FINAL

Site Inspection Report
Camp Davis Site
Holly Ridge, North Carolina

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

FUDS Project No. I04NC001702
Contract: W912DY-04-D-0005
Task Order: 0008

Prepared For:
U.S. Army Corps of Engineers, Wilmington District
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June 2008

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Parsons has completed the Final Site Inspection Report for the Camp Davis site, Holly Ridge, North Carolina. 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.

June 17, 2008

Study/Design Team Leader and Team Members

June 17, 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.

June 17, 2008

Parsons Program Manager(s)

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June 17, 2008

U.S. Army Engineering & Support Center
ATTN: CEHNC-OE-DC (Mr. Doug Garretson)
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Subject: Contract W912DY-04-D-0005, Delivery Order 0008
MMRP SI for SE and Pacific IMA Region – Final SI Report
Camp Davis Site, Holly Ridge, North Carolina

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 simultaneously forwarded five copies of the document to Mr. John Baden of the USACE Wilmington District (CESAW) for his use and distribution. We have also forwarded copies to the North Carolina Department of Environment and Natural Resources (NCDENR), USACE HQ and 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 Project Manager (Ms. Laura Kelley) at (678) 969-2437.

Sincerely,

PARSONS

Don Silkebakken, P.E.
MMRP SI Program Manager

cc: John Baden – 5 copies/5 CDs
Jeff Waugh – (USACE HQ) – 1 CD
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U.S. Army Corps of Engineers
Southeast and Pacific IMA Region

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Camp Davis Site
Holly Ridge, North Carolina

FUDS Project No. I04NC001702
June 2008

In Support of

FUDS MMRP Site Inspections Project

Prepared By:
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ACRONYMS AND ABBREVIATIONS

APP	Accident Prevention Plan
ASR	Archive Search Report
bgs	below ground surface
CEMVR	U.S. Army Corps of Engineers, Rock Island District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund
CESAW	U.S. Army Corps of Engineers, Wilmington District
CFR	Code of Federal Regulations
CHE	Chemical Hazard Evaluation
CRREL	Cold Regions Research and Engineering Laboratory
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
CWM	Chemical Warfare Material
CZMP	Coastal Zone Management Program
DC	Design Center
DEP ARC	Defense Environmental Programs Annual Report to Congress
DERP	Defense Environmental Response Program
DID	Data Item Description
DMM	Discarded Military Munitions
DoD	Department of Defense
DQO	Data Quality Objective
EE/CA	Engineering Evaluation/Cost Analysis
EHE	Explosive Hazard Evaluation
EOD	Explosive Ordnance Disposal
EPP	Environmental Protection Plan
ER	Engineer Regulation
ERA	Ecological Risk Assessment
ESE	Environmental Science & Engineering, Inc.
ESV	Ecological Screening Values
FDE	Findings and Determination of Eligibility
FIP	Field Investigation Plan
FSP	Field Sampling Plan
FTL	Field Team Leader
FUDS	Formerly Used Defense Site
GIS	Geographic Information System
gpm	gallons per minute
GPS	Global Positioning System
HE	High Explosive
HEI	High Explosive Incendiary
HFA	Human Factors Application, Inc.
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HRS	Hazardous Ranking System

HTW	Hazardous and Toxic Waste
HWS	Hazardous Waste Section
IAW	In Accordance With
IDW	Investigative Derived Waste
IMA	Installation Management Agency
INPR	Inventory Project Report
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams Per Kilograms
MM	Military Munitions
MMCX	Military Munitions Center of Expertise
MMDC	Military Munitions Design Center
MMR	Military Munitions Response
MMRP	Military Munitions Response Program
MRA/MRS	Munitions Response Area or Site
MRDS	Mineral Resource Data System
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	mean sea level
NAD	North American Datum
NCDENR	North Carolina Department of Environment and Natural Resources
NCAC	North Carolina Administrative Code
NCP	National Contingency Plan
NCWRC	North Carolina Wildlife Resources Commission
NDAI	No Department of Defense Action Indicated
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHP	Natural Heritage Program
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHD	National Register of Historic District
NRHP	National Register of Historic Places
NRIS	National Register Information System
NWI	National Wetlands Inventory
NWRS	National Wildlife Refuge System
OEW	Ordnance and Explosive Waste
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
Parsons	Parsons Corporation
PDA	Personal Digital Assistant
PFSP	Programmatic Field Sampling Plan
POP	Period of Performance
ppm	Parts Per Million
PRG	Preliminary Remediation Goal

PSAP	Programmatic Sampling and Analysis Plan
PWP	Programmatic Work Plan
PWS	Performance Work Statement
QA	Quality Assurance
QC	Quality Control
QR	Qualitative Reconnaissance
RA	Removal Action
RAC	Risk Assessment Code
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SLRA	Screening Level Risk Assessment
SOP	Standard Operating Procedure
SS-SAP	Site-Specific Sampling & Analysis Plan
SS-WP	Site-Specific Work Plan
SSL	Soil Screening Level
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
µg/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
USAESCH	United States Army Corps of Engineers Engineering and Support Center, Huntsville
USC	United States Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
USN	United States Navy
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
wt %	Weight Percent

GLOSSARY OF TERMS

anomaly	Any item that deviates from the expected subsurface ferrous and non-ferrous material at a site (i.e., pipes, power lines, etc.).
inhabited structure	Permanent or temporary structure, other than military munitions-related structures, routinely occupied by one or more persons for any portion of the day.
magnetometer	An instrument for measuring the strength of a magnetic field; used to detect buried iron.
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 UXO, 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 (e.g., penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

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 within an MRA 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 PROJECT OBJECTIVES

ES.1.1 The objective of this site inspection (SI) is to determine whether the Camp Davis site in Pender and Onslow Counties, North Carolina warrants further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The Camp Davis site was used during World War II mainly for the training of U.S. Army troops in the use of artillery and small arms training and is comprised of three munitions response sites (MRSs): 1) MRS01, the Rifle & Pistol Range; 2) MRS02, the Coastal Anti-Aircraft Range; and 3) MRS03, Range Complex No.1. The Rifle & Pistol Range was used during World War II solely as a small arms training facility. The Coastal Anti-Aircraft Range was used for anti-aircraft training employing targets pulled by aircraft. Range Complex No.1 consisted of two artillery ranges, the Track Target Range and the Anti-Aircraft Range; both employed the use of 37mm and 40mm artillery. Also included in the Range Complex No.1 was a hand grenade court. The ranges were officially closed in September 1944. The area of the Coastal Anti-Aircraft Range was used by the Department of the Navy in the late 1940s by for "Operation Bumblebee" which entailed the testing of guided missile rocket motor propulsion systems; this operation was discontinued in 1948. Camp Davis has been declared a Formerly Used Defense Site (FUDS) based on use as an anti-aircraft and artillery range. The site was recommended for an Ordnance and Explosive Waste (OEW) project and assigned FUDS identification #I04NC001702. 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 at the three MRSs were performed. Figure ES.1 shows the Camp Davis MRS locations.

ES.1.2 Outcomes for the three MRSs could include MEC response action or no Department of Defense (DoD) action indicated (NDAI), among others. If NDAI status is recommended and approved after evaluation of the SI data, the process for closeout of the site from the FUDS inventory will be initiated. If an imminent threat is identified to the public or the environment, a time-critical removal action (TCRA) may be performed as an interim action; otherwise a remedial investigation and feasibility study (RI/FS) will be initiated to evaluate feasible MEC response actions.

ES.1.3 It was determined during the Technical Project Planning (TPP) process that the collection of eleven surface soil samples and one groundwater sample would be sufficient to meet the SI project objectives. Eight surface soil samples were collected in locations with the highest likelihood for MC contamination. The remaining three surface soil samples were collected within the FUDS boundaries but in areas suspected to have

not been impacted by the DoD. One groundwater sample was collected from a supply well located within MRS03 Range Complex No.1.

ES.2 SUMMARY OF RESULTS

ES.2.1 The SI evaluation included approximately 13.2 linear miles of walked QR and the collection of eleven surface soil samples and one ground water sample.

ES.2.2 The field team did not encounter MEC during the QR along inspection of the three MRSs at the Camp Davis site. MD items noted during the site inspection included two expended .38-caliber rounds, one entire (not expended) .30-caliber munition, one expended .50-caliber munition, and one expended 37mm projectile identified as being a practice round. All of the aforementioned were found along the Range Complex No.1 MRS. An expended assumed .45-caliber slug found in the soil berm backstop at the Rifle & Pistol Range was also noted. Table ES.1 and Figure ES.1 summarize the results of the SI for the three MRSs.

ES.2.3 TestAmerica (formerly Severn Trent Laboratories) in Arvada, Colorado analyzed the surface soil and groundwater samples for explosives and metals, with the groundwater sample also tested for presence of perchlorate. No explosive compounds were found in any of the samples and no perchlorate was detected in the groundwater sample. The metals analytical results from the surface soil were compared to U.S. Geological Survey (USGS) background levels and ambient concentrations. The analytical results were then compared to the following three 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 considered a hazardous substance listed in 40 CFR Part 302, Table 302.4 of CERCLA?
- Was the analyte detected above background screening levels?

ES.2.4 SLRAs for human health and ecological receptors were performed on the soil samples. The SLRA for the Rifle & Pistol Range MRS indicated presence of lead in excess of human health criteria and antimony, copper and lead in excess of ecological screening values. The groundwater screening values used for this SI were the North Carolina Department of Environment and Natural Resources (NCDENR) Groundwater Protection Standards. No metals detected in groundwater exceeded human health screening levels. No explosive compounds or perchlorate were detected in the groundwater sample collected within the Range Complex No.1 MRS.

Table ES.1
Summary of Site Inspection Results
Camp Davis, Pender and Onslow Counties, NC

MRS	Acreage	MEC Found	Munitions Debris Found	MC Contamination
MRS1 Rifle & Pistol Range	1942	No	One .45-caliber (assumed) slug expended	Yes, antimony, copper and lead in soil
MRS2 Coastal AA Range	768 (land) 29,265 (water)	No	No	No
MRS3 Range Complex No.1	26,025	No	Four small arms munitions – 3 expended, 1 discarded and 1 37mm projectile practice - expended	No

ES.3 CONCLUSIONS REGARDING POTENTIAL MUNITIONS AND EXPLOSIVES OF CONCERN

An MEC SLRA was conducted based on the QR conducted in the field and historical data regarding previous site visits (Chapter 6). The types of ordnance historically used at the Coastal Anti-Aircraft Range MRS (37mm, 40mm, 3-inch, 90mm, 105mm and 155mm projectiles) and the Range Complex No.1 MRS (37mm and 40mm projectiles) have the potential to harm human receptors if they are contacted and are still functional. Anti-Aircraft training at the Coastal Anti-Aircraft MRS was conducted over the Atlantic Ocean and exposure to these munitions is therefore considered very unlikely. Based on reports of and encounters with MEC and MD, as reported in the 1994 Archives Search Report (ASR) (U.S. Army Corps of Engineers [USACE] Rock Island District [CEMVR], 1994) and the 2004 ASR Supplement (CEMVR, 2004), the MEC exposure pathway at the Range Complex No.1 MRS is considered complete. The impact areas along the Range Complex No.1 MRS are often situated within pocosin swamps and therefore are undisturbed except for use of these lands for game hunters. Forest lands along this MRS are currently being harvested and exposure to these munitions is more likely. The Rifle & Pistol Range MRS was used for small arms training and therefore no explosive munitions are believed to exist in this area. No removal action is believed to be warranted at this time for any of the MRSs.

ES.4 CONCLUSIONS REGARDING POTENTIAL MUNITIONS CONSTITUENTS EXPOSURE PATHWAYS

ES.4.1 An exposure pathway is not considered to be completed unless all four of the following elements are present (U.S. Environmental Protection Agency [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.4.2 The analytical results from the surface soil sampling were evaluated in the human health risk assessment using the USEPA Region 9 Residential Soil Preliminary Remediation Goals (PRGs). The analytical results from the surface water sampling were evaluated in the human health risk assessment using the most conservative of applicable North Carolina Hazardous Waste Section guidance and USEPA Region 9 PRGs for Human Health. Screening values used in this Screening Level Ecological Risk Assessment (SLERA) analysis include USEPA Region 4 Ecological Screening Values (ESVs) for metals in the soil. Groundwater screening criteria used the more conservative values from the NCDENR Title 15 Subchapter 2L standards or the USEPA Region 9 Tap Water Standards. The perchlorate screening value for human health and ecological risk assessments, which is 24 micrograms per liter (µg/L), is based on the Policy on DoD Required Actions Related to Perchlorate Memorandum dated January 26, 2006.

ES.4.3 MRS 01 – Rifle & Pistol Range MRS: Regarding Human Health, the soil pathway is complete for the Rifle & Pistol Range MRS with elevated lead concentrations in the range's soil backstop. Air, groundwater, surface water and sediment exposure pathways were not evaluated for this MRS. The elevated lead in the soil may be considered a *significant risk* of adverse human health effects in this MRS. Additionally, the lead concentrations in soil along with elevated concentration of antimony and copper are expected to be a high potential for ecological risk with regard to MCs at the Rifle & Pistol Range MRS.

ES.4.4 MRS 02 – Coastal Anti-Aircraft Range MRS: The soil exposure pathway is considered incomplete for the Coastal Anti-Aircraft Range MRS. MCs were not detected above background levels in the surface soil. Air, groundwater, surface water and sediment exposure pathways were not evaluated for this MRS. There is *no significant risk* of adverse human health effects in this MRS. Additionally, there is not expected to be a high potential for ecological risk with regard to MCs at the Coastal Anti-Aircraft Range MRS.

ES.4.5 MRS 03 – Range Complex No. 1 MRS: The soil and groundwater exposure pathways were evaluated and considered incomplete for the Range Complex No. 1 MRS. Air, surface water and sediment exposure pathways were not evaluated for this MRS. There is *no significant risk* of adverse human health effect or of adverse ecological effects from MCs in this MRS.

ES.5 RECOMMENDATIONS

A status of RI/FS is recommended for the Rifle & Pistol Range MRS and the Range Complex No. 1 MRS of the Camp Davis site. An NDAI status is recommended for the Coastal Anti-Aircraft Range MRS. Further evaluation of MC is recommended for the Rifle & Pistol Range but not for the Range Complex No.1 MRS. No Removal Action is believed warranted for any of the MRSs at this time.

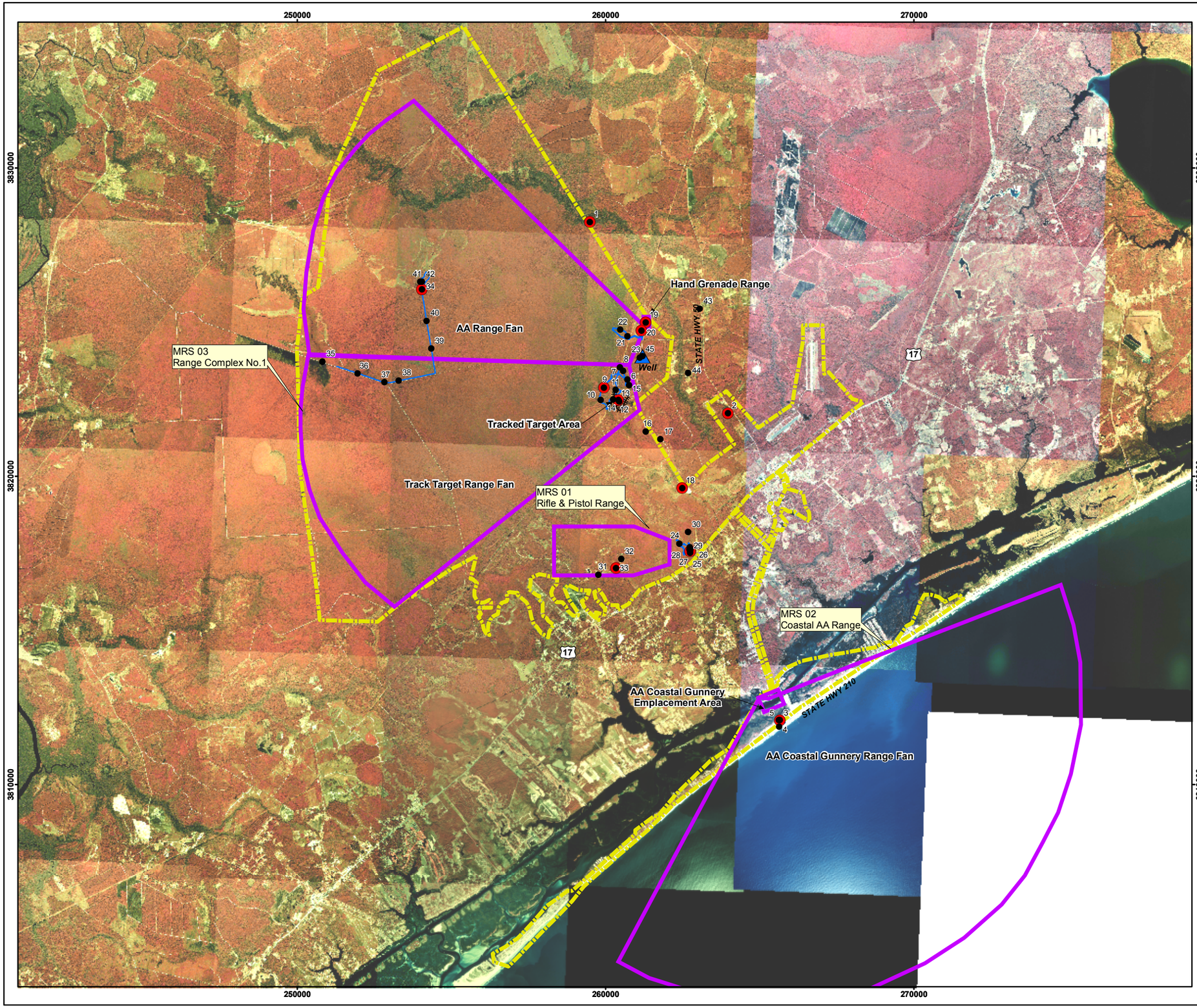
Table ES.2
Recommendations
Camp Davis, Pender and Onslow Counties, NC

MRS	Recommendation	Justification
MRS 01 –Rifle & Pistol Range	RI/FS	Antimony, copper and lead present in shallow soil samples above ecological risk levels with lead also in excess of its respective human health criteria for soil.
MRS 02 – Coastal Anti Aircraft Range	NDAI	No historical or present day findings of MEC or MD. No detected MC above human health and ecological risk criteria.
MRS 03 – Range Complex No. 1	RI/FS	Historical use and recent findings of a single37mm projectile (practice). Believed use of 37mm high explosive (HE) and possibly 40mm projectiles. Historical use and past findings of MD relating to use of hand grenades.

Figure ES.1

General Site Overview
Camp Davis

Holly Ridge, North Carolina



Legend

- Field Observation Location
- Ground Water Sample Location
- Soil Sample Location
- Approximate MRS Boundary
- Approximate Site Boundary
- Qualitative Reconnaissance Track
- Tracked Target Area

AA = Anti-Aircraft

Note: Water sample locations to be determined.

Site Location in North Carolina

Image Source: 1998 Orthophotos
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

PARSONS

U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	General Site Overview	
DRAWN BY: BT	SCALE: As Shown	PROJECT NUMBER: 744647.32000
CHECKED BY: SC	DATE: June 2008	PAGE NUMBER: ES-6
SUBMITTED BY: DS	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\FigES_1.mxd	

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

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 former Camp Davis site located near the town of Holly Ridge and in Pender and Onslow Counties, North Carolina. Camp LeJeune Marine Corps Base, an active military installation, borders the Camp Davis site to the east. The former Camp Davis, comprised of approximately 47,000 acres, was used for training of U.S. Army personnel during World War II. The camp included an Anti-Aircraft Training Center, airfield, schools, and redistribution center that later changed to a hospital and rehabilitation center. Ranges and impact areas included an Anti-Aircraft Impact Area, Tack Target Impact Area, Grenade Range, Rifle and Pistol Range, Anti-Aircraft Coastal Gunnery Range Gun Emplacement Area and Anti-Aircraft Coastal Gunnery Impact Area. The coordinates for the center point of the three Munitions Response Sites (MRSs) for Camp Davis are listed in Table 1.1. The coordinates are in meters (Universal Transverse Mercator [UTM] Zone 17 North American Datum [NAD] 83).

Table 1.1
Camp Davis MRS Coordinates

Parcel	X-Coordinate (meters)	Y-Coordinate (meters)
Rifle/Pistol Range – MRS01	260928 E	3817822
Coastal Anti-Aircraft Range – MRS02	268818	3808754
Range Complex No.1 – MRS03	255513	3823370

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 Formerly Used Defense Sites (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, 2004) 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 of 1980 (CERCLA) (42 USC §9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 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, pollutants or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC/MC, 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 the minimum 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 United States Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the release for effective and rapid 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 findings identified in the Archives Search Report (ASR) performed by the USACE – Rock Island District (CEMVR). All work adhered to the DERP for FUDS and relevant U.S. Army regulations and guidance for MEC programs. As specified in the task order, this report is prepared to summarize the SI sampling events and presents an accounting of the MEC/MC contamination identified on-site (CEMVR, 1994).

1.3 PROJECT SCOPE

1.3.1 Due to the historical use of the site as a large caliber artillery training range and as a small arms range and evidence of MEC and munitions debris (MD) during previous site investigations, it was agreed by the Technical Project Planning (TPP) Team that the SI approach for the former Camp Davis site would proceed in a manner to support either a RI/FS or a No DoD Action Indicated (NDAI) recommendation. The SI for the former Camp Davis Site will not only attempt to evaluate MEC and MD absence or presence in the known range areas but will also evaluate MEC and MD absence or presence in peripheral portions of the site to provide circumstantial supporting evidence reflective of the absence or presence of MEC and MD in these areas. Additionally, MC sampling was also part of the scope of the SI to determine the level of impact on the environment that MEC/MD may have had.

1.3.2 The TPP Team concurred that the SI data collection efforts would focus on screening for MC contamination in surface soil and groundwater. A total of two soil samples were collected within the Rifle and Pistol Range MRS, one soil sample from within the Coastal Anti-Aircraft Range, and five soil samples and one groundwater

sample from the Range Complex No.1 MRS, along with the appropriate Quality Assurance/Quality Control (QA/QC) samples and field duplicates. The surface soil samples were collected with maximum bias to coincide with site locations most likely to display evidence of residual MC contamination (such as the target areas or areas displaying munitions debris presence). Three samples intended as ambient soil samples were collected from anticipated "non DoD impacted" locations outside the MRS locations, but within the FUDS boundary. Table 1.2 provides the sampling rationale.

Table 1.2
Sampling Rationale
Camp Davis, Holly Ridge, North Carolina

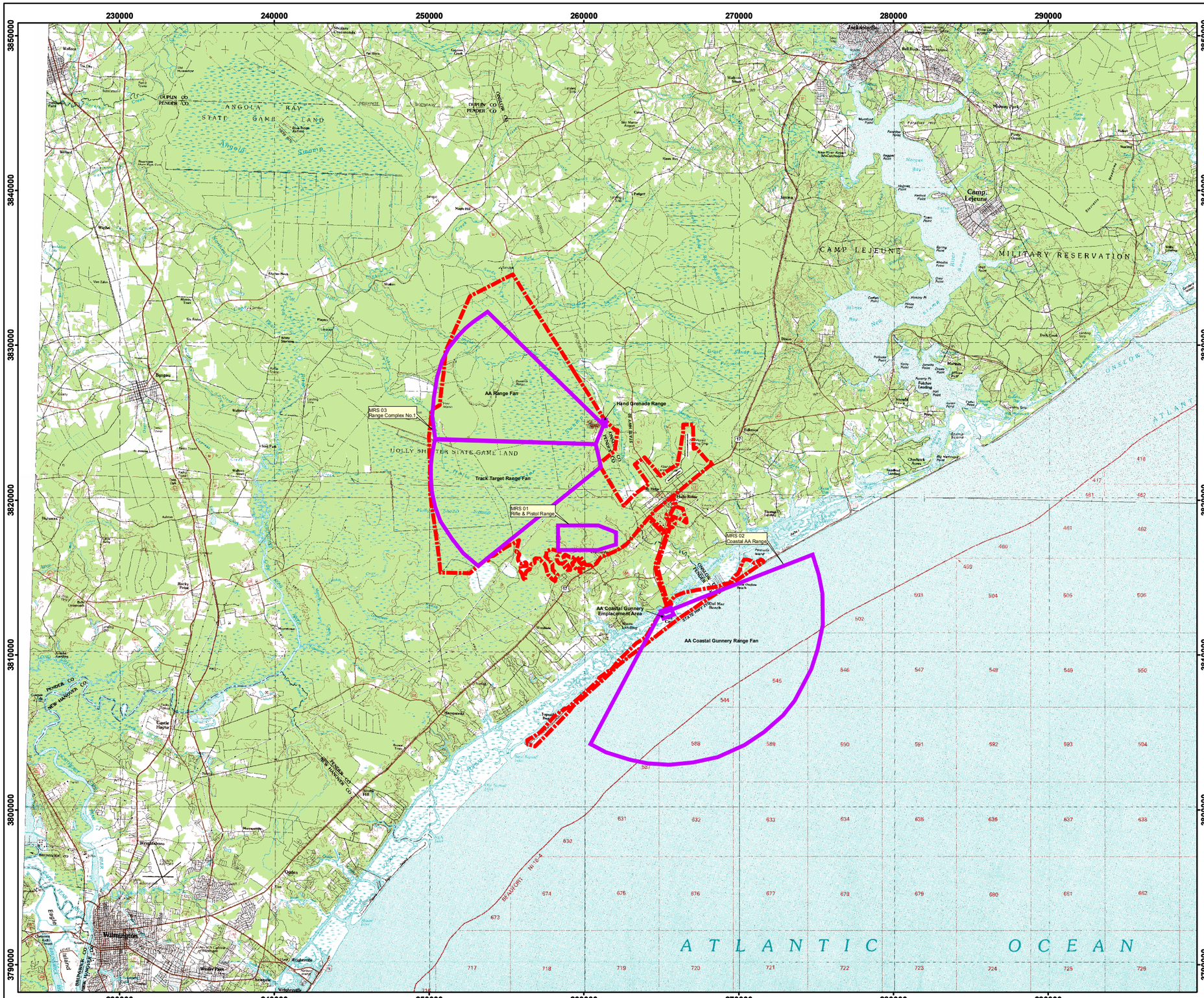
Sample ID	Sample Coordinates Longitude	Latitude	Media	Analysis	Historical Use of Munitions in Area	Rationale
CD-AMB-SS-02-01	-77.57106	34.51303	Soil	Metals, Explosives	No historical use of munitions known in area.	Sample collected within Remaining Land Area to estimate ambient metal concentrations.
CD-AMB -SS-02-02	-77.62156	34.57595	Soil	Metals, Explosives	No historical use of munitions known in area.	Sample collected within Remaining Land Area to estimate ambient metal concentrations.
CD-AMB -SS-02-03	-77.58657	34.49086	Soil	Metals, Explosives	No historical use of munitions known in area.	Sample collected within Remaining Land Area to estimate ambient metal concentrations.
CD-MRS03 -SS-02-04	-77.60234	34.53660	Soil	Metals, Explosives	Small Arms Munitions, 37mm and 40mm projectiles.	Sample collected within AA Impact Area to screen for MC.
CD-MRS03 -SS-02-05	-77.60995	34.51617	Soil	Metals, Explosives	Small Arms Munitions, 37mm and 40mm projectiles.	Sample collected within Track Target Range Impact Area to screen for MC.
CD-MRS03 -SS-02-06	-77.60097	34.53902	Soil	Metals, Explosives	Hand Grenades, Practice and Fragmentation	Sample collected within approximate area of magazines
CD-MRS02 -SS-02-07	-77.54999	34.42372	Soil	Metals, Explosives	Small Arms Munitions, rocket motors, 37mm, 40mm, 3-inch, 105mm and 155mm projectiles.	Sample collected within AA Coastal Gunnery Range to screen for MC.
CD-MRS03 -SS-02-08	-77.68025	34.54695	Soil	Metals, Explosives	Small Arms Munitions, 37mm and 40mm projectiles.	Sample collected within AA Impact Area to screen for MC.
CD-MRS03 -SS-02-09	-77.61512	34.51969	Soil	Metals, Explosives	Small Arms Munitions, 37mm and 40mm projectiles.	Sample collected within Track Target Range Impact Area to screen for MC.
CD-MRS01 -SS-02-10	-77.60925	34.46699	Soil	Lead, Copper, Antimony	Small Arms Munitions	Sample collected within Rifle and Pistol Range to screen for MC.
CD-MRS01 -SS-02-11	-77.58321	34.47245	Soil	Lead, Copper, Antimony	Small Arms Munitions	Sample collected within Rifle and Pistol Range to screen for MC.
CD-MRS03 –GW1	-77.60183	34.52906	Water	Metals, Explosives, Perchlorate	Small Arms Munitions, 37mm and 40mm projectiles	Screen for MC presence in groundwater

Metals and explosives – List of metals, explosives and perchlorate identified in 5.3 and 5.4.

Figure 1.1

Site Location
Camp Davis

Holly Ridge, North Carolina



Legend

- Approximate MRS Boundary
- Approximate Site Boundary

AA = Anti-Aircraft

Site Location in North Carolina

Image Source: USGS Topos, 1991
Projection: UTM Zone 18 NAD83, Map Units in Meters

5 2.5 0 5 Miles

N

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DESIGNED BY: BT	**Site Location**
DRAWN BY: BT	SCALE: As Shown; PROJECT NUMBER: 744647.32000
CHECKED BY: SC	DATE: June 2008; PAGE NUMBER: 1-5
SUBMITTED BY: DS	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\ Fig1_1.mxd

CHAPTER 2
PROPERTY DESCRIPTION AND HISTORY

2.1 SITE DESCRIPTION

The former Camp Davis site is located in Pender and Onslow Counties, North Carolina near the town of Holly Ridge and is approximately 30 miles northeast of Wilmington. The property consists mainly of undeveloped state gaming lands. Camp LeJeune Marine Corps Base, an active military installation borders the former Camp Davis site to the east of North Carolina Highway 50. The site is comprised of a three MRSs: MRS01 - The Rifle and Pistol Range (1942 acres); MRS02 - Coastal Anti-Aircraft Range (768 land acres and 29,265 sea acres); and MRS03 - Range Complex No.1 (26,025 land acres). The Coastal Anti-Aircraft Range MRS is actually located along the Atlantic coast in the town of Surf City. Figure 2.1 illustrates the FUDS boundary as well as the three MRS boundaries.

2.2 SITE LOCATION AND SETTING

2.2.1 Topography and Vegetation

The main body to the former Camp Davis site varies in elevation from 38 to 67 feet above sea level with an essentially flat slope. The portion of the site that comprises the Coastal Anti-Aircraft Range is at or near sea level. Stands of pine forest dominate upland portions of the site, while creeks and tributaries drain lowland hardwood areas and pocosin swamp.

2.2.2 Geology and Soil

The area around the former Camp Davis site lies within the Carolina Coastal Plain physiographic province. Three stratigraphic units are associated with the Pender and Onslow County substrata, which occur beneath a veneer of surficial sands and clays. Immediately under the surficial sands is the Yorktown formation; beneath the Yorktown formation are the Castle Hayne and Pee Dee formations. The local geology at Camp Davis is composed predominately of the Castle Hayne formation. The formation is composed of the white or gray shell material with sand. Individual beds vary in degree of consolidation from a dense limestone to a loose shell and sand. The formation thickness rarely exceeds 100 feet, occurring approximately 75 to 100 feet below mean sea level (MSL). Surface soil units that have been identified on the site belong to the Hydric soil series, including Croatan muck, Muckalee loam, Torhunta fine sandy loam, Woodington loamy fine sand, Leon fine sand, Rains fine sandy loam, and Pantego mucky loam. These units are typically poor to very poorly drained soils. The high water table (0.5-1.5 feet below ground surface [bgs]) below these units imposes a severe limitation to both urban and vehicular traffic.

2.2.3 Wetlands

The site is heavily forested and swampy and contains many wetlands. The predominant wetland vegetation types on site consist of forested and scrub shrub wetlands. These are identified by the National Wetlands Inventory (NWI) as:

- PFO3/4B-Palustrine, forested, broad-leaved or needle-leaved evergreen, saturated.
- PSS1/3B-Palustrine, scrub-shrub, broad-leaved deciduous or broad-leaved evergreen, saturated.
- PSS3/4A-Palustrine, scrub-shrub, broad-leaved or needle-leaved evergreen, temporarily flooded.

2.2.4 Significant Structures

The majority of the former Camp Davis site is located in Pender County, North Carolina, with a smaller portion in Onslow County. The majority of the land is controlled by the State of North Carolina as a wildlife management and wetland area. Some residential areas exist along the FUDS boundary and a privately owned airport occupies a portion of the Rifle and Pistol Range MRS.

2.2.5 Demographics

2.2.5.1 The demographics information for Pender and Onslow Counties, North Carolina was obtained from the 2006 United States Census Bureau website (http://quickfacts.census.gov/qfd/states/37.html).

2.2.5.2 Pender County has a human population of approximately 48,630, with approximately 47.2 persons per square mile. Onslow County population is 150,673 persons with a density of 196 persons per square mile. Figure 2.2 shows a breakdown of population within a 4-mile buffer of the site. The segment of the population under the age of 18 for Pender and Onslow Counties is 22% and 27.9%, respectively, while 14.4% and 7.4% are over the age of 65, respectively. There are 23,509 households within the Pender County and 62,017 households in Onslow County. The three MRSs are located either wholly or in part of each of the two counties. MRS-01, the Rifle & Pistol Range, is located entirely within Pender County; the land portions of MRS-02, the Coastal Anti-Aircraft Range, is located in Onslow County and entirely within the town of Surf City; and MRS-03, Range Complex No.1, is located mostly in Pender County with lesser portions in Onslow County.

2.2.5.3 As noted in Table 2.1, over 15,500 individuals live within a 4-mile buffer of the former Camp Davis site. There are approximately 20 to 30 inhabited structures, as reported by the SVT, within the former Camp Davis site. The town of Holly Ridge, located southeast of the Range Complex No.1 MRS and east of the Rifle & Pistol Range MRS, had a 2000 Census population of 831 persons with a population density of 604.9 persons per square mile. The town of Surf City, located along the Atlantic Coast and encompassing the land portions of the Coastal Anti-Aircraft Range MRS boundary, has a 2000 Census boundary of 331.6 persons per square mile. Figure 2.2 depicts the 2000 Census Bureau census blocks and population in the vicinity of the site.

Table 2.1
Population within 4-Mile Buffer of the MRSs
Camp Davis Site, Holly Ridge, North Carolina

MRS	On Site	0 to 1/4 Mile	1/4 to 1/2 Mile[1]	1/2 to 1 Mile[1]	1 to 2 Miles[1]	2 to 3 Miles[1]	3 to 4 Miles[1]	Total[1]
MRS01 - Rifle & Pistol Range	143			169	1784	1664	2200	5960
MRS02- Coastal AA Range	335	657	305	349	1100	1260	3017	7023
MRS03 -Range Complex No.1	0			20	93	614	3894	4621

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 boundary, or buffer line.
[1] Population has been calculated for each individual MRS and may have overlap between other MRSs

2.2.6 Cultural and Archeological Resources

According to the National Register Information System (NRIS), the National Historic Landmarks (NHL) program, the National Heritage Areas (NHA) program, and the North Carolina State Historic Preservation Office (SHPO), there are no cultural or archeological resources within the former Camp Davis site. The site visit team (SVT) did not encounter any cultural or archeological resources during the November 2007 site visit.

2.2.7 Current and Future Land Use

The majority of the former Camp Davis site is undeveloped state and privately owned game lands. The game lands occur along almost the entire Range Complex No.1 MRS and the Rifle & Pistol Range MRS. Some of the land along the Range Complex No.1 is used for timber harvesting and approximately 20 to 30 home sites were noted by the SVT to occur within the Rifle & Pistol Range MRS. A small privately owned airport was noted to exist along the eastern portion of the Rifle & Pistol Range as well. There have been no disclosed plans for the game lands other than their present day use and no new residential construction noted.

2.3 SITE OWNERSHIP AND HISTORY

The War Department acquired a total of 46,682 acres by lease from numerous individuals, corporations, and government agencies to form Camp Davis. The Camp included an Anti-Aircraft Training Center, airfield, school, and redistribution center, which was later used a convalescent hospital and rehabilitation center. Ranges and impact areas at Camp Davis include: an Anti-Aircraft Impact Area, Track Target Impact Area, Grenade Range, Rifle and Pistol Range, Anti-Aircraft Coastal Gunnery Range Gun Emplacement Area and Anti-Aircraft Coastal Gunnery Range Impact Area. Coastal artillery Training ceased at the camp in September 1944. Following World War II, the U.S. Navy (USN) assumed command of a portion of the camp that had been used as the coastal artillery firing range. The USN used this area for the testing of rocket motor propulsion systems as part of codename “Operation Bumblebee”. No ordnance was

associated with the rocket testing procedures. In 1948, the USN closed testing operations; Camp Davis was declared surplus, decommissioned, and salvaging and sale of camp assets was conducted. Leased land was returned to the original landowners. CEMVR completed and Archives Search Report for Camp Davis in May 1994. CEMVR found no records of any ordnance related cleanup locations. Since its closure, practice small arms munitions (.50-caliber bullets) and practice artillery ammunition (37mm and 40mm projectiles) have been found on the former Camp Davis site. A Risk Assessment was provided by the CEMVR in May 2003. A Risk Assessment Code (RAC) score of 4, indicating a negligible risk of exposure to MEC, was assigned to the anti-aircraft, tracked target impact areas, and hand grenade range. A RAC score of 5, indicating no risk to MEC exposure, was assigned to the Rifle/Pistol Range and Coastal Anti-Aircraft Range.

2.4 SITE OPERATIONS AND WASTE CHARACTERISTICS

2.4.1 MRS-Specific Descriptions/Operations

2.4.1.1 The description of the three MRSs found within the former Camp Davis FUDS was obtained from the 1994 ASR and 2004 ASR Supplement except where noted.

2.4.1.2 *Rifle & Pistol Range – MRS01* consists of 1942 land acres. The range operated as a small arms training only for soldiers during World War II. From site observations made as part of this SI and historical knowledge of the site, the range consisted of four concrete backstops, all approximately 600 feet in length, with the four backstops placed end to end. A concrete walkway was placed on the back side of each concrete structure to allow soldiers to manually raise targets. Sandy soil had been pushed up against the front of each backstop to prevent bullets from ricocheting off the concrete. In many sections, this soil was removed. The four concrete backstops are now well covered with young trees and brush, land further downrange is composed of heavy brush.

2.4.1.3 *Coastal Anti-Aircraft Range – MRS02* is situated along the Atlantic coast shoreline with the land portion situated on a barrier island, most of which now is part of the town of Surf City, North Carolina. MRS02 consists of 768 land acres and 29,265 sea acres. The range was used during World War II for training of anti-aircraft gunners with gun emplacements placed along the beach. Gunners reportedly fired at targets that were pulled from aircraft. No records of the exact types of ordnance used at the range were found during previous investigations. It was presumed in the ASR that 37mm, 40mm, 3-inch, 90mm, 105mm, and 155mm rounds may have been used, based on the known purpose of the range.

2.4.1.4 *Range Complex No.1 – MRS03,* with 26,025 acres, comprises the bulk of the former Camp Davis lands. The MRS is made up of three contiguous ranges: 1) the *Anti-Aircraft Range,* 13,154 acres; 2) the *Track Target Range,* 13,056 acres; and 3) the *Hand Grenade Range* (Court), 25 acres. The three ranges were used by the U.S. Army for gunnery and hand grenade training purposes during World War II. The Anti-Aircraft and Track Targets ranges were comprised of two pie shaped areas that abutted each other with the firing points to both ranges set at the eastern end of the range. Gunners would fire at targets placed to the west. Based on USACE interviews with longtime residents, game land employees, and historical knowledge of the camp, munitions used at the two

ranges included small arms, 37mm, and 40mm artillery rounds. Past findings of .50-caliber munitions and 37mm and 40mm rounds were reported.

2.4.2 Regulatory Compliance

The USACE is conducting the SI at the former Camp Davis site as part of FUDS response activities pursuant to and in accordance with the guidance, regulations, and legislation listed in Chapter 1.

2.5 PREVIOUS INVESTIGATIONS

2.5.1 1990 Preliminary Assessment

The Preliminary Assessment (PA) was completed by USACE, Wilmington District (CESAW) on April 9, 1990. This document established the former Camp Davis site as a FUDS, established the site boundary, and assigned the project number I04NC001702. The PA identified that the former Camp Davis site consisted of approximately 46,682 acres acquired by a combination of lease, fee, easement, and maneuver permits, and that the land had been used by the Army General Forces. The PA identified the site as having ranges that were apparently used for anti-aircraft and artillery training by the U.S. Army with impact areas over land and the Atlantic Ocean. A hand grenade range and a rifle and pistol range were also mentioned.

2.5.2 1992 Site Investigation

A site investigation was completed in 1992 by Black & Veatch Waste Technology under Project Number I04NC001701. The objective of the site investigation was to evaluate the shallow soils and groundwater surrounding the estimated perimeter of a landfill on the former Camp Davis grounds. The landfill was reported used by camp personnel from 1941 to 1948 for the disposal of household waste, trash and miscellaneous debris including demolition debris, incinerator ash, tires, and general waste. Munitions were not identified as being disposed of in the landfill. As a precaution, explosive parameters were tested in sample media with no detectable concentrations found. Metals were identified in the samples analyzed, but were not presumed to be associated with munitions.

2.5.3 1994 Archives Search Report

2.5.3.1 The ASR was completed by CEMVR in May 1994 (CEMVR, 1994). The ASR was prepared after reviewing available records, photographs, 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 it identifies the key areas of focus for the SI. As part of the ASR, a site visit was conducted in 1993 which included a site walkthrough, interviews with local officials, and records review of historical documents.

2.5.3.2 Munitions have been encountered and reported by local residents, workers, and hunters familiar with the site lands since closure of the site (CEMVR, 1994). During repair of a dirt road located on lands belonging to the Oak Island Hunt Club (situated on along the Range Complex No.1 MRS boundary), a backhoe operator unearthed several practice .50-caliber, 37mm, and 40mm rounds. No other reports of munitions findings were noted.

2.5.4 2004 Archives Search Report Supplement

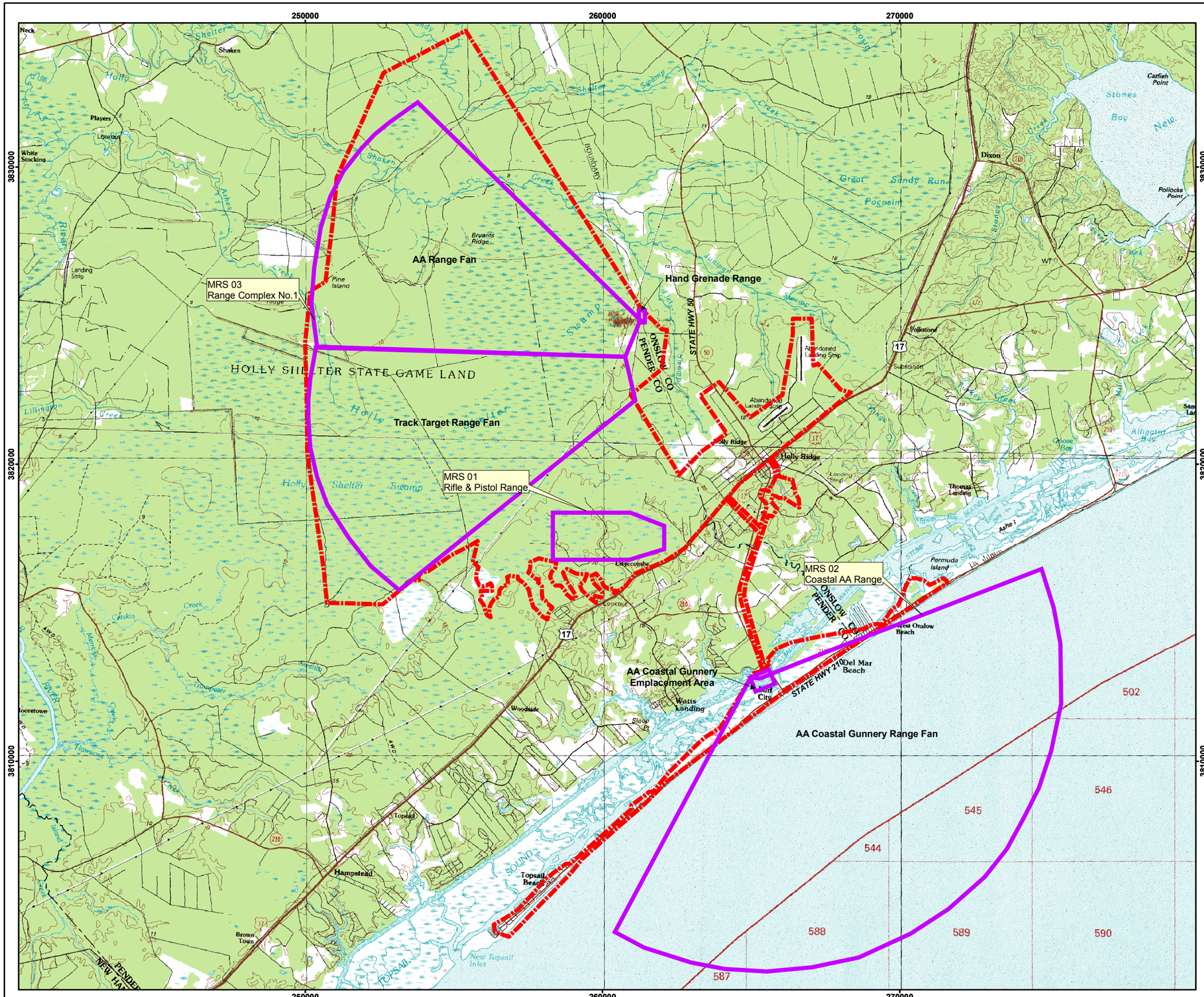
The ASR Supplement was completed by CEMVR as an addition to the 1994 ASR. This document identified the three range areas and the types of munitions that may have been used at the site. A Risk Assessment Score for the three identified MRSs was also completed and the following scores were assigned:

- Rifle & Pistol Range – RAC of 5;
- Coastal Anti-Aircraft Range – RAC of 5;
- Range Complex No.1 – RAC of 4 for the Anti-Aircraft Range, RAC of 4 for the Track Target Range and RAC of 4 for the Hand Grenade Range.

Figure 2.1

Site Setting
Camp Davis

Holly Ridge, North Carolina



Legend

- Approximate MRS Boundary
- Approximate Site Boundary

AA = Anti-Aircraft

Site Location in North Carolina

Image Source: USGS Topos, 1991
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

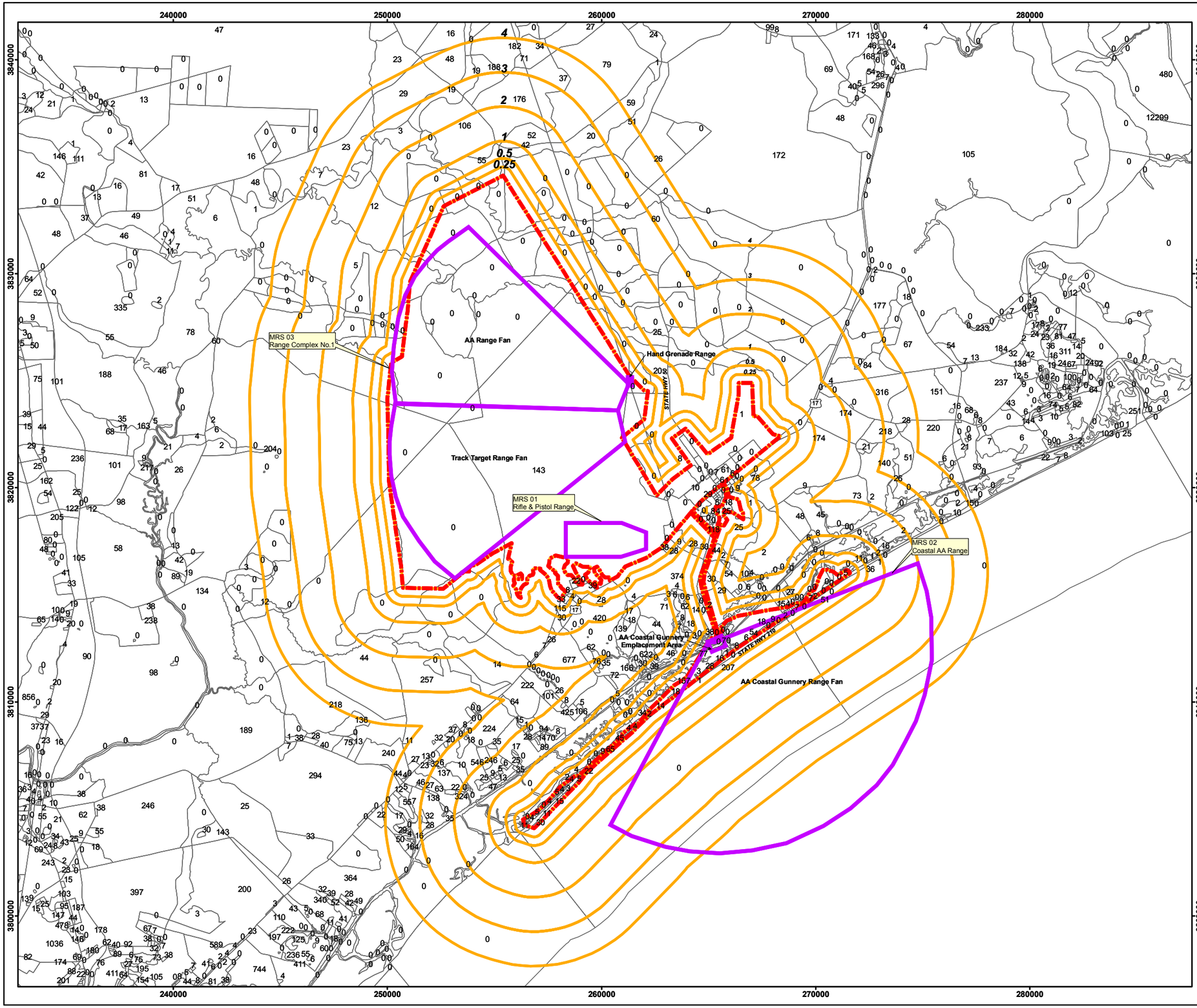
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Site Setting	
DRAWN BY: BT	SCALE: As Shown	PROJECT NUMBER: 744647.32000
CHECKED BY: SC	DATE: June 2008	PAGE NUMBER: 2-7
SUBMITTED BY: DS	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\ Fig2_1.mxd	

Figure 2.2

2000 Census Data
Camp Davis

Holly Ridge, North Carolina



Legend

- 4 — 2000 Census Block Boundary with Total Population
- Buffer (Mile)
- Approximate MRS Boundary
- Approximate Site Boundary

AA = Anti-Aircraft

Site Location in North Carolina

Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

PARSONS

U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

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

2000 Census Data

SCALE: As Shown

PROJECT NUMBER: 744647.32000

DATE: June 2008

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CHAPTER 3
SI TASKS

3.1 HISTORICAL RECORD REVIEW

The existing body of information pertinent to the former Camp Davis site was thoroughly reviewed in advance of the Initial TPP Meeting on July 12, 2006 and summarized to the TPP Team as part of the development and concurrence of the selected Technical Approach for the site. Sampling locations and qualitative reconnaissance (QR) planning were the direct result of this review process. This information has been augmented with institutional knowledge and additional documentation provided by CESAW or obtained by Parsons during coordination of the field effort.

3.2 TECHNICAL PROJECT PLANNING SUMMARY

The former Camp Davis site falls under the purview of CESAW. The Initial TPP meeting was facilitated by CESAW and included representatives of CESAW, USAESCH, Parsons, the North Carolina Department of the Environment and Natural Resources (NCDENR), and the town of Holly Ridge. Unanimous TPP Team concurrence with the Technical Approach presented in the Final TPP Memorandum issued on October 13, 2006 was achieved (see Appendix B). Key TPP facts and decisions are summarized below:

- The Project Team concurred with the Technical Approach (RI/FS or NDAI) as revised at the TPP meeting on July 12, 2006 inclusive of number, type and location of samples as well as sampling methodology and laboratory analyses.
- The Project Team concurred to use USEPA Region 9 Preliminary Remediation Goals (PRGs) – applicable residential values and North Carolina Soil to Groundwater Screening values for explosives and metals.
- The Project Team concurred that a groundwater exposure pathway may be present for this site. Collection of one groundwater sample will be conducted from an existing groundwater supply well located on the Anti-Aircraft Range. North Carolina Administrative Code 15, Subchapter 2L Groundwater Quality Standards and USEPA Region 9 Human Health Screening Values will be used in comparison to groundwater analytical results.

3.3 NON-MEASUREMENT DATA COLLECTION

The following sources were consulted for identifying biological and cultural resources at the former Camp Davis site:

- Topographic Map – U.S. Geological Survey (USGS)

- Wetlands Online Mapper – National Wetlands Inventory (NWI), U.S. Fish and Wildlife Service (USFWS)
- Threatened and Endangered (T&E) Species System (TESS) – Endangered Species Program, USFWS
- North Carolina Wildlife Resources Commission (NCWRC)
- North Carolina's Rare, Threatened and Endangered Species –NCDENR
- National Register Information System (NRIS) – National Register of Historic Places, National Park Service
- List of National Historic Landmarks (NHL) – National Historic Landmarks Program, National Park Service
- List of National Heritage Areas (NHA) – National Heritage Areas Program, National Park Service
- North Carolina State Historic Preservation Office (SHPO)
- Coastal Zone Management Program (CZMP) – Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration (NOAA)
- North Carolina Natural Heritage Program (NHP)
- May 1994 ASR Findings for the former Camp Davis, Holly Ridge, North Carolina

3.4 SITE-SPECIFIC WORK PLAN

3.4.1 The Site-Specific Work Plan (SS-WP) Addendum (Parsons, 2007) augments the Programmatic Work Plan (PWP) and Programmatic Sampling and Analysis Plan (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 Addendum 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 former Camp Davis site. The field investigation plan presented the approved Technical Approach to guide sample documentation of MEC/MD as well as media collection and analysis for MC to ensure that the results were sufficient to meet the project Data Quality Objectives (DQOs). QR conducted as part of this SI was focused to refine and focus the MEC field investigation. Similarly, the MC DQO was attained by collection of environmental samples in the primary target area and in peripheral areas. The SS-WP Addendum included a sampling rationale for each planned sample location and the latitude and longitude of the planned samples. The sampling rationale has been updated with actual sample location coordinates and is included here as Table 1.2.

3.4.4 The sampling and analysis plan (SAP) discussed procedures for surface soil, surface water, and groundwater sample acquisition from locations biased toward the highest potential for MC 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 (EPP) evaluated 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 (APP) supplemented the programmatic accident prevention plan with site-specific emergency contact information and directions to the nearest hospital.

3.4.5 Eight biased surface soil samples and three ambient surface soil samples, for a total of eleven surface soil samples, were planned (see Subchapter 3.6 for Departures From Planning Documents). One groundwater sample collected from a supply well within the Range Complex No.1 MRS was planned.

3.5 SITE VISIT ACTIVIES

Site visit activities were conducted from November 13 to 16, 2007. In general, site visit activities included QR (including the collection of site observations relevant to MEC/MD seen and other DoD related activity), anomaly avoidance, and surface soil and groundwater sampling. Site visit activities are described in Chapter 3 – Field Investigation Plan of the SS-WP Addendum (Parsons, 2007). Activities conducted on a daily basis are identified in the daily reports. These reports are included here in Appendix D.

3.6 DEPARTURES FROM PLANNING DOCUMENTS

3.6.1 The Cold Regions Research and Engineering Laboratory (CRREL) seven-point wheel composite sampling technique was employed for soil sampling. However, field personnel measured the distances for the composite sampling with a marked tape instead of using a 4-foot-diameter plastic template as specified in the PSAP Addendum. It is not anticipated that there are any impacts on the data quality based on the absence of the template.

3.6.2 The labeling of the soil and groundwater samples collected was altered slightly to identify MRS number relative to sample or if sample intended for ambient purposes. To help identify each sample a “MRS” or “AMB” designation was attached. Due to time constraints when conducting inspection activities far from a courier, all soil samples collected on November 14 and 15 and QA samples collected on November 13 were held on ice, and custody maintained by the field team until November 16 when they were shipped to the analytical laboratories on November 16, 2007 via overnight courier. Several of the soil samples were moved based either on findings in the field or due to concerns of potential contamination from non DoD sources. Sample CD-MRS03-SS-02-04 was moved from its proposed location to an area where an unexpended .30 caliber munition and a .50 caliber casing was found (the only items found on the ground in the MRS). Sample CD-MRS03-SS-02-05 was moved from its proposed location to the base of the berm located in the track target area of the MRS. Ambient sample CD-MRS03-SS-02-03 was moved from its proposed location to an alternate location in the Remaining Lands portion of the FUDS as it was initially placed within 300 feet of an abandoned

automobile race track. Sample CD-MRS03-SS-02-08 was moved from its planned position, as the soil was obviously transported in from another location to construct a road through the pocosin, and placed at a point approximately one-eighth of a mile to the west where soil was undisturbed. Sample CD-MRS01-SS-02-11 was moved to the base of a rifle range backstop to assess potential soil contamination in the area. Due to the heavy growth of pocosin swamp in most of the Rifle & Pistol Range MRS and privately owned residential properties in the area of the proposed sample, Sample CD-MRS03-SS-02-10 was placed in an area of the MRS that was accessible. Much of the proposed QR route was modified due to the heavy vegetation in the pocosin swamp and presence of residential properties (in the Rifle & Pistol Range MRS only). The QR path in the Rifle & Pistol Range MRS was also modified due to the observance of four actual concrete backstops along the firing line. The updated soil sample locations and QR paths have been illustrated on Figure 5.2.

3.6.3 Regarding comparison criteria of the groundwater analysis, both North Carolina and USEPA Region 9 Tap Water Standards were proposed during the initial TPP Meeting of July 2006. No Region 9 Standards are presented in Table 6.8 or compared to during the risk assessment of the groundwater analysis simply because all of the North Carolina 2L Standards were more stringent for the four metals that were reviewed as part of the risk assessment.

3.6.4 The evaluation of biased soil sample metals results to ambient metals values as specified in Section 4.7.1 of the Final SS-WP was modified in the Risk Assessment of this SI Report. Instead biased samples were compared to either the USGS background metals values for Pender and Onslow Counties or the maximum concentration of the three ambient samples if a USGS background value was not assigned. Values used for the soil sample background screening levels are listed in Table 5.5.

CHAPTER 4
MEC FINDINGS

4.1 GENERAL INFORMATION

4.1.1 Based on a preliminary assessment of the FUDS eligible sites within the former Camp Davis site, it was determined that the Range Complex No.1 MRS potentially had MEC/MD on the surface or directly under the surface. As a result, QR was conducted to assess the presence of MEC/MD at this MRS as well as at the Rifle and Pistol Range MRS and the Coastal Anti-Aircraft MRS. This chapter details the overall DQOs, MEC history, and inspection activities for the three MRSs found at the former Camp Davis.

4.1.2 To assess the presence of MEC/MD at the three MRSs, the field team conducted QR within the FUDS boundary for a total of 69,671 linear feet (13.2 miles). The field visit took place from November 13 to 16, 2007. Site QR consisted of visual reconnaissance of the site surface identify indicators of suspect areas, including concrete backstops, earthen berms, ground scars or craters, target remnants, and visible metallic debris.

4.1.3 QR was conducted along the routes prescribed in the SS-WP Addendum (Parsons, 2007); due to the extensive presence of pocosin swamp which was often impassable, the majority of the QR path was modified. The team recorded field observations regarding found debris, unique site features, visual indicators of munitions use, or if a sample was collected. Additionally, observations were recorded when there was a change in terrain, vegetation, presence of pocosin swamp, or when roads or other barriers were encountered. Figure 4.1 shows 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. The potential constituents of the supposed MEC are also listed in this table. The MEC conceptual site model (CSM) and conceptual site exposure model (CSEM) are included in Appendix J.

4.1.4 The SVT initiated the QR by referring to the proposed QR tracks as identified in the Garmin Rino handheld global positioning system (GPS) and establishing a "base" from which to conduct the QR on foot. The QR involved using a Schonstedt GA-92XT*i* magnetometer for safety purposes. The SVT walked to the sampling locations and collected surface soil and groundwater samples. ***Five MD items were***

found during the QR and one MEC item, an unexpended .30 Caliber munition regarded to be a Discarded Military Munition (DMM,) were encountered at the former Camp Davis site. *Two physical observances of probable munitions use at the site were noted during the QR. Four concrete backstops at the Rifle & Pistol Range MRS (all lined up in series) and a soil berm at the Track Target Area of the Range Complex No.1 MRS were noted.* Table 4.2 summarizes the findings for the former Camp Davis site.

4.1.5 MC sampling was completed in the former Camp Davis site. In all, eleven surface soil samples were collected. Eight biased surface soil samples were collected in areas believed to be most likely impacted by training activities. Three ambient surface soil samples were collected in areas believed to be least likely impacted by training activities. The biased and ambient samples were collected at areas as agreed by the TPP Team and are believed to be representative of conditions as following military training activities up to the close of Camp Davis. Current training activities conducted at Camp LeJeune are believed not to have effect on environmental conditions at the FUDS due to the distance (approximately one mile between the nearest soil sample and the Camp LeJeune boundary) and based on the relative absence of MC in the soil samples collected nearest Camp LeJeune. All soil samples were analyzed for explosive compounds and total metal concentrations. One groundwater sample was collected from a supply well located within the Range Complex No.1 (MRS-03) and was analyzed for total metals, explosives and perchlorate. Sampling results are presented in Chapter 5 with analytical results summarized on Tables 5.3 and 5.4.

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 Camp Davis site DQOs at the TPP meeting on July 12, 2006. Appendix B presents TPP documentation. Tables 4.3 through 4.6 present the DQO worksheets. *All the DQOs for the MRS 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; 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 the former Camp Davis site. 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. One potential piece of MEC was found on the site and five pieces of MD were noted at three separate locations. Appendix D contains field notes detailing the specific observations made by the SVT. Appendix E contains photo 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 the former Camp Davis site. Although particular site-specific metals and explosives were identified in the SS-WP Addendum (and listed below in Table 4.1), the entire list of metals and explosives identified in the PWP were analyzed as agreed in the July 2006 TPP Meeting. A summary of the MC known to occur in the MEC suspected at the former Camp Davis site 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 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 HISTORICAL MEC INFORMATION

4.3.1 Rifle & Pistol Range MRS

The Rifle & Pistol Range (MRS-01) consists of a total of 1942 acres. The range was used for small arms training from 1941 until 1944. General small arms use is believed to only been used at this range. Table 4.1 lists the associated fillers and constituents to provide a more complete picture of the potential contamination on site. No historical accounts of range cleanup are known. No historical evidence of small arms or any other MD or MEC have been reported in the ASR as being found at this range and no MEC or MD were encountered during the March 1994 ASR site visit. One MD item believed to be a .45 Caliber slug was noted in the November 2007 SI site visit.

4.3.2 Coastal Anti-Aircraft Range MRS

The Coastal Anti-Aircraft Range (MRS-02) is made up of 768 land and 29,265 tidal water acres and operated as an anti-aircraft training facility from April 1941 to September 1944. No records of the exact type and quantity of ordnance used were found for the ASR. It was assumed in the ASR that only practice munitions were used at the range and likely consisted of 37mm, 40mm, 3-inch, 90mm, 105mm and 155mm projectiles. Firing was believed conducted from the shore towards aircraft pulled targets located over the ocean. No known evidence of ordnance contamination following range closure associated with this MRS is known. Following the end of WWII, the Coastal Anti-Aircraft Range was used by the U.S. Navy for their secret operation, code name "Operation Bumblebee". Operation Bumblebee involved the testing of rocket motor propulsion systems. No ordnance or explosive materials were reportedly involved with the testing. The U.S. Navy closed down its operations at the site in 1948.

4.3.3 Range Complex No.1 MRS

The Range Complex No. 1 (MRS-03) is comprised of three ranges and/or impact areas and spans 26,025 land acres. The area is made up of very dense brush and part of a pocosin swamp. Two range impact areas; the Anti-Aircraft Impact Area and the Track Target Impact Area along with the Grenade Range comprise the Range Complex No.1 MRS. The Anti-Aircraft Impact Area lies along what is now known as the Holly Shelter Game Lands. Historical records and previous site inspections have indicated the discovery of .50 Caliber small arms munitions, 37mm and 40mm projectiles as well as spent fuses and fragments of hand grenades. Several pieces of MD including two .38 Caliber small arms munitions, one .50 Caliber small arms munition and one 37mm projectile (practice), all expended, and one MEC item, an unexpended .30 Caliber munition, were found within the Range Complex No.1 MRS during the November 2007 site visit for this SI.

4.3.4 Inspection Activities

The SI effort for the former Camp Davis site was conducted from November 13 to 16, 2007. QR (to search for visible signs of munitions use) and environmental sampling was conducted as part of the SI. Eight biased surface soil samples (numbers 4 through 11) were collected in the MRS areas believed to be most likely impacted by training activities. Three ambient surface soil samples (numbers 1, 2 and 3) were collected in areas outside the MRS areas, but within the FUDS boundary. One groundwater sample was collected from a supply well located within the Range Complex No.1 MRS. Three field team members completed QR around the MRSs. Figures 4.1 and 5.2 illustrate the completed QR path, as well as sample locations. Five pieces of MD were noted along the QR pathway when in the Rifle & Pistol Range and Range Complex No.1 MRSs. One MEC item, a discarded full .30 Caliber munition, was found in the Range Complex No.1 MRS. The presence of the munition was reported to the Onslow County Sheriff who responded on November 14, 2007 and removed the round that day for disposal by the Onslow County Sheriffs Office.

Table 4.1
Chemical Composition of Munitions and Explosives of Concern and Potential Munitions Constituents
Camp Davis Site, Holly Ridge, North Carolina

General Munition Type	Type/Model	Case Composition	Filler	Potential Constituent
Small Arms Ammunition .30 cal Carbine with gliding metal jacket	M1 Ball M16 Tracer Propellant Primer, Percussion	Brass, steel, aluminum	Lead antimony Tracer Composition Single- or double-base powder Primer Composition	Lead, antimony, iron, copper, zinc, molybdenum, aluminum, calcium, strontium, nitrocellulose, nitroglycerin, dinitrotoluene
Small Arms Ammunition .50 cal with gliding metal jacket	M2 Ball M1 Tracer M10 Tracer M17 Tracer M21 Tracer M2 AP Propellant Primer, Percussion	Brass, steel, aluminum	Soft steel Tracer Composition Tracer Composition Tracer Composition Tracer Composition Tungsten Chrome Steel Single- or double-base powder Primer Composition	Antimony, calcium, chromium, diphenylamine, iron, lead, magnesium, potassium, perchlorate, nitroglycerin, nitrocellulose, strontium, tungsten.
Small Arms Ammunition .30 cal with gliding metal jacket	M2 Ball M1 Tracer M2 Armor Piercing Primer, Percussion	Brass, steel, aluminum	Lead antimony Tracer Composition, Tungsten Chrome Steel Single-or double-base powder Primer Composition	Aluminum, antimony, chromium, copper, dinitrotoluene, lead, nitroglycerin, nitrocellulose, tungsten, zinc
Cartridge, 37mm, HE Cartridge Case Fuse, Base Detonating	M63 M63 Mod 1 M16 M58	Steel Brass Steel	0.085lb flaked TNT 20 gr Igniter mix 90 gr Tracer mix 24.68 gr Black Powder M1 Propellant Tetryl Lead Azide	Iron, potassium, nitrate, sulfur, TNT, charcoal, lead azide, tetryl, dibutlyphthalate, dinitrotoluene, diphenylamine, nitrocellulose, copper, zinc
Cartridge, 37mm, HE- T/SD (Self Destruct) Fuze, Point Detonating Booster Tracer, Self Destruct Cartridge Case	M54 M56 M17, M17B1	Steel Aluminum Alloy Brass, Steel	0.10 tetryl Lead azide, tetryl, Composition A Tracer mixture Black powder M1, M2 Propellant, Primer	Antimony sulfide, barium nitrate, charcoal, copper, dubutylphthalate, diphenylamine, iron, lead thiocyanate, nitrocellulose, nitroglycerin, sulfur, potassium chlorate, potassium nitrate, TNT (Trinitrotoluene), aluminum,

Table 4.1
Chemical Composition of Munitions and Explosives of Concern and Potential Munitions Constituents
Camp Davis Site, Holly Ridge, North Carolina

General Munition Type	Type/Model	Case Composition	Filler	Potential Constituent
Cartridge, 37mm, HE (continued) Relay pellet,				(continued from p 4-5) carborundum, lead azide, tetryl, RDX (Cyclotrimethylenetrinitramine), magnesium, strontium nitrate, zinc.
Cartridge, 40mm , TP-T (Target Practice-Tracer)Cartridge Case	M91 TP-T M81A1 AP-T M25, M25B1	Steel Brass	Tracer composition Igniter composition M1 Propellant, Primer Mixture	Iron, magnesium, strontium, copper, zinc, dibutlyphthalate, dinitrotoluene, diphenylamine, nitrocellulose, potassium chlorate, lead thiocyanate, antimony sulfide, TNT (Trinitrotoluene), potassium nitrate, charcoal, sulfur
Shell, 3-Inch, Fixed, Practice Fuze, Mechanical Time Cartridge Case	M42B2 M43 MkI Mod 2	Steel Brass	.230 lb Black Powder, tetryl, primer mixture, smokeless powder	Antimony sulfide, charcoal, copper, diphenylamine, iron, lead azide, lead thiocyanate, nitrocellulose, potassium, nitrate, potassium chlorate, sulfur, TNT (Trinitrotoluene), tetryl, zinc
Cartridge, 90mm, TP (Target Practice) Cartridge Case	M71 M19, M19B1	Steel Brass	Inert M15, M6 Propellant, Primer Mixture	Antimony sulfide, copper, cryolite, dibutlyphthalate, dinitrotoluene, diphenylamine, iron, lead thiocyanate, nitrocellulose, nitroglycerin, nitroguanidine, potassium chlorate, TNT (Trinitrotoluene), zinc,
Cartridge, 90mm, AP-T Cartridge Case	M77 M19	Steel Brass	Tracer Composition, M6 Propellant, Primer Mixture	Copper, iron, dibutlyphthalate, dinitrotoluene, diphenylamine, magnesium, nitrocellulose, potassium chlorate, lead thiocyanate, antimony sulfide, TNT (Trinitrotoluene), zinc

Table 4.1
Chemical Composition of Munitions and Explosives of Concern and Potential Munitions Constituents
Camp Davis Site, Holly Ridge, North Carolina

General Munition Type	Type/Model	Case Composition	Filler	Potential Constituent
105mm Shell, Practice Booster Detonator Closing cup, booster pellet Cartridge Case	M38A1 M20A1 M6	Steel Brass	0.80 lb Black Powder Lead azide over tetryl Tetryl M1 Propelling Charge	Potassium, lead, nitrate, sulfur, charcoal, tetryl, copper, iron, dibutylphthalate, dinitrotoluene, diphenylamine, nitrocellulose, zinc
Shell, 155mm, Target Practice	M101	Steel	Sand	Iron
Propelling Charge, 155mm	M3, M4, M5, M6	Cloth	Propellant, Primer Mix	Aluminum powder, antimony sulfide, barium nitrate, dibutylphthalate, dinitrotoluene, diphenylamine, lead alloy, lead carbonate, lead styphnate, methylcellulose, nitrocellulose, PETN, potassium nitrate, potassium sulfate, tetracene
Grenade, Hand, Practice Fuze	M21 M205	Steel Zinc Alloy	.74 oz Black Powder Primer mixture, expelling charge, Delay element	Antimony sulfide, aluminum, barium chromate, barium nitratetetracene, charcoal, iron, nickel, nitrate, potassium, sulfur, lead styphnate, potassium perchlorate, zinc, zirconium-nickel alloy.
Grenade, Hand, Fragmentation Fuze Primer Detonator	Mk2, Mk2A1 M10 Mk5	Steel Zinc Alloy, Aluminum	0.74 oz EC black powder, TNT 0.4 gr primer mixture 2’ black powder train 7 gr loose black powder	Iron, potassium, nitrate, sulfur, lead sulfocyanate, barium nitrate, TNT (Trinitrotoluene), nitrocellulose, diphenylamine, aluminum, zinc, charcoal.

Table 4.2
Summary of Qualitative Reconnaissance Observations
Camp Davis, Holly Ridge, North Carolina

MRS	MEC	Munitions Debris	Munitions-Related Features
MRS01 Rifle and Pistol Range	None observed	Lead slug, probably .45 Cal	Four Concrete Small Arms Firing Backstops and man made soil banks
MRS02 Coastal Anti-Aircraft Range	None observed	None observed	None observed
MRS03 Range Complex No.1	.30 Cal Cartridge (dated 1942).	.50 Cal. Casing, two .38 Cal Slugs. One 37mm projectile practice, inert.	Link to .50 Cal Ammunition Belt

Table 4.3
MEC DATA QUALITY OBJECTIVE WORKSHEET

SITE: **Former Camp Davis, Holly Ridge, North Carolina**
PROJECT: **MMRP Site Inspection / FUDS Project No. I04NC00001702**

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, Munitions debris	Y
4	Media of Interest	N/A	
5	Required Locations or Areas	Artillery Range and Remaining Lands	Y
6	Number of Samples Required	Completed QR path 69,671 feet (13.195 miles) Proposed QR path was 12.1 miles	Y
7	Reference Concentration of Interest or Other Performance Criteria	Any indication of residual MEC/MD will be evaluated. Based on the indications of type, degree and quantity of MEC/MD a recommendation will be made regarding subsequent actions at the site. If the presence of MEC is confirmed or physical evidence of a potential explosive hazard is identified, a RI/FS may be recommended. If there are no anomalies detected and a potential explosive hazard is not identified, an NDAI recommendation may be warranted.	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	Qualitative Reconnaissance with magnetometer (Schonstedt GA 92XTi)	Y
9	Analytical Method	N/A	Y

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

Table 4.4
MC DATA QUALITY OBJECTIVE WORKSHEET
SITE: **Former Camp Davis, Holly Ridge, North Carolina**
PROJECT: **MMRP Site Inspection / FUDS Project No. I04NC00001702**

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	See Tables 5.4 and 5.5	Y
4	Media of Interest	Surface Soil, Groundwater	Y
5	Required Sampling Locations or Areas and Depths	As determined by the Project Team, see Figures 4.1 and 5.2. Biased locations based on locations of the various areas of concern. Depth is 0 to 2 inches.	Y
6	Number of Samples Required	Eight biased and three ambient surface soil samples and one groundwater sample, plus associated QA/QC samples.	Y
7	Reference Concentration of Interest or Other Performance Criteria	USEPA Region 9 PRGs and applicable North Carolina soil-to-groundwater site screening levels for soil. North Carolina Water Quality Standards (NCAC T15, 2L and 2B) and USEPA 9 PRGs	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	Composite samples in accordance with the PSAP and PSAP Addendum	Y
9	Analytical Method	Explosives - SW8321A; Metals (except mercury) SW6010B or SW6020. Mercury - SW7471A. Perchlorate SW6850	Y

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

TABLE 4.5
MRSPP DATA QUALITY OBJECTIVE WORKSHEET
SITE: **Former Camp Davis, Holly Ridge, North Carolina**
PROJECT: **MMRP Site Inspection / FUDS Project No. I04NC00001702**

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	Completion of MRSPP Scoring sheets	Y
Intended Need Requirements:			
2	Data User Perspective(s)	Risk and remedy	Y
3	Contaminant or Characteristic of Interest	Explosives, chemical, and health hazards, if any, associated with SVT findings.	Y
4	Media of Interest	Surface Soil, Groundwater	Y
5	Required Sampling Locations or Areas and Depths	In accordance with (IAW) MC DQO	Y
6	Number of Samples Required	IAW MC DQO	Y
7	Reference Concentration of Interest or Other Performance Criteria	Completion of Explosive Hazard Evaluation (EHE) Tables 1 - 10, Chemical Hazard Evaluation (CHE) Tables 11 – 20, and Health Hazard Evaluation (HHE) Tables 21 – 25.	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	N/A	
9	Analytical Method	N/A	

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

TABLE 4.6
HRS DATA QUALITY OBJECTIVE WORKSHEET
SITE: **Former Camp Davis, Holly Ridge, North Carolina**
PROJECT: **MMRP Site Inspection / FUDS Project No. I04NC00001702**

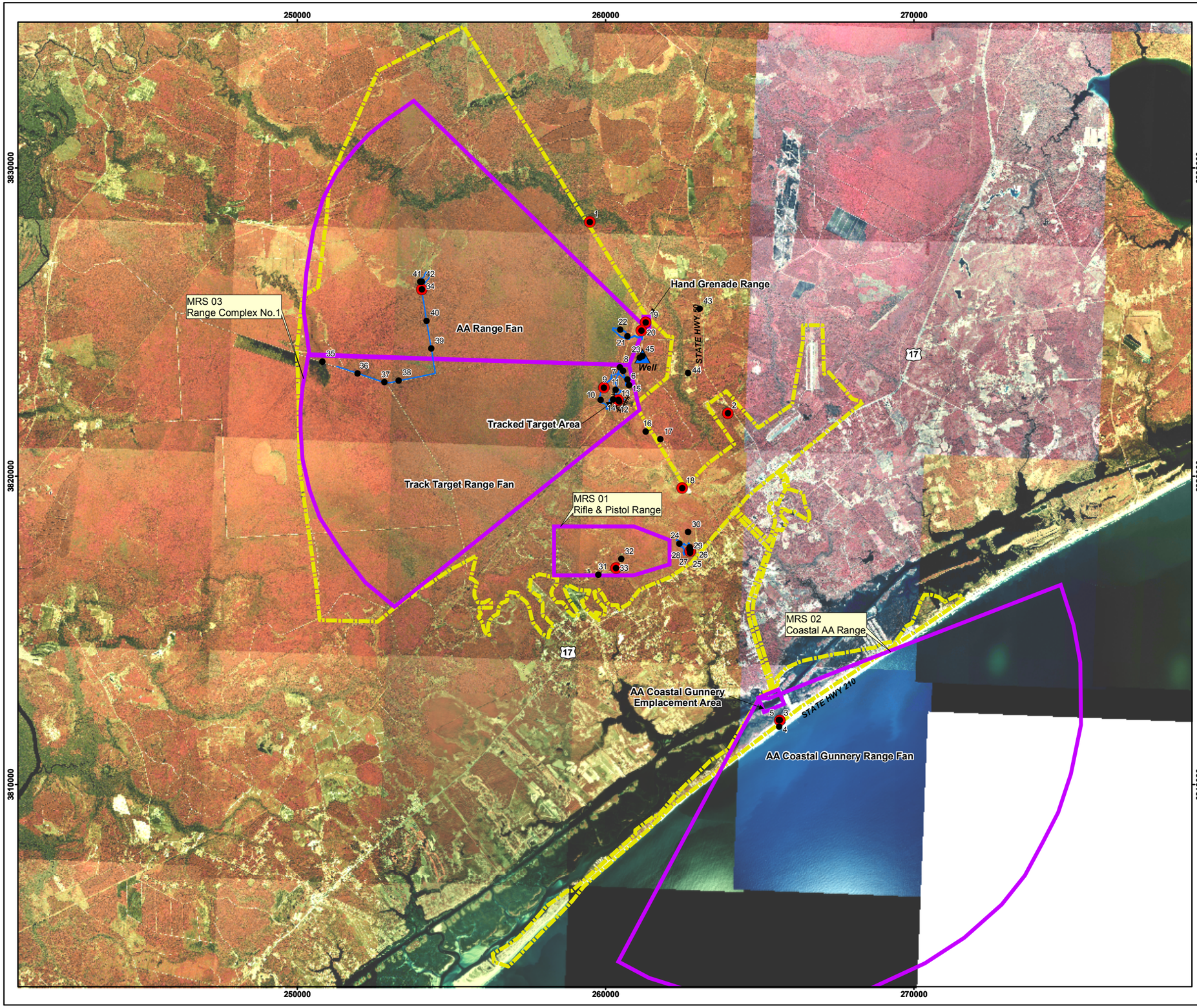
DQO Element Number*	DQO Element Description*	Site-Specific DQO Statement	Objective Met? Yes (Y)/No (N)
Intended Data Use(s):			
1	Project Objective(s) Satisfied	Collection of USEPA HRS MC-related information	Y
Intended Need Requirements:			
2	Data User Perspective(s)	Risk, compliance, and remedy	Y
3	Contaminant or Characteristic of Interest	IAW MC DQO	Y
4	Media of Interest	Surface Soil, Groundwater	Y
5	Required Sampling Locations or Areas and Depths	IAW MC DQO	Y
6	Number of Samples Required	IAW MC DQO	Y
7	Reference Concentration of Interest or Other Performance Criteria	Results of the MC findings in order for USEPA to complete the MC-related HRS scoring.	Y
Appropriate Sampling and Analysis Methods:			
8	Sampling Method	IAW MC DQO	Y
9	Analytical Method	IAW MC DQO	Y

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

Figure 4.1

Qualitative Reconnaissance and Field Observation Locations Camp Davis

Holly Ridge, North Carolina



Legend

- Field Observation Location
- Ground Water Sample Location
- Soil Sample Location
- Approximate MRS Boundary
- Approximate Site Boundary
- Qualitative Reconnaissance Track
- Tracked Target Area

AA = Anti-Aircraft

Note: Water sample locations to be determined.

Site Location in North Carolina

Image Source: 1998 Orthophotos
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

PARSONS

U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Qualitative Reconnaissance and Field Observation Locations**	
DRAWN BY: BT	SCALE: As Shown	PROJECT NUMBER: 744647.32000
CHECKED BY: SC	DATE: June 2008	PAGE NUMBER: 4-13
SUBMITTED BY: DS	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\Fig4_1.mxd	

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, sediment, soil, and air. The CSEM for the former Camp Davis (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 accompanies the elements.

- *A source and mechanism for contaminant release:* For example, a site has known MEC from which MC have leached and contaminated soil.
- *An environmental transport and/or exposure medium*. For example, the MC is mobile and can contaminate groundwater.
- *A point of exposure at which the contaminant can interact with a receptor*. For example, a drinking water well drawing from the contaminated aquifer is located at the site.
- *A receptor and a likely route of exposure at the exposure point*. For example, a resident lives onsite and drinks water from the well.

5.1.2 In the hypothetical example of the resident described above, all four conditions are true. Therefore, the groundwater exposure pathway is complete. However, if any single factor was absent (for example, MC contamination was not present in soil or the resident obtained drinking water from another source), then the pathway would be incomplete.

5.2 GENERAL INFORMATION

5.2.1 Regional Geologic Setting

The former Camp Davis site is part of the Sea Island Section of the Coastal Plain Physiographic Province, which essentially covers the eastern third of North Carolina. Three stratigraphic units are associated with the Onslow County substrata, which occur beneath a veneer of surficial sands and clays. Immediately under the surficial sands (Quaternary Period) is the Yorktown formation; beneath the Yorktown formation are the Castle Hayne (Tertiary Period) and Pee Dee (Cretaceous) formations. The local geology at Camp Davis is composed predominately of the Castle Hayne formation. The formation

is composed of white or gray shell material with sand. Individual beds vary in degree of consolidation from a dense limestone to a loose shell and sand. The formation thickness averages approximately 100 feet, occurring approximately 75 to 100 feet below MSL. Surface soil units that have been identified on the site belong to the Hydric soil series, including Croatan muck, Muckalee loam, Torhunta fine sandy loam, Woodington loamy fine sand, Leon fine sand, Rains fine sandy loam, and Pantego mucky loam. These units are typically poor to very poorly drained soils. The saturated soils within these units impose a severe limitation to both urban and vehicular traffic. The current land surface is predominated by pocosin, a low lying swamp typically occurring along the Atlantic coast of North and South Carolina and Virginia. Also known to exist along the area of the North Carolina Coast are the Carolina Bays, a series of shallow, elliptical shaped depressions, typically with a rim of sand along the southeastern edge. The Carolina Bays are known to exist along the Atlantic Coast from northern Florida to Delaware.

5.2.2 Regional Hydrogeologic Setting

The groundwater supply in Onslow County is derived principally from three distinct groundwater aquifers. A shallow aquifer is made up of Coastal Plain Physiographic Province deposits consisting mainly of sand, clay, and fossiliferous limestone extending to depths of 65 feet. Water in this surface material is corrosive and is used only for irrigation. Clay units of the geologic formations separate the three aquifers. The intermediate aquifer contains the Tertiary limestone deposits, primarily of the Castle Hayne formation, occurring at depths of 75 to 100 feet below MSL with an average thickness of about 100 feet. Wells set in this aquifer range typically yield between 200 to 500 gallons per minute (gpm), but in some cases yield in excess of 2000 gpm. The lowermost aquifer consists of the fine to medium sand deposits of the Pee Dee aquifer occurring at depths of 175 to200 feet below MSL with an average thickness of 135 feet. Wells in this aquifer typically yield up to 200 gpm. Under current conditions, the Pee Dee and Castle Hayne aquifers are full of water throughout the year. Recharge for the shallow aquifer is predominantly via rainfall. Recharge for the two deeper aquifers is from lateral movement through the aquifer or by vertical movement through leaky confining units. (North Carolina Division of Water Resources, December 21, 2007)

5.2.3 Regional Groundwater Use

A water well search of wells present within 4 miles of the FUDS was conducted by Banks Environmental Data Group (Banks, 2008) for the Camp Davis site, with the report presented in Appendix L. Thirty-two wells (including two wells identified by the Parsons SVT) were identified as being within four miles of the site. Well locations are illustrated on Figure 5.1. The actual use of the 30 wells identified in the Banks report was not disclosed and it is assumed that at least some of the wells are public supply wells, as they are located near the town of Holly Ridge. Holly Ridge is located approximately one mile east of the Rifle & Pistol Range MRS and approximately two miles southeast of the Range Complex MRS. Other wells identified are located near the town of Surf City, where the land portion of the Coastal Anti-Aircraft Range is located, and are assumed to be public supply wells. Interviews with the authorities in the town of Holly Ridge and Surf City indicate that Holly Ridge receives their potable water supply from the Onslow Water & Sewer Authority and Surf City from their own wells, with the three main wells being located on the mainland north of Surf City and the Intercoastal Waterway. A

backup well is located within the Surf City town limits. Most wells used to supply water for both towns are screened in the Castle Hayne aquifer, with one of Surf City's wells screened in the deeper Pee Dee aquifer. Of the 32 wells identified, one well is noted to occur within any of the three MRS boundaries. Four wells either border or lie within the FUDS boundary and, based on their proximity of two of these wells to the town of Holly Ridge, are likely municipal supply wells. Two wells identified by the Parsons SVT are private supply wells that provided water for two separate hunting clubs near the eastern border of the Range Complex No.1 MRS, with one of these wells located within the Range Complex No.1 MRS.

Table 5.1
Active Groundwater Wells within a
4-Mile Radius of Camp Davis

Domestic Wells	Public Water Supply	Irrigation	Stock	Undetermined	Industrial	Total
2				30		32

5.2.4 Regional Hydrologic Setting

The former Camp Davis site is situated within the Cape Fear River Watershed. Drainage of the Cape Fear River is to the Atlantic Ocean. The Cape Fear Watershed is comprised of 9,322 square miles, with 6,049 miles of rivers and streams. Except for the Atlantic Ocean and the Intracoastal Waterway, which the Coastal Anti-Aircraft Range - MRS02 borders, no major surface water bodies lie within the former Camp Davis site. The main portion of the FUDS property, Range Complex No.1 – MRS03, especially along North Carolina – Holly Shelter State Game Lands, does contain a number of ponds (likely comprised of Carolina Bays) and streams. Discharge from these surface water bodies flows southward to Mullet Creek, located approximately two miles to the south and to the southeast towards the Cape Fear River. Discharge from both Mullet Creek and the Cape Fear River empties directly into the Atlantic Ocean. Surface water flow from the Rifle & Pistol Range – MRS01 also discharges to Mullet Creek. As mentioned, the Holly Shelter Game Lands contain a number of large ponds, creeks and pocosin swamp. Wetlands dominate the area with the Rifle & Pistol Range – MRS01 being comprised of approximately one-third wetlands and Range Complex No.1 – MRS03 being almost entirely wetlands. A description of the wetlands for each of the MRSs is included in the Hydrologic Setting discussion for each of the three MRSs located onsite.

5.2.5 Regional Sensitive Ecological Resources

5.2.5.1 The Camp Davis site is not located within a national wildlife refuge, a state or national park, or a national forest. The majority of the former Camp Davis land is controlled by the State of North Carolina as a wildlife management and wetland area. The former Camp Davis is primarily comprised of pocosin, which refers to a flat swampy region that is often wooded and located in an upland coastal region, also referred to as the "Dismal Swamp".

5.2.5.2 The site has numerous wetlands on-site and there are federal- or state-listed threatened and endangered species that may be present at the site as identified in the SS-WP Addendum (Parsons, 2007). According to the USFWS, there are 46 federally-listed threatened and endangered species or state-listed threatened species that may be present in the state of North Carolina; ten of those species potentially exist at the Camp Davis site. Habitat for the ten species is potentially present at the site, as described in Table 5.2. The SVT did not observe any threatened or endangered species during the site field activities at the site.

5.2.5.3 The Camp Davis site is not designated as critical habitat for any species. A portion of the site is located within the Holly Shelter Game Land. The Holly Shelter Game Land, which is owned by the State Wildlife Resources Commission, is open to the public for hunting, birding, and nature study. The Holly Shelter Game Land is designated as a Significant Natural Area by the North Carolina NHP. A Significant Natural Heritage Area is an area of land or water identified by the NHP as being important for conservation of the state's biodiversity. These areas contain one or more Natural Heritage elements such as high-quality or rare natural communities, rare species, and special animal habitats. The Holly Shelter Game Land is recognized as one of the largest and most significant areas of pine flatwoods pocosin in the state.

5.2.5.4 Based on the above information, a review of the Army Checklist for Important Ecological Places (USACE, 2006) demonstrates that the former Camp Davis site is considered to be an important ecological place due to the presence of the state game land, the wetlands, coastal zone, and potential habitat for T&E species. Therefore, ecological receptors are considered to be receptors for exposure pathways at this site.

Table 5.2
State and Federally-Listed Species Potentially Located Within the Former Camp Davis

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat present at Site?
Bald Eagle	*Haliaeetus leucocephalus*	Not Listed	Imperiled	Preferentially roosts in conifers or other sheltered sites in winter in some areas; typically selects the larger, more accessible trees. Perching in deciduous and coniferous trees is equally common in other areas.	Yes
Red-cockaded Woodpecker	*Picoides borealis*	Endangered	Imperiled	Live in old-growth (60-70+ years) loblolly, shortleaf, and especially slash and longleaf pine forests. Nesting and roosting cavities are made only in living pine trees over 60 years old, often trees with red-heart disease. These trees produce large amounts of resin around the woodpeckers' cavities. The sap-encrusted tree can resemble a large candle and is often easier to identify than the bird. Ideal colony sites are located in park-like stands of pines with little or no understory growth.	Yes
Piping Plover	*Charadrius melodus*	Threatened	Threatened	Sandy upper beaches, especially where scattered grass tufts are present, and sparsely vegetated shores and islands of shallow lakes, ponds, rivers, and impoundments. Nests may also be built on sandy open flats among shells or cobble behind foredunes. Breeds mainly on gently sloping foredunes and blow-out areas behind primary dunes of sandy coastal beaches, and on suitable dredge oil deposits. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Green Sea Turtle	*Chelonia mydas*	Threatened	Not Listed	Most commonly feeds in shallow, low-energy waters with abundant submerged vegetation. Migrates across open seas. Adults are tropical in distribution, whereas juveniles range into temperate waters. Hatchlings often float in masses of sea plants (e.g., Sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. Inactive on the bottom in winter in the northern Gulf of California. Basks on beaches in some areas (e.g., Hawaii). Nests on beaches, usually on islands but also on mainland. Sand may be coarse to fine, has little organic content; physical characteristics vary greatly in different regions. Prefers high energy beaches with deep sand. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

Table 5.2
State and Federally-Listed Species Potentially Located Within the Former Camp Davis

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat present at Site?
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	Not Listed	Open sea to more than 500 miles from shore, mostly over continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers; mainly warm temperate and subtropical regions not far from shorelines. Off North Carolina, loggerheads inhabit waters of 13-28 C (available range 5-32 C). Adults occupy various habitats, from turbid bays to clear waters of reefs. Subadults occur mainly in nearshore and estuarine waters. Hatchlings move directly to sea after hatching, often float in masses of sea plants (Sargassum); may remain associated with sargassum rafts perhaps for 3-5 years. Nesting occurs usually on open sandy beaches above high-tide mark, seaward of well-developed dunes. Nests primarily on high-energy beaches on barrier strands adjacent to continental land masses in warm temperate and subtropical regions; steeply sloped beaches with gradually sloped offshore approaches are favored. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Not Listed	Marine; open ocean, often near edge of continental shelf; also seas, gulfs, bays, and estuaries. Mainly pelagic, seldom approaching land except for nesting. Concentrates in summer in waters mostly 20-40 m deep near Cape Canaveral, Florida. Dives almost continuously, to depths of up to at least several thousand meters; may linger at the surface at midday but spends most of time submerged. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	Not Listed	Shortnose sturgeons inhabit rivers, estuaries, and the sea; usually they are most abundant in estuaries, generally within a few miles of land when at sea. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

Table 5.2
State and Federally-Listed Species Potentially Located Within the Former Camp Davis

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Habitat present at Site?
West Indian Manatee	*Trichechus manatus*	Endangered	Endangered	Shallow coastal waters, estuaries, bays, rivers, and lakes; throughout most of the range, appears to prefer rivers and estuaries to marine habitats. Not averse to traveling through dredged canals or using quiet marinas. Apparently not able to tolerate prolonged exposure to water colder than 20 C. In the north during October-April, congregates in warmer water bodies (spring-fed rivers, outfalls from power plants). Prefers waters at least 1-2 m in depth; along coast often in water 3-5 m deep; usually avoids areas with strong current. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Cooley's Meadowrue	*Thalictrum cooleyi*	Endangered	Endangered	Sunny, moist places such as open, savanna-like forest edges and clearings, wet savannas over calcareous clays, and ecotones between wet savannas and non-riverine swamp forests. Soils are basic, sandy loams. Also on roadsides and power line rights-of-way in former savannas. It grows on circumneutral soils in wet pine savannas, grass-sedge bogs, and savanna-like areas, often at the border of intermittent drainages or swamp forests. Boggy savannah-like borders of low woodlands, roadside ditches, and power line rights-of-way. Usually associates with some type of disturbance, e.g., clearings, the edges of frequently burned savannas, power line right-of ways which are maintained either by fire or mowing, and roadside edges. Typically on Grifton soil. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes
Golden Sedge	*Carex lutea*	Endangered	Endangered	Wet savannahs with sandy soils underlain by coquina limestone. This somewhat open, calcareous habitat is highly unusual on the Atlantic Coastal Plain. Associates include other rare plants such as Cooley's meadowrue (Thalictrum cooleyi), pineland plantain (Plantago sparsiflora), and Thorne's beakrush (Rhynchospora thornei). Carex lutea plants occur mostly in the somewhat shaded ecotone between savannah and swamp. (http://www.natureserve.org/explorer/servlet/NatureServe)	Yes

5.2.6 Sample Locations/Methods

5.2.6.1 QR was conducted on November 13 through 16, 2007. Eleven surface soil samples and one groundwater sample were collected from the Camp Davis site (Figure 5.2). In all, 69,671 feet of QR was conducted using a three-man team. As previously mentioned, most of the QR path was altered from the pathway as proposed in the SS-WP due to the impassable nature of the pocosin swamp. The actual QR path length was however consistent with the proposed QR distance. No intrusive MEC investigations, explosives handling, or MEC detonations were conducted during the course of this SI.

5.2.6.2 Of the 11 soil samples, eight of the samples were collected within the three designated MRSs that were selected to represent areas with the highest likelihood for the presence of MEC or MC contamination (per the SS-WP Addendum [Parsons 2007]). Of the biased soil samples, two (CD-MRS01-SS-02-10 and CD-MRS01-SS-02-11) were collected from the Rifle & Pistol Range with sample CD-MRS01-SS-02-11 collected at the base of one of the four concrete target backstops and sample CD-MRS01-SS-02-10 collected downrange near a residential area within the MRS. A single biased soil sample CD-MRS02-SS-02-07 was collected from within the Coastal Anti-Aircraft Range near a facility warehouse identified as part of the former Camp Davis. Five soil samples were collected from within the Range Complex No.1 (MRS03). Of the five samples, one (SS-02-06) was collected in the vicinity of the Hand Grenade Court, two samples (SS-02-4 and SS-02-08) within the Anti-Aircraft Range Fan and two samples (SS-02-05 and SS-02-09) from within the Track Target Range Fan. No discretionary soil samples were collected by the SVT. Three ambient soil sample locations were selected to obtain metals concentrations from areas of the camp not anticipated to have been used for any sort of munitions training. Two duplicate biased surface soil samples were also collected. Surface soil samples were collected from 0 to 2 inches bgs and each of the sampling locations was recorded with a GPS unit for later reference.

5.2.6.3 The Unexploded Ordnance (UXO) Technician III screened and approved each potential soil sample location prior to the collection of the sample. In accordance with the PSAP Addendum (Parsons 2006a), the CRREL seven-point wheel composite sampling technique was employed for the surface soil samples. The actual GPS coordinates for each sample location were recorded and updated in the geographic information system (GIS) database.

5.2.6.4 The sample collection procedures presented in the Sampling and Analysis Plan (USACE 2005) and the Parsons Final PSAP Addendum (Parsons, 2006a) were followed with the exception of the use of a plastic template as discussed in Subchapter 3.5.

5.2.6.5 Surface soil and groundwater samples were analyzed by TestAmerica Laboratories in Arvada Colorado for indicator metals using Methods 6010B, 6020 and 7470A (mercury in soil) and 7471A (mercury in water) and explosives using Method 8321A. Quality Assurance samples were analyzed by GPL Laboratory of Frederick, MD using Method 8330A. The results of the analyses for samples of surface soil are presented in Table 5.3.

5.2.6.6 Several of the soil samples were moved based either on findings in the field or due to concerns of potential contamination from non-DoD sources. Sample CD-MRS03-SS-02-04 was moved from its proposed location to an area where an unexpended .30 round and a .50 caliber casing were found (the only items found on the ground in the MRS). Sample CD-MRS03-SS-02-05 was moved from its proposed location to the base of the berm located in the track target area of the MRS. Ambient sample CD-MRS03-SS-02-03 was moved from its proposed location to an alternate location in the Remaining Lands portion of the FUDS, as it was initially placed within 300 feet of an abandoned automobile race track. Sample CD-MRS03-SS-02-08 was moved from its planned position as the soil was obviously transported in from another location to construct a road through the pocosin and placed at a point approximately one-eight of a mile to the west where soil was undisturbed. Sample CD-MRS01-SS-02-11 was moved to the base of a rifle range backstop to assess potential soil contamination in the area. Due to the heavy growth of pocosin swamp in most of the Rifle & Pistol Range MRS and privately owned residential properties in the area of the proposed sample, Sample CD-MRS03-SS-02-10 was placed in an area of the MRS that was accessible. Much of the proposed QR route was modified due to the heavy vegetation in the pocosin swamp and presence of residential properties (in the Rifle & Pistol Range MRS only). The QR path in the Rifle & Pistol Range MRS was also modified due to the observance of four actual concrete backstops along the firing line. The updated soil sample locations and QR paths have been illustrated on Figure 5.2

5.2.6.7 Groundwater sampling was conducted at the request of the NCDENR during the initial TPP meeting. A known supply well located in the Range Complex No.1 MRS was selected for use as a sampling point (see Figure 4.1). The location of the groundwater sample was also recorded using a GPS for later reference. Well construction data was not placarded at the wellhead or available for public record (see Banks well report in Appendix L). A duplicate sample, along with appropriate QA/QC samples, was also obtained. No ambient groundwater samples were collected for comparison. Groundwater was analyzed for metals, explosives and perchlorate with analytical results presented in Table 5.4.

5.2.6.8 No surface water or sediment samples were collected as part of this SI in accordance with the direction of the TPP Team.

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 nor 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 at the site:

- Average concentrations of elements in Pender and Onslow Counties, North Carolina, identified by the USGS and provided in Appendix L(USGS, 2008); and
- Analytical results of ambient samples collected during the 2007 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 Pender and Onslow Counties.

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, 2008). This dataset is considered to likely be representative of conditions within Pender and Onslow Counties; however, the data available are limited to a select group of metals. Since the site lies in both Pender and Onslow Counties, the USGS derived background concentrations are based on the maximum mean concentration from the two counties plus two times the standard deviation to approximate the 95% Upper Confidence Limit of the higher mean. The data for the two counties are provided in Appendix L.

5.2.7.3 To provide an indication of the range of concentrations of metals naturally present at the site, three ambient surface soil samples (CD-AMB-SS-02-01, CD-AMB-SS-02-02, and CD-AMB-SS-02-03), as shown in Figure 5.2, were collected during the SI. Owing to this small number of samples, calculation of a more statistically robust site-specific background value is not possible. However, these ambient samples provide an indication of the range of naturally occurring metals concentrations. These samples were collected outside the MRS. No MEC or MD were observed in the areas of the ambient sample locations, suggesting that these locations are representative of the naturally occurring soils in the area. No explosives were detected in any of the ambient samples.

5.2.7.4 The USGS background concentrations for Pender and Onslow Counties, and the maximum concentrations detected in the collected surface soil ambient samples, are summarized in Table 5.5 (surface soil). The background screening concentrations are selected from those available in the following order: the USGS value is used if there is one; if there is no USGS value, then the maximum ambient concentration is used. These concentrations are used to represent the selected background concentrations for the site which is one of the criteria used to evaluate whether or not a source of contamination may be present (Subchapter 5.1.8).

Table 5.3
Summary of Validated Analytical Results for Camp Davis MMRP Soil Samples Collected in November 2007

SAMPLE ID:		CD-AMB-SS-02-01*		CD-AMB-SS-02-02*		CD-AMB-SS-02-03*		CD-MRS03-SS-02-04		CD-MRS03-SS-02-05		CD-MRS03-SS-02-12**		CD-MRS03-SS-02-06		CD-MRS02-SS-02-07		CD-MRS03-SS-02-08		CD-MRS03-SS-02-13**		CD-MRS03-SS-02-09		CD-MRS01-SS-02-10		CD-MRS01-SS-02-11	
DATE SAMPLED:		11/13/07		11/13/07		11/14/07		11/14/07		11/14/07		11/14/07		11/14/07		11/13/07		11/15/07		11/15/07		11/14/07		11/15/07		11/15/07	
LAB SAMPLE ID:		D7K140324001		D7K140324002		D7K200327004		D7K200327006		D7K200327002		D7K200327003		D7K200327005		D7K140324003		D7K200327010		D7K200327009		D7K200327001		D7K200327008		D7K200327007	
	Units																										
Explosives - SW8321A																											
1,3,5-Trinitrobenzene	µg/kg	120	U	120	U	120	U	120	U	120	U	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	500	U	500	U	500	U	500	U	500	U				
Metals - SW6010B/6020/7471A																											
Aluminum	mg/kg	**2500**	J	**480**		**690**		**680**		**11000**	J	**12000**		**64**	J	**2900**		**280**		**250**		**4000**					
Antimony	mg/kg	0.29	UJ	0.26	U	0.68	U	0.26	U	0.31	UJ	0.63	U	0.58	U	0.29	U	0.62	U	0.62	U	0.57	U	0.27	U	**0.54**	
Arsenic	mg/kg	**0.33**	J	**0.066**	J	**0.29**	J	**0.15**	J	**1.0**		**1.3**	J	**0.049**	J	**0.79**		**0.20**	J	**0.21**	J	**0.81**	J				
Barium	mg/kg	**3.8**	J	**0.76**		**5.3**		0.43	U	**7.2**	J	**8.8**		**0.83**		**8.3**		**3.6**		**3.7**		**12**					
Beryllium	mg/kg	**0.027**	J	0.10	U	0.27	U	0.10	U	**0.065**	J	**0.080**	J	0.23	U	**0.084**	J	0.25	U	0.25	U	**0.069**	J				
Cadmium	mg/kg	**0.013**	J	0.10	U	**0.027**	J	**0.013**	J	**0.11**	J	**0.15**	J	0.23	U	**0.054**	J	**0.019**	J	**0.020**	J	**0.061**	J				
Calcium	mg/kg	**88**	J	**62**	J	**740**		140	U	**24**	J	**22**	J	**30**	J	**2400**		**92**	J	**120**	J	**130**	J				
Chromium	mg/kg	**2.6**		**0.52**	J	**0.93**	J	**0.87**		**9.8**	J	**12**		1.6	U	**4.2**		**0.51**	J	**0.50**	J	**4.2**					
Cobalt	mg/kg	**0.14**		**0.023**	J	**0.069**	J	0.10	U	**0.36**		**0.44**		0.23	U	**0.22**		**0.052**	J	**0.054**	J	**0.24**					
Copper	mg/kg	**1.2**		**0.19**	J	**1.2**		**37**		**1.2**		**1.7**		0.74	U	**3.5**		0.80	U	0.80	U	**1.0**		0.35	U	**56**	
Iron	mg/kg	**840**	J	**1300**		**400**		**270**		**3000**	J	**3500**		**53**	J	**660**		**210**		**200**		**2600**					
Lead	mg/kg	**5.5**	J	**1.1**		**2.5**		**2.4**		**8.4**		**11**		**0.64**	J	**13**		**4.5**		**4.3**		**9.2**		**0.96**		**400**	
Magnesium	mg/kg	**94**		**16**	J	**240**		**14**	J	**190**		**200**		**8.4**	J	**530**		**46**		**55**		**130**					
Manganese	mg/kg	**1.8**		**1.5**		**0.66**	J	**0.89**	J	**3.4**		**4.3**		**1.1**	J	**7.7**		**1.6**	J	**2.1**	J	**4.5**					
Mercury	mg/kg	0.038	U	0.034	U	0.045	U	0.035	U	**0.028**	J	**0.026**	J	0.038	U	**0.054**		0.041	U	0.041	U	**0.028**	J				
Molybdenum	mg/kg	**0.13**	J	**0.031**	J	**0.059**	J	**0.031**	J	**0.23**	J	**0.28**	J	0.46	U	**0.096**	J	**0.056**	J	**0.052**	J	**0.15**	J				
Nickel	mg/kg	**0.58**		**0.099**	J	**0.31**	J	**0.10**	J	**2.1**		**2.6**		0.81	U	**1.2**		**0.22**	J	**0.23**	J	**1.1**					
Potassium	mg/kg	**66**	J	310	U	410	U	310	U	**150**	J	**160**	J	350	U	**220**	J	370	U	370	U	**100**	J				
Selenium	mg/kg	**0.17**	J	**0.11**	J	1.4	U	0.52	U	0.62	U	1.3	U	1.2	U	**0.40**	J	1.2	U	1.2	U	1.1	U				
Silver	mg/kg	**0.22**		0.10	U	0.27	U	0.10	U	**0.020**	J	0.25	U	0.23	U	0.11	U	0.25	U	0.25	U	0.23	U				
Sodium	mg/kg	650	U	590	U	780	U	600	U	700	U	710	U	660	U	650	U	710	U	710	U	650	U				
Thallium	mg/kg	**0.020**	J	0.10	U	0.27	U	**0.0037**	J	**0.047**	J	**0.064**	J	0.23	U	**0.030**	J	0.25	U	0.25	U	**0.044**	J				
Titanium	mg/kg	**72**	J	**58**		**34**		**40**		**56**	J	**61**		**80**		**25**		**68**		**53**		**75**					
Vanadium	mg/kg	**3.1**		**1.2**		**1.1**	J	**1.3**		**18**	J	**23**		**0.31**	J	**3.0**		**1.2**		**1.3**		**8.6**					
Zinc	mg/kg	**2.4**	J	**1.6**	J	**2.4**	J	**0.44**	J	**3.3**		**4.3**	J	**1.1**	J	**18**		**1.2**	J	**1.4**	J	**2.0**	J				

QA NOTES AND DATA QUALIFIERS:
(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the practical quantitation limit (PQL).
UJ - Analyte not detected, reported PQL may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
* - Ambient sample.
** - Field duplicate of sample on left.
Detections are bolded.

Table 5.4
Summary of Validated Analytical Results for Camp Davis MMRP Water Samples Collected in November 2007

SAMPLE ID:		CD-MRS03-GW1		CD-MRS03-GW2*	
DATE SAMPLED:		11/13/07		11/13/07	
LAB SAMPLE ID:		D7K140324005		D7K140324004	
	Units				
Explosives - SW8321A					
1,3,5-Trinitrobenzene	µg/L	0.12	U	0.12	U
1,3-Dinitrobenzene	µg/L	0.12	U	0.12	U
2,4,6-Trinitrotoluene (TNT)	µg/L	0.12	U	0.12	U
2,4-Dinitrotoluene	µg/L	0.12	U	0.12	U
2,6-Dinitrotoluene	µg/L	0.12	U	0.12	U
2-Amino-4,6-dinitrotoluene	µg/L	0.12	U	0.12	U
2-Nitrotoluene	µg/L	0.20	U	0.20	U
3-Nitrotoluene	µg/L	0.20	U	0.20	U
4-Amino-2,6-dinitrotoluene	µg/L	0.12	U	0.12	U
4-Nitrotoluene	µg/L	0.20	U	0.20	U
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	µg/L	0.12	U	0.12	U
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	µg/L	0.12	U	0.12	U
Nitrobenzene	µg/L	0.12	U	0.12	U
Nitroglycerin	µg/L	0.15	U	0.15	U
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	µg/L	0.12	UJ	0.12	U
Pentaerythritol Tetranitrate (PETN)	µg/L	0.12	U	0.12	U
Total Metals - SW6010B/6020/7470A					
Aluminum	µg/L	300	U	300	U
Antimony	µg/L	6.0	U	6.0	U
Arsenic	µg/L	5.0	U	5.0	U
Barium	µg/L	**56**		**49**	
Beryllium	µg/L	1.0	U	1.0	U
Cadmium	µg/L	1.0	U	1.0	U
Calcium	µg/L	**86000**		**86000**	
Chromium	µg/L	10	U	10	U
Cobalt	µg/L	**0.29**	J	**0.28**	J
Copper	µg/L	2.0	U	**3.7**	
Iron	µg/L	**5000**		**4900**	
Lead	µg/L	**0.56**	J	**0.77**	J
Magnesium	µg/L	**2900**		**2900**	
Manganese	µg/L	**86**		**86**	
Mercury	µg/L	0.20	U	0.20	U
Molybdenum	µg/L	2.0	U	2.0	U
Nickel	µg/L	**1.4**	J	**1.4**	J
Potassium	µg/L	**1600**	J	**1700**	J
Selenium	µg/L	5.0	U	5.0	U
Silver	µg/L	5.0	U	5.0	U
Sodium	µg/L	**10000**		**11000**	
Thallium	µg/L	1.0	U	1.0	U
Titanium	µg/L	10	U	10	U
Vanadium	µg/L	6.0	U	6.0	U
Zinc	µg/L	20	U	20	U
Perchlorate - SW6860					
Perchlorate	µg/L	0.10	U	0.10	U

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification. U - Analyte was analyzed for but not detected above the practical quantitation limit (PQL).
J - Analyte detected, estimated concentration. * - Field duplicate of sample on left. Detections are bolded.
UJ - Analyte not detected, reported PQL may be inaccurate or imprecise.

Table 5.5
Surface Soil Background Screening Levels
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum County USGS Background Conc. [a]	Maximum Surface Soil Ambient Concentration	Selected Surface Soil Background Concentration [b]
Metals				
Aluminum	mg/kg	**18000**	**2500**	**18000**
Antimony	mg/kg	**NA**	<0.68	<0.68
Arsenic	mg/kg	**3.8**	**0.33**	**3.8**
Barium	mg/kg	**NA**	**5.3**	**5.3**
Beryllium	mg/kg	**NA**	**0.027**	**0.027**
Cadmium	mg/kg	**NA**	**0.027**	**0.027**
Calcium	mg/kg	**4100**	**740**	**4100**
Chromium	mg/kg	**NA**	**2.6**	**2.6**
Cobalt	mg/kg	**NA**	**0.14**	**0.14**
Copper	mg/kg	**6.4**	**1.2**	**6.4**
Iron	mg/kg	**9000**	**1300**	**9000**
Lead	mg/kg	**40**	**5.5**	**40**
Magnesium	mg/kg	**470**	**240**	**470**
Manganese	mg/kg	**230**	**1.8**	**230**
Mercury	mg/kg	**NA**	**0.032**	**0.032**
Molybdenum	mg/kg	**NA**	**0.13**	**0.13**
Nickel	mg/kg	**NA**	**0.58**	**0.58**
Potassium	mg/kg	**NA**	**66**	**66**
Selenium	mg/kg	**0.51**	**0.17**	**0.51**
Silver	mg/kg	**NA**	**0.22**	**0.22**
Sodium	mg/kg	**2300**	<780	**2300**
Strontium	mg/kg	**NA**	**0.020**	**0.020**
Thallium	mg/kg	**NA**	**72**	**72**
Vanadium	mg/kg	**NA**	**3.1**	**3.1**
Zinc	mg/kg	**29**	**2.4**	**29**

a - USGS derived background concentration for Pender and Onslow Counties, NC. Value equals the maximum mean + 2xSD (rounded to two significant figures).
b - The background concentrations are selected from those available in the column order shown (i.e., the USGS value is used if there is one; if there is no USGS value, then the maximum ambient concentration is used).
NA - Background concentration not available.
NOTE: No explosives were detected in the ambient media samples at the MRS.
< ### – Analyte not detected above the adjusted practical quantitation limit (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 contamination present. To make this determination, analytical results for MC metals are screened against several criteria in order to evaluate whether or not a source of MC contamination is present. For an analyte to be considered

potential contamination related to a release from munitions-related activities at the site or within a MRS, it is necessary for the following conditions to be true:

- The analyte is detected in the sample medium; AND
- The analyte is present above the selected background concentration (see Subchapter 5.2.7); AND
- The analyte is a potential constituent of the munitions formerly used at the site (see Table 4.1).

5.2.8.2 The MC metals analyzed at the site were evaluated against these criteria to determine whether or not potential MC contamination was present at the MRS. Only detections of metals that meet the conditions above are retained for consideration in the Screening Level Risk Assessments (SLRAs) in Chapter 6. Furthermore, calcium, iron, magnesium, potassium, and sodium are essential nutrients that are not expected to pose a human or ecological risk. Therefore, these analytes are not retained for consideration in the SLRA. Any detection of explosives or perchlorate at the site is considered to be potential MC contamination and is evaluated in the SLRA. However, there were no detected explosives in the soil or groundwater samples and no perchlorate in the groundwater.

5.2.8.3 For MC metals that do not have background concentrations available, such as the groundwater samples, any detected concentration was retained for consideration in the SLRA.

5.3 MRS01 - RIFLE & PISTOL RANGE

This subchapter of the SI Report evaluates exposure pathways for MRS01, the Rifle & Pistol Range. 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

The Rifle & Pistol Range was used by soldiers of the U.S. Army from 1941 to 1944 for small arms training. Four concrete backstops were constructed at the range with soil piled in front of the backstops to stop bullets from ricocheting off the backstops. During the QR session of the SI for the MRS, the SVT noted that much of the soil that was piled in front of the backstops had been removed. One MD item, a spent small arms slug was seen by the SVT at the surface of the soil during the inspection. In 2003, during the conduct of the ASR Supplement, a RAC score of 5 was assigned for this MRS on the basis of its sole use as a small arms range.

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. No groundwater samples were collected within MRS01 – Rifle & Pistol Range.

5.3.2.1 Geologic and Hydrogeologic Setting

5.3.2.1.1 Geologically, the area of the Rifle & Pistol Range MRS is consistent with Coastal Plain sediments. The area is dominated by unconsolidated sand and clays. These sediments typically dip and thicken to the east. Water from precipitation events is able to infiltrate through the loose sands into the shallow aquifer. Vertical flow may be restricted by clay layers or lenses and may, along some areas, migrate down to the lower aquifers through more permeable sections of the clays or along areas free of clays.

5.3.2.1.2 Groundwater in the area occurs in shallow, intermediate and deep aquifers, with the latter two typically used for domestic and municipal supply. The wells set in the intermediate aquifer, the Castle Hayne, are usually set around 160 feet in depth. Water to the local residents is supplied by the Onslow Water & Sewer Authority and no supply wells have been identified to occur within the MRS.

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 the small arms activities due to the inability of small arms to penetrate the soil to the depth of the water table.

5.3.2.3 Groundwater Migration Pathway and Receptors

No groundwater wells exist within the Rifle & Pistol Range MRS. Potential human receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, and recreational users. The contaminants noted in Subchapter 5.3.4.5 have the potential for leaching from the soil into the surficial groundwater table. For the human receptors, the groundwater pathway is a complete pathway, evaluated through the use of the soil screening levels (SSLs). It is generally assumed that groundwater is not accessible to most ecological receptors, due to the inability of ecological receptors to directly interact with groundwater. Therefore, the groundwater exposure pathway is incomplete for ecological receptors.

5.3.2.4 Groundwater Sample Locations and Methodologies

No groundwater sampling was conducted at the Rifle & Pistol Range MRS in accordance with the direction of the TPP Team.

5.3.2.5 Groundwater Migration Pathway Analytical Results

No groundwater sampling was conducted at the Rifle & Pistol Range MRS.

5.3.2.6 Groundwater Migration Pathway Conclusions

The groundwater migration pathway is incomplete for ecological receptors at MRS01 – Rifle & Pistol Range. No water wells are located at the site. Therefore, there is no current receptor exposure point present, which is necessary for a complete migration pathway. However future wells could provide a complete exposure pathway.

5.3.3 Surface Water and Sediment Migration Pathways

Surface water can serve as a contaminant transport mechanism that may affect other 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 hydraulic setting for the Rifle & Pistol Range – MRS01 is similar to the setting described in Subchapter 5.2.4. The MRS is dominated by pocosin, hard wood and/or pine forests with few ponds and creeks. Surface water flow from these features is to the south and the Cape Fear River. The Rifle & Pistol Range MRS is located on privately owned and state maintained Game Lands (Holly Shelter). No use of surface water other than for some recreational purposes is noted.

5.3.3.1.2 Wetlands make up approximately one-third of the Rifle & Pistol Range MRS and occur mainly along its western portion. The classification for the wetland in the MRS is PSS3B – Palustrine, Scrub Shrub, Broad Leaved Deciduous or Broad-Leaved Evergreen, Saturated.

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 this MRS. The presence of local surface water provides a potential migration pathway through which releases of MC to soil as a result of small arms munitions activities would migrate to surface water or sediment via runoff or erosion.

5.3.3.3 Surface Water and Sediment Migration Pathways and Receptors

Approximately one-third of the area of the Rifle & Pistol Range MRS is comprised of wetlands. The terrain of the area is comprised of depressions set in the unconsolidated sand. These depressions are referred to as the Carolina Bays, which are often filled with water, making shallow ponds or lakes. Potential receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.3.3.4 Surface Water and Sediment Sample Locations and Methodologies

No surface water and/or sediment samples were collected from this MRS in accordance with the direction of the TPP Team.

5.3.3.5 Surface Water and Sediment Migration Pathway Analytical Results

No surface water and/or sediment samples were collected at this MRS.

5.3.3.6 Surface Water and Sediment Migration Pathway Conclusions

The surface water and sediment migration pathway are potentially complete for human and ecological receptors within the MRS. Three MC were detected above background concentrations (antimony, copper, and lead) in the surface soil samples collected from the site, as discussed in Subchapter 5.2.4.5. Therefore, there is a potential source of MC contamination, a migration pathway, and receptors present, providing the elements necessary for a complete migration pathway. However, surface water was not collected at the MRS in accordance with the directions from the TPP Team. The surface water and sediment migration pathway for human health receptors at the MRS is, therefore, potentially complete but not quantitatively assessed.

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

Lands along the MRS are primarily owned by the State of North Carolina and are currently state game lands. Some residential areas exist near the center of the MRS approximately 1.5 miles south of the firing line. Land along the firing line is owned by a private group that maintains an airstrip. Lands belonging to the state are identified as such and are open to the public. Privately owned lands are well identified and for the most part fenced. The pocosin acts, along most of the area, as a natural barrier as the thick growth significantly limits access. Potential receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.3.4.2 Actual or Potential Contamination Areas

The Rifle & Pistol Range MRS was used in the 1940s by the U.S. Army for small arms training. Small arms munitions as listed in Table 4.1 are believed to have been used for training and practice. No previous discoveries of munitions other than at the immediate target area are known. It is anticipated that overshoots from the target area may have traveled for thousands of feet past the backstops, and would not likely be discovered in the thick pocosin swamp. No MC sampling events prior to this SI were identified regarding this MRS.

5.3.4.3 Soil Exposure Pathways and Receptors

The CSEM is presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near MRS01 – Rifle and Pistol Range 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 would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.3.4.4 Soil Sample Locations and Methodologies

Two soil samples (CD-MRS01-SS-02-[10 and 11]) were collected in the Rifle & Pistol Range MRS with locations referenced on Figure 5.2. Sampling methodologies and analysis are summarized in Subchapter 5.2.6.

5.3.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from MRS01 – Rifle & Pistol Range are presented in Table 5.3. These results were evaluated using the criteria described in Subchapter 5.2.8. For surface soil samples, this evaluation was performed for selected metals. The source evaluation for surface soil is summarized in Table 5.6. As shown in this table, two MC (copper and lead) were detected above the selected background concentration in the surface soil samples analyzed. Additionally, antimony was detected in site samples, but not in background samples. Therefore, antimony was conservatively assumed to exceed the background concentration. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this site.

5.3.4.6 Soil Exposure Conclusions

Three MC (antimony, copper, and lead) were detected above the selected background concentration in the surface soil samples analyzed. Therefore, potential MC contamination is present within the MRS. MC contamination can migrate to other media through leaching, erosion, runoff, and blowing dust. The interaction with potential human and ecological receptors can occur through incidental ingestion, dermal contact, or inhalation of re-suspended particulates. Therefore, the exposure pathways are complete for the soil medium at MRS01 - Rifle & Pistol Range. A SLRA is presented in Chapter 6 for the three retained analytes at this MRS.

Table 5.6
MRS01 - Rifle & Pistol Range
Surface Soil Source Evaluation
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [a]	Exceeds Background Conc.?	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Metals							
Antimony	mg/kg	**0.54**	<0.68	**Yes**[c]	**Yes**	**Yes**	--
Copper	mg/kg	**56**	**6.4**	**Yes**	**Yes**	**Yes**	--
Lead	mg/kg	**400**	**40**	**Yes**	**Yes**	**Yes**	--

a - Background Screening Level as established in Table 5.5
b - Potential MC as listed in Table 4.1
c – Antimony is detected in site samples, but not in background. Therefore, it is assumed to exceed background.
< ### – Analyte not detected above the adjusted practical quantitation limit (PQL)

5.3.5 Air Migration Pathway

5.3.5.1 Climate

In general, for the former Camp Davis site, the climate consists of very warm, humid summers with moderate breezes along the coast. Winters are somewhat cool with morning lows occasionally below freezing. Hurricanes approach from along the Atlantic Coast in the late summer and fall months.

5.3.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the MRS01 – Rifle & Pistol Range. The air migration pathway accounts for hazardous substance migration in gaseous or particulate form though the air. Inhalation of a contaminant can be a potential exposure pathway for human and ecological receptors. The Rifle & Pistol Range MRS is comprised mainly of pocosin swamp which is typically very heavily vegetated. The potential for excessive exposure to dust at this MRS is considered very low. No air sampling was performed at the MRS and the TPP Team agreed that air sampling would not be performed as part of this SI.

5.3.5.3 Air Migration Pathways and Receptors

Based on the observations of the site visit team, there are approximately 20 to 30 households within the MRS. The home sites were noted approximately 1.5 miles

downrange from the firing line. Land outside of the MRS is also sparsely populated. Based on the known current and future uses of the land, the potential air migration pathway receptors at the MRS would be current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to surface soil through inhalation of re-suspended particulate matter through the air migration pathway. The CSEM are presented in Appendix J.

5.3.5.4 Air Sample/Monitoring Locations and Methodologies

Air sampling was not conducted at this MRS during the SI.

5.3.5.5 Air Migration Pathway Analytical Results

Air sampling was not conducted at this MRS during the SI.

5.3.5.6 Air Migration Pathway Conclusions

As discussed in Subchapter 5.4.4.6, three MC analytes were detected above background concentrations in the surface soil samples collected from the site and, therefore, potential MC contamination may be present. 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.

5.4 MRS02 -COASTAL ANTI-AIRCRAFT RANGE

This subchapter of the SI Report evaluates exposure pathways for MRS02 the Coastal Anti-Aircraft Range. 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

The Coastal Anti-Aircraft Range MRS was used in the 1940s for training with anti-aircraft munitions. No known evidence of ordnance contamination has been recorded since the range was closed in 1944. Due to lack of documented ordnance used, it is presumed that practice rounds consisting of 37mm, 40mm, 3-inch, 90mm, 105mm and 155mm projectiles were used based on the knowledge that practice consisted of gunners firing upon targets that were pulled across the sky by aircraft. In the late 1940s, the U.S. Navy conducted Operation Bumblebee within this range. The purpose of the operation was to test rocket propulsion systems and no explosives or ordnance was associated with this testing. Operation Bumblebee was halted in 1948.

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. No groundwater samples were collected within MRS02 – Coastal Anti-Aircraft Range.

5.4.2.1 Geologic and Hydrogeologic Setting

5.4.2.1.1 Geologically, the area of the Coastal Anti-Aircraft Range MRS is consistent with Coastal Plain sediments. The area is dominated by unconsolidated sand and clays. These sediments typically dip and thicken to the east. Water from precipitation events is able to infiltrate through the loose sands into the shallow aquifer. However, due to location of the land portion of this MRS along a barrier island with moderately sloping surface, much of the surface water flows directly to the Intercoastal Waterway or the Atlantic Ocean. Groundwater at the MRS is much different compared to the rest of the former Camp Davis. The MRS is set along the coast of the Atlantic Ocean and due to this proximity and the high transmissivity of the loose sands, shallow groundwater occurs near sea level.

5.4.2.1.2 Groundwater in the area occurs in shallow, intermediate and deep aquifers, with the latter two typically used for domestic and municipal supply. The wells set in the intermediate aquifer, the Castle Hayne, are usually set around 160 feet in depth. Water to the local residents is supplied by the town of Surf City with supply wells located north of the town and the Intercoastal Waterway that do not occur within the MRS.

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 the munitions activities due to the inability of the munitions used at the site to penetrate the soil to the depth of the water table.

5.4.2.3 Groundwater Migration Pathway and Receptors

Potential human receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, and recreational users. No groundwater wells currently exist within the Coastal Anti-Aircraft Range MRS. However, a shallow groundwater table exists at the site, and it is possible that future human receptors could have contact with groundwater. Therefore, the human exposure pathways are complete for future receptors. It is generally assumed that groundwater is not directly accessible to ecological receptors, due to the inability of these receptors to interact with groundwater. Therefore, the groundwater exposure pathway is incomplete for ecological receptors.

5.4.2.4 Groundwater Sample Locations and Methodologies

No groundwater sampling was conducted at the Coastal Anti-Aircraft Range MRS.

5.4.2.5 Groundwater Migration Pathway Analytical Results

No groundwater sampling was conducted at the Coastal Anti-Aircraft Range MRS.

5.4.2.6 Groundwater Migration Pathway Conclusions

The groundwater migration pathway is incomplete for ecological receptors at MRS02 – Coastal Anti-Aircraft Range. No water wells are located at the site, however, future human contact with groundwater cannot be ruled out. Therefore, human exposure pathways are complete at this MRS.

5.4.3 Surface Water and Sediment 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

5.4.3.1.1 The Coastal Anti-Aircraft Range MRS is situated along the coastline of the Atlantic Ocean. Artillery practice was conducted from batteries situated along the coast and fired to targets that were pulled over the Atlantic Ocean by aircraft. The land portion of this MRS is situated along a barrier island which is flanked by the Atlantic Ocean to the east and Banks Channel and the Intracoastal Waterway to the west. Soils of the area are comprised of sands that are constantly moved by storm events and shoreline deposition and/or erosion primarily along the ocean shoreline. Surface water runoff, primarily from storm events, drains to both water bodies.

5.4.3.1.2 The land portion of the Coastal Anti-Aircraft Range has some small areas identified as wetlands. These areas are identified as:

- E2EM1N Estuarine, intertidal, emergent, persistent, regularly exposed;
- E2SS3/4P Estuarine, intertidal, emergent, scrub-shrub, broad-leaved evergreen/needle-leaved evergreen, irregularly flooded, and
- E1UBLx Estuarine, subtidal, unconsolidated bottom, excavated

5.4.3.1.3 Wetlands along the Coastal Anti-Aircraft Range MRS are as identified on Figure 5.3.

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 this MRS. The presence of local surface water provides a potential migration pathway through which releases of MC to soil as a result of munitions activities would migrate to surface water or sediment via runoff or erosion.

5.4.3.3 Surface Water and Sediment Migration Pathways and Receptors

The Coastal Anti-Aircraft Range MRS is situated on Top Sail Island, a barrier island, and is located in between the Atlantic Ocean to the east and Banks Channel and the Intracoastal Waterway to the west. The shoreline to the Atlantic Ocean is comprised of a beach environment with loose highly reworked sands that dominate the subsurface and sediment of the area. Sediment along the Cape Fear River is not as reworked as compared to the sands along the Atlantic Coast but is likely derived from both the land portion of the MRS and from up river sources. Surface water from the MRS drains to both the Atlantic Ocean and the Intracoastal Waterway. Potential receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users and ecological receptors.

5.4.3.4 Surface Water and Sediment Sample Locations and Methodologies

No surface water or sediment sampling was conducted for evaluation of this MRS due to the volume of water in both surface water features and the dynamic nature of these bodies.

5.4.3.5 Surface Water and Sediment Migration Pathway Analytical Results

No surface water or sediment sampling was conducted for evaluation of this MRS.

5.4.3.6 Surface Water and Sediment Migration Pathway Conclusions

The surface water and sediment migration pathways are potentially complete for human and ecological receptors within the MRS. Three MC were detected above background concentrations (barium, nickel, and strontium) in the surface soil samples collected from the site, as discussed in Subchapter 5.3.4.5. Therefore, there is a potential source of MC contamination, a migration pathway, and receptors present providing the elements necessary for a complete migration pathway. However, surface water was not collected at the MRS in accordance with the directions from the TPP Team. The surface water and sediment migration pathway for human health and ecological receptors at the MRS is, therefore, potentially complete but not quantitatively assessed.

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

Land portions of the Coastal Anti-Aircraft MRS are within the Surf City town limits and are essentially residential, with the Atlantic shore belonging to the State of North Carolina being used for recreational purposes. Access to the state owned beach is unrestricted. Potential receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.4.4.2 Actual or Potential Contamination Areas

No recorded findings of munitions are known for this MRS. Documented munitions use is limited but it is believed that 37mm, 40mm, 3-inch, 90mm, 105mm and 155mm projectiles were used based on the knowledge that practice consisted of gunners firing upon targets that were pulled behind aircraft.

5.4.4.3 Soil Exposure Pathways and Receptors

The CSEM is presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near MRS02 – Coastal Anti-Aircraft Range 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 would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.4.4.4 Soil Sample Locations and Methodologies

One soil sample CD-MRS02-SS-02-07 was collected in the coastal Anti-Aircraft Range MRS with its location referenced on Figure 5.2. Sampling methodologies and analysis are summarized in Subchapter 5.2.6.

5.4.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil sample collected from MRS02 – Coastal Anti-Aircraft Range are presented in Table 5.3. These results were evaluated using the criteria described in Subchapter 5.2.8. No explosives were detected in the surface soil sample, so this evaluation was performed for metals only. The source evaluation for surface soil is summarized in Table 5.7. As shown in this table, three MC (barium, nickel, and strontium) were detected above the selected background concentration in the surface soil sample analyzed. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this site.

Table 5.7
MRS02 -Coastal Anti-Aircraft Range
Surface Soil Source Evaluation
Camp Davis, Holly Ridge , NC

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [a]	Exceeds Background Conc.?	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Metals							
Aluminum	mg/kg	**2900**	**18000**	No	**Yes**	No	Not detected above background
Antimony	mg/kg	< 0.29	<0.68	No	**Yes**	No	Not detected at MRS
Arsenic	mg/kg	**0.79**	**3.8**	No	No	No	Not detected above background
Barium	mg/kg	**8.3**	**5.3**	**Yes**	**Yes**	**Yes**	--
Beryllium	mg/kg	**0.084**	**0.027**	**Yes**	No	No	Not a potential MC
Cadmium	mg/kg	**0.054**	**0.027**	**Yes**	No	No	Not a potential MC
Calcium	mg/kg	**2400**	**4100**	No	**Yes**	No	Essential nutrient (c)
Chromium	mg/kg	**4.2**	**2.6**	**Yes**	No	No	Not a potential MC
Cobalt	mg/kg	**0.22**	**0.14**	**Yes**	No	No	Not a potential MC
Copper	mg/kg	**3.5**	**6.4**	No	**Yes**	No	Not detected above background
Iron	mg/kg	**660**	**9000**	No	**Yes**	No	Essential nutrient (c)
Lead	mg/kg	**13**	**40**	No	**Yes**	No	Not detected above background
Magnesium	mg/kg	**530**	**470**	**Yes**	**Yes**	No	Essential nutrient (c)
Manganese	mg/kg	**7.7**	**230**	No	No	No	Not detected above background
Mercury	mg/kg	**0.054**	**0.032**	**Yes**	No	No	Not a potential MC
Molybdenum	mg/kg	**0.096**	**0.13**	No	**Yes**	No	Not detected above background
Nickel	mg/kg	**1.2**	**0.58**	**Yes**	**Yes**	**Yes**	--
Potassium	mg/kg	**220**	**66**	**Yes**	**Yes**	No	Essential nutrient (c)
Selenium	mg/kg	**0.40**	**0.51**	No	No	No	Not detected above background
Silver	mg/kg	< 0.11	**0.22**	No	No	No	Not detected at MRS
Sodium	mg/kg	< 650	**2300**	No	No	No	Essential nutrient (c)
Strontium	mg/kg	**0.030**	**0.020**	**Yes**	**Yes**	**Yes**	--
Thallium	mg/kg	**25**	**72**	No	No	No	Not detected above background
Vanadium	mg/kg	**3.0**	**3.1**	No	No	No	Not detected above background
Zinc	mg/kg	**18**	**29**	No	**Yes**	No	Not detected above background

a - Background Screening Level as established in Table 5.5 b - Potential MC as listed in Table 4.1

c - Calcium, Iron, Magnesium, Potassium, and Sodium are essential nutrients and are not expected to pose an unacceptable risk to human or ecological receptors

< ### – Analyte not detected above the adjusted practical quantitation limit (PQL) NOTE: No explosives were detected in the ambient or biased media samples at the MRS.

5.4.4.6 Soil Exposure Conclusions

Three MC (barium, nickel, and strontium) were detected above the selected background concentration in the surface soil samples analyzed. Therefore, based on the results presented in this report, potential MC contamination is present within the MRS. MC contamination can migrate to other media through leaching, erosion, runoff, and blowing dust. The interaction with potential human and ecological receptors can occur through incidental ingestion, dermal contact, or inhalation of re-suspended particulates. Therefore, the exposure pathways are complete for the soil medium at MRS02 – Coastal Anti-Aircraft Range. A SLRA is presented in Chapter 6 for the retained three analytes for this MRS.

5.4.5 Air Migration Pathway

5.4.5.1 Climate

In general, for the former Camp Davis site, the climate consists of very warm, humid summers with moderate breezes along the coast. Winters are somewhat cool with morning lows occasionally below freezing. Hurricanes approach from along the Atlantic Coast in the late summer and fall months.

5.4.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the MRS02 – Coastal Anti-Aircraft Range. The air migration pathway accounts for hazardous substance migration in gaseous or particulate form though the air. Inhalation of a contaminant can be a potential exposure pathway for human and ecological receptors. The Coastal Anti-Aircraft Range is comprised mainly of a beach environment with residential lots dominating the landscape. A strip of open beach is found along the Atlantic coast and has very little to no vegetative cover. The potential for transport for MC exposure via dust inhalation at this MRS is considered good. No air sampling was performed at the MRS and the TPP Team agreed that air sampling would not be performed as part of this SI.

5.4.5.3 Air Migration Pathways and Receptors

The year 2000 population for the town of Surf City included 1,393 residents. This does not include vacationers who visit the area commonly in the spring and summer. Based on the known current and future uses of the land, the potential air migration pathway receptors at the MRS would be current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to surface soil through inhalation of re-suspended particulate matter through the air migration pathway. The CSEM are presented in Appendix J.

5.4.5.4 Air Sample/Monitoring Locations and Methodologies

Air sampling was not conducted at this MRS during the SI.

5.4.5.5 Air Migration Pathway Analytical Results

Air sampling was not conducted at this MRS during the SI.

5.4.5.6 Air Migration Pathway Conclusions

As discussed in Subchapter 5.4.4.6, three MC analytes were detected above background concentrations in the surface soil samples collected from the site and, therefore, potential MC contamination may be present. 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 MRS03 – RANGE COMPLEX NO.1

This subchapter of the SI Report evaluates exposure pathways for MRS03 - Range Complex No.1. 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

The Range Complex No.1 MRS was used in the 1940s for training mainly with anti-aircraft munitions; a grenade court is also included within the MRS. Figure 2.1 shows the outline of the Range Complex No.1 MRS and included three identified ranges: the Anti-Aircraft Impact Area, the Track Target Area and the Grenade Range. No documented findings of ordnance have been found in this or previously conducted studies for the Anti-Aircraft Impact Area. Interviews with local landowners indicated the presence of .50 Caliber munitions and 37mm and 40mm artillery rounds at the Track Target Impact Area. A site inspection team sent by CENCR in 1994 resulted in the discovery of several .50 Caliber practice rounds also within the Track Target Area. Interviews with landowners and observations by the 1994 site visit team indicated the presence of grenade fuze heads and grenade fragmentation along the grenade court.

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.

5.5.2.1 Geologic and Hydrogeologic Setting

5.5.2.1.1 Geologically, the area of the Range Complex No.1 MRS is consistent with Coastal Plain sediments. The area is predominated by unconsolidated sand and clays. These sediments typically dip and thicken to the east. Water from precipitation events is able to infiltrate through the loose sands into the shallow aquifer. Vertical flow may be restricted by clay layers or lenses and may, along some areas, migrate down to the lower aquifers through more permeable sections of the clays or along areas free of clays.

5.5.2.1.2 Groundwater in the area occurs in shallow, intermediate and deep aquifers, with the latter two typically used for domestic and municipal supply. The wells set in the

intermediate aquifer, the Castle Hayne, are usually set around 160 feet in depth. Water to the local residents is supplied by the Onslow Water & Sewer Authority and no supply wells have been identified within the Range Complex No.1 MRS. Two private supply wells located on two hunting club lands do exist. These wells are used during hunting seasons. One of these wells was identified as being within the Range Complex No.1 MRS and the other is situated immediately to the east of the MRS. The well belonging to the Oak Island Hunt Club lies to the east of the MRS and was sampled, as decided during the 2006 TPP meeting (sample CD-MRS03-GW1 and CD-MRS03-GW2), during this SI; results presented in this report.

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 the munitions activities due to the inability of the munitions to penetrate soil to the depth of the water table.

5.5.2.3 Groundwater Migration Pathway and Receptors

Two wells are known to exist within this MRS; one was the well sampled at the Oak Island Hunt Club and a second well is located on an adjacent hunting camp property. No public supply wells were identified to exist within the Range Complex No.1 MRS. Potential human receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, and recreational users. 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.

5.5.2.4 Groundwater Sample Locations and Methodologies

One groundwater sample was collected at the Range Complex No.1 MRS – CD-MRS03-GW1. The well, a nominal 6-inch diameter supply well, was located on privately held lands near the MRS and was initially installed as a supply well for use by Camp Davis personnel. Appropriate QA/QC samples were also collected from the well, including a field duplicate sample – CD-MRS03-GW2. An ambient groundwater sample was not collected.

5.5.2.5 Groundwater Migration Pathway Analytical Results

The analytical results for the groundwater samples collected from MRS03 – Range Complex No.1, are presented in Table 5.5. These results were evaluated using the criteria described in Subchapter 5.2.8. No explosives or perchlorate were detected in any of the groundwater samples, so this evaluation was performed for metals only. The source evaluation for surface soil is summarized in Table 5.8. As shown in this table, four MC (barium, copper, lead, and nickel) were detected in the groundwater samples analyzed. As there were no background concentrations identified, all detected MC analytes were retained for a SLRA in Chapter 6. Therefore, based on these sample results, there is potential MC contamination present in the groundwater at this site.

Table 5.8
MRS03 – Range Complex No.1
Groundwater Source Evaluation
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Conc.	Detected Conc.? [a]	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Metals						
Aluminum	µg/L	< **300**	No	**Yes**	No	Not detected at MRS
Antimony	µg/L	< **6.0**	No	**Yes**	No	Not detected at MRS
Arsenic	µg/L	< **5.0**	No	No	No	Not detected at MRS
Barium	µg/L	**56**	**Yes**	**Yes**	**Yes**	--
Beryllium	µg/L	< 1.0	No	No	No	Not detected at MRS
Cadmium	µg/L	< 1.0	No	No	No	Not detected at MRS
Calcium	µg/L	**86000**	**Yes**	**Yes**	No	Essential nutrient (c)
Chromium	µg/L	< 10	No	No	No	Not detected at MRS
Cobalt	µg/L	**0.29**	**Yes**	No	No	Not a potential MC
Copper	µg/L	**3.7**	**Yes**	**Yes**	**Yes**	--
Iron	µg/L	**5000**	**Yes**	**Yes**	No	Essential nutrient (c)
Lead	µg/L	**0.77**	**Yes**	**Yes**	**Yes**	--
Magnesium	µg/L	**2900**	**Yes**	**Yes**	No	Essential nutrient (c)
Manganese	µg/L	**86**	**Yes**	No	No	Not a potential MC
Mercury	µg/L	< 0.20	No	No	No	Not detected at MRS
Molybdenum	µg/L	< **2.0**	No	**Yes**	No	Not detected at MRS
Nickel	µg/L	**1.4**	**Yes**	**Yes**	**Yes**	--
Potassium	µg/L	**1700**	**Yes**	**Yes**	No	Essential nutrient (c)
Selenium	µg/L	< 5.0	No	No	No	Not detected at MRS
Silver	µg/L	< 5.0	No	No	No	Not detected at MRS
Sodium	µg/L	**11000**	**Yes**	No	No	Essential nutrient (c)
Strontium	µg/L	< **1.0**	No	**Yes**	No	Not detected at MRS

Table 5.8
MRS03 – Range Complex No.1
Groundwater Source Evaluation
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Conc.	Detected Conc.? [a]	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Thallium	µg/L	< 10	No	No	No	Not detected at MRS
Vanadium	µg/L	< **6.0**	No	No	No	Not detected at MRS
Zinc	µg/L	< **20.0**	No	**Yes**	No	Not detected at MRS

a - Any detected MC concentration is considered to be above the background concentration.

b - Potential MC as listed in Table 4.1

c - Calcium, Iron, Magnesium, Potassium, and Sodium are essential nutrients and are not expected to pose an unacceptable risk to human or ecological receptors

< ### – Analyte not detected above the adjusted practical quantitation limit (PQL)

NOTE: No explosives were detected in the ambient or biased media samples at the MRS.

5.5.2.6 Groundwater Migration Pathway Conclusions

5.5.2.6.1 Four MC (barium, copper, lead, and nickel) were detected in the groundwater samples analyzed. Therefore, potential MC contamination is present within the MRS. Some of the analytes detected in groundwater are naturally occurring, or could be associated with well construction. However, in the absence of ambient data, these analytes will be retained for consideration in the SLRA in Chapter 6. Two wells were identified at hunting camps within the MRS. Other residents receive water through a public water supply. The interaction with potential human receptors can occur through ingestion as drinking water, incidental ingestion, or dermal contact. Therefore, the exposure pathway is complete for the hunting clubs (residents) using the wells for the groundwater medium at MRS03 – Range Complex No.1. A SLRA is presented in Chapter 6 for the four retained analytes for this MRS.

5.5.2.6.2 For other human and ecological receptors without access to the wells, it is generally assumed that groundwater is not accessible to most receptors, due to the inability of ecological receptors to directly interact with groundwater. Therefore, the groundwater exposure pathway is incomplete for non-resident human and ecological receptors since there is no receptor exposure point present, which is necessary for a complete migration pathway.

5.5.3 Surface Water and Sediment 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

5.5.3.1.1 The Range Complex No.1 MRS is situated within the main portion of the former Camp Davis. Land along the MRS is generally flat with most of the land comprised of pocosin swamp or forested lands. Much of the land has been harvested of its trees with many young pine saplings planted for conservation/reuse purposes.

5.5.3.1.2 Wetlands dominate the area and consist of forested and scrub shrub wetlands. Wetland types identified by the National Wetlands Institute include:

- PFO3/4B-Palustrine, forested, broad-leaved or needle-leaved evergreen, saturated.
- PSS1/3B-Palustrine, scrub-shrub, broad-leaved deciduous or broad-leaved evergreen, saturated.
- PSS3/4A-Palustrine, scrub-shrub, broad-leaved or needle-leaved evergreen, temporarily flooded.

5.5.3.1.3 An outline of the wetland areas of the former Camp Davis are shown on Figure 5.3.

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 this MRS. The presence of local surface water provides a potential migration pathway through which

releases of MC to soil as a result of munitions activities would migrate to surface water or sediment via runoff or erosion.

5.5.3.3 Surface Water and Sediment Migration Pathways and Receptors

The Range Complex No.1 MRS is situated on the mainland away from the barrier island. As previously mentioned the majority of the MRS is comprised of flat low lying swamp referred to as pocosin. The pocosin is made of areas of forests and/or thick brush with many areas of shallow lake, ponds and creeks occurring in the swamp. Surface water flow from the MRS is via creeks and the Cape Fear River. Discharge from these creeks and the river is directly to the Atlantic Ocean. Potential receptors would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.5.3.4 Surface Water and Sediment Sample Locations and Methodologies

No surface water or sediment sampling was conducted for evaluation of this MRS as per the decision of the TPP Team.

5.5.3.5 Surface Water and Sediment Migration Pathway Analytical Results

No surface water or sediment sampling was conducted for evaluation of this MRS.

5.5.3.6 Surface Water and Sediment Migration Pathway Conclusions

The surface water and sediment migration pathway are potentially complete for human and ecological receptors within the MRS. Five MC were detected above background concentrations (barium, copper, molybdenum, nickel, and strontium) in the surface soil samples collected from the site, as discussed in Subchapter 5.5.4.5. Therefore, there is a potential source of MC contamination, a migration pathway, and receptors present providing the elements necessary for a complete migration pathway. However, surface water was not collected at the MRS in accordance with the directions from the TPP Team. The surface water and sediment migration pathway for human health receptors at the MRS is, therefore, 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

Range Complex No.1 MRS is for the most part undeveloped, consisting of privately owned hunting lands and Holly Ridge State Game Lands. Residential areas do exist along State Highway 50 to the east and along some secondary roads west of the MRS. Access to the MRS is semi-restricted along eastern portions of the site as locked gates prevent casual access to the site. State game lands along the western portions of the site are generally unrestricted but appear limited to interested recreational use (hunting). Potential receptors would include current and future residents, construction workers,

commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.5.4.2 Actual or Potential Contamination Areas

Documented munitions use is limited but it is believed that 37mm and 40mm projectiles were used based on the description of the ranges in the ASR. Recorded findings of munitions for this MRS, small arms and a single 37mm projectile (training) that was found at a hunting club cabin, obviously placed in its present day position. Other munitions may be present but are concealed in the pocosin.

5.5.4.3 Soil Exposure Pathways and Receptors

The CSEM is presented in Appendix J. The soil exposure pathway provides for the potential exposure of human and ecological receptors on or near MRS03 – Range Complex No.1 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 would include current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors.

5.5.4.4 Soil Sample Locations and Methodologies

Five surface soil samples, CD-MRS03-SS-02-(04, 05, 06, 08 and 09), were collected in the Range Complex No.1 MRS, with locations referenced on Figure 5.2. Field duplicate samples CD-MRS03-SS-02-12 (duplicate of 05) and CD-MRS03-SS-02-13 (duplicate of 08) were also collected and analyzed. Sampling methodologies and analysis are summarized in Subchapter 5.2.6.

5.5.4.5 Soil Exposure Analytical Results

The analytical results for the surface soil samples collected from MRS03 – Range Complex No.1 are presented in Table 5.3. These results were evaluated using the criteria described in Subchapter 5.2.8. No explosives were detected in any of the surface soil samples, so this evaluation was performed for metals only. The source evaluation for surface soil is summarized in Table 5.9. As shown in this table, five MC (barium, copper, molybdenum, nickel, and strontium) were detected above the selected background concentration in the surface soil samples analyzed. Therefore, based on these sample results, there is potential MC contamination present in the surface soil at this site.

5.5.4.6 Soil Exposure Conclusions

Five MC (barium, copper, molybdenum, nickel, and strontium) were detected above the selected background concentration in the surface soil samples analyzed. Therefore, potential MC contamination is present within the MRS. MC contamination can migrate to other media through leaching, erosion, runoff, and blowing dust. The interaction with potential human and ecological receptors can occur through incidental ingestion, dermal contact, or inhalation of re-suspended particulates. Therefore, the exposure pathways are complete for the soil medium at MRS03 – Range Complex No.1. A SLRA is presented in Chapter 6 for the retained analytes for this MRS.

Table 5.9
MRS03 – Range Complex No.1
Surface Soil Source Evaluation
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [a]	Exceeds Background Conc.?	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Metals							
Aluminum	mg/kg	**12000**	**18000**	No	**Yes**	No	Not detected above background
Antimony	mg/kg	< 0.63	<0.68	No	**Yes**	No	Not detected at MRS
Arsenic	mg/kg	**1.3**	**3.8**	No	No	No	Not detected above background
Barium	mg/kg	**12**	**5.3**	**Yes**	**Yes**	**Yes**	--
Beryllium	mg/kg	**0.080**	**0.027**	**Yes**	No	No	Not a potential MC
Cadmium	mg/kg	**0.15**	**0.027**	**Yes**	No	No	Not a potential MC
Calcium	mg/kg	**130**	**4100**	No	**Yes**	No	Essential nutrient (c)
Chromium	mg/kg	**12**	**2.6**	**Yes**	No	No	Not a potential MC
Cobalt	mg/kg	**0.44**	**0.14**	**Yes**	No	No	Not a potential MC
Copper	mg/kg	**37**	**6.4**	**Yes**	**Yes**	**Yes**	--
Iron	mg/kg	**3500**	**9000**	No	**Yes**	No	Essential nutrient (c)
Lead	mg/kg	**11**	**40**	No	**Yes**	No	Not detected above background
Magnesium	mg/kg	**200**	**470**	No	**Yes**	No	Essential nutrient (c)
Manganese	mg/kg	**4.5**	**230**	No	No	No	Not detected above background
Mercury	mg/kg	**0.028**	**0.032**	No	No	No	Not detected above background
Molybdenum	mg/kg	**0.28**	**0.13**	**Yes**	**Yes**	**Yes**	--
Nickel	mg/kg	**2.6**	**0.58**	**Yes**	**Yes**	**Yes**	--
Potassium	mg/kg	**160**	**66**	**Yes**	**Yes**	No	Essential nutrient (c)
Selenium	mg/kg	< 1.3	**0.51**	No	No	No	Not detected at MRS
Silver	mg/kg	**0.020**	**0.22**	No	No	No	Not detected above background
Sodium	mg/kg	< 710	**2300**	No	No	No	Essential nutrient (c)
Strontium	mg/kg	**0.064**	**0.020**	**Yes**	**Yes**	**Yes**	--

Table 5.9
MRS03 – Range Complex No.1
Surface Soil Source Evaluation
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Conc.	Background Conc. [a]	Exceeds Background Conc.?	Potential MC? [b]	SLRA Required?	Primary reason for exclusion from SLRA
Thallium	mg/kg	**80**	**72**	**Yes**	No	No	Not a potential MC
Vanadium	mg/kg	**23**	**3.1**	**Yes**	No	No	Not a potential MC
Zinc	mg/kg	**4.3**	**29**	No	**Yes**	No	Not detected above background

a - Background Screening Level as established in Table 5.5

b - Potential MC as listed in Table 4.1

c - Calcium, Iron, Magnesium, Potassium, and Sodium are essential nutrients and are not expected to pose an unacceptable risk to human or ecological receptors

< ### – Analyte not detected above the adjusted practical quantitation limit (PQL)

NOTE: No explosives were detected in the ambient or biased media samples at the MRS.

5.5.5 Air Migration Pathway

5.5.5.1 Climate

In general, for the former Camp Davis site, the climate consists of very warm, humid summers with moderate breezes along the coast. Winters are somewhat cool with morning lows occasionally below freezing. Hurricanes approach from along the Atlantic Coast in the late summer and fall months.

5.5.5.2 Releases and Potential Releases to Air

There are no known direct releases of MC to air at the MRS03 – Range Complex No.1. The air migration pathway accounts for hazardous substance migration in gaseous or particulate form though the air. Inhalation of a contaminant can be a potential exposure pathway for human and ecological receptors. The Range Complex No.1 MRS is comprised mainly of pocosin swamp which is typically very heavily vegetated. The potential for excessive exposure to dust at this MRS is considered very low. No air sampling was performed at the MRS and the TPP Team agreed that air sampling would not be performed as part of this SI.

5.5.5.3 Air Migration Pathways and Receptors

The year 2003 population for the town of Holly Ridge located south of the MRS was estimated to be 790 persons. Other residents live in rural areas of the county primarily south of the MRS and would be considered potential receptors as well. Based on the known current and future uses of the land, the potential air migration pathway receptors at the MRS would be current and future residents, construction workers, commercial and industrial workers, site visitors, recreational users, and ecological receptors. These receptors could be exposed to surface soil through inhalation of re-suspended particulate matter through the air migration pathway. The CSEM is presented in Appendix J.

5.5.5.4 Air Sample/Monitoring Locations and Methodologies

Air sampling was not conducted at this MRS during the SI.

5.5.5.5 Air Migration Pathway Analytical Results

Air sampling was not conducted at this MRS during the SI.

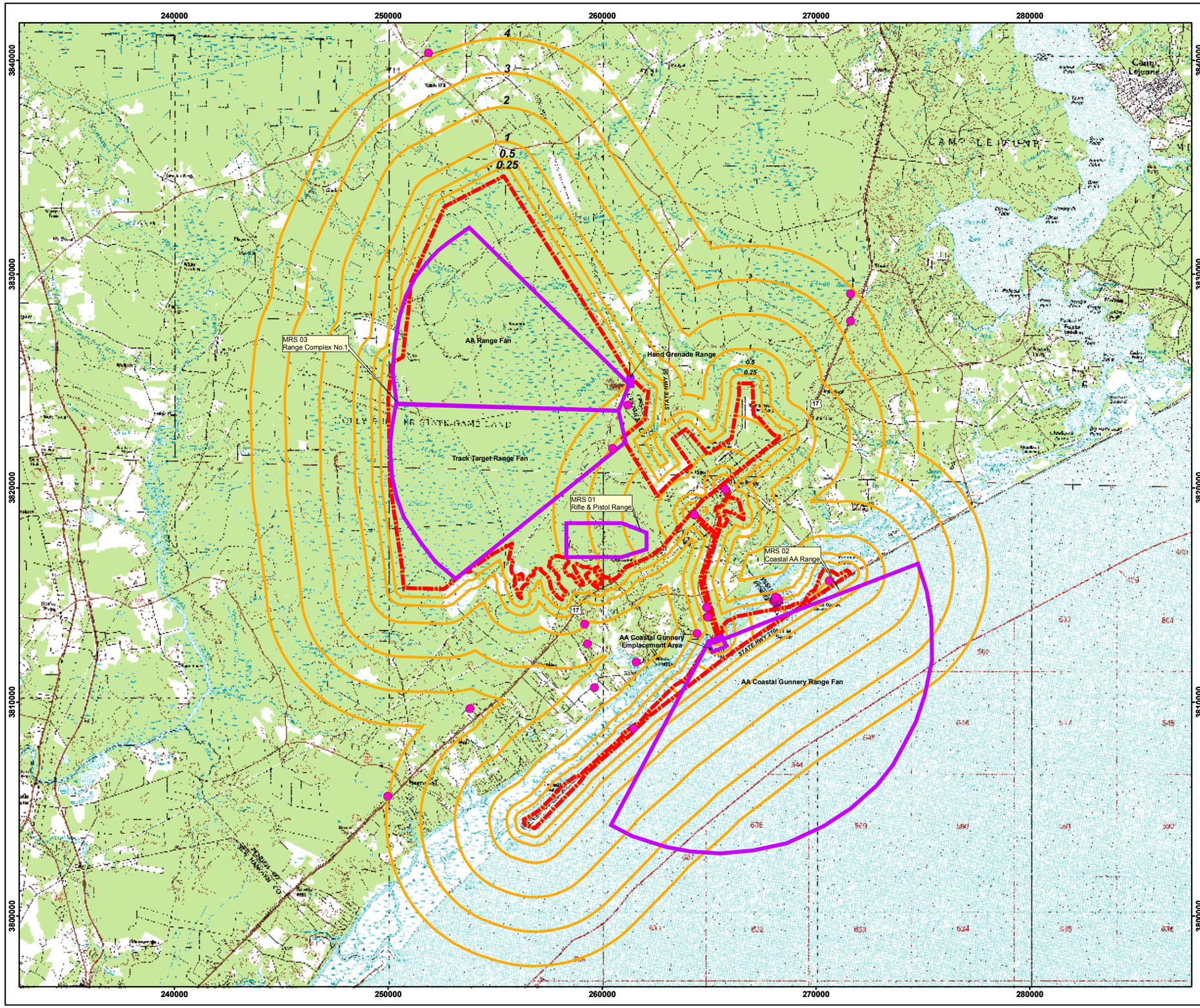
5.5.5.6 Air Migration Pathway Conclusions

As discussed in Subchapter 5.5.4.6, five MC analytes were detected above background concentrations in the surface soil samples collected from the site and, therefore, potential MC contamination may be present. 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.

Figure 5.1

Water Wells within 4-Mile Buffer Camp Davis

Holly Ridge, North Carolina



Legend

- Water Well Location
- Buffer (Mile)
- Approximate MRS Boundary
- Approximate Site Boundary

AA = Anti-Aircraft

Site Location in North Carolina

Image Source: USGS Topos, 1991
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

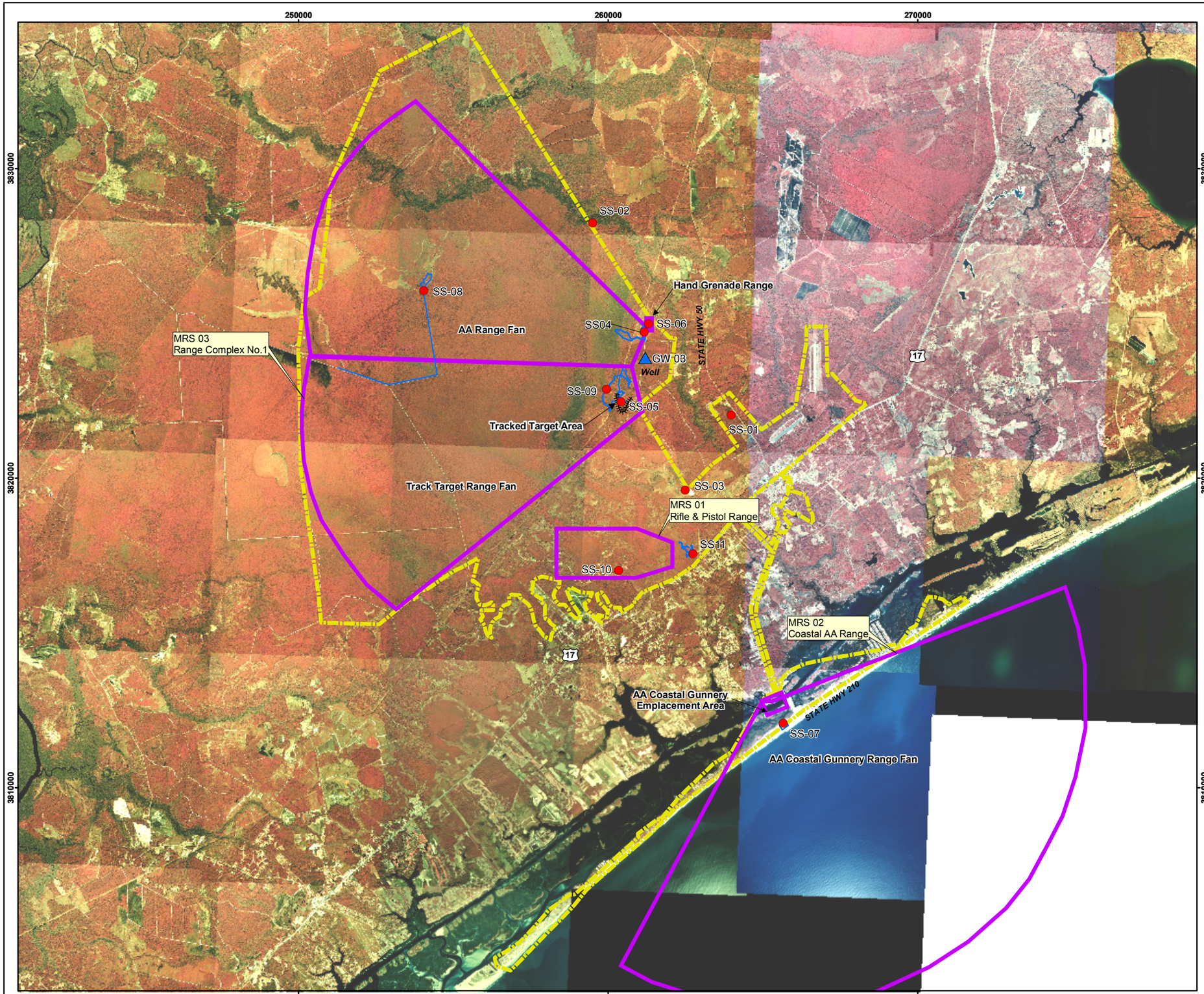
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Water Wells within 4-Mile Buffer**		
DRAWN BY: BT			
CHECKED BY: SC	SCALE: As Shown	PROJECT NUMBER: 744647.32000	
SUBMITTED BY: DS	DATE: June 2008	PAGE NUMBER: 5-36	
	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\ Fig5_1.mxd		

Figure 5.2

Qualitative Reconnaissance and Sample Locations Camp Davis

Holly Ridge, North Carolina



Legend

- Ground Water Sample Location
- Soil Sample Location
- Approximate MRS Boundary
- Approximate Site Boundary
- Qualitative Reconnaissance Track
- Tracked Target Area

AA = Anti-Aircraft

Note: Water sample locations to be determined.

Site Location in North Carolina

Image Source: 1998 Orthophotos
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

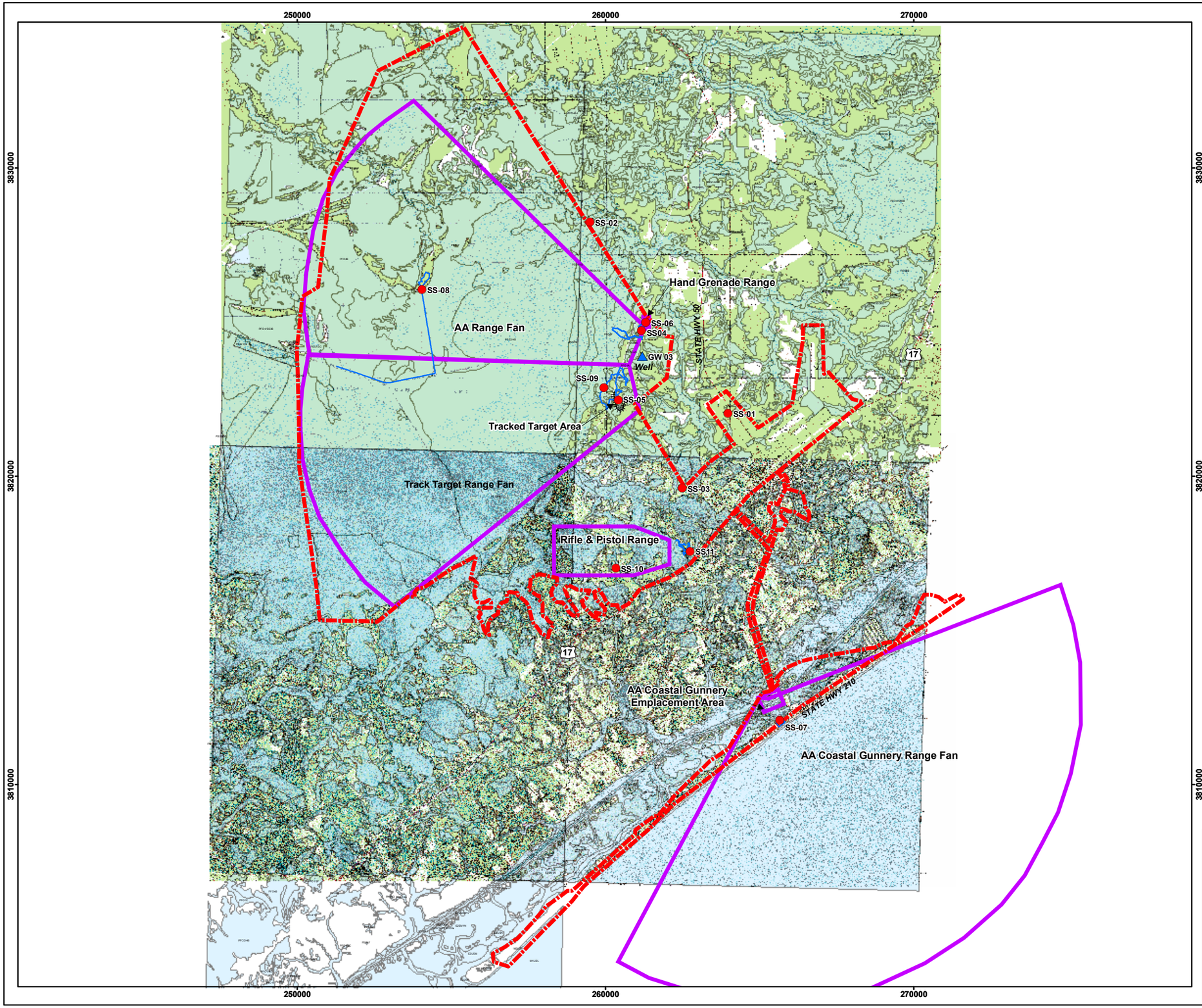
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Qualitative Reconnaissance and Sample Locations**	
DRAWN BY: BT	SCALE: As Shown	PROJECT NUMBER: 744647.32000
CHECKED BY: SC	DATE: June 2008	PAGE NUMBER: 5-37
SUBMITTED BY: DS	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\Fig5_2.mxd	

Figure 5.3

Wetlands
Camp Davis

Holly Ridge, North Carolina



Legend

- Ground Water Sample Location
- Soil Sample Location
- Approximate Range Boundary
- Approximate Site Boundary
- Approximate Qualitative Reconnaissance Track
- Tracked Target Area
- Wetland (Obtained from U.S. Fish & Wildlife Service)

Predominant Wetland Types:

PFO3/4 B-Palustrine, Forested, Broad-Leaved or Needle-Leaved Evergreen, Saturated
PSS1/3 B-Palustrine, Scrub-Shrub, Broad-Leaved Deciduous or Broad-Leaved Evergreen, Saturated
PSS 3/4 A-Palustrine, Scrub-Shrub, Broad-Leaved or Needle-Leaved Evergreen, Temporarily Flooded

AA = Anti-Aircraft

Note: Water sample locations to be determined.

Site Location in North Carolina

Image Source: USGS 7.5' Topo Quadrangles, 1970
Projection: UTM Zone 18 NAD83, Map Units in Meters

2 1 0 2 Miles

10,000 5,000 0 10,000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Wetlands	
DRAWN BY: BT		
CHECKED BY: KB	SCALE: As Shown	PROJECT NUMBER: 744647.32000
SUBMITTED BY: DS	DATE: June 2008	PAGE NUMBER: 5-38
	FILE: X:\GIS\Site_inspections_ne\Maps\davis_NC\Fig5_3.mxd	

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 the former Camp Davis, 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 former the Camp Davis. 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 a 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 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 the former Camp Davis 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 – MRS01 – Rifle & Pistol Range

6.1.4.1 Site Inspection activities for the Rifle & Pistol Range MRS were conducted on November 15, 2007. Site observations for the inspection of the MRS included the following:

- One piece of MD was noted in a soil berm to one of four target backstops for the Rifle & Pistol Range. The sole piece of MD is believed to be an expended .45 Caliber slug. The condition of the item was so mangled a positive identification was not made.
- A total of four concrete backstops were identified as being part of the Rifle & Pistol Range. Each backstop is approximately 600 feet in length and approximately 10 feet high. Sandy soil was placed along the front edge of the backstops to slow the progress of small arms once fired. Much of this soil has been removed and young tree saplings and other forms of vegetation have now grown over the backstops.
- No documented findings of munitions were noted in this and studies previously conducted.
- The presence of small arms ammunition has been confirmed and evidence, such as the concrete backstops and historical description of the MRS, suggests that no other types of munitions were used or are present at the Rifle & Pistol Range. Based on the known use of the range and finding of the QR, no MEC is believed to occur at this MRS.

6.1.4.2 Historical Munitions Use:

- From the previous studies conducted for the Rifle & Pistol Range, munitions used included general small arms of the World War II Era. Records indicating the exact munitions use at this range have not been found, it is assumed that munitions used at the Rifle & Pistol Range MRS include .22 Caliber, .30 Caliber, .38 Caliber, .45 Caliber and possibly .50 Caliber munitions.

- Findings from either previous conducted site inspections or the November 2007 SI did not indicate any other munitions types compared to the above listed items.
- Other than the propellant charge for these munitions, no explosives or explosively hazardous components are known to exist for these items. It is anticipated that the munitions found at this MRS have all been expended and therefore no explosives hazards would exist with these present munitions.
- From the above listed use, the MRS is designated "Small arms only" as summarized in Table 6.2.

6.1.4.3 Physical Description of the Rifle & Pistol Range MRS:

- MRS01 is located entirely within the FUDS property boundary. The MRS is situated immediately north (less than one mile) of North Carolina Highway 17. Land along the MRS boundary is owned/maintained by various owners or agencies. The area where the firing line was situated, along with the concrete bunkers, is on land that is owned by a privately maintained airport. Land further downrange is either residentially owned (comprised of 20 to 30 home sites) or the state owned Holly Shelter Game Lands. The Holly Shelter Game Lands are comprised of natural forest lands and pocosin swamp.
- Access to the MRS is limited by the heavy vegetation of the pocosin and fence lines along the home sites but is still somewhat accessible.
- Based on the information above and referencing Table 6.2 the "Site Accessibility" for the Rifle & Pistol Range MRS is classified as "Accessible."

6.1.5 Munitions and Explosives of Concern Risk Assessment – MRS02 - Coastal Anti Aircraft Range

6.1.5.1 Site Inspection activities for the Coastal Anti-Aircraft Range MRS were conducted on November 13, 2007. Site observations for the inspection of the MRS included the following:

- The land portion of the MRS is almost completely developed. Home sites, most of which are vacation homes, cover the area. The beach along the Atlantic coast is open and maintained by the town of Surf City or the State.
- No MEC or MD were noted and no historical findings of munitions are known and are likely non-existent, as the area was used as a firing point. A wood garage-like structure approximately 50 years in age still stands, located approximately 400 feet off the beach. This building was believed to have been used by the military during the time when Camp Davis was active.
- The historical description of the MRS strongly suggests munitions were fired from the land portions of the Coastal Anti-Aircraft Range. The area has been extensively residentially developed since camp closure, with no reported

findings of MEC/MD. Based on the known use of the land portion of this range, lack of historical findings of MEC/MD and the finding of the QR, no MEC is believed to occur at this MRS.

6.1.5.2 Historical Munitions Use:

- From the previous studies conducted for the Coastal Anti-Aircraft Range, munitions used may have included artillery rounds of the World War II Era. Records indicating the exact munitions use at this range have not been found. It is assumed that munitions used at the Coastal Anti-Aircraft Range MRS include .37mm, 40mm, 3-inch, 90mm, 105mm and 155mm projectiles. Rounds may have been practice munitions in which a spotting charge and a propellant were used. High explosive (HE) rounds may have also been used, but not considered likely, as targets were reported to have been pulled by aircraft. Use of the land portion of the range was as a gun emplacement; therefore, it is assumed that rounds were fired from this area, and any rounds not fired would have been returned to their point of issue.
- Findings from either previous conducted site inspections or the November 2007 SI did not indicate any other munitions types compared to the above listed items.
- From the above listed use, the MRS is designated "Potentially Hazardous" as summarized in Table 6.2, although use of the land portion for firing only would make this designation extremely remote. Lack of findings of MEC or MD since closure and extensive development corroborates this assumption.

6.1.5.3 Physical Description of the Coastal Anti-Aircraft Range MRS:

- MRS02 is located along the southernmost portion of FUDS property boundary and is situated on a barrier island along the Atlantic Coast of North Carolina. The southern tip North Carolina Highway 50 passes through the land portion of the MRS. Land along the MRS is now very well developed for residential use. Many of the home sites are used as vacation homes and not occupied during the winter months. Beach front land is owned and maintained by local and state agencies.
- Access to the MRS is open and very accessible.
- Based on the information above and referencing Table 6.3, the "Site Accessibility" for the Coastal Anti-Aircraft Range MRS is classified as "Accessible."

6.1.6 Munitions and Explosives of Concern Risk Assessment – MRS-03 Range Complex No.1

6.1.6.1 Site Inspection activities for the Range Complex No.1 MRS were conducted on November 14 through 16, 2007. Site observations for the inspection of the MRS included the following:

- The land portion of the MRS is essentially made up of natural lands consisting of pocosin swamp and hardwood and/or pine forests. Some of the lands, especially along the east, are privately owned by hunt clubs or utilized for timber production. The western two-thirds of the MRS are state game lands.
- During the QR, one full .30 Caliber munition was found along with three expended small arms munitions. Two .22 Caliber rounds were found at the base of an earthen berm, apparently a backstop for small arms training, and a .50 Caliber slug was found at the same position as was the full.30 Caliber munition. A clip to a .30 Caliber firing belt was also found in the same place. The full .30 Caliber round was called in to the local sheriff's department, who removed the item from the site for disposal. A practice 37mm expended round was found staged at a bunkhouse for one of the hunt clubs. The round was determined by the UXO technician to be a practice round and inert.
- The historical description of the MRS indicated that the range was used for anti-aircraft training. Gun emplacements were situated along the eastern part of the range with firing conducted in a western direction. The northern half of the MRS consisted of an Anti-Aircraft Range and the southern half was used as a Track Target Range. The range safety fan for both ranges extends to approximately seven miles to the west of the gun emplacement areas. No historical findings of MEC or MD exist for the Anti-Aircraft Range. For the Track Target Range, interviews with local residents and workers have indicated the presence of .50 caliber munitions along with 37mm and 40mm artillery rounds. It was not determined if the found small arms munitions were expended or if the artillery rounds were practice or HE rounds. A USACE site inspection team conducting the ASR and site visit had also reported finding practice .50 Caliber munitions. A Hand Grenade Court was also located within the Range Complex and was reportedly placed along the northern edge of the Anti-Aircraft Range and near the firing line of the range. This area was inspected as well, and the full .30 Caliber and the expended .50 Caliber munitions were found in this area. Historical findings along the Hand Grenade Court include grenade fragments and fuze heads. Based on the known use of the Range Complex No.1 MRS, historical findings of MEC/MD and the finding of the QR, MEC is believed to potentially occur at this MRS.

6.1.6.2 Historical Munitions Use:

- From the previous studies conducted for the Range Complex No.1, munitions used may have included artillery rounds of the World War II Era. Records indicating the exact munitions use at this range have not been found. It is possible that munitions used at the Range Complex No.1 MRS include .30 and .50 Caliber small arms munitions and 37mm and 40mm projectiles, both practice and HE, some of these rounds may have also included the use of

tracers. Additionally hand grenades were reportedly used in the form of practice and fragmentation.

- Findings from both previous conducted site inspections and the November 2007 SI did not indicate any other munitions types compared to the above listed items.
- From the above listed use, the MRS is designated "Potentially Hazardous" as summarized in Table 6.

6.1.6.3 Physical Description of the Range Complex No.1 MRS:

- MRS03 is located entirely within the FUDS property boundary. The MRS is situated immediately north of North Carolina Highway 17 and east of Highway 50. Camp LeJeune Marine Corps Base borders the MRS to the east. Land along the MRS boundary is owned/maintained by various owners or agencies. The area where the firing line to both the Track Target and the Anti-Aircraft Ranges is on land that is privately owned hunting clubs or property that is currently being timber harvested. MRS land further west and along the main portion of the range impact areas is state owned Holly Shelter Game Lands. The Holly Shelter Game Lands are comprised of natural forest lands and pocosin swamp. No residential holdings are known to occur within this MRS although many home sites occur immediately to the south and west of the area.
- Access to the MRS is limited by the heavy vegetation of the pocosin and locked gates along the hunting club roads but is still somewhat accessible. State game lands are open to the public but again the pocosin limits access to much of the site.
- Based on the information above and referencing Table 6.3 the "Site Accessibility" for the Rifle & Pistol Range MRS is classified as "Accessible."

6.1.7 Risk Summary

6.1.7.1 The qualitative MEC risk evaluation for the former Camp Davis is summarized in Table 6.4.

Table 6.4
MEC Risk Evaluation
Former Camp Davis

MRS	MEC Presence	MEC Type [1]		Site Accessibility	Further Evaluation?
MRS01 - Rifle & Pistol Range	Small Arms use only	Small arms ammunition, general	Small Arms only	Accessible	No
MRS02 - Coastal Anti-Aircraft Range	No evidence of MEC nor expected presence	Cartridge, 37mm, HE (M63) and TP-T (M54) Cartridge, 40mm, TP-T (M81) and AP-T (M91) Shell, 3-ich, fixed, practice, M42B2 Cartridge, 90mm, TP, M71 Cartridge, 90mm, AP-T, M77 Shell, 105mm, Practice, M38A1 Shell, 155mm, Practice, M101	Potentially Hazardous	Accessible	No
MRS 03 - Range Complex No.1	Confirmed or suspected	Cartridge, 37mm, HE (M63) and TP-T (M54) Cartridge, 40mm, TP-T (M81) and AP-T (M91) Hand Grenade, frag, Mk2/Mk2A1 Hand Grenade, Practice, M21 Small arms ammunition, general	Potentially Hazardous	Accessible	Yes

1/ Where multiple MEC items were used at an MRS, the item which poses the greatest risk to public health is listed for purposes of this risk assessment.

6.1.7.2 Based on this qualitative MEC risk evaluation, there is the possibility that human receptors might come into contact with explosively hazardous MEC at MRS 03. Therefore, there is the potential for an explosive safety risk at this MRS. Based on this qualitative MEC risk evaluation, no explosive hazards remain at MRS 01 and MRS 02 and, therefore, no explosive safety risk is considered to be present at these MRSs.

6.2 MC HUMAN HEALTH SCREENING LEVEL RISK ASSESSMENT

6.2.1 Conceptual Site Model

Potential human receptors for Camp Davis include current and future residents, construction workers, commercial or industrial workers, site visitors, and recreational users. The MC CSEM identified affected media, transport mechanisms, exposure routes, and potential receptors. CSEMs developed for the three MRSs are included in Appendix J.

6.2.2 Affected Media

Direct release of MC from munitions activities at the site would have been to surface soil. Migration of MC is possible from surface soil to groundwater through leaching, or to surface water and sediment through runoff or erosion. Based on decisions made at the TPP meeting, one groundwater sample and one duplicate, and eight biased and three ambient surface soil samples and two duplicates were collected during the SI at Camp Davis. The TPP Team also agreed that if MC contamination was detected during the SI, then further sampling may be recommended during a subsequent RI/FS phase.

6.2.3 Screening Values

The SLRA surface soil and groundwater human health screening values were selected by the TPP Team for this SI. The soil screening values used were the more stringent of the NCDENR Hazardous Waste Section (HWS) SSLs and the USEPA Region 9 Residential PRGs (dated October 2004 and revised December 28, 2004) as identified in Table 4.5a of the SS-WP (Parsons, 2007). The groundwater screening values used for this SI were the more stringent of the NCDENR Groundwater Protection Standards (North Carolina Administrative Code [NCAC] Title 15, Subchapter 2L) and the USEPA Region 9 PRGs for Tap Water (dated October 2004 and revised December 28, 2004), as identified in Table 4.5b of the SS-WP (Parsons, 2007).

6.2.4 MRS Risk Characterization

6.2.4.1 To complete the risk characterization for the three MRSs of the Camp Davis site, the maximum detected concentration of each MC analyte retained for consideration in the SLRA in Chapter 5 (Tables 5.6, 5.7, 5.8, and 5.9) was compared to the screening values described above. For an analyte to be considered as a possible health concern related to a release from munitions activities at the site, 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.

6.2.4.2 The following subchapters evaluate the Camp Davis MRSs and any potential effects on human health.

6.2.5 MRS01 - Rifle & Pistol Range

6.2.5.1 Groundwater, surface water, sediment, and air samples were not collected during this SI at the MRS01 – Rifle & Pistol Range; therefore, these pathways were not evaluated in the SLRA. Two surface soil samples (CD-MRS01-SS-02-10 and CD-MRS01-SS-02-11) were collected at the Rifle & Pistol Range MRS and analyzed for selected metals. As shown in Table 5.6, three MC analytes (antimony, copper, and lead) were detected above the selected background concentration in the surface soil samples analyzed. A SLRA is presented in Table 6.5 for the three retained analytes for this MRS.

Table 6.5
MRS01 - Rifle & Pistol Range
Surface Soil Screening Level Human Health Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Human Health Screening Values Residential Soil		Exceeds Screening Level?
Metals					
Antimony	mg/kg	0.54	5.4	a	No
Copper	mg/kg	56	700	a	No
Lead	mg/kg	400	270	a	**Yes**

a - NCDENR Hazardous Waste Section "Guidelines for Establishing Remediation Goals at RCRA Hazardous Waste Sites", dated May 2005

b - USEPA Region 9 PRGs revised 28 December 2004

6.2.5.2 As shown in Table 6.5, of the three MC metals that exceeded background, one metal (lead) exceeded the human health North Carolina SSL. The lead concentration matched the Region 9 PRG (400 mg/kg). Therefore, based on the analytical results presented in this report, an unacceptable human health risk from this metal is possible through exposure to groundwater that may have been contaminated by leaching of MC from the surface soil at MRS01 – Rifle & Pistol Range.

6.2.6 MRS02 - Coastal Anti Aircraft Range

6.2.6.1 Groundwater, surface water, sediment, and air samples were not collected during this SI at the MRS02 – Coastal Anti-Aircraft Range; therefore, these pathways were not evaluated in the SLRA. One surface soil sample CD-MRS02-SS-02-07 was collected at the Coastal Anti-Aircraft Range MRS and analyzed for metals and explosives. No explosives were detected in the soil samples collected. As shown in Table 5.7, three MC analytes (barium, nickel. and strontium) were detected above the

selected background concentration in the surface soil samples analyzed. A SLRA is presented in Table 6.6 for the three retained analytes for this MRS.

Table 6.6
MRS02 -Coastal Anti-Aircraft Range
Surface Soil Screening Level Human Health Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Human Health Screening Values Residential Soil		Exceeds Screening Level?
Metals					
Barium	mg/kg	8.3	8.5	a	No
Nickel	mg/kg	1.2	56	a	No
Strontium	mg/kg	0.03	47,000	b	No

a - NCDENR Hazardous Waste Section "Guidelines for Establishing Remediation Goals at RCRA Hazardous Waste Sites", dated May 2005

b – USEPA Region 9 PRGs revised 28 December 2004

6.2.6.2 The maximum detected concentrations of barium, nickel, and strontium did not exceed the screening values. Therefore, an unacceptable human health risk from metals or explosives is not expected through exposure to the surface soil at MRS02 - Coastal Anti-Aircraft Range. .

6.2.7 MRS03 - Range Complex No. 1

6.2.7.1 Surface water, sediment, and air samples were not collected during this SI at the MRS03 – Range Complex No.1; therefore, these pathways were not evaluated in the SLRA.

6.2.7.2 Five surface soil samples (CD-MRS03-SS-02-04, CD-MRS03-SS-02-05, CD-MRS03-SS-02-06, CD-MRS03-SS-02-08 and CD-MRS03-SS-02-09) and two duplicate samples (CD-MRS03-SS-02-12 and CD-MRS03-SS-02-13) were collected at the Range Complex No.1 MRS and analyzed for metals and explosives. No explosives were detected in the soil samples collected. As shown in Table 5.9, five MC analytes (barium, copper, molybdenum, nickel, and strontium) were detected above the selected background concentration in the surface soil samples analyzed. A SLRA is presented in Table 6.7 for the five retained analytes for this MRS.

Table 6.7
MRS03 – Range Complex No.1
Surface Soil Screening Level Human Health Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Human Health Screening Values Residential Soil		Exceeds Screening Level?
Metals					
Barium	mg/kg	12	8.5	a	**Yes**
Copper	mg/kg	37	700	a	No
Molybdenum	mg/kg	0.28	390	b	No
Nickel	mg/kg	2.6	56	a	No
Strontium	mg/kg	0.064	47000	b	No

a - NCDENR Hazardous Waste Section "Guidelines for Establishing Remediation Goals at RCRA Hazardous Waste Sites", dated May 2005

b - USEPA Region 9 PRGs revised 28 December 2004

6.2.7.3 The maximum detected concentrations of copper, molybdenum, nickel, and strontium did not exceed the screening values. Therefore, an unacceptable human health risk from these five metals or explosives is not expected through exposure to the surface soil at MRS03 – Range Complex No.1. The maximum detected concentration of barium exceeds the North Carolina SSLs. It does not exceed the Region 9 PRG (5400mg/kg for direct exposure). Therefore, an unacceptable human health risk from this metal is possible through exposure to groundwater that may have been contaminated by leaching of MC from the surface soil at MRS03 – Range Complex No.1.

6.2.7.4 One groundwater sample CD-MRS03-GW1 and one duplicate CD-MRS03-GW2 were collected at a well GW1 located along the eastern portion of the Range Complex No.1 MRS. Groundwater samples were analyzed for metals, explosives, and perchlorate. No explosives or perchlorate were detected in the groundwater samples collected. As shown in Table 5.8, four MC analytes (barium, copper, lead and nickel.) were detected in the groundwater samples analyzed. A SLRA is presented in Table 6.8 for the four retained analytes for this MRS.

Table 6.8
MRS03 – Range Complex No.1
Groundwater Screening Level Human Health Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Human Health Screening Values Groundwater		Exceeds Screening Level?
Metals					
Barium	µg/L	56	2000	a	No
Copper	µg/L	3.7	1000	a	No
Lead	µg/L	0.77	15	a	No
Nickel	µg/L	1.4	100	a	No

a - NCDENR Groundwater Protection Standards as specified in 15A N.C.A C 2L.0200 (dated May 2005)

6.2.7.5 The maximum detected concentrations of barium, copper, lead, and nickel did not exceed the risk-based human health screening values. Therefore, based on the analytical results presented in this report, an unacceptable human health risk from metals or explosives is not expected through exposure to the groundwater at MRS03 – Range Complex No.1.

6.2.8 Discussion

Three MRSs were identified at the former Camp Davis site. Sampling for MC at the Camp Davis site included surface soil and groundwater. No explosives or perchlorate were detected in any of the surface soil and groundwater samples collected when analyzed. None of the groundwater results exceeded human health risk-based screening levels. None of the surface soil results exceeded Region 9 human health risk-based screening levels. The only MC analytes detected in surface soils that exceeded North Carolina soil screening levels involved lead and barium. The lead SSL exceedance was in surface soils at MRS01-Rifle & Pistol Range. The barium SSL exceedance was in surface soils at MRS03 – Range Complex No.1. Therefore, an unacceptable human health risk from this metal is possible through exposure to groundwater that may have been contaminated by leaching of MC from the surface soil at MRS01-Rifle & Pistol Range and MRS03 – Range Complex No.1.

6.3 MC ECOLOGICAL SCREENING LEVEL RISK ASSESSMENT

The majority of the former Camp Davis land is controlled by the state of North Carolina as a wildlife management and wetland area. Other land uses include a private airport, residential, and private interests (primarily agriculture). According to the USFWS, there are 46 federally-listed threatened and endangered species or state-listed threatened species that may be present in the state of North Carolina, of which ten species potentially exist at the Camp Davis site. Habitat for the ten species is potentially present at the site (USFWS, 2006b). The Holly Shelter Game Land has been designated as a

Significant Natural Area by the North Carolina Natural Heritage Program. Therefore, the Camp Davis site is considered to be an important ecological place.

6.3.1 Conceptual Site Model

Based on the information available, Camp Davis is an important ecological place and ecological receptors may come in contact with a source of contamination through direct or indirect exposure. The MC CSEM identified impacted media, transport mechanisms, exposure routes, and potential receptors. CSEMs developed for the three MRSs located on the FUDS are included in Appendix J.

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 will 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 that can be identified is to protect individuals of the listed species that are present on site.

6.3.3 Affected Media

6.3.3.1 The direct release of MC from munitions activities at the site would likely be primarily to surface soil. If there were releases of MC to surface soil as a result of the munitions-related activities, contaminants could migrate to surface water and sediment via runoff and erosion. The MC in the surface soil can also become airborne in fugitive dust.

6.3.3.2 Surface soil is expected to act as an indicator of potential contamination. Activities at the site would be expected to release MC directly to surface soil, and result in the highest concentrations in the soil. Thus the absence of MC in surface soil would likely indicate an absence of contamination in other media. Surface water and sediment were present at the site and were not sampled during this SI as directed by the TPP Team. 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. Therefore, the groundwater exposure pathway is incomplete for ecological receptors.

6.3.4 Screening Values

The ecological screening values for this SI are the ecological screening values as specified in the Final PSAP Addendum (Parsons, 2006a).

6.3.5 Ecological Risk Characterization

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 Screening Level Ecological Risk Assessment (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. An ecological risk due to exposure to explosives is not considered to be present at this site since no explosives were detected in any samples collected from the site.

6.3.6 MRS01 - Rifle & Pistol Range

6.3.6.1 Surface water, sediment, and air samples were not collected during this SI at the MRS01 – Rifle & Pistol Range; therefore, these pathways were not evaluated in the SLERA. Two surface soil samples (CD-MRS01-SS-02-10, and CD-MRS01-SS-02-11) were collected at the Rifle & Pistol Range MRS and analyzed for selected metals. As shown in Table 5.6, three MC analytes (antimony, copper, and lead) were detected above the selected background concentration in the surface soil samples analyzed. A SLRA is presented in Table 6.9 for the three retained analytes for this MRS.

Table 6.9
MRS01 - Rifle & Pistol Range
Surface Soil Screening Level Ecological Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Soil Ecological Screening Values		HQ
Metals					
Antimony	mg/kg	0.54	0.3	a	1.8
Copper	mg/kg	56	40	a	1.4
Lead	mg/kg	400	16	a	25.0

a - Final Programmatic Sampling and Analysis Plan Addendum (Parsons, 2006a)

6.3.6.2 As shown in Table 6.9, all of the three MC metals (antimony, copper, and lead) that exceeded background also exceeded the risk-based ecological screening level. The HQs are greater than one. Therefore, based on the analytical results presented in this report, an unacceptable ecological risk from metals is possible through exposure to the surface soil at MRS01 – Rifle & Pistol Range.

6.3.7 MRS02 – Coastal Anti-Aircraft Range

6.3.7.1 One surface soil sample CD-MRS02-SS-02-07 was collected at the Coastal Anti-Aircraft Range MRS and analyzed for metals and explosives. No explosives were detected in the soil samples collected. As shown in Table 5.7, three MC analytes (barium, nickel. and strontium) were detected above the selected background concentration in the surface soil samples analyzed. A SLERA is presented in Table 6.10 for the three retained analytes for this MRS.

Table 6.10
MRS02 -Coastal Anti-Aircraft Range
Surface Soil Screening Level Ecological Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Soil Ecological Screening Values		HQ
Metals					
Barium	mg/kg	8.3	330	a	≤1
Nickel	mg/kg	1.2	38	a	≤1
Strontium	mg/kg	0.030	--		NA

a - Final Programmatic Sampling and Analysis Plan Addendum (Parsons, 2006a)
-- Screening level is not available
NA - Not Applicable

6.3.7.2 An ESV for strontium is not available; therefore, the ecological risk associated with strontium cannot be determined. The maximum detected concentrations of barium and nickel did not exceed ESV and therefore have HQ values of less than one.

The maximum detected site concentration for strontium was 0.03 mg/kg as compared to a background concentration of 0.02 mg/kg. Based on these results, unacceptable ecological risk from MC is not expected due to exposure to surface soil at MRS02 - Coastal Anti-Aircraft Range.

6.3.8 MRS03 – Range Complex No. 1

6.3.8.1 Surface water, sediment, and air samples were not collected during this SI at the MRS03 – Range Complex No.1; therefore, these pathways were not evaluated in the SLERA. Five surface soil samples (CD-MRS03-SS-02-04, CD-MRS03-SS-02-05, CD-MRS03-SS-02-06, CD-MRS03-SS-02-08 and CD-MRS03-SS-02-09) and two duplicate samples (CD-MRS03-SS-02-12 and CD-MRS03-SS-02-13) were collected at the Range Complex No.1 MRS and analyzed for metals and explosives. No explosives were detected in the soil samples collected. As shown in Table 5.9, five MC analytes (barium, copper, molybdenum, nickel, and strontium) were detected above the selected background concentration in the surface soil samples analyzed. A SLERA is presented in Table 6.11 for the five retained analytes for this MRS.

Table 6.11
MRS03 – Range Complex No. 1
Surface Soil Screening Level Ecological Risk Assessment
Camp Davis, Holly Ridge, NC

Analyte	Units	Maximum Detected Site Concentration	Ecological Receptors		
			Soil Ecological Screening Values		HQ
Metals					
Barium	mg/kg	12	330	a	≤1
Copper	mg/kg	37	40	a	≤1
Molybdenum	mg/kg	0.28	2	b	<1
Nickel	mg/kg	2.6	38	a	≤1
Strontium	mg/kg	0.064	--	a	NA

a - Final Programmatic Sampling and Analysis Plan Addendum (Parsons, 2006a)
b – USEPA Region 4 Ecological Screening Value
-- Screening level is not available
NA - Not Applicable

6.3.8.2 An ESV for strontium is not available; therefore, the ecological risk associated with strontium cannot be determined. The maximum detected concentrations of barium, copper, molybdenum, and nickel did not exceed the ESVs and therefore have HQ values of less than one. The maximum detected site concentration as compared to an ambient concentration for strontium was 0.064 mg/kg vs. 0.02 mg/kg, which is a marginal difference. Based on these results, unacceptable ecological risk from MC is not expected due to exposure to surface soil at MRS03 – Range Complex No.1.

6.3.9 Discussion

Three MRSs were identified at the former Camp Davis site. Sampling for MC at the Camp Davis site included surface soil. No explosives or perchlorate were detected in any of the surface soil and groundwater samples collected when analyzed. The only MC analytes detected in surface soils that exceeded ecological screening levels involved antimony, copper and lead at MRS01-Rifle & Pistol Range.

CHAPTER 7
SUMMARY AND CONCLUSIONS

7.1 SUMMARY

7.1.1 Three MRSs were identified and evaluated to determine its potential to cause significant contamination to the environment or to adversely affect human and ecological receptors. The evaluation included the collection of surface soil and groundwater samples as well as the implementation of QR within the MRSs.

7.1.2 During the QR and sampling conducted from November 14 to November 16, 2007, ***no MEC were discovered*** in any of the three MRSs onsite. One entire small arms munition, a .30 Caliber round was found in the Range Complex No.1 MRS along with four pieces of MD in the form of expended small arms and a small arms link. A single 37mm practice artillery round was also found in the Range Complex No.1 MRS, deliberately staged at a hunting club bunkhouse. This type of round was known to have been used at this MRS but was obviously placed at its current position. A single piece (apparent .45 Caliber slug) of MD was found at the Rifle & Pistol Range MRS along with four concrete walls that were obviously used as target backstops by the DoD. No MEC or MD was noted from the inspection of the Coastal Anti-Aircraft Range MRS.

7.1.3 Eight surface soil and one groundwater sample were collected from the three MRSs located on the Camp Davis site and analyzed for metals and explosives. The groundwater sample was also tested for presence of perchlorate. No explosives were detected in any of the samples collected from within the three MRSs nor were perchlorates detected in the groundwater sample. All metals detected above screening levels are constituents of munitions known or suspected to have been used at this site.

7.1.4 For soil samples collected within the Rifle & Pistol Range MRS, three metal analytes (antimony, copper and lead) were detected at levels above their respective screening levels, posing ecological threats, with lead also posing a human health risk. Groundwater and surface water were not analyzed for this MRS and may contain some environmental risk possibly associated with past DoD activity.

7.1.5 No human health or ecological risk was determined from the single soil sample collected from the Coastal Anti-Aircraft Range MRS. Groundwater and surface water were not analyzed for this MRS, and human health and ecological risks, if any, are undetermined. However, human receptors living within this MRS do receive drinking water from an offsite source.

7.1.6 No explosive compounds or metals were determined to pose either a human health or an ecological risk based on soil sample analysis of the MRS. Although four metal analytes were detected in groundwater, there is not an unacceptable human

health from MCs, as the maximum concentration did not exceed the screening values. Surface water and sediment were not analyzed for the MRS and effects of past DoD activity on this media are unknown.

7.2 CONCLUSIONS REGARDING POTENTIAL MUNITIONS AND EXPLOSIVES OF CONCERN EXPOSURE PATHWAYS

An MEC SLRA was conducted based on the QR conducted in the field and historical data regarding previous site visits (Chapter 6). The MEC exposure pathway at the former Camp Davis Range Complex No.1 MRS is ***potentially complete*** due to the historic findings of MD at the site and the historic use of 37mm HE shells. The MEC exposure pathway for both the Rifle & Pistol Range MRS and the Coastal Anti-Aircraft Range MRSs are considered incomplete due to the historic use of small arms and/or inert munitions at both sites and the lack of MEC or MD findings at these sites since DoD closure.

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 No explosive compounds were detected in surface soil or groundwater samples collected from worst-case locations at the three Camp Davis MRSs. From the Risk Assessment of MRS01, the Rifle & Pistol Range displays elevated lead concentrations along one of the four firing berms that are in excess of human health and ecological criteria. Antimony and copper concentrations for the MRS were also slightly in excess of the Hazard Quotients for both metals. No human health or ecological risks were found for the Coastal Anti-Aircraft Range MRS. Groundwater and soil in the Range Complex No.1 MRS showed no concentrations of metals analytes above human health screening criteria and no explosive compounds were detected in these media. No apparent ecological risks based on soils analysis within the Range Complex MRS were noted as well.

7.4 OVERALL CONCLUSIONS

Although no MEC were encountered during this SI, MD with the potential of displaying an explosive hazard (37mm and 40mm projectiles and hand grenades) have been encountered in the Range Complex No.1 MRS since site closure. The area in general is heavily vegetated and difficult to access because of the vegetation. Although the presence of the heavy vegetation limits access to the MRS, it also likely hides other potentially dangerous munitions as well. The potential for future discoveries of MEC is likely. Elevated concentrations of antimony, copper and especially lead pose environmental risks in the Rifle & Pistol Range MRS.

CHAPTER 8
RECOMMENDATIONS

8.1 Based on the November 2007 SI field effort, the analysis results, historical information, and the QR conducted, the following recommendations are made for the Camp Davis site:

8.2 A status of RI/FS is recommended two of the MRSs and include MRS01 – the Rifle & Pistol Range, and MRS03 – Range Complex No.1. A status of NDAI is recommended for MRS02 – the Coastal Anti-Aircraft Range. The supporting evidence for these recommendations is as follows:

- Spent small arms munitions were found in the soil berm to the firing backstop for the ***Rifle & Pistol Range MRS*** along with elevated concentrations of antimony, copper and lead in these soils. Lead in these soils was found well in excess of its health screening criteria and poses both a human health and ecological risk.
- 37mm munitions were found during this SI and 40mm munitions were reported as having been used within the ***Range Complex No.1 MRS***. Possible 37mm HE rounds were used on two of the component ranges to this MRS: the Track Target Range and the Anti-Aircraft Range. Limited use of the lands along this MRS due to the presence of a thickly vegetated pocosin swamp has been a natural barrier to munitions exposure.
- No MC related metals were found in excess of their respective criteria for the ***Costal Anti-Aircraft Range MRS*** and no MEC/MD has been found in this MRS since site closure.

Table 8.1
Recommendations
Camp Davis

MRS	Recommendation	Justification
MRS01 – Rifle & Pistol Range	RI/FS	Antimony, copper and lead present in shallow soil samples above ecological risk levels with lead also in excess of its respective human health criteria for soil.
MRS02 – Coastal Anti-Aircraft Range	NDAI	No historical or present day findings of MEC or MD. No detected MC above human health and ecological risk criteria.
MRS03 – Range Complex No. 1	RI/FS	Historical use and recent findings of a single 37mm projectile (practice). Believed use of 37mm HE and possibly 40mm projectiles. Historical use and past findings of MD relating to use of hand grenades.

CHAPTER 9
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