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FINAL

Volume I

Site Inspection Report

USAF Avon Park Range

Okeechobee, Osceola, and

Polk Counties, Florida

U.S. Army Corps of Engineers

Southeast and Pacific IMA Region

FUDS Project No. I04FL028701

Contract: W912DY-04-D-0005

Task Order: 0008



Prepared For:

U.S. Army Corps of Engineers, Jacksonville District

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Jacksonville, Florida 32207

and

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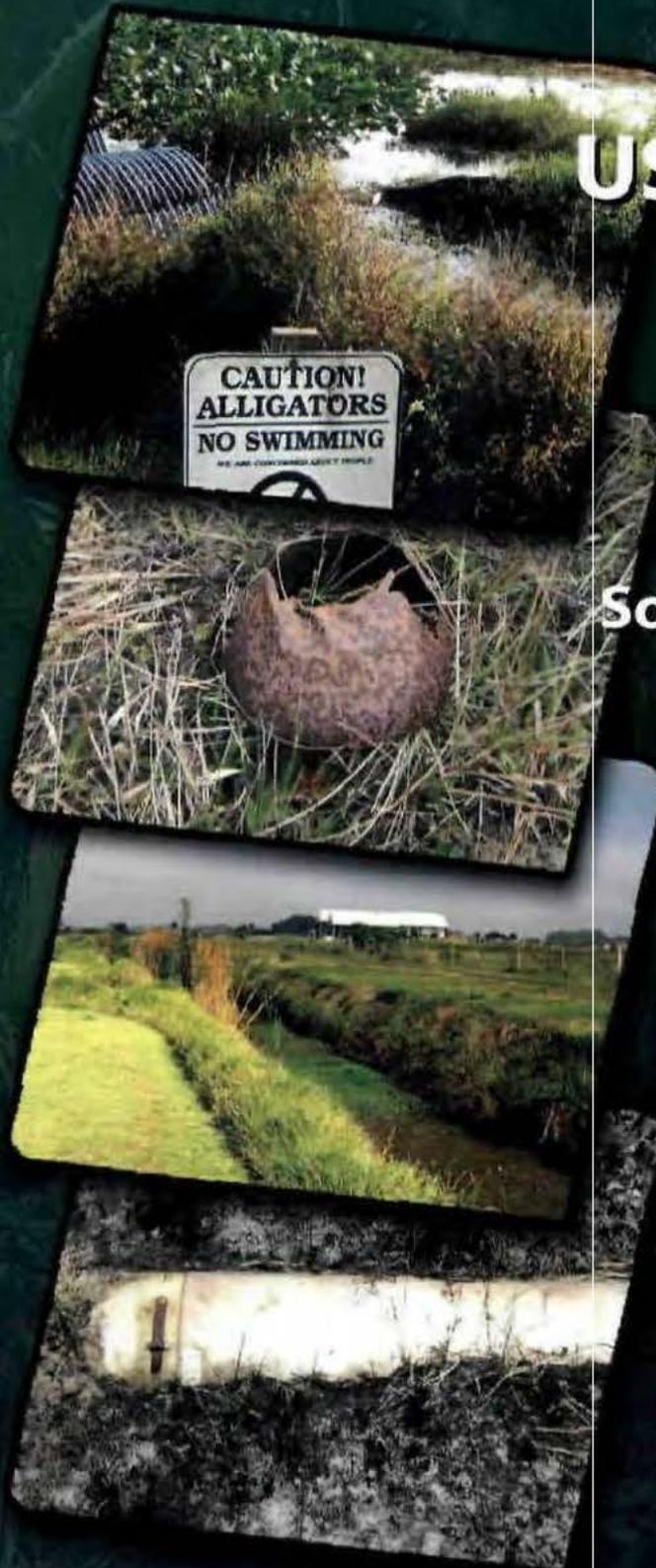
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Norcross, Georgia 30092

October 2008



The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

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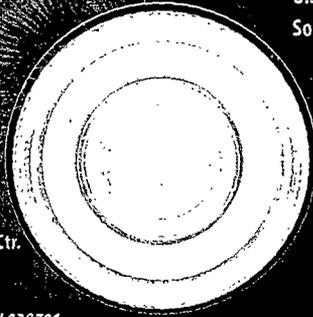
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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Parsons has completed the Final Site Inspection report for the USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

Jim L. Decker CKelison

Kan Boulware *SKA*

October 30, 2008

Study/Design Team Leader and Team Members

CKelison

October 30, 2008

Independent Technical Review Team Leader

Significant concerns and the explanation of the resolution are as follows:

None

As noted above, all concerns resulting from independent technical review of the project have been considered.

Don *Pauro Kelly*

October 30, 2008

Parsons Program Manager(s)

PARSONS

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October 30, 2008

U.S. Army Engineer Center Huntsville
CEHNC-OE-DC (Mr. Doug Garretson)
4820 University Square
Huntsville, AL 35816-1822
(256) 895-1066

Subject: Contract W912DY-04-D-0005, Delivery Order 0008
MMRP SI for SE and Pacific IMA Region – Final SI Report,
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Dear Mr. Garretson:

Parsons has prepared this Final Site Inspection (SI) Report in accordance with the Performance Work Statement (PWS) to include the completed Munitions Response Site Prioritization Protocol (MRSPP). In addition, copies of previous reports are included as appendices. Two copies have been provided for your records.

We have forwarded five copies of the document to Mr. Charles Fales of the Jacksonville District for his record and distribution to stakeholders. We have also submitted single copies of this Final document to EM CX. Electronic copies have also been provided.

If you have any questions or comments, please contact me at (678) 969-2384 or (404) 606-0346 (cell) or the Deputy Project Manager (Ms. Laura Kelley) at (678) 969-2437.

Sincerely,

PARSONS



Don Silkebakken, P.E.
MMRP SI Project/Program Manager

cc: Charles Fales – 5 copies/5DVDs
Jeff Waugh – 1DVD
Brad McCowan/Deborah Walker (EM CX) – 1 copy/1 DVD
Heidi Novotny (EM CX) - 1 DVD
Laura Kelley/Project File (744647.69000)





**U.S. Army Corps of Engineers
Southeast and Pacific IMA Region**

FINAL
**Site Inspection Report
USAF Avon Park Range
Okeechobee, Osceola, and Polk
Counties, Florida**

**FUDS Project No. I04FL028701
October 2008**

In Support of
FUDS MMRP Site Inspections Project

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5390 Triangle Parkway, Suite 100
Norcross, Georgia 30092

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**Contract: W912DY-04-D-0005
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ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
AAB	Army Air Base
4WD	four Wheel Drive
AAF	Army Air Field
ADR	Automatic Data Review
ARC	Annual Report to Congress
ASR	Archive Search Report
BGR	Bombing and Gunnery Range
bgs	Below Ground Surface
BTAG	U.S. Army Biological Technical Assistance Group
CCV	Continuing Calibration Verification
CEMVS	USACE St. Louis District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAJ	USACE Jacksonville District
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CHE	Chemical Hazard Evaluation
COC	Chain-Of-Custody
CREEL	Cold Regions Research and Engineering Laboratory
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
CWM	Chemical Warfare Material
CZMP	Coastal Zone Management Program
DEP	Defense Environmental Programs
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DMM	Discarded Military Munitions
DoD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objective
DT	Dilution Test
EDD	Electronic Data Deliverable
EHE	Explosive Hazard Evaluation
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
ER	Engineer Regulation
ERA	Ecological Risk Assessment

ACRONYMS AND ABBREVIATIONS

ESL	Ecological Screening Level
ESV	Ecological Screening Values
FAC	Florida Administrative Code
FDC	Fire Direction Center
FDE	Findings and Determination of Eligibility
FDEP	Florida Department of Environmental Protection
FL SHPO	Florida State Historic Preservation Office
FMSF	Florida Master Site File
FNAI	Florida Natural Areas Inventory
FTL	Field Team Leader
FTM	Field Team Member
FTS	Field Team Safety
FUDS	Formerly Used Defense Site
FUDSMIS	FUDS Management Information System
FWC	Fish and Wildlife Conservation Commission
GIS	Geographic Information System
GP	General Purpose
GPS	Global Positioning System
HE	High Explosive
HHE	Health Hazard Evaluation
HQ	Hazard Quotient
HRS	Hazard Ranking System
HTRW	Hazardous, Toxic, and Radioactive Waste
ICAL	Initial Calibration
IH	Interstate Highway
IMA	Installation Management Agency
INPR	Inventory Project Report
KICCO	Kissimmee Island Cattle Company
LCS	Laboratory Control Sample
MC	Munitions Constituent
MD	Munitions Debris
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams Per Kilograms
MQL	Method Quantitation Limit
MMRP	Military Munitions Response Program
MRDS	Mineral Resources Data System
MRS	Munitions Response Site

ACRONYMS AND ABBREVIATIONS

MRSPP	Munitions Response Site Prioritization Protocol
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSL	Mean Sea Level
MSSL	Media-Specific Soil Screening Level
NAD	North American Datum
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No DoD Action Indicated
NHA	National Heritage Areas
NHL	National Historic Landmarks
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHD	National Register of Historic Districts
NRHP	National Register of Historic Places
NRIS	National Register Information System
NWI	National Wetlands Inventory
NWRS	National Wildlife Refuge System
OB/OD	Open Burn/Open Detonation
OCHP	Office of Cultural and Historical Programs
OEW	Ordnance And Explosive Waste
OP	Observation Point
PA	Preliminary Assessment
PAOI	Potential Area of Interest
Parsons	Parsons Corporation
PCL	Protective Concentration Level
PFC	Position Firing Course
PSAP	Programmatic Sampling And Analysis Plan
PRG	Preliminary Remediation Goal
PWP	Programmatic Work Plan
QA	Quality Assurance
QC	Quality Control
QR	Qualitative Reconnaissance
RAC	Risk Assessment Code
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RPD	Relative Percent Difference
SD	Standard Deviation

ACRONYMS AND ABBREVIATIONS

SDG	Sample Delivery Group
SFWMD	South Florida Water Management District
SI	Site Inspection
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
SLRA	Screening Level Risk Assessment
SOP	Standard Operating Procedure
SQAG	Sediment Quality Assessment Guidelines
SSL	Soil Screening Level
SS-WP	Site-Specific Work Plan
STL	Severn Trent Laboratories
SVT	Site Visit Team
SWQS	Surface Water Quality Standards
T&E	Threatened And Endangered
TCRA	Time Critical Removal Action
TESS	Threatened And Endangered Species System
TPP	Technical Project Planning
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAESCH	United States Army Engineering and Support Center, Huntsville
USAF	U.S. Air Force
USC	U.S. Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
WMA	Wildlife Management Area

GLOSSARY OF TERMS

Anomaly	Any item that deviates from the expected subsurface ferrous and non-ferrous material at a site (<i>i.e.</i> , pipes, power lines, <i>etc.</i>).
Inhabited Structure	Permanent or temporary structures, other than military munitions-related structures, that are routinely occupied by one or more persons for any portion of a day.
Magnetometer	An instrument for measuring the strength of a magnetic field; used to detect buried iron and other metal objects.
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 Department of Defense, the Coast Guard, the Department of Energy, and the 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.
Munitions And Explosives Of Concern (MEC)	Military munitions that may pose unique explosives safety risks, including unexploded ordnance, discarded military munitions, or munitions constituents present in high enough concentrations to pose an explosive or other health hazard.
Munitions Constituents (MC)	Any materials originating from unexploded ordnance, discarded military munitions, 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 (<i>e.g.</i> , penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

GLOSSARY OF TERMS

Munitions Response	Response actions, including investigation, removal actions, and remedial actions, to address the explosive safety, human health, or environmental risks presented by unexploded ordnance, discarded military munitions, or munitions constituents, or to support a determination that no removal or remedial action is required.
Munitions Response Site (MRS)	A discrete location that is known to require a munitions response.
Projectile	Object projected by an applied force and continuing in motion by its own inertia. This includes bullets, bombs, shells, grenades, guided missiles, and rockets.
Unexploded Ordnance (UXO)	Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; that have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and that remain unexploded whether by malfunction, design, or any other cause.

EXECUTIVE SUMMARY

ES.1 The objective of this site inspection (SI) is to determine whether the United States Air Force (USAF) Avon Park Range Formerly Used Defense Site ([FUDS] project # I04FL028701), located in Okeechobee, Osceola, and Polk Counties, Florida, warrants further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The work was performed under Contract No. W912DY-04-D-0005, Task Order No. 0008 from the United States Army Corps of Engineers (USACE), Engineering and Support Center, Huntsville (USAESCH). Described at one time as the largest bombing range in the world, the Avon Park General Bombing Range opened officially in March 1942. Additional land acquisition between 1942 and 1977 increased the land area to 218,224 acres. The site was used primarily for training B-17 Aircraft Crews for air-to-ground bombing. In December 1945, over 111,000 acres east of the Kissimmee River were declared excess. In 1949, the site was transferred to the Air Force, at which time it was known as Avon Park Air Force Base. In 1956, the site was renamed Avon Park Air Force Range. The USAF continues to own and operate approximately 106,000 acres located west of the Kissimmee River as the Avon Park Air Force Range (these active ranges adjacent to the FUDS are not FUDS-eligible). The remaining acres (112,771.6 acres) were reported excess and leases to various portions of the site were terminated between 1946 and 1983. Training activities within the FUDS evaluated during this SI occurred from 1942 to 1945. Range types within the FUDS include land skip bombing, combination bombing and gunnery range (BGR), position firing courses (PFC), practice bombing target, water bombing target (Lake Kissimmee), and two restricted use areas. There is one munitions disposal area associated with the USAF Avon Park Range. A large portion of this FUDS is currently owned by the State of Florida and is managed as Kissimmee Prairie Preserve State Park.

ES.2 There are 12 Munitions Response Sites (MRSs) (within three noncontiguous areas) covering a total acreage of 60,342 acres. One MRS, the *MRS M01 Arbuckle Creek Disposal Area*, is located to the west of the Kissimmee River (Figure ES.1). The *MRS R11 Lake Kissimmee Water Bombing Target* is located within Lake Kissimmee (Figure ES.1). There are ten MRSs (listed below in Table ES.1) associated with the FUDS located east of the Kissimmee River (Figure ES.2). The SI was performed to confirm MRS locations and to evaluate the evidence for the presence of munitions and explosives of concern (MEC) and munitions debris (MD) at the site. To accomplish this objective, qualitative reconnaissance (QR) and munitions constituent (MC) sampling were performed within 11 of the 12 MRSs. The *MRS R11 Lake Kissimmee Water Bombing Target* was not evaluated during the field visit, as discussed amongst the Technical Project Planning (TPP) Team. This target occurs entirely within the approximately 38,000-acre Lake Kissimmee. The area within this MRS has likely

been subject to silt and sediment removal actions. The area around the structure located down gradient of the MRS has also been subject to silt and sediment removal actions and dredged during construction. Figures ES.1 and ES.2 show the USAF Avon Park Range FUDS and MRS boundaries.

ES.3 One biased surface water sample and one biased sediment sample was collected within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. As an adequate location for ambient surface water and sediment samples could not be located, neither ambient surface water samples nor ambient sediment samples were collected. One groundwater sample was collected from remaining land (within the FUDS boundary, but outside MRS boundaries). This sample was collected from the Kissimmee Prairie Preserve State Park water well which supplies water to the campground and offices. Samples were not collected from the *MRS R11 Lake Kissimmee Water Bombing Target*, as discussed amongst the TPP team. The area within this MRS has likely been subject to silt and sediment removal actions and the area around the structure located down gradient of the MRS has been subject to silt and sediment removal actions and dredged during construction.

ES.4 Twenty surface soil samples (and associated QA/QC samples) were collected from the remaining ten MRSs located east of the Kissimmee River. Seventeen of the twenty surface soil sample locations were selected to represent areas with the highest likelihood for the presence of MEC or MC contamination, such as target centers or areas displaying MD. The remaining three surface soil sample locations were selected to represent areas with the lowest likelihood for the presence of MEC or MC contamination to estimate ambient metals concentrations on-site. Based on the surface water/groundwater interconnection at the USAF Avon Park Range and the large areal dimensions of the range (> 100,000 total acres), the TPP Team concurred (December 4, 2007 TPP Team Meeting) with the limited biased sample collection approach focusing on the surface soils in target areas of the ten MRSs located east of the Kissimmee River. Based on site use and the presence of wetlands, surface water, and groundwater, the TPP Team agreed to defer the sediment, surface water, and groundwater evaluation at the site during the anticipated follow-on RI/FS.

ES.5 The SI field effort for USAF Avon Park Range was conducted from May 5th to May 10th and May 12th, 2008. The SI field effort included approximately 42 linear miles of walked QR and the collection of MC samples.

ES.6 During the 2008 site visit, ***no MEC items were found. Several MD items were identified.*** A .50- caliber casing and M38A2 practice bomb debris was found within *MRS R01 Target XI – Land Skip Bombing Target*. M38A2 practice bomb debris was found within *MRS R04 Target XIII – Practice Bombing Target*. Also at target center of this MRS, the SVT noted a circular mound approximately 50 feet in circumference, covered in thick vegetation and containing bomb debris. AN-M50 Incendiary Bomb debris was found within *MRS R06 Range XIX – Position Firing Course*. M38A2 practice bomb debris was found within *MRS R08 Area Bombing Target*. Approximately 200 .50-caliber casings and one .50- caliber projectile was found within *MRS R10 Central Restricted Use Area*. Table ES.1 summarizes the results of the SI for USAF Avon Park Range.

**Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS M01 Arbuckle Creek Fuze Disposal Area</i>	1	None	Yes; Barium and lead detected in surface water.* Barium detected in sediment.*	Remedial Investigation / Feasibility Study (RI/FS). Further surface water and sediment sampling may be warranted as the MC source may be located further downstream than the original disposal location due to surface water and sediment movement since site closure. MEC have been found at the site resulting in two civilian deaths in the 1940's. Partial restrictions to access of the MRS exist in the form of fencing along the roadside. Munitions known to have been disposed of at this MRS (fuzes) contain explosives that might present a residual hazard if they remain at the site intact.
<i>MRS R01 Target XI – Land Skip Bombing Target</i>	649	No MEC found. MD originating from .50-caliber munitions and aM38A2 100-lb. practice bomb.	Yes; Barium detected in surface soil above background.	RI/FS. MD originating from M85 practice bomb have been previously found. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.

* Comparison data were not available, so it cannot be determined if the detected concentration is within range of site-specific conditions.

**Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R02 Target XII – Combination BGR</i>	649	None	None	RI/FS. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.
<i>MRS R03 Range XII – Position Firing Course</i>	20,252	None	Yes; Barium detected in surface soil above background. Antimony detected in surface soil.	RI/FS. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for leaching to the groundwater and 18 registered groundwater wells which provide an exposure route. Further surface water, sediment, and groundwater sampling may be warranted.

**Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R04 Target XIII – Practice Bombing Target</i>	649	No MEC found. MD originating from M38A2 100-lb. practice bombs was found within a 50 foot circumference circular located at target center.	Yes; Antimony detected in surface soil.	RI/FS. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.
<i>MRS R05 Target XIV – Practice Bombing Target</i>	649	None	None	RI/FS. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for surface water recharge to the groundwater and one registered groundwater well which provides an exposure route. Further surface water, sediment, and groundwater sampling may be warranted.

**Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R06 Range XIX – Position Firing Course</i>	29,186	No MEC found. MD originating from an AN-M50 incendiary bomb.	Yes; Barium and copper were detected in the surface soil above background. Antimony was detected in the surface soil.	<p>RI/FS. MEC in the form of a 250-lb. General Purpose bomb has been found (and detonated) onsite. Munitions suspected to have been used at this MRS (practice bombs with signals and high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for leaching to the groundwater and two registered groundwater wells which provide an exposure route. Further surface water, sediment, and groundwater sampling may be warranted.</p>

Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R07 Target XV – Practice Bombing Target</i>	649	None	Yes; Antimony was detected in the surface soil.	<p>RI/FS. The current landowner reportedly removed what he referred to as “control tower footings”. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.</p>
<i>MRS R08 Area Bombing Target</i>	649	No MEC found. MD originating from M38A2 100-lb. practice bombs.	Yes; Copper was detected in the surface soil above background. Antimony was detected in the surface soil.	<p>RI/FS. Target remnants were visible in 1994. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.</p>

Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R09 North Restricted Use Area</i>	2,785	None	None	<p>RI/FS. The exact reason for “surface use only” restrictions in historical documents remains unclear. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.</p>
<i>MRS R10 Central Restricted Use Area</i>	3,575	No MEC found. MD (projectile and casings) originating from .50- caliber munitions.	None	<p>RI/FS. The exact reason for “surface use only” restrictions in historical documents remains unclear. Munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Further surface water and sediment sampling may be warranted.</p>

**Table ES.1
Summary of 2008 Site Inspection Results
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Acreage	MEC / MD Found	MC Contamination	Recommendation / Justification
<i>MRS R11 Lake Kissimmee Water Bombing Target</i>	649	N/A	N/A	RI/FS. Further surface water and sediment sampling may be warranted. The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. This relatively shallow lake is used for public recreation. Public access by boat. Surface water and sediment sampling was not performed during the SI due to programmatic limitations. The TPP team deferred further sampling of these media to the RI/FS.

ES.7 TestAmerica (formerly Severn Trent Laboratories) in Arvada, Colorado analyzed the surface soil, sediment, surface water, and groundwater samples for explosives and indicator metals (aluminum, antimony, barium, copper, lead, and zinc). Samples collected within the *MRS R09 North Restricted Use Area* and *MRS R10 Central Restricted Use Area* were additionally analyzed for iron to account for their potential (not documented) use as Open Burn / Open Detonation areas. The analytical results were then compared to the following criteria to determine the need to perform a screening-level risk assessment (SLRA) for each particular analyte:

- Was the analyte a potential constituent of munitions known or suspected of being used on site?
- Was the analyte detected above background screening levels?

ES.8 Explosives were not detected in any of the samples collected at USAF Avon Park Range. MRS-specific detections which exceeded the selected background concentrations are listed in Table ES.1.

ES.9 The SLRA surface soil and sediment human health screening values used for this SI are the more stringent value of the Florida Administrative Code (FAC) 62-777, Soil Cleanup Levels, Direct Exposure Residential and the U.S. Environmental Protection Agency (USEPA) Regional Screening Levels (SL) for Residential Soil. The SLRA surface water human health screening values used for this SI are the more stringent of 1) the USEPA Regional SLs for Tap Water, 2) the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels, Freshwater Surface Water Criteria, and 3) the FAC 62-302 Surface Water Quality Standards (SWQS) for Class III waters. The SLRA groundwater human health screening values used for this SI are the more stringent of the USEPA Regional SLs for Tap Water and the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels, Groundwater Criteria.

ES.10 The primary Screening Level Ecological Risk Assessment (SLERA) soil screening values used for this SI were obtained from the USEPA Region 4 ESVs for soil. The primary SLERA screening values for sediment used for this SI were the most stringent values of the USEPA Region 4 ESVs for sediment and the FAC Sediment Quality Assessment Guidelines (SQAG), January 2003. The primary SLERA screening values for surface water used for this SI were the most stringent values of the USEPA Region 4 ESVs for freshwater surface water and the FAC 62-302 SWQS for Class III waters. In absence of available values from the primary screening value sources, screening values were supplemented with current screening values from sources established in the PSAP (USACE, 2005).

ES.11 *MRS M01 Arbuckle Creek Fuze Disposal Area*: Barium and lead in surface water and barium in sediment were detected at concentrations *less than* the respective human health screening values. Barium in surface water and sediment was detected at concentrations *less than* the respective ESVs. Lead was detected at concentrations *greater than* the selected ESV; therefore, the hazard quotient (HQ) was greater than one for lead in surface water.

ES.12 Of the analytes evaluated in the SLRA (see Table ES.1), the maximum detected concentrations of MC metals in the surface soil were less than the respective human health screening values and ESVs for the following MRSs:

- MRS R01 Target XI – Land Skip Bombing Target
- MRS R03 Range XII – Position Firing Course
- MRS R04 Target XIII – Practice Bombing Target
- MRS R06 Range XIX – Position Firing Course
- MRS R07 Target XV – Practice Bombing Target
- MRS R08 Area Bombing Target

ES.13 During the 2008 site visit, several MD items indicative of MEC were found within several MRSs (see paragraph ES.5 and Table ES.1). MEC and MD have been historically found within numerous MRSs associated with the USAF Avon Park Range. MEC in the form of fuzes (AN-M103 or AN-M101A2) have been recovered from this MRS in the 1940's, resulting in two civilian fatalities. A live 250-lb. bomb (Bomb, 250 lb., GP, AN-M57) was located within *MRS R06 Range XIX – Position Firing Course* in 1999; the response and detonation was conducted by Moody Explosive Ordnance Disposal (EOD) and McDill EOD. Based on the qualitative MEC Screening Level Risk Assessment (Chapter 6), there is the possibility that human receptors might come into contact with explosively hazardous MEC at all 12 of the MRSs associated with the USAF Avon Park Range; therefore, there is the potential for an explosive safety risk at these MRSs.

ES.14 An exposure pathway is not considered to be completed unless all four of the following elements are present (USEPA, 1989):

- A source and mechanism for chemical release;
- An environmental transport/exposure medium;
- A receptor exposure point; and
- A receptor and a likely route of exposure at the exposure point.

ES.15 MRS M01 Arbuckle Creek Fuze Disposal Area: The groundwater and surface soil migration pathways are incomplete. The surface water and sediment migration pathways are complete, as barium and lead were detected in the surface water and barium was detected in the sediment. As these detections did not exceed the respective human health screening values, this MRS is not expected to pose a risk to human receptors via exposure to surface water or sediment. Lead was detected in the surface water at a concentration exceeding the ESV. The calculated HQ for lead was 6.3. Based on the analytical results presented in this report, unacceptable risk to ecological receptors exposed to surface water within this MRS cannot be ruled out. *However, as there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background.* Due to natural and anthropogenic-influenced surface water flow since site closure, the MC source

(potentially remaining MEC/MD) is likely located further downstream than the original disposal location.

ES.16 MRS R01 Target XI – Land Skip Bombing Target: The groundwater migration pathways are incomplete. The surface soil exposure pathways are complete for this MRS. Barium was detected within the surface soil sample at concentrations exceeding background. However, the maximum detected concentration did not exceed the human health screening value or the ESV. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

ES.17 MRS R02 Target XII – Combination BGR: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathways are potentially complete (not quantitatively evaluated). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

ES.18 MRS R03 Range XII – Position Firing Course: The surface soil migration pathways are complete, as barium was detected above background. Antimony was additionally detected. The maximum detected concentrations of these analytes did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. The groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. There is a potential source of MC contamination (MC metals detected within the surface soil), leaching from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there are 18 registered wells.

ES.19 MRS R04 Target XIII – Practice Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as antimony was detected in the surface soil (no background data were available for comparison). As the maximum detected concentration of antimony did not exceed human health or ecological screening values, this MRS is not expected to pose a risk to human or ecological receptors with respect to exposure to MC metals via surface soil contact. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water

in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

ES.20 MRS R05 Target XIV – Practice Bombing Target: The surface soil migration pathways are incomplete. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Additionally, the groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. Surface water recharge from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there is one registered well.

ES.21 MRS R06 Range XIX – Position Firing Course: The surface soil migration pathways are complete, as barium and copper were detected above background. Antimony was additionally detected. The maximum detected concentrations of these analytes did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. The groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. There is a potential source of MC contamination (MC metals detected within the surface soil); leaching from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there are two registered wells.

ES.22 MRS R07 Target XV – Practice Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as antimony was detected. The maximum detected concentration of antimony did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

ES.23 MRS R08 Area Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as copper was detected above background. Additionally, antimony was detected. The maximum detected concentrations of antimony and copper did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples

were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

ES.24 MRS R09 North Restricted Use Area: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathways are potentially complete (not quantitatively evaluated). Surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Surface water samples were not collected. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

ES.25 MRS R10 Central Restricted Use Area: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

ES.26 MRS R11 Lake Kissimmee Water Bombing Target: The groundwater and soil migration pathways are incomplete. The surface water migration pathway is potentially complete (not quantitatively assessed). Surface water and sediment samples were not collected, as this MRS was pre-determined to proceed to RI/FS status due to the potential for MEC hazards. This target occurs entirely within the approximately 38,000-acre Lake Kissimmee. The large expanse of the lake and regular draw down events and silt and sediment removal projects since site closure may over time reduce the risk of MC exposure to human and ecological receptors, but further evaluation may be necessary.

ES.27 The 12 MRSs associated with the USAF Avon Park Range FUDS are recommended to proceed to *RI/FS* status. ***Munitions removal actions are not warranted at this time.*** Further evaluation of the surface soil in 10 of the 12 MRSs is not recommended (see Table ES.1). Further evaluation of the surface water, sediment, and groundwater in several MRSs is recommended (see Table ES.1).

Figure ES.1

General Site Overview West of Kissimmee River USAF Avon Park Range FUDS Project No. I04FL028701

Okeechobee, Osceola, and Polk Counties

Legend

- 14 ● Other Field Observation Location
- ▲ Surface Water/Sediment Sample Location
- MRS M01-Arbuckle Creek Fuse Disposal Area
- Avon Park Air Force Range (active range)
- MRS R11- Lake Kissimee Water Bombing Target



Image: 2006 Orthophoto
Projection: UTM Zone 17 NAD83, Map Units in Meters



PARSONS

U.S. ARMY CORPS
OF ENGINEERS
HUNTSVILLE CENTER

DESIGNED BY
BT

DRAWN BY
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CHECKED BY
DS

SUBMITTED BY
DS

General Site Overview

SCALE: As Shown PROJECT NUMBER: 744647.69000

DATE: October 2008

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PAGE NUMBER: ES-15

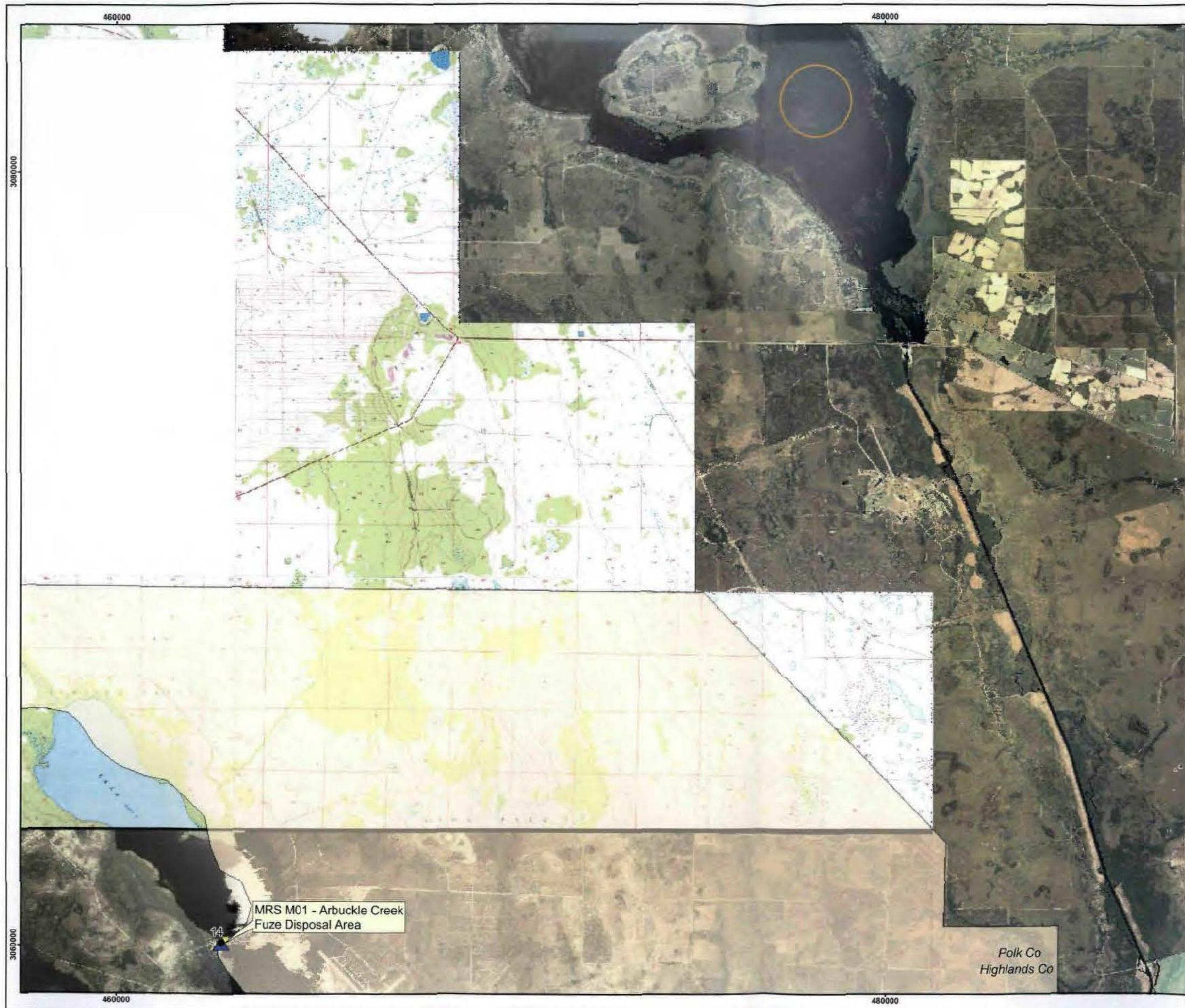


Figure ES.2

**General Site Overview
East of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**
Okeechobee, Osceola, and Polk Counties

Legend

- 1 ● Munitions Debris Observation Location
- 2 ● Other Field Observation Location
- Non-WWII Era
- Munitions and Explosives of Concern
- Soil Sample Location
- ⊗ Groundwater Sample Location
- Approximate FUDS Boundary
- Qualitative Reconnaissance Track
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- ▨ MRS R09- North Restricted Use Area
- ▨ MRS R10- Central Restricted Use Area
- ▨ Kissimmee Prairie Preserve State Park
- ▨ Avon Park Air Force Range (active range)

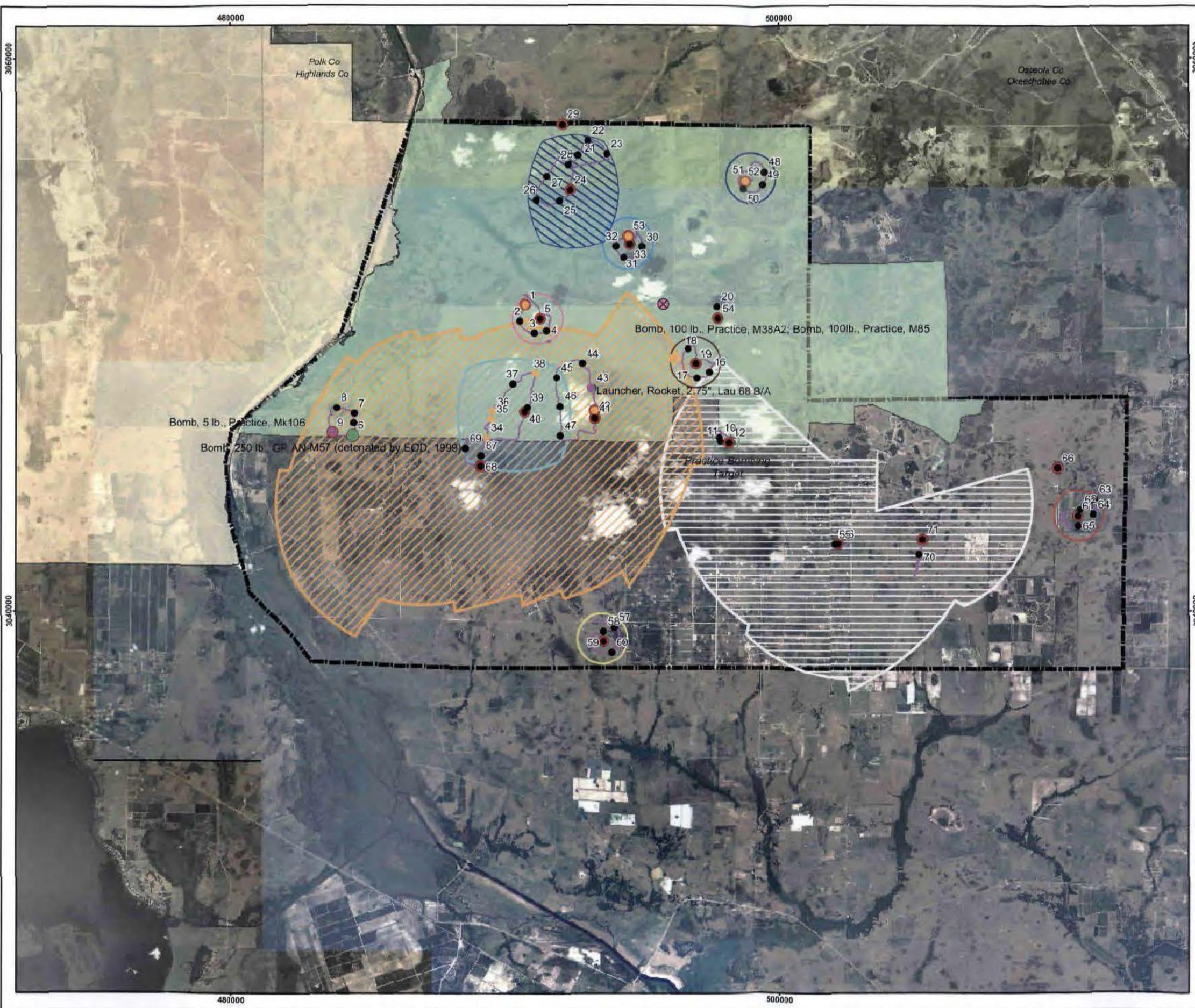


Image: 2006 Orthophoto
Projection: UTM Zone 17 NAD83, Map Units in Meters



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CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Parsons Corporation (Parsons) received Contract No. W912DY-04-D-0005, Task Order No. 0008, from the United States Army Corps of Engineers (USACE), Engineering and Support Center, Huntsville (USAESCH) to perform a Site Inspection (SI) at the U.S. Air Force (USAF) Avon Park Range Formerly Used Defense Site (FUDS) located in Okeechobee, Osceola, and Polk Counties, Florida. This site consists of 111,713 acres that are no longer owned or leased for government/military purposes (i.e. designated as FUDS). This site has been assigned FUDS project number I04FL028701.

1.1.2 The USAF Avon Park Range is located in central Florida. The United States initially acquired the site to be used for training B-17 Aircraft Crews for air-to-ground bombing. Between 1942 and 1977, the total land acquisition amounted to a total of 218,883.88 acres. In December 1945, over 111,000 acres east of the Kissimmee River were declared excess. In 1949, the site was transferred to the Air Force, at which time it was known as Avon Park Air Force Base. In 1956, the site was renamed Avon Park Air Force Range. The USAF still owns and operates approximately 106,000 acres located to the west of the Kissimmee River as the Avon Park Air Force Range (these active ranges adjacent to the FUDS are not FUDS-eligible). The remaining acres (112,771.6 acres) were reported excess and leases to various portions of the site were terminated between 1946 and 1983. Training activities within the FUDS evaluated during this SI occurred from 1942 to 1945. Range types within the FUDS include land skip bombing, combination bombing and gunnery range (BGR), position firing courses (PFC), practice bombing target, water bombing target (Lake Kissimmee), and two restricted use areas. There is one munitions disposal area associated with the USAF Avon Park Range. There are 12 Munitions Response Sites (MRSs) (within three noncontiguous areas) covering a total acreage of 60,342 acres. The coordinates for the center point of the MRSs are listed in Table 1.1. The coordinates are in meters [Universal Transverse Mercator (UTM) Zone 17 North American Datum (NAD) 83]. Figures 1.1 and 1.2 depict the FUDS property and MRS boundaries for the site.

Table 1.1
USAF Avon Park Range MRS Acreage and Coordinates

MRS	MRS Acreage¹	X-Coordinate (meters)	Y-Coordinate (meters)
<i>MRS M01 Arbuckle Creek Fuze Disposal Area</i>	1	462784.15	3060134.62
<i>MRS R01 Target XI – Land Skip Bombing Target</i>	649	491236.09	3050646.71
<i>MRS R02 Target XII – Combination Bombing and Gunnery Range (BGR)</i>	649	496971.27	3049076.17
<i>MRS R03 Range XII – Position Firing Course</i>	20,252	501755.79	3042653.91
<i>MRS R04 Target XIII – Practice Bombing Target</i>	649	498995.13	3055727.83
<i>MRS R05 Target XIV – Practice Bombing Target</i>	649	493576.75	3039054.79
<i>MRS R06 Range XIX – Position Firing Course</i>	29,186	489486.76	3045279.35
<i>MRS R07 Target XV – Practice Bombing Target</i>	649	510898.69	3043551.42
<i>MRS R08 Area Bombing Target</i>	649	494501.31	3053355.03
<i>MRS R09 North Restricted Use Area</i>	2,785	492525.44	3055240.70
<i>MRS R10 Central Restricted Use Area</i>	3,575	490370.75	3047141.94
<i>MRS R11 Lake Kissimmee Water Bombing Target</i>	649	478216.21	3081853.79

1 - Acreage based on Archives Search Report (ASR) Supplement.

1.2 PROJECT OBJECTIVES

1.2.1 The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the USACE is conducting environmental response activities at FUDS for the Army, DoD's Executive Agent for the FUDS program.

1.2.2 Pursuant to USACE's Engineer Regulation (ER) 200-3-1 (USACE, 2004a) and the Management Guidance for the Defense Environmental Response Program (DERP) (Office of the Deputy Under Secretary of Defense [Installations and Environment], September 2001), USACE is conducting FUDS response activities in accordance with the DERP statute (10 United States Code [USC] 2701 et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC §9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300). As such, USACE is conducting remedial SIs, as set forth in the NCP, to evaluate hazardous substance releases or threatened releases from eligible FUDS.

1.2.3 While not all MEC/MC constitute CERCLA-hazardous substances, the DERP statute provides DoD the authority to respond to releases of MEC/MC that pose an imminent and substantial endangerment and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2.4 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action under CERCLA or not. The SI collects a sufficient amount of information necessary to make this determination. Additionally, it (i) determines the potential need for a removal action (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the U.S. Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the release for effective initiation of the Remedial Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to collect the additional data necessary to complete the Munitions Response Site Prioritization Protocol (MRSPP).

1.2.5 The SI was performed as a result of the potential for MEC/MC contamination within the MRSs associated with the USAF Avon Park Range. All work adhered to the DERP for FUDS and relevant U.S. Army regulations and guidance for MMRP programs. As specified in the task order, this report is prepared to summarize the SI sampling events and present an account of the MEC/MC contamination within the MRSs associated with the USAF Avon Park Range.

1.3 PROJECT SCOPE

1.3.1 Due to the historical findings of MEC and munitions debris (MD) at the MRSs associated with the USAF Avon Park Range, the Technical Project Planning (TPP) Team concurred that the SI would proceed in a manner to support an RI/FS.

1.3.2 The TPP Team agreed that the SI data collection efforts would focus on screening for MC contamination in soil, surface water, sediment, and groundwater. A total of 20 surface soil samples, one surface water and sediment sample "couple", and one groundwater sample along with the appropriate Quality Assurance/Quality Control (QA/QC) samples and field duplicates were collected from within USAF Avon Park Range boundaries. All of the samples were analyzed for explosives and selected metals

(aluminum, antimony, barium, copper, lead, and zinc). Two of the 20 surface soil samples were additionally analyzed for iron. Seventeen of the 20 soil samples and the surface water/sediment sample “couple” were collected in locations were selected to represent areas with the highest likelihood for the presence of MEC or MC contamination, such as target centers or areas displaying MD.

1.3.3 The primary project planning documents used to perform the SI include the Site-Specific Work Plan (SS-WP) Addendum for the USAF Avon Park Range (Parsons, 2008b), the USAESCH Programmatic Work Plan (PWP) (Parsons, 2005), the Programmatic Sampling and Analysis Plan (PSAP) (USACE, 2005), and the PSAP Addendum (Parsons, 2006). The performance work statement for this project is included in Appendix A.

Figure 1.1

Site Location
USAF Avon Park Range
FUDS Project No. I04FL028701

Okeechobee, Osceola, and Polk Counties, Florida

Legend

- Approximate FUDS Boundary
- Representative Qualitative Reconnaissance Track
- MRS M01- Arbuckle Creek Fuse Disposal Area
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- ▨ MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- ▨ MRS R09- North Restricted Use Area
- ▨ MRS R10- Central Restricted Use Area
- MRS R11- Lake Kissimmee Water Bombing Target
- ▨ Kissimmee Prairie Preserve State Park
- ▨ Avon Park Air Force Range (active range)

Note: The FUDS Property Boundary is derived from historic data and has not been surveyed.



Image Source: USGS 7.5' Topo Quadrangles, 1981
 Projection: UTM Zone 17 NAD83. Map Units in Meters



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DESIGNED BY: BT	Site Location	
DRAWN BY: BT		
CHECKED BY: DS	SCALE: As Shown	PROJECT NUMBER: 744647.69000
SUBMITTED BY: DS	DATE: October 2008	PAGE NUMBER: 1-5
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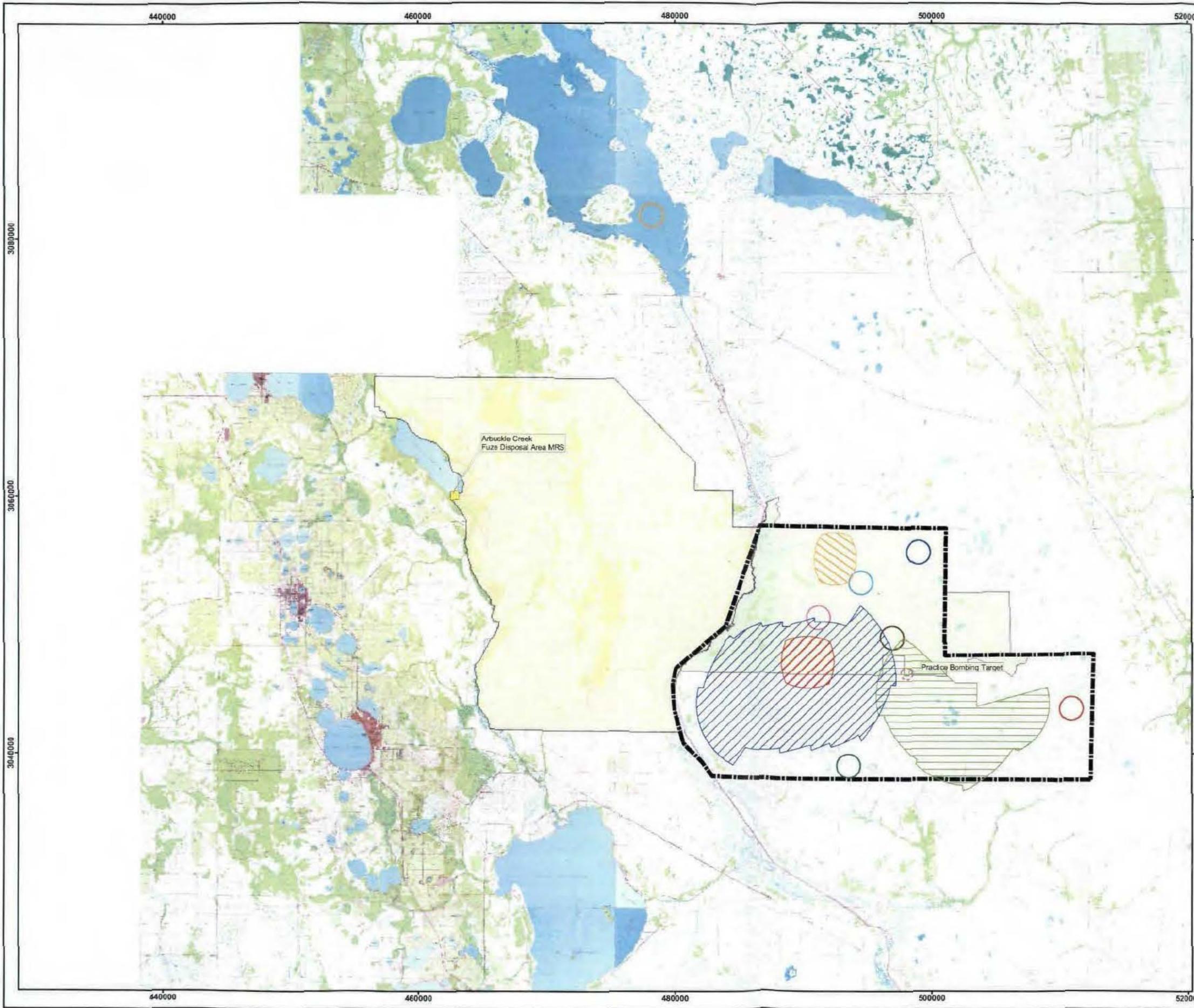


Figure 1.2

Site Location
USAF Avon Park Range
FUDS Project No. I04FL028701

Okeechobee, Osceola, and Polk Counties

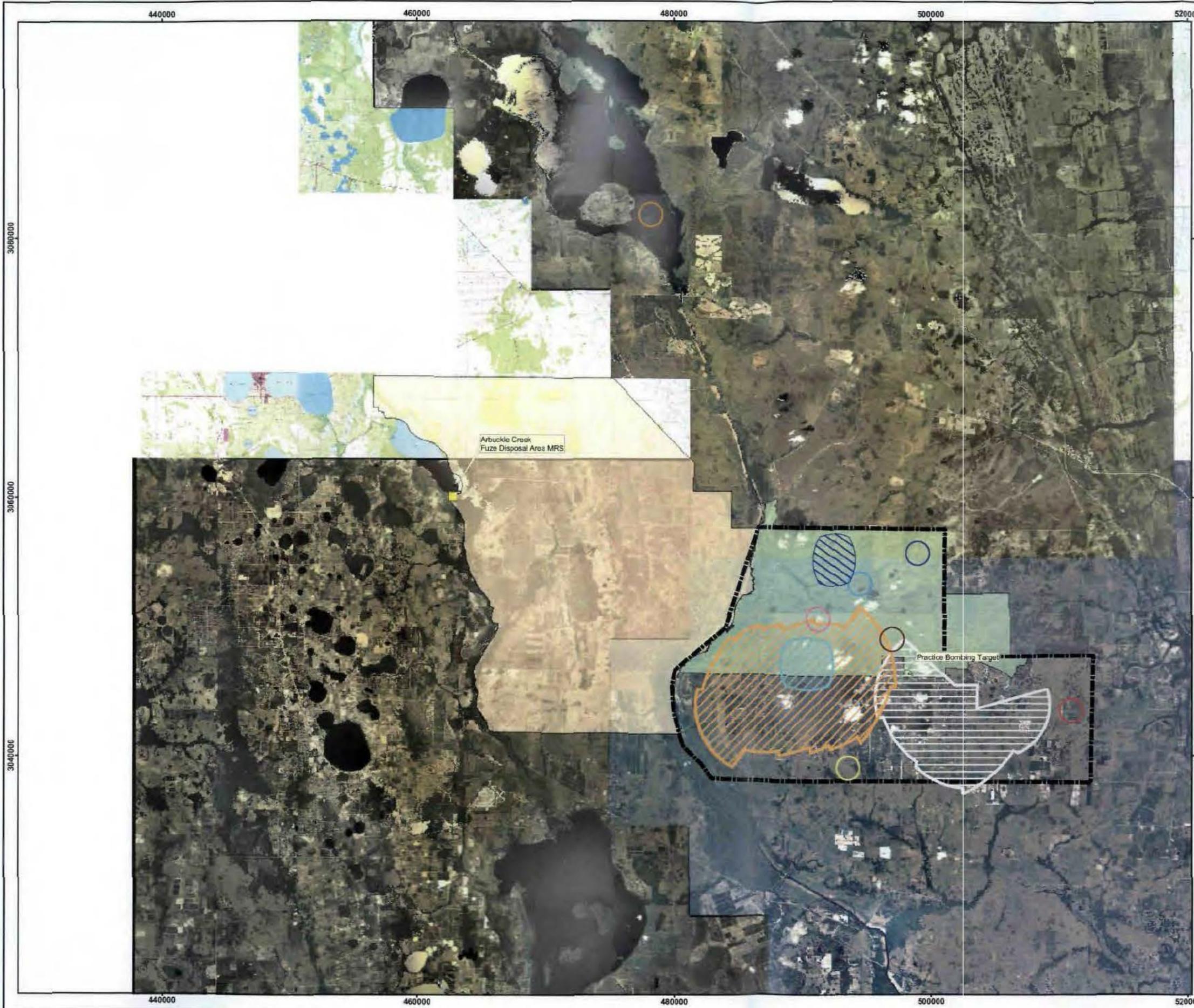
Legend

- MRS M01- Arbuckle Creek Fuse Disposal Area
- Approximate FUDS Boundary
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- MRS R09- North Restricted Use Area
- MRS R10- Central Restricted Use Area
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)

Note: The FUDS Property Boundary is derived from historic data and has not been surveyed.



Image: 2006 Orthophoto
 Projection: UTM Zone 17 NAD83, Map Units in Meters



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CHAPTER 2 PROPERTY DESCRIPTION AND HISTORY

2.1 SITE DESCRIPTION

The USAF Avon Park Range is located in Okeechobee, Osceola, and Polk Counties, Florida. The SI for USAF Avon Park Range includes the evaluation of 12 MRSs within three noncontiguous areas. There are ten MRSs associated with the FUDS located east of the Kissimmee River, in Okeechobee County. One MRS, the *MRS M01 – Arbuckle Creek Disposal Area*, is located to the west of the Kissimmee River, in Polk County. The *MRS R11- Lake Kissimmee Water Bombing Target* is located within Lake Kissimmee, in Osceola County. The total property acreage listed in the 2004 ASR Supplement is 111,713 acres. The recorded acreage in the Defense Environmental Programs Annual Report to Congress (DEP ARC) for fiscal year 2007 is 181,026 acres. A large portion of this FUDS is operated by the State of Florida and is managed as Kissimmee Prairie Preserve State Park. Figure 2.1 shows the location of the FUDS and MRS boundaries located to the west of the Kissimmee River. Figure 2.2 shows the location of the FUDS and MRS boundaries located to the east of the Kissimmee River.

2.2 SITE LOCATION AND SETTING

2.2.1 Topography and Vegetation

The area is nearly flat with an approximate elevation range between 55 and 65 feet. Local relief is relatively low. Plant communities on site consist of Florida Dry Prairie, hardwood hammocks, and wetlands. The Florida Dry Prairie community is treeless with low shrubs (such as palmettos) and grasses (such as wiregrass) dominating. The hardwood hammocks typically consist of a dense overstory in which live oaks dominate and a shrub midstory which includes saw palmettos. The entire site is heavily covered in wetland areas, as described in further detail in Chapter 5.

2.2.2 Geology and Soils

2.2.2.1 The information below regarding the geology and soils associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE, 1996). Additional detail regarding the regional geology and soils is included in Subchapter 5.2.1. The USAF Avon Park Range is located in the Floridan section of the Coastal Plain physiographic province. This area consists of Tertiary and Quaternary sediments. The underlying rocks are upper-Precambrian to lower-Paleozoic. The site occurs on the Osceola Plain physiographic zone. The Osceola Plain, a marine terrace, is bounded on the west by the Lake Wales Ridge and on the east by lower lying marine scarps.

2.2.2.2 The west-central peninsula of Florida consists of igneous and metamorphic basement rocks overlain by 4,000 feet of sedimentary rocks, principally

limestones. These geologic units and the description of their general lithology are summarized further in Subchapter 5.2.1. The top of the limestone bedrock tends to be very irregular and was formed by dissolution of the limestone caused by acidic ground water. Other effects of dissolution activity apparent at this site are caverns, sinkholes, pinnacles, solution pipes, and a "honeycomb-structure" of voids in the limestone.

2.2.2.3 The USAF Avon Park Range encompasses a large area that includes several different types of soil. The soils are all sands and fine sand mixtures, they all are poorly and very poorly drained, and they are all deep soils (extending to depths well over 7 feet). The corrosive effects of the soil are high for uncoated steel and low for concrete. These soils generally have a high water table that is at a depth of 10 to 20 inches for 4 to 12 months of the year and below this level during long dry periods. In other areas the water table, the majority of the year, is at or near the surface and becomes ponded after heavy rains and remains as such if the soil in that area is of low permeability. In these areas the soil has a higher content of silt and may even be an organic muck.

2.2.3 Climate

2.2.3.1 The information regarding the climate associated with USAF Avon Park Range was obtained from the 1996 ASR (USACE 1996). The climatic data collected at Avon Park, Florida for the period of 1931-1993 shows an average annual precipitation of 52.74 inches. Approximately 59 percent of this amount falls from June through September. The climate in the study area is subtropical, characterized by short mild winters and long warm humid summers. Average annual temperature for the area is about 73 degrees Fahrenheit.

2.2.3.2 The following information regarding severe weather associated with the USAF Avon Park Range area was obtained from the National Hurricane Center (NOAA, 2007). Severe weather occurs in this site area. The Atlantic hurricane season spans from June 1 through November 30. The San Felipe-Okeechobee Hurricane occurred in this area in 1928, causing many casualties and destruction. Hurricanes Charley, Frances and Jeanne passed through this area in 2004. Tropical Storm Ernesto passed through the area in 2006.

2.2.4 Hydrology

2.2.4.1 The information regarding the regional hydrologic setting associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE, 1996). Additional detail regarding the regional hydrology is included in Subchapter 5.2.4. The FUDS considered for this SI encompasses three general areas with respect to surface water. The first area is located at the Lake Arbuckle and its surrounding areas. This area includes the *MRS M01-Arbuckle Creek Fuze Disposal Area*. All the surface runoff drains into the Lake and the Arbuckle Creek. The Livingston Creek flows into the Lake from northwest and the control structure of the Lake releases water into the Arbuckle Creek.

2.2.4.2 The second area, consisting of *MRS R11-Lake Kissimmee Water Bombing Target*, is situated on the southeastern quarter of the Lake Kissimmee. Lake Kissimmee is a 34,948-acre lake.

2.2.4.3 The third area, which is located between the Kissimmee River and Highway 441, covers a large portion of the Okeechobee County. This area consists of the remaining ten MRSs. The Kissimmee River flows along the west boundary of the area. Wetlands areas are located extensively throughout the site. The surface drainage system in most of the area is poorly developed and, instead, runoff predominately drains into numerous sinks, closed depressions, lakes and grassy prairies. Surface runoff also drains toward the Kissimmee River. After heavy rainfall, small intermittent streams flow to sinkholes where the water either percolates rapidly, or ponds, to form prairie lakes. During extended dry periods, these channels and lakes are usually dry. Portions of the area are likely to be flooded by the Kissimmee River overbank flooding. Cattle and sod farms within this portion of the FUDS use man-made canals for irrigation and drainage.

2.2.5 Groundwater

2.2.5.1 The information regarding the groundwater associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE, 1996). Additional detail regarding regional groundwater is included in Subchapters 5.2.2 and 5.2.3. Two aquifer systems, the Floridan aquifer and the surficial aquifer, lie beneath the site. The Floridan aquifer is unconfined at this location since an overlying clay aquitard is absent. The Floridan aquifer is the principal aquifer supplying most of the water used in the region. The configuration of the top of the aquifer is highly variable due to erosion and dissolution in the limestones that form its upper surface. The elevation of the top of the aquifer ranges from slightly below sea level to more than 100 feet above sea level. Subsurface information from nearby water wells indicates that the top of the Floridan aquifer at the site is about elevation 25 feet (Mean Sea Level [MSL]). Recharge of the Floridan aquifer occurs from direct contact with the surficial aquifer, through rainfall percolation through unconsolidated sands and clays, surface exposure, and where there are lakes, sinks and rivers.

2.2.5.2 The surficial aquifer is found where sands overlie the limestones and dolomites of the Floridan aquifer. This aquifer is exposed at the surface and is in an unconfined condition. The thickness of the surficial aquifer is highly variable due to large variations in the thickness of sands. The thickness of the surficial aquifer system is typically less than 50 feet, but may be as thick as 400 feet; the thickness generally increases coastward. The shallow aquifer may directly overlie the Floridan aquifer, or they may be separated by clays or other relatively impermeable units. Recharge to the surficial aquifer is almost entirely from local rainfall, except in those areas where it is hydraulically connected to the Floridan aquifer, which is the likely condition at this site. Discharge from the surficial aquifer may be by downward percolation into the Floridan aquifer, seepage into streams, lakes, sinkholes, and pumpage from wells.

2.2.6 Significant Structures

2.2.6.1 *MRS M01 Arbuckle Creek Fuze Disposal Area* is located in Arbuckle Creek. Lake Arbuckle drains into Arbuckle Creek to the south. Lake Arbuckle is used recreationally for boating and fishing. A bridge on County road 64 crosses Arbuckle Creek and is the location from which the fuzes were disposed into the creek below. This bridge is reportedly a popular fishing location and a fish camp is located approximately

75 feet upstream of the bridge. The area immediately adjacent to the MRS includes land still actively used by Avon Park Air Force Range and Avon Park Correctional Institution, and undeveloped, forested land managed by Florida Fish and Wildlife Conservation Commission (FWC) as the Arbuckle Wildlife Management Area. There are more than 26 inhabited structures within two miles of this MRS in the form of residences, the correctional facility, Air Force Range buildings, and fishing camps.

2.2.6.2 *MRS R11-Kissimmee Water Bombing Target* is located entirely within Lake Kissimmee. There are no structures within this MRS. The lake is used recreationally for fishing and numerous fish camps flank the shoreline. A water control structure regulates flow from the lake to the Kissimmee River to the south; this structure is located approximately three and a half miles from the *MRS R11-Kissimmee Water Bombing Target* boundary. There are more than 26 private residences and fishing camps within two miles of the MRS.

2.2.6.3 The remaining ten MRSs are situated on the east side of Kissimmee River on lands owned by numerous private entities (residential and cattle pasture) and the State of Florida. The State of Florida manages approximately 54,000 acres of this land as Kissimmee Prairie Preserve State Park. Approximately 6,000 acres of the park are used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. The park includes park offices and campgrounds with facilities. Outside of the park there are numerous residences, structures associated with agricultural industry, and light commercial buildings. There are no known inhabited structures within two miles of the *MRS R01 Target XI – Land Skip Bombing Target*. There are at least five inhabited structures within two miles of the *MRS R08 Area Bombing Target*. There are at least six inhabited structures within two miles of the *MRS R04 Target XIII – Practice Bombing Target* and *MRS R09 North Restricted Use Area*. There are more than 26 inhabited structures within two miles of, or within the boundaries of, the following MRSs: *MRS R02 Target XII – Combination BGR*, *MRS R03 Range XII – Position Firing Course*, *MRS R05 Target XIV – Practice Bombing Target*, *MRS R06 Range XIX – Position Firing Course*, *MRS R07 Target XV – Practice Bombing Target*, and *MRS R10 Central Restricted Use Area*.

2.2.7 Demographics

2.2.7.1 The demographics information for Okeechobee, Osceola, and Polk Counties, Florida was obtained from the 2000 United States Census Bureau website (US Census Bureau, 2000a, 2000b and 2000c) and from the American Fact Finder Fast Access to Information link on the United States Census Bureau website (US Census Bureau, 2000d, 2000e, and 2000f). See Figures 2.3 and 2.4 for a breakdown of population within a 4-mile buffer of the site.

2.2.7.2 In 2006, the population of Okeechobee County was estimated to be approximately 40,406. According to a 2000 estimate, Okeechobee County had 46.4 persons per square mile. In 2000, the percentage of the population over the age of 18 was 74.8%, while 16.3% was over the age of 65. The median age in 2000 was 36.7 years. In Okeechobee County in 2000, approximately 88.8% of the population was Caucasian, 8.0% Black or African American, 1.1% Asian, and 1.0% American Indian and Alaska

Native. There were 12,593 occupied households with an average household size of 2.69. In 2000, the occupational breakdown, by number of persons and percentage, in Okeechobee County was as follows:

- Management, professional, and related occupations – 3,052, 21.5%
- Service occupations – 2,482, 17.5%
- Sales and office occupations – 3,068, 21.7%
- Farming, fishing, and forestry occupations – 1,723, 12.2%
- Construction, extraction, and maintenance occupations – 2,052, 14.5%
- Production, transportation, and material moving occupations – 1,792, 12.6%

2.2.7.3 In 2006, the population of Osceola County was estimated to be 244,045. According to a 2000 estimate, Osceola County had 130.5 persons per square mile. In 2006, the percentage of the population over the age of 18 was 74.7%, while 11.2% was over the age of 65. The median age in 2006 was 34.5 years. In Osceola County in 2006, approximately 71.1% of the population was Caucasian, 10.2% Black or African American, 2.9% Asian, and 0.2% American Indian and Alaska Native. In 2000, there were 60,977 occupied households with an average household size of 2.79. In 2006, the occupational breakdown, by number of persons, in Osceola County was as follows:

- Management, professional, and related occupations – 27,058
- Service occupations – 22,863
- Sales and office occupations – 36,951
- Farming, fishing, and forestry occupations – 590
- Construction, extraction, and maintenance occupations – 14,103
- Production, transportation, and material moving occupations – 13,784

2.2.7.4 In 2006, the population of Polk County was estimated to be 561,606. According to a 2000 estimate, Polk County had 296.4 persons per square mile. In 2000, the percentage of the population over the age of 18 was 75.6%, while 18.3% was over the age of 65. The median age in 2000 was 38.6 years. In Polk County in 2000, approximately 79.6% of the population was Caucasian, 13.5% Black or African American, 0.9% Asian, and 0.0% American Indian and Alaska Native. There were 187,233 occupied households with an average household size of 2.52. In 2000, the occupational breakdown, by number of persons and percentage, in Polk County was as follows:

- Management, professional, and related occupations – 54,150, 26.2%
- Service occupations – 34,539, 16.7%
- Sales and office occupations – 56,000, 27.1%
- Farming, fishing, and forestry occupations – 4,057, 2.0%
- Construction, extraction, and maintenance occupations – 24,396, 11.8%

- Production, transportation, and material moving occupations – 33,318, 16.1%

2.2.7.5 As noted in Table 2.1, there are approximately 2,091 individuals within a 4-mile buffer of the USAF Avon Park Range FUDS associated with the *MRS M01-Arbuckle Creek Fuze Disposal Area*. There are more than 26 inhabited structures within two miles of this MRS in the form of residences, Avon Park Correctional Institution, Avon Park Air Force Range buildings, and fishing camps. Figure 2.3 depicts the 2000 Census Bureau census blocks and population in the vicinity of the FUDS associated with this MRS.

2.2.7.6 As noted in Table 2.1, there are approximately 576 individuals within a 4-mile buffer of the *MRS R11 – Lake Kissimmee Water Bombing Target*. There are more than 26 private residences and fishing camps within two miles of the MRS. Figure 2.3 depicts the 2000 Census Bureau census blocks and population in the vicinity of this MRS.

2.2.7.7 As noted in Table 2.1, approximately 1,525 individuals live within a 4-mile buffer of the USAF Avon Park Range FUDS east of the Kissimmee River. There are no known inhabited structures within two miles of the *MRS R01 Target XI – Land Skip Bombing Target*. There are at least five inhabited structures within two miles of the *MRS R08 Area Bombing Target*. There are at least six inhabited structures within two miles of the *MRS R04 Target XIII – Practice Bombing Target* and *MRS R09 North Restricted Use Area*. There are more than 26 inhabited structures within two miles of, or within the boundaries of the following MRSs: *MRS R02 Target XII – Combination BGR*, *MRS R03 Range XII – Position Firing Course*, *MRS R05 Target XIV – Practice Bombing Target*, *MRS R06 Range XIX – Position Firing Course*, *MRS R07 Target XV – Practice Bombing Target*, and *MRS R10 Central Restricted Use Area*. Figure 2.4 depicts the 2000 Census Bureau census blocks and population in the vicinity of the site to the east of the Kissimmee River.

Table 2.1
Population within a 4-Mile Buffer of the Site
USAF Avon Park Range
Okeechobee and Polk Counties, Florida

Area	On Site	0 to 1/4 Mile	1/4 to 1/2 Mile	1/2 to 1 Mile	1 to 2 Miles	2 to 3 Miles	3 to 4 Miles	Total
FUDS boundary associated with MRS M01- Arbuckle Creek Fuze Disposal Area	1,456	65	0	0	315	51	204	2,091
MRS R11 - Lake Kissimmee Water Bombing Target	0	0	0	182	334	56	4	576
FUDS - East of the Kissimmee River	468	7	1	56	81	138	774	1,525

Source: U.S. Census 2000 data. The population within the site, MRS, or within any buffer area is determined using a conservative approach to calculate the population of an area by including the total number of people for any census block that falls within or overlaps the site boundary, MRS boundaries, or buffer line.

2.2.8 Current and Future Land Use

2.2.8.1 *MRS M-01 Arbuckle Creek Fuze Disposal Area* is located in Arbuckle Creek. Lake Arbuckle drains into Arbuckle Creek to the south. Lake Arbuckle is used recreationally for boating and fishing. The bridge over which the fuzes were disposed is reportedly a popular fishing location and a fish camp is located approximately 75 feet upstream of the bridge. The area immediately adjacent to the MRS includes land still actively used by the Avon Park Air Force Range and the Avon Park Correctional Institution, and undeveloped, forested land managed by Florida FWC as the Arbuckle Wildlife Management Area. The land use in this area is not anticipated to change.

2.2.8.2 *MRS R11-Kissimmee Water Bombing Target* is located entirely within Lake Kissimmee. Lake Kissimmee is used recreationally for fishing and numerous fish camps flank the shoreline. A water control structure regulates flow from the lake to the

Kissimmee River to the south; this structure is located approximately three and a half miles from the MRS boundary. The land to the south of the lake is managed by South Florida Water Management District (SFWMD) and FWC as Kissimmee Island Cattle Company (KICCO) Wildlife Management Area (west of Kissimmee River) and Blanket Bay Management Area (east of Kissimmee River). The land use is not expected to change.

2.2.8.3 The remaining ten MRSs are situated on the east side of Kissimmee River on lands owned by numerous private entities (residential and cattle pasture) and the State of Florida. The State of Florida manages approximately 54,000 acres of this land as Kissimmee Prairie Preserve State Park. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. The site contains habitat suitable to support numerous federally-protected species. The land use is expected to continue as a state park, agricultural, residential, and light commercial.

2.2.9 Site Ownership and History

2.2.9.1 The Avon Park Range was started in February 1942 with units from McDill Field moving to 111,000 acres of recently acquired land located approximately 10 miles east of Avon Park, Florida. Described at one time as the largest bombing range in the world, the Avon Park General Bombing Range opened officially in March 1942. Additional land acquisition between 1942 and 1977 increased the land area to 218,224 acres (approximately 353 square miles), spanning three Florida counties: Okeechobee, Highlands, and Polk. During World War II, this site was also known as Avon Park Army Air Field (AAF). The site was used primarily for training B-17 Aircraft Crews for air-to-ground bombing. Improvements to the site included storm drainage, water and electrical systems, sewer, runways, roadways, bridges, towers, fencing and over 500 buildings. In 1949, the site was transferred to the Air Force, at which time it was known as Avon Park Air Force Base. In 1956, the site was renamed Avon Park Air Force Range. The USAF still owns and operates approximately 106,000 acres of the original site as the Avon Park Air Force Range (these active ranges adjacent to the FUDS are not FUDS-eligible). The remaining acres (112,771.6 acres) were reported excess and leases to various portions of the site were terminated between 1946 and 1983.

2.2.9.2 Range types within the FUDS include land skip bombing, combination bombing and gunnery range (BGR), position firing courses (PFC), practice bombing target, water bombing target (Lake Kissimmee), and two restricted use areas. Munitions types used include small arms ammunition and various bombs and flares. The 1996 ASR reports that chemical warfare training using live mustard gas, tear gas, and smoke occurred routinely at the Air Field and in a training area. According to a 1996 Recovered Chemical Warfare Material (CWM) review, this training was conducted on the currently active USAF Range and not on the FUDS.

2.2.9.3 A Certificate of Deduinding (September 22, 1958) exists for the USAF Avon Park Range FUDS but is very circumspect in its claims of clearance due to the prevalence of water covering much of the site. The certificate states...“That portion of

the above described land which is solid or firm earth has been given a careful visual search and has been cleared of all dangerous and/or explosive materials reasonably possible to detect.” This implies that the areas covered with mud or water were not dedudded; this includes large tracts of the range. This clearance addressed less than one acre within the FUDS located on the east side of the Kissimmee River.

2.2.9.4 There are two reported incidences involving deaths of civilians related to USAF Avon Park Range. Both incidents occurred while the site was in caretaker status (inactive, but not closed) and were related to the fuze disposal procedure. During 1945, approximately 200 live bomb fuzes, in the original packaging, were disposed of by Avon Park Range personnel into Arbuckle Creek. The following year, during a severe drought which lowered the creek level, two fisherman located and removed fuzes from the creek. On May 25, 1946, a 3-year old boy was killed while playing with a fuze found in Arbuckle Creek. On November 9, 1946, a child was killed and several others injured while playing with a fuze found beneath a former base housing unit. As a result of these incidents, a clearance was conducted covering a “large portion of the eastern part of this facility” in 1949. However, the associated certificate did not specifically address the Arbuckle Creek area, indicating the Arbuckle Creek area may not have been addressed in this clearance. No other reports of incidents were noted in the ASR or ASR Supplement.

2.3 SITE OPERATIONS AND WASTE CHARACTERISTICS

2.3.1 MRS-Specific Descriptions/Operations

The USAF Avon Park Range consists of 12 MRSs within three noncontiguous areas. There are ten MRSs associated with the FUDS located east of the Kissimmee River. One MRS, the *MRS M01 – Arbuckle Creek Disposal Area*, is located to the west of the Kissimmee River. The *MRS R11- Lake Kissimmee Water Bombing Target* is located entirely within Lake Kissimmee. The total property acreage listed in the 2004 ASR Supplement is 111,713 acres. The recorded acreage in the DEP ARC for fiscal year 2007 is 181,026 acres. A description of each of the MRSs follows below. The risk assessment code (RAC) score assigned to each MRS was based on the 2004 ASR Supplement evaluation of hazard severity (type of munitions) and hazard probability.

- *MRS M01 – Arbuckle Creek Fuze Disposal Area*: Comprised of 1 land acre as depicted on Figure 2.1. A RAC score of 3 was assigned to the MRS based on a marginal hazard severity and a probable hazard probability. This MRS is located adjacent to the main entrance of the active Avon Park Air Force Range. A bridge on County Road 64 crosses Arbuckle Creek. In 1945, approximately 200 live bomb fuzes (AN-M103 and potentially AN-M101A2) were dumped into Arbuckle Creek from the bridge. Two civilians were killed in the mid-1940s as a result of fuzes from the area. As a result of these incidents, a clearance was conducted covering a “large portion of the eastern part of this facility” in 1949. However, the associated certificate did not specifically note the Arbuckle Creek area, indicating the Arbuckle Creek area may not have been addressed in this clearance.
- *MRS R01 – Target XI – Land Skip Bombing Target*: Comprised of land 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS overlaps with

MRS R06 - Range XIX – PFC. This target was used for practice bombing. The target area was an approximately 80-acre rectangle. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Evidence of additional munitions use has been found and indicates .50-caliber munitions and M85 100 lb. practice bombs were used at this MRS. The following spotting charges were typically used with M85 and M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.

- *MRS R02 – Target XII – Combination Bombing and Gunnery Range:* Comprised of 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS overlaps with *MRS R06 - Range XIX – PFC* and *MRS R03 – Range XII - PFC*. This target was used as a practice bombing and gunnery range. The target area was an approximately 80-acre rectangle. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- *MRS R03 – Range XII – Position Firing Course:* Comprised of 20,252 acres as depicted on Figure 2.2. A RAC score of 4 (RAC override: low probability) was assigned to the MRS based on a negligible hazard severity and a remote hazard probability. This MRS overlaps with *MRS R02 - Target XII – Combination BGR* and *MRS R06 - Range XIX – PFC*. An additional practice bombing target location was identified in the 1996 ASR within the boundaries of the MRS, but was not designated as an MRS; the non-MRS bombing target location is shown on Figure 2.2 (pink dashed outline; labeled as “Practice Bombing Target”). The PFC target area consisted of eight scattered targets, which were fired upon by the side machine guns on B-17 aircraft. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus), however, due to the presence of the Practice Bombing Target within this MRS, M38A2 100 lb. practice bombs and M1A1, M3, and M5 spotting charges may have also been used. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.

- MRS R04 – Target XIII – Practice Bombing Target: Comprised of 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS does not overlap with any other MRS. This target was used as a practice bombing target with one approach pattern from the northwest. The 1996 ASR investigation team noted three concrete footings they attributed to the likely remnants of an observation tower. The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. MD originating from M38A2 practice bombs was found during the 2008 SI field visit. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- MRS R05 – Target XIV – Practice Bombing Target: Comprised of 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS does not overlap with any other MRS. This target was used as a practice bombing target with two approach patterns (from the northwest and northeast). The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- MRS R06 – Range XIX – Position Firing Course: Comprised of 29,186 acres as depicted on Figure 2.2. A RAC score of 4 (RAC override: low probability) was assigned to the MRS based on a negligible hazard severity and a remote hazard probability. This MRS overlaps with *MRS R01 – Target XI – Land Skip Bombing Target*, *MRS R02 – Target XII – Combination BGR*, *MRS R03 – Range XII – PFC*, and *MRS R10 – Central Restricted Use Area*. This range consisted of four separate target areas with scattered ground targets used for firing the chin-mounted machine guns as well as the side guns on the B-17 aircraft. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus); however, MEC and MD originating from bombs have been found within this MRS. A 250 lb. AN-M57 general purpose (GP) bomb found in 1999, was determined to be “live not a practice round”, and was detonated in place by Moody Explosive Ordnance Disposal (EOD) and McDill EOD. The narrative for the disposal of this item is included in Appendix L. Several pieces of AN-M50 Incendiary Bombs were found during the May 2008 site visit. State Park employees have found Vietnam-era MD originating from a Mk106 5lb. practice

bomb and a rocket pod suspected to have originated from the adjacent active range. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.

- *MRS R07 – Target XV – Practice Bombing Target:* Comprised of 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS does not overlap with any other MRS. This target was used as a practice bombing target with two approach patterns (from the southwest and the southeast). The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- *MRS R08 – Area Bombing Target:* Comprised of 649 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. This MRS overlaps with *MRS R09 – North Restricted Use Area*. This target was used as a practice formation bombing target. The target area was an approximately 160-acre rectangle. Remnants of the limestone target outline were visible in 1994 and a scrap pile consisting of M38A2 practice bomb components was located at the center of the target. The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- *MRS R09 – North Restricted Use Area:* Comprised of 2,785 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. A 1952 deed certificate suggested that the 320 acres for which this MRS was established “be restricted to surface use only”. The reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 320-acre area in question. This MRS overlaps with *MRS R08 – Area Bombing Target*. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100

lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.

- MRS R10 – Central Restricted Use Area: Comprised of 3,575 acres as depicted on Figure 2.2. A RAC score of 4 was assigned to the MRS based on a critical hazard severity and a remote hazard probability. A 1952 deed certificate suggested that the 640 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 640-acre area in question. The *MRS R06 – Range XIX – PFC* entirely encompasses this MRS. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.
- MRS R11 – Lake Kissimmee Water Bombing Target: Comprised of 649 water acres in Lake Kissimmee as depicted on Figure 2.1. Lake Kissimmee covers an area of approximately 38,000 acres and is relatively shallow lake with depths ranging from four to ten feet. A water control structure regulates flow from the lake to the Kissimmee River to the south. A RAC score of 4 was assigned to the MRS based on a marginal hazard severity and a remote hazard probability. This target is located approximately 16 miles north of the main USAF Avon Park Range property. This target was used for skip bombing practice. The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2. The following spotting charges were typically used with M38A2 100 lb. practice bombs: M1A1, M3, and M5. Based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list.

2.3.2 Regulatory Compliance

The USACE is conducting the SI at USAF Avon Park Range as part of FUDS response activities pursuant to and in accordance with the guidance, regulations, and legislation listed in Chapter 1.

2.4 PREVIOUS INVESTIGATIONS

2.4.1 1992 Inventory Project Report

An Inventory Project Report (INPR; USACE 1992) of ordnance contamination was completed for the USAF Avon Park Range site by USACE, Jacksonville District

(CESAJ) in December 1992. A brief site visit was conducted between April 24 through 26, 1992 by a contractor, who performed an on-ground survey of the FUDS associated with *MRS M01- Arbuckle Creek Fuze Disposal Area* and aerial surveys of the FUDS located to the east of Kissimmee River. Underground Storage Tanks (UST) had formerly been removed from the FUDS associated with *MRS M01- Arbuckle Creek Fuze Disposal Area*; debris remained. No other contamination (including MEC or MD) or stressed vegetation was noted in the FUDS associated with *MRS M01- Arbuckle Creek Fuze Disposal Area*. No structures or flight pattern indications were noted during the aerial survey of the FUDS located to the east of Kissimmee River. A RAC of 3, indicating moderate risk, was assigned to the site in January 12, 1993. A Findings and Determination of Eligibility (FDE), dated December 24, 1992, concluded that the site was formerly used by the DoD and 112,771.6 acres of the site are eligible for Defense Environmental Restoration Program (DERP) - FUDS.

2.4.2 1996 Archives Search Report

2.4.2.1 The ASR (USACE, 1996) was completed by USACE, St. Louis District (CEMVS) in 1996. The ASR was prepared after reviewing available records, interviews, site inspection, analysis and reports that documented the history of the site. The ASR is the source of most of the historical information pertaining to site operations and identifies the key areas of focus for the SI.

2.4.2.2 The ASR team reviewed all reports, newspaper articles; historical documents and reference material pertaining to the use and history of USAF Avon Park Range (see Subchapter 2.2.9 here). A site visit was conducted between January 10 through 12, 1996. The site visit included on-ground and aerial surveys. No MEC were identified at the MRSs during the 1996 ASR site visit. Various items of MD were observed at the *MRS R01 - Target XI-Land Skip Bombing Target* (debris was stacked at edge of target area) and the *MRS R08 Area Bombing Target* (debris pile near target center). The only target features viewed by the ASR team were those at *MRS R08 Area Bombing Target* (target outline). Possible cratering was observed at all MRSs, but localized sinkholes resemble craters and may be misinterpreted when reviewing aerial photos. There are anecdotal reports of MD, in the form of bombs and flares, found at USAF Avon Park Range during post-DoD activities. The ASR team found a 1942 newspaper article stating "bombs ranging in size from 15 lb. practice bombs to 2000 lb. demolition bombs" were to be used on the range. The ASR concluded that while no MEC were observed directly, MD observations, historical reports of fatalities, and other indirect evidence (historical records, aerial photos, interviews, and cratering) support a possibility that conventional ordnance or explosive waste remain at the USAF Avon Park Range. The ASR recommends that any development activities have Unexploded Ordnance (UXO) standby/avoidance in the areas of the bombing targets and UXO clearance is necessary if large areas of disturbance are necessary.

2.4.3 1999 Removal Action

A live 250-lb. bomb (Bomb, 250 lb., GP, AN-M57) was located within *MRS R06 - Range XIX-PFC* on the Kissimmee Prairie Preserve State Park in 1999; the item was

determined to be “live not a practice round” and was detonated in place by Moody EOD and McDill EOD. The narrative for the disposal of this item is included in Appendix L.

2.4.4 2004 Archives Search Report Supplement

2.4.4.1 The ASR Supplement (USACE, 2004b) was prepared by CEMVS as a supplement to the 1996 ASR. This ASR Supplement identified twelve MRSs (11 ranges and one disposal area) and assigned a RAC score to each of the MRSs (as detailed above in paragraph 2.3.1. The specific data for each MRS are in the CSM in Appendix B.

2.4.4.2 Although the ASR Supplement states that the only known munitions used on the range property were 100 lb. practice bombs, small arms ammunition and flares; however previous investigations and MD and MEC finding have confirmed additional munitions were used at this range.

2.4.5 Defense Environmental Programs Annual Report to Congress

The acreage recorded in the DEP ARC for fiscal year 2007 is 181,026 acres.

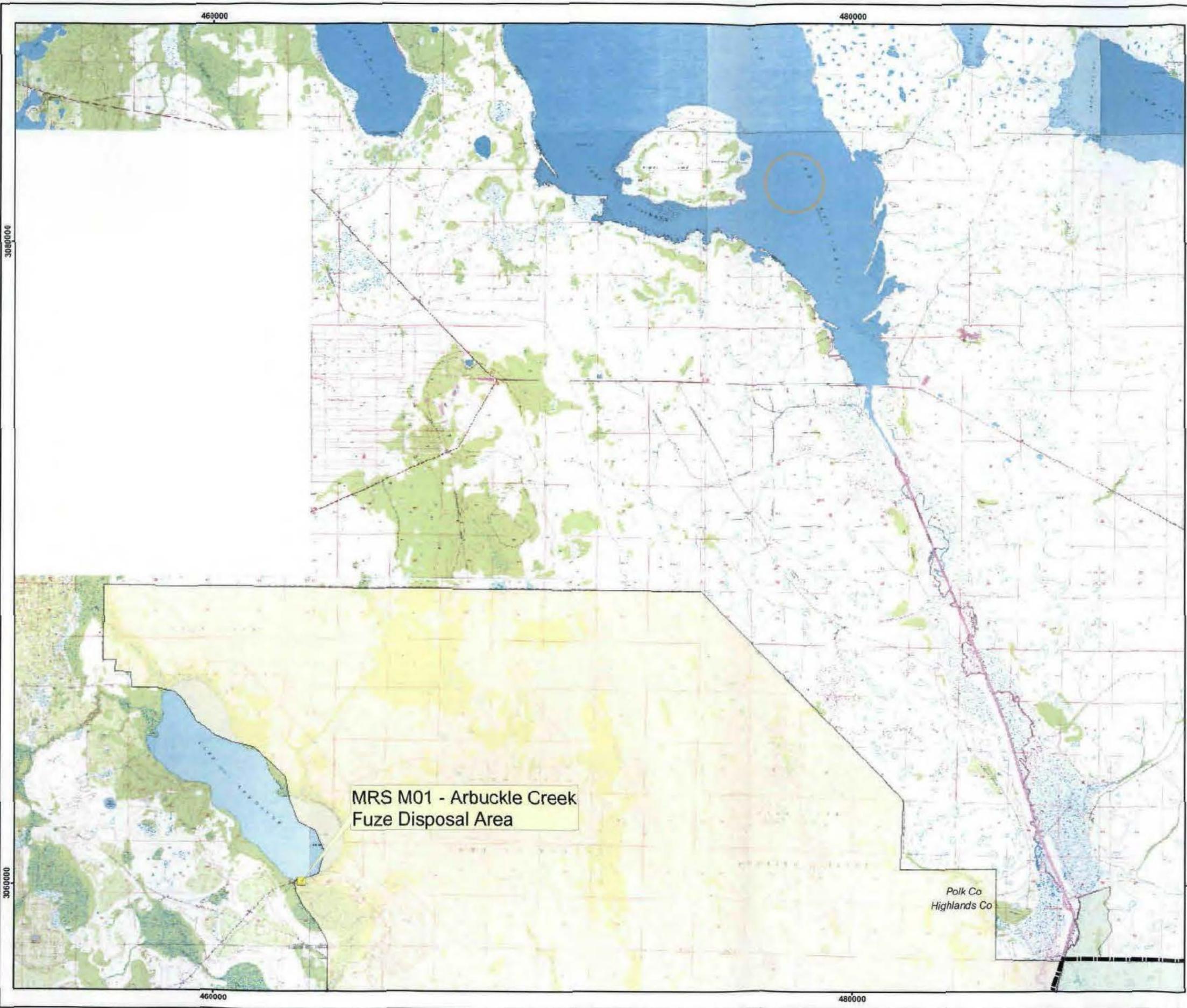


Figure 2.1

Site Setting
West of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701
 Okeechobee, Osceola, and Polk Counties

Legend

- MRS M01- Arbuckle Creek Fuze Disposal Area
- MRS R11- Lake Kissimee Water Bombing Target
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)

Note: The FUDS Property Boundary is derived from historic data and has not been surveyed.



Site Location in Florida

Image Source: USGS 7.5' Topo Quadrangles, 1981
 Projection: UTM Zone 17 NAD83. Map Units in Meters



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DESIGNED BY: BT
 DRAWN BY: BT
 CHECKED BY: DS
 SUBMITTED BY: DS

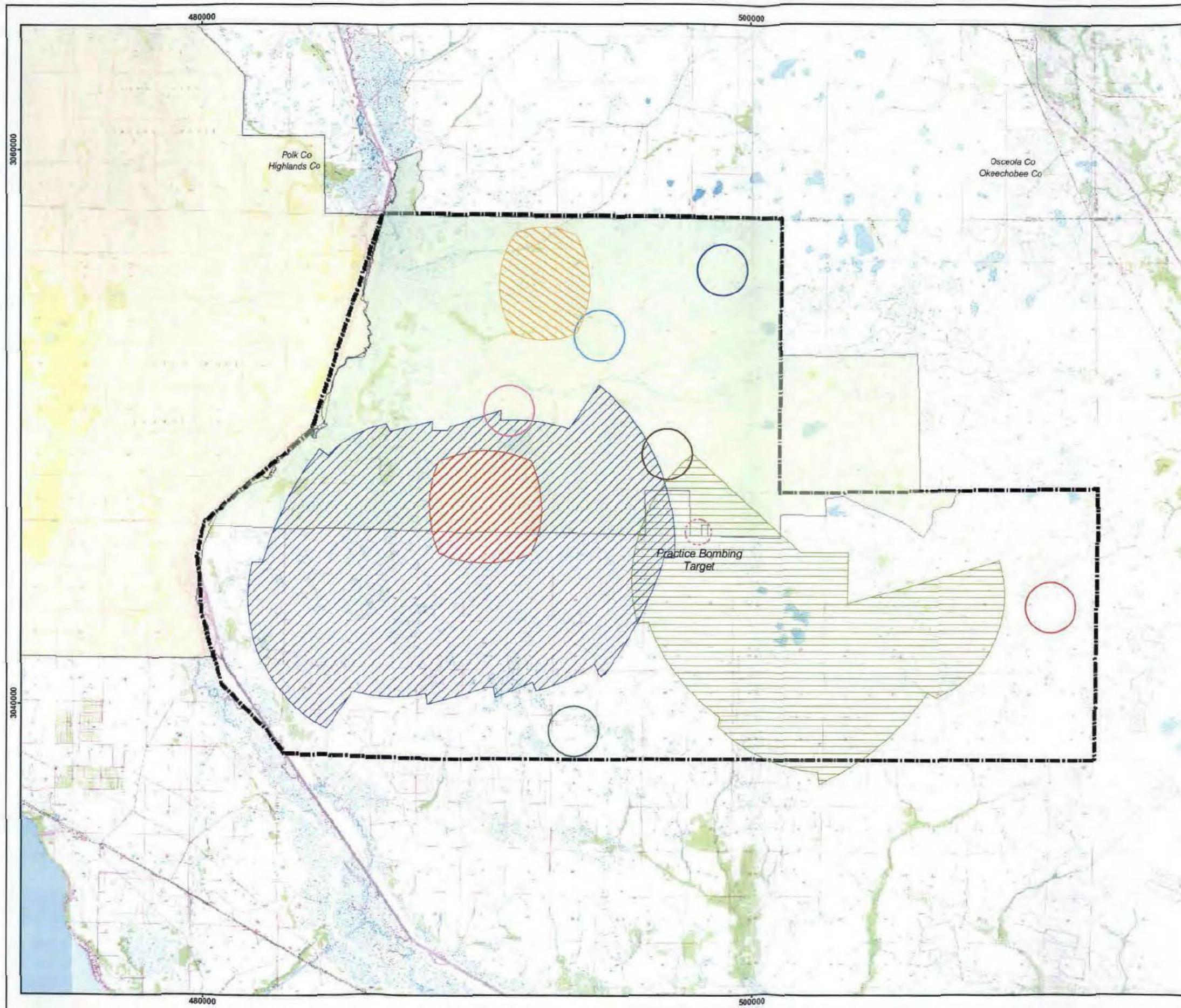
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Figure 2.2

**Site Setting
East of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**

Okeechobee, Osceola, and Polk Counties



Legend

- Approximate FUDS Boundary
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- MRS R09- North Restricted Use Area
- MRS R10- Central Restricted Use Area
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)

Notes:
The FUDS Property Boundary is derived from historic data and has not been surveyed.



Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83, Map Units in Meters



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DRAWN BY:
BT

CHECKED BY:
DS

SUBMITTED BY:
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Site Setting

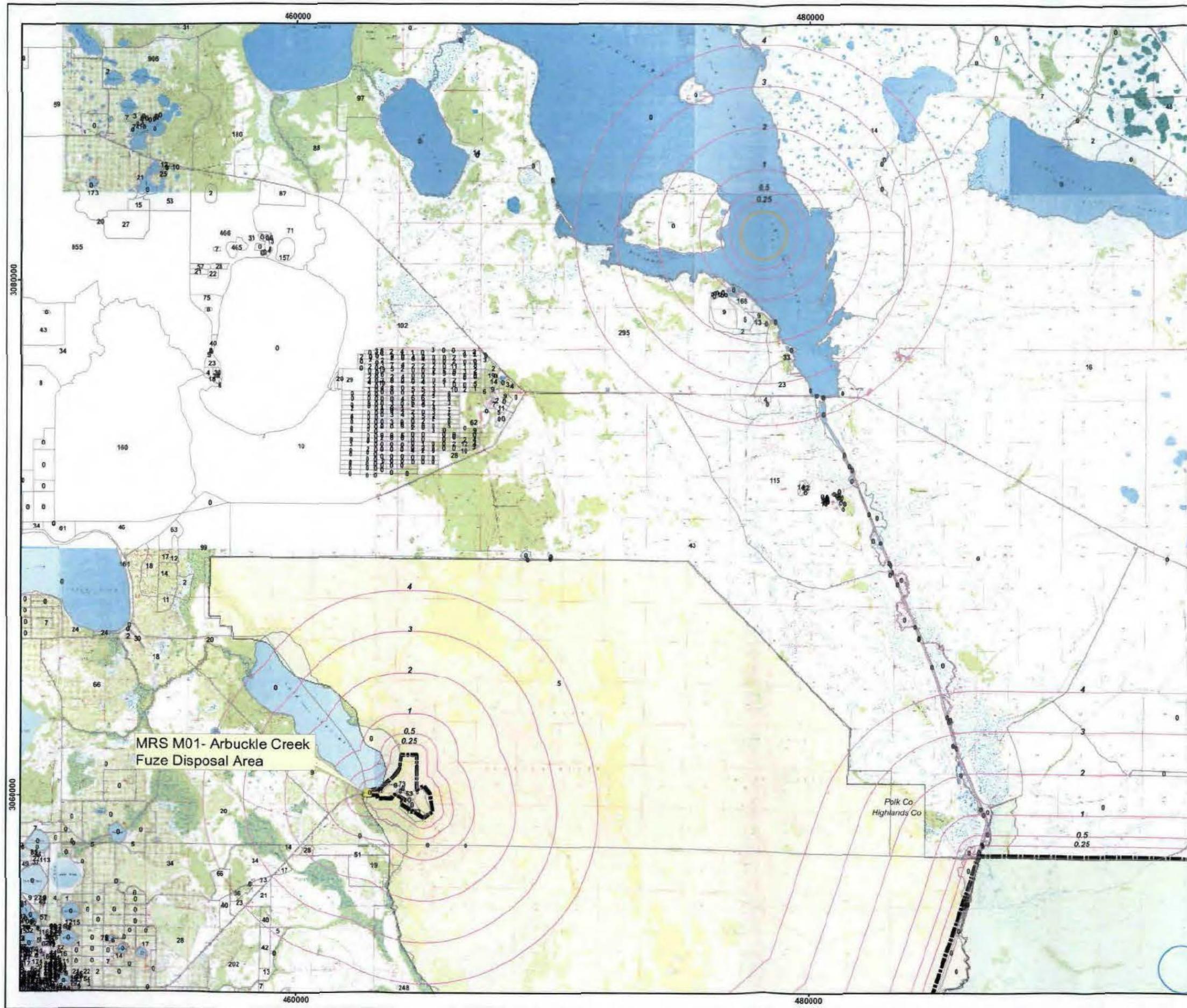
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Figure 2.3

**2000 Census Data
West of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**

Okeechobee, Osceola, and Polk Counties



Legend

- 2000 Census Block Boundary with Total Population
- MRS M01-Arbuckle Creek Fuze Disposal Area
- MRS R11- Lake Kissimmee Water Bombing Target
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)
- Buffer (Mile)

Note: The FUDS Property Boundary is derived from historic data and has not been surveyed.



Site Location in Florida

Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83, Map Units in Meters



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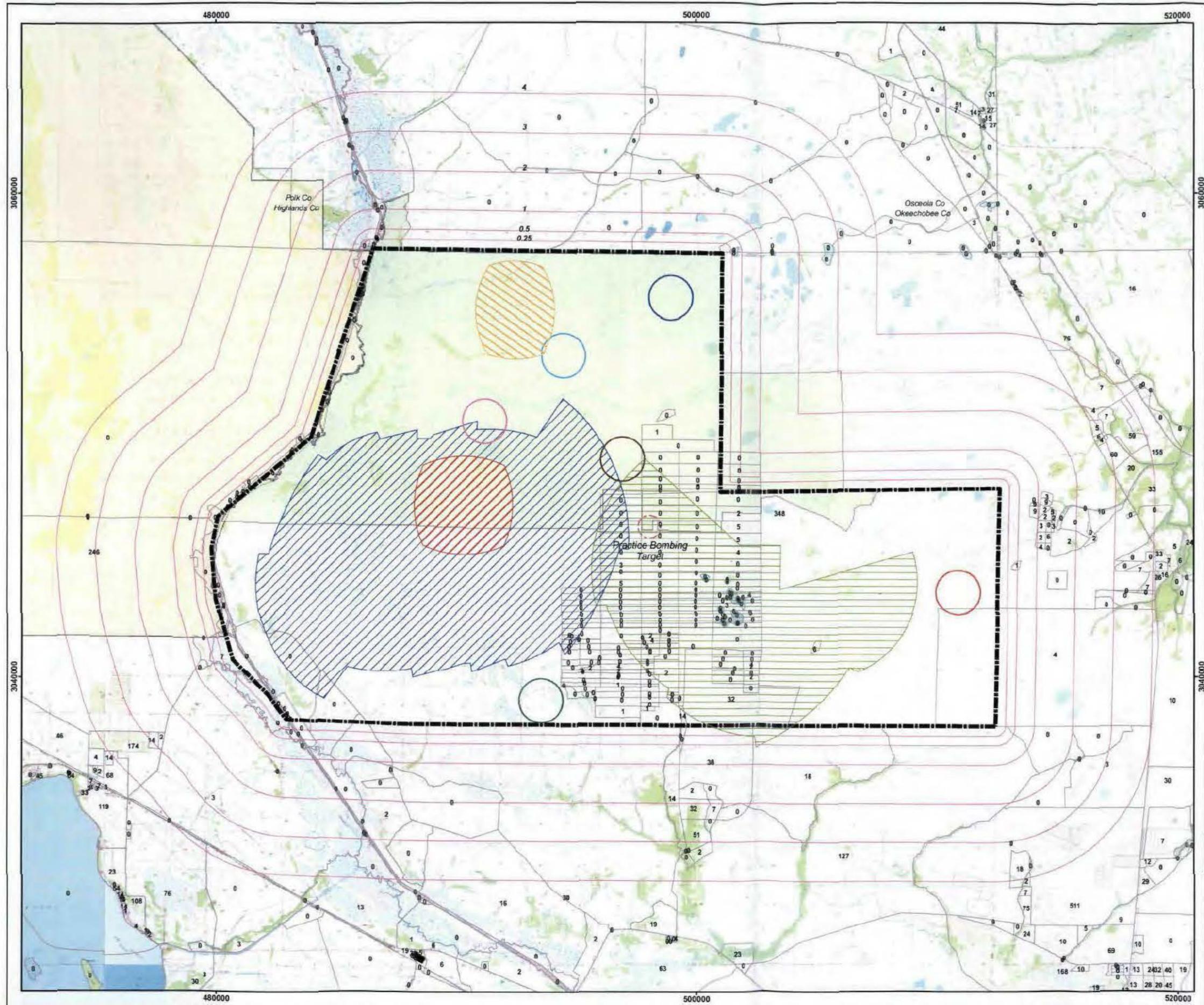
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Figure 2.4

**2000 Census Data
East of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**
Okeechobee, Osceola, and Polk Counties



Legend

- 2000 Census Block Boundary with Total Population
- Approximate FUDS Boundary
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- MRS R09- North Restricted Use Area
- MRS R10- Central Restricted Use Area
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)
- Buffer (Mile)

Notes:
The FUDS Property Boundary is derived from historic data and has not been surveyed.



Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83, Map Units in Meters



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CHAPTER 3 SITE INSPECTION TASKS

3.1 HISTORICAL RECORD REVIEW

The existing body of information pertinent to the USAF Avon Park Range site was thoroughly reviewed in advance of the TPP Meeting and summarized to the TPP Team as part of the development and concurrence of the selected Technical Approach for the site. Documents reviewed included the 1992 INPR (USACE, 1992), the 1996 ASR (USACE, 1996), and the 2004 ASR Supplement (USACE, 2004b). Sampling locations and Qualitative Reconnaissance (QR) planning, as presented in the SS-WP Addendum and implemented during the SI were the direct result of this review process. This information has been augmented with institutional knowledge and additional documentation provided by CESAJ or obtained by Parsons during coordination of the field effort. As part of mobilization preparation for the SI, the site visit team (SVT) became re-familiarized with all existing site information.

3.2 TECHNICAL PROJECT PLANNING

The USAF Avon Park Range falls under the purview of the CESAJ. A TPP meeting was facilitated by CESAJ on December 4, 2007 and included representatives of CESAJ, USAESCH, Parsons, the Florida Department of Environmental Protection (FDEP) and Kissimmee Prairie Preserve State Park. Unanimous TPP Team concurrence with the Technical Approach presented in the Final TPP Memorandum (Parsons, 2008a) issued on January 30, 2008 was achieved (see Appendix B). Key TPP facts and decisions are summarized below:

- The TPP Team concurred with the Technical Approach (supporting an anticipated RI/FS) as presented and refined at the TPP meeting on December 4, 2007 inclusive of number, type, and location of samples as well as sampling methodology and laboratory analyses.
- Parsons agreed to provide shapefiles depicting MRS boundaries to Charles Brown, Park Manager. *These files were provided on December 12, 2007.*
- Charles Fales, of CESAJ, will obtain Water Management District well coordinates and construction information for wells located on Kissimmee Prairie Preserve State Park.
- Charles Brown will provide shapefiles depicting State Park boundary, trail system, and campground and office locations. *These files were provided on January 23, 2008.*

- Charles Brown requested notification of site visit dates and duration for coordination of preserve activities, primarily prescribed burns. *Field visit activities were coordinated with Charles Brown.*
- The TPP Team agreed that QR should be conducted in the Potential Area of Interest (PAOI) along the east side of the Kissimmee River in the area near the location of the 1999 250-lb. bomb (MEC) discovery. However, after receiving the coordinates for the item, it was determined this location is within the *MRS R06-Range XIX – Position Firing Course* (whereas it was previously believed to be located outside the MRS). QR was planned and conducted within the *MRS R06- Range XIX – Position Firing Course*, around the area where the item was found.
- It was noted that the area directly under the bridge associated with the *MRS M01-Arbuckle Creek Fuze Disposal Area* has been cleaned by the Department of Transportation (DOT) several times. One surface water sample and one sediment sample was collected south of the bridge, on the west bank of the creek.
- The area within the *MRS R11-Lake Kissimmee Water Bombing Target* has been demucked and the area around the structure located down gradient of the MRS has been demucked and dredged during construction. No samples were planned to be collected in this area.
- Two discretionary surface soil samples were proposed to be collected, one within the MRS R09-North Restricted Use Area and one within the MRS R10-Central Restricted Use Area. The FTL did not find evidence (such as MD, stained soil, stressed vegetation) warranting the collection of additional samples within these MRSs. The two discretionary samples were collected adjacent to MD located within *MRS R06 – Range XIX – Position Firing Course* and *MRS R08 Area Bombing Target*.
- Surface soil samples collected within the *MRS R09-North Restricted Use Area* and the *MRS R10-Central Restricted Use Area* were analyzed for iron in addition to the MC list provided.
- It was agreed that samples would be collected in accordance with the FDEP request for discrete samples, but based on the sandy nature of the soils at this site, sample locations may be relocated as necessary to acquire samples with more organic matter that are more likely to hold contaminants. Sample depths up to 6 inches were approved for this endeavor.
- The TPP Team agreed that the following screening criteria would be used to evaluate human health risk: for surface soil and sediment, the more stringent of the Florida Administrative Code (FAC) 62-777, Soil Cleanup Target Levels, Direct Exposure Residential and USEPA Region 9 Preliminary Remediation Goals (PRGs) Residential Soil; for surface water, the more stringent of the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels Freshwater Surface Water Criteria and USEPA Region 9 PRGs for Tap Water; and, for

groundwater, the more stringent of the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels Groundwater Criteria and USEPA Region 9 PRGs for Tap Water. Ecological Screening Values (ESVs) provided in the 2005 PSAP (USACE, 2005) would be used in comparison to the sampling results in the Screening Level Ecological Risk Assessment (SLERA).

Note: Between the time of the Final SS-WP Addendum (Parsons, 2008b) and this SI Report, the USEPA and Oak Ridge National Laboratory released updated screening criteria replacing USEPA Region 9 criteria. These updated criteria, USEPA Regional Screening Levels (SLs), are used in the Screening Level Risk Assessment (SLRA) (Chapter 6) in place of the USEPA Region 9 criteria.

- Charles Brown supplied coordinates for one MEC item found within the State Park and photographs of MD items located on the State Park and agreed to provide additional coordinates, information and reports regarding these items. Any relevant information would be included in the SI Report. *Additional information was provided on February 14, 2008 and is included in Appendix L, herein.*
- The Field Team Leader coordinated on-site transportation arrangements with Charles Brown.
- Any findings of an archeological nature or ecological nature would be recorded, Global Positioning System (GPS) points collected and reported to the Park Manager. *The SVT did not encounter any additional cultural, ecological, or archeological resources during the May 2008 visit.*
- The TPP Team agreed that an expedited review was not necessary for this site.

3.3 NON-MEASUREMENT DATA COLLECTION

3.3.1 The following sources were consulted for identifying environmental and cultural resources at USAF Avon Park Range:

- Topographic Map – U.S. Geological Survey (USGS)
- Wetlands Online Mapper – National Wetlands Inventory (NWI), U.S. Fish and Wildlife Service (USFWS)
- Threatened and Endangered Species System (TESS) – Endangered Species Program, USFWS
- National Wildlife Refuge System (NWRS) – USFWS
- Florida Fish and Wildlife Conservation Commission (FWC)
- Florida Natural Areas Inventory (FNAI) – Polk, Highlands, and Okeechobee Counties
- National Register Information System (NRIS) – National Register of Historic Places (NRHP), and National Register of Historic Districts (NRHD), National Park Service (NPS)

- List of National Historic Landmarks (NHL) – National Historic Landmarks Program, NPS
- List of National Heritage Areas (NHA) – National Heritage Areas Program, NPS
- Florida State Historic Preservation Office (FL SHPO) – Florida Office of Cultural and Historical Programs (OCHP) Florida Master Site File (FMSF)
- National Oceanic and Atmospheric Administration (NOAA) - Coastal Zone Management Program (CZMP)
- May 1996 ASR Findings Avon Park Air Force Range, Avon Park, Florida, Okeechobee and Polk Counties

3.3.2 According to the NRIS, NHL, NRHP databases, NHA, and NRHD databases the USAF Avon Park Range site is not registered as an archaeological or cultural area. The Florida Master Site File (FMSF) has reviewed the site for known archaeological and cultural areas within the site boundary. There are multiple archaeological and cultural sites listed within the FUDS boundary. There are multiple archaeological and cultural sites listed within the *MRS R06 Range XIX – Position Firing Course* and *MRS R09 North Restricted Use Area*. There are no known archaeological and cultural sites listed within the *MRS R01 Target XI – Land Skip Bombing Target*, *MRS R02 Target XII – Combination BGR*, *MRS R04 Target XIII – Practice Bombing Target*, *MRS R08 Area Bombing Target*, or *MRS R10 Central Restricted Use Area*. Based on the pre-historic and historic use of the area, it is likely there are additional archaeological and cultural sites within the *MRS M01 Arbuckle Creek Fuze Disposal Area*, *MRS R03 Range XII – Position Firing Course*, *MRS R05 Target XIV – Practice Bombing Target*, and *MRS R07 Target XV – Practice Bombing Target*. Due to the location of the MRS entirely within Lake Kissimmee, it is not anticipated that any archaeological and cultural sites are located within the *MRS R11-Kissimmee Water Bombing Target*. The FMSF has provided a map of these locations that was available to the FTL for reference in the field; however, the map is not included this report due to the sensitive nature of the information. The SVT did not encounter any additional cultural or archeological resources during the May 2008 visit.

3.3.3 Ecological resources are identified in Subchapter 5.2 of this report.

3.4 SITE-SPECIFIC WORK PLAN ADDENDUM

3.4.1 The SS-WP Addendum (Parsons, 2008b) augments the PWP and PSAP, as warranted, to present pertinent site-specific information and procedural adjustments that could not be readily captured in the programmatic documents or that resulted from TPP Team agreements that required modifying the preliminary SI technical approach.

3.4.2 The PWP and PSAP are intended to be umbrella documents that set overall programmatic objectives and approaches, whereas the SS-WP Addendum provides site-specific details and action plans. The PWP, PSAP, and SS-WP were taken to the site for reference by the SVT during SI field activities.

3.4.3 The SS-WP Addendum included the project description, the field investigation plan, the sampling and analysis plan, the environmental protection plan, and

the health and safety plan specific to the USAF Avon Park Range. The field investigation plan developed a technical approach to guide sample collection and analysis for MEC and MC to ensure that the results were sufficient to determine whether additional investigations or implementation of a remedy are necessary for the site. Key elements of the technical approach included the CSEM to help determine types of samples and their locations, data quality objectives (DQOs) to ensure the data acquired are sufficient to characterize MEC and MC at the site and QR to confirm the known target locations. The SS-WP Addendum included a sampling rationale for each sample location and the latitude and longitude of the final sample locations. The sampling rationale has been updated to show actual conditions observed by the SVT and is included in Table 3.1

3.4.4 The sampling and analysis plan discusses procedures for surface soil, sediment, surface water, and groundwater sample acquisition from locations biased toward the highest potential for MEC contamination; QC and QA for the sampling process; sample shipment to an approved, independent laboratory; and analysis of the samples by the laboratory. The environmental protection plan evaluates compliance with Army Regulation 200-2 by presenting procedures for avoiding, minimizing, and mitigating potential impacts to environmental and cultural resources during site field activities. The accident prevention plan supplements the programmatic accident prevention plan with site-specific emergency contact information and directions to the nearest hospital.

3.5 DEPARTURES FROM PLANNING DOCUMENTS

There were minor deviations from the approved planning documents (such as, SS-WP Addendum) during the SI phase of the project. These deviations are described below.

- The SVT attempted to follow the proposed QR track as much as possible. Due to numerous wetlands and thick vegetation, the QR paths were modified during the SI field effort. The actual QR paths and locations of the samples collected are discussed in more detail in the MRS-specific sections in Chapter 5.
- Between the time of the Final SS-WP Addendum and this SI Report, the USEPA and Oak Ridge National Laboratory released updated screening criteria replacing USEPA Region 9 criteria. These updated criteria, USEPA Regional SLs, are used in the SLRA (Chapter 6) in place of the USEPA Region 9 criteria.
- Due to lack of ROE, samples APR-MRSM01-SW01 and APR-MRSM01-SED01 were not collected at the downstream location as planned. These samples were collected approximately 20 feet downstream of the bridge which crosses Arbuckle Creek.
- Sample APR-MRSR01-SS-06-01 was relocated as the planned location was ponded at the time of the field visit.
- Sample APR-MRSR06-SS-06-06 was relocated from planned location to a location adjacent to Mk106 5lb. practice bomb debris. The SVT did not find

evidence (such as MD, stained soil, stressed vegetation) warranting the collection of a sample at the proposed location.

- Two discretionary samples proposed for collection within *MRS R09-North Restricted Use Area* or *MRS R10-Central Restricted Use Area* were relocated as the SVT did not find additional evidence (such as MD, stained soil, stressed vegetation) warranting the collection of additional samples within these MRSs. One discretionary sample (APR-MRSR06-SS-06-16) was collected within a crater containing AN-M50 Incendiary Bomb debris located within *MRS R06 – Range XIX – Position Firing Course*. One discretionary sample (APR-MRSR06-SS-06-14) was collected from the target center of *MRS R08 Area Bombing Target*, adjacent to previously found M38A2 practice bomb debris.
- Sample APR-MRSR03-SS-06-05 was moved approximately 400 feet from the planned location due to the presence of livestock. The purpose and intent of the samples was maintained.
- Two ambient surface soil samples (APR-RL-SS-06-17 and APR-RL-SS-06-19) were relocated due to difficulty of obtaining access to the planned location properties. The purpose and intent of the samples was maintained.
- Several samples were held on ice until shipment, as detailed in the daily field reports included in Appendix D.

**Table 3.1
Sampling Rationale
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

Sample ID	Sample Coordinates		Media	Analysis	Munitions (Source)	Rationale
	Longitude	Latitude				
APR-MRSM01-SW-01	-81.3780	27.6643	Surface Water	Total Explosives, Selected Metals	Fuze, Bomb, AN-M103; Fuze, Bomb, AN-M101A2 ^(CDE)	Sample collected approximately 20 feet downstream of the bridge crossing Arbuckle Creek to evaluate environmental risk associated with the <i>MRS M01-Arbuckle Creek Fuze Disposal Area</i> .
APR-MRSM01-SED-01	-81.3780	27.6643	Sediment	Total Explosives, Selected Metals	Fuze, Bomb, AN-M103; Fuze, Bomb, AN-M101A2 ^(CDE)	Sample collected approximately 20 feet downstream of the bridge crossing Arbuckle Creek to evaluate environmental risk associated with the <i>MRS M01-Arbuckle Creek Fuze Disposal Area</i> .
APR-MRSR01-SS-06-01	-81.0882	27.5795	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R01-Target XI-Land Skip Bombing Target</i> .
APR-MRSR01-SS-06-02	-81.0937	27.5840	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected within <i>MRS R01-Target XI-Land Skip Bombing Target</i> near munitions debris pile (originating from M38A2) identified during 1996 ASR Field Visit
APR-MRSR02-SS-06-03	-81.0309	27.5648	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R02-Target XII-Combination Bombing and Gunnery Range</i>
APR-MRSR03-SS-06-04	-80.9784	27.5065	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in <i>MRS R03-Range XII- Position Firing Course (PFC)</i> , possible gunnery target area.
APR-MRSR03-SS-06-05	-80.9474	27.5071	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in <i>MRS R03-Range XII-PFC</i> , possible gunnery target area.
APR-MRSR04-SS-06-06	-81.0127	27.6243	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R04-Target XIII-Practice Bombing Target</i> ; target center consisted of a circular mound approximately 50 feet circumference covered within thick vegetation and littered with bomb debris originating from M38A2 practice bombs.

**Table 3.1
Sampling Rationale
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

Sample ID	Sample Coordinates		Media	Analysis	Munitions (Source)	Rationale
	Longitude	Latitude				
APR-MRSR05-SS-06-07	-81.0649	27.4737	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R05-Target XIV-Practice Bombing Target</i>
APR-MRSR06-SS-06-08	-81.1100	27.5312	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in <i>MRS R06-Range XIX- PFC</i> , possible gunnery target area.
APR-MRSR06-SS-06-09	-81.0681	27.5468	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in <i>MRS R06-Range XIX- PFC</i> , possible gunnery target area.
APR-MRSR03-SS-06-10	-81.0186	27.5390	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Historical maps in 1996 ASR suggest a practice bomb target was located within the <i>MRS R03-Range XII- PFC</i> . Sample collected at target center.
APR-MRSR07-SS-06-11	-80.8901	27.5150	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R07-Target XV-Practice Bombing Target</i>
APR-MRSR08-SS-06-12	-81.0551	27.6038	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected at target center of <i>MRS R08-Area Bombing Target</i>
APR-MRSR09-SS-06-13	-81.0773	27.6211	Surface Soil	Total Explosives, Selected Metals plus Iron	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in center of <i>MRS R09-North Restricted Use Area</i> .

**Table 3.1
Sampling Rationale
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

Sample ID	Sample Coordinates		Media	Analysis	Munitions (Source)	Rationale
	Longitude	Latitude				
APR-MRSR08-SS-06-14	-81.0556	27.6064	Surface Soil	Total Explosives, Selected Metals plus Iron	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Discretionary sample collected within target center of <i>MRS R08- Area Bombing Target</i> , adjacent to previously found M38A2 Practice Bomb debris.
APR-MRSR10-SS-06-15	-81.0940	27.5490	Surface Soil	Total Explosives, Selected Metals plus Iron	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in center of <i>MRS R10-Central Restricted Use Area</i> .
APR-MRSR06-SS-06-16	-81.0682	27.5494	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Discretionary sample collected within <i>MRS R06- Range XIX- PFC</i> within crater containing AN-M50 Incendiary Bomb debris.
APR-RL-SS-06-17	-81.0225	27.5795	Surface Soil	Total Explosives, Selected Metals	None	Ambient sample collected outside MRSs, but within FUDS boundary, to establish background metals concentrations in surface soil
APR-RL-SS-06-18	-81.0801	27.6425	Surface Soil	Total Explosives, Selected Metals	None	Ambient sample collected outside MRSs, but within FUDS boundary, to establish background metals concentrations in surface soil
APR-RL-SS-06-19	-80.8977	27.5306	Surface Soil	Total Explosives, Selected Metals	None	Ambient sample collected outside MRSs, but within FUDS boundary, to establish background metals concentrations in surface soil
APR-MRSR06-SS-06-20	-81.1644	27.5421	Surface Soil	Total Explosives, Selected Metals	50 Cal. Machine Gun ^(CDE) ; Bomb, 100-lb, practice, M38A2 ^(CDE) ; Bomb, 100-lb, practice, M85 ^(CE) ; Bomb, 250-lb., GP, AN-M57 ^(BEF) ; Bomb, 250-lb., Target ID, M89 & M90 ^(BEF) ; Signal, M1A1 ^(C) ; Signal, M3 & M5 ^(H) ; Bomb, 4lb, Incendiary, AN-M50 ^(E) ; Flare, illuminating, Mk4, Mk5, & Mk10 ^(ADG) ; Flare, airport, M8 ^(ADG)	Sample collected in location of previously discovered Mk106 5lb. practice bomb debris.
APR-RL-GW-01	-81.0427	27.5842	Groundwater	Total Explosives, Selected Metals	None	Groundwater sample collected from Kissimmee Prairie Preserve State Park water well to evaluate environmental risk. This well provides drinking water to the offices and campground.

Source: **A**- Private account, unconfirmed. **B**-EOD response. **C**-ASR (USACE 1996). **D**-ASR Supplement (USACE 2004). **E**-Field findings. **F**-Speculation based on incomplete records; munitions type not verified. 250-lb. bomb "live, not practice" reported destroyed on-site by AVON UXO (KPPSP internal memorandum 3/23/99). **G**-Speculation based on incomplete records; munitions type not verified. ASR Supplement RAC scoring states CEHNC "safety personnel have personal knowledge of flares being found on the range" (USACE2004). **H**-Typically used with M38A2.

CHAPTER 4 MEC FINDINGS

4.1 GENERAL INFORMATION

4.1.1 Based on a preliminary assessment of the FUDS eligible sites within USAF Avon Park Range, it was determined that this site potentially had MEC/MD on the surface or directly under the surface. As a result, QR was conducted. This chapter details the overall DQOs, MEC history, and inspection activities for the twelve MRSs.

4.1.2 The primary task of the SI was to assess the presence of MEC, MD, and MC. The field visit to USAF Avon Park Range took place from May 5th to May 10th and May 12th, 2008. To assess the presence of MEC/MD, the field team conducted QR within the FUDS boundaries of the former range for a total of approximately 42 miles. Site QR consisted of visual reconnaissance of the site surface to identify indicators of suspect areas, including earthen berms, distressed vegetation, stained soil, ground scars or craters, target remnants, and visible metallic debris.

4.1.3 QR was primarily conducted along the routes prescribed in the SS-WP Addendum (Parsons, 2008b). The team recorded field observations if debris or unique site features or visual indicators were observed or if a sample was collected. Additionally, observations were recorded when there was a change in terrain, when roads or other barriers were encountered, or if there had been no variations since the last observation (approximately 15 minutes of no change). Figures 4.1 and 4.2 show the QR routes and observation locations. The observation location numbers correspond to the photo station numbers documented in the photo documentation log (Appendix E). The QR route was not limited to the proposed path depicted in the SS-WP Addendum, but was determined in the field by the field team leader (FTL) based on considerations such as location, site size and complexity, vegetation, professional judgment, and areas of predetermined focus (Parsons, 2005). Table 4.1 presents the potential MEC anticipated to be present at the site based on the ASR and ASR Supplement (USACE 1996, 2004b). The potential constituents of the supposed MEC are also listed in this table. The MEC CSM and conceptual site exposure model (CSEM) are included in Appendix J.

4.1.4 The *MRS R11 Lake Kissimmee Water Bombing Target* was not inspected during the 2008 SI, as discussed during the December 2007 TPP meeting. The area within this MRS has likely been demucked and the area around the structure located down gradient of the MRS has been demucked and dredged during construction.

Table 4.1
Chemical Composition of MEC and Potential Munitions Constituents
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida

General Munitions Type	Type/Model	Case Composition	Filler	Potential Constituent
Bomb, 250-lb., GP ^{ABC}	AN-M57	Steel	Amatol OR Tritonal OR TNT	Ammonium Nitrate, Iron, TNT (Trinitrotoluene) OR Flaked Aluminum, Iron, TNT (Trinitrotoluene) OR Iron, TNT (Trinitrotoluene)
Bomb, 250-lb., Target ID ^{ABC}	M89 M90	Steel	Black Powder, Pyrotechnic Mixture (M89 = 61; M103 non-delay candles) (M90 = 57; M103 non-delay candles, 2 exploding M105 one-minute and 2 exploding M105 two-minute candles)	Aluminum, Barium Nitrate, Hexachlorobenzene, Iron, Magnesium, Potassium Perchlorate, Sodium Oxalate, Strontium Nitrate
Bomb, 100-lb, practice ^{BDEFN}	M38A2	Steel	Sand	Iron
Bomb, 100-lb, practice ^{BDFN}	M85	Reinforced Concrete	None	Iron
Bomb, 4lb, Incendiary ^B	AN-M50	Steel (Cadmium Coating)	Magnesium, Thermite (TH3), Bursting Charge, First Fire Mixture	Aluminum, Barium Nitrate, Cadmium, Iron, Magnesium, Potassium Nitrate, Sulfur

Table 4.1
Chemical Composition of MEC and Potential Munitions Constituents
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida

General Munitions Type	Type/Model	Case Composition	Filler	Potential Constituent
Charge, Spotting, Bomb DGH	M1A1	Steel	Black Powder Smokeless Powder Primer Mix	Antimony Sulfide, Dinitrotoluene, Diphenylamine, Iron, Lead Styphnate, Nitrocellulose, Pentaerythritoltetranitrate, Potassium Nitrate, Tetracene
Charge, Spotting, Bomb GH	M3	Steel	Black Powder Dark Smoke Composition Priming Cap Composition	Antimony Sulfide, Dinitrotoluene, Diphenylamine, Iron, Lead Styphnate, Magnesium, Nitrocellulose, Pentaerythritoltetranitrate, Potassium, Potassium Nitrate, Tetracene
Charge, Spotting, Bomb GH	M5	Glass	FS smoke mixture (Sulfur- trioxide chlorosulfonic acid solution)	N/A ^(L)
Fuze, bomb, tail ^{BDEI}	AN-M101A2	Steel	Black Powder, Primer Mixture, TNT (Trinitrotoluene)	Barium Nitrate, Iron, Lead Azide, Lead Thiocyanate, Potassium Chlorate, Potassium Nitrate, Tetryl, TNT (Trinitrotoluene)
Fuze, bomb, nose ^{BDE}	AN-M103	Steel	Tetryl, Primer Mixture	Barium Nitrate, Iron, Lead Thiocyanate, Potassium Chlorate, Tetryl, TNT (Trinitrotoluene)

**Table 4.1
Chemical Composition of MEC and Potential Munitions Constituents
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida**

General Munitions Type	Type/Model	Case Composition	Filler	Potential Constituent
Cartridge, 22 caliber, Small Arms ^E	General	Brass, steel, aluminum	Smokeless powder, primer mix	Lead, antimony, tetrazene, nitrocellulose ^O , copper, nitroglycerin ^O , iron, diphenylamine ^O , barium, potassium Nitrate, PETN
Small Arms, Cartridge, .30 Caliber ^E	M1906 Ball M1917 Tracer 1918 Armor Piercing	Brass, Steel, Aluminum	Lead antimony Single- or double-base powder Primer Composition Tracer Composition	Lead, antimony, barium nitrate, barium peroxide, copper, zinc, nitrocellulose ^O , iron, lead azide, lead thiocyanate, potassium chlorate, PETN (Pentaerythritol Tetranitrate), aluminum, magnesium, nitroglycerin ^O , nickel, dinitrotoluene ^O , diphenylamine, zinc
Cartridge, .38 caliber, Small Arms ^E	General	Brass, steel, aluminum	Smokeless powder, primer mix	Lead, antimony, aluminum, PETN (Pentaerythritol Tetranitrate), tetrazene, nitrocellulose ^O , diphenylamine ^O , copper ^O , nitroglycerin ^O , iron, potassium nitrate, barium nitrate,

**Table 4.1
Chemical Composition of MEC and Potential Munitions Constituents
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida**

General Munitions Type	Type/Model	Case Composition	Filler	Potential Constituent
Cartridge, .45 caliber, Small Arms ^E	General	Brass, steel, aluminum	Smokeless powder, primer mix	Lead, barium nitrate, barium peroxide, antimony, lead styphanate, PETN (Pentaerythritol Tetranitrate),magnesium, tetrazene, nitrocellulose ^O , diphenylamine ^O , strontium peroxide, calcium resinate, barium nitrate, dinitrotoluene ^O , potassium chlorate, potassium nitrate, potassium sulfide, copper, nitroglycerin ^O , iron, nickel, zinc
Cartridge, .50- Cal. Machine Gun ^{BDE}	M2 Ball M2 Armor Piercing (AP) M1 Tracer M10 Tracer M17 Tracer M21 Tracer M1 Incendiary M23 Incendiary M1 Blank	Brass, steel, aluminum	Lead antimony, Tungsten chrome steel, Tracer Composition, Incendiary Composition, Single based propellant, Double based propellant, Primer composition	Calcium, Copper, Iron, Strontium, Lead, Magnesium, Molybdenum, Antimony, Potassium, Perchlorate, Nitroglycerin, Nitrocellulose, Diphenylamine, Zinc
Flare, Aircraft, Parachute ^{EJK}	Mk4	Chipboard w/ Zinc Alloy Sheathing	Illumination Mix, Black Powder	Magnesium Powder, Sodium Oxilate, Barium Nitrate, Potassium Nitrate, Zinc

Table 4.1
Chemical Composition of MEC and Potential Munitions Constituents
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida

General Munitions Type	Type/Model	Case Composition	Filler	Potential Constituent
Flare, Aircraft, Parachute ^{EJK}	Mk5	Chipboard w/ Zinc Alloy Sheathing	Illumination Mixture, Black Powder, Primer Mixture	Antimony Sulfide, Barium Nitrate, Carborundum, Lead Azide, Magnesium Powder, Potassium Chlorate, Potassium Nitrate, Zinc
Flare, Aircraft, Parachute ^{EJK}	Mk10	Chipboard w/ Zinc Alloy Sheathing	Illumination Mixture, Black Powder, Primer Mixture	Antimony Sulfide, Barium Nitrate, Carborundum, Lead Azide, Magnesium Powder, Potassium Chlorate, Potassium Nitrate, Zinc
Flare, Aircraft, Parachute ^{EJK}	Mk8	Chipboard w/ Zinc Alloy Sheathing	Illumination Mix, Black Powder	Barium Nitrate, Sodium Oxilate, Magnesium Powder, Aluminum Powder, Potassium Nitrate

Summary of potential constituents: Aluminum, Amatol, Ammonium Nitrate, Antimony, Antimony Sulfide, Barium, Barium Nitrate, Calcium, Carborundum, Chromium, Copper, Dibutylphthalate, Dinitrotoluene, Diphenylamine, Hexachlorobenzene, Iron, Lead, Lead Azide, Lead Styphnate, Lead Thiocyanate, Magnesium, Molybdenum, Nitrocellulose, Nitroglycerin, Pentaerythritoltetranitrate, Perchlorate, Potassium, Potassium Chlorate, Potassium Nitrate, Potassium Perchlorate, Red Phosphorous^(M), Sodium Oxalate, Strontium, Strontium Nitrate, TNT, Tetracene, Tetryl, Titanium Tetrachloride, Tungsten, Zinc.

Source/Note: A-EOD response. B-Field findings. C-Speculation based on incomplete records; munitions type not verified. 250-lb. bomb "live, not practice" reported destroyed on-site by UXO contractor (KPPSP internal memorandum 3/23/99). D-ASR (USACE 1996). E-ASR Supplement (USACE 2004). F-May be used with M1A1, M3, and/or M5 spotting charges. G-Typically used with M38A2 practice bomb. H-Typically used with M85 practice bomb. I-Information provided for M100 series. J- Private account, unconfirmed. K-Speculation based on incomplete records; munitions type not verified. ASR Supplement RAC scoring states CEHNC "safety personnel have personal knowledge of flares being found on the range" (USACE2004). L-Chlorosulfonic acid reacts violently with water evolving heat and large quantities of white fumes of hydrochloric acid and sulfuric acid. Sulfur-trioxide reacts with the moisture in the air to produce sulfuric acid mist. The mixture of these two compounds does not have any potential MC constituents. M-There is no test for Red Phosphorous currently. N-Practice bombs do not pose a safety hazard unless a spotting charge is present and remains intact. O- Items are for the propulsion portion of the annotated munitions item.

4.1.5 As shown in Appendix E, the SVT noted discrete field observations throughout the course of the SI, including detail on topography, soil color, drainage features, the presence of any barriers, and indications of surface MD. The QR involved using a Schonstedt GA-92XTi magnetometer for safety purposes. The SVT walked to the sampling locations and collected surface soil, sediment, surface water, and groundwater samples. Pertinent field observations are summarized in Table 4.2. Appendix D includes related field forms.

Table 4.2
Summary of Qualitative Reconnaissance Observations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

MRS	MEC	Munitions Debris	Munitions-Related Features
<i>MRS M01 Arbuckle Creek Fuze Disposal Area</i>	None	None	None
<i>MRS R01 Target XI – Land Skip Bombing Target</i>	None	.50- cal casing and M38A2 Practice Bomb debris	None
<i>MRS R02 Target XII – Combination BGR</i>	None	None	None
<i>MRS R03 Range XII – Position Firing Course</i>	None	None	None
<i>MRS R04 Target XIII – Practice Bombing Target</i>	None	M38A2 Practice Bomb debris	At target center, circular mound approximately 50 feet in circumference, covered in thick vegetation
<i>MRS R05 Target XIV – Practice Bombing Target</i>	None	None	None
<i>MRS R06 Range XIX – Position Firing Course</i>	None	AN-M50 Incendiary Bomb debris	None

Table 4.2
Summary of Qualitative Reconnaissance Observations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

MRS	MEC	Munitions Debris	Munitions-Related Features
<i>MRS R07 Target XV –Practice Bombing Target</i>	None	None	None
<i>MRS R08 Area Bombing Target</i>	None	M38A2 Practice Bomb debris	None
<i>MRS R09 North Restricted Use Area</i>	None	None	None
<i>MRS R10 Central Restricted Use Area</i>	None	Approximately 200 .50- caliber casings and one .50- caliber projectile	None

4.1.6 Seventeen biased surface soil samples, one biased surface water sample, and one biased sediment sample were collected in areas believed to be most likely impacted by disposal or munitions-related training activities. Three ambient surface soil samples were collected in areas believed to be least likely impacted by training activities, to represent ambient site conditions. One groundwater sample was collected from remaining land (within the FUDS boundary, but outside MRS boundaries). Sample locations are shown on Figures 5.1 and 5.2. Sampling results are presented in Chapter 5.

4.2 DATA QUALITY OBJECTIVES

4.2.1 Introduction

4.2.1.1 DQOs are qualitative and quantitative statements that clarify study objectives and specify the type and quality of the data necessary to support decisions. The development of DQOs for a specific site takes into account factors that determine whether the quality and quantity of data are adequate for project needs, such as data collection, uses, types, and needs. While developing these DQOs in accordance with the process presented in Chapter 3, paragraph 3.1.2 of the PWP (Parsons, 2005), Parsons followed the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001 (USEPA, 2006).

4.2.1.2 The goal of the TPP process is to achieve stakeholder, USACE, and applicable state and federal regulatory concurrence with the DQOs for a given site. The TPP Team approved the USAF Avon Park Range DQOs at the TPP meeting on

December 4, 2007. Appendix B presents TPP documentation. Tables 4.3 through 4.6 present the DQO worksheets. *All the DQOs for the MRSs have been met.*

4.2.1.3 As stated in Subchapter 1.2, Paragraph 1.2.4 of this SI Report, data must be sufficient to do the following: 1) determine the potential need for a removal action; 2) enable HRS scoring by USEPA; 3) characterize the release for initiation of RI/FS, if necessary; and 4) complete the MRSPP.

4.2.1.4 DQOs cover four project objectives that SI data must satisfy: 1) evaluate potential presence of MEC; 2) evaluate potential presence of MC; 3) collect data needed to complete MRSPP scoring sheets; and 4) collect information for HRS scoring.

4.2.2 Munitions and Explosives of Concern DQO

The MEC DQO was achieved by evaluating potential presence of MEC at USAF Avon Park Range. The QR team searched for visual evidence of MEC/MD including non-direct evidence of range activity such as the visual indicators listed in paragraph 4.1.2. *No MEC was visually identified.* Several MD items were noted within five of the MRSs. A summary of MD findings are included in Table 4.2. Appendix D contains the daily field reports detailing the specific observations by the SVT. Appendix E contains photograph documentation of observations made by the SVT.

4.2.3 Munitions Constituents DQO

The MC DQO was achieved by evaluating potential presence of MC on USAF Avon Park Range. The TPP Team evaluated the composition of the munitions (and fillers) disposed of or used on the range and developed a list of compounds/analytes for sample analysis. A summary of the MC known to occur in the MEC known or suspected used or disposed of at USAF Avon Park Range is provided in Table 4.1. Chapter 5 presents the MC sampling results.

4.2.4 Munitions Response Site Prioritization Protocol DQO

The MRSPP DQO was achieved by obtaining sufficient information to complete the MRSPP scoring sheets. Specific input data were collected, and the three modules for the MRSPP were populated as part of the SI. The scoring sheets for the MRSPP are included in Appendix K.

4.2.5 Hazard Ranking System DQO

The HRS DQO was achieved by including information in the SI report necessary for the USEPA to populate the HRS score sheets. Source documents for the HRS information include the INPR, ASR, and ASR Supplement documents, as well as the MC sampling results reported in Chapter 5 and information from local and state agencies regarding population, groundwater well users, and drinking water well use.

4.3 MRS M01 ARBUCKLE CREEK FUZE DISPOSAL AREA

4.3.1 Historical MEC Information

MRS M01 Arbuckle Creek Fuze Disposal Area, consisting of one acre, is located in Arbuckle Creek, below the control structure of Lake Arbuckle. In 1945, approximately

200 live bomb fuzes (AN-M103 and potentially AN-M101A2) were dumped into the creek from the bridge crossing the creek. On May 25, 1946, a 3-year old boy was killed while playing with a fuze found in Arbuckle Creek. On November 9, 1946, a child was killed and several others injured while playing with a fuze found beneath a former base housing unit. As a result of these incidents, a clearance was conducted covering a “large portion of the eastern part of this facility” in 1949. However, the associated certificate did not specifically address the Arbuckle Creek area, indicating the Arbuckle Creek area may not have been addressed in this clearance. The 1996 ASR inspection team visited this MRS and noted “it was impossible to determine if any fuzes remained submerged” (USACE, 1996). Table 4.1 lists the fillers and constituents associated with the munitions disposed of at the *MRS M01 Arbuckle Creek Fuze Disposal Area* to provide a more complete picture of the potential contamination on site.

4.3.2 Inspection Activities

One biased sediment sample and one biased surface water sample was collected from this MRS on May 6th, 2008. Neither MEC nor MD were found within the *MRS M01 Arbuckle Creek Fuze Disposal Area* during the 2008 SI field visit. Figure 4.1 illustrates the observation locations. Appendix E contains photo documentation of the findings. The sample locations are shown on Figure 5.1.

4.4 MRS R01 TARGET XI – LAND SKIP BOMBING TARGET

4.4.1 Historical MEC Information

The *MRS R01 Target XI – Land Skip Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. A pile of MD originating from M38A2 and M85 practice bombs was identified during the 1996 ASR site visit. Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004b), and the 1996 and 2008 field visits, the munitions known or suspected to have been used within the *MRS R01 Target XI – Land Skip Bombing Target* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Bomb, 100 lb., Practice, M85; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R01 Target XI – Land Skip Bombing Target* to provide a more complete picture of the potential contamination on site.

4.4.2 Inspection Activities

Two biased surface soil samples were collected from this MRS on May 5th, 2008. Three field team members completed QR around sample locations and target center. Debris originating from a M38A2 practice bomb and a .50-caliber casing was found within the *MRS R01 Target XI – Land Skip Bombing Target* during the May 2008 site visit. No target structures, craters, stressed vegetation, or other visual indicators were noted. Figure 4.2 illustrates the completed QR path as well as observation locations.

Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.5 MRS R02 TARGET XII – COMBINATION BOMBING AND GUNNERY RANGE

4.5.1 Historical MEC Information

The *MRS R02 Target XII – Combination BGR* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. No MEC or MD were found within the *MRS R02 Target XII – Combination BGR* during the January 1996 ASR site visit. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R02 Target XII – Combination BGR* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R02 Target XII – Combination BGR* to provide a more complete picture of the potential contamination on site.

4.5.2 Inspection Activities

One biased surface soil sample was collected from this MRS on May 6th, 2008. Three field team members completed QR around sample location and MRS. No MEC or MD were found within this MRS during the 2008 SI field visit. No target structures, craters, stressed vegetation, or other visual indicators were noted. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.6 MRS R03 RANGE XII – POSITION FIRING COURSE

4.6.1 Historical MEC Information

The *MRS R03 Range XII – Position Firing Course* is comprised of 20,252 land acres. The *MRS R03 Range XII – Position Firing Course* target area consisted of eight scattered targets, which were fired upon by the side machine guns on B-17 aircraft. An additional practice bombing target location was identified in the 1996 ASR within the boundaries of the MRS, but was not designated as an MRS. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R03 Range XII – Position Firing Course* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and

constituents associated with the munitions known or suspected used at the *MRS R03 Range XII – Position Firing Course* to provide a more complete picture of the potential contamination on site.

4.6.2 Inspection Activities

Three biased surface soil samples were collected from this MRS on May 5th, May 9th, and May 12th, 2008. Three field team members completed QR around sample location and MRS. No MEC or MD were found within this MRS, including within the aforementioned non-MRS practice bombing target. No target structures, craters, stressed vegetation, or other visual indicators were noted. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.7 MRS R04 TARGET XIII – PRACTICE BOMBING TARGET

4.7.1 Historical MEC Information

The *MRS R04 Target XIII – Practice Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. The 1996 ASR investigation team conducted an aerial survey of this MRS, during which they noted three concrete footings they attributed to the likely remnants of an observation tower. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R04 Target XIII – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R04 Target XIII – Practice Bombing Target* to provide a more complete picture of the potential contamination on site.

4.7.2 Inspection Activities

One biased surface soil sample was collected from the *MRS R04 Target XIII – Practice Bombing Target* on May 9th, 2008. Three field team members completed QR around sample location and MRS. A controlled burn was conducted prior to the May 2008 site visit. At the target center, the SVT noted a circular mound approximately 50 feet in circumference, which was covered in thick vegetation. The center of the former target was littered with debris originating from M38A2 practice bombs during the May 2008 SI site visit. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.8 MRS R05 TARGET XIV – PRACTICE BOMBING TARGET

4.8.1 Historical MEC Information

The *MRS R05 Target XIV – Practice Bombing Target* is comprised of 649 land acres. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R05 Target XIV – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R05 Target XIV – Practice Bombing Target* to provide a more complete picture of the potential contamination on site.

4.8.2 Inspection Activities

One biased surface soil sample was collected from this MRS on May 9th, 2008. Three field team members completed QR around sample location and MRS. No MEC or MD were found within the *MRS R05 Target XIV – Practice Bombing Target* during the May 2008 site visit. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.9 MRS R06 RANGE XIX – POSITION FIRING COURSE

4.9.1 Historical MEC Information

The *MRS R06 Range XIX – Position Firing Course* is comprised of 29,186 land acres. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. A live 250-lb. bomb (Bomb, 250 lb., GP, AN-M57) was located within this MRS on the Kissimmee Prairie Preserve State Park in 1999; the item was determined to be “live not a practice round” and was detonated in place by Moody EOD and McDill EOD. The narrative for the disposal of this item is included in Appendix L. Vietnam-era MD has been located within this MRS, and documented using GPS and photography. Photographs of these items, provided by Kissimmee Prairie Preserve State Park, are included in Appendix L. The first two of the items shown (“Rocket Launcher” or Launcher, Rocket, 2.75”, LAU 68 B/A; and “Small Bomb” or Bomb, 5lb., Practice, Mk106) are of Vietnam-era, are not known to used on this site during training, and are considered anomalous findings, likely originating from the adjacent active range. Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004b), historical findings, and the 2008 field visit, the munitions known or suspected to have been used within the *MRS R06 Range XIX – Position Firing Course* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; Bomb, 250 lb., GP, AN-M57; Bomb, 4-lb. Incendiary, AN-M50; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC

as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R06 Range XIX – Position Firing Course* to provide a more complete picture of the potential contamination on site.

4.9.2 Inspection Activities

Three biased surface soil samples were collected from this MRS on May 8th and May 12th, 2008. The SVT noted that the northeastern part of the MRS had been control burned on May 5th, 2008, three days prior to their first visit of the area. Three field team members completed QR around the sample locations and MRS. Several pieces of AN-M50 Incendiary Bombs were found. The SVT also observed the rocket pod and Mk106 5lb. practice bomb previously found by State Park employees. As stated above, both of these items are of Vietnam-era, are not known or suspected to have been used on this site during training, and are considered anomalous findings, likely originating from the adjacent active range. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.10 MRS R07 TARGET XV – PRACTICE BOMBING TARGET

4.10.1 Historical MEC Information

The *MRS R07 Target XV – Practice Bombing Target* is comprised of 649 land acres. The 1996 ASR investigation team conducted a ground survey of this MRS, but did not find any ordnance. The site had been cultivated and was used for cattle grazing at that time. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R07 Target XV – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R07 Target XV – Practice Bombing Target* to provide a more complete picture of the potential contamination on site.

4.10.2 Inspection Activities

One biased surface soil sample was collected from this MRS on May 10th, 2008. Three field team members completed QR around the sample locations and MRS. The SVT did not observe MEC, MD, or target remnants. The owner of the farm reported to the team that he has never found any MD or MEC on the property (See Appendix D for daily field report). He previously removed what he referred to as “footing for a control tower.” Approximately one foot of soil has been removed for sod and the area has been leveled. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.11 MRS R08 AREA BOMBING TARGET

4.11.1 Historical MEC Information

The *MRS R08 Area Bombing Target* is comprised of 649 land acres. The 1996 ASR investigation team conducted a ground and aerial survey of the *MRS R08 Area Bombing Target*. At that time, remnants of the limestone target outline were visible. The team observed the remains of a scrap pile located at the center of the target. The remains included M38A2 practice bomb components. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R08 Area Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R08 Area Bombing Target* to provide a more complete picture of the potential contamination on site.

4.11.2 Inspection Activities

Two biased surface soil samples were collected from this MRS on May 7th and May 9th, 2008. Three field team members completed QR around the sample locations and MRS. The SVT also observed the aforementioned pile of debris, but did not find any MEC. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.12 MRS R09 NORTH RESTRICTED USE AREA

4.12.1 Historical MEC Information

The *MRS R09 North Restricted Use Area* is comprised of 2,785 land acres located within the Kissimmee Prairie Preserve State Park. A 1952 deed certificate suggested that the 320 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 320-acre area in question. It is unclear whether the 1996 ASR investigation team conducted an aerial survey of the *MRS R09 North Restricted Use Area*. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R09 North Restricted Use Area* are: Small Arms, General and .50- caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R09 North Restricted Use Area* to provide a more complete picture of the potential contamination on site.

4.12.2 Inspection Activities

One biased surface soil sample was collected from this MRS on May 7th, 2008. Three field team members completed QR around the sample locations and MRS. The SVT found it challenging to navigate through this MRS as the palmettos have grown to five to six feet high due to lack of controlled burns. They did not find any MD or MEC. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.13 MRS R10 CENTRAL RESTRICTED USE AREA

4.13.1 Historical MEC Information

The *MRS R10 Central Restricted Use Area* is comprised of 3,575 land acres located within the Kissimmee Prairie Preserve State Park. The *MRS R06 Range XIX – Position Firing Course* entirely encompasses this MRS. A 1952 deed certificate suggested that the 640 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 640-acre area in question. The 1996 ASR investigation team conducted an aerial survey over a portion of the *MRS R10 Central Restricted Use Area*, but only noted a dried up pond in the area. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R10 Central Restricted Use Area* are: Small Arms, General and .50- caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R10 Central Restricted Use Area* to provide a more complete picture of the potential contamination on site.

4.13.2 Inspection Activities

One biased surface soil sample was collected from this MRS on May 8th, 2008. Three field team members completed QR around the sample locations and MRS. A portion of this MRS was control burned three days prior to the 2008 SI visit to this MRS. The SVT found approximately 200 .50- caliber shell casings and one .50- caliber projectile within this MRS. Figure 4.2 illustrates the completed QR path as well as observation locations. Appendix E contains photo documentation of the range. The sample locations are shown on Figure 5.2.

4.14 MRS R11 LAKE KISSIMMEE WATER BOMBING TARGET

4.14.1 Historical MEC Information

This 649-acre MRS is located entirely within Lake Kissimmee. Lake Kissimmee covers an area of approximately 38,000 acres and is relatively shallow lake with depths

ranging from 4 to 10 feet. The 1996 ASR inspection team conducted an aerial survey over the *MRS R11 Lake Kissimmee Water Bombing Target* within Lake Kissimmee, but noted the subsurface visibility was no better than two feet below surface. They did not observe MEC, MD, or target remnants. Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R11 Lake Kissimmee Water Bombing Target* are: Bomb, 100 lb., Practice, M38A2; and Charge, Spotting, Bomb, M1A1, M3, and M5. However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. Table 4.1 lists the fillers and constituents associated with the munitions known or suspected used at the *MRS R11 Lake Kissimmee Water Bombing Target* to provide a more complete picture of the potential contamination on site.

4.14.2 Inspection Activities

This MRS was not inspected during the 2008 SI, as discussed during the December 2007 TPP meeting. The area within this MRS has likely been subject to muck removal actions and the area around the structure located down gradient of the MRS has been subject to muck removal actions and dredged during construction.

TABLE 4.3

MEC DATA QUALITY OBJECTIVE WORKSHEET

SITE: USAF Avon Park Range; Okeechobee, Osceola, and Polk Counties, FLPROJECT: MMRP Site Inspection / FUDS No. I04FL028701

DQO STATEMENT NUMBER: 1 of 4

DQO Element Number *	DQO Element Description *	Site-Specific DQO Statement	Objective Met? Yes (Y)/No (N)
Intended Data Use(s):			
1	Project Objective(s) Satisfied	Evaluate presence/lack thereof of MEC	Y
Intended Need Requirements:			
2	Data User Perspective(s)	Risk, Remedy	Y
3	Contaminant or Characteristic of Interest	MEC, MD	Y
4	Media of Interest	N/A	N/A
5	Required Sampling Locations or Areas and Depths	<i>MRS M01 Arbuckle Creek Fuze Disposal Area MRS R01 Target XI - Land Skip Bombing Target MRS R02 Target XII - Combination BGR MRS R03 Range XII - Position Firing Course MRS R04 Target XIII - Practice Bombing Target MRS R05 Target XIV - Practice Bombing Target MRS R06 Range XIX - Position Firing Course MRS R07 Target XV - Practice Bombing Target MRS R08 Area Bombing Target MRS R09 North Restricted Use Area MRS R10 Central Restricted Use Area</i>	Y
6	Number of Samples Required	N/A	N/A
7	Reference Concentration of Interest or Other Performance Criteria	TBD	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	Qualitative Reconnaissance (limited)	Y
9	Analytical Method	N/A	N/A

* Refer to EM 200-1-2, Paragraph 4.2.1

**TABLE 4.4
MC DATA QUALITY OBJECTIVE WORKSHEET**

SITE: USAF Avon Park Range; Okeechobee, Osceola, and Polk Counties, FL

PROJECT: MMRP Site Inspection / FUDS No. I04FL028701

DQO STATEMENT NUMBER: 2 of 4

DQO Element Number*	DQO Element Description*	Site-Specific DQO Statement	Objective Met? Yes (Y)/No (N)
Intended Data Use(s):			
1	Project Objective(s) Satisfied	Evaluate presence/lack thereof of MC	Y
Intended Need Requirements:			
2	Data User Perspective(s)	Risk, Remedy	Y
3	Contaminant or Characteristic of Interest	Total Explosives, selected metals.	Y
4	Media of Interest	Surface soil, sediment, surface water, groundwater	Y
5	Required Sampling Locations or Areas and Depths	As determined by the TPP Team, see Figures 5.1 and 5.2. Locations based on bomb target, range configuration, and MEC/MD findings.	Y
6	Number of Samples Required	20 surface soil samples, 1 groundwater samples, 1 surface water sample, 1 sediment sample plus associated QC samples.	Y
7	Reference Concentration of Interest or Other Performance Criteria	Human Health Screening Levels- Soil and Sediment: FAC 62-777 Soil Cleanup Target Levels Direct Exposure Residential and USEPA Regional SLs for Residential Soil; Surface Water: FAC 62-777 Surface Water Criteria and USEPA Regional SLs for Tap Water; Groundwater screening levels: FAC 62-777 Groundwater Criteria. Ecological Screening Levels- as in Tables 4.5a and 4.5b	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	Discrete samples in accordance with the FDEP and TPP Team concurrence	Y
9	Analytical Method	Total Explosives - SW8321A; Selected Metals SW6010B or SW6020.	Y

* Refer to EM 200-1-2, Paragraph 4.2.1

TABLE 4.5
MRSPP DATA QUALITY OBJECTIVE WORKSHEET

Site: USAF Avon Park Range Project: MMRP Site Inspection / FUDS No. I04FL028701 DQO Statement Number: 3 of 4					
Module	Table #	Table Description	Known Data	Current Data Gap	Data Source
Explosive Hazard Evaluation (EHE)	1	Munitions Type	X		Historical Records/Findings
	2	Source of Hazard	X		Historical Maps
	3	Location of Munitions	X		Historical or Field Findings
	4	Ease of Access	X		Field Findings
		Status of Property	X		Historical Records
	6	Population Density	X		U.S. Census Bureau
	7	Population Near Hazard	X		Field Findings
	8	Types of Activities/Structures	X		Regional Zoning
	9	Ecological and/or Cultural Resources	X		State Historic Preservation Office
	10	Determining the EHE	X		Scores from Tables 1 through 9
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration	X		Historical Records/Findings
	12	Sources of CWM	X		Historical Records/Findings
	13	Location of CWM	X		Historical or Field Findings
	14	Ease of Access	X		Field Findings
	15	Status of Property	X		Historical Records
	16	Population Density	X		U.S. Census Bureau
	17	Population Near Hazard	X		Field Findings
	18	Types of Activities/Structures	X		Regional Zoning
	19	Ecological and/or Cultural Resources	X		State Historic Preservation Office
	20	Determining the CHE	X		Scores from Tables 11 through 19

**TABLE 4.5
MRSPP DATA QUALITY OBJECTIVE WORKSHEET**

Site: USAF Avon Park Range Project: MMRP Site Inspection / FUDS No. I04FL028701 DQO Statement Number: 3 of 4					
Module	Table #	Table Description	Known Data	Current Data Gap	Data Source
Health Hazard Evaluation (HHE)	21	Groundwater Data	X		Groundwater Sampling Results
	22	Surface Water - Human Endpoint	X		Surface Water Sampling Results
	23	Sediment - Human Endpoint	X		Sediment Sampling Results
	24	Surface Water - Ecological Endpoint	X		Surface Water Sampling Results
	25	Sediment - Ecological Endpoint	X		Sediment Sampling Results
	26	Surface Soil	X		Surface Soil Sampling Results
	27	Supplemental Contaminant Hazard Factor	X		All MC Sampling Results
	28	Determining the HHE	X		Scores from Tables 21 through 27
	29	MRS Priority	X		Scores from Tables 10, 20, and 28
	A	MRS Background Information	X		DoD Databases

**TABLE 4.6
HRS DATA QUALITY OBJECTIVE WORKSHEET**

Site: USAF Avon Park Range Project: MMRP Site Inspection / FUDS No. I04FL028701 DQO Statement Number: 4 of 4.			
Data Description	Known Data	Current Data Gap	Data Source
Source Type	X		Historical Records/Findings
Estimated Volume or Area	X		Field Findings
Hazardous Substance	X		Constituents of Suspected Munitions
Groundwater Sample Concentration	X		Sample Results
Groundwater Use	X		Well Records/Municipal Data
Surface Water Sample Concentration	X		Sample Results
Surface Water Pathways	X		Field Findings
Soil Sample Concentration	X		Sample Results
Soil Pathways	X		Municipal Data
Sensitive Environments	X		State Historic Preservation Office, US Fish and Wildlife Service, various government agencies
Attractiveness/Accessibility	X		Field Findings/Land Use Records

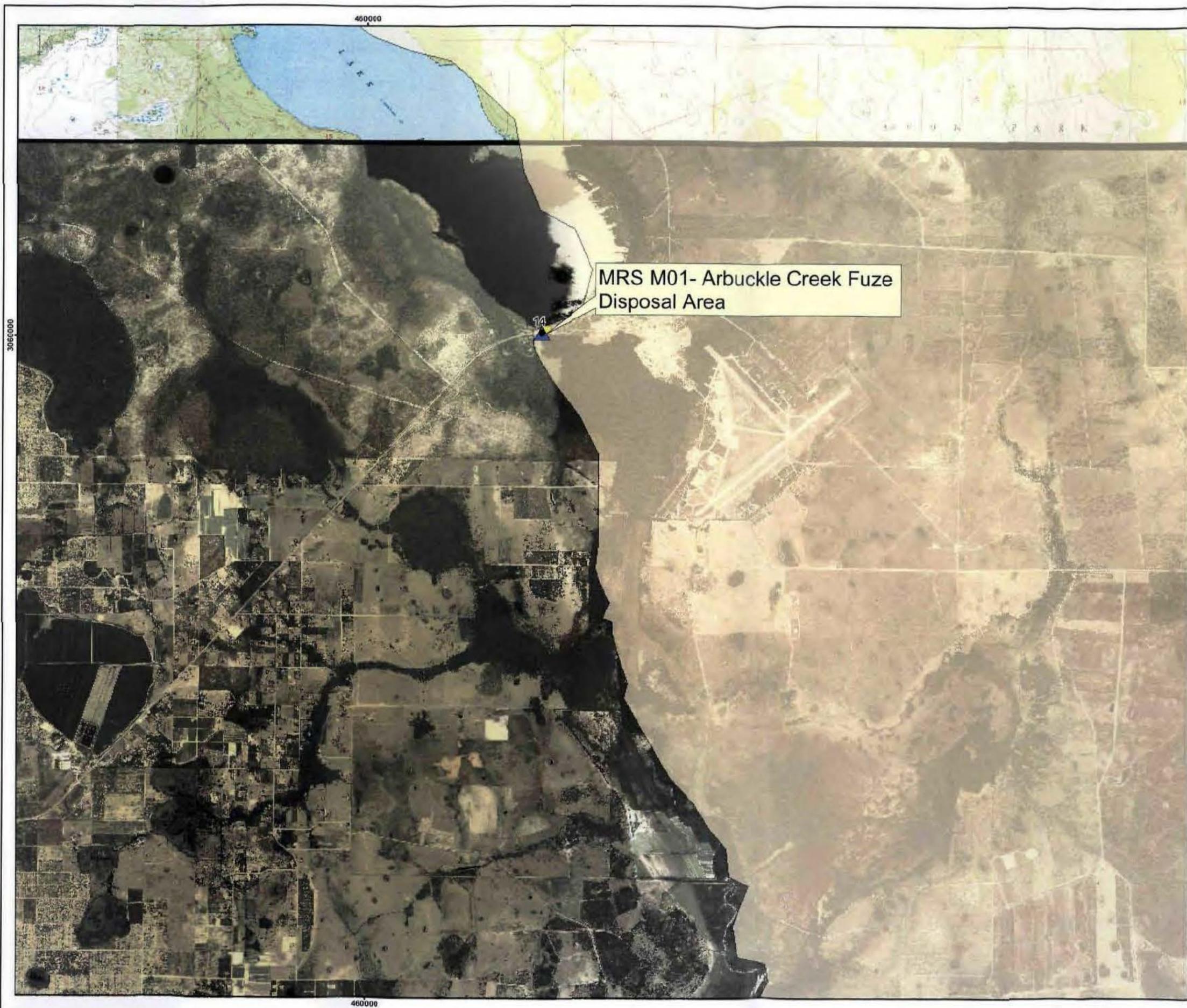


Figure 4.1

**Qualitative Reconnaissance and
Field Observation Locations
West of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**

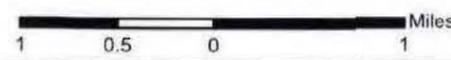
Okeechobee, Osceola, and Polk Counties

Legend

- 14 ● Other Field Observation Location
- ▲ Surface Water/Sediment Sample Location
- MRS M01- Arbuckle Creek Fuze Disposal Area
- Avon Park Air Force Range (active range)



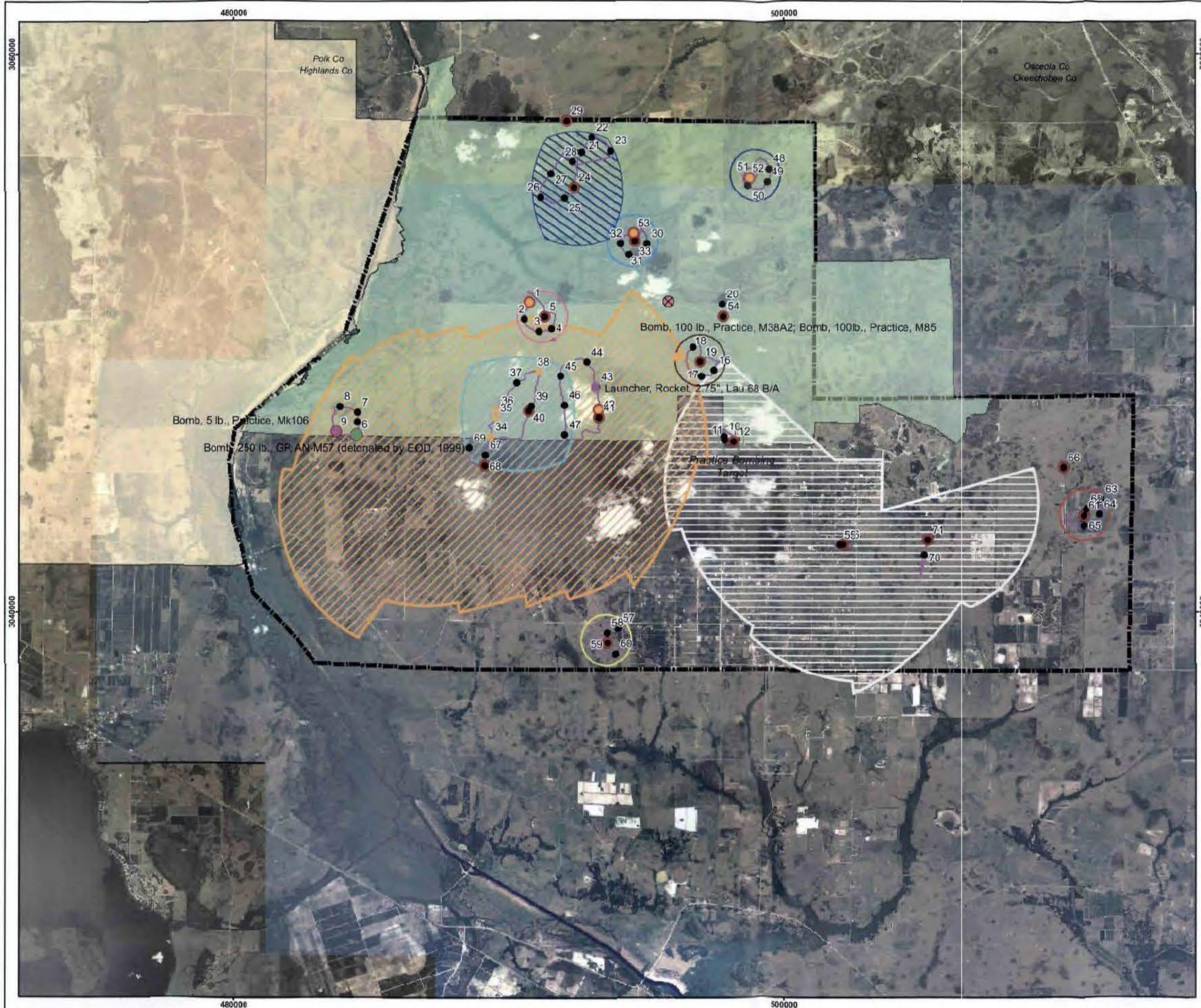
Image: 2006 Orthophoto
Projection: UTM Zone 17 NAD83, Map Units in Meters



PARSONS		U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER	
DESIGNED BY BT	Qualitative Reconnaissance and Field Observation Locations		
DRAWN BY BT			
CHECKED BY DS	SCALE: As Shown	PROJECT NUMBER: 744647.69000	
SUBMITTED BY DS	DATE: October 2008	PAGE NUMBER: 4-23	
	FILE: X:\GIS\Site_inspection_n\Maps\avon_FL\Fig4_1.mxd		

Figure 4.2

Qualitative Reconnaissance and Field Observation Locations East of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701
 Okeechobee, Osceola, and Polk Counties



Legend

- 1 ● Munitions Debris Observation Location
- 2 ● Other Field Observation Location
- Non-WWII Era
- Munitions and Explosives of Concern
- Soil Sample Location
- ⊗ Groundwater Sample Location
- Approximate FUDS Boundary
- Qualitative Reconnaissance Track
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- ▨ MRS R09- North Restricted Use Area
- ▨ MRS R10- Central Restricted Use Area
- ▨ Kissimmee Prairie Preserve State Park
- ▨ Avon Park Air Force Range (active range)



Image: 2006 Orthophoto
 Projection: UTM Zone 17 NAD83, Map Units in Meters



PARSONS		U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER	
DESIGNED BY BT	Qualitative Reconnaissance and Field Observation Locations		
DRAWN BY BT			
CHECKED BY DS	SCALE: As Shown	PROJECT NUMBER 744647.69000	
SUBMITTED BY DS	DATE: October 2008	PAGE NUMBER 4-24	
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CHAPTER 5 MIGRATION/EXPOSURE PATHWAYS AND RECEPTORS

5.1 INTRODUCTION

5.1.1 This chapter of the SI report evaluates the potential for release of MC to the environment based on site-specific conditions. It is necessary to evaluate site-specific conditions and land use to evaluate risks posed to potential receptors under current and future land use scenarios for each MRS. This chapter of the SI report evaluates exposure pathways for groundwater, surface water, soil, and air. The CSEM for the USAF Avon Park Range (Appendix J) summarizes which potential receptor exposure pathways are (or may be) complete and which are (and are likely to remain) incomplete for the MRS. An exposure pathway is not considered to be complete unless all four of the following elements are present (USEPA, 1989). An example regarding a hypothetical groundwater exposure pathway is included.

- *A source of contamination.* For example, a site has known MEC from which MC have leached and contaminated surface soil.
- *An environmental transport and/or exposure medium.* In the example, the MC in soil is mobile and can contaminate groundwater.
- *A point of exposure at which the contaminant can interact with a receptor.* A drinking water well drawing from the contaminated aquifer is at the site.
- *A receptor and a likely route of exposure at the exposure point.* An on-site resident uses groundwater as a source of drinking water.

5.1.2 In the hypothetical example of the resident, all four factors are present and, therefore, the groundwater exposure pathway is complete. If any single factor was not present (for example, MC was not present in soil, or the resident used drinking water from another source), the pathway would be incomplete.

5.2 GENERAL INFORMATION

5.2.1 Regional Geologic Setting

5.2.1.1 The USAF Avon Park Range FUDS is located in Okeechobee, Osceola, and Polk Counties in central Florida. The FUDS is located approximately 70 straight-line miles south-southeast of Orlando, Florida. The information below regarding the geology and soils associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE, 1996). The USAF Avon Park Range is located in the Floridan section of the Coastal Plain physiographic Province. This section is further divided into the Central Highlands province. The site occurs on the Osceola Plain. The Osceola Plain, a marine terrace, is bounded on the west by the Lake Wales Ridge and on the east by lower lying marine scarps. Local relief is generally low (Ford and others, 1990).

5.2.1.2 The west-central peninsula of Florida consists of igneous and metamorphic basement rocks overlain by 4,000 feet of sedimentary rocks, principally limestones. These geologic units and the description of their general lithology are summarized in Table 5.1. The top of the limestone bedrock tends to be very irregular varying more than 100 feet in elevation over a distance of a few hundred feet. This irregular surface was formed by dissolution of the limestone caused by acidic ground water. Other effects of dissolution activity are caverns, sinkholes, pinnacles, solution pipes, and a "honeycomb-structure" of voids in the limestone.

Table 5.1
Geologic Stratigraphic Units of the USAF Avon Park Range
Okeechobee and Polk Counties, Florida (USACE, 1996)

Age	Stratigraphic Unit	Lithology	Thickness (ft.)
Recent and Pleistocene	Undifferentiated sand and clay	Interbedded sand and clay	10-120
Miocene	Tampa Limestone	White to gray, sandy fossiliferous limestone	50-3000
Oligocene	Suwannee Limestone	Fossiliferous, yellow to white, fine-grained limestone	
Eocene	Crystal River Formation	Soft, chalky, white to tan coquinoid limestone	60-150
	Williston Formation	Soft, chalky, white to tan coquinoid limestone	
	Inglis Formation	Hard, fossiliferous, brown to gray dolomitic limestone	95
	Avon Park Limestone	Soft to hard, fossiliferous, brown limestone	200-400 ⁽¹⁾
	Lake City Limestone	Soft to hard, fossiliferous, brown limestone	400-700 ⁽¹⁾

⁽¹⁾ Faulkner 1973

5.2.1.3 The USAF Avon Park Range encompasses a large area that includes several different types of soil. The soils differ mainly in their characteristics and not soil content. The soils are all sands and fine sand mixtures, they all are poorly and very poorly drained, and they are all deep soils (extending to depths well over 7 feet). The corrosive effects of the soil are high for uncoated steel and low for concrete. The majority of the soil is in depressions, swamps, or grassy sloughs. The surface layer is dark gray or dark grayish brown fine sand. The subsoil generally grades to a lighter color as does the substratum to a depth over 80 inches. These soils generally have a high water table that is at a depth of 10 to 20 inches for 4 to 12 months of the year and below this level during long dry periods. In other areas, the water table, the majority of the year, is at or near the surface and becomes ponded after heavy rains and remains ponded, if the soil in that area is of low permeability. In these areas, the soil has a higher content of silt and may even be an organic muck. These soils have a higher available water capacity (Ford et al, 1990).

5.2.2 Regional Hydrogeologic Setting

5.2.2.1 The information regarding the hydrogeologic setting associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE 1996). Two aquifer systems, the surficial aquifer, and the Floridan aquifer; underlie the study area. The Floridan aquifer is the principal aquifer supplying most of the water used in the region. In the study area it is represented by limestones and dolomites of the Upper Floridan aquifer which includes the Lake City Limestone, Avon Park Limestone, Ocala Group Limestones, Suwannee Limestone, and the St. Marks Formation (Tampa Limestone).

5.2.2.2 The top of the Floridan aquifer is defined as the first consistent limestone below which no clay confining beds occur. The configuration of the top of the aquifer is highly variable due to erosion and dissolution in the limestones that form its upper surface. The elevation of the top of the aquifer ranges from slightly below sea level to more than 100 feet above sea level. Subsurface information from nearby water wells indicates that the top of the Floridan aquifer at the site is about 25 feet above MSL. The Floridan aquifer is unconfined at this location since an overlying clay aquitard is absent (Wetterhall, 1964).

5.2.2.3 The regional direction of groundwater movement in the Floridan aquifer is from east to west. Water level data from wells in the site vicinity indicate that the local groundwater flow is to the west, under a gradient of about 8 feet per mile (Fretwell, 1988). Recharge of the Floridan aquifer occurs from the overlying surficial aquifer in areas where it is in direct contact with the Floridan or through leaky confining beds between the Floridan and the water-table aquifer. Rainfall percolates through the unconsolidated sands and clays to recharge the underlying Upper Floridan aquifer. Recharge can also occur where the limestone is exposed at the surface or overlain by a thin veneer of sand, and where there are lakes, sinks and rivers.

5.2.2.4 The shallow aquifer, or water table (or surficial) aquifer, is found where sands overlie the limestones and dolomites of the Floridan aquifer. This aquifer is exposed at the surface. The thickness of the shallow aquifer is highly variable due to large variations in the thickness of sands. The thickness of the surficial aquifer system is typically less than 50 feet, but its thickness in Florida varies from 400 feet in Indian River

and St. Lucie Counties to 150 feet in eastern St. Johns County. The thickness generally increases coastward (Miller, 1990). The shallow aquifer may directly overlie the Floridan aquifer, or they may be separated by clays or other relatively impermeable units. Recharge to the water-table aquifer is almost entirely from local rainfall, except in those areas where it is hydraulically connected to the Floridan aquifer, which is the likely condition at this site. Discharge from the shallow aquifer may be by downward percolation into the Floridan aquifer, seepage into streams, lakes, sinkholes, and pumpage from wells. The shallow aquifer is mainly used for small domestic supplies. The average hydraulic conductivity of the surficial sand aquifer in this region has been estimated as about 1.3×10^{-4} (Fretwell, 1988). This aquifer is in an unconfined condition.

5.2.3 Regional Groundwater Use

5.2.3.1 Table 5.2 lists the registered groundwater wells within four miles of the USAF Avon Park Range site. Within a four mile radius of the *MRS M01 – Arbuckle Creek Fuze Disposal Area*, there are nine registered water wells (Figure 5.3). These wells range from 40 feet to 1,030 feet in depth. Four of these wells are registered as public supply wells. Information regarding the specific number of individuals using each of the drinking water wells was not available.

5.2.3.2 There are 14 registered water wells within a four mile radius of the *MRS R11 Lake Kissimmee Water Bombing Target* (Figure 5.3). These wells range from 0 feet to 1,000 feet in depth; the majority of these wells are 1,000 feet in depth. Two of these wells are registered as public supply wells. Information regarding the specific number of individuals using each of the drinking water wells was not available.

5.2.3.3 Within a four mile radius of the FUDS located on the east side of the Kissimmee River, there are 292 registered wells (Figure 5.3). Thirty-five registered wells exist within the FUDS boundary. These wells range from 30 feet to 1,200 feet in depth. One registered public supply well is located within the remaining lands of the FUDS on Kissimmee Prairie Preserve State Park. This well is drilled to 120 feet. One groundwater sample was collected from this well; the analytical results are presented below in Subchapter 5.15. Information regarding the specific number of individuals using each of the drinking water wells was not available. The remainder of the wells located within the FUDS boundary is registered as livestock or irrigation wells. The well report is included in Appendix L.

5.2.3.4 Based on information accumulated from Banks Information Systems (Appendix L), one water well is located within the *MRS R05 Target XIV – Practice Bombing Target*. This well has a depth of 115 feet and is registered for livestock use. There are two water wells within the area of overlap between *MRS R06 Range XIX – Position Firing Course* and *MRS R03 Range XII – Position Firing Course*. These wells are at a depth of 140 feet and are registered for livestock use. There are 18 registered wells within the *MRS R03 Range XII – Position Firing Course*, including those in the aforementioned area of overlap. Eight of these are registered for irrigation use and six are registered for livestock use. The use of the remaining four registered water wells is unknown, though they are registered to a single dairy. These wells range from 30 feet to 1,200 feet in depth.

5.2.3.5 In Polk County, the Upper Floridian Aquifer is the primary drinking water source. The primary source of drinking water in Okeechobee County is from Lake Okeechobee which is provided to customers by Okeechobee Utility Authority. Lake Okeechobee is approximately 30 miles downstream of USAF Avon Park Range.

Table 5.2
Active Groundwater Wells within a 4-Mile Radius of
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL

Area	Public Water Supply	Irrigation	Livestock /Dairy	Undetermined /Other	Industrial	Total
MRS M01-Arbuckle Creek Fuze Disposal Area	4	-	5	-	-	9
MRS R11 – Lake Kissimmee Water Bombing Target	2	11	-	1 (Air Conditioning)	-	14
MRSs East of the Kissimmee River	2	224	52	13*	1	292

* The use of these wells is not reported. They are registered to individuals, ranches, and dairies. Detailed well information is included in Appendix L.

5.2.3.6 As noted in Subchapter 2.2.7, there are approximately 2,091 individuals within a 4-mile buffer of the USAF Avon Park Range FUDS associated with the *MRS M01-Arbuckle Creek Fuze Disposal Area*. There are approximately 576 individuals within a 4-mile buffer of the *MRS R11 – Lake Kissimmee Water Bombing Target*. Approximately 1,525 individuals live within a 4-mile buffer of the USAF Avon Park Range FUDS east of the Kissimmee River. Activities are conducted, or inhabited structures are located, up to two miles from the MRS boundaries or within the MRS boundaries, that are associated with the following purposes: residential; commercial; parks and nature preserves, or other recreational uses; and agriculture. The *MRS M01 Arbuckle Creek Fuze Disposal Area* is located approximately 100' from the entrance to a State of Florida correctional facility and the active Avon Park Range. Over 75 inhabited structures are estimated to be within a 2-mile buffer of the site. Figures 2.3 and 2.4 depict the 2000 Census Bureau census blocks and population in the vicinity of the site.

5.2.4 Regional Hydrologic Setting

5.2.4.1 The information regarding the regional hydrologic setting associated with the USAF Avon Park Range was obtained from the 1996 ASR (USACE, 1996). The FUDS considered for this SI encompasses three general areas with respect to surface water. The first area is located at the Lake Arbuckle and its surrounding areas. This area includes the *MRS M01-Arbuckle Creek Fuze Disposal Area*. All the surface runoff drains into Lake Arbuckle and the Arbuckle Creek. The Livingston Creek flows into the lake from northwest and the control structure of the lake releases water into the Arbuckle Creek. A stream gage for the Livingston Creek near Frostproof, Florida, about 10 miles upstream of the lake, has a drainage area of 120 square miles with only two years of record (1990-1992). This gage shows a maximum peak flow of 1811 cubic feet per second (cfs) (08 July 1991) and a maximum stage of 45.56 feet (24 August 1992). The gage for the Arbuckle Creek near De Soto city has a drainage area of 379 square miles with 44 years record (1939-1992). The period of record shows an average discharge of 326 cfs, a maximum discharge of 7,380 cfs (23 September 1948) and a maximum stage of 44.96 feet-national geodetic vertical datum (FT-NGVD; 12 September 1960). The minimum flow and stage at Arbuckle occurred on 10 September 1956 and are 275 cfs and 40.33 FT-NGVD.

5.2.4.2 The second area, consisting of *MRS R11-Lake Kissimmee Water Bombing Target*, is situated on the southeastern quarter of the Lake Kissimmee and its surrounding areas. Lake Kissimmee is a 34,948-acre lake. All the surface runoff drains toward the Lake Kissimmee. A stream gage for the Kissimmee River at S-65, near Lake Wales, Florida, about 1 mile south of the site, has a drainage area of 1,607 square miles with 52 years of record (1929-1992). The period of record shows an average discharge of 1,042 cfs, a maximum peak discharge of 11,100 cfs (23 February 1988) and a maximum stage of 54.13 FT-NGVD (08 October 1969).

5.2.4.3 The third area, which is located between the Kissimmee River and Highway 441, covers a large portion of the Okeechobee County. This area consists of the remaining ten MRSs and is complex and dynamic with regard to hydrology. The Kissimmee River flows along the west boundary of the area. The surface drainage system in most of the area is poorly developed and, instead, runoff predominately drains into numerous sinks, closed depressions, lakes and grassy prairies. Surface runoff also drains toward the Kissimmee River. After heavy rainfall, small intermittent streams flow to sinkholes where the water either percolates rapidly, or ponds, to form prairie lakes. Rainfall also percolates through the unconsolidated sands and clays to recharge the underlying Upper Floridan aquifer. During extended dry periods, these channels and lakes are usually dry. The hydrologic system of the USAF Avon Park Range has also been impacted by anthropogenic alterations over time. Cattle and sod farms within this portion of the FUDS use man-made canals for irrigation. Numerous drainage canals were historically installed on lands in and around the USAF Avon Park Range to remove surface water for grazing and other land use. Some of these canals remain while others have been restored.

5.2.4.4 A stream gage for the Kissimmee River at S-65E, near Okeechobee, Florida has an indeterminate drainage area. The gage is about 10 miles downstream from

the site with the average discharges of 2,188 cfs for a 34 years period (water year 1929-1962) and of 1,349 cfs for a 21 years record (water year 1965-1985), respectively. The period record for the Kissimmee River shows, a peak flow of 25,800 cfs (03 October 1969) and a maximum stage of 23.3 FT-NGVD (05 October 1969). Portions of the area are likely to be flooded by the Kissimmee River overbank flooding.

5.2.4.5 The USFWS Wetlands Online Mapper, through the NWI, was used to identify wetlands within the USAF Avon Park Range site. Wetlands areas are located extensively throughout the site, as shown in Figures 5.4 and 5.5. There are three main types of wetland systems with varying classes, subclasses, and modifiers. The three main wetland types located within the site:

- PFO1C – Palustrine, forested, broad-leaved deciduous, seasonally flooded
- L1UBH – Lacustrine, limnetic, unconsolidated bottom, permanently flooded
- PEM1C – Palustrine, emergent, persistent, seasonally flooded

5.2.5 Regional Sensitive Ecological Resources

5.2.5.1 The USAF Avon Park Range site is not within a national wildlife refuge, national park, national forest, or county park. The southeastern area is mostly undeveloped scrub and wetlands used for grazing, hunting, and the Kissimmee Prairie Preserve State Park. The area is extensively covered in a shallow layer of water, grasses, underbrush and the subsurface is subject to cover collapse and the formation of sinkholes. Wetlands are located extensively throughout the site as described in paragraph 5.2.4.4 and shown on Figures 5.4 and 5.5. Several Bald Eagle and Crested Caracara nests, a breeding shorebird area, and several areas of rare oak-scrub habitats are known to be in the vicinity of the site.

5.2.5.2 The state of Florida supports 114 federally listed Threatened and Endangered (T&E) species consisting of 59 animals and 55 plants. According to FNAI and USFWS, nine federally listed animals and 20 plant species are known to exist in Polk County, 12 federally listed animals and 11 plant species are known to exist in Osceola County, and seven federally listed animals and no plant species are known to exist in Okeechobee County. Most of these listed species are the same for each county. Since the Osceola County MRS was a water target the listed T&E species are not applicable for that MRS. There are no listed fish species for Osceola County and none of the listed plants species would be found within the lake target MRS. Since the main focus of the SI is within the Kissimmee Prairie Preserve State Park, only the nine T&E species known to exist within and around the park boundaries are shown in Table 5.3. The SVT observed American alligators (*Alligator mississippiensis*), gopher tortoises (*Gopherus polyphemus*), and crested caracaras (*Caracara cheriway*) during the 2008 site visit.

5.2.5.3 Based on the above information and a review of the Army Checklist for Important Ecological Places (USACE, 2006), the USAF Avon Park Range FUDS is an important ecological place due to the presence of habitat for T&E species, the presence of wetlands, and the presence of the Prairie Reserve State Park. Therefore, ecological receptors are potential receptors for exposure pathways at this site.

Table 5.3
State and Federally-Listed Threatened and Endangered Species Potentially Located Within USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat potentially present on site?
Eastern Indigo Snake 	<i>Drymarchon couperi</i>	Threatened	Threatened	Habitat includes sand hill regions dominated by mature longleaf pines, turkey oaks, and wiregrass; flatwoods; most types of hammocks; coastal scrub; dry glades; palmetto flats; prairie; brushy riparian and canal corridors; and wet fields. Occupied sites are often near wetlands and frequently are in association with gopher tortoise burrows. Pineland habitat is maintained by periodic fires. Viable populations of this species require relatively large tracts of suitable habitat. Refuges include tortoise burrows, stump holes, land crab burrows, armadillo burrows, or similar sites. Eggs may be laid in gopher (<i>Geomys</i>) burrows. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Florida Scrub-Jay 	<i>Aphelocoma coerulescens</i>	Threatened	Threatened	Oak scrub on white, drained sand, in open areas without a dense canopy. Palmetto, sand pine and rosemary may co-occur. Includes scrub with no canopy, sandpine scrub, scrubby flatwoods, and coastal scrub. Fire-suppressed scrubs with dense, tall understories or encroaching pine canopies provide poor habitat. Rarely in areas with greater than 50% canopy cover that is taller than 3 m. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Crested Caracara 	<i>Caracara cheriway</i>	Threatened	Threatened	Associated with open country; dry prairie with scattered cabbage palms (SABAL PALMETTO), wetter prairies, and to some extent also improved pastures and sometimes even rather wooded areas having associated limited areas of open grassland; center of range is the Kissimmee Prairie, an area of shallow ponds and sloughs with scattered hummocks of live oaks and cabbage palms. Nests in trees, usually in sight concealed among branches or palm fronds (often in cabbage palm in Florida), or in cacti; 2.5-15+ m above ground. In treeless areas may nest on rock ledge or under overhanging rocks, or on ground in secluded site such as marsh island. Nests often are reused from year to year. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

Table 5.3
 State and Federally-Listed Threatened and Endangered Species Potentially Located Within USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat potentially present on site?
Wood Stork 	<i>Mycteria americana</i>	Endangered	Endangered	Chiefly freshwater situations: marshes, swamps, lagoons, ponds, flooded fields; depressions in marshes are important during drought; also occurs in brackish wetlands. Nests mostly in upper parts of cypress trees, mangroves, or dead hardwoods over water or on islands along streams or adjacent to shallow lakes. Feeds in freshwater marshes, swamps, lagoons, ponds, flooded pastures and flooded ditches, depressions in marshes (especially during drought). (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Snail Kite 	<i>Rostrhamus sociabilis plumbeus</i>	Endangered	Endangered	Large, open freshwater marshes and lakes with shallow (< 4 ft) open waters; open water areas without emergent vegetation are required for foraging; nests usually 1-5 m above water in low tree or shrub (commonly willow, wax myrtle, pond apple, or cattails), also occasionally sawgrass, maidencane (especially during low water) used for support; usually builds (mainly male) a new nest for each nesting attempt, though may build over old nest or in same location as old nest. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
American Alligator 	<i>Alligator mississippiensis</i>	Not Listed	Threatened	Fresh and brackish marshes, ponds, lakes, rivers, swamps, bayous, large spring runs. Basks on land next to water. Digs dens in river or lake margins or in marshes; spends cold winter and drought periods in den. Depends on access to air holes to survive in ice-covered ponds. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

Table 5.3
State and Federally-Listed Threatened and Endangered Species Potentially Located Within USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat potentially present on site?
Florida Panther 	<i>Puma concolor coryi</i>	Endangered	Endangered	Generally occurs in heavily forested areas in lowlands and swamps, also upland forests in some parts of range; areas with adequate deer or wild hog population. Habitats include tropical hammocks, pine flatwoods, cabbage palm forests, mixed swamp, cypress swamp, live oak hammocks, sawgrass marshes, and Brazilian pepper thickets; depends on large contiguous blocks of wooded habitat, though interspersed fields and early successional habitats may be beneficial through their positive effect on prey populations; day-use sites typically are dense patches of saw palmetto surrounded by swamp, pine flatwoods, or hammock. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Whooping Crane 	<i>Grus americana</i>	Endangered	Endangered	Freshwater marshes and wet prairies, in migration and winter also in grain and stubble fields and on shallow lakes and lagoons. Winters on salt flats, marshes, and along barrier islands. Radio-marked migrants roosted primarily in palustrine wetlands, many of which were smaller than 0.5 ha. Migration habitat includes mainly sites with good horizontal visibility, water depth of 30 cm or less, and minimum wetland size of 0.04 ha for roosting. Nests in dense emergent vegetation (sedge, bulrush) in shallow ponds, freshwater marshes, wet prairies, or along lake margins, within large expanses of undisturbed wilderness. Pothole breeding sites are separated by narrow ridges vegetated by black spruce, tamarack, and willow. Favors sites with slightly alkaline ponds. The nest is a mound of marsh vegetation rising 8-19 inches above the surrounding water level. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Florida Grasshopper Sparrow 	<i>Ammodramus savannarum floridanus</i>	Endangered	Endangered	Dry prairie with stunted saw palmetto and dwarf oaks, bluestems and wiregrass; unimproved cattle pastures. Habitat is maintained by periodic fires. Cannot survive in pastureland if it is stripped of shrubby patches. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

5.2.6 Sample Locations/Methods

5.2.6.1 The field effort for USAF Avon Park Range was completed from May 5th to May 10th and May 12th, 2008. The field effort included both MC sampling and QR. No intrusive MEC investigations, explosives handling, or MEC detonations were conducted in conjunction with this field effort. Extensive QR of the parcels was not performed beyond a visual assessment to further evaluate the condition of the site. Preliminary QR routes were identified by the TPP Team with the understanding that the SVT could determine alternate routes to accommodate conditions on the ground.

5.2.6.2 One biased surface water sample and one biased sediment sample was collected within the *MRS M01 Arbuckle Creek Fuze Disposal Area* in a location selected to represent the highest likelihood for the presence of MEC or MC contamination (Figure 5.1). One field duplicate and QA/QC sediment sample was also collected. As an adequate location for ambient surface water and sediment samples could not be located, neither ambient surface water samples nor ambient sediment samples were collected. One groundwater sample was collected from remaining land (within the FUDS boundary, but outside MRS boundaries). This sample was collected from the Kissimmee Prairie Preserve State Park water well which supplies water to the campground and offices. Samples were not collected from the *MRS R11 Lake Kissimmee Water Bombing Target*, as discussed amongst the TPP team and further detailed in subchapter 5.14. The area within this MRS has likely been subject to silt and sediment removal actions and the area around the structure located down gradient of the MRS has been subject to silt and sediment removal actions and dredged during construction.

5.2.6.3 Twenty surface soil samples (and associated QA/QC samples) were collected from the remaining ten MRSs located east of the Kissimmee River (Figure 5.2). Seventeen of the twenty surface soil sample locations were selected to represent areas with the highest likelihood for the presence of MEC or MC contamination, such as target centers or areas displaying MD. The remaining three surface soil sample locations were selected to represent areas with the lowest likelihood for the presence of MEC or MC contamination to estimate ambient metals concentrations on-site. Two field duplicate and QA/QC soil samples were also collected. Soil samples were collected from 0- to 6-inches bgs with vegetative cover being removed prior to sample collection.

5.2.6.4 The USAF Avon Park Range has a dynamic hydrologic system that varies depending on the amount of rainfall during the wet and dry seasons and the effects from tropical storms and hurricanes. Although numerous drainage canals were installed on lands in and around the USAF Avon Park Range to remove surface water for grazing and other land use, there remains substantial surface water with interconnections to the surficial aquifer through highly permeable soils, sinkholes, and prairie lakes. Based on the surface water/groundwater interconnection at the USAF Avon Park Range and the large areal dimensions of the range (> 100,000 total acres), the TPP Team concurred (December 4, 2007 TPP Team Meeting) with the limited biased sample collection approach focusing on the surface soils in target areas of the 10 MRSs located east of the Kissimmee River. Collection of sufficient surface water, sediment, and groundwater samples to further assess the condition of waters on the site is better evaluated under a more in-depth investigation. Based on site use and the presence of wetlands, surface

water, and groundwater, the TPP Team agreed to defer the sediment, surface water, and groundwater evaluation at the site during the anticipated follow-on RI/FS.

5.2.6.5 Sample locations were guided by the preliminary sample locations identified before the SVT arrived on site and were approved by the UXO technician prior to final location selection and sample collection. For safety reasons, the UXO technician used a Schonstedt magnetometer prior to final location selection and collection of the samples. Discrete samples were collected at the request of FDEP and in accordance with the SS-WP Addendum. GPS coordinates for each sample location were recorded for later reference.

5.2.6.6 The collected samples were packaged and shipped to TestAmerica (formerly Severn Trent Laboratories), in Arvada, Colorado for analysis. All samples were analyzed for indicator metals (Methods SW6010B, SW6020) and explosives (Method SW8321A). Samples collected within the *MRS R09 North Restricted Use Area* and *MRS R10 Central Restricted Use Area* were additionally analyzed for iron, as requested by FDEP. Sample results are presented in Tables 5.4 (groundwater and surface water), 5.5 (sediment), and 5.6 (surface soil).

Table 5.4
Summary of Validated Analytical Results for USAF Avon Park Range MMRP Groundwater and Surface Water
Samples Collected in May 2008

SAMPLE ID:		APR-RL-GW-01		APR-RL-GW-02*		APR-MRSM01-SW-01	
DATE SAMPLED:		05/06/08		05/06/08		05/06/08	
LAB SAMPLE ID:		D8E070379002		D8E070379003		D8E070379001	
	Units						
Explosives - SW8321A							
1,3,5-Trinitrobenzene	µg/L	0.12	U	0.12	U	0.12	U
1,3-Dinitrobenzene	µg/L	0.12	U	0.12	U	0.12	U
2,4,6-Trinitrotoluene (TNT)	µg/L	0.12	U	0.12	U	0.12	U
2,4-Dinitrotoluene	µg/L	0.12	U	0.12	U	0.12	U
2,6-Dinitrotoluene	µg/L	0.12	U	0.12	U	0.12	U
2-Amino-4,6-dinitrotoluene	µg/L	0.12	U	0.12	U	0.12	U
2-Nitrotoluene	µg/L	0.20	U	0.20	U	0.20	U
3-Nitrotoluene	µg/L	0.20	U	0.20	U	0.20	U
4-Amino-2,6-dinitrotoluene	µg/L	0.12	U	0.12	U	0.12	U
4-Nitrotoluene	µg/L	0.20	U	0.20	U	0.20	U
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	µg/L	0.48	U	0.48	U	0.48	U
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	µg/L	0.12	U	0.12	U	0.12	U
Nitrobenzene	µg/L	0.12	U	0.12	U	0.12	U
Nitroglycerin	µg/L	0.15	U	0.15	U	0.15	U
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	µg/L	1.2	U	1.2	U	1.2	U
Pentaerythritol Tetranitrate (PETN)	µg/L	0.12	U	0.12	U	0.12	U
Total Metals - SW6010B/6020							
Aluminum	µg/L	300	U	300	U	1600	
Antimony	µg/L	6.0	U	6.0	U	0.15	J
Barium	µg/L	24		26		51	
Copper	µg/L	87	J	54	J	4.8	
Lead	µg/L	8.8		9.2		8.3	
Zinc	µg/L	39		19	J	21	

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

U - Analyte was analyzed for but not detected above the sample specific practical quantitation limit (PQL_sa).

J - Analyte detected, estimated concentration.

* - Field duplicate of sample on left.

Detections are bolded.

Table 5.5
Summary of Validated Analytical Results For USAF Avon Park Range MMRP Sediment Samples Collected in May 2008

SAMPLE ID:		APR-MRSM01-SED-01		APR-MRSM01-SED-02*	
DATE SAMPLED:		05/06/08		05/06/08	
LAB SAMPLE ID:		D8E070379010		D8E070379011	
	Units				
Explosives - SW8321A					
1,3,5-Trinitrobenzene	µg/kg	120	U	120	U
1,3-Dinitrobenzene	µg/kg	120	U	120	U
2,4,6-Trinitrotoluene (TNT)	µg/kg	120	U	120	U
2,4-Dinitrotoluene	µg/kg	120	U	120	U
2,6-Dinitrotoluene	µg/kg	120	U	120	U
2-Amino-4,6-dinitrotoluene	µg/kg	120	U	120	U
2-Nitrotoluene	µg/kg	120	U	120	U
3-Nitrotoluene	µg/kg	120	U	120	U
4-Amino-2,6-dinitrotoluene	µg/kg	120	U	120	U
4-Nitrotoluene	µg/kg	120	U	120	U
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	µg/kg	180	U	180	U
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	µg/kg	300	U	300	U
Nitrobenzene	µg/kg	120	U	120	U
Nitroglycerin	µg/kg	500	U	500	U
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	µg/kg	120	U	120	U
Pentaerythritol Tetranitrate (PETN)	µg/kg	500	U	500	U
Metals - SW6010B/6020					
Aluminum	mg/kg	230	J	200	
Antimony	mg/kg	0.34	UJ	0.32	U
Barium	mg/kg	1.7		1.3	
Copper	mg/kg	0.37	J	0.43	
Lead	mg/kg	1.3		1.2	
Zinc	mg/kg	2.2	J	1.8	J

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

U - Analyte was analyzed for but not detected above the sample specific practical quantitation limit (PQL_{sa}).

UJ - Analyte not detected, reported PQL_{sa} may be inaccurate or imprecise.

J - Analyte detected, estimated concentration.

* - Field duplicate of sample on left.

Detections are bolded.

Table 5.6
Summary of Validated Analytical Results for USAF Avon Park Range MMRP Soil Samples Collected in May 2008

SAMPLE ID:		APR-RL-SS-06-17*	APR-RL-SS-06-18*	APR-RL-SS-06-19*	APR-MRSR01-SS-06-01	APR-MRSR01-SS-06-02	APR-MRSR02-SS-06-03	APR-MRSR03-SS-06-04	APR-MRSR03-SS-06-05	APR-MRSR04-SS-06-06	APR-MRSR05-SS-06-07	APR-MRSR06-SS-06-08											
DATE SAMPLED:		05/09/08	05/07/08	05/10/08	05/05/08	05/05/08	05/06/08	05/09/08	05/12/08	05/09/08	05/09/08	05/12/08											
LAB SAMPLE ID:		D8E140353010	D8E140353002	D8E140353014	D8E070379006	D8E070379005	D8E070379004	D8E140353011	D8E140353016	D8E140353008	D8E140353012	D8E140353015											
Units																							
Explosives - SW8321A																							
1,3,5-Trinitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
1,3-Dinitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,4,6-Trinitrotoluene (TNT)	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,4-Dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,6-Dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2-Amino-4,6-dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
3-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
4-Amino-2,6-dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
4-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	µg/kg	180	U	180	U	180	U	180	U	180	U	180	U										
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	µg/kg	300	U	300	U	300	U	300	U	300	U	300	U										
Nitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Nitroglycerin	µg/kg	500	U	500	U	500	U	500	U	500	U	500	U										
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Pentaerythritol Tetranitrate (PETN)	µg/kg	500	U	500	U	500	U	500	U	500	U	500	U										
Metals - SW6010B/6020																							
Aluminum	mg/kg	1100		1000		280		1500		150		420		95		500		130		72		140	
Antimony	mg/kg	0.28	U	0.27	U	0.25	U	0.38	U	0.27	U	0.28	U	0.25	U	0.036	J	0.15	J	0.26	U	0.28	U
Barium	mg/kg	5.8		3.1		0.72		6.6		5.5		2.4		0.65		8.6		4.2		2.1		3.6	
Copper	mg/kg	0.22	J	0.37		0.29	J	1.0		4.4		0.72		0.30	J	2.8		7.1		2.5		1.9	
Iron	mg/kg																						
Lead	mg/kg	1.7		1.6		0.85		5.3		2.5		1.8		1.6		3.6		4.2		0.78		0.95	
Zinc	mg/kg	2.8	U	2.7	U	2.5	U	1.3	J	1.5	J	0.97	J	2.5	U	7.6		18		4.7		2.8	U

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

U - Analyte was analyzed for but not detected above the sample specific practical quantitation limit (PQL_sa).

J - Analyte detected, estimated concentration.

* - Ambient sample.

** - Field duplicate of sample on left.

Detections are bolded.

Table 5.6 (Continued)
 Summary of Validated Analytical Results for USAF Avon Park Range MMRP Soil Samples Collected in May 2008

SAMPLE ID:		APR-MRSR06-SS-06-09	APR-MRSR03-SS-06-10	APR-MRSR03-SS-06-22**	APR-MRSR07-SS-06-11	APR-MRSR08-SS-06-12	APR-MRSR09-SS-06-13	APR-MRSR09-SS-06-23**	APR-MRSR08-SS-06-14	APR-MRSR10-SS-06-15	APR-MRSR06-SS-06-16	APR-MRSR06-SS-06-20											
DATE SAMPLED:		05/08/08	05/05/08	05/05/08	05/10/08	05/07/08	05/07/08	05/07/08	05/09/08	05/08/08	05/08/08	05/05/08											
LAB SAMPLE ID:		D8E140353006	D8E070379008	D8E070379009	D8E140353013	D8E140353003	D8E140353001	D8E140353004	D8E140353009	D8E140353005	D8E140353007	D8E070379007											
	Units																						
Explosives - SW8321A																							
1,3,5-Trinitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
1,3-Dinitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,4,6-Trinitrotoluene (TNT)	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,4-Dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2,6-Dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2-Amino-4,6-dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
2-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
3-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
4-Amino-2,6-dinitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
4-Nitrotoluene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	µg/kg	180	U	180	U	180	U	180	U	180	U	180	U										
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	µg/kg	300	U	300	U	300	U	300	U	300	U	300	U										
Nitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Nitroglycerin	µg/kg	500	U	500	U	500	U	500	U	500	U	500	U										
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	µg/kg	120	U	120	U	120	U	120	U	120	U	120	U										
Pentaerythritol Tetranitrate (PETN)	µg/kg	500	U	500	U	500	U	500	U	500	U	500	U										
Metals - SW6010B/6020																							
Aluminum	mg/kg	92		1600		1400		350		150		360	J	320		190		170		560		170	
Antimony	mg/kg	0.29	U	0.25	U	0.25	U	0.019	J	0.28	U	0.27	U	0.28	U	0.17	J	0.29	U	0.028	J	0.28	U
Barium	mg/kg	1.2		5.9		5.6		5.2		4.1		1.6		1.5		1.2		4.4		88		7.4	
Copper	mg/kg	0.19	J	0.90		0.95		4.4		0.46		0.32	J	0.39		11		0.29	J	11		0.48	
Iron	mg/kg									1600	J	1200		23000		130		640					
Lead	mg/kg	1.2		2.9		3.0		1.3		2.0		2.3		2.4		3.3		1.8		6.1		2.3	
Zinc	mg/kg	2.9	U	7.2		7.8		2.7	U	2.8	U	2.7	U	2.8	U	2.8	U	2.9	U	3.0	U	0.90	J

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
 U - Analyte was analyzed for but not detected above the sample specific practical quantitation limit (PQL_{sa}).
 J - Analyte detected, estimated concentration.
 * - Ambient sample.
 ** - Field duplicate of sample on left.
 Detections are bolded.

5.2.6.6 With the exception of the departures discussed in paragraph 3.5 and below, the sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range SS-WP Addendum (Parsons 2008b) were followed. The following samples were moved from the planned locations: APR-MRSR01-SS-06-01, APR-MRSR03-SS-06-05, APR-MRSR08-SS-06-14, APR-MRSR06-SS-06-16, APR-RL-SS-06-17, APR-RL-SS-06-19, APR-MRSR03-SS-06-20; these departures are discussed below in the MRS-specific subchapters and in paragraph 3.5.

5.2.7 Background/Ambient Metals Concentrations

5.2.7.1 No site-specific statistical evaluation of background metals concentrations is available. Due to the limited scope of the SI, conducting a site-specific statistical background evaluation of metals concentrations (which typically requires collection of at least 10 background samples) was not considered practical or warranted at this stage of investigation. Two sources of information, each described in detail in the following paragraphs, were used to approximate background metals concentrations in soil at the site:

- Average concentrations of elements in Okeechobee or Polk County, Florida, identified by the USGS (USGS, 2008; see Appendix L); and
- Analytical results of three ambient surface soil samples collected during the 2008 SI field activities within the FUDS boundary in areas outside the MRS that are not expected to be affected by munitions activities, used in the absence of an average concentration for Okeechobee or Polk County from the USGS.

5.2.7.2 The nationwide Mineral Resources Data System (MRDS) database of concentrations of elements provides county-specific background concentrations for selected metals. The MRDS includes mineral resource occurrence data covering the world, most thoroughly within the United States. This database contains the records previously provided in the MRDS of USGS and the Mineral Availability System/Mineral Industry Locator System originated by the U.S. Bureau of Mines, which is now part of the USGS. According to the USGS, the MRDS is a large and complex relational database developed over several decades by hundreds of researchers and reporters (USGS, 2007). This dataset is considered to be representative of conditions within Okeechobee and Polk Counties; however, the data available are limited to a select group of metals. The USGS-derived background concentrations are based on the mean concentration plus two times the standard deviation (SD) to approximate the 95% Upper Confidence Limit of the mean. These data for Okeechobee and Polk Counties are provided in Appendix L. These County USGS Background Concentrations are applicable for sediment and soil at the site.

5.2.7.3 To provide an indication of the concentration of metals naturally present in the surface soil at the site, three ambient surface soil samples (APR-RL-SS-06-17, APR-RL-SS-06-18, APR-RL-SS-06-19) were collected during the SI, as shown in Figure 5.2. These ambient samples provide an indication of the range of naturally occurring metals concentrations. These samples were collected outside the MRSs. No MEC or

MD were observed in the vicinity of these sample locations and no explosives were detected in the ambient samples collected, suggesting they are likely representative of the naturally occurring soils in the area.

5.2.7.4 The USGS Background Concentrations for Okeechobee and Polk Counties, and the maximum concentrations detected in the collected ambient samples are summarized in Table 5.7. These values are used to estimate the background concentration in soil and sediment for the site, which is one of the criteria used to evaluate whether or not a source of MC contamination is present (Subchapter 5.2.7). The USGS Background Concentrations for Polk County are applicable to sediment sample APR-MRSM01-SED01 (and field duplicate), which was collected in Polk County. The USGS Background Concentrations for Okeechobee County are applicable to the surface soil samples, all of which were collected in Okeechobee County.

5.2.7.5 As no ambient surface water samples were collected and no additional source of background data was available, it could not be determined whether the detections of barium and lead in the surface water sample were within the range of site-specific conditions. No ambient sediment samples were collected. Although USGS Background Concentrations for Polk County data were available for comparison, this data set does not include concentrations of barium, so it could not be determined whether the detection of barium in the sediment sample was within the range of site-specific conditions. Detections of analytes where no comparison data are available are conservatively assumed to exceed site-specific conditions and are evaluated in the SLRA.

5.2.7.6 Finally, antimony was not detected in the three ambient surface soil samples collected and antimony is not included in the USGS Background Concentrations for Okeechobee County data set. Thus, detections of antimony in the biased surface soil samples are evaluated in the SLRA.

Table 5.7
Soil and Sediment Background Screening Levels
USAF Avon Park Range, Okeechobee and Polk Counties, FL

Analyte	Units	Okeechobee County USGS Background Concentration ^a	Polk County USGS Background Concentration ^a	Maximum Ambient Soil Concentration	Selected Soil Background Concentration ^b	Selected Sediment Background Concentration ^c
Metals						
Aluminum	mg/kg	4,960	7,540	1,100	4,960	7,540
Antimony	mg/kg	NA	NA	0.28 U	0.28 U	NA
Barium	mg/kg	NA	NA	5.8	5.8	NA
Copper	mg/kg	8.185	133.694	0.37	8.185	133.694
Iron	mg/kg	1,920	3,850	NA	1,920	3,850
Lead	mg/kg	8.763	37.824	1.7	8.763	37.824
Zinc	mg/kg	18.253	83.949	2.8 U	18.253	83.949

a - USGS derived background concentrations for Okeechobee and Polk County, FL. Value equals the mean + 2xSD.

b - The surface soil screening values are selected from those available in the column order shown (such as, the USGS (Okeechobee County) value is used if available; in the absence of a USGS value, the maximum ambient concentration is used).

c - As no ambient sediment samples were collected, the USGS (Polk County) value is used.

NA - Background concentration not available.

NOTE: No explosives were detected in the ambient surface soil samples.

U - Analyte not detected above the adjusted PQL.

5.2.8 MC Source Evaluation

5.2.8.1 As explained earlier in this chapter, an exposure pathway is not considered to be complete unless there is potential contamination present. To make this determination, analytical results for MC metals are screened against several criteria to evaluate whether or not a source of MC contamination is present. For a chemical to be considered to be contamination potentially related to a release from munitions-related activities at the site, it is necessary for the following conditions to be true:

- The chemical is detected in the sample medium; AND
- The chemical is present above the background concentration (see Subchapter 5.1.7); AND
- The chemical is a potential constituent of the munitions formerly used at the site (see Table 4.1).

5.2.8.2 Each of the MC analyzed at the site were evaluated against these criteria to determine whether a source of MC contamination was present at the MRS. Only detections of metals that meet the conditions above are retained for consideration in the SLRAs in Chapter 6. *Although iron is considered an essential nutrient, this analyte is evaluated within the MRS R09-North Restricted Use Area and the MRS R10-Central Restricted Use Area, as discussed by the TPP Team during the December 2007 meeting.* As the use of these areas remains unclear, this additional analysis was conducted to evaluate the potential for iron content due to these areas potential (not documented) use

as Open Burn/Open Detonation (OB/OD) Areas. Any detection of explosives at the site is considered to be a source of MC contamination and is evaluated in the SLRA.

5.2.8.3 For metals that do not have comparison concentrations available, such as antimony and barium in sediment, detections of these analytes will be evaluated in the SLRA. As antimony was not detected in the ambient surface soil samples collected, any detection of antimony in the biased surface soil samples are evaluated in the SLRA. As there are no surface water or groundwater background data for comparison, it cannot be determined if the observed concentrations within the surface water and groundwater samples are within the range of background. Detections of MC metals in surface water and groundwater are evaluated in the SLRA in Chapter 6.

5.3 MUNITIONS RESPONSE SITE M01 ARBUCKLE CREEK FUZE DISPOSAL AREA

This subchapter of the SI Report evaluates exposure pathways for the *MRS M01 Arbuckle Creek Fuze Disposal Area*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.3.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.3.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS M01 Arbuckle Creek Fuze Disposal Area*.

5.3.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at the *MRS M01 Arbuckle Creek Fuze Disposal Area* and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS. There are four registered public supply wells within a four mile radius of the MRS (Figure 5.3 and Appendix L). These public supply wells range from 1,000 feet to 1,035 feet in depth.

5.3.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions disposal activities. Due to the potential for surface water recharge, groundwater may have been indirectly affected by the munitions disposal activities associated with this MRS.

5.3.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. There are four registered public supply wells within a four mile radius of the MRS (Figure 5.3 and Appendix L). These public supply wells range from 1,000 feet to 1,035 feet in depth. Potential human receptors within this MRS would include commercial and industrial workers, site visitors, and recreational users. Contaminant migration via surface water recharge to the groundwater may be possible at this MRS. However, it is unlikely that human or ecological receptors would be exposed to the groundwater, resulting in incomplete pathways for human and ecological receptors.

5.3.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.3.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.3.2.6 Groundwater Migration Pathway Conclusions

5.3.2.6.1 Groundwater sampling was not performed at the *MRS M01 Arbuckle Creek Fuze Disposal Area*. Although there are four registered public supply wells within a four mile radius of the MRS, there are no registered public supply wells within the MRS. As discussed in paragraph 5.3.3.5, two MC metals (barium and lead) were detected in the surface water sample collected within this MRS. Additionally, one MC (barium) was detected in the sediment samples collected from this MRS. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. Contaminant migration via surface water recharge to the groundwater is possible at this MRS. However, it is unlikely that human receptors would be exposed to the groundwater, resulting in incomplete pathways for human receptors.

5.3.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.3.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.3.3.1 Hydrologic Setting

5.3.3.1.1 The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As shown in Figures 5.1 and 5.4, there is year-round surface water and sediment within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. *MRS M01 Arbuckle Creek Fuze Disposal Area* is located in Arbuckle Creek, below the control structure of Lake Arbuckle. Lake Arbuckle drains into Arbuckle Creek to the south. The *MRS M01 Arbuckle Creek Fuze Disposal Area* includes a small portion of Arbuckle Creek. In 1945, approximately 200 live bomb fuzes (AN-M103 and potentially AN-M101A2) were dumped into the creek from the bridge crossing the creek. No MEC or MD were found during the 2008 field visit. The 1996 ASR inspection team visited this MRS and noted “it was impossible to determine if any fuzes remained submerged” (USACE, 1996).

5.3.3.1.2 As shown in Figure 5.4, the following wetland types occur within this MRS:

- PFO1A - Palustrine, forested, broad-leaved deciduous, temporarily flooded
- PFO3/1C - - Palustrine, forested, broad-leaved evergreen / broad-leaved deciduous, seasonally flooded

5.3.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS M01 Arbuckle Creek Fuze Disposal Area*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions disposal activities would occur.

5.3.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment located within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. The bridge over which the fuzes were disposed is reportedly a popular fishing location and a fish camp is located approximately 75 feet upstream of the bridge. Potential receptors within the MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in surface water and sediment through incidental ingestion and dermal contact, as well as through ingestion of biota (for example, fish) that may be exposed to MC in surface water and sediment. Ecological receptors may also be exposed to MC through ingestion of surface water as a drinking water source.

5.3.3.4 Surface Water and Sediment Sample Locations and Methodologies

5.3.3.4.1 Because there is surface water and sediment present within the *MRS M01 Arbuckle Creek Fuze Disposal Area*, the TPP Team agreed the collection of surface water and sediment samples was necessary. One biased surface water sample (APR-MRSM01-SW01) and one biased sediment sample (APR-MRSM01-SED01) (and field duplicate) were collected from approximately 20 feet downstream of the bridge which crosses Arbuckle Creek, as shown in Figure 5.1. Due to lack of ROE, these samples were not collected at the planned location downstream. Ambient surface water and sediment samples were not collected.

5.3.3.4.2 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP

(USACE, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed.

5.3.3.5 Surface Water and Sediment Migration Pathway Analytical Results

5.3.3.5.1 The analytical results for the surface water and sediment samples collected from the *MRS M01 Arbuckle Creek Fuze Disposal Area* are presented in Tables 5.4 and 5.5, respectively. As described in Subchapter 5.2.8, these results were evaluated to determine whether or not there was a source of contamination present.

5.3.3.5.2 The source evaluations for surface water and sediment are summarized in Tables 5.8 and 5.9, respectively. Explosives were not detected in the surface water or sediment samples collected within this MRS. Therefore, these source evaluations are performed for indicator metals only. As shown in Table 5.8, two MC metals (barium and lead) were detected in the surface water samples collected from the MRS. As there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background. These metals will be evaluated in the SLRA in Chapter 6. As shown in Table 5.9, one MC metal (barium) was detected in the sediment samples analyzed. As no background concentration is available for comparison, barium in sediment will be evaluated in the SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the surface water and sediment at this MRS.

Table 5.8
Surface Water Source Evaluation
MRS M01 – Arbuckle Creek Fuze Disposal Area
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Potential MC? ^a	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>					
Aluminum	µg/L	1,600	No	No	Not a potential MC
Antimony	µg/L	0.15	No	No	Not a potential MC
Barium	µg/L	51	Yes	Yes	--
Copper	µg/L	4.8	No	No	Not a potential MC
Lead	µg/L	8.3	Yes	Yes	--
Zinc	µg/L	21	No	No	Not a potential MC

a – Potential MCs (AN-M103 Fuze and AN-M101A2 Fuze) as listed in Table 4.1
 Background concentration not available (See 5.2.7.5)

Table 5.9
Sediment Source Evaluation
MRS M01 – Arbuckle Creek Fuze Disposal Area
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	230	7,540	No	No	No	Not detected above background
Antimony	mg/kg	0.34 U	NA	No	No	No	Not detected at MRS
Barium	mg/kg	1.7	NA	Yes	Yes	Yes	--
Copper	mg/kg	0.43	133.69	No	No	No	Not detected above background
Lead	mg/kg	1.3	37.82	No	Yes	No	Not detected above background
Zinc	mg/kg	2.2	83.95	No	No	No	Not detected above background

a – Background concentration as established in Table 5.4

NA – Background concentration not available

b – Potential MCs (AN-M103 Fuze and AN-M101A2 Fuze) as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.3.3.6 Surface Water and Sediment Migration Pathway Conclusions

The surface water and sediment migration pathways are complete for this MRS. Two MC metals (barium and lead) were detected in the surface water sample collected from this MRS. One MC (barium) was detected in the sediment samples collected from this MRS. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. These analytes are further evaluated in the SLRA in Chapter 6. Due to natural and anthropogenic-influenced surface water flow since site closure, the MC source (potentially remaining MEC/MD) is likely located further downstream than the original disposal location.

5.3.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.3.4.1 Physical Source Access Conditions

The *MRS M01 Arbuckle Creek Fuze Disposal Area* consists of a small portion of Arbuckle Creek, downstream of the control structure associated with Lake Arbuckle. The area flanking the creek is forested land. Access from land via foot is partially restricted due to the presence of a fence along County Road 64, which crosses Arbuckle Creek. There are no known restrictions to access via boat. Potential receptors within the MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.3.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. Munitions disposal activities would not have directly affected soils. Approximately 200 live fuzes (AN-M103 and potentially AN-M101A2) were dumped from the bridge into Arbuckle Creek in this area in 1945. No MEC or MD were found during the 2008 field visit. The 1996 ASR inspection team visited this MRS and noted "it was impossible to determine if any fuzes remained submerged" (USACE, 1996). No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.3.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS M01 Arbuckle Creek Fuze Disposal Area* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at the *MRS M01 Arbuckle Creek Fuze Disposal Area* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.3.4.4 Soil Sample Locations and Methodologies

Soil samples were not collected from the *MRS M01 Arbuckle Creek Fuze Disposal Area*. Surface water and sediment are the primary migration pathways at this MRS.

5.3.4.5 Soil Exposure Analytical Results

Soil samples were not collected.

5.3.4.6 Soil Exposure Conclusions

Not applicable. Soil samples were not collected. Munitions disposal activities would not have directly affected soils. The soil migration pathways are incomplete.

5.3.5 Air Migration Pathway

5.3.5.1 Climate

The climate for the *MRS M01 Arbuckle Creek Fuze Disposal Area* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1 through November 30.

5.3.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS M01 Arbuckle Creek Fuze Disposal Area*. The occurrence of windblown dust may occur at the site.

5.3.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS M01 Arbuckle Creek Fuze Disposal Area* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.3.4.6, munitions disposal activities would not have directly affected soils and soil samples were not collected.

5.3.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.3.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.3.5.6 Air Migration Pathway Conclusions

As described in Subchapter 5.3.4.6, munitions disposal activities would not have directly affected soils and soil samples were not collected. The soil migration pathways are incomplete. Consequently, human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust is not expected.

5.4 MUNITIONS RESPONSE SITE R01 TARGET XI - LAND SKIP BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R01 Target XI – Land Skip Bombing Target*. The analysis of each pathway (groundwater, surface

water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.4.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.4.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R01 Target XI – Land Skip Bombing Target*.

5.4.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at the *MRS R01 Target XI – Land Skip Bombing Target* and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.4.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions -related activities associated with this MRS.

5.4.2.3 Groundwater Migration Pathway and Receptors

Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. There are no registered public supply water wells located within the *MRS R01 Target XI – Land Skip Bombing Target*. It is unlikely that human or ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for human and ecological receptors.

5.4.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.4.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.4.2.6 Groundwater Migration Pathway Conclusions

5.4.2.6.1 Groundwater sampling was not performed at the *MRS R01 Target XI – Land Skip Bombing Target*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.4.4.5, barium was detected in surface soil above the selected background concentration. However, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.4.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.4.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.4.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is surface water, sediment, and shallow groundwater which may be exposed at the surface within the *MRS R01 Target XI – Land Skip Bombing Target*. The following semi-permanently flooded wetland types occur within this MRS:

- PEM1A/F/C - Palustrine, emergent, persistent, temporarily flooded / semi-permanently flooded / seasonally flooded

5.4.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R01 Target XI – Land Skip Bombing Target*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.4.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands located within the *MRS R01 Target XI – Land Skip Bombing Target*. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological

receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.4.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.4.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.4.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R01 Target XI – Land Skip Bombing Target*. As stated in paragraph 5.4.4.5 and shown in Table 5.10, barium was detected in surface soil above the selected background concentration. Additionally, there is potential for direct release within this MRS. Therefore, the surface water and sediment migration pathways are potentially complete, not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.4.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.4.4.1 Physical Source Access Conditions

The *MRS R01 Target XI – Land Skip Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This MRS was used for practice bombing. This MRS is relatively remote, though it is approximately 2.5 miles from the State Park campground and office. The area is accessible via 4WD vehicle, foot, and horseback.

5.4.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R01 Target XI – Land Skip Bombing Target*. Munitions-related activities could have directly affected soils. This target was used for practice bombing using M38A2 100-lb. practice bombs with spotting charges. Debris originating from a M38A2 practice bomb was found within this MRS during the May 2008 site visit. Small arms munitions were also used at this target, as evidenced by a .50-caliber casing found during the May 2008 site visit. A pile of munitions debris originating from M38A2 and M85 practice bombs was identified during the 1996 ASR site visit. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.4.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R01 Target XI – Land Skip Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.4.4.4 Soil Sample Locations and Methodologies

5.4.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R01 Target XI – Land Skip Bombing Target* with two biased surface soil samples (APR-MRSR01-SS-06-01, APR-MRSR01-SS-06-02). Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.4.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the global information system (GIS) database. Surface soil sample APR-MRSR01-SS-06-01 was moved due to the presence of a pond at the planned location.

5.4.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.4.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R01 Target XI – Land Skip Bombing Target* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface soil samples collected within this MRS. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.10. As shown in this table, one MC metal (barium) was detected at concentrations greater than the selected background concentration.

Table 5.10
Surface Soil Source Evaluation
MRS R01 Target XI – Land Skip Bombing Target
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration ^a	Exceeds Background Concentration?	Potential MC? ^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	1,500	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.38 U	0.28 U	No	Yes	No	Not detected at MRS
Barium	mg/kg	6.6	5.8	Yes	Yes	Yes	--
Copper	mg/kg	4.4	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	5.3	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	1.5	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.4.4.6 Soil Exposure Conclusions

Two biased surface soil samples were collected from the *MRS R01 Target XI – Land Skip Bombing Target*. Explosives were not detected in the samples. One MC metal (barium) was detected at concentrations greater than the selected background concentration. The soil migration pathways are complete for this MRS. Barium in surface soil is further evaluated in the SLRA in Chapter 6.

5.4.5 Air Migration Pathway

5.4.5.1 Climate

The climate for the *MRS R01 Target XI – Land Skip Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.4.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R01 Target XI – Land Skip Bombing Target*. The occurrence of windblown dust may occur at the site.

5.4.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R01 Target XI – Land Skip Bombing Target* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.4.4.5, barium was detected above background concentrations in the surface soil at this MRS, which indicates inhalation via fugitive dust is a potentially complete exposure route for MC.

5.4.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R01 Target XI – Land Skip Bombing Target*. Air sampling was not performed as part of the SI.

5.4.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.4.5.6 Air Migration Pathway Conclusions

As described in Subchapter 5.4.4.5, barium was detected above background concentrations in the surface soil at this MRS; potential MC contamination may be present within this MRS, which indicates inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human health screening levels chosen include the inhalation pathway. The ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.5 MUNITIONS RESPONSE SITE R02 TARGET XII - COMBINATION BOMBING AND GUNNERY RANGE

This subchapter of the SI Report evaluates exposure pathways for the *MRS R02 Target XII – Combination BGR*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.5.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.5.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R02 Target XII – Combination BGR*.

5.5.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.5.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions -related activities associated with this MRS.

5.5.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R02 Target XII – Combination BGR*. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.5.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.5.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.5.2.6 Groundwater Migration Pathway Conclusions

5.5.2.6.1 Groundwater sampling was not performed at the *MRS R02 Target XII – Combination BGR*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. However, as discussed in paragraph 5.5.4.5, no MC metals were detected in the surface soil samples above background concentrations within this MRS. Additionally, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.5.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.5.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.5.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is year-round surface water and sediment within the *MRS R02 Target XII – Combination BGR* in the form of semi-permanently flooded wetlands. The following wetland types occur within this MRS:

- PEM1A/F - Palustrine, emergent, persistent, temporarily flooded / semi-permanently flooded

5.5.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R02 Target XII – Combination BGR*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.5.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands located within the *MRS R02 Target XII – Combination BGR*. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water for human receptors, but ecological receptors may use surface water as a drinking water source.

5.5.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.5.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.5.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R02 Target XII – Combination BGR*. Direct releases of MCs could occur to surface soil, surface water, and sediment. As stated in paragraph 5.5.4.5 and shown in Table 5.11, no MC metals were detected in surface soil above background concentrations. Additionally, explosives were not detected. Although there is no source of MC contamination in the surface soil, the surface water and sediment migration pathways may be complete as a result of direct release of MC to the surface water and/or sediment. The surface water and sediment pathways are potentially complete, but not quantitatively assessed.

5.5.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.5.4.1 Physical Source Access Conditions

The *MRS R02 Target XII – Combination BGR* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This target was used for practice bombing and gunnery. This MRS is relatively remote, though it is approximately 1.5 miles from the State Park campground and office. The area is accessible via 4WD vehicle, foot, and horseback.

5.5.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R02 Target XII – Combination BGR*. Munitions-related activities could have directly affected soils. This target was used for practice bombing and gunnery using M38A2 100-lb. practice bombs with spotting charges, small arms munitions including .50-caliber ammunition, and “flares, signals, simulators, or screening smoke (other than white phosphorus)” (USACE, 2004b). No MEC or MD were found within this MRS during the January 1996

ASR site visit or during the May 2008 SI site visit. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.5.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R02 Target XII – Combination BGR* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.5.4.4 Soil Sample Locations and Methodologies

5.5.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R02 Target XII – Combination BGR* with one biased surface soil sample (APR-MRSR02-SS-06-03) located near target center. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.5.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.5.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.5.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R02 Target XII – Combination BGR* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface sample collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.11. As shown in this table, no MC metals were detected at concentrations greater than the selected background concentration. Therefore, based on these sample results, there is no MC contamination present in the surface soil at this MRS.

Table 5.11
Surface Soil Source Evaluation
MRS R02 Target XII – Combination Bombing and Gunnery Range
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	420	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.28 U	0.28 U	No	Yes	No	Not detected at MRS
Barium	mg/kg	2.4	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	0.72	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	1.8	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	0.97	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.5.4.6 Soil Exposure Conclusions

One biased surface soil sample was collected from the *MRS R02 Target XII – Combination BGR*. Explosives were not detected in the samples. No MC metals were detected at concentrations greater than the selected background concentration. Therefore, based on the analytical results presented in this report, the concentrations of these metals are not elevated as a result of munitions-related activities at the site. Based on the current information available for the site, the soil migration pathway is incomplete for the *MRS R02 Target XII – Combination BGR* as there is no MC contamination present.

5.5.5 Air Migration Pathway

5.5.5.1 Climate

The climate for the *MRS R02 Target XII – Combination BGR* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. There are no known historical dust storms for this region. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.5.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R02 Target XII – Combination BGR*. The occurrence of windblown dust may occur at the site.

5.5.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R02 Target XII – Combination BGR* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. However, as discussed in Subchapter 5.5.4.5, there are no MC metals detected above background in the surface soil at this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC because a source of MC contamination in surface soil is not present.

5.5.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R02 Target XII – Combination BGR*. Air sampling was not performed as part of the SI.

5.5.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.5.5.6 Air Migration Pathway Conclusions

Air samples were not collected during this SI. As discussed in Subchapter 5.5.4.5, there are no MC above background in surface soil at this MRS. Therefore, the soil pathway and the inhalation via fugitive dust exposure pathway are incomplete.

5.6 MUNITIONS RESPONSE SITE R03 RANGE XII – POSITION FIRING COURSE

This subchapter of the SI Report evaluates exposure pathways for the *MRS R03 Range XII – Position Firing Course*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.6.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.6.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R03 Range XII – Position Firing Course*.

5.6.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. There are 18 registered wells within the *MRS R03 Range XII – Position Firing Course*. Eight of these are registered for irrigation use and six are registered for livestock use. The use of the remaining four registered water wells is unknown, though they are registered to a single dairy. These wells range from 30 feet to 1,200 feet in depth.

5.6.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions - related activities associated with this MRS.

5.6.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R03 Range XII – Position Firing Course*. However, there are 18 registered wells. The use of four of these wells is unknown. The registered use of 14 of the wells is for livestock and irrigation. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is

possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.6.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.6.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.6.2.6 Groundwater Migration Pathway Conclusions

5.6.2.6.1 Groundwater sampling was not performed at the *MRS R03 Range XII – Position Firing Course*. As described in Subchapter 5.6.4.5, one MC metal (barium) was detected above the selected background concentration in the surface soil within this MRS. Antimony was also detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, as there is a potential source of MC contamination, leaching from the MRS could provide a potential environmental transport mechanism. There are 18 registered groundwater wells within this MRS. Therefore, the groundwater exposure pathway is potentially complete for human receptors. Receptors may be exposed to groundwater via incidental ingestion and dermal contact.

5.6.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.6.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.6.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is surface water, sediment, and shallow groundwater which may be exposed at the surface within the *MRS R03 Range XII – Position Firing Course*. Outside the Kissimmee Prairie State Park Preserve, these wetlands are partially drained or ditched. The following wetland types occur within this MRS:

- PEM1A/F/C - Palustrine, emergent, persistent, temporarily flooded / semi-permanently flooded / seasonally flooded

5.6.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R03 Range XII – Position Firing Course*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.6.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water and sediment resulting from wetlands located within this MRS. Potential receptors would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.6.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.6.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.6.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R03 Range XII – Position Firing Course*. Direct releases of MCs could occur to surface soil, surface water, and sediment. As described in Subchapter 5.6.4.5, one MC metal (barium) was detected above the selected background concentration in the surface soil within this MRS. Antimony was additionally detected. Therefore, as there is a potential source of MC contamination, the surface water and sediment migration pathways are potentially complete, but not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.6.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.6.4.1 Physical Source Access Conditions

The *MRS R03 Range XII – Position Firing Course* is comprised of 20,252 land acres. This MRS overlaps with the Kissimmee Prairie Preserve State Park and residential properties. There are no known access restrictions to this MRS. This target was used for gunnery practice.

5.6.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R03 Range XII – Position Firing Course*. Munitions-related activities could have directly affected soils. The PFC target area consisted of eight scattered targets, which were fired upon by the side machine guns on B-17 aircraft. An additional practice bombing target location was identified in the 1996 ASR within the boundaries of the MRS, but was not designated as an MRS; the non-MRS bombing target location is shown on Figures 2.2 and 5.2 (pink dashed outline or lime green solid outline, respectively; labeled as “Practice Bombing Target”). Munitions known or suspected used at this MRS include M38A2 100-lb. practice bombs with spotting charges, small arms munitions including .50-caliber ammunition, and “flares, signals, simulators, or screening smoke (other than white phosphorus)” (USACE, 2004 b). The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. No MEC or MD were found within this MRS during the May 2008 SI site visit. No MEC or MD were found within the aforementioned non-MRS practice bombing target during the 2008 site visit. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.6.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R03 Range XII – Position Firing Course* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.6.4.4 Soil Sample Locations and Methodologies

5.6.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R03 Range XII – Position Firing Course* with three biased surface soil samples (and QA/QC samples). Surface soil samples APR-MRSR03-SS-06-04 and APR-MRSR03-SS-06-05 were collected within this MRS. Surface soil sample APR-MRSR03-SS-06-10 (and field duplicate APR-MRSR03-SS-06-22) was collected from the target center of the aforementioned non-MRS practice bombing target. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.6.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.6.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.6.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R03 Range XII – Position Firing Course* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface samples collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.12. As shown in this table, one MC metal (barium) was detected at a concentration greater than the selected background concentration. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. These metals will be evaluated in the SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this MRS.

Table 5.12
Surface Soil Source Evaluation
MRS R03 Range XII – Position Firing Course
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	1,600	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.036	0.28 U	Yes	Yes	Yes	--
Barium	mg/kg	8.6	5.8	Yes	Yes	Yes	--
Copper	mg/kg	2.8	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	3.6	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	7.8	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.6.4.6 Soil Exposure Conclusions

The surface soil migration pathways are complete for the *MRS R03 Range XII – Position Firing Course*. Three biased surface soil samples (and one field duplicate) were collected from this MRS. Although explosives were not detected in the surface samples collected, one MC metal (barium) was detected at a concentration greater than the selected background concentration. Additionally, antimony was detected. As there are no background data for comparison (for antimony in surface soil), it cannot be determined if the observed concentrations are within the range of background. These metals will be evaluated in the SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this MRS.

5.6.5 Air Migration Pathway

5.6.5.1 Climate

The climate for the *MRS R03 Range XII – Position Firing Course* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.6.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R03 Range XII – Position Firing Course*. The occurrence of windblown dust may occur at the site.

5.6.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R03 Range XII – Position Firing Course* would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.6.4.5, one MC metal (barium) was detected above the selected background concentration in the surface soil within this MRS. Antimony was additionally detected. The inhalation via fugitive dust is a potentially complete exposure route for MC.

5.6.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R03 Range XII – Position Firing Course*. Air sampling was not performed as part of the SI.

5.6.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.6.5.6 Air Migration Pathway Conclusions

One MC metal (barium) was detected above the selected background concentration in the surface soil within this MRS. Antimony was additionally detected. The inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human health screening levels chosen include the inhalation pathway. The

ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.7 MUNITIONS RESPONSE SITE R04 TARGET XIII –PRACTICE BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R04 Target XIII – Practice Bombing Target*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.7.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.7.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R04 Target XIII – Practice Bombing Target*.

5.7.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.7.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.7.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R04 Target XIII – Practice Bombing Target*. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.7.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.7.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.7.2.6 Groundwater Migration Pathway Conclusions

5.7.2.6.1 Groundwater sampling was not performed at the *MRS R04 Target XIII – Practice Bombing Target*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.7.4.5, one MC metal (antimony) was detected in the surface soil sample collected within this MRS. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, there is potential MC contamination within the surface soil which may leach to the groundwater. However, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.7.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.7.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.7.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is surface water, sediment, and shallow groundwater which may be exposed at the surface within the *MRS R04 Target XIII – Practice Bombing Target*. The following wetland types occur within this MRS:

- PEM1A/C - Palustrine, emergent, persistent, temporarily flooded / seasonally flooded

5.7.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R04 Target XIII – Practice Bombing Target*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.7.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water and sediment resulting from wetlands located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.7.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.7.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.7.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R04 Target XIII – Practice Bombing Target*. As stated in paragraph 5.7.3.2, the presence of local surface water and sediment (in the form of wetlands and shallow groundwater which may be exposed at the surface) provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities could occur. One MC metal (antimony) was detected in the surface soil sample. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. This metal is evaluated in the SLRA in Chapter 6. Therefore, as there is a potential source of MC contamination, the surface water and sediment migration pathways are potentially complete, not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.7.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.7.4.1 Physical Source Access Conditions

The *MRS R04 Target XIII – Practice Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This MRS was used for practice bombing with one approach pattern. This MRS is relatively remote, though it is accessible via 4WD vehicle, foot, and horseback.

5.7.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R04 Target XIII – Practice Bombing Target*. Munitions-related activities could have directly affected soils. This MRS was used for practice bombing with one approach pattern. Munitions known or suspected used at this MRS include M38A2 100-lb. practice bombs with spotting charges and “flares, signals, simulators, or screening smoke (other than white phosphorus)” (USACE, 2004b). The 1996 ASR investigation team conducted an aerial survey of this MRS, during which they noted three concrete footings they attributed to the likely remnants of an observation tower. A controlled burn was conducted prior to the May 2008 site visit. At target center, the SVT noted a circular mound approximately 50’ in circumference, which was covered in thick vegetation. The center of the former target was littered with bomb debris originating from M382 practice bombs during the May 2008 SI site visit. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.7.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R04 Target XIII – Practice Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.7.4.4 Soil Sample Locations and Methodologies

5.7.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R04 Target XIII – Practice Bombing Target* with one biased surface soil sample (APR-MRSR04-SS-06-6) located at target center. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.7.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.7.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.7.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil sample collected from *MRS R04 Target XIII – Practice Bombing Target* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface soil sample collected within this MRS. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table

5.13. As shown in this table, no MC metals were detected at concentrations exceeding the available, selected background concentrations. Antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Based on these sample results, there is potential MC contamination present in the surface soil at this MRS.

Table 5.13
Surface Soil Source Evaluation
MRS R04 Target XIII – Practice Bombing Target
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	130	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.15	0.28 U	Yes	Yes	Yes	--
Barium	mg/kg	4.2	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	7.1	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	4.2	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	18.0	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.7.4.6 Soil Exposure Conclusions

The surface soil migration pathway is complete for this MRS. One biased surface soil sample was collected from the *MRS R04 Target XIII – Practice Bombing Target*. Explosives were not detected in the sample. One MC metal (antimony) was detected in the surface soil sample. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. This metal is evaluated in the SLRA in Chapter 6.

5.7.5 Air Migration Pathway

5.7.5.1 Climate

The climate for the *MRS R04 Target XIII – Practice Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.7.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R04 Target XIII – Practice Bombing Target*. The occurrence of windblown dust may occur at the site.

5.7.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R04 Target XIII – Practice Bombing Target* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.7.4.5, one MC metal (antimony) was detected in the surface soil within this MRS. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC.

5.7.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R04 Target XIII – Practice Bombing Target*. Air sampling was not performed as part of the SI.

5.7.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.7.5.6 Air Migration Pathway Conclusions

One MC metal (antimony) was detected in the surface soil within *MRS R04 Target XIII – Practice Bombing Target*. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human health screening levels chosen include the inhalation pathway. The ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.8 MUNITIONS RESPONSE SITE R05 TARGET XIV –PRACTICE BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R05 Target XIV – Practice Bombing Target*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.8.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.8.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R05 Target XIV – Practice Bombing Target*.

5.8.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. One water well is located within the *MRS R05 Target XIV – Practice Bombing Target*. This well has a depth of 115 feet and is registered for livestock use.

5.8.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.8.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply drinking water wells located within the *MRS R05 Target XIV – Practice Bombing Target*. One water well registered for livestock use is located within this MRS. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.8.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.8.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.8.2.6 Groundwater Migration Pathway Conclusions

5.8.2.6.1 Groundwater sampling was not performed at the *MRS R05 Target XIV – Practice Bombing Target*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.8.4.5, no MC metals were detected above background in the surface soil within this MRS. However, there is potential for direct release of MC to surface water and sediment, as well as potential for surface water recharge of groundwater. There is one water well registered for livestock use within this MRS. Human receptors may be exposed to groundwater at this MRS via incidental ingestion and dermal contact. The groundwater exposure pathway is potentially complete for human receptors.

5.8.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.8.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.8.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is surface water, sediment, and shallow groundwater which may be exposed at the surface within the *MRS R05 Target XIV – Practice Bombing Target*. The following wetland types occur within this MRS:

- PEM1F/C - Palustrine, emergent, persistent, semi- permanently flooded / seasonally flooded

5.8.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R05 Target XIV – Practice Bombing Target*. The presence of local surface water and sediment (in the form of wetlands and shallow groundwater) provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities could occur.

5.8.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands located within this MRS. Potential receptors would include current or future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.8.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.8.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.8.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R05 Target XIV – Practice Bombing Target*. As stated in paragraph 5.8.3.2, the presence of local surface water and sediment (in the form of wetlands and shallow groundwater) provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities could occur. As stated in paragraph 5.8.4.5, no MC metals were detected above background in the surface soil sample collected within this MRS. Additionally, explosives were not detected. Although there is no source of MC contamination in the surface soil, the surface water and sediment migration pathways are potentially complete due to the potential for direct releases of MC to surface water and/or sediment. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.8.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.8.4.1 Physical Source Access Conditions

The *MRS R05 Target XIV – Practice Bombing Target* is comprised of 649 land acres. This MRS was used for practice bombing with two approach patterns. This MRS is located on residential and agricultural (cattle pasture) land. There are no known access restrictions.

5.8.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R05 Target XIV – Practice Bombing Target*. Munitions-related activities could have directly affected soils. This MRS was used for practice bombing with two approach patterns. Munitions known or suspected used at this MRS include M38A2 100-lb. practice bombs with spotting charges and “flares, signals, simulators, or screening smoke (other than white phosphorus)” (USACE, 2004b). The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. No MEC or MD were found during the May 2008 site visit. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.8.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R05 Target XIV – Practice Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.8.4.4 Soil Sample Locations and Methodologies

5.8.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R05 Target XIV – Practice Bombing Target* with one biased surface soil sample located at target center (APR-MRSR05-SS-06-07). Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.8.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.8.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.8.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil sample collected from *MRS R05 Target XIV – Practice Bombing Target* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface soil sample collected within this MRS. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.14. As shown in this table, no MC metals were detected in the surface soil sample at concentrations exceeding the selected background concentrations. Therefore, based on these sample results, there is no MC contamination present in the surface soil at this MRS.

Table 5.14
Surface Soil Source Evaluation
MRS R05 Target XIV – Practice Bombing Target
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	72	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.26 U	0.28 U	No	Yes	No	Not detected at MRS
Barium	mg/kg	2.1	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	2.5	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	0.78	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	4.7	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.8.4.6 Soil Exposure Conclusions

The surface soil migration pathway is incomplete for *MRS R05 Target XIV – Practice*. Explosives were not detected in the samples. No MC metals were detected at concentrations greater than the selected background concentration. Therefore, based on the analytical results presented in this report, the concentrations of these metals are not elevated as a result of munitions-related activities at the site. Based on the current information available for the site, the soil migration pathway is incomplete for this MRS as there is no potential MC contamination present.

5.8.5 Air Migration Pathway

5.8.5.1 Climate

The climate for the *MRS R05 Target XIV – Practice Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.8.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R05 Target XIV – Practice Bombing Target*. The occurrence of windblown dust may occur at the site.

5.8.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R05 Target XIV – Practice Bombing Target* would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.8.4.5, no MC metals were detected in the surface soil within this MRS. The inhalation via fugitive dust is an incomplete exposure route for MC.

5.8.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R05 Target XIV – Practice Bombing Target*. Air sampling was not performed as part of the SI.

5.8.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.8.5.6 Air Migration Pathway Conclusions

Air samples were not collected during this SI. As discussed above in Subchapter 5.8.4., no MC metals were detected above the selected background concentration in the surface soil sample collected within *MRS R05 Target XIV – Practice Bombing Target*. Therefore, the soil pathway and the inhalation via fugitive dust exposure route are incomplete.

5.9 MUNITIONS RESPONSE SITE R06 RANGE XIX – POSITION FIRING COURSE

This subchapter of the SI Report evaluates exposure pathways for the *MRS R06 Range XIX – Position Firing Course*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.9.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.9.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R06 Range XIX – Position Firing Course*.

5.9.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. There are two registered water wells within the area of overlap between *MRS R06 Range XIX – Position Firing Course* and *MRS R03 Range XII – Position Firing Course* (Figure 5.3). These wells are at a depth of 140 feet and are registered for livestock use (Appendix L).

5.9.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.9.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply drinking water wells located within the *MRS R06 Range XIX – Position Firing Course*. There are two water wells registered for livestock use within this MRS. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.9.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.9.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.9.2.6 Groundwater Migration Pathway Conclusions

5.9.2.6.1 Groundwater sampling was not performed at the *MRS R06 Range XIX – Position Firing Course*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.9.4.5, two MC metals (barium and copper) were detected above background concentrations in the surface soil samples collected within this MRS. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. There are two water wells registered for livestock use within this MRS. Human receptors may be exposed to groundwater within this MRS via incidental ingestion and dermal contact. The groundwater exposure pathway is potentially complete for human receptors.

5.9.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.9.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.9.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. As indicated in Figure 5.4, there is surface water, sediment, and shallow groundwater which may be exposed at the surface within the *MRS R06 Range XIX – Position Firing Course*. Outside the Kissimmee Prairie State Park Preserve, many of these wetlands are partially drained or ditched. The following wetland types occur within this MRS:

- PEM1A/F/C - Palustrine, emergent, persistent, temporarily flooded / semi-permanently flooded / seasonally flooded

- PFO1/3C – Palustrine, forested, broad-leaved deciduous or broad-leaved evergreen, seasonally flooded
- PFO3/1A - Palustrine, forested, broad-leaved deciduous or broad-leaved evergreen, temporarily flooded

5.9.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R06 Range XIX – Position Firing Course*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.9.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands located within this MRS. Potential receptors would include current or future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.9.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.9.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.9.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R06 Range XIX – Position Firing Course*. However, direct releases of MCs could occur to the surface soil, surface water, and sediment. Although explosives were not detected in the surface soil samples collected, two MC metals (barium and copper) were detected in the surface soil at concentrations greater than the selected background concentrations. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, as there is a potential source of MC contamination, the surface water and sediment migration pathways are potentially complete, but not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.9.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.9.4.1 Physical Source Access Conditions

The *MRS R06 Range XIX – Position Firing Course* is comprised of 29,186 land acres. This MRS was used for gunnery practice; however MD originating from bombs has been found within this MRS. This MRS is located on residential, agricultural (cattle pasture), and State Park land. There are no known access restrictions.

5.9.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R06 Range XIX – Position Firing Course*. This range consisted of four separate target areas with scattered ground targets used for firing the chin-mounted machine guns as well as the side guns on the B-17 aircraft. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Munitions-related activities could have directly affected soils. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. The May 2008 SVT observed MD originating from an Mk106 5lb. practice bomb previously discovered by State Park employees. Several pieces of AN-M50 Incendiary Bombs were found during the May 2008 site visit. The SVT also observed a rocket pod previously found by State Park employees. The SVT noted that the northeastern part of the MRS had been control burned on May 5, 2008, three days prior to their visit of the area. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.9.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R06 Range XIX – Position Firing Course* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.9.4.4 Soil Sample Locations and Methodologies

5.9.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R06 Range XIX – Position Firing Course* with three biased surface soil sample locations (APR-MRSR06-SS-06-08, APR-MRSR06-SS-06-09, APR-MRSR06-SS-06-20). Surface soil sample APR-MRSR06-SS-06-20 was moved from the planned location to the location adjacent to the Mk106 bomb debris. One additional surface soil sample (APR-MRSR06-SS-06-16) was collected from within the crater with AN-M50 debris. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.9.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.9.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.9.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R06 Range XIX – Position Firing Course* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface soil samples collected within this MRS. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.15. Barium and copper were detected in the surface soil at concentrations exceeding the selected background concentrations. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. These metals will be evaluated in the SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this MRS.

Table 5.15
Surface Soil Source Evaluation
MRS R06 Range XIX – Position Firing Course
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	560	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.028	0.28 U	Yes	Yes	Yes	--
Barium	mg/kg	88	5.8	Yes	Yes	Yes	--
Copper	mg/kg	11	8.185	Yes	Yes	Yes	--
Lead	mg/kg	6.1	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	0.90	18.253	No	Yes	No	Not detected above background

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.9.4.6 Soil Exposure Conclusions

The surface soil migration pathways are complete for the *MRS R06 Range XIX – Position Firing Course*. Four biased surface soil samples were collected from the *MRS R06 Range XIX – Position Firing Course*. Although explosives were not detected in the surface samples collected, two MC metals (barium and copper) were detected at concentrations greater than the selected background concentrations. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. These metals will be evaluated in the SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this MRS.

5.9.5 Air Migration Pathway

5.9.5.1 Climate

The climate for the *MRS R06 Range XIX – Position Firing Course* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.9.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R06 Range XIX – Position Firing Course*. The occurrence of windblown dust may occur at the site.

5.9.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R06 Range XIX – Position Firing Course* would include current and future residents, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.9.4.5, two MCs (barium and copper) were detected above background concentrations in the surface soil at this MRS. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. The inhalation via fugitive dust is a potentially complete exposure route for MC.

5.9.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at the *MRS R06 Range XIX – Position Firing Course*. Air sampling was not performed as part of the SI.

5.9.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.9.5.6 Air Migration Pathway Conclusions

Two MCs (barium and copper) were detected above background concentrations in the surface soil at *MRS R06 Range XIX – Position Firing Course*. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above

background concentrations. The inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human health screening levels chosen include the inhalation pathway. The ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.10 MUNITIONS RESPONSE SITE R07 TARGET XV –PRACTICE BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R07 Target XV –Practice Bombing Target*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.10.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.10.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R07 Target XV –Practice Bombing Target*.

5.10.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary (Figure 5.3 and Appendix L).

5.10.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.10.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R07 Target XV –Practice Bombing Target*. Potential human receptors would include commercial and

industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.10.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.10.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.10.2.6 Groundwater Migration Pathway Conclusions

5.10.2.6.1 Groundwater sampling was not performed at the *MRS R07 Target XV – Practice Bombing Target*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.10.4.5, one MC metal (antimony) was in the surface soil within this MRS. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, there is potential MC in the surface soil which may leach to the groundwater. However, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.10.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.10.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.10.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. There is potential for shallow groundwater to be exposed at the surface within this MRS. As indicated in Figure 5.4, there are partially drained or ditched wetlands within the *MRS R07 Target XV – Practice Bombing Target*. The following wetland types occur within this MRS:

- PEM1Fd - Palustrine, emergent, persistent, semi- permanently flooded, partially drained / ditched
- PEM1Ad – Palustrine, emergent, persistent, temporarily flooded, partially drained / ditched

5.10.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R07 Target XV –Practice Bombing Target*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.10.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands and shallow groundwater which may be exposed at the surface located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. Ecological receptors may also be exposed to surface water through ingestion as a drinking water source.

5.10.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.10.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.10.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R07 Target XV –Practice Bombing Target*. However, direct releases of MCs could occur to the surface soil, surface water, and sediment. Although explosives were not detected in the surface soil samples collected, one MC metal (antimony) was detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, as there is a potential source of MC contamination, the surface water and sediment migration pathways are potentially complete, but not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.10.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.10.4.1 Physical Source Access Conditions

The *MRS R07 Target XV –Practice Bombing Target* is comprised of 649 land acres. This target was used as a practice bombing target with two approach patterns. This MRS is located on agricultural land (cattle and sod). There are no known access restrictions.

5.10.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R07 Target XV –Practice Bombing Target*. This target was used as a practice bombing target with two approach patterns. The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Munitions-related activities could have directly affected soils. The 1996 ASR investigation team conducted a ground survey of this MRS, but did not find any ordnance. The site had been cultivated and was used for cattle grazing at that time. The May 2008 SVT did not observe MEC, MD, or target remnants. The owner of the farm reported to the SVT that he has never found any MD or MEC on the property. He previously removed what he referred to as “footing for a control tower.” Approximately one foot of soil has been removed for sod and the area has been leveled. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.10.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R07 Target XV –Practice Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.10.4.4 Soil Sample Locations and Methodologies

5.10.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R07 Target XV –Practice Bombing Target* with one biased surface soil sample location (APR-MRSR07-SS-06-11) to be collected within the central area of the former target. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.10.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.10.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.10.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil sample collected from *MRS R07 Target XV – Practice Bombing Target* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface sample collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.16. As shown in this table, no MC metals were detected at concentrations exceeding the available, selected background concentrations. However, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. This metal will be evaluated in the SLRA in Chapter 6. Based on these sample results, there is potential MC contamination in the surface soil at this MRS.

**Table 5.16
Surface Soil Source Evaluation
MRS R07 Target XV – Practice Bombing Target
USAF Avon Park Range, Okeechobee and Polk Counties, Florida**

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	350	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.019	0.28 U	Yes	Yes	Yes	--
Barium	mg/kg	5.2	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	4.4	8.185	No	Yes	No	Not detected above background
Lead	mg/kg	1.3	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	2.7 U	18.253	No	Yes	No	Not detected at MRS

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.10.4.6 Soil Exposure Conclusions

The surface soil migration pathways are complete for the *MRS R07 Target XV – Practice Bombing Target*. One biased surface soil sample was collected from target center of this MRS. Explosives were not detected in the sample. No MC metals were detected at concentrations greater than the available, selected background concentrations. However, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. This metal will be evaluated in the SLRA in Chapter 6. Based on these sample results, there is potential MC contamination in the surface soil at this MRS.

5.10.5 Air Migration Pathway

5.10.5.1 Climate

The climate for the *MRS R07 Target XV –Practice Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.10.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R07 Target XV –Practice Bombing Target*. The occurrence of windblown dust may occur at the site.

5.10.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R07 Target XV –Practice Bombing Target* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.10.4.5, antimony was detected in the surface soil at this MRS. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC.

5.10.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.10.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.10.5.6 Air Migration Pathway Conclusions

One MC metal (antimony) was detected in the surface soil within the *MRS R07 Target XV –Practice Bombing Target*. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human

health screening levels chosen include the inhalation pathway. The ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.11 MUNITIONS RESPONSE SITE R08 AREA BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R08 Area Bombing Target*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.11.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.11.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R08 Area Bombing Target*.

5.11.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.11.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.11.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R08 Area Bombing Target*. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.11.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.11.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.11.2.6 Groundwater Migration Pathway Conclusions

5.11.2.6.1 Groundwater sampling was not performed at the *MRS R08 Area Bombing Target*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.11.4.5, one MC metal (copper) was detected above the selected background concentration in the surface soil. Antimony was additionally detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, there is potential MC in the surface soil which may leach to the groundwater. However, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.11.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.11.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.11.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. There is potential for shallow groundwater to be exposed at the surface within this MRS. As indicated in Figure 5.4, the following wetland types occur within the *MRS R08 Area Bombing Target*:

- PEM1C - Palustrine, emergent, persistent, seasonally flooded
- PEM1A – Palustrine, emergent, persistent, temporarily flooded

5.11.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R08 Area Bombing Target*. The presence of local surface water, sediment, and shallow groundwater which may be exposed at the surface provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.11.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands and shallow groundwater which may be exposed at the surface located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. Ecological receptors may also be exposed to surface water through ingestion as a drinking water source.

5.11.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.11.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.11.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R08 Area Bombing Target*. However, direct releases of MCs could occur to the surface soil, surface water, and sediment. Although explosives were not detected in the surface soil samples collected, one MC metal (copper) was detected above the selected background concentration in the surface soil. Antimony was additionally detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, as there is a potential source of MC contamination, the surface water and sediment migration pathways are potentially complete, not quantitatively assessed. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.11.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.11.4.1 Physical Source Access Conditions

The *MRS R08 Area Bombing Target* is comprised of 649 land acres. This target was used as a practice formation bombing target. The target area was an approximately 160-

acre rectangle. This MRS is located within the Kissimmee Prairie Preserve State Park. There are no known access restrictions.

5.11.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R08 Area Bombing Target*. This target was used as a practice formation bombing target. The target area was an approximately 160-acre rectangle. The ASR Supplement lists the following munitions associated with this MRS: Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Munitions-related activities could have directly affected soils. The 1996 ASR investigation team conducted a ground and aerial survey of this MRS. At this time, remnants of the limestone target outline were visible. The team observed the remains of a scrap pile located at the center of the target. The remains included M38A2 practice bomb components. The May 2008 SVT also observed this pile of debris, but did not find any MEC. This MRS was control burned in 2007. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.11.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R08 Area Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.11.4.4 Soil Sample Locations and Methodologies

5.11.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R08 Area Bombing Target* with one biased surface soil sample location (APR-MRSR08-SS-06-12) to be collected within the central area of the former target. A discretionary biased surface soil sample (APR-MRSR08-SS-06-14) was collected next to the debris pile described above. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.11.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.11.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.11.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R08 Area Bombing Target* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface

sample collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.17. As shown in this table, one MC metal (copper) was detected in the surface soil at concentrations exceeding the selected background concentrations. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. These metals will be evaluated in the SLRA in Chapter 6. Based on these sample results, there is potential MC contamination in the surface soil at this MRS.

**Table 5.17
Surface Soil Source Evaluation
MRS R08 Area Bombing Target
USAF Avon Park Range, Okeechobee and Polk Counties, Florida**

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	190	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.17	0.28 U	Yes	Yes	Yes	--
Barium	mg/kg	4.1	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	11	8.185	Yes	Yes	Yes	--
Lead	mg/kg	3.3	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	2.8 U	18.253	No	Yes	No	Not detected at MRS

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.11.4.6 Soil Exposure Conclusions

The surface soil migration pathways are complete for the *MRS R08 Area Bombing Target*. Two biased surface soil samples were collected from this MRS. Explosives were not detected in the sample. One MC metal (copper) was detected at concentrations greater than the, selected background concentrations. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. These metals will be evaluated in the SLRA in Chapter 6. Based on these sample results, there is potential MC contamination in the surface soil at this MRS.

5.11.5 Air Migration Pathway

5.11.5.1 Climate

The climate for the *MRS R08 Area Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.11.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R08 Area Bombing Target*. The occurrence of windblown dust may occur at the site.

5.11.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R08 Area Bombing Target* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. As described in Subchapter 5.11.4.5, copper was detected above the selected background concentration in the surface soil at this MRS. Additionally, antimony was detected in the surface soil at this MRS. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC.

5.11.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.11.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.11.5.6 Air Migration Pathway Conclusions

One MC metal (copper) was detected above the selected background concentration in the surface soil within the *MRS R08 Area Bombing Target*. Antimony was additionally detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. Inhalation via fugitive dust is a potentially complete exposure route for MC. Consequently, there is a potential for human and ecological

receptor exposure to contaminated soil particulates through inhalation of fugitive dust. This pathway is evaluated as a soil pathway in the SLRA, as the human health screening levels chosen include the inhalation pathway. The ecological screening values do not include the inhalation pathway; thus, the inhalation pathway for ecological receptors is potentially complete, but not quantitatively evaluated.

5.12 MUNITIONS RESPONSE SITE R09 NORTH RESTRICTED USE AREA

This subchapter of the SI Report evaluates exposure pathways for the *MRS R09 North Restricted Use Area*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.12.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.12.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R09 North Restricted Use Area*.

5.12.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.12.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.12.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R09 North Restricted Use Area*. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Human receptors in the area could be exposed to groundwater via incidental ingestion and dermal contact. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this

MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.12.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.12.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.12.2.6 Groundwater Migration Pathway Conclusions

5.12.2.6.1 Groundwater sampling was not performed at the *MRS R09 North Restricted Use Area*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.12.4.5, no MC metals were detected in the surface soil above the selected background concentrations. Additionally, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.12.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.12.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.12.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. There is potential for shallow groundwater to be exposed at the surface within this MRS. As indicated in Figure 5.4, the following wetland types occur within the *MRS R09 North Restricted Use Area*:

- PEM1C - Palustrine, emergent, persistent, seasonally flooded
- PEM1A – Palustrine, emergent, persistent, temporarily flooded
- PEM1F - Palustrine, emergent, persistent, semi-permanently flooded
- PSS1/3Cd - Palustrine, scrub-shrub, broad-leaved deciduous / broad-leaved evergreen, seasonally flooded, partially drained / ditched

5.12.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R09 North Restricted Use Area*. The presence of local surface water, sediment, and shallow groundwater potentially exposed at the surface provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.12.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands and shallow groundwater which may be exposed at the surface located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. Ecological receptors may also be exposed to surface water through ingestion as a drinking water source.

5.12.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.12.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.12.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R09 North Restricted Use Area*. However, direct releases of MCs could occur to the surface soil, surface water, and sediment. Explosives were not detected in the surface soil samples collected. As discussed in paragraph 5.12.4.5, no MC metals were detected in the surface soil above the selected background concentrations. Although there is no MC contamination in the surface soil, the surface water and sediment migration pathways may be complete as a result of the potential for direct release of MC to these media. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.12.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.12.4.1 Physical Source Access Conditions

The *MRS R09 North Restricted Use Area* is comprised of 2,785 land acres. A 1952 deed certificate suggested that the 320 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open

Detonation area around the 320-acre area in question. This MRS is located within the Kissimmee Prairie Preserve State Park. There are no known access restrictions.

5.12.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R09 North Restricted Use Area*. A 1952 deed certificate suggested that the 320 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 320-acre area in question. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Munitions-related activities could have directly affected soils. It is unclear whether the 1996 ASR investigation team conducted an aerial survey of this MRS. The May 2008 SVT found it challenging to navigate through this MRS as the palmettos have grown to five to six feet high due to lack of controlled burns. They did not find any MD or MEC. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.12.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R09 North Restricted Use Area* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.12.4.4 Soil Sample Locations and Methodologies

5.12.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R09 North Restricted Use Area* with one biased surface soil sample (APR-MRSR09-SS-06-13) (and field duplicate APR-MRSR09-SS-06-23) to be collected within this MRS. A discretionary biased surface soil sample was deemed unnecessary to collect as the SVT did not note any MEC, MD, or areas of potential contamination. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.12.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.12.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.12.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from *MRS R09 North Restricted Use Area* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface sample collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.18. As shown in this table, no MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. Based on these sample results, there is no MC contamination in the surface soil at this MRS.

**Table 5.18
Surface Soil Source Evaluation
MRS R09 North Restricted Use Area
USAF Avon Park Range, Okeechobee and Polk Counties, Florida**

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	360	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.28 U	0.28 U	No	Yes	No	Not detected at MRS
Barium	mg/kg	1.6	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	0.39	8.185	No	Yes	No	Not detected above background
Iron	mg/kg	1,600	1,920	No	Yes	No	Not detected above background
Lead	mg/kg	2.4	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	2.8 U	18.253	No	Yes	No	Not detected at MRS

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.12.4.6 Soil Exposure Conclusions

The surface soil migration pathways are incomplete for the *MRS R09 North Restricted Use Area*. One biased surface soil sample (and field duplicate sample) was collected from this MRS. Explosives were not detected in the sample. No MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. Based on the current information available for this MRS, there is no MC contamination present.

5.12.5 Air Migration Pathway

5.12.5.1 Climate

The climate for the *MRS R09 North Restricted Use Area* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.12.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R09 North Restricted Use Area*. The occurrence of windblown dust may occur at the site.

5.12.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R09 North Restricted Use Area* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. However, as described in Subchapter 5.12.4.5, no MC metals were detected above background concentrations in the surface soil at this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.12.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.12.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.12.5.6 Air Migration Pathway Conclusions

The air migration pathway is incomplete for the *MRS R09 North Restricted Use Area*. As described in Subchapter 5.12.4.5, no MC metals were detected above background concentrations in the surface soil at this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.13 MUNITIONS RESPONSE SITE R10 CENTRAL RESTRICTED USE AREA

This subchapter of the SI Report evaluates exposure pathways for the *MRS R10 Central Restricted Use Area*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.13.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.13.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R10 Central Restricted Use Area*.

5.13.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. No registered wells are located within the MRS boundary.

5.13.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for leaching and surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.13.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R10 Central Restricted Use Area*. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Contaminant migration to the groundwater via leaching and surface water recharge is possible at this MRS. It is unlikely that ecological receptors would be exposed to the groundwater, resulting in an incomplete pathway for ecological receptors.

5.13.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.13.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.13.2.6 Groundwater Migration Pathway Conclusions

5.13.2.6.1 Groundwater sampling was not performed at the *MRS R10 Central Restricted Use Area*. Leaching and surface water recharge from the MRS could provide a potential environmental transport mechanism. As discussed in paragraph 5.13.4.5, no

MC metals were detected in the surface soil above the selected background concentrations. Additionally, there are no known groundwater wells at the site. Therefore, the groundwater exposure pathway is incomplete for human receptors.

5.13.2.6.2 It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. However, in some special situations (for example, the presence of groundwater seeps, or very shallow groundwater) some ecological receptors may come in contact with groundwater. Due to the shallowness of the surficial aquifer and the potential for exposure of this aquifer at the surface, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. The groundwater exposure pathway is incomplete for ecological receptors.

5.13.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.13.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. There is potential for shallow groundwater to be exposed at the surface within this MRS. As indicated in Figure 5.4, the following wetland types occur within the *MRS R10 Central Restricted Use Area*:

- PEM1C - Palustrine, emergent, persistent, seasonally flooded
- PEM1A - Palustrine, emergent, persistent, temporarily flooded
- PEM1F - Palustrine, emergent, persistent, semi-permanently flooded

5.13.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R10 Central Restricted Use Area*. The presence of local surface water, sediment, and shallow groundwater which may be exposed at the surface provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur.

5.13.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands and shallow groundwater which may be exposed at the surface located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. Ecological receptors may also be exposed to surface water through ingestion as a drinking water source.

5.13.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.13.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.13.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R10 Central Restricted Use Area*. However, direct releases of MCs could occur to the surface soil, surface water, and sediment. Explosives were not detected in the surface soil samples collected. As discussed in paragraph 5.13.4.5, no MC metals were detected in the surface soil above the selected background concentrations. Although there is no MC contamination in the surface soil, the surface water and sediment migration pathways may be complete as a result of the potential for direct release of MC to these media. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water within this MRS is not used as drinking water.

5.13.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use.

5.13.4.1 Physical Source Access Conditions

The *MRS R10 Central Restricted Use Area* is comprised of 3,575 land acres. A 1952 deed certificate suggested that the 640 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 640-acre area in question. The *MRS R06 Range XIX – Position Firing Course* entirely encompasses this MRS. This MRS is located within the Kissimmee Prairie Preserve State Park. There are no known access restrictions.

5.13.4.2 Actual or Potential Contamination Areas

Prior to the SI, there were no known contamination areas within the *MRS R10 Central Restricted Use Area*. A 1952 deed certificate suggested that the 640 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 640-acre area in question. The *MRS R06 Range XIX – Position Firing Course* entirely encompasses this MRS. The ASR Supplement lists the following munitions associated with this MRS: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). Munitions-related activities could have directly affected soils. The 1996 ASR investigation team conducted an aerial survey over a portion of this MRS, but only noted a dried up pond in

the area. A portion of this MRS was control burned three days prior to the 2008 SI visit. The May 2008 SVT found approximately 200 .50-caliber shell casings and one .50-caliber bullet within this MRS. No MC sample analyses of this MRS are known to have been conducted previous to this SI.

5.13.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R10 Central Restricted Use Area* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the known current and future uses of the land, the potential receptors at this MRS would include commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.13.4.4 Soil Sample Locations and Methodologies

5.13.4.4.1 During the December 4, 2007 TPP meeting, the TPP Team agreed to establish the sample scheme for the *MRS R10 Central Restricted Use Area* with one biased surface soil sample (APR-MRSR10-SS-06-15) to be collected within this MRS. A discretionary biased surface soil sample was deemed unnecessary to collect. Figure 5.2 shows the actual QR paths and sample locations for this MRS.

5.13.4.4.2 All surface soil sampling locations are screened and approved by a UXO Technician III to confirm the absence of potential subsurface anomalies prior to final selection of locations and collection of samples. Discrete soil samples were collected at a depth of 0 to 6 inches bgs at each sample location. The actual GPS coordinates of the sample locations were recorded and updated in the GIS database.

5.13.4.4.3 The sample collection procedures presented in the Sampling and Analysis Plan (USACE, 2005), the Parsons Final PSAP Addendum (Parsons, 2006), the PWP (Parsons, 2005), and the USAF Avon Park Range Final SS-WP Addendum (Parsons, 2008b) were followed except as discussed in Subchapter 3.5.

5.13.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil sample collected from *MRS R10 Central Restricted Use Area* are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. Explosives were not detected in the surface sample collected. Therefore, this evaluation was performed for indicator metals only. The source evaluation for surface soil is summarized in Table 5.19. As shown in this table, no MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. Based on these sample results, there is no MC contamination in the surface soil at this MRS.

**Table 5.19
Surface Soil Source Evaluation
MRS R10 Central Restricted Use Area
USAF Avon Park Range, Okeechobee and Polk Counties, Florida**

Analyte	Units	Maximum Detected Site Concentration	Background Concentration^a	Exceeds Background Concentration?	Potential MC?^b	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>							
Aluminum	mg/kg	170	4,960	No	Yes	No	Not detected above background
Antimony	mg/kg	0.29 U	0.28 U	No	Yes	No	Not detected at MRS
Barium	mg/kg	4.4	5.8	No	Yes	No	Not detected above background
Copper	mg/kg	0.29	8.185	No	Yes	No	Not detected above background
Iron	mg/kg	130	1,920	No	Yes	No	Not detected above background
Lead	mg/kg	1.8	8.763	No	Yes	No	Not detected above background
Zinc	mg/kg	2.9 U	18.253	No	Yes	No	Not detected at MRS

a – Background concentration as established in Table 5.4

b – Potential MCs as listed in Table 4.1

U – Analyte not detected above the adjusted PQL.

5.13.4.6 Soil Exposure Conclusions

The surface soil migration pathways are incomplete for the *MRS R10 Central Restricted Use Area*. One biased surface soil sample was collected from this MRS. Explosives were not detected in the sample. No MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. Based on the current information available for this MRS, there is no MC contamination present.

5.13.5 Air Migration Pathway

5.13.5.1 Climate

The climate for the *MRS R10 Central Restricted Use Area* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.13.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R10 Central Restricted Use Area*. The occurrence of windblown dust may occur at the site.

5.13.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R10 Central Restricted Use Area* would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. However, as described in Subchapter 5.13.4.5, no MC metals were detected above background concentrations in the surface soil at this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.13.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.13.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.13.5.6 Air Migration Pathway Conclusions

The air migration pathway is incomplete for the *MRS R10 Central Restricted Use Area*. As described in Subchapter 5.13.4.5, no MC metals were detected above background concentrations in the surface soil at this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.14 MUNITIONS RESPONSE SITE R11 LAKE KISSIMMEE WATER BOMBING TARGET

This subchapter of the SI Report evaluates exposure pathways for the *MRS R11 Lake Kissimmee Water Bombing Target*. The analysis of each pathway (groundwater, surface water/sediment, soil, and air) is described in detail. The related CSEM for this MRS is provided in Appendix J.

5.14.1 Historical Munitions Constituent Information

To date, no historical MC-related groundwater, surface water, sediment, soil or air sampling has been documented at this MRS.

5.14.2 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway. No groundwater samples were collected within the *MRS R11 Lake Kissimmee Water Bombing Target*.

5.14.2.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic settings at this MRS and the setting described for the overall range in Subchapter 5.2. The MRS is located entirely within Lake Kissimmee. No registered wells are located within the MRS boundary.

5.14.2.2 Releases and Potential Releases to Groundwater

There are no known releases or potential releases of MC to groundwater at this MRS. Potable groundwater would not have been directly affected by munitions-related activities. Due to the potential for surface water recharge, groundwater may have been indirectly affected by the munitions-related activities associated with this MRS.

5.14.2.3 Groundwater Migration Pathway and Receptors

There are no registered public supply water wells located within the *MRS R11 Lake Kissimmee Water Bombing Target*. The MRS is located entirely within Lake Kissimmee. Potential human receptors would include site visitors, and recreational users. Contaminant migration from the surface water within this MRS to the groundwater via recharge may be possible at this MRS. It is unlikely that human or ecological receptors would be exposed to the groundwater, resulting in incomplete pathways for human and ecological receptors.

5.14.2.4 Groundwater Sample Locations and Methodologies

No groundwater samples were collected at this MRS, as agreed upon by the TPP Team.

5.14.2.5 Groundwater Migration Pathway Analytical Results

Not applicable. No groundwater samples were collected at this MRS.

5.14.2.6 Groundwater Migration Pathway Conclusions

Groundwater sampling was not performed at the *MRS R11 Lake Kissimmee Water Bombing Target*. Surface water recharge from the MRS could provide a potential environmental transport mechanism. The MRS is located entirely within Lake Kissimmee. Neither human nor ecological receptors in the MRS are not expected to be exposed to groundwater. Therefore, the groundwater exposure pathway is incomplete for human and ecological receptors.

5.14.3 Surface Water Migration Pathway

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the surface water and sediment through runoff and erosion.

5.14.3.1 Hydrologic Setting

The hydrologic setting of USAF Avon Park Range is described in Subchapter 5.2.4. There is year-round surface water within this MRS, as this MRS is entirely within Lake Kissimmee. As indicated in Figure 5.3, the following wetland types occur within the *MRS R11 Lake Kissimmee Water Bombing Target*:

- L1UBH – Lacustrine, limnetic, unconsolidated bottom, permanently flooded

5.14.3.2 Releases and Potential Releases to Surface Water and Sediment

There are no known releases of MC to surface water or sediment at the *MRS R11 Lake Kissimmee Water Bombing Target*. The presence of local surface water and sediment provides a potential migration pathway through which direct releases of MC to surface water and/or sediment via munitions-related activities would occur. This MRS is composed of 649 acres within Lake Kissimmee. This target was used for skip bombing practice using M38A2 100 lb. practice bombs. There are no known access restrictions. The 1996 ASR inspection team conducted an aerial survey over Lake Kissimmee, but noted the subsurface visibility was no better than two feet below surface. They did not observe MEC, MD, or target remnants. This MRS was not inspected during the 2008 SI, as discussed during the December 2007 TPP meeting. The area within this MRS has likely been subject to sediment and silt removal. The area around the structure located down gradient of the MRS has been subject to sediment and silt removal and dredged during construction. No samples were collected in this area.

5.14.3.3 Surface Water and Sediment Migration Pathways and Receptors

There is surface water or sediment resulting from wetlands and shallow groundwater which may be exposed at the surface located within this MRS. Potential receptors would include commercial and industrial workers, site visitors, recreational users, and ecological receptors. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. Ecological receptors may also be exposed to surface water through ingestion as a drinking water source.

5.14.3.4 Surface Water and Sediment Sample Locations and Methodologies

Surface water and sediment samples were not collected within this MRS.

5.14.3.5 Surface Water and Sediment Migration Pathway Analytical Results

Not applicable. Neither surface water nor sediment samples were collected from this MRS.

5.14.3.6 Surface Water and Sediment Migration Pathway Conclusions

Neither surface water nor sediment sampling was performed during the SI at the *MRS R11 Lake Kissimmee Water Bombing Target*. However, direct releases of MCs could occur to the surface water and sediment. Receptors may be exposed to surface water and sediment via incidental ingestion and dermal contact. The surface water and sediment migration pathways are potentially complete, not quantitatively assessed. The surface water within this MRS is not used as drinking water.

5.14.4 Soil Exposure Pathway

Potential soil exposure pathways include incidental ingestion, dermal contact, and inhalation of re-suspended particulates by both human and ecological receptors, as well as leaching to groundwater and runoff and erosion to surface water and sediment. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil exposed at the ground surface, site-specific geology, climate, and expected future land use. *There is no soil within this MRS.*

5.14.4.1 Physical Source Access Conditions

The *MRS R11 Lake Kissimmee Water Bombing Target* is comprised of 649 inland water acres. This MRS is located entirely within Lake Kissimmee. There are no known access restrictions. *There is no soil within this MRS.*

5.14.4.2 Actual or Potential Contamination Areas

The *MRS R11 Lake Kissimmee Water Bombing Target* is comprised of 649 inland water acres located entirely within Lake Kissimmee. *There is no soil within this MRS.*

5.14.4.3 Soil Exposure Pathways and Receptors

The CSM and CSEM are presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near the *MRS R11 Lake Kissimmee Water Bombing Target* who may come into contact with contaminated soil through incidental ingestion, dermal contact, or inhalation of dust. Based on the lack of soil within this MRS, there are no potential receptors that would be exposed to MC contaminated soil.

5.14.4.4 Soil Sample Locations and Methodologies

The *MRS R11 Lake Kissimmee Water Bombing Target* is comprised of 649 inland water acres located entirely within Lake Kissimmee. There is no soil within this MRS. Surface soil samples were not collected within this MRS.

5.14.4.5 Soil Exposure Analytical Results

Not Applicable. There is no soil within this MRS and surface soil samples were not collected within this MRS.

5.14.4.6 Soil Exposure Conclusions

The surface soil migration pathways are incomplete for the *MRS R11 Lake Kissimmee Water Bombing Target*. This MRS is located entirely within Lake Kissimmee. There is no soil within this MRS.

5.14.5 Air Migration Pathway

5.14.5.1 Climate

The climate for the *MRS R11 Lake Kissimmee Water Bombing Target* does not differ from that of the overall site (Sub-paragraph 2.2.3). In general, the climate of the USAF Avon Park Range is subtropical. This site is affected by the Atlantic hurricane season, which occurs from June 1st through November 30th.

5.14.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the *MRS R11 Lake Kissimmee Water Bombing Target*. The occurrence of windblown dust is not expected at this MRS.

5.14.5.3 Air Migration Pathways and Receptors

Based on the known uses of the land, the potential receptors at the *MRS R11 Lake Kissimmee Water Bombing Target* would include site visitors, recreational users, and ecological receptors. These receptors could be exposed to MC in air through inhalation of fugitive dust. However, there is no soil within this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.14.5.4 Air Sample/Monitoring Locations and Methodologies

There is no historical record of air sampling at this MRS. Air sampling was not performed as part of the SI.

5.14.5.5 Air Migration Pathway Analytical Results

Not applicable. Air samples were not collected.

5.14.5.6 Air Migration Pathway Conclusions

The air migration pathway is incomplete for the *MRS R11 Lake Kissimmee Water Bombing Target*. As described above, there is no soil within this MRS, which indicates inhalation via fugitive dust is not a complete exposure route for MC.

5.15 GROUNDWATER CONFIRMATION SAMPLE

One groundwater confirmation sample was collected from a drinking water well located within the FUDS, but outside any MRS boundaries. This sample was collected to evaluate the potential for groundwater contamination originating from munitions activities conducted within the MRSs. The results of the sample analyses follow.

5.15.1 Groundwater Migration Pathway

Groundwater can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, drinking water supplies, vegetation, and sensitive environmental areas such as wetlands. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use. Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface water migration pathway.

5.15.1.1 Geologic and Hydrogeologic Setting

There are no known differences between the geologic and hydrogeologic setting at this sample location and the setting described for the overall range in Subchapter 5.2.

5.15.1.2 Releases and Potential Releases to Groundwater

There are no known previous releases of MC to groundwater at this location. If there were releases of MC to soil as a result of munitions-related activities, it is possible that the constituents could leach to groundwater at the site. This location is not within an area where munitions-related activities are known or expected to have occurred.

5.15.1.3 Groundwater Migration Pathways and Receptors

The location of the water well from which the groundwater confirmation sample was collected is shown on Figure 5.2. The water well provides drinking water to the Kissimmee Prairie Preserve State Park offices and campground. Potential receptors include commercial or industrial workers, and site visitors or recreational users. The groundwater pathway is not considered to be a complete exposure route for ecological receptors since they do not have access to groundwater.

5.15.1.4 Groundwater Sample Locations and Methodologies

No known groundwater sampling was previously performed this location. This public supply well is drilled to 120 feet in depth. One groundwater sample (APR-RL-GW-01) (and one field duplicate sample) was collected from this location. The sample was collected from a spigot right above where the pipe comes out of the ground and before the water filtration unit that is attached to the well.

5.15.1.5 Groundwater Analytical Results

The groundwater analytical results for these samples are presented in Table 5.4. These results were evaluated using the criteria described in Section 5.2.8. The source evaluation for groundwater is summarized in Table 5.20. There were no explosives detected in the groundwater samples collected, thus the evaluation was performed for indicator metals. As shown in Table 5.20, four MC metals (barium, copper, lead, and zinc) were detected in the groundwater samples. No ambient groundwater samples were collected and no data relating to site-specific ambient metal concentrations in groundwater were available. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background.

5.15.1.6 Groundwater Migration Pathway Conclusions

Four MC metals (barium, copper, lead, and zinc) were detected in the groundwater samples. No ambient groundwater samples were collected and no data relating to site-specific ambient metal concentrations in groundwater were available. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. The metals will be evaluated in the SLRA in Chapter 6. Potential receptors including commercial or industrial workers, and site visitors or recreational users may be exposed to groundwater via ingestion and dermal contact.

Table 5.20
Groundwater Source Evaluation
Groundwater Confirmation Sample
USAF Avon Park Range, Okeechobee and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Potential MC? ^a	SLRA Required?	Primary reason for exclusion from SLRA
<i>Metals</i>					
Aluminum	µg/L	300 U	Yes	No	Not detected at MRS
Antimony	µg/L	6.0 U	Yes	No	Not detected at MRS
Barium	µg/L	26	Yes	Yes	--
Copper	µg/L	87	Yes	Yes	--
Lead	µg/L	9.2	Yes	Yes	--
Zinc	µg/L	39	Yes	Yes	--

a – Potential MCs as listed in Table 4.1

NA – Background concentration not available

U – Analyte not detected above the adjusted PQL.

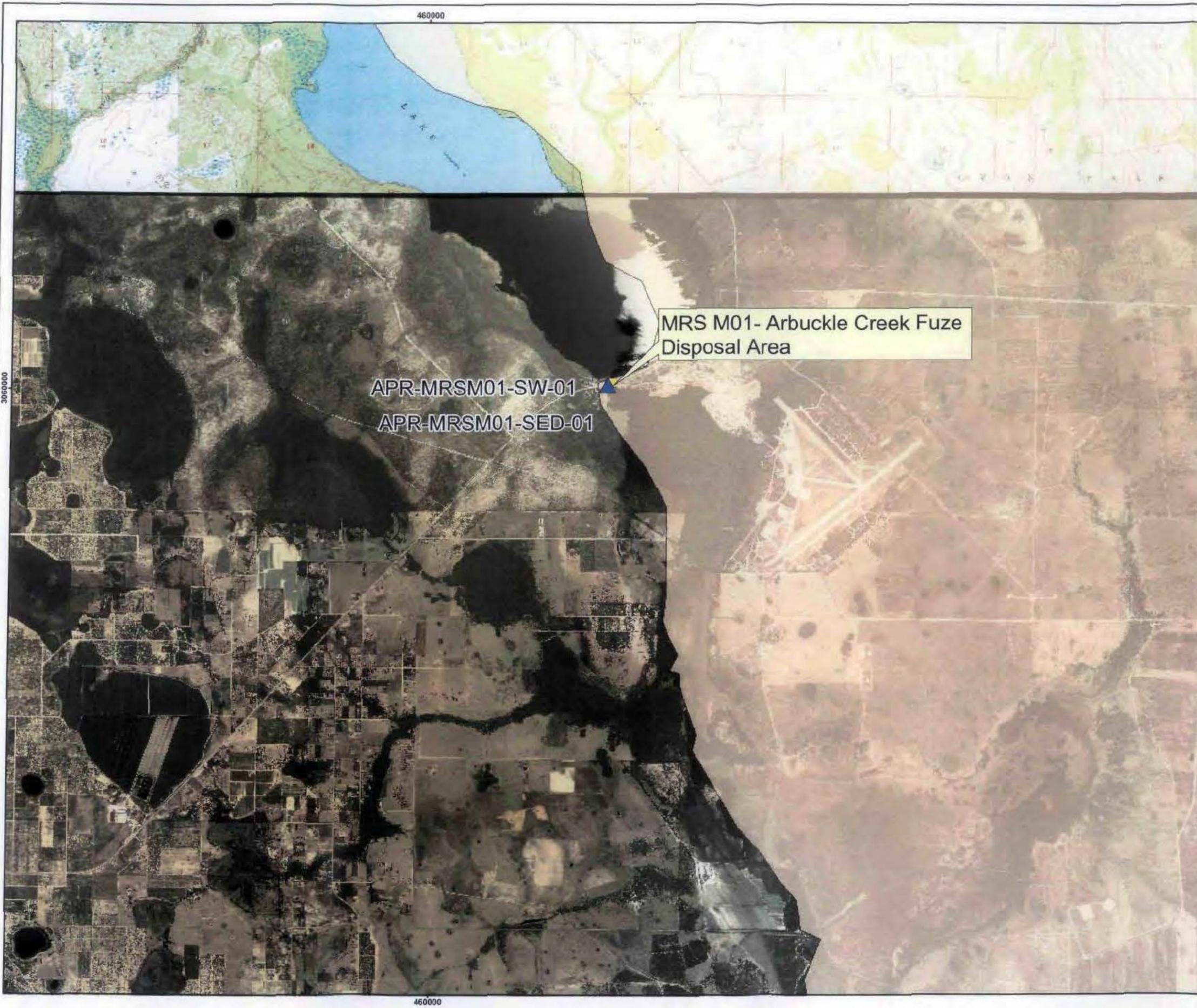


Figure 5.1

**Qualitative Reconnaissance and
Sample Locations
West of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**

Okeechobee, Osceola, and Polk Counties

Legend

-  Surface Water/Sediment Sample Location
-  MRS M01- Arbuckle Creek Fuze Disposal Area
-  Avon Park Air Force Range (active range)



Image: 2006 Orthophoto
Projection: UTM Zone 17 NAD83, Map Units in Meters



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DESIGNED BY:
BT
DRAWN BY:
BT
CHECKED BY:
DS
SUBMITTED BY:
DS

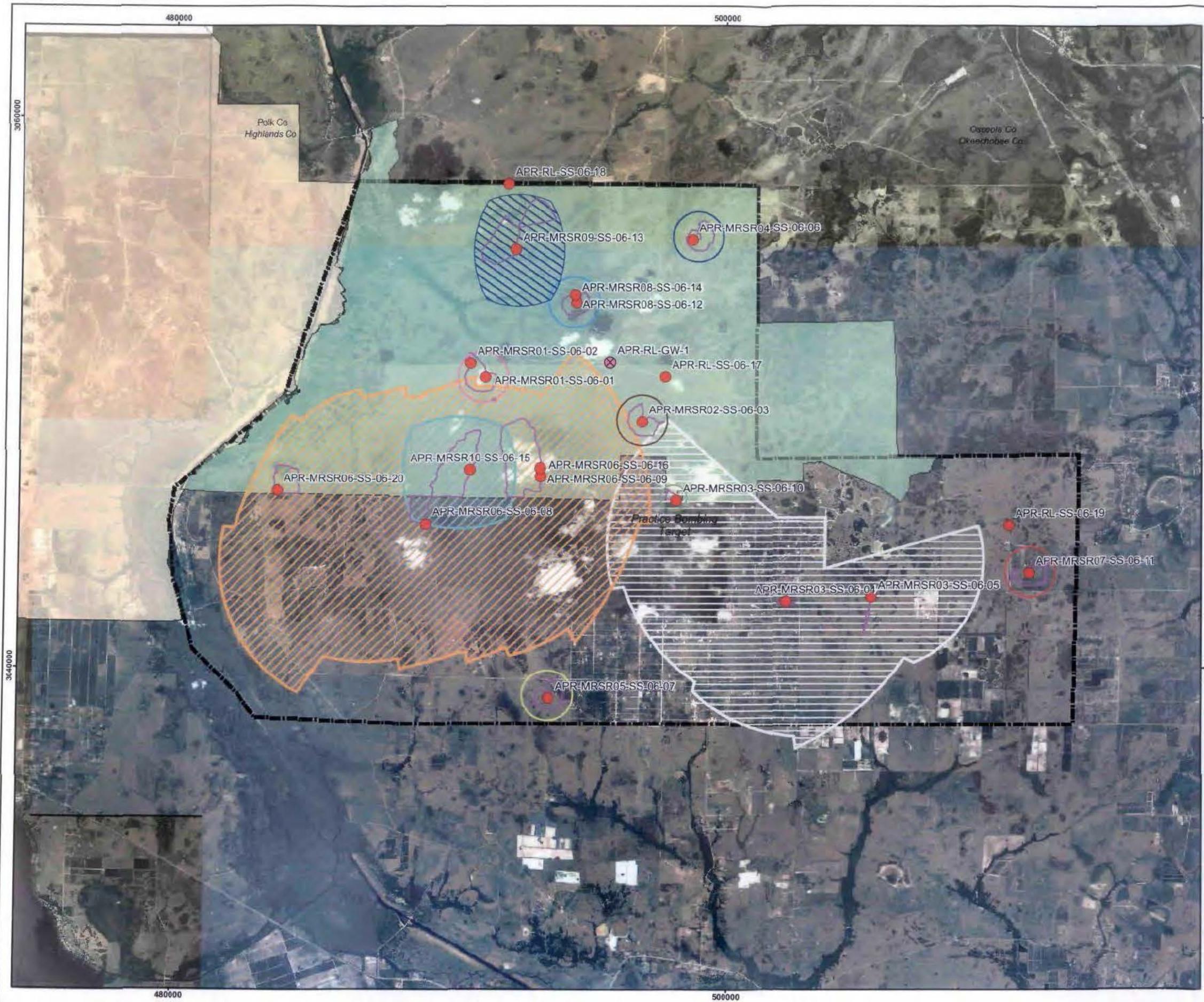
**Qualitative Reconnaissance and
Sample Locations**

SCALE	As Shown	PROJECT NUMBER	744647.69000
DATE	October 2008	PAGE NUMBER	5-100
FILE	X:\GIS\Site_Inspections_ne\Maps\avon_FL\Fig5_1.mxd		



Figure 5.2

**Qualitative Reconnaissance and Sample Locations
East of Kissimmee River
USAF Avon Park Range
FUDS Project No. I04FL028701**
Okeechobee, Osceola, and Polk Counties



Legend

- Soil Sample Location
- ⊗ Groundwater Sample Location
- Approximate FUDS Boundary
- Qualitative Reconnaissance Track
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- ▨ MRS R09- North Restricted Use Area
- ▨ MRS R10- Central Restricted Use Area
- ▨ Kissimmee Prairie Preserve State Park
- ▨ Avon Park Air Force Range (active range)



Image: 2006 Orthophoto
Projection: UTM Zone 17 NAD83, Map Units in Meters



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DESIGNED BY: BT	Qualitative Reconnaissance and Sample Locations	
DRAWN BY: BT		
CHECKED BY: DS	SCALE: As Shown	PROJECT NUMBER: 744647.69000
SUBMITTED BY: DS	DATE: October 2008	PAGE NUMBER: 5-101
	FILE: X:\GIS\Site_inspections_n\Maps\avon_FL\Fig4_2.mxd	

Figure 5.3

Water Wells within 4-Mile Buffer USAF Avon Park Range FUDS Project No. I04FL028701

Okeechobee, Osceola, and Polk Counties

Legend

- Other Wells
- Domestic Water Wells
- Approximate FUDS Boundary
- Representative Qualitative Reconnaissance Track
- MRS R01- Target XI- Land Skip Bombing Target
- MRS R02- Target XII- Combination BGR
- MRS R03- Range XII- Position Firing Course
- MRS R04- Target XIII- Practice Bombing Target
- MRS R05- Target XIV- Practice Bombing Target
- MRS R06- Range XIX- Position Firing Course
- MRS R07- Target XV- Practice Bombing Target
- MRS R08- Area Bombing Target
- MRS R09- North Restricted Use Area
- MRS R10- Central Restricted Use Area
- MRS R11- Lake Kissimmee Water Bombing Target
- Kissimmee Prairie Preserve State Park
- Avon Park Air Force Range (active range)



Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83. Map Units in Meters



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HUNTSVILLE CENTER

DESIGNED BY:
BT

DRAWN BY:
BT

CHECKED BY:
DS

SUBMITTED BY:
DS

Water Wells within 4-Mile Buffer

SCALE: As Shown PROJECT NUMBER: 744647.69000

DATE: October 2008 PAGE NUMBER: 5-102

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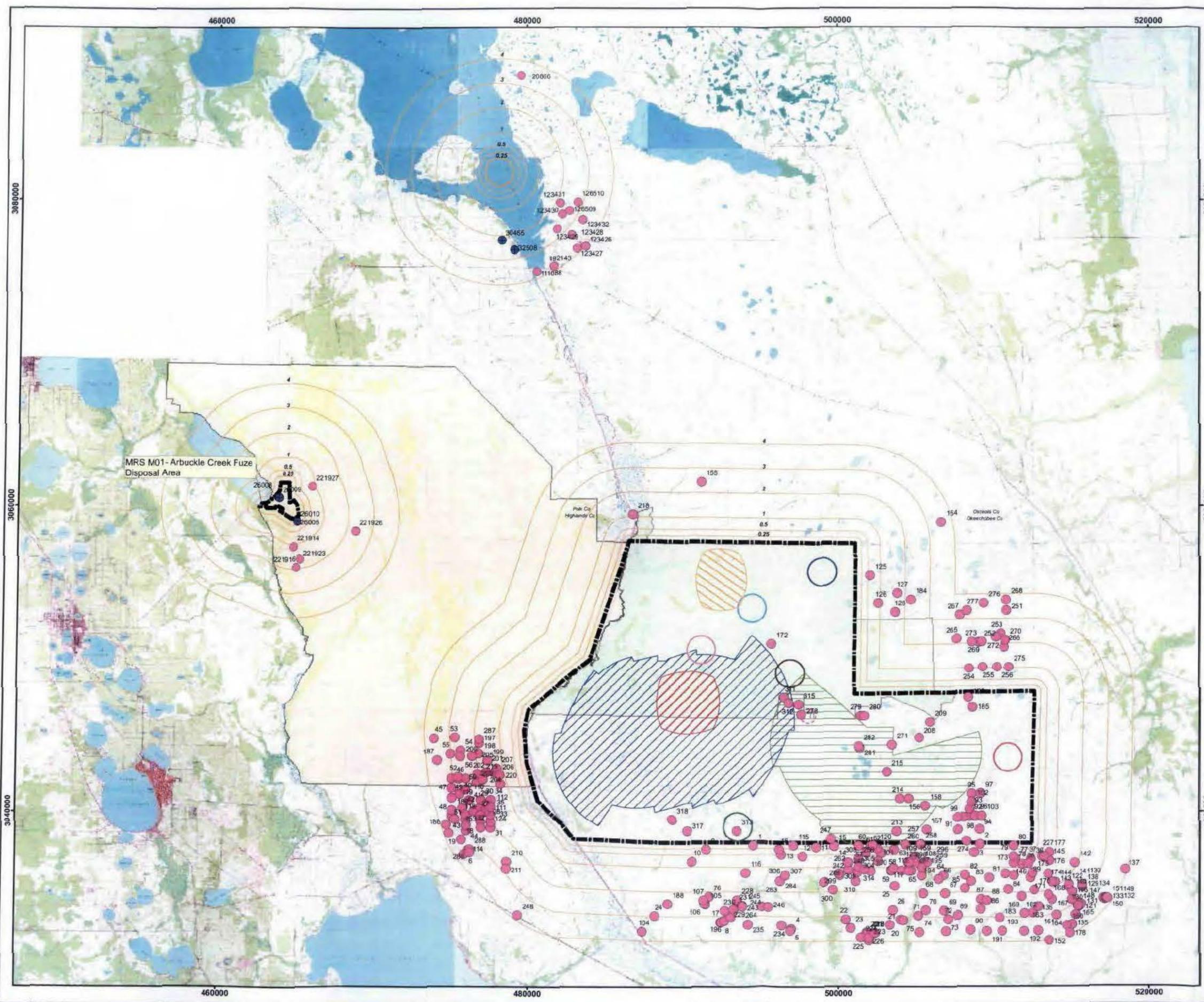
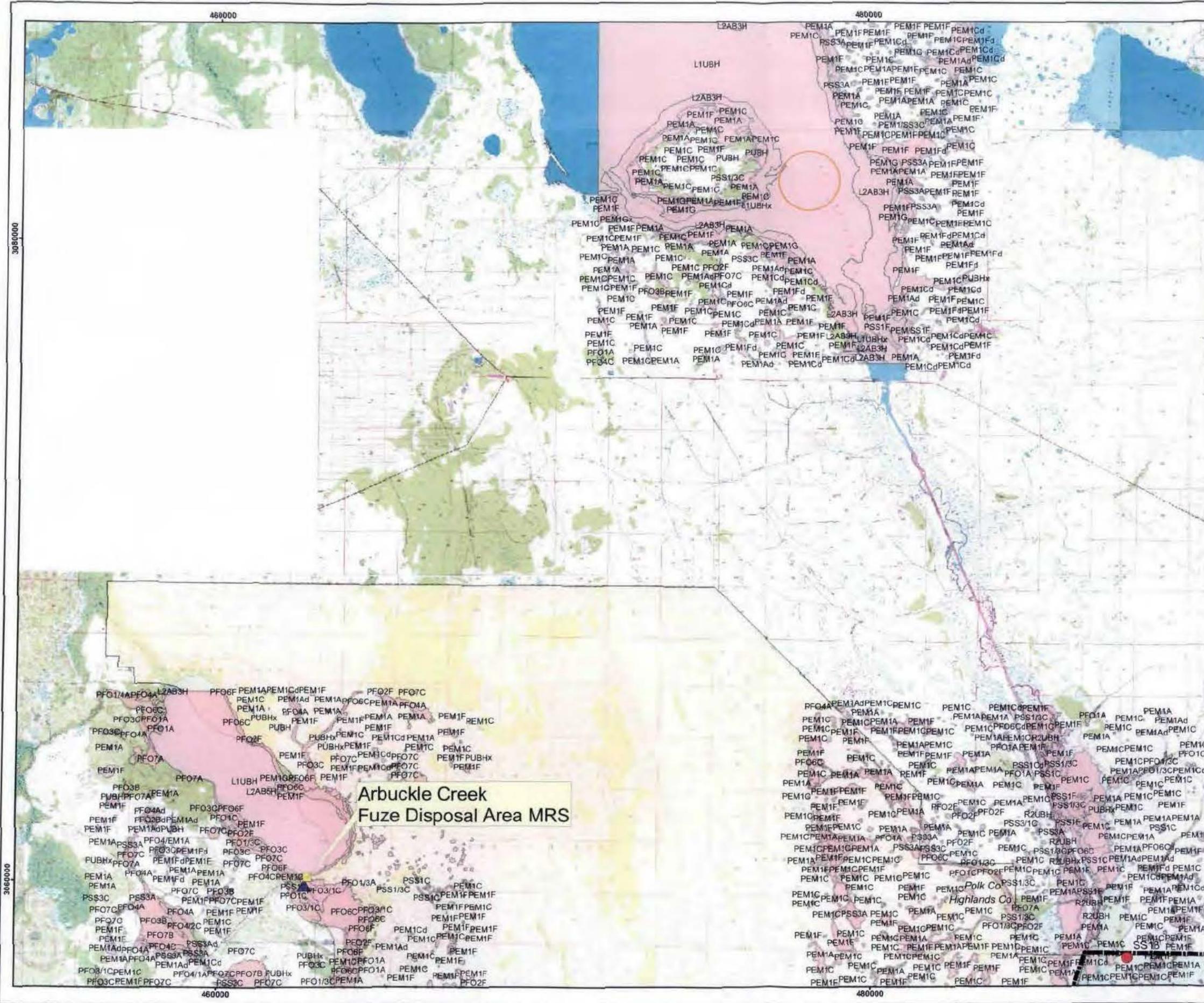


Figure 5.4

Wetlands West of Kissimmee River USAF Avon Park Range FUDS Project No. I04FL028701

Okeechobee, Osceola, and Polk Counties



Legend

- Soil Sample Location
 - ▲ Surface Water/Sediment Sample Location
 - MRS M01- Arbuckle Creek Fuse Disposal Area
 - MRS R11- Lake Kissimmee Water Bombing Target
 - Kissimmee Prairie Preserve State Park
 - Avon Park Air Force Range (active range)
- Note: The FUDS Property Boundary is derived from historic data and has not been surveyed.
- Wetland (Obtained from U.S. Fish & Wildlife Service)

Predominant Wetland Types:



Site Location in Florida

Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83. Map Units in Meters

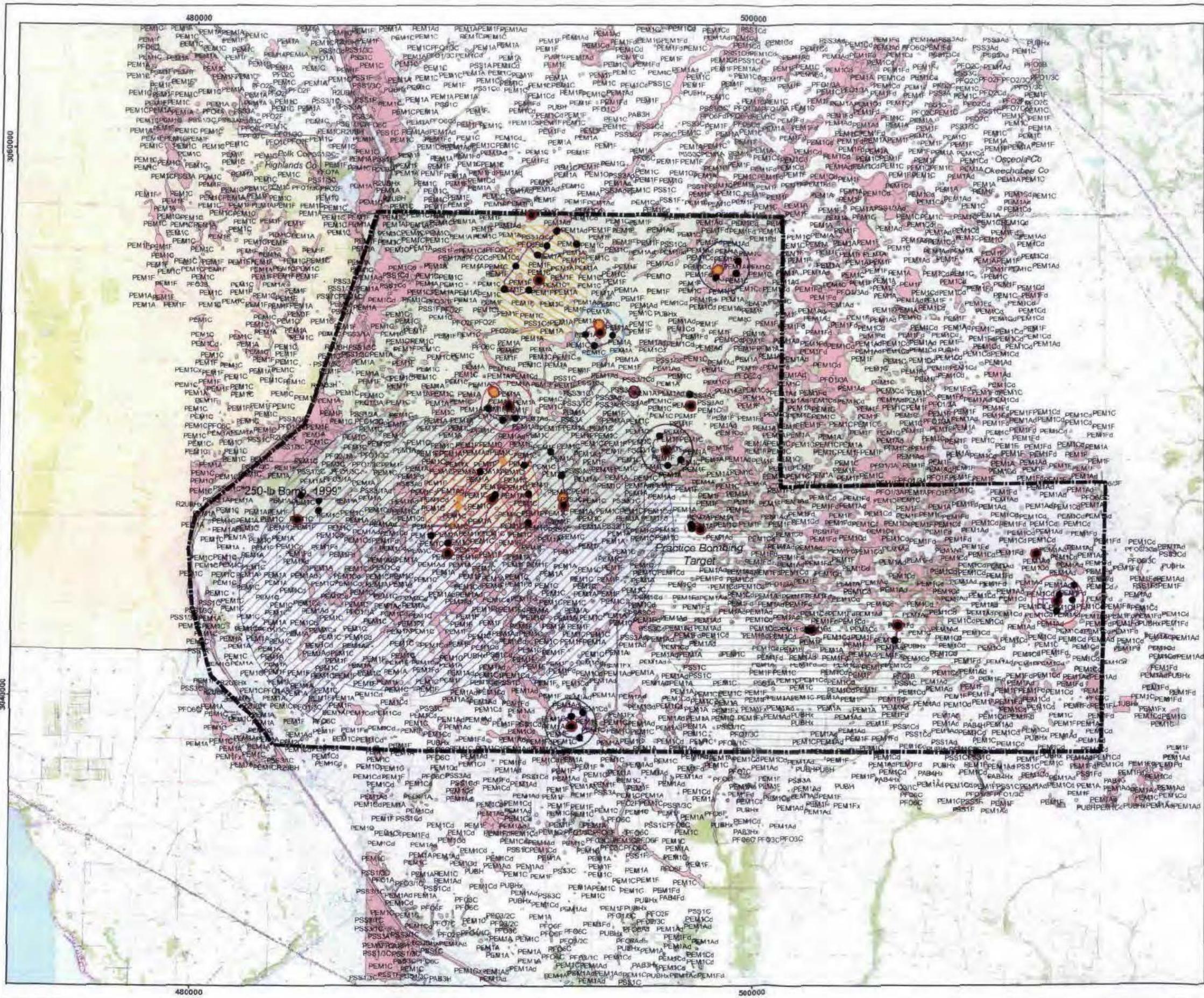
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DRAWN BY: BT		SCALE: As Shown	
CHECKED BY: DS		DATE: October 2008	PAGE NUMBER: 5-103
SUBMITTED BY: DS		FILE: X:\GIS\Site_inspections_nel\Mappl\avon_FL\Figs_4.mxd	

Figure 5.5

Wetlands East of Kissimmee River USAF Avon Park Range FUDS Project No. I04FL028701 Okeechobee, Osceola, and Polk Counties



- Legend**
- 1 ● Munitions Debris Observation Location
 - 2 ● Other Field Observation Location
 - Soil Sample Location
 - Groundwater Sample Location
 - Approximate FUDS Boundary
 - MRS R01- Target XI- Land Skip Bombing Target
 - MRS R02- Target XII- Combination BGR
 - MRS R03- Range XII- Position Firing Course
 - MRS R04- Target XIII- Practice Bombing Target
 - MRS R05- Target XIV- Practice Bombing Target
 - MRS R06- Range XIX- Position Firing Course
 - MRS R07- Target XV- Practice Bombing Target
 - MRS R08- Area Bombing Target
 - MRS R09- North Restricted Use Area
 - MRS R10- Central Restricted Use Area
 - Kissimmee Prairie Preserve State Park
 - Avon Park Air Force Range (active range)

Note:
The FUDS Property Boundary is derived from historic data and has not been surveyed.

Wetland (Obtained from U.S. Fish & Wildlife Service)

Predominant Wetland Types:

- PFO1C – Palustrine, forested, broad-leaved deciduous, seasonally flooded
- L1UBH – Lacustrine, limnetic, unconsolidated bottom, permanently flooded
- PEM1C – Palustrine, emergent, persistent, seasonally flooded



Image Source: USGS 7.5' Topo Quadrangles, 1981
Projection: UTM Zone 17 NAD83, Map Units in Meters



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CHAPTER 6 SCREENING-LEVEL RISK ASSESSMENT

6.1 MUNITIONS AND EXPLOSIVES OF CONCERN SCREENING-LEVEL RISK ASSESSMENT

6.1.1 Conceptual Site Model

The CSM for USAF Avon Park Range, included in Appendix J, summarizes conditions at the site that could result in human exposure to MEC. It describes the types of MEC potentially present in each MRS, past MEC and MD findings, and current and projected future land use and receptors.

6.1.2 Introduction

6.1.2.1 A qualitative risk evaluation was conducted to assess the potential explosive safety risk to the public at the USAF Avon Park Range. The purpose of this risk evaluation is to qualitatively communicate whether a potential risk is present at the site and the primary causes of that potential risk. The risk evaluation presented here is based on historical information presented in prior studies (for example, INPR, ASR, and ASR Supplement) and observations made during the SI QR.

6.1.2.2 An explosive safety risk exists if a person can come near or into contact with a MEC item and interact with it in a manner that results in a detonation. The potential for an explosive safety risk depends on the presence of three critical elements:

- a source (*such as*, presence of MEC), AND
- a human receptor (*such as*, a person), AND
- the potential for interaction between the source and receptor (*such as*, the possibility the item might be picked up or disturbed by the receptor).

6.1.2.3 All three of these elements must be present for there to be an explosive safety risk. There is no risk if any one element is missing. Each of these three elements provides a basis for implementing effective risk-management response actions.

6.1.3 Qualitative Risk Evaluation

6.1.3.1 The potential risk posed by MEC was characterized qualitatively by evaluating three primary risk factors for each MRS at the site. These factors are related to the three critical elements listed above and are:

- 1) MEC Presence: whether there is the potential for MEC to be present at the MRS;
- 2) MEC Type: the type(s) of MEC that might be present at the MRS and the related potential explosive hazards; and
- 3) Site Accessibility: the potential receptors at the MRS and how they might interact with the MEC.

6.1.3.2 The known or suspected presence of an explosive hazard and any potential human receptors at an MRS will typically be considered sufficient justification for RI/FS. The following paragraphs describe each of the primary risk factors.

6.1.3.3 **MEC Presence:** this factor describes whether MEC either has been confirmed or is suspected to be present at the MRS, either at the surface or in the subsurface, and is based on historical information presented in prior studies (for example, INPR, ASR, and ASR Supplement) and observations made during the SI QR. Note that if there is historical evidence of potential MEC presence at a site, lack of confirmation of MEC presence during the SI QR will not be considered as evidence of MEC absence for this qualitative risk evaluation. Table 6.1 lists the three possible categories used to describe MEC Presence for this evaluation.

**Table 6.1
Categories of MEC Presence**

MEC Presence	Description
Confirmed or suspected	There is physical or confirmed historical evidence of MEC presence at the MRS, or there is physical or historical evidence indicating that MEC may be present at the MRS.
Small arms only ⁽¹⁾	The presence of small arms ammunition is confirmed or suspected, and there is evidence that no other types of munitions were used or are present at the MRS.
Evidence of no munitions	Following investigation of the MRS, there is physical or historical evidence that there are no UXO or discarded military munitions (DMM) present.

(1) Small arms ammunition is defined as “ammunition, without projectiles that contain explosives (other than tracers), that is .50-caliber or smaller or for shotguns” (Department of the Army 2005).

6.1.3.4 **MEC Type:** this factor describes whether the MEC potentially present at the MRS might be detonated, resulting in injury to one or more human receptors. If multiple MEC items are potentially present at an MRS, the item that poses the greatest

risk to public health is selected for purposes of this qualitative risk evaluation. This determination is based on historical information presented in prior studies (for example, INPR, ASR, and ASR Supplement) and observations made during the SI QR. Table 6.2 lists the three possible categories used to describe MEC Type for this evaluation.

**Table 6.2
Categories of MEC Type**

MEC Type	Description
Potentially Hazardous	Fuzed or unfuzed MEC that may result in physical injury to an individual if detonated by an individual's activities.
Small arms only ⁽¹⁾	Small arms ammunition is confirmed or suspected, and there is evidence that no other types of munitions were used or are present at the MRS.
Inert	Munitions debris or other items that will cause no injury (for example, training ordnance containing no explosives, fuzes, spotting charges, etc.).

(1) Small arms ammunition is defined as "ammunition, without projectiles that contain explosives (other than tracers), that is .50-caliber or smaller or for shotguns" (Department of the Army, 2005).

6.1.3.5 Site Accessibility: this factor describes whether human receptors have any access to the MRS and, therefore, may interact with any MEC present at the surface or in the subsurface. For purposes of this qualitative risk evaluation, if MEC is confirmed or suspected to be present at the MRS, it is assumed that human receptors might come into contact with that MEC unless there is "Complete Restriction to Access." A description of the potential receptors will also be given with this assessment. Table 6.3 lists the two possible categories used to describe Site Accessibility for this evaluation.

**Table 6.3
Categories of Site Accessibility**

Site Accessibility	Description
Accessible	Access control is not complete: residents, site workers, visitors, or trespassers can gain access to all or part of the MRS.
Complete restriction to access	Human receptors are completely prevented from gaining access to the MRS.

6.1.3.6 With regard to this qualitative risk evaluation, further evaluation (such as, RI/FS) for the MRS will typically be justified if the following conditions are true:

- MEC is confirmed or suspected to be present, AND
- The MEC confirmed or suspected to be present is potentially hazardous, AND
- The MRS is accessible.

6.1.3.7 The primary risk factors identified above were evaluated for each MRS at USAF Avon Park Range using data collected during the SI field investigation and the historical data available from other studies. The following sections discuss the qualitative risk evaluation by each primary risk factor to determine whether or not further evaluation is justified at each MRS.

6.1.4 Munitions and Explosives of Concern Risk Assessment - MRS M01 Arbuckle Creek Fuze Disposal Area

6.1.4.1 Neither MEC nor MD were found within the *MRS M01 Arbuckle Creek Fuze Disposal Area* during the 2008 SI field visit. The 1996 ASR inspection team visited this MRS and noted “it was impossible to determine if any fuzes remained submerged” (USACE, 1996). In 1945, approximately 200 live bomb fuzes (AN-M103 and potentially AN-M101A2) were dumped into the creek from the bridge crossing the creek. On May 25, 1946, a 3-year old boy was killed while playing with a fuze found in Arbuckle Creek. On November 9, 1946, a child was killed and several others injured while playing with a fuze found beneath a former base housing unit. As a result of these incidents, a clearance was conducted covering a “large portion of the eastern part of this facility” in 1949. However, the associated certificate did not specifically address the Arbuckle Creek area, indicating the Arbuckle Creek area may not have been addressed in this clearance. Based on this information, the presence of MEC at the *MRS M01 Arbuckle Creek Fuze Disposal Area* is assessed to be “Confirmed or suspected.”

6.1.4.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been disposed of within the *MRS M01 Arbuckle Creek Fuze Disposal Area* are Fuze, Bomb, Tail, AN-M101A2; and Fuze, Bomb, Nose, AN-M103. These munitions contain explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS M01 Arbuckle Creek Fuze Disposal Area* is assessed to be “Potentially Hazardous.”

6.1.4.3 *MRS M01 Arbuckle Creek Fuze Disposal Area* is located in Arbuckle Creek, below the control structure of Lake Arbuckle. Lake Arbuckle drains into Arbuckle Creek to the south. The bridge over which the fuzes were disposed is reportedly a popular fishing location and a fish camp is located approximately 75 feet upstream of the bridge. The area flanking the creek is forested land. Access from land via foot is partially restricted due to the presence of a fence along County Road 64, which crosses Arbuckle Creek. There are no known restrictions to access via boat. The land use is not expected to change. Potential human receptors within the MRS would include commercial and industrial workers, site visitors, and recreational users. Based on this information, the Site Accessibility at the *MRS M01 Arbuckle Creek Fuze Disposal Area* is considered to be “Accessible.”

6.1.5 Munitions and Explosives of Concern Risk Assessment - MRS R01 Target XI – Land Skip Bombing Target

6.1.5.1 Debris originating from a M38A2 practice bomb was found within the *MRS R01 Target XI – Land Skip Bombing Target* during the May 2008 site visit. Small arms munitions were also used at this target, as evidenced by a .50-caliber casing found during the May 2008 site visit. A pile of munitions debris originating from M38A2 and M85 practice bombs was identified during the 1996 ASR site visit. Based on this information, the presence of MEC at the *MRS R01 Target XI – Land Skip Bombing Target* is assessed to be “Confirmed or suspected.”

6.1.5.2 Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004b), and the 1996 and 2008 field visits, the munitions known or suspected to have been used within the *MRS R01 Target XI – Land Skip Bombing Target* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Bomb, 100 lb., Practice, M85; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. With the exception of small arms ammunitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R01 Target XI – Land Skip Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.5.3 The *MRS R01 Target XI – Land Skip Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This MRS is relatively remote, though it is approximately 2.5 miles from the State Park campground and office. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. The area is accessible via 4-wheel drive (4WD) vehicle, foot, and horseback. There are no known access restrictions. The land use is not expected to change. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Based on this information, the Site Accessibility at the *MRS R01 Target XI – Land Skip Bombing Target* is considered to be “Accessible.”

6.1.6 Munitions and Explosives of Concern Risk Assessment - MRS R02 Target XII – Combination BGR

6.1.6.1 No MEC or MD were found within the *MRS R02 Target XII – Combination BGR* during the January 1996 ASR site visit or during the May 2008 SI site visit. This target was used for practice bombing and gunnery using 100-lb. practice bombs with spotting charges, small arms munitions including .50-caliber ammunition, and “flares, signals, simulators, or screening smoke (other than white phosphorus)” (USACE, 2004b). The presence of MEC at the *MRS R02 Target XII – Combination BGR*

is assessed to be “Confirmed or suspected” based on historical documentation suggesting past use of the target.

6.1.6.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R02 Target XII – Combination BGR* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. With the exception of small arms ammunitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R02 Target XII – Combination BGR* is assessed to be “Potentially Hazardous.”

6.1.6.3 The *MRS R02 Target XII – Combination BGR* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This MRS is relatively remote, though it is approximately 1.5 miles from the State Park campground and office. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. The area is accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions. The land use is not expected to change. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users. Based on this information, the Site Accessibility at the *MRS R02 Target XII – Combination BGR* is considered to be “Accessible.”

6.1.7 Munitions and Explosives of Concern Risk Assessment - MRS R03 Range XII – Position Firing Course

6.1.7.1 The *MRS R03 Range XII – Position Firing Course* target area consisted of eight scattered targets, which were fired upon by the side machine guns on B-17 aircraft. An additional practice bombing target location was identified in the 1996 ASR within the boundaries of the MRS, but was not designated as an MRS; the non-MRS bombing target location is shown on Figure 2.2 (pink dashed outline; labeled as “Practice Bombing Target”). The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. No MEC or MD were found within this MRS during the May 2008 SI site visit. No MEC or MD were found within the aforementioned non-MRS practice bombing target during the 2008 site visit. However, the presence of MEC at the *MRS R03 Range XII – Position Firing Course* is assessed to be “Confirmed or suspected” based on historical documentation suggesting past use.

6.1.7.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R03 Range XII – Position Firing Course* are: Small Arms, General and .50-caliber

machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. With the exception of small arms ammunitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R03 Range XII – Position Firing Course* is assessed to be “Potentially Hazardous.”

6.1.7.3 The *MRS R03 Range XII – Position Firing Course* is comprised of 20,252 land acres. This MRS overlaps with the Kissimmee Prairie Preserve State Park and residential properties. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. Areas within the park are accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions to this MRS. The land use is not expected to change. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users. Based on this information, the Site Accessibility at the *MRS R03 Range XII – Position Firing Course* is considered to be “Accessible.”

6.1.8 Munitions and Explosives of Concern Risk Assessment - MRS R04 Target XIII – Practice Bombing Target

6.1.8.1 The *MRS R04 Target XIII – Practice Bombing Target* was used for practice bombing with one approach pattern. The 1996 ASR investigation team conducted an aerial survey of this MRS, during which they noted three concrete footings they attributed to the likely remnants of an observation tower. A controlled burn was conducted prior to the May 2008 site visit. At the target center, the SVT noted a circular mound approximately 50 feet in circumference, which was covered in thick vegetation. The center of the former target was littered with debris originating from M38A2 practice bombs. Based on this information, the presence of MEC at the *MRS R04 Target XIII – Practice Bombing Target* is assessed to be “Confirmed or suspected.”

6.1.8.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R04 Target XIII – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R04 Target XIII – Practice Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.8.3 The *MRS R04 Target XIII – Practice Bombing Target* is comprised of 649 land acres within Kissimmee Prairie Preserve State Park. This MRS is relatively remote, though it is accessible via 4WD vehicle, foot, and horseback. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. There are no known access restrictions to this MRS. The land use is not expected to change. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users.

6.1.9 Munitions and Explosives of Concern Risk Assessment - MRS R05 Target XIV – Practice Bombing Target

6.1.9.1 No MEC or MD were found within the *MRS R05 Target XIV – Practice Bombing Target* during the May 2008 site visit. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. This MRS was used for practice bombing with two approach patterns. The presence of MEC at the *MRS R05 Target XIV – Practice Bombing Target* is assessed to be “Confirmed or suspected” based on historical documentation suggesting potential use of this range.

6.1.9.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R05 Target XIV – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R05 Target XIV – Practice Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.9.3 The *MRS R05 Target XIV – Practice Bombing Target* is comprised of 649 land acres. This MRS is located on residential and agricultural (cattle pasture) land. There are no known access restrictions. The land use is not expected to change. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users.

6.1.10 Munitions and Explosives of Concern Risk Assessment - MRS R06 Range XIX – Position Firing Course

6.1.10.1 The *MRS R06 Range XIX – Position Firing Course* was used for gunnery practice; however MEC and MD originating from bombs have been found within this MRS. The 1996 ASR investigation team conducted an aerial survey of this MRS, but did not note any target, range, or firing course remnants. A live 250-lb. bomb (Bomb, 250 lb., GP, AN-M57) was located within this MRS on the Kissimmee Prairie Preserve State

Park in 1999; the item was determined to be “live not a practice round” and was detonated in place by Moody EOD and McDill EOD. The narrative for the disposal of this item is included in Appendix L. Several pieces of AN-M50 Incendiary Bombs were found during the May 2008 site visit. The SVT also observed a rocket pod and Mk106 5lb. practice bomb previously found by State Park employees. Both of these items are of Vietnam-era, are not known or suspected to have been used on this site during training, and are considered anomalous findings, likely originating from the adjacent active range. The SVT noted that the northeastern part of the MRS had been control burned on May 5, 2008, three days prior to their visit of the area. Based on this information, the presence of MEC at the *MRS R06 Range XIX – Position Firing Course* is assessed to be “Confirmed or suspected.”

6.1.10.2 Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004b), historical findings, and the 2008 field visit, the munitions known or suspected to have been used within the *MRS R06 Range XIX – Position Firing Course* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; Bomb, 250 lb., GP, AN-M57; Bomb, 4-lb. Incendiary, AN-M50; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R06 Range XIX – Position Firing Course* is assessed to be “Potentially Hazardous.”

6.1.10.3 The *MRS R06 Range XIX – Position Firing Course* is comprised of 29,186 land acres. This MRS is located on residential, agricultural (cattle pasture), and Kissimmee Prairie Preserve State Park land. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. Areas within the park are accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions. The land use is not expected to change. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users.

6.1.11 Munitions and Explosives of Concern Risk Assessment - MRS R07 Target XV – Practice Bombing Target

6.1.11.1 The *MRS R07 Target XV – Practice Bombing Target* was used as a practice bombing target with two approach patterns. The 1996 ASR investigation team conducted a ground survey of this MRS, but did not find any ordnance. The site had been cultivated and was used for cattle grazing at that time. The May 2008 SVT did not observe MEC, MD, or target remnants. The owner of the farm reported to the SVT that he has never found any MD or MEC on the property. He previously removed what he referred to as “footing for a control tower.” Approximately one foot of soil has been

removed for sod and the area has been leveled. Based on this information, the presence of MEC at the *MRS R07 Target XV – Practice Bombing Target* is assessed to be “Confirmed or suspected.”

6.1.11.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R07 Target XV – Practice Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R07 Target XV – Practice Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.11.3 The *MRS R07 Target XV – Practice Bombing Target* is comprised of 649 land acres. This MRS is located on agricultural land (cattle and sod). There are no known access restrictions. The land use is not expected to change. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users.

6.1.12 Munitions and Explosives of Concern Risk Assessment - MRS R08 Area Bombing Target

6.1.12.1 The 1996 ASR investigation team conducted a ground and aerial survey of the *MRS R08 Area Bombing Target*. At that time, remnants of the limestone target outline were visible. The team observed the remains of a scrap pile located at the center of the target. The remains included M38A2 practice bomb components. The May 2008 SVT also observed this pile of debris, but did not find any MEC. Based on this information, the presence of MEC at the *MRS R08 Area Bombing Target* is assessed to be “Confirmed or suspected.”

6.1.12.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R08 Area Bombing Target* are: Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R08 Area Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.12.3 The *MRS R08 Area Bombing Target* is comprised of 649 land acres. This MRS is located within the Kissimmee Prairie Preserve State Park. The park uses

prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. Areas within the park are accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions and the land use is not expected to change. Potential human receptors include commercial and industrial workers, site visitors, and recreational users.

6.1.13 Munitions and Explosives of Concern Risk Assessment - MRS R09 North Restricted Use Area

6.1.13.1 It is unclear whether the 1996 ASR investigation team conducted an aerial survey of the *MRS R09 North Restricted Use Area*. The May 2008 SVT found it challenging to navigate through this MRS as the palmettos have grown to five to six feet high due to lack of controlled burns. They did not find any MD or MEC. A 1952 deed certificate suggested that the 320 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 320-acre area in question. The presence of MEC at the *MRS R09 North Restricted Use Area* is assessed to be “Confirmed or suspected” based on historical documentation suggesting past use of the area.

6.1.13.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R09 North Restricted Use Area* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. With the exception of small arms munitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R09 North Restricted Use Area* is assessed to be “Potentially Hazardous.”

6.1.13.3 The *MRS R09 North Restricted Use Area* is comprised of 2,785 land acres. This MRS is located within the Kissimmee Prairie Preserve State Park. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. Areas within the park are accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions and the land use is not expected to change. Potential human receptors include commercial and industrial workers, site visitors, and recreational users.

6.1.14 Munitions and Explosives of Concern Risk Assessment - MRS R10 Central Restricted Use Area

6.1.14.1 The 1996 ASR investigation team conducted an aerial survey over a portion of the *MRS R10 Central Restricted Use Area*, but only noted a dried up pond in the area. A portion of this MRS was control burned three days prior to the 2008 SI visit. The May 2008 SVT found approximately 200 .50-caliber shell casings and one .50-caliber projectile within this MRS. A 1952 deed certificate suggested that the 640 acres for which this MRS was established “be restricted to surface use only”. The exact reason for the restriction is unknown. As such, this MRS was established by plotting a Safety Danger Zone for an Open Burn / Open Detonation area around the 640-acre area in question. The *MRS R06 Range XIX – Position Firing Course* entirely encompasses this MRS. Based on this information, the presence of MEC at the *MRS R10 Central Restricted Use Area* is assessed to be “Confirmed or suspected.”

6.1.14.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R10 Central Restricted Use Area* are: Small Arms, General and .50-caliber machine gun; Bomb, 100 lb., Practice, M38A2; Charge, Spotting, Bomb, M1A1, M3, and M5; and Flares, Signals, Simulators, or Screening Smoke (other than White Phosphorus). However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. With the exception of small arms munitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R10 Central Restricted Use Area* is assessed to be “Potentially Hazardous.”

6.1.14.3 The *MRS R10 Central Restricted Use Area* is comprised of 3,575 land acres. The *MRS R06 Range XIX – Position Firing Course* entirely encompasses this MRS. This MRS is located within the Kissimmee Prairie Preserve State Park. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. Areas within the park are accessible via 4WD vehicle, foot, and horseback. There are no known access restrictions and the land use is not expected to change. Potential human receptors include commercial and industrial workers, site visitors, and recreational users.

6.1.15 Munitions and Explosives of Concern Risk Assessment - MRS R11 Lake Kissimmee Water Bombing Target

6.1.15.1 The 1996 ASR inspection team conducted an aerial survey over the *MRS R11 Lake Kissimmee Water Bombing Target* within Lake Kissimmee, but noted the subsurface visibility was no better than two feet below surface. They did not observe MEC, MD, or target remnants. This MRS was not inspected during the 2008 SI, as discussed during the December 2007 TPP meeting. The area within this MRS has likely

been subject to silt and sediment removal actions. The area around the structure located down gradient of the MRS has been subject to silt and sediment removal actions and dredged during construction. This MRS is composed of 649 acres within Lake Kissimmee. This target was used for skip bombing practice using M38A2 100 lb. practice bombs. Based on this information, the presence of MEC at the *MRS R11 Lake Kissimmee Water Bombing Target* is assessed to be “Confirmed or suspected.”

6.1.15.2 Based on the ASR (USACE, 1996) and ASR Supplement (USACE, 2004b), the munitions known or suspected to have been used within the *MRS R11 Lake Kissimmee Water Bombing Target* are: Bomb, 100 lb., Practice, M38A2; and Charge, Spotting, Bomb, M1A1, M3, and M5. However, based on historical and recent findings of MD and MEC as well as proximity to adjacent ranges, it is apparent that munitions other than those reported in the ASR and ASR Supplement may have been used within this MRS. See Table 4.1 for the complete munitions list. These munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact. Based on this information, the MEC Type at the *MRS R11 Lake Kissimmee Water Bombing Target* is assessed to be “Potentially Hazardous.”

6.1.15.3 This 649-acre MRS is located entirely within Lake Kissimmee. Lake Kissimmee covers an area of approximately 38,000 acres and is relatively shallow lake with depths ranging from four to ten feet. The lake is used recreationally for fishing and numerous fish camps flank the shoreline. A water control structure regulates flow from the lake to the Kissimmee River to the south. Regular drawdown events expose new shoreline and are accompanied by silt and sediment removal for lake habitat restoration and revitalization. The land to the south of the lake is managed by SFWMD and FWC as KICCO Wildlife Management Area (west of Kissimmee River) and Blanket Bay Management Area (east of Kissimmee River). Land use is not expected to change. A boat is necessary for access to the MRS. Potential human receptors within the MRS R11 Lake Kissimmee Water Bombing Target include site visitors and recreational users.

6.1.16 Risk Summary

6.1.16.1 The qualitative MEC risk evaluation for the USAF Avon Park Range is summarized in Table 6.4.

**Table 6.4
MEC Risk Evaluation
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida**

MRS	MEC Presence	MEC Type ^{/1}	Site Accessibility	Further Evaluation?	
<i>MRS M01 Arbuckle Creek Fuze Disposal Area</i>	Confirmed or suspected	Fuze, bomb, AN-M103; Fuze, bomb, AN-M101A2	Potentially Hazardous	Accessible	YES
<i>MRS R01 Target XI – Land Skip Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R02 Target XII – Combination BGR</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R03 Range XII – Position Firing Course</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R04 Target XIII – Practice Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R05 Target XIV – Practice Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R06 Range XIX – Position Firing Course</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES

**Table 6.4
MEC Risk Evaluation
USAF Avon Park Range
Okeechobee, Osceola, and Polk Counties, Florida**

MRS	MEC Presence	MEC Type^{1/}		Site Accessibility	Further Evaluation?
<i>MRS R07 Target XV – Practice Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R08 Area Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R09 North Restricted Use Area</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R10 Central Restricted Use Area</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES
<i>MRS R11 Lake Kissimmee Water Bombing Target</i>	Confirmed or suspected	Bomb, 250-lb., GP, AN-M57	Potentially Hazardous	Accessible	YES

^{1/} Where multiple MEC items were used at an MRS, *only* the item which poses the greatest risk to public health is listed for purposes of this risk assessment.

6.1.16.2 Based on this qualitative MEC risk evaluation, there is the possibility that human receptors might come into contact with explosively hazardous MEC at the MRSs listed below. Therefore, there is the potential for an explosive safety risk at these MRSs.

- *MRS M01 Arbuckle Creek Fuze Disposal Area*
- *MRS R01 Target XI – Land Skip Bombing Target*
- *MRS R02 Target XII – Combination BGR*
- *MRS R03 Range XII – Position Firing Course*
- *MRS R04 Target XIII – Practice Bombing Target*
- *MRS R05 Target XIV – Practice Bombing Target*
- *MRS R06 Range XIX – Position Firing Course*
- *MRS R07 Target XV – Practice Bombing Target*
- *MRS R08 Area Bombing Target*
- *MRS R09 North Restricted Use Area*

- *MRS R10 Central Restricted Use Area*
- *MRS R11 Lake Kissimmee Water Bombing Target*

6.2 MUNITIONS CONSTITUENT HUMAN HEALTH SCREENING LEVEL RISK ASSESSMENT

6.2.1 Conceptual Site Model

6.2.1.1 The USAF Avon Park Range FUDS is located in Okeechobee, Osceola, and Polk Counties, Florida. There are two MRSs west of the Kissimmee River: *MRS M-01 Arbuckle Creek Fuze Disposal Area* (located in Polk County) and *MRS R11-Kissimmee Water Bombing Target* (located in Osceola County). The remaining ten MRSs are located to the east of the Kissimmee River, in Okeechobee County. *MRS M-01 Arbuckle Creek Fuze Disposal Area* is located in Arbuckle Creek. The bridge over which the fuzes were disposed is reportedly a popular fishing location and a fish camp is located approximately 75 feet upstream of the bridge. The area immediately adjacent to the MRS includes land still actively used by Avon Park Air Force Range to the east of Arbuckle Creek; the land to the west of Arbuckle Creek is undeveloped, forested land managed by Florida FWC as the Arbuckle Wildlife Management Area. Access from land via foot is partially restricted due to the presence of a fence along County Road 64, which crosses Arbuckle Creek. There are no known restrictions to access via boat. Potential human receptors would include commercial and industrial workers, site visitors, and recreational users.

6.2.1.2 *MRS R11-Kissimmee Water Bombing Target* is located entirely within Lake Kissimmee. Lake Kissimmee is used recreationally for fishing and numerous fish camps flank the shoreline. The lake drains into the Kissimmee River to the south. The land to the south of the lake is managed by SFWMD and FWC as KICCO Wildlife Management Area (west of Kissimmee River) and Blanket Bay Management Area (east of Kissimmee River). Potential human receptors would include commercial and industrial workers, site visitors, and recreational users.

6.2.1.3 The remaining ten MRSs located on lands owned by numerous private entities (residential and agricultural) and the State of Florida. The State of Florida manages approximately 54,000 acres of this land as Kissimmee Prairie Preserve State Park. The park uses prescribed burning to maintain the fire-adapted prairie ecosystem. Approximately 6,000 acres of the park is used for cattle grazing. The property is also used for outdoor recreational activities including bird-watching, hiking, biking, horseback riding, and camping. There are no known access restrictions. Potential human receptors would include current and future residents, commercial and industrial workers, site visitors, and recreational users.

6.2.1.4 Receptors may be exposed to MC through direct contact with soil (incidental ingestion, dermal contact, and inhalation of fugitive dust) or surface water/sediment (incidental ingestion, and dermal contact). Due to the shallowness of the surficial aquifer and the potential for surface exposure of this aquifer, there may be direct communication between the groundwater in this aquifer and the surface water at this site. The groundwater contained within the surficial aquifer is therefore evaluated as a surface

water migration pathway. The MC CSEMs presented in Appendix J identify source media, transport mechanisms, exposure routes, and potential receptors for each MRS.

6.2.2 Affected Media

6.2.2.1 Direct release of MC from munitions activities within the MRSs would have been to surface soil, surface water, and/or sediment. If releases of MC to surface soil as a result of munitions-related activities occur, MC could migrate to surface water and sediment through runoff and erosion or to groundwater through leaching. MC in the surface soil can also become airborne in fugitive dust. Releases could have also occurred directly to surface water and sediment. If releases of MC to surface water occur, MC could migrate to the groundwater via recharge.

6.2.2.2 Based on decisions made at the December 2007 TPP Meeting, surface water, sediment, and surface soil were the media determined to be most likely affected by MC. Releases could have occurred directly to surface soil, surface water, and sediment within ten of these MRSs. Releases could have occurred directly to surface water and sediment within the *MRS M-01 Arbuckle Creek Fuze Disposal Area* and the *MRS R11-Kissimmee Water Bombing Target*. Seventeen biased surface soil samples, one biased surface water sample, and one biased sediment sample (and associated QA/QC samples) were collected during this SI. One groundwater sample was collected within the FUDS, but outside any MRS to evaluate potential off-site migration of MC in groundwater.

6.2.3 Screening Levels

6.2.3.1 The SLRA surface soil and sediment human health screening values used for this SI are the more stringent value of the FAC 62-777, Soil Cleanup Levels, Direct Exposure Residential and the USEPA Regional SLs for Residential Soil.

6.2.3.2 The SLRA surface water human health screening values used for this SI are the more stringent of 1) the USEPA Regional SLs for Tap Water, 2) the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels, Freshwater Surface Water Criteria, and 3) the FAC 62-302 Surface Water Quality Standards (SWQS) for Class III waters.

6.2.3.3 The SLRA groundwater human health screening values used for this SI are the more stringent of the USEPA Regional SLs for Tap Water and the FAC 62-777 Groundwater and Surface Water Cleanup Target Levels, Groundwater Criteria.

6.2.4 Risk Characterization

6.2.4.1 As discussed in Subchapter 5.2.8, the source evaluation is used to determine which analytes are retained for consideration in a SLRA. Only those analytes retained for consideration in the SLRA following the source evaluation are evaluated in this chapter.

6.2.4.2 To complete the human health risk characterization for surface soil and sediment at this site, the maximum detected concentration of each analyte retained for consideration in the SLRA (Tables 5.9 through 5.19) was compared with the screening

levels as described in Subchapter 6.2.3. For an analyte to be considered as a possible health concern related to a release from munitions activities at USAF Avon Park Range, the following conditions must be true:

- The analyte is present above background concentrations, AND
- The analyte is a potential constituent of the formerly used munitions, AND
- The analyte is present above human health screening levels.

6.2.4.3 No ambient surface water samples or groundwater samples were collected and no data relating to site-specific ambient metal concentrations in surface water or groundwater were available. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. MC metals detected in surface water and groundwater samples are evaluated below.

6.2.5 MRS M01 Arbuckle Creek Fuze Disposal Area

6.2.5.1 Groundwater, surface soil, and air samples were not collected from the *MRS M01 Arbuckle Creek Fuze Disposal Area*. One surface water sample and one sediment sample (and field duplicate sample) were collected within this MRS. As shown in Table 5.8, two MC metals (barium and lead) were detected in the surface water samples collected from the MRS. As there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background. As noted below in Table 6.5, barium and lead were detected at concentrations *less than* the respective human health screening value.

**Table 6.5
MRS M01 Arbuckle Creek Fuze Disposal Area
Surface Water Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values	Exceeds Screening Level?
<i>Metals</i>				
Barium	µg/L	51	7,300 a	No
Lead	µg/L	8.3	15 b	No

a – USEPA Regional SLs dated June 12, 2008 (http://epa-prgs.ornl.gov/chemicals/download/master_sl_table_run_12JUNE2008.pdf)

b – Maximum Contaminant Level (MCL) as provided by USEPA Regional SLs dated June 12, 2008 (http://epa-prgs.ornl.gov/chemicals/download/master_sl_table_run_12JUNE2008.pdf)

6.2.5.2 As shown in Table 5.9, one MC metal (barium) was detected in the sediment samples collected from the MRS. As there are no sediment background data for barium for comparison, it cannot be determined if the observed concentrations are within the range of background. As noted below in Table 6.6, barium was detected at concentrations *less than* the respective human health screening value.

Table 6.6
MRS M01 Arbuckle Creek Fuze Disposal Area
Sediment Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metal</i>					
Barium	mg/kg	1.7	120	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.6 MRS R01 Target XI – Land Skip Bombing Target

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R01 Target XI – Land Skip Bombing Target*. Two surface soil samples were collected within this MRS. As shown in Table 5.10, barium was detected at a concentration exceeding the selected background value. As noted below in Table 6.7, barium was detected at concentrations *less than* the respective human health screening value.

Table 6.7
MRS R01 Target XI – Land Skip Bombing Target
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metal</i>					
Barium	mg/kg	6.6	120	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.7 MRS R03 Range XII – Position Firing Course

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R03 Range XII – Position Firing Course*. Three biased surface soil samples were collected within this MRS. As shown in Table 5.12, barium was detected above the background concentration and was evaluated in this SLRA. Antimony was additionally detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.8; antimony and barium were detected at concentrations *less than* the respective human health screening value.

Table 6.8
MRS R03 Range XII – Position Firing Course
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Antimony	mg/kg	0.036	27	a	No
Barium	mg/kg	8.6	120	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.8 MRS R04 Target XIII – Practice Bombing Target

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R04 Target XIII – Practice Bombing Target*. One biased surface soil sample was collected within this MRS. As shown in Table 5.13, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.9, antimony was detected at concentrations *less than* the respective human health screening value.

Table 6.9
MRS R04 Target XIII – Practice Bombing Target
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Antimony	mg/kg	0.15	27	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.9 MRS R06 Range XIX – Position Firing Course

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R06 Range XIX – Position Firing Course*. Four biased surface soil samples were collected within this MRS. As shown in Table 5.15, barium and copper were detected at concentrations exceeding the selected background values. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.10, antimony, barium, and copper were detected at concentrations *less than* the respective human health screening values.

Table 6.10
MRS R06 Range XIX – Position Firing Course
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Antimony	mg/kg	0.028	27	a	No
Barium	mg/kg	88	120	a	No
Copper	mg/kg	11	150	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.10 MRS R07 Target XV – Practice Bombing Target

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R07 Target XV – Practice Bombing Target*. One biased surface soil sample was collected within this MRS. As shown in Table 5.16, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.11, antimony was detected at a concentration *less than* the respective human health screening value.

Table 6.11
MRS R07 Target XV – Practice Bombing Target
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Antimony	mg/kg	0.019	27	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.11 MRS R08 Area Bombing Target

Groundwater, surface water, sediment, and air samples were not collected from the *MRS R08 Area Bombing Target*. Two biased surface soil samples were collected within this MRS. As shown in Table 5.17, copper was detected at concentrations exceeding the selected background value. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.12, antimony and copper were detected at concentrations *less than* the respective human health screening values.

Table 6.12
MRS R08 Area Bombing Target
Surface Soil Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Antimony	mg/kg	0.17	27	a	No
Copper	mg/kg	11	150	a	No

a – Florida Administrative Code 62-777 Soil Cleanup Target Levels, Direct Exposure Residential, dtd February 2005

6.2.12 Groundwater Confirmation Sample

One groundwater confirmation sample was collected from a drinking water well located within the FUDS, but outside any MRS boundaries. The water well from which the sample was collected provides drinking water to the Kissimmee Prairie Preserve State Park offices and campground. This sample was collected to evaluate the potential for groundwater contamination originating from munitions activities conducted within the MRSs. Four MC metals (barium, copper, lead, and zinc) were detected in the groundwater samples. No ambient groundwater samples were collected and no data relating to site-specific ambient metal concentrations in groundwater were available. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. As noted below in Table 6.13, barium, copper, lead, and zinc were detected at concentrations *less than* the respective human health screening values.

Table 6.13
Groundwater Confirmation Sample
Groundwater Screening Level Human Health Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Site Specific Human Health Screening Values		Exceeds Screening Level?
<i>Metals</i>					
Barium	µg/L	26	2,000	a	No
Copper	µg/L	87	1,000	a	No
Lead	µg/L	9.2	15	a	No
Zinc	µg/L	39	5,000	a	No

a – Florida Administrative Code 62-777 Groundwater and Surface Water Cleanup Target Levels, Groundwater Criteria, dtd February 2005

6.2.13 Discussion

6.2.13.1 Barium and lead were detected in the surface water within the *MRS M01 Arbuckle Creek Fuze Disposal Area* at concentrations less than the respective human health screening values. Additionally, barium was detected in the sediment within the *MRS M01 Arbuckle Creek Fuze Disposal Area* at concentrations less than the human health screening value. Barium was detected in the surface soil within the *MRS R01 Target XI – Land Skip Bombing Target* at a concentration less than the human health screening value. Antimony and barium were detected in the surface soil within the *MRS R03 Range XII – Position Firing Course* at concentrations less than the respective human health screening values. Antimony was detected in the surface soil within the *MRS R04 Target XIII – Practice Bombing Target* and *MRS R07 Target XV – Practice Bombing Target* at concentrations less than the human health screening value. Antimony, barium, and copper were detected in the surface soil within the *MRS R06 Range XIX – Position Firing Course* at concentrations less than the respective human health screening values. Antimony and copper were detected in the surface soil within the *MRS R08 Area Bombing Target* at concentrations less than the respective human health screening values. *Therefore, based on the analytical results presented in this report, an unacceptable human health risk from the aforementioned metals is not expected through exposure to the surface soil at the following MRSs:*

- *MRS M01 Arbuckle Creek Fuze Disposal Area*
- *MRS R01 Target XI – Land Skip Bombing Target*
- *MRS R03 Range XII – Position Firing Course*
- *MRS R04 Target XIII – Practice Bombing Target*
- *MRS R06 Range XIX – Position Firing Course*
- *MRS R07 Target XV – Practice Bombing Target*
- *MRS R08 Area Bombing Target*

6.2.13.2 Barium, copper, lead, and zinc were detected in the groundwater confirmation sample at concentrations less than the respective human health screening values. *Based on the analytical results presented in this report, an unacceptable human health risk from the barium, copper, lead, and zinc is not expected through exposure to the groundwater provided at Kissimmee Prairie Preserve State Park well from which the sample was collected.*

6.3 MUNITIONS CONSTITUENT SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

6.3.1 The USAF Avon Park Range site is not within a national wildlife refuge, national park, national forest, or county park. The southeastern area is mostly undeveloped scrub and wetlands used for grazing, hunting, and the Kissimmee Prairie Preserve State Park. The area is extensively covered in a shallow layer of water, grasses, underbrush and the subsurface is subject to cover collapse and the formation of sinkholes. USFWS NWI-classified wetlands are located extensively throughout the site as described in paragraph 5.2.4.4 and shown on Figures 5.4 and 5.5. Several Bald Eagle and Crested

Caracara nests, a breeding shorebird area, and several areas of rare oak-scrub habitats are known to be in the vicinity of the site.

6.3.2 The site contains habitat suitable to support numerous federally protected species. The state of Florida supports 114 federally-listed Threatened and Endangered (T&E) species consisting of 59 animals and 55 plants. According to FNAI and USFWS, nine federally listed animals and 20 plant species are known to exist in Polk County and seven federally listed animals and no plant species are known to exist in Okeechobee County. Most of these listed species are the same for each county. Since the main focus of the SI is with the Kissimmee Prairie Preserve State Park, only the nine T&E species known to exist within and around the park boundaries are shown in Table 5.3. The SVT observed American Alligators and Crested Caracaras during the 2008 site visit.

6.3.3 Based on the above information and a review of the Army Checklist for Important Ecological Places (USACE, 2006), the USAF Avon Park Range FUDS is an important ecological place due to the presence of habitat for T&E species and the presence of wetlands. Therefore, ecological receptors are potential receptors for exposure pathways at this site.

6.3.1 Conceptual Site Model

As discussed above, the site contains habitat suitable to support numerous federally protected species. Ecological receptors may be exposed to MC through direct contact with soil (incidental ingestion, dermal contact, and inhalation of fugitive dust) or surface water/sediment (ingestion of surface water as drinking water, incidental ingestion, dermal contact, and ingestion of biota). The MC CSEM presented in Appendix J identifies source media, transport mechanisms, exposure routes, and potential receptors.

6.3.2 Management Goals

6.3.2.1 Management goals are defined as general statements about the desired condition of ecological values of concern. The goals vary based on the objectives of the property owner, current and reasonable future land use, regulatory requirements, the ecosystem, and the environmental needs of the community or other stakeholders (USACE 2006). The Department of the Army has an over-arching management goal for ecological risk assessments (ERA):

Protect valuable biological resources from unreasonable adverse effects due to the release of hazardous substances associated with Army operations, including past Department of Defense operations for FUDS (Department of the Army 2005).

6.3.2.2 All site-specific management goals should be consistent with this over-arching goal. Various valuable ecological resources are expected to be present within the site. Based on these ecological resources, the primary ERA management goal is to protect wetlands and habitats which support federally protected species that are present at the site.

6.3.3 Affected Media

6.3.3.1 Direct release of MC from munitions activities within the MRSs would have been to surface soil, surface water, and/or sediment. If releases of MC to surface soil as a result of munitions-related activities occur, MC could migrate to surface water and sediment through runoff. MC in the surface soil can also become airborne in fugitive dust. Releases could have also occurred directly to surface water and sediment. Releases could have occurred directly to surface soil, surface water, and sediment within ten of these MRSs. Releases could have occurred directly to surface water and sediment within the *MRS M-01 Arbuckle Creek Fuze Disposal Area* and the *MRS R11-Kissimmee Water Bombing Target*.

6.3.3.2 Based on decisions made at the December 2007 TPP Meeting, surface water, sediment, and surface soil were the media determined to be most likely affected by MC. Seventeen biased surface soil samples, one biased surface water sample, and one biased sediment sample (and associated QA/QC samples) were collected during this SI.

6.3.3.3 It is generally assumed that groundwater is not directly accessible to most ecological receptors, due to the inability of ecological receptors to interact with groundwater present at depth. Therefore, the groundwater exposure pathway is incomplete for ecological receptors.

6.3.4 Screening Values

6.3.4.1 The primary SLERA soil screening values used for this SI were obtained from the USEPA Region 4 ESVs for soil. These were supplemented with current screening values from sources established in the PSAP (USACE, 2005).

6.3.4.2 The primary SLERA screening values for sediment used for this SI were the most stringent values of the USEPA Region 4 ESVs for sediment and the FAC Sediment Quality Assessment Guidelines (SQAG), January 2003. These were supplemented with current screening values from sources established in the PSAP (USACE, 2005).

6.3.4.3 The primary SLERA screening values for surface water used for this SI were the most stringent values of the USEPA Region 4 ESVs for freshwater surface water and the FAC 62-302 SWQS for Class III waters. These were supplemented with current screening values from sources established in the PSAP (USACE, 2005).

6.3.5 Ecological Risk Characterization for Soil

6.3.5.1 As discussed in Subchapter 5.2.8, the source evaluation is used to determine which analytes are retained for consideration in a SLERA. Only those analytes retained for consideration in the SLERA following the source evaluation are evaluated in this chapter.

6.3.5.2 In order to complete the ecological risk characterization for this site, the maximum detected concentration of each selected analyte was evaluated against the screening values (Subchapter 6.3.4). This comparison resulted in the calculation of

hazard quotients (HQ) for each analyte. The HQ was calculated by determining the ratio of the maximum detected site concentration to the screening value (in this case, ecological medium-specific screening value). If the HQ was equal to or less than one, the potential for ecological risk for that medium was considered to be negligible. If the HQ was greater than one, then unacceptable ecological risks cannot be ruled out based on the screening comparison alone. HQs greater than one should be reviewed to evaluate the significance of the exceedance.

6.3.6 MRS M01 Arbuckle Creek Fuze Disposal Area

6.3.6.1 Surface soil and air samples were not collected from the *MRS M01 Arbuckle Creek Fuze Disposal Area*. One surface water sample and one sediment sample (and field duplicate sample) were collected within this MRS. As shown in Table 5.8, two MC metals (barium and lead) were detected in the surface water samples collected from the MRS. As there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background. As noted below in Table 6.14, barium was detected at concentrations *less than* the respective ecological screening value. The maximum detected concentration of lead in surface water exceeded the respective ecological screening value; therefore, the lead HQ was greater than one. Specifically, the lead HQ was 6.3.

Table 6.14
MRS M01 Arbuckle Creek Fuze Disposal Area
Surface Water Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Water Ecological Screening Values		HQ
<i>Metals</i>					
Barium	µg/L	51	1,000	a	<1
Lead	µg/L	8.3	1.32	b	6.3

a - San Francisco Regional Water Quality Control as referenced by the PSAP (Parsons 2006)

b - USEPA Region 4 Ecological Screening Values for Freshwater Surface Water, updated November 30, 2001 (<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.6.2 As shown in Table 5.9, one MC metal (barium) was detected in the sediment samples collected from the MRS. As there are no sediment background data for barium for comparison, it cannot be determined if the observed concentrations are within the range of background. As noted below in Table 6.15, the maximum detected concentration of barium in sediment was less than the selected ecological screening value; therefore, the HQ was less than one.

Table 6.15
MRS M01 Arbuckle Creek Fuze Disposal Area
Sediment Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Sediment Ecological Screening Values ^a		HQ
<i>Metals</i>					
Barium	mg/kg	1.7	20	a	<1

a – FDEP Sediment Quality Assessment Guidelines, January 2003. TEC for sediment-dwelling organisms (Table 5.1)
(http://www.dep.state.fl.us/water/monitoring/docs/seds/SQAGs_for_Florida_Inland_Waters_01_03.PDF).

6.3.7 MRS R01 Target XI – Land Skip Bombing Target

Surface water, sediment, and air samples were not collected from the *MRS R01 Target XI – Land Skip Bombing Target*. Two surface soil samples were collected within this MRS. As shown in Table 5.10, barium was detected at a concentration exceeding the selected background value. As noted below in Table 6.16, the maximum detected concentration of barium in surface soil was less than the selected ecological screening value; therefore, the HQ was less than one.

Table 6.16
MRS R01 Target XI – Land Skip Bombing Target
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Barium	mg/kg	6.6	165	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
(<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.8 MRS R03 Range XII – Position Firing Course

Surface water, sediment, and air samples were not collected from the *MRS R03 Range XII – Position Firing Course*. Three biased surface soil samples were collected within this MRS. As shown in Table 5.12, barium was detected above the background concentration and was evaluated in this SLRA. Antimony was additionally detected in the surface soil. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.17, the maximum detected

concentrations of antimony and barium in surface soil were less than the selected ecological screening values; therefore, the HQs were less than one.

Table 6.17
MRS R03 Range XII – Position Firing Course
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Antimony	mg/kg	0.036	3.5	a	<1
Barium	mg/kg	8.6	165	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
 (<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.9 MRS R04 Target XIII – Practice Bombing Target

Surface water, sediment, and air samples were not collected from the *MRS R04 Target XIII – Practice Bombing Target*. One biased surface soil sample was collected within this MRS. As shown in Table 5.13, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.18, the maximum detected concentration of antimony in surface soil was less than the selected ecological screening value; therefore, the HQ was less than one.

Table 6.18
MRS R04 Target XIII – Practice Bombing Target
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Antimony	mg/kg	0.15	3.5	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
 (<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.10 MRS R06 Range XIX – Position Firing Course

Surface water, sediment, and air samples were not collected from the *MRS R06 Range XIX – Position Firing Course*. Four biased surface soil samples were collected within this MRS. As shown in Table 5.15, barium and copper were detected at concentrations exceeding the selected background values. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above

background concentrations. As noted below in Table 6.19, the maximum detected concentrations of antimony, barium, and copper in surface soil were less than the selected ecological screening values; therefore, the HQs were less than one.

Table 6.19
MRS R06 Range XIX – Position Firing Course
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Antimony	mg/kg	0.028	3.5	a	<1
Barium	mg/kg	88	165	a	<1
Copper	mg/kg	11	40	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
(<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.11 MRS R07 Target XV – Practice Bombing Target

Surface water, sediment, and air samples were not collected from the *MRS R07 Target XV – Practice Bombing Target*. One biased surface soil sample was collected within this MRS. As shown in Table 5.16, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in Table 6.20, the maximum detected concentration of antimony in surface soil was less than the selected ecological screening value; therefore, the HQ was less than one.

Table 6.20
MRS R07 Target XV – Practice Bombing Target
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Antimony	mg/kg	0.019	3.5	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
(<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.12 MRS R08 Area Bombing Target

Surface water, sediment, and air samples were not collected from the *MRS R08 Area Bombing Target*. Two biased surface soil samples were collected within this MRS. As shown in Table 5.17, copper was detected at concentrations exceeding the selected background value. Additionally, antimony was detected. As antimony was not detected in the ambient samples, the detection of antimony is conservatively assumed to indicate that antimony may be present above background concentrations. As noted below in

Table 6.21, the maximum detected concentrations of antimony and copper in surface soil were less than the selected ecological screening values; therefore, the HQs were less than one.

Table 6.21
MRS R08 Area Bombing Target
Surface Soil Screening Level Ecological Risk Assessment
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Surface Soil Ecological Screening Values ^a		HQ
<i>Metals</i>					
Antimony	mg/kg	0.17	3.5	a	<1
Copper	mg/kg	11	40	a	<1

a – USEPA Region 4 Ecological Screening Values, updated November 30, 2001
(<http://www.epa.gov/region04/waste/ots/epatab4.pdf>)

6.3.13 Discussion

6.3.13.1 Barium was detected in the surface water and sediment within the *MRS M01 Arbuckle Creek Fuze Disposal Area* at concentrations *less than* the respective ecological screening values; therefore the HQs of these analytes were less than one. However, lead was detected in the surface water within this MRS at a concentration *greater than* the selected ecological screening value. The lead HQ is 3.3. *Unacceptable risk to ecological receptors exposed to lead in surface water within the MRS M01 Arbuckle Creek Fuze Disposal Area cannot be ruled out. However, as there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background.*

6.3.13.2 Barium was detected in the surface soil within the *MRS R01 Target XI – Land Skip Bombing Target* at a concentration *less than* the ecological screening value. Antimony and barium were detected in the surface soil within the *MRS R03 Range XII – Position Firing Course* at concentrations *less than* the respective ecological screening values. Antimony was detected in the surface soil within the *MRS R04 Target XIII – Practice Bombing Target* and *MRS R07 Target XV – Practice Bombing Target* at concentrations *less than* the ecological screening value. Antimony, barium, and copper were detected in the surface soil within the *MRS R06 Range XIX – Position Firing Course* at concentrations *less than* the respective ecological screening values. Antimony and copper were detected in the surface soil within the *MRS R08 Area Bombing Target* at concentrations *less than* the respective ecological screening values. The HQs of the above mentioned analytes are less than one, indicating negligible risk to ecological receptors. *Therefore, an unacceptable ecological risk through to exposure to the aforementioned metals in the surface soil at the following MRSs is not expected:*

- *MRS R01 Target XI – Land Skip Bombing Target*
- *RS R03 Range XII – Position Firing Course*
- *MRS R04 Target XIII – Practice Bombing Target*

FINAL

- *MRS R06 Range XIX – Position Firing Course*
- *MRS R07 Target XV – Practice Bombing Target*
- *MRS R08 Area Bombing Target*

CHAPTER 7 SUMMARY AND CONCLUSIONS

7.1 SUMMARY

7.1.1 Twelve MRSs at the USAF Avon Park Range FUDS were identified and evaluated to determine their potential to cause significant MEC and/or MC contamination to the environment or to adversely affect human and ecological receptors. The evaluation included the collection of groundwater, surface water, sediment, and surface soil samples as well as the implementation of QR within 11 of the 12 MRSs. The *MRS R11 Lake Kissimmee Water Bombing Target* was not evaluated during the field visit, as discussed amongst the TPP team and further detailed in subchapter 5.14. The area within this MRS has likely been subject to silt and sediment removal actions and the area around the structure located down gradient of the MRS has been subject to silt and sediment removal actions and dredged during construction.

7.1.2 During the site visit conducted from May 5th to May 10th, and May 12th, 2008, the SVT completed approximately 42 miles of QR. ***No MEC items were found during the SI. Several MD items were identified*** including over 200 .50- cal casings, one .50- caliber projectile, M38A2 Practice Bomb debris, and AN-M50 Incendiary Bomb debris.

7.1.3 The following paragraphs summarize the MC sampling results for each of the 11 MRSs from which samples were collected and analyzed. All samples collected were analyzed for explosives and indicator metals (aluminum, antimony, barium, copper, lead, and zinc). Samples collected within the *MRS R09 North Restricted Use Area* and *MRS R10 Central Restricted Use Area* were additionally analyzed for iron to account for their potential (not documented) use as OB/OD areas. No ambient surface water samples or groundwater samples were collected and no data relating to site-specific ambient metal concentrations in surface water or groundwater were available. Additionally, there are no background (or comparison) data available for antimony or barium in sediment. As there are no background data for comparison, it cannot be determined if the observed concentrations are within the range of background. As antimony was not detected in the ambient surface soil samples, detections of antimony are conservatively assumed to indicate that antimony may be present above background concentrations. Therefore, it was assumed any detection of MC metals exceeded background and were evaluated in a SLRA.

7.1.4 ***MRS M01 Arbuckle Creek Fuze Disposal Area:*** One biased surface water sample and one biased sediment sample (and field duplicate) were collected. No explosives were detected in the samples collected within this MRS. Two MC metals (barium and lead) were detected in the surface water sample collected from the MRS.

One MC metal (barium) was detected in the sediment samples analyzed. Therefore, the surface water and sediment migration pathways are complete. These MC metals were detected at concentrations *less than* the respective human health screening values. Barium in surface water and sediment was detected at concentrations *less than* the respective ESVs. Lead was detected at concentrations *greater than* the selected ESV; therefore, the HQ was greater than one for lead in surface water.

7.1.5 MRS R01 Target XI – Land Skip Bombing Target: Two biased surface soil samples were collected within this MRS. No explosives were detected in the samples collected within this MRS. Barium was detected in the surface soil samples at concentrations greater than the selected background concentration. The soil migration pathways are complete. The maximum detected concentration of barium in the surface soil did not exceed the human health screening value or ESV.

7.1.6 MRS R02 Target XII – Combination BGR: One biased surface soil sample was collected within this MRS. No explosives were detected in the sample collected within this MRS. No MC metals were detected at concentrations greater than the selected background concentrations. The soil migration pathways are incomplete.

7.1.7 MRS R03 Range XII – Position Firing Course: Three biased surface soil samples (and QA/QC samples) were collected within this MRS. No explosives were detected in the samples collected within this MRS. One MC metal (barium) was detected at a concentration greater than the selected background concentration. Additionally, antimony was detected (see paragraph 7.1.3). The soil migration pathways are complete. Barium and antimony were detected at concentrations *less than* the respective human health screening values and ESVs.

7.1.8 MRS R04 Target XIII – Practice Bombing Target: One biased surface soil sample was collected within this MRS. No explosives were detected in the sample collected within this MRS. Antimony was detected (see paragraph 7.1.3). The soil migration pathways are complete. Antimony was detected at a concentration *less than* the respective human health screening value and ESV.

7.1.9 MRS R05 Target XIV – Practice Bombing Target: One biased surface soil sample was collected within this MRS. No explosives were detected in the sample collected within this MRS. No MC metals were detected in the surface soil sample at concentrations exceeding the selected background concentrations. The soil migration pathways are incomplete.

7.1.10 MRS R06 Range XIX – Position Firing Course: Three biased surface soil samples were collected within this MRS. No explosives were detected in the samples collected within this MRS. Barium and copper were detected in the surface soil at concentrations exceeding the selected background concentrations. Additionally, antimony was detected (see paragraph 7.1.3). The soil migration pathways are complete. Antimony, barium, and copper were detected at concentrations *less than* the respective human health screening values and ESVs.

7.1.11 MRS R07 Target XV – Practice Bombing Target: One biased surface soil sample was collected within this MRS. Antimony was detected (see paragraph 7.1.3).

The soil migration pathways are complete. Antimony was detected at a concentration *less than* the respective human health screening value and ESV.

7.1.12 *MRS R08 Area Bombing Target*: Two biased surface soil samples were collected within this MRS. One MC metal (copper) was detected in the surface soil at concentrations exceeding the selected background concentrations. Additionally, antimony was detected (see paragraph 7.1.3). The soil migration pathways are complete. Antimony and copper were detected at concentrations *less than* the respective human health screening values and ESVs.

7.1.13 *MRS R09 North Restricted Use Area*: One biased surface soil sample (and field duplicate) was collected within this MRS. No MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. The soil migration pathways are incomplete.

7.1.14 *MRS R10 Central Restricted Use Area*: One biased surface soil sample was collected within this MRS. No MC metals were detected in the surface soil at concentrations exceeding the selected background concentrations. The soil migration pathways are incomplete.

7.2 CONCLUSIONS REGARDING POTENTIAL MUNITIONS AND EXPLOSIVES OF CONCERN EXPOSURE PATHWAYS

7.2.1 Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004), the munitions known or suspected to have been disposed of within the *MRS M01 Arbuckle Creek Fuze Disposal Area* include Fuze, bomb, AN-M103 and Fuze, bomb, AN-M101A2. Based on the ASR (USACE, 1996), ASR Supplement (USACE, 2004), the 1999 EOD response, and the 2008 field findings, the munitions known or suspected to have been used within the remaining 11 MRSs are: Small Arms, General; 50 Cal. Machine Gun; Bomb, 100-lbs, practice, M38A2; Bomb, 100-lbs, practice, M85; Bomb, 250-lb., GP, AN-M57; Bomb, 250-lb., Target ID, M89 & M90; Bomb, 4lb, Incendiary, AN-M50; Signal, M1A1; Signal, M3 & M5; Flare, illuminating, Mk4, Mk5, & Mk10; and, Flare, airport, M8. With the exception of small arms munitions, these munitions contain fuzes and explosives, and might present a residual explosive hazard if they remain at the site intact.

7.2.2 During the 2008 site visit, *no MEC items were found. Several MD items were identified.* A .50- caliber casing and M38A2 practice bomb debris was found within *MRS R01 Target XI – Land Skip Bombing Target*. M38A2 practice bomb debris was found within *MRS R04 Target XIII – Practice Bombing Target*. Also at target center of this MRS, the SVT noted a circular mound approximately 50 feet in circumference, covered in thick vegetation and containing bomb debris. AN-M50 Incendiary Bomb debris was found within *MRS R06 Range XIX – Position Firing Course*. M38A2 practice bomb debris was found within *MRS R08 Area Bombing Target*. Remnants of the limestone target outline were visible in 1994 (USACE, 1996). Approximately 200 .50-caliber casings and one .50- caliber projectile was found within *MRS R10 Central Restricted Use Area*.

7.2.3 Although the SVT did not find MD or MEC within *MRS M01 Arbuckle Creek Fuze Disposal Area*, MEC in the form of two fuzes (AN-M103 or AN-M101A2)

have been recovered from this MRS in the 1940's, resulting in two civilian fatalities. A live 250-lb. bomb (Bomb, 250 lb., GP, AN-M57) was located within *MRS R06 Range XIX – Position Firing Course* in 1999; the response and detonation was conducted by Moody EOD and McDill EOD. No MEC or MD were found during the 2008 site visit and none have been reported or found since closure within the following MRSs: *MRS R02 Target XII – Combination BGR*; *MRS R03 Range XII – Position Firing Course*; *MRS R05 Target XIV – Practice Bombing Target*; and *MRS R09 North Restricted Use Area*. The 2008 SVT noted thick vegetation within the *MRS R09 North Restricted Use Area*, which may hinder the ability to view MEC or MD on the surface of the MRS. No MEC or MD have been reported found within the *MRS R11 Lake Kissimmee Water Bombing Target*. The ASR team conducted an aerial survey of this MRS in 1994. No MEC or MD have been reported found within the *MRS R07 Target XV – Practice Bombing Target*. The current landowner reported to the 2008 SVT that he previously removed what he referred to as “footing for a control tower.” Although no MEC or MD have been found or reported within the aforementioned MRSs, there remains the possibility explosively hazardous MEC could remain intact within these MRSs.

7.2.4 Based on the qualitative MEC Screening Level Risk Assessment (Chapter 6), there is the possibility that human receptors might come into contact with explosively hazardous MEC at all 12 of the MRSs associated with the USAF Avon Park Range; therefore, there is the potential for an explosive safety risk at these MRSs.

7.3 CONCLUSIONS REGARDING POTENTIAL MUNITIONS CONSTITUENTS EXPOSURE PATHWAYS

7.3.1 An exposure pathway is not considered to be completed unless all four of the following elements are present (USEPA, 1989):

- A source and mechanism for chemical release;
- An environmental transport/exposure medium;
- A receptor exposure point; and
- A receptor and a likely route of exposure at the exposure point.

7.3.2 *MRS M01 Arbuckle Creek Fuze Disposal Area*: The groundwater and surface soil migration pathways are incomplete. The surface water and sediment migration pathways are complete, as barium and lead were detected in the surface water and barium was detected in the sediment. As these detections did not exceed the respective human health screening values, this MRS is not expected to pose a risk to human receptors via exposure to surface water or sediment. Lead was detected in the surface water at a concentration exceeding the ESV. The calculated HQ for lead was 6.3. Based on the analytical results presented in this report, unacceptable risk to ecological receptors exposed to surface water within this MRS cannot be ruled out. *However, as there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of background.* Due to natural and anthropogenic-influenced surface water flow since site closure, the MC source (potentially remaining MEC/MD) is likely located further downstream than the original disposal location.

7.3.3 MRS R01 Target XI – Land Skip Bombing Target: The groundwater migration pathways are incomplete. The surface soil exposure pathway is complete for this MRS. Barium was detected within the surface soil sample at concentrations exceeding background. However, the maximum detected concentration did not exceed the human health screening value or the ESV. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Surface water samples were not collected.

7.3.4 MRS R02 Target XII – Combination BGR: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Surface water samples were not collected. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

7.3.5 MRS R03 Range XII – Position Firing Course: The surface soil migration pathways are complete, as barium was detected above background. Antimony was additionally detected. The maximum detected concentrations of these analytes did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. The groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. There is a potential source of MC contamination (MC metals detected within the surface soil), leaching from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there are 18 registered wells.

7.3.6 MRS R04 Target XIII – Practice Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as antimony was detected in the surface soil (no background data were available for comparison). As the maximum detected concentration of antimony did not exceed human health or ecological screening values, this MRS is not expected to pose a risk to human or ecological receptors with respect to exposure to MC metals via surface soil contact. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

7.3.7 MRS R05 Target XIV – Practice Bombing Target: The surface soil migration pathways are incomplete. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Additionally, the groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. Surface water recharge from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there is one registered well.

7.3.8 MRS R06 Range XIX – Position Firing Course: The surface soil migration pathways are complete, as barium and copper were detected above background. Antimony was additionally detected. The maximum detected concentrations of these analytes did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. The groundwater migration pathways are potentially complete (not quantitatively assessed). Groundwater samples were not collected within this MRS. There is a potential source of MC contamination (MC metals detected within the surface soil), leaching from the MRS could provide a potential environmental transport mechanism. Although there are no known drinking water wells within this MRS, there are two registered wells.

7.3.9 MRS R07 Target XV – Practice Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as antimony was detected. The maximum detected concentration of antimony did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

7.3.10 MRS R08 Area Bombing Target: The groundwater migration pathways are incomplete. The surface soil migration pathways are complete, as copper was detected above background. Additionally, antimony was detected. The maximum detected concentrations of antimony and copper did not exceed the human health or ecological screening values. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human or ecological receptors with regard to exposure to MC in the surface soil within this MRS. The surface water migration pathways are potentially complete (not quantitatively assessed). Surface water samples were not collected, though surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS.

7.3.11 MRS R09 North Restricted Use Area: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Surface water samples were not collected. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

7.3.12 MRS R10 Central Restricted Use Area: The groundwater and surface soil migration pathways are incomplete. No MC metals were detected in the soil sample above background. The surface water migration pathway is potentially complete (not quantitatively evaluated). Surface water in the form of wetlands and shallow groundwater which may be exposed at the surface is present within this MRS. Surface water samples were not collected. Based on the analytical results presented in this report, this MRS does not represent an increased risk to human receptors or ecological receptors exposed to surface soil.

7.3.13 MRS R11 Lake Kissimmee Water Bombing Target: The groundwater and soil migration pathways are incomplete. The surface water migration pathway is potentially complete (not quantitatively assessed). Surface water and sediment samples were not collected, as this MRS was pre-determined to proceed to RI/FS status due to the potential for MEC hazards. This target occurs entirely within the approximately 38,000-acre Lake Kissimmee. The large expanse of the lake and regular draw down events and silt and sediment removal projects since site closure may over time reduce the risk of MC exposure to human and ecological receptors, but further evaluation may be necessary.

7.4 OVERALL CONCLUSIONS

7.4.1 Several MD items indicative of MEC were found within several MRSs associated with the USAF Avon Park Range during this SI. Additionally, historical reports indicate use of small arms munitions and practice and high explosive bombs as well as disposal of fuzes at this range. Based on these findings, the known use of the MRSs for bombing activities, and the potential for MEC to remain within the MRSs, ***the MEC exposure pathways for the twelve MRSs associated with USAF Avon Park Range are considered complete.***

7.4.2 Although a completed pathway for surface water and sediment was identified for the *MRS M01 Arbuckle Creek Fuze Disposal Area*, ***this MRS does not represent a potential risk to human receptors with regard to MC.*** As the maximum detection of lead slightly exceeded the ESV, ***the risk to ecological receptors exposed to surface water within this MRS cannot be ruled out.*** As there are no surface water background data for comparison, it cannot be determined if the observed concentrations are within the range of site-specific conditions or are attributable to munitions disposal. Due to natural and anthropogenic-influenced surface water flow since site closure, the MC source (potentially remaining MEC/MD) is likely located further downstream than the original disposal location. *Further evaluation of sediment and surface may be warranted during the RI/FS.*

7.4.3 Completed soil exposure pathways were identified within several of the MRSs associated with the USAF Avon Park Range. However, as the maximum detected concentrations of MC metals did not exceed human health screening values or ESVs, these MRSs do not represent an increased risk to human receptors or ecological receptors exposed to surface soil. Based on the extensive presence of wetlands, the surface water/groundwater interconnection, and the large areal dimensions of the range (> 100,000 total acres), the TPP Team concurred with the limited biased sample collection approach focusing on the surface soils in target areas of the 10 MRSs located east of the Kissimmee River. The TPP Team agreed to defer the sediment, surface water, and groundwater evaluation at the site during the anticipated follow-on RI/FS. Collection of sufficient surface water, sediment, and groundwater samples to further assess the condition of waters on the site is better evaluated under a more in-depth investigation. Further evaluation of groundwater, surface water, and sediment may be warranted within these MRSs, as detailed in Table 7.1.

7.4.4 While the large expanse of Lake Kissimmee and regular draw down events and silt and sediment removal projects *may* over time reduce the risk of MC exposure to human and ecological receptors, further evaluation of *MRS R11 Lake Kissimmee Water Bombing Target* is necessary to evaluate the potential for risk due to MC exposure.

**Table 7.1
Summary of Munitions Constituents Sampling Results and Conclusions
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL**

MRS	Media	MC detection exceeding background? (*if comparison data not available, conservative approach assumes concentration exceeds background; see 5.2.7 and MRS-specific sub-chapters for further details)	Complete pathway? (See MRS-specific sub-chapters for details)	Exceeds Human Health Screening Value?	Exceeds Ecological Screening Value?	Further MC Evaluation?
M01 MRS Arbuckle Creek Fuze Disposal Area	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Barium*, lead*	Yes	No	Yes	Yes
	Sediment	Barium*	Yes	No	No	Yes
	Surface soil	Not sampled during SI	No	-	-	No
	Air	Not sampled during SI	No	-	-	No
MRS R01 Target XI – Land Skip Bombing Target	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Barium	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No
MRS R02 Target XII – Combination BGR	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	No MC detected exceeding background	No	-	-	No
	Air	Not sampled during SI	No	-	-	No

- = Not applicable

Table 7.1 (Continued)
Summary of Munitions Constituents Sampling Results and Conclusions
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL

MRS	Media	MC detection exceeding background? (*if comparison data not available, conservative approach assumes concentration exceeds background; see 5.2.7 and MRS-specific sub-chapters for further details)	Complete pathway? (See MRS-specific sub-chapters for details)	Exceeds Human Health Screening Value?	Exceeds Ecological Screening Value?	Further MC Evaluation?
MRS R03 Range XII – Position Firing Course	Groundwater	Not sampled during SI	Potentially	-	-	Yes
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Antimony* and barium	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No
MRS R04 Target XIII – Practice Bombing Target	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Antimony*	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No
MRS R05 Target XIV – Practice Bombing Target	Groundwater	Not sampled during SI	Potentially	-	-	Yes
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	No MC detected exceeding background	No	-	-	No
	Air	Not sampled during SI	No	-	-	No

- = Not applicable

Table 7.1 (Continued)
Summary of Munitions Constituents Sampling Results and Conclusions
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL

MRS	Media	MC detection exceeding background? (*if comparison data not available, conservative approach assumes concentration exceeds background; see 5.2.7 and MRS-specific sub-chapters for further details)	Complete pathway? (See MRS-specific sub-chapters for details)	Exceeds Human Health Screening Value?	Exceeds Ecological Screening Value?	Further MC Evaluation?
MRS R06 Range XIX – Position Firing Course	Groundwater	Not sampled during SI	Potentially	-	-	Yes
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Antimony*, barium, and copper	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No
MRS R07 Target XV – Practice Bombing Target	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Antimony*	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No
MRS R08 Area Bombing Target	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Antimony* and copper	Yes	No	No	No
	Air	Not sampled during SI	Yes	No	No	No

- = Not applicable

Table 7.1 (Continued)
Summary of Munitions Constituents Sampling Results and Conclusions
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL

MRS	Media	MC detection exceeding background? (*if comparison data not available, conservative approach assumes concentration exceeds background; see 5.2.7 and MRS-specific sub-chapters for further details)	Complete pathway? (See MRS-specific sub-chapters for details)	Exceeds Human Health Screening Value?	Exceeds Ecological Screening Value?	Further MC Evaluation?
MRS R09 North Restricted Use Area	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	No MC detected exceeding background	No	-	-	No
	Air	Not sampled during SI	No	-	-	No
MRS R10 Central Restricted Use Area	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	No MC detected exceeding background	No	-	-	No
	Air	Not sampled during SI	No	-	-	No
MRS R11 Lake Kissimmee Water Bombing Target	Groundwater	Not sampled during SI	No	-	-	No
	Surface water	Not sampled during SI	Potentially	-	-	Yes
	Sediment	Not sampled during SI	Potentially	-	-	Yes
	Surface soil	Not sampled during SI	NA	-	-	No
	Air	Not sampled during SI	NA	-	-	No

- = Not applicable

Table 7.1 (Continued)
Summary of Munitions Constituents Sampling Results and Conclusions
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, FL

MRS	Media	MC detection exceeding background? (*if comparison data not available, conservative approach assumes concentration exceeds background; see 5.2.7 and MRS-specific sub-chapters for further details)	Complete pathway? (See MRS-specific sub-chapters for details)	Exceeds Human Health Screening Value?	Exceeds Ecological Screening Value?	Further MC Evaluation?
Groundwater confirmation sample	Groundwater	Barium*, copper*, lead*, and zinc*	Yes	No	-	-

- = Not applicable

CHAPTER 8 RECOMMENDATIONS

Based on the May 2008 SI field effort, the analysis results, and the historical record review, the twelve MRSs associated with the USAF Avon Park Range FUDS (listed below in Table 8.1) are recommended for RI/FS. ***Munitions removal actions are not warranted at this time.*** Further evaluation of the surface soil in ten of the twelve MRSs is not recommended (see Table 8.1). Further evaluation of the surface water, sediment, and groundwater in several MRSs may be warranted (see Table 8.1). The RI/FS recommendations are based on the following:

- MD and MEC have been found at the site since DoD closure and there is a potential for additional items to be present at the site. Based on the qualitative MEC risk evaluation (Subchapter 6.1), there is a possibility that human receptors might come into contact with explosively hazardous MEC at the MRSs associated with the USAF Avon Park Range; therefore, there is the potential for an explosive safety risk at these MRSs.
- No explosives were detected in any of the soil, sediment, surface water, or groundwater samples collected at the site. Surface water and sediment exist on site in the form of extensive wetlands and shallow groundwater which may be exposed at the surface. Direct release of MC to this surface water and sediment is possible. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. Leaching and surface water recharge to the groundwater may occur and the presence of registered wells within three MRSs provides an exposure route. Complete surface soil pathways were identified within several MRSs, though the maximum detected concentrations of MC metals did not exceed the human health or ecological screening values. Complete surface water and sediment exposure pathways were identified within the *MRS M01 Arbuckle Creek Fuze Disposal Area*. Only lead in surface water exceeded the ESV. Though this exceedance is slight, increased risk to ecological receptors exposed to surface water at this MRS cannot be ruled out. Further MRS-specific media sampling recommendations are specified below in Table 8.1.

**Table 8.1
Recommendations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Recommendation	Justification
<i>MRS M01 Arbuckle Creek Fuze Disposal Area</i>	RI/FS. Further surface water and sediment sampling may be warranted.	MEC has been found at the site resulting in two civilian deaths in the 1940's. Partial restrictions to access of the MRS exist in the form of fencing. The munitions known to have been disposed of at this MRS (fuzes) contain explosives that might present a residual hazard if they remain at the site intact. Due to surface water flow since site closure, MEC/MD/MC may be located further downstream that the original disposal location.
<i>MRS R01 Target XI – Land Skip Bombing Target</i>	RI/FS. Further surface water and sediment sampling may be warranted.	MD originating from .50- caliber munitions and a M38A2 100-lb. practice bomb were found during the SI. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.
<i>MRS R02 Target XII – Combination BGR</i>	RI/FS. Further surface water and sediment sampling may be warranted.	The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.

**Table 8.1
Recommendations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Recommendation	Justification
<i>MRS R03 Range XII – Position Firing Course</i>	RI/FS. Further surface water, sediment, and groundwater sampling may be warranted.	The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for leaching to the groundwater and 18 registered groundwater wells which provide an exposure route.
<i>MRS R04 Target XIII – Practice Bombing Target</i>	RI/FS. Further surface water and sediment sampling may be warranted.	MD originating from M38A2 100-lb. practice bombs was found within a 50 foot circumference circular located at target center. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.
<i>MRS R05 Target XIV – Practice Bombing Target</i>	RI/FS. Further surface water, sediment, and groundwater sampling may be warranted.	The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for surface water recharge to the groundwater and one registered groundwater well which provides an exposure route.

**Table 8.1
Recommendations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Recommendation	Justification
<i>MRS R06 Range XIX – Position Firing Course</i>	RI/FS. Further surface water, sediment, and groundwater sampling may be warranted.	MEC in the form of a 250-lb. GP bomb has been found (and detonated) onsite. MD originating from an AN-M50 incendiary bomb was found during this SI. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS. There is potential for leaching to the groundwater and two registered groundwater wells which provide an exposure route.
<i>MRS R07 Target XV – Practice Bombing Target</i>	RI/FS. Further surface water and sediment sampling may be warranted.	The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. The current landowner reportedly removed what he referred to as “control tower footings”. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.
<i>MRS R08 Area Bombing Target</i>	RI/FS. Further surface water and sediment sampling may be warranted.	MD originating from M38A2 100-lb. practice bombs have been found. Target remnants were visible in 1994. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.

**Table 8.1
Recommendations
USAF Avon Park Range, Okeechobee, Osceola, and Polk Counties, Florida**

MRS	Recommendation	Justification
<i>MRS R09 North Restricted Use Area</i>	RI/FS. Further surface water and sediment sampling may be warranted.	The exact reason for “surface use only” restrictions in historical documents remains unclear. The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.
<i>MRS R10 Central Restricted Use Area</i>	RI/FS. Further surface water and sediment sampling may be warranted.	The exact reason for “surface use only” restrictions in historical documents remains unclear. MD originating from .50- caliber munitions were found during this SI. The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. There are no known access restrictions. Shallow groundwater which may be exposed at the surface and extensive wetlands are present, through which direct release of MC may have occurred. Surface water and sediment sampling was not performed during the SI. The TPP team deferred further sampling of these media to the RI/FS.
<i>MRS R11 Lake Kissimmee Water Bombing Target</i>	RI/FS. Further surface water and sediment sampling may be warranted.	The munitions suspected to have been used at this MRS (practice bombs with signals and potentially high explosive bombs) contain explosives that might present a residual hazard if they remain at the site intact. This relatively shallow lake is used for public recreation. Public access by boat. Surface water and sediment sampling was not performed during the SI due to programmatic limitations. The TPP team deferred further sampling of these media to the RI/FS.

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