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FINAL RECORD OF DECISION OPERABLE UNIT 20 (OU 20) SITE 86 MCB CAMP LEJEUNE NC

07/01/2014

CH2M HILL

Final

Record of Decision
Operable Unit 20, Site 86

Marine Corps Installations East – Marine Corps Base Camp Lejeune
North Carolina
July 2014

1 Declaration

Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for Operable Unit (OU) No. 20, Site 86, located at Marine Corps Installations East-Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ), 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: NC6170022580). The remedy set forth in this ROD was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on information contained in the Administrative Record 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. 20. Thus, the ROD is based on 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 Department of the Navy (Navy), and the United States Marine Corps (USMC) 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. 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 86.

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, USMC, and USEPA. NCDENR, the support regulatory agency, actively participated throughout the investigation process, has reviewed this ROD and the materials on which it is based, and concurs with this Selected Remedy.

Scope and Role of Response Action

OU No. 20 is one of 25 OUs in the IRP at MCIEAST-MCB CAMLEJ. 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. OU No. 20 is solely composed of Site 86. Investigations at Site 86 have included the analysis of soil, groundwater, surface water, and sediment. Unacceptable human health risks were identified from exposure to semivolatile organic compounds (SVOCs) and metals in soil and volatile organic compounds (VOCs) in groundwater. A soil removal action was conducted in 2005 to address the soil contamination. No further action is required for soil, surface water, and sediment. A response action is required for groundwater, and this ROD presents the final remedial action for Site 86 and OU No. 20.

1.1 Selected Remedy

Assessment of the Site

Previous investigations have identified the presence of VOCs in groundwater at Site 86 at concentrations that pose a potential threat to human health if the groundwater were used as a drinking water supply or for other consumptive purposes. However, the groundwater beneath Site 86 is not presently used for such purposes. Investigation and evaluation of soil, surface water, and sediment determined that there is no unacceptable risk to human health and the environment; therefore, no remedial action is necessary for those media.

The Selected Remedy for Site 86 is monitored natural attenuation (MNA) and land use controls (LUCs) to prohibit aquifer use. Additionally, LUCs require evaluation of vapor intrusion pathways prior to future changes in building or land use, until such time as groundwater concentrations or vapor intrusion mitigation measures allow for unlimited use and unrestricted exposure (UU/UE). MNA is a remedial approach that involves monitoring and analyzing the progress of natural attenuation processes of contaminants in multiple areas of the groundwater plumes in view of attaining cleanup levels in a reasonable timeframe. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions. The Selected Remedy does not satisfy the statutory preference for treatment as a principal element because previous actions have removed the highest concentrations of VOC mass and no source materials constituting principal threats are present. Trends over time indicate that MNA will be effective and degrade VOCs to attain cleanup levels within a reasonable timeframe and LUCs will prohibit exposure and restrict groundwater uses until concentrations allow for UU/UE.

This remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE; therefore, in accordance with CERCLA Section 121(c) and the NCP at 40 Code of Federal Regulations (CFR) § 300.430 (f)(4)(ii), a statutory review will be conducted by the Navy within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed or MNA 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 2 of this ROD. Additional information can be found in the Administrative Record[1] file for MCIEAST-MCB CAMLEJ, Site 86.

- Constituents of concerns (COCs) and their respective concentrations (Section 2.1, Section 2.4, and Table 2)
- Baseline risk represented by the COCs (Section 2.6 and Table 7)
- Cleanup levels established for COCs and the basis for these levels (Section 2.8 and Table 9)
- How source materials constituting principal threats are addressed (Section 2.7)
- 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 2.5)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.10.3 and Table 12)

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

- 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 2.9 and Table 10)
- Key factor(s) that led to selecting the remedy (describing how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.10)

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

1.3 Authorizing Signatures

This ROD presents the Selected Remedy at Site 86, OU No. 20, at MCIEAST-MCB CAMLEJ, located in Onslow County, North Carolina.

20140910

Date

J. W. CLARK , JR.
Colonel, U.S. Marine Corps
Acting Commander
Marine Corps Installations East-Marine Corps Base Camp Lejeune

10/29/14

Date

Randall Chaffins
Acting Director, Superfund Division
United States Environmental Protection Agency, Region 4

With concurrence from:

9/18/2014

Date

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

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 and other assigned units.

Site 86 consists of a VOC groundwater plume (**Figure 2**) that underlies an area of approximately 147 acres at Marine Corps Air Station New River, adjacent to Camp Geiger in the northwest portion of MCIEAST-MCB CAMLEJ. The site is located on an active military flight line with multiple areas of limited or restricted access. Approximately half of Site 86 is developed with buildings, parking lots, landscaped areas, and the flight line. The remaining portion of the site is an open, grassy area. An open, unlined drainage ditch, located on the eastern portion of the site, receives surface water runoff from the stormwater conveyance network, extends through the grassy area, and discharges to the New River (**Figure 3**). The potential sources of contamination are shown on **Figure 2** and include the following:

- Aboveground Storage Tank (AST) area—Contained three 25,000-gallon ASTs that held fuel oil from 1954 until 1974 and waste oil from 1979 to 1988. The tanks were contained within an earthen berm. A small pump house was used to transfer oil to and from the ASTs. The tanks were emptied and removed in 1992.
- Helicopter Wash Pad—Used nozzles embedded in the tarmac to clean aircraft from 1968 until abandonment in 2001.
- Several hangars—Housed carburetor, battery, and engine buildup shops used for aircraft maintenance.
- Solid Waste Management Unit (SWMU) 303—Consisted of two former steel ASTs that were contained within a concrete, bermed structure.
- SWMU 318—Consisted of a concrete, multichambered oil/water separator and grit chamber associated with the former Helicopter Wash Pad.
- Gas station and garage.
- Underground Storage Tank AS-510—Located near the footprints of three former buildings used for various activities, including a steam power plant and waste storage.

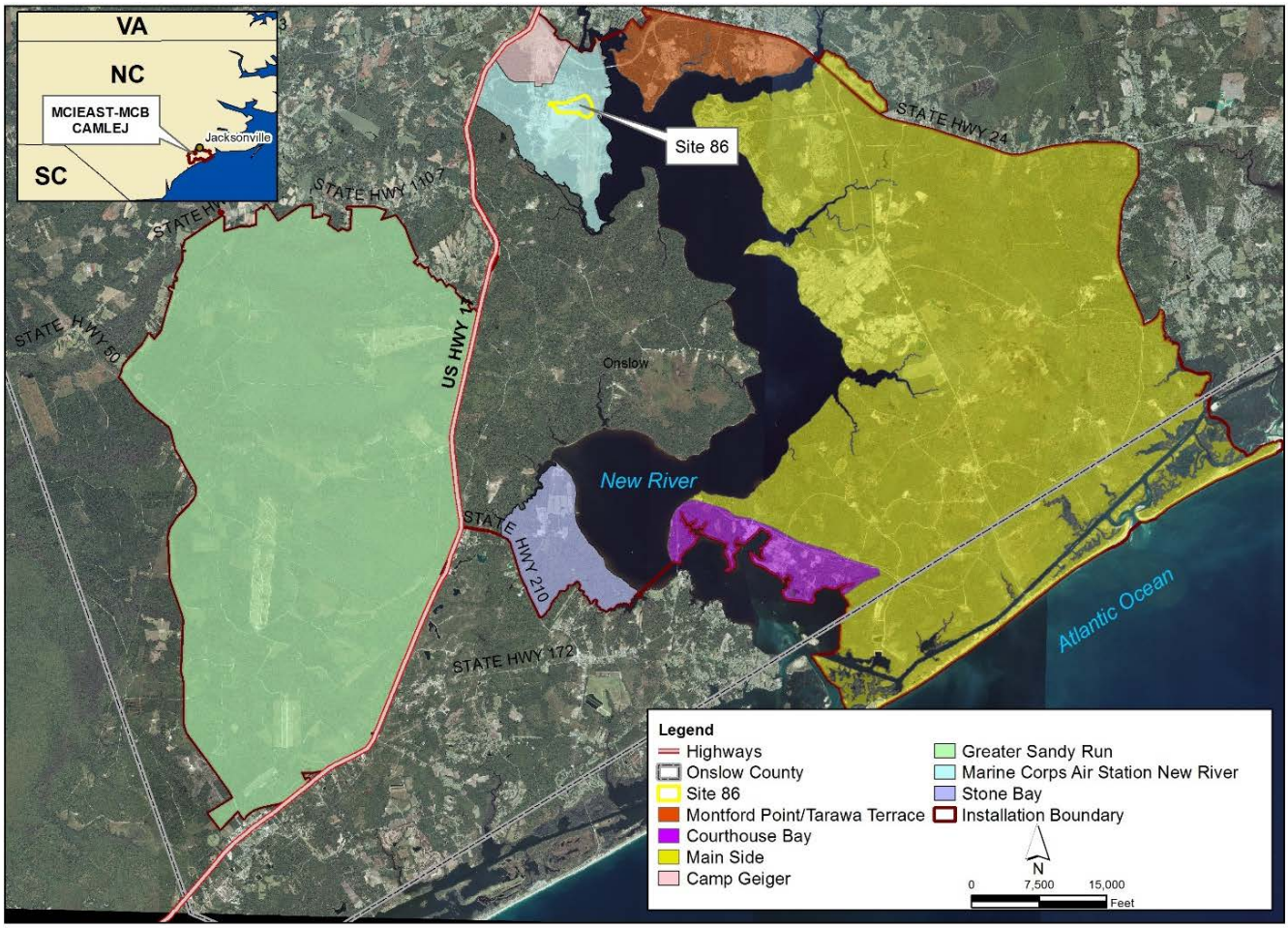
2.2 Site Characteristics

Site 86 is relatively flat, with elevations ranging from 8 to 20 feet above mean sea level, with a slight slope to the east toward the New River (**Figure 2**). Stormwater runoff from the western portion of the site flows east through storm drains that discharge to a drainage ditch. Stormwater from the northern portion of the site flows to a retention pond. Stormwater that has not infiltrated the ground surface eventually discharges to the New River. Since the northern and western portions of the site are paved or developed, it is anticipated that infiltration rates are low. However, higher rates of infiltration are expected in the northeast grass area.

Groundwater investigations completed at Site 86 have focused on the surficial aquifer and underlying Castle Hayne aquifer designated as follows: surficial aquifer (5 to 25 feet below ground surface [bgs]), upper Castle Hayne aquifer (25 to 60 feet bgs), and middle Castle Hayne aquifer (greater than 60 feet bgs). Groundwater flow within the surficial and Castle Hayne aquifers generally flows east-northeast towards the New River. The average horizontal hydraulic gradient for both the surficial and upper Castle Hayne aquifers is 0.003 feet per foot (ft/ft). Aquifer testing completed in 2012 indicated that the horizontal hydraulic conductivity in the surficial aquifer ranges from 0.97 feet per day (ft/day) to 10.61 ft/day with a geometric mean of 3.44 ft/day. The calculated hydraulic conductivity within the upper Castle Hayne aquifer ranged from 1.37 to 26.85 ft/day with a geometric mean of 10.02 ft/day. Based on these data, and assuming an effective porosity of 0.25, typical for coastal plain sandy sediments, the geometric mean seepage velocities for the surficial and upper Castle Hayne aquifers were calculated to be 0.042 and 0.12 ft/day, respectively. Downward vertical hydraulic gradients were observed between surficial and upper Castle Hayne aquifer well pairs ranging from 0.002 to 0.112 ft/ft. A slight downward

gradient was observed between upper and middle Castle Hayne aquifer well pairs ranging from 0.003 to 0.049 ft/ft.

FIGURE 1
Site Location Map

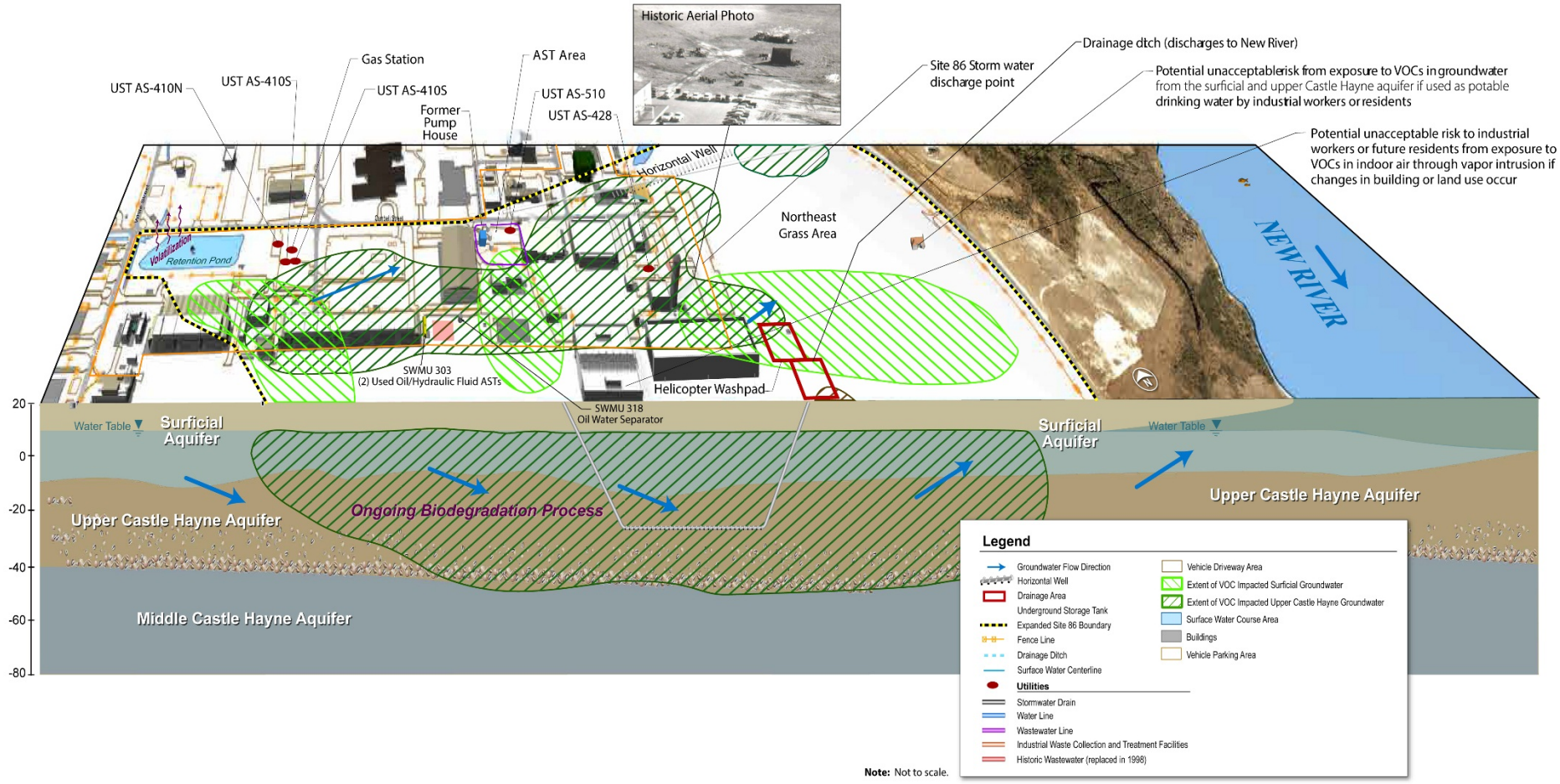


Site 86 is underlain by undifferentiated sediments. These surficial deposits vary in thickness from 30 feet in the western portion of the site to 40 feet near the central portion of the site. The deposits consist of sand, silty sand, and sandy clay that, when saturated, compose the surficial aquifer.

The River Bend formation underlies these undifferentiated sediments and is composed of silty sand and weakly cemented sandy limestone. This formation is typically observed at approximately 30 feet to 40 feet bgs and ranges in thickness from 15 feet in the western portion of the site to 45 feet in the northeast grass area. The fossilized shells observed in this limestone are an identifying characteristic of the River Bend formation. The proportion of shell fragments is greatest at approximately 45 to 55 feet bgs. Below the weakly cemented sandy limestone lies a greenish gray sand with some silty sand lenses and fossils. The maximum depth of investigation at Site 86 was 90 feet bgs.

FIGURE 2

Conceptual Site Model



Note: Not to scale.

2.3 Previous Investigations

From 1990 to 2012, environmental media, including surface and subsurface soil, groundwater, surface water, sediment, and soil gas, have been investigated at Site 86. Investigations were initially conducted from 1990 through 1992 under the MCIEAST-MCB CAMLEJ Underground Storage Tank Program and focused on total petroleum hydrocarbons and VOCs. The original site boundary encompassed the AST area (**Figure 2**). Based on the presence of chlorinated volatile organic compound (CVOC) impacted soil and groundwater, the site was transferred to the IRP and designated as Site 86. The site was expanded in 2006 to include a Helicopter Wash Rack (Building AS513), several hangers, SWMUs 303 and 318, a gas station and garage (Building 410), and Building AS510; and again in 2010 to include the majority of the industrial area north of the flight line in order to encompass the potential sources listed in Section 2.1.

Investigations at Site 86 have included the collection of samples from 85 soil locations, 204 groundwater monitoring wells, 14 surface water locations, eight sediment locations, and five soil gas locations. **Figure 3** presents the environmental sample locations that were collected during all previous investigations. **Table 1** presents a brief chronological list of those investigations and interim actions taken to address site contamination. Investigations at Site 86 are part of the Administrative Record and can be referenced for further details.

TABLE 1
Summary of Previous Investigations

Previous Investigations/Actions*	Administrative Record Numbers	Dates	Activities and Findings
Preliminary Site Investigation (Dewberry & Davis, 1991)	005880	1990	In 1990, a preliminary site investigation was conducted to evaluate the Site 86 AST area. Soil samples were collected, and analytical data indicated that total petroleum hydrocarbons and VOCs were present in soil and were likely attributable to localized surface spills from ASTs.
Site Assessment (O'Brien & Gere, Inc., 1992)	004603	1992	In 1992, a site assessment was completed at the Site 86 AST area. Soil and groundwater samples were collected, and analytical results indicated that soil and groundwater collected were impacted with total petroleum hydrocarbons and VOCs.
Remedial Investigation (RI) (Baker Environmental, Inc., 1996)	001719 and 001720	1996	In 1995, an RI was conducted to characterize the nature and extent of contamination identified in the site assessment. Surface and subsurface soil samples contained concentrations of metals and semivolatile organic compounds (SVOCs) and groundwater samples contained concentrations of VOCs and metals above the human health risk-based levels for future use scenarios.
Post-RI Activities (Baker Environmental, Inc., 1998)	003775	1998	In 1997, post-RI activities were conducted to refine the horizontal and vertical extent of VOCs in groundwater. Groundwater analytical data indicated that the horizontal extent of VOCs in groundwater was not delineated.
Amended RI (CH2M HILL and Baker Environmental, Inc., 2003)	003740	2003	In 2001 and 2002, Amended RI activities were conducted to further characterize the groundwater contamination and to re-evaluate impacts to human health and the environment identified in the RI. The Amended RI concluded that the extent of VOC contamination in the soil was limited, and that two groundwater plumes were present near Site 86. The plume near Site 86 was adequately defined; however, an unrelated upgradient plume was not defined.
Resource Conservation and Recovery Act Facilities Investigation (RFI) (Baker Environmental, Inc., 2006)	005800	2005-2006	In 2005 and 2006, an RFI was conducted to evaluate SWMUs 303 and 318. Surface and subsurface soil samples and groundwater samples contained concentrations of VOCs, SVOCs, and metals above human health risk-based levels. The RFI recommended the removal of SVOC- and metal-impacted soil from beneath the wash pad near SWMUs 303 and 318 and further investigation of groundwater contamination to determine the source of the VOCs.

TABLE 1
Summary of Previous Investigations

Previous Investigations/Actions*	Administrative Record Numbers	Dates	Activities and Findings
Interim Measure (Shaw Environmental and Infrastructure, Inc., 2006)	04313	2006	In 2005, approximately 1,200 tons of SVOC- and metal-impacted soil identified during the RFI was removed from SWMUs 303 and 318 under an Interim Measure. Confirmatory soil samples indicated that all target contaminants were below applicable screening criteria.
Air/Ozone Pilot Study (CH2M HILL, 2006)	003942	2004-2006	In 2004, a Pilot Study was conducted to evaluate the effectiveness of air sparging (AS) utilizing a **horizontal directionally drilled well** for transferring trichloroethene (TCE) mass in the target area (**Figure 4**). A 950-foot-long, 65-foot-deep horizontal directionally drilled well was constructed with a 350-foot section of screen. Twelve monitoring wells were installed in the upper Castle Hayne aquifer, and periodic groundwater monitoring was conducted from 16 wells (12 new wells and four existing wells). Beginning in February 2005, the air sparge system was operated nearly continuously for approximately 6 months. From late July 2005 to late January 2006, a combined air and ozone sparge system was operated. The results indicated that TCE was reduced by 99 percent. The zone of influence created by sparging operations was observed to propagate 50 feet on either side of the horizontal directionally drilled well. Groundwater samples collected from wells within the mass transfer area contained target VOCs below the North Carolina Groundwater Quality Standards (NCGWQS) within 1 year of the start of system operation.
Expanded Supplemental Remedial Investigation (ESRI) (CH2M HILL, 2011)	004731	2006–2010	An ESRI was conducted in a phased approach from 2006 to 2010 to present a complete history of the investigation activities, assess the current nature and extent and fate and transport of contamination, and quantify the potential risks to the human and ecological receptors. Passive soil gas, soil, groundwater, sediment, and surface water samples were collected and evaluated. SVOCs, pesticides, and metals were detected in soil at concentrations consistent with industrial use of the area and background concentrations for metals. CVOCs and benzene were the primary contaminants in groundwater samples collected from the surficial and upper Castle Hayne aquifers. Isolated concentrations of tetrachloroethene (PCE), polycyclic aromatic hydrocarbons (PAHs), and chromium were reported in the samples collected from the middle Castle Hayne aquifer but they did not appear to be vertically or laterally extensive. Analytical data collected as part of the ESRI was considered in conjunction with historical data previously collected at Site 86 to evaluate potential risks to human health and the environment. **Unacceptable human health risks** were identified based on the following: • Exposure to chromium in surface soil by hypothetical future residents. • Future potable use of surficial aquifer and upper Castle Hayne aquifer groundwater by residents or industrial workers from exposure to VOCs. • Future potable use of middle Castle Hayne aquifer groundwater from exposure to chloroform, PAHs, and chromium. The **ecological risk assessment** concluded that the overall risk to ecological receptors was acceptable. A Feasibility Study (FS) was recommended to identify remedial action objectives (RAOs) and identify and evaluate remedial alternatives to address the potential human health risks identified. No unacceptable risks to human or ecological populations were identified based on exposure to surface water or sediment.

TABLE 1
Summary of Previous Investigations

Previous Investigations/Actions*	Administrative Record Numbers	Dates	Activities and Findings
Basewide Vapor Intrusion Evaluation (AGVIQ/ CH2M HILL, 2009; CH2M HILL, 2011)	002772 through 002777 and 004694 through 004698	2007-2011	Site 86 was included in the phased **Basewide vapor intrusion evaluation** to determine whether complete or significant exposure pathways exist into buildings. Current subslab soil gas concentrations were within an estimated target risk range; therefore, it was concluded that vapor intrusion is not a current significant pathway of concern for the buildings evaluated at Site 86. If new buildings are planned for construction in the vicinity of the VOC groundwater plume, the potential for a vapor intrusion pathway was recommended to be re-evaluated and mitigated if needed.
Expanded Soil Background Study Report (CH2M HILL, 2011)	004705 and 04706	2011	Surface and subsurface soil samples were collected from developed and undeveloped areas of MCIEAST-MCB CAMLEJ to evaluate background threshold values (BTVs) for use in site-specific environmental investigations and risk assessments. The BTVs were not available at the time the ESRI was completed; therefore, the BTVs were used to re-evaluate potentially unacceptable risks identified in the ESRI. This risk evaluation is discussed in the FS.
FS (CH2M HILL, 2013)	005608	2012–2013	The FS **re-evaluated potential unacceptable human health risks** identified in the ESRI from exposure to soil and middle Castle Hayne aquifer groundwater as follows: • Soil—Between the time the ESRI and FS were completed, additional Base background soil data were collected, and concentrations of both naturally occurring total chromium and hexavalent chromium were measured. Based on the chromium speciation data, a ratio of hexavalent chromium to total chromium of 1:5 was calculated. Once the ratio was applied to the total chromium data from Site 86, the maximum estimated concentrations of hexavalent chromium were within the acceptable cancer risk range. Therefore, exposure to soil does not pose unacceptable risk to human health receptors. • Middle Castle Hayne aquifer groundwater—Potential risks identified were associated with COCs (chloroform, PAHs, and chromium) detected in one groundwater sample from one well. Based on the infrequency of detections, low concentrations, and laboratory qualifiers associated with the detections (estimated concentrations), the well was re-sampled, and the COCs were not detected. Therefore, groundwater from the middle Castle Hayne aquifer does not pose unacceptable risk. Based on these results, potential risks to human health are only associated with potable use of groundwater within the surficial and upper Castle Hayne aquifers. A pilot study was conducted to assist with the evaluation of potential remedial alternatives (**Figure 4**). The study was conducted in two zones*: in situ* chemical oxidation (ISCO) using slow-release permanganate candles in the surficial aquifer and an enhanced reductive dechlorination (ERD) injection/extraction recirculation system in the upper Castle Hayne aquifer. At the conclusion of the study, analytical data from the surficial aquifer indicated a decrease after 3 months of treatment but experienced a slight rebound after 9 months of treatment due to the low seepage velocity and high oxidant demand; however, analytical data from the upper Castle Hayne aquifer indicated that overall concentrations of VOCs in the upper Castle Hayne aquifer had decreased by approximately 80 percent relative to baseline concentrations.

TABLE 1
Summary of Previous Investigations

Previous Investigations/Actions*	Administrative Record Numbers	Dates	Activities and Findings
			The following **remedial alternatives** were evaluated to address the remaining potential risks from future potable use of surficial aquifer and upper Castle Hayne aquifer groundwater containing VOCs: • Alternative 1—No Action • Alternative 2—MNA and LUCs • Alternative 3—AS with MNA and LUCs • Alternative 4—ISCO with MNA and LUCs • Alternative 5—ERD with MNA and LUCs

Note:

*Documents listed are available in the Administrative Record and provide detailed information to support remedy selection at Site 86.

FIGURE 3
Historical Sample Locations

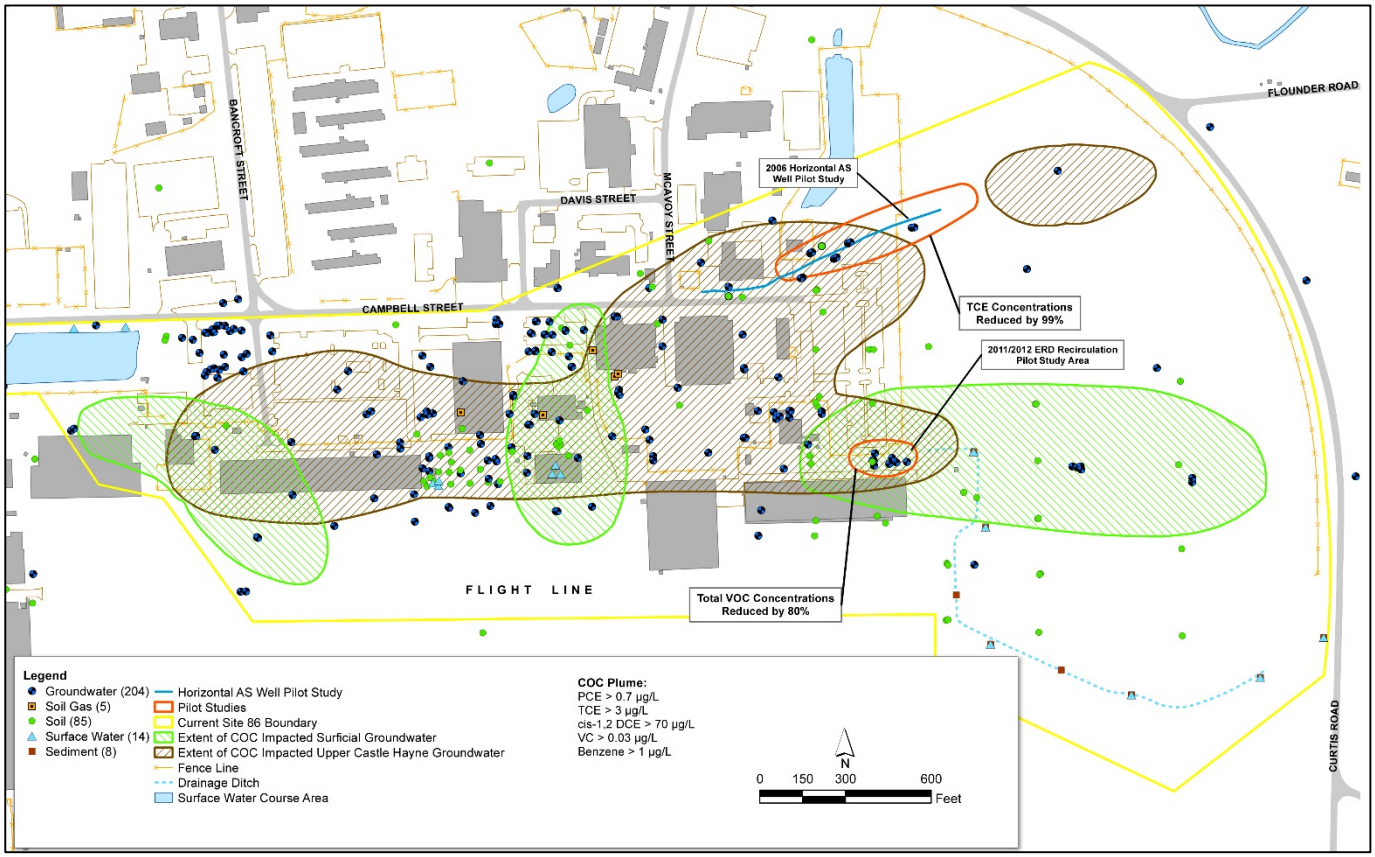
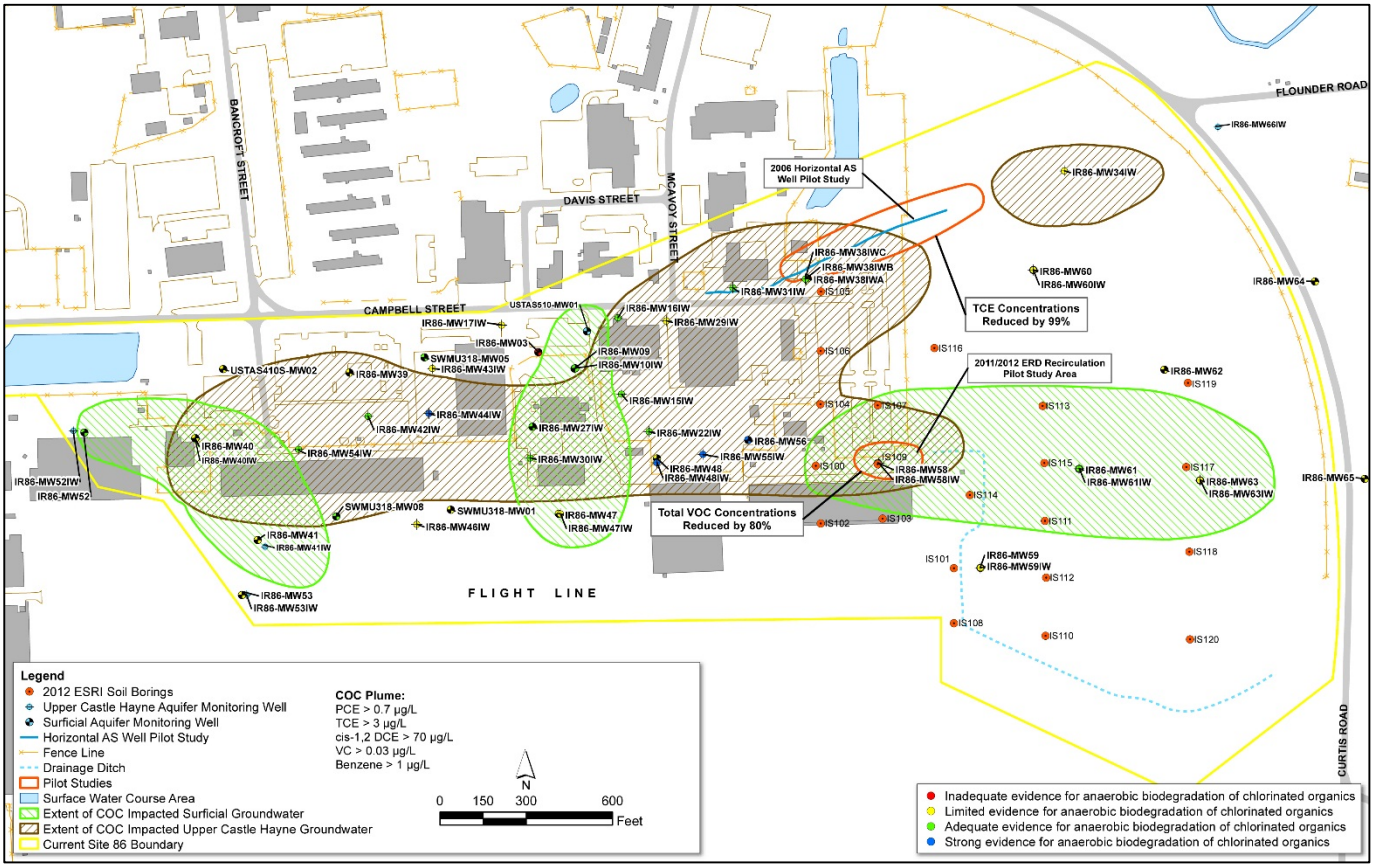


FIGURE 4
Nature and Extent



2.4 Nature and Extent and Fate and Transport of Contamination

The following section summarizes current site conditions at Site 86, including nature and extent, fate and transport, and natural attenuation (NA) processes.

Nature and Extent of Contamination

The surficial and upper Castle Hayne aquifers at Site 86 are impacted by the following VOCs: benzene, PCE, TCE, cis-1,2-dichloroethene (DCE), and vinyl chloride (VC). These COCs have been detected at concentrations exceeding the NCGWQS and/or Safe Drinking Water Act Federal Maximum Contaminant Levels (MCLs).

Pilot studies have been implemented to reduce COC mass in the areas with the highest historical concentrations:

- 2006 AS/ozone injection pilot study reduced concentrations of TCE by approximately 99 percent in the northeastern portion of the site (**Figure 4**).
- 2011/2012 ERD recirculation pilot study reduced concentrations of VOCs by approximately 80 percent near eastern end of the industrial portion of Site 86 (**Figure 4**).

The Site 86 conceptual site model, presented on **Figure 2**, illustrates the current extent of groundwater contamination.

Within the surficial aquifer, VOCs appear as three large, diffuse plumes. The westernmost plume extends approximately 750 feet between monitoring wells IR86-MW52 and IW86-MW41 on the industrial and flight line portion of the site and is approximately 300 feet wide. The central plume extends approximately 700 feet between monitoring well USTAS510-MW01 and monitoring well IR86-MW47 and is approximately 400 feet wide. The easternmost plume extends approximately 1,650 feet between monitoring wells IR86-MW58 and IR86-MW63

and is approximately 500 feet wide. The vertical extent of impacts within the surficial aquifer ranges from approximately 5 to 25 feet bgs.

Within the upper Castle Hayne aquifer, VOCs appear as two large, diffuse plumes similar to those observed in the surficial aquifer, with slight differences in orientation and generally higher levels of VOCs. The larger of the two plumes extends approximately 2,400 feet east from monitoring well IR86-MW40IW across the industrial portion of the site to monitoring well IR86-MW58IW. The plume ranges in width from 500 feet in the western portion of the site to 700 feet in the eastern portion of the site. The second plume, not present in the surficial aquifer, is located in the grassy area in the northeast portion of the site and centers on IR86-MW34IW. The vertical extent of impacts within the upper Castle Hayne aquifer ranges from 25 to 60 feet bgs.

Based on the most recent data from March 2012, there are no detectable concentrations of VOCs in the middle Castle Hayne aquifer.

Figure 4 shows the horizontal and vertical extents of the VOCs by aquifer and **Table 2** provides the maximum concentrations detected for each VOC in groundwater at Site 86.

TABLE 2
Maximum Concentration of VOCs

VOCs	NCGWQS/MCL* (micrograms per liter [µg/L])	Maximum Concentration			
		Surficial Aquifer		Upper Castle Hayne Aquifer	
		Concentration (µg/L)	Date	Concentration (µg/L)	Date
Benzene	1	11	December 2009	4	December 2009
PCE	0.7	190	December 2009	0.28 J	December 2009
TCE	3	170	May 2012	330	December 2009
cis-1,2-DCE	70	150 J	December 2009	350 J	December 2009
VC	0.03	68 J	December 2009	76	May 2012

Notes:
J – Analyte present, value may or may not be accurate or precise
*NCGWQS or MCL, whichever is more conservative

Fate and Transport of Contamination

The primary contaminant migration pathway is through groundwater flow in the surficial and upper Castle Hayne aquifers. The mechanisms of transport include advection and dispersion.

The surficial aquifer, which is under unconfined conditions, occurs within the sediments of the undifferentiated formation. The Castle Hayne confining unit, typically represented within the lower portion of the Belgrade formation, was not encountered at Site 86. The absence of a laterally continuous confining unit allows direct hydraulic communication between the surficial and Castle Hayne aquifers. Groundwater flows generally to the east-northeast towards the New River. Vertical migration of VOC contamination is limited to the surficial and upper Castle Hayne aquifers based on the lack of detections of VOCs in the middle Castle Hayne aquifer. The New River is located downgradient of the eastern boundary of Site 86 and is the ultimate receptor for surface water and groundwater discharged from the site. However, VOCs have not been detected above the NCGWQS in samples collected from wells located between the current groundwater plume and the New River.

Groundwater modeling was conducted using analytical and hydrogeologic data collected during the ESRI to forecast concentrations of VOCs that may potentially discharge from groundwater to the New River. This modeling focused on VC because VC is the most persistent, mobile, and toxic VOC in groundwater at Site 86. The model indicated that the maximum VC concentrations that may discharge to the New River are below the North Carolina Surface Water Quality Standards.

Natural Attenuation Processes

The potential efficacy of NA was evaluated with a three-tiered approach in accordance with USEPA guidance, *Use of Monitored Natural Attenuation at Superfund, RCRA* (Resource Conservation and Recovery Act) *Corrective Action, and Underground Storage Tank Sites*, which analyzes the following lines of evidence: clear and meaningful trends of decreasing contaminant mass, hydrogeologic and geochemical data that demonstrate the types of NA process active at the site, and data from field or microcosm studies. As detailed in the ESRI and FS, analysis of VOCs and natural attenuation indicator parameters (NAIPs) indicated that NA is currently occurring based on the following:

Historical Data

- Historical data trends from samples collected from monitoring well IR86-MW27IW show a decrease in VOC concentrations, indicating overall degradation of VOCs (**Table 3** and **Figure 4**) in the surficial aquifer.
- Historical data trends from samples collected from monitoring wells IR89-MW20IW and IR86-29IW show a decrease in VOC concentrations, indicating overall degradation of VOCs (**Table 3** and **Figure 4**) in the upper Castle Hayne aquifer.
- Historical data trends from samples collected from monitoring well IR86-MW30IW show an overall decrease in TCE concentrations and an increase in concentrations of daughter products, which indicates reductive dechlorination is occurring in the upper Castle Hayne aquifer (**Table 3** and **Figure 4**).

TABLE 3
Historical VOC Concentrations

VOCs	NCGWQS/MCL* µg/L	IR86-MW27IW Surficial Aquifer		IR86-MW20IW Upper Castle Hayne Aquifer		IR86-MW29IW Upper Castle Hayne Aquifer		IR86-MW30IW Upper Castle Hayne Aquifer	
		Baseline (2005) µg/L	Current (2009) µg/L	Baseline (2000) µg/L	Current (2007) µg/L	Baseline (2000) µg/L	Current (2009) µg/L	Baseline (2000) µg/L	Current (2009) µg/L
Benzene	1	6 J	0.75 J	5 U	10 U	5 U	0.45 J	5 U	1.1
PCE	0.7	10 U	1 U	5 U	10 U	5 U	1 U	5 U	1 U
TCE	3	350	13	180	57	1100	140	14	1.1
cis-1,2-DCE	70	310	15	24	25	130	15	9	150
VC	0.03	32	1.1	ND	ND	3	ND	1	1.6

Note:
*NCGWQS or MCL, whichever is more conservative

J – Analyte present, value may or may not be accurate or precise
U – Material analyzed for but not detected

Geochemical Data

- Indicator parameters suggest that conditions in the CVOC plume area of the surficial aquifer are somewhat favorable for reductive dechlorination in some areas while limited in others. The surficial aquifer is naturally more aerobic and oxidizing than the other aquifers at the site. However, within the plume area, groundwater is more reduced and dissolved oxygen (DO) is typically below 0.5 milligram per liter (mg/L). The lack of nitrite and nitrate indicates that denitrification may not be a significant process in groundwater. On the contrary, the presence of ferrous iron (Fe(II)) provides evidence of iron reduction, particularly in plume area wells, which had the highest concentrations. Limited methanogenesis is also occurring based on the presence of trace concentrations of methane. Because there is very limited sulfide, no conclusion can be made in regards to sulfate reduction (**Figure 4** and **Table 4**).

TABLE 4
Surficial Aquifer NAIP Summary

Parameter	Favorable Criteria for NA	Plume Area		Non-Plume Area	
		Measured Range	Frequency Meeting Criteria	Measured Range	Frequency Meeting Criteria
Temperature (degrees Celsius [°C])	> 20	16.2–23.39	4/9	16.90-23.53	10/16
DO (mg/L)	<0.5	0.4-2.95	8/9	0.12-3.91	12/16
pH (standard unit)	5–9	4.84-7.04	8/9	4.31–8.45	12/16
Oxidation-reduction Potential (ORP) (millivolts [mV])	<50	(-150.2)–50.0	8/9	(-204.2)–186.8	14/16
Fe(II) (mg/L)	>1	1.2-3.4	8/9	1.1–5.8	12/15*
Sulfide (mg/L)	>1	0.64J-1.7	1/9	0.82J-18	4/16
Nitrite (mg/L)	presence	ND	0/9	ND	0/15*
Methane (µg/L)	>500	0.01-1.7	2/9	0.003J–1	4/16
Chloride (mg/L)	> 2X background (7)	6 B–38 B	4/9	4.5 B–23 B	5/16
Alkalinity (mg/L)	> 2X background (30)	7.2 J–520	5/9	6.0 J–430	10/16
Sulfate (mg/L)	<20	11 B-130 B	2/9	0.24 JB–5,700	9/16
Nitrate (mg/L)	<1	ND	9/9	ND	15/15*
Total Organic Carbon (mg/L)	> 20	1.8-75	0/9	0.74 J–11	0/16
Ethene (µg/L)	>0.01	ND	0/9	0.00078 J	0/16
Ethane (µg/L)	>0.01	ND	0/9	0.00072 J	0/16
USEPA Scores	>14	8 – 19	3/9	5 – 21	4/16

Notes:

Data Collected between December 2009 and January 2010

B – Value may be attributable to blank contamination

J – Analyte present, value may or may not be accurate or precise

ND – Not Detected

* Ferrous Iron, Nitrate, and Nitrite data not collected for well IR86-MW65

- NAIPs suggest that conditions in the CVOC plume area of the upper Castle Hayne aquifer are favorable for reductive dechlorination. This aquifer appears to be naturally under anaerobic and somewhat reduced conditions, with DO typically below 0.5 mg/L and ORP below -100 mV. DO and ORP levels within the plumes are comparable to those measured outside of the plume extents. Similar to the surficial aquifer, denitrification does not appear to be a significant process. Other geochemical data indicate that iron reduction and methanogenesis are proceeding. Sulfate reduction is likely occurring but difficult to identify as sulfide is non-detect (**Figure 4** and **Table 5**).

TABLE 5
Upper Castle Hayne Aquifer NAIP Summary

Parameter	Favorable Criteria for NA	Plume Area		Non-Plume Area	
		Measured Range	Frequency Meeting Criteria	Measured Range	Frequency Meeting Criteria
Temperature (°C)	> 20	17.79–21.55	9/13	17.5-22.31	5/10
DO (mg/L)	<0.5	0.11-2.43	12/13	0.13-0.31	10/10
pH (standard unit)	5–9	6.82-2.43	13/13	6.19–8.99	10/10
ORP (mV)	<50	(-152.6)–(-13.3)	13/13	(-356.1)–(-45)	10/10
Fe(II) (mg/L)	>1	1.4-4.0	13/13	0.5–3.4	8/10
Sulfide (mg/L)	>1	6.8	1/13	0.99 J	0/10
Nitrite (mg/L)	presence	ND	0/13	ND	0/10
Methane (µg/L)	>500	0.02 B-1.2	3/13	0.01 JB–0.79	1/10
Chloride (mg/L)	> 2X background (7)	10 B–32 B	7/13	7.0 B–130 B	3/10
Alkalinity (mg/L)	> 2X background (30)	210–400	13/13	200–430	10/10
Sulfate (mg/L)	<20	0.29 J-1,400 B	7/13	0.13 JB–39 B	8/10
Nitrate (mg/L)	<1	8.8	12/13	4.84	9/10
Total Organic Carbon (mg/L)	> 20	0.7 J-6.9	0/13	0.48 J–2.8	0/10
Ethene (µg/L)	>0.01	0.01 J	0/13	ND	0/10
Ethane (mg/L)	>0.01	ND	0/13	ND	0/10
USEPA Scores	>14	14 – 23	11/13	10 – 21	3/10

Notes:

Data Collected between December 2009 and January 2010

B – Value may be attributable to blank contamination

J – Analyte present, value may or may not be accurate or precise

ND – Not detected

Microcosm Studies

- Microbial analysis conducted in the upper Castle Hayne aquifer indicated that populations of Dehalococcoides (DHC), Desulfitobacterium, and Desulfuromonas are present at Site 86 (**Table 6**). All three genera of microorganisms can carry reductive dechlorination of chloroethenes, although DHC is the only genus that can mediate complete reductive dechlorination to ethene. Although the populations of DHC are not in the optimal range for ERD, it is reasonable to assume that reductive dechlorination will occur, albeit more slowly than under enhanced conditions.

TABLE 6
Microbial Analysis

Parameter	Favorable Criteria for NA	Plume Area	
		Measured Range	Frequency Meeting Criteria
DHC (gene count per milliliter [gc/ml)]	>1,000	1.8 – 78.9	0/6
Dehalobacter (gc/ml)	>1,000	196 – 13,700	4/6
Desulfuromonas (gc/ml)	>1,000	189 – 2,930	2/6

2.5 Current and Potential Future Land and Water Uses

The flight line that occupies the majority of Site 86 has been in service since 1951. Over time, the surrounding area has been developed to provide support for aircraft and personnel. There are no current plans for non-industrial use at Site 86.

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. Regionally in southeastern North Carolina, the Castle Hayne aquifer may be used as a potable source of domestic water supply, for watering lawns, or for filling swimming pools. All potable supply wells at Marine Corps Air Station New River are located upgradient of Site 86. No active public water supply wells are located within a 1,500-foot radius of Site 86, and the site is not located within a designated wellhead protection area.

2.6 Summary of Site Risks

Potential human health and ecological risks from exposure to media at Site 86 were evaluated as part of the ESRI, Basewide Vapor Intrusion Evaluation, and FS. **Table 7** and the following subsections briefly summarize the findings of these risk assessments.

TABLE 7
Site 86 Risk Summary

Media	Human Health Risk	Ecological Risk
Surface Soil	Acceptable	Acceptable
Subsurface Soil	Acceptable	Not Applicable (N/A)*
Groundwater	Unacceptable	N/A*
Sediment	Acceptable	Acceptable
Surface Water	Acceptable	Acceptable
Indoor Air	Acceptable	N/A*

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

2.6.1 Human Health Risk Summary

The human health risk assessments (HHRAs) were completed to evaluate the potential impact from exposure to surface soil, subsurface soil, surface water, sediment, groundwater, and vapor intrusion at Site 86.

Potential **exposure pathways** evaluated included: exposure to combined surface and subsurface soil by future residents, construction workers, military personnel, industrial workers, maintenance workers, and trespassers and/or visitors; exposure to surface water and sediment for current and future military personnel, maintenance workers, and trespassers and/or visitors, future construction workers and future residents; exposure to

groundwater for future construction workers, industrial workers, and residents; and exposure to indoor air for current and future industrial workers and future 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 below, and an acceptable non-cancer hazard as an HI that does not exceed 1. The estimates of risk at Site 86 were used to determine whether any further actions were required to sufficiently protect human health. **Table 8** summarizes the potential human health risks. The HHRA concluded the following:

- There is no unacceptable risk from exposure to surface soil, subsurface soil, surface water, sediment, and/or middle Castle Hayne groundwater.
- There is a potential unacceptable risk from exposure to benzene, PCE, TCE, and VC in groundwater from the surficial and upper Castle Hayne aquifers, if used as potable drinking water by industrial workers or residents.
- While VOCs were detected in groundwater at concentrations above vapor intrusion groundwater screening levels for an industrial building, current subslab soil gas concentrations result in estimated risk within the target risk range; therefore, vapor intrusion is not a significant pathway of concern based on current site use. However, the pathway would need to be re-evaluated if new construction were to take place or if future building or land uses change.

The conceptual site model (**Figure 2**) depicts the potential unacceptable risk identified at Site 86, including the exposure media, exposure routes, and potential human health receptors.

2.6.2 Ecological Risk Summary

The **ERA** was conducted as part of the 2011 ESRI to evaluate potential risks to ecological receptors from exposure to soil, groundwater, surface water, or sediment. Risk was estimated by calculating hazard quotients 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 hazard quotient was greater than 1 (the concentration exceeded the ESV), the contaminant 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 constituents of potential concern 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 there are no significant risks to populations of ecological receptors exposed to constituents in soil, surface water, or sediment at Site 86.

2.6.3 Basis for Response Action

Based on the HHRA, exposure to benzene, PCE, TCE, and VC in groundwater at Site 86 poses an unacceptable risk to human health if used as potable drinking water. In addition, under **North Carolina's groundwater classification**, the surficial and Castle Hayne aquifers are considered Class GA, a potential source of drinking water. NCDENR identified NCGWQS as a 'relevant and appropriate' requirement for groundwater remediation. As a result, the VOCs that were identified in groundwater at Site 86 at concentrations exceeding the NCGWQS (benzene, PCE, TCE, cis-1,2-DCE, and VC) are all considered COCs. In addition, if new construction were to take place or if there are future building or land uses changes within 100 feet of the groundwater VOC plume, vapor intrusion pathways should be evaluated.

TABLE 8
Summary of Potential Human Health Risks

Receptor	Media	Pathway	COC	Exposure Point Concentration (µg/L)[a]	Reasonable Maximum Exposure (RME) Non-Cancer HI	Central Tendency Exposure (CTE) Non-Cancer HI	RME Cancer Risk	CTE Cancer Risk	Non-Cancer Toxicity Factor - Reference Dose[b c]			Cancer Toxicity Factor – Cancer Slope Factor[b c]		
									Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation
Future Child Resident	Groundwater Surficial Aquifer	Ingestion/ Dermal contact/ inhalation	Benzene	2.3	N/A	N/A	2.8×10^{-06}	1.4×10^{-07}	N/A			5.5×10^{-02}	5.5×10^{-02}	7.8×10^{-06}
		Ingestion/dermal contact/ inhalation	PCE	190	2	0.16	2.4×10^{-03}	1.1×10^{-04}	1.0×10^{-02}	1.0×10^{-02}	2.7×10^{-01}	5.4×10^{-01}	5.4×10^{-01}	5.9×10^{-06}
		Ingestion/dermal contact/ inhalation	TCE	45	N/A	N/A	7.0×10^{-06}	2.9×10^{-07}	N/A			5.9×10^{-03}	5.9×10^{-03}	2.0×10^{-06}
		Ingestion/dermal contact/ inhalation	VC	10	0.2	0.03	1.1×10^{-04}	7.9×10^{-06}	3.0×10^{-03}	3.0×10^{-03}	1.0×10^{-01}	7.2×10^{-01}	7.2×10^{-01}	4.4×10^{-06}
Future Child/ Adult Resident	Groundwater Upper Castle Hayne Aquifer	Ingestion/dermal contact/ inhalation	Benzene	1.8	N/A	N/A	2.3×10^{-05}	1.1×10^{-07}	N/A			5.5×10^{-02}	5.5×10^{-02}	7.8×10^{-06}
		Ingestion/dermal contact/ inhalation	TCE	157	N/A	N/A	3.8×10^{-04}	1.0×10^{-06}	N/A			5.9×10^{-03}	5.9×10^{-03}	2.0×10^{-06}
		Ingestion/dermal contact/ inhalation	VC	23	N/A	N/A	4.6×10^{-04}	1.8×10^{-05}	N/A			7.2×10^{-01}	7.2×10^{-01}	4.4×10^{-06}
Future Industrial Worker	Groundwater Surficial Aquifer	Ingestion	PCE	190	N/A	N/A	3.6×10^{-04}	1.1×10^{-04}	N/A			5.4×10^{-01}	N/A	N/A
		Ingestion	VC	10	N/A	N/A	2.5×10^{-05}	7.9×10^{-06}	N/A			7.2×10^{-01}	N/A	N/A

Notes:
There were no potential unacceptable risks to human health due to the presence of cis-1,2-DCE; however, cis-1,2-DCE was included as a COC because it was detected at concentrations exceeding NCGWQS.
[a] Exposure Point Concentration = 95 percent upper confidence level
[b] Sources: Integrated Risk Information System, Health Effects Assessment Summary Tables, Agency for Toxic Substances and Disease Registry Toxicity Profiles, California Environmental Protection Agency, and National Center for Environmental Assessment, current at time HHRA conducted
[c] ingestion and dermal milligram per kilogram per day, inhalation milligram per cubic meter
Shading indicates an exceedance of the non-cancer HI of 1 or the cancer risk of 1×10^{-6}

The concentrations of COCs requiring a response action are summarized in **Table 2**, and the extent of groundwater impacts is shown on **Figure 4**.

It is the current judgment of the Navy, USMC, 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.

2.7 Principal Threat Wastes

"Principal threat wastes" are source materials considered to be highly toxic or highly mobile 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. NAPL has not been observed during groundwater sampling activities. Dissolved concentrations of VOCs in groundwater at approximately 1 percent, or greater, of a compound's solubility could suggest the presence of NAPL in the subsurface. The maximum concentration of TCE was observed in the upper Castle Hayne aquifer at a concentration of 0.33 mg/L, which is 0.023 percent of the water solubility of TCE (1,280 mg/L). The maximum concentration of PCE was observed in the surficial aquifer at a concentration of 0.19 mg/L, which is 0.092 percent of the water solubility of PCE (206 mg/L). Based on these lines of evidence, NAPL is not likely present at the site.

2.8 Remedial Action Objectives

In order to be protective of human health and the environment and address potential future risks identified in the HHRA, the RAOs identified for Site 86 are as follows:

- 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 North Carolina Administrative Code (NCAC) 02L.0201.
- Prevent exposure to COCs in groundwater and vapor intrusion from COCs in groundwater until such time as groundwater concentrations or vapor intrusion mitigation measures allow for UU/UE.

Cleanup levels were developed for COCs contributing to unacceptable risks and hazards from exposure to groundwater at Site 86 (see **Table 9**). The cleanup levels for the COCs listed are based upon chemical-specific applicable or relevant and appropriate requirements (**ARARs**) and are based on the more conservative of the NCGWQS or federal MCL. In this case, the NCGWQS is more stringent than the MCL for each COC.

TABLE 9
Groundwater Cleanup Levels

COC	NCGWQS/MCL* (µg/L)
Benzene	1
PCE	0.7
TCE	3
cis-1,2,-DCE	70
VC	0.03

Note:
*NCGWQS or MCL, whichever is more conservative

2.9 Description and Comparative Analysis of Remedial Alternatives

2.9.1 Description of Remedial Alternatives

Remedial alternatives to address groundwater impacts at Site 86 were developed and are detailed in the 2013 FS. Based on the initial **screening of technologies**, five remedial alternatives to address groundwater impacts at Site 86 were developed and are summarized in **Table 10**. For active treatment alternatives, target treatment areas

were defined by the presence of VC in groundwater at concentrations greater than 100 times the NCGWQS to maximize the potential for mass reduction (**Figure 4**).

TABLE 10
Summary of Remedial Alternatives

Alternative	Components	Details	Cost/Timeframe	
1 – No Action	None	None	Total Cost Timeframe	$0 Indefinite
2 – MNA and LUCs	MNA	NA process to reduce sitewide concentrations of VOCs in groundwater. Installation of additional monitoring wells to provide a representative distribution of site conditions within the surficial and upper Castle Hayne aquifers. Groundwater monitoring annually for VOCs and every 5 years for NAIPs to evaluate trends over time and progress towards meeting the cleanup levels.	Capital Cost Total Monitoring Cost Total Present-value Cost Timeframe	$28,000 $557,000 $585,000 53 Years
	LUCs	LUCs to prohibit aquifer use and to require evaluation of vapor intrusion if future changes in building or land use occur or for new construction.		
3 – AS, MNA, and LUCs	AS	Injection of air to induce mass transfer (stripping) of VOCs from groundwater and/or aerobic biodegradation. Installation of two AS wells in the surficial aquifer and six AS wells in the upper Castle Hayne aquifer in the target treatment areas. Semi-annual performance monitoring and O&M of the AS systems would continue for up to 5 years.	Capital Cost Total Monitoring Cost Total Present-value Cost Timeframe	$3,419,000 $2,042,000 $5,461,000 40 Years
	MNA	MNA would initially be implemented outside the target treatment areas on select wells, and would later be implemented sitewide after active AS operations ceased. Installation of additional monitoring wells to provide a representative distribution of site conditions within the surficial and upper Castle Hayne aquifers. Groundwater monitoring annually for VOCs and every 5 years for NAIPs to evaluate trends over time and progress towards meeting the cleanup levels.		
	LUCs	LUCs to prohibit aquifer use and to require evaluation of vapor intrusion if future changes in building or land use occur or for new construction.		
4 – ISCO, MNA, and LUCs	ISCO	Injection of chemical oxidant permanganate to chemically degrade VOCs in groundwater. Installation of 68 injection wells in the surficial and upper Castle Hayne aquifers within the target treatment areas. Injection of approximately 3,304,029 gallons of 4 percent potassium permanganate solution. Semi-annual performance monitoring would continue for up to 5 years.	Capital Cost Total Monitoring Cost Total Present-value Cost Timeframe	$7,376,000 $535,000 $7,911,000 40 Years

TABLE 10
Summary of Remedial Alternatives

Alternative	Components	Details	Cost/Timeframe
4 – ISCO, MNA, and LUCs (cont.)	MNA	MNA would initially be implemented outside the treatment areas in select wells, and would later be implemented sitewide following active treatment. Installation of additional monitoring wells to provide a representative distribution of site conditions within the surficial and upper Castle Hayne aquifers. Groundwater monitoring annually for VOCs and every 5 years for NAIPs to evaluate trends over time and progress towards meeting the cleanup levels.	
	LUCs	LUCs to prohibit aquifer use and to require evaluation of vapor intrusion if future changes in building or land use occur or for new construction.	
5 – ERD, MNA, and LUCs	Enhanced bioremediation	Injection of electron donor substrate consisting of 50 percent emulsified vegetable oil and 50 percent lactate to promote anaerobic biodegradation of VOCs by reductive dechlorination. Installation of 68 injection wells in the surficial and upper Castle Hayne aquifers within the target treatment areas. Injection of approximately 260,000 gallons of emulsified vegetable oil-lactate solution. Semi-annual performance monitoring would continue for up to 5 years.	Capital Cost $2,954,000 Total Monitoring Cost $697,000 Total Present-value Cost $3,651,000 Timeframe 40 Years
	MNA	MNA would initially be implemented outside the treatment areas on select wells, and would later be implemented sitewide following active treatment. Installation of additional monitoring wells to provide a representative distribution of site conditions within the surficial and upper Castle Hayne aquifers. Groundwater monitoring annually for VOCs and every 5 years for NAIPs to evaluate trends over time and progress towards meeting the cleanup levels.	
	LUCs	LUCs to prohibit aquifer use and to require evaluation of vapor intrusion if future changes in building or land use occur or for new construction.	

2.9.2 Comparative Analysis of Alternatives

A comparative analysis using the **nine USEPA criteria** was completed and is discussed in this section. The analysis is summarized in **Table 11**.

TABLE 11
Comparative Analysis of Alternatives

CERCLA Criteria	No Action	MNA and LUCs	AS, MNA, and LUCs	ISCO, MNA, and LUCs	ERD, MNA, and LUCs
	(1)	(2)	(3)	(4)	(5)
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-worth Cost	$0	$585k	$5.46M	$7.91M	$3.65M

Notes:
Relative 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, MNA, and/or LUCs. Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) provide active treatment and mass transfer to reduce the concentrations of COCs in groundwater, potentially expediting the NA process. Monitoring of the natural attenuation processes and LUCs will provide protection until RAOs are achieved for Alternatives 2 (MNA), 3 (AS), 4 (ISCO), and 5 (ERD).

Compliance with ARARs

Section 121(d) of CERCLA, as amended, specifies in part that remedial actions for cleanup of hazardous substances must comply with the requirements and standards under federal or more stringent state environmental laws and regulation that are ARARs to the hazardous substances or particular circumstances at a site unless such ARARs are waived under CERCLA Section 121(d) (4). See also 40 CFR §300.430(e)(9)(iii)(B).

All alternatives, except the No Action alternative, are expected to comply with ARARs presented in **Appendix A**. Alternatives 2 (MNA), 3 (AS), 4 (ISCO), and 5 (ERD) would comply with chemical-specific ARARs (NCGWQS and MCLs) through treatment and/or natural attenuation. MNA and LUCs would be implemented to prevent exposure to groundwater until such time that chemical-specific ARARs can be achieved. All alternatives, except No Action, would also comply with action-specific ARARs, including North Carolina regulations for monitoring well construction, abandonment, waste management, and LUCs. Additional action-specific ARARs apply if Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) are implemented regarding installation of underground injection wells, and control of VOC emissions from groundwater treatment. All alternatives, except the No Action alternative, would comply with applicable location-specific ARARs, which includes consideration of migratory birds and work within a coastal zone.

Primary Balancing Criteria

Long-term Effectiveness and Permanence

Each alternative, except the No Action alternative, provides some degree of long-term protection that increases if mass transfer and treatment components are included. The effectiveness and permanence of Alternative 2 (MNA) is dependent entirely upon NA, whereas Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) employ active treatment and mass transfer to reduce the concentrations of COCs in groundwater, and then rely on NA to reduce COCs in groundwater to their respective cleanup levels. Therefore, Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) will reach the cleanup levels in a shorter timeframe than Alternative 2 (MNA). Based on groundwater modeling, the remediation timeframe to effectively reduce mobile phase VC concentrations to less than the NCGWQS without additional treatment is 53 years. With further treatment, the remediation timeframe is 40 years. Thus, implementation of an active remedial treatment technology may only reduce the remediation timeframe by 13 years.

Rebound is a potential issue with any injection or AS scenario; therefore, subsurface distribution is the key to effectiveness and treatment timeframe. Due to the possibility of rebound, multiple injections (or system restart for AS) may be required for Alternatives 3 (AS), 4 (ISCO), and 5 (ERD). However, Alternative 5 (ERD) may have a slightly higher long-term effectiveness because it may provide a longer, more sustained treatment of potential contaminant rebound as bioaugmentation will likely increase the biodegradation potential of the aquifer after the initial substrate injection and extraction.

Reviews conducted at least every 5 years, as required by CERCLA, 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 UU/UE.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) would reduce toxicity, mobility, and volume through treatment. The technologies are effective at reducing the concentrations of CVOCs in groundwater; however, AS and MNA are typically more effective technologies at removing benzene from groundwater than ISCO and ERD. Although Alternative 2 (MNA) does not include active treatment, natural reduction of VOC concentrations through a variety of physical, chemical, or biological activities will occur over time.

Alternative 4 (ISCO) is expected to provide the fastest reduction in toxicity and volume of CVOCs in groundwater through chemical oxidation, while Alternative 5 (ERD) would provide for reduction at a slower rate because it is dependent on biological processes. Alternative 3 (AS) would reduce toxicity and volume; however, AS is not a destructive process and the transferred mass of VOCs, if not biodegraded aerobically in the vadose zone, would release into the atmosphere. Therefore, Alternatives 4 (ISCO) and 5 (ERD) provide the highest reduction of toxicity, mobility, and volume through treatment followed by Alternative 3 (AS).

Short-term Effectiveness

Short-term effectiveness, in terms of risks to workers, the community, and environment during implementation, would be lowest for Alternative 2 (MNA) since no construction is involved with the implementation of the remedy. Alternative 2 also has the lowest potential environmental impacts during implementation since no active treatment, only groundwater monitoring, would be performed.

Risks to workers, the community, and the environment are higher for the active treatment Alternatives 3 (AS), 4 (ISCO), and 5 (ERD), but would be minimized through the use of appropriate personal protective equipment, air monitoring, and engineering controls to prevent any spills or damage to the environment. Although the period of time to implement Alternatives 3 (AS) and 4 (ISCO) are similar to Alternative 5 (ERD), the risks to workers are generally higher. This is due to increased labor required to perform O&M on the AS system, the elevated risks associated with handling a strong oxidant during the ISCO injection and recirculation activities, and the potential for AS to increase risks to Base workers from vapor intrusion into occupied buildings.

The potential environmental impacts (greenhouse gas or air pollutant emissions from running equipment or vehicle emissions) and resource use (water or energy) were evaluated for each active remedy (AS, ISCO, and ERD).

Alternative 3 (AS) has the highest potential environmental impacts, primarily from electricity use during system operations. Alternatives 4 (ISCO) and 5 (ERD) has similar potential environmental impacts, with ISCO having higher water use to dilute the chemicals before injection.

Implementability

Each alternative is technically and administratively feasible with services and materials required to implement the remedy readily available. Alternative 2 (MNA) has the highest implementability of all the remedies evaluated because it requires no construction and the site labor is limited to sampling activities. However, the implementability of Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) decrease significantly because Site 86 is located on an active military flight line with multiple areas of limited or restricted access that may preclude the installation of a sitewide remediation system infrastructure. The alternatives involve drilling, construction, and maintenance activities that will likely disrupt flight line operations. Additionally, subsurface injections of air or liquid rely heavily on distribution throughout the impacted media. Since the aquifer media is not uniform, preferential flow through more porous media may cause inadequate contact with contaminated groundwater. Therefore, Alternatives 3 (AS), 4 (ISCO), and 5 (ERD) are considered to have moderate implementability.

Cost

An order-of-magnitude cost for each alternative has been estimated based on a variety of key assumptions. The estimated timeframes to achieve the RAOs vary among alternatives and were developed using groundwater flow and solute transport models based on data collected during the ESRI. Remedy components that were used in the cost estimate are summarized in **Table 10**.

The estimated present-worth costs for the alternatives, not including the No Action alternative, range from $585,000 for Alternative 2 (MNA) to $7.91 million for Alternative 4 (ISCO). Alternative 5 (ERD) is expected to cost approximately $3 million more than Alternative 2, and Alternative 3 (AS) is estimated to cost approximately $5 million more than Alternative 2. Cost summaries can be found in **Table 10**.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA and remedy selection process. NCDENR supports the Preferred Alternative, and its final concurrence will be solicited following the review of all comments received during the public comment period.

Community Acceptance

The public meeting was held on February 26, 2014, to present the Proposed Remedial Action Plan (PRAP) and answer community questions regarding the proposed remedial action at Site 86. 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.

2.10 Selected Remedy

The Selected Remedy for Site 86 is Alternative 2, MNA and LUCs.

2.10.1 Rationale for the Selected Remedy

Alternative 2 is preferred because previous actions have removed the highest concentrations of VOC mass, NA is ongoing to further degrade VOCs in a reasonable timeframe, and solute transport modeling suggests that MNA will be protective of the New River. Alternative 2 also has an order-of-magnitude lower associated cost than Alternatives 3, 4, and 5, which would still require MNA and LUCs, and, based on modeling results, active treatment may only reduce the remedial timeframe by 13 years. Lastly, the only remaining unacceptable risk is based on the potable use of groundwater and potential for vapor intrusion based on future building or land use changes, which will be restricted through LUCs.

The ultimate objective is to restore groundwater quality to its beneficial uses as a potential drinking water supply. Based on information obtained during previous investigations and analysis of all remedial alternatives, MNA is an

acceptable alternative to achieve this objective. In accordance with USEPA guidance*, Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, clear and meaningful trends of decreasing contaminant mass have been documented, hydrogeologic and geochemical data demonstrate active NA processes at the site, and microcosm studies indicate the presence of favorable microorganisms at the site. Site-specific lines of evidence for MNA are presented in Section 2.4 and are summarized as follows:

- Removal of mass from higher concentration areas through the implementation of two pilot studies.
- Detection of parent VOC degradation compounds have been observed site-wide.
- Presence of adequate MNA scores for groundwater samples collected from wells screened within the upper Castle Hayne aquifer has been observed.
- Presence of microbial populations observed in groundwater samples collected from wells screened within the upper Castle Hayne aquifer.
- Indication that MNA will be protective of the New River based on predictive groundwater modeling.
- Similarity between remedial timeframes for active treatment alternatives and MNA.

LUCs will be implemented to prevent potable use of groundwater and potential vapor intrusion until the cleanup levels and RAOs are achieved.

2.10.2 Description of the Selected Remedy

The Selected Remedy for Site 86 includes the following:

- MNA to monitor groundwater throughout various locations of the plumes and track changes in COC concentrations and geochemical parameters in view of documenting decreasing trends that demonstrate cleanup levels can be attained in a reasonable timeframe
- LUCs to prohibit aquifer use and to require evaluation of vapor intrusion pathways if future changes in building or land use occur

MNA is planned to include annual groundwater sampling of monitoring wells in the surficial and upper Castle Hayne aquifers for analysis of COCs until cleanup levels have been met. Additional monitoring wells will be installed to establish a monitoring well network that provides a representative distribution of site conditions within the surficial and upper Castle Hayne aquifers. VOCs are expected to reach cleanup levels in approximately 53 years. Natural degradation of COCs is expected to proceed, and favorable conditions exist at the location of the highest concentrations. NAIPs will be collected in support of MNA every 5 years. The specific details of sampling, frequency, and the monitoring network will be presented in the Remedial Design (RD).

LUCs including, but not limited to, land use restrictions in the Base Master Plan, filing a Notice of Contaminated Site with the Onslow County Register of Deeds, and administrative procedures to prohibit unauthorized activities (for example, excavation, 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 also required prior to any new construction or changes to existing building use or structure within the LUC boundary. The LUCs will be implemented and maintained by the Navy and MCIEAST-MCB CAMLEJ until the concentration of hazardous substances in groundwater are at such levels to allow for UU/UE. The Navy and USMC are 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 will retain ultimate responsibility for the remedy integrity.

The LUC performance objectives include:

- To prohibit human consumption of groundwater from the surficial and upper Castle Hayne aquifers underlying Site 86.
- To mitigate the potential for future vapor intrusion pathways.
- To maintain the integrity of any existing or future monitoring system at the site such as monitoring wells.

The specific types of LUCs that will be implemented (to meet the objectives) include:

- Incorporating land and groundwater use prohibitions (Aquifer Use Control and Industrial/Non-Industrial Use Control) into the MCIEAST-MCB CAMLEJ Base Master Plan, including consideration of vapor intrusion for new construction or modification to existing structures 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.
- Filing deed and/or lease restrictions in the event of transfer for any portion of Site 86.

The estimated LUC boundaries are provided on **Figure 5**; the actual LUC boundaries will be finalized in the RD. 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 RD.

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 RD. The need for LUCs to prevent exposure and ensure protection will be periodically reassessed as COC concentrations are reduced over time.

Because COCs will remain at the site above levels that allow for UU/UE, the Navy will review the final remedial action no less than every 5 years to assess the protectiveness of the remedy.

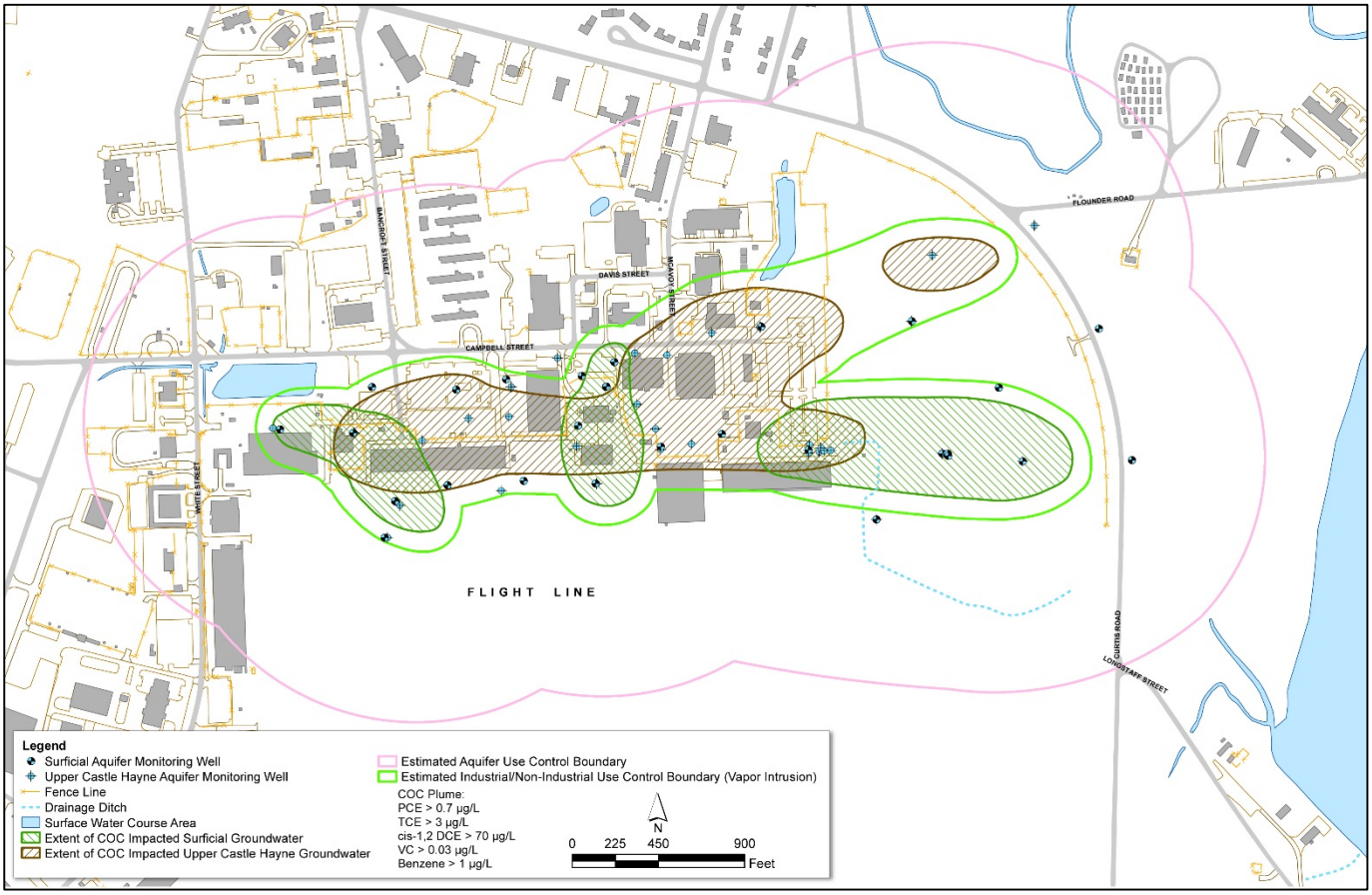
2.10.3 Expected Outcomes of the Selected Remedy

Current land uses are expected to continue at Site 86. Cleanup levels for the Selected Remedy are based on UU/UE. Exposure will be controlled through LUCs until COCs in groundwater are reduced to the cleanup levels. **Table 12** 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 12
Expected Outcomes

Risk	RAO	Remedy Component	Metric	Expected Outcome
Future residential and industrial worker exposure to COCs 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.	MNA	Implement until each groundwater COC is at or below its respective cleanup level for four consecutive monitoring events.	UU/UE
	Prevent exposure to COCs in groundwater and vapor intrusion from COCs in groundwater until such time that groundwater concentrations or vapor intrusion mitigation measures allow for UU/UE.	LUCs	Maintain until each groundwater COC is at or below its respective cleanup level for four consecutive monitoring events.	

FIGURE 5
Selected Remedial Alternative



2.10.4 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 more stringent 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—The LUC components of the Selected Remedy will protect human health and the environment by preventing aquifer use and protecting any future potential receptors from vapor intrusion until MNA restores the groundwater to meet drinking water standards (MCLs or NCGWQS).

Compliance with ARARs—Section 121(d) of CERCLA, as amended, specifies, in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 CFR § 300.430(f)(1)(ii)(B). ARARs include only federal and state environmental or facility citing laws and regulations and do not include occupational safety or worker protection requirements. Compliance with Occupational Safety and Health Administration standards is required by 40 CFR § 300.150; therefore, the CERCLA requirement for compliance with or wavier of ARARs does not apply to Occupational Safety and Health Administration standards. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to-be-

considered for a particular release. In accordance with 40 CFR § 300.400(g), the Navy, USEPA, and NCDENR have identified the ARARs for the Selected Remedy. **Appendix A** lists, respectively, the chemical-, location-, and action-specific ARARs and TBCs for the Selected Remedy. The Selected Remedy will meet all identified ARARs and TBCs.

Cost-effectiveness—The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The following definition was used to determine cost-effectiveness: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP §300.430[f][1][ii][D]). This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. The overall effectiveness of the Selected Remedy was compared to costs to determine cost-effectiveness. The Selected Remedy's costs were determined to be proportional to overall effectiveness, thus representing a reasonable value for the money.

The estimated present-worth cost of the Selected Remedy is $585,000, and the remedial timeframe is predicted to be approximately 53 years. Alternatives 3, 4, and 5 present-worth costs are significantly higher and are only expected to reduce the remedial timeframe by 13 years.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable—Although the use of treatment technologies is typically preferred, the Navy, USMC, USEPA, and NCDENR determined that MNA and LUCs provide the best balance of tradeoffs with respect to the balancing and modifying criteria. Pilot studies have been implemented to treat and reduce COC mass in the areas with the highest historical concentrations.

Although the Selected Remedy is expected to require a longer period of time (53 years) to restore groundwater to UU/UE than Alternatives 3, 4, and 5 (40 years) and does not include treatment, COCs in groundwater are expected to be reduced through NA processes for a reasonable present-worth cost ($585,000). Treatment, such as through implementation of Alternatives 3, 4, or 5, would require drilling, construction, and maintenance activities that would disrupt flight line operations. LUCs will prevent exposure to COCs until cleanup levels have been reached and the state and community support the Selected Remedy.

Preference for Treatment as a Principal Element—While the Selected Remedy does not satisfy the statutory preference for treatment as a principal element, MNA is expected to be successful in attaining cleanup levels throughout the plume and the RAOs for groundwater-based contaminant trends over time. Additionally, NAPL has not been observed during groundwater sampling, concentrations of COCs indicating NAPL have not been detected, and no source materials constituting principal threats are present.

Five-year Review Requirements—This remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE; therefore, in accordance with CERCLA Section 121(c) and the NCP at 40 CFR § 300.430 (f)(4)(ii), a statutory review will be conducted by the Navy within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed or MNA is unsuccessful, then additional remedial actions would be evaluated by the FFA parties and the Navy may be required to undertake additional remedial action.

2.11 Community Participation

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

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period for the Site 86 PRAP from February 10, 2014, through March 14, 2014. A public meeting to present the PRAP was held on February 26, 2014, at Coastal Carolina Community College. Public notice of the meeting and availability of

documents was placed in *The Jacksonville Daily News*, the *RotoVu*, and *The Globe* newspapers on February 10, February 12, and February 13, 2014, respectively.

The Administrative Record, Community Involvement Plan, IRP fact sheets, and final technical reports concerning Site 86 can be obtained from the IRP web site: http://go.usa.gov/Dy5T. Internet access is available to the public at the following location:

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

2.12 Documentation of Significant Changes

The PRAP for Site 86 was released for public comment on February 26, 2014. No comments were submitted during the public comment period. 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 February 26, 2014, included representatives of the Navy, USMC, USEPA, and NCDENR. Several community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes in the 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

TABLE A-1
Chemical-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
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	Establishes maximum contaminant concentrations for groundwater. The following remedial goals have been set using these criteria: • Benzene (1 µg/L) • PCE (0.7 µg/L) • TCE (3 µg/L) • cis-1,2-DCE (70 µg/L) • VC (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) and (b)
	Shall not exceed the Safe Drinking Water Act National Revised Primary Drinking Water Regulations: MCLs for organic contaminants specified in 40 CFR 141.61(a). • Benzene (5 µg/L) • PCE (5 µg/L) • TCE (5 µg/L) • VC (2 µg/L) • cis-1,2-DCE (70 µg/L)	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 .1517

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
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
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 stormwater 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-52(6) of more than 1 acre of land – **Applicable**	15A NCAC 4B.0105
	Erosion and sedimentation control plan must address the following basic control objectives: (1) Identify areas subject to severe erosion and offsite 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 offsite sedimentation damage (6) Include measures to control velocity of stormwater 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 runoff of 10-year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52(6) of more than 1 acre of land – **Applicable**	15A NCAC 4B.0108
	Shall conduct activity so that the post-construction velocity of the 10-year storm runoff 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
	Erosion and sedimentation control measures, structures, and devices with 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(6) of more than 1 acre of land in HQW zones – **Applicable**	15A NCAC 4B.0124(b)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Managing stormwater runoff from land-disturbing activities (cont.)	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, whichever period is shorter.		15A NCAC 4B.0124(e)
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. 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. 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. Shall be constructed in such a manner as to preclude the vertical migration of contaminants with and along borehole channel. 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. 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 1-foot-thick seal, composed 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.	Installation of wells (including temporary, monitoring wells) other than for water supply **- Applicable**	15A NCAC 02C .0108(a) 15A NCAC 02C .0108(c) 15A NCAC 02C .108(d) 15A NCAC 02C .108(f) 15A NCAC 02C .108(g) 15A NCAC 02C .0108(h)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Construction of groundwater monitoring well(s) (cont.)	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 hole wells. The grout shall comply with Paragraph (e) of Rule .0107 of this section except that the upper 3 feet of grout shall be concrete or cement grout.	Installation of wells (including temporary wells, monitoring wells) other than for water supply - **Applicable**	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 1 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.		15A NCAC 02C .0108(k) and 15A NCAC 02C .0108(l)
	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.		
	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 .108(n)
	Shall have permanently affixed an identification plate. The identification plate shall be constructed of a durable, waterproof, rustproof material 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 .108(o)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Construction of groundwater monitoring well(s) (cont.)	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 .108(p)
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) 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 .107(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	Permanent abandonment of wells (including temporary wells, monitoring wells, and test borings other than for water supply l*ess 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 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 well) other than for water supply - **Applicable**	15A NCAC 02C .0113(f)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Waste Characterization and Storage — Primary Wastes (i.e., well soil cuttings and purge water) and secondary Wastes (e.g., PPE and used equipment)			
Characterization of solid waste	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and Must determine if waste is listed under 40 CFR Part 261; or Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.	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) 40 CFR 262.11(b) 15A NCAC 13A .0107 40 CFR 262.11(c) 15A NCAC 13A .0107
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. 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 broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.	Generation of solid waste which is determined *not* to be hazardous - **Relevant and Appropriate**	15A NCAC 13B .0104(f) 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
Determination of requirements related to land disposal	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the waste. 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. Must determine each USEPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40 et. seq.	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 40 CFR 268.7 15A NCAC 13A.0112 40 CFR 268.9(a) 15A NCAC 13A.0112

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
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**	40 CFR 262.34(a) 15A NCAC 13A.0107 40 CFR 262.34(a)(1)(i) 40 CFR 262.34(a)(2) 15A NCAC 13A.0107 40 CFR 262.34(a)(3) 5A NCAC 13A.0107
		Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation - **Applicable**	40 CFR 262.34(c)(1) 5A NCAC 13A.0107
	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 with 40 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
Disposal of Wastes			
Disposal of solid waste	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 – **Applicable**	15A NCAC 13B .0106(b)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
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	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste **Applicable**	40 CFR 268.40(a) 15A NCAC 13A.0112
	Must be treated according to the UTSs [specified in 40 CFR 268.48 Table UTS] 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
	All underlying hazardous constituents (as defined in 40 CFR 268.2[i]) must meet the Universal Treatment Standards (UTS), 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 Clean Water Act, that is Clean Water Act 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 identified 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 RCRA toxicity characteristic wastes (D004-D011) that are newly identified (i.e., wastes, soil, or debris identified by the TCLP but not the Extraction Procedure) – **Applicable**	40 CFR 268.34(f) 15A NCAC 13A .0112
Transportation of Wastes			
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the Hazardous Materials Transportation Act and Department of Transportation Hazardous Material Regulation 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)

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
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)
	Must comply with the requirements of 40 CFR 263.11-263.31.	Transportation of hazardous waste within the United States requiring a manifest - **Applicable**	40 CFR 263.10(a)
	A transporter who meets all applicable requirements of 49 CFR 171-179 and the requirements of 40 CFR 263.11 and 263.31 will be deemed in compliance with 40 CFR 263.		
Transportation of samples	Are not subject to any requirements of 40 CFR parts 261 through 268 or 270 when: (1) the sample is being transported to a laboratory for the purpose of testing; (2) the sample is being transported back to the sample collector after testing; or (3) the sample is being stored by sample collector before transport to a lab for testing.	Sample 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
	In order to qualify for the exception in paragraphs (d)(1) (i) and (ii), a sample collector shipping the samples to a laboratory must: (1) comply with United States Department of Transportation, United States Postal Service, or any other applicable shipping requirements (2) assure that the information provided in (1) through (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

TABLE A-2
Action-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirement	Prerequisite	Citation
Institutional Controls for Contamination Left in Place			
Notice of Contaminated Site	Prepare and certify by professional land surveyor a survey plat which identifies contaminated areas which shall be entitled "NOTICE OF CONTAMINATED SITE". Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance and meet the requirements of NCGS 47-30 for maps and plans. 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.	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) 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 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 included in a remedial action plan as provided in G.S. 143B-279.9(a) **- To-Be-Considered**	NCGS 143B-279.10(e)

TABLE A-3
Location-Specific ARARs
Operable Unit No. 20 (Site 86)
Record of Decision
MCIEAST-MCB CAMLEJ, North Carolina

Location	Requirement	Prerequisite	Citation
Federal and North Carolina Location-Specific ARARs			
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 USC 703 50 CFR 21.11
Coastal zone as defined in 16United States Code §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 15 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 930.11**– Applicable**	15 CFR 930.33(a)(1), (a)(2), (a)(4), (b)

Appendix B
Acronyms and Abbreviations

Acronyms and Abbreviations

µg/L	microgram per liter
°C	degree Celsius
ARAR	applicable or relevant and appropriate requirement
AS	air sparging
AST	aboveground storage tank
bgs	below ground surface
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COC	constituent of concern
CTE	central tendency exposure
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DHC	Dehalococcoides
DO	dissolved oxygen
DOT	Department of Transportation
ERD	enhanced reductive dechlorination
ESRI	Expanded Supplemental Remedial Investigation
ESV	ecological screening value
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft/day	feet per day
ft/ft	feet per foot
gc/ml	gene count per milliliter
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IRP	Installation Restoration Program
ISCO	*in situ* chemical oxidation
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/L	milligram per liter
MNA	monitored natural attenuation
mV	millivolt
N/A	not applicable
NA	natural attenuation
NAIP	natural attenuation indicator parameter
NAPL	non-aqueous phase liquid
Navy	Department of the Navy
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources

NCGS	North Carolina General Statute
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operations and maintenance
ORP	oxidation-reduction potential
OU	Operable Unit
PCE	tetrachloroethene
PRAP	Proposed Remedial Action Plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFI	Resource Conservation and Recovery Act Facilities Investigation
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
USMC	United States Marine Corps
UU/UE	unlimited use and unrestricted exposure
VC	vinyl chloride
VOC	volatile organic compound

Appendix C
NCDENR Concurrence Letter

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

July 11, 2014

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

RE: Concurrence with the 2013 Final Record of Decision (ROD) for OU 20, Site 86
Soil and Groundwater
MCB Camp Lejeune, NC
NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Cleland:

The NC Superfund Section has received and reviewed the Final Record of Decision (ROD) for OU 20, Site 86 at MCB, Camp Lejeune dated July 2014 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 Final ROD dated July 2014 for OU 20 Site 86. 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 Beth Hartzell at (919) 707-8335 or email beth.hartzell@ncdenr.gov.

Sincerely,

Linda M. Culpepper
Director, Division of Waste Management

Cc: David Lown, Head, PE, PG, Federal Remediation Branch
Charity Delaney, 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	Horizontal directionally drilled well	Table 1	AGVIQ/CH2M HILL. 2006. *Final Pilot Study Report Site 86 Operable Unit No. 20 Marine Corps Base Camp Lejeune, North Carolina.* September. Section 2 and 3.
2	Unacceptable human health risks	Table 1	CH2M HILL. 2011. *Final Expanded Supplemental Remedial Investigations Site 86 – Operable Unit No. 20 Marine Corps Base Camp Lejeune Jacksonville North Carolina*. February. Sections 7 and 9
3	ecological risk assessment	Table 1	CH2M HILL. 2011. *Final Expanded Supplemental Remedial Investigations Site 86 – Operable Unit No. 20 Marine Corps Base Camp Lejeune Jacksonville North Carolina*. February. Section 8.
4	Basewide vapor intrusion evaluation	Table 1	CH2M HILL. 2011. Phase III *Vapor Intrusion Evaluation Report Volume 4 of 5 – Air Station, Marine Corps Base Camp Lejeune, North Carolina*. October. Section 4.2.1
5	re-evaluated potential unacceptable human health risks	Table 1	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Section 2.4.
6	remedial alternatives	Table 1	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Sections 4 and 5.
7	Groundwater modelling	Section 2.4	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Sections 2.6.1.3 and Appendix D.
8	exposure pathways	Section 2.6.1	CH2M HILL. 2011. *Final Expanded Supplemental Remedial Investigations Site 86 – Operable Unit No. 20 Marine Corps Base Camp Lejeune Jacksonville North Carolina*. February. Section 7.2.4. Appendix I Table 1.
9	cancer risk	Section 2.6.1	CH2M HILL. 2011. *Final Expanded Supplemental Remedial Investigations Site 86 – Operable Unit No. 20 Marine Corps Base Camp Lejeune Jacksonville North Carolina*. February. Section 7.
10	hazard index	Section 2.6.1	CH2M HILL. 2011. *Final Expanded Supplemental Remedial Investigations Site 86 – Operable Unit No. 20 Marine Corps Base Camp Lejeune Jacksonville North Carolina*. February. Section 7.

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
11	**North Carolina's groundwater classification**	Section 2.6.3	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.
12	**ARARs**	Section 2.8	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Section 3.1.
13	**screening of technologies**	Section 2.9.1	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Section 4.
14	**nine USEPA criteria**	Section 2.9.2	CH2M HILL. 2013. *Final Feasibility Study Site 86, Operable Unit 20, Marine Corps Installations East – Marine Corps Base Camp Lejeune, North Carolina.* October Section 5.1.