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MCB CAMP LEJEUNE
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FINAL RECORD OF DECISION OPERABLE UNIT 16 (OU16) SITE 89 MCB CAMP LEJEUNE NC

8/1/2012

MCB CAMP LEJEUNE

Final

Record of Decision
Operable Unit 16, Site 89

Marine Corps Installations East – Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

August 2012

1 Declaration

Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for Operable Unit (OU) No. 16, Site 89, at the Marine Corps Installations East-Marine Corps Base Camp Lejeune (MCIEAST–MCB CAMLEJ), located in Onslow County, North Carolina. MCIEAST–MCB CAMLEJ was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective November 4, 1989 (USEPA Identification [ID]: NC6170022580). This remedy 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 (SARA), 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 file for this site. Information not specifically summarized in this ROD or its References, but contained in the Administrative Record has been considered and is relevant to the selection of the remedy at OU No. 16. Thus, the ROD is based and relies upon the entire Administrative Record file in making the decision. As a result of the NPL listing, and pursuant to CERCLA, the USEPA Region 4, North Carolina Department of Environment and Natural Resources (NCDENR), the United States Department of the Navy (Navy), and the Marine Corps entered into a Federal Facilities Agreement (FFA) for MCIEAST-MCB CAMLEJ 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 response actions taken when 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. No enforcement activities have been recorded at Site 89.

Statement of Basis and Purpose

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

Scope and Role of Response Action

OU No. 16 is one of 25 OUs under investigation in the IRP, and consists of Site 89 and Site 93, which have been grouped together because of their proximity to one another and unique characteristic of suspected waste (solvents). Site 93 – Building TC-942, located west of Site 89, is currently Remedy-in-Place (RIP) status. The ROD for Site 93 was signed in 2006, and the remedial action (in situ chemical oxidation [ISCO], monitored natural attenuation [MNA], and land use controls [LUCs]) was initiated in October 2006 to address volatile organic compound (VOC) contamination in groundwater. MNA and LUCs are ongoing. This ROD presents the final remedial action for Site 89 and OU No. 16.

Information on the status of all the OUs and sites at MCIEAST-MCB CAMLEJ can be found in the current version of the Site Management Plan, available as part of the Administrative Record.

1.1 Selected Remedy

Assessment of the Site

This ROD identifies the Selected Remedy for addressing VOC groundwater contamination and migration to surface water at Site 89. The Selected Remedy for Site 89 includes air sparging (AS) using horizontal wells to treat areas of groundwater with high contaminant concentrations (source area), a permeable reactive barrier (PRB) to treat the downgradient groundwater, aerators to treat surface water, MNA to monitor plume stability and natural attenuation (NA) processes, and LUCs to prevent aquifer use and mitigate exposure to vapor intrusion.

Statutory Determinations

The Selected Remedy meets the statutory requirements and is protective of human health and the environment, complies with federal and state regulations that are applicable or relevant and appropriate to the remedial action, is cost-effective, utilizes permanent solutions to the maximum extent practicable, and satisfies the preference for treatment as a principle element of the remedy. Because this remedy will result in pollutants or contaminants remaining onsite in groundwater above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after the initiation of the remedial action to ensure that the remedy is protective of human health and the environment in accordance with CERCLA Section 121(c) and the NCP at 40 CFR300.430 (f)(4)(ii). If the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed or treatment is unsuccessful, then additional remedial actions would be evaluated by the FFA parties and the Navy may be required to undertake additional remedial action.

1.2 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record[1] file for MCIEAST-MCB CAMLEJ, Site 89.

- Chemicals of concern (COCs) and their respective concentrations (Section 2.3 and Table 7)
- Baseline risk represented by the COCs (Section 2.5)
- Cleanup levels established for COCs and the basis for these levels (Section 2.7)
- How source materials constituting principal threats will be addressed (Section 2.6)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.4 and Section 2.5)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.9.3 and Table 15)
- Estimated capital, annual operations and maintenance (O&M), and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.8 and Tables 9, 10, and 11)
- 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 2.9.1)

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] **Bold blue text identifies detailed site information available in the Administrative Record and listed in the References Table.**

1.3 Authorizing Signatures

This ROD presents the Selected Remedy at Site 89, OU No. 16, at MCIEAST-MCB CAMLEJ, located in Onslow County, North Carolina.

10-16-12

D. L. THACKER, JR.
Colonel, U. S. Marine Corps
Commander, Acting
Marine Corps Installation East-Marine Corps Base Camp Lejeune

Date

12/6/12

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

Date

With concurrence from:

11-30-12

Dexter R. Matthews
Director, Division of Waste Management
North Carolina Department of Environment and Natural Resources

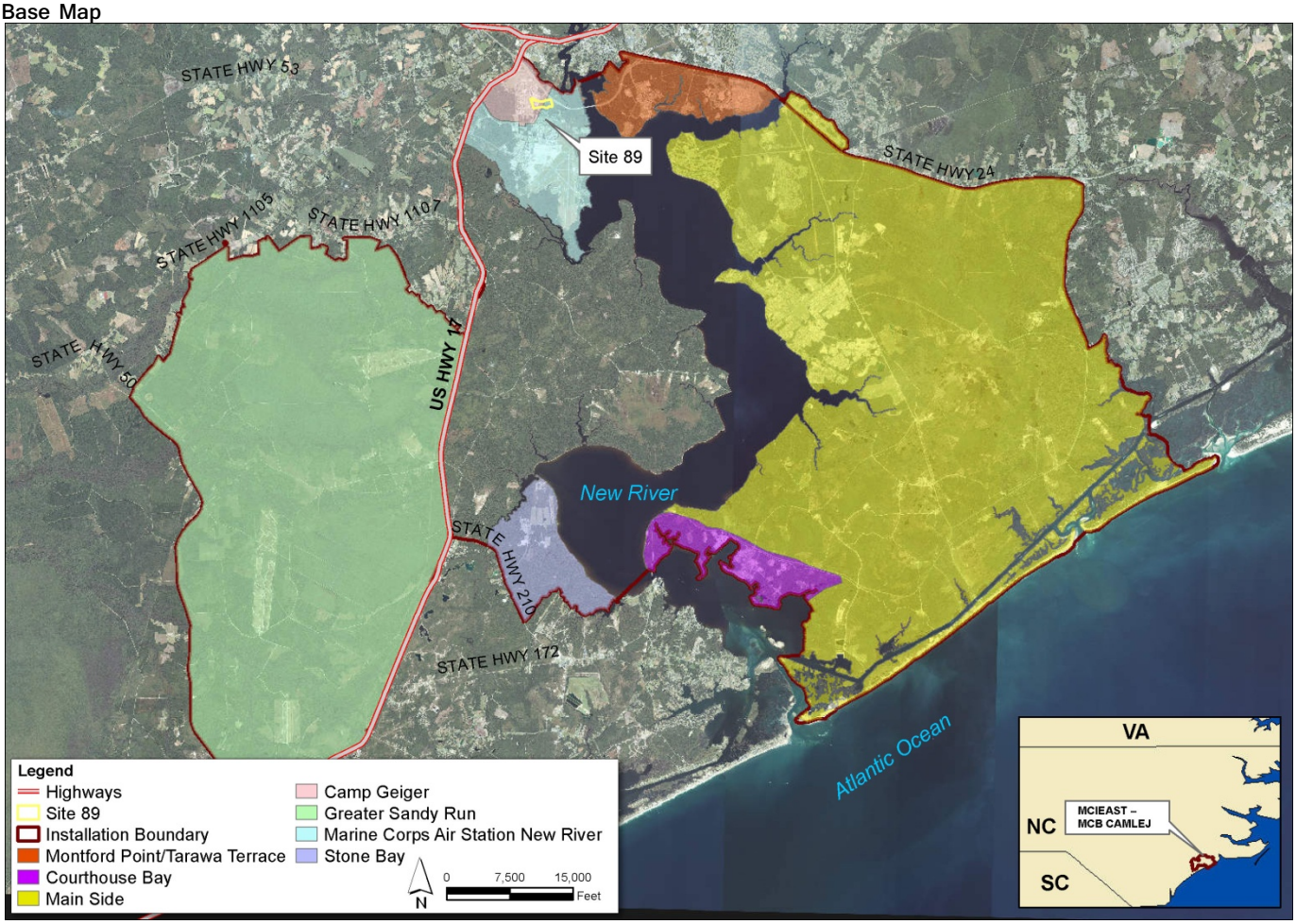
Date

2 Decision Summary

2.1 Site Description and History

MCIEAST-MCB CAMLEJ is a 156,000-acre facility located in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville (Figure 1). The mission of MCIEAST-MCB CAMLEJ is to maintain combat-ready units for expeditionary deployment. The Base provides housing, training facilities, and logistical support for Fleet Marine Force Units and other assigned units.

FIGURE 1
Base Map

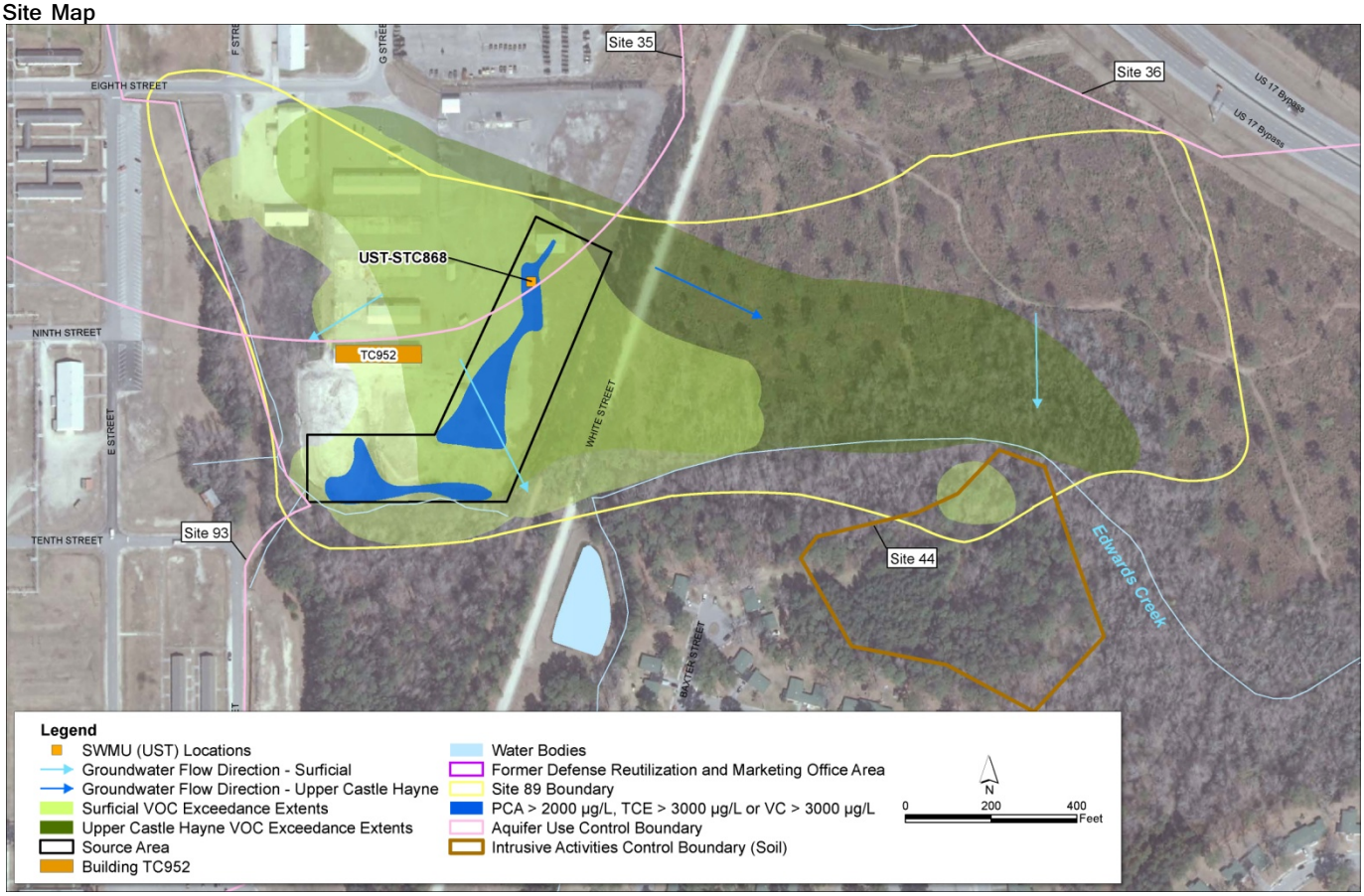


Site 89 is located on Camp Geiger, in the northwest portion of MCIEAST-MCB CAMLEJ. The Base motor pool operated on the site until 1988 and reportedly used solvents such as acetone, trichloroethene (TCE), and 2-butanone (methyl-ethyl-ketone) for cleaning parts and equipment. A steel 550-gallon underground storage tank (UST) was used to store waste oil from 1983 until its removal in 1993. During removal, visible signs of contamination were observed and the contaminated soil was removed until groundwater was encountered. Other structures historically located in the former UST area include Building STC-867, which was used to store hazardous soil, and a wash rack with an associated drain and oil and water separator.

The Defense Reutilization and Marketing Office (DRMO) was operated by the Defense Logistics Agency on the site until 2000. The area was used as a storage yard for items such as scrap and surplus metal, electronic equipment, vehicles, rubber tires, and fuel bladders. The site has not been used since the DRMO relocated in 2000. The only site activity since that time has been related to environmental investigations and actions.

The highest concentrations of groundwater contamination at Site 89 are located in the southern and eastern portion of the former DRMO. Based on the high concentrations reported, the former DRMO area has been identified as the source area. The primary contaminants in the groundwater at Site 89 are **chlorinated volatile organic compounds** (VOCs) (CH2M HILL, 2012). Chlorinated VOCs are also present in the surface water, indicating that groundwater is discharging into Edwards Creek. Figure 2 depicts the location of the groundwater VOC source and downgradient extents of the VOC plume.

FIGURE 2
Site Map



2.2 Site Characteristics

The former DRMO area is surrounded by a fence with an access gate, and the ground surface is covered with concrete slabs, asphalt, gravel, or grass (the areas east of the former UST STC-868 and south of former Building TC952). The area surrounding the former DRMO area to the west and south is primarily wetland along Edwards Creek. The eastern portion of Site 89 is generally undeveloped and covered in wetland and forest.

Site 89 is located within an interstream area and has little topographic relief. Edwards Creek is located to the west and south of Site 89 and eventually flows into the New River. Stormwater from Camp Geiger is conveyed via manmade drainage ditches into the source of Edwards Creek near the intersection of 8th and E Streets, as illustrated on Figure 2. Surface water at Site 89 also drains into Edwards Creek. The elevation of the DRMO Area is approximately 14 feet above mean sea level (msl) but drops off as the site approaches Edwards Creek.

Groundwater investigations completed at Site 89 have focused on the surficial aquifer and underlying Castle Hayne aquifer. For the purposes of the ROD, the aquifer **hydrogeologic units** at Site 89 have been divided into three zones corresponding to the following depths: surficial (5 to 10 feet below msl), upper Castle Hayne aquifer (10 to 40 feet below msl), and middle Castle Hayne aquifer (greater than 40 feet below msl).

Groundwater flow within the surficial aquifer is influenced by Edwards Creek and generally flows to the south-southeast from the former DRMO area. Surficial groundwater from the area south of Edwards Creek flows north towards the creek. In general, groundwater flow within the Castle Hayne aquifer is to the southeast towards the New River.

Site 89 is underlain by undifferentiated sediments (coinciding with the surficial aquifer) consisting primarily of fine, loose to medium dense sands with lesser amounts of silt and clay to approximately 20 to 25 feet below ground surface (bgs). Thin discontinuous lenses of silt and clay are also present in the undifferentiated formation. The undifferentiated sediments at MCIEAST-MCB CAMLEJ are typically underlain by a laterally discontinuous semi-confining unit, the Belgrade Formation, or Castle Hayne Confining Unit, which generally consists of mostly fine sands, silts, and clays, with lesser amounts of shell fragments. The Belgrade Formation appears to be laterally discontinuous at Site 89.

The River Bend Formation (coinciding with the Castle Hayne aquifer) underlies the Belgrade Formation and is composed of cemented sands, silt, shells, fossil fragments, and trace amounts of clay. Shells and cemented clasts are found within the silty sand from 20 to approximately 40 feet bgs, decreasing with depth. A layer of dense silty sand exhibiting a decrease in moisture content was encountered in borings at depths of approximately 40 to 45 feet bgs. Fine-grained sands, silty sands, and clays were encountered to 70 feet bgs. The maximum depth of investigation at Site 89 was 90 feet bgs.

2.3 Previous Investigations

Site 89 was characterized under numerous investigations and studies in the IR program between 1996 and the present. The primary contaminants in the groundwater and surface water at Site 89 are chlorinated VOCs. Table 1 presents a chronological list of those studies and interim actions taken to address site contamination. Figure 3 presents the extent of contamination based on the previous investigations and identifies where previous actions were implemented. The respective investigations are a part of the Administrative Record and can be referenced for further details for specific sampling strategies, media investigations, and information on when and where sampling was performed.

TABLE 1
Previous Investigations and Actions

Previous Investigation/Action*	Administrative Record Number	Dates	Activities and Findings
One Well Site Check Plus Resample Two Existing Wells (R.E. Wright Associates, INC, 1994)	000315	1994	Conducted a soil and groundwater investigation in the vicinity of the former UST. Groundwater samples reported elevated levels of various chlorinated solvents and let to the inclusion of Site 89 in MCB Camp Lejeune IR Program.
Remedial Investigation (RI) OU No. 16 (Sites 89 and 93) (Baker, 1998)	002278 and 002279	1996 - 1997	Conducted RI to detect the presence or absence of VOCs, SVOCs, pesticides and PCBs and metals in groundwater, surface water, sediment, and subsurface soil. Chlorinated solvents were detected in soil and groundwater in the surficial and upper Castle Hayne aquifers within the DRMO area, and in the surface water and sediment in Edwards Creek.
Long-Term Monitoring (LTM) and Immediate Response Field Effort (Baker, 1999)	002569	1999	Collected groundwater samples from Site 89 as part of the Basewide groundwater monitoring program. Conducted a field investigation as an **immediate response** to the 1,1,2,2-tetrachloroethane (PCA) concentration of 30,000 micrograms per liter (µg/L) in the sample from surficial aquifer monitoring well IR89-MW02 to re-sample the well and install additional wells to confirm and delineate groundwater and potential soil impacts. Concentrations of VOCs indicated the potential for dense non-aqueous phase liquid (DNAPL) in the eastern and southern portions of the DRMO area.

TABLE 1
Previous Investigations and Actions

Previous Investigation/Action*	Administrative Record Number	Dates	Activities and Findings
Additional Sampling (soil, groundwater, surface water and sediment) (Baker, 2000)	004140	1999-2000	Conducted additional VOC investigations of soil, groundwater, surface water, and sediment. Identified **elevated VOC impacts in the soil vadose zone** indicative of a source of groundwater and surface water contamination. A time-critical removal action (TCRA) was recommended for shallow soil in the southern DRMO area.
TCRA (OHM, 2000)	003519	2000	Removed 24,000 tons of shallow (0 to 5 feet bgs), VOC-impacted soil and treated the soil using **low temperature thermal desorption** (LTTD). Treatment was considered complete when confirmatory samples of the treated soil indicated that concentrations of 1,1,2,2-PCA were below 1 milligram per kilogram (mg/kg). Additionally, an aeration system was installed in Edwards Creek, immediately downstream of Site 89, to volatilize VOCs from surface water.
Supplemental Investigation (SI) and Evaluation (CH2M HILL, Baker, and CDM, 2001)	003956	2001	Investigated the horizontal and vertical extent of DNAPL through soil, groundwater, surface water, and sediment sampling. The SI identified **two DNAPL source zones** affecting 25,000 cubic yards of soil in the southern portion of the DRMO area.
Electrical Resistance Heating (ERH) Pilot Test (Shaw, 2005)	003806	2003-2005	Conducted a pilot test of an ERH system in the southern portion of the former DRMO area to remove free-phase DNAPL from below the groundwater surface. The treatment area was approximately 15,900 square feet and treated soil to a depth of 19 to 26 feet bgs. An estimated 48,500 pounds of **VOC-contaminated soil was treated** and confirmatory soil sampling indicated that DNAPL treatment was effective.
Comprehensive RI (CH2M HILL, 2008a)	004169	2003-2008	Investigated the extent of chlorinated VOCs semivolatile organic compounds (SVOCs) , and metals in groundwater and surface water of Edwards Creek, and VOCs, SVOCs, metals, and pesticides/ PCBs in sediment of Edwards Creek. The RI concluded that the groundwater was still impacted by VOCs. The **human health risk assessment** (HHRA) concluded that the subsurface soil posed a potential risk to the future adult and child residents, and that groundwater posed a potential risk to industrial receptors. Soil risks were driven by soil in the southern portion of the DRMO area at the suspected source of groundwater contamination. The screening-level **ecological risk assessment** (ERA) identified concentrations of polycyclic aromatic hydrocarbons (PAHs) and pesticides that posed a potential risk to the benthic invertebrate community in the wetlands.
Treatability Studies (AGVIQ-CH2M HILL Joint Venture, 2008)	004123	2006-2008	Implemented a treatability study to evaluate the performance and design of **four remedial technologies** in support of the Feasibility Study (FS): enhanced reductive dechlorination (ERD) by injecting a combination of sodium lactate and emulsified vegetable oil (EVO), chemical reduction via zero valent iron (ZVI) injection using pneumatic fracture, AS via a horizontal well, and a PRB using mulch and compost as backfill. While AS and ERD injections reduced contaminant mass for a similar cost per volume treated, AS was determined to be the most practical technology for full-scale implementation.
Results of the August 2008 SI (CH2M HILL, 2008b)	004210	2008	Collected groundwater samples from four temporary wells and surface water samples from three locations in Edwards Creek, from the eastern portion of Site 89, to evaluate the presence of chlorinated VOCs in groundwater and surface water in the eastern portion of Site 89.

TABLE 1
Previous Investigations and Actions

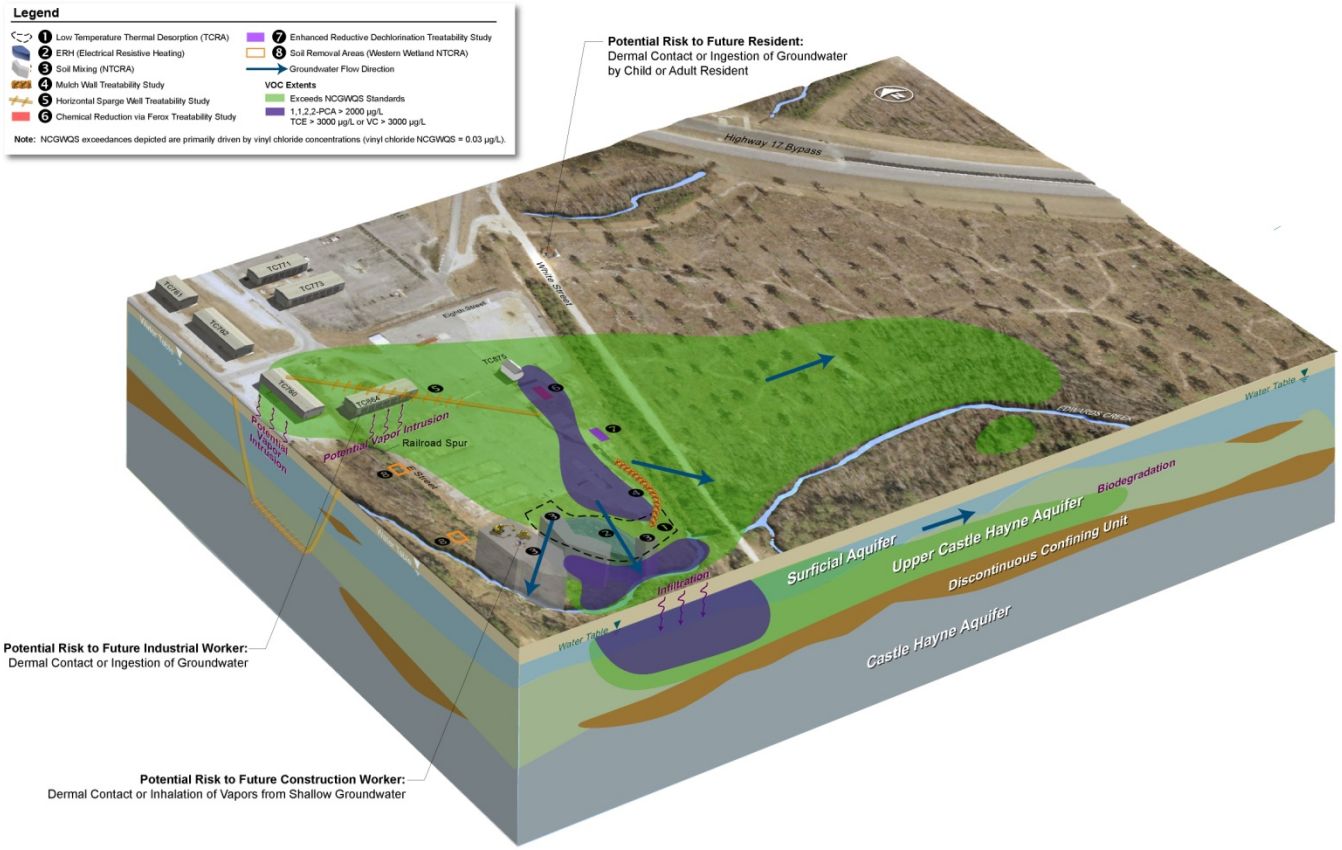
Previous Investigation/Action*	Administrative Record Number	Dates	Activities and Findings
Baseline ERA Addendum for the Western Wetland (CH2M HILL, 2008c)	004205	2008	Collected confirmatory soil and sediment samples to assess the **extent of PAH and pesticide impacts to the wetlands**. Removal of the impacted soil and sediment from the western wetland area was recommended.
Vapor Intrusion Evaluation Report (CH2M HILL, 2009)	002777	2008	Collected subslab soil gas and indoor air samples from buildings TC860 and TC864, located immediately northwest of the former DRMO area, to assess **potential vapor intrusion pathways** as part of a Basewide vapor intrusion study. No current risks to human health from vapor intrusion of VOCs were identified, but further vapor intrusion evaluation during future groundwater remediation was recommended based on soil vapor data collected during the treatability study while the AS system was running.
Soil Mixing Non-Time-Critical Removal Action (NTCRA) (AGVIQ-CH2M HILL Joint Venture, 2010)	002789	2007-2009	Treated source area DNAPL by mixing ZVI and clay into contaminated soil in the southern portion of the former DRMO area. Treated a 32,000-square-foot area to a depth of 25 feet, resulting in a total **treated volume of 30,000 cubic yards**. Post-treatment monitoring indicated significant reduction in VOC concentrations in the soil, groundwater, and adjacent creek. Soil samples within the mixing area indicated that soil impacts and associated risks from exposure were removed.
Western Wetland NTCRA (CH2M HILL, 2010)	002841	2010	**Removed soil and sediment with PAHs and pesticide** concentrations that contributed to unacceptable ecological risks. Confirmatory samples verified that the cleanup levels had been achieved, and any remaining ecological risks were considered minimal and acceptable.
Phase III Vapor Intrusion Evaluation Report Volume 5 of 5 (CH2M HILL, 2011)	004698	2010	Collected a second round of subslab soil gas and indoor air samples from Buildings TC860 and TC864 and an outdoor air sample near TC860. Further investigation of the VI pathway was not recommended for TC860 unless construction activities that involve slab penetration are necessary. An additional round of subslab soil gas and indoor air sampling is recommended at TC864 during the 5-year review or if construction activities involving slab penetration are required.
FS, Site 89, OU No. 16 (CH2M HILL, 2012)	004745	2008-2012	Conducted comprehensive groundwater and surface water sampling for VOCs and **NA** parameters sampling to assess current site conditions and conducted a fate and transport study in the soil mixing area to monitor the migration of treated groundwater. Groundwater concentrations of parent compounds (TCE, and 1,1,2,2-PCA) were significantly lower (one to two orders of magnitude) than historically detected, and concentrations of degradation daughter products (cis-1,2-dichloroethene [DCE], trans-1,2-DCE, and vinyl chloride [VC]) were higher. This suggests that previous pilot studies and targeted removal actions were successful in reducing the source area contaminant volume. Although detection of COCs in the upgradient wells is decreasing, the water discharging into Edwards Creek is still impacted by VOCs. Assessed the following **remedial alternatives** for VOC-impacted groundwater and surface water: Source Area Groundwater Alternatives: (1) No action, (2) ERD, (3) ISCO, (4) AS Downgradient Groundwater Alternatives: (1) No Action, (2) MNA, (3) PRB with MNA. Surface Water Alternatives: (1) No Action, (2) PRB, (3) Aerators

*Documents listed are available in the Administrative Record and provide detailed information to support remedy selection at Site 89.

During the most recent groundwater sampling events conducted from 2009 to 2011, 109 groundwater samples were collected from temporary and permanent monitoring wells and analyzed for VOCs. The compounds 1,1,2,2-PCA, 1,1,2,-trichloroethane (TCA), cis-1,2-DCE, tetrachloroethene (PCE), trans-1,2-DCE, TCE, and VC were detected in groundwater samples at concentrations exceeding the North Carolina Groundwater Quality Standards (NCGWQS) and were retained as COCs. **Concentrations of COCs** within the former DRMO area (hereinafter referred to as the source area) were generally one to two orders of magnitude greater than in the downgradient plume area. Generally, COCs were more prevalent and detected at higher concentrations in samples collected from monitoring wells screened in the surficial aquifer than the concentrations detected in the samples collected from the monitoring wells screened in the upper Castle Hayne aquifer.

Based on analytical data from the **2010 surface water sampling** event, it appears that COCs are discharging into Edwards Creek. The highest concentrations of VOCs were observed in the sample immediately downgradient of the source area and upstream of the current aeration system. Concentrations reported in samples collected downstream of the existing aeration system are approximately 50 percent lower, suggesting that the aeration system is decreasing the levels of VOCs in the surface water. Although VOC concentrations drop off after the aerator, subsequent groundwater discharge increases these concentrations until they eventually dissipate.

FIGURE 3
Conceptual Site Model



2.4 Current and Potential Future Land and Water Uses

Site 89 encompasses approximately 50 acres of currently undeveloped property, which consists of the former DRMO and wooded area east of the site. There are no current development plans at Site 89 and the area is not targeted for future development. The majority of Site 89 is enclosed by a fence. The areas north of the DRMO Area are generally developed and currently occupied by the School of Infantry. The area south of the site is generally undeveloped although a portion is residential.

Potable water for MCIEAST-MCB CAMLEJ and the surrounding residential area is provided by public water supply wells that pump groundwater from the Castle Hayne aquifer. There are no water supply wells within 1,500 feet of Site 89. Groundwater from the Castle Hayne aquifer at Site 89 is classified by NCDENR as a potential drinking water source but is not expected to impact public water supply because the nearest public supply wells are located upgradient of the site.

Edwards Creek is classified as a high quality, nutrient sensitive, salt water body used for aquatic life and secondary recreation (SC; HQW,NSW). The portion of the creek that runs through Site 89 is currently fenced in.

2.5 Summary of Site Risks

Potential human health and ecological risks at Site 89 were evaluated and documented during previous investigations (Table 1). Table 2 and the following subsections briefly summarize the findings of these risk assessments.

TABLE 2
Risk Summary

Medium	Human Health Risk	Ecological Risk
Surface Soil	Acceptable	Acceptable
Subsurface Soil	Acceptable	Not Applicable*
Groundwater	Unacceptable	Not Applicable*
Sediment	Acceptable	Acceptable
Surface Water	Acceptable	Acceptable
Indoor Air	Unacceptable	Not Applicable*

*Ecological receptors are not exposed to subsurface soil, groundwater, or indoor air

2.5.1 Human Health Risk Summary

The HHRA was completed to evaluate the potential impact of COCs on human health resulting from exposure to soil, sediment, surface water, groundwater, and indoor air at Site 89. There are no current receptors (no residents or workers); consequently, the potential human receptors included in risk estimations are **future receptors.** The **exposure scenarios** evaluated included: exposure to surface soil for future maintenance and industrial workers, recreational users, and residents; exposure to subsurface soil for future construction workers and residents; exposure to surface water and sediment for future recreational users; exposure to groundwater for future industrial and construction workers and residents; and exposure to indoor air for future industrial workers and residents Health risks are based on a conservative estimate of the potential cancer risk or the potential to cause other health effects not related to cancer (non-cancer hazard, or **hazard index** [HI])). USEPA identifies an acceptable **cancer risk** range of 1 in 10,000 (10^{-4}) to 1 in 1,000,000 (10^{-6}) and an acceptable non-cancer hazard as an HI of less than 1 (CH2M HILL, 2008a). The estimates of risk at Site 89 were used to determine if any further actions were required to sufficiently protect human health. Based on the results of the HHRA, it was concluded:

- There is no unacceptable risk from exposure to surface soil.
- There is no unacceptable risk from exposure to surface water. However, since the chemicals detected in surface water indicate that contaminated groundwater is discharging into Edwards Creek, the HHRA recommended establishing cleanup levels and continuing to monitor chlorinated VOC concentrations in surface water.
- There was a potential risk identified from exposure to VOCs in subsurface soil. However, the soil-mixing NTCRA has since been implemented to treat the high VOC concentrations and DNAPL, and the results of follow-up sampling suggest that this removal action was successful in treating subsurface soils and that potential risk from exposure to subsurface soil was removed.
- There is a potential risk to future industrial workers and residents from exposure to chlorinated VOCs in groundwater used as a potable water supply.

- There is a potential risk to construction workers from dermal and inhalation exposure to chlorinated VOCs in shallow groundwater.
- There is a potential for risk to future industrial workers and residents from exposure to VOCs in indoor air if the vapor intrusion pathway is completed by constructing buildings within 100 feet of the groundwater plume.

Tables 3, 4, 5, and 6 summarize the potential human health risks for future industrial workers, construction workers, adult residents and child residents, respectively. The conceptual site model (CSM) (Figure 3) depicts the potential risk identified at Site 89, including the exposure media, exposure routes, and potential human health receptors.

TABLE 3
Site 89 Potential Future Industrial Worker Risk

Pathway	COC	Exposure Point Concentration[1] (µg/L)	Reasonable Maximum Exposure (RME) Cancer Risk	RME HI	Cancer Slope Factor (CSF) mg/kg-day	Reference Dose (RfD) mg/kg-day
Surficial Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.80E+06	7.10E-01	290	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	2.00E-03	24	5.70E-02	4.00E-03
	cis-1,2-DCE	9.18E+04	-	90	-	1.00E-02
	PCE	9.20E+02	1.70E-03	0.9	5.40E-01	1.00E-02
	trans-1,2-DCE	3.40E+04	-	16	-	2.00E-02
	TCE	5.00E+05	1.90E-02	820	1.10E-02	6.00E-03
	VC	2.40E+03	5.90E-03	7.7	7.20E-01	3.00E-03
Dermal	1,1,2,2-PCA	1.80E+06	1.80E-01	48	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	2.40E-04	2.9	5.70E-02	4.00E-03
	cis-1,2-DCE	9.20E+04	-	10	-	1.00E-02
	trans-1,2-DCE	3.40E+04	-	1.8	-	2.00E-02
	TCE	5.00E+05	4.10E-03	180	1.10E-02	6.00E-03
	VC	2.40E+03	3.80E-04	0.49	7.20E-01	3.00E-03
Inhalation	1,1,2,2-PCA	1.80E+06	9.90E-01	1,000	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	9.50E-03	120	5.60E-02	4.00E-03
	1,2- DCA	1.40E+02	2.50E-04	5.5	9.10E-02	1.40E-03
	cis-1,2-DCE	9.20E+04	-	580	-	1.00E-02
	PCE	9.20E+02	3.50E-04	4.8	2.00E-02	1.00E-02
	trans-1,2-DCE	3.40E+04	-	110	-	2.00E-02
	TCE	5.00E+05	5.90E-02	2,900	6.00E-03	1.00E-02
	VC	2.40E+03	9.80E-04	6.4	1.50E-02	2.80E-02
Total Surficial Aquifer			**2.00E+00**	**6,164**		
Upper Castle Hayne Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.70E+02	1.20E-04	0.027	2.00E-01	6.00E-02
	PCE	6.30E+01	1.20E-04	0.061	5.40E-01	1.00E-02
	TCE	1.80E+03	6.90E-05	2.9	1.10E-02	6.00E-03
Inhalation	1,1,2,2-PCA	1.70E+02	4.00E-04	0.093	2.00E-01	6.00E-02
	cis-1,2-DCE	5.90E+02	-	3.7	-	1.00E-02
	TCE	1.80E+03	2.20E-04	10	6.00E-03	1.00E-02
Total Upper Castle Hayne Aquifer			**1.60E-02**	**23**		

Notes:
[1] The exposure point concentration used in the HHRA was reported before pilot studies and significant removal actions were completed.
Potential unacceptable risks or hazards are shaded in yellow.
Only COCs with a potential unacceptable risk or hazard are included in this table.
mg/kg-day = milligrams per kilogram per day

TABLE 4

Site 89 Potential Future Construction Worker Risk

Pathway	COC	Exposure Point Concentration[1] (µg/L)	RME Cancer Risk	RME HI	CSF mg/kg-day	RfD mg/kg-day
Surficial Aquifer Groundwater						
Dermal	1,1,2,2-PCA	1,800,000	8.20E-03	48	2.00E-01	6.00E-02
	1,1,2-TCA	10,000	9.50E-06	2.9	5.70E-02	4.00E-03
	cis-1,2-DCE	92,000	-	10	-	1.00E-02
	trans-1,2-DCE	34,000	-	1.8	-	2.00E-02
	TCE	500,000	1.70E-04	180	1.10E-02	6.00E-03
Inhalation	1,1,2,2-PCA	1,800,000	4.40E-02	260	2.00E-01	6.00E-02
	1,1,2-TCA	10,000	8.60E-05	27	5.60E-02	4.00E-03
	1,2- DCA	140	2.30E-06	1.3	9.10E-02	1.40E-03
	cis-1,2-DCE	92,000	-	120	-	1.00E-02
	trans-1,2-DCE	34,000	-	22	-	2.00E-02
	TCE	500,000	4.90E-04	580	6.00E-03	1.00E-02
	VC	2,400	8.70E-06	1.4	1.50E-02	2.80E-02
	Total Surficial Aquifer		**5.30E-02**	**1,255**		

Notes:

[1] The exposure point concentration used in the HHRA was reported before pilot studies and significant removal actions were completed.

Potential unacceptable risks or hazards are shaded in yellow.

Only COCs with a potential unacceptable risk or hazard are included in this table.

TABLE 5
Site 89 Potential Future Adult Resident Risk

Pathway	COC	Exposure Point Concentration[1] (µg/L)	RME Cancer Risk	RME HI	CSF mg/kg-day	RfD mg/kg-day
Surficial Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.80E+06	9.70E-01	820	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	5.40E-03	68	5.70E-02	4.00E-03
	1,2-DCA	1.40E+02	1.20E-04	0.2	9.10E-02	2.00E-02
	cis-1,2-DCE	9.20E+04	-	250	-	1.00E-02
	PCE	9.20E+02	4.70E-03	2.5	5.40E-01	1.00E-02
	trans-1,2-DCE	3.40E+04	-	46	-	2.00E-02
	TCE	5.00E+05	5.10E-02	2,300	1.10E-02	6.00E-03
	VC	2.40E+03	1.60E-02	22	7.20E-01	3.00E-03
Dermal	1,1,2,2-PCA	1.80E+06	2.60E-01	73	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	3.50E-04	4.5	5.70E-02	4.00E-03
	cis-1,2-DCE	9.20E+04	-	15	-	1.00E-02
	trans-1,2-DCE	3.40E+04	-	2.8	-	2.00E-02
	TCE	5.00E+05	6.10E-03	270	1.10E-02	6.00E-03
	VC	2.40E+03	5.60E-04	0.75	7.20E-01	3.00E-03
Inhalation	1,1,2,2-PCA	1.80E+06	1.00E+00	1,400	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	1.30E-02	170	5.60E-02	4.00E-03
	1,2- DCA	1.40E+02	3.40E-04	7.7	9.10E-02	1.43E-03
	cis-1,2-DCE	9.20E+04	-	810	-	1.00E-02
	PCE	9.20E+02	4.60E-04	6.8	2.00E-02	1.00E-02
	trans-1,2-DCE	3.40E+04	-	150	-	2.00E-02
	TCE	5.00E+05	7.90E-02	4,000	6.00E-03	1.00E-02
	VC	2.40E+03	1.30E-03	8.9	1.50E-02	2.80E-02
Total Surficial Aquifer			**2.40E+00**	**10,415**		
Upper Castle Hayne Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.70E+02	3.10E-04	0.077	2.00E-01	6.00E-02
	cis-1,2-DCE	5.90E+02	-	1.6	-	1.00E-02
	PCE	6.30E+01	3.20E-04	0.17	5.40E-01	1.00E-02
	TCE	1.80E+03	1.80E-04	8.2	1.10E-02	6.00E-03
	VC	1.70E+01	1.20E-04	0.16	7.20E-01	3.00E-03
Dermal	PCE	6.30E+01	1.40E-04	0.075	5.40E-01	1.00E-02
Inhalation	1,1,2,2-PCA	1.70E+02	5.40E-04	0.13	2.00E-01	6.00E-02
	cis-1,2-DCE	5.90E+02	-	5.2	-	1.00E-02
	TCE	1.80E+03	2.90E-04	14	6.00E-03	1.00E-02
Total Upper Castle Hayne Aquifer			**2.40E-02**	**35**		

Notes:

[1] The exposure point concentration used in the HHRA was reported before pilot studies and significant removal actions were completed.

Potential unacceptable risks or hazards are shaded in yellow.

Only COCs with a potential unacceptable risk or hazard are included in this table.

TABLE 6

Site 89 Potential Future Child Resident Risk

Pathway	COC	Exposure Point Concentration[1] (µg/L)	RME Cancer Risk	RME HI	CSF mg/kg-day	RfD mg/kg-day
Surficial Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.80E+06	8.60E-01	1,900	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	3.10E-03	160	5.70E-02	4.00E-03
	cis-1,2-DCE	9.20E+04	-	590	-	1.00E-02
	PCE	9.20E+02	2.70E-03	5.9	5.40E-01	1.00E-02
	trans-1,2-DCE	3.40E+04	-	110	-	2.00E-02
	TCE	5.00E+05	3.00E-02	5,400	1.10E-02	6.00E-03
	VC	2.40E+03	9.30E-03	50	7.20E-01	3.00E-03
Dermal	1,1,2,2-PCA	1.80E+06	1.70E-01	170	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	2.00E-04	10	5.70E-02	4.00E-03
	cis-1,2-DCE	9.20E+04	-	35	-	1.00E-02
	trans-1,2-DCE	3.40E+04	-	6.4	-	2.00E-02
	TCE	5.00E+05	3.50E-03	610	1.10E-02	6.00E-03
	VC	2.40E+03	3.20E-04	1.7	7.20E-01	3.00E-03
Inhalation	1,1,2,2-PCA	1.80E+06	1.00E+00	11,000	2.00E-01	6.00E-02
	1,1,2-TCA	1.00E+04	2.50E-02	1,300	5.60E-02	4.00E-03
	1,1-DCE	4.10E+02	-	4.9	-	6.00E-02
	cis-1,2-DCE	9.20E+04	-	6,500	-	1.00E-02
	PCE	9.20E+02	9.20E-04	54	2.00E-02	1.00E-02
	trans-1,2-DCE	3.40E+04	-	1,200	-	2.00E-02
	TCE	5.00E+05	1.50E-01	32,000	6.00E-03	1.00E-02
	VC	2.40E+03	2.60E-03	71	1.50E-02	2.80E-02
Total Surficial Aquifer			**2.30E+00**	**60,982**		
Upper Castle Hayne Aquifer Groundwater						
Ingestion	1,1,2,2-PCA	1.70E+02	1.80E-04	0.18	2.00E-01	6.00E-02
	cis-1,2-DCE	5.90E+02	-	3.8	-	1.00E-02
	PCE	6.30E+01	1.90E-04	0.4	5.40E-01	1.00E-02
	TCE	1.80E+03	1.10E-04	19	1.10E-02	6.00E-03
Dermal	TCE	1.80E+03	1.20E-05	2.2	1.10E-02	6.00E-03
Inhalation	1,1,2,2-PCA	1.70E+02	1.10E-03	1	2.00E-01	6.00E-02
	cis-1,2-DCE	5.90E+02	-	41	-	1.00E-02
	PCE	6.30E+01	6.30E-05	3.7	2.00E-02	1.00E-02
	trans-1,2-DCE	1.10E+02	-	3.8	-	2.00E-02
	TCE	1.80E+03	5.80E-04	110	6.00E-03	1.00E-02
Total Upper Castle Hayne Aquifer			**1.50E-02**	**198**		

Notes:

[1] The exposure point concentration used in the HHRA was reported before pilot studies and significant removal actions were completed.

Potential unacceptable risks or hazards are shaded in yellow.

Only COCs with a potential unacceptable risk or hazard are included in this table.

2.5.2 Ecological Risk Summary

The ERA was conducted to evaluate whether site activities had adversely affected terrestrial and aquatic communities on, or adjacent to, Site 89. Risk was estimated by calculating hazard quotients (HQs) using the concentration of each contaminant in applicable media (soil, surface water, and sediment) and dividing by an ecological screening value (ESV). Contaminants were retained for further assessment if the HQ was greater than 1 (the concentration exceeded the ESV), the contaminants was detected but did not have an ESV, or the contaminant was not detected but the reporting limit was greater than the ESV. The list of COCs was further refined using a weight-of-evidence approach that considered spatial and temporal distribution of analytical results, the general ecological setting and health of the ecosystems, and food web modeling.

The results indicated that the only ecological risk at Site 89 was to the benthic invertebrate community (animals with no backbones that live in sediments) exposed directly to the surface soil and sediment containing elevated levels of PAHs and pesticides in the western wetland adjacent to Edwards Creek.

In 2010, a Western Wetland NTCRA was conducted to remove the soil and sediment with PAHs and pesticide contamination exceeding ecological risk screening levels (Figure 3). **Confirmatory sampling** results verified that the performance standards had been achieved and that any remaining ecological risk was within acceptable levels.

2.5.3 Basis for Response Action

Based on the HHRA, exposure to groundwater at Site 89 poses an unacceptable risk to human health due to the presence of chlorinated VOCs. In addition, under **North Carolina's groundwater classification**, the surficial and Castle Hayne aquifers are considered Class GA, a potential source of drinking water (North Carolina Administrative Code [NCAC], 2010). NCDENR identified NCGWQS as 'relevant and appropriate' chemical-specific requirements for groundwater remediation of this aquifer. Remedial action at this site has been determined to be necessary due to unacceptable risk from potential human consumption of the contaminated groundwater and exceedance of the NCGWQS or MCLs (maximum contaminant levels) (measures that define unacceptable levels for drinking water). As a result, chlorinated VOCs identified in groundwater at Site 89 at concentrations exceeding the NCGWQS (Table 7) are all considered COCs.

Additionally, VOCs identified in surface water at Site 89 above the North Carolina Surface Water Quality Standards (NCSWQS) (Table 7) are also considered COCs.

It is the current judgment of the Navy, United States Marine Corps, and USEPA, in concurrence with NCDENR, that the Selected Remedy identified in this ROD, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

The concentrations of COCs requiring a response action are summarized in Table 7 and the extent of groundwater impacts is shown on Figure 2.

TABLE 7
COCs Requiring a Response Action

Groundwater COCs	Detection Frequency	Maximum Concentration (µg/L)[1]	NCGWQS (µg/L)
Surficial Aquifer			
1,1,2,2-PCA	15/63	9,300 J	0.2
1,1,2-TCA	13/63	310 J	5
cis-1,2-DCE	49/63	33,000	70
PCE	14/63	600 J	0.7
trans-1,2-DCE	36/63	6,000	100
TCE	35/63	69,000	3
VC	45/63	14,000	0.03

TABLE 7
COCs Requiring a Response Action

Groundwater COCs	Detection Frequency	Maximum Concentration (µg/L)[1]	NCGWQS (µg/L)
Upper Castle Hayne Aquifer			
1,1,2,2-PCA	3/27	6.2	0.2
1,1,2-TCA	1/27	48	5
cis-1,2-DCE	16/27	34,000	70
PCE	4/27	70	0.7
trans-1,2-DCE	11/27	7,000	100
TCE	15/27	4,900	3
VC	12/27	1,100	0.03
Surface Water COCs	**Detection Rate**	**Maximum Concentration (µg/L)**	**NCSWQS (µg/L)**
1,1,2,2-PCA	5/8	83	4
TCE	7/8	5	30
VC	7/8	83	2.4

[1] Maximum concentration detected in 2010 or 2011

J analyte detected, concentration may or may not be accurate or precise

2.6 Principal Threat Wastes

"Principal threat wastes" are source materials considered to be highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed. Contaminated groundwater generally is not considered to be a source material; however, non–aqueous phase liquids (NAPLs) in groundwater may be viewed as a source material. The maximum concentration of TCE (69 milligrams per liter [mg/L] collected from monitoring well IR89-MW53) in the surficial aquifer was detected at approximately 5 percent of the compound's solubility (1,280 mg/L in water). However, based on current data and the actions conducted to-date, DNAPL is not expected to be present at Site 89 based on the following lines of evidence:

- NTCRAs at this site using soil mixing and LTTD addressed both DNAPL and high-concentration VOC-contaminated soils that were considered principal threat wastes.
- DNAPL was not observed during the sampling of IR89-MW53.
- Concentrations of TCE detected in samples collected from nearby monitoring wells screened within the surficial and upper Castle Hayne aquifers were one to two orders of magnitude lower.

2.7 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for Site 89 are based upon the potential of future residential receptors using groundwater as a potable water supply. The RAOs identified for Site 89 are as follows:

1. Restore groundwater quality at Site 89 to meet NCDENR and federal primary drinking water standards, based on the classification of the aquifer as a potential source of drinking water [Class GA or Class GSA] under 15A NCAC 02L.0201
2. Minimize degradation of Edwards Creek from COC-impacted groundwater discharging into surface water until surface water COC concentrations meet the NCSWQS
3. Control exposure to COCs in groundwater and vapor intrusion from COCs in groundwater

Cleanup levels were developed for COCs contributing to unacceptable risks and hazards from exposure to groundwater (see Table 8). COCs detected in surface water indicate that the contaminated groundwater is discharging into Edwards Creek; therefore, cleanup levels were established for surface water. The cleanup levels for the COCs listed in Table 8 are based upon chemical-specific applicable or relevant and appropriate

requirement (ARARs). The cleanup levels for groundwater are based on the more stringent of the NCGWQS or Federal MCL. The cleanup levels for surface water are based on the NCSWQS.

TABLE 8
Cleanup Levels

Groundwater		Surface Water	
COC	NCGWQS/MCL (µg/L)	COC	NCSWQS (µg/L)
1,1,2,2-PCA	0.2	1,1,2,2-PCA	4
1,1,2-TCA	5	TCE	30
cis-1,2-DCE	70	VC	2.4
PCE	0.7		
trans-1,2-DCE	100		
TCE	3		
VC	0.03		

2.8 Description and Comparative Analysis of Remedial Alternatives

2.8.1 Description of Remedial Alternatives

Remedial alternatives to address groundwater and surface water impacts at Site 89 were developed and are detailed in the 2012 FS (CH2M HILL, 2012). Based on initial **screening of technologies**, four remedial alternatives were retained for groundwater in the source area, three remedial alternatives were retained for groundwater in the downgradient area, and three remedial alternatives were retained for the surface water. A detailed comparative analysis was conducted for each alternative. A description is provided in Tables 9, 10, and 11.

TABLE 9
Description of Remedial Alternatives for Site 89 – Source Area Groundwater

Alternative	Components	Details	Cost	
1 - No Action	None	None	**Total Cost**	**$0**
			Time frame	**Indefinite**
2 – ERD	Enhanced bioremediation	Injection of electron source and substrate to promote anaerobic biodegradation of VOCs by reductive dechlorination.	Capital cost	$1,624,500
			Semi-annual monitoring (yr 1)	$57,300
	Performance monitoring	Semi-annual groundwater monitoring for the first year to evaluate effectiveness of ERD injections.	**Total present value**	**$1,682,000**
		Active treatment would be considered complete when 95 percent reduction of COCs has been achieved.	**Time frame**	**3 to 5 years**
	MNA and LUCs	MNA and LUCs included in Downgradient Groundwater alternatives.		
3 – ISCO using Persulfate	Chemical oxidation of VOCs	Injection of chemical oxidant and activation agent to chemically degrade VOCs.	Capital cost	$4,095,500
			Quarterly monitoring (yr 1)	$41,100
	Performance monitoring	Quarterly groundwater monitoring for the first year to evaluate effectiveness of injections.	**Total present value**	**$4,137,000**
			Time frame	**1 year**
		Active treatment would be considered complete when 95 percent reduction of COCs has been achieved.		
	MNA and LUCs	MNA and LUCs included in Downgradient Groundwater alternatives.		
4 – AS	AS	Injection of air to induce mass transfer (stripping) of VOCs from groundwater and/or aerobic biodegradation.	Capital cost	$919,900
			Annual O&M (years 1-3)	$151,000
			Total present value	**$1,360,000**
	Performance monitoring	Semi-annual groundwater monitoring for first 3 years to evaluate effectiveness of sparge well.	**Time frame**	**3 years**
		Active treatment would be considered complete when 95 percent reduction of COCs has been achieved.		
	MNA and LUCs	MNA and LUCs included in Downgradient Groundwater alternatives.		

TABLE 10
Description of Remedial Alternatives for Site 89 – Downgradient Groundwater

Alternative	Components	Details	Cost	
1 - No Action	None	None	**Total Cost**	**$0**
			Time frame	**Indefinite**
2 – MNA	MNA	Site-wide long-term groundwater and surface water monitoring and reporting to evaluate:	Capital Cost	$11,000
			Annual monitoring	$58,000
		-Progress of NA over time	**Total Present Value**	**$841,000**
		-Potential impacts to surface water	**Time frame**	**90 years**
		-Plume stability		
	LUCs	LUCs to prevent exposure to groundwater and vapor intrusion.		
3 – PRB / MNA	PRB	Installation of a PRB to promote biodegradation through physical, chemical, or biological processes. Carbon substrate injections every 3 years to extend the lifespan of the PRB.	Capital Cost	$805,000
			PRB Operation	$24,000
			Annual monitoring	$58,000
			Total Present Value	**$1,836,000**
	MNA	Site-wide long-term groundwater and surface water monitoring and reporting to evaluate:	**Time frame**	**90 years**
		-Effectiveness of the PRB		
		-Progress of NA over time		
		-Potential impacts to surface water		
		-Plume stability		
	LUCs	LUCs to prevent exposure to groundwater and vapor intrusion.		

TABLE 11
Description of Remedial Alternatives for Site 89 – Surface Water

Alternative	Components	Details	Cost	
1 - No Action	None	None	**Total Cost**	**$0**
			Time frame	**Indefinite**
2 – PRB	PRB	Installation of a PRB to promote biodegradation through physical, chemical, or biological processes. Carbon substrate injections every 3 years extend the lifespan of the PRB.	Capital cost	$674,700
			PRB Operations	$75,700
			Total present value	**$1,952,000**
	LTM	LTM of surface water will be performed as long as groundwater concentrations exceed NCSWQS in the surficial aquifer. MNA is included in downgradient groundwater alternatives.	**Time frame**	**30 years**
	LUCs	LUCs included in Downgradient Groundwater alternatives.		
3 - Aerators	Air Stripping	Aerators utilize air stripping technology to transfer contaminants from aqueous solutions to air.	Capital cost	$47,250
			Annual O&M	$15,000
	LTM	LTM of surface water will be performed as long as groundwater concentrations exceed NCSWQS in the surficial aquifer. MNA is included in Downgradient Groundwater alternatives.	**Total present value**	**$297,000**
			Time frame	**30 years**
	LUCs	LUCs included in Downgradient Groundwater alternatives.		

2.8.2 Comparative Analysis of Alternatives

A comparative analysis using the **nine USEPA criteria** was completed and is provided as follows. The analyses are summarized in Tables 12, 13, and 14 for groundwater and surface water, respectively. It is assumed that the No Action Alternative does not comply with any criteria and will not be compared in the following sections.

TABLE 12
Source Area Groundwater Comparison

CERCLA Criteria	Alt 1 No Action	Alt 2 ERD	Alt 3 ISCO	Alt 4 AS
Threshold Criteria				
Protection of human health and the environment	❍	●	●	●
Compliance with ARARs	❍	●	●	●
Primary Balancing Criteria				
Long-term effectiveness and permanence	❍	⭘	⭘	●
Reduction in toxicity, mobility, or volume through treatment	❍	⭘	●	●
Short-term effectiveness	❍	●	⭘	⭘
Implementability	●	⭘	⭘	●
Present Cost	$0	$1.7 M	$4.1 M	$1.4 M

Ranking: ● High ⭘ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

TABLE 13
Downgradient Groundwater Comparison

CERCLA Criteria	Alt 1 No Action	Alt 2 MNA	Alt 3 PRB
Threshold Criteria			
Protection of human health and the environment	❍	●	●
Compliance with ARARs	❍	●	●
Primary Balancing Criteria			
Long-term effectiveness and permanence	❍	⭘	●
Reduction in toxicity, mobility, or volume through treatment	❍	❍	●
Short-term effectiveness	❍	⭘	⭘
Implementability	●	●	⭘
Present Cost	$0	$0.9 M	$1.9 M

Ranking: ● High ⭘ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

TABLE 14
Surface Water Comparison

CERCLA Criteria	Alt 1 No Action	Alt 2 PRB	Alt 3 Aerators
Threshold Criteria			
Protection of human health and the environment	❍	●	●
Compliance with ARARs	❍	●	●
Primary Balancing Criteria			
Long-term effectiveness and permanence	❍	◘	◘
Reduction in toxicity, mobility, or volume through treatment	❍	●	◘
Short-term effectiveness	❍	◘	●
Implementability	●	◘	●
Present Cost	$0	$2 M	$0.3 M

Ranking: ● High ◘ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

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 treatment and/or LUCs. Source area Alternatives 2 (ERD), 3 (ISCO), and 4 (AS) provide active treatment to reduce the concentrations of COCs in groundwater, expediting the NA process. The downgradient groundwater Alternatives 2 (MNA) and 3 (PRB and MNA) provide passive treatment and monitoring to ensure that the plume is stable and LUCs remain protective. The surface water Alternative 2 (PRB) provides treatment of groundwater immediately before discharging into Edwards Creek and surface water Alternative 3 (aerators) provides direct treatment of surface water. Monitoring and LUCs will provide protection until RAOs are achieved.

Compliance with ARARs

The ARARs include any Federal or State standards, requirement, criteria, or limitations that are determined to be legally applicable or relevant and appropriate to a CERCLA site or action and are provided in Appendix A. TBC criteria are non-promulgated advisories or guidance issued by Federal or State government and do not have the status of potential ARARs but are evaluated along with ARARs. The timeframe for compliance with Chemical specific ARARs will vary with different remedial alternatives. Location-specific ARARS remain the same for each alternative and Action-specific ARARs may vary to some extent with the different remedial alternatives. All alternatives, except the No Action Alternative (Alternative 1 for each area or media), are expected to comply with **ARARs**. The source area Alternatives 3 (ISCO) and 4 (AS) are expected to meet chemical-specific ARARs in a shorter time frame because they rely on chemical or physical removal that reduces concentrations on contact. Source area alternative 2 (ERD) will take a longer time to meet ARARs because it relies on biological processes.

Downgradient Alternative 2 (MNA) will have a longer time frame to meet ARARs because it relies only on natural degradation, whereas downgradient Alternative 3 (PRB and MNA) provides enhanced conditions for biological degradation of COCs in groundwater migrating from the source area, reducing the time frame to meet ARARs.

Surface water Alternatives 2 (PRB) and 3 (aerators) will meet ARARs. Alternative 3 (aerators) requires fewer materials and less heavy construction for installation than Alternative 2 (PRB), resulting in fewer applicable action-specific ARARs.

Primary Balancing Criteria

Long-term Effectiveness and Permanence

Source Area Groundwater. All source area groundwater alternatives are expected to be effective in the long term, as active treatment is intended to treat the highest concentrations of the dissolved-phase contamination and then allow NA to reduce groundwater contaminant concentration to below cleanup levels. Although "**rebound**" is a potential issue related to any injection scenario or AS. Subsurface distribution is the key to the treatment effectiveness and timeframe.

Source area Alternative 2 (ERD) would take the longest of the active treatment alternatives because it relies on biological degradation rather than chemical or physical processes to remove contaminant mass. Because ISCO rapidly oxidizes COCs to innocuous compounds on contact, source area Alternative 3 (ISCO) would likely remove COCs in the shortest amount of time. Source area Alternative 4 (AS) would also remove COCs within a relatively short amount of time, and air may be more effective than liquid injection (Alternatives 2 [ERD] and 3 [ISCO]) for making contact with the contaminated media.

Due to the possibility of rebound, multiple injections (or system restart for AS) may be required for source area Alternatives 2 (ERD), 3 (ISCO), and 4 (AS); however, it is less labor- and material-intensive to restart the compressor than to re-inject substrate or oxidant. Reviews conducted at least every 5 years, as required, would be necessary to evaluate the effectiveness of any of the alternatives because hazardous substances would remain onsite at concentrations above levels that allow for unlimited use and unrestricted exposure.

Downgradient Groundwater. Downgradient Alternatives 2 (MNA) and 3 (PRB and MNA) would be expected to be effective in the long term. Alternative 2 (MNA) would take the longest time to achieve RAOs because it relies on NA; whereas Alternative 3 (PRB and MNA) provides enhanced conditions for reductive dechlorination. Alternative 3 (PRB and MNA) requires more long-term maintenance in the form of periodic (roughly every 5 years) injections of a carbon source to replenish the electron donor in the PRB.

Surface Water. Active treatment of groundwater is planned to remove the source of surface water contamination from impacted surficial groundwater discharge. In the interim, surface water Alternatives 2 (PRB) and 3 (aerators) would likely be effective. Both alternatives require long-term O&M. Alternative 2 requires more costly material- and labor-intensive monitoring and maintenance (potential future injections of ERD substrate) than Alternative 3.

Reduction of Toxicity, Mobility, or Volume through Treatment

Source Area Groundwater. Source area Alternatives 2 (ERD), 3 (ISCO), and 4 (AS) would reduce toxicity, mobility, and volume through treatment. Source area Alternatives 3 (ISCO) and 4 (AS) would quickly reduce the toxicity and volume of COCs in groundwater through chemical oxidation or air stripping, while Alternative 2 (ERD) would reduce COCs at a relatively slower rate because it is dependent on biological processes.

Downgradient Groundwater. Downgradient Alternative 3 (PRB and MNA) would reduce toxicity, mobility, and volume through treatment by providing passive remediation of contaminants migrating from the source area, but it would not treat the source directly. Although downgradient Alternative 2 (MNA) would not provide for active treatment, the natural reduction of contaminant concentrations through a variety of physical, chemical, or biological activities is expected over time.

Surface Water. Surface water Alternative 2 (PRB) would reduce toxicity, mobility, and volume through treatment by providing passive remediation of contaminants migrating from the source (groundwater), but it would not treat the surface water directly. Alternative 3 (aerators) would reduce the toxicity and volume of contaminants in Edwards Creek.

Short-term Effectiveness

Source Area Groundwater. Short-term effectiveness, in terms of risks to workers, the community, and the environment, would be minimized for source area Alternatives 2 (ERD), 3 (ISCO), and 4 (AS) through the use of appropriate personal protective equipment and air monitoring. Source area Alternative 3 (ISCO) has the highest

short-term risk to workers because of the use of oxidants and strongly corrosive chemicals and the possibility of re-injection. In general, emissions, water consumption, and energy use are greatest for source area Alternative 4 (AS) because of the electricity used to power the AS system for 3 years. Source area Alternatives 3 (ISCO) and 4 (AS) are most likely to achieve RAOs in the shortest period of time because of the use of relatively fast-acting reagents, particularly chemical oxidation. Source area Alternative 4 (AS) will take less time to implement construction than source area Alternatives 2 (ERD) and 3 (ISCO).

Downgradient Groundwater. Short-term effectiveness, in terms of risks to the environment, workers, and the community during implementation, is similar for downgradient Alternative 2 (MNA) and downgradient Alternative 3 (PRB and MNA). Although both alternatives include MNA for 90 years, Alternative 3 (PRB and MNA) is likely to reach RAOs within a shorter timeframe but would have higher environmental impacts because of installation activities and maintenance of the PRB.

Surface Water. The short-term effectiveness of surface water Alternatives is similar to the downgradient alternatives. The PRB would be significantly more labor-intensive and require more materials to install and maintain than aerators.

Implementability

Source Area Groundwater. Each alternative is implementable, with materials and services readily available. However, subsurface liquid injections rely heavily on the ability to distribute reagents uniformly at acceptable quantities. In addition, ISCO (Alternative 3) would require extra health and safety precautions for the handling of both the oxidant and the activator. AS (Alternative 4) also relies on a relatively uniform distribution of air. Air injected beneath the cemented sand layer or any clay lenses would likely follow this layer until it reaches the point where it is discontinuous and may circumvent contaminated groundwater. Alternatives 2 (ERD), 3 (ISCO), and 4 (AS) would involve significant construction activities during installation of 108 injection wells (5,875 linear feet total) or 2,950 linear feet of horizontal wells. While horizontal directional drilling is more specialized than vertical drilling, the two horizontal wells are installed in close proximity to each other so set-up and breakdown costs would be relatively minor compared to 108 different well locations for source area groundwater Alternatives 2 (ERD) and 3 (ISCO).

Downgradient Groundwater. Each alternative is implementable, with materials and services readily available. Downgradient Alternative 2 (MNA) is significantly easier to implement because no construction activities are required. The PRB would require significant site preparation and construction activities to implement. Additionally, it would involve significant soil handling (approximately 1,500 cubic yards) during initial implementation and potential future periodic injections during the life span of the PRB. There are also a limited number of one-pass trenching companies for the PRB.

Surface Water. Both surface water alternatives are implementable, with materials and services readily available. Preparation, installation, and maintenance for Alternative 3 (aerators) would be significantly easier than Alternative 2 (PRB). Site preparation to clear vegetation from the trencher path would be logistically difficult in the wetland. Additionally, it would involve soil handling (approximately 2,000 cubic yards) during initial implementation and potential future periodic injections during the life span of the PRB. There are also a limited number of one-pass trenching companies for the PRB.

Cost

Tables 9, 10, and 11 summarize the capital costs, as well as long-term O&M costs (as applicable) for the alternatives. For comparative purposes, a 90-year time frame was used for downgradient groundwater alternatives and a 30-year time frame was used for surface water alternative comparisons.

Source Area Groundwater. The estimated present-worth cost of source area Alternative 3 (ISCO) is $4,137,000, which is more than twice the cost of source area Alternatives 2 (ERD) ($1,680,000) or 4 (AS) ($1,360,000).

Downgradient Groundwater. The estimated present-worth cost of downgradient Alternative 2 (MNA) is $841,000, which is less than half of the cost of downgradient Alternative 3 (PRB and MNA), estimated at $1,836,000.

Surface Water. The estimated present-worth cost of Alternative 2 (PRB) is $1,952,000, which is significantly higher than Alternative 3 (aerators), estimated at $297,000.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA process. NCDENR, as the designated state support agency in North Carolina, concurs with the Selected Remedy.

Community Acceptance. The public meeting was held on May 24, 2012, to present the Proposed Remedial Action Plan (PRAP) and answer community questions regarding the proposed remedial action at Site 89. The questions and concerns raised at the meeting were general inquiries for informational purposes only. No comments requiring amendment to the PRAP were received from the public during the meeting and public comment period.

2.9 Selected Remedy

The Selected Remedy for Site 89 includes AS using horizontal wells to treat areas of groundwater with high contaminant concentrations (source area), PRB to treat the downgradient groundwater, and aerators to treat groundwater discharge to surface water, MNA to monitor plume stability and NA processes, and LUCs to prevent aquifer use and mitigate exposure to vapor intrusion.

2.9.1 Rationale for the Selected Remedy

AS was selected because it has been proven effective at Site 89 during pilot studies, complies with ARARs, is expected to remove 95 percent or better of the COCs within a reasonable timeframe, and is less expensive than source area Alternatives 2 (ERD) and 3 (ISCO).

The PRB and MNA remedy was selected to address downgradient groundwater contamination because it has also been proven effective at Site 89 in pilot studies, protects human health and the environment, complies with ARARs, will enhance conditions for reductive dechlorination, and will reduce the toxicity, mobility, and volume of the COCs through treatment. MNA would be implemented across the site during active treatment and after active treatment has been completed.

Aerators were selected as the remedy to address surface water contamination because it complies with ARARs, reduces the COCs in Edwards Creek immediately following installation, has the smallest environmental impact and potential risk to workers during implementation, and is less expensive than Alternative 2.

LUCs were selected to prevent aquifer use, restrict groundwater intrusive activities, and mitigate vapor intrusion until cleanups levels have been reached. LUCs are relatively inexpensive and will protect human health and the environment until active and passive treatment has been completed.

2.9.2 Description of the Selected Remedy

The proposed locations of the AS, PRB, and aerators are presented on Figure 4.

AS will be conducted using horizontally directionally drilled (HDD) wells to distribute air through the source area subsurface. Using a compressor, air is injected through the horizontal well, promoting mass transfer of VOCs and/or biological degradation. The system is expected to operate for 3 years and will include monthly O&M. LTM will be conducted to measure the effectiveness of the AS and changes in COC concentration. The treatment will be considered complete when COC concentrations of 100 µg/L are achieved, or COC reductions in source area wells demonstrate an asymptotic trend prior to achieving the target reduction.

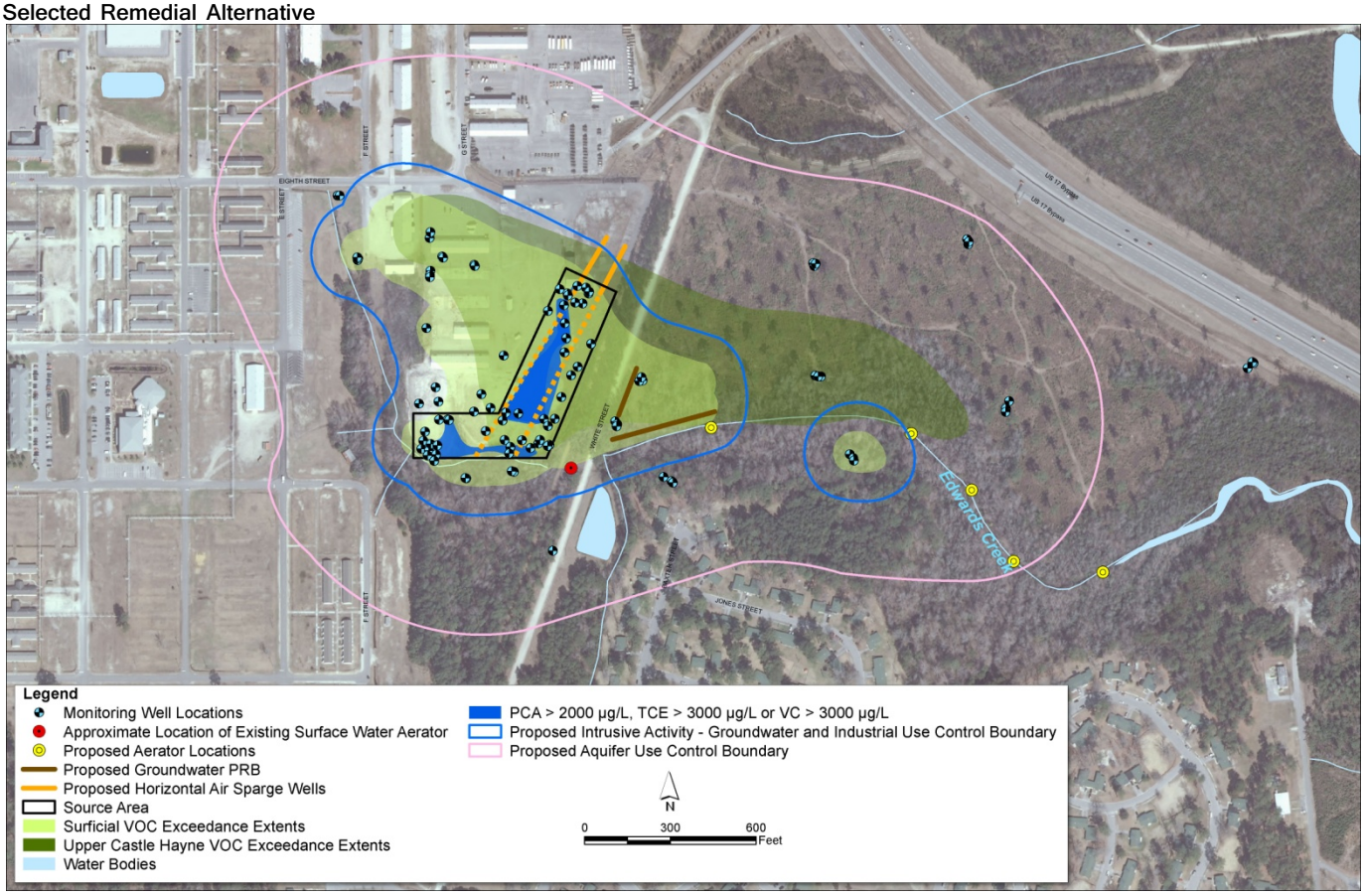
A downgradient PRB will be installed between White Street and Edwards Creek, perpendicular to groundwater flow. The PRB will be composed of 40 percent mulch and 60 percent sand. The wall will be 2 feet wide and placed

at a depth that treats groundwater that will eventually discharge to the creek. In order to extend the life-span of the PRB, a carbon substrate will be injected into the wall approximately every 5 years after the initial life-span of the mulch. Performance monitoring will be conducted to evaluate the effectiveness of the PRB and changes in COC concentrations. It is presumed that the PRB will no longer be necessary when active treatment has met the RAOs and treated groundwater has reached the PRB; this is conservatively estimated to occur after 15 years.

In addition to performance monitoring, MNA will be conducted to monitor plume stability and analyze NA parameters. Groundwater and surface water samples will be collected and analyzed for site-specific COCs to assess site-wide groundwater conditions and trends. Frequency of sampling and the monitoring well network will be determined in the Remedial Design.

Up to five aerators, in addition to the aerator currently located in Edwards Creek, will be installed downstream of the source area. LTM will be conducted to measure the effectiveness of the aerators and changes in COC concentrations.

FIGURE 4
Selected Remedial Alternative



LUCs including, but not limited to, land use restrictions in the Base Master Plan, filing a Notice of Contaminated Site with the Register of Deeds of Onslow County, and administrative procedures to prohibit unauthorized intrusive activities (for example, excavation into the water table, drinking water well installation, or construction) will be implemented as part of the remedy to prevent exposure to the residual contamination on the site that exceeds the cleanup levels. Consideration of vapor intrusion is required prior to any new construction or changes to existing building use or structure within the LUC boundary. LUCs will be maintained until the concentrations of hazardous substances in the groundwater are at such levels to allow for unrestricted use and exposure. The Navy and United States Marine Corps is responsible for implementing, maintaining, reporting on, and enforcing LUCs. Although the Navy and MCIEAST – MCB CAMLEJ may later transfer these procedural responsibilities to another

party by contract, property transfer agreement, or through other means, the Navy and MCIEAST – MCB CAMLEJ shall retain ultimate responsibility for the remedy integrity. The LUC performance objectives include:

- To prevent use of the surficial and Castle Hayne aquifers
- To prevent construction worker exposure to COCs in groundwater within the surficial aquifer
- To mitigate exposure of COCs in indoor air from vapor intrusion pathways
- To maintain the integrity of any existing or future monitoring or remediation system at the site

To achieve the LUC objectives, the Navy will implement the following LUCs for Site 89:

- Aquifer Use Control – To prohibit the withdrawal and use of groundwater, except for environmental monitoring, where groundwater contamination remains in-place above concentrations that allow for unlimited use and unrestricted exposure. This LUC boundary is defined to the northeast by the United States Highway 17 Bypass and encompasses the Camp Geiger area (west of White Street) from 7th Street to the north, D Street to the west, 11th Street to the south, and the boundary of the housing development to the south (east of White Street).
- Industrial and Non-Industrial Use Control (Vapor Intrusion) – To evaluate future buildings and land use for potential vapor intrusion pathways, prior to construction, within the extent of groundwater contamination remaining in-place above concentrations that allow for unlimited use and unrestricted exposure. This LUC boundary encompasses the area within 100 feet of surficial and Castle Hayne groundwater COCs exceeding cleanup levels.
- Intrusive Activities Control (Groundwater) – To restrict intrusive activities within the extent of groundwater contamination. This LUC boundary is defined as the area with concentrations of COCs contributing to construction worker risks and is conservatively assumed to include the area within 100 feet of the entire extent of surficial groundwater COCs exceeding cleanup levels.
- Access Control **–** To prevent exposure to surface water in Edwards Creek, fencing and signs around the perimeter of the site will be maintained.

The Navy will implement the following actions as part of the LUCs for Site 89:

- Incorporating land and groundwater use prohibitions into the MCIEAST–MCB CAMLEJ Base Master Plan, including consideration of vapor intrusion for new construction or modification to existing structures foundations within 100 feet of contaminated groundwater
- Recording a Notice of Contaminated Site filed in Onslow County real property records in accordance with North Carolina General Statutes (NCGSs) 143B-279.9 and 143B-279.10
- Maintaining the integrity of any current or future remedial or monitoring system, such as conducting site inspections to verify the integrity of the monitoring wells and to verify compliance with use restrictions

The estimated LUC boundary is provided on Figure 4, the actual LUC boundaries will be finalized in the remedial design document. The LUC implementation actions, including monitoring and enforcement requirements, will be provided in a Land Use Control Implementation Plan (LUCIP) that will be prepared as part of the Remedial Design document. The Navy will submit the LUCIP to USEPA and NCDENR for review and approval pursuant to the primary document review procedures stipulated in the FFA within 90 days of the ROD signature. The Navy will maintain, monitor (including conducting periodic inspections), and enforce the LUCs according to the requirements contained in the LUCIP and the ROD. The need for LUCs to prevent exposure and ensure protection will be periodically reassessed as COC concentrations are reduced over time.

2.9.3 Expected Outcomes of the Selected Remedy

Current land uses are expected to continue at Site 89. Cleanup levels for the Selected Remedy are based on unlimited use and unrestricted exposure. Exposure will be controlled through LUCs until COCs in groundwater and surface water are reduced to the cleanup levels. Table 15 summarizes the unacceptable risks, the RAOs identified

to address the risks, the remedy components intended to achieve the RAOs, the metrics that measure the remedial action progress, and the expected outcome that the remedy will have.

TABLE 15
Expected Outcomes

Risk	RAO	Remedy Component	Metric	Expected Outcome
Future industrial and construction worker and residential exposure to VOCs in groundwater and indoor air	Restore groundwater quality to meet NCDENR and federal primary drinking water standards, based on the classification of the aquifer as a potential source of drinking water [Class GA or Class GSA] under 15A NCAC 02L.0201	Air Sparge	Operate the system for up to 3 years, until COC concentrations are 100 µg/L, or COC reductions in source area wells demonstrate an asymptotic trend prior to achieving the target reduction	Unlimited use and unrestricted exposure
		PRB	Maintain until COCs in groundwater meet surface water cleanup levels	
		MNA	Maintain until COCs in groundwater meet cleanup levels for four consecutive monitoring events*	
	Control exposure to COCs in groundwater and vapor intrusion from COCs in groundwater	LUCs	Implement until each groundwater COC is at or below its respective cleanup level for four consecutive monitoring events*	
Discharge of COCs into surface water and offsite migration	Minimize degradation of Edwards Creek from COC-impacted groundwater discharging into surface water	Aerators LTM	Maintain until COCs in surface water are below surface water cleanup levels	

*The Navy and Marine Corps, in partnership with USEPA and the State, will evaluate the discontinuation of monitoring of individual COCs that have met the remediation goals after four rounds based on site conditions. The Navy, Marine Corps, USEPA, and NCDENR may agree for the groundwater LUC component of the Selected Remedy to be terminated at site closeout.

2.9.4 Statutory Determinations

Remedial actions undertaken at NPL sites must meet the statutory requirements of Section 121 of CERCLA and thereby achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, 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— Because there is unacceptable risk to human health, due to contaminated groundwater at this site that is considered a potential drinking water source, a remedial action is required to restore the groundwater to meet drinking water standards (i.e., MCLs or NCGWQS). Although there is no risk based on current land use, the Selected Remedy is needed to restore groundwater to levels consistent for future drinking water use and to protect human health and the environment by reducing site risks through groundwater and surface water treatment. The implementation of LUCs will prevent exposure to the surficial and Castle Hayne aquifers underlying Site 89, mitigate exposure of COCs in indoor air from vapor intrusion pathways, and maintain the integrity of any existing or future monitoring or remediation system.

Compliance with ARARs and To-Be-Considered (TBC) Criteria—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 (ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 Code of Federal Regulations (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, and therefore the CERCLA requirement for compliance with or wavier 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. The TBC category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies. See 40 CFR § 300.400(g)(3) for more information. In accordance with 40 CFR § 300.400(g), the Navy, USEPA, and NCDENR have identified the ARARs and TBCs for the Selected Remedy. Appendix A lists, respectively, the chemical-, location- and action-specific ARARs and TBCs for the Selected Remedy. The Selected Remedy will meet all identified ARARs.

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 threshold criteria. The costs are proportional to overall effectiveness by achieving long-term effectiveness and permanence within a reasonable timeframe. The PRB with MNA was selected instead of MNA alone despite increased costs because it will reduce toxicity, mobility, and volume of COCs more rapidly. The Navy, United States Marine Corps, USEPA, and NCDENR believe that the PRB’s additional cost provides a significant increase to protection of human health and the environment and a significant decrease in the time needed to achieve RAOs.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable—The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 89. Because long-term effectiveness and permanence along with reduced toxicity and volume are achieved in the shortest timeframe with the Selected Remedy, the Navy, United States Marine Corps, USEPA, and NCDENR determined that the Selected Remedy provides the best balance of tradeoffs in terms of the balancing criteria while also considering the statutory preference for treatment as a principal element and considering state and community acceptance.

The Selected Remedy treats the high concentrations of dissolved phase COCs in the former DRMO area, achieving significant reduction in COCs in groundwater. Treatment of surficial groundwater in the area of highest COC concentrations and using a PRB downgradient of this area also removes the contaminant source in Edwards Creek. The Selected Remedy satisfies long-term effectiveness by permanently removing high concentrations of COCs from groundwater using active treatment. LUCs and MNA will prevent exposure to COCs and monitor effectiveness of treatment and natural degradation in groundwater. The Selected Remedy does not present short-term risks different from the other treatment alternatives. Trenching technologies for the PRB are limited and a specialized system may be required to efficiently place the PRB.

Preference for Treatment as a Principal Element—The Selected Remedy uses treatment as a principal element, and therefore satisfies the statutory preference for treatment. The selected remedy includes air sparging to actively treat surficial groundwater in the former DRMO, PRBs to passively treat groundwater downgradient of the DRMO area, and aerators to treat surface water.

Five-Year Review Requirements— This remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure. Until COC concentrations onsite are below these levels, the Navy will maintain LUCs and conduct a statutory remedy review every 5 years after initiating remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment in accordance with CERCLA Section 121(c) and the NCP at 40 CFR300.430 (f)(4)(ii).

2.10 Community Participation

The Navy, United States Marine Corps, USEPA, and NCDENR provide information regarding the cleanup of MCIEAST-MCB CAMLEJ to the public through the community relations program, which includes a Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, and announcements published in local newspapers. RAB meetings continue to be held to provide an information exchange among community members, the Navy, United States Marine Corps, 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 from May 22, 2012, through June 25, 2012, for the PRAP for Site 89. A public meeting to present the PRAP was held on May 24, 2012, at the Carolina Coastal Community College. Public notice of the meeting and availability of documents was placed in *The Globe*, *The Jacksonville Daily News*, and the *RotoVu* newspapers on May 10, May 13, and May 23, respectively.

The PRAP for Site 89 was released for public comment on May 22, 2012. The PRAP identified AS using a horizontal well to treat areas of groundwater with high contaminant concentrations (source area), PRB to treat the downgradient groundwater, aerators to treat groundwater discharge to surface water, MNA, and LUCs as the Selected Remedy.

The Administrative Record, Community Relations Plan, IRP fact sheets, and final technical reports concerning Site 89 can be obtained from the IRP web site: http://go.usa.gov/jZi. 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

2.11 Documentation of Significant Changes

The PRAP for Site 89 was released for public comment on May 22, 2012. The Navy reviewed all comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the PRAP, were necessary or appropriate.

3 Responsiveness Summary

The participants in the Public Meeting held on May, 24, 2012, included representatives of the Navy, United States Marine Corps, USEPA, and NCDENR. Six community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes in the Administrative Record. There were no comments received at the public meeting requiring amendment to the PRAP, and no additional written comments, concerns, or questions were received from community members during the public comment period.

Appendix A
ARARs and TBC

TABLE A-1
Chemical-Specific ARARs
Record of Decision
Operable Unit No. 16 (Site 89)
MCIEAST-MCB CAMLEJ, North Carolina

Media	Requirement	Prerequisite	Citation
Federal and North Carolina Chemical-Specific ARARs			
Classification of contaminated groundwater	Groundwaters in the state naturally containing 250 mg/L or less of chloride are *classified as GA (Existing or potential source of drinking water supply for humans)* under 15A NCAC 02L .0201(1)	Groundwaters located within the boundaries or under the extraterritorial jurisdiction of the State of North Carolina - **Applicable**	15A NCAC 02L .0302(1)
	Groundwaters in the state naturally containing greater than 250 mg/L of chloride are *classified as GSA* under 15A NCAC 02L .0201(2)		15A NCAC 02L .0302(2)
Restoration of contaminated groundwater	Shall not exceed the groundwater quality standards[1] for contaminants specified in Paragraphs (g) or (h) for the site related contaminants of concern. · 1,1,2,2 - PCA (0.2 µg/L) · 1,1,2 - TCA (5 µg/L) · cis-1,2-DCE (70 µg/L) · PCE (0.7 µg/L) · Trans -1,2-DCE (100 µg/L) · TCE (3 µg/L) · Vinyl Chloride (0.03 µg/L)	Class GA or GSA groundwaters with contaminant(s) concentrations exceeding standards listed in 15A NCAC 02L .0202 **- Relevant and Appropriate**	15A NCAC 02L .0202(a), (b), and (g) 40 CFR 141.61(a)
	Shall not exceed the Safe Drinking Water Act National Revised Primary Drinking Water Regulations: maximum contaminant levels (MCLs) for organic contaminants specified in 40 CFR 141.61(a).	Groundwaters classified as GA or GSA which are an existing or potential source of drinking water **- Relevant and Appropriate**	40 CFR 141.61(a) 15A NCAC 18C .1518
Protection of adjacent surface water body	Toxic substances: shall not exceed the numerical quality standards (maximum permissible levels) to protect human health from carcinogens through consumption of fish (and shellfish) · 1,1,2,2 - PCA (4 µg/L) · TCE (30 µg/L) · Vinyl Chloride (2.4 µg/L)	Tidal Salt Waters classified as Class SC (under 15A NCAC 02B.0220) with chemical concentrations exceeding 15A NCAC 02B Standards **- Relevant and Appropriate**	15A NCAC 02B .0208(a)(2)(B)
	Monitor and undertake management practices for sources of pollution such that water quality standards and best usage of receiving waters and all downstream waters will not be impaired.	Indirect discharges of waste or other source of water pollution into Tidal Salt Waters classified as Class SC - **Relevant and Appropriate**	15A NCAC 02B .0203
	If the groundwater plume is expected to intercept surface waters, the groundwater discharge will not possess contaminant concentrations that would result in violations of standards for surface waters.	Groundwater concentrations will not be at concentrations that will cause a violation in the surface water standards at a surface water body - **Relevant and Appropriate**	15A NCAC 2L.0106(k)(5)

Notes:

[1] Groundwater quality standards established on the basis of a National secondary drinking water standards are not utilized as remediation goals since these are based on taste, odor and other considerations unrelated to human health.

TABLE A-2
Potential Action-Specific ARARs
Record of Decision
Operable Unit No. 16 (Site 89)
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Federal and North Carolina Action-Specific ARARs			
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing storm water runoff from land-disturbing activities	Shall take all reasonable measures to protect all public and private property from damage caused by such activities.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-53) of more than 1 acre of land **- Applicable**	15A NCAC 4B.0105
	Erosion and sedimentation control plan must address the following basic control objectives:		15A NCAC 4B.0106
	(1) Identify areas subject to severe erosion, and off-site areas especially vulnerable to damage from erosion and sedimentation.		
	(2) Limit the size of the area exposed at any one time.		
	(3) Limit exposure to the shortest feasible time.		
	(4) Control surface water run-off originating upgrade of exposed areas .		
	(5) Plan and conduct land-disturbing activity so as to prevent off-site sedimentation damage.		
	(6) Include measures to control velocity of storm water runoff to the point of discharge.		
	Erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the run-off of 10 year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-53) of more than 1 acre of land **- Applicable**	15A NCAC 4B.0108
	Shall conduct activity so that the post-construction velocity of the ten year storm run-off in the receiving watercourse to the discharge point does not exceed the parameters provided in this Rule.		15A NCAC 4B.0109
	Shall install and maintain all temporary and permanent erosion and sedimentation control measures.		15A NCAC 4B.0113
Monitoring Well Installation, Operation, and Abandonment			
Implementation of groundwater monitoring system	Shall be constructed in a manner that will not result in contamination of adjacent groundwaters of a higher quality.	Installation of monitoring system to evaluate effects of any actions taken to restore groundwater quality, as well as the efficacy of treatment **- Applicable**	15A NCAC 02L .0110 (b)
Construction of groundwater monitoring well(s)	No well shall be located, constructed, operated, or repaired in any manner that may adversely impact the quality of groundwater.	Installation of wells (including temporary wells, monitoring wells) other than for water supply **- Applicable**	15A NCAC 02C .0108(a)
	Shall be located, designed, constructed, operated and abandoned with materials and by methods which are compatible with the chemical and physical properties of the contaminants involved, specific site conditions, and specific subsurface conditions.		15A NCAC 02C .0108(c)
	Monitoring well and recovery well boreholes shall not penetrate to a depth greater than the depth to be monitored or the depth from which contaminants are to be recovered. Any portion of the borehole that extends to a depth greater than the depth to be monitored or the depth from which contaminants are to be recovered shall be grouted completely to prevent vertical migration of contaminants.		15A NCAC 02C .0108(d)
	Shall be constructed in such a manner as to preclude the vertical migration of contaminants with and along borehole channel.	Installation of wells (including temporary wells, monitoring wells) other than for water supply - **Applicable**	15A NCAC 02C .0108(f)
	The well shall be constructed in such a manner that water or contaminants from the land surface cannot migrate along the borehole annulus into any packing material or well screen area.		15A NCAC 02C .0108(g)

TABLE A-2
Potential Action-Specific ARARs
Record of Decision
Operable Unit No. 16 (Site 89)
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Construction of groundwater monitoring well(s), continued	Packing material placed around the screen shall extend at least one foot above the top of the screen. Unless the depth of the screen necessitates a thinner seal, a one foot thick seal, comprised of chip or pellet bentonite or other material approved by the Department as equivalent, shall be emplaced directly above and in contact with the packing material.		15A NCAC 02C .0108(h)
	Grout shall be placed in the annular space between the outermost casing and the borehole wall from the land surface to the top of the bentonite seal above any well screen or to the bottom of the casing for open end wells. The grout shall comply with Paragraph (e) of Rule .0107 of this Section except that the upper three feet of grout shall be concrete or cement grout.		15A NCAC 02C .0108(i)
	All wells shall be grouted within seven days after the casing is set. If the well penetrates any water-bearing zone that contains contaminated or saline water, the well shall be grouted within one day after the casing is set.		15A NCAC 02C .0108(j)
	Shall be secured with a locking well cap to ensure against unauthorized access and use. Shall be equipped with a steel outer well casing or flush-mount cover, set in concrete, and other measures sufficient to protect the well from damage by normal site activities.		15A NCAC 02C .0108(k) and (l)
	The well casing shall be terminated no less than 12 inches above land surface unless all of the following conditions are met: (1) site-specific conditions directly related to business activities, such as vehicle traffic, would endanger the physical integrity of the well; and (2) the well head is completed in such a manner so as to preclude surficial contaminants from entering the well.		15A NCAC 02C .0108(n)
	Shall have permanently affixed an identification plate. The identification plate shall be constructed of a durable, waterproof, rustproof metal or other material approved by the Department as equivalent and shall contain the following information: (1) well contractor name and certification number; (2) date well completed; (3) total depth of well; (4) a warning that the well is not for water supply and that the groundwater may contain hazardous materials; (5) depth(s) to the top(s) and bottom(s) of the screen(s); and (6) the well identification number or name assigned by the well owner.		15A NCAC 02C .0108(o)
	Shall be developed such that the level of turbidity or settleable solids does not preclude accurate chemical analyses of any fluid samples collected or adversely affect the operation of any pumps or pumping equipment.		15A NCAC 02C .0108(p)

TABLE A-2
Potential Action-Specific ARARs
Record of Decision
Operable Unit No. 16 (Site 89)
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Construction of groundwater monitoring well(s), continued	Shall be constructed in such a manner as to preclude the vertical migration of contaminants within and along the borehole channel.	Installation of temporary wellsand all other non-water supply wells - **Applicable**	15A NCAC 02C .0108(s)
Maintenance of groundwater monitoring well(s)	Every well shall be maintained by the owner in a condition whereby it will conserve and protect groundwater resources, and whereby it will not be a source or channel of contamination or pollution to the water supply or any aquifer.	Installation of wells (including temporary wells and monitoring wells) other than for water supply **- Applicable**	15A NCAC 02C .0112(a)
	Broken, punctured, or otherwise defective or unserviceable casing, screens, fixtures, seals, or any part of the well head shall be repaired or replaced, or the well shall be abandoned pursuant to 15A NCAC 02C .0113		15A NCAC 02C .0112(d)
	All materials used in the maintenance, replacement, or repair of any well shall meet the requirements for new installation.		15A NCAC 02C .0112(c)
	No well shall be repaired or altered such that the outer casing is completed less than 12 inches above land surface. Any grout excavated or removed as a result of the well repair shall be replaced in accordance with Rule .0107(f) of this Section.		15A NCAC 02C .0112(f)
Abandonment of groundwater monitoring and remediation well(s)	Shall be abandoned by filling the entire well up to land surface with grout, dry clay, or material excavated during drilling of the well and then compacted in place; and	Permanent abandonment of wells (including temporary wells, monitoring wells, and test borings) other than for water supply less than 20 feet in depth and which do not penetrate the water table - **Applicable**	15A NCAC 02C .0113(d)(1)
	Shall be abandoned by completely filling with a bentonite or cement - type grout.	Permanent abandonment of wells (including temporary wells, monitoring wells, and test borings) other than for water supply *greater than 20 feet in depth* and which do not penetrate the water table **- Applicable**	15A NCAC 02C .0113(d)(2)
	All wells shall be permanently abandoned in which the casing has not been installed or from which the casing has been removed, prior to removing drilling equipment from the site.	Permanent abandonment of wells (including temporary wells) other than for water supply **– Applicable**	15A NCAC 02C .0113(f)
Underground Injection Control (injection of air)			
Construction of wells for the injection of air	The air injected shall not exceed ambient air quality standards set forth in 15A NCAC o2D.0400 and shall not contain petroleum or any constituent that would cause a violation of groundwater standards specified in Subchapter 02L Shall be constructed in accordance with the well construction standards applicable to monitoring wells specified in Rule .0108 of this Subchapter.	Installation of groundwater remediation wells for the subsurface injection of ambient air for the treatment of contaminated soil or groundwater - **Applicable**	15A NCAC 02C.0225(b)(4)(A) and (B)
	No violation of groundwater quality standards specified in Subchapter 02L resulting from the injection shall occur outside the specified portion of the injection zone as detected by a monitoring plan approved by the Division.		15A NCAC 02C.0225(e)(2)
	All permanent injection wells require tests for mechanical integrity, which shall be conducted in accordance with Rule .0207 of this Section. An injection well has internal mechanical integrity when there is no leak in the casing, tubing, or packer. An injection well has external mechanical integrity when there is no fluid movement into groundwaters through vertical channels adjacent to the injection well bore .		15A NCAC 02C.0225(h)

TABLE A-2
Potential Action-Specific ARARs
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MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Monitoring Network for Injection Systems	Monitoring wells shall be of sufficient quantity and location so as to detect any movement of injection fluids, injection process byproducts or formation fluids outside the injection zone in accordance with 15A NCAC 02C.0225(e)(2).	Installation of groundwater remediation wells for any subsurface injection for the treatment of contaminated soil or groundwater - **Applicable**	15A NCAC 02C.0225(e)(9)
	NOTE: The Monitoring of the injection wells will be specified in a monitoring plan included as part of a CERCLA Primary document (e.g., Remedial Action Work Plan) that is approved by EPA and NCDENR. Substantive provisions of 15A NCAC 02C.0225(j) including monitoring well location, frequency, sample type and required analysis will be addressed.		15A NCAC 02C.0225(j)
Design criteria for all injection wells	No person shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water if the presence of that contaminant may cause a violation of any applicable groundwater quality standard specified in Subchapter 02L or may otherwise adversely affect human health.	Design, construction, or operation of any injection well - **Applicable**	15A NCAC 02C.0211(c)
Control of Diffuse VOC Emissions from Groundwater Treatment			
Emissions of VOCs from groundwater treatment (e.g., sparging system)	Shall not emit any of the toxic air pollutants listed in the table of the Rule in such quantities that may cause or contribute beyond the premises (adjacent property boundary) to any significant ambient air concentration that may adversely affect human health.	Emissions of toxic air pollutants (e.g., VOCs) from facility into the ambient air **- Applicable**	15A NCAC 02D .1104
	Shall install and operate reasonable available control technology to limit emissions of VOCs.	Air emissions of VOCs from facilities where there is no other applicable emissions control rule **- Relevant and Appropriate**	15A NCAC 02D .0951(c)
	One of the applicable test methods in Appendix M in 40 CFR part 51 or Appendix A in 40 CFR Part 60 shall be used to determine compliance with VOC emission standards.	VOC emission source not covered by 15A NCAC 02D.2613(b) through (e) - **Relevant and Appropriate**	15A NCAC 02D .2613(g)
	Control emissions by meeting limitations and work practice standards reflecting application of the maximum achievable control technology.	Air emissions of organic Hazardous Air Pollutants (e.g.,VOCs) from site remediation **- Relevant and Appropriate**	40 CFR 63 Subpart GGGGG, NESHAPS for Site Remediation
	Periodic inspection of equipment and monitoring are required for the life of the remediation.		
Waste Characterization and Storage — Primary Wastes (i.e., excavated contaminated soils and purge water) and Secondary Wastes (e.g., PPE and used equipment)			
Characterization of solid waste (e.g., well soil cuttings)	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(a) **- Applicable**	40 CFR 262.11(a) and (b)
	Must determine if waste is listed under 40 CFR Part 261; or		15A NCAC 13A .0107
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.		40 CFR 262.11(c) 15A NCAC 13A .0107
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous **- Applicable**	40 CFR 262.11(d) 15A NCAC 13A .0107
	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.		15A NCAC 13B .0104(e)
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal - **Applicable**	40 CFR 264.13(a)(1) 15A NCAC 13A .0109

TABLE A-2
Potential Action-Specific ARARs
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Action	Requirement	Prerequisite	Citation
Determinations for management of hazardous waste	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal **- Applicable**	40 CFR 268.9(a) 15A NCAC 13A .0112
	Must determine if the waste is restricted from land disposal under 40 CFR 268 *et seq.* by testing in accordance with prescribed methods or use of generator knowledge of waste.	Generation of hazardous waste for storage, treatment or disposal – **Applicable**	40 CFR 268.7(a)(1) 15A NCAC 13A .0112
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40 et. seq.		40 CFR 268.9(a) 15A NCAC 13A .0112
Storage of solid waste	All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard.	Generation of solid waste which is determined *not* to be hazardous **– Relevant and Appropriate**	15A NCAC 13B .0104(f)
	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.		15A NCAC 13B .0104(e)
Temporary storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that: · waste is placed in containers that comply with 40 CFR 265.171-173; and · the date upon which accumulation begins is clearly marked and visible for inspection on each container · container is marked with the words "hazardous waste"; or · container may be marked with other words that identify the contents.	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10 **- Applicable** Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation **- Applicable**	40 CFR 262.34(a) 15A NCAC 13A .0107 40 CFR 262.34(a)(1)(i) 40 CFR 262.34(a)(2) 40 CFR 264.34(a)(3) 15A NCAC 13A .0107 40 CFR 262.34(c)(1) 15A NCAC 13A .0107
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR 264.175(b)	Storage of RCRA hazardous waste in containers *with free liquids* – **Applicable**	40 CFR 264.175(a) 15A NCAC 13A .0109
	Area must be sloped or otherwise designed and operated to drain liquid resulting from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA-hazardous waste in containers that *do not contain free liquids* (other than F020, F021, F022, F023,F026 and F027) – **Applicable**	40 CFR 264.175(c)(1) and (2) 15A NCAC 13A .0109
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed. [Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with40 CFR 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262 through 266 of this chapter].	Storage of RCRA hazardous waste in containers in a unit with a containment system **– Applicable**	40 CFR 264.178 15A NCAC 13A .0109

TABLE A-2
Potential Action-Specific ARARs
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MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Waste Treatment and Disposal – Primary Wastes (i.e., excavated contaminated soils and purge water) and Secondary Wastes (e.g., PPE and used equipment)			
Disposal of RCRA hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste – **Applicable**	40 CFR 268.40(a) 15A NCAC 13A .0112
	All underlying hazardous constituents [as defined in 40 CFR 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR 268.48 Table UTS prior to land disposal	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **Applicable**	40 CFR 268.40(e) 15A NCAC 13A .0112
	To determine whether a hazardous waste indentified in this section exceeds the applicable treatment standards of 40 CFR 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste. If the waste contains constituents (including UHCs in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR 268.48, the waste is prohibited from land disposal, and all requirements of part 268 are applicable, except as otherwise specified.	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **Applicable**	40 CFR 268.34(f) 15A NCAC 13A .0112
Disposal of RCRA-hazardous waste in a land-based unit	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or according to the UTSs specified in 40 CFR 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils – **Applicable**	40 CFR 268.49(b) 15A NCAC 13A .0112
Disposal of solid waste (e.g., contaminated soil)	Shall ensure that waste is disposed of at a site or facility which is permitted to receive the waste.	Generation of solid waste intended for off-site disposal – **Relevant and Appropriate**	15A NCAC 13B .0106(b)
Transportation of Wastes			
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and DOT HMR at 49 CFR 171-180.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material – **Applicable**	49 CFR 171.1(c)
Transportation of hazardous waste on-site	The generator manifesting requirements of 40 CFR 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way **- Applicable**	40 CFR 262.20(f)
Transportation of hazardous waste off-site	Must comply with the generator requirements of 40 CFR 262.20□23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding, Sect. 262.40, 262.41(a) for record keeping requirements, and Sect. 262.12 to obtain EPA ID number.	Preparation and initiation of shipment of RCRA-hazardous waste off-site – **Applicable**	40 CFR 262.10(h); 15A NCAC 13A .0107
Transportation of hazardous waste off-site	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • the sample is being transported to a laboratory for the purpose of testing; or • the sample is being transported back to the sample collector after testing. • the sample is being stored by sample collector before transport to a lab for testing	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **Applicable**	40 CFR 261.4(d)(1)(i)-(iii) 15A NCAC 13A .0106

TABLE A-2
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Action	Requirement	Prerequisite	Citation
	In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements • Assure that the information provided in (1) thru (5) of this section accompanies the sample. Package the sample so that it does not leak, spill, or vaporize from its packaging.		40 CFR 261.4(d)(2)(i)(A) and (B) 15A NCAC 13A .0106
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".	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)
	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.		
	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)

TABLE A-3

Location-Specific ARARs

Record of Decision

Operable Unit No. 16 (Site 89)

MCIEAST-MCB CAMLEJ, North Carolina

Location	Requirement	Prerequisite	Citation
Federal and North Carolina Location-Specific ARARs			
Presence of wetlands	Concentrations or combination of substances, which are toxic or harmful to human, animal, or plant life may not be present in amounts, which individually or cumulatively, can cause adverse impacts on existing wetland uses.	Activities within, wetlands as defined by G.S. 143-212(6) – **Applicable**	15A NCAC 02B.0231(b)(4)
	Standards provided in 15A NCAC 02B.0231(b)(1), (2), (3), (5), and (6) shall be used to ensure the maintenance or enhancement of the existing uses of wetlands identified in 15A NCAC 02B.0231(a)		
	Requires Federal agencies to evaluate action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands.	Actions that involve potential impacts to, or take place within, wetlands – **To Be Considered**	Executive Order 11990 – Protection of Wetlands Section 1.(a)
Location encompassing aquatic ecosystem as defined in 40 CFR 230.3 (c)	No discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if will cause or contribute significant degradation of the waters of the US.	Action that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands – **Applicable**	40 Part 230.10(a) and (c) Clean Water Act Regulations – Section 404(b) Guidelines
	Except as provided in § 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps in accordance with Subpart H at 40 CFR 230.70 et seq. have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem.		40 CFR 230.10(d) Clean Water Act Regulations – Section 404(b) Guidelines
	Must comply with the substantive requirements of the NWP 38 General Conditions, as appropriate, any regional or case-specific conditions recommended by the Corps District Engineer, after consultation.	On-site CERCLA action conducted by Federal agency that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands –**Applicable**	Nation Wide Permit (38) Cleanup of Hazardous and Toxic Waste 33 CFR 323.3(b)
Presence of floodplain designated as such on a map	Shall consider alternatives to avoid, to the extent possible, adverse effects on and incompatible development in the floodplain.	Federal actions that involve potential impacts on, or take place within, floodplains—**To Be Considered**	Executive Order 11988 – *Floodplain Management* Section 2(a)(2)
Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 -**or**- critical habitat of such species listed in 50 CFR 17.95	Actions that jeopardize the existence of a listed species or results in the destruction or adverse modification of critical habitat must be avoided or reasonable and prudent mitigation measures taken.	Action that is likely to jeopardize fish, wildlife, or plant species or destroy or adversely modify critical habitat—**Applicable**	16 USC 1531 *et seq* ., Sect. 7(a)(2)
	Except as provided in the rule, no person may take the specified reptiles.	Action that is likely to jeopardize or adversely modify critical habitat for American alligator, green turtle, and/or loggerhead turtle — **Applicable**	50 CFR 17.42(a) and (b)

TABLE A-3

Location-Specific ARARs

Record of Decision

Operable Unit No. 16 (Site 89)

MCIEAST-MCB CAMLEJ, North Carolina

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
Coastal zone as defined in 16 U.S.C.§1453	Federal agency shall determine which of their activities affect any coastal use or resource of States with approved management programs. If agency determines activity has no effects on coastal use or resource, and a negative determination under § 930.35 is not required, then coordination with State Agencies under Section 307 of the Act is not required. The State agency and federal agencies may agree to exclude environmentally beneficial agency activities (either on a case-by-case basis or for a category of activities) from further State agency consistency review. NOTE: Consultation is generally considered an 'administrative' requirement and therefore under CERCLA 121(e)(1) a federal agency is not required to perform. However, such consultation is strongly recommended considering under 50 CFR 930.34 Federal agencies shall provide State(s) with a consistency determination.	Federal agency activity that may have effect on any coastal use or resource as defined in 15 CFR 930.11Wetland**— Applicable**	15 CFR 930.33(a)(1), (a)(2), (a)(4); (b); Coastal Zone Management Act of 1972, 16 U.S.C.§1451 et. seq.
Surface Water classified as High Quality Waters	Erosion and sedimentation control measures, structures, and devices within High Quality Water (HQW) zones shall be planned, designed and constructed to provide protection from the runoff of the 25 year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land in High Quality Water (HQW) zones **— Applicable**	15A NCAC 4B.0124(b)
	Provisions for ground cover sufficient to restrain erosion must be provided for any portion of the land-disturbing activity with 15 working days or 60 calendar days following completion of the construction or development, which period is shorter.		15A NCAC 4B.0124(e)
	Implement good construction management techniques, best management practices for sediment and erosion controls, and storm water management measures in accordance with 15A NCAC 02H .1008 to ensure storm water discharges are in compliance.	Development activity (otherwise requiring a stormwater permit) within one mile of and draining to waters classified as High Quality Waters (HQW) **— Relevant and Appropriate**	15A NCAC 02H .1006, NC General Permit CNCG 0100000

Appendix B
Acronyms and Abbreviations

Acronyms and Abbreviations

µg/L	microgram per liter
ARAR	applicable or relevant and appropriate requirement
AS	air sparging
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COC	contaminant of concern
CSF	cancer slope factor
CSM	conceptual site model
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DRMO	Defense Reutilization and Marketing Office
ERA	ecological risk assessment
ERD	enhanced reductive dechlorination
ERH	electrical resistance heating
ESV	ecological screening value
EVO	emulsified vegetable oil
FFA	Federal Facilities Agreement
FS	Feasibility Study
HDD	horizontally directionally drilled
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
ID	Identification
IRP	Installation Restoration Program
ISCO	in situ chemical oxidation
LTM	Long-term Monitoring
LTTD	low temperature thermal desorption
LUC	land use control
LUCIP	Land Use Control Implementation Plan
MCIEAST-MCB CAMLEJ	Marine Corps Installations East-Marine Corps Base Camp Lejeune
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
mg/L	milligram per liter
MNA	monitored natural attenuation
msl	mean sea level
NA	natural attenuation
NAPL	non-aqueous phase liquid
Navy	United States Department of the Navy
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NCSWQS	North Carolina Surface Water Quality Standards
NPL	National Priorities List
NTCRA	non-time-critical removal action
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCA	tetrachloroethane
PCE	tetrachloroethene
PRAP	Proposed Remedial Action Plan
PRB	permeable reactive barrier
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RfD	reference dose
RI	Remedial Investigation
RIP	Remedy-in-Place
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	supplemental investigation
SVOC	semivolatile organic compound
TBC	to-be-considered
TCA	trichloroethane
TCE	trichloroethene
TCRA	time-critical removal action
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
ZVI	zero valent iron

Appendix C
NCDENR Concurrence Letter

North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

August 31, 2012

NAVFAC Mid-Atlantic
Attn: Dave Cleland Code: OPQE
USMC NC IPT, EV Business Line
6506 Hampton Blvd
Norfolk, VA 23508

RE: Concurrence with the August 2012 revised Draft Final Record of Decisions for OU# 16, Site 89 at MCB Camp Lejeune, NC, Groundwater, Surface Water, and Soil
Camp Lejeune, NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Cleland:

The NC Superfund Section has received and reviewed the revised Draft Final Record of Decision (ROD) for Ou#16, Site 89 at MCB, Camp Lejeune dated August 2012 and concurs that the selected remedy is protective of human health and the environment.

The State's concurrence is based solely on the information contained in the Revised Draft Final ROD dated August 2012 for OU#16, Site 89. 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 me, at (919) 707-8325 or email **David.Lown@ncdenr.gov**

Sincerely,

David J. Lown, LG, PE
Head, Federal Remediation Branch
Superfund Section

Cc: Randy McElveen, NC Superfund Section
Charity Rychak, EMD/IR
Gena Townsend, USEPA

References

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	chlorinated volatile organic compounds	Section 2.1	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 2.7.
2	hydrogeologic units	Section 2.2	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Section 4.3.2.
3	immediate response	Table 1	Baker. 1999. *Long-Term Monitoring (LTM) and Immediate Response Field Effort, Letter Report.* November. Page 4
4	elevated VOC impacts in the soil vadose zone	Table 1	Baker. 2000. *Letter Report Summary of March/April 2000 Field Work, Marine Corps Base Camp Lejeune, North Carolina.* May. Page 3
5	low temperature thermal desorption	Table 1	OHM Remediation Services Corp. (OHM). 2000. *Summary of LTTD Performance Testing Site 89 TCRA, Marine Corps Base Camp Lejeune, North Carolina.* October.
6	two DNAPL source zones	Table 1	CH2M HILL, Baker, and CDM. 2001. *Supplemental Investigation and Evaluation Report, Operable Unit No. 16 (Site 89), Marine Corps Base Camp Lejeune, North Carolina.* August. Section 3.3.
7	VOC-contaminated soil was removed	Table 1	Shaw Environmental, Inc. (Shaw). 2005. Final OU-16 (Site 89) *Electrical Resistance Heating Pilot Test Implementation Report*, Marine Corps Base Camp Lejeune, North Carolina. July. Section 6.3.
8	human health risk assessment	Table 1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Section 7.
9	ecological risk assessment	Table 1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina*. May. Section 8.
10	four remedial technologies	Table 1	AGVIQ-CH2M HILL Joint Venture. 2008. *Treatability Studies Report Site 89, Operable Unit 16 Marine Corps Base Camp Lejeune, North Carolina.* February. Section 3,4,5 and 6

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11	extent of PAH and pesticide impacts to the wetlands	Table 1	CH2M HILL. 2008c. *Baseline Ecological Risk Assessment Addendum for the Western Wetland,* Site 89 Operable Unit 16, Marine Corps Base Camp Lejeune, North Carolina. December. Section 3.
12	potential vapor intrusion pathways	Table 1	CH2M HILL. 2009. *Vapor Intrusion Evaluation Report Volume 6 of 6 – Camp Geiger, Marine Corps Base Camp Lejeune, North Carolina*. November. Section 4.3.2
13	treated volume of 30,000 cubic yards	Table 1	AGVIQ-CH2M HILL Joint Venture. 2010. *Non-time-critical Removal Action Summary Report Site 89, Operable Unit 16 Marine Corps Base Camp Lejeune, North Carolina*. March. Section 2, 4 and 6.
14	removed soil and sediment with PAHs and pesticide	Table 1	CH2M HILL. 2010. *Non-time-critical Removal Action Summary, Site 89 - Western Wetland, Operable Unit No. 16, Marine Corps Base Camp Lejeune, North Carolina.* July. Page 4.
15	NA	Table 1	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 2.9.
16	remedial alternatives	Table 1	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Sections 4 and 5.
17	Concentrations of COCs	Section 2.3	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 2.7.
18	2010 surface water sampling	Section 2.3	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 2.7.1.
19	future receptors	Section 2.5.1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Section 7.3.5.
20	exposure scenarios	Section 2.5.1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Table 7-2.
21	hazard index	Section 2.5.1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Section 7.5.2 and 7.5.3, Table 7-4, and Appendix C.
22	cancer risk	Section 2.5.1	CH2M HILL. 2008a. *Comprehensive Remedial Investigation Site 89, Operable Unit No. 16, Former Defense Reauthorization and Marketing Office, Marine Corps Base Camp Lejeune, North Carolina.* May. Section 7.5.1 and 7.5.3, Table 7-4, and Appendix C.
23	confirmatory sampling	Table 1	CH2M HILL. 2010. *Non-time-critical Removal Action Summary, Site 89 - Western Wetland, Operable Unit No. 16, Marine Corps Base Camp Lejeune, North Carolina.* July. Page 4.

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24	**North Carolina's groundwater classification**	Section 2.5.3	North Carolina Administrative Code, Title 15A, Department of Environment, Health and Natural Resources, Subchapter 2L – Groundwater Classification and Standards. Section 200, Rule .0202. NCDENR, January 2010.
25	**screening of technologies**	Section 2.8.1	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 4.
26	**nine USEPA criteria**	Section 2.8.2	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 5.
27	**ARARs**	Section 2.8.2	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 3.1
28	**rebound**	Section 2.8.2	CH2M HILL. 2012. *Final Feasibility Study, Site 89, Operable Unit No. 16, Marine Corps Base, Camp Lejeune, Jacksonville, North Carolina.* February. Section 5.3.2.3.