FINAL
REMEDIAL INVESTIGATION REPORT
FORMER CONWAY BOMBING AND GUNNERY RANGE
HORRY COUNTY, SOUTH CAROLINA
MRS-R01, RANGE II; MRS-R02, RANGE III; MRS-R03, RANGE IV; MRS-R09, MACHINE GUN/RIFLE RANGE
(U.S. ARMY CORPS OF ENGINEERS, CHARLESTON DISTRICT)

Contract W912DY-10-D-0023
Task Order 0018

Prepared for:

U.S. Army Corps of Engineers
U.S. Army Engineering and Support Center, Huntsville

May 2018

This page was intentionally left blank.

FINAL
REMEDIAL INVESTIGATION REPORT
FORMER CONWAY BOMBING AND GUNNERY RANGE
HORRY COUNTY, SOUTH CAROLINA
MRS-R01, RANGE II; MRS-R02, RANGE III; MRS-R03, RANGE IV; MRS-R09, MACHINE GUN/RIFLE RANGE
(U.S. ARMY CORPS OF ENGINEERS, CHARLESTON DISTRICT)

Contract W912DY-10-D-0023
Task Order 0018
FUDS Project I04SC002501R01
FUDS Project I04SC002501R02
FUDS Project I04SC002501R03
FUDS Project I04SC002501R09

Prepared for:
U.S. Army Corps of Engineers
U.S. Army Engineering and Support Center, Huntsville

Prepared by:
HydroGeoLogic Inc.
11107 Sunset Hills Road
Suite 400
Reston, VA 20190

May 2018

Signed: 
Kimberly Vaughn
HGL Project Manager

This page was intentionally left blank.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

This page was intentionally left blank.

LIST OF TABLES

Page

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF APPENDICES

°F	degrees Fahrenheit
%	percent
AAB	Army Air Base
AAF	Army Air Field
ARAR	applicable or relevant and appropriate requirements
ASR	archives search report
ATF	Bureau of Alcohol, Tobacco, and Firearms
BGEPA	Bald and Golden Eagle Protection Act
BGR	Bombing and Gunnery Range
bgs	below ground surface
BLRA	baseline risk assessment
Cd	Cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
cm	centimeter
COC	contaminant of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CWA	Clean Water Act
DERP	Defense Environmental Restoration Program
DGM	digital geophysical mapping
DMM	discarded military munition
DNT	dinitrotoluene
DoD	Department of Defense
DQO	data quality objective
Eco-SSL	ecological soil screening level
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
EM	Engineer Manual
EM CX	Environmental and Munitions Center of Expertise
EODT	EOD Technologies, Inc.
EP	Engineer Pamphlet
ER	Engineer Regulation
ERM	Environmental Resources Management
ESA	Endangered Species Act
ESP	Explosives Site Plan
EZ	exclusion zone
FFAR	Folding-Fin Aircraft Rocket

FS	Feasibility Study
ft	foot/feet
FUDS	Formerly Used Defense Site
FUDSMIS	Formerly Used Defense Site Management Information System
FWV	fieldwork variance
GDB	Oasis Montaj geophysical databases
GIS	geographical information system
GPS	global positioning system
GSV	geophysical system verification
HA	hazard assessment
Hg	Mercury
HGL	HydroGeoLogic, Inc.
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HVAR	high velocity aircraft rocket
Hz	hertz
IAW	in accordance with
IC	institutional control
ID	identification
IS	incremental sampling
ISM	incremental sampling method
ISO	industry standard object
IVS	instrument verification strip
lb	pound
LC_{50}	50 percent lethal concentration
LDC	Laboratory Data Consultants, Inc.
LE	Listed Endangered
LOAEL	lowest observed adverse effect level
LT	Listed Threatened
LUC	land use control
MC	munitions constituent
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MG	Machine Gun
MGFD	munition with greatest fragmentation distance
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mm	millimeter

MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRA	munitions response area
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolts
NDAI	No DoD Action Indicated
NMEA	National Marine Electronics Association
NOAEL	no observed adverse effects level
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
Pb	Lead
PDA	personal digital assistant
PDT	project delivery team
PEL	permissible exposure limit
PRG	preliminary remediation goal
PWS	Performance Work Statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCP	Quality Control Plan
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROE	right-of-entry
RR	Rifle Range
RSL	Regional Screening Level
RTK	real-time kinematic
SAA	Small Arms Ammunition
SCAR	Sub-Caliber Aircraft Rocket
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SE	State Endangered
SI	Site Inspection

SLERA	Screening Level Ecological Risk Assessment
ST	State Threatened
SU	sampling unit
SUXOS	senior unexploded ordnance supervisor
TBC	to-be-considered
TCRA	Time Critical Removal Action
TCT-St. Louis	Twin City Testing – St. Louis
TNB	trinitrobenzene
TNT	trinitrotoluene
TO	task order
TPP	technical project planning
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USAE	USA Environmental
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UTL	upper tolerance limit
UXO	unexploded ordnance
UXOQCS	unexploded ordnance quality control specialist
UXOSO	unexploded ordnance safety officer
VSP	Visual Sampling Plan
WAAS	wide area augmentation system
WERS	Worldwide Environmental Remediation Services
Zn	Zinc

FINAL
REMEDIAL INVESTIGATION REPORT
FORMER CONWAY BOMBING AND GUNNERY RANGE
HORRY COUNTY, SOUTH CAROLINA

1.0 EXECUTIVE SUMMARY

1.1 BACKGROUND

1.1.1 HydroGeoLogic, Inc. (HGL) conducted a Remedial Investigation (RI) for four Munitions Response Site (MRSs) at the former Conway Bombing and Gunnery Range (BGR) located in Horry County, South Carolina. Field activities for the RI were completed by HGL and its subcontractors from August 25, 2015, through May 13, 2016. This RI report describes the investigation conducted at four MRSs within the 55,854-acre Conway BGR Formerly Used Defense Site (FUDS). The Formerly Used Defense Sites Management Information System (FUDSMIS) is a single online database of information for tracking and support of environmental cleanup and restoration projects on FUDS. For continuity with previous investigations, current and previous MRS references and the FUDSMIS Project Numbers are included in **Table 1.1**. The following FUDS projects characterized by this investigation and will be collectively referred to as the "project site":

1) MRS-R01, Range II, approximately 649 acres (FUDS Project No. I04SC002501R01);
2) MRS-R02, Range III, approximately 1,961 acres (FUDS Project No. I04SC002501R02);
3) MRS-R03, Range IV, approximately 888 acres (FUDS Project No. I04SC002501R03);
4) MRS-R09, Machine Gun (MG)/Rifle Range (RR), approximately 2,056 acres (FUDS Project No. I04SC002501R09).

Table 1.1, Current and Previous MRS References

Current RI MRS Reference	2012 EODT RI Reference	EE/CA Reference	Original MRS Reference	FUDS Project No.	FUDSMIS 2014 Reference
MRS-R01	MRS-R01	Area A and Area A-1	Range II	I04SC002501R01	Project 05
MRS-R02	MRS-R02	Area B and Area B-1	Range III	I04SC002501R02	Project 01, Project 08, and Project 09
MRS-R03	MRS-R03	Area C and Area C-1	Range IV	I04SC002501R03	Project 03
MRS-R09	MRS-R09	None	Machine Gun/Rifle Range	I04SC002501R09	Project 07

1.1.2 The location of the project site, the MRS boundaries, and the expanded investigation areas are shown in Figures 1.1 through 1.4. During development of the RI Work Plan, extensive historical research on past investigation and past removal efforts was conducted and added to the project geographical information system (GIS) database to help define the areas needing

investigation to delineate the munitions and explosives of concern (MEC)-contamination boundary. Multiple privately funded removal actions have been performed for various parcels, paid for by private developers, in advance of construction of housing subdivisions. Where possible, the privately funded removal actions reports were obtained by U.S. Army Corps of Engineers (USACE) and by inquiries made to other Contractors. Some landowners have negotiated settlement agreements with the U.S. Government effectively relieving the U.S. Government of liability at these properties. For this reason, the parcels owned by these entities are not included in U.S. Government future response actions. For work conducted by private entities without U.S. Government supervision, the quality of the data cannot be confirmed. However, some of the privately funded work was reviewed by SCDHEC and information was provided to USACE by SCDHEC. Also during development of the RI Work Plan, a preliminary conceptual site model (CSM) for MEC and for munitions constituents (MC) was developed to provide an understanding of the site conditions and identify potential data needs. The preliminary CSM was developed from historical investigation reports, reports of MEC/munitions debris (MD) discovered after site closure, and the potential for source/receptor interaction. Right-of-entry (ROE) refusals prevented HGL's geophysical investigation or intrusive investigation in all planned locations. Portions of all the MRSs were not investigated because of ROE refusals.

1.1.3 As established in the approved work plan (HGL, 2015a), the objective of the RI is to characterize the nature and extent of MEC, and to define a MEC-contamination boundary. An additional objective is to determine if MC contamination is present and collect defensible analytical data to determine the nature and extent of any contamination. HGL has met the objectives of the project site RI and has safely completed the MEC and MC investigation to characterize the project site in accordance with (IAW) the approved data quality objectives (DQOs) as set out in the approved work plan. This characterization is sufficient to identify and evaluate potential MEC and MC contamination and these results will be used to support the Feasibility Study (FS) to identify appropriate remedial alternatives, if necessary.

1.1.4 The RI fieldwork included vegetation clearance and surface clearance of MEC, geophysical surveying, and intrusive investigations conducted where ROE was granted by landowners at MRS-R01, MRS-R02, MRS-R03, and MRS-R09. Surface soil samples also were collected from the project site and analyzed for MC. The field investigation was conducted under the February 2015 Final Work Plan (HGL, 2015a), and all approved fieldwork variances (FWVs) reviewed and approved by the technical project planning (TPP) team, which includes the U.S. Army Engineering and Support Center, Huntsville (USAESCH), USACE Charleston, Wilmington and Savannah Districts, and the South Carolina Department of Health and Environmental Control (SCDHEC).

1.2 MEC CHARACTERIZATION

1.2.1 MEC Explosive Hazards Risk Assessment

1.2.1.1 Three of the four MRSs have an unacceptable risk due to explosive hazards (MRS-R01, MRS-R02, and MRS-R03). Based on the MEC contamination present, an unacceptable risk exists for human receptors to be exposed to explosive hazards at these three MRSs. For the evaluation of MEC explosive hazards, a baseline risk assessment was performed utilizing Risk

Matrices (Appendix K) developed for the proposed delineated MRSs, in accordance with the interim guidance document *Trial Period for Risk Management Methodology at Formerly Used Defense Sites Military Munitions Response Program Projects* (USACE, 2017). This methodology determines if unacceptable risk exists for MEC and aides the development of Remedial Action Objectives to identify remedial action alternatives to be evaluated in the FS. The existing (i.e., baseline) conditions at the three recommended MRSs and the no further action MRS, using the risk matrices are presented in Appendix K. This information will provide the baseline for the assessment of response alternatives to be conducted in the FS.

1.2.2 MEC Contamination Extent

1.2.2.1 The extent of MEC contamination at the four MRSs was determined based on the RI field investigation and evaluation of previous investigation results. As described in Subchapters 5.2.1, 5.2.3, and 5.2.4, MEC contamination was identified in MRS-R01, MRS-R02, and MRS-R03. The RI was conducted IAW the approved Work Plan and to meet the established DQOs (Table 1.1 shows the extent of RI field activities). MEC contamination boundaries were determined within the MRSs and the types of munitions and depths that items may be found were determined. Based on MEC contamination boundaries determined during the RI, the following MRS delineation is proposed:

- MRS-01: 296 acres, the MEC-contaminated area of the former MRS-R01. The remainder of the MRS (353 acres) are recommended for no further action.
- MRS-02: 1,525 acres, the MEC-contaminated area of the former MRS-R02. The remainder of the MRS (436 acres) are recommended for no further action.
- MRS-03: 495 acres, the MEC-contaminated area of the former MRS-R03. The remainder of the MRS (393 acres) are recommended for no further action.
- MRS-R09: No MEC contamination was identified; the portion of MRS-R09 that is not part of the MEC contaminated portion of MRS-R02 should be recommended for no further action.

1.2.2.2 The proposed new MRS-01, MRS-02 and MRS-03 are recommended for further evaluation in the FS. The remainder of each of MRS-R01, MRS-R02 and MRS-R03 are recommended for no further action. The area of MRS-R09 that is not part of the MEC contaminated portion of MRS-R02 is recommended for no further action.

1.2.3 Land Use by MRS

1.2.3.1 The land uses and receptors for each MRS were evaluated and presented in Section 3.1.1 and Section 5.5 summarized that the RI data gathered did not identify any changes to the land uses and receptors previously identified. The current and future land uses for each MRS are:

- MRS-R01, Range II: residential, commercial/industrial and recreational;
- MRS-R02, Range III: residential, commercial/industrial and recreational;
- MRS-R03, Range IV: residential, commercial/industrial (forestry), recreational (hunting) and minor agricultural; and

- MRS-R09, MG/RR: residential, commercial/industrial (forestry), recreational (hunting) and minor agricultural.

1.2.3.2 The receptors present at the four MRSs are identical under the current and potential future land use scenarios and are summarized in Section 3.1.2. The potential activities conducted by receptors include activities from the surface through up to 25-ft bgs.

Table 1.2
Summary of Field Activities Completed by MRS

Item Description	Unit	MRS-R01	MRS-R02	MRS-R03	MRS-R09
Brush Clearance (all Transect types)	Miles	7.74	13.33	3.31	4.03
Overland Mag and Count Transects	Miles	0.64	0.36	0.61	0.28
Wetland Mag and Count Transects	Miles	1.89	1.33	0.51	0.24
Residential Mag and Count Transects	Miles	0.25	0	0	0
Overland DGM Transects	Miles	8.71	7.41	0.31	3.38
Wetland DGM Transects	Miles	5.82	2.19	0.16	0.35
Golf Course DGM Transects	Miles	16.2	0	0	4.82
Characterization DGM Grids	Grids	50	36	28	10
	Equivalent Acres	2.48	2.07	1.61	0.57
Characterization DGM Grids Intrusively Investigated	Grids	47	30	28	10
	Equivalent Acres	2.31	1.72	1.61	0.57
Characterization DGM Grids in Background Areas Intrusively Investigated	Grids	38	30	26	10
	Equivalent Acres	1.79	1.72	1.49	0.57
Background Mag and Dig Transects (4.5-ft)	Miles	7.34	4.5	4.17	0
	Acres	4.00	2.45	2.28	0.00
QC Transects	Miles	0.94	0.26	0.63	0
Background DGM Grids	Grids	12	4	3	8
	Equivalent Acres	2.54	0.75	0.52	1.84
Background Grids Intrusively Investigated*	Grids	12	6	5	8
	Equivalent Acres	2.54	1.08	0.96	1.84
EE/CA DGM Grids Intrusively Investigated in Background Areas	Grids	9	32	59	0
	Equivalent Acres	0.52	1.84	3.39	0.00
Intrusively Investigated Anomalies (within Grids)	Each	688	202	227	162
Incremental Samples / with co-located Discrete Surface Soil Sample	Each	9	10	10	10
Background Sample, for metals	Each	10	10	10	10

*includes analog grids
DGM = digital geophysical mapping
QC = quality control

1.3 MC CHARACTERIZATION AND RISK ASSESSMENT

1.3.1 Munitions Constituents

1.3.1.1 During the RI/FS activities, Incremental Sampling Method (ISM) surface soil samples were collected within the all four MRSs and in background areas and analyzed for explosives and metals. The RI results as well as historical MC sampling investigation were evaluated as part of this RI. No MC was detected at levels constituting a risk to human health or the

environment, indicating there is no MC contamination. The results of the Baseline Risk Assessment (BLRA) for MC are summarized below.

1.3.2 BLRA for MC

1.3.2.1 MC contamination was assessed in surface soil collected from 0 to 0.5 feet (ft) below ground surface (bgs). As discussed in Chapters 5.2, 7.2.3, and 7.2.5. The screening of the analytical results against background concentrations and health-based screening values identified one chemical of potential concern (COPC): cadmium (Cd) in MRS-R02; however, after evaluation the Cd was determined to be no threat to human health under unrestricted land use. The initial screening identified Cd, mercury (Hg), and zinc (Zn) as chemicals of potential ecological concern (COPECs) for MRS-R02; and lead (Pb) and Zn as COPECs for MRS-R09. No COPECs were identified for MRS-R01 and MRS-R03. The Screening Level Ecological Risk Assessment (SLERA) showed that no threats were identified for exposure of ecological receptors to soil in all four MRSs. Based on the information provided in Chapter 7.2, it was concluded that no MC is present on site at levels that present a risk to human health or the environment. Therefore, MC sampling performed during this RI, and during previous investigations, does not indicate a release of MC.

1.4 RI RESULTS AND RECOMMENDATIONS

1.4.1 The conclusions of this RI and the MEC Risk Assessment show that MEC contamination was identified within MRS-R01, MRS-R02 and MRS-R03 and does pose explosive hazards to current and future receptors. No MEC contamination was identified in the portion of MRS-R09 that does not overlap with MRS-R02. The BLRA for MC identified no actionable risk to human or ecological receptors at any of the MRSs.

1.4.2 The site was recommended for future Formerly Used Defense Site Management Information System (FUDSMIS) delineation as proposed for MRS-R01, MRS-R02 and MRS-R03. An unacceptable risk for MEC has been identified at these MRSs and the MRSs are recommended for inclusion in an FS to develop potential remedial alternatives capable of reducing MEC site hazards. No further action for MC is recommended in these MRSs. The southern portion of MRS-R09 that does not overlap with MRS-R02 is an uncontaminated area recommended for no further action for MEC and MC. The collected data and the associated characterization described in this report are considered sufficient to characterize the project site, to identify and evaluate associated potential MEC hazards or MC risks, and to support the recommended FS.

This page was intentionally left blank.

Table 1.3 RI Recommendations

MRS	Recommended MRS Acreage	Potential MEC Hazards	Munitions Identified	Depth of MEC	MC Risk Present	Recommendation
MRS-R01, Range II	296	High	• 100-pound (lb) M38A2 Practice bomb • 20-lb M41 Fragmentation Bomb • 2.25-inch Sub-Caliber Aircraft Rocket (SCAR) • MK1 50-lb Practice Bomb • Small Arms Ammunition (SAA) – 0.50-caliber cartridge	0-5 ft	No	FS for MEC only
MRS-R02, Range III	1,525	High	• 1.1-inch Mark 2 projectile • 100-lb M38A2 Practice Bomb • M48 20-lb Practice Bomb • 5-inch high velocity aircraft rocket (HVAR) Mk 1 • 4-lb Incendiary AN-M54 • 6-lb Incendiary AN-M69X • 250-lb M57 Bomb • practice 2.5-inch rocket • 2.25-inch SCAR • 2.36-inch rocket • 5-inch HVAR, Mk 1 • 5-inch Mk 24 Mod 0 Zuni Rocket • Mk4 2.75-inch Folding-Fin Aircraft Rocket (FFAR) • M16 Smoke Grenade • AN-M110 A1 Bomb Fuze • M63 37mm Projectiles • SAA (0.50-cal casings)	0-6 ft	No	FS for MEC only
MRS-R03, Range IV	495	High	• 4-lb Incendiary AN-M54 • M48 20-lb Practice Bomb • 100-lb M38A2 Practice bomb • Mk4 2.75-inch FFAR	0-3.5 ft	No	FS for MEC only
MRS-R09, Machine Gun (MG)/Rifle Range (RR)	886	Low	• SAA only	N/A	No	No Further Action

This page was intentionally left blank.

FIGURES

This page was intentionally left blank.

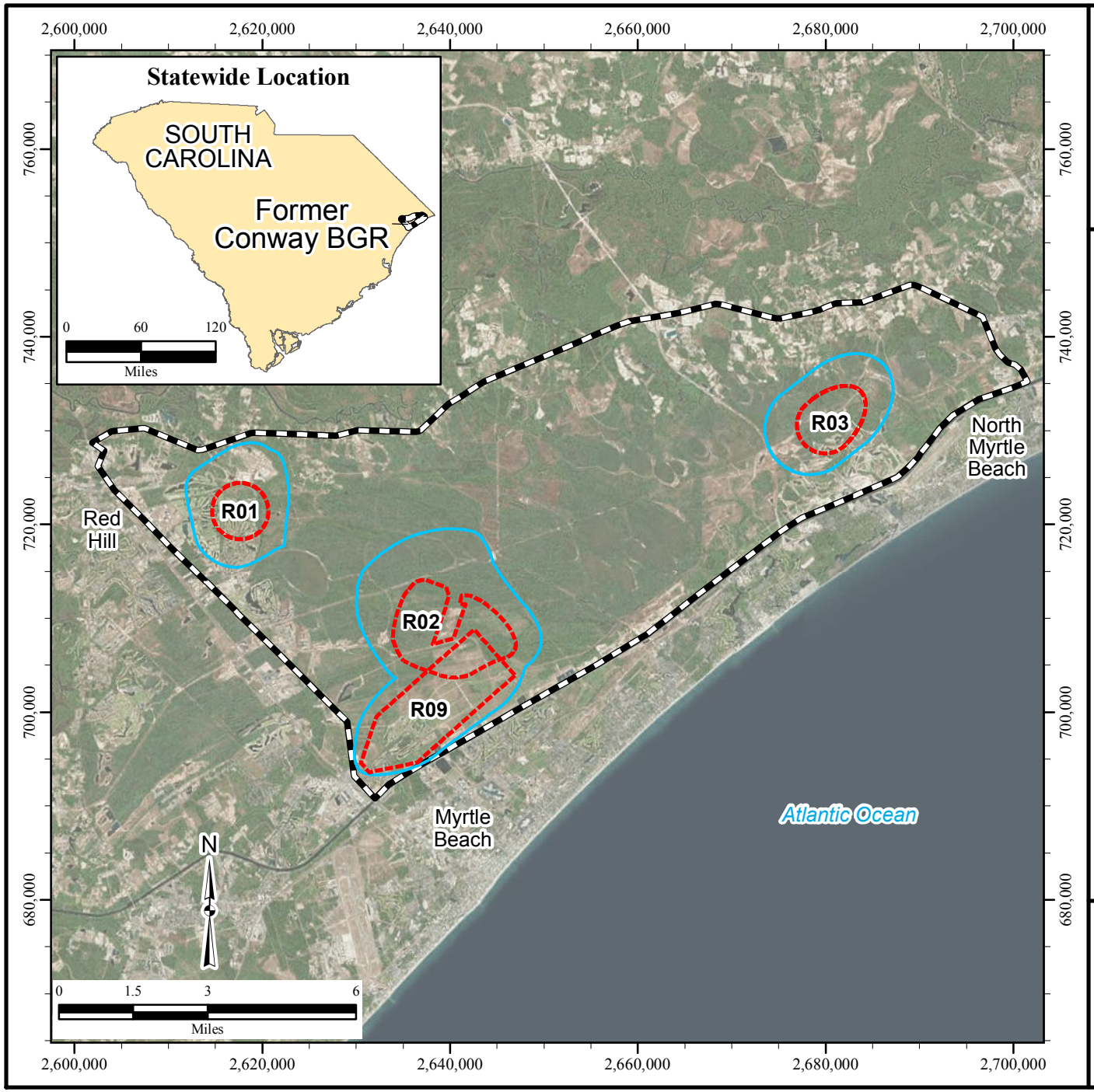


Figure 1.1
General Location
Former Conway BGR

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site
- Expanded Investigation Area

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

BGR=Bombing and Gunnery Range
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(1-01)Site_Locations.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

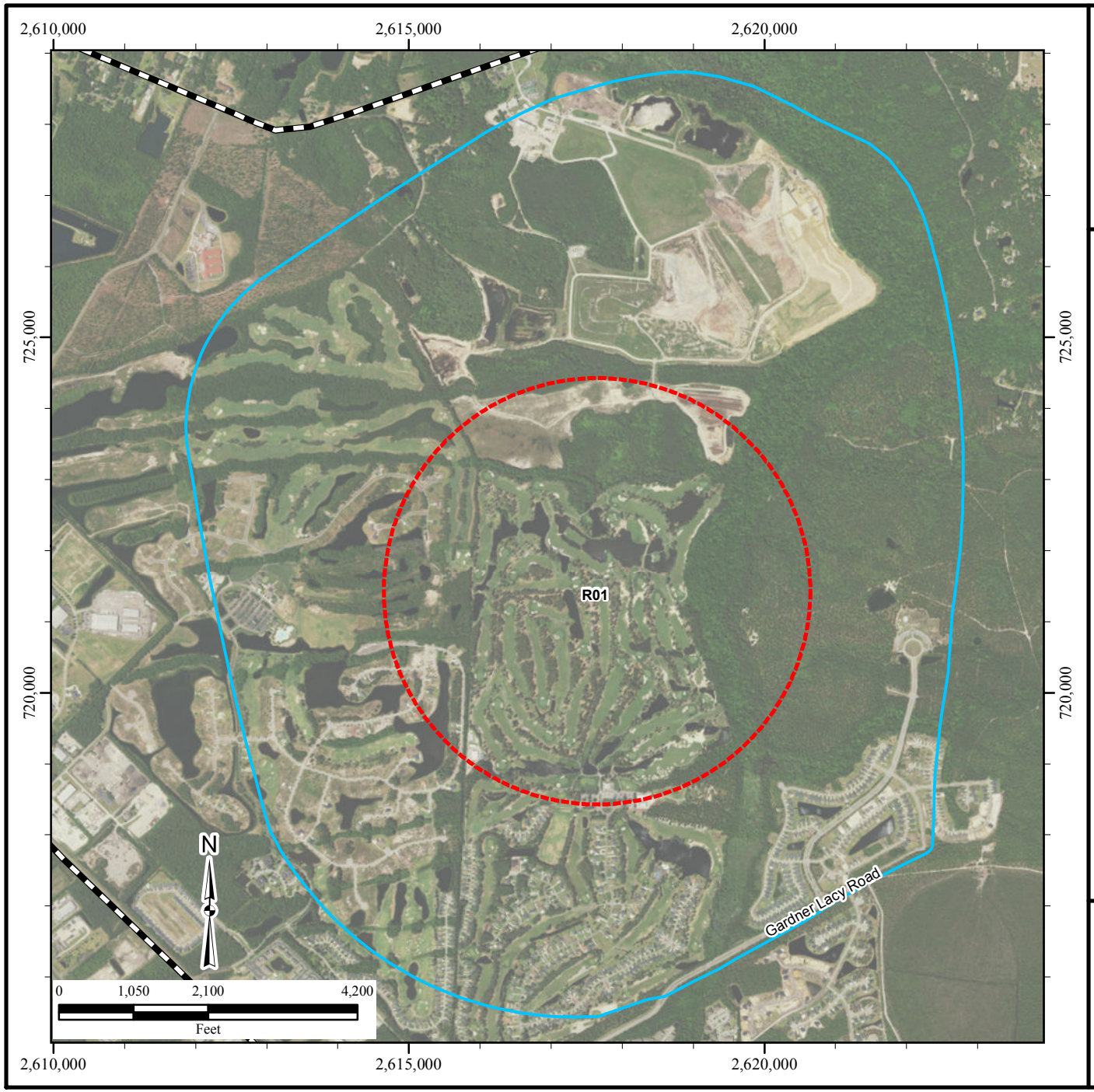


Figure 1.2
MRS-R01
Range II Location

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (649.2 acres)
- Expanded Investigation Area (2,629 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(1-02)R01.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HGL HydroGeoLogic, Inc

This page was intentionally left blank.

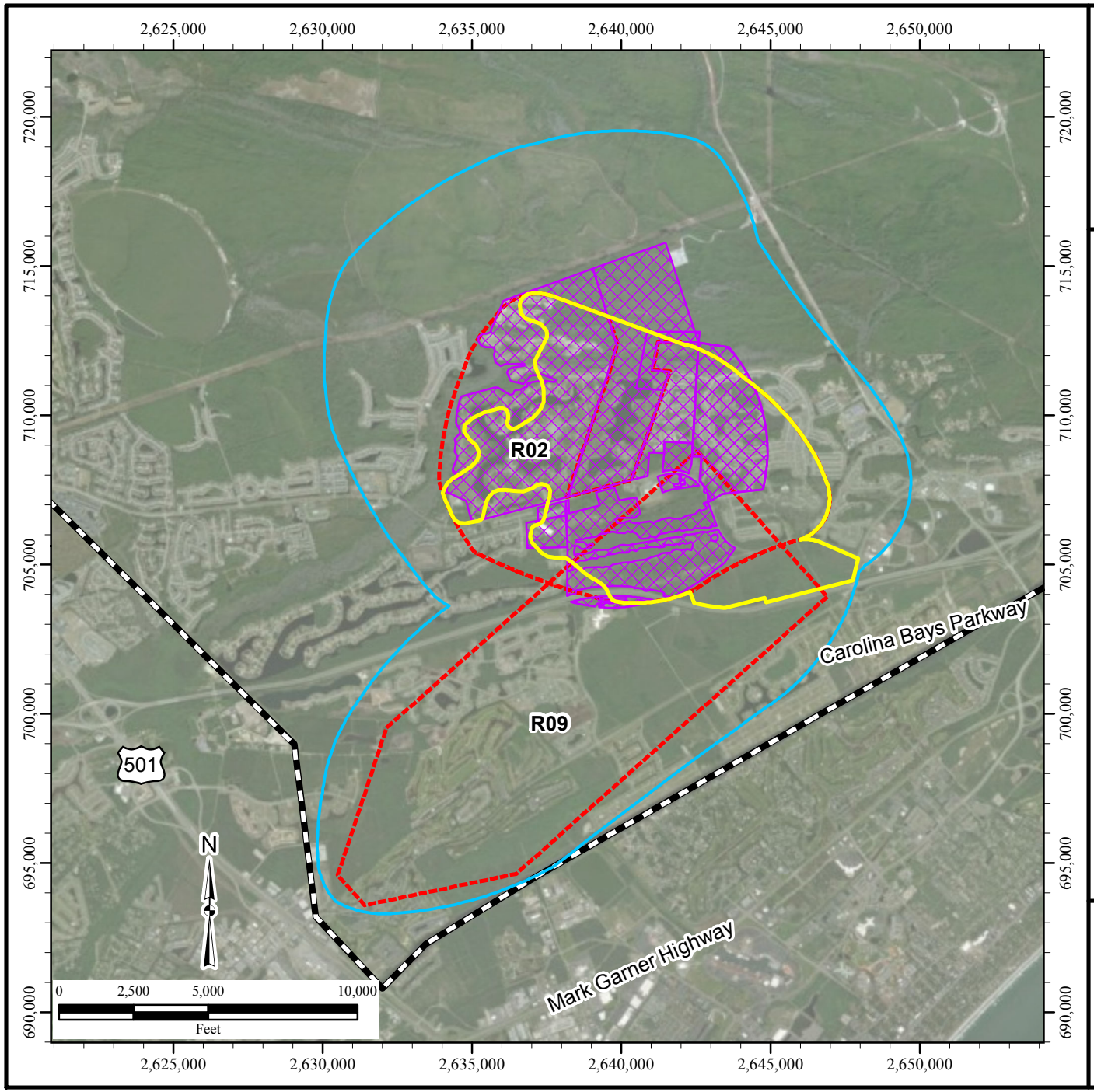


Figure 1.3a
MRS-R02/MRS-R09 Range III and Machine Gun/Rifle Range Location With Federal Settlement Agreement Areas

Legend

- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Federal Settlement Agreement Area
- Munitions Response Site (1,961.2 acres)
- Expanded Investigation Area (8,189.6 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
The U.S. Government has been relieved of liability through multiple federal settlement agreements with private landowners.

DOD=Department of Defense
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(1-03a)R02.mxd
5/9/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

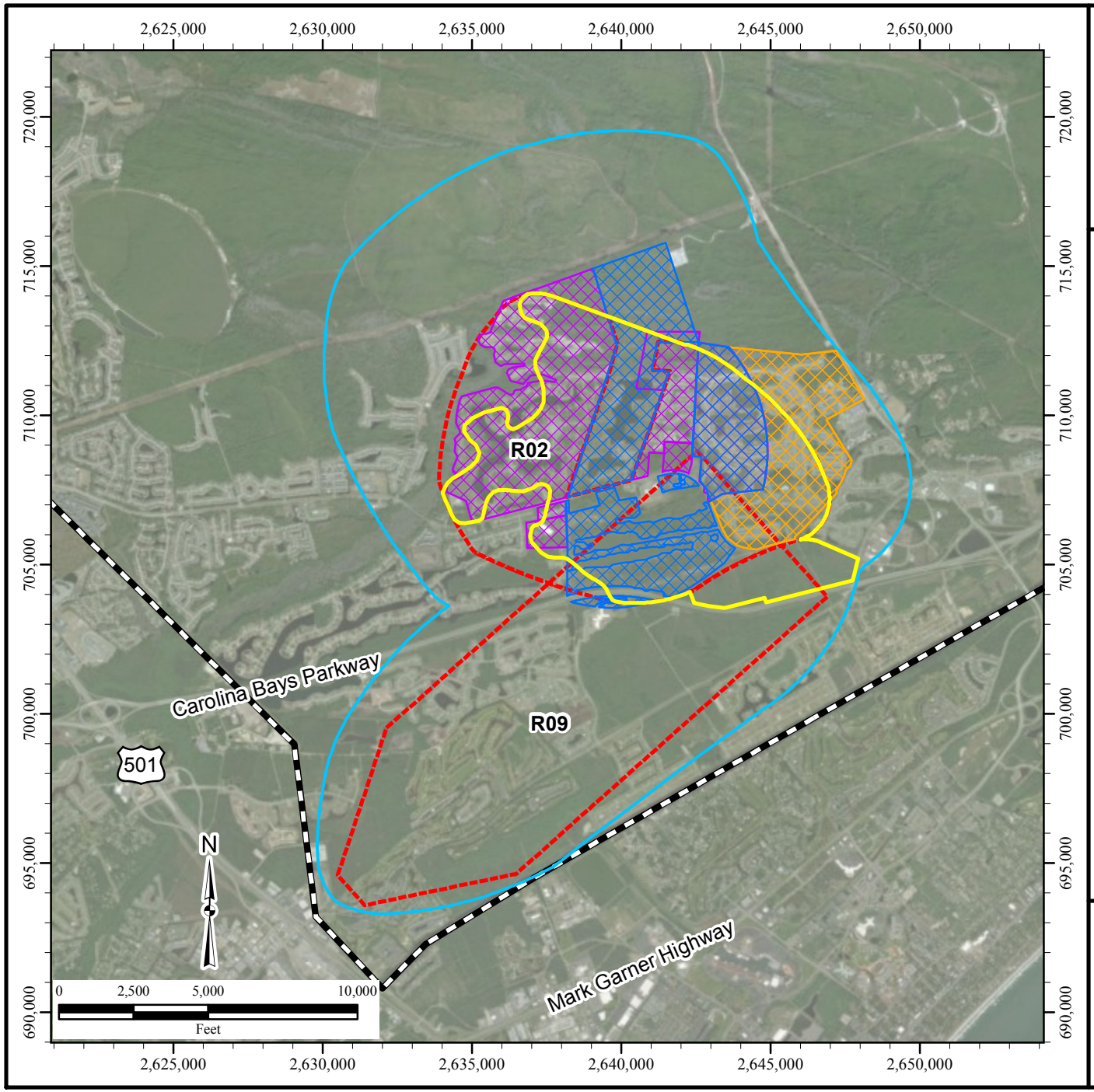


Figure 1.3b
MRS-R02/MRS-R09 Range III and Machine Gun/Rifle Range Location With SCDHEC Consent Agreement Areas

Legend

- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Federal Settlement Agreement Area
- SCDHEC Consent Agreement Area
- SCDHEC Consent and Federal Settlement Agreement Areas
- Munitions Response Site (1,961.2 acres)
- Expanded Investigation Area (8,189.6 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
The U.S. Government has been relieved of liability for the Federal Settlement Agreement Area.

DOD=Department of Defense
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation
SCDHEC= South Carolina Department of Health and Environmental Control

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(1-03b)R02.mxd
5/9/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

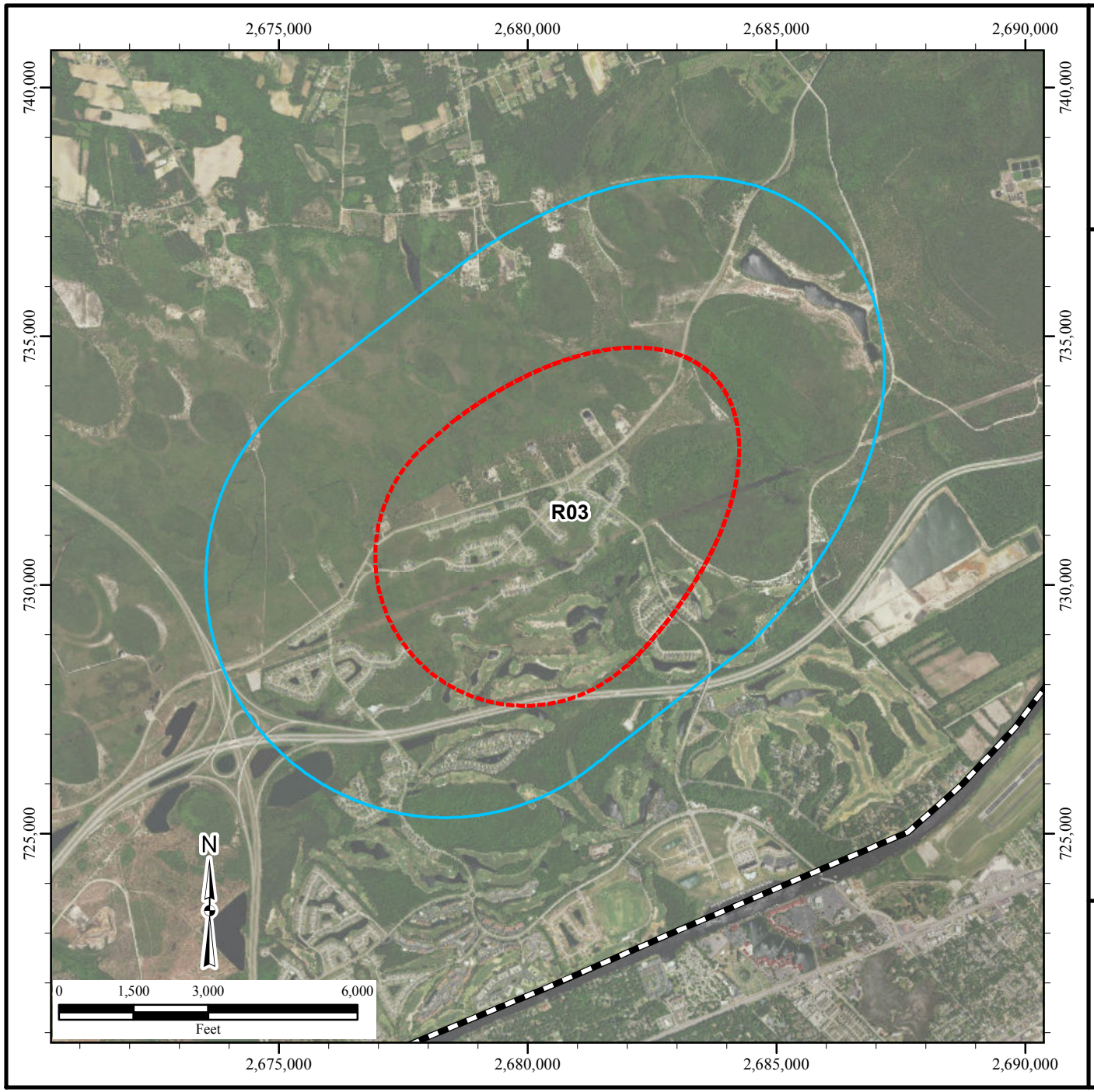


Figure 1.4
MRS-R03
Range IV Location

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (886.4 acres)
- Expanded Investigation Area (2,812 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(1-04)R03.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

2.0 INTRODUCTION

2.0.1 HGL conducted this RI at four MRSs within the former Conway BGR located in Horry County, South Carolina (Figure 1.1). This work was executed for USACE under Contract W912DY-10-D-0023, Task Order (TO) 0018. The objective of this TO is to perform an RI/FS and achieve acceptance of Decision Documents in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan, 40 Code of Federal Regulation (CFR) Part 300. The RI was executed IAW the approved Work Plan (HGL, 2015a) and FWVs and provides sufficient data to facilitate implementation of remedial action through the future FS. This MEC/MC RI is prepared IAW CERCLA and characterizes the nature and extent of MEC and MC contamination at the MRSs. The RI meets the project DQOs as defined during the TPP process (Appendix E) and set out in the accepted Final Work Plan.

2.0.2 This RI Report has been prepared IAW the requirements of the Performance Work Statement (PWS), dated April 11, 2013, and with USACE data item description Worldwide Environmental Remediation Services (WERS)-010.01. This RI Report was prepared in compliance with USACE Engineer Pamphlet (EP) 1110-1-18 and Environmental and Munitions Center of Expertise (EM CX) Interim Guidance 06-04, and Army RI/FS guidance. The ecological and human health risk assessment (HHRA) is performed IAW the U.S. Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund (RAGS) and USACE Engineer Manual (EM) 200-1-4, Volumes I and II, as appropriate. This RI Report is a standalone document; it includes characterization of the previously defined MRSs and recommendations for revised MRS boundaries that will be further addressed in a future FS.

2.0.3 The RI report is organized as follows:

- **Chapter 1.0 Executive Summary –** Provides a brief summary of objectives of the RI; RI activities; RI data and interpretation; risk assessment information; and recommendations.
- **Chapter 2.0 Introduction –** Describes the layout of the report, the purpose of the RI, the physical site setting, and the historical information about the site and each MRS, and also summarizes previous investigations.
- **Chapter 3.0 Project Remedial Response Objectives –** Discusses the results of the TPP process, which addresses both MEC and MC. It includes the overall project remedial response objectives developed for the planned or reasonably anticipated future use of the site property.
- **Chapter 4.0 Characterization of MEC and MC –** Summarizes the RI field activities. The processes used for identifying and characterizing MEC and MC contamination are detailed and departures from the work plan are discussed.
- **Chapter 5.0 Revised CSM and RI Results –** Presents information on the nature and extent of MEC at the project site, MC contamination of environmental media, and physical characteristics of the project site determined from the field activities conducted as part of the RI.

- **Chapter 6.0 Contaminant Fate and Transport –** Provides a discussion of fate and transport of contaminants detected at the project site.
- **Chapter 7.0 Baseline Risk Assessment for MC and Explosive Hazards Risk Assessment for MEC –** Details site-specific evaluations conducted for hazards posed by MEC and risks posed by MC to human and ecological receptors. MEC Risk Assessment results are discussed and MC results are compared to screening levels to determine whether contamination is present at levels that pose unacceptable risk.
- **Chapter 8.0 Summary of Results –** Summarizes the results of the RI including the following: nature and extent of MEC and MC at the project site; whether the findings are consistent with known sources; the magnitude, direction, and rate of contaminant migration; presents a summary of site risks; and presents conclusions.
- **Chapter 9.0 References –** Lists the documents and other materials used in the preparation of this RI.
- **Appendices:**
    - Appendix A – Documentation of Disposition of Material Potentially Presenting an Explosive Hazard (MPPEH), MD and Wastes
    - Appendix B – Analytical Results Tables, Risk Assessment and Quality Assurance (QA)/Quality Control (QC) Evaluations
    - Appendix C – Institutional Analysis and Institutional Analysis Report
    - Appendix D – Demolition Activity Summation Tables
    - Appendix E – TPP Memorandum
    - Appendix F – Geophysical Summary Reports and Instrument Verification Strip (IVS) Letter Report
    - Appendix G – Field Work Variances
    - Appendix H – Senior Unexploded Ordnance (UXO) Supervisor (SUXOS), UXO Safety Officer (UXOSO), UXO QC Specialist (UXOQCS) Reports, Logs, and Memoranda
    - Appendix I – Corrective Action Requests
    - Appendix J – Project Photographs
    - Appendix K – Munitions Response Site Prioritization Protocol (MRSPP) Scoring Sheets and MEC Risk Assessment
    - Appendix L – Geographic Information System (GIS) Submittal

2.1 PURPOSE

2.1.1 The purpose of this RI is to determine the nature and extent of MEC and evaluate the presence of MC contamination within four MRSs at the former Conway BGR. The RI identifies data gaps, updates the CSM, evaluates MEC hazards and human health and ecological risks,

and includes updated MRSPP scoring sheets. Results from the RI will be used to develop and evaluate remedial alternatives and to provide recommendations as part of a future FS.

2.2 PROPERTY DESCRIPTION AND PROBLEM IDENTIFICATION

2.2.1 Project Location and Land Use

2.2.1.1 Project Location

2.2.1.1.1 The former Conway BGR encompasses approximately 55,854 acres in Horry County, South Carolina, immediately southeast of Conway, South Carolina. The southern boundary of the site is situated to the north of the U.S. Hwy 501 and U.S. Hwy 17 intersection and the Atlantic Ocean is located to the east. A general site location map is provided in Figure 1.1. The former Conway BGR consists of nine MRSs; however, only four are addressed by this TO. MRS-R01, Range II (MRS-R01), MRS-R02, Range III (MRS-R02), MRS-R03, Range IV (MRS-R03), and MRS-R09, MG/RR (MRS-R09) are included in this RI report.

2.2.1.1.2 During preparation of this RI Report, the individual MRS boundaries used in the RI report were compared to the current data recorded in FUDSMIS, the USACE repository which documents FUDS property acreages. It was determined the property boundaries were revised in an update to FUDSMIS in 2014 (see Table 1.1). The MRS boundaries used in this RI Report were kept consistent with those used throughout the planning phase to avoid confusion. The MRS acreage recommended to continue to the Feasibility Study phase were compared to the current FUDSMIS boundaries, for consistency with FUDSMIS in future phases.

2.2.1.1.3 Based on historical information, previous investigations conducted at each MRS, and project delivery team (PDT) input, the investigation areas of the four MRSs were expanded for the current RI/FS. Various previous investigations identified MEC near the boundaries of the MRSs. The modified investigation areas include potential source areas located outside of the original MRS boundaries and exclude areas previously characterized. Table 2.1 presents the historical MRS acreages as well as the expanded areas investigated during the RI/FS.

Table 2.1
Investigation Areas

MRS	MRS Acreage [1]	RI/FS Expanded Investigation Acreage [2]
MRS-R01, Range II	649	2,629
MRS-R02, Range III	1,961	5,823
MRS-R03, Range IV	888	2,812
MRS-R09, MG/RR	2,056	2,366[3]

[1] – MRS Acreage provided to HGL in the *Memorandum for Commander, South Atlantic Division,* on May 26, 2017.
[2] The RI/FS Expanded Investigation Acreage includes the Historical MRS Acreage.
[3] For the munitions response operations to establish the Explosive Siting Plan safety zones, MRS-R02 and MRS-R09 were grouped by one boundary since the areas are contiguous and share the same munitions with the greatest fragmentation distance (MGFD).

2.2.1.1.1 MRS-R01, Range II

2.2.1.1.1.1 MRS-R01 is located in the northwest section of the former Conway BGR. The MRS is composed of approximately 649 acres. Figure 1.2 illustrates the location of MRS-R01 and Figure 2.1 shows the wetlands in the area.

2.2.1.1.2 MRS-R02, Range III

2.2.1.1.2.1 MRS-R02 is located in the southern section of the former Conway BGR. The MRS is composed of approximately 1,961 acres. MRS-R02 overlaps the northern portion of MRS-R09. For the purposes of this RI investigation, the overlapping portion of MRS-R02 and MRS-R09 was investigated and documented as a part of MRS-R02. Four private landowners whose parcels lie within the MRS-R02 boundary have negotiated settlement agreements with the U.S. Government effectively relieving the U.S. Government of liability at these properties. For this reason, the parcels owned by these entities are not included in U.S. Government future response actions. For work conducted by private entities without U.S. Government supervision, the quality of the data cannot be confirmed. However, some of the privately funded work was reviewed by SCDHEC and information was provided to USACE by SCDHEC. The Federal Settlement Agreement Areas will not be included in any future DoD funded response actions due to transfer of U.S. Government liability. Figure 1.3a illustrates the location, MRS boundary, Federal Settlement Agreement Areas and investigation area of MRS-R02 and MRS-R09 and Figure 2.2 shows the wetlands in the area. Figure 1.3b illustrates the location, MRS boundary, Federal Settlement Agreement Areas and SCDHEC Consent Agreement Areas.

2.2.1.1.2.2 A portion of this MRS was recommended for No DoD Action Indicated (NDAI) during the 2014 FUDSMIS realignment. FUDSMIS is the USACE database repository which tracks all FUDS properties. Parcels on the east side of MRS-R02 were recommended for NDAI because they were part of privately funded removal actions, reviewed by SCDHEC as part of a consent agreement (Figure 1.3b). As currently documented in FUDSMIS, the privately cleared lands portion of MRS-R02 is now designated as Project 09 and was recommended for NDAI on August 1, 2014. The parcels were cleared of munitions related hazards by a private landowner funded operation. SCDHEC has concurred with the NDAI recommendation. These acres are not recommended to move forward to the FS phase. For consistency with the work plan and RI field documentation, the "Current RI MRS" reference shown in Table 1.1 is used throughout this RI Report.

2.2.1.1.3 MRS-R03, Range IV

2.2.1.1.3.1 MRS-R03 is located in the eastern section of the former Conway BGR. The MRS is composed of approximately 888 acres. Figure 1.4 illustrates the location of MRS-R03 and Figure 2.3 shows the wetlands in the area.

2.2.1.1.4 MRS-R09, Machine Gun/Rifle Range

2.2.1.1.4.1 MRS-R09 is located in the southern section of the former Conway BGR. The MRS is composed of approximately 2,056 acres. The northern portion of MRS-R09 overlaps with the southern boundary of MRS-R02. The overlapping area was investigated and documented as a

part of MRS-R02. Figures 1.3a and 1.3b illustrate the location of MRS-R02 and MRS-R09 and Figure 2.2 shows the wetlands.

2.2.1.2 Projected Land Use

2.2.1.2.1 The former Conway BGR is currently owned by private as well as public groups. The South Carolina Department of Natural Resources (SCDNR) is the largest land owner for the entire munitions response area (MRA). For the four MRSs which are included in this RI, there are diverse landowners, with parcels used for recreational (golf courses), residential, and commercial purposes. The undeveloped portions are used primarily for hunting and timber harvesting. The future land use is projected to remain similar to the current usage, and extensive residential development is planned and ongoing. Additional land use information is covered in Section 3.1.1 and additional landowner information is included in the description of the ROE obtained, in Section 3.4.2.

2.2.2 Demographics

2.2.2.1 The former Conway BGR is located in Horry County in the northeastern portion of South Carolina, immediately north of the intersection of U.S. Hwy 501 and U.S. Hwy 17. It is surrounded by Conway, South Carolina to the northwest and the Atlantic Ocean to the east. The 2010 U.S. Census Bureau estimated population for Horry County is 309,199 with a population density of approximately 237.5 people per square mile (U.S. Census Bureau, 2016).

2.2.3 Surface Features

2.2.3.1 Horry County is within the Lower Atlantic Coastal Plain province and the Pee Dee River Basin. This physiographic area is characterized by minor topographic relief and several wetlands associated with the surrounding Carolina Bays. Elevation varies from just above sea level to approximately 40 ft above mean sea level.

2.2.4 Climate

2.2.4.1 The former Conway BGR, located in the Atlantic Coastal Region, has a humid subtropical climate. Climate statistics are as follows (U.S. Climate Data, 2016).

- Average annual temperature: 64.3 degrees Fahrenheit (°F)
- Average winter temperature: 53°F
- Average summer temperature: 75°F
- Total annual precipitation: approximately 52 inches (approximately 60 percent of the rain falling between April and September)
- Wettest month of the year: August (followed by July and September)
- Snowfall: no measurable amount
- Average relative humidity in mid-afternoon: approximately 60 percent
- Sunshine: about 65 percent in summer and 60 percent in winter

2.2.4.2 Based on these climate statistics, there is minimal to no potential for MEC movement from frost heave at the MRSs.

2.2.5 Geology and Soil

2.2.5.1 The project area lies on top of Upper Cretaceous, Tertiary, and Pleistocene deposits. The Middendorf Formation, the Black Creek Formation, and the Pee Dee Formation lie on top of basement rock within the Upper Cretaceous deposit and vary from medium course grain sand to dark gray fine clay sands. The Tertiary Formation consists of fine clayey sand, fine calcareous sand, and coquina. Interbedded fossiliferous sands and clays make up the remainder of the formation (EOD Technologies, Inc. [EODT], 2012).

2.2.5.2 Soils present at the project site are classified into four soil associations: The Lynn-Haven-Leon association, the Yuahanna-Ogeechee-Bladen association, the Pocomoke-Echaw-Centenary association and the Brookman-Bladen Association. All associations are characterized by very poorly drained to moderately well drained soils (EODT, 2012).

2.2.6 Hydrology and Groundwater Conditions

2.2.6.1 Horry County obtains well water from the Black Creek aquifer; however, it tends to have a high mineral content and a significant concentration of certain ions. This aquifer lies below the Pee Dee Formation requiring well to be drilled between 250 and 600 ft bgs. The Pee Dee River Basin slopes to the southeast allowing for surface water runoff to drain into several rivers including the Pee Dee, Little Pee Dee, Waccamaw, and the Intercoastal Waterway (EODT, 2012).

2.2.7 Ecology

2.2.7.1 Endangered Species

2.2.7.1.1 The species listed below occur within Horry County and have a status of Threatened (LT) or Endangered (LE) with protection under the Endangered Species Act (ESA), or are state protected as Threatened (ST) or Endangered (SE). The bald eagle is federally protected under the Bald and Golden Eagle Protection Act (BGEPA).

Bald eagle (*Haliaeetus leucocephalus*) – BGEPA

Wood stork (*Mycteria Americana*) – LE, SE

Red-cockaded woodpecker (*Picoides borealis*) – LE, SE

Least Tern (*Sterna antillarum*) – ST

Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) – SE

2.2.7.1.2 Additionally, three species of plants are found in the county with the status of LE under the ESA.

American Chaffseed (*Schwalbea americana*) – LE

Canby's dropwort (*Oxypolis canbyi*) – LE

Pondberry (*Lindera melissifolia*) – LE

2.2.7.2 Vegetation

2.2.7.2.1 The vegetation at Conway BGR varies based on land use. Nearly half of the county is considered forestland, 30 percent of which is classified as forested wetlands. Vegetation in these areas includes thick underbrush, a variety of pine species, bald cypress, and water tupelo trees (Horry County, 2015).

2.2.7.3 Sensitive Environmental Resources at the Project Site

2.2.7.3.1 The MRSs investigated under this RI are not located within a national wildlife refuge, national forest, state park, or protected area (U.S. Fish and Wildlife Service [USFWS], 2014a; USFWS, 2014b; National Park Service [NPS], 2014a; U.S. Forest Service, 2014). However, the 9,393-acre Lewis Ocean Bay Heritage Preserve Wildlife Management Area is located in the central portion of the former Conway BGR just northeast of MRS-R02.

2.3 HISTORICAL INFORMATION

2.3.0.1 Prior to 1940, the Conway BGR area was primarily privately owned and used for timber harvesting and farming. Research has provided no evidence that munitions or explosives were used on the site prior to War Department acquisition (EODT, 2012). From June 1940 to December 1941, the Army Air Corps conducted aerial photographing and charting of the local area. In 1941, the 112th Observation squadron established support operations for BGR in the Myrtle Beach Area and later provided coastal defense of the area. Live fire training was conducted, including aerial bombing and direct-fire training using rockets, small arms, and small artillery (37 millimeter [mm]) (EODT, 2012).

2.3.0.2 From 1942 through 1947, several Army Air Fields (AAFs) and Army Air Bases (AAB) utilized the former Conway BGR for various types of airplanes and practice ordnances. In March 1942, the 112th Observation Squadron was replaced by a detachment from Savannah AAB. The Myrtle Beach municipal airport became the Myrtle Beach General BGR in March 1942. The range, which was renamed Myrtle Beach AAF on November 8, 1943, was composed of approximately 100,000 acres of land. The AAF consisted of a cantonment area in Myrtle Beach, an air to ground gunnery ranges in the Myrtle Beach area, a BGR in the Conway Area (Conway BGR), a BGR in the Georgetown area, and a crash target boats at Murrells Inlets (EODT, 2012).

2.3.0.3 During World War II, Myrtle Beach AAF conducted flight, air to ground gunnery, and bombing training for Army Air Corps and Army Air Forces pilots. The principal plane used at Myrtle Beach AAF was the Douglas A-26 Invader; however, other types include the North American B-25 Mitchell, North American P-51 Mustang, Northrop P-61 Black Widow, and Republic P-47 Thunderbolt. Other airfields/bases utilized the Myrtle Beach AAF, including Columbia AAB, Greenville AAB, Florence AAF, Morris Field, and Charleston AAB (USACE, 1995). The Myrtle Beach AAF closed in November 1947.

2.3.0.4 On February 4, 1948, Conway BGR was declared surplus to U.S. Government needs. On June 22, 1948, 19,246 acres of land owned by the U.S. Government in fee was transferred to the War Assets Administration and eventually sold. By October 1948, leases on 34,685 acres had been terminated and the land returned to the International Paper Company (EODT, 2012).

The Conway BGR areas have been developed into recreational, commercial, and/or residential areas with plans for additional development.

2.3.0.5 The following subchapters provide historical information by MRS.

2.3.1 MRS-R01, Range II History

2.3.1.1 The historical usage of MRS-R01 was practice bombing, including high- and medium-altitude bombing, skip bombing, parafrag bombing, and rocket firing (EODT, 2012). Figure 2.4a and Figure 2.4b illustrate in further detail the historical investigations currently available to USACE for evaluation and historical use areas determined from historical aerial photograph research conducted in previous investigations (Parsons, 2003) and during this project.

2.3.2 MRS-R02, Range III History

2.3.2.1 The historical usage of MRS-R02 was high- and medium- altitude bombing, skip bombing, and rocket firing including demolitions bombing, dive bombing, strafing, rocket firing, and incendiary bombing (EODT, 2012). Historical evidence at this MRS indicated that 100-pound (lb) practice bombs and 2.25-inch rockets were used (USACE, 1995). Figure 2.5a and Figure 2.5b further illustrate details on the historical investigations currently available to USACE for evaluation and historical use areas determined from historical aerial photograph research conducted in previous investigations (Parsons, 2003) and during this project.

2.3.2.2 Historical MEC finds in MRS-R02 have included 37-mm projectiles and 2.36-inch rockets. These items have been recovered in a portion of MRS-R02 adjacent to MRS-R09. In the past, EODT concluded those types of munitions would probably not have been used on MRS-R02, which is a bombing range (EODT, 2012). In the past, EODT concluded that those munitions were present due to being overshoots from MRS-R09, which used ground fired munitions (EODT, 2012). Based on information gathered during the RI and an evaluation of the types of munitions found across MRS-R02, MRS-R09 was not used for those types of munitions. The 37-mm projectiles and 2.36-inch rockets are included as used historically on MRS-R02. Based on results obtained during the RI, those munitions are not included as being historically used on MRS-R09, though past reports state they were.

2.3.3 MRS-R03, Range IV History

2.3.3.1 The historical usage of MRS-R03 was for practice bombing, including medium-altitude bombing (EODT, 2012). This site was identified in a 2003 Engineering Evaluation/Cost Analysis (EE/CA) (Parsons, 2003) and further investigated during the 2012 RI. Figure 2.6a and Figure 2.6b further illustrate details on the historical investigations currently available to USACE for evaluation and historical use areas determined from historical aerial photograph research conducted in previous investigations (Parsons, 2003) and during this project.

2.3.4 MRS-R09, Machine Gun/Rifle Range History

2.3.4.1 Historical documentation indicated that activities at MRS-R09 were limited to firing bomber turrets and MGs in a ground-mounted mode. The historical use of the range was reported

as exclusively for small arms training activities, such as basic rifle marksmanship training. Privately funded cleanups in the overlapping portions of MRS-R02 and MRS-R09 have recovered items ranging from 37-mm projectiles to 2.36-inch rockets. However, those munitions were determined to be used historically on MRS-R02 only. Due to lack of ROEs for this MRS, it was not characterized for MEC and MC during the 2012 RI (EODT, 2012). Figure 2.7a and Figure 2.7b further illustrate details on the historical investigations currently available to USACE for evaluation and historical use areas determined from historical aerial photograph research conducted in previous investigations (Parsons, 2003) and during this project.

2.4 PREVIOUS INVESTIGATIONS

2.4.0.1 This section describes the previous investigations that have been conducted at the former Conway BGR, MRS-R01, MRS-R02, MRS-R03, and MRS-R09. It should be noted that other privately funded removals may have been conducted without notification to USACE and therefore are not included in this RI report.

2.4.1 Former Conway BGR

2.4.1.1 The following investigations of the former Conway BGR, which occurred between 1991-1995, were the preliminary investigations leading to the establishment of the MRSs at the installation:

- 1991: A Preliminary Assessment (PA) of ordnance contamination at the former Conway BGR was prepared by USACE and Twin City Testing – St. Louis (TCT-St. Louis). The assessment, titled "Final Archives Report" consisted of three volumes; "Final Report," "Conclusion and Recommendations," and "Records Compilation." The PA concluded that MEC contamination potentially existed at the former Conway BGR, specifically at Ranges II, III, and IV. A high priority confirmation study at these ranges using visual and geophysical surveys was recommended (EODT, 2012).
- 1991: The U.S. Department of Transportation and South Carolina Department of Highways and Public Transportation prepared a Final Environmental Impact Statement (EIS) for proposed bypass, which crossed through the former Conway BGR. The EIS acknowledged the site was once used as a bombing range that is possible for MEC to exist in the area (EODT, 2012).
- 1994: A PA was performed by the USACE - Charleston District under the Defense Environmental Restoration Program (DERP)/FUDS program. At that time, the "Findings and Determination of Eligibility," dated 4 January 1994, concluded that the 55,854-acre site located in Horry County, South Carolina had been formerly used by the Army Air Corps. A MEC site inspection (SI) was recommended (EODT, 2012).
- 1995: An SI and archives search of the former Conway BGR was conducted by USACE, Rock Island District. The final report outlined the nature and degree of MEC recovered from the former ranges, as well as estimated depth at which ordnance may be present (by area), and probable end usage of the land. The Archives Search Report (ASR) concluded that the presence of ordnance is "confirmed" in Area A and Area C based on verifiable historical evidence and direct witness of ordnance items. The presence of

ordnance was "potential" in Areas B, D, E, A-1, B-1, C-1, D-1, and E-1 based on inference from records and indirect witness accounts. Areas F and G were not considered to have any MEC based on a lack of "confirmed" or "potential" ordnance evidence. No historical recorded evidence was located to suggest the presence of Chemical Warfare Materiel or radiological waste at the site (EODT, 2012).

- Various investigations included soil sampling as part of the field effort for MRS-R01, MRS-R02, and MRS-R03. These data were also incorporated into the planning phase for the RI field activities and analytical results are incorporated into the MC characterization for these MRS. The historical sampling locations which are included in this RI evaluation are shown on Figure 2.8 (for MRS-R01), Figure 2.9 (for MRS-R02), and Figure 2.10 (for MRS-R03).

2.4.2 MRS-R01, Range II

2.4.2.1 The list below provides a summary of previous investigations (Figure 2.4a and Figure 2.4b) at MRS-R01:

- 1991: A PA was prepared by TCT-St. Louis. The PA concluded that MEC contamination potentially existed at MRS-R01.
- 1991: When TCT-St-Louis conducted the SI, a practice rocket and 0.50-cal bullets were found within Range II (MRS-R01). Between 1991 and the 2003 EE/CA, golf course management reported encountered with MD (Parsons, 2003).
- 1995: USACE Rock Island District conducted a SI and ASR. The ASR established MRS-R01 and recommended further investigation. The ASR confirmed that MPPEH was present at MRS-R01, Range II (USACE, 1995).
- 2003: The EE/CA investigated MRS-R01, and identified the potential presence of MEC in Area A, which was a 425-acre circular area established at the center of MRS-R01, Range II. No risk due to MEC presence was identified in Area A-1 (a buffer created around the centrally located Area A). The EE/CA recommended clearance to depth only for planned construction sites within Area A (the 425-acre circular area). The EE/CA also recommended surface clearance elsewhere (in the buffer area) and institutional controls (ICs) throughout the MRS (Parsons, 2003). During the EE/CA, MD identified included a 100-lb practice bomb and small arms ammunition (SAA) debris.
- 2005/2006: Final Sampling Report (Removal Action), Areas A and A-1. EODT performed a geophysical sampling subsurface investigation for Sun Star, LLC. The investigation covered 439 acres at the Wild Wing Plantation (including the Avocet, Wood Stork, and Hummingbird golf courses, as well as the clubhouse). No MEC items were identified, but MD items found included the following: 100-lb practice bomb pieces (Wood Stork #2); 100-lb practice bomb (tail fin only) (Avocet #4); bomb rack, 20-lb (Wood Stork #5); expended .50-cal cartridge (Wood Stork #15); bomb lugs (Wood Stork Hole # 16); expended .50-cal cartridge (Avocet # 3). The Final Sampling Report recommended 70 acres for subsurface clearance. Geophysical surveys were performed on 50 of the 439 acres investigated and a preliminary report was issued in 2005 summarizing the results. Additional surface clearance and construction support followed,

which was summarized in the Interim Final Report issued in 2006 covering the UXO Clearance in Area A. EODT performed a removal on 70 acres of the Wild Wing Company LLC property located in Area A.

- 2012: The RI report prepared by EODT concluded that the potential for MEC hazard was "Unlikely" and that no MC contamination was present; however, the RI report states that MEC had not been delineated and recommended further investigation. The refusal of ROEs impacted the RI field activities that could be conducted (EODT, 2012).

2.4.2.2 Figure 2.4a and Figure 2.4b illustrate that areas within the MRS-R01 that have been characterized previously and the locations of recovered MD.

2.4.3 MRS-R02, Range III

2.4.3.1 The list below is a summary of previous investigations (Figure 2.5a and Figure 2.5b) at MRS-R02:

- 1991: A PA was prepared by TCT-St. Louis. The PA concluded that MEC contamination potentially existed at MRS-R02, Range III.
- 1995: USACE Rock Island District conducted an SI and ASR. The ASR established nine MRSs and recommended further investigation. USACE conducted a site visit in 1997 and confirmed the presence of MEC at Range III, and located .50-cal shell casings, bullets, fragments of 4-lb incendiary bombs, and a practice 2.5-inch rocket.
- 1997: During site visit at the former Conway BGR in Range III (Area B) several 0.50-cal shell casings, bullets, and fragments of 4-lb incendiary bombs were noted at the ground surface. A practice 2.5-inch rocket was also discovered along the edge of the access dirt road. Aerial photographs depicting site conditions in the early 1950s were reviewed as part of an archival records search to identify specific areas or locations where evidence of MEC can be more adequately assessed during the EE/CA investigation. The photographs were included in Appendix E of the "Final EE/CA Report" (Parsons, 2003).
- 2002: A Time Critical Removal Action (TCRA) was performed in 2002 on 45 acres of MRS-R02. Construction support was provided during the property owner's construction activities on all 45 acres (EODT, 2012). MEC items identified included the following: MK II 1.1-inch projectile; M38A2 100-lb sand-filled practice bombs; M48 practice 20-lb fragmentation bomb; practice 5-inch HVAR warhead; M54 4-lb incendiary bomb; M69 6-lb incendiary bomb; fuzes, including M16 fuze burster, M16 igniter, and AN-M16 white phosphorus igniter; and M57 250-lb general purpose old style bomb. During the TCRA, the large number of 4-lb incendiary bombs encountered brought about concerns of potential presence of Cd in the site soils. Over the seven-month period, 16 soil samples were collected and analyzed only for Cd. Cd was not detected in the soil samples, but was detected in the metal alloy of the incendiary bombs at 51.1 milligrams per kilogram (mg/kg). The Toxicity Characteristic Leaching Procedure result of 0.0553 milligrams per liter (mg/L) for Cd was well below the USEPA regulatory level of 1.0 mg/L. The results of air samples analyzed for Cd during the investigation were below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 0.005 milligrams per cubic meter (mg/m^3). Therefore, Cd was not a concern

during the remainder of the removal action. The detailed laboratory analysis results were provided in Appendix E of the "Final Removal Report TCRA" (Parsons, 2002).

- 2005: Environmental Resources Management (ERM) conducted a removal action for International Paper Realty Company (former property owner) in multiple phases between 2004 and 2005. The removal action covered 231 acres along the central border to the north and east of Range III as shown in Figure 2.5b. A 100 percent geophysical survey was performed. ERM's removal summary listed MEC items, including M54, 4-lb incendiary bombs, 2.25" SCAR, 5" HVAR, M38A1 100-lb sand-filled practice bombs, and cluster support, with a total count of 254 items. The removal action report states that the property was "cleared of UXO and ordnance related items identified as potential anomalies . . . to a depth of six feet below ground surface." However, the exact MEC identification and count by types are unknown. During the work planning phase, HGL evaluated the text from the Phase II and Phase III Removal Action reports; however, the count and locations of these items was unknown during the work plan phase. After RI field work was completed, the figures that accompany the 2005 Phase II and Phase III reports were obtained. This data has been incorporated into the GIS for historical MRS-R02 investigations.
- 2005: ERM conducted geophysical surveys and removal actions for International Paper Realty Company (former property owner) at two parcels located in the central portion of the MRS; however, the exact locations where removals were conducted are unknown. Geophysical surveys were conducted over 100% of the project area with the exception of jurisdictional wetlands. Of the anomalies recovered, no BIP procedures were required. All UXO items, including M54 four-pound incendiary bombs, were destroyed in two separate consolidated detonations just south of each removal areas. The exact number and type of items recovered and destroyed is unknown. Soil samples were collected from the bottom of the demolition pits and analyzed for explosives and barium. Specific results of the soil samples collected are unknown. The Phase II geophysical survey report and Phase III removal report for each area indicated that "All detected UXO and OE have been removed to a maximum depth of six feet below the original ground surface…"
- 2005: Clearance was performed by Kestrel (with others) covering 456 acres (Parcels A and B). MEC contamination was confirmed. Soil sampling was conducted for explosives. No MC contamination was identified.
- 2006: An MC investigation of soil and surface water was conducted at the Goodson site, located within Range III. A total of 16 samples (including one duplicate sample and one background sample) were analyzed for explosives and metals associated with munitions use. Of these constituents, only Pb, Zn, Cd, and Hg were identified as potential constituents from munitions used at the former Conway BGR. No explosives were detected. The metals detected (Pb, Zn, Cd, and Hg) were related to MC potentially present. However, based on a limited background investigation and the potential for these constituents to be present as a result of natural or anthropogenic sources, additional sampling was recommended to confirm the presence or absence of MCs at Range III (Parsons, 2006).

- 2006: A Phase I ordnance removal was conducted for D.R. Horton on 114 acres immediately east of and outside the Area B-1 safety zone, which was established during the EE/CA. MD found included a 100-lb practice bomb; a 5-inch ZUNI rocket warhead; and 2.75-inch rocket.
- 2006: A privately funded removal action was conducted by EODT in support of construction in the east-central portion of MRS-R02. During the action, several 2.25" practice rockets and 100-lb bombs were removed and destroyed. A half-acre portion of the parcel was unable to be investigated due to wetlands; however, the remaining 4.5 acres were described as "clear of UXO contamination".
- 2007: Removal was conducted for Landbank, LLC, on 336 acres (Tracts 15, 16A, and 16B) within the buffer safety zone. Digital geophysical mapping (DGM) was conducted.
- 2010: An investigation was performed for Horry County Schools on approximately 40 acres prior to development. 371 targets identified using geophysical techniques were investigated, and there were only cultural debris items found; no MEC or MPPEH related items were discovered.
- 2012: An RI confirmed the presence of MEC and concluded that no MC contamination was present. The report also states that MEC had not been delineated and that further investigation should be performed.
- 2016: A privately funded investigation and removal action was conducted over approximately 13 acres in the east-central portion of the MRS-R02 for New Harmony. The final report indicated that no further action for MEC or MC is necessary and regulatory concurrence and closure was document in an April 26, 2016 memorandum.

2.4.3.2 Figure 2.5a and Figure 2.5b illustrate the areas within the MRS-R02 that have been characterized previously and the location of recovered MEC/MD.

2.4.4 MRS-R03, Range IV

2.4.4.1 The list below is a summary of previous investigations (Figure 2.6a and Figure 2.6b) at MRS-R03:

- 1991: A PA was prepared by TCT-St. Louis. The PA concluded that MEC contamination potentially existed at MRS-R03.
- 1995 USACE Rock Island District conducted an SI and ASR. The ASR established MRS-R03 and recommended further investigation.
- 2003: The EE/CA identified the potential presence of MEC in both Area C and Area C-1, as they were designated at that time, in Range IV. The EE/CA recommended clearance to depth only at planned construction sites, and surface clearance elsewhere for both areas. MD identified included the following: 4-lb incendiary bombs; 20-lb fragmentation bombs; and 100-lb practice bombs (Parsons, 2003).
- 2004-2005: USA Environmental (USAE) conducted a geophysical survey and removals for Centex Homes in the Barefoot Resort area. The report, "Final Report Conway BGR,

South Carolina Phase IV Investigations, Centex Homes" (USAE, 2006), indicated no MEC items were encountered.

- 2006: Arcadis performed soil and groundwater sampling for Centex Homes prior to the development of the Barefoot Golf Course. No explosives detected. Volatile organic compounds and some metals were detected (Arcadis, 2006).
- 2012: RI report concluded that the potential for a MEC hazard was "Unlikely" and that no MC contamination was present. Although a MEC hazard was not anticipated for this MRS, further investigation was recommended (EODT, 2012).

2.4.4.2 Figure 2.6a and Figure 2.6b illustrate the areas within the MRS-R03 that have been characterized previously and the locations of recovered MEC/MD.

2.4.5 MRS-R09, Machine Gun/Rifle Range

2.4.5.1 The list below is a summary of previous investigation (Figure 2.7a and Figure 2.7b) at the southern portions of MRS-R09 that does not overlap with MRS-R02:

- 2003: EE/CA recommended a No U.S. Department of Defense (DoD) Action Indicated (NDAI) determination for this MRS (Parsons, 2003).
- 2012: RI concluded there was a potential presence of MEC that was unable to be investigated because of ROE refusal. The RI did not assess MC contamination and recommended further investigation (EODT, 2012).

2.4.5.2 Figure 2.7a and Figure 2.7b illustrate the areas within the MRS-R09 that have been characterized previously.

FIGURES

This page was intentionally left blank.

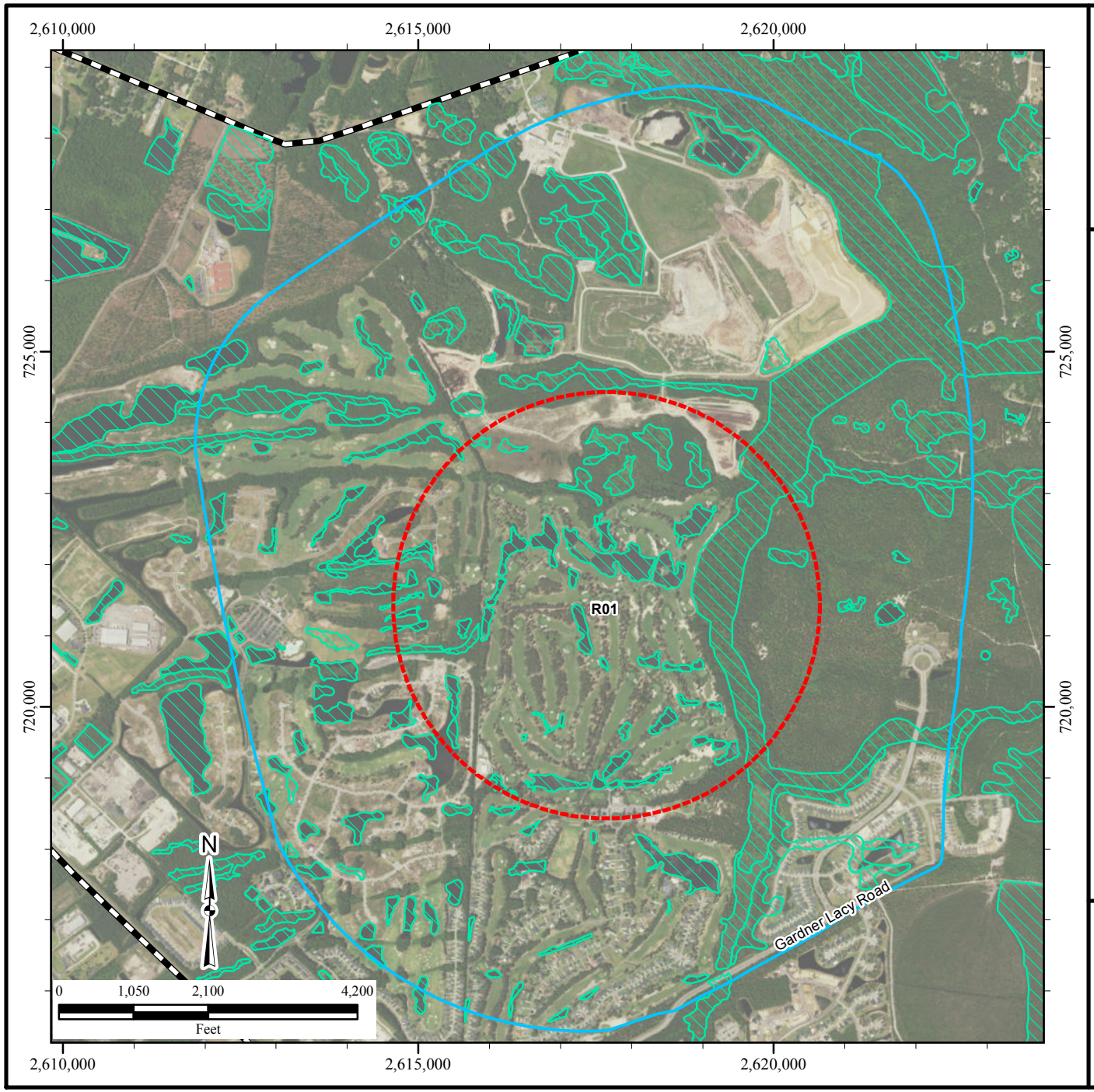


Figure 2.1
MRS-R01
Range II Wetlands

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (649.2 acres)
- Expanded Investigation Area (2,629 acres)
- NWI Wetlands (May 2015)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
NWI=National Wetlands Inventory
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI
(2-01)R01_Wetlands.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE, NWI
ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

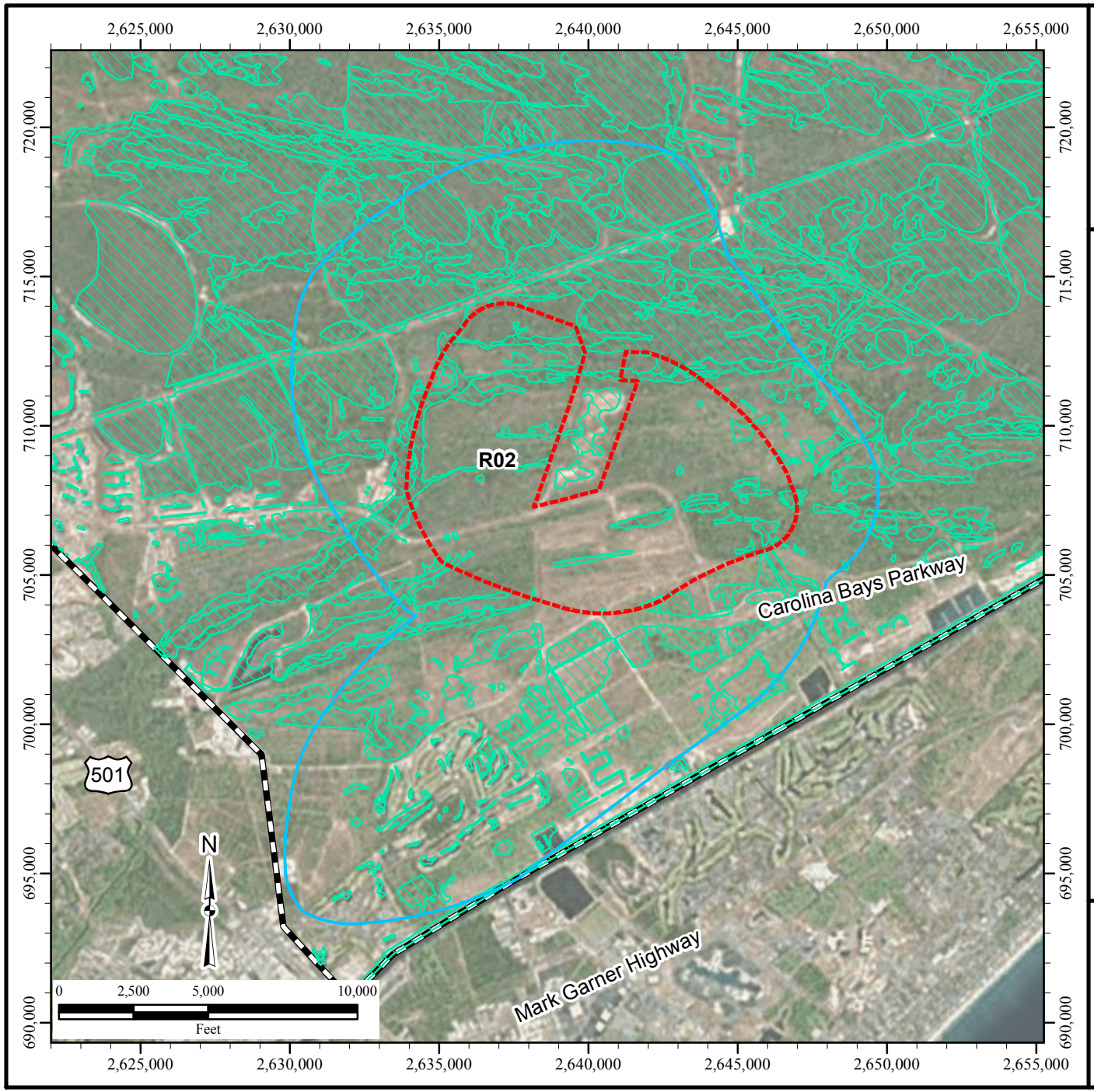


Figure 2.2
MRS-R02
Range III Wetlands

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (1,961.2 acres)
- Expanded Investigation Area (8,188.6 acres)
- NWI Wetlands (May 2015)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
NWI=National Wetlands Inventory
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-02)R02R09_Wetlands.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE, NWI
ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

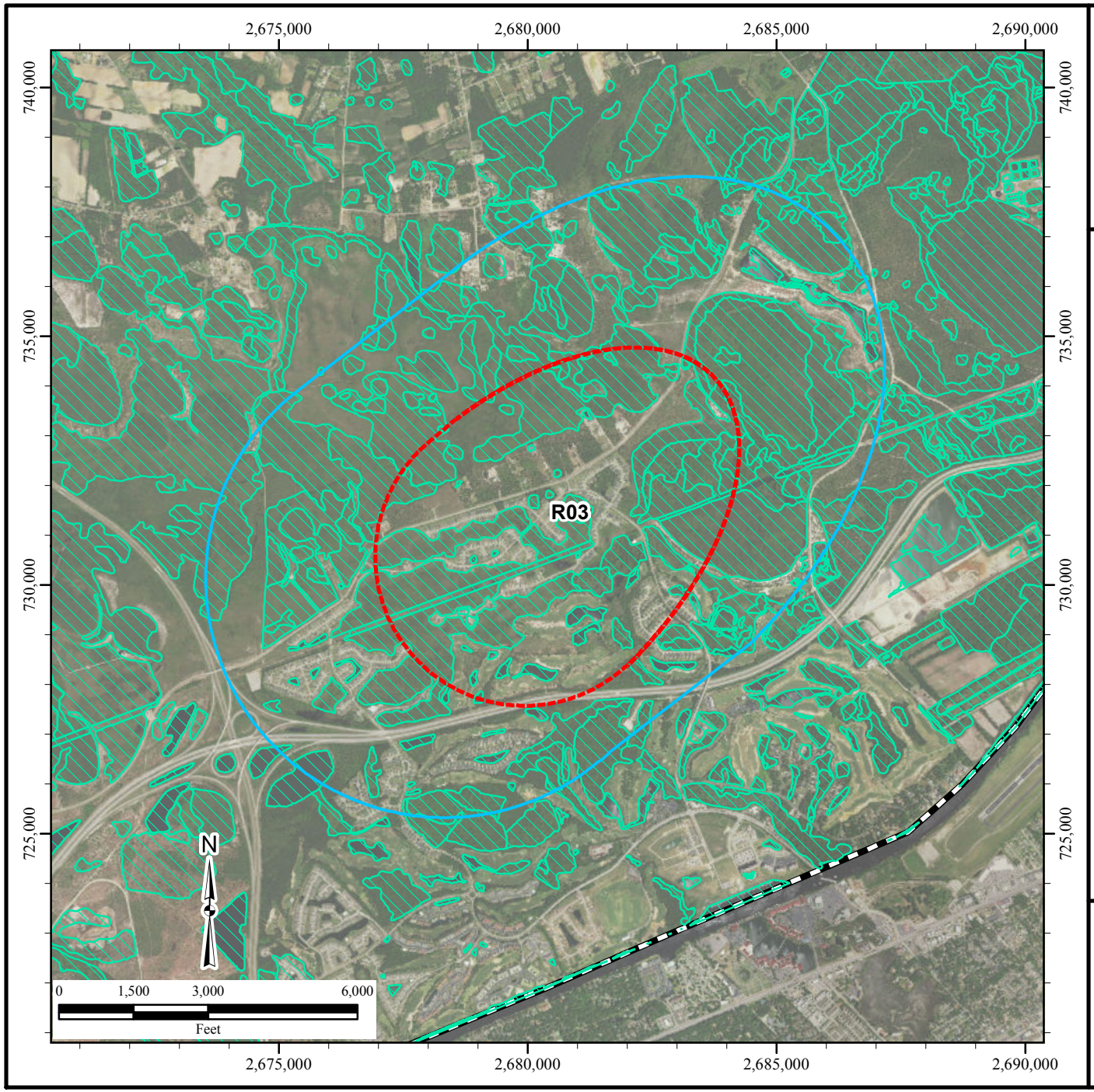


Figure 2.3
MRS-R03
Range IV Wetlands

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (886.4 acres)
- Expanded Investigation Area (2,812 acres)
- NWI Wetlands (May 2015)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
NWI=National Wetlands Inventory
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI
(2-03)R03_Wetlands.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE, NWI
ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

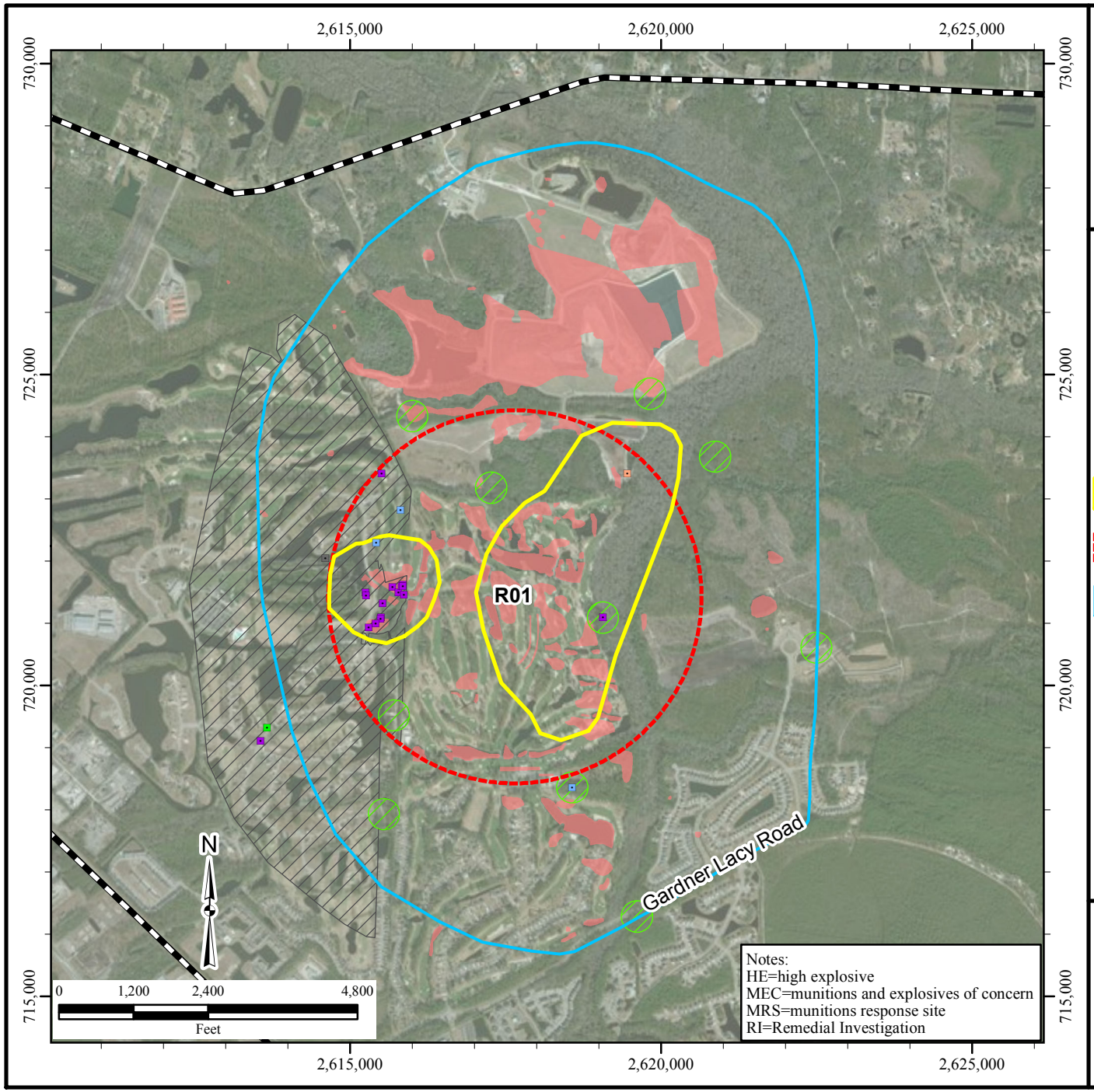


Figure 2.4a
MRS-R01
Historical Information and Previous Investigation

Legend

- 100lb Bomb (16 Items)
- 2.25" Rocket (1 Item)
- 20lb Bomb (1 Item)
- Small Arms (3 Items)
- Other (1 Item)
- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Munitions Response Site (649.2 acres)
- Expanded Investigation Area (2,209.8 acres)
- Previously Characterized Area within Investigation Area (45 acres)
- Previously Investigated Area
- Historical Use Area (318.6 acres)

Notes:
HGL considers it unlikely that munitions with HE filler are present within MRS-R01.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.
Coordinates in South Carolina State Plane, NAD83, feet.

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-04a)R01_Historical.mxd
5/9/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

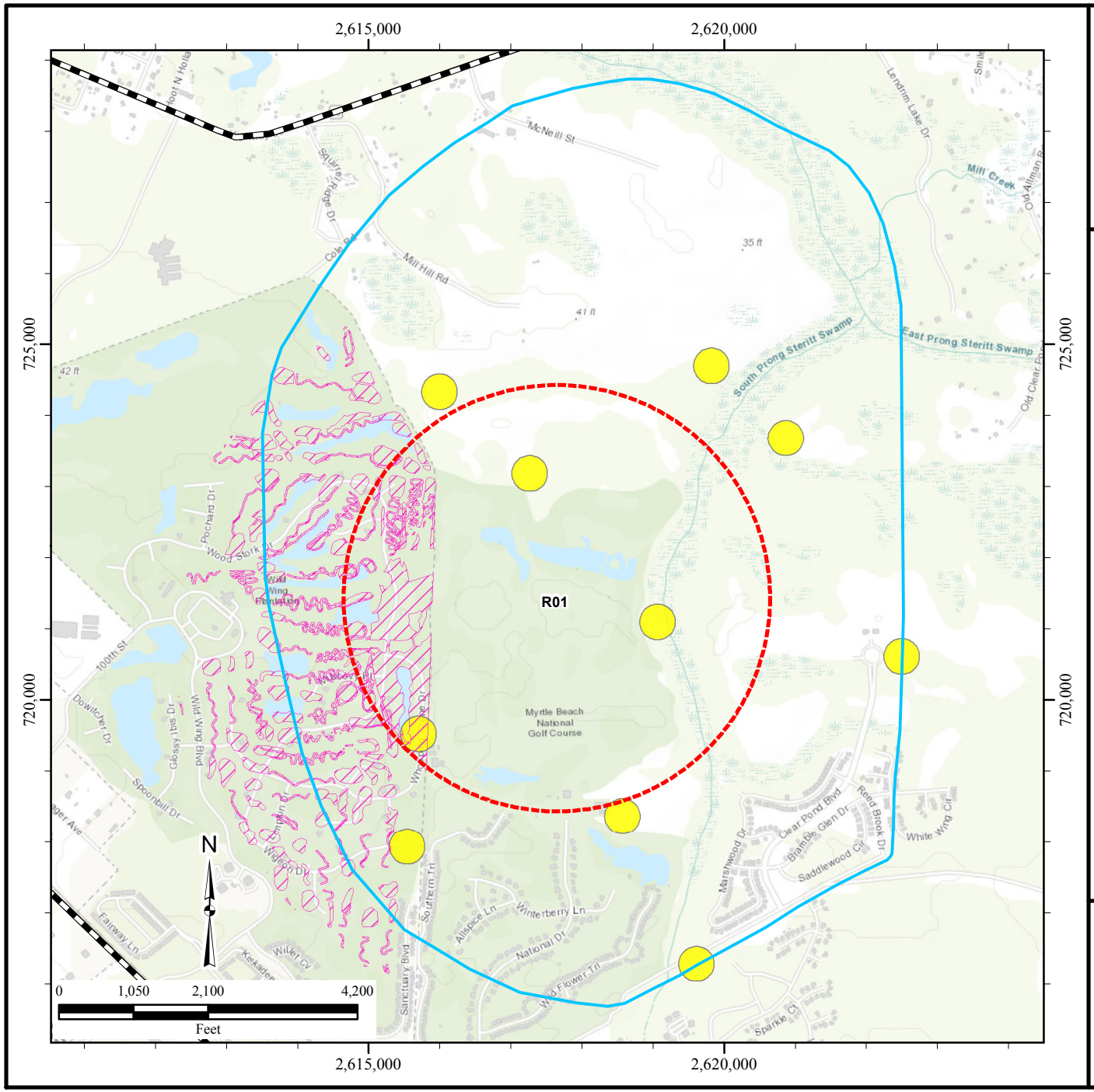


Figure 2.4b
MRS-R01
Range II Historical Work (by Type)

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (649.2 acres)
- Expanded Investigation Area (2,209.8 acres)

Funded by USACE

- Parsons, 2003 (Investigation)

Funded Privately

- EODT for Sun Star Subsurface 2006, (Removal)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-04b)R01_Historical_Work.mxd
5/9/2018 JAR
Source: HGL, USACE, Parsons, Sun Star ArcGIS Online Topographic Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

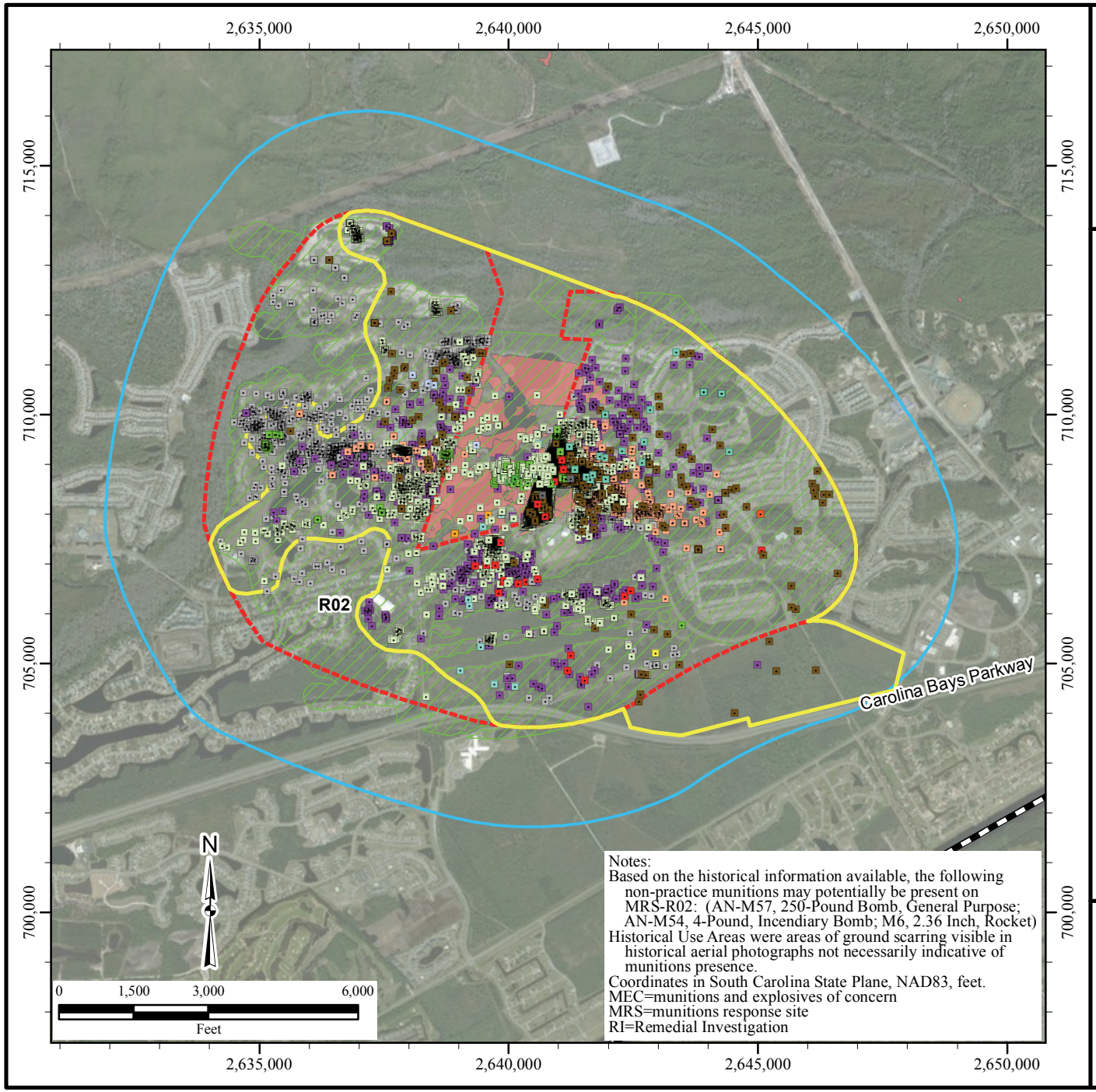


Figure 2.5a
MRS-R02
Historical Information and Previous Investigation

Legend

- 1.1" Projectile (4 Items)
- 100lb Bomb (2,705 Items)
- 10lb Bomb (2 Items)
- 2.25" Rocket (689 Items)
- 2.36" Rocket (3 Items)
- 2.75" Rocket (4 Item)
- 3" Rocket (1 Item)
- 20lb Bomb (160 Items)
- 250lb Bomb (17 Items)
- 37mm Projectile (31 Items)
- 4lb Bomb (3,942 Items)
- 5" Rocket (236 Items)
- 6lb Bomb (6 Items)
- Other (2,224 Items)
- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Munitions Response Site (1,961.2 acres)
- Expanded Investigation Area (2,192.0 acres)
- Previously Investigated Area (2057.6 acres)
- Historical Use Area (165.6 acres)

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-05a)R02_Historical.mxd
3/14/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

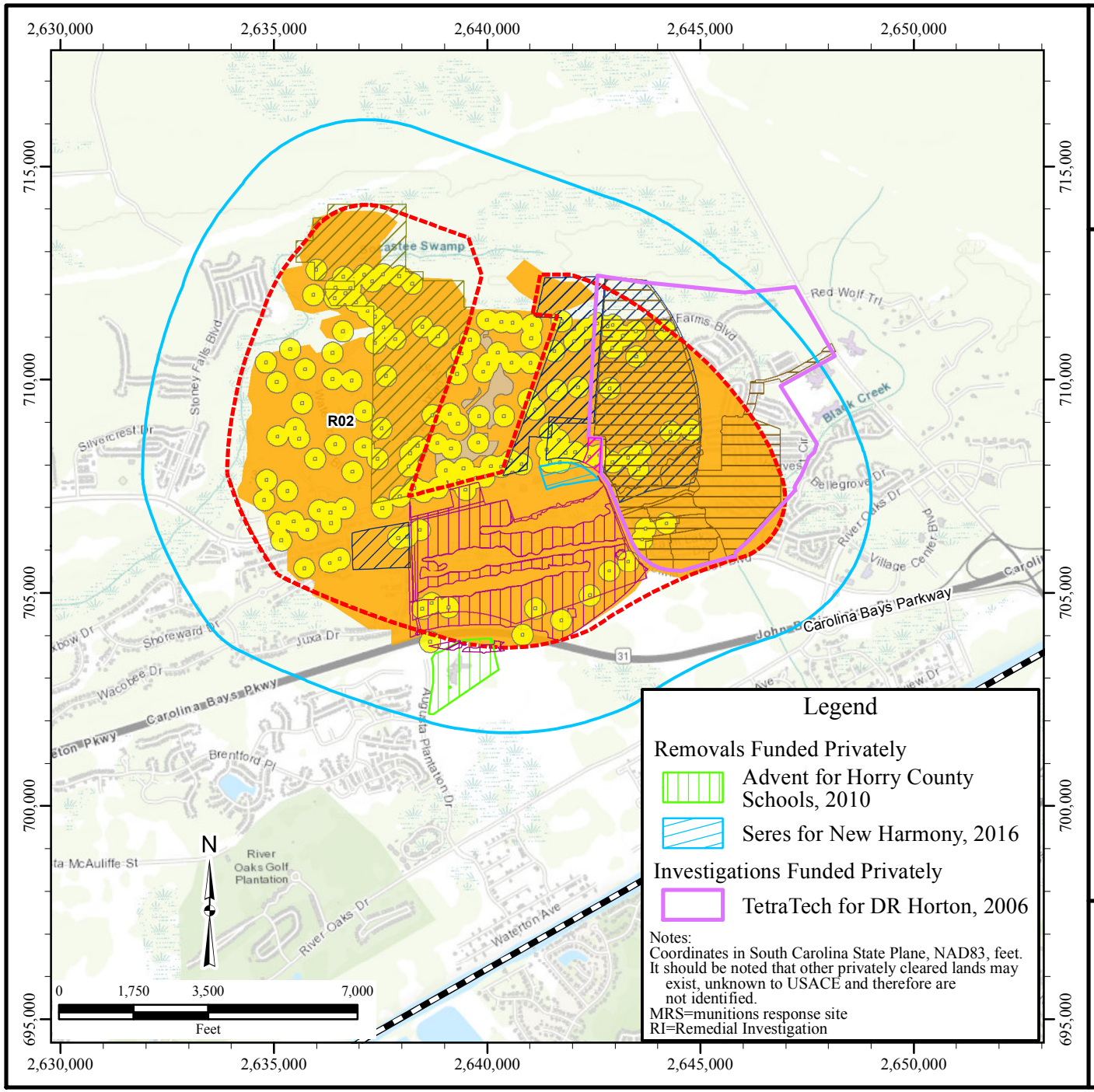


Figure 2.5b
MRS-R02
Range III Historical Work (by Type)

Legend

Former Conway Bombing and Gunnery Range Boundary

Munitions Response Site (1,961.2 acres)

Expanded Investigation Area (2,192.0 acres)

Funded by USACE

Parsons, 2003 (Investigation)

Parsons, 2003 (Removal)

EODT, 2012 (Investigation)

Removals Funded Privately

ERM for International Paper, 2005

EODT for Seventh Day Adventist Church, 2006

Kestrel for LandBank, 2006-2008

Kestrel & Advent for Waterbridge, 2006

Tetra Tech for DR Horton, 2006

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\ (2-05b)R02_Historical_Work.mxd
5/9/2018 JAR
Source: HGL, USACE, ERM, Kestrel, Parsons, Tetra Tech ArcGIS Online Topographic Imagery

HydroGeoLogic, Inc

HGL—RI Report—Former Conway Bombing and Gunnery Range, SC

This page was intentionally left blank.

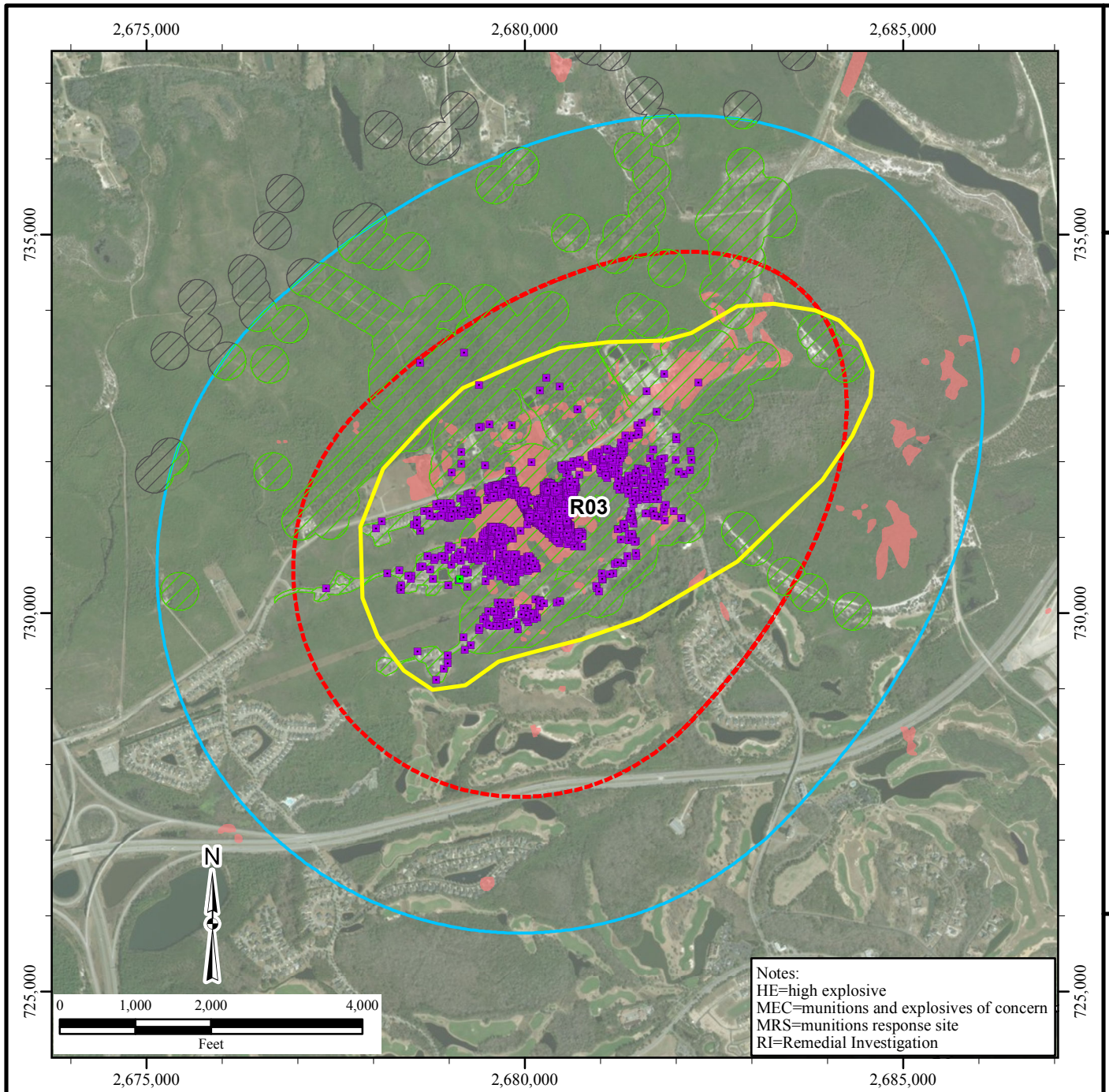


Figure 2.6a
MRS-R03
Historical Information and Previous Investigation

Legend

- 100lb Bomb (1,386 Items)
- 2.75" Rocket (3 Items)
- 20lb Bomb (5 Items)
- 4lb Bomb (4 Items)
- Other (10 Items)
- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Munitions Response Site (886.4 acres)
- Expanded Investigation Area (2,056.4 acres)
- Previously Characterized Area within Investigation Area (570.8 acres)
- Previously Investigated Area
- Historical Use Area (103.0 acres)

Notes:
HGL considers it unlikely that munitions with HE filler are present within MRS-R03.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.
Coordinates in South Carolina State Plane, NAD83, feet.

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-06a)R03_Historical.mxd
5/9/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

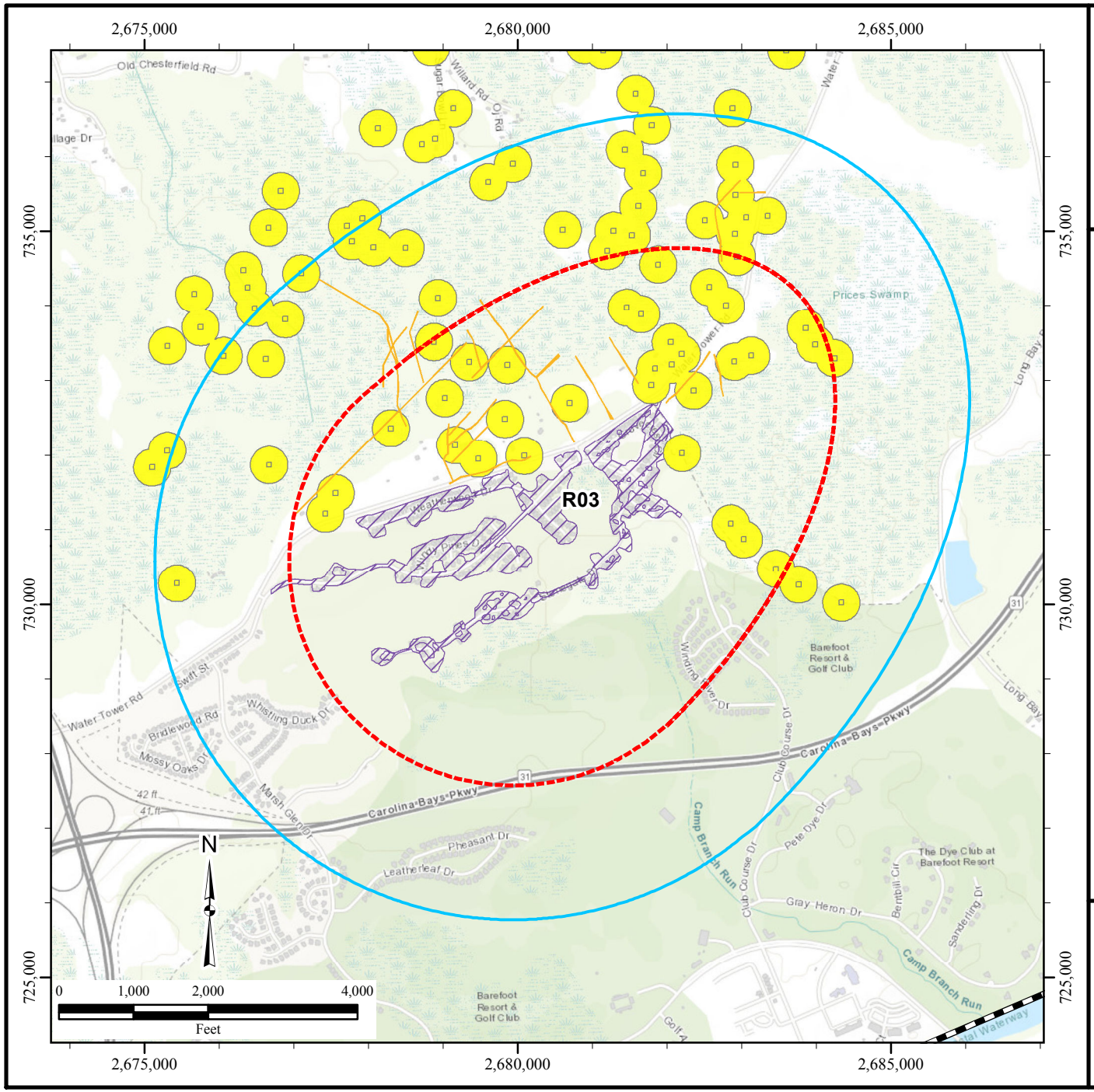


Figure 2.6b
MRS-R03
Range IV Historical Work (by Type)

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (886.4 acres)
- Expanded Investigation Area (2,056.4 acres)

Funded by USACE

- Parsons, 2003 (Investigation)
- EODT, 2012 (Investigation)

Funded Privately

- USA Environmental for Centex 2005, (Removal)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-06b)R03_Historical_Work.mxd
5/9/2018 JAR
Source: HGL, USACE, Parsons, USA Environmental, EODT
ArcGIS Online Topographic Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

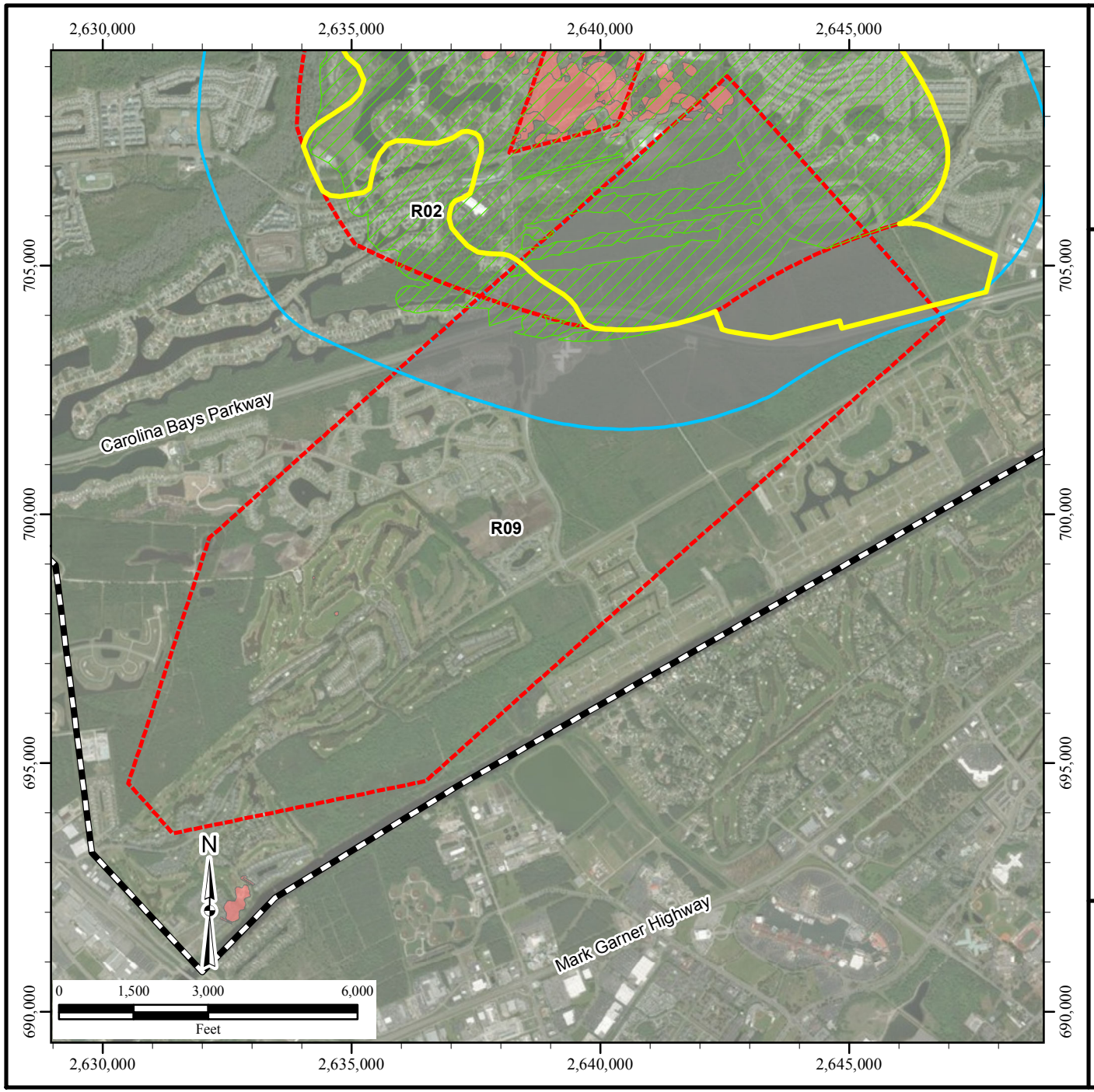


Figure 2.7a
MRS-R09
Historical Information and Previous Investigation

- Former Conway Bombing and Gunnery Range Boundary
- MEC Contamination Area
- Munitions Response Site (2,503.2 acres)
- Expanded Investigation Area
- Portion Investigated under MRS-R02 (905.2 Acres)
- Previously Investigated Area
- Historical Use Area

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.

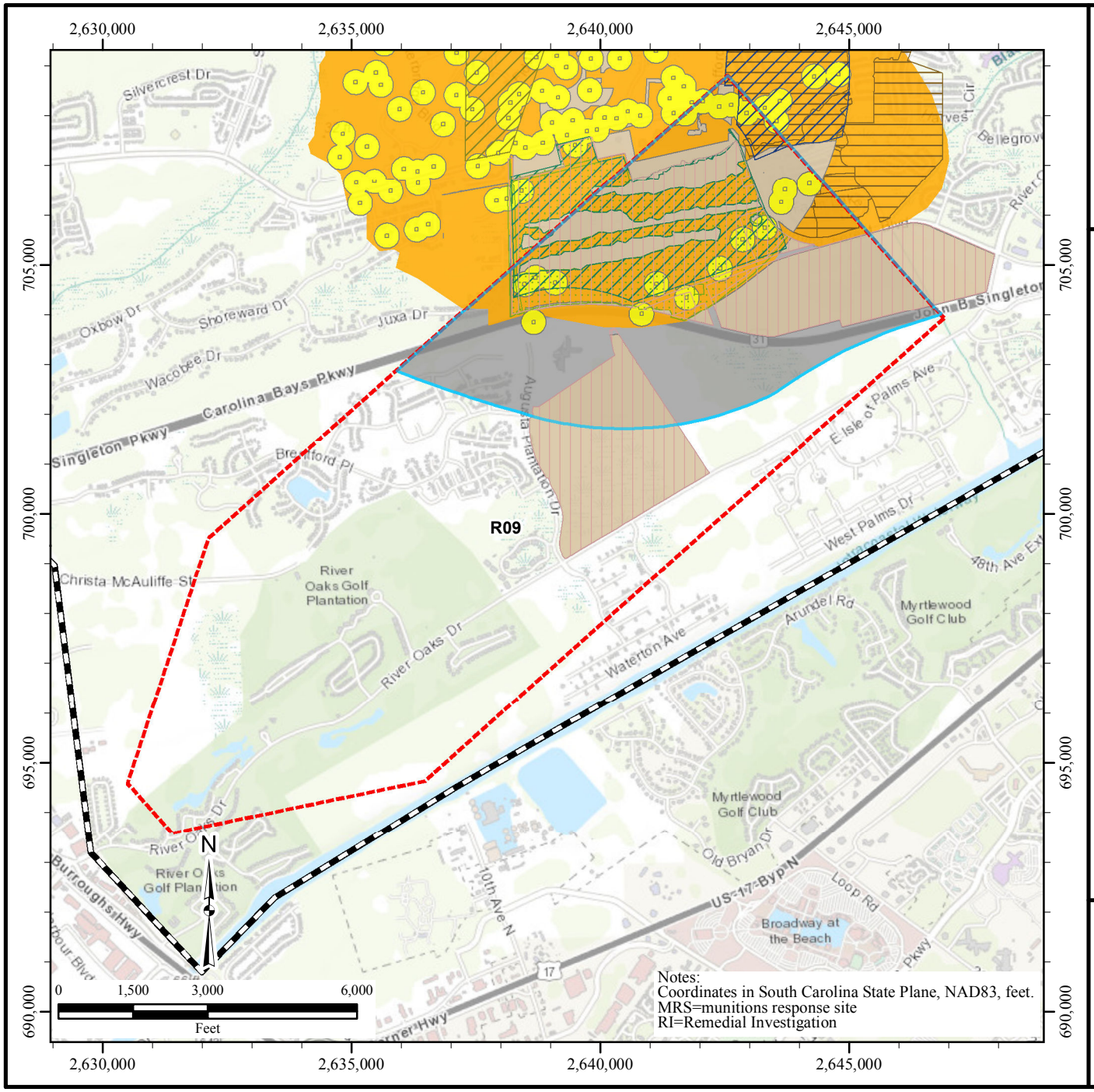
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-07a)R09_Historical.mxd
5/9/2018 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

Figure 2.7b
MRS-R09
Machine Gun/Rifle Range
Historical Work
(by Type)



Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
MRS=munitions response site
RI=Remedial Investigation

Legend

- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (2,503.2 acres)
- Portion Investigated under MRS-R02 (905.2 Acres)

Funded by USACE

- Parsons, 2003 (Investigation)
- Parsons, 2003 (Removal)
- EODT, 2012 (Investigation)

Funded Privately

- ERM, 2005 (Removal)
- Kestrel, 2006 (Removal)
- Kestrel, 2007 (Removal)
- Kestrel, 2009 Advent, 2009 (Removal)
- Tetra Tech, 2006 (Removal)
- Landbank, 2001 (Removal)
- Sweet 16, LLC (Removal)

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\ (2-07b)R09_Historical_Work.mxd
5/9/2018 JAR
Source: HGL, USACE, Parsons, ERM, Kestrel, Tetra Tech ArcGIS Online Topographic Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

Figure 2.8
MRS-R01
Range II
Historical MC Sampling

Legend

- MEC/MC Sample
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site
- Expanded Investigation Area

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

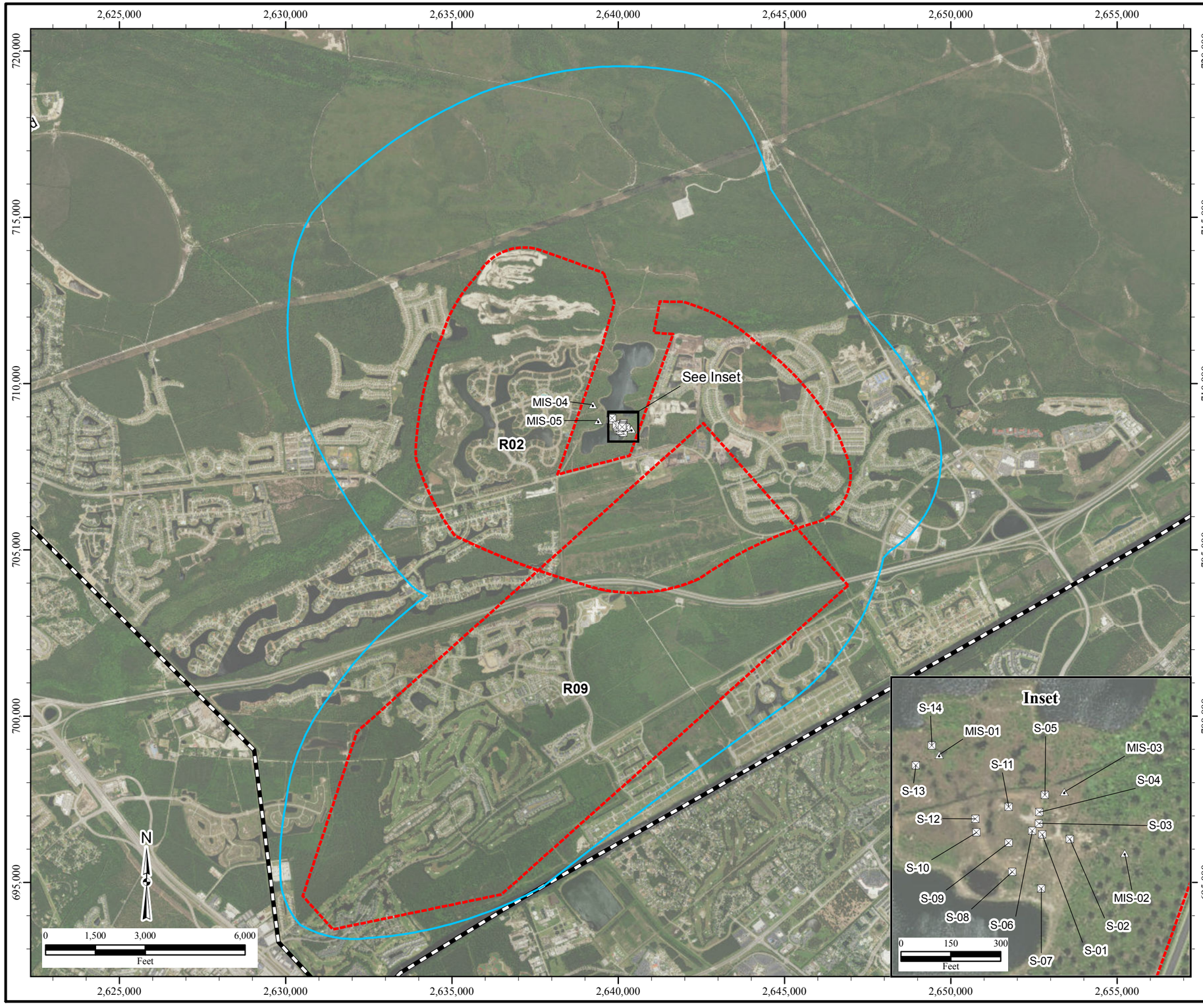
MC=Munitions Constituents
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(2-08)R01_HistoricalMC.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HGL HydroGeoLogic, Inc

This page was intentionally left blank.

Figure 2.9
MRS-R02
Range III
Historical MC Sampling



Legend

- MEC/MC Sample
- 2005 Parsons Soil Sample
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site
- Expanded Investigation Area

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

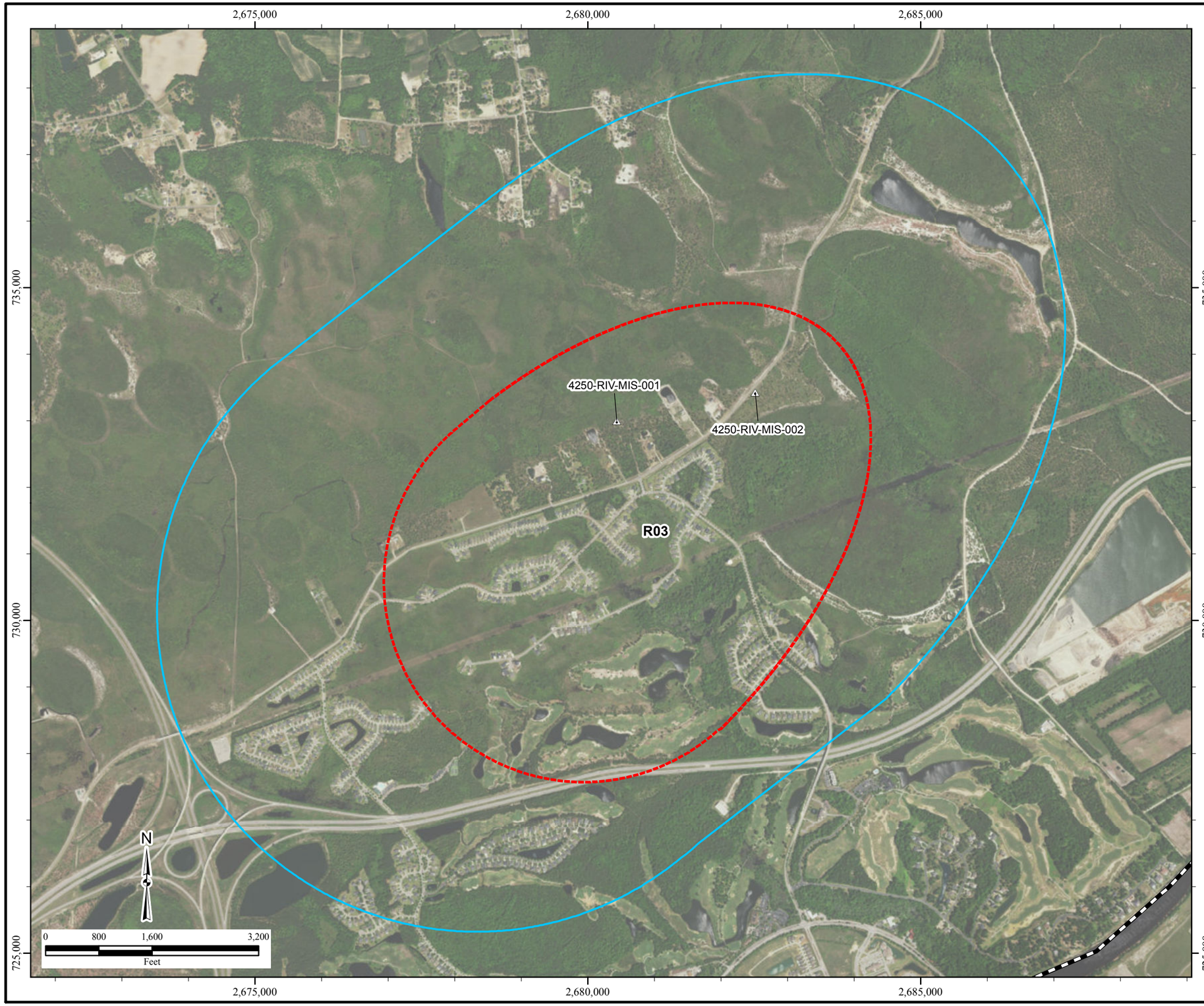
MC=Munitions Constituents
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI
(2-09)R02_HistoricalMC.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HGL HydroGeoLogic, Inc

This page was intentionally left blank.

Figure 2.10
MRS-R03
Range IV
Historical MC Sampling



Legend

- MEC/MC Sample
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site
- Expanded Investigation Area

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MC=Munitions Constituents
MEC=munitions and explosives of concern
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI
(2-10)R01_HistoricalMC.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HGL HydroGeoLogic, Inc

This page was intentionally left blank.

3.0 PROJECT REMEDIAL RESPONSE OBJECTIVES

3.0.1 This RI was conducted IAW the PWS, the approved Final Work Plan (HGL, 2015a), and Field Work Variances (provided in Appendix G). The purpose of this RI (Section 2.1.1) is to determine the nature and extent of MEC and evaluate the presence of MC contamination within the MRSs at Conway BGR. Further, if MC contamination is identified, the RI will determine the nature and extent MC contamination. The overall goal of this process is to gather information for development and future evaluation of remedial alternatives in a FS, and to provide sufficient data to facilitate the future remedial action. The preliminary remedial response objectives are presented in Chapter 3.2.

3.1 CONCEPTUAL SITE MODEL AND PROJECT APPROACH

3.1.1 Current and Future Land Use

3.1.1.1 Current land use within the former Conway BGR includes residential, commercial, and recreational (golf courses) uses. It is anticipated that future land use will remain consistent with current land use, and increased development is planned and ongoing. The presence of a known/suspected source of MEC and possible receptor interaction with MEC means that exposure pathways are potentially complete at the former Conway BGR. Current or future human receptors may be exposed to MEC hazards and MC contamination, if present, at the project site. **Table 3.1** presents the current and future land uses evaluated based on GIS data and the receptors for each MRS. The receptors and activities are discussed further in the paragraphs below.

3.1.2 Preliminary Conceptual Site Model

3.1.2.1 As part of the TPP process for the RI at the project site, preliminary CSMs were prepared for MEC and MC, based on site-specific details for each MRS. The preliminary CSMs indicate the known or suspected MEC/MC contamination sources; the potential/suspected locations and distribution of contamination; the related source or exposure media; the current and future receptors; and the potentially complete exposure pathways IAW EM 1110-1-1200. The CSMs incorporate the presence of MEC and MC in the environment and the pathways by which the receptors may contact MEC or MC. These exposure pathways can vary based on site-specific conditions. The site-specific conditions are incorporated into the evaluation of risks posed to receptors, along with the current and future land use, for any contaminated media confirmed to be present onsite. The exposure pathways are considered incomplete unless all four of the following are present:

- A source for contamination;
- An environmental transport and/or exposure medium;
- A point of exposure where contaminants contact a receptor; and
- A likely route of exposure at the point of exposure.

3.1.2.2 If any single factor listed is not present, the pathway is considered incomplete, meaning that there is no means for a receptor to contact MEC or MC. If there is no complete exposure pathway, there is no risk present from exposure to MEC or MC. Based on the initial evaluation

Table 3.1
Current and Future Land Use and Receptors by MRS

MRS	Land Use Types	Percent of Investigated Area [(1)]	Receptors
MRS-R01	Commercial	32%	Resident Indoor/Outdoor Worker Construction Worker Utility Worker Trespasser Recreational User
	Industrial	1%	
	Recreational	21%	
	Residential	32%	
	Unclassified [(2)]	14%	
MRS-R02	Commercial	3%	Resident Indoor/Outdoor Worker Construction Worker Utility Worker Trespasser Recreational User
	Industrial	1%	
	Recreational	1%	
	Residential	94%	
	Unclassified	1%	
MRS-R03	Commercial	5%	Resident Indoor/Outdoor Worker Construction Worker Utility Worker Trespasser Recreational User
	Industrial	4%	
	Recreational	20%	
	Residential	71%	
	Unclassified	0%	
MRS-R09	Commercial	19%	Resident Indoor/Outdoor Worker Construction Worker Utility Worker Trespasser Recreational User
	Industrial	2%	
	Recreational	19%	
	Residential	56%	
	Unclassified	4%	

[(1)] – *Land use percentages estimated using the current RI investigation GIS data. The percentage of the Expanded Investigation Area investigated during the current RI field activities is given.*
[(2)] – *Unclassified acreage consists of public roads or highways and other similar types of land use.*

conducted before the RI fieldwork commenced, the following receptors are considered to have the potential to be present at the former Conway BGR under the current and potential future land use scenarios:

- Trespasser;
- Recreational User;
- Resident;
- Indoor Worker;
- Utility Worker;
- Construction Worker; and
- Outdoor Worker (e.g., landscaper).

3.1.2.3 The activities performed by receptors at the site that may disturb surface soil are construction activities (for example residential or utility construction), gardening and home improvement projects by residential users, and landscaping projects by commercial users.

Construction projects by residential or commercial users may disturb subsurface soil. The presence of a known/suspected source of MEC and possible receptors means that exposure pathways are potentially complete. The identified current or future human receptors would potentially be exposed to explosive hazards and MC within the MRSs. Based on the identified current and future land uses (Commercial/Industrial, Recreational, and Residential, see **Table 3.1**) the human receptors for all MRSs are the receptors listed above. Typical intrusive activities could be conducted to 2-ft bgs for residential and recreational users, with intrusive activities conducted up to 25-ft bgs for construction workers (construction of ponds, utilities, swimming pools, etc.).

3.1.2.4 The preliminary MEC CSMs are presented on Figures 3.1a through Figure 3.1d and the preliminary MC CSMs are presented on Figure 3.2a through Figure 3.2d. The preliminary CSM is based on past DoD activities, potential MEC/MD presence, MEC/MD found since closure, previous investigation or historical clearance activities, historical and current land use, potential receptors, potential source and receptor interaction, and relevant exceedances of screening criteria for the MRSs present at the former Conway BGR.

3.1.2.5 The land that comprises MRS-R01 and MRS-R02 is privately owned and has been developed for residential housing and golf courses. Land uses identified within MRS-R01 and MRS-R02 include commercial/industrial, residential, recreational, and forestry. The maximum depth of intrusive activities associated with these land uses is anticipated to be up to 25-ft bgs. The preliminary MEC CSMs developed for MRS-R01 and MRS-R02 are presented in Figure 3.1a and Figure 3.1b. Preliminary MC CSMs for MRS-R01 and MRS-R02 are presented in Figure 3.2a and Figure 3.2b.

3.1.2.6 Similarly to MRS-R01 and MRS-R02, the land that comprises the MRS-R03 and MRS-R09 is privately owned and has been developed for residential housing and golf courses. Land uses identified within MRS-R03 and MRS-R09 include residential, recreational, and forestry. Hunting, mining, and agricultural activities have also taken place within MRS-R03 and MRS-R09; however, there is very little farm land remaining within these areas. The maximum depth of intrusive activities associated with these land uses is anticipated to be up to 25-ft bgs. The preliminary MEC CSMs developed for MRS-R03 and MRS-R09 a presented in Figure 3.1c and Figure 3.1d. Preliminary MC CSMs for MRS-R03 and MRS-R09 are presented in Figure 3.2c and Figure 3.2d.

3.2 PRELIMINARY REMEDIATION GOALS

3.2.1 Preliminary remediation goals (PRGs) are concentrations of contaminants for each exposure pathway that are believed to be protective based on preliminary site information. As with the CSM, PRGs may be reevaluated and refined throughout the RI process as new information becomes available.

3.2.2 As agreed to by the PDT during the TPP process (Appendix E), the goal of this RI/FS is: "to reduce the potential of exposure to MEC hazards and MC risk and ensure hunters, workers, residents, and farmers are aware of the risk of MEC. After completion of the Decision Document requirements that potential risk to human health and the environment from MEC or MC will be

reduced to the extent practical." This site closeout statement developed during the TPP process, and concurred to be the current stakeholders, is not confined specifically to this RI project. This site closeout statement should be viewed as the overall goal for the site in the future and following this RI project and any future projects, investigations or removals.

3.2.3 The PRG for MC is based on the screening values agreed to by the TPP Team and established in the work plan as protective to the receptors in the identified exposure pathways for former Conway BGR. The PRG is to ensure that any identified MC contamination at the site determined to pose an unacceptable risk to human health or the environment is addressed to minimize or mitigate those risks. For unacceptable risks, and in accordance with 40 CFR Part 300.430(e)(i), the USACE shall establish remedial action objectives (RAOs) specifying contaminants and media of concern, potential exposure pathways, and remediation goals. There were not unacceptable risks due to MC.

3.2.4 For unacceptable risk due to explosive hazards, development of the RAO requires the identification of specific munitions and explosives of concern (MEC) and media of concern at each MRS, the identification of exposure pathways to receptors within each MRS, and identification of acceptable remediation goals for each MRS. Then, for each MRS, the RAOs are presented in Section 8.2.

3.3 PRELIMINARY IDENTIFICATION OF ARARS AND TBC INFORMATION

3.3.0.1 Preliminary identification of chemical-specific and location-specific ARARs is conducted during the RI site characterization. Under federal and state laws, and as required by USACE Engineer Regulation (ER) 200-3-1, response actions must identify and attain or formally waive ARARs. ARARs are used as a starting point to determine the protectiveness of a site remedy. ARARs will guide the extent of site cleanup; help scope, formulate, and select appropriate remedial alternatives; and implementation and operation of the selected remedial alternative. As part of the future FS, primary consideration will be given to remedial alternatives that attain or exceed the requirements of the identified ARARs (Table 3.2). When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories, and guidance referred to as TBC are useful in designing and selecting a remedial alternative. The TBC information identified for this site is also presented in Table 3.2.

Table 3.2
Potential ARARs and TBCs

Standard, Requirement, Criterion, or Limitation	ARAR Status	Description	Analysis	Method of Attainment
Chemical-Specific				
USEPA Regional Screening Levels (RSLs)	TBC	RSLs are conservative, risk-based screening concentrations used for evaluating and cleaning up contaminated sites. USEPA has developed RSLs for industrial and residential land use. These concentrations represent allowable levels of chemicals in soil, groundwater, and drinking water. The RSL table can be found at: http://www.epa.gov/region9/superfund/prg/	Levels are applicable comparison criteria for MC analytical results.	Comparison of sample analytical results to RSLs.
Location-Specific				
Clean Water Act, 33USC §1344, Section 404(b)(1) 33 CFR 320,322, 323, 325-330 33 USC 1341, Section 401, 40 CFR 230-231	Applicable	Actions must be taken to avoid adverse impacts to, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	Potentially applicable if any water bodies are present on site and if any possible actions may result in disturbance within or adjacent to water bodies.	Work within wetland areas is limited to investigation and removal of MEC, MPPEH, or MD.
Action-Specific				
Resource Conservation and Recovery Act (RCRA), Subpart X, 40 CFR 264.601	Relevant and Appropriate	Environmental performance standards for treatment of munitions using consolidated shots at a designated open burning and open detonation OB/OD location.	Applicable if OB/OD areas are used during any remedial actions for consolidated shots. Not applicable for blow-in-place shots.	Waste material (such as deposition of explosives and metals in soil) resulting from disposal activities will be characterized by soil sampling IAW requirements.

3.3.1 Chemical-Specific ARARs

3.3.1.1 Chemical-specific ARARs are promulgated health-based or risk-based numerical values that establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. There are no chemical -specific ARARs identified for former Conway BGR. The risk-based screening levels (e.g., USEPA RSLs) are not considered chemical-specific ARARs because they are not promulgated, however are categorized as "To

Be Considered (TBC)". The chemical-specific TBCs that may be applicable were evaluated based on the completed exposure pathways.

3.3.2 Location-Specific ARARs

3.3.2.1 Location-specific ARARs generally are restrictions placed on the concentration of a hazardous substance or the conduct of activities solely because they are in special locations. The location-specific ARAR identified at the former Conway BGR includes the Clean Water Act (CWA), 33USC 1251, et seq., due to wetlands with the boundaries of the MRSs.

3.3.3 Action-Specific ARARs

3.3.3.1 Action-specific ARARs are usually technology or activity-based requirements or limitations placed on actions taken with respect to remedial actions, or requirements to conduct certain actions to address the conditions present at a site. One action-specific ARAR has been identified for the former Conway BGR, 40 CFR 264.601 (Subpart X). Any consolidated shot, or consolidated and blow activities, would need to adhere to RCRA rules. Waste material (such as deposition of explosives and metals in soil) resulting from disposal activities will be characterized by soil sampling IAW requirements.

3.4 SUMMARY OF INSTITUTIONAL ANALYSIS

3.4.1 Institutional analyses are prepared to support the development of IC strategies and plans of action as a munitions response alternative. These strategies rely on existing powers and authorities of government agencies to protect the public at large from potential MEC hazards and MC risks.

3.4.2 A review of government institutions and private entities that exercise jurisdiction and ownership of the project site indicated that ownership and control of land within the boundary of the four MRSs which are included in the RI are varied. Research during the ROE solicitation process indicates that of the 450 separate parcels identified within the four MRSs, there are 315 unique landowners, with some landowners holding multiple parcels. Of the 315 landowners, the majority are single family residences, with one unique owner for each parcel. Other types of landowners include: 28 commercial businesses, eight golf course management companies, eight property homeowner associations, 21 land developers, and five churches. The institutional analysis identified the entities with jurisdiction over the project site with regard to ICs. The Institutional Analysis is provided as Appendix C of this RI Report.

3.5 DATA NEEDS AND DATA QUALITY OBJECTIVES

3.5.1 Data Needs

3.5.1.1 Previous investigations at the former Conway BGR (as discussed in Chapter 2.4) were reviewed and evaluated during development of the Work Plan. Decision rules were developed and included in the Final Work Plan (HGL, 2015a) and are shown in Table 3.3. The methods used for the RI data collection included:

- Development of DQOs and data requirements through the TPP (documentation of TPP-related activities are presented in Appendix E);
- Performance of geophysical investigations to delineate potential extent of MEC contamination;
- Intrusive investigation of anomalies to evaluate the types and depths of MEC present;
- Sampling of site-specific media (surface and subsurface soil, sediment, and groundwater), as site-specific conditions dictate;
- Laboratory analysis and data management to compare detected MC concentrations with accepted criteria;
- Disposal of MEC, as necessary;
- Reporting of results through the TPP during the RI to identify data gaps and/or gain stakeholder concurrence;
- Update of the CSM and MRSPP; and
- Submittal of the RI report.

3.5.2 Data Quality Objectives

3.5.2.1 The DQOs are qualitative and quantitative statements that specify the data needs including type, amount, and quality required to support the decision-making processes for a project. The DQOs developed during the TPP process are provided in Tables 3.3a through 3.3e. The overall project DQOs were developed to obtain data to sufficiently characterize the nature and extent of MEC and/or MC contamination present at the project site, and to evaluate potential MEC hazards related to any identified contamination. The data obtained must also be sufficient to assess human health and ecological risks to facilitate development of the future FS. Chapter 5.1 through 5.3 show how DQOs were met. Chapter 5.1 discusses characterization of the types of MEC encountered within the site. Chapter 5.2 discusses the potential for MC contamination. Finally, Chapter 5.3 addresses the extent of MEC and MC contamination.

This page intentionally left blank.

Table 3.3
Decision Rules for MRSs, Former Conway BGR, Horry County, South Carolina

Row No.	Characterization (UXO/MC) and Preliminary Status	Investigation	Decision Rule	Intermediate Status	Decision Rule	Intermediate Status	Decision Rule	Final Status and Recommendation
1	UXO characterization where **UXO contamination** is anticipated	Conduct surface sweep in areas to undergo DGM survey and conduct DGM survey (visual inspection of surface and aboveground locations for UXO or MD).	If UXO and MD are located: Modify MRS boundaries to improve boundary accuracy and expand investigations (if needed).	**UXO contamination** is anticipated.	Following completion of geophysical surveys, the area will be identified as: 1) an area having elevated anomaly density or the potential to contain UXO, or 2) areas unlikely to contain UXO contamination.	1) Elevated Anomaly Density: Demonstrate that a 90 percent confidence has been achieved for determining both the potential depth of UXO and the nature (type and density) of UXO (See Section 4.2.1.0.1 and Table 4.1).	**UXO Contaminated:** Following intrusive investigation, if UXO or a significant amount of MD is found, the area will be characterized as UXO contaminated.	**UXO Contaminated:** Recommended for evaluation in FS.
						2) **Unlikely to Contain UXO Contamination**: Demonstrate that the investigation approach was capable of locating potential UXO contamination.	**Unlikely to Contain UXO Contamination:** If no MEC or MD are found, the area will be characterized as No Significant UXO Present.	**No Significant UXO Present:** No FS evaluation required, potential for NDAI.
2	UXO characterization where n**o UXO contamination is anticipated** [(1)]	Conduct surface reconnaissance using a Schonstedt magnetometer in non-MEC use areas.	If UXO and MD are located: Modify MRS boundaries to improve boundary accuracy and expand investigations (if needed).	**UXO contamination is anticipated.**	If UXO contamination is anticipated, the decision rules in Row 1 will apply.			
				UXO contamination is not anticipated.	If no UXO or MD is found, the area will be characterized as **no significant UXO present**.	**No significant UXO is present.** Recommended for NDAI.		
3	MC characterization	Conduct sampling of soil for MC (explosives and select metals) during Phase 1.	If MC is not detected during Phase 1 sampling or if concentrations are less than screening levels and/or background (as defined in the Work Plan Quality Assurance Project Plan [QAPP], Appendix E), then:	**No MC contamination is present.**				
			If MC are detected during Phase 1 sampling at concentrations exceeding the screening levels and/or background, then:	**MC contamination is present.**	If MC contamination is present, additional evaluations of the nature and extent of MC contamination (soil, sediment, and groundwater sampling) will be performed during Phase 2 and 3, and a risk assessment will be conducted to determine if a risk to human health or the environment exists.	**If MC contamination is present and there is a risk to human health or the environment, then additional evaluations of the nature and extent of the MC contamination will be performed.** Recommended for FS.		

(1) Areas where no UXO contamination is anticipated based on historical data or observed site conditions are omitted from the statistical requirements of the PWS.

This page was intentionally left blank.

Table 3.4a
Site-Specific MEC Data Quality Objective Summary for MRS-R01

Criteria from USEPA[1]	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
MEC Characterization	There is a potential for MEC to be present at MRS-R01, Range II, because it was used as practice bombing range, including high- and medium-altitude bombing, skip bombing, parafrag bombing, and rocket firing. The goal of the RI is to define the nature and extent of MEC potentially associated with MRS-R01, Range II and to determine if further response actions are required to support current and future residential, commercial, and recreational land use[2]	Risk, Remedy	MEC (UXO)	Surface and Subsurface soil	The analytical data inputs for this RI include the results of the previous investigations conducted at MRS-01, Range II. As listed in Section 1.7.2, these include a PA, SI, EE/CA, Removal Action and RI. The 2012 RI concluded that MEC had not been delineated and recommended further investigation. The boundaries of the current RI will address an expanded investigation area, which include potential source areas located outside of the original MRS boundaries in areas that were not previously characterized. The MRS-R01, Range II RI/FS Expanded Investigation Area is 1,561 acres.	The analytical approach for the RI will include performing: • Surface sweep in areas to undergo DGM survey; • DGM surveys (transects and grids) and; • Intrusive investigations. See RI Approach detailed in the Work Plan.	All investigations were conducted in accordance with (IAW) the performance and data quality metrics outlined in the Work Plan Quality Control Plan (QCP) (Section 4.0). The investigation set out in Figure 3.3 will meet the performance standards of the PWS: • all areas with elevated anomaly density or with potential to contain UXO are traversed and that there is a 90 percent chance of detecting these areas; • the boundaries of all identified UXO contaminated areas have been delineated to an accuracy of at least 250 ft; • 90 percent confidence has been achieved for determining the potential depth of UXO; • 90 percent confidence in the nature (type and density) of UXO and munitions related debris, for each relatively homogeneous UXO contaminated area, has been achieved; • portions of an MRS which are unlikely to contain UXO contamination may be omitted from the above statistical requirements; and • Demonstrate areas unlikely to contain a target with elevated anomaly density, but with the potential for UXO contamination (e.g. burial pits) are capable of being located by the investigation approach.	Following the DGM surveys, the expanded investigation area will be delineated into "elevated anomaly density" areas and areas unlikely to contain UXO contamination. The intrusive investigations will be placed accordingly based on the performance criteria and decision rule applied, with project team concurrence. Evaluations of the presence of UXO, MD, and known high-density anomaly areas will be used to indicate the likelihood of contamination.	Not applicable, see analytical methods listed for MCs.

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a crosswalk for each DQO element to the development steps from both the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA, USEPA QA/G-4, USEPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized here will continually be evaluated during field investigations against the appropriate decision rules.

(2) For the RI/FS the preliminary remediation objective for MEC is based on limiting interaction between any residual MEC and any receptors accessing the site and is anticipated to be either removal of any MEC present to a depth at which they no longer present a hazard to the anticipated human receptors, or to implement land use controls that will minimize the possibility of receptors coming into contact with MEC at the site.

This page was intentionally left blank.

Table 3.4b
MEC DQO Summary for MRS-R02

Criteria from USEPA [1]	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Project Objectives Satisfied**	**Data User Perspectives**
MEC Characterization	There is a potential for MEC to be present at MRS-R02, Range III because it was for high- and medium-altitude bombing, skip bombing, and rocket firing including demolition bombing, dive bombing, strafing, rocket firing, and incendiary bombing. The goal of the RI is to define the nature and extent of MEC potentially associated with MRS-R02, Range III and to determine if further response actions are required to support current and future residential, commercial and recreational land use[2]	Risk, Remedy	MEC (UXO)	Surface and Subsurface soil	The analytical data inputs for this RI include the results of the previous investigations conducted at MRS-02, Range III. There have been numerous investigations of this MRS, as listed in Section 1.7.3, which include: PA, SI, TCRA, EE/CA, removal actions and RI. The 2012 RI confirmed the presence of MEC, concluded that MEC had not been delineated, and recommended further investigation. The boundaries of the current RI will address an expanded investigation area, which include potential source areas located outside of the original MRS boundaries in areas that were not previously characterized. The MRS-R02, Range III RI/FS Expanded Investigation Area is 4,153 acres.	The analytical approach for the RI will include performing: • Surface sweep in areas to undergo DGM survey; • DGM surveys (transects and grids) and; • Intrusive investigations. See RI Approach detailed in the Work Plan.	• All investigations were conducted IAW the performance and data quality metrics outlined in the Work Plan QCP (Section 4.0). The investigation set out in Figure 3.4 will meet the performance standards of the PWS: • all areas with elevated anomaly density or with potential to contain UXO are traversed and that there is a 90 percent chance of detecting these areas; • the boundaries of all identified UXO contaminated areas have been delineated to an accuracy of at least 250 ft; • 90 percent confidence has been achieved for determining the potential depth of UXO; • 90 percent confidence in the nature (type and density) of UXO and munitions related debris, for each relatively homogeneous UXO contaminated area, has been achieved; • portions of an MRS which are unlikely to contain UXO contamination may be omitted from the above statistical requirements; and • Demonstrate areas unlikely to contain a target with elevated anomaly density, but with the potential for UXO contamination (e.g. burial pits) are capable of being located by the investigation approach.	Following the DGM surveys, the expanded investigation area will be delineated into "elevated anomaly density" areas and areas unlikely to contain UXO contamination. The intrusive investigations will be placed accordingly based on the performance criteria and decision rule applied, with project team concurrence. Evaluations of the presence of UXO, MD, and known high-density anomaly areas will be used to indicate the likelihood of contamination.	Not applicable, see analytical methods listed for MCs.

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a crosswalk for each DQO element to the development steps from both the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA, USEPA QA/G-4, USEPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized here will continually be evaluated during field investigations against the appropriate decision rules.

(2) For the RI/FS the preliminary remediation objective for MEC is based on limiting interaction between any residual MEC and any receptors accessing the site and is anticipated to be either removal of any MEC present to a depth at which they no longer present a hazard to the anticipated human receptors, or to implement land use controls that will minimize the possibility of receptors coming into contact with MEC at the site.

This page was intentionally left blank.

Table 3.4c
MEC DQO Summary for MRS-R03

Criteria from USEPA (1)	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
MEC Characterization	There is a potential for MEC to be present at MRS-R03, Range IV, because was for practice bombing, including medium-altitude bombing The goal of the RI is to define the nature and extent of MEC potentially associated with MRS-R03, Range IV and to determine if further response actions are required to support current and future residential, commercial, and recreational land use(2)	Risk, Remedy	MEC (UXO)	Surface and Subsurface soil	The analytical data inputs for this RI include the results of the previous investigations conducted at MRS-03, Range IV. As listed in Section 1.7.4, these include a PA, SI, EE/CA, Removal Action and RI. The 2012 RI concluded that MEC had not been delineated and recommended further investigation. The boundaries of the current RI will address an expanded investigation area, which include potential source areas located outside of the original MRS boundaries in areas that were not previously characterized. The MRS-R03, Range IV RI/FS Expanded Investigation Area is composed of 1,170 acres.	The analytical approach for the RI will include performing: • Surface sweep in areas to undergo DGM survey; • DGM surveys (transects and grids) and; • Intrusive investigations. See RI Approach detailed in the Work Plan.	All investigations will be conducted IAW the performance and data quality metrics outlined in the QCP (Section 4.0). The investigation set out in Figure 3.5 will meet the performance standards of the PWS: • all areas with elevated anomaly density or with potential to contain UXO are traversed and that there is a 90 percent chance of detecting these areas; • the boundaries of all identified UXO contaminated areas have been delineated to an accuracy of at least 250 ft; • 90 percent confidence has been achieved for determining the potential depth of UXO; • 90 percent confidence in the nature (type and density) of UXO and munitions related debris, for each relatively homogeneous UXO contaminated area, has been achieved; • portions of an MRS which are unlikely to contain UXO contamination may be omitted from the above statistical requirements; and • Demonstrate areas unlikely to contain a target with elevated anomaly density, but with the potential for UXO contamination (e.g. burial pits) are capable of being located by the investigation approach.	Following the DGM surveys, the expanded investigation areas will be delineated into "elevated anomaly density" areas and areas unlikely to contain UXO contamination. The intrusive investigations will be placed accordingly based on the performance criteria and decision rule applied, with project team concurrence. Evaluations of the presence of UXO, MD, frag, and known high-density anomaly areas will be used to indicate the likelihood of contamination.	Not applicable, see analytical methods listed for MCs.

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a crosswalk for each DQO element to the development steps from both the USEPA's Guidance on Systematic Planning Using the Data *Quality Objectives Process* USEPA, USEPA QA/G-4, USEPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized here will continually be evaluated during field investigations against the appropriate decision rules.

(2) For the RI/FS the preliminary remediation objective for MEC is based on limiting interaction between any residual MEC and any receptors accessing the site and is anticipated to be either removal of any MEC present to a depth at which they no longer present a hazard to the anticipated human receptors, or to implement land use controls that will minimize the possibility of receptors coming into contact with MEC at the site.

This page was intentionally left blank.

Table 3.4d
MEC DQO Summary for MRS-R09

Criteria from USEPA (1)	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
MEC Characterization	There is a potential for MEC to be present at MRS-R09, MG/RR because the historical use of the range was exclusively for small arms training activities, such as basic rifle marksmanship training. The goal of the RI is to define the nature and extent of MEC potentially associated with MRS-R09 to determine if further response actions are required to support current and future residential, commercial, and recreational land use(2)	Risk, Remedy	MEC (UXO)	Surface and Subsurface soil	The analytical data inputs for this RI include the results of the previous EE/CA and RI investigation conducted at MRS-09, as discussed in Section 1.7.5. The 2012 RI concluded that there was a potential presence of MEC at MRS-R09, however it was unable to be investigated due to ROE refusal. The historical boundary of MRS-R09, encompassing 2,056 acres, was not expanded for the RI. However, the portion of MRS-R09 that is also part of MRS-R02, will be investigated as a part of MRS-02. The remaining acres were investigated as MRS-09 during the current RI.	The analytical approach for the RI will include performing: • Surface sweep in areas to undergo DGM survey; • DGM surveys (transects and grids) and; • Intrusive investigations. See RI Approach detailed in the Work Plan.	All investigations will be conducted IAW the performance and data quality metrics outlined in the QCP (Section 4.0). The investigation set out in Figure 3.6 will meet the performance standards of the PWS: • all areas with elevated anomaly density or with potential to contain UXO are traversed and that there is a 90 percent chance of detecting these areas; • the boundaries of all identified UXO contaminated areas have been delineated to an accuracy of at least 250 ft; • 90 percent confidence has been achieved for determining the potential depth of UXO; • 90 percent confidence in the nature (type and density) of UXO and munitions related debris, for each relatively homogeneous UXO contaminated area, has been achieved; • portions of an MRS which are unlikely to contain UXO contamination may be omitted from the above statistical requirements; and • Demonstrate areas unlikely to contain a target with elevated anomaly density, but with the potential for UXO contamination (e.g. burial pits) are capable of being located by the investigation approach.	Following the DGM surveys, the MRS will be delineated into "elevated anomaly density" areas and areas unlikely to contain UXO contamination. The intrusive investigations will be placed accordingly based on the performance criteria and decision rule applied, with project team concurrence. Evaluations of the presence of UXO, MD, and known high-density anomaly areas will be used to indicate the likelihood of contamination.	Not applicable, see analytical methods listed for MCs.

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a crosswalk for each DQO element to the development steps from both the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA, USEPA QA/G-4, USEPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized here will continually be evaluated during field investigations against the appropriate decision rules.

(2) For the RI/FS the preliminary remediation objective for MEC is based on limiting interaction between any residual MEC and any receptors accessing the site and is anticipated to be either removal of any MEC present to a depth at which they no longer present a hazard to the anticipated human receptors, or to implement land use controls that will minimize the possibility of receptors coming into contact with MEC at the site.

This page was intentionally left blank.

Table 3.4e
MC DQO Summary: MRS-R01, MRS-R02, MRS-R03 and MRS-R09

Criteria from USEPA (1)	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
MC Characterization	Evaluate and determine nature and extent of MC contamination (2)	Risk, Remedy	MC to include explosives and select metals analyses in soil.	Soil	Incremental sampling methodology (ISM) sampling (explosives) and discrete sampling (metals) conducted at locations selected based on historical information, DGM data, and intrusive investigative results. If required, surface water features adjacent to impacted areas were identified for surface water, and sediment sampling. Additionally, existing groundwater wells down gradient of impacted MRSs were sampled.	Ten 100- by 100-ft ISM sampling unit (SU) parcels based on results of the geophysical survey. Ten discrete samples collected within each MRS. (One discrete sample collected from each of the 10 SUs.)	The screening levels as developed during the TPP process are set out in the Work Plan Appendix E (QAPP) worksheets. Site-specific background samples were used to assess metals concentrations. Decision rules regarding MC characterization are provided in Table 3.3. If there are MC detections at concentrations indicating contamination is present which may constitute a risk to the public or the environment, a risk assessment will be performed (Section 7.2).	Approach included collection of ISM soil samples, and discrete surface soil samples within each MRS.	ISM samples were analyzed for explosives (8330B). Analysis of discrete soil samples included select metals (6020A/7471).

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a crosswalk for each DQO element to the development steps from both the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA, USEPA QA/G-4, USEPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized here will continually be evaluated during field investigations against the appropriate decision rules.

(2) For the RI/FS the preliminary remediation objective for MC is based on the screening levels agreed to by the TPP team as being protective of the identified exposure pathways shown in the CSM. The preliminary remediation objective is to ensure that any identified MC contamination at the site determined to pose an unacceptable risk to human health or the environment is addressed to minimize or mitigate those risks.

This page was intentionally left blank.

FIGURES

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MEC	Surface Soil			Surface Soil	Direct Contact	●	●	●	●	●	●	--	●
	Subsurface Soil			Subsurface Soil	Direct Contact	●	--	●	--	--	--	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Figure 3.1a
Conceptual Site Model - MEC
Contamination
Current Site Conditions
Conway RI; MRS-R01, Range II

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MEC	Surface Soil			Surface Soil	Direct Contact	●	●	●	●	●	●	--	●
	Subsurface Soil			Subsurface Soil	Direct Contact	●	--	●	--	--	--	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Figure 3.1b
Conceptual Site Model - MEC
Contamination
Current Site Conditions
Conway RI; MRS-R02, Range III

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MEC	Surface Soil			Surface Soil	Direct Contact	●	●	●	●	●	●	--	●
	Subsurface Soil			Subsurface Soil	Direct Contact	●	--	●	--	--	--	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Figure 3.1c
Conceptual Site Model - MEC
Contamination
Current Site Conditions
Conway RI; MRS-R03, Range IV

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MEC	Surface Soil			Surface Soil	Direct Contact	●	●	●	●	●	●	--	●
	Subsurface Soil			Subsurface Soil	Direct Contact	●	--	●	--	--	--	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Figure 3.1d
Conceptual Site Model - MEC
Contamination
Current Site Conditions
Conway RI; MRS-R09, Machine Gun/Rifle Range

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MC (from MEC presence)	Erosion and Stormwater Runoff			Surface Soil	Incidental Ingestion	●	●	●	●	●	●	--	●
					Dermal Contact	●	●	●	●	●	--	--	●
				Sediment	Incidental Ingestion	--	--	--	●	●	●	--	●
					Dermal Contact	--	--	--	●	●	--	--	●
		Surface Soil	Bioaccumulation	Vegetation/Prey	Ingestion	--	--	--	--	●	●	--	●
		Surface Soil	Dust Emissions	Ambient Air	Inhalation	●	●	●	●	●	--	●	●
		Subsurface Soil		Subsurface Soil	Incidental Ingestion	●	--	●	--	--	--	--	--
					Dermal Contact	●	--	●	--	--	--	--	--
	Leaching			Groundwater	Ingestion	--	--	--	--	--	--	--	●
					Dermal Contact	--	--	--	--	--	--	--	●
					Inhalation while Showering	--	--	--	--	--	--	--	●
					Direct Contact[1]	--	--	--	--	--	●	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Note: The composition of future surface soil (surface soil data or pooled surface/subsurface soil data) will be determined after evaluation of the soil data.

[1] If the shallow groundwater is sampled, potential effects to the transition zone community will be evaluated.

Figure 3.2a
Conceptual Site Model - MC Contamination
Current Site Conditions
Conway RI; MRS-R01, Range II

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MC (from MEC presence)	Erosion and Stormwater Runoff			Surface Soil	Incidental Ingestion	●	●	●	●	●	●	--	●
					Dermal Contact	●	●	●	●	●	--	--	●
				Sediment	Incidental Ingestion	--	--	--	●	●	●	--	●
					Dermal Contact	--	--	--	●	●	--	--	●
		Surface Soil	Bioaccumulation	Vegetation/Prey	Ingestion	--	--	--	--	●	●	--	●
		Surface Soil	Dust Emissions	Ambient Air	Inhalation	●	●	●	●	●	--	●	●
		Subsurface Soil		Subsurface Soil	Incidental Ingestion	●	--	●	--	--	--	--	--
					Dermal Contact	●	--	●	--	--	--	--	--
	Leaching			Groundwater	Ingestion	--	--	--	--	--	--	--	●
					Dermal Contact	--	--	--	--	--	--	--	●
					Inhalation while Showering	--	--	--	--	--	--	--	●
					Direct Contact[1]	--	--	--	--	--	●	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Note: The composition of future surface soil (surface soil data or pooled surface/subsurface soil data) will be determined after evaluation of the soil data.

[1] If the shallow groundwater is sampled, potential effects to the transition zone community will be evaluated.

Figure 3.2b
Conceptual Site Model - MC Contamination
Current Site Conditions
Conway RI; MRS-R02, Range III

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MC (from MEC presence)	Erosion and Stormwater Runoff			Surface Soil	Incidental Ingestion	●	●	●	●	●	●	--	●
					Dermal Contact	●	●	●	●	●	--	--	●
				Sediment	Incidental Ingestion	--	--	--	●	●	●	--	●
					Dermal Contact	--	--	--	●	●	--	--	●
		Surface Soil	Bioaccumulation	Vegetation/Prey	Ingestion	--	--	--	--	●	●	--	●
		Surface Soil	Dust Emissions	Ambient Air	Inhalation	●	●	●	●	●	--	●	●
		Subsurface Soil		Subsurface Soil	Incidental Ingestion	●	--	●	--	--	--	--	--
					Dermal Contact	●	--	●	--	--	--	--	--
	Leaching			Groundwater	Ingestion	--	--	--	--	--	--	--	●
					Dermal Contact	--	--	--	--	--	--	--	●
					Inhalation while Showering	--	--	--	--	--	--	--	●
					Direct Contact[1]	--	--	--	--	--	●	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Note: The composition of future surface soil (surface soil data or pooled surface/subsurface soil data) will be determined after evaluation of the soil data.

[1] If the shallow groundwater is sampled, potential effects to the transition zone community will be evaluated.

Figure 3.2c
Conceptual Site Model - MC Contamination
Current Site Conditions
Conway RI; MRS-R03, Range IV

This page was intentionally left blank.

Source		Interaction				Receptors							
						Current/Future							
Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Contaminated Medium	Exposure Route	Construction Worker	Outdoor Worker	Utility Worker	Trespasser	Recreational User	Biota	Indoor Worker	Resident
MC (from MEC presence)	Erosion and Stormwater Runoff			Surface Soil	Incidental Ingestion	●	●	●	●	●	●	--	●
					Dermal Contact	●	●	●	●	●	--	--	●
				Sediment	Incidental Ingestion	--	--	--	●	●	●	--	●
					Dermal Contact	--	--	--	●	●	--	--	●
		Surface Soil	Bioaccumulation	Vegetation/Prey	Ingestion	--	--	--	--	●	●	--	●
		Surface Soil	Dust Emissions	Ambient Air	Inhalation	●	●	●	●	●	--	●	●
		Subsurface Soil		Subsurface Soil	Incidental Ingestion	●	--	●	--	--	--	--	--
					Dermal Contact	●	--	●	--	--	--	--	--
	Leaching			Groundwater	Ingestion	--	--	--	--	--	--	--	●
					Dermal Contact	--	--	--	--	--	--	--	●
					Inhalation while Showering	--	--	--	--	--	--	--	●
					Direct Contact[1]	--	--	--	--	--	●	--	--

● Potentially Complete Exposure Route

-- Incomplete Exposure Route

Note: The composition of future surface soil (surface soil data or pooled surface/subsurface soil data) will be determined after evaluation of the soil data.

[1] If the shallow groundwater is sampled, potential effects to the transition zone community will be evaluated.

Figure 3.2d
Conceptual Site Model - MC Contamination
Current Site Conditions
Conway RI; MRS-R09, Machine Gun/Rifle Range

This page was intentionally left blank.

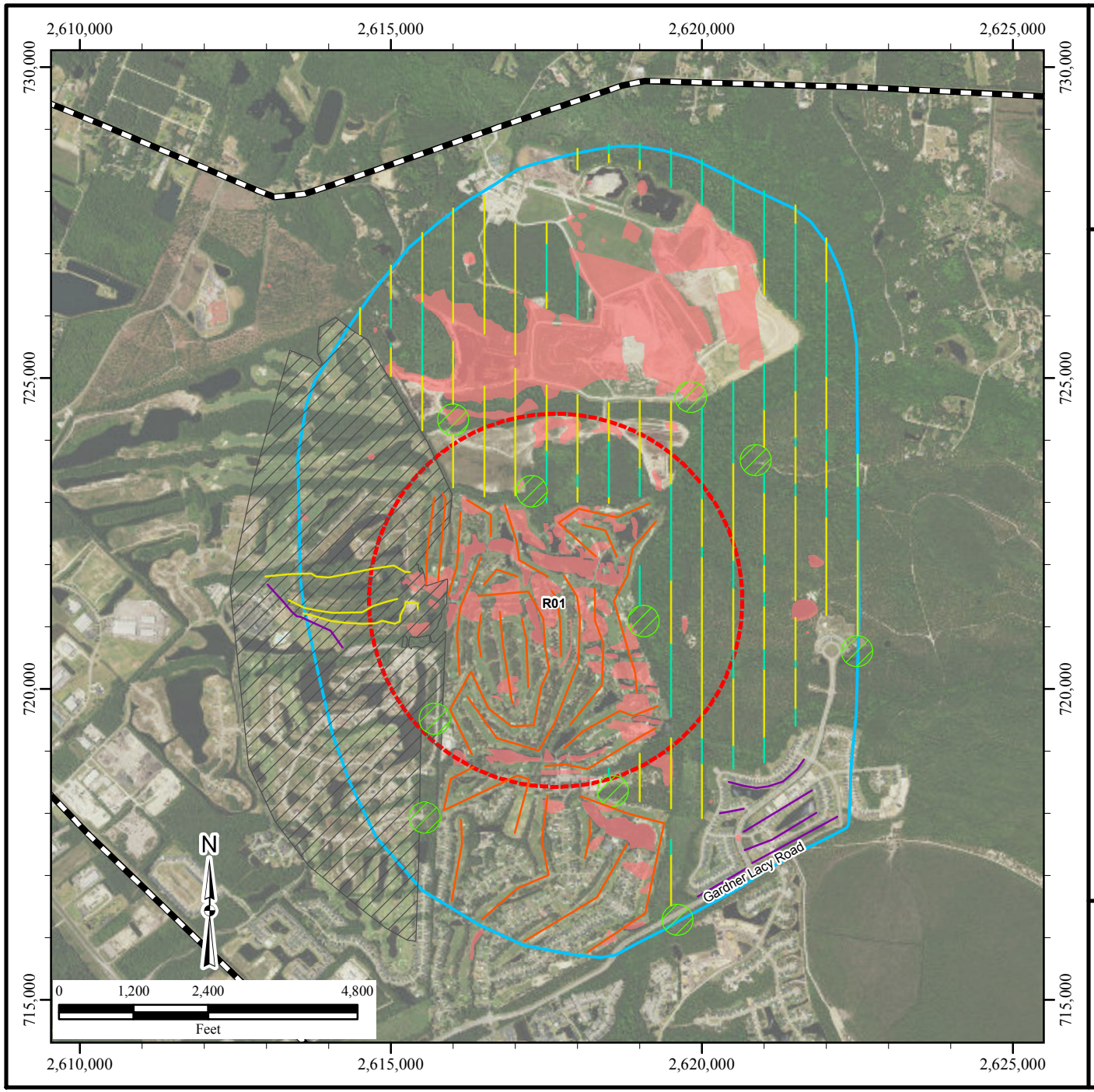


Figure 3.3
MRS-R01
Proposed Field Activity Work Plan

Legend

- Proposed Overland Transect (55,981 ft)
- Proposed Wetland Transect (25,318 ft)
- Proposed Golf Course Transect (78,018 ft)
- Proposed Residential Transect (8,445 ft)
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (649.2 acres)
- Expanded Investigation Area (2,209.8 acres)
- Previously Investigated Area within Investigation Area (362 acres)
- Previously Investigated Area
- Historical Use Area (318.6 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(3-03)R01_Field_Activity.mxd
10/9/2017 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

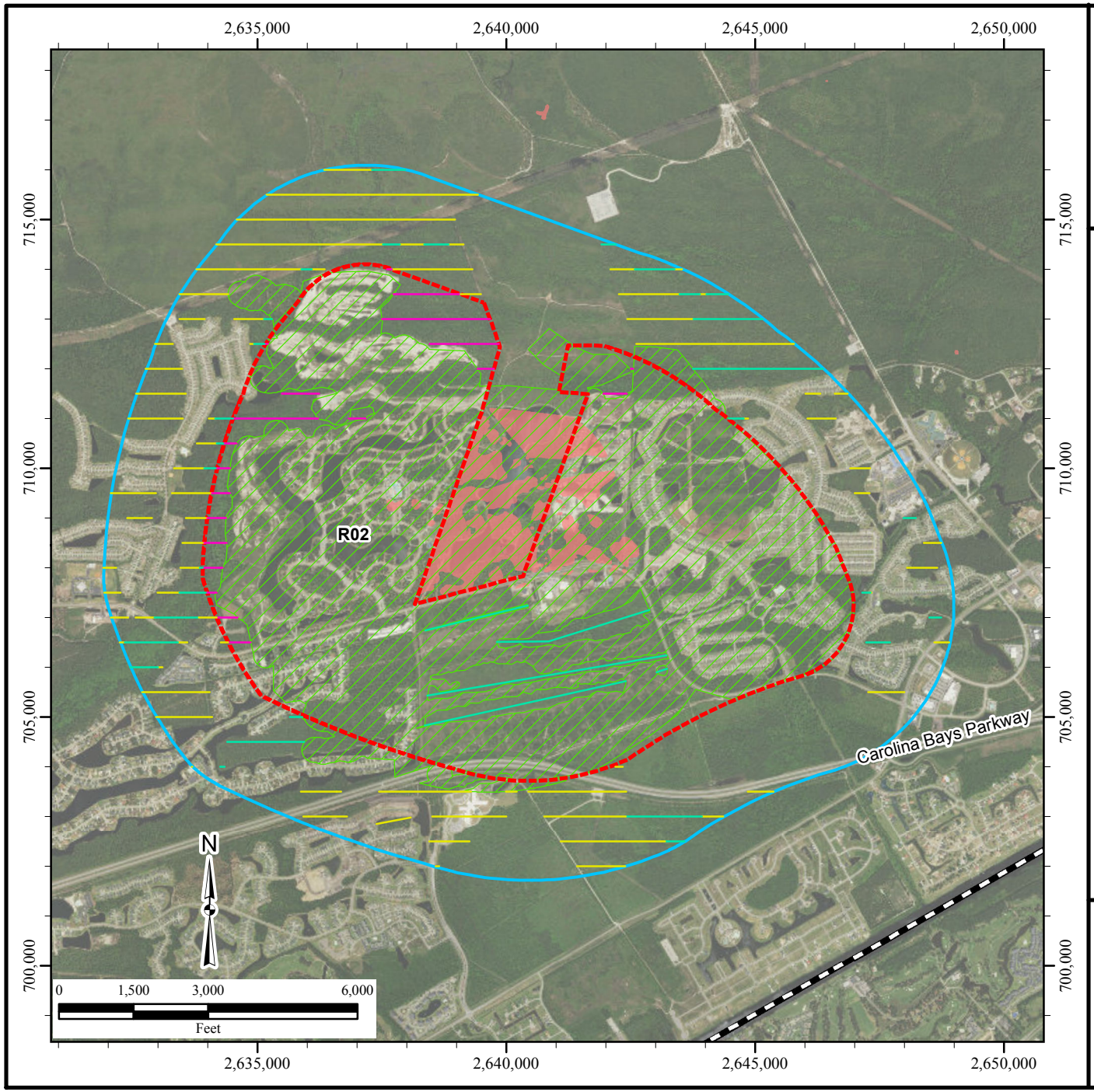


Figure 3.4
MRS-R02
Proposed Field Activity Work Plan

Legend

- Proposed Overland Transect (58,366.1 ft)
- Proposed Wetland Transect (31,513.7 ft)
- Proposed Mag and Dig Transect (11,893.2 ft)
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (1,961.2 acres)
- Expanded Investigation Area (2,192.0 acres)
- Previously Investigated Area (1,966.3 acres)
- Historical Use Area (165.6 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(3-04)R02_Field_Activity.mxd
10/9/2017 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

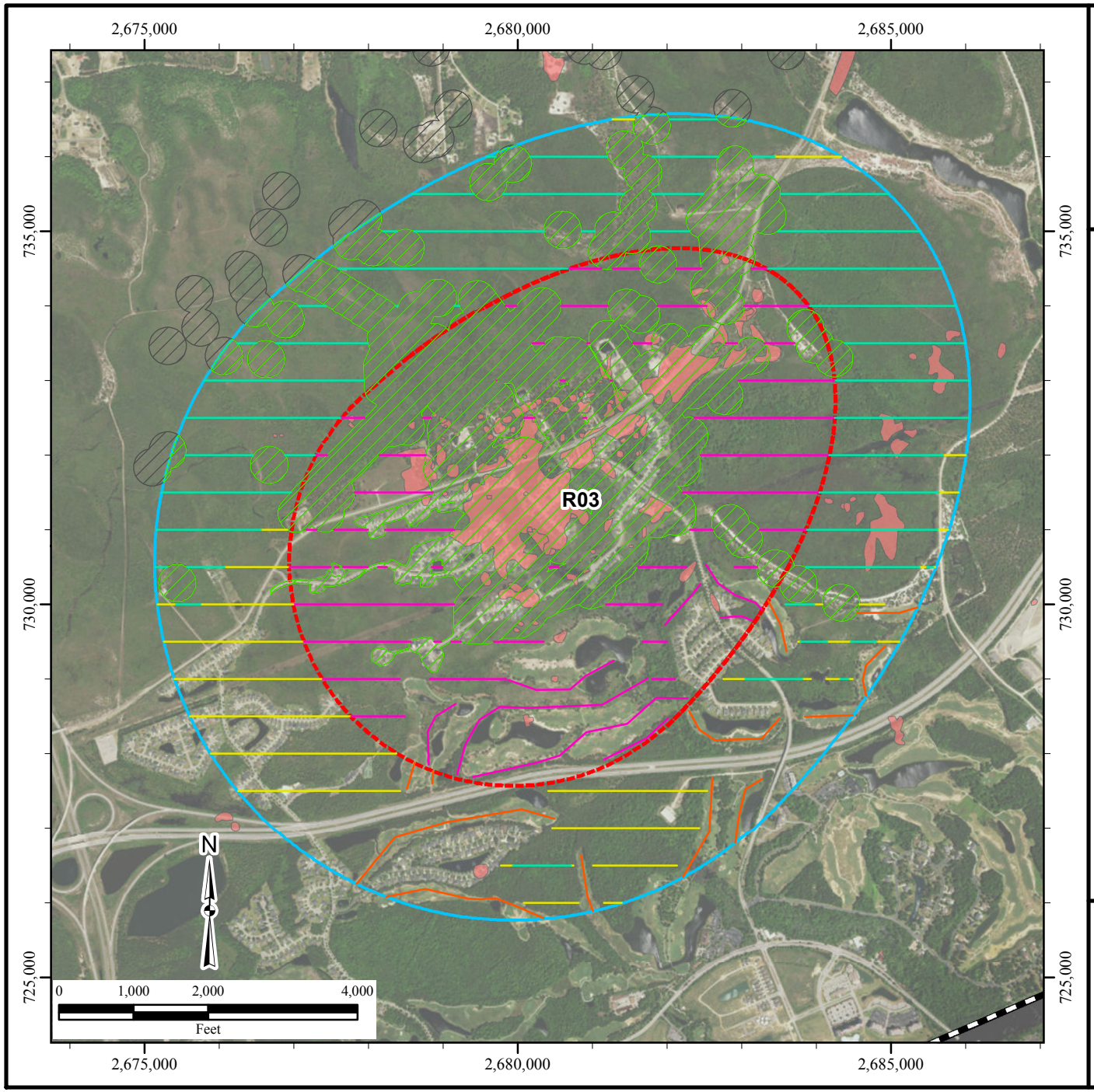


Figure 3.5
MRS-R03
Proposed Field Activity Work Plan

Legend

- Proposed Overland Transect (18,544 ft)
- Proposed Wetland Transect (45,718 ft)
- Proposed Golf Course Transect (13,419 ft)
- Proposed Mag and Dig Transect (39,428 ft)
- Proposed Residential Transect (4,989 ft)
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (886.4 acres)
- Expanded Investigation Area (2,056.4 acres)
- Previously Investigated Area within Investigation Area (570.8 acres)
- Previously Investigated Area
- Historical Use Area (103.0 acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.
Historical Use Areas were areas of ground scarring visible in historical aerial photographs not necessarily indicative of munitions presence.
MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(3-05)R03_Field_Activity.mxd
10/9/2017 JAR
Source: HGL, USGS, USACE ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.

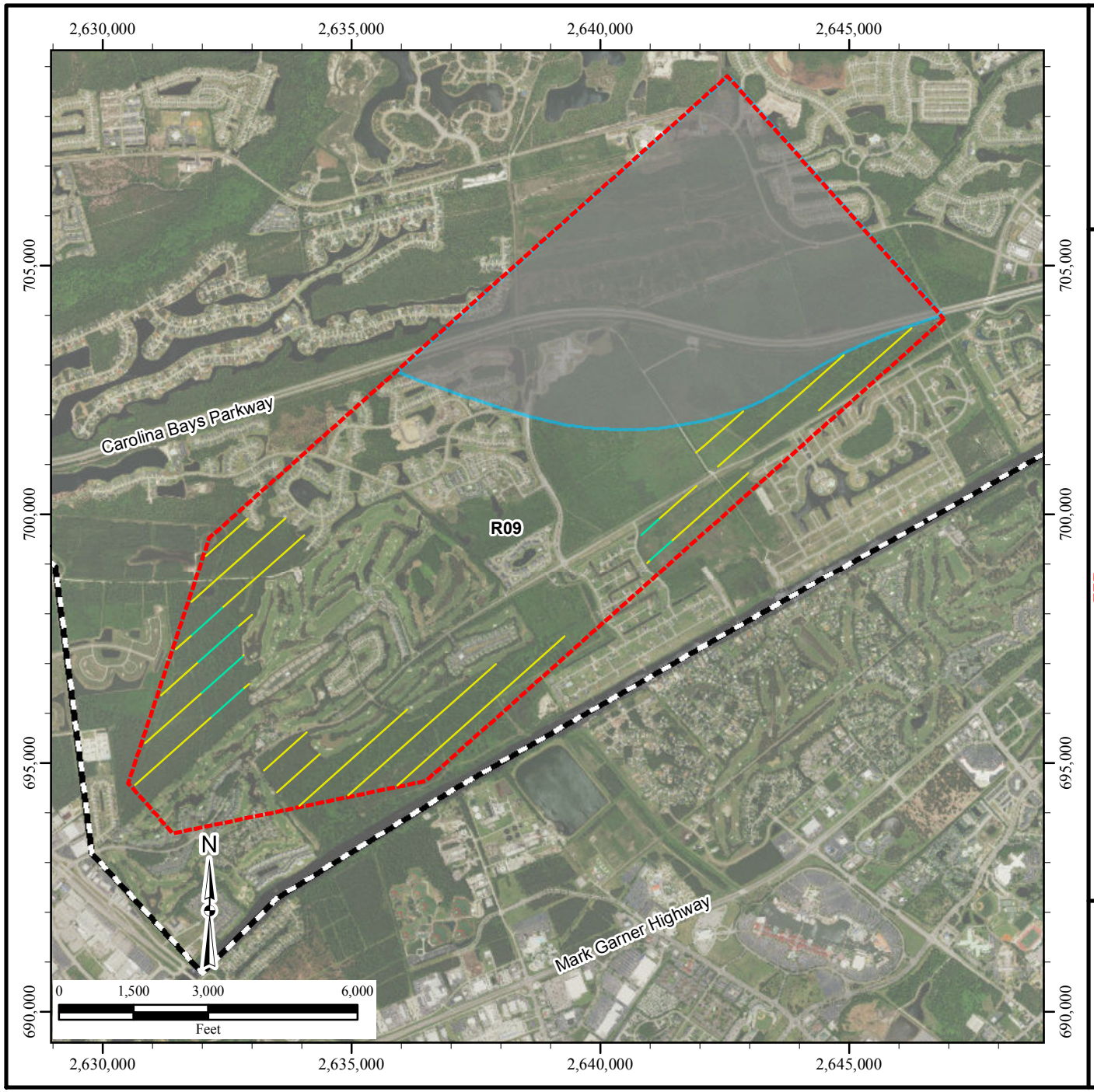


Figure 3.6
MRS-R09
Proposed Field Activity Work Plan

Legend

- Proposed Overland Transect (36,024 ft)
- Proposed Residential Transect (231 ft)
- Proposed Wetland Transect (4,874 ft)
- Former Conway Bombing and Gunnery Range Boundary
- Munitions Response Site (2,503.2 acres)
- Portion Investigated under MRS-R02 (905.2 Acres)

Notes:
Coordinates in South Carolina State Plane, NAD83, feet.

MRS=munitions response site
RI=Remedial Investigation

\\Gst-srv-01\HGLGIS\Conway_MSIW\RI\(3-06)R09_Field_Activity.mxd
4/14/2017 JAR
Source: HGL, USGS, USACE
ArcGIS Online World Imagery

HydroGeoLogic, Inc

This page was intentionally left blank.