (approximately 4,000 personnel). Construction was scheduled to be complete for a majority of the complex during the summer of 2011. During the course of construction efforts on this project, site workers encountered munitions debris and MEC items during site grading and during the spreading of soil from two stockpiles amassed during grading activities. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control. These responses are discussed in Section 4.1.3.1 and in Appendix J. Work in an area where soil had been spread was put on hold 1 December 2010 when a MEC item was discovered by a contractor.

During the period of 14-26 February 2011, the USACE, Baltimore District Explosive Safety Staff conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest within the 4th IBCT construction site at Fort Stewart. GA. The investigation consisted of conducting subsurface magnetometer investigations on pre-staged suspect soil piles and in areas where suspect soil had been spread. The purpose of this investigation was to determine if MEC hazards existed and if so to locate and remove all MEC hazards in order to allow safe construction activities to continue. Per the results of this investigation the USACE recommended, "That the remaining areas within the construction site receive a MEC Quality Assurance Investigation to Depth of Detection in order to ensure that these areas warrant a "low probability" categorization as well."

Following the February 2011 field effort, the USACE Savannah District and FTSW Installation Officials requested that the USACE Baltimore District Explosive Safety Staff conduct a MEC Investigation to Depth of Detection on a five-acre site identified as the AAFES Mini Mart Future Construction Site located in close proximity to the 4th Infantry Brigade Combat Team Construction site (Appendix K).

During the period of 13-21 April 2011, the USACE, Baltimore District Explosive Safety Staff conducted a MEC Investigation to Depth of Detection on the Future Mini Mart Site. The investigation consisted of conducting subsurface magnetometer investigation of the accessible areas on the five-acre site. The purpose of this investigation was to verify that these remaining areas could be classified as "low probability" for encountering MEC per the guidance established in the Department of Defense Explosive Safety Manual (6055.9M). There was no damage to utilities or facilities in the performance of this investigation. The results of this investigation indicate that construction efforts on the site are safe to continue following "low probability" for encountering MEC protocols.

4.1.2 Fieldwork Activities

4.1.2.1 MEC Activities and Purpose

Based on information presented in the HRR, the potential for MEC at the site exists. Therefore, a magnetometer assisted visual survey was performed during sample activities. Field personnel (escorted by a UXO Technician III) traversed the MRA to complete the magnetometer-assisted visual survey of the undeveloped areas.

4.1.2.2 MC Activities and Purpose

Four discrete surface soil samples were collected from randomly distributed locations. Based on the historical layout and use of this MRA, berms or burial areas were not anticipated therefore, only surface soil samples, at a depth of 0 – 6 inches, were collected. Soil samples were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified). Data was compared to FTSW inorganic/metal background values, USEPA Residential RSLs, and USEPA Region 4 Ecological Screening Values for Surface Soil for metals and explosives.

4.1.3 Fieldwork Results

4.1.3.1 MEC Results

A magnetometer-assisted visual survey was conducted in the accessible undeveloped areas of the MRA, as portions of the MRA are currently under construction and behind a fence. A foxhole was observed on the property (as shown in Appendix C). However, because the hole was very shallow and Airsoft bullets were found in the immediate vicinity it was assumed to be used by teenagers from the adjacent housing development, and not for military use. (Airsoft is a recreational activity using replica firearms that shoot small plastic pellets. It is commonly used for competitive gaming, similar to paintball).

No MEC or munitions debris were observed on the MRA. However, according to FTSW Range Control, a number of EOD responses were reported on the MRA during the construction activities within the fenced area from 31 August 2009 until work was halted on 1 December 2010. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control.

During the period of 14-26 February 2011, the USACE, Baltimore District Explosive Safety Staff conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest within the 4th IBCT construction site to address the EOD responses (Appendix J). A MEC removal action was also conducted in two construction sites (10^{th} Engineering Battalion and Dog Kennel) which are adjacent to the 4^{th} IBCT construction site. A total of 7 small arms (50-caliber), 16 munitions debris (15 M2 Target Rockets and one 3.5" rocket motor) and 1 MEC item (Point Detonating Fuze) were recovered as a result of this investigation. Per the results of this investigation the USACE recommended, "That the remaining areas within the construction site receive a MEC Quality Assurance Investigation to Depth of Detection in order to ensure that these areas warrant a "low probability" categorization as well."

Following the February 2011 field effort, the USACE Savannah District and FTSW Installation Officials requested that the USACE Baltimore District Explosive Safety Staff conduct a MEC Investigation to Depth of Detection on a five-acre site identified as the AAFES Mini Mart Future Construction Site located in close proximity to the 4^{th} IBCT Construction site (Appendix K). This investigation was conducted during the period of 13-21 April 2011. A total of 54 M2

Target Rockets, 19 M2 Target Rocket Motors and two 81mm Practice Mortars were recovered. All items were identified as munitions debris and turned over to the local EOD unit for disposal. The results of this investigation indicate that construction efforts on the site are safe to continue following "low probability" for encountering MEC protocols.

Based on the explosive hazard probably designations assigned during the investigations performed by USACE Baltimore District Explosive Safety, the Anti-Aircraft Range-4 MRA was divided into two MRSs. This will be instrumental in managing the MRA through future investigations. The first MRS, Anti-Aircraft Range-4-A, includes the construction areas where the investigations were conducted; this area was assigned a low probability for encountering MEC designation. The second MRS, Anti-Aircraft Range-4-B, encompasses the undeveloped portion of the site that was assigned a low probability for encountering MEC designation.

4.1.3.2 MC Results

Four discrete surface soil samples were collected at Anti-Aircraft Range - 4 and analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. The analytical data are summarized in Table 4-1, and sample locations are shown on Map 4-1. The following are the results of the soil sampling analysis at Anti-Aircraft Range - 4:

- **Metals:** All metals were detected well below USEPA RSLs and Region 4 Ecological Screening Values.
- **Explosives:** No explosives were detected above method detections or laboratory reporting limits.

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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Map 4-1
Anti-Aircraft Range - 4-A and Ant-Aircraft Range - 4-B

420000 425000 430000 435000 440000 445000 450000

3550000 3545000 3540000 3535000 3530000

N

40 MM
SS-04
EOD Response (no information)
Mortar Round
2.75 rocket
SS-02
SS-01
M67
SS-03
EOD Response (no information)

Legend

Installation Data
- Installation Boundary
- Other than Operational Area
- Operational Area
- Fenceline
- Cantonment Area
- Area Inaccessible Due to Construction

EOD Finds
- EOD Response

Confirmatory Sampling Data
- Sample Location
- Site Walk

Phase 2 MRS (Other than Operational Area)
- Anti-Aircraft Range - 4A
- Anti-Aircraft Range - 4B

Anti-Aircraft Range 90-MM - 2 Historical Fans
- 90-mm Anti-Aircraft (C Range) 1957,1962,1964
- 40-mm Anti-Aircraft (C 40-mm 11850 YRDS) 1941
- 90-mm Anti-Aircraft (C 90-mm 20500 YRDS) 1941

Hydrology
- River/Stream

0 2,000 4,000 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0043
Edition: Final
Date: September 2011

Table 4-1: Anti-Aircraft Range - 4

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-01-082310	FTSW-SS-02-082310	FTSW-SS-02DUP-082310	FTSW-SS-03-082310	FTSW-SS-04-082310
	mg/kg	mg/kg	mg/kg	mg/kg					
METALS (mg/kg)									
Aluminum	2	-	77,000	-	990	249	218	3960	638
Antimony	0.6	-	31	3.5	0.20 J	0.12 UJ	0.08 UJ	0.09 UJ	0.09 UJ
Copper	0.3	-	3,100	40	4.9	2.4 J	1.5 J	2.2	2.1
Lead	0.3	11.1	400	50	**12.8**	1.7	1.3	5.4	2.7
Zinc	0.7	15.5	23,000	50	2.8 J	0.40 J	0.39	5.3	1.2 J
EXPLOSIVES (ug/kg)									
EGDN	800	N/A	-	-	ND	ND	ND	ND	ND
PETN	800	N/A	-	-	ND	ND	ND	ND	ND
NG	800	N/A	6,100	1.6	ND	ND	ND	ND	ND
HMX	100	N/A	3,800,000	2300	ND	ND	ND	ND	ND
RDX	100	N/A	5,500	0.23	ND	ND	ND	ND	ND
1,3,5-TNB	100	N/A	2,200,000	3,900	ND	ND	ND	ND	ND
4-NT	100	N/A	30,000	3.9	ND	ND	ND	ND	ND
1,3-DNB	100	N/A	6,100	3.3	ND	ND	ND	ND	ND
NB	100	N/A	4,800	0.079	ND	ND	ND	ND	ND
TETRYL	100	N/A	240,000	1,400	ND	ND	ND	ND	ND
2,4,6-TNT	100	N/A	19,000	13	ND	ND	ND	ND	ND
4-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND
2-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND
2,6-DNT	100	N/A	61,000	50	ND	ND	ND	ND	ND
2,4-DNT	100	N/A	1,600	0.29	ND	ND	ND	ND	ND
2-NT	100	N/A	2,900	0.29	ND	ND	ND	ND	ND
3-NT	100	N/A	6100	3.4	ND	ND	ND	ND	ND

Notes:

(1) Information provided by Phase II RCRA Facility Investigation Report for 16 Solid Wate Management Units At Fort Stewart, GA

Bold	exceeded FTSW background
	exceeded USEPA Region 4 Ecological Soil Screening Values
	exceeded USEPA RSLs for Residential Soil

Definitions:

AM Amino
C Carcinogen
DNB Dinitrobenzene
EGDN Ethylene Glycol Dinitrate
HMX High Melting Point Explosive
mg/kg milligram/kilogram
µg/kg microgram/kilogram
N Non-carcinogen
J Analyte was positively identified; however, the result should be considered an estimated value
ND Analyte not detected above the method detection limit or laboratory reporting limit.
NB Nitrobenzene
NG Nitroglycerin
NT Nitrotoluene
PQL Project Quantitation Limit
PETN Pentaerythritol tetranitrate
RDX Cyclotrimethylene trinitramine
TETRYL 2, 4, 6, Trinitrophenylmethyinitramine (Explosive)
TNB Trinitrobenzene
U Analyte not detected above the reporting limit
UJ Analyte was not detected above the reporting limit; however, the reporting limit is considered an estimated value.

4.1.4 Conceptual Site Model

4.1.4.1 MMRP Site Profile

4.1.4.1.1 Area and Layout

The MRA encompasses approximately 1,128 acres and is located in the southern portion of the installation, approximately 3 miles northwest of the cantonment area. The majority of area (465 acres) within Anti-Aircraft Range – 4-A is currently developed. The majority of the area (663 acres) within the Anti-Aircraft Range-4-B is currently undeveloped.

4.1.4.1.2 Structures

There are currently 17 buildings on Anti-Aircraft Range – 4-A. These buildings are mostly residential. Construction on this site includes 20 barracks facilities, six company operations facilities, six tactical equipment maintenance facilities, a consolidated Brigade/Battalion Headquarters facility, a large dining facility, a physical fitness center, and a soldier family care clinic. Anti-Aircraft Range-4-B is largely undeveloped with no structures.

4.1.4.1.3 Utilities

FSTW is a fully functioning installation containing various basic utilities such as the following: water distribution system, electricity, and communications. Natural gas is distributed by the Directorate of Public Works through a 30-mile network via high-pressure mains. There is a wastewater treatment facility located within the cantonment area.

The Anti-Aircraft Range - 4 MRA is a mix of developed and undeveloped areas, with many buildings and roads passing through the MRA. Specific information on any utilities located at the site is unknown.

4.1.4.1.4 Boundaries

The MRA is bordered to the north and west by an undeveloped area, to the east by Fort Stewart Road 47, and to the south by Georgia Highway 144 East.

4.1.4.1.5 Security

Fences and guards are present at the Installation boundary. Temporary fences currently exist on the MRA and associated with the ongoing construction. The cantonment area has 24-hour security.

4.1.4.2 Physical Profile

4.1.4.2.1 Climate

The climate of FTSW is humid subtropical. Temperatures range from an average of 52 degrees Fahrenheit (°F) in January to 81°F in July. The annual precipitation is approximately 48 inches, with slightly over one-half falling from June to September. Average wind speed is from zero to 5 miles per hour (mph), with the prevailing wind direction to the northwest. However, thunderstorms, hurricanes, and tropical storms, occurring most frequently from May through September, produce gusty surface winds with speeds over 5 mph.

4.1.4.2.2 Geology

Known geology of coastal Georgia dates to the Paleozoic epoch and extends to 4000 meters (m) below the ocean surface. The sedimentary section consists of 700 m of Paleozoic rocks of Late Devonian age overlain by 2300 m of Early and Late Cretaceous sediments from the Mesozoic era. Cretaceous rocks are overlain by 100 m of Cenozoic sediments, most of which are Eocene in age.

FTSW is located within the Southern Atlantic Coastal Plain physiographic province. It is characterized by a wedge of gentle, southeast-dipping, clastic sediments that covers crystalline basement rock. The unconsolidated clastic (sand, silt, and clay) sediments thicken in an easterly direction. The basement rocks underlying the sediments dip coastward at about 5.7 m per kilometer from the Fall Line near Macon and Augusta; they appear near the surface in the Savannah area. The basement complex is composed of metamorphic and igneous rocks that range in age from Precambrian to Triassic. The overlying coastal plain sediments are dominated by clastics in the western areas (near the Fall Line) and become more nonclastic near the coast.

No specific geologic information pertaining to this site was available.

4.1.4.2.3 Topography

Most of the installation is flat, with typical elevations of 2 to 30 m above mean sea level (amsl). The northwestern portion is characterized by rolling hills and has elevations from 30 to 55 m.

The topography at Anti-Aircraft Range - 4 is flat, level terrain. The ground surface elevation at the site is approximately 20 feet amsl.

4.1.4.2.4 Soil

The most common soil series are Ellabelle loamy sand, Ogeechee, Pelham, Stilson, Rutlege, Leefield, and Mascotte. Most of the soils exhibit a sandy surface layer overlying a subsoil that may be sandy, clayey, loamy, or any combination thereof. The natural soil types range from excessively drained to poorly drained; the poorly drained soil tends to be higher in organic matter than other soils. The excessively drained soil tends to occur at lower elevations in association with swamps. The soil is especially vulnerable to erosion once vegetation has been removed. In coastal Georgia, drainage from three physiographic provinces (the Blue Ridge Mountains, Piedmont Plateau, and Coastal Plain) affects the composition of the alluvial deposits. Near FTSW, the parent material for all soils is water-lain sediments deposited prior to and during the Pleistocene Age.

The soil at Anti-Aircraft Range - 4 is classified as sand-silt/sand-clay.

4.1.4.2.5 Hydrogeology

There are three distinct aquifer systems in the FTSW region. The principle artesian aquifer is a deep sequence of limestone of the Eocene to Oligocene age, the primary source of large groundwater withdrawals in the coastal area. This aquifer is generally 92 to 153 m below the surface and is comprised of two different layers. The upper layer is derived from the Oligocene series of sandy, phosphatic limestone and, generally, is not used as a water source. It is underlain by the Ocala Limestone of Eocene age. Primary recharge to the principal aquifer

occurs approximately 50 to 90 miles northwest of FTSW, where the rocks composing the aquifer outcrop at the surface. The principal artesian aquifer is overlain by two shallow aquifer systems. A 120- to 150-meter-thick series of Miocene clays, sandy clays, and gravel lies directly above the principal artesian aquifer. The surface aquifer is composed of a relatively thin layer of sands, gravels, and clays. It is recharged directly from rainfall percolating through sediments. It is used almost exclusively as a source for domestic water, but primarily as a secondary water supply rather than for drinking water.

FTSW has its own potable water distribution system. There are 20 groundwater wells located on the installation; fifteen of these are used to supply drinking water through the distribution system to the cantonment area. The cantonment area wells range in depth from 500 to 800 feet and are cased to depths of 400 to 470 feet. Three additional drinking water wells will be added once the permitting process is complete. The remaining two wells are used for latrines only.

No MRA specific information about hydrogeologic conditions at the site was available.

4.1.4.2.6 Hydrology

The majority of FTSW is located within the Canoochee River watershed. Most of the surface waters on FTSW drain into the Canoochee River, which passes through the northwestern, central, and southeastern areas of the installation and joins the southward-flowing Ogeechee River. The Canoochee River merges with the Ogeechee River about 35 miles inland from the Ossabaw Sound. The northeastern section of the installation drains directly into the Ogeechee River, and the southwestern section drains into the Altamaha River. The Ogeechee River forms part of the northeastern boundary of FTSW. The remaining surface waters represent a relatively small percentage of the total volume of water leaving the area. In the eastern half of the installation, 60% of the surface area is comprised of marshes and swamps. Four major lakes and/or ponds are located on FTSW: Pineview Lake, Glissons Pond, Holbrook Pond, and Cantonment Pond.

A perennial/unnamed stream is adjacent to the southeastern end of the MRA boundary. There are some wetland areas within the MRA.

4.1.4.2.7 Vegetation

On a broad scale, there are four types of ecosystems on FTSW: sand hills, pine flatwoods, upland forests, and wetlands. The installation acreage is made up of approximately 57% upland forest, approximately 29% forested wetlands, and approximately 14% cleared areas. Major tree species found at FTSW include longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), loblolly pine (*Pinus taeda*), tupelo (*Nyssa sylvatica*), other gums (*Nyssa spp.*), water oak (*Quercus nigra*), and bald cypress (*Taxodium distichum*).

This property is developed with a small forested and grassy area.

4.1.4.3 Land Use and Exposure Profile

4.1.4.3.1 Current Land Use / Activities

The Anti-Aircraft Range – 4 consists of the cantonment area and undeveloped former training areas.

4.1.4.3.2 Current Human Receptors

The current human receptors of potential MEC or MC on Anti-Aircraft Range - 4 include authorized installation personnel, contractors, and trespassers.

4.1.4.3.3 Potential Future Land Use

The potential future land use of Anti-Aircraft Range - 4 is planned to be the cantonment area (Installation Support and Barracks and Operations), an Equestrian Club, and garden plots.

4.1.4.3.4 Potential Future Human Receptors

The future human receptors of potential MEC or MC remain the same as the current human receptors (authorized installation personnel, contractors, and trespassers). This area is currently under construction.

4.1.4.3.5 Zoning / Land Use Restrictions

There are no known zoning or access restrictions at FTSW. Site-specific zoning or land use restrictions are unknown.

4.1.4.3.6 Beneficial Resources

Specific beneficial resources include various aquatic habitats that provide fish and crustaceans for human consumption, wetland habitats, and water recreational areas. FTSW has a number of natural or man-made ponds and lakes, the Canoochee River, Canoochee Creek and tributaries, and a number of bottomland swamps and pools. Dense growth of aquatic vegetation is typical, especially during the summer months. FTSW contains approximately 82,148 acres of wetlands, covering approximately 30% of the installation. Forested areas also serve as a habitat to game, which are hunted for recreation and human consumption. FTSW contains more than 158,869 acres of forested land. It also contains a large amount of grassland, which serves as a habitat to many species. FTSW acts as a home to many threatened, endangered, or special concern plants and animals.

There are no known site-specific beneficial resources.

4.1.4.3.7 Demographics

According to the 2000 U.S. Census, the population at FTSW was 11,205. The city of Hinesville, which is located at the southern boundary of FSTW, has a population of 30,152 according to the 2008 U.S. Census. The city of Savannah, located northeast of FTSW, has a population of 131,510.

4.1.4.4 Ecological Profile

4.1.4.4.1 Habitat Type

FTSW has a large portion of forested property and wetlands; therefore, it serves as a habitat for the many animals and fish that reside on FTSW. The site has a small forested area with grasses.

4.1.4.4.2 Degree of Disturbance

The current degree of disturbance at the Anti-Aircraft Range - 4 is high, as the area is largely developed and under construction. According to FTSW Range Control, a number of EOD responses were reported on the MRA during the construction activities within the fenced area from 31 August 2009 through 1 December 2010. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control.

USACE Baltimore District Explosive Safety Staff conducted two MEC investigations on areas of interest within the construction area to address the EOD responses. A total of seven small arms (50 caliber), 16 munitions debris (15 M2 Target Rockets and one 3.5" rocket motor) and 1 MEC item (Point Detonating Fuze) were recovered as a result of the February investigation. A total of 54 M2 Target Rockets, 19 M2 Target Rocket Motors and two 81mm Practice Mortars were recovered during the April investigation. All items were identified as munitions debris and turned over to the local EOD unit for disposal.

4.1.4.4.3 Ecological Receptors

There are four basic types of vegetative ecosystems on FTSW: sand hills, pine flat woods, upland forests, and wetlands. Mixed coniferous and deciduous trees can be found in the sand hills and the upland forests. Pine species can be found in the flat woods. Wetlands provide critical nursery areas, as well as a habitat, for numerous fish, bird and reptile species. The wetlands range from seasonally saturated to permanently inundated. Wetland ecosystems found on FTSW include black water swamps, bay forests, stream head pocosins, wet pine flat woods, and cypress-gum swamps. The fauna at FTSW typically consist of birds (such as Wood Duck, Eastern Wild Turkey, Bobwhite Quail, and Mourning Dove), mammals (such as eastern gray squirrel, eastern fox squirrel, eastern cottontail rabbit, feral hog, white-tailed deer), and fish (such as largemouth bass, blue gill, redear sunfish, channel catfish, black crappie, and hybrid striped bass). FTSW is also a home to many state and federally threatened, endangered, and/or species of concern. The federally listed threatened/endangered species include Southern Bald Eagle (*Haliaeetus leucocephalus l.*), Wood Stork (*Mycteria americana*), Red-cockaded Woodpecker (*Picoides borealis*),eastern indigo snake (*Drymarchon coralis couperi*), flatwoods salamander

(*Ambystoma cingulatum*), and shortnose sturgeon (*Acipenser brevirostrum*). The state-listed threatened/endangered species include the species listed above as well as the following: Peregrine Falcon (*Falco peregrinus*) and gopher tortoise (*Gopherus polyphemus*).

4.1.4.4.4 Munitions Types and Release Mechanisms

Table 4-3 presents a summary of the types of munitions debris and MEC that may exist at the Anti-Aircraft Range - 4 based on the Phase 2 CS field activities and information collected from the HRR and EOD records.

Table 4-2: Summary of Potential and Actual Munitions Debris and MEC – Anti-Aircraft Range - 4

MRA	Munitions Debris / MEC Observed During Phase 2 CS Field Activities	Potential Munitions Debris / MEC Identified During HRR and EOD Responses	Primary Release Mechanism
Anti-Aircraft Range – 4	No MEC or munitions debris were observed during the visual survey.	40mm[1] 40mm high explosive[1] High-explosive plastic (HEP)[1] 90mm[1] 90mm High-Explosive (HE)[1] 90mm M71 HE projectiles[1] 2.75” rocket[2] M67 grenade[2] M2 3.25” Rocket[2]	Munitions firing Malfunctioned munitions Discarded munitions

[1]Item is based on historical use. Not confirmed.

[2]Items reported during EOD responses; items not identified from historical use. Items may be a result of undocumented historical training activities, or items may have been discarded/disposed of on site.

4.1.4.4.5 Maximum Probable Penetration Depth

Table 4-3 provides the expected penetration depths for MEC for various types of soils that are expected to be found at Anti-Aircraft Range – 4 (USACE, Engineering Manual 1110-1-4009 *Ordnance and Explosives Response*). For the Anti-Aircraft Range – 4 MRA, the soil type is considered sand-silt/sand-clay. Therefore, the depths of penetration for Anti-Aircraft Range – 4 MRA are based upon the penetration depth for a loamy soil. These penetration depths are estimated on a worst-case scenario, which assumes that the impact is perpendicular to ground surface and that the munitions item does not become deformed upon impact. The majority of Anti-Aircraft Range–4-A was developed, after its use as a range, as buildings associated with the cantonment area. Anti-Aircraft Range–4-B is undeveloped. Thus, the depths to MEC at either MRS may not be representative of the depths presented in Table 4-3 and MEC could be encountered at any depth within the MRA.

Table 4-3: Summary of Expected MEC Penetration Depths – Anti-Aircraft Range – 4

Munitions Item	Depth of Penetration feet below ground surface (bgs)		
	Sand	Loam	Clay
40mm, 40mm HEP projectiles	0.2	0.3	0.4
90mm, 90mm HE, 90mm M71 HE projectiles	2.0	2.7	4.1
2.75” rocket	3.5	6.0	7.5
M2 3.25” Rocket	5.5	8.0	10.5
M67 grenades	0.0	0.0	0.0

4.1.4.4.6 MEC Density

No MEC or munitions debris was observed during the Phase 2 CS magnetometer-assisted visual survey. However, according to FTSW Range Control, numerous EOD responses were reported

on the MRA during the construction activities within the fenced area from 31 August 2009 through 1 December 2010. Based on discrepancies in data sources (EOD and Range Control), the exact number of EOD responses are unclear. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control.

As the majority of the Anti-Aircraft Range-4-A is developed or currently under construction, it is unlikely that MEC would remain on the surface or subsurface after construction activities are complete. MEC density on the surface is expected to be low, due to the amount of the site that has been developed, and the investigation conducted by USACE Baltimore Explosive Safety Staff (see Appendices J and K). Based on the frequency of EOD finds during construction activities at anti-Aircraft Range-4-A, MEC density on anti-Aircraft Range-4-B is believed to be medium to high.

4.1.4.4.7 Munitions Debris

No MEC or munitions debris was observed during the Phase 2 CS magnetometer-assisted visual survey. However, there is potential for munitions debris items in undeveloped areas because EOD has responded to several emergency calls in the area. The following historical EOD responses occurred at the site; “40mm” projectile (along the northern boundary of the site), “mortar round” (western central section of the site), “M67” hand grenade (along the southeast boundary), and a “2.75-inch rocket” (southern central section of the site). Additionally, one EOD response [labeled “EOD Response (no information)”] was reported along the southern boundary and northern central section of the site. Details regarding these munitions items encountered were not available.

According to FTSW Range Control, numerous EOD responses were reported on the MRA during the construction activities within the fenced area from 31 August 2009 through 1 December 2010. Based on discrepancies in data sources (EOD and Range Control), the exact number of EOD responses are unclear. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control.

4.1.4.4.8 Associated MC

Based on the analytical results, no soil samples exceeded the USEPA RSLs or USEPA Region 4 Ecological Screening Values for metals. No explosive compounds were detected above laboratory detection or reporting limits. However, potential MC associated with 40mm, 40mm HEP, 90mm, 90mm HE, 90mm M71 HE projectiles include Composition (CMP) A, CMP B, and trinitrotoluene (TNT). Potential MC associated with M67 grenades include CMP B. (Refer to the appropriate Ordnance Technical Data Sheets in Appendix G.) Four discrete surface soil samples were collected at Anti-Aircraft Range - 4 and analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330 modified.

4.1.4.4.9 Transport Mechanisms / Migration Routes

The primary transport mechanisms considered for Anti-Aircraft Range – 4 include the following:

Erosion: The north portion of Anti-Aircraft Range – 4 is developed area; therefore, erosion is not expected in this area and is not a factor in transporting and migrating possible MC contaminated soil. The southeastern portion of the MRA is undeveloped, forested land; therefore, erosion is not expected in this area and is not a factor in transporting and migrating possible MC contaminated soil.

Soil Disturbance: The current degree of disturbance is relatively high, as a majority of the area has been developed and cleared since the range was used. On-going development could unveil potential MC that are in the surface or subsurface.

Infiltration: Based on the soil types associated with Anti-Aircraft Range – 4, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through filtration.

4.1.4.5 Pathway Analysis

4.1.4.5.1 MEC

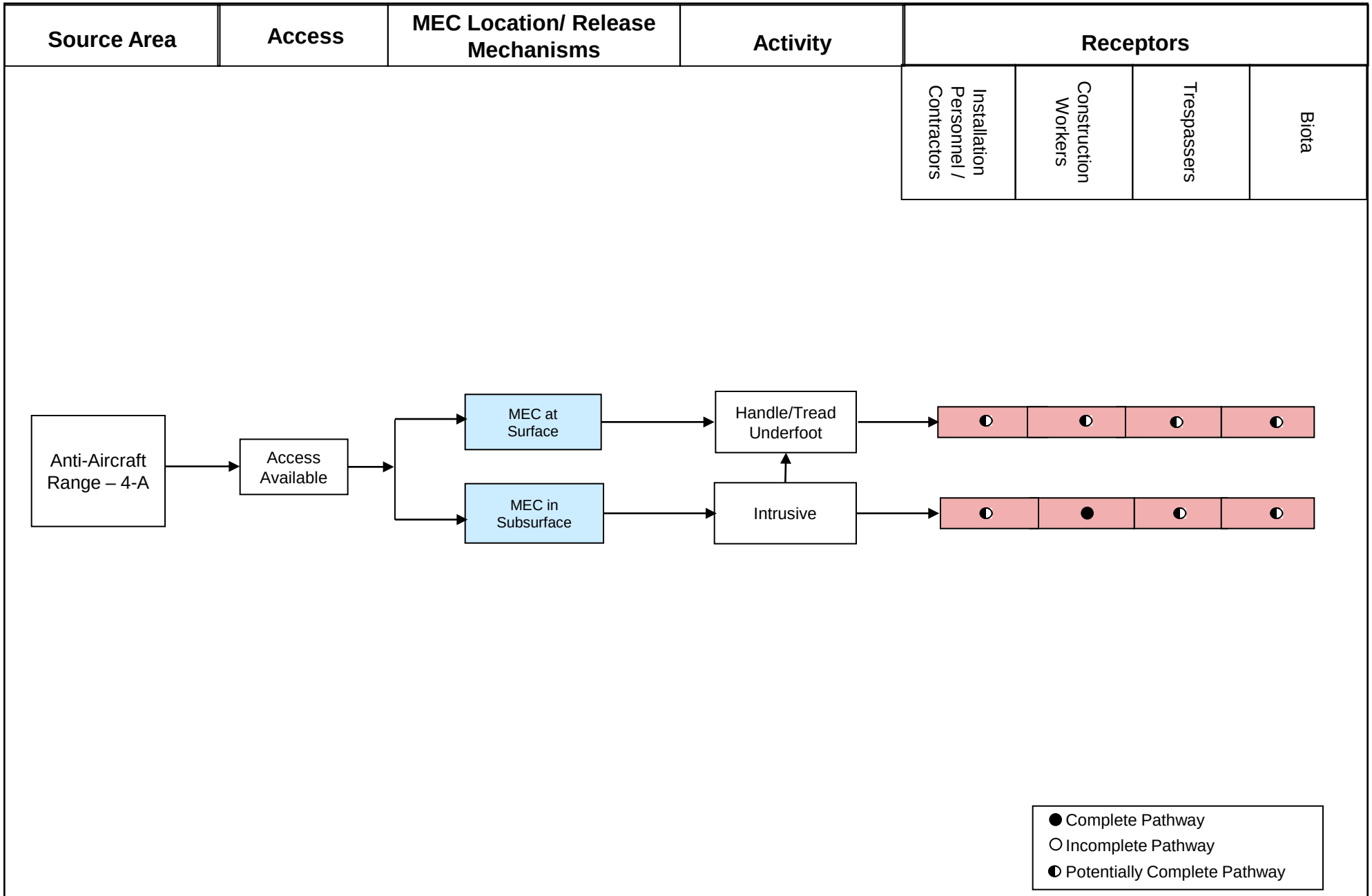
Based on EOD responses during construction and the investigation and removal activities conducted by USACE Baltimore Explosive Safety, the potential exists for MEC to be present on

the site. As illustrated in the Exposure Pathway Analysis for MEC (Figure 4-1), the pathways for human and ecological receptors at Anti-Aircraft Range-4-A in the surface are potentially complete following the 100% clearance to depth. Potentially complete pathways for installation personnel, contractors, trespassers and biota for MEC in the subsurface exist as these receptors have the potential to conduct intrusive activities. The pathway for MEC in the subsurface is incomplete for trespassers.

As illustrated in the Exposure Pathway Analysis for MEC (Figure 4-2), the pathways for all human and ecological receptors are at Anti-Aircraft Range-4-B complete for all receptors to encounter MEC on the surface and subsurface in undeveloped areas. Complete pathways for installation personnel, contractors, trespassers, construction workers, and biota for MEC in the subsurface exist as these receptors have the potential to conduct intrusive activities.

4.1.4.5.2 MC

As illustrated in the MC Exposure Pathway Analysis for the Anti-Aircraft Range-4-A MRS and the Anti-Aircraft Range-4-B MRS (Figure 4-3 and 4-4, respectively), soil and groundwater represent the potential primary source media. Four discrete surface soil samples were analyzed for aluminum, antimony, copper, lead, and zinc (USEPA Method 6010B) and explosives (USEPA Method 8330B modified). Analytical results indicate no explosives were detected and no metals exceeded USEPA RSLs or USEPA Region 4 Ecological Screening Values. Since analytical results do not indicate a presence of MC above applicable screening criteria, no complete or potentially complete pathways exist at the Anti-Aircraft Range – 4 MRA.



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CONFIRMATORY SAMPLING REPORT
ANTI-AIRCRAFT RANGE – 4-A – MEC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-1
September 2011

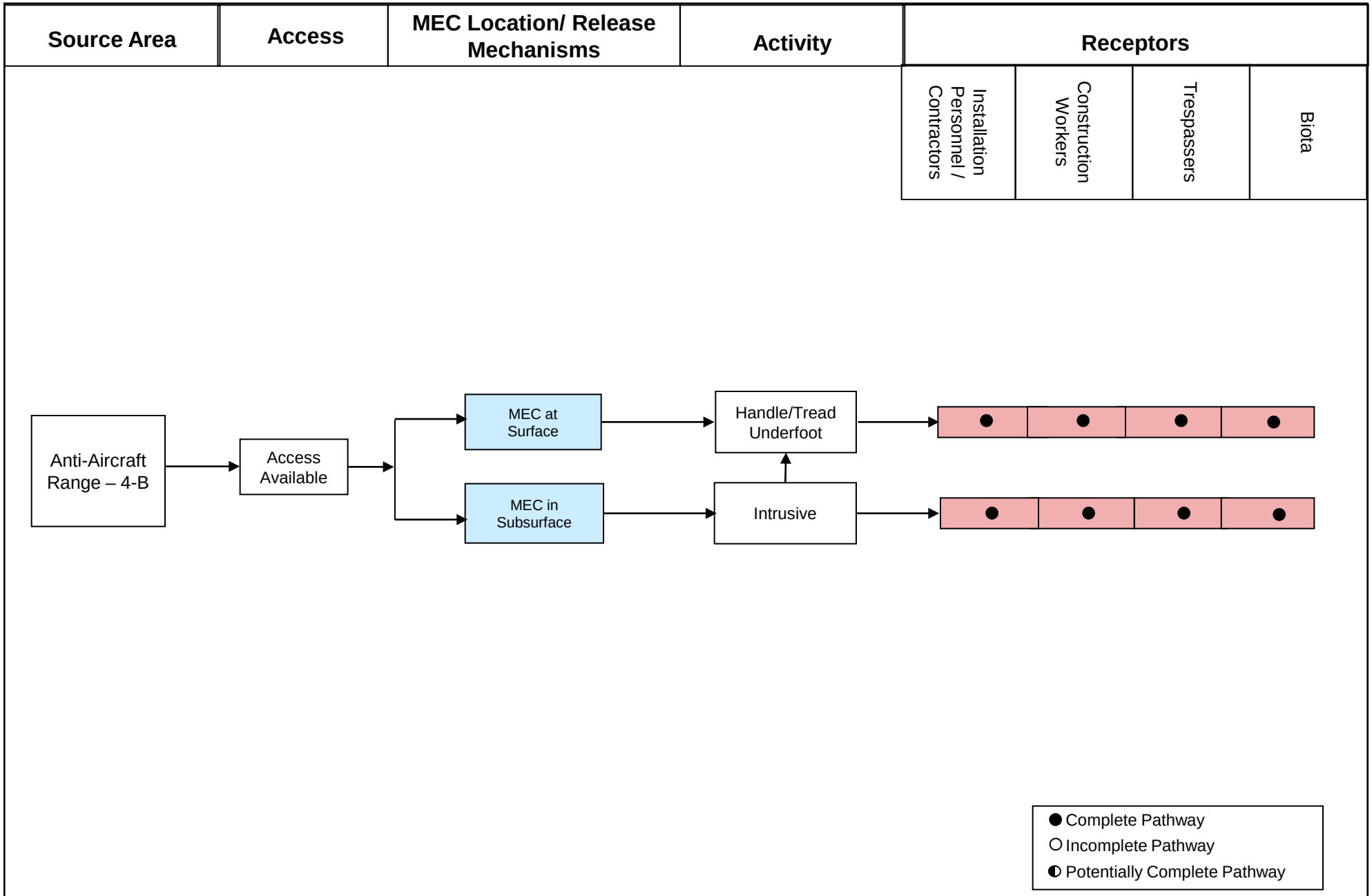

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FIGURE 4-2
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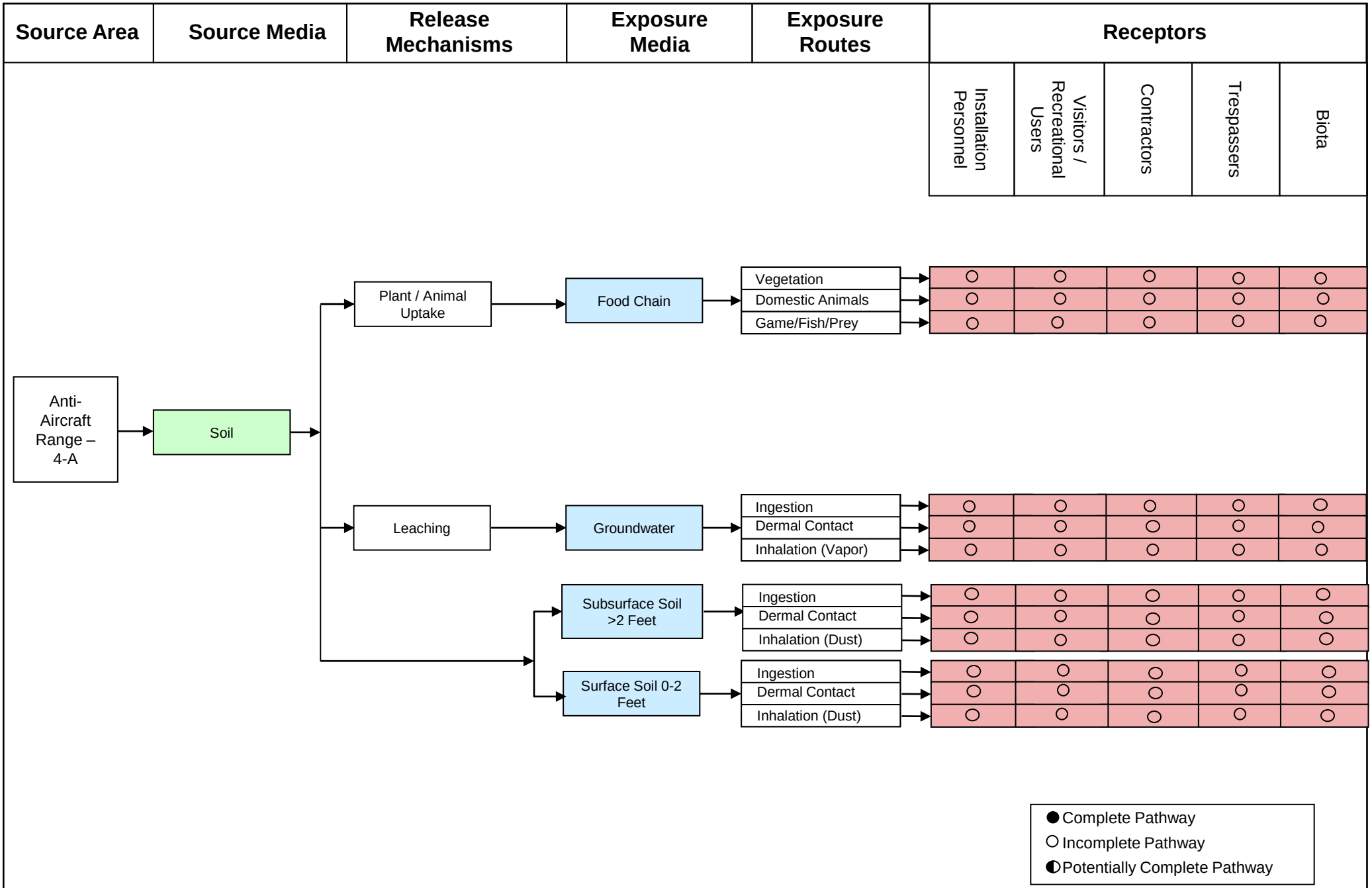

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ANTI-AIRCRAFT RANGE – 4-A – MC EXPOSURE PATHWAY ANALYSIS
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FIGURE 4-3
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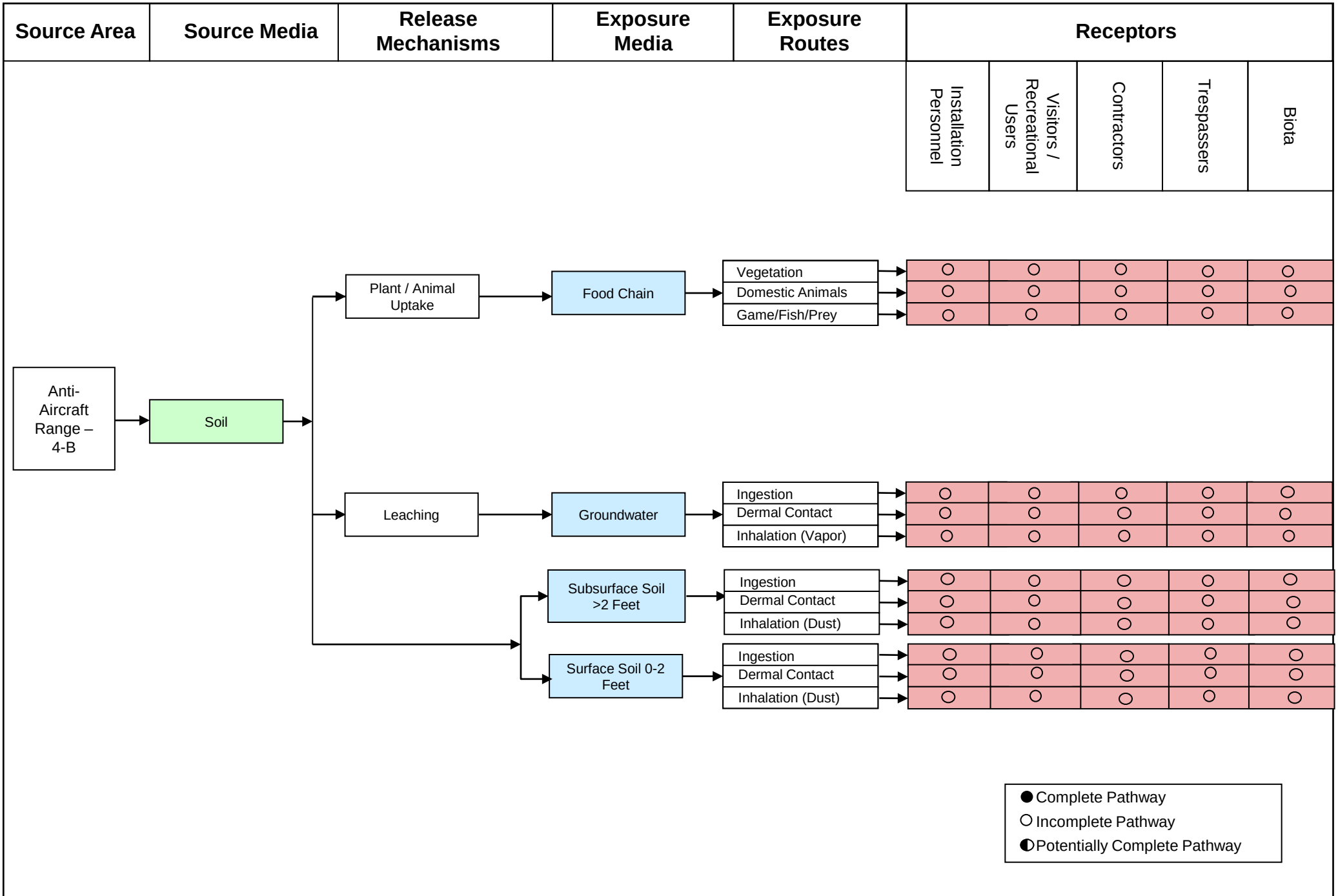

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ANTI-AIRCRAFT RANGE – 4-B – MC EXPOSURE PATHWAY ANALYSIS
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FIGURE 4-4
September 2011

4.1.5 Site Summary and Conclusions

4.1.5.1 MEC

During the magnetometer-assisted visual survey, no MEC or munitions debris was observed and no definitive range features were identified. However, because there have been a number of historical EOD responses and EOD responses during on-going construction activities on the Anti-Aircraft Range – 4 MRA, the site is recommended for RCRA Facility Investigation / Corrective Measures Study (RFI/CMS).

4.1.5.2 MC

Four surface soil samples were collected from Anti-Aircraft Range - 4 and analyzed for aluminum, copper, zinc, lead, antimony, and explosives. Analytical results indicate that none of the metal concentrations exceeded USEPA RSLs or Region 4 Ecological Screening Values and no explosive compounds were detected above laboratory detection or reporting limits. It is recognized that because the MRA is recommended for RFI/CMS for MEC, MC may also be evaluated based on MRA findings as part of the study.

4.1.6 Site Recommendations

During the MEC Phase 2 CS field activities, MEC and munitions debris were not found. However, based on EOD responses during construction and the explosive hazard probably designations assigned during the investigations performed by USACE Baltimore District Explosive Safety, the Anti-Aircraft Range-4 MRA was divided into two MRSs. This will be instrumental in managing the MRA through future investigations. The first MRS, Anti-Aircraft Range-4-A, includes the construction areas where the investigations and removal activities were conducted; this area was assigned a low probability for encountering MEC designation. The second MRS, Anti-Aircraft Range-4-B, encompasses the undeveloped portion of the site that was assigned a low probability for encountering MEC designation. Both MRSs within the Anti-Aircraft Range – 4 MRA are recommended for RFI/CMS for MEC.

4.2 ANTI-TANK RANGE 90-MM – 2 (AEDB-R ID: FTSW-010-R-01)

Site Description and Historical Overview

The MRS layout and location are presented on Map 4-2. This 546-acre MRS is located in the northwestern portion of the cantonment area and was used for anti-aircraft, anti-tank, grenade launcher, and small arms training during the 1940s. The MRS is composed of eight range fans. The total acreage covered by the eight historical ranges is 17,015 acres, 546 acres of which overlap the other than operational area and make up Anti-Tank Range 90-MM – 2. The MRS is composed of the firing point of two separate collocated ranges (Anti-Tank Range 90-MM – 2 and a 40mm anti-aircraft range) and the downrange area of six separate ranges (Ranges A, N, M, HBANM small arms range, grenade launcher range and a 120mm anti-aircraft range). The known munitions use associated with this MRS includes 40mm and 120mm anti-aircraft projectiles, 40mm grenades (practice), and 90mm anti-tank projectiles. No documentation of EOD responses were identified at this site.

4.2.1 Fieldwork Activities

4.2.1.1 MEC Activities and Purpose

Based on information presented in the HRR, the potential for MEC at the site exists; therefore, a magnetometer assisted visual survey was performed during sample activities. A magnetometer-assisted visual survey was used to determine the presence of MEC on the site. Field personnel (escorted by a UXO Technician III) traversed the MRS in order to complete the magnetometer-assisted visual survey of 10% of the undeveloped area (approximately 33 acres).

4.2.1.2 MC Activities and Purpose

Four discrete surface soil samples were collected. Two of the samples were biased and collected from the firing points of the Anti-Tank 90-MM Range and Anti-Aircraft 40-MM ranges. The remaining two samples were randomly distributed. Based on the historical layout and use of this MRS, berms or burial areas were not anticipated therefore only surface soil samples, at a depth of 0 – 6 inches, were collected. Soil samples were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified.

Data was compared to FTSW inorganic/metal background values, USEPA Residential RSLs, and USEPA Region 4 Ecological Screening Values for Surface Soil for metals and explosives.

4.2.2 Fieldwork Results

4.2.2.1 MEC Results

The UXO Technician used magnetometer anomaly avoidance, as these objects may have been covered by vegetation. The magnetometer-assisted visual survey was conducted through the undeveloped portions of the MRS. A large portion of the MRS was inaccessible due to flooding, being fenced within the paved motor pool, or being located within a borrow pit. The focus of the investigation was the two suspected firing points of the Anti-Tank 90-MM Range and Anti-Aircraft 40-MM ranges.

A line approximately 120’ in length of 2.5’ by 2.5’ concrete pads were found on this MRS. It is unknown what these pads were used for, but the pads may have been used for a firing line based on the observations made by the UXO Technician III onsite. This is shown in Figure 4-5.

Figure 4-5: Concrete Pads

Additionally there was a concrete structure, approximately 10’ high forming three sides of a box (shown in Photo Log, Appendix C). It is assumed that this was used to house a dumpster. Metal plates were found nearby the concrete structure. They could have been used as target structures; however, there was no indication that the plates had been fired upon.

One munitions debris item, an inert anti-personnel mine, was found during the investigation. This item is shown in Figures 4-6 and 4-7. Table 4-5 presents the items and structures observed during the magnetometer-assisted visual survey. The MEC Discovery Form for the inert anti-personnel mine is included in Appendix B.

Figure 4-6: Inert Antipersonnel Mine M16A1

Figure 4-7: Inert Antipersonnel Mine M16A1

Table 4-4: Site Discoveries at Anti-Tank Range 90-MM-2

Item ID	Description
MEC Item	
None	None
Munitions Debris	
Inert AP mine (M-16 A1)	The M16A1 inert mine identified was used for training and handling only. It contains no explosive components and uses the M605 inert fuze. The item was left in place.
Structures/Debris	
Concrete Pads	Several 2.5' x 2.5' concrete pads were found in a line approximately 120' across. Believed to be a former firing line.
Metal plates	A pile of metal plates was found in the wooded portion of the site. The metal plates may have been target frames, but there was no evidence that they had been fired upon.

4.2.2.2 MC Results

Four surface soil samples were collected at Anti-Tank Range 90-MM - 2 and analyzed for aluminum, antimony, copper, lead and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Two of the surface soil samples were collected from biased (FTSW-SS-05-082410, FTSW-SS-06-082410) locations based on suspected firing lines. The other two surface soil samples were collected randomly (FTSW-SS-07-082410, FTSW-SS-08-082410) throughout the site. The analytical data are summarized in Table 4-6, and sample locations are shown on Map 4-2. The following are the results of the soil sampling analysis at the Anti-Tank Range 90-MM - 2:

- **Zinc:** No samples exceed the USEPA RSLs for zinc. One soil sample exceeded the FTSW background level and USEPA Region 4 Ecological Screening Values.
- **Other metals:** Aluminum, antimony, copper, and lead were detected below USEPA RSLs and USEPA Region 4 Ecological Screening Values.
- **Explosives:** No explosives were detected above method detections or laboratory reporting limits.

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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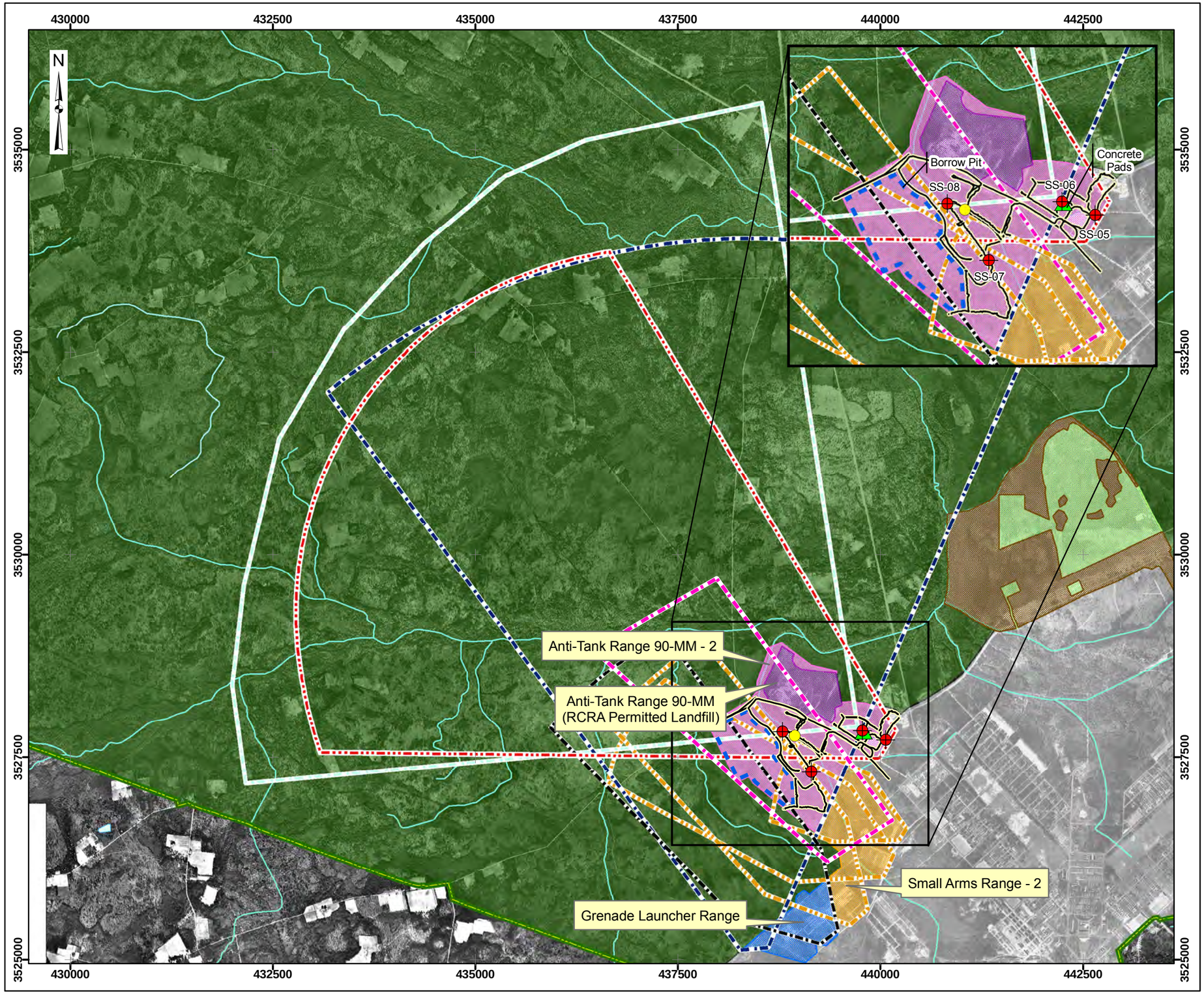
Map 4-2
Anti-Tank Range 90-MM - 2



Legend

Installation Data
- Installation Boundary
- Other than Operational Area
- Operational Area

Confirmatory Sampling Data
- Sample Location
- Inert Anti-Personnel Mine (M16A1)
- Concrete Pads
- Site Walk
- Borrow Pit

Phase 2 MRS (Other than Operational Area)
- Small Arms Range - 2
- Anti-Tank Range 90-MM - 2
- Anti-Aircraft Range - 4A
- Anti-Aircraft Range - 4B
- Grenade Launcher Range

Phase 1 MRS
- Anti-Tank Range 90-MM (RCRA Permitted Landfill)

Anti-Tank Range 90-MM - 2 Historical Fans
- Anti-Tank (E 90-mm 14540 yards) 1941
- 40-mm Anti-Aircraft (E 40-mm 8500 YRDS) 1941
- 120-mm Anti-Aircraft

Small Arms Range - 2 Historical Range Fans
- Small Arms 1944
- Small Arms (HBANM RANGES) 1940
- Grenade Launcher Range

Hydrology
- River/Stream
- Water Body

0 1,000 2,000 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0004
Edition: Final
Date: September 2011

Table 4-5: Anti-Tank Range 90MM - 2

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-05-082410	FTSW-SS-06-082410	FTSW-SS-07-082410	FTSW-SS-08-082410
	mg/kg	mg/kg	mg/kg	mg/kg				
METALS (mg/kg)								
Aluminum	2	-	77,000	-	4270	8710	4490	3570
Antimony	0.6	-	31	3.5	0.09 UJ	0.68 J	0.09 UJ	0.11 UJ
Copper	0.3	-	3,100	40	3.8	11.3	2.8	2.9
Lead	0.3	11.1	400	50	9.8	**21.5**	4.3	8.2
Zinc	0.7	15.5	23,000	50	7.2	**85.8**	2.8	2.5
EXPLOSIVES (ug/kg)								
EGDN	800	N/A	-	-	ND	ND	ND	ND
PETN	800	N/A	-	-	ND	ND	ND	ND
NG	800	N/A	6,100	1.6	ND	ND	ND	ND
HMX	100	N/A	3,800,000	2300	ND	ND	ND	ND
RDX	100	N/A	5,500	0.23	ND	ND	ND	ND
1,3,5-TNB	100	N/A	2,200,000	3,900	ND	ND	ND	ND
4-NT	100	N/A	30,000	3.9	ND	ND	ND	ND
1,3-DNB	100	N/A	6,100	3.3	ND	ND	ND	ND
NB	100	N/A	4,800	0.079	ND	ND	ND	ND
TETRYL	100	N/A	240,000	1,400	ND	ND	ND	ND
2,4,6-TNT	100	N/A	19,000	13	ND	ND	ND	ND
4-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND
2-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND
2,6-DNT	100	N/A	61,000	50	ND	ND	ND	ND
2,4-DNT	100	N/A	1,600	0.29	ND	ND	ND	ND
2-NT	100	N/A	2,900	0.29	ND	ND	ND	ND
3-NT	100	N/A	6100	3.4	ND	ND	ND	ND

Notes:

(1) Information provided by Phase II RCRA Facility Investigation Report for 16 Solid Wate Management Units At Fort Stewart, GA

Bold	exceeded FTSW background
	exceeded USEPA Region 4 Ecological Soil Screening Values
	exceeded USEPA RSLs for Residential Soil

Definitions:

AM Amino
C Carcinogen
DNB Dinitrobenzene
EGDN Ethylene Glycol Dinitrate
HMX High Melting Point Explosive
mg/kg milligram/kilogram
µg/kg microgram/kilogram
N Non-carcinogen
J Analyte was positively identified; however, the result should be considered an estimated value
ND Analyte not detected above the method detection limit or laboratory reporting limit.
NB Nitrobenzene
NG Nitroglycerin
NT Nitrotoluene
PQL Project Quantitation Limit
PETN Pentaerythritol tetranitrate
RDX Cyclotrimethylene trinitramine
TETRYL 2, 4, 6, Trinitrophenylmethyinitramine (Explosive)
TNB Trinitrobenzene
U Analyte not detected above the reporting limit
UJ Analyte was not detected above the reporting limit; however, the reporting limit is considered an estimated value.

4.2.3 Conceptual Site Model

4.2.3.1 MMRP Profile

4.2.3.1.1 Area and Layout

The Anti-Tank Range 90-MM – 2 is approximately 546 acres located in the northwest portion of the cantonment area.

4.2.3.1.2 Structures

A motor pool is located on the MRS, but there are no structures within the motor pool.

4.2.3.1.3 Utilities

Utilities are described in Section 4.1.4.1.3. Site-specific utilities are unknown.

4.2.3.1.4 Boundaries

The site is bounded to the west by an unnamed road and on the north, east, and south by undeveloped property.

4.2.3.1.5 Security

Fences and guards are present at the Installation boundary. The motor pool area within the MRS is also fenced. The cantonment area has 24-hour security.

4.2.3.2 Physical Profile

4.2.3.2.1 Climate

General installation climate information is presented in Section 4.1.4.2.1.

4.2.3.2.2 Geology

General geologic information for FTSW is presented in Section 4.1.4.2.2. No specific geologic information pertaining to the site was available.

4.2.3.2.3 Topography

General information about the topography of FTSW is presented in Section 4.1.4.2.3. The Anti-Tank Range 90-MM – 2 is approximately 20 feet amsl; the site is generally flat and has level terrain.

4.2.3.2.4 Soil

General information about the soil types present on FTSW is presented in Section 4.1.4.2.4. The soil at the Anti-Tank Range 90-MM – 2 is classified as clay-sand/clay-silt.

4.2.3.2.5 Hydrogeology

General information about the hydrogeologic conditions at FTSW is presented in Section 4.1.4.2.5. There is no site-specific information on hydrogeology.

4.2.3.2.6 Hydrology

General information about hydrologic conditions at FTSW is presented in Section 4.1.4.2.6. Taylor's Creek is located along northern portion of the site. Mill Creek is located along western portion of the site. Engineer's Pond is located within the southeast portion of the site.

4.2.3.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Anti-Tank Range 90-MM – 2 is primarily forested and grasslands.

4.2.3.3 Land Use and Exposure Profile

4.2.3.3.1 Current Land Use / Activities

The Anti-Tank Range 90-MM – 2 is comprised of undeveloped area and the cantonment area.

4.2.3.3.2 Current Human Receptors

The current human receptors of the Anti-Tank Range 90-MM – 2 are authorized installation personnel, contractors, and trespassers.

4.2.3.3.3 Potential Future Land Use

There is no known change in land use at this time; the potential future land use is assumed to remain the same as the current land use.

4.2.3.3.4 Potential Future Human Receptors

There is no known change in land use at this time; therefore, the potential future human receptors of potential MEC or MC remain the same as the current human receptors (authorized installation personnel, contractors, hunters, fishermen, and trespassers.).

4.2.3.3.5 Zoning / Land Use Restrictions

General information about zoning and land use restrictions at FTSW is presented in Section 4.1.4.3.5. There is a motor pool and borrow pit located on the site; much of the remaining area is undeveloped land.

4.2.3.3.6 Beneficial Resources

General information about the beneficial resources on FTSW is presented in Section 4.1.4.3.6. Site-specific resources include the forested areas, which act as habitat.

4.2.3.3.7 Demographics/Zoning

General information about the demographics/zoning on FTSW is presented in Section 4.1.4.3.7.

4.2.3.4 Ecological Profile

4.2.3.4.1 Habitat Type

General information on habitat types at FTSW is provided in Section 4.1.4.4.1. Site-specific habitat types include the forested areas.

4.2.3.4.2 Degree of Disturbance

Currently, there is a medium degree of disturbance. Approximately 20% has been cleared and developed; the remaining acreage is undeveloped.

4.2.3.4.3 Ecological Receptors

General information about the ecological receptors on FTSW is presented in Section 4.1.4.4.3.

4.2.3.5 Munitions/Release Profile

4.2.3.5.1 Munitions Types and Release Mechanisms

Table 4-7 presents a summary of the types of potential munitions that were identified during Phase 2 CS field activities. The mechanisms by which the munitions, if present, could have been released into the environment are also presented in the table.

Table 4-6: Summary of Potential and Actual Munitions Debris and MEC – Anti-Tank Range 90-MM – 2

MMRP Site	Munitions Debris / MEC Observed During Phase 2 CS Field Activities	Potential Munitions Debris / MEC Identified During HRR[1]	Primary Release Mechanism
Anti-Tank Range 90-MM – 2	M16 A1 inert landmine	37mm HE M54, 40mm, 40mm HEP 90mm, 90mm HE 90mm M71 HE projectiles 120mm HE 0.22-caliber (cal) 0.30-cal, 0.30-cal (with tracer) 0.45-cal 0.50-cal, 0.50-cal (with tracer) 0.50-cal (armor piercing) small arms 40mm rifle grenade (practice)	Hand placement Munitions firing Malfunctioned munitions Discarded munitions

[1]Item is based on historical use. Not confirmed.

4.2.3.5.2 Maximum Probability Penetration Depth

There is no associated maximum probability penetration depth for the inert landmines. Due to hand placement, they would be no more than 2 feet deep, unless the area had been filled since use as a range or the items were buried.

Table 4-8 provides the expected penetration depths for MEC for various types of soils that are expected to be found at Anti-Tank Range 90-MM – 2. For the Anti-Tank Range 90-MM – 2, the soil type is considered sand-silt/sand-clay. Therefore, the depths of penetration for Anti-Tank Range 90-MM – 2 are based upon the penetration depth for a loamy soil and are estimated on a worst-case scenario. Portions of the Anti-Tank Range 90-MM – 2 were developed after its use as a range for uses associated with the cantonment area. It is unknown if the site was filled and

graded during construction. Thus, the depths to MEC may not be representative of the depths presented in Table 4-8 and MEC could be encountered at any depth within the MRS area.

The Interstate Technology and Regulatory Council (ITRC) has prepared a document titled *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges*, dated January 2003, to provide information on the general layout of small arms ranges, as well as information on areas that may be impacted with MC and/or MEC as a result of range use and the characterization of munitions used. According to the ITRC document, the maximum expected penetration depth is 1 foot.

Table 4-7: Expected MEC Penetration Depths – Anti-Tank Range 90-MM – 2

Munitions Item	Depth of Penetration (feet bgs)		
	Sand	Loam	Clay
37mm projectiles	3.9	5.2	7.9
40mm, 40mm HEP projectiles	0.2	0.3	0.4
90mm, 90mm HE, 90mm M71 HE projectiles	2.0	2.7	4.1
120mm HE	9.0	13.0	17.0
0.22-cal 0.30-cal, 0.30-cal (with tracer) 0.45-cal 0.50-cal, 0.50-cal (with tracer), 0.50-cal (armor piercing) small arms	1.0	1.0	1.0
40mm rifle grenade (practice)	0.2	0.3	0.4
M16 A1 inert landmine	0.0	0.0	0.0

4.2.3.5.3 MEC Density

The MEC density of this MRS is considered to be low based on the site investigation. There have been no reported finds of MEC; however, the majority of the area is undeveloped.

4.2.3.5.4 Munitions Debris

Because the inert mine was found on the MRS, there is the potential for munitions debris items. No EOD responses have been reported at the site.

4.2.3.5.5 Associated MC

Four discrete surface soil samples were collected. Two of the samples were biased and collected from the firing points of the Anti-Tank 90-MM Range and Anti-Aircraft 40MM ranges. The remaining two samples were randomly distributed. Based on the historical layout and use of this MRS, berms or burial areas were not anticipated therefore only surface soil samples, at a depth of 0 – 6 inches, were collected. Soil samples were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Based on analytical results, zinc was the only metal detected in concentrations exceeding Region 4 Ecological Screening Values but below USEPA RSLs. No explosive compounds were detected above laboratory detection or reporting limits.

4.2.3.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms considered for the Anti-Tank Range 90-MM – 2 include:

Erosion: Anti-Tank Range 90-MM – 2 may be disturbed by flooding of the adjacent Mill Creek and adjacent other creeks, which could result in erosion.

Soil Disturbance: The current degree of disturbance is medium, as a portion of the site has been developed. Future development could unveil potential MEC or MC that are in the surface or subsurface soil.

Infiltration: Based on the soil types associated with Anti-Tank Range 90-MM – 2, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through filtration.

4.2.3.6 Pathway Analysis

4.2.3.6.1 MEC

Based on the munitions debris found at the site and the historical use of the site as an anti-tank training area, including two firing points, a mounted target track, and an anti-aircraft range, the potential exists for MEC to be present on the site. As illustrated in the Exposure Pathway Analysis for MEC (Figure 4-8), the pathways for all human and ecological receptors are potentially complete as the potential exists for these receptors to encounter MEC on the surface. The potential exists for MEC on the surface because of historical use and the limited visual survey that was performed as part of this CS, streams exist along the MRS boundaries, and a pond is located on the MRS. Potentially complete pathways for installation personnel, contractors, and biota for MEC in the subsurface exist as these receptors have the potential to conduct intrusive activities. The pathway for MEC in the subsurface is incomplete for trespassers.

4.2.3.6.2 MC

As illustrated in the MC Exposure Pathway Analysis (Figure 4-9), soil and groundwater represent the potential primary source media. Four surface soil samples were analyzed for aluminum, antimony, copper, lead and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Based on analytical results, no explosive compounds were detected above laboratory detection or reporting limits. Zinc was the only metal detected in concentrations exceeding FTSW background levels and USEPA Region 4 Ecological Screening Values but below USEPA RSLs. Therefore, pathways for all human receptors are incomplete.

<u>Food Chain</u>

A potentially complete pathway to MC in the source media through uptake into vegetation exists for grazing/foraging biota. This exposure pathway is incomplete for all other receptors. As there are no domestic animals on FTSW, the pathway to MC in the source media through this exposure route is incomplete for all receptors. The pathway to MC in the source media through the game/fish/prey exposure route is potentially complete for biota. This exposure pathway is

incomplete for all other receptors as their activities are not expected to include hunting and MC levels only exceed Ecological Screening Values.

Groundwater

Precipitation infiltration may provide for contaminant mobility into the shallow or surficial groundwater aquifer. However, based on a review of hydrogeological data (Section 4.2.4.2.5), it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW. Receptor contact with groundwater is possible if the soil is disturbed through excavation or construction activities, creating possible migration routes/mechanisms for MC in shallow groundwater. As such, biota have potentially complete pathways to MC in shallow groundwater through the (incidental) ingestion and dermal contact exposure routes, as MC concentrations only exceed the Ecological Screening Values. Given that it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW, the dermal and ingestion exposure routes are incomplete for trespassers. Since the upper aquifer is not used as a potable water source and MC are typically not volatile, the inhalation (vapor) exposure route is incomplete for all receptors.

Surface Water / Sediment

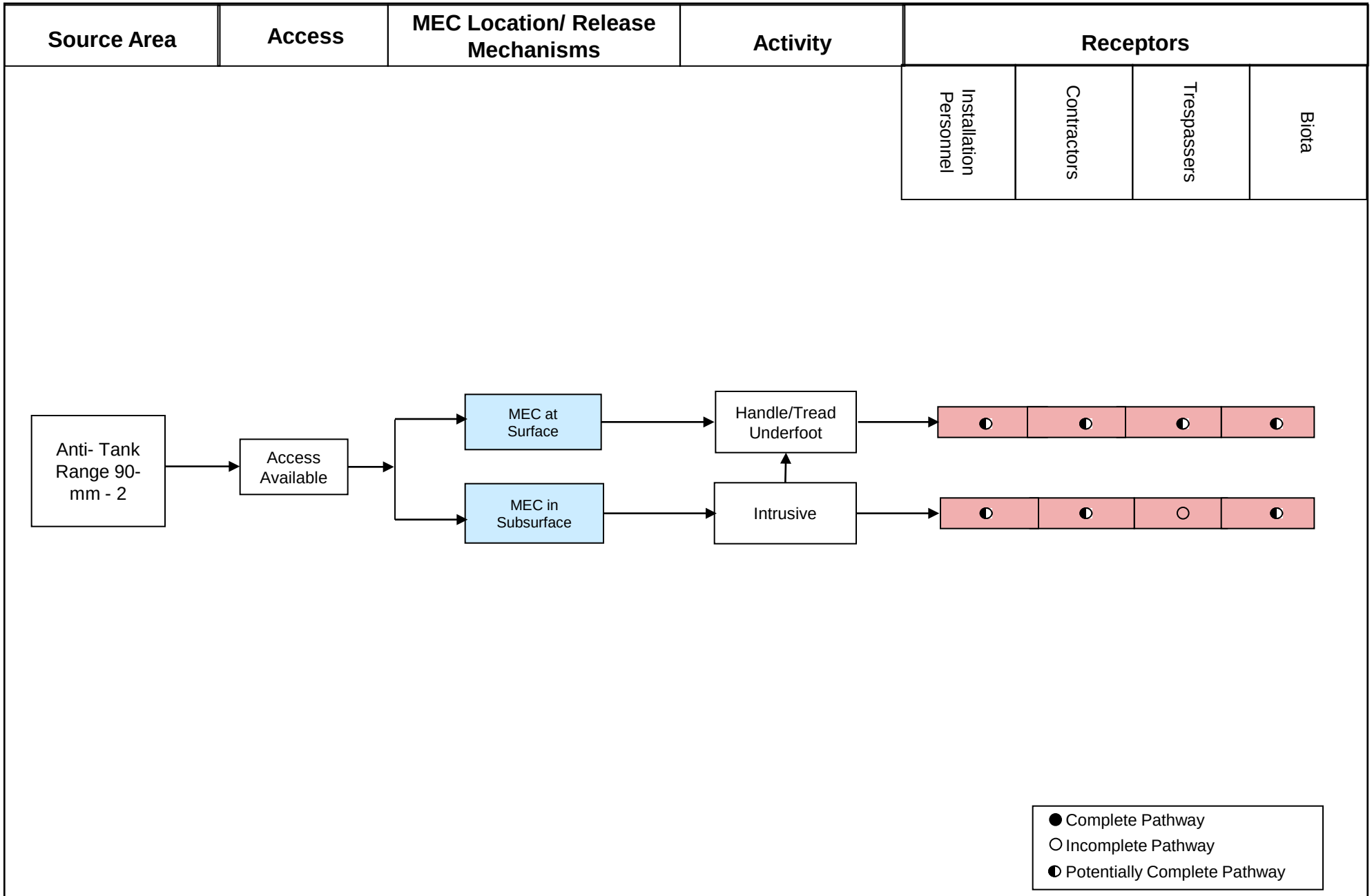
The surface water / sediment exposure pathways are considered to be potentially complete for ecological receptors since there is a pond present on the Anti-Tank Range 90-MM – 2. The pathway is incomplete for human receptors.

Subsurface Soil

Since the potential exists for MC in the subsurface soil in the Anti-Tank Range 90-MM – 2, receptor contact with subsurface soil is possible if the soil is disturbed through excavation or construction activities, creating possible receptor pathways to MC in subsurface soils. As such, biota have potentially complete pathways to MC in subsurface soil through the (incidental) ingestion, dermal contact, and inhalation (dust) exposure routes. Since MC concentrations only exceed Ecological Screening Values, incomplete pathways exist in the subsurface soil for all human receptors.

Surface Soil

Ecological receptors within the Anti-Tank Range 90-MM – 2 may be exposed to surface soil. Therefore, the pathways to MC in surface soil through the (incidental) ingestion, dermal contact, and inhalation of dust exposure routes are potentially complete for biota. Since MC concentrations only exceed Ecological Screening Values, incomplete pathways exist in the surface soil for all human receptors.



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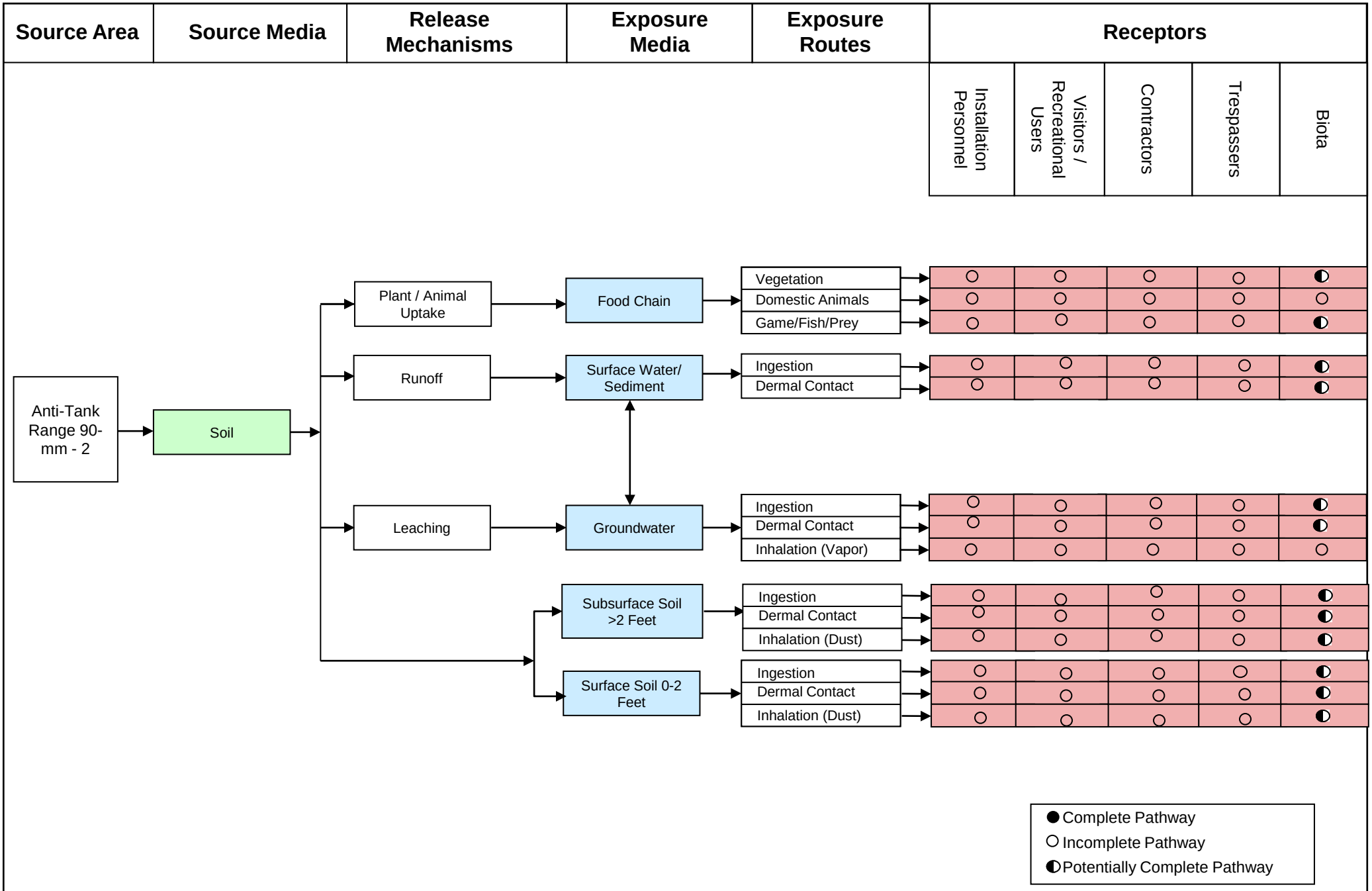
CONFIRMATORY SAMPLING REPORT
ANTI- TANK RANGE 90MM – 2 – MEC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-8
September 2011



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CONFIRMATORY SAMPLING REPORT
ANTI-TANK RANGE 90-MM – 2 – MC EXPOSURE PATHWAY ANALYSIS
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FIGURE 4-9
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4.2.4 Site Summary and Conclusions

4.2.4.1 MEC

Based on field observations and limited nature of the visual survey conducted for this CS, munitions debris may be present on this MRS. While MEC were not observed on the ground surface, an inert mine was found during field activities. Based on the potential for MEC and munitions debris to be present, this MRS is recommended for RFI/CMS.

4.2.4.2 MC

Four surface soil samples were collected from the MRS and analyzed for aluminum, antimony, copper, lead, zinc, and explosives. Analytical results indicate that none of the metal concentrations exceeded USEPA RSLs and no explosive compounds were detected above laboratory detection or reporting limits. With the exception of zinc, none of the metals concentrations exceeded the USEPA RSLs or the USEPA Region 4 Ecological Screening Values. The concentrations of zinc observed at this MRS were less than an order of magnitude above the established background levels; this is likely indicative of naturally occurring conditions and not evidence of an impact of the former land use. It is recognized that because the MRS is recommended for RFI/CMS for MEC, MC may also be evaluated as part of the study.

4.2.5 Site Recommendations

The findings of the MEC Phase 2 CS field activities indicate that MEC and munitions debris may be present on Anti-Tank Range 90-MM - 2. As a result, the Anti-Tank Range 90-MM – 2 is recommended for RFI/CMS.

4.3 GRENADE LAUNCHER RANGE (AEDB-R ID: FTSW-011-R-01)

4.3.1 Site Description and Historical Overview

The MRS layout, location, and sample locations are presented on Map 4-3. This 132-acre MRS is located along the western perimeter of the cantonment area and was historically used as a grenade launcher range (practice), infiltration course, 120mm anti-aircraft range, and three small arms ranges during the 1940s. The total acreage covered by the six historical ranges is 10,947.6 acres, 132 acres of which overlap the other than operational range area and make up Grenade Launcher Range MRS. According to documents reviewed for the HRR, munitions used on the Grenade Launcher Range included 40mm practice grenades, small arms, and TNT. Archival documents from 1941 document the use of .30 caliber (cal) and .50-cal machine guns on FTSW. Therefore, it is assumed that .30-cal and .50-cal small arms were used on this MRS. Additionally, 120mm anti-aircraft projectile use occurred on approximately 15 acres of the MRS. No EOD responses have been reported for this MRS.

4.3.2 Fieldwork Activities

4.3.2.1 MEC Activities and Purpose

Based on information presented in the HRR, the potential for MEC at the site exists; therefore, a magnetometer assisted visual survey was performed during sample activities. A magnetometer-assisted visual survey was used to determine the presence of MEC on the site. Field personnel (escorted by a UXO Technician III) traversed the MRS in order to complete the magnetometer-assisted visual survey of 10% of the undeveloped area (approximately 4 acres).

4.3.2.2 MC Activities and Purpose

Fourteen discrete surface soil samples were collected at biased locations when possible or at random locations throughout the site. Based on the historical layout and use of this MRS, berms may be present. Three samples were collected from locations of the berms from Ranges H, B, and A. Additionally, three samples were collected from the firing point of the 120-MM Anti-Aircraft Range. Soil samples were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Data was

compared to FTSW inorganic/metal background values, USEPA Residential RSLs, and USEPA Region 4 Ecological Screening Values for Surface Soil for metals and explosives.

4.3.3 Fieldwork Results

4.3.3.1 MEC Results

The UXO Technician used a magnetometer for anomaly avoidance and to aid in the detection of ferrous metal objects on the surface that may have been covered by vegetation. A limited magnetometer assisted visual survey consisting of 10% of the undeveloped area was conducted.

Concrete backstop walls were observed on the MRS (see Figure 4-10). The wall was broken in sections with an earthen berm in front of a portion of it. In other portions, the soil had been scraped off and removed. Behind the concrete wall was a shelter area and wooden target frames (see Figure 4-11). Near the operational areas boundary was a concrete tank that is assumed to have been used for drainage (see Photographic Log, Appendix C).

Figure 4-10: Concrete Wall

Figure 4-11: Behind Concrete Wall with Wood Target Frames

Near the wall were piles of pop flares (expended), empty ammo cans, and expended small arms cartridges (.30-cal and .45-cal) were found nearby. The munitions appeared to have been burned, and then discarded at the site. Site discoveries are described in Table 4-9.

Figure 4-12: Expended Small Arms Cartridges (.30-cal and .45-cal)

Figure 4-13: Tail of M125A1 Pop Flare

Table 4-8: Site Discoveries at Grenade Launcher Range

Item ID	Description
MEC Item	
None	None
Munitions Debris	
Pop flares, empty ammo cans, expended small arms cartridges	Items were found by berms. They appeared to have been burned, and then discarded at the site.
Structures/Debris	
Concrete Backstops	Concrete backstops were observed on the site. The wall was broken in sections with an earthen berm in front of a portion of it. In other portions, the soil had been scraped off. Behind the concrete wall was a shelter area and wooden target frames.

4.3.3.2 MC Results

Fourteen soil samples were collected from the Grenade Launcher Range and analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. The analytical data are summarized in Table 4-10, and sample locations are shown on Map 4-3.

The following are the results of the soil sampling analysis at the Grenade Launcher Range:

- **Lead:** None of the samples collected exceeded the USEPA RSL for lead. Three of the samples exceeded the Ecological Screening Value for lead in surface soil. Nine samples exceeded the FTSW background level for lead.
- **Other metals:** Aluminum, antimony, copper, and zinc did not exceed the USEPA RSLs or the USEPA Region 4 Ecological Screening Values.
- **Explosives:** No explosives were detected above laboratory detection or method reporting limits.

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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Map 4-3
Grenade Launcher Range

436000 438000 440000

3528000 3526000

N

Anti-Tank Range - 90-MM (RCRA Permitted Landfill)

Anti-Tank Range - 90-MM - 2

Small Arms Range - 2

A Range

Grenade Launcher Range

B Range

H Range

Discarded Munitions Debris

Discarded Munitions Debris

Infiltration Course

SS-18 SS-19 SS-20 SS-21 SS-22 SS-23 SS-24 SS-25 SS-26 SS-28 SS-29 SS-30 SS-31 SS-32

120-mm Anti-Aircraft Range

Grenade Launcher Range

Legend

Installation Data
- Installation Boundary
- Other than Operational Area
- Operational Area
- Infiltration Course
- Existing Berm Location
- Historical Berm Location

Confirmatory Sampling Data
- Sample Location
- Site Walk
- Discarded Munitions Debris

Phase 2 MRS (Other than Operational Area)
- Small Arms Range - 2
- Anti-Tank Range 90-MM - 2
- Grenade Launcher Range

Phase 1 MRS
- Anti-Tank Range 90-MM (RCRA Permitted Landfill)

Grenade Launcher Historical Range Fans
- Small Arms 1944
- Grenade Launcher Range
- 120-mm Anti-Aircraft

Hydrology
- River/Stream
- Water Body

0 500 1,000 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0004
Edition: Final
Date: September 2011

Table 4-9: Grenade Launcher Range

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-18-082510	FTSW-SS-19-082510	FTSW-SS-20-082510	FTSW-SS-21-082510	FTSW-SS-21-DUP-082510	FTSW-SS-22-082510	FTSW-SS-24-082510	FTSW-SS-25-082510
	mg/kg	mg/kg	mg/kg	mg/kg								
METALS (mg/kg)												
Aluminum	2	-	77,000	-	3,470	2,830	2,530	6,240	6,540	1,650	2,820	2,810
Antimony	0.6	-	31	3.5	0.09 UJ	0.15 J	0.09 UJ	0.10 UJ	0.09 UJ	0.07 UJ	0.25 J	0.10 UJ
Copper	0.3	-	3,100	40	8.1	6.2	2	3.5	3	2.2	8.7	5.2
Lead	0.3	11.1	400	50	**22.6**	**54.8**	**61.4**	4.9	5.1	1.9	**58.8**	**17.1**
Zinc	0.7	15.5	23,000	50	5.7	11.7 J	**33.8 J**	13 J	7.8 J	1.6 J	**41.8**	14.9
EXPLOSIVES (ug/kg)												
EGDN	800	N/A	-	-	ND	ND	ND	ND	ND	ND	ND	ND
PETN	800	N/A	-	-	ND	ND	ND	ND	ND	ND	ND	ND
NG	800	N/A	6,100	1.6	ND	ND	ND	ND	ND	ND	ND	ND
HMX	100	N/A	3,800,000	2300	ND	ND	ND	ND	ND	ND	ND	ND
RDX	100	N/A	5,500	0.23	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-TNB	100	N/A	2,200,000	3,900	ND	ND	ND	ND	ND	ND	ND	ND
4-NT	100	N/A	30,000	3.9	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DNB	100	N/A	6,100	3.3	ND	ND	ND	ND	ND	ND	ND	ND
NB	100	N/A	4,800	0.079	ND	ND	ND	ND	ND	ND	ND	ND
TETRYL	100	N/A	240,000	1,400	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	100	N/A	19,000	13	ND	ND	ND	ND	ND	ND	ND	ND
4-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND	ND	ND	ND
2-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	100	N/A	61,000	50	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	100	N/A	1,600	0.29	ND	ND	ND	ND	ND	ND	ND	ND
2-NT	100	N/A	2,900	0.29	ND	ND	ND	ND	ND	ND	ND	ND
3-NT	100	N/A	6100	3.4	ND	ND	ND	ND	ND	ND	ND	ND

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-23-082510	FTSW-SS-26-082510	FTSW-SS-28-082610	FTSW-SS-29-082610	FTSW-SS-30-082610	FTSW-SS-31-082610	FTSW-SS-32-082610
	mg/kg	mg/kg	mg/kg	mg/kg							
METALS (mg/kg)											
Aluminum	2	-	77,000	-	3,240	4,920	3,450	3,090	3,950	4,240	5,910
Antimony	0.6	-	31	3.5	0.10 UJ	0.09 UJ	0.08 UJ	0.09 UJ	0.08 UJ	0.44 UJ	0.10 UJ
Copper	0.3	-	3,100	40	3.3	7.3	2.1	2.6	2.3	27	2.9
Lead	0.3	11.1	400	50	**13.2**	**13.4**	**18.8**	5.2	4.4	**13.7**	9.9
Zinc	0.7	15.5	23,000	50	4.7	7.7	4	5.9	2.6	3.8 J	12
EXPLOSIVES (ug/kg)											
EGDN	800	N/A	-	-	ND	ND	ND	ND	ND	ND	ND
PETN	800	N/A	-	-	ND	ND	ND	ND	ND	ND	ND
NG	800	N/A	6,100	1.6	ND	ND	ND	ND	ND	ND	ND
HMX	100	N/A	3,800,000	2300	ND	ND	ND	ND	ND	ND	ND
RDX	100	N/A	5,500	0.23	ND	ND	ND	ND	ND	ND	ND
1,3,5-TNB	100	N/A	2,200,000	3,900	ND	ND	ND	ND	ND	ND	ND
4-NT	100	N/A	30,000	3.9	ND	ND	ND	ND	ND	ND	ND
1,3-DNB	100	N/A	6,100	3.3	ND	ND	ND	ND	ND	ND	ND
NB	100	N/A	4,800	0.079	ND	ND	ND	ND	ND	ND	ND
TETRYL	100	N/A	240,000	1,400	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	100	N/A	19,000	13	ND	ND	ND	ND	ND	ND	ND
4-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND	ND	ND
2-AM-DNT	100	N/A	150,000	56	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	100	N/A	61,000	50	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	100	N/A	1,600	0.29	ND	ND	ND	ND	ND	ND	ND
2-NT	100	N/A	2,900	0.29	ND	ND	ND	ND	ND	ND	ND
3-NT	100	N/A	6100	3.4	ND	ND	ND	ND	ND	ND	ND

Notes:

(1) Information provided by Phase II RCRA Facility Investigation Report for 16 Solid Wate Management Units At Fort Stewart, GA

Bold exceeded FTSW background

exceeded USEPA Region 4 Ecological Soil Screening Values

exceeded USEPA RSLs for Residential Soil

Definitions:

AM Amino
C Carcinogen
DNB Dinitrobenzene
EGDN Ethylene Glycol Dinitrate
HMX High Melting Point Explosive
mg/kg milligram/kilogram
µg/kg microgram/kilogram
N Non-carcinogen
J Analyte was positively identified; however, the result should be considered an estimated value
ND Analyte not detected above the method detection limit or laboratory reporting limit.
NB Nitrobenzene
NG Nitroglycerin
NT Nitrotoluene
PQL Project Quantitation Limit
PETN Pentaerythritol tetranitrate
RDX Cyclotrimethylene trinitramine
TETRYL 2, 4, 6, Trinitrophenylmethyinitramine (Explosive)
TNB Trinitrobenzene
U Analyte not detected above the reporting limit
UJ Analyte was not detected above the reporting limit; however, the reporting limit is considered an estimated value.

4.3.4 Conceptual Site Model

4.3.4.1 MMRP Profile

4.3.4.1.1 Area and Layout

The Grenade Launcher Range is approximately 143 acres located in the southern portion of the installation.

4.3.4.1.2 Structures

There are currently 28 buildings on the MRS. This area is used for industrial purposes.

4.3.4.1.3 Utilities

Utilities are described in Section 4.1.4.1.3. Site-specific utilities are unknown.

4.3.4.1.4 Boundaries

The area to the north, west, and south of the site are undeveloped. The site is bounded to the east by 15th Street and to the west by FS-90.

4.3.4.1.5 Security

There is no site-specific security.

4.3.4.2 Physical Profile

4.3.4.2.1 Climate

General installation climate information is presented in Section 4.1.4.2.1.

4.3.4.2.2 Geology

General geologic information for FTSW is presented in Section 4.1.4.2.2. No specific geologic information pertaining to the site was available.

4.3.4.2.3 Topography

General information about the topography of FTSW is presented in Section 4.1.4.2.3. The Grenade Launcher Range is approximately 20 feet amsl; the site is generally flat and has level terrain.

4.3.4.2.4 Soil

General information about the soil types present on FTSW is presented in Section 4.1.4.2.4. The soil at the Grenade Launcher Range is classified as clay-sand/clay-silt.

4.3.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at FTSW is presented in Section 4.1.4.2.5. There is no site-specific information on hydrogeology.

4.3.4.2.6 Hydrology

General information about hydrologic conditions at FTSW is presented in Section 4.1.4.2.6. There are no hydrology features on the site.

4.3.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. The Grenade Launcher Range is primarily forested and grassland.

4.3.4.3 Land Use and Exposure Profile

4.3.4.3.1 Current Land Use / Activities

The Grenade Launcher Range is comprised of the cantonment area, including an industrial area and warehouses, and undeveloped land.

4.3.4.3.2 Current Human Receptors

The current human receptors of the Grenade Launcher Range are authorized installation personnel, contractors, visitors, and trespassers.

4.3.4.3.3 Potential Future Land Use

In the cantonment area (Installation Support), plans include an industrial area, warehouses, tactical equipment maintenance facility, company operations facility, and undeveloped land.

4.3.4.3.4 Potential Future Human Receptors

The potential future human receptors of potential MEC or MC remain the same as the current human receptors (authorized installation personnel, contractors, visitors, and trespassers.).

4.3.4.3.5 Zoning / Land Use Restrictions

General information about zoning and land use restrictions at FTSW is presented in Section 4.1.4.3.5. Site-specific information about zoning and land use is unknown.

4.3.4.3.6 Beneficial Resources

General information about the beneficial resources on FTSW is presented in Section 4.1.4.3.6. Site-specific resources include the forested areas, which act as habitat.

4.3.4.3.7 Demographics/Zoning

General information about the demographics/zoning on FTSW is presented in Section 4.1.4.3.7.

4.3.4.4 Ecological Profile

4.3.4.4.1 Habitat Type

General information on habitat types at FTSW is provided in Section 4.1.4.4.1. Site-specific habitat types include the forested areas.

4.3.4.4.2 Degree of Disturbance

Currently, there is a high degree of disturbance because the majority of the site is developed.

4.3.4.4.3 Ecological Receptors

General information about the ecological receptors on FTSW is presented in Section 4.1.4.4.3.

4.3.4.5 Munitions/Release Profile

4.3.4.5.1 Munitions Types and Release Mechanisms

Table 4-11 presents a summary of the types of potential and actual munitions debris that were identified during research conducted for the HRR and during CS field activities, respectively. The mechanisms by which the munitions, if present, could have been released into the environment are also presented in the table.

Table 4-10: Summary of Potential and Actual Munitions Debris and MEC – Grenade Launcher Range

MMRP Site	Munitions Debris / MEC Observed During Phase 2 CS Field Activities	Potential Munitions Debris / MEC Identified During HRR[1]	Primary Release Mechanism
Grenade Launcher Range	Pop flares (expended) Empty ammo cans Expended small arms cartridges (.30-cal and .45-cal)	0.22-cal 0.30-cal, 0.30-cal (with tracer) 0.45-cal 0.50-cal, 0.50-cal (with tracer), 0.50-cal (armor piercing) small arms 40mm rifle grenade (practice) 120mm projectile	Munitions firing Malfunctioned munitions Discarded munitions

[1]Item is based on historical use. Not confirmed.

4.3.4.5.2 Maximum Probability Penetration Depth

Table 4-12 provides the expected penetration depths for 40mm rifle grenades and 120mm projectiles for various types of soils that are expected to be found at Grenade Launcher Range. For Grenade Launcher Range, the soil type is considered sand-silt/sand-clay. Therefore, the depths of penetration for Grenade Launcher Range are based upon the penetration depth for a loamy soil. As discussed in Section 4.1.4.5.2, these penetration depths are estimated on a worst-case scenario.

The ITRC has prepared a document titled *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges*, dated January 2003, to provide information on the general layout of small arms ranges, as well as information on areas that may be impacted with MC and/or MEC as a result of range use and the characterization of munitions used. According to the ITRC document, the maximum expected penetration depth is 1 foot.

The pop flares (expended), ammo cans, and expended small arms cartridges (.30-cal and .45-cal) were discarded; therefore, they would not have a penetration depth.

Table 4-11: Expected MEC Penetration Depths – Grenade Launcher Range

Munitions Item	Depth of Penetration (feet bgs)		
	Sand	Loam	Clay
40mm rifle grenade (practice)	0.2	0.3	0.4
120mm projectile	5.5	8.5	11.5

4.3.4.5.3 MEC Density

The MEC density of this MRS is considered to be low based on the site investigation. There have been no reported finds of MEC; however, MEC may exist in the undeveloped areas due to the limited nature of the CS visual survey.

4.3.4.5.4 Munitions Debris

Based on the magnetometer-assisted visual survey, there is the potential for munitions debris items. Potential munitions debris associated with small arms ammunition include spent projectiles, fragments, and shell casings. Additionally, munitions debris associated with the 120-MM Anti-Aircraft Range, Grenade Launcher Range (practice), and Infiltration Course is possible.

4.3.4.5.5 Associated MC

Fourteen discrete surface soil samples were collected, randomly distributed throughout the MRS. Based on the historical layout and use of this MRS, burial areas were not anticipated; therefore, only surface soil samples, at a depth of 0 – 6 inches, were collected. Soil samples were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Based on analytical results, lead was the only metal detected in concentrations that exceeded USEPA Region 4 Ecological Screening Values but below USEPA RSLs. No explosive compounds were detected above laboratory detection or reporting limits.

4.3.4.5.6 Transport Mechanisms / Migration Routes

The primary transport mechanisms considered for Grenade Launcher Range include the following:

Erosion: Grenade Launcher Range is only partially developed; therefore, erosion is potentially a factor in transporting and migrating possible MC contaminated soil.

Soil Disturbance: The current degree of disturbance is high, as a majority of the site has been developed and cleared since the range was used. However, MC could be present in the surface or subsurface.

Infiltration: Based on the soil types associated with Grenade Launcher Range, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through filtration.

4.3.4.6 Pathway Analysis

4.3.4.6.1 MEC

Based on historical documents and information obtained during the data collection process, the potential exists for MEC to be present on the site. As illustrated in the Exposure Pathway Analysis for MEC (Figure 4-14), the pathways for all human and ecological receptors are potentially complete as the potential exists for these receptors to encounter MEC on the surface. Potentially complete pathways for installation personnel, contractors, and biota for MEC in the subsurface exist as these receptors have the potential to conduct intrusive activities. The pathway for MEC in the subsurface is incomplete for trespassers.

4.3.4.6.2 MC

As illustrated in the MC Exposure Pathway Analysis (Figure 4-15), soil and groundwater represent the potential primary source media. Fourteen surface soil samples were analyzed for aluminum, antimony, copper, lead and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. Based on analytical results, no explosive compounds were detected above laboratory detection or reporting limits. Lead was the only metal detected in

concentrations that exceeded USEPA Region 4 Ecological Screening Values but below USEPA RSLs. Therefore, all pathways for human receptors are incomplete.

Food Chain

A potentially complete pathway to MC in the source media through uptake into vegetation exists for grazing/foraging biota. This exposure pathway is incomplete for all other receptors. As there are no domestic animals on FTSW, the pathway to MC in the source media through this exposure route is incomplete for all receptors. The pathway to MC in the source media through the game/fish/prey exposure route is potentially complete for biota. This exposure pathway is incomplete for all other receptors as their activities are not expected to include hunting and MC levels only exceed USEPA Region 4 Ecological Screening Values.

Groundwater

Precipitation infiltration may provide for contaminant mobility into the shallow or surficial groundwater aquifer. However, based on a review of hydrogeological data (Section 4.3.4.2.5), it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW. Receptor contact with groundwater is possible if the soil is disturbed through excavation or construction activities, creating possible migration routes/mechanisms for MC in shallow groundwater. As such, biota have potentially complete pathways to MC in shallow groundwater through the (incidental) ingestion and dermal contact exposure routes, as MC concentrations only exceed the USEPA Region 4 Ecological Screening Values. Given that it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW, the dermal and ingestion exposure routes are incomplete for trespassers. Since the upper aquifer is not used as a potable water source and MC are typically not volatile, the inhalation (vapor) exposure route is incomplete for all receptors.

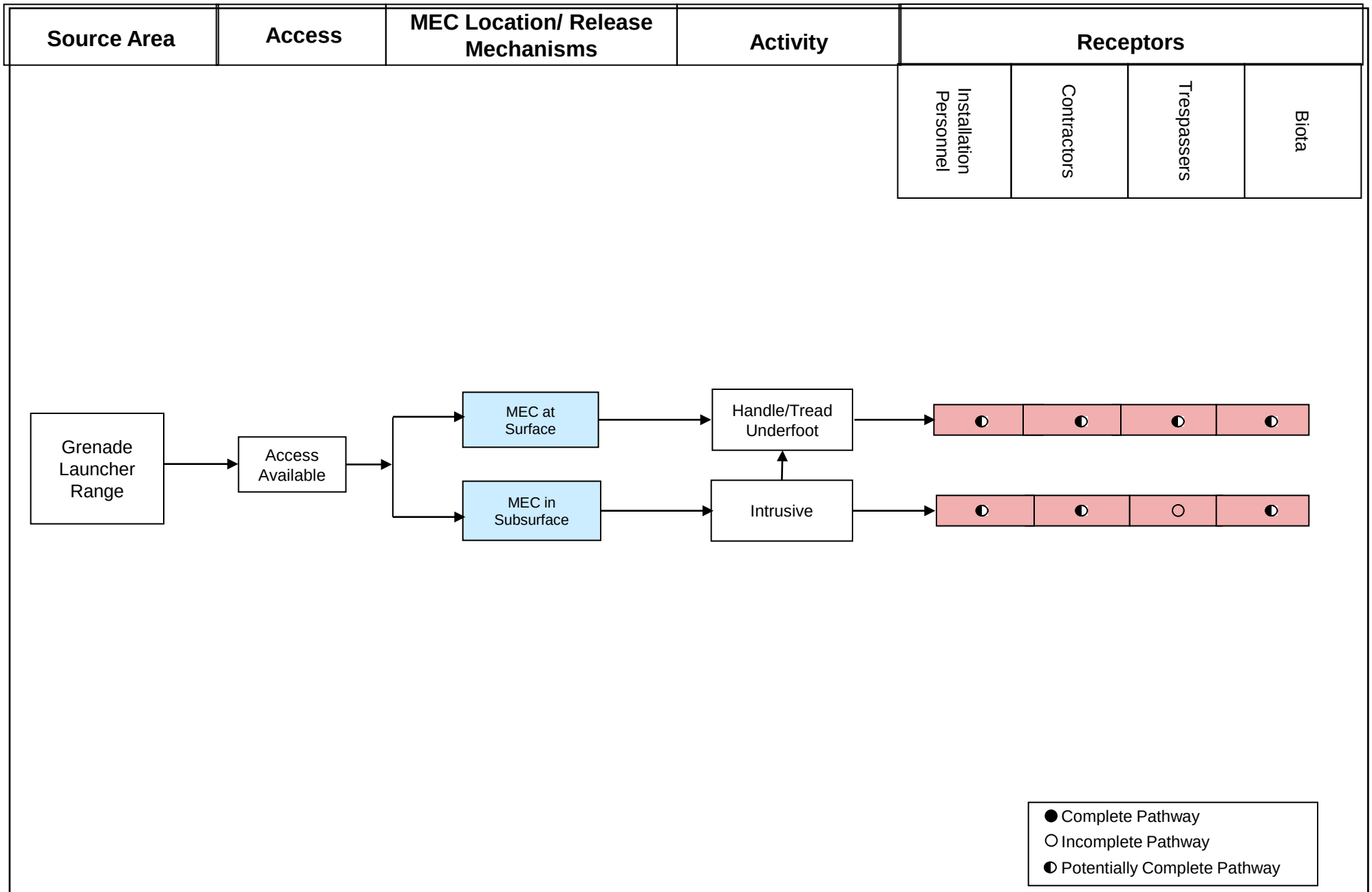
Subsurface Soil

Since the potential exists for MC in the subsurface soil in the Grenade Launcher Range, receptor contact with subsurface soil is possible if the soil is disturbed through excavation or construction activities, creating possible receptor pathways to MC in subsurface soils. As such, biota have

potentially complete pathways to MC in subsurface soil through the (incidental) ingestion, dermal contact, and inhalation (dust) exposure routes. Since MC concentrations only exceed USEPA Region 4 Ecological Screening Values, incomplete pathways exist in the subsurface soil for all human receptors.

Surface Soil

Ecological receptors within the Grenade Launcher Range may be exposed to surface soil. Therefore, the pathways to MC in surface soil through the (incidental) ingestion, dermal contact, and inhalation of dust exposure routes are potentially complete for biota. Since MC concentrations only exceed USEPA Region 4 Ecological Screening Values, incomplete pathways exist in the surface soil for all human receptors.



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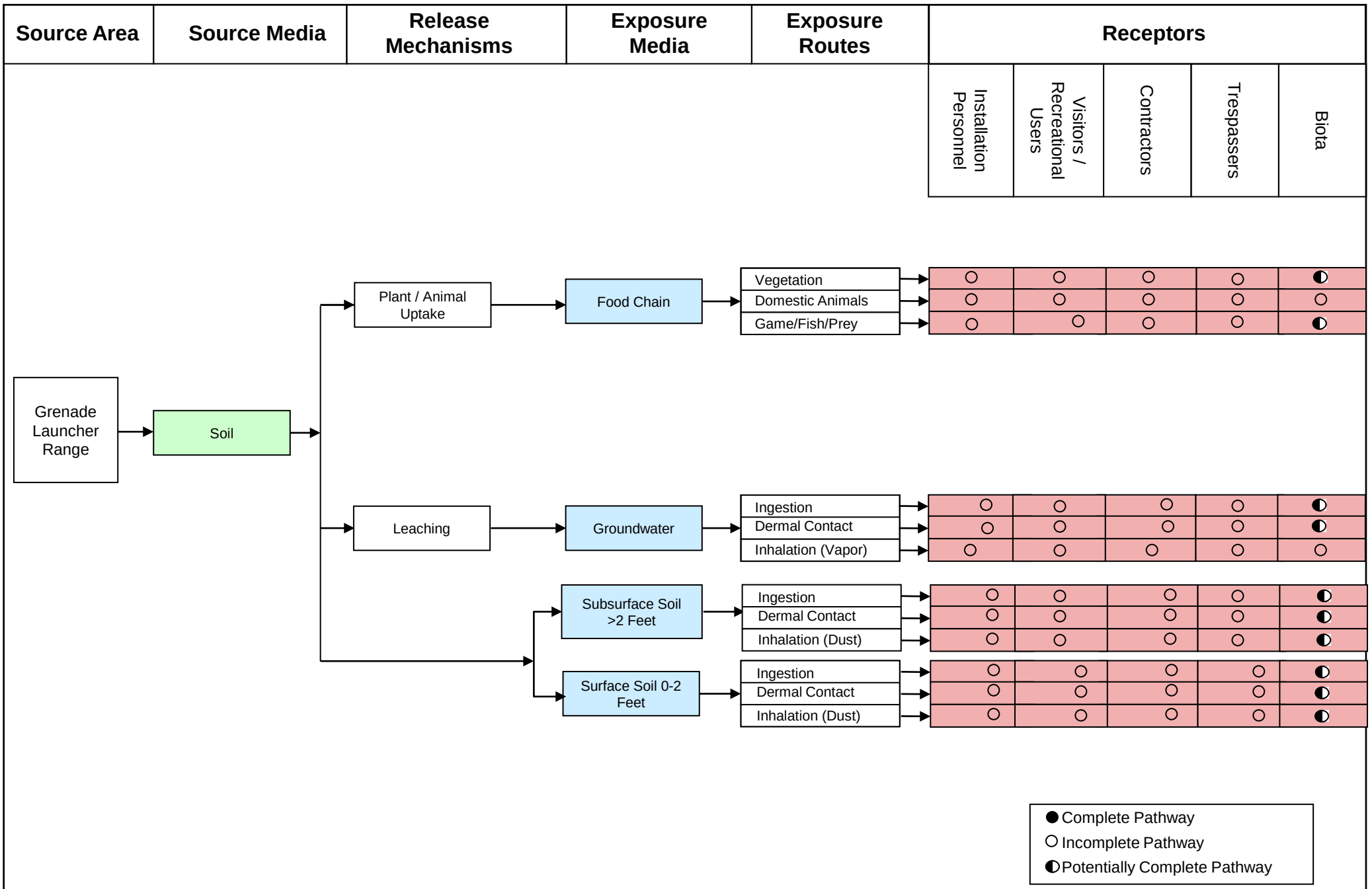
CONFIRMATORY SAMPLING REPORT
GRENADE LAUNCHER RANGE – MEC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-14
September 2011



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CONFIRMATORY SAMPLING REPORT
GRENADE LAUNCHER RANGE – MC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-15
September 2011

4.3.5 Site Summary and Conclusions

4.3.5.1 MEC

Piles of pop flares (expended), empty ammo cans, and expended small arms cartridges (.30-cal and .45-cal) were observed during the Phase 2 CS field activities. The munitions debris appeared to be burned and discarded at the MRS, not from live-fire activities. A concrete backstop wall was also observed at the site. Because there is a possibility that MEC may remain on the MRS due to limited nature of the CS visual survey, the Grenade Launcher Range is recommended for RFI/CMS for MEC.

4.3.5.2 MC

Fourteen surface soil samples was collected from the Grenade Launcher Range and analyzed for aluminum, antimony, copper, zinc, lead, and explosives in order to complete the MRSPP. Based on the results of the metals analysis, lead was the only metal detected in concentrations that exceeded USEPA Region 4 Ecological Screening Values. No metals were detected at or above their respective USEPA RSLs. No explosive compounds were detected above laboratory detection or reporting limits. The concentrations of lead observed at this MRS were less than an order of magnitude above the established background levels; this is likely indicative of naturally occurring conditions and not evidence of an impact of the former land use. It is recognized that because the MRS is recommended for RFI/CMS for MEC, MC may also be evaluated as part of the study.

4.3.6 Site Recommendations

Munitions debris and range features were observed during the Phase 2 CS field activities. Therefore, the Grenade Launcher Range is recommended for RFI/CMS.

4.4 SMALL ARMS RANGE – 2 (AEDB-R ID: FTSW-006-R-01)

4.4.1 Site Description and Historical Overview

The MRS layout and location are presented on Map 4-4. This 287-acre MRS is located along the western perimeter of the cantonment area and historically was used for small arms training during the 1940s and 1950s. The combined acreage of the overlapping range fans is 2,091 acres, 287 acres of which overlap the other than operational area and make up Small Arms Range – 2. The MRS is composed of the firing points of the four small arms ranges and the downrange area of Range M and HBANM Ranges. According to documents reviewed for the June 2010 HRR, munitions used on the small arms range were .50-cal or less; however, the exact calibers are unknown. Archival documents from 1941 document the use of .30-cal and .50-cal machine guns on FTSW. Therefore, it is assumed that .30-cal and .50-cal small arms were used on this MRS. Two documented EOD responses were identified at the site. The first involved a 105mm projectile and occurred in April 2003. The second occurred in 2008; however, the munitions item encountered was not documented.

The berm of a former small arms range, identified as the "Fire Station 5 Berm" due to its proximity to a fire station, was identified within the Small Arms Range – 2 MRS boundary. The USACE Savannah District conducted an investigation of this berm. During this investigation, soil samples were collected from the Fire Station 5 Berm on the August 7 and 8, 2008. In total, 22 samples were collected and analyzed for antimony, copper, and lead. Concentrations of antimony ranged from below the method detection limit to 2.38 mg/kg. Concentrations of copper ranged from 0.247 to 104 mg/kg. Concentrations of lead ranged from 2.19 to 1,000 mg/kg. Three samples exceeded the 400 mg/kg USEPA Region 9 Preliminary Remediation Goals for lead. The Fire Station 5 Berm was subsequently removed.

Currently a Supplemental Investigation and TCRA are on-going at the "Fire Station 5 Berm." The investigations are being conducted to ensure worker safety during the construction of a Fire Station on the site. Soil, surface water and groundwater are being investigated for lead, the constituent of concern. The TCRA field activities were completed in September 2010. The

berm was subsequently removed under Best Management Practices to refurbish another operational berm.

Because of this on-going investigation, field work was intentionally not conducted in this area. However, this area is part of the Small Arms Range – 2 MRS; the berm is suspected to be associated with Range M.

4.4.2 Fieldwork Activities

4.4.2.1 MEC Activities and Purpose

No MEC field activities were conducted for this MRS because historical evidence suggests only small arms were used at this MRS.

4.4.2.2 MC Activities and Purpose

A visual survey, escorted by an UXO Technician III using an all-metals detector, was completed to identify any berms on site. A total of ten discrete surface soil samples were collected throughout the site. Six of the ten samples were collected from Range N. Samples were collected from the location of each of the four firing positions/berms on Range N. Two samples were collected from a berm in Range A. Because GPS coordinates were available, an explosive sample was also collected at the location of each of the two EOD responses within the MRS. All samples were analyzed for lead using USEPA Method 6010B. The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, and zinc using Method 6010B and for explosives using USEPA Method 8330B modified. Data was compared to the FTSW background values, USEPA Residential RSLs, and USEPA Region 4 Ecological Screening Values for surface soil.

4.4.3 Fieldwork Results

4.4.3.1 MEC Results

No MEC field activities were conducted for this MRS because historical evidence suggests only small arms were used at this MRS. However, observations were recorded while conducting the MC sampling. All site observations are described in Table 4-13. The UXO Technician used an

all-metals detector for anomaly avoidance, to aid in the detection of metallic objects on the surface that may have been covered by vegetation, and to identify range features.

The locations of two of the former berms on the MRS have been turned into an obstacle course. Beyond the obstacle course is an operational bayonet course; no firing is conducted at the site. Both the obstacle course and the bayonet course are shown in the Photographic Log (Appendix C).

An earthen berm was located near the bayonet course. The berm had a concrete wall behind it similar to that of the Grenade Launcher Range, but the wall was broken in pieces, as shown in Figure 4-16.

Figure 4-16: Berm with Broken Concrete Wall

Beyond the earthen berm was a concrete backstop wall similar to the one located on the Grenade Launcher Range (see Figure 4-17). An earthen berm would have been in front of the backstop, but the soil has since been removed. Metal frames to lift the targets were found behind the backstop wall (see Figure 4-18).

Figure 4-17: Concrete Backstop

Figure 4-18: Metal Frames

Two munitions debris items were observed during the magnetometer-assisted visual survey: a 9mm projectile and an expended 25mm cartridge. The 9mm projectile was near the southernmost berm of Range N at a presumed firing point. The expended 25mm cartridge was likely an expended cartridge disposed from a Bradley fighting vehicle located on the opposite side of the adjacent motor pool fence. It is assumed that the expended cartridge was disposed of here, but not fired here.

Figure 4-19: 9mm Projectile

Figure 4-20: 25mm Cartridge, Expended

Table 4-12: Site Discoveries at Small Arms Range - 2

Item ID	Description
MEC Item	
None	None
Munitions Debris	
9mm projectile	An expended 9mm projectile was found approximately 200' away from the second obstacle course berm at the assumed firing point.
25mm cartridge, expended	The expended cartridge was likely from one of the Bradley fighting vehicles which are housed in the motor pool on the opposite side of the fence line. It is assumed that the expended cartridge was disposed of here, but not fired here.
Structures/Debris	
Earthen berm with broken concrete wall	The berm had a concrete wall behind it similar to that of the Grenade Launcher Range, but the wall was broken in pieces.
Concrete Backstop	A concrete backstop, similar to the one at the Grenade Launcher Range, was found. There would have been at earthen berm in front of the wall, but the soil has since been removed.
Metal Frames	Metal frames were found behind the concrete backstop. These would be used to lift up targets.

4.4.3.2 MC Results

A total of ten soil samples were collected from the Small Arms Range - 2 and analyzed for lead by USEPA Method 6010B. The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, and zinc using Method 6010B and for explosives using USEPA Method 8330B modified. The analytical data are summarized in Table 4-14, and sample locations are shown on Map 4-4.

The following are the results of the soil sampling analysis at the Small Arms Range - 2:

- **Lead:** None of the lead samples exceeded the USEPA RSL for lead. Three samples and one duplicate exceeded the FTSW background levels for lead and the USEPA Region 4 Ecological Screening Value for lead in surface soil.
- **Other metals:** Aluminum, antimony, copper, and zinc did not exceed USEPA Region 4 Ecological Screening Values or USEPA RSLs in the two samples analyzed.
- **Explosives:** No explosives were detected above laboratory detection or method reporting limits in the two samples analyzed.

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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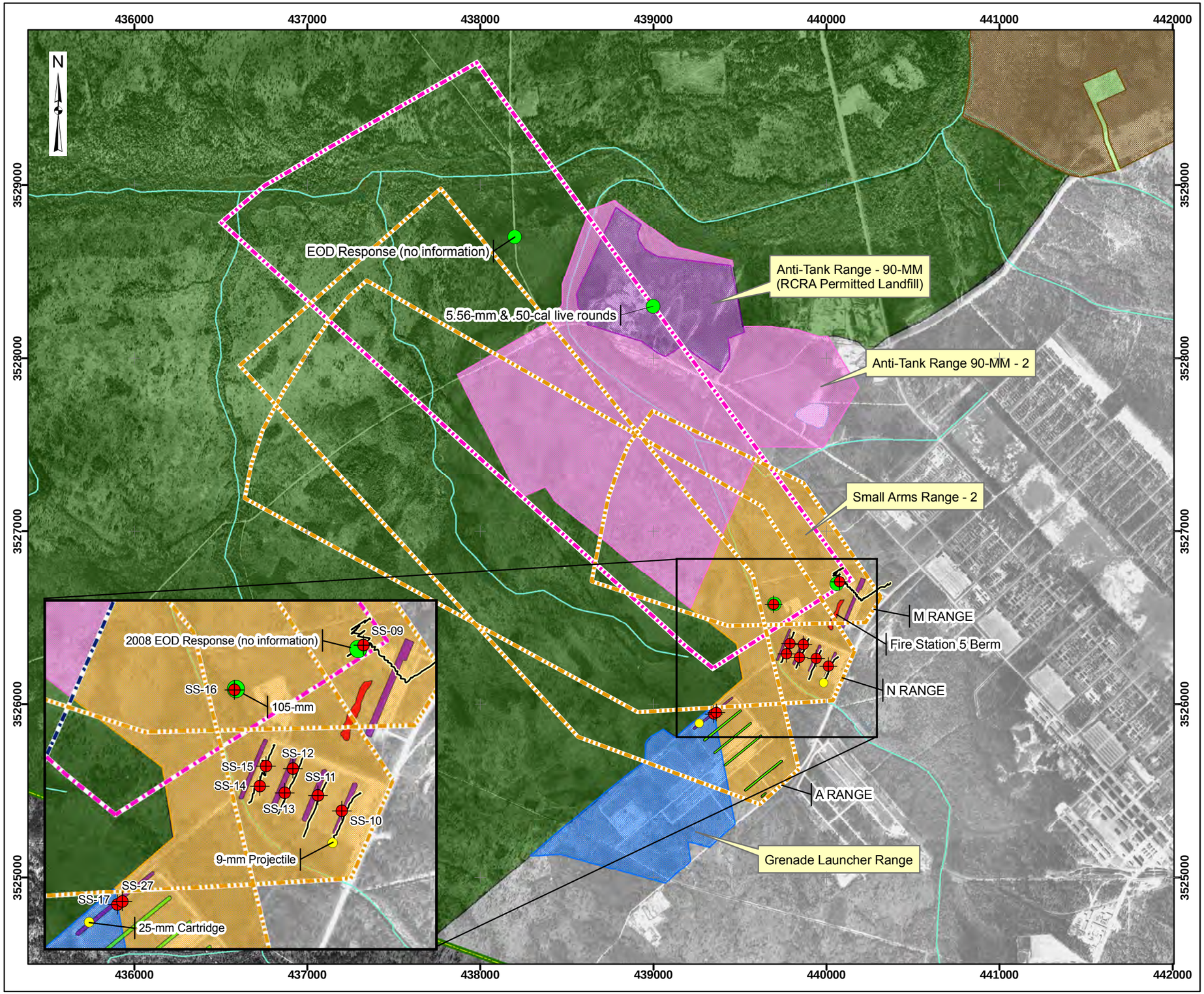
Map 4-4
Small Arms Range - 2



Legend

Installation Data
- Installation Boundary
- Other than Operational Area
- Operational Area
- Existing Berm Location
- Fire Station 5 Berm
- Historical Berm Location

Confirmatory Sampling Data
- Sample Location
- Site Walk
- Munitions Debris

EOD Finds
- EOD Response

Phase 2 MRS (Other than Operational Area)
- Small Arms Range - 2
- Anti-Tank Range 90-MM - 2
- Anti-Aircraft Range - 4A
- Anti-Aircraft Range - 4B
- Grenade Launcher Range

Phase 1 MRS
- Anti-Tank Range 90-MM (RCRA Permitted Landfill)

Small Arms Range Historical Fans
- Small Arms (HBANM RANGES) 1940
- Small Arms 1944

Hydrology
- River/Stream
- Water Body

0 500 1,000 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0043
Edition: Final
Date: September 2011

Table 4-13: Small Arms Range - 2

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-09-082410	FTSW-SS-09-DUP-082410	FTSW-SS-10-082510	FTSW-SS-11-082510	FTSW-SS-12-082510	FTSW-SS-13-082510
	mg/kg	mg/kg	mg/kg	mg/kg						
METALS (mg/kg)										
Aluminum	2	-	77,000	-	965	884				
Antimony	0.6	-	31	3.5	0.09 UJ	0.09 UJ				
Copper	0.3	-	3,100	40	3.2	3				
Lead	0.3	11.1	400	50	**29.9**	**50.1 J**	**111 J**	**31.8**	8.5	**49.4**
Zinc	0.7	15.5	23,000	50	1.2 J	1.1				
EXPLOSIVES (ug/kg)										
EGDN	800	N/A	-	-	ND	ND				
PETN	800	N/A	-	-	ND	ND				
NG	800	N/A	6,100	1.6	ND	ND				
HMX	100	N/A	3,800,000	2300	ND	ND				
RDX	100	N/A	5,500	0.23	ND	ND				
1,3,5-TNB	100	N/A	2,200,000	3,900	ND	ND				
4-NT	100	N/A	30,000	3.9	ND	ND				
1,3-DNB	100	N/A	6,100	3.3	ND	ND				
NB	100	N/A	4,800	0.079	ND	ND				
TETRYL	100	N/A	240,000	1,400	ND	ND				
2,4,6-TNT	100	N/A	19,000	13	ND	ND				
4-AM-DNT	100	N/A	150,000	56	ND	ND				
2-AM-DNT	100	N/A	150,000	56	ND	ND				
2,6-DNT	100	N/A	61,000	50	ND	ND				
2,4-DNT	100	N/A	1,600	0.29	ND	ND				
2-NT	100	N/A	2,900	0.29	ND	ND				
3-NT	100	N/A	6,100	3.4	ND	ND				

Analyte	PQLs	FTSW[1] Inorganic Metal Concentrations	EPA RSLs for Residential Soil	EPA Ecological Surface Soil Screening	FTSW-SS-14-082510	FTSW-SS-15-082510	FTSW-SS-16-082510	FTSW-SS-17-082510	FTSW-SS-27-082510
	mg/kg	mg/kg	mg/kg	mg/kg					
METALS (mg/kg)									
Aluminum	2	-	77,000	-			348		
Antimony	0.6	-	31	3.5			0.10 UJ		
Copper	0.3	-	3,100	40			2.8		
Lead	0.3	11.1	400	50	**171**	**118**	7.2	**15.6**	**17.9**
Zinc	0.7	15.5	23,000	50			3.4		
EXPLOSIVES (ug/kg)									
EGDN	800	N/A	-	-			ND		
PETN	800	N/A	-	-			ND		
NG	800	N/A	6,100	1.6			ND		
HMX	100	N/A	3,800,000	2300			ND		
RDX	100	N/A	5,500	0.23			ND		
1,3,5-TNB	100	N/A	2,200,000	3,900			ND		
4-NT	100	N/A	30,000	3.9			ND		
1,3-DNB	100	N/A	6,100	3.3			ND		
NB	100	N/A	4,800	0.079			ND		
TETRYL	100	N/A	240,000	1,400			ND		
2,4,6-TNT	100	N/A	19,000	13			ND		
4-AM-DNT	100	N/A	150,000	56			ND		
2-AM-DNT	100	N/A	150,000	56			ND		
2,6-DNT	100	N/A	61,000	50			ND		
2,4-DNT	100	N/A	1,600	0.29			ND		
2-NT	100	N/A	2,900	0.29			ND		
3-NT	100	N/A	6,100	3.4			ND		

Notes:

(1) Information provided by Phase II RCRA Facility Investigation Report for 16 Solid Wate Management Units At Fort Stewart, GA

Bold	exceeded FTSW background
	exceeded USEPA Region 4 Ecological Soil Screening Values
	exceeded USEPA RSLs for Residential Soil

Definitions:

AM	Amino
C	Carcinogen
DNB	Dinitrobenzene
EGDN	Ethylene Glycol Dinitrate
HMX	High Melting Point Explosive
mg/kg	milligram/kilogram
µg/kg	microgram/kilogram
N	Non-carcinogen
J	Analyte was positively identified; however, the result should be considered an estimated value
ND	Analyte not detected above the method detection limit or laboratory reporting limit.
NB	Nitrobenzene
NG	Nitroglycerin
NT	Nitrotoluene
PQL	Project Quantitation Limit
PETN	Pentaerythritol tetranitrate
RDX	Cyclotrimethylene trinitramine
TETRYL	2, 4, 6, Trinitrophenylmethyinitramine (Explosive)
TNB	Trinitrobenzene
U	Analyte not detected above the reporting limit
UJ	Analyte was not detected above the reporting limit; however, the reporting limit is considered an estimated value.

4.4.4 Conceptual Site Model

4.4.4.1 MMRP Profile

4.4.4.1.1 Area and Layout

The Small Arms Range – 2 is approximately 293 acres located in the southern portion of the installation.

4.4.4.1.2 Structures

There are currently 12 buildings on the MRS.

4.4.4.1.3 Utilities

Utilities are described in Section 4.1.4.1.3. Site-specific utilities are unknown.

4.4.4.1.4 Boundaries

The property is bounded to the north, south, and west by undeveloped property. A landfill is located to the north of the site. McFarland Avenue and W. 15th Street border the site to the east.

4.4.4.1.5 Security

Fences and guards are present at the Installation boundary. There is no security on the site.

4.4.4.2 Physical Profile

4.4.4.2.1 Climate

General installation climate information is presented in Section 4.1.4.2.1.

4.4.4.2.2 Geology

General geologic information for FTSW is presented in Section 4.1.4.2.2. No specific geologic information pertaining to the site was available.

4.4.4.2.3 Topography

General information about the topography of FTSW is presented in Section 4.1.4.2.3. The Small Arms Range – 2 is approximately 10 feet amsl; the site is generally flat and has level terrain.

4.4.4.2.4 Soil

General information about the soil types present on FTSW is presented in Section 4.1.4.2.4. The soil at the Small Arms Range – 2 is classified as clay-sand/clay-silt.

4.4.4.2.5 Hydrogeology

General information about the hydrogeologic conditions at FTSW is presented in Section 4.1.4.2.5. There is no site-specific information on hydrogeology.

4.4.4.2.6 Hydrology

General information about hydrologic conditions at FTSW is presented in Section 4.1.4.2.6. Mill Creek is located within the middle of the site, going southeast to the north.

4.4.4.2.7 Vegetation

General information about vegetation at the installation is presented in Section 4.1.4.2.7. Small Arms Range - 2 is primarily forested and grassy areas.

4.4.4.3 Land Use and Exposure Profile

4.4.4.3.1 Current Land Use / Activities

The Small Arms Range – 2 is comprised of the cantonment area, including an industrial area and warehouses, and undeveloped land.

4.4.4.3.2 Current Human Receptors

The current human receptors of the Small Arms Range – 2 are authorized installation personnel, contractors, visitors, and trespassers.

4.4.4.3.3 Potential Future Land Use

Potential future land use for the site is the cantonment area (Installation Support), including an industrial area, warehouses, tactical equipment maintenance facility, company operations facility, and undeveloped land.

4.4.4.3.4 Potential Future Human Receptors

The potential future human receptors of potential MEC or MC remain the same as the current human receptors (authorized installation personnel, contractors, visitors, and trespassers).

4.4.4.3.5 Zoning / Land Use Restrictions

General information about zoning and land use restrictions at FTSW is presented in Section 4.12.4.3.5. Site-specific information about zoning and land use is unknown.

4.4.4.3.6 Beneficial Resources

General information about the beneficial resources on FTSW is presented in Section 4.1.4.3.6. Site-specific resources include the forested areas, which act as habitat.

4.4.4.3.7 Demographics/Zoning

General information about the demographics/zoning on FTSW is presented in Section 4.1.4.3.7.

4.4.4.4 Ecological Profile

4.4.4.4.1 Habitat Type

General information on habitat types at FTSW is provided in Section 4.1.4.4.1. Site-specific habitat types include the forested areas.

4.4.4.4.2 Degree of Disturbance

Currently, there is a medium degree of disturbance because forest and grasses remain on a portion of site.

4.4.4.4.3 Ecological Receptors

General information about the ecological receptors on FTSW is presented in Section 4.1.4.4.3.

4.4.4.5 Munitions/Release Profile

4.4.4.5.1 Munitions Types and Release Mechanisms

Table 4-15 presents a summary of the types of potential and actual munitions debris that were identified during research conducted for the HRR and during CS field activities, respectively. The mechanisms by which the munitions, if present, could have been released into the environment are also presented in the table.

Table 4-14: Summary of Potential and Actual Munitions Debris and MEC – Small Arms Range – 2

MMRP Site	Munitions Debris / MEC Observed During Phase 2 CS Field Activities	Potential Munitions Debris / MEC Identified During HRR and EOD Responses	Primary Release Mechanism
Small Arms Range - 2	9mm projectile 25mm cartridge, expended	0.22-cal[1] 0.30-cal, 0.30-cal (with tracer)[1] 0.45-cal[1] 0.50-cal, 0.50-cal (with tracer)[1] 0.50-cal (armor piercing) small arms[1] 105mm projectile[2]	Munitions firing Malfunctioned munitions Discarded munitions

[1]Item is based on historical use. Not confirmed.

[2]Item reported during an EOD response; item not identified from historical use

Maximum Probability Penetration Depth

Table 4-16 provides the expected penetration depths for 105mm projectile for various types of soils that are expected to be found at Small Arms Range – 2. For Small Arms Range – 2, the soil type is considered sand-silt/sand-clay. Therefore, the depths of penetration for Small Arms Range – 2 are based upon the penetration depth for a loamy soil. As discussed in Section 4.1.4.5.2, these penetration depths are estimated on a worst-case scenario. The penetration depth of a 105mm projectile is 8.5 feet.

The ITRC has prepared a document titled *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges*, dated January 2003, to provide information on the general layout of small arms ranges, as well as information on areas that may be impacted with MC and/or MEC as a result of range use and the characterization of munitions used. According to the ITRC document, the maximum expected penetration depth is 1 foot.

Table 4-15: Expected MEC Penetration Depths – Small Arms Range – 2

Munitions Item	Depth of Penetration (feet bgs)		
	Sand	Loam	Clay
105mm projectile	5.5	8.5	11.5

4.4.4.5.2 MEC Density

Due to the nature of small arms ammunition, MEC are not typically expected. However, there have been two EOD responses to the site: a 105mm projectile was found in April 2003 and an unidentified munitions item found in October 2008.

Two munitions debris were observed during the magnetometer-assisted visual survey: a 9mm projectile and a 25mm cartridge, expended. The 9mm projectile was near the southernmost berm of Range N at a presumed firing point. The expended 25mm cartridge was likely an expended cartridge disposed from a Bradley fighting vehicle located on the opposite side of the adjacent motor pool fence.

4.4.4.5.3 Munitions Debris

Two munitions debris were observed during the magnetometer-assisted visual survey: a 9mm projectile and a 25mm cartridge, expended. Two EOD responses have also been reported at this site: a 105mm projectile and an unidentified munitions item. Therefore, munitions debris is likely to be found on the MRS.

4.4.4.5.4 Associated MC

A total of ten discrete surface soil samples were collected from the MRS. The samples were analyzed for lead (USEPA Method 6010B). The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, and zinc using Method 6010B and for explosives using USEPA Method 8330B modified. Based on analytical results, lead was the only metal detected in concentrations exceeding USEPA Region 4 Ecological Screening Values

but was below USEPA RSLs. No explosive compounds were detected above laboratory detection or reporting limits.

4.4.4.5.5 Transport Mechanisms / Migration Routes

The primary transport mechanisms considered for Small Arms Range – 2 include the following:

Erosion: Small Arms Range – 2 is only partially developed; therefore, erosion is potentially a factor in transporting and migrating possible MC contaminated soil.

Soil Disturbance: The current degree of disturbance is medium, as a portion of the site has been developed and cleared since the range was used. Two EOD responses have been reported at this site, a 105mm projectile and an unidentified munitions item; MC could be present in the surface or subsurface.

Infiltration: Based on the soil types associated with Small Arms Range – 2, the potential exists for MC to migrate from one environmental medium to another (surface to subsurface soil to groundwater) through filtration.

4.4.4.6 Pathway Analysis

4.4.4.6.1 MEC

Based on historical documents and information obtained during the data collection process and the two EOD responses that have been reported at this site, the potential exists for MEC to be present on the site. As illustrated in the Exposure Pathway Analysis for MEC (Figure 4-21), the pathways for all human and ecological receptors are potentially complete as the potential exists for these receptors to encounter MEC on the surface. Potentially complete pathways for installation personnel, contractors, and biota for MEC in the subsurface exist as these receptors have the potential to conduct intrusive activities. The pathway for MEC in the subsurface is incomplete for trespassers.

4.4.4.6.2 MC

As illustrated in the MC Exposure Pathway (Figure 4-22), a total of ten soil samples were collected from the Small Arms Range - 2 and analyzed for lead by USEPA Method 6010B. The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, and zinc using Method 6010B and for explosives using USEPA Method 8330B modified. Analytical results indicated no explosives were detected and no metals exceeded USEPA RSLs. Lead was found at concentrations that exceed the USEPA Region 4 Ecological Screening Values in three samples and one duplicate. Therefore, all pathways for human receptors are incomplete.

Food Chain

A potentially complete pathway to MC in the source media through uptake into vegetation exists for grazing/foraging biota. This exposure pathway is incomplete for all other receptors. As there are no domestic animals on FTSW, the pathway to MC in the source media through this exposure route is incomplete for all receptors. The pathway to MC in the source media through the game/fish/prey exposure route is potentially complete for biota. This exposure pathway is incomplete for all other receptors as MC levels only exceed USEPA Region 4 Ecological Screening Values.

Groundwater

Precipitation infiltration may provide for contaminant mobility into the shallow or surficial groundwater aquifer. However, based on a review of hydrogeological data (Section 4.4.4.2.5), it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW. Receptor contact with groundwater is possible if the soil is disturbed through excavation or construction activities, creating possible migration routes/mechanisms for MC in shallow groundwater. As such, biota have potentially complete pathways to MC in shallow groundwater through the (incidental) ingestion and dermal contact exposure routes, as MC concentrations only exceed the USEPA Region 4 Ecological Screening Values. Given that it is unlikely that MC in shallow groundwater would migrate to the deeper aquifers that are used as a water supply for FTSW, the dermal and ingestion exposure routes are incomplete for

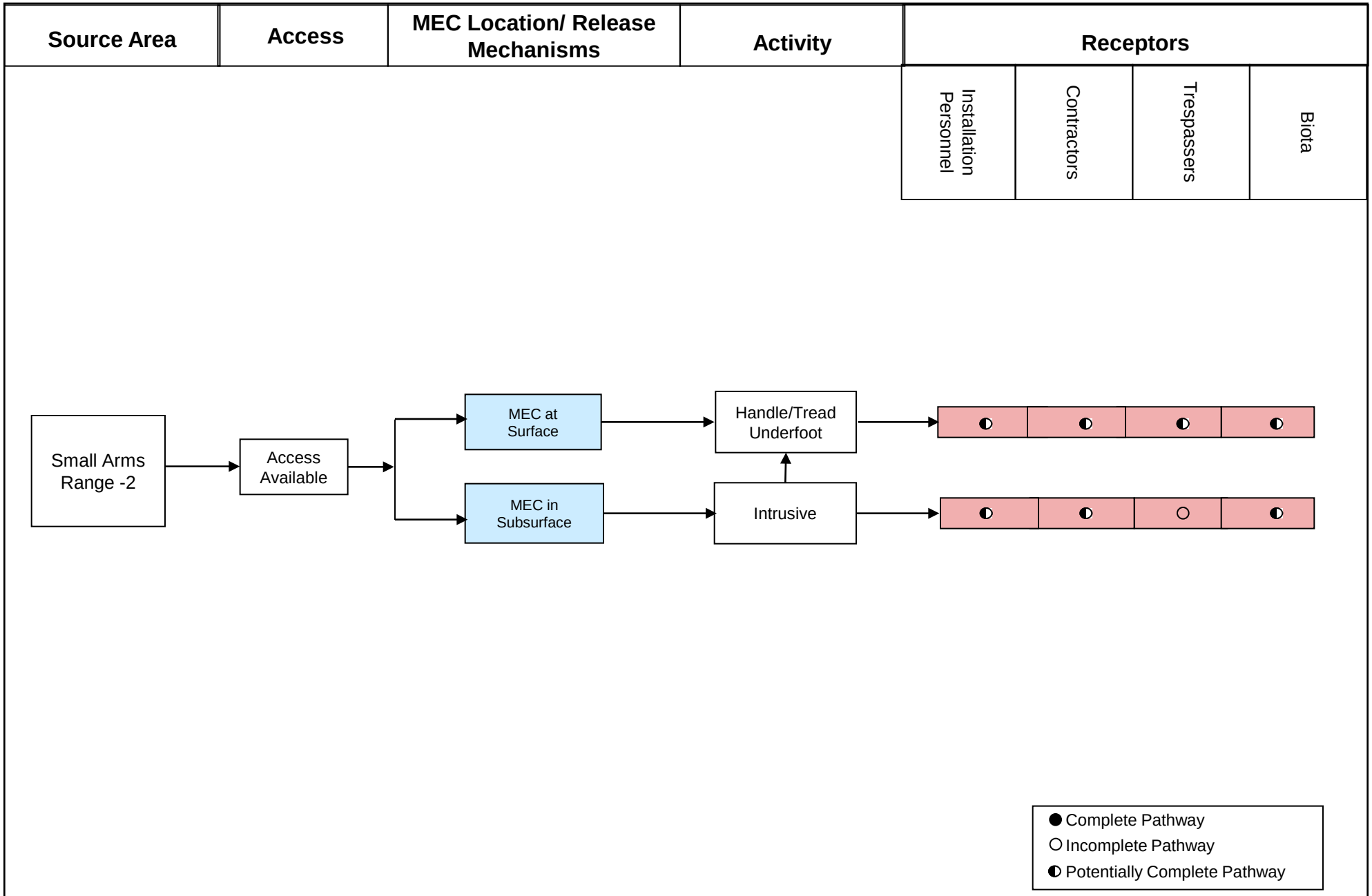
trespassers. Since the upper aquifer is not used as a potable water source and MC are typically not volatile, the inhalation (vapor) exposure route is incomplete for all receptors.

Subsurface Soil

Since the potential exists for MC in the subsurface soil in the Small Arms Range - 2, receptor contact with subsurface soil is possible if the soil is disturbed through excavation or construction activities, creating possible receptor pathways to MC in subsurface soils. As such, biota have potentially complete pathways to MC in subsurface soil through the (incidental) ingestion, dermal contact, and inhalation (dust) exposure routes. Since MC concentrations only exceed USEPA Region 4 Ecological Screening Values, incomplete pathways exist in the subsurface soil for all human receptors.

Surface Soil

Ecological receptors within the Small Arms Range -2 may be exposed to surface soil. Therefore, the pathways to MC in surface soil through the (incidental) ingestion, dermal contact, and inhalation of dust exposure routes are potentially complete for biota. Since MC concentrations only exceed USEPA Region 4 Ecological Screening Values, incomplete pathways exist in the surface soil for all human receptors.



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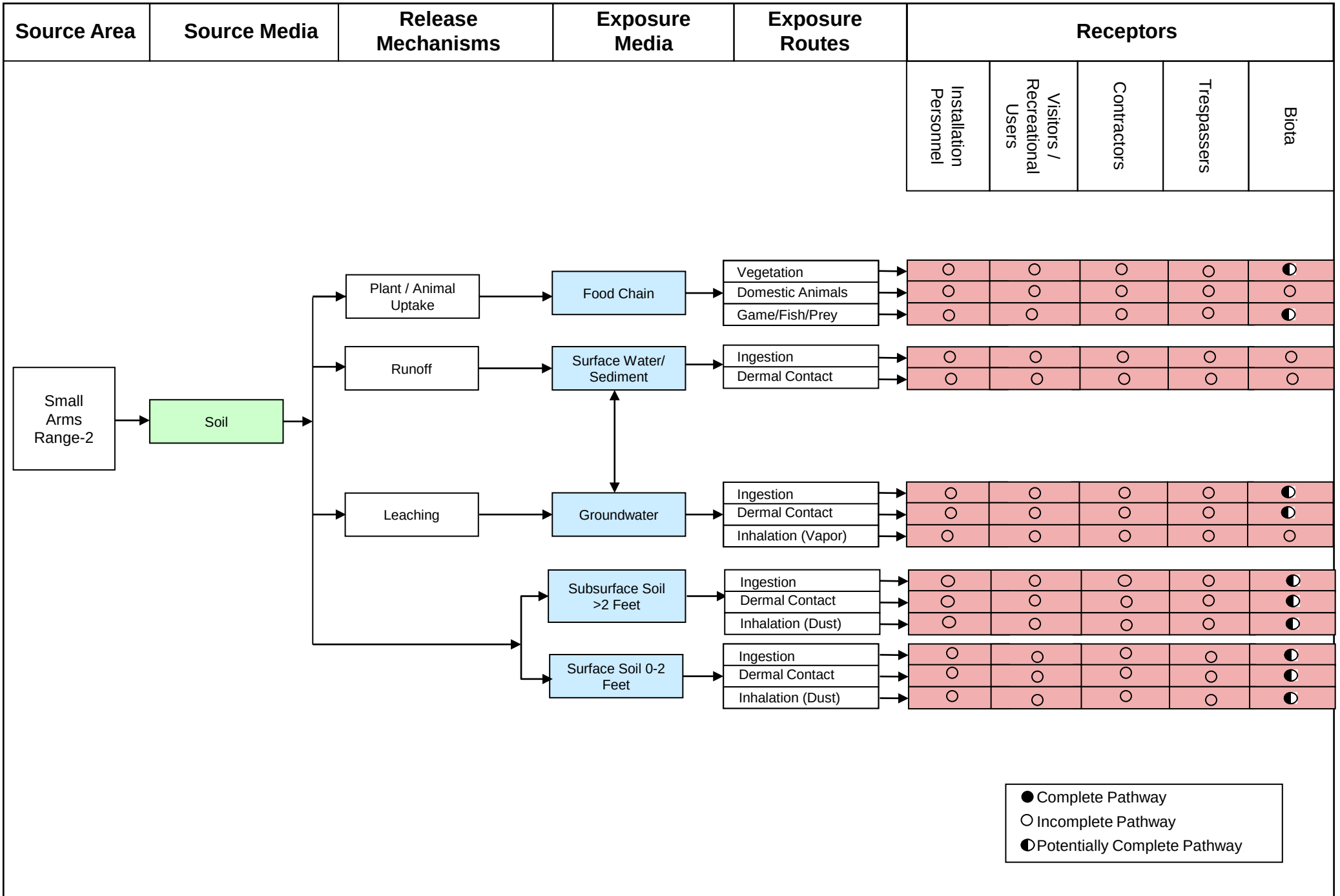
CONFIRMATORY SAMPLING REPORT
SMALL ARMS RANGE - 2 – MEC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-21
September 2011



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CONFIRMATORY SAMPLING REPORT
SMALL ARMS RANGE - 2– MC EXPOSURE PATHWAY ANALYSIS
FORT STEWART, GEORGIA

ARCADIS/ MALCOLM PIRNIE, INC.

FIGURE 4-22
September 2011

4.4.5 Site Summary and Conclusions

4.4.5.1 MEC

There were no MEC activities conducted at the Small Arms Range – 2 MRS, because historical evidence suggested that only small arms were used at this MRS. However, an all-metals detector was used to identify any berms or range features on site. During the MC investigation, two munitions debris were observed during the magnetometer-assisted visual survey: a 9mm projectile and a 25mm cartridge, expended. Because of the two historic EOD responses and the two munitions debris discoveries, the Small Arms Range – 2 is recommended for RFI/CMS.

4.4.5.2 MC

A total of ten soil samples were collected from the Small Arms Range - 2 and analyzed for lead by USEPA Method 6010B. The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, and zinc using Method 6010B and for explosives using USEPA Method 8330B modified. Based on the results of the metals analysis, metals were detected in concentrations exceeding USEPA Region 4 Ecological Screening Values for lead. No explosive compounds were detected above laboratory detection or reporting limits. It is recognized that because the MRS is recommended for RFI/CMS for MEC, MC may also be evaluated as part of the study.

4.4.6 Site Recommendations

Based on the two historical EOD responses on the MRS and two munitions debris discoveries, the Small Arms Range – 2 is recommended for RFI/CMS.

4.5 CHEMICAL DATA QUALITY ASSESSMENT

The MC data were verified by a senior chemist at ARCADIS/Malcolm Pirnie. Data review was performed in accordance with the procedures specified in the Quality Assurance Project Plan (Work Plan Appendix A, Malcolm Pirnie, 2010), USEPA Functional Guidelines for Inorganic

and Organic Data Review, and quality control (QC) parameters set forth by the project laboratory, Analytical Laboratory Services, Inc.

Sample results were subject to a Level III data review that includes an evaluation of the following QC parameters:

- Sample preservation and temperature upon laboratory receipt
- Holding times
- Method blank contamination
- Surrogate recovery (for explosives analyses)
- Laboratory control sample recovery
- Matrix spike / matrix spike duplicate (MS/MSD) recovery and relative percent difference
- Field duplicates

The data quality for the sampling at FTSW was also measured and evaluated in terms of the following specific indicators:

- Precision
- Bias
- Representativeness
- Comparability
- Completeness
- Sensitivity

The data verification concluded that several metals required data qualification based on MS/MSD and duplicate recoveries that were outside of acceptance limits. Overall, the sample analyses were completed with quality assurance and control protocols met. The data set is considered usable and meets project data quality objectives.

5 RECOMMENDATIONS REVIEW

5.1 SUMMARY OF SITE INSPECTION RECOMMENDATIONS

The recommendations for the MRSs at FTSW are presented in Table 5-1 and graphically in Map 5-1. They are based on decisions made and agreed upon during the TPP sessions held on April 29, 2010 and August 24, 2011, as well as, the data collected during the Phase 2 CS field activities and the conclusions presented in Section 4 of this report.

Table 5-1: Summary of Phase 2 CS Recommendations

MRS	Phase 2 CS Recommendation	Basis for Recommendation	
		MEC	MC
Anti-Aircraft Range – 4 (FTSW-009-R-01)	RFI/CMS	Based on two historic EOD responses and numerous EOD responses during on-going construction activities, the Anti-Aircraft Range -4 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.
	Split into two MRSs Anti-Aircraft Range-4-A and Anti-Aircraft Range-4B	Based on the results of the two MEC investigations conducted by USACE Baltimore District Explosive Safety, the constructed area of the MRS was deemed "low probability" for explosive hazard. The remainder of the site remains a medium to high probability for encountering MEC.	None

MRS	Phase 2 CS Recommendation	Basis for Recommendation	
		MEC	MC
Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)	RFI/CMS	Based on the discovery of an inert mine, the Anti-Tank Range 90-MM – 2 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.
Grenade Launcher Range (FTSW-011-R-01)	RFI/CMS	Based on range features and observed munitions debris, the Grenade Launcher Range is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.
Small Arms Range – 2 (FTSW-006-R-01)	RFI/CMS	Two unexpected munitions debris items, a9mm projectile and a 25mm expended cartridge, were found during the visual survey. Based on munitions debris finds and two historic EOD responses, the Small Arms Range – 2 is recommended for RFI/CMS for MEC.	No explosives were detected and no metals were detected at or above their USEPA RSLs. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

Phase 2 Confirmatory Sampling Activities and Findings Fort Stewart, GA

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Map 5-1
MEC/MC Recommendations

437500 440000 442500 445000

3530000 3527500 3525000

N

Anti-Aircraft Range - 4-B
Anti-Aircraft Range - 4-B
Anti-Aircraft Range - 4-B
Anti-Aircraft Range - 4-A
Anti-Aircraft Range - 4-A
Anti-Tank Range 90-MM (RCRA Permitted Landfill)
Anti-Tank Range 90-MM - 2
Small Arms Range - 2
Grenade Launcher Range

Legend

Installation Data
- Installation Boundary
- Other than Operational Area
- Operational Area

Phase 2 MRS (Other than Operational Area)
- MRS Boundary

MEC/MC Recommendation
- RFI/CMS

Phase 1 MRS
- Anti-Tank Range 90-MM (RCRA Permitted Landfill)

Historical Fans
- Small Arms (HBANM RANGES) 1940
- Anti-Tank (E 90-mm 14540 yards) 1941
- 90-mm Anti-Aircraft (C Range) 1957,1962,1964
- 40-mm Anti-Aircraft (C 40-mm 11850 YRDS) 1941
- 90-mm Anti-Aircraft (C 90-mm 20500 YRDS) 1941
- 40-mm Anti-Aircraft (E 40-mm 8500 YRDS) 1941
- 120-mm Anti-Aircraft
- Small Arms 1944
- Grenade Launcher Range

Hydrology
- River/Stream
- Water Body

0 500 1,000 1,500 Meters

Data Source: Fort Stewart, GA

Coordinate System: UTM Zone 17N
Datum: NAD83
Units: Meters

Contract: DACA31-05-D-0004
Edition: Final
Date: September 2011

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Appendix A: Field Notes

Appendix B: Field Forms

B-1: Field Sampling Sheets

B-2: Field Data Quality Control Reports

B-3: MEC Discovery Form-M16A1 Inert Mine

Appendix C: Photographic Log

C-1: Anti-Aircraft Range - 4

C-2: Anti-Tank Range 90MM - 2

C-3: Grenade Launcher Range

C-4: Small Arms Range - 2

Appendix D: Analytical Results and Verification Data

(Provided on the enclosed CD)

Appendix E: Sample Coordinates

Appendix F: Munitions Response Site Prioritization Protocol

F-1: Anti-Aircraft Range - 4

F-2: Anti-Tank Range 90MM - 2

F-3: Grenade Launcher Range

F-4: Small Arms Range 2

Appendix G: Ordnance Technical Data Sheets

Appendix H: Technical Project Planning Meeting Minutes

Appendix I: Record of Environmental Consideration

Appendix J: IBCT Construction Site MEC QA Follow On Investigation To Depth Of Detection

Appendix K: AAFES Shoppette Highway 144 Construction Site MEC Investigation To Depth Of Detection