

Engineering Evaluation and Cost Analysis
Non-Time Critical Removal Action
Phase II Water Line Construction
PFC/PFAS Sampling and Mitigation
Joint Base McGuire-Dix-Lakehurst, NJ

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Prepared for:



US Army Corps of Engineers
Omaha District
1616 Capital Avenue
Omaha, NE 68102

Prepared by:



BERS-Weston Services JVA, LLC
720 Corporate Circle Suite D
Golden, CO 80401

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
ACRONYMS AND ABBREVIATIONS	iii
EXECUTIVE SUMMARY.....	1
1.0 INTRODUCTION.....	1
1.1 Purpose and Objective.....	1
1.2 Report Organization	1
2.0 SITE CHARACTERIZATION.....	2
2.1 Site Description and Background.....	2
2.2 Source, Nature, and Extent of Contamination.....	4
2.3 Analytical Data.....	5
2.4 Streamlined Risk Evaluation	5
3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS.....	7
3.1 Statutory Framework.....	7
3.2 Scope of the Removal Action	7
3.2.1 Removal Action Objective.....	7
3.3 Applicable or Relevant and Appropriate Requirements.....	8
3.4 Removal Action Criteria.....	10
3.5 Removal Schedule.....	10
3.6 Planned Remedial Activities.....	10
4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES.....	10
4.1 Removal Action Alternatives.....	11
4.1.1 Alternative 1 – No Action	11
4.1.2 Alternative 2 – Install and Maintain POET Systems	12
4.1.3 Alternative 3 – Construct Phase II Water Line.....	13
5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES.....	15
5.1 Effectiveness.....	15
5.2 Implementability	15

5.3 Costs.....16

6.0 COMMUNITY PARTICIPATION16

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE16

8.0 REFERENCES.....18

TABLES

- 5-1 Cost Summary of Alternative 2
- 5-2 Cost Summary of Alternative 3

FIGURES

- Figure 1 Site Location
- Figure 2 EE/CA Drinking Water Coverage Area for Drinking Water Wells Above the PFOS/PFOA HA Levels

ACRONYMS AND ABBREVIATIONS

µg/kg	microgram per kilogram
µg/L	microgram per liter
ARAR	Applicable, or Relevant and Appropriate requirements
BERS-Weston	BERS-Weston Services JVA, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DERP	Defense Environmental Restoration Program
DoDI	Department of Defense Instruction
EE/CA	engineering evaluation / cost analysis
EESOH-MIS	Enterprise Environmental Safety and Occupational Health Management Information System
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FTA	fire training area
GAC	granular activated carbon
HA	health advisory
JBMDL	Joint Base McGuire-Dix-Lakehurst
MCL	Maximum Contaminant Level
MUA	Municipal Water Authority
NATTC	Naval Air Technical Training Center
NCP	National Contingency Plan
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NTCRA	non-time critical removal action
O&M	operation and maintenance
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
POET	point-of-entry treatment
PRG	Preliminary Remediation Goal

ACRONYMS AND ABBREVIATIONS (continued)

RAO	removal action objective
ROE	right-of-entry
SDWA	Safe Drinking Water Act
SI	site inspection
TBC	to be considered
U.S.C.	United States Code
USAF	United States Air Force
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

The United States Air Force (USAF) will conduct a non-time critical removal action (NTCRA) to address per- and polyfluoroalkyl substances (PFAS) contamination, including perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), in the drinking water at the area surrounding Joint Base McGuire-Dix-Lakehurst (JBMDL), New Jersey (NJ). Specifically, this NTCRA will reduce PFOS and PFOA concentrations below the U.S. Environmental Protection Agency (EPA) Lifetime health advisory (HA) in shallow drinking water wells at impacted private properties in the off-base areas surrounding JBMDL in the Lakehurst portion of the base. In six (6) privately-owned wells located at five (5) properties, concentrations of PFOS and PFOA are greater than the EPA Lifetime HA levels. These exceedances prevent the receptors from using their wells for potable water and triggered the need for this NTCRA.

This engineering evaluation and cost analysis (EE/CA) identifies the removal action objective (RAO), identifies and evaluates potential alternatives for completing the NTCRA, and recommends which alternative or combination of alternatives should be implemented to achieve the RAO. These alternatives are:

- Alternative 1 – No action. With this alternative, no action would be taken to address PFOS/PFOA-impacted properties with drinking water above the EPA Lifetime HA.
- Alternative 2 – Install and maintain point-of-entry treatment (POET) systems. POETs would be installed, monitored, and maintained at PFOS/PFOA-impacted properties with drinking water above the EPA Lifetime HA.
- Alternative 3 – Connect PFOS/PFOA-impacted properties to municipal water. This alternative would connect PFOS/PFOA-impacted properties to municipal public water systems that obtain drinking water from deep confined aquifers that are not impacted by PFOS/PFOA above the EPA Lifetime HA. Connection includes both water main extension and lateral service connection to the existing point of entry.

The three (3) alternatives were evaluated with respect to effectiveness, implementability, and cost. Alternative 1, no action, has the lowest degree of effectiveness. Alternative 2 would require ongoing operation and maintenance (O&M) of the mitigation systems, long-term sampling and monitoring of PFOS/PFOA concentrations, and estimated servicing of granular activated carbon (GAC) change-outs and media disposal. Alternative 3 would eliminate the PFOS/PFOA exposure risk by connecting all impacted properties to a municipal water line. The overall cost of Alternative 3 is less than Alternative 2. Based on its cost, long-term effectiveness, and lack of O&M and PFOS/PFOA monitoring, Alternative 3 is the recommended alternative.

1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVE

The United States Air Force (USAF) will conduct a non-time critical removal action (NTCRA) to address per- and polyfluoroalkyl substances (PFAS) contamination, including perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), in the drinking water in off-base areas surrounding Joint Base McGuire-Dix-Lakehurst (JBMDL), New Jersey (NJ) in the Lakehurst portion of the base. Specifically, this NTCRA will reduce PFOS and PFOA concentrations in shallow drinking water wells to below the EPA Lifetime HA levels.

This NTCRA will be performed in accordance with, and satisfies the requirements of, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Title 42 United States Code (U.S.C.) 9604, as further implemented by the National Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR) Part 300.415 (40 CFR 300.415) (EPA,1993). The USAF Installation Restoration Program is authorized by the Defense Environmental Restoration Program (DERP) (10 U.S.C. 2701 et. Seq.). The DERP is the environmental restoration program the military services use to conduct CERCLA response actions and satisfy CERCLA lead agency functions as delegated by Executive Order 12580 (DAFI 32-7020). This engineering evaluation and cost analysis (EE/CA) has been prepared by BERS-Weston JVA, LLC (BERS-Weston), on behalf of the USAF, under US Army Corps of Engineers, Omaha District, contract W9128F-14-D-0009.

This EE/CA identifies and evaluates proposed alternatives for completing the NTCRA. The EE/CA identifies the removal action objective (RAO); identifies and evaluates potential alternatives for conducting the removal action; and recommends the best-suited alternative. This removal action will provide a permanent solution to protect human health from exposure of PFOS and PFOA above the EPA Lifetime HA levels or 0.07 micrograms per liter ($\mu\text{g/L}$), individually or combined, in drinking water (EPA, 2016a: EPA 2016b).

1.2 REPORT ORGANIZATION

The remainder of this EE/CA is organized in the following sections:

- Section 2.0 provides site characterization information such as site description, site investigation, and a streamlined risk assessment.
- Section 3.0 defines the RAO for the proposed removal action.
- Section 4.0 presents the identification and analysis of removal action alternatives.
- Section 5.0 provides a comparative analysis of removal action alternatives.
- Section 6.0 identifies the recommended removal action alternative.
- Section 7.0 provides references used in preparation of this report.

2.0 SITE CHARACTERIZATION

2.1 SITE DESCRIPTION AND BACKGROUND

JBMDL is a tri-service joint-installation partnership complex comprised of McGuire, Lakehurst, and Dix. The three installations at JBMDL are contiguously located adjacent to each other and cover approximately 42,000 acres across Burlington and Ocean counties in central NJ (**Figure 1**). The impacted PFAS groundwater contamination area addressed under this EE/CA is depicted on **Figure 2**.

The USAF owns and operates JBMDL. JBMDL was formed as a result of the 01 October 2009 merger of the three installations. The majority of the 3,596-acres of the JBMDL-McGuire area is an airfield supporting two active runways. The JBMDL-Dix area is a permanent Class 1 Army installation with an area of approximately 30,697 acres. The JBMDL-Lakehurst area encompasses 7,382 acres and is used for research, maintenance, firefighter training, testing, and disposal activities by the U.S. Navy. This combined installation complex is surrounded by 58,000 acres of state and federally managed land to protect against encroachment.

Construction of Fort Dix began in June 1917, under the name Camp Dix, and the camp was a training and staging ground for units during World War I. The camp became a demobilization center after the war. Between the two world wars, Camp Dix was a reception, training, and discharge center for the Civilian Conservation Corps. Camp Dix became Fort Dix on March 8, 1939, and the installation became a permanent Army post. Lakehurst Maxfield Field began as a munitions testing site for the Imperial Russian Army in 1916. The U.S. Army acquired it as Camp Kendrick during World War I. The U.S. Navy then purchased the property in 1921 for use as an airship station and renamed it Naval Air Station Lakehurst. McGuire AFB was established as Fort Dix Airport in 1937 and first opened to military aircraft on January 9, 1941. On January 13, 1948, the AF renamed the facility McGuire AFB in honor of Thomas McGuire, Medal of Honor recipient.

In 1970, the AF began using AFFF, firefighting agents containing PFOS and PFOA, to extinguish petroleum fires. It is likely that the U.S. Army and Navy began using AFFF at the same time. Releases to the environment routinely occur during fire training, equipment maintenance, storage, and use. Legacy AFFF contains long-chain fluorosurfactants, having eight or more fluorinated chained-carbon atoms (referred to as C8), while the new AFFF formula contains shorter chain molecules with six or less fluorinated chained-carbon atoms (referred to as C6). JBMDL has removed all C8 AFFF in its hangar systems, fire response vehicles, and stockpiled inventory, and replaced it with C6 AFFF as of 2019.

Lakehurst was listed on the National Priorities List (NPL) in 1984. All Lakehurst area sites are NPL and managed under a Federal Facilities Agreement (FFA) in accordance with CERCLA (Naval Air Engineering Center, 1989). Specifically, Site 16 (Area C) – Naval Air Technical Training Center (NATTC) Fire School is listed in the FFA; Site 16 was changed to AT016 (NATTC Firefighting Training Area) when JBMDL was formed. AT016 is the source of the off-base PFOS/PFOA contamination, thus the reason for the NTCRA and this EE/CA. In 2014, a Preliminary Assessment (PA) was conducted at JBMDL in accordance with CERCLA and NCP §300.420 with the goal of identifying locations of potential releases of PFAS-containing AFFF to the environment. The results of the PA indicated known or potential releases of AFFF to Fire Training Areas (FTAs), crash sites, non-FTAs (hangars), fire stations, and other spills and releases, such as wastewater treatment plant (WWTP) releases.

In 2016, a Site Inspection (SI) of 34 potential PFAS release sites, consolidated into 21 AFFF areas, was conducted to determine the presence or absence of PFOA and PFOS in soil, groundwater, surface water, and sediment in the areas. Groundwater monitoring for PFAS at JBMDL was limited to the shallow Kirkwood-Cohansey aquifer. The Final SI Report (Aerostar, 2019) concluded that releases were confirmed at each of the 21 AFFF areas investigated. The screening levels identified in the SI for PFOS, PFOA, PFNA, and PFBS were the EPA Lifetime HA levels, New Jersey Department of Environmental Protection (NJDEP) drinking water guidelines, and NJDEP groundwater criteria. The combined concentrations of PFOA and PFOS were detected in groundwater at concentrations greater than EPA Lifetime HA levels at all of the 21 AFFF areas. Potential receptor pathways with immediate impacts to human health were identified. The findings of a 2014 screening level USAF Enterprise-wide investigation of AFFF releases at four sites at McGuire were also included in the 2019 SI Report.

In 2016, through a Rapid Response contract, a PFAS Groundwater Sampling and Mitigation Program was developed based on the results of the SI to: confirm potential off-base migration of PFOS/PFOA in groundwater at concentrations exceeding the EPA Lifetime HA at the base boundary; identify initial off-base areas with drinking water receptors with privately owned potable wells based on known groundwater flow; conduct door-to-door reconnaissance of the off-base areas for potentially impacted drinking water receptors; offer PFOS/PFOA sampling to properties with a drinking water well, if present; and, provide mitigation if results exceed the EPA Lifetime HA. PFOS/PFOA sampling results identified five off-base areas; one area in McGuire (AFFF Area 4), one area in Dix (AFFF Area 14), and three areas in Lakehurst (AFFF Areas 16, 17, and 18). As of January 2021, drinking water from 194 properties had been sampled. Where PFOS/PFOA were detected, a routine monitoring was initiated at individual properties, where allowed. In addition, where PFOS/PFOA were detected above the EPA Lifetime HA, the USAF provided mitigation that included bottled water as an immediate

short-term solution and the installation of filtration systems (e.g., GAC or reverse osmosis) including O&M and performance monitoring of the systems as a long-term solution.

2.2 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

A PA was conducted at JBMDL in accordance with CERCLA with the goal of identifying locations of potential releases of PFAS-containing AFFF to the environment. The results of the PA indicated known or potential release of AFFF to FTAs, crash sites, non-FTAs (hangars), fire stations, and other spills and releases, such as WWTP releases. Areas identified in the PA were investigated during the SI in 2016 at the 34 release sites (consolidated at 21 potential PFAS release areas) to determine the presence or absence of PFOA and PFOS in the soil, groundwater, surface water, and sediment in the areas.

Groundwater monitoring for PFAS conducted during SIs at JBMDL was limited to the shallow Kirkwood-Cohansey aquifer. In most cases, PFOS was detected in higher concentrations than other PFAS analytes. Maximum PFOS concentrations detected were: 260 µg/L in groundwater (Area 5 McGuire Active Fire Training Area); 9,300 micrograms per kilogram (µg/kg) in soil (Area 18 Lakehurst former FTA AT-016); 750 J µg/kg in sediment (Area 18 Lakehurst former FTA AT-016); and 8.2 J µg/L in surface water (Area 6 McGuire former FTA FT-013).

Results of the Final SI Report (Aerostar, 2019), indicated that a combined PFOA and PFOS concentration was detected in groundwater above EPA Lifetime HA levels at all 21 AFFF areas. Three of the four most impacted PFOS sites were located at McGuire, with maximum concentrations in groundwater ranging from 102 µg/L to 264 µg/L (SI Areas 2, 5, and 6).

Since the initiation of the 2016 PFAS Groundwater Sampling and Mitigation Program: offsite migration of the PFOS/PFOA has been confirmed in the five off-base areas surrounding JBMDL (i.e., AFFF Areas 4, 14, 16, 17, and 18); private drinking water receptors have been identified in each of the off-base areas; routine monitoring continues at a quarterly, semi-annual, or annual frequency for off-base properties that had PFOS/PFOA detected in their potable drinking water well but at concentrations below the EPA Lifetime HA; and, immediate and short-term mitigation solutions have been implemented and continue to be monitored and maintained at PFOS/PFOA-impacted properties with PFOS/PFOA concentrations detected above the EPA Lifetime HA in their potable drinking water wells.

Six off-base properties in the Lakehurst area have confirmed PFOS/PFOA concentrations in drinking water wells at concentrations exceeding the EPA Lifetime HA. One of the six properties was connected to municipal drinking water in December 2019, leaving five properties requiring a final mitigation solution.

The source of the PFOS/PFOA contamination to the off-base properties included in this EE/CA is a direct result of AFFF Area 18 historical release(s) in the JBMDL-Lakehurst area. AFFF Area 18 was a former Naval Air Technical Training Center Firefighting Training Area that utilized AFFF routinely (daily to monthly) from 1970 to 1986 in the source area, impacting the shallow surficial aquifer. Although the nature and extent has not been fully delineated, base boundary sampling confirms shallow aquifer groundwater impacts of PFOS/PFOA exceeding the EPA Lifetime HA. The impacted off-base properties included in this EE/CA are in close proximity to the base boundary with drinking water wells screened within the shallow surficial aquifer. A Base Wide Remedial Investigation to determine nature and extent of on-base and off-base PFAS impacts was awarded in September 2020 and includes the off-base areas identified in this EE/CA. AFFF Area 18 was validated in the Enterprise Environmental Safety and Occupational Health Management Information System (EESOH-MIS) as AT016P-Sub.

2.3 ANALYTICAL DATA

As described above, several investigations have been completed at JBMDL. The results of both SIs concluded that releases were confirmed at each of the 21 AFFF areas investigated. The screening levels identified in the SI for PFOS, PFOA, PFNA, and PFBS were the EPA Lifetime HA levels, NJDEP drinking water guidelines, and NJDEP groundwater criteria.

The 2016 PFAS Groundwater Sampling and Mitigation Program identified off-base investigation areas where potential drinking water receptors were present and confirmed the properties with private drinking water wells. Off-base properties with receptors impacted with PFOS/PFOA concentrations exceeding EPA Lifetime HA in drinking water have been confirmed in the JBMDL-Lakehurst area at six properties; one of the properties was connected to municipal water in December 2019.

2.4 STREAMLINED RISK EVALUATION

The EPA established lifetime HA values in 2016 that the USAF is using as benchmarks to determine if response actions are needed. The EPA lifetime HA is in place since research has identified that there is potential risk to human health as a result of exposure to PFAS. EPA Lifetime HA levels are developed to provide information in response to an urgent or rapidly developing situation. The EPA Lifetime HA levels reflect reasonable, health-based hazard concentrations above which action is recommended for drinking water.

Although the EPA Office of Water has identified PFOS and PFOA as contaminants of emerging concern, there are currently no federal Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) addressing these emerging contaminants. In May 2016, the EPA published the current Lifetime HA levels of 0.07 µg/L for PFOS and PFOA, individually or combined, that the USAF considers in the determination of where

response actions are needed to provide an alternative water supply for impacted drinking water sources.

In June 2020, the NJDEP issued MCLs for PFOS and PFOA in drinking water pursuant to the NJDEP Safe Drinking Water Act (N.J.A.C. 7:10). The Office of Secretary of Defense has reviewed these standards and has determined that they are potentially Applicable, or Relevant and Appropriate requirements (ARARs) under CERCLA. An ARAR analysis is conducted during the Feasibility Study phase under CERCLA after unacceptable risk is determined in a baseline risk assessment. No remedial investigation or baseline risk assessment has been completed in the off-base areas addressed in this EE/CA, thus unacceptable risk has not been determined and an ARAR analysis has not been completed to consider the NJDEP MCLs for PFOS or PFOA.

The EPA Lifetime HA levels are drinking water health advisories. Although unenforceable, the USAF, under CERCLA authority, utilizes the Lifetime HA to respond to drinking water receptors exposed to PFOS/PFOA-impacted drinking water, as a result of a USAF release, and provides mitigation to assure no one is drinking PFOS/PFOA above the EPA Lifetime HA. This removal action reflects EPA OLEM Directive No. 9283.1-47 (EPA, 2019) on PFOS and PFOA groundwater cleanup which includes the following interim recommendations:

- “Using the PFOA and PFOS Lifetime Drinking Water Health Advisories (HAs) of 70 ppt (combined or individually) as the recommended Preliminary Remediation Goal (PRG) for groundwater that is a current or potential source of drinking water, where no state or tribal MCL or other applicable or relevant and appropriate requirements (ARARs) are available or sufficiently protective.”
- “In situations where groundwater is currently being used for drinking water, EPA expects that responsible parties will address levels of PFOA and/or PFOS over 70 ppt.”

As noted above, the USAF identified PFOS/PFOA above the EPA Lifetime HA in drinking water wells at off-base properties in the JBMDL-Lakehurst area, downgradient of the AFFF Area 18 (EESOH-MIS site AT016P-Sub), attributed to historical releases of AFFF at the former fire training area. For the individual human health receptors who use these wells as a potable water supply, their exposure to PFOS and PFOA through the use of the well may pose an unacceptable health risk.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.1 STATUTORY FRAMEWORK

This removal action will be performed pursuant to CERCLA and the NCP under the authority delegated by the Office of the President of the United States through Executive Order (EO) 12580 as re-delegated. This order, as implemented through U.S. Department of Defense Instruction (DoDI) 4715.07 and U.S. Department of Defense Manual 4715.20 as amended, provides USAF with authorization to conduct removal actions. DERP provides funding to USAF for removal actions conducted under CERCLA. This removal action is non-time critical because the planning period from the time a removal action was determined to be necessary to the time when the removal action will be initiated is greater than six (6) months. Because this is not an EPA Superfund-lead site, the \$2 million and 12-month statutory limits for Superfund-financed removal actions pursuant to Section 104(c)(1) of CERCLA do not apply.

This EE/CA provides an analysis of three removal alternatives for the site and recommends a removal action alternative. This EE/CA complies with the requirements of CERCLA, the Superfund Amendments and Reauthorization Act, NCP, the Defense Environmental Restoration Program, and EO 12580. This EE/CA is undertaken pursuant to Title 40 of the CFR, Part 300.415(b)(4)(i). The requirements for this EE/CA and its mandated public comment period provide an opportunity for public input with regard to the cleanup process [40 CFR 300.415(n)] (EPA,1994).

3.2 SCOPE OF THE REMOVAL ACTION

The scope of this removal action is to supply drinking water to the impacted properties that have private wells that cannot be used for drinking water due to the presence of PFOS and/or PFOA (individually or combined) at concentrations greater than the EPA Lifetime HA levels. This NTCRA includes only properties with potable wells that supply drinking water to private, off-base properties in the JBMDL-Lakehurst area.

3.2.1 Removal Action Objective

The RAO specifies what the proposed removal action is expected to accomplish, defining the goals for the removal action. As such, RAOs are site-specific and are influenced by the nature and extent of chemical contamination, current and potentially threatened resources, and the potential for human and environmental exposure. Based on the scope of the removal action, which is to prevent human health exposure to PFOS and PFOA in drinking water, the following RAO was developed:

- Eliminate the human health risk posed by PFOS/PFOA-impacted drinking water above the EPA Lifetime HA levels of 0.07 µg/L (individually or combined).

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or Relevant and Appropriate Requirements (ARARs) are Federal and State human health and environmental requirements used to define the appropriate extent of site cleanup, identify sensitive land areas or land uses, develop response alternatives, and direct site cleanup. The NCP requires in support of removal actions fund financed under CERCLA § 104 and removal actions conducted under CERCLA §106 that “to the extent practicable considering the exigencies of the situation” that the removal action attain identified ARARs; NCP §300.415(j).

Potential ARARs and TBC requirements identified for this removal action are presented in Tables 3-1 and 3-2, respectively. Proposed removal action alternatives are evaluated with respect to compliance with ARARs. The identification of ARARs is an iterative process, and the final determination of ARARs will be made in the Action Memorandum, which will be submitted after public review of this EE/CA as part of the selection process for this response action [40 CFR 300.415(n)] (EPA,1994). The Action Memorandum is the primary Decision Document for NTCRAs and provides a concise, written record of the decision to select an appropriate removal action. It substantiates the need for a removal action, identifies the proposed action, and explains the rationale for the removal action.

TABLE 3-1

Identification of Potential ARARs
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Federal or State Statute, Regulation, or Guidance	Requirement	Type of ARAR	Actions to be Taken to Attain Requirement
NJ Administrative Code 7:10-11.10 (Safe Drinking Water Act) for regulatory approval of distributions systems.	Identifies the construction and permit requirements under the State Safe Drinking Water Act.	Applicable	Design drawings will be submitted to the State for approval prior to construction.
Code of Manchester Township, NJ Part II, General Legislation, Chapter 133 Construction Codes	Identifies the construction requirements for Manchester Township, NJ.	Applicable	Design drawings will be submitted to Manchester Township for approval prior to construction. Construction activities involving water main extension and service line installation will comply with required construction codes.

TABLE 3-2

Identification of TBCs
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Federal or State Statute, Regulation, or Guidance	Requirement	To-Be Considered	Actions to be Taken to Attain Requirement
Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA Docket No. 822-R-16-004 (EPA, May 2016) Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), EPA Docket No. 822-R-16-005 (EPA, May 2016)	Provides drinking water system operators information on the health risks of PFOS and PFOA and recommendations about reducing exposure to PFOS and PFOA in drinking water. Establishes EPA lifetime HA action level for PFOS and PFOA concentrations, individually or in combination, of 0.07 µg/L.	Health advisories are not "Applicable" or "Relevant and Appropriate". These are TBC because they provide response criteria that are useable in the absence of ARARs.	The EPA lifetime HA will be the concentration that the removal action is designed to achieve.

3.4 REMOVAL ACTION CRITERIA

The removal action criteria are the contaminant concentrations that the RAO must achieve. The current EPA Lifetime HA level of 0.07 µg/L for PFOS and PFOA concentrations (individually or combined) is the identified removal action criteria. The EPA Lifetime HA levels are drinking water health advisories which are unenforceable but the USAF, under CERCLA authority, is utilizing the Lifetime HA to respond to drinking water receptors exposed to PFOS/PFOA-impacted drinking water, as a result of a USAF release, and provides mitigation to assure no one is drinking PFOS/PFOA above the EPA Lifetime HA.

3.5 REMOVAL SCHEDULE

JBMDL intends to initiate the removal action in 2021, once all required regulatory documents, plans, and permits are approved.

3.6 PLANNED REMEDIAL ACTIVITIES

At this time, specific remedial activities for PFOS and PFOA in groundwater are not planned because investigation of the potential source area(s) is ongoing. Until there is a more complete understanding of the nature and extent of PFOS and PFOA contamination, as well as risks to human health and the environment via exposure routes, potential remedial activities have not yet been identified.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section identifies removal action alternatives that could achieve the RAO and evaluates each removal action alternative in terms of effectiveness, implementability, and cost. EPA guidance on NTCRA's (EPA, 1993) provides the following guidance about effectiveness, implementability, and cost:

- **Effectiveness:** An alternative's effectiveness is its ability to meet the objective within the scope of the removal action. This criterion considers protection of public health, the community, workers during implementation, and the environment. The following factors are also considered:
 - Long-term effectiveness and permanence: the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.
 - Reduction of toxicity, mobility, or volume through treatment.
 - Short-term effectiveness, which addresses the effects of the alternative during implementation before the RAO has been met.

- **Implementability:** This criterion evaluates the technical and administrative feasibility of each alternative, and the availability of the services and materials needed to implement the alternative. This criterion also considers state and community acceptance. The acceptance of an alternative will be evaluated during the public comment period and preparation of the Action Memorandum. The final version of this EE/CA will be made available for a 30-day public comment period, and all comments received will be summarized and addressed in the responsiveness summary section of the Action Memorandum [40 CFR 300.415(n)] (EPA,1994).
 - Technical feasibility: the ability of the technology to implement the remedy and the technology’s reliability. Technical feasibility is evaluated from construction through operation and maintenance of the removal action. This factor also evaluates whether an alternative will contribute to the anticipated performance of any remedial activity.
 - Administrative feasibility: this factor evaluates those activities needed to coordinate with other offices and agencies, the need for permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies.
 - Availability of services and materials: this factor considers whether the requisite personnel, equipment, and materials will be available during the removal action schedule; the adequacy of offsite treatment capacity if the alternative includes offsite removal and treatment of waste; and whether the technology has been sufficiently developed for full-scale application.
- **Cost:** The direct and indirect capital, operation, and maintenance costs are estimated for each alternative. Costs are calculated on a present value basis for any removal action lasting longer than 12 months.

4.1 REMOVAL ACTION ALTERNATIVES

Three removal action alternatives were developed:

- Alternative 1: No action.
- Alternative 2: Install and maintain point-of-entry treatment (POET) systems.
- Alternative 3: Connect PFOS/PFOA-impacted properties to municipal water.

4.1.1 Alternative 1 – No Action

With this alternative, no action would be taken to address PFOS/PFOA-impacted properties and receptors would continue to consume drinking water above the EPA Lifetime HA.

Effectiveness: The no-action alternative would not be protective of human health. Because there is a direct pathway from the contaminated groundwater to human exposure via drinking water wells, the no-action alternative would not prevent receptors from being exposed to PFOS and PFOA in drinking water above the EPA Lifetime HA, thus, would not achieve the RAO.

Implementability: In the short-term, the no-action alternative is readily implementable. No labor, equipment, or materials are needed to meet this alternative.

Cost: There is no cost associated with Alternative 1.

4.1.2 Alternative 2 – Install and Maintain POET Systems

Alternative 2 consists of installing, monitoring, and maintaining GAC POET systems at six (6) wells (five impacted properties), including service and associated O&M activities.

GAC has been shown to effectively remove PFOS and PFOA from drinking water when it is used in a flow through filter mode after particulates have already been removed. GAC is made from organic materials with high carbon content such as wood, lignite, and coal. The POET systems will be dual-stage (two (2) treatment vessels in parallel) and use GAC as the treatment media. As water fills the treatment system vessels, the contaminated water flows through the GAC where the PFOS and PFOA is adsorbed. A 5-micron sediment filter is installed prior to entry into the treatment system to remove particulates. Adsorption units will be operated in a lead-lag mode to ensure effective use of media. The lead vessel will be monitored to identify breakthrough. Once the GAC has reached capacity in the lead vessel and cannot adsorb PFOS and PFOA below the EPA Lifetime HA, the GAC media in the lead vessel will be removed, the vessel cleaned, and refilled with new GAC media. The lag vessel will be placed in lead mode, and the freshly cleaned GAC vessel will become the lag vessel. Following removal from the POET system, spent GAC media will be stored in appropriate containers prior to disposal via incineration and in accordance with USAF guidelines.

Quarterly O&M sampling of the influent, between-stage, and effluent sample ports of the POET system will be performed to monitor PFOS and PFOA concentrations and determine when a GAC media service is deemed necessary. Media service will take place when analytical sample results for PFOS and PFOA are observed in the between-stage sample (following the lead vessel in treatment vessel 1) result, indicating that the life of the GAC media in the first treatment vessel is expended.

Effectiveness: This alternative is protective of human health and meets the RAO. The POET treatment systems can effectively remove PFOS and PFOA to concentrations less than the EPA Lifetime HA levels provided that the system is monitored and maintained. Proper monitoring and maintenance requires long-term access to the impacted properties.

The intent of the removal action is to protect human health, not remediate impacted groundwater. Given the small volume of groundwater that would be treated by these systems relative to the probable volume of contaminated groundwater, the active PFOS and PFOA treatment provided by this alternative would have negligible effect on the overall remediation of the PFOS/PFOA plume.

Implementability: In the short-term, this alternative is readily implementable because the POET treatment systems can be installed and maintained with available material, services, and labor. Short-term effects include disruption of water service to the property while installation is taking place and during O&M activities. These effects can be managed through proper coordination with the property owner. In the long-term, however, it may be difficult for the USAF to retain the access needed to properly monitor and maintain the POET treatment systems, particularly if the impacted properties are sold.

There are no permits required for this alternative; however, right-of-entry (ROE) agreements will need to be obtained from property owners to install and maintain the POET systems.

Cost: The estimated cost for Alternative 2 is provided below:

The 30-year cost is estimated to be \$2,503,074 and is based on the following assumptions:

- Six (6) wells at five impacted properties would receive installation of GAC POET systems.
- O&M costs are based on current EPA and USAF guidelines for monitoring PFAS.
- Costs include quarterly O&M sampling and media service of the POET treatment systems at the five (5) affected properties.
- Costs include two (2) disposal events of spent GAC media per year.
- Assumes that ROE agreements from property owners will be obtained by the USAF.

4.1.3 Alternative 3 – Construct Phase II Water Line

Alternative 3 would connect PFOS/PFOA-impacted properties to municipal water as a permanent long-term solution. This alternative consists of extending existing water mains and installing new service lines to affected properties. Water would be provided by the Municipal Water Authority (MUA) of the jurisdiction the impacted property is located within. Manchester Township MUA and the Borough of Lakehurst MUA, Ocean County, NJ, operate, maintain, and distribute water obtained from deep confined aquifers free of PFOS/PFOA surface contamination.

The new water pipeline consists of the construction and installation of a new 12-inch-diameter water main and 2-inch-diameter service connections in Manchester Township and the Borough of Lakehurst. The new 12-inch water main will tie into the existing 12-inch water main along the south side of Ridgeway Boulevard and to the existing 6-inch Borough of Lakehurst water main along Route 70. The water main extension will be installed in the public rights-of-way (township and county, as appropriate) along with curb-stops to the impacted properties. New 2-inch service connections will be routed from the new water main to the existing point-of-entry of the impacted properties. A water meter will be installed at the property for future metering and billing by the municipality. A ROE will be obtained for the construction and installation of the service line on the private properties. Manchester Township and the Borough of Lakehurst would own and operate the associated sections of the distribution system within their jurisdiction. After installation, individual property owners would own their individual service line from the curb-stop to the point of entry connection point. The individual property owner would be responsible for future cost of water to the municipality.

Permits may be required for USAF to construct the new distribution system.

Effectiveness: This alternative would achieve the RAO and be protective of human health since this alternative eliminates exposure pathways by obtaining drinking water from the MUA.

Alternative 3 would provide a permanent, long-term solution. There may be short-term effects to the local community and workers during construction of the water pipeline and service connections because construction activities will take place within roadways and private property. The potential effects could be managed through standard construction practices.

This alternative would not treat or reduce the volume or contaminant concentrations of the PFOS/PFOA plume since groundwater would no longer be removed from the shallow aquifer.

Implementability: This alternative could be implemented with readily available material, services, and labor. This alternative relies on well-established, conventional technologies. This alternative includes capital costs only, as no future O&M mitigation costs to the USAF would be associated with the water pipeline.

The new water pipeline would be constructed along Ridgeway Boulevard and Route 70, Ocean County, NJ. ROE agreements will need to be obtained by the USAF where construction activity and service connections will take place on private property.

Cost: The 30-year cost is estimated to be \$1,209,646 and is based on the assumptions listed below:

- Manchester Township and the Borough of Lakehurst will operate and maintain the water pipeline distribution and provide drinking water to the impacted properties.
- The USAF will not pay for O&M of the water pipeline or future water cost by the impacted properties.
- Assumes that ROE agreements from property owners will be obtained.
- Assumes that any permits associated with service connections will be obtained by Manchester Township and the Borough of Lakehurst.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section provides a comparative analysis of the alternatives described and evaluated in Section 4.

5.1 EFFECTIVENESS

The No-Action alternative (Alternative 1) would not provide clean drinking water to affected properties; therefore, would not meet the RAO in reducing the risk to human health.

Alternative 2 has the lowest potential for short-term impacts and would meet the RAO. POET systems installation and O&M would effectively remove PFOS and PFOA from the drinking water. This alternative decreases contaminant toxicity through concentrating the PFOS and PFOA on the GAC and incinerating the spent media. Because Alternative 2 requires long-term monitoring and maintenance of the POET systems, this alternative provides a relatively low degree of long-term effectiveness.

Alternative 3 has the highest potential for short-term impacts; however, the short-term risks to workers are those associated with conventional construction projects that can be mitigated through standard health and safety practices. Alternative 3, construct Phase II water line, would replace the impacted properties water source with a new water pipeline and service connections joined to Manchester Township and the Borough of Lakehurst. The new water pipeline would effectively eliminate the human health exposure to PFOS and PFOA in drinking water. This alternative provides a high degree of long-term effectiveness.

5.2 IMPLEMENTABILITY

All three alternatives are readily implementable. Alternative 1 requires no implementability effort but does not meet the RAO. Alternative 2 is readily implementable with available material, services, and labor. However, Alternative 2 requires long-term O&M including sampling and monitoring of PFOS and PFOA, POET system servicing, and disposal of spent GAC. Alternative 3 is readily implementable using

conventional technologies and readily available material, services, and labor. Alternative 3 has no long-term O&M obligation to the USAF after construction is completed.

5.3 COSTS

The cost of Alternative 1 (No Action) is \$0. The cost of Alternative 2 (installation of POET systems and O&M) is estimated at \$2,503,074 over an implementation period of 30 years. The cost of Alternative 3 (construct Phase II water line) is estimated at \$1,209,646.

6.0 COMMUNITY PARTICIPATION

Community relations in removal actions taken pursuant to 40 CFR 300.415(b)4 are dictated in 40 CFR 300.415(n) and requires the AF, as lead agency under its authority, to inform the community of actions taken, respond to inquiries, and provide information concerning the release.

This EE/CA has been prepared to provide the community the opportunity to participate in the removal action by inspecting the EE/CA and providing written comments within a 30-day public comment period. A public notice of the EE/CA, notifying its availability to the public, will be included in the Asbury Park Press and Pinelands Tribune after regulatory acceptance on the EE/CA has been received.

This EE/CA will be made available for public inspection at the Ocean County Library, located at 101 Washington Street, Toms River, NJ 08753, and can be found at the library's information repository desk. Further, an electronic copy of this EE/CA will be made available on the AF administrative record website at <http://ar.afcec-cloud.af.mil/>.

Significant written comments received during the 30-day public comment period will be responded to and included in a responsiveness summary to a NTCRA Memorandum; the NTCRA Memorandum documents the USAFs selected removal action alternative that will be implemented for this action.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

As described in Section 5.0, Alternative 1 would not meet the RAO and is the least effective of the three removal action alternatives. For this reason, Alternative 1 is not recommended.

Alternatives 2 and 3 are similar in terms of their effectiveness in meeting the RAO. However, Alternative 2 requires long-term O&M to properly maintain the systems and annual ROE agreements with property owners, which over time could deteriorate and lead to receptor exposure to PFOS/PFOA impacted drinking water. Alternative 3 is an effective long-term solution. It eliminates potential future exposure to impacted drinking

water by connecting the receptor to municipal water and relieves the USAF of long-term obligation after construction is complete.

Both Alternatives 2 and 3 are implementable using readily available materials and supplies and utilize standard installation and construction techniques. However, Alternative 2 requires continual long-term O&M while Alternative 3 requires no long-term obligation to the USAF after construction.

Alternative 3 is less expensive than Alternative 2. Alternative 3 only has capital costs that are available and funded now; whereas, Alternative 2 has capital and O&M costs. In addition, in obtaining the funding for future year O&M costs, there are additional indirect administrative costs to the USAF for programming and maintaining the site within the restoration program.

Based on Alternative 3s ability to effectively meet the RAO, is readily implementable without future O&M obligations, and has the lowest costs that meet the RAO, Alternative 3 is the recommended alternative.

8.0 REFERENCES

- Aerostar SES, LLC. (2019). Final Site Inspections Report of Fire Fighting Foam Usage at Joint Base McGuire-Dix-Lakehurst, Burlington and Ocean Counties, New Jersey. January.
- Instruction (DoDI) 4715.07. Defense Environmental Restoration Program (DERP), May 21, 2013, incorporating Change 2, August 31, 2018.
- U.S. Department of Defense Manual 4715.20, Defense Environmental Restoration Program (DERP) Management, March 9, 2012, incorporating Change 1, August 31, 2018.
- DoDI 4165.71, Real Property Acquisition, January 6, 2005, Incorporating Change 1, August 31, 2018.
- U.S. Environmental Protection Agency (EPA). (1993). Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA. EPA 540-R-93-057. August.
- EPA. (2016a). Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). EPA 822-R-16-005, May.
- EPA. (2016b). Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). EPA 822-R-16-004, May.
- EPA (2019). Interim Recommendations to Address Groundwater Contaminated with Perfluorooctanoic Acid and Perfluorooctanesulfonate. EPA OLEM Directive No. 9283.1-47, December 19, 2019.
- EPA. Contaminant Candidate List (CCL) and Regulatory Determination. February 2021. <https://www.epa.gov/ccl/regulatory-determination-4>
- EPA Region II and the U.S. Department of the Navy. (1989). Federal Facility Agreement Under CERCLA Section 120; Administrative Docket Number: II-CERCLA-90105. September.
- HydroGeologic (HGL) 2015. Final Preliminary Assessment Report for Perfluorinated Compounds at Joint Base McGuire-Dix-Lakehurst, New Jersey. August.

TABLES

Table 5-1
Cost Summary of Alternative 2

Alternative 2: Install and Maintain POET Systems					
Item No.	Description of Item	Unit	Quantity	Unit Cost	Total Cost
A-1	Install and Service POET System				
1	Install POET System (Materials and Labor)	EA	6	\$ 4,605.00	\$ 27,630.00
2	Service Call for Diagnostics and Labor of Work Required	EA	180	\$ 155.00	\$ 27,900.00
3	Service Labor	EA	180	\$ 275.00	\$ 49,500.00
4	5 Micron Sediment Filter	EA	210	\$ 55.00	\$ 11,550.00
5	GAC Rebed (Empty, Clean, and Refill)	EA	360	\$ 1,530.00	\$ 550,800.00
6	GAC Media Storage (Storage of Media at GAC System Vendor Facility Until Disposed)	EA	210	\$ 125.00	\$ 26,250.00
7	GAC Incineration	LS	1	\$ 82,105.80	\$ 82,105.80
				Subtotal	\$ 775,735.80
A-2	O&M				
1	PFOS/PFOA Sampling (Analytical, Field Labor, Travel, ODC's)	LS	1	\$ 1,041,700.80	\$ 1,041,700.80
2	PFOS/PFOA Reporting (Data Validation, Reporting)	HR	4800	\$ 53.97	\$ 259,056.00
3	Admin, Planning, Coordination	EA	960	\$ 53.73	\$ 51,580.80
				Subtotal	\$ 1,352,337.60
A-3	ROE Agreements				
1	Annual Air Force Administrative Costs to Maintain ROE Agreements	EA	150	\$ 2,500.00	\$ 375,000.00
				Total Estimated Project Cost	\$ 2,503,073.40

Notes:

1. Unit costs are 2021 dollars.
2. Quantities are based on a 30-year duration, with exception of lines A-1.1, A-1.7, and A-2.1.
3. Costs do not include inflation.

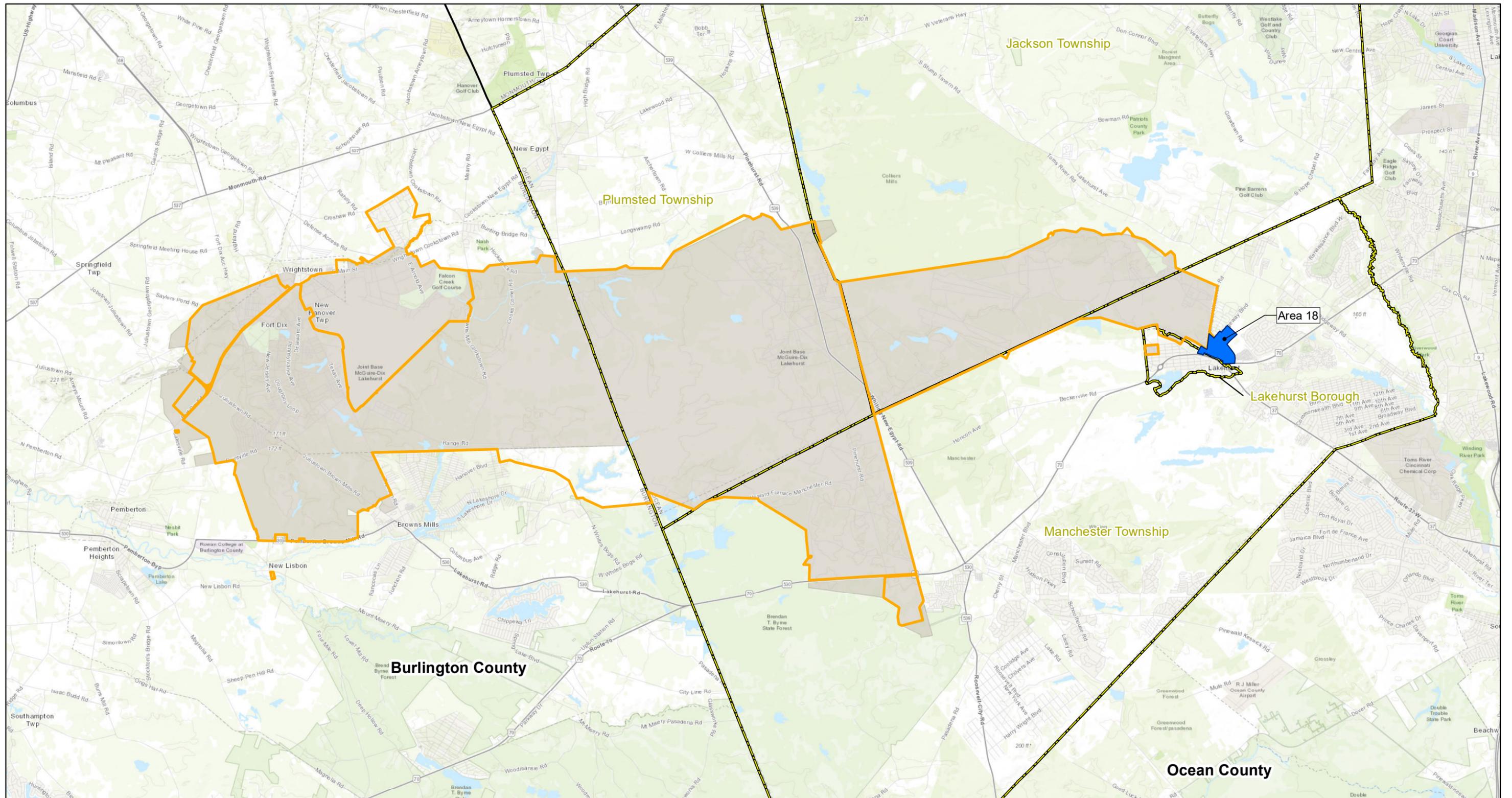
Table 5-2
Cost Summary of Alternative 3

Alternative 3: Construct and Install Phase II Water Line						
Item No.	Description of Item	Unit	Quantity	Unit Cost	Total Cost	
1	Project Submittals	LS	1	\$ 1,000.00	\$	1,000.00
2	Project Schedules	LS	1	\$ 1,000.00	\$	1,000.00
3	Mobilization	LS	1	\$ 50,113.13	\$	50,113.13
4	Temporary Facilities	LS	1	\$ 15,000.00	\$	15,000.00
5	Provide and Install 12-inch PVC Water Main	LF	1250	\$ 180.00	\$	225,000.00
6	Provide and Install 6-inch PVC Pipe and Fire Hydrants	EA	3	\$ 10,500.00	\$	31,500.00
7	Provide and Install 2-inch Service Connections	LF	1200	\$ 45.00	\$	54,000.00
8	Provide and Install 12-inch Water Main Pipe by HDD at Manapaqua Brook Crossing	LF	250	\$ 350.00	\$	87,500.00
9	Provide and Install Interconnection Pre-Cast Vault	LS	1	\$ 55,000.00	\$	55,000.00
10	Excavation, Backfill, and Restoration of Unpaved Surfaces for 12-inch Pipe	LF	580	\$ 11.00	\$	6,380.00
11	Excavation, Backfill, and Pavement Restoration for Ocean County Roadways, Parking Lots, and Driveways	LF	450	\$ 21.00	\$	9,450.00
12	Excavation, Backfill, and Pavement Restoration for State Roadways, Parking Lots, and Driveways for 12-	LF	220	\$ 21.00	\$	4,620.00
13	Excavation, Backfill, and Pavement Restoration for Ocean County Roadways, Parking Lots, and Driveways	LS	325	\$ 21.00	\$	6,825.00
14	Excavation, Backfill, and Restoration of Unpaved Surfaces for 2-inch Pipe	LF	875	\$ 11.00	\$	9,625.00
15	Replace Concrete Island at Diner	LS	1	\$ 5,200.00	\$	5,200.00
16	Additional Pavement Restoration at Diner Parking Lot and Driveway	SY	300	\$ 25.00	\$	7,500.00
17	Additional Milling and Pavement Restoration in Ocean County Roadways	SY	1400	\$ 25.00	\$	35,000.00
18	Sedimentation and Erosion Control	LS	1	\$ 10,000.00	\$	10,000.00
19	Demobilization	LS	1	\$ 5,000.00	\$	5,000.00
20	As-Built Documents	LS	1	\$ 1,000.00	\$	1,000.00
21	Construction and Oversight Costs	LS	1	\$ 588,932.00	\$	588,932.00
					Subtotal	\$ 1,209,645.13
					Total Estimated Project Cost	\$ 1,209,645.13

Notes:

1. Unit costs are 2021 dollars.

FIGURES



Legend

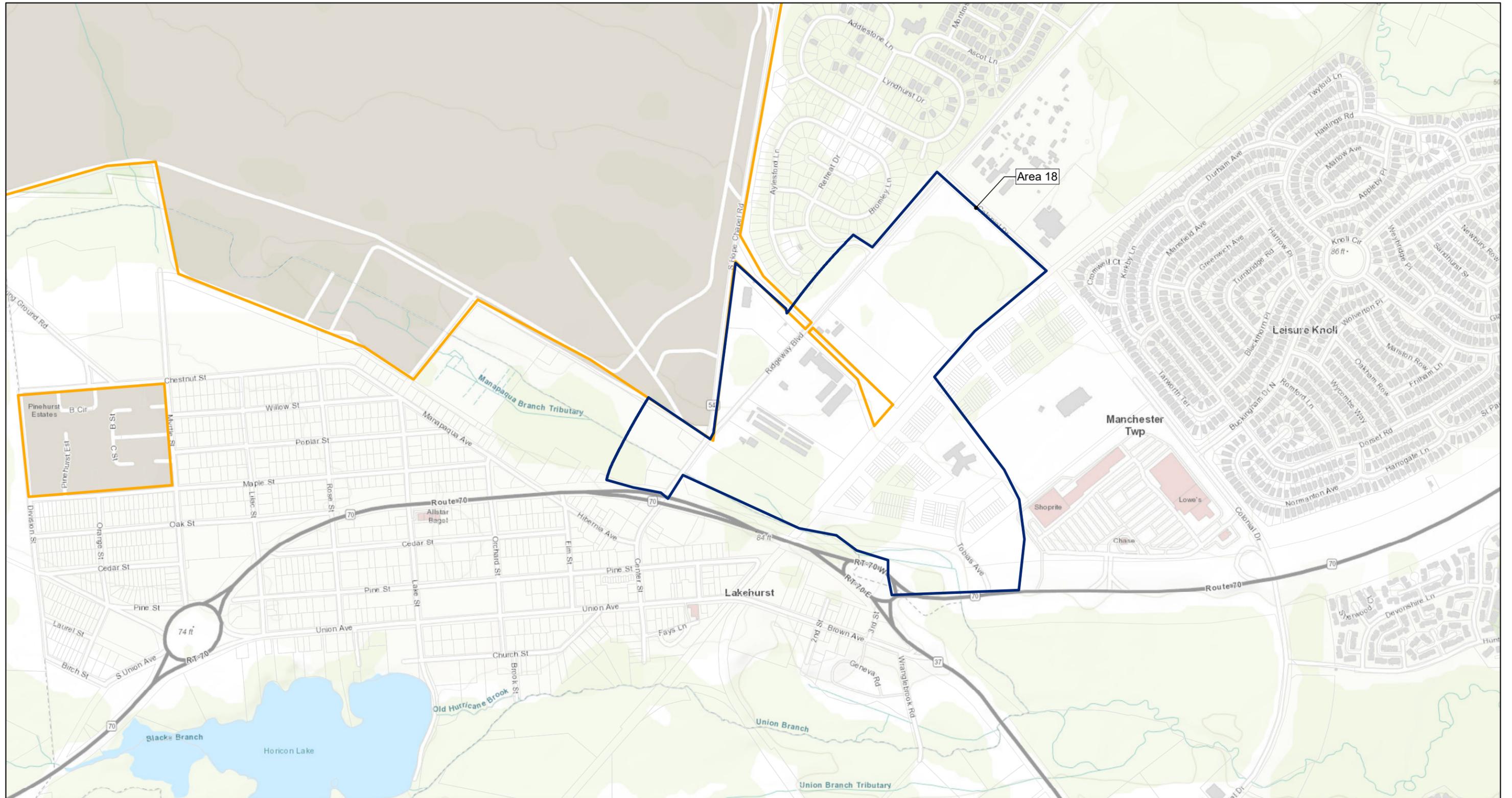
- JBMDL Installation Boundary
- County Boundary
- Municipal Boundary
- Off-Base Investigation Area

**Joint Base
McGuire-Dix-Lakehurst
New Jersey**

NOTES:
Aerial Source: ESRI, Nat Geo
World Map

Figure 1
Site Location Map

Coordinate System: NJ State Plane, NAD83, US Foot	4/6/2021
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Legend

- JBMDL Installation Boundary
- Off-Base Investigation Area

BERS-Weston Services JVA, LLC

**Joint Base
McGuire-Dix-Lakehurst
New Jersey**

NOTES:
Aerial Source: ESRI, Nat Geo
World Map

Figure 2

**EE/CA Drinking Water Coverage Area
for Drinking Water Wells Above the
PFOS/PFOA HA Levels**

Coordinate System: NJ State Plane, NAD83, US Foot	4/6/2021
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