

INTRODUCTION

Marine Corps Base (MCB) Camp Lejeune was commissioned in 1941 with a mission that still holds true to this day: to maintain combat-ready warfighters for expeditionary deployment. Camp Lejeune is a training base that promotes combat readiness of the operating forces and missions of other tenant commands by providing training venues, facilities, services, and support in order to be responsive to the needs of Marines, sailors, and their families.



Environmental, Geographical, and Regional Setting

Camp Lejeune covers more than 156,000 acres in the Atlantic coastal plain of southeastern North Carolina in Onslow County, adjacent to the City of Jacksonville. The Base consists of a diverse environmental setting including approximately 72,000 acres of upland forests, 49,000 acres of wetlands, 26,000 acres of water, and 7,500 acres of urban/developed land with elevations ranging from sea level to 70 feet above mean sea level. The Base boundary includes approximately 14 miles of beach along the Atlantic Ocean. Beach frontage consists of a barrier island system and is separated from the mainland by salt marshes, small bays, and the Atlantic Intracoastal Waterway. Several large, publicly owned tracts of land, including Croatan National Forest, Hoffman Forest, and Hammocks Beach State Park, are located within 15 miles of the Base. The remaining surrounding land uses are a mix of urban, suburban, small town, and agricultural, as Onslow County has grown and developed with Camp Lejeune. Estuaries along the coast support commercial fishing, recreation, and tourism, and residential resort areas along the coast are important to the regional economy.

Community Setting

Camp Lejeune and the surrounding community are home to a large concentration of Marines and Sailors, with an active duty, dependent, retiree, and civilian employee population of approximately 148,000 people. Camp Lejeune enjoys a close relationship with the Base community and neighboring civilian communities. Neighboring communities, cities, and towns include the City of Jacksonville, Verona, Holly Ridge, North Topsail Beach, Surf City, Piney Green, Sneads Ferry, and Swansboro.

BACKGROUND

Historical operations, storage, and disposal practices at Camp Lejeune resulted in environmental impacts to soil and groundwater. As a result, Camp Lejeune has been actively engaged in environmental investigations and remediation programs since 1981. In 1989, the United States Environmental Protection Agency (EPA) placed Camp Lejeune on the National Priorities List (NPL). Camp Lejeune is a leading Department of Defense (DoD) installation, operating at the forefront of environmental restoration programs. By maintaining collaborative relationships with regulatory agencies and the supportive local community, the team has made tremendous progress in investigating and cleaning up over 500 sites to-date under several environmental programs, including: Comprehensive Environmental Response,



Compensation, and Liability Act (CERCLA) that covers the Installation Restoration Program (IRP) and Military Munitions Response Program (MMRP); Resource, Conservation, and Recovery Act (RCRA); and the Underground Storage Tank (UST) program, with a goal to ensure continued protection of those living and working aboard Camp Lejeune.

Organization, Staffing, and Management Approach

Base Environmental Management Division (EMD) leads the environmental compliance and restoration programs to manage over 75 active sites. The Base is supported by technical, acquisition, and legal professionals across the Naval Facilities Engineering Systems Command (NAVFAC) organization. Experienced Partnering Teams for the CERCLA (formed in the 1990s) and for the UST programs consist of representatives of Camp Lejeune, NAVFAC, North Carolina Department of Environmental Quality (NCDEQ), and/or EPA. The teams meet quarterly and are supported by multiple environmental consulting firms supporting the environmental investigations and cleanup process. By bringing these key parties together in regular, structured meetings to discuss and resolve issues, the Partnering Team promotes trust and cooperation that enables the remediation process to move forward more quickly than possible under traditional procedures. During this achievement period, the team wished farewell to a long-standing Navy member.

During this achievement period, the team installed over 20 monitoring wells, collected over 900 environmental samples (soil, groundwater, surface water, sediment, pore water, sewer vapor, soil gas, indoor air, outdoor air), conducted munitions surface clearance over 300 acres, and identified and removed over 300 munitions items, managed over 4,200 acres of land use controls, and maintained and monitored four vapor intrusion mitigation systems. Pilot studies and treatment remedies were conducted to expedite site cleanup. This resulted in treating over 180 million gallons of water through the groundwater extraction and treatment system at Site 82, treating over 3.7 million gallons of water in Site 82 subgrade biogeochemical reactors and 59,000 gallons of water in the Site 93 subgrade biogeochemical reactors, operating the air sparge systems at Sites 35, 82, and 89 for approximately 3,000 hours each, injecting over 1.4 million gallons of 2% sodium permanganate and recirculating almost 10 million gallons at Site 88 from January 2022 through June 2022 alone. The teams key successes during Fiscal Years 2022 and 2023 were:

- Winning the EPA National Notable Achievement Award for Federal Facilities Excellence in Partnering Team of the Year.
- Planning for per- and polyfluoroalkyl substances (PFAS) Remedial Investigations, completing work plan documents for 11 priority sites.

The team also made significant progress under the UST program including:

- Receiving no further action for eight petroleum remediation sites (1232, AS-820, FC-39, LCH-4015, 645, SCR-145, AST 1657-01G, AS-118 2019 Surface Release).
- Assessing seven emergent release sites (2603, 977, TLZ Parrot, 353-01AG, Curtis Road, 511, G-920).
- Excavating and disposing of approximately 93 tons of petroleum impacted soil (from 2603, TLZ Parrot, 353, Curtis Rd, and 511).
- Completing assessments of 26 historical UST removal sites to ensure no soil or groundwater impacts remain.



Navy Team Member Appreciation

- Achieving no further action status with land use restrictions at two sites with active remediation systems, which resulted in cost-saving shut down of the systems (645 and LCH-4015).
- Working to improve land use restriction management by inspecting sites and documenting annually.

The UST program also supported operation of six remediation systems and continued addressing PFAS including effluent treatment at sites AS-4141 and the Rapid Refueler, as well as groundwater sampling of remediation system effluent for PFAS, where applicable. Site highlights at Petroleum, Oil, and Lubricant Remediation Sites include:

- Rapid Refueler – Installed three additional wells in February 2023 from which 324.84 gallons of free product have been recovered, and treated approximately 102,895 gallons of PFAS-impacted water to remove PFAS to below permitted levels.
- Building 820 – Secured funding for the removal of the USTs, which is planned for completion during Fiscal Year 24.
- Gottschalk Marina and Building 820 – Employed supplemental remediation technologies by conducting permitted bio-injections, where bio-additive materials were injected into the groundwater at each site to enhance the remediation of contaminated groundwater. A total of approximately 150 gallons of bio-additive material was injected across nine wells between the two sites. The bio-injections were successfully completed in accordance with the approved NCDEQ permits for each site.

Community and Stakeholder Involvement

The Base provides information regarding investigation and cleanup efforts to the public through the community relations program which includes a Community Involvement Plan (CIP), Restoration Advisory Board (RAB) (<http://www.lejeune.marines.mil/OfficesStaff/EnvironmentalMgmt/RestorationAdvisoryBoard>), public meetings, Administrative Record (<https://go.usa.gov/xSdBH>), Information Repository file at the Onslow County Library, and public announcements. The first CIP was prepared for Camp Lejeune in 1990, following the Base’s inclusion on the NPL, and is updated every five years. The RAB was established in 1995 and meetings are held quarterly, are open to the public, and provide an information exchange among community members and the Partnering Team.

To maintain communication with stakeholders, the Base published success stories on digital media addressing timely topics such as land use control management, promoting RAB membership, surface clearance at UXO-28 and UXO-29, and the UXO-30 Proposed Plan and public meeting.

Environmental Restoration Agreements and Plans

This timeline shows the key environmental restoration agreements, dates of their preparation, and last revision.

1984	1989	1990	1991	1992	1999	2020	2020	2020	2023
★	★	★	★	★	★	★	★	★	★
RCRA Permit Issued	NPL	First CIP	Federal Facility Agreement	First SMP	First Five-Year Review	Latest Five-Year Review	Latest CIP	Latest RCRA Permit Update Submitted	Latest SMP

SMP = Site Management Plan



Relevant Environmental Restoration Documents

The Camp Lejeune team has been developing the investigation and remediation strategies for the IRP, MMRP, RCRA, and UST Program, working to develop solutions that support the mission of the Marine Corps, while meeting Navy metrics and regulatory requirements. During Fiscal Years 2022 and 2023, over 60 work plans and reports were approved by the regulatory agencies and finalized and included the key tabulated documents.

Environmental Restoration Work Plans and Reports – Fiscal Years 2022–2023

Program Management Documents and Schedules	4
Proposed Plans, Decision Document, Records of Decision (RODs), and post-ROD Documents	11
LTM Work Plans and Reports	21
Installation Restoration Program Investigations and Reports	5
Munitions Response Program Investigations and Reports	3
Pilot Studies	4
Emerging Contaminants	9
Vapor Intrusion	3
TOTAL	60

SUMMARY OF ACCOMPLISHMENTS

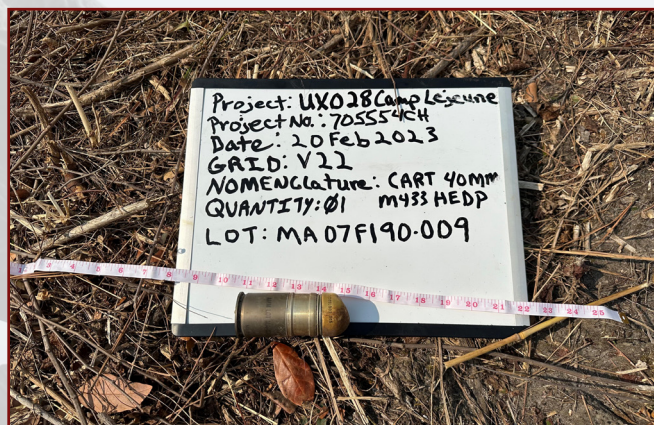
Accelerated Environmental Cleanup: Site UXO-28 Munitions Surface Clearance

Camp Lejeune conducted a munitions ground surface clearance within approximately 129 acres near Parachute Tower Road and Endurance Drive on the Mainside of the Base to reduce or prevent the potential for direct physical contact with unexploded ordnance (UXO), which could present an explosive hazards risk to human health and the environment. The surface clearance was completed within an area known as Site UXO-28, that includes Base housing, a portion of a commissary, a fitness center, and an armory. Base construction is planned for portions of the area. Site UXO-28 comprises the following areas: portions of the former D-9 Skeet Range; portions of the Greater Wallace Creek Area; and former Tactical Landing Zone Sparrow. The area was also likely used as a maneuver training area from the 1940s to 2010.

UXO-qualified technicians cleared the surface area using hand-held magnetometers. Vegetation was removed prior to the clearance to allow for field team and equipment access. Ground depressions that appeared to be potential former fighting positions or foxholes were also investigated for the presence of munitions. Fifty-one munitions items were identified and removed during the clearance consisting of the following: M433, 40 millimeter (mm), high-explosive, dual-purpose grenade; M127 and Mk13 flares; M18 smoke hand grenades; 105mm projectile cartridges; and expended small arms ammunition. This accelerated surface clearance allowed for property reuse and Base development within approximately 70 percent of the approximately 176 undeveloped acres within the site.



Unexploded ordnance team conducting surface clearance



Munition of explosive concern item located during surface clearance activities



Innovative Technology Demonstration/ Validation and Implementation: Site 89

A supplemental investigation was completed using a membrane interface probe and hydraulic profiling tool (MIHPT) (with confirmation soil and groundwater sampling) to delineate a previously unknown source area in support of an Engineering Evaluation and Cost Analysis (EE/CA). The use of a MIHPT allowed a large area of the site to be investigated (130,000 square feet) comparatively quickly, while also reducing the generation of hazardous investigation derived waste (IDW) and associated cost when compared to traditional delineation via exclusively soil sampling. In total, 50 locations were analyzed using a MIHPT; 19 soil screening borings were completed using direct push technology (DPT); 77 soil samples were collected for analysis of chlorinated volatile organic compounds (CVOCs), total organic carbon, total oxidant demand, and/or geophysical parameters; and 24 groundwater samples were collected in the surficial and Castle Hayne aquifers and analyzed for groundwater contaminants of concern (COCs), nitrate, nitrite, and ferrous iron.

Based on the results of this investigation, source areas totaling approximately 2,450 cubic yards (based on total CVOC concentrations greater than 100,000 $\mu\text{g}/\text{kg}$) were identified in the surficial aquifer. In the Castle Hayne aquifer, a CVOC plume of 700 square feet is present from 63 to 69 feet bgs, and a 6,000-square-foot CVOC plume is present from 103 to 115 feet bgs. These refined impacted areas led to development of an EE/CA to evaluate remedies for treatment of both areas. Well delineated treatment areas reduce cost and time during remedy implementation.

Partnerships Addressing Environmental Restoration Issues Between DoD and Other Entities: Basewide PFAS Remedial Investigations

The Camp Lejeune Installation Restoration Partnering Team worked together to efficiently and cost effectively develop 11 Uniform Federal Policy-Sampling and Analysis Plans (UFP-SAPs) for 11 Remedial Investigations (RI) to delineate the nature and extent of PFAS and to evaluate potential human and health and ecological risks. The Camp Lejeune Partnering Team consists of members representing the US EPA Region 4, the NCDEQ, NAVFAC, and Camp Lejeune. As UFP-SAPs were scoped and drafted starting in early 2022, lessons learned were applied to subsequent documents, resulting in faster reviews with progressively fewer comments at every stage. This increasingly efficient process unfolded under a dynamic setting of changing scientific, regulatory, and Navy information. The changes were captured as they were identified and systematically incorporated into documents earlier in the review process.



Confirmation soil borings were analyzed for VOCs, lithology, and soil geophysical/geochemical parameters.



A MIHPT is advanced via a DPT generating little to no waste.



Real time MIHPT results allow for dynamic field events where locations can be selected and plumes delineated in minimal mobilizations without waiting on lab results.

As of late 2023, 7 UFP-SAPs have been finalized with one in regulatory review, three in internal Navy review, and one still under preparation.

Additionally, the first site with an approved RI UFP-SAP is located adjacent to the base boundary, and the local municipal water and sewer authority operates a water supply well approximately 4,600 feet from the site, which is located side-gradient relative to the natural groundwater flow direction. As part of the RI for this site, the Navy and Base collaborated with the water and sewer authority to conduct aquifer testing, with the water and sewer authority operating their supply well and providing the operating parameter data to the Navy and Base, such that water level changes associated with pumping that were observed on the site could be used to develop a groundwater flow model. This collaborative partnership reduced the RI costs by an amount equivalent to the installation of water supply well.

Reducing Risk to Human Health and the Environment: Long-term Monitoring Program

The Long-Term Monitoring (LTM) Program includes routine groundwater, surface water, and/or sediment sampling on an annual, semi-annual, or every five year schedule at 19 sites with remedies in place. Sampling strategy (i.e., sampling locations and frequency) is reviewed and optimized annually based on historical results, trends, and agreement from EPA and NCDEQ or every five years in support of the Five Year Review. At nine sites (Sites 2, 3, 36, 49, 69, 86, 99, 100, and 101), site-wide monitoring has been reduced to once every five years in support of the Five Year Review after evaluation of historical data and trends proved that protectiveness of human health and the environment is maintained. For example, at Site 86, only downgradient monitoring wells closest to the New River are sampled on an annual basis to evaluate the migration of the leading edge of the plume, while site-wide sampling is conducted every five years. This approach optimizes LTM sampling and reduces lifecycle costs, while maintaining protection of human health and the environment.



Final PFAS UFP-SAPs completed by the partnering team



LTM optimized to once every five years at Site 49, adjacent to the New River, while maintaining protectiveness of human health and the environment



Site 2: LTM performed once every five years



Groundwater treatment plant at Site 78, temporarily shut down during military construction to protect human health and the environment from an uncontrolled release of contaminated groundwater



Mann-Kendall statistical analysis is used to evaluate COC concentrations over time at each sampling location to determine if trends are increasing, decreasing, or stable and whether an overall plume is expanding or contracting. This analysis strengthens justification for optimized LTM approaches by providing an objective and quantitative demonstration of plume behavior and provides an additional line of evidence of protection of human health and the environment.

In addition to routine sampling, the LTM program evaluates the effectiveness of the selected remedies and compliance with Records of Decision and/or Statements of Basis as part of the overall site strategy. Following review of annual LTM data, and with consensus of the Partnering Team, the operation of a network of groundwater extraction wells at Site 78 was suspended while military construction (MILCON) was ongoing. Reasonable concern was presented that an accidental strike to a conveyance line could result in the uncontrolled discharge of contaminated groundwater, potentially impacting human health and the environment. While the extraction wells were shut down, a rebound study was conducted as part of the LTM program to evaluate potential changes in the groundwater plume. The plume has remained stable following system shutdown. These findings will inform the next phase of work at Site 78. In this way, the LTM program facilitates continual reviews of the protectiveness of human health and the environment.

Green Remediation

Cleaning up sites improves environmental conditions, but cleanup activities also use energy, water, and natural resources; cost money; and affect the community. MCB Camp Lejeune sets a standard of excellence in implementing best management practices into each phase of cleanup activities. During this achievement period the following best practices were implemented:

- Eliminated over 2,000 gallons of aqueous IDW through passive sampling.
- Treated over 100,000 gallons of groundwater using exclusively solar power (estimated savings of 84 kW/hr).
- Recycled 6,797 pounds of metallic debris.

As part of the remedy selection process for the Site 89 Engineering Evaluation and Cost Estimate, a footprint analysis was prepared for each alternative using SiteWise Version 3.1. The results of this assessment were included in the detailed analysis of alternatives. Additionally, recognizing that a remedy is unable to be green and sustainable if it is not also resilient, a qualitative resilience evaluation was also completed for each alternative. Both the sustainability and resilience considerations will be used to support the final remedy selection along with implementability, effectiveness, cost, and uncertainties.

Site 89 Engineering Evaluation and Cost Estimate Analysis

Criteria	Alternative SA1 – In Situ Thermal Treatment	Alternative SA2 – Excavation	Alternative SA3 – Soil Mixing	Alternative SA4 – Targeted Excavation and Hydraulic Fracturing	Alternative SA5 – Bioelectrochemical Remediation
Resilience	Would be resilient to extreme weather because it would be a short-term in situ system with limited aboveground components.	Extreme weather events could increase dewatering requirements or result in contaminant release.	Extreme weather events could increase dewatering requirements or result in contaminant release.	Extreme weather events could increase dewatering requirements or result in contaminant release.	Would be resilient to extreme weather because it would be an in situ system with limited aboveground components.

