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MCB CAMP LEJUENE
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FINAL RECORD OF DECISION OU 25, SITE UXO-19 MCB CAMP LEJEUNE NC
10/01/2015
CH2M HILL

Final

Record of Decision

Operable Unit 25, Site UXO-19

Marine Corps Base Camp Lejeune

North Carolina

October 2015

1 Declaration

1.1 Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for controlling explosive hazards from munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) at Operable Unit (OU) 25, Military Munitions Response Program (MMRP) Site UXO-19, located at Marine Corps Base Camp Lejeune (MCB Camp Lejeune), in Onslow County, North Carolina. Site UXO-19 is a cantonment area, known as Camp Devil Dog, that is used for training.

MCB Camp Lejeune was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective November 4, 1989 (USEPA Identification: NC6170022580). The remedy set forth in this ROD was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on information contained in the Administrative Record (AR) file for this site. Information not specifically summarized in this ROD or its references but contained in the AR has been considered and is relevant to the selection of the remedy at OU 25. Thus, the ROD is based on and relies upon the entire AR file in making the decision. Because of the NPL listing, and pursuant to CERCLA, the USEPA Region 4, North Carolina Department of Environment and Natural Resources (NCDENR), the Department of the Navy (Navy), and the United States Marine Corps (USMC) entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune in 1991. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at the Base are thoroughly investigated, and remediation of hazardous substances are undertaken in accordance with CERCLA when determined necessary to protect human health and the environment. The Installation Restoration Program (IRP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. Additionally, because of previous use of the site as a range, resulting in potential presence of MEC/MPPEH, the site is managed under the MMRP. No enforcement activities have been recorded at Site UXO-19.

1.2 Statement of Basis and Purpose

The Navy is the lead agency and provides funding for site cleanups at MCB Camp Lejeune. The remedy set forth in this ROD has been selected by the Navy, USMC, and USEPA. NCDENR, the support regulatory agency, actively participated throughout the investigation process, has reviewed this ROD and the materials on which it is based, and concurs with this Selected Remedy.

1.3 Scope and Role of Response Action

OU 25 is solely comprised of UXO-19 and is one of 25 OUs in the IRP at MCB Camp Lejeune. Information on the status of all the OUs and sites at MCB Camp Lejeune can be found in the current version of the Site Management Plan, available as part of the AR. This ROD presents the final remedial action for Site UXO-19 and OU 25.

1.4 Selected Remedy

1.4.1 Assessment of the Site

The Preliminary Assessment (PA)/Site Inspection (SI) and Expanded Site Inspection (ESI) (documented in the Remedial Investigation [RI] Report) at Site UXO-19 have identified unacceptable risks to human receptors from explosive hazards. Potential explosive hazards were significantly reduced during the MMRP investigations; however, there are limitations to MMRP investigations, including those imposed by instrument limits and site conditions that prevent 100 percent removal. Therefore, MEC/MPPEH may remain onsite in those areas where it could not be detected because of the above limitations, and contact with the types of MEC/MPPEH that may be present could potentially result in injury or death. The response action selected in this ROD is necessary to protect public health or welfare from potential explosive hazards.

The Selected Remedy for Site UXO-19 is land use controls (LUCs) to reduce or prevent the potential for direct physical contact with MEC/MPPEH to allow current and reasonably anticipated land use (infantry training) at the site to continue. LUCs include signs, educational programs, and administrative and legal controls that help to minimize the potential for exposure to contamination and protect the integrity of a response action.

1.4.2 Statutory Determinations

The Selected Remedy is protective of human health, complies with federal and state **applicable or relevant and appropriate requirements (ARARs)**, is cost-effective, and uses permanent solutions to the maximum extent practicable. The Selected Remedy does not satisfy the statutory preference for treatment as a principal element because LUCs are being used to prevent any remaining unacceptable risks to human health and the environment. If MEC/MPPEH is later encountered in areas subject to LUCs, MCB Camp Lejeune explosive ordnance disposal (EOD) personnel, or similarly qualified unexploded ordnance (UXO) technicians, will evaluate the material to determine if it poses an explosive hazard. Based on the evaluation, the Navy will take all necessary actions, including onsite treatment, as appropriate, to address unacceptable risks to human health and the environment.

Because the remedy will result in potential explosive hazards remaining onsite that prevent unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy is or will be protective of human health and the environment. The Navy will review the final remedial action no less than every 5 years after initiation of the remedial action, in accordance with CERCLA Section 121(c) and the NCP at 40 Code of Federal Regulations (CFR) § 300.4309 (f)(4)(ii). If results of the 5-year reviews reveal that remedy integrity is compromised and protection of human health is insufficient, additional remedial actions would be evaluated by the parties and implemented by the Navy.

1.5 Data Certification Checklist

The following information is included in **Section 2, Decision Summary** of this ROD. Additional information can be found in the AR[1] file for MCB Camp Lejeune, Site UXO-19.

- Types of MEC/MPPEH identified during the MMRP intrusive investigations (**Section 2.1**, **Section 2.5**, and **Table 4**)
- Explosive hazard evaluation (**Section 2.6**)
- How source materials constituting principal threats (MEC) are addressed (**Section 2.7**)
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessment and ROD (**Section 2.6**)
- Potential land use that will be available at the site as a result of the Selected Remedy (**Section 2.10.3** and **Table 10**)
- Estimated capital, annual operations and maintenance, and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (**Section 2.9** and **Table 8**)

[1] **Bold blue text** identifies detailed site information available in the AR and listed in the References Table.

- Key factor(s) that led to selecting the remedy (describing how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (**Section 2.10**)

If contamination posing an unacceptable risk to human health or the environment is discovered after execution of this ROD, the Navy will undertake all necessary actions to ensure continued protection of human health and the environment.

1.6 Authorizing Signatures

This ROD presents the Selected Remedy at Site UXO-19, OU 25, at MCB Camp Lejeune, located in Onslow County, North Carolina.

NOV 0 9 2015

T.D. WEIDLEY
Brigadier General, U.S. Marine Corps
Commanding General
Marine Corps Installations East-Marine Corps Base, Camp Lejeune

Date

12/9/15

Franklin E. Hill
Director, Superfund Division
United States Environmental Protection Agency, Region 4

Date

With concurrence from:

Jim Patterson for:

11/16/2015

Linda Culpepper
Director, Division of Waste Management
North Carolina Department of Environment and Natural Resources

Date

2 Decision Summary

2.1 Site Description and History

MCB Camp Lejeune is a 156,000-acre facility located in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville. The mission of MCB Camp Lejeune is to maintain combat-ready units for expeditionary deployment. The Base provides housing, training facilities, and logistical support for Fleet Marine Force and other assigned units.

Site UXO-19 occupies an area of approximately 64 acres of the Camp Devil Dog training area. Camp Devil Dog is a training area in the northwest portion of MCB Camp Lejeune where each year roughly 21,000 Marines receive training in land navigation, first aid, defensive combat, offensive combat, and night maneuvers. Facilities within the boundary of Site UXO-19 currently consist of billeting, training classrooms, and messing.

A Military Operations in Urban Terrain (MOUT) training facility is adjacent to the eastern site boundary. The MOUT is an active training area for troops to practice tactical combat maneuvers in an urban setting. The MOUT was initially investigated as part of Site UXO-19 but was removed from the site because it will continue to be an active training area.

Various **ranges and training courses** have been in use within and adjacent to the site since the early 1950s, resulting in the potential presence of explosive hazards at Site UXO-19. The potential sources of explosive hazards are the MEC/MPPEH resulting from the use of military munitions at these historical and active ranges within and adjacent to Site UXO-19 (**Figure 1**).

2.2 Site Characteristics

2.2.1 Topography, Drainage, and Surface Features

The topography within the site boundary is relatively flat, with surface elevations ranging from 14 feet to 26 feet above mean sea level across the site. No surface water bodies lie within the site boundary, although stormwater runoff is presumed to flow toward the east and southeast, eventually discharging to unnamed tributaries of the New River.

Buildings within the site consist of small concrete block classrooms, military housing, a small medical facility, a bath house, and a headquarters building. An obstacle training course is also located at the site. The eastern portion of the site is generally undeveloped. Before investigation activities began, a portion of the site was heavily vegetated. Much of the vegetation, including trees smaller than 6 inches in diameter, was cleared during the MMRP intrusive investigations. The surface features are depicted on the conceptual site model, **Figure 2**.

2.2.2 Geology and Hydrogeology

Site-specific **geological and hydrogeological characteristics** were derived from soil borings collected during the PA/SI field activities. These activities were limited to a depth of roughly 25 feet below ground surface (bgs). The shallow soils encountered within the site consist of poorly graded sands, sands with variable amounts of silt and clay, and occasional clay lenses ranging from 3 inches to more than 9 feet thick.

The hydrogeological information was derived from temporary monitoring wells installed during the PA/SI. Monitoring wells were gauged before groundwater samples were collected. The water table was encountered at depths ranging from 9.54 feet bgs to 17.20 feet bgs, with groundwater elevations ranging from 4.62 to 10.40 feet above mean sea level. Groundwater in the surficial aquifer generally flows toward the northeast with an average hydraulic gradient of 0.002 foot/foot (**Figure 2**).

2.3 Previous Investigations

Site UXO-19 was characterized through investigations conducted between 2009 and 2013 as summarized in **Table 1**. Investigations at Site UXO-19 are part of the AR and can be referenced for further details.

FIGURE 1

Site and Historical Range Location Map

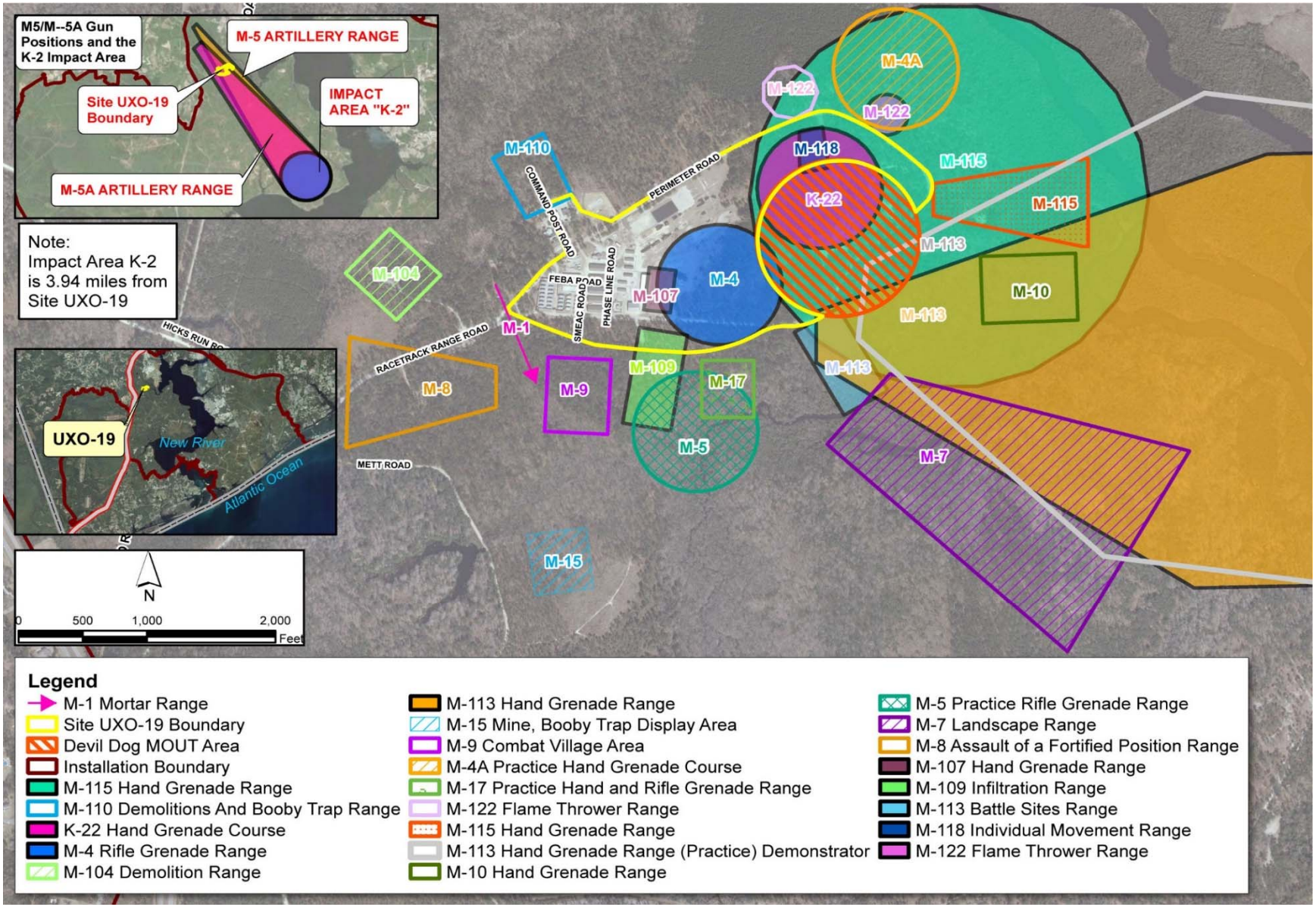
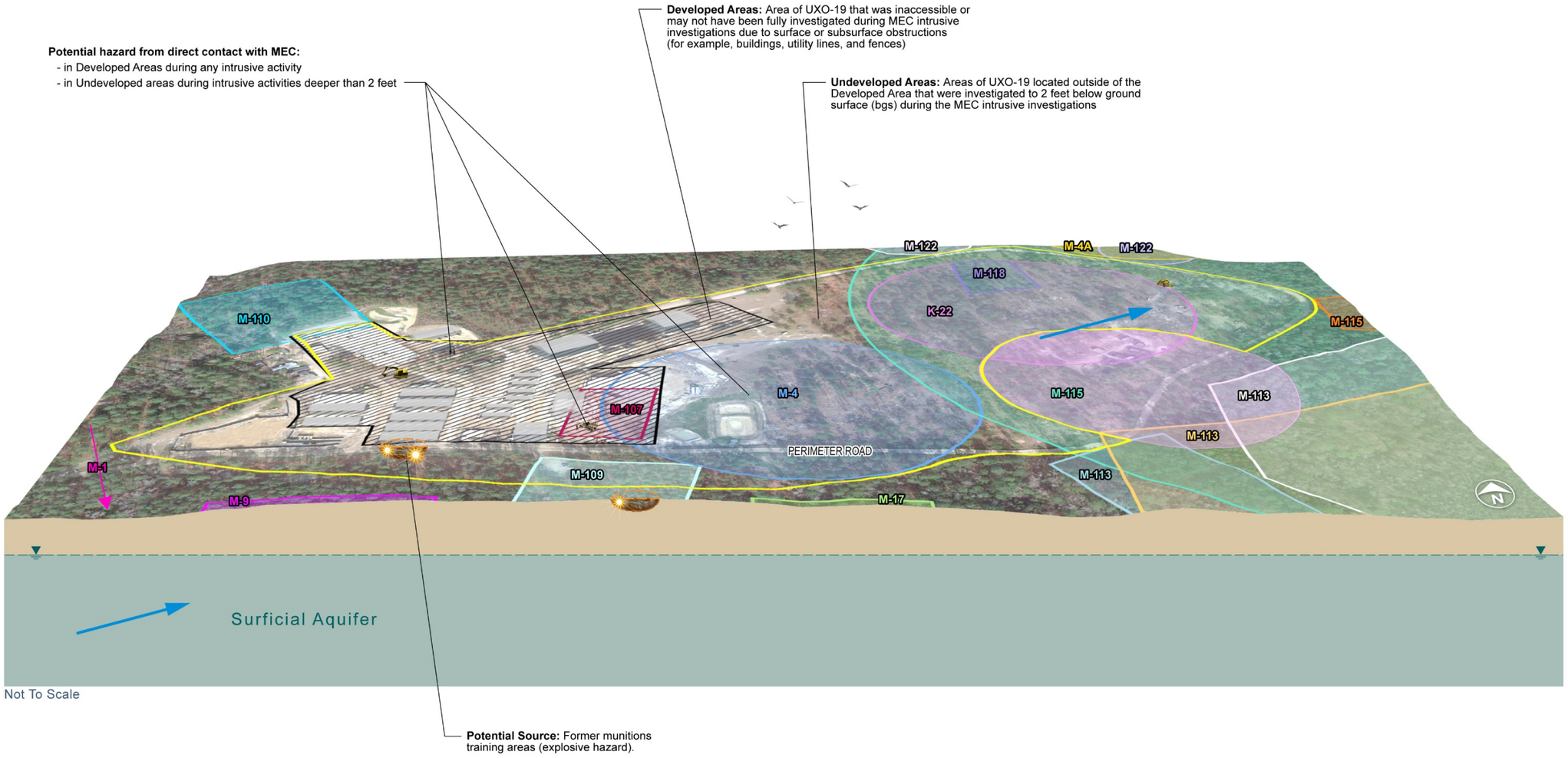


FIGURE 2
Conceptual Site Model



LEGEND

- Site UXO-19 Boundary
- Developed areas
- Water table
- Groundwater flow direction (surficial aquifer)
- Possible buried munitions and explosives of concern (MEC)/ material potentially presenting an explosive hazard (MPPEH)
- M-1 Mortar Range
- K-22 Hand Grenade Course
- M-4 Rifle Grenade Range
- M-4A Practice Hand Grenade Course
- M-9 Combat Village Area
- M-17 Practice Hand and Rifle Grenade Range
- M-107 Hand Grenade Range
- M-109 Infiltration Range
- M-110 Demolitions And Booby Trap Range
- Devil Dog MOUT
- M-113 Battle Sites Range
- M-113 Hand Grenade Range (Practice) Demonstrator
- M-113 Hand Grenade Range
- M-115 Hand Grenade Range
- M-115 Hand Grenade Range
- M-118 Individual Movement Range
- M-122 Flame Thrower Range
- M-122 Flame Thrower Range

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TABLE 1
Summary of Previous Investigations

Previous Investigations/ Actions	AR Numbers	Date	Activities and Findings
PA/SI	002885	2009	The PA/SI was conducted at Site UXO-19 to evaluate the potential for contamination of site media that may have resulted from former range activities. Soil and groundwater samples were collected and an MMRP investigation was conducted in transects that covered approximately 10 percent of the site (**Figure 3**). Field activities were completed in accordance with the MMRP Master Project Plans (AR 004162) and Site-Specific Work Plan Addendum for Focused PA/SI, Camp Devil Dog Construction Area (AR 004399). 3-nitrotoluene in groundwater and arsenic, antimony, and nitroglycerin in soil **exceeded screening levels** at one or more locations. A total of 4,645 geophysical anomalies were identified; 4,417 were investigated (the remaining items were inaccessible due to surface features such as packed roadways, standing water, and semi-permanent training aids). Approximately 51 percent of the anomalies investigated were identified as MEC or MPPEH. The 42 MEC items were disposed of using explosive detonation. The MPPEH items were inspected, demilitarized, and disposed of as material documented as safe (MDAS). **Human health and ecological risk screenings** were conducted to assess the potential for unacceptable risks from exposure to munitions constituents (MC) in soil or groundwater. No unacceptable risks were identified to human or ecological receptors from exposure to MC in soil or groundwater based on current or potential future use. However, there were unacceptable risks identified to human receptors from explosive hazards. A 100 percent MMRP intrusive investigation was recommended to reduce the overall risk.
RI/Feasibility Study (FS)	005876	2013	In 2013, an MMRP intrusive investigation was completed at Site UXO-19 within an expanded 64-acre area of the site. Field activities[2] were completed in accordance with the PA/SI Work Plan Addendum (AR 002929). The MMRP intrusive investigation was completed over 100 percent of accessible areas, including the area previously investigated during the PA/SI. The entire site including the MOUT was investigated. The extent of the digital geophysical mapping (DGM) survey is shown on **Figure 4**. MEC/MPPEH was encountered from ground surface to as deep as 4 feet bgs. During both the PA/SI and ESI, a total of 51,604 **anomalies were investigated**, of which 447 items were identified as MEC and 50,771 items were identified as MPPEH. The majority of MEC and MPPEH items were from 60-millimeter (mm) and 81-mm mortar projectiles. Upon inspection, all demilitarized MPPEH were certified as MDAS. However, MEC/MPPEH may remain onsite in those areas where it could not be detected because of instrumentation limitations and site conditions preventing 100 percent investigation. An **explosive hazard assessment,** evaluating the conditions after the MMRP intrusive investigation was completed, indicated that there is a potential for explosive hazards from subsurface MEC, deeper than the investigation limits in the undeveloped area and in the developed/inaccessible areas.

[2] The investigation was initially planned as an ESI; however, based on the results and potential explosive hazards remaining after the ESI, an RI was recommended. The ESI field work and results were documented in the RI and no additional field work was warranted for the RI.

TABLE 1
Summary of Previous Investigations

Previous Investigations/ Actions	AR Numbers	Date	Activities and Findings
RI/FS (continued)	005876	2013	Remedial alternatives were developed and evaluated to address the remaining potential explosive hazards. The following **remedial alternatives were evaluated**: • 1 – No Action • 2 – LUCs • 3 – Subsurface removal of MEC/MPPEH in undeveloped areas (via excavation, DGM, and intrusive investigation) and LUCs • 4 – Subsurface removal of MEC/MPPEH in undeveloped areas (via excavation and sifting) and LUCs

2.4 Munitions Constituents - Nature and Extent and Fate and Transport

Surface and subsurface soil and groundwater were investigated during the PA/SI (**Figure 3**). The MC data, consisting of explosives residues, including pentaerythritol tetranitrate and nitroglycerin; perchlorate; and select metals (lead, antimony, copper, zinc, and arsenic) were compared to the following screening levels[3]:

- Groundwater – the more conservative value between the federal maximum contaminant level (MCL) and North Carolina Groundwater Quality Standard (NCGWQS), USEPA adjusted[4] tapwater regional screening level (RSL), and MCB Camp Lejeune **background threshold value** (BTV) for metals.
- Soil – North Carolina Soil Screening Level for the protection of groundwater (NC SSL), USEPA-adjusted residential and industrial RSL, and MCB Camp Lejeune BTV for metals

The following constituents were detected above one or more screening levels

- Groundwater – 3-nitrotoluene at one location (**Table 2**)
- Surface Soil – antimony, arsenic, and nitroglycerin at one or more locations (**Table 3**)
- Subsurface Soil – arsenic at one or more locations (**Table 3**)

Explosives residues and metals have the potential to be released into the environment if the MEC/MPPEH corrodes, exposing the filler, or if filler is exposed because of incomplete detonation. Upon release, fate and transport of the explosives residues and metals are controlled by physical processes such as sorption, dilution, advection, and dispersion and by chemical and biological processes such as biodegradation, phototransformation (transformation processes requiring natural light), and phytotransformation (uptake and possible degradation through plants).

[3] Screening levels used during the PA/SI were current as of December 2009. The screening levels were reviewed during the RI/FS to identify changes from the PA/SI, and updated BTVs and RSLs current at the time of the RI/FS (November 2012) were used to identify exceedances.
[4] Noncarcinogenic RSLs are adjusted by dividing by 10 to account for exposure to multiple chemicals.

TABLE 2
Groundwater Screening Level Exceedances

Constituent	Screening Level		Rate of Exceedances	Concentration
	NCGWQS	Adjusted Tapwater RSL (November 2012)		
Groundwater				
Explosives Residues (µg/L)				
3-nitrotoluene	NS	0.13	1/27	0.21

µg/L – microgram per liter
NS – no standard

TABLE 3
Soil Screening Level Exceedances

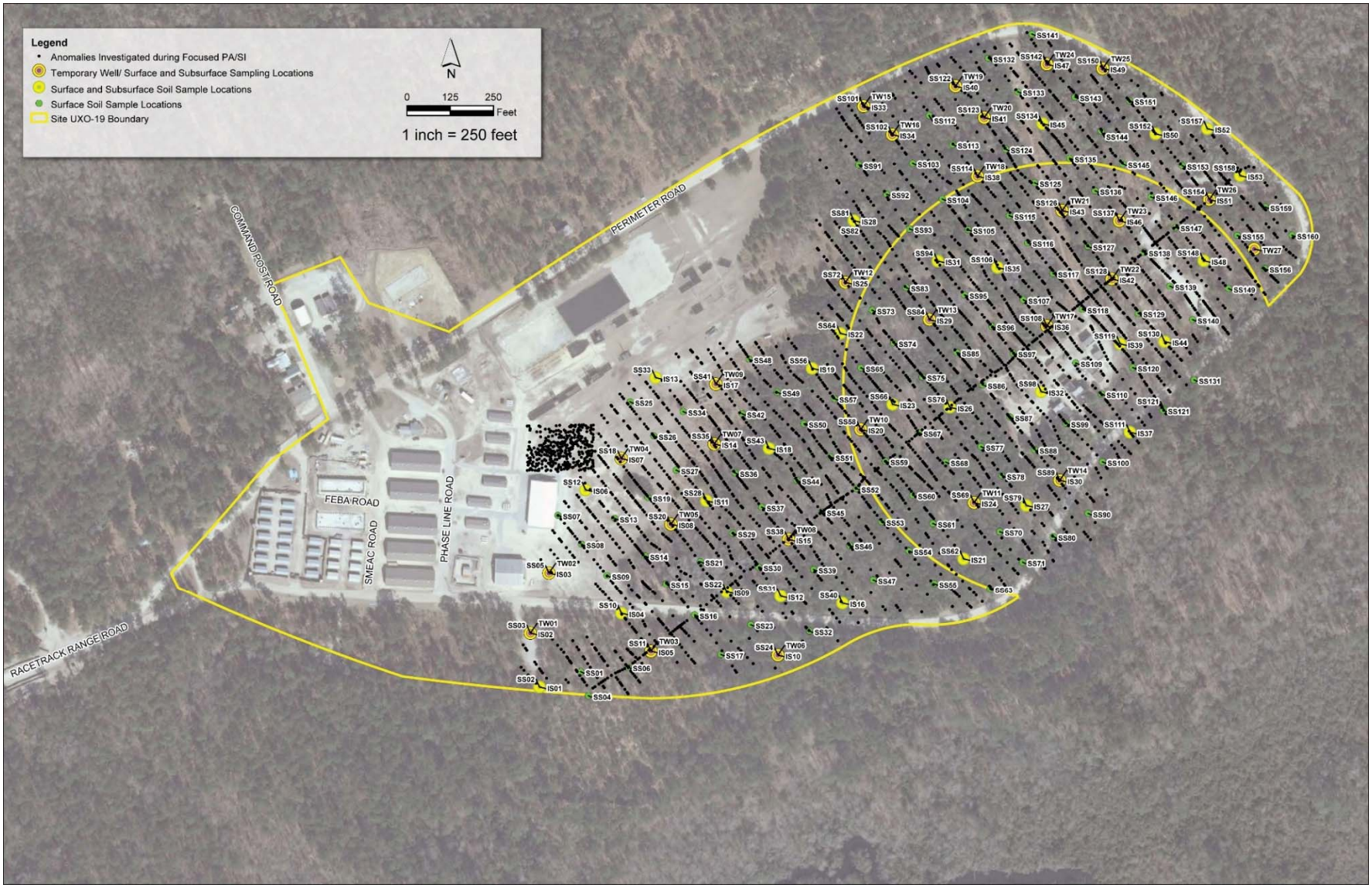
Constituent	Screening Level				Rate of Exceedances	Range of Concentrations
	Background	NC SSL	Adjusted Industrial RSL (November 2012)	Adjusted Residential RSL (November 2012)		
Surface Soil						
Explosives Residues (mg/kg)						
Nitroglycerin	NS	NS	8.2	0.62	1/160	ND to 3.6
Metals (mg/kg)						
Antimony	1.87 (a)	0.9	41	3.1	1/160	ND to 5.2
Arsenic	1.17 (a)	5.8	3	0.67	15/160	1.6 to 11.7
Subsurface Soil						
Metals (mg/kg)						
Arsenic	5.09 (b)	5.8	3	0.67	36/54	1.4 to 11.7

(a) BTV for undeveloped area surface soil, combined soil types (AR 04705, 04706)

(b) BTV for undeveloped area subsurface soil, combined soil types (AR 04705, 04706)

mg/kg – milligram per kilogram
ND – not detected above laboratory detection limits
NS – no standard

FIGURE 3
PA/SI Sampling Locations



2.5 MEC/MPPEH - Nature and Extent and Release Mechanisms and Migration

The DGM survey indicated widespread anomalies representing potential MEC/MPPEH throughout the investigation area. DGM could not be completed in areas where buildings, permanent or semi-permanent structures, heavy vegetation or uneven ground, or other obstacles were present. Additionally, although DGM was completed as close as a geophysical instrument could physically move next to buildings and other structures, interference from the obstacles may have occurred, causing incomplete clearance of the areas around the excluded areas. The DGM mosaic and exclusion areas are shown on **Figure 4**.

During the PA/SI, the DGM survey was conducted along transects over approximately 10 percent of the site. A total of 4,645 geophysical anomalies that represented potential subsurface MEC were identified and 4,417 anomalies were investigated (shown on **Figure 3**). During the 100 percent MMRP intrusive investigation, performed as part of the RI, a total of 46,911 individual geophysical anomalies and 24 saturated response areas (SRAs), were identified for intrusive investigation. An SRA is an area where one or more subsurface geophysical anomalies are present for which the signal is so strong that individual anomalies cannot be distinguished. Upon intrusive investigation, the SRAs were resolved into 276 individual anomalies.

A total of 447 MEC and 50,771 MPPEH items were identified during the intrusive investigations. The types of items are summarized on **Table 4** and the locations are shown on **Figure 5**. The following is a summary of the MMRP intrusive investigation findings:

- MEC/MPPEH was recovered from both the surface and subsurface to a depth of 4 feet.
- The MEC/MPPEH items were distributed throughout the site with no discernible pattern or apparent correlation with former range areas. The distribution of items appears to be denser in the undeveloped eastern portion of the site; however, this may be because the developed/inaccessible areas were covered by roads and buildings that interfered with the intrusive investigation.
- Over 50 percent of the MEC items contained high explosive filler.
- Nine MEC items were found during military construction support in areas beneath buildings or structures that were demolished and beneath culverts.

Based on these results, MEC/MPPEH may be present at depths greater than 18 inches bgs and in areas where buildings are currently present. Although the maximum detection limit for geophysical instruments is 24 inches, it is conservatively assumed that 18 inches is the maximum depth that geophysical instruments can reliably detect grenade-sized objects.

All MEC items were disposed of through explosive detonation either in place or at a consolidation point. Upon inspection and re-inspection, all MPPEH was certified as MDAS. Approximately 2,800 pounds of MDAS resulted from the PA/SI, and approximately 6,516 pounds of MDAS and 434 pounds of small arms ammunition resulted from the 100 percent MMRP intrusive investigation. All demilitarized MDAS was sent offsite for witnessed destruction. All other recovered items were identified as non-munitions-related debris and were stockpiled onsite and recycled.

Migration of MEC (other than through human transport) is considered unlikely based on the regional conditions and natural mechanisms and because potential MEC remaining onsite is either beneath structures or buried deeper than 18 inches. Frost upheaval in the Coastal Plain region of North Carolina is considered unlikely because the average temperature in the coldest months is 45 degrees Fahrenheit and the average daily minimum temperature is 32 degrees Fahrenheit.

FIGURE 4
Expanded Site Inspection Geophysical Investigation Results

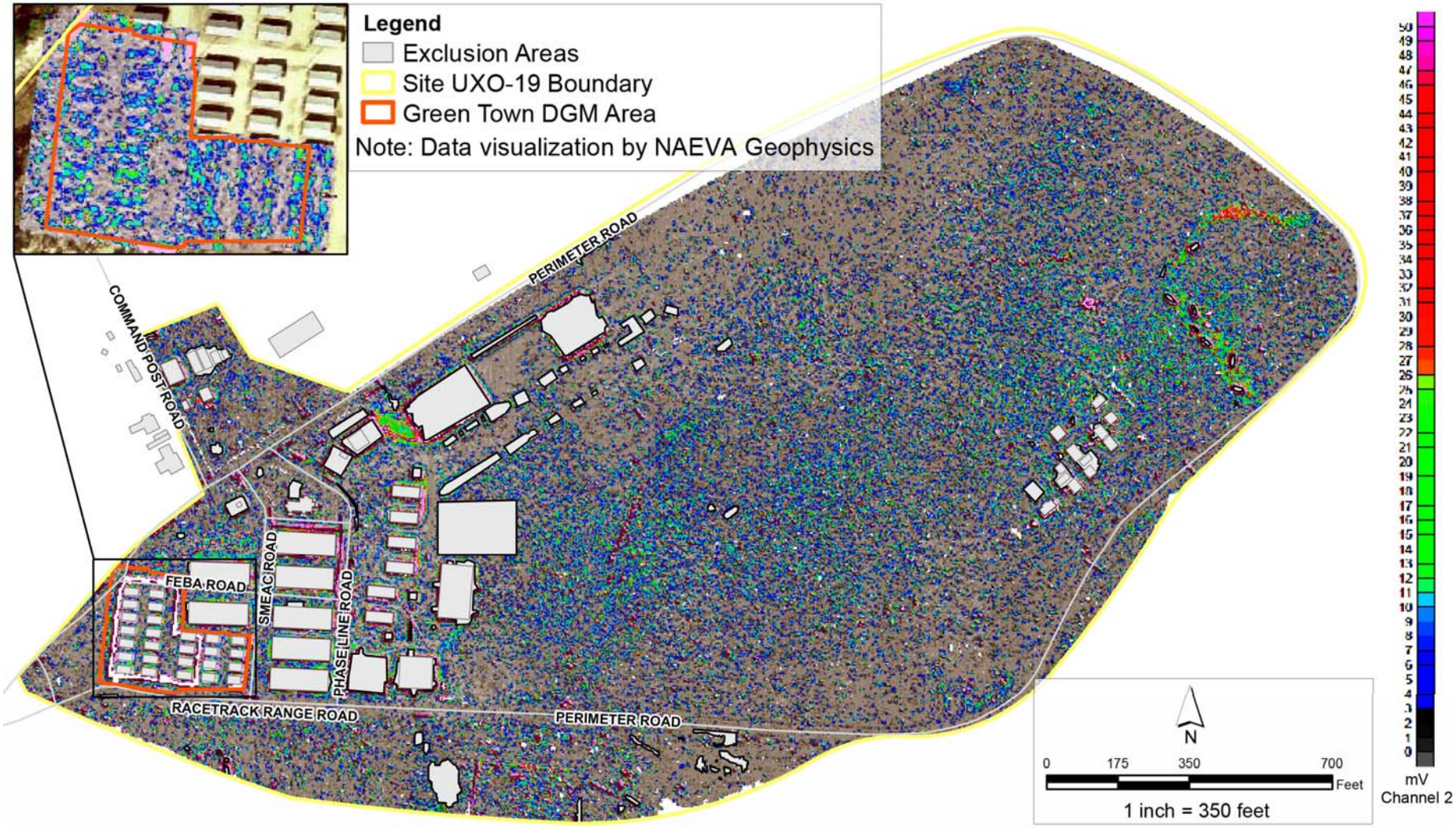


FIGURE 5
Distribution of MEC/MPPEH

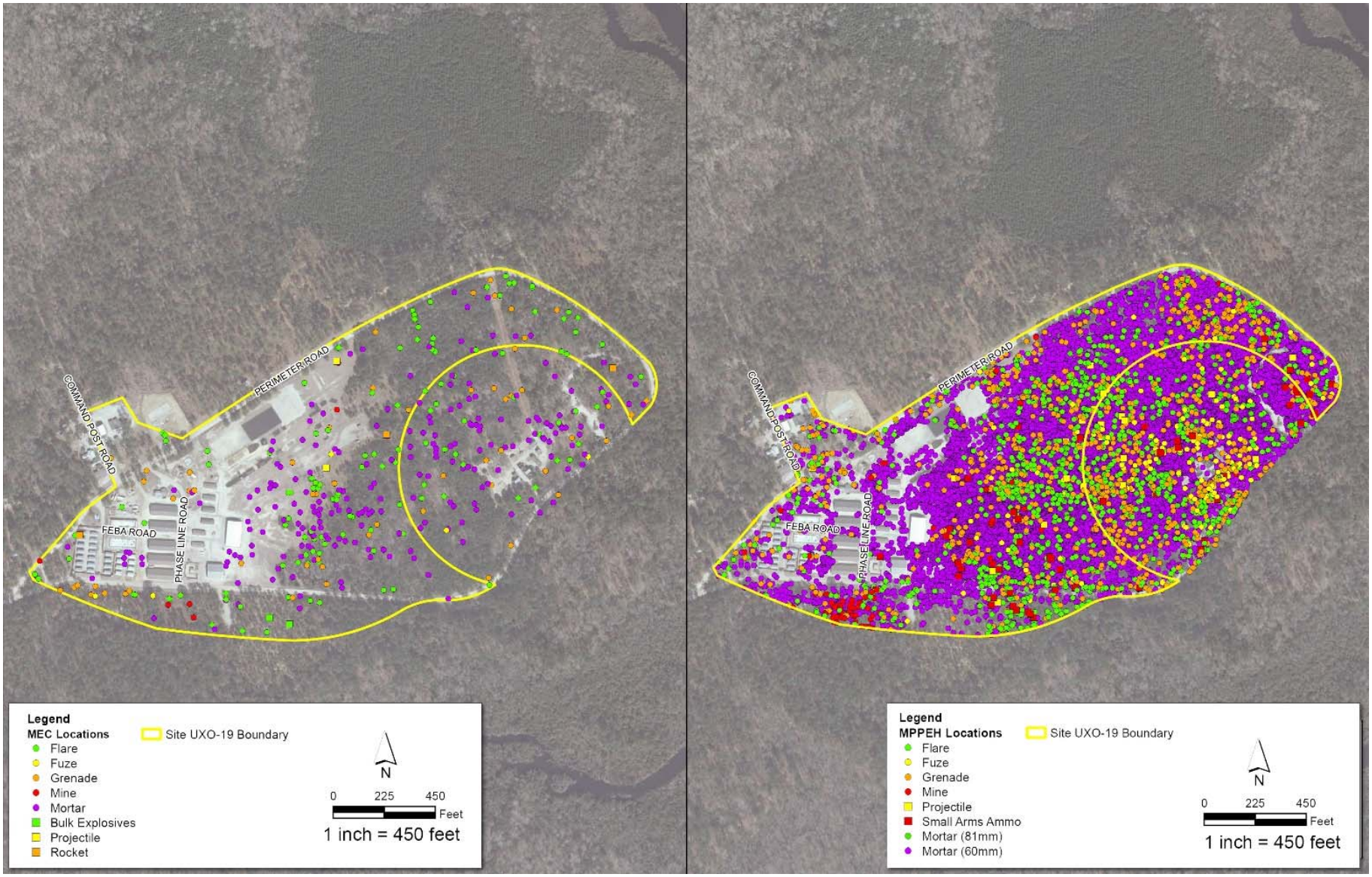


TABLE 4
Type and Quantities of MEC/MPPEH

Item Type	MEC		MPPEH	
	Number of Items*	Percent of Total	Number of Items*	Percent of Total
Flares	140	31	1,212	2.4
Fuzes and Igniters	5	1	233	0.5
Grenades	59	13	1,260	2.5
Mines	7	2	83	0.1
Mortar Projectiles	226	51	38,075	75
Bulk Explosives	3	1	0	0
Projectiles	2	0	47	0.1
Rockets	5	1	0	0
Small Arms Ammunition	Not applicable	Not applicable	9,861	19.4
Total	**447**	**100**	**50,771**	**100**

Notes:
* Multiple items were found at some individual anomaly locations.
Small arms ammunition is never classified as MEC.

2.6 Summary of Site Risks

Potential human health and ecological risks from exposure to media and explosive hazards from MEC/MPPEH at Site UXO-19 were evaluated as part of the PA/SI and RI/FS. **Table 5** and the following subsections briefly summarize the findings of these risk assessments.

TABLE 5
Site UXO-19 Risk Summary

Media	Human Health Risk	Ecological Risk
Surface Soil (MC and MEC/MPPEH)	Acceptable	Acceptable
Subsurface Soil (MC)	Acceptable	Acceptable (0 to 5 feet bgs)
Subsurface Soil (MEC/MPPEH)	Unacceptable	Not Applicable
Groundwater	Acceptable	Acceptable
Sediment	Acceptable	Acceptable
Surface Water	Acceptable	Acceptable
Indoor Air	Not Applicable	Not Applicable*

Note:
*Ecological receptors are not exposed to indoor air.

2.6.1 Human Health Risk Summary – Munitions Constituents

The Human Health Risk Screening (HHRS) evaluated the potential risks to human health from exposure to MC in surface soil, subsurface soil, and groundwater. Health risks were evaluated based on a comparison to conservative human health risk-based screening levels for the most conservative potential receptors, future residents. If concentrations detected in surface soil, subsurface soil, or groundwater exceeded the conservative residential screening levels, a risk ratio approach was used to estimate the potential carcinogenic risk (CR) or the potential for other health effects not related to cancer (non-cancer hazard, or hazard index [HI]), as described below. The HHRS at Site UXO-19 was used to determine if any further actions were required to sufficiently protect human health.

Potential exposure pathways evaluated included the following:

- Contact with explosives residues and metals in surface soil (military personnel, maintenance workers, trespassers, future residents, and future construction workers; evaluated exposure to surface soil using levels protective of the most conservative receptor, a future resident)
- Contact with explosives residues and metals in subsurface soil (future residents and future construction workers; evaluated exposure to subsurface soil using levels protective of the most conservative receptor, a future resident)
- Contact with surficial groundwater during construction or excavation activities (future construction workers; evaluated exposure to groundwater using levels protective of most conservative receptor, a future resident)
- Contact with surficial groundwater used as a potable water supply (future industrial workers and future residents; evaluated exposure to groundwater using levels protective of most conservative receptor, a future resident)

The HHRS was conducted in three steps using a **risk ratio technique** as follows:

- **Step 1** – Maximum detected constituent concentrations for each medium were compared to the adjusted USEPA RSLs (tapwater RSL for groundwater and residential soil RSL for soil) current at the time the PA/SI was conducted, other human health risk screening levels (MCL and NCGWQS for groundwater), and background concentrations for metals.
- **Step 2** – If a chemical was identified as a constituent of potential concern (COPC) in Step 1, a corresponding risk level was calculated by multiplying the maximum concentration by the acceptable risk level and dividing by the RSL (not adjusted for any chemicals). USEPA identifies an acceptable cancer risk range of 1 in 10,000 (10^{-4}) to 1 in 1,000,000 (10^{-6}) and below and an acceptable non-cancer hazard as an HI that does not exceed 1. All corresponding risk levels were summed to calculate the cumulative corresponding HI for non-carcinogens and cumulative corresponding CR for carcinogens. A cumulative corresponding HI for target organ/effect was also calculated. If the cumulative corresponding HI for a target organ/effect was greater than 0.5 or the cumulative CR was greater than $5x10^{-5}$ the chemicals contributing to these values were identified as COPCs and carried forward to Step 3.
- **Step 3** – A corresponding risk level was calculated as discussed in Step 2. However, the 95 percent upper confidence limit was used in place of the maximum detected concentration. COPCs were retained based on the criteria listed in Step 2.

The HHRS concluded that risks from exposure to surface soil, subsurface soil, and surficial groundwater at Site UXO-19 are within acceptable risk management ranges. A summary of the HHRS is provided in **Table 6**.

TABLE 6
Site UXO-19 HHRS Summary

Media	Receptor	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusion
Surface Soil	Current Military Personnel Current Maintenance Workers Current Trespassers Future Resident Future Construction Worker	Nitroglycerin Antimony Arsenic	Nitroglycerin	None	Exposure to soil and groundwater within the site boundary would not result in any potentially unacceptable risks to human health.
Subsurface Soil	Future Resident Future Construction Worker	Arsenic	None	None	
Groundwater	Future Resident	3-nitrotoluene	None	None	

2.6.2 Ecological Risk Summary

The Ecological Risk Screening (ERS) evaluated potential risks to ecological receptors from MC in soil and groundwater. Analytical results for constituents in surface soil, subsurface soil, and groundwater were screened against ecological screening values (ESV) intended to be protective of ecological receptors. Potential ecological receptors include: plants, soil invertebrates, benthic invertebrates, amphibians, fish, mammals, reptiles, and birds. For each sample medium, a hazard quotient (HQ) was calculated by dividing the maximum concentration (or maximum detection limit for non-detected analytes) by the ESV. An HQ greater than 1 suggests the potential for risk. ESVs were selected from the lowest available level from the following:

- USEPA **Region 4 ESVs**
- USEPA **Ecological Soil Screening Levels**
- **National Recommended Water Quality Criteria set**

Additional lines of evidence used in the ERS to evaluate potential risk included background concentrations for metals, frequency of detection, magnitude of exceedance, relationship between screening value and average exposure concentration, and whether a constituent is a known laboratory contaminant. The ERS concluded that there were no unacceptable risks to ecological receptors from exposure to surface and subsurface soil and groundwater. In addition, based on the frequency of detection and levels detected in onsite samples, risk is considered acceptable in drainage ditches that receive runoff or discharged groundwater from the site. A summary of the ERS is provided in **Table 7**.

TABLE 7
Site UXO-19 ERS Summary

Constituent	Rationale for Identification as COPC	Conclusion
Surface Soil		
Antimony	HQ greater than 1	No significant risk because of low frequency of detection (1 out of 160 samples).
Copper	HQ greater than 1	No significant risk because maximum concentrations were relatively low and average exposure concentrations were less than the ESV.
Lead	HQ greater than 1	
Zinc	HQ greater than 1	
Subsurface Soil (0 to 5 feet bgs)		
None	Not Applicable	No significant risk to ecological receptors.
Groundwater		
None	Not Applicable	No significant risk to ecological receptors.

2.6.3 Explosive Hazard Summary

An assessment was conducted of the relative risks posed to human receptors by MEC/MPPEH potentially present within the Site UXO-19 boundary. For MEC/MPPEH to result in a human injury or death, there must be the presence of MEC/MPPEH; a human receptor in contact with, or in the vicinity of, the MEC/MPPEH; and an event to cause functioning of the MEC. In order to assess the likelihood of an explosive injury occurring, three types of factors were evaluated:

- **Site Factors –** These factors address site-specific features that affect the likelihood that human receptors may be at a location where they are able to encounter MEC or MPPEH, or be within close enough range of MEC/MPPEH to be injured during an explosive event. Site factors include accessibility of the site and migration of MEC/MPPEH over time. Access to Site UXO-19 is restricted to military or other authorized personnel who have been trained to recognize potential explosive hazards. There are no physical barriers to the site, but natural features and the presence of military personnel limit the likelihood that trespassers would enter the site.
- **Human Factors –** These factors address the likelihood that human receptors on a site would encounter or be close to MEC or MPPEH. Human factors include the number of people accessing the site, the frequency and duration of access, and the activities conducted while onsite. Approximately 21,000 Marines are trained at Camp Devil Dog annually. Troops live in barracks and spend most of their time onsite, resulting in a high amount of potential contact time. Training may include intrusive activities, resulting in contact with buried MEC/MPPEH. All military and civilian personnel who access the site are required to complete munitions safety training.
- **Ordnance Factors –** These factors address whether an explosive event is likely to occur if contact is made with MEC or MPPEH, and the severity of the explosive event if one did occur. Ordnance factors include ordnance type, sensitivity, location, density, and depth. The majority of MEC/MPPEH items found were mortar projectiles and flares with a variety of filler types, including high explosives, white phosphorus, illuminating, smoke, and hexachloroethane filler. If MEC/MPPEH of the types previously discovered are onsite and did not function as designed, the probability of an unintentional detonation by casual contact, such as accidently stepping on it, is low to moderate. More aggressive contact, such as striking the MEC/MPPEH, would raise the probability.

A MEC Hazard Assessment (HA) was conducted to evaluate the potential explosive hazards to receptors based on current conditions at Site UXO-19 using the **Interim MEC HA methodology**. MEC HA is a qualitative tool developed to evaluate baseline explosive hazards to people based on current or reasonably anticipated land use, and to evaluate the relative reduction of explosive hazards by removal or other actions. The MEC HA is structured around three components of potential explosive hazard incidents:

- **Severity –** potential consequences of the effect (death or injury, for example) on a human receptor if an item detonates (ordnance factors)
- **Accessibility –** likelihood that a receptor will be able to come in contact with a MEC item (human and site factors)
- **Sensitivity –** likelihood that a receptor will be able to detonate the item (ordnance factors)

The MEC hazard assessment (HA) tool provides a score based on user inputs that falls within four defined ranges, called hazard levels. Although a numeric score is given, the results of the MEC HA should not be interpreted as a quantitative measure of explosive hazard.

- **Hazard Level 1** is a score between 840 and 1,000 and identifies a site with the highest potential explosive hazard conditions out of all of the hazard levels.
- **Hazard Level 2** is a score between 725 and 835 and identifies a site with high potential explosive hazard conditions.
- **Hazard Level 3** is a score between 530 and 720 and identifies a site with moderate potential explosive hazard conditions.
- **Hazard Level 4** is a score between 125 and 525 and identifies a site with low potential explosive hazard conditions.

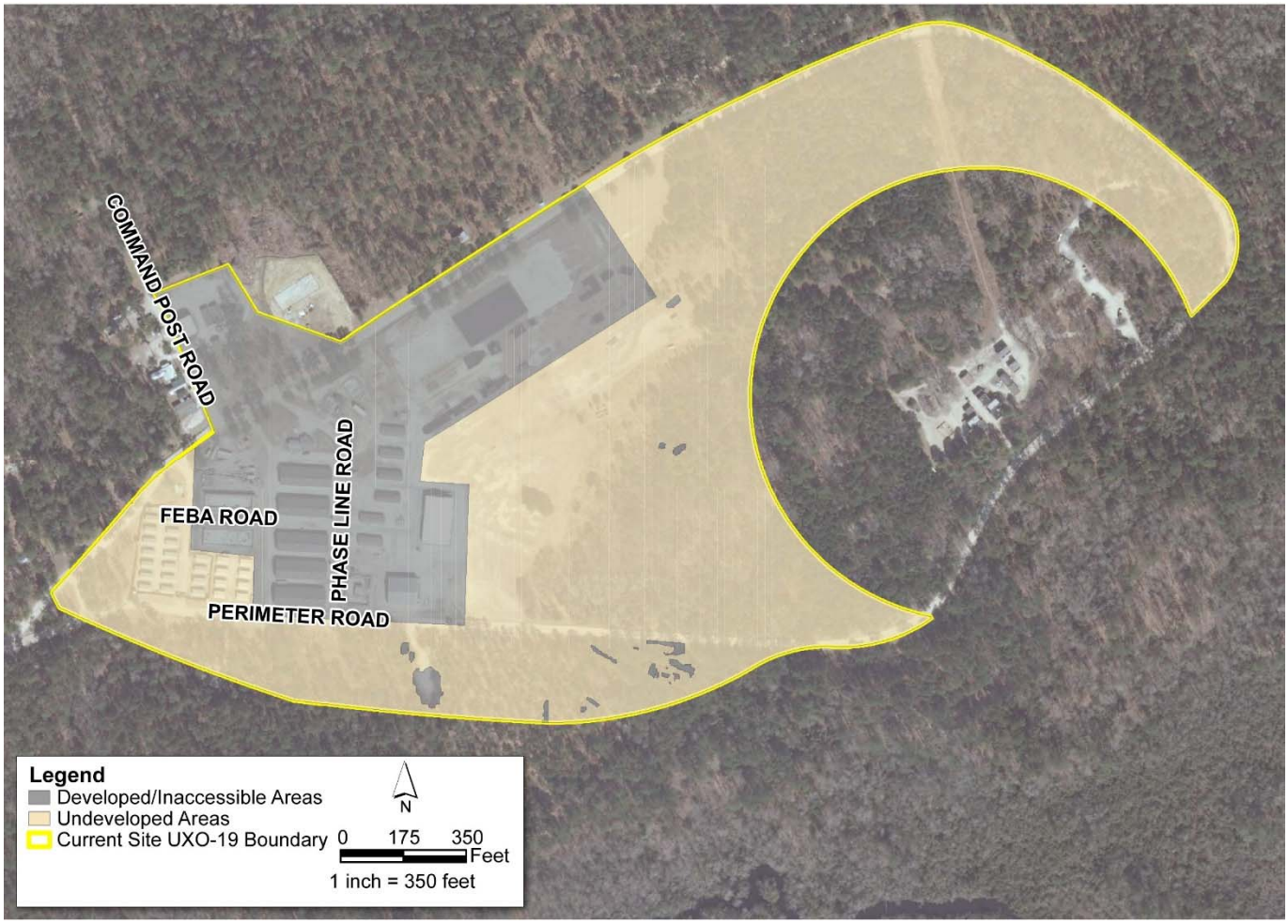
The MEC HA tool was used to evaluate the site conditions before (baseline) and after (current site conditions) the MMRP investigations were completed. The baseline score was 975, resulting in a Hazard Level of 1 (highest potential for explosive hazard). Under the current conditions, the MEC HA indicated that the undeveloped area had a Hazard Level of 4 (lowest potential for explosive hazards) and the developed/inaccessible area had a Hazard Level of 3 (moderate potential for explosive hazards).

Potential explosive hazards were significantly reduced as a result of the MMRP investigations; however, there are limitations to MMRP investigations including those imposed by instrument limits and site conditions that prevent 100 percent removal. Therefore, MEC/MPPEH may remain onsite in those areas where it could not be detected because of the above limitations, and contact with the types of MEC/MPPEH that may be present could potentially result in injury or death.

2.6.4 Basis for Response Action

Based on the explosive hazard evaluation, there is an unacceptable risk from potential exposure to explosive hazards from MEC/MPPEH at Site UXO-19 that can result in injury or death. Instrument limitations and site accessibility prevented complete removal of MEC/MPPEH and potential explosive hazards exist in the area that was investigated (referred to as "undeveloped area" in **Figure 6**) and in the inaccessible or developed areas (**Figure 6**). It is the current judgment of the Navy, USMC, and USEPA, in concurrence with NCDENR, that the response action selected in this ROD is necessary to protect public health or welfare or the environment from exposure to MEC/MPPEH that may present an endangerment to public health or welfare or the environment.

FIGURE 6
Proposed LUC Boundaries



2.7 Principal Threat Wastes

MEC, specifically discarded military munitions or UXO, if any, that remains present at MCB Camp Lejeune may constitute a principal threat to human health at Site UXO-19, OU 25 due to the explosive hazard that could result in injury or death. MEC found during the previous removal action was determined to be a principal threat waste (PTW) and was treated on site by explosive detonation in accordance with the approved "**Explosives Safety Submission** (ESS), Munitions Response Activities, Camp Devil Dog (ESS-118)". If MEC is later encountered in those areas, MCB Camp Lejeune EOD personnel, or similarly qualified UXO Technicians, will evaluate the material to determine if it poses an explosive hazard. The Navy and the USEPA will consult, in accordance with the terms of the MCB Camp Lejeune FFA, to make a determination as to whether the material should, as defined by CERCLA, the NCP, and USEPA guidance, be classified as a PTW. If the material is determined to be a PTW, the Navy will take all necessary actions to ensure the protectiveness of human health and the environment to address unacceptable risks posed by the material designated as a PTW.

2.8 Remedial Action Objective

In order to be protective of human health and the environment and to address potential hazards identified in the explosive hazard evaluation, the Remedial Action Objective (RAO) identified for Site UXO-19 is:

- Reduce or prevent the potential for direct physical contact with MEC/MPPEH to allow current and reasonably anticipated land use (infantry training) at the site to continue.

2.9 Description and Comparative Analysis of Remedial Alternatives

2.9.1 Description of Remedial Alternatives

The remedial alternatives that were developed and evaluated to address potential MEC/MPPEH in the developed/inaccessible areas and undeveloped area at Site UXO-19 are detailed in the FS. A summary of remedial alternatives is presented in **Table 8**.

TABLE 8
Summary of Remedial Alternatives for Site UXO-19

Alternative	Components	Details	Cost/Timeframe	
1 – No Action	None	None	None	
2 – LUCs	LUCs	LUCs to prevent potential for direct physical contact with MEC/MPPEH within Site UXO-19: • Installing warning signs around the perimeter of the site. • Requiring UXO construction support[5] for all intrusive activities greater than 18 inches bgs in the undeveloped area and any intrusive activity in the developed/inaccessible area. • Requiring munitions safety awareness training for all personnel working within the site boundary.	Capital Cost Total Periodic Cost Total Present Value Cost Cost Estimate Timeframe	$40,000 $530,000 $570,000 30 Years

[5] Actual construction support requirements will be determined by the Installation's Explosives Safety Officer, Marine Corps Systems Command, and the Department of Defense Explosives Safety Board. Construction support shall be determined by submission of an Explosives Safety Submission and/or an Explosives Safety Submission Determination Request, in accordance with appropriate Navy and Marine Corps regulations.

TABLE 8
Summary of Remedial Alternatives for Site UXO-19

Alternative	Components	Details	Cost/Timeframe
3 – Subsurface Removal of MEC/MPPEH in Undeveloped Areas (via Excavation, DGM, and Intrusive Investigation) and LUCs	Removal Action LUCs	Subsurface removal of MEC/MPPEH in undeveloped areas to 6 feet bgs using excavation to depth, DGM, and conducting an intrusive investigation on all anomalies identified as representing potential subsurface MEC. LUCs to prevent potential for direct physical contact with MEC/MPPEH within Site UXO-19: • Installing warning signs around the perimeter of the site. • Requiring UXO construction support[6] for all intrusive activities greater than 6 feet bgs in the undeveloped area and any intrusive activity in the developed/inaccessible area. • Requiring munitions safety awareness training for all personnel working within the site boundary.	Capital Cost $2,500,000 Total Periodic Cost $300,000 Total Present Value Cost $2,800,000 Cost Estimate Timeframe 30 Years
4 – Subsurface Removal of MEC/MPPEH (via Excavation and Sifting) and LUCs	Removal Action LUCs	Subsurface removal of MEC/MPPEH in undeveloped areas to 6 feet bgs. The entire area would be excavated from 0 to 6 feet bgs, with soils from 18 inches to 6 feet bgs being sifted to remove items 1 inch and larger from the soil mass. LUCs to prevent potential for direct physical contact with MEC/MPPEH within Site UXO-19: • Installing warning signs around the perimeter of the site. • Requiring UXO construction support[6] for all intrusive activities greater than 6 feet bgs in the undeveloped area and any intrusive activity in the developed/inaccessible area. • Requiring munitions safety awareness training for all personnel working within the site boundary.	Capital Cost $7,300,000 Total Periodic Cost $300,000 Total Present Value Cost $7,600,000 Cost Estimate Timeframe 30 Years

2.9.2 Comparative Analysis of Alternatives

A comparative analysis using the **nine USEPA criteria** was completed and is discussed in this section. The analysis is summarized in **Table 9**.

[6] Actual construction support requirements will be determined by the Installation's Explosives Safety Officer, Marine Corps Systems Command, and the Department of Defense Explosives Safety Board. Construction support shall be determined by submission of an Explosives Safety Submission and/or an Explosives Safety Submission Determination Request, in accordance with appropriate Navy and Marine Corps regulations.

TABLE 9
Comparative Analysis of Alternatives

CERCLA Criteria	Alternative			
	(1)[1]	(2)	(3)	(4)
Threshold Criteria				
Protection of human health and the environment	❍	●	●	●
Compliance with ARARs	❍	●	●	●
Primary Balancing Criteria				
Long-term effectiveness and permanence	Not Applicable	◉	◉	◉
Reduction in toxicity, mobility, or volume through treatment	Not Applicable	❍	●	●
Short-term effectiveness	Not Applicable	●	◉	❍
Implementability	Not Applicable	●	◉	❍
Present worth cost	$0	$570K	$2.8M	$7.6M

Notes:
Alternative 1: No Action
Alternative 2: LUCs
Alternative 3: Subsurface Removal of MEC/MPPEH in Undeveloped Areas (via excavation, DGM, and intrusive investigation) and LUCs
Alternative 4: Subsurface Removal of MEC/MPPEH in Undeveloped Areas (via excavation and sifting) and LUCs

Qualitative ranking: ● High (favorable) ◉ Moderate ❍ Low (unfavorable)
[1]The No Action alternative is used as a baseline for comparison purposes only. Because it does not meet the threshold criteria, it is not a viable alternative for this site and was not further evaluated.

Threshold Criteria

Overall Protection of Human Health and the Environment

All of the alternatives screened, with the exception of the No Action alternative, are protective of human health and the environment by reducing or controlling risks posed by the site through remedial strategies and/or LUCs to reduce or prevent the potential for direct physical contact with MEC/MPPEH. Alternatives 2, 3, and 4 are protective of human health and the environment because LUCs would control exposure to the subsurface MEC by prohibiting unauthorized intrusive activities. The intrusive investigation conducted to-date has reduced the potential explosive hazard by reducing the amount of MEC/MPPEH onsite. Although Alternatives 3 and 4 would involve actions to further reduce the potential to encounter MEC/MPPEH within the undeveloped area, complete removal of MEC/MPPEH cannot be guaranteed. MEC/MPPEH may also remain in the developed/inaccessible areas. Therefore, a low potential explosive hazard would still be present after the MEC/MPPEH removal actions described in Alternatives 3 and 4 were implemented and LUCs would still be needed to prevent the potential for direct contact with MEC/MPPEH.

Compliance with ARARs

Section 121(d) of CERCLA, as amended, specifies in part, that remedial actions for cleanup of hazardous substances must comply with the ARARs unless they are waived under CERCLA Section 121(d)(4). See also 40 CFR 300.430(f)(1)(ii)(B).

All alternatives, except the No Action alternative, are expected to comply with ARARs and To Be Considered (TBC) guidance (**Appendix A**). Alternatives 2, 3, and 4 include LUCs and a Notice of Contaminated Site will be filed as part of the remedy. Additional action-specific ARARs would apply to Alternatives 3 and 4 based on earth-moving activities and the potential for MEC/MPPEH to be encountered, requiring management and disposal.

Primary Balancing Criteria

Alternative 1, No Action, does not protect human health and the environment; therefore, it does not meet the threshold criteria and will not be evaluated further.

Long-term Effectiveness and Permanence

Each alternative provides some degree of long-term protection that increases if MEC/MPPEH removal is included. Alternatives 3 and 4 may appear to be more effective in the long term because they would involve permanent removal of MEC/MPPEH up to a depth of 6 feet bgs throughout the undeveloped areas of the site. However, the resulting improvement of long-term effectiveness and permanence is marginal when compared to Alternative 2. Although removal of subsurface MEC/MPPEH minimizes the potential for exposure over time, the ability to remove the subsurface MEC/MPPEH is subject to the technology available to detect them and complete removal cannot be guaranteed. Additionally, the potential for trespassers to encounter MEC/MPPEH is limited because MEC/MPPEH most likely to have been encountered (from the surface to 18 inches bgs) were removed, to the maximum extent practicable, during previous investigation activities. Therefore, the actual level of long-term protection for Alternatives 2, 3, and 4 would be relatively similar and LUCs would be required to minimize uncontrolled exposure to MEC/MPPEH that potentially remain.

Reviews conducted at least every 5 years, as required by CERCLA, would be necessary to evaluate the effectiveness of any of the alternatives because hazards would remain onsite above levels that allow for unlimited use and unrestricted exposure.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3 and 4 achieve reduction of toxicity, mobility, or volume through treatment because they include the removal and treatment (detonation) of subsurface MEC/MPPEH within the undeveloped areas of the site. There would be no reduction in toxicity, mobility, or volume through implementation of Alternative 2 because no treatment technologies would be employed.

Short-term Effectiveness

Short-term effectiveness, in terms of risks to workers, potential impacts to the community and environment during implementation, and time to implement would be most favorable for Alternative 2 as no activities other than administration of LUCs would be conducted, resulting in lower potential risks. Alternative 2 also has the lowest potential impact to the environment during implementation and shortest implementation time frame, as no active treatment would be performed, only LUCs.

Risks to workers and the environment are higher for the active treatment Alternatives 3 and 4, but would be minimized by engineering controls to prevent damage to human health and the environment. Alternative 3 is more effective than Alternative 4 in the short term based on the shorter period to implement the remedy (6 months versus 1 year). Alternative 4 would have the largest potential impact to the environment because it would require significant use of heavy equipment to implement, resulting in higher emissions released into the atmosphere, and would result in greater risk to workers than Alternatives 2 and 3.

Implementability

Alternative 2 would be the easiest to implement because LUCs are primarily an administrative action with minor field work to install signs. It is technically and administratively feasible, and the services, equipment, and materials required for its implementation are readily available. Both Alternatives 3 and 4 would require extensive vegetation clearance, soil excavation, stockpiling, and intrusive removal action activities that would potentially affect military training activities during implementation. Alternative 3 would include DGM, and subsequent intrusive investigation of the undeveloped area of the site and the resources and technologies to implement these activities are commonly used and available. Alternative 4 involves soil sifting and would have the lowest degree of implementability because of the overall volume of soil to be sifted and the duration estimated to complete the removal action.

Cost

An order-of-magnitude cost for each alternative has been estimated based on a variety of key assumptions. Costs and remedy components that were used in the cost estimate are summarized in **Table 8**. The estimated present worth costs for the alternatives range from $570,000 for Alternative 2 to $7.6 million for Alternative 4.

Overall, the capital costs for Alternative 2 (LUCs) are low ($40,000) as compared to Alternatives 3 and 4. Alternative 3 involves a significant amount of earthwork to remove to allow for additional DGM and intrusive investigations in the undeveloped area from 18 inches to 6 feet bgs. Alternative 4 involves earthwork to remove soil, specialized equipment to mechanically separate MEC/MPPEH from the surrounding soil, and labor costs to inspect all sifted soils. The majority of the cost for Alternative 2 is based on providing construction support. The construction support consists of UXO technicians overseeing intrusive activities in areas with possible MEC/MPPEH.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA and remedy selection process. NCDENR supports the Selected Remedy, and their final concurrence is provided in **Appendix C.**

Community Acceptance

The public meeting was held on April 8, 2015, to present the Proposed Plan and answer community questions regarding the preferred remedy at Site UXO-19. No comments requiring amendment to the Proposed Plan were received from the general public during the meeting and public comment period.

2.10 Selected Remedy

The Selected Remedy for Site UXO-19 is Alternative 2, LUCs.

2.10.1 Rationale for the Selected Remedy

Although treatment is preferred wherever feasible, LUCs were selected because they provide a similar level of long-term protection as the active removal alternatives, and previous intrusive actions have already removed MEC/MPPEH from the surface to 18 inches bgs. LUCs are being selected as the remedy for this Site because they are effective at controlling unacceptable exposure by prohibiting unauthorized intrusive activities. Implementation of LUCs would be significantly less disruptive to current training operations, and would be less expensive than Alternatives 3 and 4, both of which would still require LUCs in the long-term.

2.10.2 Description of the Selected Remedy

The Selected Remedy (LUCs) for Site UXO-19 includes the following components:

- Installing warning signs around the perimeter of the site.
- Requiring UXO construction support for all intrusive activities greater than 18 inches bgs in the undeveloped area and any intrusive activity in the developed/inaccessible area.
- Requiring munitions safety awareness training for all personnel working within the site boundary.
- Revising the Base Master Plan and/or geographic information systems mapping with the land use restrictions marked for this site.
- Filing a Notice of Contaminated Site in Onslow County real property records in accordance with North Carolina General Statutes 143B-279.9 and 143B-279.10.

The LUC performance objectives are to:

- Restrict activities within areas possibly containing MEC/MPPEH to prevent exposure that could result in an explosion, causing injury or death.
- Maintain the integrity of any current or future remedial or monitoring system such as the warning signs.

The following land use restrictions would be implemented:

- **Intrusive Activities Control (MEC) in Developed/Inaccessible Areas –** Require UXO construction support for any intrusive activities within the areas identified as developed or inaccessible within Site UXO-19. Require

Recognize, Retreat, Report (3R) munitions safety awareness training for Base personnel and subcontractors working within the Site UXO-19 boundary.

- **Intrusive Activities Control (MEC) in Undeveloped Areas –** Restrict intrusive activities within the undeveloped area with potential explosive safety hazards to less than 18 inches bgs. Require UXO construction support for all intrusive activities greater than 18 inches bgs and 3R munitions safety awareness training for all personnel working within the Site UXO-19 boundary.

The Navy and MCB Camp Lejeune are responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although the Navy and MCB Camp Lejeune may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for the remedy. The estimated LUC boundaries are shown on **Figure 6**; the actual LUC boundaries will be finalized in the Land Use Control Implementation Plan (LUCIP). The LUC implementation actions, including enforcement requirements, will also be provided in the LUCIP. Actual construction support requirements will be determined by the Installation's Explosives Safety Officer, Marine Corps Systems Command, and the Department of Defense Explosives Safety Board. Construction support shall be determined by submission of an Explosives Safety Submission and/or an Explosives Safety Submission Determination Request, in accordance with appropriate Navy and Marine Corps regulations.

The Navy will submit the LUCIP within 90 days of ROD signature to USEPA and NCDENR for review and approval pursuant to the primary document review procedures stipulated in the FFA. The Navy will maintain, monitor (including conducting periodic inspections), and enforce the LUCs according to the requirements contained in the LUCIP. LUCs will be maintained indefinitely unless additional action is taken to remove potential explosive hazards, allowing for unlimited use and unrestricted exposure. Because potential explosive hazards remain and unlimited use and unrestricted exposure will not be achieved, the Navy will review the final remedial action no less than every 5 years to assess the protectiveness of the remedy.

2.10.3 Expected Outcomes of the Selected Remedy

Current land use is expected to continue at Site UXO-19. Exposure to MEC/MPPEH will be controlled through LUCs. **Table 10** summarizes the unacceptable risks, the RAO identified to address the risks, the remedy components intended to achieve the RAO, the metrics that measure the remedial action progress, and the expected outcome that the remedy will have.

TABLE 10
Expected Outcomes

Risk	RAO	Remedy Component	Metric	Expected Outcome
Potential explosive hazard from contact with MEC/MPPEH	Reduce or prevent the potential for direct physical contact with MEC/MPPEH to allow current and reasonably anticipated land use (infantry training) at the site to continue.	LUCs	Maintain and monitor LUCs quarterly	Infantry Training

2.10.4 Statutory Determinations

Remedial actions undertaken at NPL sites must meet the statutory requirements of Section 121 of CERCLA and be protective of human health and the environment, comply with ARARs of both federal and more stringent state environmental laws and regulations unless a waiver is justified, be cost-effective, and utilize to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

Protection of Human Health and the Environment—The Selected Remedy (LUCs) will protect human health and the environment by prohibiting actions that could result in an explosion through educational training for MEC/MPPEH avoidance, warning signs, and administrative controls restricting intrusive activities in areas and at depths that have not been previously investigated.

Compliance with ARARs—Section 121(d) of CERCLA, as amended, specifies, in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 CFR § 300.430(f)(1)(ii)(B). ARARs include only federal and state environmental or facility citing laws and regulations and do not include occupational safety or worker protection requirements. Compliance with Occupational Safety and Health Administration (OSHA) standards is required by 40 CFR § 300.150; therefore, the CERCLA requirement for compliance with or waiver of ARARs does not apply to OSHA standards. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to-be-considered for a particular release. In accordance with 40 CFR § 300.400(g), the Navy, USEPA, and NCDENR have identified the ARARs for the Selected Remedy. **Appendix A** lists, respectively, the location-, and action-specific ARARs and TBC criteria for the Selected Remedy. There are no chemical-specific ARARs for the Selected Remedy. The Selected Remedy will meet all identified ARARs and TBCs.

Cost-effectiveness—The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The following definition was used to determine cost-effectiveness: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP §300.430[f][1][ii][D]). This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. The overall effectiveness of the Selected Remedy was compared to costs to determine cost-effectiveness. The Selected Remedy's costs were determined to be proportional to overall effectiveness, thus representing a reasonable value for the money. Furthermore, the MMRP investigations conducted during the PA/SI and ESI removed the majority of MEC/MPPEH that would likely be encountered, within the top 18-inches of soil using best available technology to the maximum extent practicable, thereby reducing overall site risk. Additional removal action would not improve the effectiveness proportionally to the additional costs.

The estimated present-worth cost of the Selected Remedy is $570,000, and the cost-estimate timeframe is predicted to be approximately 30 years. Alternatives 3 and 4 present-worth costs are significantly higher and are not expected to reduce the remedial timeframe because residual MEC/MPPEH may be present even after removal actions are completed.

- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable**— The Selected Remedy does not use permanent solutions such as excavation or treatment (detonation of MEC) or resource recovery (recycling of scrap or spent munitions). Although the use of treatment technologies is typically preferred, based on the current state of the industry, there is no guarantee of complete removal of MEC/MPPEH. Therefore, LUCs would be required regardless of the alternative selected.
- **Preference for Treatment as a Principal Element**—The Selected Remedy which consists of LUCs that prevent exposure to MEC/MPPEH does not satisfy the statutory preference for treatment. As described above, previous investigations and removal actions have removed MEC/MPPEH, some of which was considered to be PTW due to the explosive hazard and was burned /ignited (i.e., treated) to effectively render it safe for disposition such as disposal.
- **Five-year Review Requirements**—This remedy will result in MEC/MPPEH remaining onsite, preventing unlimited use and unrestricted exposure; therefore, in accordance with CERCLA Section 121(c) and the NCP at 40 CFR § 300.430 (f)(4)(ii), a statutory review will be conducted by the Navy within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If

the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed, then additional remedial actions would be evaluated by the FFA parties, and the Navy may be required to undertake additional remedial action.

2.11 Community Participation

The Navy, USMC, USEPA, and NCDENR provide information regarding the cleanup of MCB Camp Lejeune to the public through the Community Relations Program, which includes a Restoration Advisory Board, public meetings, the AR file for the site, and announcements published in local newspapers. Restoration Advisory Board meetings continue to be held to provide an information exchange among community members, the Navy, USMC, USEPA, and NCDENR. These meetings are open to the public and are held quarterly.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period for the Site UXO-19 Proposed Plan from February 25 through April 24, 2015. A public meeting to present the Proposed Plan was held on April 8, 2015, at Coastal Carolina Community College. Public notice of the meeting and availability of documents was placed in *The Jacksonville Daily News* and *The Globe* newspapers on February 10 and February 13, 2015, respectively.

The AR, Community Involvement Plan, IRP fact sheets, and final technical reports concerning Site UXO-19 can be obtained from the IRP web site: http://go.usa.gov/Dy5T. Internet access is available to the public at the following location:

Onslow County Public Library
58 Doris Avenue East
Jacksonville, North Carolina 28540
(910) 455-7350

2.12 Documentation of Significant Changes

The Proposed Plan for Site UXO-19 was released for public comment on February 25, 2015. No comments were submitted during the public comment period. No significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

3 Responsiveness Summary

The participants in the Public Meeting held on April 8, 2015, included representatives of the Navy, USMC, USEPA, and NCDENR. Several community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes in the AR. There were no comments received at the public meeting requiring amendment to the Proposed Plan, and no additional written comments, concerns, or questions were received from community members during the public comment period.

References

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	applicable or relevant and appropriate requirements (ARARs)	**Section 1.1**	CH2M HILL. 2015. *Revised Final Remedial Investigation/Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 8.3.
2	ranges and training courses	**Section 2.1**	CH2M HILL. 2015. *Revised Final Remedial Investigation/Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 2.
3	geological and hydrogeological characteristics	**Section 2.2.2**	CH2M HILL. 2010. *Focused Preliminary Assessment/Site Inspection Report, Camp Devil Dog Construction Area and Military Munitions Response Program UXO-19. Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. October. Section 3.2.
4	exceeded screening levels	**Table 1**	CH2M HILL. 2010. *Focused Preliminary Assessment/Site Inspection Report, Camp Devil Dog Construction Area and Military Munitions Response Program UXO-19. Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. October. Section 5. CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 3.

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
5	Human health and ecological risk screenings	Table 1	CH2M HILL. 2010. *Focused Preliminary Assessment/Site Inspection Report, Camp Devil Dog Construction Area and Military Munitions Response Program UXO-19. Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. October. Section 6 and 7. CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 6 and Appendix G and H.
6	anomalies were investigated	Table 1	CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 4.
7	explosive hazard assessment	Table 1	CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 6.3.
8	remedial alternatives were evaluated	Table 1	CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 9.
9	background threshold value	Section 2.4	CH2M HILL. 2011c. *Final Expanded Soil Background Study Report. Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. August. CH2M HILL. 2012. *Expanded Groundwater Background Study Report. Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. September.
10	risk ratio technique	Section 2.6.1	CH2M HILL. 2015. *Revised Final Remedial Investigation/ Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 6 and Appendix G.
11	Region 4 ESVs	Section 2.6.2	EPA. 2001. Region IV Recommended Ecological Screening Values. http://www.epa.gov/region04/waste/ots/ecolbul.htm. Accessed: March 2012
12	Ecological Soil Screening Levels	Section 2.6.2	USEPA. 2009. Ecological Soil Screening Levels. http://www.epa.gov/ecotox/ecossl/

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
13	**National Recommended Water Quality Criteria set**	**Section 2.6.2**	USEPA. 2009. National Recommended Water Quality Criteria. Originally published May 2005. Website version updated in 2009. http://epa.gov/waterscience/criteria/wqctable/
14	**Interim MEC HA methodology**	**Section 2.6.3**	EPA. 2008. Munitions and Explosives of Concern Hazard Assessment (MEC HA) Methodology Technical Work Group (TWG). http://www.epa.gov/fedfac/documents/hazard_assess_wrkgrp.htm. Accessed: March 2013
15	**Explosives Safety Submission**	**Section 2.7**	CH2M HILL. 2011b. *Amendment No. 2, Explosives Safety Submission for Munitions Response Activities Camp Devil Dog, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (ESS-118). January.
16	**nine USEPA criteria**	**Section 2.9.2**	CH2M HILL. 2015. *Revised Final Remedial Investigation/Feasibility Study Report, Operable Unit 25/Site UXO-19, Camp Devil Dog, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* January. Section 10.

Appendix A
ARARs

APPENDIX A

Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Location-Specific ARARs			
Location	**Requirement**	**Prerequisite**	**Citation**
Presence of Migratory birds listed in 50 CFR 10.13	No person may take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such bird except as may be permitted under the terms of a valid permit issued pursuant to the provisions of this part and part 13 of this chapter, or as permitted by regulations in this part, or part 20 of this subchapter (the hunting regulations).	Action that have potential impacts on, or is likely to result in a 'take' (as defined in 50 CFR 10.12) of migratory birds – **Applicable**	Migratory Bird Treaty Act, 16 U.S.C. §703(a) 50 CFR 21.11
Federal and North Carolina Action-Specific ARARs and TBCs			
Action	**Requirement**	**Prerequisite**	**Citation**
Institutional Controls for Contamination Left in Place			
Notice of Contaminated Site	Prepare and certify by professional land surveyor a survey plat which identifies contaminated areas which shall be entitled "NOTICE OF CONTAMINATED SITE". Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance and meet the requirements of NCGS 47-30 for maps and plans.	Contaminated site subject to current or future use restrictions included in a remedial action plan as provided in G.S. 143B-279.9(a) **- To Be Considered**	NCGS 143B-279.10(a)
	The Survey plat shall identify: • The location and dimensions of any disposal areas and areas of potential environmental concern with respect to permanently surveyed benchmarks; • The type location, and quantity of contamination known to exist on the site; and • Any use restriction on the current or future use of the site.		NCGS 143B-279.10(a)(1)-(3)
	The deed or other instrument of transfer shall contain in the description section, in no smaller type than used in the body of the deed or instrument, a statement that the property is a contaminated site and reference by book and page to the recordation of the Notice.	Contaminated site subject to current or future use restrictions as provided in G.S. 143B-279.9(a) that is to sold, leased, conveyed or transferred **- To Be Considered**	NCGS 143B-279.10(e)

Appendix B
Acronyms and Abbreviations

Acronyms and Abbreviations

AR	administrative record
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COPC	constituent of potential concern
CR	carcinogenic risk
DGM	digital geophysical mapping
DoD	Department of Defense
EOD	explosive ordnance disposal
ERS	Ecological Risk Screening
ESI	Expanded Site Inspection
ESS	Explosives Safety Submission
ESV	ecological screening value
FFA	Federal Facilities Agreement
FS	Feasibility Study
HA	hazard assessment
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
IRP	Installation Restoration Program
LUC	land use control
LUCIP	Land Use Control Implementation Plan
MC	munitions constituents
MCL	maximum contaminant level
MCB Camp Lejeune	Marine Corps Base Camp Lejeune
MDAS	material documented as safe
MEC	munitions and explosives of concern
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MOUT	Military Operations in Urban Terrain
Navy	Department of the Navy
NC SSL	North Carolina Soil Screening Levels for the protection of groundwater
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
OU	operable unit
PA	Preliminary Assessment
PTW	principal threat waste

RAO	remedial action objective
RI	Remedial Investigation
ROD	Record of Decision
RSL	regional screening level
SI	Site Inspection
SRA	saturated response area
TBC	to-be-considered
USEPA	United States Environmental Protection Agency
USMC	United States Marine Corps
UXO	unexploded ordnance

Appendix C
NCDENR Concurrence Letter

North Carolina Department of Environmental Quality

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

October 12, 2015

David T. Cleland, P.G.
NAVFAC MID-ATLANTIC
Marine Corps IPT, Code OPQE3
9324 Virginia Avenue
Norfolk, VA 23511-3095

RE: Concurrence with the 2015 Final Record of Decision (ROD) for OU #25, Site UXO-19
Soil, Groundwater, UXO
MCB Camp Lejeune, NC
NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Cleland:

The NC Superfund Section has received and reviewed the Final Record of Decision (ROD) for Ou#25, Site UXO-19 at MCB, Camp Lejeune dated October 2015 and concurs that the selected remedy is the most cost effective alternative and is protective of human health and the environment.

The State's concurrence is based solely on the information contained in the Revised Final ROD dated October 2015 for Operable Unit #25, Site UXO-19. Should we receive additional information that significantly affects the conclusions of the ROD, we may modify or withdraw this concurrence with written notice to the Naval Facilities Engineering Command for Camp Lejeune and the EPA Region IV.

If you have any questions or comments, please contact Randy McElveen, at (919) 707-8341 or email randy.mcelveen@ncdenr.gov

Sincerely,

James Bateson
Chief, Superfund Section

Cc: David Lown, Head, PE, PG, Federal Remediation Branch
Charity Delaney, EMD/IR
Gena Townsend, USEPA
Bryan Beck, NAVFAC