UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
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Via Electronic Mail

Date: See signature stamp below

Rose H. Forbes, P.E.
Remediation Program Manager
HQ AFCEC/JBCC
322 East Inner Road
Otis ANG Base, MA 02542-5028

Re: Final Sixth Five-Year Review Report
Joint Base Cape Cod/Otis Air National Guard Base/Camp Edwards Superfund Site
Cape Cod, MA

Dear Ms. Forbes:

EPA has reviewed the *Final Sixth Five-Year Review Report Joint Base Cape Cod/Otis Air National Guard Base/Camp Edwards Superfund Site Cape Cod, MA* dated September 2023. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining on the site be subject to a five-year review (FYR).

Protectiveness determinations are an important outcome of the FYR and are based on the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) which provides that remedial actions which results in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure be reviewed every five years to ensure protection of human health and the environment.

The following table summarizes Tables 1-6 from the Final Sixth FYR which presents the protectiveness determinations for four source area sites, 12 groundwater plumes, and one Military Munitions Response Site (MMRP).

Category	*Site (OU)*	*Protectiveness Determination*
Source Area Sites	CS-10 Detail C and F (OU8)	Short-term Protective
	LF-1 (OU7)	Protective
	FTA-2/LF-2 (OU5)	Short-term Protective
	PFSA (FS-10/FS-11) (OU5)	Protective
Groundwater	Ashumet Valley (OU15)	Short-term Protective
	CS-4 (OU9)	Protective

SEMS Doc ID 100027168

	CS-10 (OU14)	Short-term Protective
	CS-19 (OU24)	Protective
	CS-21 (OU9)	Protective
	FS-12 (OU1)	Protective
	FS-13 (OU9)	Protective
	FS-28 (OU19)	Protective
	LF-1 (OU16)	Short-term Protective
	SD-5 (OU20)	Protective
	FTA-2/LF-2 (OU5)	Short-term Protective
	PFSA (OU5)	Protective
MMRP	Mock Village (OU29)	Protective

Based on EPA's review of the final report, EPA agrees with the above protectiveness determinations.

For those sites which are protective in the short-term, EPA is also in agreement with the identified issues, proposed recommendations, and completion dates from Tables 1-4 in the FYR and summarized below.

Source Area Sites			
Site (OU)	*Issue*	*Recommendation*	*Completion Date*
CS-10 Detail C and F (OU8)	Potential risk from vapor intrusion pathway.	Evaluate vapor intrusion risk. If needed, develop CERCLA decision document (DD).	October 2026
	Potential contaminant source in storm drain coating	Evaluate storm drain coating. If needed, develop DD.	October 2026
	Assess residual contaminants in soil/sediment against current values.	Evaluate residual contaminants and conduct risk assessment. If needed, develop DD.	October 2026
	Assess residual contaminants and update land use controls	Evaluate residual contaminants and conduct risk assessment. If needed, prepare DD with changes.	October 2026
FTA-2/LF-2 (OU5)	Changed site conditions due to new contaminants.	Assess data, collect additional data as necessary, and evaluate risk. If needed, develop DD.	December 2026

Groundwater Sites			
Site	*Issue*	*Recommendation*	*Completion Date*
Ashumet Valley (OU15)	Emerging contaminants	Complete RI/FS. Develop DD to establish COCs, RAOs, and identify any required remedial action.	May 2025

CS-10 (OU14)	Emerging contaminants	Investigate PFAS in groundwater. Develop DD to establish COCs, RAOs, and identify any required remedial action.	October 2027
LF-1 (OU16)	Emerging contaminants	Develop DD to establish COCs, RAOs and identify any required remedial action.	August 2024
FTA-2/LF-2 (OU5)	Cleanup levels not up-to-date	Develop new cleanup levels. Develop DD to document change in cleanup level and identify any required remedial action.	October 2026
PFSA (OU5)	Cleanup levels not up-to-date	Develop new cleanup levels. Develop DD to document change in cleanup level and identify any required remedial action.	October 2026

Because several sites are found to be short-term protective, EPA will report in the Annual Report to Congress Short-Term Protective for the overall site, as required by CERCLA § 121(c). The statutory deadline for the Seventh Joint Base Cape Cod FYR Report is September 30, 2027.

Please feel free to me or my team with any questions.

Sincerely,

Olson, Bryan Digitally signed by Olson, Bryan Date: 2023.09.29 10:12:03 -04'00'

Bryan Olson, Director
Superfund & Emergency Management Division

cc: Anni Loughlin, EPA
Robert Lim, EPA
David Peterson, EPA Senior Enforcement Counsel
Greg Gervais, EPA FFRRO
Randi Augustine, MassDEP
Diane Baxter, MassDEP
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DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER
INSTALLATION RESTORATION PROGRAM
OTIS AIR NATIONAL GUARD BASE, MA 02542-1320

28 Sep 2023

AFCEC/JBCC
322 East Inner Road
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Mr. Robert Lim
United States Environmental Protection Agency, Region One
5 Post Office Square – Suite 100
Mail Code, OSRR7-3
Boston, MA 02109-3912

Mr. Leonard Pinaud
Massachusetts Department of Environmental Protection, Southeast Region
20 Riverside Drive
Lakeville, MA 02347

Dear Mr. Lim and Mr. Pinaud:

AFCEC is hereby submitting the ***Final 6th Five Year Review, 2017 – 2022 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA***.

Subsequent to regulator comment resolution on the JBCC 6th Five-Year Review, minor changes were made in the document during an additional Air Force internal review. Please note that these changes did not affect the protectiveness determinations or recommendations. The changes are as follows:

a. Exhibit 3-1j/Table 1-4 – Recommendation #3 at CS-10 Detail C and F. First sentence has been changed to read (new language underlined): "Once an assessment of residual contaminants has been completed, develop federal risk-based standards for those contaminants that ~~remain at the site~~ <u>present an unacceptable risk</u> and preclude a UU/UE designation."

b. Section 3.3.5.1, FTA-1/LF-1 Source Area, Question A: Second sentence has been changed to read (new language underlined): "However, PAHs do remain in shallow soil (<15 ft bgs) at concentrations exceeding current EPA Industrial RSLs so UU/UE conditions (which was not an objective of the remedy) ~~have~~ <u>may</u> not <u>have</u> been met (AFCEE 2014)."

c. Section 4.1.2.3, AV Groundwater, Status of Implementation: Second sentence in last paragraph has been changed to read: "Specifically, AFCEC has conducted outreach in areas of known 1,4-dioxane or PFAS groundwater contamination, sampled existing private and municipal wells, and conducted numerous removal actions for ~~1,4-dioxane and~~ PFAS.

d. Section 4.1.2.1, AV Groundwater, Basis for Taking Action: First sentence in second paragraph has been changed to read (new language underlined): "Future residential exposure to

the AV groundwater COCs (at time of ROD) presented an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$ for PCE and TCE and a hazard index (HI) > 1 for thallium and Mn.

e. Section 4.9.2.1, LF-1 Groundwater, Basis for Taking Action: First sentence in second paragraph has been changed to read (new language underlined): Future residential exposure to the LF-1 groundwater COCs (except Mn) presents an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. Future residential exposure to Mn in LF-1 groundwater results in a HI > 1 (AFCEE 1996).

If you have any questions, please contact me at (508) 968-4670, extension 5613.

Sincerely,

FORBES.ROSE.H.1036416218 Digitally signed by FORBES.ROSE.H.1036416218 Date: 2023.09.28 15:01:49 -04'00'

ROSE FORBES, P.E.
Remediation Program Manager

Joint Base Cape Cod

Final 6th Five Year Review, 2017 – 2022
Joint Base Cape Cod (JBCC) Superfund Site
Otis Air National Guard Base, MA

September 2023

Prepared by:
AFCEC/JBCC
Installation Restoration Program
322 East Inner Road
Otis ANGB, MA 02542

APPROVAL SIGNATURE

U.S. AIR FORCE

Steffanie Metzger

Date: 09/28/2023

STEFFANIE K. METZGER, P.E., GS-14, DAF
Director, Environmental Management
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PAUL W. FREDIN, Colonel, USAF, P.E.
Director, Environmental Management
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ACRONYMS AND ABBREVIATIONS

AFCEC	Air Force Civil Engineer Center
AFCEE	Air Force Center for Engineering and the Environment
AFFF	aqueous film-forming foam
AOC	area of concern
APEMS ID	Air Force Parcel and Easement Management System Identification Number
AR	administrative record
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
AV	Ashumet Valley
AVGAS	aviation gasoline
bgs	below ground surface
BOH	Board of Health
BOMARC	Boeing Michigan Aerospace Research Center
BSVR	biosparge/vapor recovery
BWD	Bourne Water District
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CIA	Central Impact Area
CMR	Code of Massachusetts Regulations
COC	contaminant of concern
CS	Chemical Spill
CSM	conceptual site model
CWMA	Crane Wildlife Management Area
CWSW	Coonamessett Water Supply Well
CY	Coal Yard
DD	decision document
DDT	dichlorodiphenyltrichloroethane

DoD	Department of Defense
DSRP	Drainage Structure Removal Program
EC	emerging contaminant
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
ESD	Explanation of Significant Difference
ESV	ecological screening values
ETR	extraction, treatment, and reinjection
EW	extraction well
FFA	Federal Facilities Agreement
FS	Fuel Spill
ft	feet/foot
FTA	Fire Training Area
FYR	five-year review
GAC	granular activated carbon
GP	Gun Position
gpm	gallons per minute
GW-1	Groundwater-1
HA	Health Advisory
HATF	Hunter Avenue Treatment Facility
HFPO-DA (Gen-X)	hexafluoropropylene oxide dimer acid
HI	hazard index
HQ	hazard quotient
IAGWSP	Impact Area Ground Water Study Program
IC	Institutional Control
IP	In-Plume
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IRP	Installation Restoration Program
JBCC	Joint Base Cape Cod
JBCCCT	JBCC Cleanup Team
JP-4	Jet Propulsion-4

lbs	pounds
LF	Landfill
LTM	long term monitoring
LUC	Land Use Control
LUCIP	Land Use Control Implementation Plan
MAARNG	Massachusetts Army National Guard
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MDFW	Massachusetts Division of Fisheries and Wildlife
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
MMCL	Massachusetts Maximum Contaminant Level
MMR	Massachusetts Military Reservation
MMRP	Military Munitions Response Program
Mn	manganese
MNA	monitored natural attenuation
MRA	Munitions Response Area
MRS	munitions response sites
MTU	mobile treatment unit
NCL	north-central lobe
NCP	National Contingency Plan
NL	northern lobe
NPL	National Priorities List
NWOU	Northwest Operable Unit
OU	Operable Unit
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PCM	post-closure monitoring
PFAS	per- and polyfluoroalkyl substances
PFAS6	the total sum of the concentrations of six PFAS

PFBS	perfluorobutane sulfonic acid
PFDA	perfluorodecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexane sulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PFSA	Petroleum Fuels Storage Area
PPRTV	Provisional Peer-Reviewed Toxicity Value
PRA	preliminary risk assessment
PWSW	Public Water Supply Well
RACR	Remedial Action Completion Report
RAO	Remedial Action Objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive or hexahydro-1,3,5-trinitro-1,3,5-triazine
RfC	reference concentration
RfD	reference dose
RG	remediation goal
RI	remedial investigation
ROD	Record of Decision
RSL	Regional Screening Level
S-1	Soil-1
SD	Storm Drain
SEMS	Superfund Enterprise Management System
SI	site inspection
SL	southern lobe
SLR	Summary Letter Report
SPEIM	System Performance and Ecological Impact Monitoring
SRTF	Sandwich Road Treatment Facility
STCL	soil target cleanup level
STP	sewage treatment plant

SVE	soil vapor extraction
SWOU	Southwest Operable Unit
TBC	To Be Considered
TCE	trichloroethylene
TMB	trimethylbenzene
TNT	trinitrotoluene
TPH	total petroleum hydrocarbon
TTRS	Tanker Truck Rollover Site
USAF	U.S. Air Force
USCG	U.S. Coast Guard
UST	underground storage tank
UTES	Unit Training Equipment Site
UU/UE	unlimited use and unrestricted exposure
UXO	unexploded ordnance
VA	U.S. Department of Veterans Affairs
VC	vinyl chloride
VI	vapor intrusion
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
1,1,2,2-TeCA	1,1,2,2-tetrachloroethane
1,1-DCE	1,1-dichloroethene
1,4-DCB	1,4-dichlorobenzene

1.0 INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The Air Force Civil Engineer Center (AFCEC)[1], on behalf of the U.S. Air Force (USAF), is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 Code of Federal Regulations Section 300.430(f)(4)(ii)), and considering Department of Defense and USAF policy.

This is the sixth FYR for the Joint Base Cape Cod (JBCC) Site (Figure 1-1), covering the period from 01 October 2017 through 30 September 2022. The triggering action for this statutory review is the completion date of the previous FYR which was 30 September 2018. The FYR has been prepared because hazardous substances, pollutants, contaminants or potential munitions and explosives of concern (MEC) remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

For the purposes of this FYR, the word "Site" (capital "S") refers to the collection of all the individual source areas, groundwater sites, and munitions response sites (MRS) at the JBCC Site that are being addressed by the USAF pursuant to CERCLA under the Installation Restoration Program (IRP) and Military Munitions Response Program (MMRP). The general locations of the IRP sites and MRSs[2] are shown on Figure 1-2. In total, six IRP source area sites (Section 3.0), 12 groundwater plumes (Section 4.0), and

[1] In October 2012, the Air Force Center for Engineering and the Environment (AFCEE) adopted a new organizational name, the Air Force Civil Engineer Center (AFCEC). Therefore, the AFCEE and AFCEC acronyms refer to the same entity but are used in this document in relation to the date of the specific topic/document.

[2] Sites being addressed under the MMRP are called Munitions Response Sites. Further information is found in Section 5.

one MRS (Section 5.0) were assessed in this FYR. There are 24 sites that were not reviewed because remedies have not been finalized and/or the sites are under investigation (Table 1-1c).

The JBCC Site FYR was led by Mr. Jonathan Davis, Sol Solutions (environmental consultant). Participants included Ms. Rose Forbes (AFCEC JBCC Remedial Program Manager), Ms. Kimberly Gill (AFCEC JBCC Project Manager), and Mr. Douglas Karson (AFCEC Community Involvement Lead). Input also was provided by base contractors, the Environmental Protection Agency (EPA), and the Massachusetts Department of Environmental Protection (MassDEP).

1.1 JBCC OVERVIEW

The JBCC Site is located on western Cape Cod in Barnstable County, Massachusetts, approximately 60 miles south of Boston and immediately south of the Cape Cod Canal (Figure 1-1).

Most of the activity at JBCC has occurred since 1935, including operations by the U.S. Army, U.S. Navy, U.S. Coast Guard (USCG), USAF, Massachusetts Air National Guard, Massachusetts Army National Guard (MAARNG), and U.S. Department of Veterans Affairs. In general, two different types of operations have dominated military activity at JBCC: (1) training, maneuvers, and maintenance support (Camp Edwards) and (2) military aircraft operations, maintenance, and support (Otis Air Force Base/Air National Guard Base/USCG Air Station).

JBCC (formerly known as the Massachusetts Military Reservation [MMR]) was added to the National Priorities List (NPL) in 1989 as Otis Air National Guard Base/Camp Edwards (Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS] number MA2570024487). A Federal Facility Agreement (FFA), which provided the legal framework for investigating and remediating numerous sites at JBCC, was first signed in 1991. In 1996, the FFA was amended to add the USAF as the lead agency for the cleanup at JBCC. A revised FFA, which supersedes the original FFA, was signed in 2000. The revised FFA incorporated earlier amendments, removed the

USCG as a party to the FFA, and added Section 7003 of the Resource Conservation and Recovery Act (RCRA) to the FFA (EPA 2002). In 2002, amendment #5 removed the Chemical Spill-13 site from the FFA. In addition to the USAF, the EPA and the National Guard Bureau are parties to the FFA for JBCC. The MassDEP is not a signatory of the FFA but is an active participant in the cleanup process and provides review, comments, and recommendations to the USAF. The USAF and EPA have jointly selected the remedies for these sites. The MassDEP has concurred with the selected remedies.

1.2 SITES ADDRESSED WITH THIS FIVE-YEAR REVIEW

For this FYR, JBCC IRP sites and MRSs have been divided into three general categories as follows:

- IRP Sites and MRSs Not Requiring a FYR: Sites do not require a FYR if they meet UU/UE criteria (i.e., closed sites) or do not have a Record of Decision (ROD) and a selected remedial action.
    - Table 1-1a lists all the closed sites that meet UU/UE criteria and no longer require a FYR.
    - Table 1-1b contains a listing and summary rationale for seven sites that were closed during *this* FYR period and allow UU/UE; these sites are also included on Table 1-1a.
    - Table 1-1c lists the open sites that do not have a ROD and a selected remedial action and therefore were not addressed during this FYR.

  The IRP source areas and MRSs not requiring a FYR are identified on Figure 1-2 by the green shaded areas. The closed IRP groundwater plumes not requiring a FYR are not shown on Figure 1-2. More recently identified per- and polyfluoroalkyl substances (PFAS) sites and groundwater plumes are shown on Figure 1-2; however, none of the PFAS sites or plumes have a ROD and a selected remedial action and do not require a FYR.

- IRP Source Area Sites and MRSs Requiring a FYR: Table 1-2 lists the six IRP source area sites and one MRS that are addressed in this FYR. These sites require a FYR because the remedial actions required by their respective RODs have left hazardous substances, pollutants, contaminants or potential MEC above levels that allow for UU/UE. Sections 3.0 and 5.0 present the FYR results for IRP source area sites and the MRS, respectively, which are identified on Figure 1-2 by the orange shaded areas.

- IRP Groundwater Sites Requiring a FYR: Table 1-3 lists the 12 groundwater sites that are addressed in this FYR. These sites require a FYR because the remedial actions required by their respective RODs have left hazardous substances, pollutants, or contaminants above levels that allow for UU/UE. Section 4.0 presents the FYR results for the groundwater sites which are identified on Figure 1-2.

1.3 REPORT ORGANIZATION

Section 1.0 provides an introduction to this FYR and Section 2.0 presents an overview of global issues or activities that are common to many of the sites addressed in this FYR. Sections 3.0, 4.0 and 5.0 provide the FYR site assessments for the IRP source areas, IRP groundwater plumes, and MRS, respectively. A matrix that cross references the EPA Superfund Enterprise Management System (SEMS) Operable Unit Numbers to the IRP and MRS site names and document section is provided in Table 1-8. Appendix A includes a copy of newspaper announcement of the commencement of JBCC FYR Process; Appendix B includes private well determinations for private wells assessed under the Land Use Control (LUC) program during this FYR period; and Appendix C includes documentation on regulator comment resolution and concurrence letters.

1.4 OVERVIEW OF FIVE-YEAR REVIEW RESULTS

The subject FYR indicated that all JBCC Site remedies are either Protective or Protective in the Short-Term. Each site assessment concludes with resultant Issues/Recommendations and/or Other Findings, if applicable, and an overall Protectiveness Statement for the site. A consolidated listing of all Issues/Recommendations and Other Findings are shown on Tables 1-4 and 1-5, respectively. A consolidated listing of all Protectiveness Statements is shown on Table 1-6. An overall Protectiveness Statement is shown on Table 1-7.

The FYR review summary form for the JBCC Site follows in Exhibit 1-1.

EXHIBIT 1-1

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Joint Base Cape Cod		
EPA ID: MA2570024487		
Region: 1	**State:** MA	**City/County:** Barnstable County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Air Force		
Author name: Jonathan Davis		
Author affiliation: Sol Solutions, Inc. – contract support for AFCEC/JBCC		
Review period: 01 June 2022 – 30 September 2023		
Date of site inspection: 27 Oct 2022		
Type of review: Statutory		
Review number: 6		
Triggering action date: 30 September 2018 (submittal date of Fifth Five-Year Review)		
Due date *(five years after triggering action date)*: 30 September 2023		

1.5 REFERENCES

EPA Region I and the United States Department of Defense, National Guard Bureau. 2002 (June). *Federal Facility Agreement (FFA) Under CERCLA § 120 and RCRA § 7003 for the Massachusetts Military Reservation* as amended.

2.0 GLOBAL ISSUES FOR THE JBCC SITE

2.1 EMERGING CONTAMINANTS

The initial recommendation for investigating the emerging contaminants (EC) 1,4-dioxane and PFAS was presented in the *Final 4th Five-Year Review, 2007-2012, Massachusetts Military Reservation (MMR) Superfund Site Otis Air National Guard Base, MA* (AFCEC 2013). Much work regarding these contaminants has been conducted at JBCC, but final remedies are pending in most cases.

The development process for EC clean-up standards, especially PFAS, has been dynamic and on-going during this FYR period. New standards should be considered during the FYR process as part of the protectiveness determination. Under the NCP, if a new requirement is promulgated after the ROD is signed, and, as part of the FYR process it is determined that the requirement needs to be attained to ensure that the remedy is protective of human health and the environment, then the FYR should recommend that a future decision document (DD) be issued that adds the new requirement as an applicable or relevant and appropriate requirement (ARAR) to the remedy (EPA 2022).

EPA guidance states:

"Subsequent to the initiation of the remedial action new standards based on new scientific information or awareness may be developed and these standards may differ from the cleanup standards on which the remedy was based. These new … [standards] should be considered as part of the review conducted at least every five years under CERCLA §121(c) for sites where hazardous substances remain on-site. The review requires EPA to assure that human health and the environment are being protected by the remedial action. Therefore, the remedy should be examined in light of any new standards that would be applicable or relevant and appropriate to the circumstances at the site or pertinent new [standards], in order to ensure that the remedy is still protective. In certain situations, new standards or the information on which they are based may indicate that the site presents a significant threat to health or environment. If such information comes to light at times other than at the five-year reviews, the necessity of acting to modify the remedy should be considered at such times." (EPA 2008)

The following sections provide background information on 1,4-dioxane and PFAS and a description of the activities completed at JBCC to date.

2.1.1 1,4-Dioxane

The primary industrial use of 1,4-dioxane was to stabilize solvents, particularly 1,1,1-trichloroethane, which is less chemically stable than other common solvents such as tetrachloroethylene (PCE) and trichloroethylene (TCE). 1,4-Dioxane is soluble and mobile in groundwater and biologically persistent in the environment and is not readily adsorbed or treated by granular activated carbon (GAC), which is the treatment media currently in use for other groundwater contaminants of concern (COCs) at JBCC. Investigations have confirmed that 1,4-dioxane is present above risk-based goals at the Chemical Spill-10 (CS-10) and Landfill-1 (LF-1) groundwater sites. The Ashumet Valley (AV) groundwater site data indicate 1,4-dioxane will not need to be added as a COC (AFCEC 2022d).

The CS-10 groundwater remedy has been modified to include 1,4-dioxane as a COC with a site-specific risk-based remediation goal (RG) of 0.46 µg/L. This RG is based on a residential drinking water scenario with a cancer risk of 1E-06 and was selected because there is no enforceable Federal or State drinking water standard for 1,4-dioxane (i.e., Maximum Contaminant Level [MCL] or Massachusetts Maximum Contaminant Level) (AFCEC 2021d). Remedy modifications to address 1,4-dioxane, if necessary, at the LF-1 groundwater site are pending.

No removal actions have been necessary to prevent human exposure to 1,4-dioxane in drinking water.

- There have been no CS-10-related 1,4-dioxane detections in private or municipal wells.
- 1,4-Dioxane associated with AV has been detected in 29 private wells (maximum concentration of 0.27 micrograms per liter [µg/L]) (AFCEC 2022d). All detected concentrations have been below both the EPA site-specific, risk-based RG of 0.46 µg/L and the MassDEP Massachusetts Contingency Plan (MCP) Method 1 Groundwater-1 (GW-1) standard of 0.3 µg/L.
- 1,4-Dioxane associated with LF-1 has been detected in Bourne Public Water Supply Well No. 5 at a concentration of 0.206 µg/L which is below both the EPA

site-specific, risk-based RG of 0.46 µg/L and the MassDEP MCP Method 1 GW-1 standard of 0.3 µg/L (AFCEC 2018c).

2.1.2 Per- and Polyfluoroalkyl Substances (PFAS)

PFAS are found in aqueous film-forming foam (AFFF), a firefighting foam used by the USAF in fire training exercises, suppressing aircraft and other vehicle fires, and in aircraft hangar fire suppression systems since 1970. PFAS are also used extensively in household and industrial products, clothing, and food wrappers. PFAS are soluble and mobile in groundwater and are chemically and biologically persistent in the environment and some PFAS can be treated by GAC with varying effectiveness. Investigations (as a result of previous FYR recommendations) have confirmed that PFAS are present at the AV (Fire Training Area-1 [FTA-1])[3] and LF-1 groundwater sites (AFCEC 2017, 2018c). Extraction well sampling at CS-10 has indicated PFAS is present and a recommendation to conduct an investigation is included in this FYR (Section 4.3). Additionally, 8 new sites with PFAS in groundwater and/or soil have been identified (2022b, 2022e) and are included on Table 1-1c and Figure 1-2.

2.1.2.1 <u>PFAS Human Health Risk</u>

Final remedies for PFAS at JBCC's sites are pending; however, numerous removal actions have been conducted at AV (FTA-1) and the Tanker Truck Rollover Site (TTRS) to address human exposure to PFAS from private and municipal drinking water wells. The removal actions included 1) providing bottled water, whole-house filtration systems, and/or connecting private residences to municipal drinking water, 2) connecting a 93-unit trailer park with its own water supply well to municipal drinking water, and 3) constructing wellhead treatment systems on municipal wells in Falmouth and Mashpee, MA (AFCEC 2022c, 2022f, 2022g, 2022h, 2021b, 2018b). See Section 2.2 for further discussion on controlling exposures to JBCC contaminants, including PFAS, in drinking water.

[3] FTA-1 is one of the source areas for the AV chlorinated solvent plume and it is the primary source of the PFAS contamination at the site since PFAS are found in AFFF, a firefighting foam previously used in fire training exercises at FTA-1. During the Supplemental RI, PFAS contamination in groundwater was determined to be more widespread than the AV chlorinated solvent plume and, therefore, it was considered more accurate to associate the PFAS contamination with the FTA-1 source area than the AV chlorinated solvent plume (AFCEC 2022d).

The removal actions conducted for PFAS at JBCC prior to January 2022 addressed perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) in drinking water. The associated action levels were based on EPA's 2016 lifetime health advisory (HA) values for PFOS and PFOA in drinking water of 0.07 µg/L (individually or combined) (EPA 2016a, 2016b).

In October 2020, the MassDEP promulgated a Massachusetts Maximum Contaminant Level (MMCL) of 0.02 µg/L for PFOS, PFOA, perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), perfluoroheptanoic acid (PFHpA), and perfluorodecanoic acid (PFDA), collectively referred to as the PFAS6 (individually or summed) in drinking water (310 Code of Massachusetts Regulations [CMR] 22). In January 2022, the USAF agreed to undertake removal actions at utilized drinking water sources with identified exceedances of the PFAS6 MMCL within the AV (FTA-1) and TTRS groundwater plume areas. The USAF had identified and responded to exceedances of the EPA 2016 lifetime HA in other drinking water wells in AV (FTA-1) and TTRS with the same hydrogeological conditions as the drinking water wells that exceeded the PFAS6 MMCL but were below the EPA 2016 lifetime HA. Given these conditions, the USAF expected these drinking water wells to exceed the EPA 2016 lifetime HA resulting in exposure to drinking water in excess of the EPA 2016 lifetime HA which necessitated the removal actions (AFCEC 2022c, 2022h).

In May 2021, EPA issued an updated noncancer reference dose (RfD) value for perfluorobutane sulfonic acid (PFBS) and in May 2022, EPA issued updated noncancer RfD values for several other PFAS compounds which result in the following Tap Water Regional Screening Levels (RSLs) at hazard quotient (HQ) target 0.1 (EPA 2022):

- PFBS 601 ng/L (0.601 µg/L)
- PFOA 6 ng/L (0.006 µg/L)
- PFOS 4 ng/L (0.004 µg/L)
- PFNA 6 ng/L (0.006 µg/L)
- PFHxS 39 ng/L (0.039 µg/L)
- Hexafluoropropylene oxide dimer acid (HFPO-DA [Gen-X]) 6 ng/L (0.006 µg/L)

The RfD values for PFOA, PFOS, PFNA and PFHxS are based on Agency for Toxic

Substances and Disease Registry Minimal Risk Levels for ingestion exposure while the PFBS and HFPO-DA (Gen-X) RfDs are based on a chronic oral RfD. EPA has also developed soil RSLs based on the RfDs for these same PFAS chemicals.

These updated RSLs and associated RfDs are being integrated into the JBCC groundwater and soil screening and risk assessment processes associated with the pending PFAS remedy decisions in accordance with Department of Defense (DoD) policy (DoD 2022).

2.1.2.2 PFAS Ecological Risk

Ecological screening values (ESVs) have been developed to support screening-level ecological risk assessments sites where PFAS have been detected in soils and surface waters. The ESVs, developed for eight PFAS, represent PFAS concentrations in soil and surface water at or below which chronically exposed biota are not expected to be adversely affected and ecological risks or other impacts are unlikely.

The ESVs support the screening level steps (Steps 1 and 2 of eight steps) of EPA's Ecological Risk Assessment Guidance for Superfund and may be applied at sites undergoing investigation for the historic release or disposal of PFAS, to identify whether PFAS levels pose potential unacceptable ecological risks. Sites that have concentrations of PFAS that exceed ESVs may require further investigation in a baseline ecological risk assessment, which in turn may support risk-management decisions and actions to reduce risks. These ESVs are solely for use in conducting screening-level ecological risk assessments and are not recommended or intended for use as default cleanup values (EPA 2022).

The ESVs were developed for the following media and receptors:

- Soils for invertebrates;
- Soils for plants;
- Soils for avian and mammalian wildlife;
- Surface water for freshwater and marine aquatic biota; and
- Surface water for aquatic-dependent avian and mammalian wildlife.

(Ecological Screening Values can be found in: *Derivation of PFAS Ecological Screening Values, M. Grippo, J. Hayse, I. Hlohowskyj, and K. Picel, Environmental Science Division, Argonne National Laboratory, September 2021)* (EPA 2022)

These ESVs are being applied in the PFAS ecological risk assessments being conducted at JBCC.

The following selected reports provide additional information on PFAS at JBCC:

- *Ashumet Valley Emerging Contaminants Conceptual Site Model Technical Memorandum (AFCEC 2017).* Administrative Record (AR) #570037 and #570040.
- *Supplemental Remedial Investigation Report for 1,4-Dioxane and Perfluorinated Compounds at Landfill-1 (AFCEC 2018c).* AR #569507
- *Remedial Investigation Work Plan for Per- and Polyfluoroalkyl Substances (PFAS) at the Flight Line Area Operable Unit (AFCEC 2022b).* AR #620947.

2.2 LAND USE CONTROLS

LUCs include any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property to prevent or reduce risks to human health and the environment (USAF 2020) and are a component of many site remedies at JBCC. Each individual site assessment in Sections 3.0, 4.0 and 5.0 of this FYR describe the LUCs applicable to the sites along with an implementation status and assessment of their effectiveness. The following sections address LUC topics that relate to the entire Site and are described here to reduce repetitive information within the individual site assessments.

2.2.1 Land Use Control Implementation Plan

AFCEC maintains a Land Use Control Implementation Plan (LUCIP) which serves as the management system to provide site-specific information about the existence, purpose and maintenance of LUCs that have been implemented as part of the selected remedies managed by AFCEC at JBCC's IRP sites and MRSs. Implementation of the LUCIP ensures that site-specific information about each LUC is readily available to the various Base agencies, federal and state regulators, current property owners, future purchasers, local Boards of Health, redevelopment agencies, or anyone else who may make decisions about how a specific property is used or handled. The most recent version of the LUCIP was published in November 2020 (AFCEC 2020a).

2.2.2 Private Well Verification

A major element of the JBCC LUC program for groundwater sites is the private well verification program. The discussion in this section applies to the groundwater sites with DDs that stipulate a remedial action to address their respective COCs. The only groundwater site with 1,4-dioxane as a COC is CS-10. No DDs stipulating a remedy with PFAS as a COC in groundwater have yet been issued at JBCC. Section 2.2.3 discusses LUC activities at those groundwater sites where 1,4-dioxane or PFAS are under investigation and a DD is pending and provides information regarding the steps taken at JBCC to prevent unacceptable exposure to 1,4-dioxane and PFAS in drinking water.

Many groundwater sites assessed in Section 4.0 are located partially or entirely outside the boundaries of the JBCC (Figure 1-2). These off-base groundwater plume areas are located in four different towns: Bourne, Sandwich, Mashpee, and Falmouth. Some groundwater plumes (e.g., CS-10) are located in more than one town.

The AFCEC, EPA, and MassDEP have coordinated with the four towns in past years to develop town-specific groundwater use regulations issued through the towns' respective Boards of Health (BOH). Additionally, AFCEC has provided municipal water service and/or household connections to homes in the areas of the groundwater plumes that were previously serviced by private wells. In 2007, AFCEC and the regulatory agencies agreed that the BOH regulations and ancillary enforcement procedures were not adequate to ensure the prevention of potential exposure to contaminated groundwater from the JBCC plumes. Examples of potential exposure include: residents using former private drinking water wells for irrigation, filling of swimming pools, or car washing; parcels with more than one home using a combination of private wells and municipal water supply; or residents that declined earlier offers from AFCEC for connection to a municipal water supply.

As a result of these discussions, the groundwater site DDs (RODs and Explanations of Significant Differences [ESD]) (Table 1-3) contain specific procedures that require the USAF to verify the private well status of all parcels within the plume footprints. The well verification requirements (modified to read generically for all off-base JBCC plumes) follow:

Within three years of the signing of the ROD or ESD, the USAF shall:

a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the plume(s).

b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the plume(s), or test the private well for contamination and demonstrate the private well to be safe for human use. The USAF will continue such testing, on an appropriate frequency as determined in coordination with the EPA and MassDEP, until the plume(s) no longer presents a threat to that well as determined in coordination with EPA and MassDEP.

c. If the USAF identifies a well containing COCs, the USAF shall assess the risk that current and potential future non-drinking uses of the well may pose to human health. The USAF shall submit a draft version of any such risk assessment to EPA and MassDEP for review and concurrence.

d. If neither b nor c is able to confirm that the identified well is safe for human use, the USAF will offer the owner decommissioning of the well. If accepted, the USAF will document such action with the appropriate BOH. If the decommissioning is not accepted, the USAF will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the USAF shall submit a schedule subject to EPA and MassDEP concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the plume(s) having carcinogens in excess of ARARs (i.e., MCLs,

non-zero MCL goals), and prevent exposure to groundwater from the plume(s) that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic hazard index greater than one.

The USAF has developed a guideline for implementing this requirement titled *Verification, Decommissioning, and Documentation Guidelines for Private Wells in Areas of Potential Concern* which was updated in January 2019 (AFCEC 2022a). Additionally, the USAF developed and is using a LUC database to record the status of the well verification process and subsequent results for the over 2,000 parcels located in plume areas. As reported in Section 4.0 of this FYR, the initial well verification and well determination process required by the applicable ROD or ESD was completed by AFCEC during previous FYR periods.

Based on technical evaluations, well determinations concluded that none of the identified private wells represent a current unacceptable exposure risk to the IRP groundwater plume COCs established in existing DDs. Further details are provided in each of the groundwater site evaluations presented in Section 4.0.

The status of non-operational private wells continued to be tracked during this FYR period. AFCEC distributed a mailing, on an annual basis, to property owners within each LUC area that have inactive or decommissioned wells for which no technical evaluation could be completed due to lack of known well depths and/or inability to sample. The intent of the annual mailing is to remind these property owners that they should contact AFCEC for a technical evaluation, which may include sampling, in the event their well is put back into service. Any changes to the private well LUC monitoring program or technical evaluations completed in support of a private well that may have been restarted or newly installed (notification through Dig-Safe) were reported in the Annual LUC letter Reports (AFCEC 2022a, 2021c, 2020b, 2019), are summarized for each groundwater site in Section 4.0, and the associated private well determinations (summary of the technical evaluations) are included in Appendix B. Table 2-1 provides a summary of all parcels within established LUC areas that have or had private well concerns and the current status.

2.2.3 Interim LUCS for 1,4-Dioxane and PFAS

AFCEC has administratively imposed interim LUCs to evaluate any potential exposure to IRP-related PFAS and 1,4-dioxane in drinking water wells (AFCEC 2022a, 2021c, 2020b, 2019a). Using the private well verification procedures outlined in Section 2.2.2 as a guide, AFCEC has identified LUC outreach areas where private or municipal drinking water supply wells may be impacted based on the data gathered during the on-going PFAS and 1,4-dioxane investigations. Private well status verification and appropriate monitoring has been established in 1,4-dioxane and/or PFAS LUC outreach areas associated with the AV (FTA-1), LF-1, TTRS, and Flight Line Area Operable Unit groundwater sites and are discussed in the following sections.

2.2.3.1 Ashumet Valley (FTA-1)

Both 1,4-dioxane and PFAS have been detected in groundwater at the AV (FTA-1) site (AFCEC 2022d); however, a DD to address these emerging contaminants has not yet been prepared. The AV groundwater site has a ROD and ESD for legacy COCs and its current remedy is evaluated as part of this FYR in Section 4.1. As part of the LUC process specified in the ROD (AFCEE 2009), a private well verification survey found no private drinking water wells with an unacceptable exposure risk from the AV plume legacy COCs.

As of 30 Sep 2022, a total of 107 private wells have been identified and sampled for 1,4-dioxane and/or PFAS. The extent of AV (FTA-1) groundwater exceeding the PFAS6 MMCL is shown on Figure 1-2. The administrative PFAS LUC outreach area extends beyond the LUC area established for the ROD-stipulated COCs (Figure 2-1).

1,4-Dioxane associated with AV (FTA-1) has been detected in 29 private drinking water wells (maximum concentration of 0.27 µg/L). All detected concentrations have been below both the EPA site-specific, risk-based RG of 0.46 µg/L and the MassDEP MCP Method 1 GW-1 standard of 0.3 µg/L (AFCEC 2022d). No public water supply wells (PWSW) required sampling for 1,4-dioxane due to its limited extent in the AV (FTA-1) plume (AFCEC 2022d). No removal actions (i.e., bottled water, residential filtration systems, municipal water connections, PWSW wellhead treatment) have been required in response

to 1,4-dioxane groundwater detections at AV (FTA-1).

PFAS have been detected in 102 of the private wells sampled in the AV (FTA-1) outreach area. The 2016 EPA lifetime HA for PFOA and PFOS, individually or combined (0.07 µg/L), and the MassDEP PFAS6 MMCL (0.02 µg/L) were used for determining appropriate removal actions during this FYR period. A more comprehensive discussion of PFAS regulatory standards can be found at Section 2.1.2. The maximum combined PFOA+PFOS detection in a residential well in AV (FTA-1) was 0.567 µg/L (PFAS6 sum of 0.81 µg/L) in 2016 (residence received bottled water and was subsequently connected to municipal water). A total of 23 residences have been connected to municipal water (typically preceded by water filtration systems and/or bottled water) in areas where PFAS exceedances in AV (FTA-1) groundwater are anticipated to be present in the long-term (AFCEC 2022d). Other residences have received filtration systems and/or bottled water where PFAS exceedances were short-lived and subsequent sampling has indicated the PFAS concentrations are no longer a concern. As of 30 Sep 2022, 31 residences continue to be monitored for PFAS in the AV (FTA-1) area (AFCEC 2022d).

Nine public/community/non-community water supply wells located in the AV (FTA-1) area were sampled for PFAS by AFCEC (Figure 2-1). Two PWSWs in Mashpee had PFOS+PFOA concentrations greater than the 2016 EPA lifetime HA: the Mashpee Village PWSW (MassDEP# 4172039-06G) and a community water supply well associated with a mobile home community in Mashpee (MassDEP # 4172001-02G). The Mashpee Village PWSW was temporarily shut down in February 2017 due to PFOS+PFOA concentrations greater than the 2016 EPA lifetime HA and AFCEC installed a wellhead treatment system to remove PFOS/PFOA which began operation on 14 February 2020. AFCEC installed a water main and connections to service the residences using the former community water supply well in 2018 (93 units) (AFCEC 2022d).

Two Mashpee PWSWs (Turner Road #2 PWSW [MassDEP# 4172039-08G] and Turner Road #5 PWSW [MassDEP# 4172039-05G]) and one Falmouth PWSW (Fresh Pond PWSW [MassDEP# 4096000-02G]) had PFAS concentrations greater than the MassDEP PFAS6 MMCL but PFOS/PFOA concentrations were below the 2016 EPA lifetime HA.

These three wells were taken offline (February 2019, July 2020, and April 2017, respectively) (AFCEC 2022d). AFCEC installed temporary wellhead treatment on the Fresh Pond PWSW which began operation on June 8, 2022; a permanent system for the Fresh Pond PWSW is being planned. A permanent wellhead treatment system for Mashpee's two Turner Road PWSWs is planned to begin operation in September 2023.

Two non-community water supply wells (Sea Mist Resort #1 and Sea Mist Resort #2) located in the Town of Mashpee were sampled for PFAS by AFCEC on 20 February 2017 and concentrations were above the PFAS6 MMCL but below 2016 EPA lifetime HA. The wells were resampled on 13 May 2019 and again on 19 January 2022 after promulgation of the PFAS6 MMCL and concentrations were below the PFAS6 MMCL during each of these sampling events (AFCEC 2022d).

2.2.3.2 LF-1

Both 1,4-dioxane and PFAS have been detected in groundwater at the LF-1 site; however, a DD to address these emerging contaminants is pending. LF-1 has a ROD and ESD for legacy COCs and its current remedy is evaluated as part of this FYR in Section 4.9. The extent of LF-1 groundwater exceeding the PFAS6 MMCL is shown on Figure 1-2. As part of the LUC process specified in the ROD (AFCEE 2007), a private well verification survey identified two drinking water wells in the LF-1 LUC area (which encompasses the 1,4-dioxane and PFAS area of concern). One drinking water well is no longer in service since the resident has connected to the municipal supply. The remaining private drinking water well is located near the LF-1 Northern Lobe. This well was sampled for volatile organic compounds (VOC) in July 2010 and the LF-1 COCs were not detected. This well was determined to be screened well above the chlorinated solvent plume therefore routine monitoring was not needed. In addition, this well was not sampled for 1,4-dioxane or PFAS since these contaminants were not detected above standards or screening values in the LF-1 Northern Lobe (AFCEC 2018c). The LF-1 Northern Lobe no longer exists in the area of this private well (AFCEC 2019b).

The two Bourne PWSWs, BOPWS0002 and BOPWS0005 (Figure 4-15), that are located downgradient of the LF-1 plume area were sampled for 1,4-dioxane and PFAS by the

Bourne Water District in May 2014 and November 2014 under the Unregulated Contaminant Monitoring Rule 3 (EPA 2016a). 1,4-Dioxane was detected at BOPWS0005 at concentrations below the EPA site-specific, risk-based RG of 0.46 µg/L. 1,4-Dioxane was not detected at BOPWS0002 and PFAS were not detected at either PWSW at that time. However, the Bourne PWSWs were resampled for PFAS analysis in January 2021; PFAS were not detected at BOPWS0002, and the PFAS6 concentration at BOPWS0005 was 0.0027 µg/L, well below the PFAS6 MMCL of 0.02 µg/L (AFCEC 2022i).

No removal actions (i.e., bottled water, residential filtration systems, municipal water connections, PWSW wellhead treatment) have been required in response to 1,4-dioxane or PFAS groundwater detections at LF-1.

2.2.3.3 Tanker Truck Rollover Site

PFAS contamination has been detected in groundwater at the TTRS site. This site is located near the Route 28 rotary at the western boundary of JBCC where two tanker trucks carrying petroleum product overturned in separate incidents in 1997 and 2000 (Figure 1-2). AFFF was applied to the tanker trucks and the ground surface as part of the emergency response actions (AFCEC 2022e). The site does not yet have a DD and is not evaluated in this FYR. As of 30 Sep 2022, a total of 8 private wells have been identified and sampled for PFAS. PFAS have been detected in all 8 of the private wells sampled in the TTRS outreach area. The 2016 EPA lifetime HA for PFOA and PFOS, individually or combined (0.07 µg/L), and the MassDEP PFAS6 MMCL (0.02 µg/L) were used for determining appropriate removal actions during this FYR period. The maximum combined PFOA+PFOS detection in a residential well was 0.4881 µg/L (PFAS6 of 0.549 µg/L) in 2016. Seven of the residences had detections in excess of the 2016 lifetime HA and/or MassDEP PFAS6 MMCL and were provided with a water filtration system and/or bottled water and were subsequently connected to municipal water by AFCEC in January 2022 as part of a CERCLA non-time-critical removal action (AFCEC 2022c). The Bourne Water District connected the eighth residence, which was consistently below the 2016 lifetime HA and MMCL, as a condition of their permit for new construction (AFCEC 2022e).

2.2.3.4 Flight Line Area Operable Unit

PFAS contamination has been detected in groundwater at the Flight Line Area Operable Unit (OU) located in the southeast portion of JBCC (AFCEC 2022b). This OU was created to encompass PFAS contamination in groundwater from six PFAS source areas (Table 1-1c, Figure 2-2). The OU does not yet have a DD and is not evaluated in this FYR. As of 30 Sep 2022, a total of 3 private wells have been identified and sampled for PFAS with all detections below the PFAS6 MMCL (AFCEC 2023).

2.3 SITE INSPECTIONS

Site Inspections (SI) have been completed for each of the IRP source area sites and the MRS addressed in Section 3.0 and Section 5.0, respectively. A summary of the findings is included in each of the sites' FYR evaluations. It is noted that no issues were identified at any of the source area sites that required corrective action or affect protectiveness.

Similar to prior FYRs, SIs for the groundwater sites evaluated in this FYR were not conducted because these sites, and the associated remedial systems for the plumes with active treatment, are routinely inspected (daily during the work week) as part of the ongoing operations and maintenance (O&M) activities by AFCEC's full time O&M contractor. Any operational or other issues, such as operational downtime, are reported to the regulatory agencies via notification e-mails. Restart notifications are also provided via e-mail. The IRP remedial systems are operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. While occasional operational issues are identified, these issues have been, and continue to be, addressed in a timely and effective manner such that O&M associated with the remedy is considered effective at achieving the remedy goals. O&M data and activities are summarized in O&M monthly reports and system performance and reliability is reported at Technical Update meetings and in annual Summary Letter Reports (SLRs) which are submitted to the regulatory agencies.

2.4 INTERVIEWS

Similar to the last FYR (AFCEC 2018a) and with concurrence from EPA, interviews were not conducted as part of this FYR. It was agreed that the on-going, iterative interaction between AFCEC, the regulatory agencies, and the broader stakeholder group, for example through the JBCC Cleanup Team (JBCCCT) meeting process, provided sufficient opportunity for any and all stakeholders to communicate issues or concerns. A required fact sheet summarizing the findings and conclusions of the Five-Year Review will be produced and distributed.

2.5 OVERVIEW OF THE SPEIM/LTM PROGRAM

AFCEC's System Performance and Ecological Impact Monitoring (SPEIM)/Long Term Monitoring (LTM) program was developed to monitor changes to the groundwater plumes and to ensure the effective operation of the AFCEC groundwater remediation systems at the JBCC. These objectives are met through the routine monitoring of selected media (i.e., groundwater, surface water) within and outside the groundwater plume boundaries, at the treatment plants, and through groundwater flow and transport modeling. The data collected under the SPEIM/LTM program are continually assessed by a team of professional staff and the results of these assessments are presented to the regulatory agencies initially during periodic Technical Update meetings and then through technical memoranda or project note deliverables, if warranted, based on the results of the data evaluation or to address particular plume issues. Updates on the status of the remedial action at each plume are provided to a broader stakeholder group at JBCCCT meetings.

In addition, AFCEC prepares annual SLRs for the groundwater plumes that are being addressed through active treatment under the SPEIM program. The purpose of these SLRs is to document the results of sampling activities conducted at each plume under the SPEIM program. The SLRs also include: (i) a summary of all major events and optimizations completed at the plume; (ii) O&M-related system performance information such as contaminant mass removal/air emissions, system flow rate summaries, and downtime summaries; and (iii) all relevant technical assessment documentation completed during the annual reporting period as attachments or by reference. The SLRs also address the status

of previous FYR recommendations and the LUC program's private well verification program. For the groundwater sites where active treatment was not part of the remedy, remedial progress is assessed and the results are provided through the submittal of LTM project notes or letter reports. The SLRs and LTM deliverables are provided to the broad stakeholder group for each plume or site including Federal (EPA) and State (MassDEP, Massachusetts Department of Public Health) regulatory agencies, town departments (such as the BOHs, Departments of Public Work, Water Departments, and/or Conservation Commissions), affected property owners, and other interested parties as applicable. The SLRs and LTM deliverables are publicly available in the IRP AR and AR numbers (for web access) are provided to local town libraries.

2.6 SUSTAINABILITY

In a world that is resource limited and increasingly aware of activities that could impact global climate, there is growing emphasis on designing and maintaining more sustainable, low-impact engineering solutions. This emphasis on sustainability extends to the remediation of soil and groundwater. AFCEC is committed to a more complete evaluation of sustainability metrics when considering and comparing the total impacts, benefits, and life-cycle costs of the environmental remediation decisions and actions made in support of the IRP at JBCC.

Various private and public organizations have developed policies and guidance documents on the application of sustainable practices in remediation. These practices are driven by social, environmental, and economic pressures which constitute the "triple bottom line" of sustainability. Presidential Executive Orders 13423 (Bush 2007), 13514 (Obama 2009) imposed specific goals to federal agencies regarding the incorporation of sustainable practices. Greener cleanup strategies also support the goals in Executive Order 14008 (EPA 2023a), *Tackling the Climate Crises at Home and Abroad* (Biden 2021).

Green remediation results in effective cleanups minimizing the environmental and energy "footprints" of site remediation and reuse. Sustainable practices emphasize the need to more closely evaluate core elements of a cleanup project:

- energy requirements of the treatment system,
- air emissions,
- water requirements and associated impacts on water resources,
- impacts on land and ecosystems,
- material consumption and waste generation, and
- long-term stewardship actions.

Starting in 2003, AFCEC has been promoting a strategy that fully encompasses environmental effects of cleanup actions when evaluating groundwater system operations and optimizations in order to more holistically address protectiveness. Since 2003 and prior to the development of the current green and sustainable guidance documents and approaches, AFCEC has been proactive in incorporating sustainability considerations into the SPEIM/LTM/O&M program at JBCC. Examples of sustainability initiatives implemented by AFCEC at JBCC include:

- Construction of three 1.5-megawatt wind turbines resulting in the AFCEC IRP power use being offset by 100 percent renewable energy.
- Conducting energy audits and implementing energy conservation measures such as efficient lighting, occupancy sensors, and programmable thermostats; and enrollment in a demand response program.
- Performing remedial system optimization evaluations with the objective of accelerating aquifer restoration timeframe while reducing operational flow rates and total treated volume. Initiatives include adjusting flow rates and installing packers at individual extraction wells and developing beneficial reinjection/infiltration strategies.
- Applying remedial process optimization to treatment processes including redirecting extracted groundwater flow to treatment plants with excess capacity resulting in shutdown of underused facilities, rearranging GAC filter vessels to leverage the maximum amount of the GAC's removal capacity, and conducting other pilot test initiatives with the goal of reducing the overall program costs and/or providing for a more sustainable treatment approach.
- Installing variable frequency drives which can eliminate booster pumps and downsize pump motors.
- Using AFCEC-owned and self-performed direct push drilling technology to reduce

costs and waste generation and minimize impacts on the environment and community.

- Increasing use of biofuels and environmentally sensitive hydraulic oil in fleet vehicles.
- Improving the trophic health of a pond by using an innovative zero-valent iron geochemical barrier that passively removes phosphorus discharging into the pond.
- Reusing treated water for irrigation.
- Using passive/no-purge sampling techniques, where applicable, rather than techniques that require pumps, resulting in energy savings and less waste generation.

2.7 CLIMATE CHANGE

The expected impacts of climate change in New England pose increasing risks to contaminated sites. Increases in air and water temperature, precipitation, flooding, and periods of drought may result in altered fate and transport pathways and exposure assumptions, impaired aquatic habitats, dispersal of contaminants, damage to remediation related structures, and ultimately ineffective remedies. At coastal sites, saltwater impacts made more likely by sea-level rise may cause corrosion of remediation equipment and impair restoration efforts. Increased frequency of extreme weather events may cause damage or releases at sites, impairing remedial efforts where remedies have not been adequately designed to protect against these risks.

The risks posed by climate change in New England are not expected to alter the protectiveness of the remedies at the JBCC Site. EPA's Environmental Justice Screening and Mapping Tool (EPA 2023b) was used to assess coastal flood hazard, 100 year floodplain, sea level rise, wildfire risk, and flood risk at the JBCC Site (including extent of off-base groundwater contamination). None of the noted climate change indicators were mapped in areas of the upper Cape Cod region that would have an impact on the protectiveness of the selected remedies.

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3.0 IRP SOURCE AREAS REQUIRING FIVE-YEAR REVIEW

This section presents the IRP source area sites for which a FYR is required. Six IRP sites (Table 1-2) require a FYR because the sites do not meet UU/UE conditions. The FYR evaluations for the six sites are presented in four sections as follows:

- Section 3.1: (OU 8) Chemical Spill-10 (CS-10)
- Section 3.2: (OU 7) Landfill-1 (LF-1)
- Section 3.3: (OU 5) Fire Training Area-2 (FTA-2) and co-located Landfill-2 (LF-2)
- Section 3.4: (OU 5) Petroleum Fuels Storage Area (PFSA) comprising sites Fuel Spill-10 (FS-10) and FS-11

3.1 CS-10 SOURCE AREA (DETAILS C AND F)

3.1.1 Introduction

The CS-10 source area (OU 8) occupies approximately 52 acres at the eastern boundary of the JBCC (Figures 1-2 and 3-1). Originally, the CS-10 source area consisted of a number of buildings constructed as part of the Boeing-Michigan Aeronautical Research Center (BOMARC) missile launch site by the USAF which operated between 1960 and 1973. The BOMARC buildings were removed from the site in 2005. The site is currently used by the MAARNG as the Unit Training Equipment Site (UTES) facility for maintenance and storage of vehicles.

The former BOMARC facility and UTES facility are considered the primary sources of historic contamination to soils in the source area and the CS-10 groundwater plume from 1960 to the early 1990s (AFCEC 2018). Other sources of contamination are presumed to have contributed to the CS-10 groundwater plume as it traveled beneath the JBCC (CS-10 groundwater is addressed in Section 4.3).

The remedial investigation (RI) (AFCEE 1999) divided the CS-10 source area into nine discrete details (Details A through I). Only Details C and F do not meet UU/UE criteria and are addressed in this FYR. The other seven details, including Detail G which is also known as FS-24, have met their respective UU/UE criteria (AFCEE 2011).

Detail C soil contamination is associated with a former 300-gallon jet propulsion-4 (JP-4) underground storage tank (UST). Detail F soil and sediment contamination is associated with the Eastern Storm Sewer Outfall Drainage Impoundment which receives storm water from four storm sewer outfalls. The storm sewers received runoff and discharges from facility operations (AFCEE 1999).

3.1.2 Response Action Summary

3.1.2.1 Basis for Taking Action

Many of the ROD-mandated Detail C and F soil/sediment COCs and associated cleanup levels (AFCEE 1999) were modified or removed in subsequent ESDs (AFCEE 2003, 2011). The current COCs and cleanup levels are shown in Exhibits 3-1a, 3-1b and 3-1c in Section 3.1.2.2.

At Detail C, the basis for action was the potential for leaching to groundwater from PCE and total petroleum hydrocarbons (TPH) (AFCEE 1999).

At Detail F, the human health risk assessment indicated that the MassDEP target risk of 1 x 10^{-5} was exceeded for current and future workers and future child residents exposed to polychlorinated biphenyls (PCB) in soil. Additionally, a potential for leaching to groundwater from methylene chloride and TPH was identified. Based on the ecological risk assessment, polycyclic aromatic hydrocarbons (PAH), PCBs, dieldrin, and metals in soils and sediments and metals in surface water posed unacceptable risk (AFCEE 1999).

3.1.2.2 Response Actions

Record of Decision: The final remedy for CS-10 Detail C and F was presented as part of the *Record of Decision Area of Contamination CS-10/FS-24 Source Areas* (AFCEE 1999). The Remedial Action Objectives (RAO) for all details are:

- To minimize direct contact, ingestion, and inhalation by human receptors with Source-Area-contaminated soils/sediments estimated to exceed a total cancer risk level of 10^{-6} for each carcinogenic compound, or exceed soil target cleanup levels (STCL) based on human health risk.
- To minimize adverse impacts to ecological receptors from source area contaminated soil, sediment, and surface water estimated to exceed a hazard index

of 1 or exceed soil target cleanup levels (STCLs) based on ecological risk.

- To provide a source control alternative that minimized future migration of contaminants in soil/sediments to the underlying aquifer and to off-site locations as determined by exceedances of STCLs based on leaching.
- To the extent feasible, to reduce the concentration of the inorganic COCs in soil/sediments to achieve or approach STCLs based on background.

The remedies for Detail C and F included confirmation soil/sediment sampling, excavation, on-site stock-piling, sampling of excavated soils and sediments to determine whether soils would be treated at an on-site asphalt batching facility or disposed at an off-site RCRA Subtitle C treatment, storage, and disposal facility, followed by site restoration. The remedy for Detail C also included the installation, operation, and maintenance of an in situ thermally enhanced Soil Vapor Extraction (SVE) system. The remedy for all details included "maintaining site access controls that limit potential human exposure to contaminants" as an institutional control (IC).

Explanation of Significant Differences (2003): The *Explanation of Significant Differences for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/ FTA-3/CY-4* (AFCEE 2003) implemented revised soil cleanup levels which applied to all source area sites being addressed at the time under the Source Area Remedial Action Program, including CS-10 Details C and F. Specifically, soil cleanup level changes were made in three contaminant categories:

- Inorganic Ecological Risk Based COCs
- PCBs (Aroclor-1254 for Detail F) based on Human Health Risk, and
- Petroleum Hydrocarbons (TPH for Details C and F) which were changed to MassDEP extractable petroleum hydrocarbon (EPH)/volatile petroleum hydrocarbon (VPH) S-1/GW-1 cleanup levels.

Explanation of Significant Differences (2011): The *Explanation of Significant Differences Areas of Contamination CS-10/FS-24, FS-1, and FS-9* (AFCEE 2011) documents additional changes to the CS-10 Detail C and F remedies.

- Removal of the hot air injection wells as a component to the CS-10 Detail C

treatment system and the addition of a thermal oxidizer to the CS-10 Detail C treatment system.

- Removal of a UST from CS-10 Detail C which was not described in the ROD prescribed remedy.
- No ecological-based remedial action is required for CS-10 Detail F as a result of the findings of the ecological risk evaluation performed in 2004 using post-ROD data collected in 2001 and 2003 (AFCEE 2004a, 2004b).
- SVE system shutdown for CS-10 Detail C as a result of an impact to groundwater analysis for PCE.
- MassDEP S-1/GW-1 EPH/VPH cleanup levels at CS-10 Detail C (originally implemented in place of TPH in the 2003 ESD) were updated.

The adjusted COCs and cleanup levels (after both ESDs) for Detail C (soil) and Detail F (soil and sediment) are shown in Exhibits 3-1a, 3-1b and 3-1c, respectively.

Exhibit 3-1a

CS-10 Detail C Soil COCs and Cleanup Levels after ESDs

COC	Cleanup Level (micrograms per kilogram [µg/kg])	Basis for Cleanup Level	Cleanup Level changed in ESD?	Removed as COC in ESD?
VOCs				
PCE	10	Potential Leaching to GW	N	N
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_9-C_{12} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_9-C_{18} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_{19}-C_{36} Aliphatic Hydrocarbons	3,000,000	MCP	Y - 2011	N
C_9-C_{10} Aromatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_{11}-C_{22} Aromatic Hydrocarbons	1,000,000	MCP	Y - 2011	N

Exhibit 3-1b CS-10 Detail F Soil COCs and Cleanup Levels after ESDs				
COC	**Cleanup Level (µg/kg)**	**Basis for Cleanup Level**	**Cleanup Level changed in ESD?**	**Removed as COC in ESD?**
VOCs				
Methylene Chloride	10	Potential Leaching to GW	N	N
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_9-C_{12} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_9-C_{18} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_{19}-C_{36} Aliphatic Hydrocarbons	2,500,000	MCP	Y - 2003	N
C_9-C_{10} Aromatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_{11}-C_{22} Aromatic Hydrocarbons	200,000	MCP	Y - 2003	N
SVOCs				
2-Methylnaphthalene	700	MCP	N	N
PCBs				
Aroclor-1254	1,000	Human Health Risk	Y - 2003	N
Inorganics				
Manganese	274,000	Human Health Risk	N	N

Exhibit 3-1c CS-10 Detail F Sediment COCs and Cleanup Levels after ESDs				
COC	**Cleanup Level (µg/kg)**	**Basis for Cleanup Level**	**Cleanup Level changed in ESD?**	**Removed as COC in ESD?**
VOCs				
Methylene Chloride	10	Potential Leaching to GW	No	N
PCBs				
Aroclor-1254	1,000	Human Health Risk	Y - 2003	N
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_9-C_{12} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_9-C_{18} Aliphatic Hydrocarbons	1,000,000	MCP	Y - 2003	N
C_{19}-C_{36} Aliphatic Hydrocarbons	2,500,000	MCP	Y - 2003	N
C_9-C_{10} Aromatic Hydrocarbons	100,000	MCP	Y - 2003	N
C_{11}-C_{22} Aromatic Hydrocarbons	200,000	MCP	Y - 2003	N

3.1.2.3 Status of Implementation

A SVE system operated at CS-10 Detail C from February 2002 through June 2005. Additionally, a 300-gallon UST was removed in November 2000 followed by a targeted, 80 cubic yard soil/concrete excavation in April 2005 (AFCEE 2009).

At CS-10 Detail F, the 2011 ESD discussed in Section 3.1.2.2 established a change in the remedy for remedial action to no further action for the protection of ecological receptors. Any decisions regarding excavation at Detail F will recognize that the storm water impoundment is a thriving wetlands ecosystem (AFCEE 2011). The wetland was reported to have contained Agassiz's clam shrimp (*Eulimnadia agassizii*) which continues to be a State "Endangered" species.

As reported in the last FYR (AFCEC 2018), a 2014 vapor intrusion (VI) screening evaluation assessed potential VI risks from VOCs that remain in CS-10 soils at Details C and F. The results indicated that a VI risk above target levels is unlikely for current use. However, a VI risk above target levels cannot be ruled out for future use at Details C and F (AFCEC 2014).

The CS-10 source area LUCs and their status are shown on Exhibit 3-1d.

Exhibit 3-1d

LUC Status for CS-10 Source Area

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objective	Title of LUC Instrument Implemented and Date (or planned)
CS-10 Details C and F (Figure 3-1)	Yes	Yes	• Maintaining site access controls that limit potential human exposure to contaminants.	• Base Boundary Fence in area of CS-10, existing at time of 1999 ROD • Annual fence inspection, maintenance and repair • Fence added to encompass UTES, including Detail C, in 2020 timeframe • Base Security Measures – On-Going

The 1999 ROD states "Engineered controls such as fences will be inspected and maintained/repaired not less than annually." The ROD (which did not use the term LUCs or ICs) does not specify fence types or locations or whether a fence is required as part of the remedy. The fencing listed in Exhibit 3-1d has been installed as part of facility security and contributes to protectiveness at the site. The site inspection (Section 3.1.4.2) confirmed the UTES fence is not damaged, but annual inspections have not been documented. A recommendation to update and clarify the LUC language through a DD has been included as part of this FYR.

3.1.3 Progress Since the Last Review

This section includes the protectiveness determinations and statements from the **last** FYR (Exhibit 3-1e) as well as the recommendations from the **last** FYR (Exhibit 3-1f) and the current status of those recommendations.

Exhibit 3-1e

Protectiveness Determination/Statement from the 2018 FYR – CS-10 Source Area

OU #	Protectiveness Determination	Protectiveness Statement
8 (CS-10 Source Area)	Short-term Protective	**The remedies for CS-10 source area Details C and F are protective of human health and the environment in the short-term under the current land use scenario**. The remedy is protective in the short term since access to the site is controlled by a fence that effectively limits potential human exposure. However, for the remedies to be protective in the long-term it is recommended that site characterization data be reevaluated to determine if UU/UE conditions can be met; if UU/UE closure cannot be supported for Details C and/or F, then either (i) conduct additional cleanup activities to levels that allow UU/UE; or (ii) issue a decision document implementing enforceable LUCs preventing uses for which the site may still pose an unacceptable risk under future uses that would ensure long-term protectiveness.

Exhibit 3-1f Status of Recommendations from the 2018 FYR – CS-10 Source Area				
OU #	**Issue**	**Recommendations**	**Current Status**	**Current Implementation Status Description**
8 (CS-10 Source)	LUC/long-term protectiveness	Complete an assessment of Detail C EPH/VPH data and Detail F PAH, PCB, inorganic data and pursue UU/UE closure. If UU/UE closure cannot be achieved, then document LUC plan in an ESD.	Ongoing	See Below Discussion

An initial assessment of soil and sediment data as identified in the recommendation began in March 2022. The planned methodology followed the UU/UE determination process used for the other CS-10 details as part of the 2011 ESD (AFCEE 2011). Specifically, existing soil and sediment data would be compared to applicable MassDEP S-1/GW-1 soil standards and EPA Residential Soil RSLs to determine if Details C and F meet UU/UE standards.

An assessment of the VI pathway risk using bulk soil concentrations (as conducted in 2014) is no longer valid using current EPA and MassDEP VI screening methodologies. To conduct an updated VI risk screening, which is needed to make a UU/UE determination, soil vapor gas sampling data from Details C and F are required.

Before the data assessment recommended in the 2018 FYR was completed, AFCEC was informed of an estimated 20-gallon hydraulic oil release at the UTES facility that occurred on October 27, 2021 (MassDEP Release Tracking Number 4-29046). A relatively small portion of the released oil (likely less than 5 gallons) entered a catch basin and flowed within the drainage system to an outfall at Detail F. Sampling conducted as part of the non-CERCLA environmental response by the MAARNG included sampling the interior coating (a black tar-like material) from the affected storm sewer piping. Analytical results from the coating material indicated PCB (aroclor-1260) and TPH concentrations exceeding their respective MCP S-1/GW-1 soil standards (MAARNG 2022). The coating material may present an on-going contaminant source to the Detail F source area.

AFCEC is not proceeding with the recommended Detail C and F data assessment, UU/UE determination, or ESD at this time. Instead, an additional investigation is being conducted to:

- Obtain updated soil and/or sediment data and new soil vapor data at Detail C and Detail F to determine if additional remedial measures are required to meet UU/UE conditions, and
- Address the potential on-going PCB and TPH release from the storm sewer system leading to Detail F.

The need and scope of additional investigations, remedial measures and/or a future ESD at Details C and F will be dependent on the investigation results.

3.1.4 Five-Year Review Process

3.1.4.1 Data Review

No new CERCLA data was collected at CS-10 Details C and F during this FYR period and the site is not addressed in SLRs or Project Notes. However, as part of a hydraulic oil release response into the storm sewer leading to Detail F (discussed in Section 3.1.3) an April 2022 sample of the coating material (non-soil solid) in the storm sewer piping indicated two exceedances of concern (MAARNG 2022):

- PCBs: A PCB (aroclor-1260) detection of 2,040 µg/kg exceeds the MassDEP S-1/GW-1 soil standard of 1,000 µg/kg.
- TPH: A TPH detection of 270,000 milligrams per kilogram (mg/kg) exceeds the MassDEP S-1/GW-1 soil standard of 1,000 mg/kg.

A further assessment of the storm sewer is being conducted as described in Section 3.1.3.

3.1.4.2 Site Inspections

An SI in support of this FYR was completed for CS-10 Details C and F on 27 October 2022. Since there is no ongoing O&M, the focus of the SI was to assess general site conditions and to determine whether the LUCs are in place. Based on the SI, land use at the site remains consistent with the assumptions used in the risk assessment. The fencing

that encompasses Detail C had no damage and the LUCs are preventing exposure and no concerns regarding protectiveness were identified.

3.1.4.3 Interviews

Refer to Section 2.4.

3.1.5 Technical Assessment

3.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes. The remedial action for CS-10 Detail C has eliminated groundwater impacts while the ecological assessments and subsequent ESD (AFCEE 2011, 2004a, 2004b) documented there is no unacceptable ecological risk at CS-10 Detail F.

The current LUCs of base security and a fence at the base boundary near Detail F, in addition to a fence surrounding UTES and Detail C, have been effective in preventing exposure to soil or sediments that may present an unacceptable risk to humans; however, the LUC language in the 1999 CS-10 Source Area ROD is outdated. JBCC RODs, ROD amendments, and ESDs prepared subsequent to the CS-10 Source Area ROD use LUC language that provides more robust protectiveness by including specificity regarding the Dig-Safe process and requirements for an annual LUC evaluation and regulatory notification of changes in land use, land ownership, or LUC modification/termination.

3.1.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

No. The current exposure assumptions, cleanup levels, and RAOs are not valid and need to be updated after further evaluation.

There are changes in standards and TBCs that affect the CS-10 Detail C and F remedy. In some cases the cleanup levels selected in the 1999 ROD and subsequent ESDs are based on outdated toxicity data and/or risk methodologies. There is also a change related to the use of MCP S-1/GW-1 standards for EPH/VPH from the ESDs. The EPA has RSLs for total petroleum hydrocarbon fractions which align with 5 of the 6 EPH/VPH MCP S-1/GW-1 standards cited in the 2003 and 2011 ESDs. Specific COCs requiring an update

are summarized in Exhibit 3-1g. The MassDEP S-1/GW-1 and EPA RSLs are shown for comparison purposes. Two current COCs (C_9-C_{18} Aliphatic Hydrocarbons and C_{11}-C_{22} Aromatic Hydrocarbons) have a comparative EPA RSL (shown in bold) that is lower than the current cleanup level. A recommendation has been included to develop (and adopt by ESD as deemed appropriate) federal risk-based standards based on current site data.

Exhibit 3-1g

CS-10 Detail C and F Cleanup Levels Requiring Evaluation/Update

COC	Current Cleanup Level from ROD or	Media	Detail C or Detail F	2022 MassDEP S-1/GW-1 (µg/kg)	May 2023 EPA RSL (TR = 1E-04, HQ=1) (µg/kg)
VOCs					
Methylene Chloride	10*	Soil	Detail F	100	290 (risk-based SSL)
PCE	10*	Soil	Detail C	1,000	510 (risk-based SSL)
EPH/VPH					
C_5-C_8 Aliphatic Hydrocarbons	100,000	Soil/Sediment	Both	100,000	250,000
C_9-C_{12} Aliphatic Hydrocarbons	1,000,000	Soil/Sediment	Both	1,000,000	N/A
C_9-C_{18} Aliphatic Hydrocarbons	1,000,000	Soil/Sediment	Both	1,000,000	**96,000**
C_{19}-C_{36} Aliphatic Hydrocarbons	3,000,000	Soil	Detail C	3,000,000	230,000,000
C_{19}-C_{36} Aliphatic Hydrocarbons	2,500,000**	Soil/Sediment	Detail F	3,000,000	230,000,000
C_9-C_{10} Aromatic Hydrocarbons	100,000	Soil/Sediment	Both	100,000	300,000
C_{11}-C_{22} Aromatic Hydrocarbons	1,000,000	Soil	Detail C	1,000,000	**18,000**
C_{11}-C_{22} Aromatic Hydrocarbons	200,000***	Soil/Sediment	Detail F	1,000,000	**18,000**
SVOC					
2-Methylnaphthalene	700	Soil	Detail F	700	240,000
INORGANICS					
Manganese	274,000*	Soil	Detail F	N/A	1,800,000

* These VOC cleanup levels were based on a leaching-based STCL developed in 1996.

** These levels were established in the 2003 ESD. The 2011 ESD updated the cleanup levels for these two COCs at other CS-10 details but did not include Detail F.

*** This COC cleanup level was based on a human health risk-based STCL developed in 1996.

There are changes in risk assessment methods or exposure pathways that effect the protectiveness of the CS-10 Detail C and F remedy. As discussed in Section 3.1.3, the risk assessment methods used in 2014 to evaluate potential VI risk are no longer valid.

The RAOs do not address the potential of an on-going source. As discussed in Sections 3.1.3 and 3.1.4.1 the coating material in the storm drain leading to Detail F was determined to contain PCB (aroclor-1260) and TPH concentrations in excess of the MassDEP S-1/GW-1 standards and may be an on-going source to soil/sediment contamination. Additionally, the exposure assumptions and associated RAOs (AFCEE 1999) do not include the potential VI pathway identified in the VI screening evaluation conducted in 2014 (AFCEC 2014). This FYR includes recommendations to address the potential VI issue and the potential on-going source.

3.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

3.1.6 Issues/Recommendations

Exhibit 3-1h Issue/Recommendation #1: CS-10 Detail C and F				
OU 8 (CS-10 Source Area)	**Issue Category:** Human Health Risk			
	Issue: There is no LUC to control the VI pathway which may present an unacceptable risk.			
	Recommendation: Evaluate the VI risk using soil gas data at Detail C and F. If an unacceptable VI risk exists, prepare a DD (as part of Recommendation #4) to add a RAO which addresses VI and either add a LUC to control the potential VI pathway or require a remedial action to address the VI risk.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

Exhibit 3-1i Issue/Recommendation #2: CS-10 Detail F				
OU 8 (CS-10 Source Area)	**Issue Category:** Changed Site Conditions			
	Issue: There may be an on-going contaminant source to Detail F soil/sediment from the storm drain coating.			
	Recommendation: Evaluate the PCB and EPH/VPH impacts to the soil at the Detail F outfall area. Prepare a DD (as part of Recommendation #4) and conduct additional remedial measures to address the source material as necessary to ensure protectiveness.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

Exhibit 3-1j Issue/Recommendation #3: CS-10 Detail C and F				
OU 8 (CS-10 Source Area)	**Issue Category:** Cleanup Levels			
	Issue: The recommendation from the 2018 FYR to assess residual contaminants in soil/sediment (discussed in Section 3.1.3) has not been completed. Current cleanup levels cited in the 2003 and 2011 ESDs are based on MassDEP standards or are outdated.			
	Recommendation: Once an assessment of residual contaminants has been completed, develop federal risk-based standards for those contaminants that present an unacceptable risk and preclude a UU/UE designation. Engage regulatory stakeholders to determine which updated standards will be adopted for use in executing Recommendation #4 (preparing a DD).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

Exhibit 3-1k Issue/Recommendation #4: CS-10 Detail C and F				
OU 8 (CS-10 Source Area)	**Issue Category:** Land Use Controls			
	Issue: The recommendation from the 2018 FYR to assess residual contaminants in soil/sediment (discussed in Section 3.1.3) has not been completed. The LUC language in the ROD is not specific and needs to be updated to reflect the LUC standards used at JBCC. JBCC DDs prepared after the CS-10 Source Area ROD use LUC language that provide more robust protectiveness by including specificity regarding the Dig-Safe process and requirements for an annual LUC evaluation and regulatory notification of changes in land use, land ownership, or LUC modification/termination.			
	Recommendation: In conjunction with Recommendations #1, #2, and #3, complete the additional assessment and determine whether Details C and F meet UU/UE closure requirements when applying updated cleanup standards (i.e., Recommendation #3). Prepare a DD to update the RAOs, cleanup levels and LUC language, as appropriate, recognizing that both Detail C and F may not achieve UU/UE closure.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

3.1.7 Protectiveness Statement

The remedies for CS-10 source area Details C and F are protective of human health and the environment in the short-term under the current land use scenario. The remedy is protective in the short-term since access to the site is controlled by base security and a fence that effectively limits potential human exposure. However, for the remedies to be protective in the long-term the VI pathway must be evaluated using updated procedures and the LUC language must be updated to address the VI pathway if necessary. Additionally, a potential new contaminant source from the Detail F storm drain should be evaluated and updated cleanup standards must be developed to ensure protectiveness. Finally, the LUC language must be updated to be consistent with other JBCC DDs if contaminants left in place exceed updated cleanup standards. This determination will be based on the results of a data evaluation using updated cleanup standards in conjunction with any additional remedial measures taken.

3.1.8 References

AFCEC. 2018 (September). *Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA.* Prepared by AFCEE/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2014 (July). *Final 2014 CS-10 Source Area Details C and F Vapor Intrusion Evaluation*, Otis Air National Guard Base, MA.

AFCEE. 2011 (September). *Explanation of Significant Differences Areas of Contamination CS-10/FS-24, FS-1, and FS-9.* AFCEE/MMR, Otis Air National Guard Base, MA.

_____. 2009 (September). *Chemical Spill 10 (CS-10) Detail C Remedial Action Report*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2004a (October*). Ecological Risk Assessment-Addendum Area of Concern CS-10 Detail F*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2004b (March). *Revised Screening Level Ecological Risk Assessment Area of Concern CS-10 Detail F*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2003 (February). *Explanation of Significant Differences Areas of Contamination CS-10 (A, B, & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4*. Prepared by Portage Environmental Inc. and Engineering Strategies Corp. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (July). *Record of Decision Area of Contamination CS-10/FS-24 Source Areas*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

MAARNG. 2022 (October) *Immediate Response Action Completion Report & Permanent Solution Statement*. Prepared by Clean Harbors Environmental Services, Inc. for the Massachusetts Army National Guard, Bedford, MA.

3.2 LANDFILL-1 (LF-1) SOURCE AREA

3.2.1 Introduction

The LF-1 source area (OU 7) is located in the southern portion of JBCC and is bounded by Turpentine Road to the east, Frank Perkins Road to the west, Herbert Road to the north, and Connery Avenue to the south (Figures 1-2 and 3-2). The LF-1 source area, which occupies approximately 100 acres of open to heavily wooded terrain, operated between 1941 and 1993 as the primary solid waste disposal facility at JBCC (AFCEE 2012).

Disposal at the landfill occurred in six areas consisting of five distinct cells and a natural kettle hole. The cells are designated by the years representing the approximate end date of waste disposal activities. The six disposal areas include the 1947, 1951, and 1957 cells, referred to as the Northwest Operable Unit (NWOU), which occupy approximately 40 acres of the total LF-1 landfill area; and the 1970 and Post-1970 cells and the Kettle Hole, which occupy approximately 50 acres. The remaining 10 acres comprise the space between and surrounding the cells.

Accurate documentation of the wastes disposed of at the LF-1 landfill does not exist. The wastes are believed to include general refuse, fuel tank sludge, herbicides, solvents, transformer oils, fire extinguisher fluids, blank small arms ammunition, paints, paint thinners, batteries, dichlorodiphenyltrichloroethane (DDT) powder, hospital wastes, municipal sewage sludge, coal ash, and possibly live ordnance (AFCEE 2012).

The LF-1 source area is currently maintained as a controlled area. This use is not anticipated to change over time.

3.2.2 Response Action Summary

3.2.2.1 <u>Basis for Taking Action</u>

The actions taken at the LF-1 source area were designed to address the contaminants in the groundwater associated with the landfill. The specific contaminants of concern and exposure to potential receptors are managed as part of the LF-1 groundwater operable unit (OU 16) as discussed in Section 4.9.

Human health and ecological risks associated with exposure to surface soil contamination were not evaluated for two reasons. First, no data exist on the nature and extent of soil contamination at the LF-1 source area since sampling activities may encounter buried live ordnance. Second, the potential risks associated with exposure to LF-1 groundwater were sufficient to require source remedial action (ANG 1993).

3.2.2.2 Response Actions

Interim Record of Decision: An interim remedial action for the landfill was selected and documented in the *Record of Decision Interim Remedial Action, Main Base Landfill ([Area of Concern] AOC LF-1) Source Area Operable Unit* (ANG 1993) and consisted of the following actions:

- Leaving NWOU wastes in place beneath the existing soil and vegetative cover and installing downgradient groundwater monitoring wells to assess any impacts from the older cells.
- Construction of a landfill cover system over the 1970 Cell, Post-1970 Cell, and the Kettle Hole.
- Preparation of a Post-Closure Monitoring (PCM) Plan for the 1970 Cell, Post-1970 Cell, and Kettle Hole.

Final Record of Decision: A final remedy for the 1970 Cell, Post-1970 Cell, and Kettle Hole was selected and documented in the *Record of Decision for Landfill-1 Source Area and Groundwater* (AFCEE 2007). The NWOU (the 1947, 1951, and 1957 cells) was not included in this DD.

The RAOs pertaining to the source area are:

- Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable.
- Prevent risks to human health and the environment (if any) posed by the landfill.

The remedy for the LF-1 source area (the 1970-Cell, Post-1970 Cell, and Kettle Hole) provides for continued monitoring (physical condition, landfill gas and settlement) and maintenance (mowing, clearing culverts, repairing erosion) of the existing landfill cover system and associated reporting of monitoring results. The remedy also includes LUCs to

prevent access to waste and soils beneath the LF-1 cover system and to maintain the integrity of the landfill cover system (AFCEE 2007).

Explanation of Significant Differences: The NWOU was not included in the LF-1 ROD due to EPA concerns regarding surface soil contamination related to former Gun Positions (Old GP-2 and Old GP-3) that were used on the NWOU after the landfill cells were closed. The Impact Area Ground Water Study Program (IAGWSP) addressed EPA's concerns regarding the NWOU surface soil contamination, allowing a DD to be completed for the NWOU. An ESD was issued that extends the applicable LUCs for the capped portion of the LF-1 landfill to the NWOU (AFCEC 2013).

3.2.2.3 Status of Implementation

Closure activities at the landfill, including capping three cells (1970, Post-1970, and Kettle Hole) and instituting PCM, were completed in December 1995 (AFCEE 2007). A perimeter fence was already in place around the entire landfill (capped cells and NWOU) at the time the cap was installed in 1995.

The LF-1 source area LUCs and their status are shown on Exhibit 3-2a.

Exhibit 3-2a

LUC Status for LF-1 Source Area

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD and ESD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
LF-1 Landfill -capped cells and NWOU (Figure 3-2)	Yes	Yes	• Prevent access to waste and soils beneath the NWOU and the LF-1 cover system until the waste and soils no longer pose an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as the landfill cover system, the treatment systems, and monitoring wells.	• Fence, 1995 • Dig Safe Registration and Review – On-Going

Although not a formal component of the LF-1 ROD, AFCEC documented the presence of a landfill at LF-1 to meet the intent of a deed notification per MassDEP solid waste regulations (310 CMR 19.141). AFCEC, working with the base real estate office and the Commonwealth, who owns the property, were unable to determine whether a deed for the LF-1 parcel(s) exists. Therefore, a Record of Notice of Landfill Operations was filed at the Base Real Property office (AFCEC 2018).

3.2.2.4 Remedy Operations & Maintenance

The LF-1 post-closure monitoring activities are guided by the *Final Landfill-1 2011 Post-Closure Monitoring Plan Update* (AFCEE 2012). Subsequent modifications to this plan are coordinated with EPA and MassDEP and are documented in project notes which are included in the annual LF-1 SLRs. The only modifications to the LF-1 post-closure monitoring requirements during this FYR were documented in the 2019 LF-1 SLR (AFCEC 2020):

- Conduct the landfill settlement survey every five years (instead of annually) with the next survey occurring in 2022.
- Conduct the landfill topographic survey on an as-needed basis (instead of every 5 years), based on the results of the settlement survey and/or due to observations from the annual landfill inspections.

The annual LF-1 SLRs (AFCEC 2023, 2022, 2021, 2020, 2019) contain specific details regarding the implementation and results of post-closure monitoring. A summary of post-closure monitoring activities since the last FYR is shown in the following exhibit.

Exhibit 3-2b

LF-1 Post-Closure Monitoring Activities

Post-Closure Monitoring Activity	2018	2019	2020	2021	2022	NOTES
Settlement Survey	No	No	No	No	Yes	2018 – N/A due to planned solar project. 2019-2022 – Frequency every 5 years. Last survey was in 2017.
Topographic Survey	No	No	No	No	No	2018- Not required. 2019-2022 – Frequency adjusted to as-needed.
Cap Mowing	Yes	Yes	Yes	Yes	Yes	
Landfill Inspection	Yes	Yes	Yes	Yes	Yes	

There were no implementation problems noted during the post-closure activities and all required maintenance items were routine.

3.2.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 3-2c). There were no issues or recommendations for the LF-1 source area in the last FYR.

Exhibit 3-2c

Protectiveness Determination/Statement from the 2018 FYR – LF-1 Source Area

OU #	Protectiveness Determination	Protectiveness Statement
7 (LF-1 Source Area)	Short-term Protective	**The remedy for the LF-1 source area is protective of human health and the environment in the short-term under the current land use scenario.** Groundwater monitoring under the LF-1 SPEIM/LTM program does not indicate the LF-1 source area is acting as a continuing source of groundwater contamination for current COCs and prevents contact with contaminated soil. Therefore, the landfill cap system at LF-1 is operating as expected. In addition, the LUCs are in place and are functioning as intended. For the remedy to be protective in the long-term, additional activities to address ECs in groundwater are needed.

The last FYR did not include any formal recommendations for the LF-1 source area but did include a methodology for regulatory review of a potential solar photovoltaic array at the capped landfill. The solar project is no longer being planned and the land use at the LF-1 source area remains unchanged.

3.2.4 Five-Year Review Process

3.2.4.1 Data Review

Data collected at the LF-1 source area have been reported as part of the annual landfill inspection reporting and are documented in the LF-1 SLRs (AFCEC 2023, 2022, 2021, 2020, 2019). In summary, minor maintenance and repairs to the landfill cap system (such as filling minor erosion rills and trimming vegetation) have been implemented by AFCEC following discovery during inspections. A review of 20 years of LF-1 landfill settlement survey results indicated the settlement surveys could be reduced to once every five years and the topographic surveys to an as-needed basis (AFCEC 2020) as discussed in Section

3.2.2.4. A settlement survey was completed in June 2022 and indicated no issues or requirement for corrective actions (AFCEC 2023).

3.2.4.2 Site Inspections

An SI in support of this FYR was completed for the LF-1 source area on 27 October 2022. Since the remedial actions conducted at the LF-1 source area are complete and annual landfill inspections are ongoing and well documented, the focus of the SI was to assess general site conditions and to determine whether the land use assumptions are still valid and do not affect protectiveness. Based on the SI, land use at the site remains consistent with the assumptions used in the risk assessment and no concerns regarding protectiveness were identified.

3.2.4.3 Interviews

Refer to Section 2.4.

3.2.5 Technical Assessment

3.2.5.1 Question A: Is the remedy functioning as intended by the decision document?

Yes. Based on a review of annual landfill inspection results and assessment of LF-1 groundwater plume remedial progress as discussed in Section 4.9, it can be concluded that the remedy is functioning as intended by the ROD and the RAOs are being achieved.

3.2.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection (current) still valid?

Yes, the current RAOs (AFCEE 2007) are appropriate. Because the remedy for the LF-1 source area is a landfill cap, there are no COCs associated with the LF-1 source remedy; therefore, toxicity data, exposure assumptions and cleanup levels are not applicable.

3.2.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

3.2.6 Issues/Recommendations

No specific recommendations or follow-up actions have been identified.

3.2.7 Protectiveness Determination

The remedy for the LF-1 source area is protective of human health and the environment under the current land use scenario. Groundwater monitoring under the LF-1 SPEIM/LTM program (discussed in Section 4.9) does not indicate the LF-1 source area is acting as a continuing source of groundwater contamination for current COCs and the landfill cap prevents contact with contaminated soil. Therefore, the landfill cap remedy at LF-1 is operating as expected. In addition, the LUCs are in place and are functioning as intended. Additional activities to address ECs in groundwater are needed as discussed in Section 4.9.

3.2.8 References

AFCEC. 2023 (March). *LF-1 2022 Summary Letter Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022 (April). *LF-1 2021 Summary Letter Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021 (April). *LF-1/CS-23 2020 Summary Letter Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020 (April). *LF-1/CS-23 2019 Summary Letter Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019 (April). *LF-1/CS-23 2018 Summary Letter Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2018 (September). *Final 5th Five Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA*. AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013 (September). *Final Explanation of Significant Differences for the Landfill 1 (LF-1) Source Area at the Massachusetts Military Reservation.* Prepared by

CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

AFCEE. 2012 (July). *Final LF-1 2011 Post-Closure Monitoring Plan Update.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2007 (September). *Final Record of Decision for Landfill-1 Source Area and Groundwater.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

Air National Guard (ANG) 1993 (January). Record of Decision Interim Remedial Action Main Base Landfill (AOC LF-1) Source Area Operable Unit. Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared for Hazardous Waste Remedial Actions Program, Oak Ridge, Tennessee, by ABB Environmental Services, Inc.

3.3 FIRE TRAINING AREA-2/LANDFILL-2 (FTA-2/LF-2)

3.3.1 Introduction

The FTA-2/LF-2 source area (OU 5) is located west of the southern end of Runway No. 5, within the flightline security area (Figure 1-2 and 3-3). The FTA-2/LF-2 area occupies approximately 25 acres, and includes a former FTA (FTA-2) that was located on top of a buried industrial/municipal landfill (LF-2).

Landfill operations at LF-2 began in approximately 1940 and consisted of the disposal of solid waste (e.g., bottles, glass, ash, metal scrap, wood, concrete, and asphalt construction debris). The landfilling activities were discontinued in 1944 and the area was covered with fill material before the fire-training site was developed in 1948.

Fire-training activities at FTA-2 began in an unlined depression on the southern part of the landfill that acted as a drainage swale. FTA-2 may have received up to 7,000 gallons per year of waste oil, aviation gasoline (AVGAS), JP-4 fuel, and solvents, which were ignited during fire training exercises. Sand, asphalt, and concrete rubble fill were apparently placed in the landfill swale before, during, and after fire-training activities. FTA-2 was covered with additional soil following its abandonment in 1956 (ANG 1996).

The FTA-2/LF-2 topography is a generally flat surface consisting of un-paved, grassed areas that are mowed and maintained inside the flightline security area which includes fencing and 24-hour security. Roughly 10 to 20 percent of the source area has some larger scrub pine and vegetation typical of Cape Cod. The area will be maintained as controlled open-space in the foreseeable future while the airfield and runways are in use (AFCEC 2018).

3.3.2 Response Action Summary

3.3.2.1 <u>Basis for Taking Action</u>

The COCs at the FTA-2/LF-2 source area are ethylbenzene and total xylenes in soil.

The RI (ANG 1996) included a human-health preliminary risk assessment (PRA) to evaluate potential human-health risks associated with exposure to contaminated soil under

an occupational (worker) exposure scenario. The calculated cancer risk was within the EPA acceptable risk range and the calculated noncancer hazard index was below one. An ecological PRA was also performed which concluded that there could be adverse effects to ecological receptors, however, because of current and anticipated land use of the site, no additional action was recommended. Cleanup at FTA-2/LF-2 was driven by the potential impact to groundwater by petroleum-related organic compounds in soils.

3.3.2.2 Response Actions

Record of Decision: The final remedy for the FTA-2/LF-2 source area was presented as part of the *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source Areas* (AFCEE 1998). The RAO for the FTA-2/LF-2 source area was:

- Prevent organic compounds in soils associated with FTA-2 from being a source of groundwater contamination.

The remedy components included:

- Performance of baseline ambient air monitoring;
- Collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants ethylbenzene and total xylenes;
- Designing and installing a full-scale biosparging treatment system;
- Collecting ambient air samples to assess compliance with ARARs;
- Maintaining ICs that restrict site access and limit potential human exposure to contaminants.

The cleanup levels selected in the ROD for ethylbenzene and total xylenes in soil were 700 µg/kg, and 10,000 µg/kg, respectively (AFCEE 1998).

Record of Decision Amendment: A ROD Amendment to address FTA-2/LF-2 groundwater (addressed in Section 4.11) was completed in 2016. The ROD Amendment did not include any requirements associated with the FTA-2/LF-2 source area (AFCEC 2016).

3.3.2.3 Status of Implementation

A biosparge treatment system was installed at FTA-2/LF-2 and began operation in September 2001. The biosparge treatment system was shut down in May 2003 after soil

sampling confirmed the remedial goals were met (i.e., the cleanup levels for the COCs ethylbenzene and total xylenes in soil were achieved). Later groundwater sampling at FTA-2/LF-2 confirmed the presence of a petroleum-related groundwater plume which is discussed in Section 4.11.

The FTA-2/LF-2 source area LUCs and their status are shown on Exhibit 3-3a.

Exhibit 3-3a

LUC Status for FTA-2/LF-2 Source Area

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objective	Title of LUC Instrument Implemented and Date (or planned)
FTA-2/LF-2 Source Area (Figure 3-3)	Yes	Yes	• Restrict site access and limit potential human exposure to contaminants.	• Maintain site access restrictions consistent with flightline security measures – On-going • Fence - In place at time of ROD (1998) • File a Record of Notice of Landfill Operation – 2014

3.3.3 Progress Since the Last Review

This section includes the protectiveness determinations and statements from the **last** FYR (Exhibit 3-3b). There were no issues or recommendations for the FTA-2/LF-2 source area in the last FYR.

Exhibit 3-3b

Protectiveness Determination/Statement from the 2018 FYR – FTA-2/LF-2 Source Area

OU #	Protectiveness Determination	Protectiveness Statement
5 (FTA-2/LF-2 Source Area)	Protective	**The remedy for the FTA-2/LF-2 source area is protective of human health and the environment.** Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants. A [Record of Notice of Landfill Operations]has been filed with the real property office.

3.3.4 Five-Year Review Process

3.3.4.1 Data Review

No new data was collected at the FTA-2/LF-2 source area during this FYR period.

The 2003 confirmation soil sampling included the EPH/VPH analytes. The majority of sampling targeted the capillary fringe or "smear zone" (42 – 52 feet [ft] below ground surface [bgs]) where ethylbenzene and total xylene contamination was previously detected. Results indicated no exceedances of current MCP S-3/GW-1 standards for EPH/VPH in this zone (AFCEE 2014).

Shallower soil sampling results from January 2003 indicated one C_{11} – C_{22} Aromatic Hydrocarbons (EPH) exceedance (1300 mg/kg) of the MCP S-3/GW-1 soil standard (1000 mg/kg) at 8 ft bgs at location 39DEP2 on the northern edge of the FTA-2 site. Four additional sampling locations in the area were sampled in November 2003 and all results for EPH were below standards (AFCEE 2014). It should be noted that this determination was made in 2003 when the MCP S-3/GW-1 soil standard for C_{11} – C_{22} Aromatic Hydrocarbons (EPH) was 200 mg/kg (vs the current 1000 mg/kg standard).

A separate post-ROD shallow soil sampling effort was conducted in 2003 at Test Pit 16, located approximately 300 ft south of FTA-2 (see Figure 4-19). Results indicated exceedances of EPA Industrial Soil RSLs and MCP Method 1 S-3/GW-1 standards (in effect in 2003) for multiple PAHs in the 7 – 15 ft bgs zone (AFCEE 2014). An analysis of the same shallow soil data (but expanded to the 3 – 15 ft bgs zone) indicates multiple PAH exceedances remain when compared to current EPA Industrial Soil RSLs and MCP Method 1 S-3/GW-1 standards (Table 3-1). In numerous cases, the maximum PAH concentrations detected in the post-ROD 2003 soil sampling exceed the maximum soil concentrations used during the human-health PRA (ANG 1996) as indicated on Table 3-1.

Although the RAO has been achieved, UU/UE conditions have not been met at FTA-2/LF-2 and the LUCs (Exhibit 3.3a) specified as part of the remedy are required to maintain protectiveness. This FYR includes a recommendation to evaluate the need to add an RAO to address direct contact with contaminated soil.

3.3.4.2 Site Inspections

An SI in support of this FYR was completed for FTA-2/LF-2 on 27 October 2022. Since there is no ongoing O&M, the focus of the SI was to assess general site conditions and to determine whether the LUCs described in Exhibit 3.3a are in place. Based on the SI, land use at the site remains consistent with the assumptions used in the risk assessment and the LUCs are preventing exposure and no concerns regarding protectiveness were identified.

3.3.4.3 Interviews

Refer to Section 2.4.

3.3.5 Technical Assessment

3.3.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes. Operation of the biosparging system has mitigated further impact to groundwater from the COCs identified in the ROD (i.e., ethylbenzene and total xylenes) and the soil remedial goals specified in the ROD have been met. However, PAHs do remain in shallow soil (< 15 ft bgs) at concentrations exceeding current EPA Industrial RSLs so UU/UE conditions (which was not an objective of the remedy) may not have been met (AFCEE 2014). The LUC objective of "restricting site access and limiting potential human exposure to contaminants" is being met with the current LUCs (AFCEC 2022, 2021, 2020, 2019).

3.3.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

No. Although the ROD includes a LUC objective to limit potential human exposure to contaminants, there is no associated RAO or identified COCs to address the potential direct human contact pathway for contaminants that may remain in site soils < 15 ft bgs.

Soil data collected in 2003 identified multiple PAHs above screening levels in soils <15 ft bgs. These contaminants are not identified as COCs in the 1998 ROD. A recommendation has been included in this FYR to evaluate the 2003 soil data against current screening levels, collect new data as necessary, and conduct a risk assessment to determine if the remedy requires additional COCs and an RAO(s) to address the potential direct contact

risk with shallow soil.

There have been changes in toxicity for ethylbenzene, which is one of the current COCs. In 2021, a memorandum was released from the Office of Land and Emergency Management (OLEM) regarding the use of subchronic toxicity values rather than the chronic noncancer value for 19 chemicals. This recommendation is based on OLEM's Human Health Regional Risk Assessment Forum's (OHHRRAF) Toxicity Workgroup evaluation of the toxicity of 32 chemicals. The OHHRRAF Toxicity Workgroup identified 21 oral and 11 inhalation noncancer toxicity values where a subchronic toxicity value was lower than its corresponding chronic toxicity value. After review of relevant information, the OHHRRAF recommended use of the subchronic toxicity value rather than the chronic value for 19 of the 32 chemicals, including ethylbenzene (EPA 2022). The EPA's MCL-based soil screening level for ethylbenzene is 780 µg/kg which is higher than the current leaching based cleanup level of 700 µg/kg; therefore, the current cleanup level is protective. There have been no changes in risk assessment methods or exposure pathways that affect the protectiveness of the remedy.

New contaminants not included as COCs in the ROD were identified in 2003 soil sampling and reported in the 2014 Remedial Action Report. In order to assess whether an unacceptable human health risk is posed by the contaminants, an assessment of the post-ROD shallow soil data collected at the site is required to determine if there is an unacceptable human health risk.

3.3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

3.3.6 Issues/Recommendations

Exhibit 3-3c Issue/Recommendation #5: FTA-2/LF-2 Source Area				
OU 5 (FTA-2/LF-2 Source Area)	**Issue Category:** Changed Site Conditions			
	Issue: New contaminants not included as COCs in the ROD were identified in 2003 soil sampling and reported in the 2014 Remedial Action Report and evaluated as part of this FYR (See Section 3.3.4.1). The 2003 contaminant concentrations for various PAHs in soil exceed current industrial screening standards.			
	Recommendation: Conduct an assessment of the post-ROD shallow soil data collected at the site, collect additional data as necessary, and determine if there is an unacceptable human health risk. If required, develop a DD to add soil COCs and an RAO(s) to address potential direct human exposure to soil contaminants < 15 ft bgs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	12/10/2026

3.3.7 Protectiveness Statement

The remedy for the FTA-2/LF-2 source area is protective of human health and the environment in the short-term. Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants. If workers excavate in the area, a Dig Safe notification would be sent to the IRP office for evaluation. A Record of Notice of Landfill Operation has been filed with the real property office. Since the ROD does require LUCs and has an appropriate LUC objective, the lack of a specific RAO to address human exposure in soil does not affect current protectiveness. However, in order for the remedy to be protective in the long-term, AFCEC must conduct an assessment of the post-ROD shallow soil data collected at the site, collect additional data as necessary, and determine if there is an unacceptable human health risk.

3.3.8 References

AFCEC. 2022 (October). *Annual Land Use Control (LUC) Letter Report for 2021.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021 (July). *Annual Land Use Control (LUC) Letter Report for 2020.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020 (August). *Annual Land Use Control (LUC) Letter Report for 2019.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019 (April). *Annual Land Use Control (LUC) Letter Report for 2018.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2018 (September). *Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA.* Prepared by AFCEE/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2016 (September). *Final Fire Training Area-2/Landfill-2 Record of Decision Amendment.* Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

AFCEE. 2014 (March). *Fire Training Area-2 (FTA-2)/Landfill-2 (LF-2) Remedial Action Report.* Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1998 (September). *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source Areas*. Prepared by HLA for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

ANG. 1996 (September). *Remedial Investigation Report Fire-Training Area No.2 (FTA-2) and Landfill No.2 (LF-2).* Prepared by ABB-Environmental Services for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2022 (June) *EPA FYR Technical Assessment Region 1 FY2022 Supplemental Template with PFAS revision 060122*, EPA internal guidance shared with AFCEE/JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

3.4 PETROLEUM FUELS STORAGE AREA (PFSA)

3.4.1 Introduction

The PFSA source area (OU 5) is located on the southeast corner of JBCC and served as the storage and distribution center for JP-4 jet fuel, AVGAS, motor gasoline, and No. 2 fuel oil for JBCC from the 1950s until 2009 (Figure 3-4).

The PFSA has been the location of several fuel spills and has historically been referred to as PFSA (FS-10/FS-11) but will here-after be referred to as PFSA in this document. Demolition of the PFSA facility was completed in early 2011 (demolition areas shown on Figure 3-4). Over the years, the facility consisted of three aboveground storage tanks (ASTs), several USTs, above ground and below ground fuel distribution lines, pump houses, and truck fill stands.

The PFSA site occupies approximately 13 acres and is located on base property and is bisected by South Outer Road. The former PFSA infrastructure occupied approximately five acres of relatively flat terrain on the north side of South Outer Road and is located inside the flightline security area which includes fencing and 24-hour security. The remaining area to the south of South Outer Road is also fenced and is shared with facilities used for AFCEC's restoration program. The current industrial land use in this area is expected to be maintained for the foreseeable future while the airfield and runways are in use and remedial actions are ongoing (AFCEC 2018).

3.4.2 Response Action Summary

3.4.2.1 <u>Basis for Taking Action</u>

The COCs at the PFSA source area are ethylbenzene and total xylenes in soil.

The RI (ANG 1996) included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated soil under an occupational (worker) exposure scenario. The calculated cancer risk was within the EPA acceptable risk range and the calculated noncancer hazard index was below one. Because ecological receptors are not anticipated at the PFSA, a quantitative ecological PRA was not completed (AFCEC 2013). Cleanup at PFSA was driven by the potential impact to groundwater by petroleum-related

organic compounds in soils.

3.4.2.2 Response Actions

Pre-ROD CERCLA Actions: As part of the Drainage Structure Removal Program (DSRP), the pump house French drains, the storm-sewer catch basin, and associated contaminated soil were removed in 1993 (AFCEC 2013).

Non-CERCLA Actions: In 1993, approximately 10 cubic yards of fuel-contaminated soil was excavated from around the subsurface fuel lines during construction activities. In 1994, several pump house buildings were demolished and four associated 50,000-gallon USTs were removed.

In response to the release of approximately 6,000 gallons of oil/water mixture in 1996, approximately 600 cubic yards of fuel-contaminated soil were removed as part of an Immediate Response Action performed under the MCP. An SVE system was installed to remove the remaining localized contamination associated with the release (AFCEE 1998). This SVE system was separate from the selected CERCLA remedy for PFSA as presented in the ROD.

ASTs 15 and 16 and Buildings 171, 172, and 173 at the PFSA were removed in January/February 2011 as non-CERCLA related actions. Contaminated soil was encountered during the dismantling of AST 16 and 1,056 gallons of fuel oil, 550 gallons of oily water, and 760 cubic yards of oil-impacted sand were removed for off-site disposal as part of an Immediate Response Action under the MCP (Horsley Witten 2011).

Record of Decision: The final remedy for the PFSA source area was presented as part of the *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source Areas* (AFCEE 1998). The RAO for the PFSA source area was:

- Prevent organic compounds in soils from being a source of groundwater contamination.

The remedy components included:

- Performance of baseline ambient air monitoring.
- Collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants ethylbenzene and total xylenes.
- Designing and installing a full-scale biosparging treatment system with off-gas collection and treatment for areas with capillary-fringe contamination.
- Designing and installing a bioventing system for areas with shallow vadose zone contamination.
- Collecting ambient air samples to assess compliance with ARARs.
- Maintaining ICs that restrict site access and limit potential human exposure to contaminants.

The cleanup levels selected in the ROD for ethylbenzene and total xylenes in soil were 700 µg/kg, and 10,000 µg/kg, respectively (AFCEE 1998).

Record of Decision Amendment: A ROD Amendment to address PFSA groundwater (addressed in Section 4.12) was completed in 2016. The ROD Amendment concluded that residual soil contamination that was not remediated through the operation of the ROD remedy is expected to remain in place and continue to attenuate while the remedy for groundwater is being implemented (AFCEC 2016).

3.4.2.3 Status of Implementation

A biosparge/vapor recovery (BSVR) treatment system began operation in October 2001. In February 2008, the soil vapor recovery portion of the BSVR system was shut down due to low petroleum concentrations in the influent air samples. Between November 2008 and April 2010, the sparging portion of the system for select zones continued to operate to enhance aerobic degradation of the remaining petroleum compounds. Based on a review of both soil and groundwater data, it was determined that the intent of the remedy had been met and although ethylbenzene and total xylene concentrations in soil remained above the remedial action levels, the soils were not acting as a continuing source of COC contamination to groundwater and the sparging system was shut down in April 2010 (AFCEE 2012).

Soil sampling completed in 2006 and 2007 in support of remedial system shutdown indicated that at a few locations, ethylbenzene, xylene, and EPH/VPH compounds

remained in capillary fringe soils (approximately 55 ft bgs) at concentrations above STCLs for ethylbenzene and xylene or MCP Method 1 S-3/GW-1 soil standards for EPH/VPH carbon ranges. Due to the depth of the residual soil contamination, it is not considered to represent a reasonable exposure pathway to current workers and/or residents through direct contact or ingestion (AFCEC 2016).

The PFSA source area LUCs and their status are shown on Exhibit 3-4a.

Exhibit 3-4a
LUC Status for PFSA Source Area

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
PFSA Source Area (Figure 3-4)	Yes	Yes	• Restrict site access and limit potential human exposure to contaminants.	• Maintain site access restrictions consistent with flightline security measures – On-going • Fence - In place at time of ROD (1998)

3.4.3 Progress Since The Last Review

This section includes the protectiveness determinations and statements from the **last** FYR (Exhibit 3-4b). There were no issues or recommendations for the PFSA source area in the last FYR.

Exhibit 3-4b
Protectiveness Determination/Statement from the 2018 FYR – PFSA Source Area

OU #	Protectiveness Determination	Protectiveness Statement
5 (PFSA Source Area)	Protective	**The remedy for the PFSA source area is protective of human health and the environment.** Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants.

3.4.4 Five-Year Review Process

3.4.4.1 Data Review

No new data were collected at the PFSA source area during this FYR period. The PFSA groundwater data are discussed in Section 4.12.

3.4.4.2 Site Inspections

An SI in support of this FYR was completed for PFSA on 27 October 2022. The focus of the SI was to assess general site conditions and to determine whether the LUCs described in Exhibit 3-4a are in place. Based on the SI, land use at the site remains consistent with the assumptions used in the risk assessment and the LUCs are preventing exposure and no concerns regarding protectiveness were identified.

3.4.4.3 Interviews

Refer to Section 2.4.

3.4.5 Technical Assessment

3.4.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes. Operation of the BSVR system has mitigated further impact to groundwater from the COCs identified in the ROD (i.e., ethylbenzene and total xylenes). The site inspection indicates the LUC objective of "restricting site access and limiting potential human exposure to contaminants" is being met with the current LUCs.

3.4.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. The RAO developed for the final ROD (AFCEE 1998) is appropriate and remains valid for the current COCs. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and to be considered (TBCs) that affect the PFSA remedy.

There have been changes in toxicity for ethylbenzene, which is one of the current COCs. In 2021, a memorandum was released from the Office of Land and Emergency Management (OLEM) regarding the use of subchronic toxicity values rather than the chronic noncancer value for 19 chemicals. This recommendation is based on OLEM's Human Health Regional Risk Assessment Forum's (OHHRRAF) Toxicity Workgroup evaluation of the toxicity of 32 chemicals. The OHHRRAF Toxicity Workgroup identified 21 oral and 11 inhalation noncancer toxicity values where a subchronic toxicity value was lower than its corresponding chronic toxicity value. After review of relevant information, the OHHRRAF recommended use of the subchronic toxicity value rather than the chronic value for 19 of the 32 chemicals, including ethylbenzene (EPA 2022). The EPA's MCL-based soil screening level for ethylbenzene is 780 µg/kg which is higher than the current leaching based cleanup level of 700 µg/kg; therefore, the current cleanup level is protective.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

3.4.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

3.4.6 Issues/Recommendations

No specific recommendations or follow-up actions have been identified.

3.4.7 Protectiveness Statement

The remedy for the PFSA source area is protective of human health and the environment. Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants.

3.4.8 References

AFCEC. 2018 (September). *Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA.* Prepared by AFCEE/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2016 (January). *Final Petroleum Fuels Storage Area Record of Decision Amendment.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013 (October). *Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA*. 473147-SPEIM-MULTIPLE-RPT-001. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis ANG Base, MA.

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4.0 GROUNDWATER SITES REQUIRING FIVE-YEAR REVIEW

This section presents groundwater sites for which a FYR is required. Twelve groundwater sites (Table 1-3) required a FYR because the remedy was in place at the start of this FYR period and the sites are in Remedial Action – Operation status.

4.1 ASHUMET VALLEY (AV) GROUNDWATER

4.1.1 Introduction

The AV plume (OU 15) is a dissolved-phase groundwater plume located south of the JBCC boundary. Based on the most recent groundwater monitoring data collected in 2022, the AV plume consists of four disconnected zones of contamination: the northernmost zone, a central zone, a southern zone, and a small area near the Backus River (Figure 4-1).

The land above the AV plume is used for residential, limited commercial/industrial, agricultural, and recreational purposes including golf courses, and a wildlife area managed by the Massachusetts Division of Fisheries and Wildlife (MDFW) (Crane Wildlife Management Area [CWMA]). The AV plume is located within a broad, flat, gently southward sloping glacial outwash plain (AFCEC 2018).

The sources of the AV plume are FTA-1 and the former JBCC sewage treatment plant (STP) (CS-16 and CS-17). Firefighter-training exercises were held from 1958 to 1985 at FTA-1, during which time flammable waste liquids (e.g., VOCs) were burned and extinguished. The former JBCC STP, which operated from 1936 to 1995, released treated wastewater to a series of sand infiltration beds (CS-16) while de-watered sewage sludge was disposed of in a nearby wooded area (CS-17) (AFCEE 2009).

4.1.2 Response Action Summary

4.1.2.1 <u>Basis for Taking Action</u>

The AV Groundwater COCs are PCE, TCE, manganese (Mn) and thallium. The AV plume boundary is defined as the extent of groundwater containing the COCs PCE and TCE at concentrations exceeding the MCL of 5 µg/L for each compound. Thallium and Mn are not used to define the extent of the AV plume. The cleanup level for thallium is the MCL

of 2 µg/L; the cleanup level for Mn is the EPA HA of 300 µg/L (AFCEE 2009). In 2011 thallium was no longer detected and thallium monitoring was discontinued (AFCEC 2023).

Future residential exposure to the AV groundwater COCs (at time of ROD) presented an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$ for PCE and TCE and a hazard index (HI) > 1 for thallium and Mn. An ecological risk assessment concluded that it is very unlikely that there are ecological risks associated with the AV groundwater plume COCs (AFCEE 2009).

A VI evaluation indicated an incomplete pathway for VI at AV and no further monitoring or data collection is needed specific to VI at AV (AFCEE 2012).

4.1.2.2 Response Actions

FTA-1 Source Area Removal Action: A removal action at the FTA-1 source area consisted of excavation and on-site thermal treatment of contaminated soil between June 1995 and September 1997. A total of 42,531 tons of soil were excavated, thermally treated, and backfilled. The *Final Closure Report for the FTA-1 Site* (AFCEE 2000) outlines the removal action while a later technical memorandum supported unlimited use of the FTA-1 source area based on the original source COCs (AFCEC 2014).

CS-16/CS-17 Source Area Remedial Action: A remedial action at the CS-16/CS-17 source area consisted of excavation and off-site disposal of contaminated soil between October and December 2001. A total of 2,857 cubic yards (approximately 4,000 tons) of soil were excavated and disposed of off-site. The *Final Remedial Action Report Area of Contamination CS-16/CS-17* (AFCEE 2003) outlines the remedial action while a later technical memorandum supported unlimited use of the CS-16/CS-17 source areas based on the original source COCs (AFCEC 2016).

Interim Record of Decision (IROD): An IROD was developed to implement a remedy to address AV groundwater contamination (ANG 1995). In 1999, an interim groundwater treatment system with three extraction wells and two treatment buildings employing GAC began operation. The interim system was optimized in 2007 to operate with a single extraction well (the other two extraction wells had substantially remediated the COCs

within their capture zones).

Final Record of Decision: A final remedy for AV groundwater was selected and documented in the *Final Record of Decision for Ashumet Valley Groundwater* (AFCEE 2009). The selected remedy included the continued operation of the existing optimized system (one extraction well – 95EW0703) with an additional extraction well (95EW0704) and mobile treatment unit (MTU) in the southern portion of the plume to improve plume capture in that area. Manganese and thallium would be addressed through LTM. The remedy included performance monitoring of the AV plume and remedial system and LUCs.

The RAOs for the AV groundwater plume (AFCEE 2009) are as follows:

- Prevent residential exposure to AV groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to AV groundwater with PCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the AV plume and that contains Mn concentrations greater than the lifetime HA of 300 µg/L.
- Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the AV plume and that contains thallium concentrations greater than the MCL of 2 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Explanation of Significant Differences: An ESD was completed in 2011 that clarified the inclusion of monitored natural attenuation (MNA) as a component of the selected remedy and updated the steps to achieve site closure (i.e., the three-step process) (AFCEE 2011).

4.1.2.3 Status of Implementation

As remediation has progressed, the AV remediation system has undergone various optimizations leading to the eventual shutdown of both ROD-required extraction wells and transitioning the remedy to MNA and LUCs alone (AFCEC 2022b). The extraction well (95EW0704) and MTU in the southern portion of the plume were shut down in February

2014 while the last extraction well (95EW0703) was shut down in January 2022. These extraction wells were shut down because PCE/TCE concentrations within their capture zones had declined below the MCL. Potential new COCs (PFAS) may change the operational status of the AV remediation system in the future. See Section 2.1 for further discussion regarding ECs.

The AV groundwater LUCs and their status are shown on Exhibit 4-1a.

Exhibit 4-1a

LUC Status for AV Groundwater

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
AV Groundwater LUC Area (Figure 4-1)	Yes	Yes	• Prevent access to or use of the AV contaminated groundwater until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as the treatment systems and monitoring wells.	• Falmouth BOH Water Well Regulations – Sep 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2012 and On-Going

As part of the LUC process specified in the ROD (AFCEE 2009), a private well verification survey was completed at AV between April 2009 and June 2012 (AFCEE 2013). No private wells that were identified presented an unacceptable exposure risk from the AV plume COCs.

One private residential irrigation well (APEMS ID[4] 39851) located in the northern portion of the AV plume area was determined to require annual monitoring (AFCEE 2013). Annual monitoring of this well was conducted from 2013 to 2017 (except for 2014) and no plume COCs were detected. Based on this sampling data, an updated well determination (Appendix B) was completed in 2018 which determined further sampling for this irrigation well could be discontinued (AFCEC 2019).

In addition, agricultural irrigation wells (APEMS ID 47077) located near the Backus River cranberry bogs were monitored under AFCEC's LUC Program in 2018 (and during previous FYR periods) and no exposure concerns were identified. AFCEC has discontinued sampling of these irrigation wells (AFCEC 2020).

During this FYR period, in response to AFCEC's private well verification annual mailings, four property owners (APEMS IDs 39663, 39665, 39797, 47065) notified AFCEC that they planned to restart their non-operational irrigation wells. AFCEC sampled these irrigation wells and prepared well determinations (Appendix B) that concluded the wells are suitable for irrigation/outdoor purposes (AFCEC 2022a, 2021a).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the AV Groundwater LUC Area during this FYR period (AFCEC 2023, 2022b, 2021b, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

Although AV Groundwater LUC areas have not yet been formally established for 1,4-dioxane or PFAS contamination (i.e., through a ROD amendment or ESD), AFCEC has administratively imposed interim LUCs to evaluate any potential exposure to these

[4] APEMS ID is the Air Force Parcel and Easement Management System Identification Number. An APEMS ID is used instead of an address to protect property owner privacy.

contaminants. Specifically, AFCEC has conducted outreach in areas of known 1,4-dioxane or PFAS groundwater contamination, sampled existing private and municipal wells, and conducted numerous removal actions for PFAS. These activities are described in Section 2.2.3.1. The extent of the PFAS plume area and associated interim LUC area (Ashumet and Johns Pond Private Well Outreach Area) is shown on Figure 2-1.

4.1.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-1b) as well as the recommendations from the **last** FYR (Exhibit 4-1c) and the current status of those recommendations.

Exhibit 4-1b

Protectiveness Determination/Statement from the 2018 FYR – AV Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
15 (AV Groundwater)	Short-term Protective	**The remedy for the AV groundwater plume is protective of human health and the environment for the COCs in the short-term; however, overall site protectiveness for the AV groundwater plume is being deferred due to the presence of the ECs PFAS and 1,4-dioxane.** The LUCs are in place and are functioning as intended for the COCs. Through the combination of the active treatment by the remedial system and natural attenuation processes, existing groundwater cleanup levels for the COCs are expected to be achieved within the timeframe approximated in the ROD, however, there is a potential loss of plume capture near extraction well 95EW0703 indicated by increasing PCE concentrations in a nearby monitoring well. In order for the remedy to be protective in the long-term for existing COCs, this potential issue needs to be evaluated. For ECs, particularly PFOS and PFOA, the Supplemental RI is ongoing and outreach activities are continuing to identify private wells that might be impacted by the PFOS and PFOA emanating from the JBCC. Mitigation activities including providing bottled water, filtration systems, and/or municipal water connections are being implemented for impacted drinking water supplies. In addition, there are plans to install wellhead treatment on the Mashpee Village Public Water Supply Well which has also been impacted by PFOS and PFOA from JBCC. Because there have been documented exposures, necessary mitigations, a potential for additional impacted water supplies, and LUCs have not been implemented, an overall protectiveness determination cannot be made for this site. Additional information is being collected through a Supplemental RI, tentatively scheduled for completion in September 2019 but dependent upon results obtained during the investigation, and is expected to be followed by an eventual ROD Amendment and development of a LUC area for

		ECs. Upon completion of the Supplemental RI, a Five-Year Review Addendum will be completed and a protectiveness determination will be made.

Exhibit 4-1c

Status of Recommendations from the 2018 FYR - AV Groundwater

OU #	Issue	Recommendations*	Current Status	Current Implementation Status Description
15 (AV Groundwater)	Emerging Contaminants	Complete Supplemental RI and develop Supplemental FS report; prepare an addendum to this FYR once investigation is complete.	Ongoing	See Below Discussion
15 (AV Groundwater)	Emerging Contaminants	Address potential loss of PCE capture by 95EW0703	Completed	See Below Discussion

* These two recommendations were combined into a single recommendation in the 2018 FYR under the Emerging Contaminants category. They are separated in this discussion for clarity.

Implementation Status: The fieldwork for the Supplemental RI and FS for 1,4-dioxane and PFAS has been completed and the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod, MA* was submitted for regulatory review on 28 Apr 2022. EPA and MassDEP comments were received on 29 June 2022 and 29 July 2022, respectively. Additional work on the Draft Supplemental RI was required due to the release of new PFAS standards in May 2022 (discussed in Section 2.1.2.1) including a rescreening of data against updated RSLs, sampling for Gen-X, and additional soil sampling in the source area. The Draft Supplemental RI is planned for completion in 2023. As noted in Section 2.1.1, the AV groundwater site data indicate 1,4-dioxane will not need to be added as a COC.

The *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod, MA* was submitted for regulatory review on 20 Apr 2023. Since the Supplemental RI and FS for ECs will be completed after the

close of the current FYR period (30 Sep 2022), an addendum to the 2018 FYR was not prepared as recommended. Further discussion regarding ECs can be found at Section 2.1.

The potential loss of PCE capture by 95EW0703 was addressed through monitoring conducted in 2018 and 2019. The key monitoring well (95MW1232A) indicated decreasing PCE concentrations which alleviated the concerns about the potential loss of capture. As discussed in previous sections, extraction well 95EW0703 was shut down in January 2022.

4.1.4 Five-Year Review Process

4.1.4.1 Data Review

Data collected for the AV groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the AV Plume SLRs and a Project Note during this FYR period (AFCEC 2023, 2022b, 2021b, 2020, 2019). Significant results from the data review include:

- Plume migration was controlled through the operation of the extraction wells (now shut down). The small amount of remaining mass will be reduced through natural attenuation. The AV plume boundary changes on a temporal basis are shown on Figure 4-2.
- The highest COC concentration in the AV plume monitoring network at the beginning of this FYR period (Aug 2018) was PCE at 18 µg/L in monitoring well 95MW1232A (AFCEC 2019). That same location had a PCE concentration of 6.6 µg/L at the end of the FYR period (Jul 2022) (AFCEC 2023).
- The highest COC concentration in the AV plume network at the end of the FYR period (Jul 2022) was TCE at 9.9 µg/L in 30MW0585A (AFCEC 2023). The AV concentration trends in groundwater are shown on Figure 4-3.
- Manganese concentrations remain above the EPA HA of 300 µg/L in two of the three locations sampled in 2022. Concentrations at both locations continue to decline: 30MW0582C (800 µg/L in 2019 to 640 µg/L in 2022) and USFW300030 (2,300 µg/L in 2019 to 1,300 µg/L in 2022). Manganese concentrations are dissipating to below the EPA HA over time as oxygenated water migrates into the area (AFCEC 2023). Specific restoration timeframes for manganese have not been modeled.
- PCE and TCE concentrations are expected to reach MCLs within the next two to three years (2024-2025) which is within the restoration timeframe estimate of

approximately 2021 for the VOC plume presented in the 2009 ROD (AFCEC 2023).

- Surface water sampling frequency at the Ashumet Pond recreational beach was reduced from annual to biennial in 2018 (AFCEC 2019). Surface water sampling conducted in 2021 at three locations in Ashumet Pond indicated PCE and TCE concentrations were ND (AFCEC 2022b).
- Surface water sampling frequency at the Backus River and nearby cranberry bog irrigation wells was reduced from twice during the cranberry season to once per season in 2018 (AFCEC 2019). In 2019, monitoring at the Backus River and the irrigation wells was discontinued (AFCEC 2020).
- A monitoring network optimization was completed in 2019 that discontinued monitoring at 27 AV wells and adjusted the monitoring frequency at eight AV wells (AFCEC 2020). A subsequent monitoring optimization in 2022 discontinued monitoring at seven AV wells and adjusted the monitoring frequency at two AV wells (AFCEC 2023).
- Determinations for private irrigation wells located at APEMS IDs 39851, 39663, 39665, 39797, and 47065 (discussed in Section 4.1.2.3) remain valid as there were no changes in the conceptual site model (CSM) for the AV plume COCs since the most recent determinations.

4.1.4.2 Site Inspections

Refer to Section 2.3.

4.1.4.3 Interviews

Refer to Section 2.4.

4.1.5 Technical Assessment

4.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, operation and eventual shutdown in 2022 of the AV remedial system and completion of the well verification/well determination portion of the LUCs have resulted in the remedy at AV functioning as intended by the DDs. The remedial system performed as expected for the current COCs. Cleanup levels have been achieved for thallium and the remaining COCs' cleanup levels are on a path to be achieved in a reasonable timeframe. LUCs are being properly implemented and are preventing exposure to COCs in groundwater.

Plume monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure protection of human health and the environment. Monitoring and evaluation activities are continual and well-documented for the current COCs.

4.1.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

No, there have been changes in potential standards and TBCs. While the RAOs developed for the ROD (AFCEE 2009) are appropriate and remain valid for the current COCs, new PFAS standards affect the long-term protectiveness of the current remedy selection (AV groundwater site data indicate 1,4-dioxane will not need to be added as a COC).

New standards for 1,4-dioxane and PFAS (discussed in Sections 2.1.1 and 2.1.2, respectively) have been developed. These changes are not expected to alter the protectiveness of the remedy in the short-term because, as discussed in Section 2.2.3.1, the USAF has imposed interim LUCs and conducted numerous removal actions to prevent exposure to PFAS exceedances in drinking water that are believed to be associated with the AV plume and source area FTA-1. The recommendation from the 2018 FYR to complete a Supplemental RI and FS to address known PFAS and 1,4-dioxane detections in groundwater remains valid and will be included in this FYR. See Section 4.1.3 for the current status of this recommendation.

There are no changes in toxicity or other contaminant characteristics for the AV groundwater COCs.

There are no changes in risk assessment methods that effect the protectiveness of the remedy. However, changes in exposure pathways have occurred due to the newly identified PFAS contaminants. Specifically, the LUC boundaries associated with the current AV COCs do not address the areas being impacted by PFAS exceedances in groundwater. As such, the USAF has imposed interim LUCs by developing an Ashumet and Johns Pond Private Well Outreach Area (Figure 2-1) to identify and address these potential pathways and maintain protectiveness. See Section 2.2.3.1 for further discussion.

PCE and TCE concentrations are expected to reach MCLs within the next two to three years (2024-2025) which is within the restoration timeframe estimate of approximately 2021 for the VOC plume presented in the 2009 ROD. In 2011 thallium was no longer detected and thallium monitoring was discontinued (AFCEC 2023). Manganese concentrations are dissipating to below the EPA HA over time as oxygenated water migrates into the area (AFCEC 2023). Continued manganese monitoring will indicate if the restoration timeframe for manganese will significantly exceed the 2021 restoration timeframe cited in the ROD.

4.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.1.6 Issues/Recommendations

Exhibit 4-1d Issue/Recommendation #6: AV Groundwater				
OU 15 (AV Groundwater)	**Issue Category: Emerging Contaminants**			
	Issue: Emerging contaminants, specifically PFAS and 1,4-dioxane, exceed screening standards in groundwater beyond the footprint of the current AV plume area.			
	Recommendation: Finalize the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* and the *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod*. Develop a DD to establish additional COCs and RAOs as appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	5/25/2025

4.1.7 Protectiveness Determination

The remedy for the AV groundwater plume is protective of human health and the environment in the short-term. The remedial system performed as expected and the

LUCs are in place and are functioning as intended for current COCs. Through natural attenuation processes, groundwater cleanup levels for current COCs are expected to be achieved. As of June 2023, the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* and the *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* have been submitted for regulatory review but not been finalized. Although interim LUCs and multiple removal actions have been implemented to prevent exposure to drinking water with PFAS exceedances, for the remedy to be protective in the long-term, a DD and subsequent remedial actions are required to address PFAS.

4.1.8 References

AFCEC. 2023 (February). *Ashumet Valley Plume 2022 Triennial SPEIM Data Presentation.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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AFCEE. 2013 (January). *Ashumet Valley Private Well Verification and Well Determination Project Note*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation.* Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2009 (March). *Final Record of Decision for Ashumet Valley Groundwater.* Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2000 (July). *Final Closure Report FTA-1 Site.* Prepared by Jacobs Engineering Group Inc. for the AFCEE/JBCC Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision for Interim Action of Seven Groundwater Plumes at Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared by Stone & Webster, Environmental Technology and Services for ANG JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

4.2 CHEMICAL SPILL-4 (CS-4) GROUNDWATER

4.2.1 Introduction

The CS-4 plume (OU 2, OU 9) is a dissolved-phase groundwater plume located south of the JBCC boundary below CWMA property (Figure 4-4).

The land above the CS-4 plume is undeveloped fields and woodlands used for recreational purposes (hiking, biking, hunting, etc.) within the CWMA, which is managed by the MDFW. The CS-4 plume is located within a broad, flat, gently sloping glacial outwash plain (AFCEC 2018).

The source of the CS-4 groundwater plume is the former West Truck Road Motor Pool which was used for the maintenance of military vehicles by the U.S. Army from 1940 to 1946 and by the USAF from 1955 to 1973. Wastes generated and potentially spilled or dumped during this period included oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels (ANG 1992).

4.2.2 Response Action Summary

4.2.2.1 Basis for Taking Action

The CS-4 Groundwater COCs are PCE, TCE, 1,1,2,2-tetrachloroethane (TeCA), and ethylene dibromide (EDB). The CS-4 plume boundary is defined as the extent of groundwater containing the COC PCE at concentrations exceeding its MCL of 5 µg/L. The remaining three COCs are detected sporadically at concentrations below their respective cleanup standards and are co-located with the PCE contamination. The cleanup levels for these COCs are as follows: MCL for PCE and TCE is 5 µg/L; the MCP Method 1 GW-1 standard for 1,1,2,2-TeCA is 2 µg/L; and the MMCL for EDB is 0.02 µg/L. Sampling and analysis for EDB was discontinued in 2012 due to lack of detections (AFCEC 2022).

The baseline cancer risk calculations in the Southwest Operable Unit (SWOU) RI indicated that unless remedial action is undertaken, future residential exposure to the CS-4 COCs in groundwater may present an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. Ecological risks associated with the CS-4 groundwater plume were evaluated during the RI and no significant risk was identified (AFCEE 1999).

A VI evaluation indicated an incomplete pathway for VI at CS-4 and no further monitoring or data collection is needed specific to VI at CS-4 (AFCEE 2012a).

4.2.2.2 Response Actions

CS-4 Source Area Removal Actions: There have been several source removals at CS-4 West Truck Road Motor Pool. In 1994, more than 13,000 tons of contaminated soils were treated using an on-site thermal treatment unit. AFCEE removed 24 drainage structures and 3,000 tons of contaminated soil from the CS-4 source area in 1996. In 2001, an additional 5,200 tons of contaminated soils, along with an old UST, were removed from the site (AFCEE 2008a). These removal actions resulted in a no further action decision (AFCEE 2005) followed by a UU/UE determination for the CS-4 source area in the subsequent FYR (AFCEE 2008a).

Interim Record of Decision: An IROD was developed to implement a remedy to address groundwater contamination at CS-4 (ANG 1992). In 1993, an interim groundwater treatment system with thirteen extraction wells was installed with the goal of capturing the CS-4 plume. However, results of the *Final Technical Memorandum AOC CS-4 Hydraulic Performance Evaluation* (AFCEE 1997) and the SWOU RI (AFCEE 1999) indicated that the interim remedial system was not capturing the entire CS-4 plume.

Final Record of Decision: A final remedy for CS-4 groundwater was selected and documented in the *Final Record of Decision for the CS-4, CS-20, CS-21 and FS-13 Plumes* (AFCEE 2000). The selected remedy included groundwater extraction and treatment to hydraulically capture the plume through the installation of new extraction wells, treatment at the original CS-4 treatment plant and/or a new treatment plant using GAC, performance monitoring of the CS-4 plume and remedial system, and ICs (AFCEE 2000).

Explanations of Significant Differences: An ESD was completed in 2008 to explain that the final remedy does not completely capture the toe of the CS-4 plume and to modify the LUC language (previously called ICs in the ROD) and the site closure language (AFCEE 2008b). A second ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and

updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to CS-4 groundwater with PCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to CS-4 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to CS-4 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L.
- Prevent residential exposure to CS-4 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L.
- Restore useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

4.2.2.3 Status of Implementation

The CS-4 remedial system began operation in 2005 using three extraction wells at a total flow rate of 620 gallons per minute (gpm). All groundwater from CS-4 was treated at the Hunter Avenue Treatment Facility (HATF). Based on results from the spring 2022 SPEIM event and a one-time sample event in September 2022, the last operating CS-4 extraction well, 02EW0015, was shut down on 31 January 2023 (AFCEC 2023). Therefore, the operation and maintenance component of the CS-4 remedy will not be discussed in this FYR.

The CS-4 groundwater LUCs and their status are shown on Exhibit 4-2a.

Exhibit 4-2a LUC Status for CS-4 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD/ESD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
CS-4 Groundwater LUC Area (Figure 4-4)	Yes	Yes	• Prevent access to, or use of, the groundwater from the CS-4 plume until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• Falmouth BOH Water Well Reg.- Sep 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2011 and On-Going

As part of the LUC process specified in the ROD and subsequent ESD (AFCEE 2000, 2008b), a private well verification survey was completed for the Southwest Plumes (including CS-4) between April 2009 and August 2011. No private wells were identified on properties within the CS-4 LUC area (AFCEE 2012b).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the CS-4 Groundwater LUC Area during this FYR period (AFCEC 2023, 2022, 2021, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.2.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-2b) as well as the recommendations from the **last** FYR (Exhibit 4-2c) and the current status of those recommendations.

Exhibit 4-2b

Protectiveness Determination/Statement from the 2018 FYR – CS-4 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
2 and 9 (CS-4 Groundwater)	Short-term Protective	**The remedy for the CS-4 groundwater plume is protective of human health and the environment in the short-term.** The LUCs are in place and are functioning as intended. Current plume delineation indicates that the aquifer restoration timeframe identified in the ROD may not be met. For the remedy to be protective in the long-term, the aquifer restoration timeframe should be reassessed and an ESD issued, if necessary, to update the timeframe.

Exhibit 4-2c

Status of Recommendations from the 2018 FYR - CS-4 Groundwater

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description
2 & 9	Restoration Timeframe Reassessment	Reassess aquifer restoration timeframe and present results.	Completed	See Below Discussion

Implementation Status: The aquifer restoration timeframe has been reassessed each year during this FYR period. AFCEC and the regulatory agencies agreed in August 2022 that an ESD was not necessary since aquifer restoration is being approached at CS-4 based on only one monitoring well with a PCE MCL exceedance reported in 2021 and 2022 (AFCEC 2023).

4.2.4 Five-Year Review Process

4.2.4.1 Data Review

Data collected for the CS-4 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the Southwest Plumes SLRs

during this FYR period (AFCEC 2023, 2022, 2021, 2020, 2019). Significant results from the data review include:

- Plume migration was controlled through the operation of the extraction wells (now shut down). The small amount of remaining mass will be reduced through natural attenuation. The CS-4 plume boundary changes on a temporal basis are shown on Figure 4-5.
- At the end of the FYR period, only one monitoring well (02MW1253) indicated an MCL exceedance (PCE at 8.2 µg/L) (AFCEC 2023). The estimated restoration timeframe in the ROD was 2017. Groundwater data indicates CS-4 restoration will be achieved in the next 1-2 years.
- A monitoring network optimization was completed in 2018 that included the elimination of monitoring at 13 CS-4 wells and the adjustment of monitoring frequencies at three CS-4 wells (AFCEC 2019).
- A monitoring network optimization was completed in 2021 that included the elimination of monitoring at four CS-4 wells and the adjustment of monitoring frequency at one CS-4 well (AFCEC 2022).

4.2.4.2 Site Inspections

Refer to Section 2.3.

4.2.4.3 Interviews

Refer to Section 2.4.

4.2.5 Technical Assessment

4.2.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the completion of the ROD in 2000, construction and startup of the remedial system in 2005, continued operation of the remedial system through January 2023, and completion of the well verification/well determination portion of the LUCs have resulted in the remedy at CS-4 functioning as intended by the DDs. Cleanup levels have been achieved for all COCs except PCE which is on a path to be achieved in a reasonable timeframe.

Plume monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure

protection of human health and the environment. Monitoring and evaluation activities are continual and well-documented.

4.2.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes. The RAOs developed for the final ROD (AFCEE 2000) and revised in the 2011 ESD (AFCEE 2011) are appropriate and remain valid for the current COCs. The current MCP GW-1 standard for 1,1,2,2-TeCA from the ROD and ESDs has been compared to EPA's RSL and has been determined to be protective. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the CS-4 remedy. New PFAS standards (discussed in Section 2.1) are not a concern at CS-4.

There are no changes in toxicity or other contaminant characteristics for the CS-4 groundwater COCs. For 1,1,2,2-TeCA, the current MCP GW-1 standard of 2 µg/L from the ROD and ESDs has been compared to EPA's Tap Water RSL of 7.6 µg/L (at a 10^{-4} carcinogenic risk) and has been determined to be protective.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The estimated restoration timeframe in the ROD was 2017. Groundwater data indicates CS-4 restoration will be achieved in the next 1-2 years.

4.2.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.2.6 Issues/Recommendations

No specific recommendations or follow-up actions have been identified.

4.2.7 Protectiveness Determination

The remedy for the CS-4 groundwater plume is protective of human health and the environment. The remedial system performed as expected and LUCs are functioning as intended to protect human health. Through natural attenuation processes, groundwater cleanup levels for the remaining COCs are expected to be achieved in the next 1-2 years.

4.2.8 References

AFCEC. 2023 (March). *Southwest Plumes 2022 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022 (April). *Southwest Plumes 2021 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021 (April). *Southwest Plumes 2020 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020 (April). *Southwest Plumes 2019 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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AFCEE. 2012a (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2012b (February). *Fuel Spill-28 and Southwest Plumes 2011 Private Well Verification and Well Determination Project Note*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2008b (September). *Final Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, Fuel Spill-13, Fuel Spill-28, and Fuel Spill-29 Groundwater Plumes*. Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2005 (September). *Chemical Spill 4 (CS-4) Removal Action Report.* Prepared by Engineering Strategies Corporation and Portage Environmental Inc. for AFCEE/JBCC Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21 and FS-13 Plumes.* Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1999 (May). *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1997 (June). *Final Technical Memorandum AOC CS-4 Hydraulic Performance Evaluation.* Prepared by CDM Federal Programs Corporation for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

ANG. 1992 (May). *Record of Decision for Interim Remedial Action West Truck Road Motor Pool (AOC CS-4) Groundwater Operable Unit.* Prepared by ABB Environmental Services, Inc., for ANG Installation Restoration Program, Otis Air National Guard Base, MA.

4.3 CHEMICAL SPILL-10 (CS-10) GROUNDWATER

4.3.1 Introduction

The CS-10 plume (OUs 14, 21 and 22) is a dissolved-phase groundwater plume located in the southern portion of JBCC with leading edges of the plume located southeast of the JBCC boundary (Figure 4-6). There are four separate areas in the CS-10 plume: (1) the In-Plume (IP) area, (2) the Sandwich Road lobe, (3) the southern trench area, and (4) the leading edge area which comprises three lobes: the Northern lobe (NL) (formerly known as the TCE plume); North-Central lobe (NCL); and Southern lobe (SL).

On-base land use in the vicinity of the CS-10 plume consists primarily of areas used for military operations. The area south of the base is characterized by residential areas and undeveloped woodlands and wetlands used for recreation and conservation. Surface water bodies (known as kettle ponds) in the vicinity of the CS-10 plume (Ashumet Pond and Johns Pond [Figure 4-6]) are recharged by groundwater and precipitation and provide for recreational use such as fishing, swimming, and boating. The CS-10 plume is located within a broad, flat, gently southward sloping glacial outwash plain (AFCEC 2018a).

The main sources of the CS-10 groundwater plume are the BOMARC and UTES facilities (referred to as the CS-10 Source Area) which are described in Section 3.1. Although the BOMARC and UTES facilities are considered the primary sources of contamination to the CS-10 plume, numerous other sources of contamination are presumed to have contributed to the CS-10 plume as it traveled beneath the JBCC (AFCEC 2018a).

4.3.2 Response Action Summary

4.3.2.1 <u>Basis for Taking Action</u>

The CS-10 Groundwater COCs are PCE, TCE, and 1,4-dioxane. The CS-10 plume boundary (Figure 4-6) is defined as the extent of groundwater containing TCE and/or PCE at concentrations exceeding the MCL of 5 µg/L for each compound (AFCEC 2023). The COC, 1,4-dioxane (which has a site-specific, risk-based remediation goal of 0.46 µg/L), is located within the boundaries of the CS-10 TCE plume (AFCEC 2021d).

Future residential exposure to PCE and TCE in drinking water presents an excess lifetime

cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$ (AFCEE 2001a). Future residential exposure to 1,4-dioxane in drinking water presents a cancer risk greater than $1x10^{-6}$ (AFCEC 2021d). An ecological risk assessment for PCE and TCE and an ecological screening for 1,4-dioxane concluded that discharge of the CS-10 plume to surface waters does not pose a threat to ecological receptors (AFCEE 2009, AFCEC 2017).

A VI evaluation indicated an incomplete pathway for VI at CS-10 groundwater and no further monitoring or data collection is needed specific to VI at CS-10 groundwater (AFCEE 2012). CS-10 source area Details C and F require additional VI evaluation as discussed in Section 3.1.

4.3.2.2 Response Actions

DSRP Source Area Removal Action: At the CS-10 source area (OU 8), 16 drainage structures were removed as part of the DSRP. In addition, a leaking 25,000 gallon UST was removed.

CS-10/FS-24 Source Area Remedial Action: A remedial action at the CS-10/FS-24 source area (OU 8) consisted of excavation and off-site disposal of contaminated soil and SVE operations. Further discussion regarding the CS-10 source area can be found at Section 3.1.

Interim Record of Decision: An IROD was developed to implement a remedy to address CS-10 groundwater contamination (ANG 1995). In 1999, an interim groundwater treatment system (Sandwich Road Treatment Facility [SRTF]) with eight extraction wells began operation (OU 14). In 2000, a second interim groundwater treatment system (IP) with eight extraction wells began operation (OU 21 and 22). A ninth extraction well was added to the IP system in 2004 (AFCEE 2018a).

Time-Critical Removal Action: Due to the high concentrations of TCE detected in groundwater within the NL and the knowledge that it was discharging into Johns Pond surface water, a time-critical removal action consisting of one extraction well (with treatment at the SRTF [OU 14]) began operation in 2000 to prevent the discharge of TCE into Johns Pond (AFCEE 2000).

Final Record of Decision: A final remedy for CS-10 groundwater (OU 14, 21, and 22) was selected and documented in the *Final Record of Decision for Chemical Spill-10 Groundwater* (AFCEE 2009). The selected remedy included continued operation of the previously installed interim and time-critical systems and the installation of an additional extraction well (with treatment at the SRTF) and reinjection well to address contamination in the Southern Trench area. The remedy included performance monitoring of the CS-10 plume and remedial system and LUCs. The predicted restoration timeframe for the main body of the CS-10 plume was 2094, while the leading edge restoration timeframe was predicted to be 2046.

Explanation of Significant Differences (2011): An ESD (OU 14, 21, and 22) was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to CS-10 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to CS-10 groundwater with PCE concentrations greater than the MCL of 5 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Explanation of Significant Differences (2014): The 2014 ESD (OU 14, 21, and 22) documented changes to the CS-10 CSM, modified the remedy to more aggressively remove contaminants, and amended the predicted aquifer restoration timeframe for the main body of CS-10 from 2094 (as presented in the ROD) to 2060. The modified remedy included two new extraction wells, two new reinjection wells, one MTU, and modified flow rates at selected existing extraction wells (AFCEC 2014).

Explanation of Significant Differences (2021): The 2021 ESD (OU 14, 21, and 22) added 1,4-dioxane as a COC and adopted the existing CS-10 groundwater remedy (monitoring, MNA and LUC components) for 1,4-dioxane. The ESD also added an additional RAO (AFCEC 2021d):

- Prevent residential exposure to CS-10 groundwater with 1,4-dioxane concentrations greater than the site-specific, risk-based remediation goal of 0.46 µg/L which is set at a 1E-06 cancer risk level.

4.3.2.3 Status of Implementation

The additional extraction well and reinjection well required by the CS-10 ROD became operational in 2009 (AFCEE 2010) while the additional extraction and reinjection wells and MTU cited in the 2014 ESD became operational in 2014 (AFCEC 2015). As remediation has progressed, the CS-10 remediation system has undergone various optimizations (including shutdown of the MTU in February 2020) and is currently operating with the IP treatment system with nine extraction wells at a design flow of 2,575 gpm and the SRTF with nine extraction wells at a design flow of 930 gpm (AFCEC 2023).

The CS-10 groundwater LUCs and their status are shown on Exhibit 4-3a.

Exhibit 4-3a

LUC Status for CS-10 Groundwater

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
CS-10 Groundwater LUC Area (Figure 4-6)	Yes	Yes	• Prevent access to or use of the groundwater from the CS-10 contaminated groundwater until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as the treatment systems and monitoring wells.	• Falmouth BOH Water Well Regulations – Sep 1999 • Mashpee BOH Moratorium on Groundwater Wells – Apr 1998, Amended July 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2012 and On-Going

As part of the LUC process specified in the ROD (AFCEE 2009), a private well verification survey was completed at CS-10 between January 2010 and August 2012 (AFCEE 2013). No private wells that were identified presented an unacceptable exposure risk from the CS-10 plume COCs.

The CS-10 private well verification survey identified one on-base water supply well (B-well) used for irrigation that could be impacted by TCE from the CS-10 plume. Annual sampling conducted annually between 2013 and 2017 indicated non-detect results for TCE and PCE and sampling at the B-well was discontinued in 2018 (AFCEC 2019).

During this FYR period, in response to AFCEC's private well verification annual mailings, three property owners (APEMS IDs 30518, 30589, and 39919) notified AFCEC that they planned to install new irrigation wells. Well determinations for these three irrigation wells (Appendix B) concluded the wells are suitable for irrigation/outdoor purposes. Note that the PFAS in this area would be from the FTA-1 PFAS groundwater plume (Figure 2-1).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the CS-10 Groundwater LUC Area during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.3.2.4 Remedy Operation & Maintenance

The CS-10 remedial systems are operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. A single contractor conducted O&M activities during this FYR period.

Remedial system performance monitoring data and long-term plume monitoring data collected under the SPEIM/LTM program, which is further described in Section 2.5, are used to assess: (i) whether the remedial objectives and system performance metrics are being met; (ii) whether remediation is progressing as expected; and (iii) to identify and assess optimization opportunities.

A summary of significant O&M activities since the last FYR follows:

- Extraction well 03EW2114 and its associated MTU operated in cyclic scenarios starting in July 2017 to increase efficiency (AFCEC 2019). An evaluation resulted in the extraction well and MTU being shut down in February 2020 (AFCEC 2020).
- Southern Trench extraction well 03EW2112, which had been shut down on an interim basis in November 2016, was re-started in January 2018 to capture an upgradient zone of contamination (AFCEC 2019).
- Sandwich Road extraction well 03EW2177 was shut down in February 2020 since upgradient TCE concentrations decreased below the MCL (AFCEC 2020).
- The total mass of TCE and PCE removed over the last five years (January 2018 – December 2022) from the CS-10 plume totals 625 pounds (lbs). The total mass of TCE and PCE removed from CS-10 over the lifetime of the systems (May 1999 – December 2022) totals 8,161 lbs (AFCEC 2018b, AFCEC 2023).
- The operational data collected during 2022 indicates the annual average treatment system flow rates exceed 94% of design flow rates at the IP system and 98% of design flow rates at the SRTF (AFCEC 2023).

4.3.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-3b) as well as the recommendation from the **last** FYR (Exhibit 4-3c) and the current status of the recommendation.

Exhibit 4-3b Protectiveness Determination/Statement from the 2018 FYR – CS-10 Groundwater		
OU #	**Protectiveness Determination**	**Protectiveness Statement**
14, 21 and 22 (CS-10 Groundwater)	Short-term Protective	**The remedy for the CS-10 groundwater plume is protective of human health and the environment in the short-term.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended for current COCs and there are no current plans to use the portion of the aquifer where CS-10 contamination is located for water supply. Through the combination of the active treatment by the remedial systems and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. For the remedy to be protective in the long-term, an ESD should be issued and remedial actions implemented, as necessary, to address ECs.

Exhibit 4-3c Status of Recommendation from the 2018 FYR – CS-10 Groundwater				
OU #	**Issue**	**Recommendation**	**Current Status**	**Current Implementation Status Description**
14, 21 and 22 (CS-10 Groundwater)	Emerging Contaminants	Prepare an ESD documenting 1,4-dioxane as a COC and develop an LTM Plan	Completed	See Below Discussion

Implementation Status: The *Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at CS-10* was submitted in January 2021 (AFCEC 2021d) and the *Final Remedial Action Supplemental Monitoring Plan for 1,4-Dioxane at Chemical Spill-10* was submitted in February 2021 (AFCEC 2021c).

4.3.4 Five-Year Review Process

4.3.4.1 Data Review

Data collected for the CS-10 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the CS-10 SLRs during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019). Significant results from the data review include:

- Plume migration beyond existing plume boundaries is being maintained through a combination of extraction well operations and natural attenuation. Extraction well operations are adjusted periodically to maximize mass removal and provide

containment in response to groundwater data trends. The CS-10 plume boundary changes on a temporal basis are shown on Figure 4-7.

- The highest COC concentration in the CS-10 plume monitoring network at the beginning of this FYR period (Oct 2017) was TCE at 1,500 µg/L in monitoring well 03MW1060B (AFCEC 2018b). The highest concentration at the end of the FYR period (Oct 2022) was TCE at 340 µg/L also in 03MW1060B (AFCEC 2023).
- Two of the leading edge lobes, the NCL and SL, rely solely on MNA and continue to see decreasing concentrations of TCE in the monitoring network. The highest TCE concentration in the NCL at the beginning of this FYR period (Oct 2017) was 31 µg/L at monitoring well 03MW2620A (AFCEC 2018B). The highest TCE concentration at the end of the FYR period (Oct 2022) was 22 µg/L also in 03MW2620A (AFCEC 2023). The highest TCE concentration in the SL at the beginning of this FYR period (Oct 2017) was 14 µg/L at monitoring well 00MW0606A (AFCEC 2018B). The highest TCE concentration at the end of the FYR period (Oct 2022) was 5.8 µg/L also in 00MW0606A (AFCEC 2023).
- 1,4-Dioxane was detected above the risk-based RG of 0.46 µg/L in 3 on-base monitoring wells in the most recent sampling event (October/November 2022) with a maximum concentration of 2 µg/L at 03MW1066C.
- A monitoring network optimization was completed at CS-10 in 2018 resulting in a network with 61 monitoring wells sampled on an annual basis, with an additional 83 monitoring wells sampled on a triennial basis (AFCEC 2019).
- Determinations for private irrigation wells located at APEMS IDs 30518, 30589, and 39919 (discussed in Section 4.3.2.3) remain valid as there were no changes in the CSM for the CS-10 plume COCs or FTA-1 PFAS plume since the most recent determinations.
- PFAS sampling conducted in 2021 and 2022 at the CS-10 extraction wells indicates exceedances of PFOS, PFOA, PFNA screening standards and the PFAS6 MMCL as detailed in Table 4-1. PFAS sampling and analysis in the CS-10 GAC systems is being conducted and the GAC exchange procedures have been modified to prevent the release of treated groundwater with PFAS concentrations in excess of the PFAS6 MMCL through the CS-10 groundwater infiltration and reinjection systems.

4.3.4.2 Site Inspections

Refer to Section 2.3.

4.3.4.3 Interviews

Refer to Section 2.4.

4.3.5 Technical Assessment

4.3.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, construction and startup of the remedial system components added to the interim system as part of the final remedy in 2009, continued operation of the remedial systems, and completion of the well verification/well determination portion of the LUCs have resulted in the remedy functioning as intended by the DDs for the current COCs.

The CS-10 treatment systems have a high operational effectiveness (> 94%) and are removing mass and containing the groundwater plume. Two of the leading edge lobes, the NCL and SL, rely solely on MNA. Decreasing concentrations of TCE in the monitoring network at these areas demonstrate the MNA remedy is effective at restoring this portion of the aquifer.

Plume and remedial system monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure protection of human health and the environment. Operational costs are appropriate for the remedy and a robust optimization program continues with the objective of reducing remedial system operational timeframes, the time to reach remedial goals (e.g., MCLs), and reducing future costs. Monitoring and evaluation activities are continual and well-documented for the current COCs.

4.3.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

No, there have been changes in potential standards and TBCs. While the RAOs developed for the ROD (AFCEE 2009) and revised in the 2011 and 2021 ESDs (AFCEE 2011, AFCEC 2021d) are appropriate and remain valid for the current COCs, new PFAS standards may affect the long-term protectiveness of the current remedy selection.

New standards for PFAS (discussed in Section 2.1.2) have been developed. These changes

are not expected to alter the short-term protectiveness of the remedy because LUCs in the area prevent exposure in drinking water. As discussed in Section 4.3.4.1, PFAS have been detected above the PFAS6 MMCL in CS-10 extraction wells. An investigation is being recommended to determine the extent of PFAS in the CS-10 area and to distinguish PFAS in groundwater from known sources (e.g., ANG Motor Pool Area) and currently unknown sources.

There are no changes in toxicity or other contaminant characteristics for the CS-10 groundwater COCs. There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

TCE (the most persistent CS-10 COC) concentrations are expected to reach MCLs in approximately 2060 (AFCEC 2014). The CS-10 treatment systems are removing significant amounts of COC mass.

4.3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.3.6 Issues/Recommendations

Exhibit 4-3d Issue/Recommendation #7: CS-10 Groundwater				
14, 21 and 22 (CS-10 Groundwater)	**Issue Category: Emerging Contaminants**			
	Issue: Emerging contaminants, specifically PFAS, exceed the PFAS6 MMCL in numerous CS-10 extraction wells and in groundwater in the FS-13 area (which overlies the CS-10 plume). These PFAS detections may not be related to CS-10.			
	Recommendation: Conduct an investigation of the PFAS detected in the CS-10 extraction wells and in groundwater near FS-13. Engage regulatory and AF program stakeholders regarding the appropriate reporting mechanism (e.g., expansion of on-going Flight Line OU RI, CS-10 Supplemental RI). Develop a DD to establish additional COCs and RAOs as appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2027

4.3.7 Protectiveness Determination

The remedy for the CS-10 groundwater plume is protective of human health and the environment in the short-term. The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial systems and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. For the remedy to be protective in the long-term, an investigation of PFAS in the CS-10 extraction wells and in groundwater near FS-13 should be conducted and follow-on CERCLA responses should be implemented, as necessary.

4.3.8 References

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AFCEE. 2012 (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

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4.4 CHEMICAL SPILL-19 (CS-19) GROUNDWATER

4.4.1 Introduction

The CS-19 plume (OU 24) is a dissolved-phase groundwater plume located within the west central region of the JBCC Impact Area (Figure 4-8).

The land above the CS-19 plume is primarily forested and is part of the JBCC Impact Area which is designated as an operational range. The remaining portion of the CS-19 plume is located within a broad, flat, gently sloping glacial outwash plain.

The source of the CS-19 plume is an area used historically (approximately 1967 to 1968) for ordnance disposal (AFCEE 2009, 2003).

4.4.2 Response Action Summary

4.4.2.1 Basis for Taking Action

The CS-19 groundwater COC is hexahydro-1,3,5-trinitro-1,3,5-triazine or Royal Demolition Explosive (RDX). The CS-19 plume boundary is defined as the extent of groundwater exceeding the EPA RSL of 0.97 µg/L (based on a $1x10^{-6}$ excess lifetime cancer risk calculation) (AFCEC 2022). See discussion regarding changes to the RSL in section 4.4.5.2.

Future residential exposure to the RDX in CS-19 groundwater may present an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$ (AFCEE 2009). An ecological baseline risk assessment was not conducted for groundwater because the CS-19 plume is not currently discharging to any surface water bodies, nor is it expected to in the future.

A VI evaluation indicated an incomplete pathway for VI at CS-19 and no further monitoring or data collection is needed specific to VI at CS-19 (AFCEE 2012).

4.4.2.2 Response Actions

CS-19 Source Area Removal Action: Removal activities conducted at the CS-19 source area (including the CS-19 Bunker Area) between 2004 and 2006, and between 2007 and

2009 included the excavation of the top two to three ft of soil and the associated MEC. Based on confirmatory sampling, the EPA and the MassDEP agreed that the remaining RDX levels in soil are protective and that any leaching to groundwater would be well below risk-based levels (AFCEE 2009).

Interim Record of Decision: An IROD was developed to implement an interim remedy to address CS-19 groundwater. The interim remedy included LTM of CS-19 groundwater and LUCs until a final remedy is implemented (AFCEE 2006). It was agreed that a final remedy would be evaluated in conjunction with the remedy selection process for the nearby central impact area (CIA) plume which was being addressed under the IAGWSP (EPA 2004). In 2008, AFCEE, EPA, and MassDEP agreed that the CS-19 and CIA plume remedy selection process could be conducted separately (AFCEE 2009).

Final Record of Decision: A final remedy for CS-19 groundwater was selected and documented in the *Final Chemical Spill-19 Record of Decision* (AFCEE 2009). The selected remedy includes MNA with LUCs and requires a re-evaluation of the source area if the groundwater plume does not attenuate as predicted.

Explanation of Significant Differences (2011): An ESD was completed in 2011 that slightly modified the phrasing of the RAOs and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to CS-19 groundwater with RDX concentrations greater than the EPA risk-based level of 0.6 µg/L.
- Restore useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

4.4.2.3 Status of Implementation

The selected MNA remedy has progressed without issue with monitoring being conducted on either an annual or triennial basis for select monitoring wells (AFCEC 2022, 2021, 2020, 2019, 2018a).

The CS-19 groundwater LUCs and their status are shown on Exhibit 4-4a.

Exhibit 4-4a LUC Status for CS-19 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
CS-19 Groundwater LUC Area (Figure 4-8)	Yes	Yes	• Prevent access to or use of the groundwater from the CS-19 plume area until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future groundwater monitoring system.	• MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going

Although not a ROD requirement, a well verification survey was completed for CS-19 in January 2013. No active or inactive water-supply or irrigation wells were identified within the CS-19 LUC area. Additionally no private residential wells are known to exist within the CS-19 LUC area since the plume is located entirely within the boundary of the JBCC (AFCEC 2013).

4.4.3 Progress Since the Last Review

This section includes the protectiveness determination and statements from the **last** FYR (Exhibit 4-4b). There were no issues or recommendations for CS-19 groundwater in the last FYR.

Exhibit 4-4b Protectiveness Determination/Statement from the 2018 FYR – CS-19 Groundwater		
OU #	**Protectiveness Determination**	**Protectiveness Statement**
24 (CS-19 Groundwater)	Protective	**The remedy for the CS-19 groundwater plume is protective of human health and the environment.** Remediation is progressing as expected. The LUCs are in place and are functioning as intended. Through natural attenuation processes groundwater cleanup levels are expected to be achieved within the timeframe approximated in the ROD which was considered reasonable given the particular circumstances of the site.

4.4.4 Five-Year Review Process

4.4.4.1 Data Review

Data collected for the CS-19 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the CS-19 Annual or Triennial LTM Data Presentation Project Notes during this FYR period (AFCEC 2022, 2021, 2020, 2019, 2018a). Significant results from the data review follow:

- The natural attenuation remedy prevented migration of the CS-19 plume and has significantly reduced its extent and COC concentrations (Figure 4-8).
- EPA updated the RSL for RDX in tap water from 0.7 µg/L to 0.97 µg/L in November 2018 (EPA 2018). The new RSL was integrated as a comparison value into the 2020, 2021 and 2022 CS-19 LTM project notes (AFCEC 2022, 2021, 2020). This FYR uses the ESD's risk-based level of 0.6 µg/L as a comparison value.
- At the end of the FYR period, RDX was detected above the EPA risk-based value of 0.6 µg/L in two of eight monitoring wells (maximum concentration at monitoring well 58MW0009E with RDX at 1.3 µg/L) (AFCEC 2022). This data indicates the MNA remedy will achieve the estimated date of cleanup (2037).
- A network optimization discontinued sampling at three boundary monitoring wells and reduced the sampling frequency at one well from annual to triennial (AFCEC 2019).

4.4.4.2 Site Inspections

Refer to Section 2.3.

4.4.4.3 Interviews

Refer to Section 2.4.

4.4.5 Technical Assessment

4.4.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the LTM activities and the implementation of the LUCs at CS-19 have resulted in the remedy functioning as intended by the DDs. The data evaluation indicates the MNA remedy will achieve the estimated date of cleanup (2037). Monitoring and evaluation activities are continual and well-documented.

4.4.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, however, the toxicity data for RDX has changed resulting in a less stringent standard. This change does not impact the protectiveness of the current RAOs. No other changes during this FYR period affect protectiveness at the site.

There are changes in standards and TBCs related to the CS-19 remedy. Specifically, the EPA tap water screening level for RDX was changed from 0.7 µg/L to 0.97 µg/L (EPA 2018). EPA's new RDX tap water screening level of 0.97 µg/L (which applies to groundwater at CS-19) was integrated into the CS-19 LTM program in 2020. New PFAS standards (discussed in Section 2.1) are not a concern at CS-19.

There were changes in toxicity parameters for RDX. In August 2018, EPA revised the non-cancer oral RfD and the cancer oral slope factor. These new values indicate that RDX is now less toxic from cancer and non-cancer health effects. These toxicity changes would result in decreased cancer risk and decreased non-cancer hazard from exposure to RDX (EPA 2022).

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The RAOs documented in the ESD (AFCEE 2011) remain protective. As noted previously, in 2018 EPA updated the RSL for RDX in tap water (originally 0.6 µg/L then updated by EPA to 0.7 µg/L in 2017) to 0.97 µg/L. This FYR includes a finding to document an upward

change in the RDX cleanup level in an ESD that can support future application of the three-step closeout process and the subsequent Remedial Action Completion Report (RACR).

The groundwater comparison level (i.e., current RDX risk-based level of 0.6 µg/L) is expected to be achieved earlier than the timeframe approximated in the ROD (by 2037).

4.4.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.4.6 Issues/Recommendations

No specific recommendations or follow-up actions have been identified.

Other Findings

The following finding was identified during the FYR.

- Prepare an ESD to document an upward change in the RDX cleanup level for CS-19 groundwater and establish a new MNA timeframe if justified by the remaining RDX concentrations.

4.4.7 Protectiveness Determination

The remedy for the CS-19 groundwater plume is protective of human health and the environment. Remediation is progressing faster than expected. The LUCs are in place and are functioning as intended to protect human health. Through natural attenuation processes groundwater cleanup levels are expected to be achieved earlier than the timeframe approximated in the ROD (i.e., 2037).

4.4.8 References

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4.5 CHEMICAL SPILL-21 (CS-21) GROUNDWATER

4.5.1 Introduction

The CS-21 plume (OU 9) is a dissolved-phase groundwater plume located south of the JBCC boundary (Figure 4-4).

The land above much of the CS-21 plume is undeveloped woodlands used for recreational purposes (hiking, biking, hunting, etc.) within the CWMA, which is managed by the MDFW. The eastern portion of the CS-21 plume is located within a broad, flat, gently sloping glacial outwash plain. The western portion of the plume travels into a hummocky north-south trending ridge of moraine glacial deposits (AFCEC 2018).

The CS-21 plume is detached from its source area which remains unidentified. It is speculated that contamination was released at the ground surface from a spill or release on the JBCC, migrated through the vadose zone, and entered the groundwater at the water table. The dissolved phase contamination was then carried downgradient in groundwater in a south-southwesterly direction (AFCEE 1999).

4.5.2 Response Action Summary

4.5.2.1 Basis for Taking Action

The CS-21 Groundwater COC is TCE. The CS-21 plume boundary is defined by the extent of groundwater containing TCE at concentrations exceeding its federal MCL of 5 µg/L.

The baseline cancer risk calculations in the SWOU RI indicated that unless remedial action is undertaken, future residential exposure to TCE in groundwater may present an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. Ecological risks associated with the CS-21 groundwater plume were evaluated during the RI and no significant risk was identified (AFCEE 1999).

A VI evaluation indicated an incomplete pathway for VI at CS-21 and no further monitoring or data collection is needed specific to VI at CS-21 (AFCEE 2012a).

4.5.2.2 Response Actions

Final Record of Decision: A final remedy for CS-21 groundwater was selected and documented in the *Final Record of Decision for the CS-4, CS-20, CS-21 and FS-13 Plumes* (AFCEE 2000). The selected remedy included groundwater extraction and treatment to hydraulically capture the plume through the installation of new extraction wells, treatment at a new treatment plant using GAC, performance monitoring of the CS-21 plume and remedial system, and ICs (AFCEE 2000).

Explanations of Significant Differences: An ESD was completed in 2008 to modify the LUC language (previously called ICs in the ROD) and the site closure language (AFCEE 2008). A second ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to CS-21 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Restore useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

4.5.2.3 Status of Implementation

The CS-21 remedial system began operation in 2006 using four extraction wells at a total flow rate of 1,400 gpm. All groundwater from CS-21 is treated at the HATF. As remediation has progressed, the CS-21 system has undergone various optimizations with the most recent scenario operating two extraction wells at a total flow rate of 400 gpm (AFCEC 2023).

The CS-21 groundwater LUCs and their status are shown on Exhibit 4-5a.

Exhibit 4-5a LUC Status for CS-21 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD/ESD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
CS-21 Groundwater LUC Area (Figure 4-4)	Yes	Yes	• Prevent access to, or use of, the groundwater from the CS-21 plume until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• Falmouth BOH Water Well Regulations – Sep 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program - 2011 and On-Going

As part of the LUC process specified in the ROD and subsequent ESD (AFCEE 2000, 2008), a private well verification survey was completed for the Southwest Plumes (including CS-21) between April 2009 and August 2011. No private wells that were identified presented an unacceptable exposure risk from the CS-21 plume. No private drinking water wells were identified and a total of 16 properties associated with CS-21 had one or more private wells that were used as a non-potable water source (AFCEE 2012b).

Technical evaluations were completed for each private non-potable well to determine the sampling frequency and/or re-evaluation frequencies (if necessary). The two irrigation wells at a golf course (APEMS ID 82381) were identified for annual sampling under the CS-21 LUC program because annual sampling was required per the water withdrawal permit with the Massachusetts Department of Environmental Protection. Sampling at the two irrigation wells was discontinued in 2016 (AFCEC 2019).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the CS-21 Groundwater LUC Area during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.5.2.4 Remedy Operation and Maintenance

The CS-21 remedial system is operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. A single contractor conducted O&M activities during this FYR period.

Remedial system performance monitoring data and long-term plume monitoring data collected under the SPEIM/LTM program, which is further described in Section 2.5, are used to assess: (i) whether the remedial objectives and system performance metrics are being met; (ii) whether remediation is progressing as expected; and (iii) to identify and assess optimization opportunities.

A summary of significant O&M activities since the last FYR follows:

- The CS-21 groundwater treatment system operated at a flow rate of 600 gpm at two extraction wells (82EW0001 – 500 gpm and 82EW0002 – 100 gpm) at the initiation of this FYR period. In Dec 2018, 82EW0001 was reduced to an optimized flow rate of 300 gpm (with no change at 82EW0002) resulting in a total flow rate of 400 gpm for the remainder of this FYR period. (AFCEC 2023, 2022, 2021b, 2020, 2019).
- As an in-plant optimization at HATF, the flow from CS-4 and CS-21 was combined with flow from the LF-1 extraction wells on 14 March 2019, allowing for the shutdown of the LF-1 treatment plant. The combined flow is treated through three of the existing HATF GAC trains which resulted in the shutdown of one carbon train (AFCEC 2020).

- The total mass of TCE removed over the last five years (January 2018 – December 2022) from the CS-21 plume totals 25.8 lbs. The total mass of TCE removed from CS-21 over the lifetime of the system (September 2006 – December 2022) totals 243.8 lbs (AFCEC 2018, AFCEC 2023).
- The operational data collected during 2022 indicates the annual average treatment system flow rates at CS-21 exceed 93% of design flow rates (AFCEC 2023).

4.5.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-5b). There were no issues and recommendations for CS-21 groundwater in the last FYR.

Exhibit 4-5b

Protectiveness Determination/Statement from the 2018 FYR – CS-21 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
9 (CS-21 Groundwater)	Protective	**The remedy for the CS-21 groundwater plume is protective of human health and the environment.** The remedial system is performing as expected. The LUCs are in place and are functioning as intended. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved within the timeframe approximated in the ROD which was considered reasonable given the particular circumstances of the site.

4.5.4 Five-Year Review Process

4.5.4.1 Data Review

Data collected for the CS-21 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the Southwest Plumes SLRs during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019, 2018). Significant results from the data review include:

- Plume migration is being controlled through the operation of the two remaining extraction wells. Continued extraction and natural attenuation are reducing COC concentrations. The estimated restoration timeframe in the ROD was 2025. Groundwater data indicates CS-21 restoration will be achieved in this approximate

timeframe. The CS-21 plume boundary changes on a temporal basis are shown on Figure 4-9.

- At the beginning of this FYR period (April 2017) five CS-21 monitoring wells indicated MCL exceedances of TCE with an average concentration of 15.4 µg/L. The highest TCE concentration (69MW1506B) was 34.2 µg/L (AFCEC 2018).
- At the end of this FYR period (April 2022) four CS-21 monitoring wells indicated MCL exceedances of TCE with an average concentration of 9.5 µg/L. The highest TCE concentration (69MW1506B) was 16 µg/L (AFCEC 2023).
- A monitoring network optimization was completed in 2018 that included the elimination of monitoring at 11 CS-21 wells and the adjustment of monitoring frequencies at four CS-21 wells (AFCEC 2019).
- The determination for golf course irrigation wells located at APEMS ID 82381 (discussed in Section 4.5.2.3) remains valid as there were no changes in the CSM for the CS-21 plume COCs.

4.5.4.2 Site Inspections

Refer to Section 2.3.

4.5.4.3 Interviews

Refer to Section 2.4.

4.5.5 Technical Assessment

4.5.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the completion of the ROD in 2000, construction and startup of the remedial system in 2006, continued operation of the remedial system in conjunction with MNA, and completion of the well verification/well determination portion of the LUCs have resulted in the remedy at CS-21 functioning as intended by the DDs. The estimated restoration timeframe in the ROD was 2025. Groundwater data indicates CS-21 restoration will be achieved in this approximate timeframe.

Plume and remedial system monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure protection of human health and the environment.

Operational costs are appropriate for the remedy and a robust optimization program continues with the objective of reducing remedial system operational timeframes, the time to reach remedial goals (e.g., MCLs), and reducing future costs. Monitoring and evaluation activities are continual and well-documented.

4.5.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, the RAOs developed for the final ROD (AFCEE 2000) and revised in the 2011 ESD (AFCEE 2011b) are appropriate and remain valid for the current COC. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the CS-21 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at CS-21.

There are no changes in toxicity or other contaminant characteristics for the CS-21 groundwater COC.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The estimated restoration timeframe in the ROD was 2025. Groundwater data indicates CS-21 restoration will be achieved in this approximate timeframe.

4.5.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.5.6 Issues/Recommendations

No specific recommendation or follow-up actions have been identified.

4.5.7 Protectiveness Determination

The remedy for the CS-21 groundwater plume is protective of human health and the environment. The remedial system is performing as expected. The LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved within the timeframe approximated in the ROD.

4.5.8 References

AFCEC. 2023 (March). *Southwest Plumes 2022 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022 (April). *Southwest Plumes 2021 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021a (September). *2021 Operations and Maintenance Plan for Groundwater Extraction and Treatment Systems and Wind Turbines.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021b (April). *Southwest Plumes 2020 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2018 (September). *Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA.* Prepared by AFCEE/JBCC, Installation Restoration Program, Otis ANG Base, MA.

AFCEE. 2012a (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2012b (February). *Fuel Spill-28 and Southwest Plumes 2011 Private Well Verification and Well Determination Project Note*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2008 (September). *Final Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, Fuel Spill-13, Fuel Spill-28, and Fuel Spill-29 Groundwater Plumes*. Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21 and FS-13 Plumes.* Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1999 (May). *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

4.6 FUEL SPILL-12 (FS-12) GROUNDWATER

4.6.1 Introduction

The FS-12 plume (OU 1) is a dissolved-phase groundwater plume located east of the JBCC boundary. Based on the most recent groundwater monitoring data collected in 2023, the FS-12 plume consists of three disconnected zones of contamination (Figure 4-10).

Land above the FS-12 groundwater plume consists of undeveloped areas and a summer camp. It is anticipated that the land use over the FS-12 plume area will not significantly change over time. Snake Pond, a kettle pond that is fed by groundwater and located to the west of the FS-12 plume, is used for recreational purposes such as fishing, swimming, and boating. In addition, a public beach is located on the southeast side of Snake Pond.

The FS-12 groundwater plume originated from a break in an underground pipeline located along Greenway Road that was originally believed to be discovered in 1972 (FS-12 Source Area location on Figure 4-10). The operation of the pipeline was discontinued in 1973. The FS-12 release was estimated to be about 70,000 gallons of AVGAS and JP-4 (AFCEE 2006).

4.6.2 Response Action Summary

4.6.2.1 <u>Basis for Taking Action</u>

The FS-12 Groundwater COCs are EDB and benzene. The FS-12 plume boundary is defined as the extent of groundwater containing EDB concentrations exceeding the MMCL of 0.02 µg/L. Benzene has not been detected at concentrations above the MCL of 5 µg/L within the monitoring network since 2007, therefore, monitoring for benzene within the plume was discontinued in 2008 and at the source area in 2011 (AFCEC 2023).

Future residential exposure to the FS-12 groundwater COCs presents an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. An ecological baseline risk assessment was not conducted for FS-12 due to a lack of evidence of plume discharge to Snake Pond. Extensive sampling has not detected any FS-12 contaminants in Snake Pond surface water. Therefore, it is not expected that contamination associated with the FS-12 groundwater plume would pose unacceptable ecological risk (AFCEE 2006).

A VI evaluation indicated an incomplete pathway for VI at FS-12 and no further monitoring or data collection is needed specific to VI at FS-12 (AFCEE 2012).

4.6.2.2 Response Actions

FS-12 Source Area Removal Action: A time-critical removal action consisting of a combined air sparging/soil vapor extraction system operated between October 1995 and February 1998 in the FS-12 source area and removed an estimated total of 44,579 pounds of product. The *FS-12 Source Area Removal Action Summary Report* (AFCEE 2000) outlines the removal action while a later technical memorandum supported UU/UE at the FS-12 source area based on the original source COCs (AFCEC 2014).

Interim Record of Decision: An IROD was developed to implement a remedy to address FS-12 groundwater contamination (ANG 1995). In September 1997, an interim groundwater treatment system with 25 extraction wells began operation (AFCEE 2006).

Final Record of Decision: A final remedy for FS-12 groundwater was selected and documented in the *Final Record of Decision for Fuel Spill-12 Groundwater* (AFCEE 2006). The selected remedy included continued operation of the previously installed treatment system. The remedy also included performance monitoring of the FS-12 plume and remedial system and LUCs.

Explanation of Significant Differences: An ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, added the private well verification process under LUCs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to FS-12 groundwater with benzene concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to FS-12 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L.

- Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

4.6.2.3 Status of Implementation

The FS-12 remedial system began operation in 1997 using 25 extraction wells at a total flow rate of 772 gpm. As remediation has progressed, the FS-12 system has undergone various optimizations with the most recent scenario operating four extraction wells at a maximum flow rate of 280 gpm with two extraction wells operating on a cyclic basis (AFCEC 2023).

The FS-12 groundwater LUCs and their status are shown on Exhibit 4-6a.

Exhibit 4-6a

LUC Status for FS-12 Groundwater

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
FS-12 Groundwater LUC Area (Figure 4-10)	Yes	Yes	• Prevent access to or use of the groundwater from the FS-12 plume until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• Sandwich BOH Private Well Regulations – April 2005 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2013 and On-Going

As part of the LUC process specified in the ESD (AFCEE 2011), a private well verification survey was completed at FS-12 between May 2011 and April 2013 (AFCEC 2013). No active private wells were identified. One property (summer camp) indicated to AFCEC that they formerly used one or more wells for irrigation and potable water supplies prior to

being connected to municipal water by the DoD in 1993. However, the operator of the camp verified that none of these former wells are in use.

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the FS-12 Groundwater LUC Area during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.6.2.4 Remedy Operation & Maintenance

The FS-12 remedial system is operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. A single contractor conducted O&M activities during this FYR period.

Remedial system performance monitoring data and long-term plume monitoring data collected under the SPEIM/LTM program, which is further described in Section 2.5, are used to assess: (i) whether the remedial objectives and system performance metrics are being met; (ii) whether remediation is progressing as expected; and (iii) to identify and assess optimization opportunities.

A summary of significant O&M activities since the last FYR follows:

- In November 2018, the GAC treatment train at the FS-12 plant was reconfigured from two treatment trains operating in parallel followed by a polishing treatment train to a single, three-GAC vessel train operating in series (AFCEC 2019). The GAC configuration was further optimized in June 2019 to a single four-GAC vessel train in series: lead, lag, lead polish and lag polish (AFCEC 2020).

- The total mass of EDB removed over the last five years (January 2018 – December 2022) from the FS-12 plume totals 0.46 lbs. The total mass of EDB removed from FS-12 over the lifetime of the system (September 1997 – December 2022) totals 137.35 lbs (AFCEC 2019, AFCEC 2023).
- The total mass of benzene (last detected in treatment system influent in 1999) removed over the lifetime of the system totals 56.92 lbs.
- The operational data collected during 2022 indicates the annual average treatment system flow rate at FS-12 exceeds 100% of the design flow rate (AFCEC 2023).

4.6.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-6b). There were no issues and recommendations for FS-12 groundwater in the last FYR.

Exhibit 4-6b

Protectiveness Determination/Statement from the 2018 FYR – FS-12 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
1 (FS-12 Groundwater)	Protective	**The remedy for the FS-12 groundwater plume is protective of human health and the environment.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended. Through the combination of the active treatment by the remedial systems and natural attenuation processes, groundwater cleanup levels are expected to be achieved. Since the LUCs are in place and are functioning as intended to prevent exposure and there are no current plans to use the portion of the aquifer where FS-12 contamination remains for water supply, the remedy remains protective.

4.6.4 Five-Year Review Process

4.6.4.1 Data Review

Data collected for the FS-12 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the FS-12 SLRs during this FYR period (AFCEC 2023, 2022, 2021a, 2020, 2019, 2018). Significant results from the data review include:

- Plume migration is being controlled by the remaining extraction wells in operation. Continued extraction and natural attenuation are reducing COC concentrations. The

FS-12 plume boundary changes on a temporal basis are shown on Figure 4-11.

- At the beginning of this FYR period (August/September 2017) eight FS-12 monitoring wells indicated MMCL exceedances of EDB with an average concentration of 0.75 µg/L. The highest EDB concentration (90MW0055) was 4.8 µg/L (AFCEC 2018).
- At the end of this FYR period (September 2022) five FS-12 monitoring wells indicated MMCL exceedances of EDB with an average concentration of 0.58 µg/L. The highest EDB concentration (90MW0040) was 2 µg/L (AFCEC 2023).
- Annual monitoring of the two surface water sampling locations in Snake Pond was eliminated following approval by the Sandwich Board of Health in November 2017 (AFCEC 2018).
- A monitoring network optimization was completed at FS-12 in 2019 which eliminated 11 monitoring wells that were outside the updated plume boundary and employed an annual sampling frequency at monitoring wells located within the remaining plume core areas and a triennial sampling frequency at trailing edge and boundary wells (AFCEC 2020).
- An EDB plume boundary update and monitoring network optimization was completed at FS-12 in 2022 which eliminated two monitoring wells that were outside the updated plume boundary and increased sampling frequency at one monitoring well (AFCEC 2023). The cleanup timeframe at FS-12 had been estimated to extend to 2105 based on post-ROD data collected deeper in the aquifer (AFCEC 2016). As described in the last FYR, the FS-12 remediation system was optimized with the goal of shortening the cleanup timeframe. Groundwater model transport simulations (based on the optimized FS-12 system) indicate that much of the FS-12 plume is now predicted to be remediated within the timeframe established by the ROD (approximately 2030). The extraction, treatment and reinjection (ETR) system is predicted to be shut down sometime between 2034 and 2039, at which time the remedy is expected to transition to MNA alone to address a small area of low concentration EDB that is predicted to remain at depth in the aquifer upgradient of extraction wells 90EW0025 and 90EW0026 (AFCEC 2023).

4.6.4.2 Site Inspections

Refer to Section 2.3.

4.6.4.3 Interviews

Refer to Section 2.4.

4.6.5 Technical Assessment

4.6.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, continued operation of the ETR system installed as the interim remedy in 1997, completion of the ROD in 2006, and completion of the well verification/well determination portion of the LUCs in early 2013 have resulted in the remedy functioning as intended by the DDs. Post-ROD data collected in 2015 indicated an estimated cleanup timeframe of 2105. A system optimization and associated groundwater model transport simulations indicate that much of the FS-12 plume is now predicted to be remediated within the timeframe established by the ROD (approximately 2030). The treatment system is predicted to shut down sometime between 2034 and 2039, at which time the remedy is expected to transition to MNA alone to address a small area of low concentration EDB that is predicted to remain at depth in the aquifer upgradient of extraction wells 90EW0025 and 90EW0026.

Plume and remedial system monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place. Operational costs are appropriate for the remedy and a robust optimization program continues with the objective of reducing remedial system operational timeframes, the time to reach remedial goals (e.g., MMCLs), and reducing future costs. Monitoring and evaluation activities are continual and well-documented.

4.6.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, the RAOs developed for the final ROD (AFCEE 2006) and revised in the 2011 ESD (AFCEE 2011) are appropriate and remain valid for the current COCs. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the FS-12 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at FS-12.

There are no changes in toxicity or other contaminant characteristics for the FS-12

groundwater COCs.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The estimated restoration timeframe in the ROD was approximately 2030. Current data and modeling indicate the restoration timeframe will extend beyond 2039. The next FYR will have the benefit of additional data in order to reassess the restoration timeframe.

4.6.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.6.6 Issues/Recommendations

No specific recommendation or follow-up actions have been identified.

4.6.7 Protectiveness Determination

The remedy for the FS-12 groundwater plume is protective of human health and the environment. The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved. Current groundwater data and modeling indicate the aquifer restoration timeframe of 2030 identified in the ROD will not be met. The restoration timeframe will be re-assessed in the next FYR.

4.6.8 References

AFCEC. 2023 (March). *Fuel Spill-12 2022 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2014 (May*). Action Memorandum Technical Memorandum for Areas of Concern (AOCs) CS-4 (USCG)/FS-1 (USCG), CS-5, CS-11, FS-7, FS-18, DDOU, FS-4, FTA-1, and FS-12.* Prepared by Portage, Inc. for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013 (July). *Fuel Spill-12 Private Well Verification Project Note*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

AFCEE. 2012 (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2006 (September). *Final Record of Decision for Fuel Spill-12 Groundwater Report.* Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2000 (March). *FS-12 Source Area Removal Action Summary Report.* Prepared by Advanced Infrastructure Management Technologies for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

ANG. 1995 (September). *Final Record of Decision for Interim Action of Seven Groundwater Plumes at Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared by Stone & Webster, Environmental Technology and Services for ANG JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

4.7 FUEL SPILL-13 (FS-13) GROUNDWATER

4.7.1 Introduction

The FS-13 groundwater site (OU 9) was a dilute dissolved-phase groundwater plume located within the JBCC (Figure 4-12). The groundwater contamination at FS-13 has not been delineated as a contiguous plume since 2004 due to its limited extent. The FS-13 site is located within the footprint of the CS-10 plume, although it is shallower in the aquifer than CS-10, with contamination located near the water table (AFCEC 2018).

The land in the immediate vicinity of the FS-13 groundwater contamination is within the boundary of the JBCC and is undeveloped apart from some base roads (i.e., Richardson Road and West Inner Road). The topography of the land in this area is characterized as a broad, flat, and gently southward sloping glacial outwash plain (AFCEC 2018).

The source of the FS-13 plume was a release from a pipeline of an estimated 2,000 gallons of JP-4 that is believed to have occurred near the rotary at the east end of Connery Avenue. The fuel spill was discovered in 1972 during a routine walkover inspection of an underground fuel supply pipeline (AFCEC 2018).

4.7.2 Response Action Summary

4.7.2.1 Basis for Taking Action

The FS-13 groundwater COCs are 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB (AFCEE 2000). At the time of the ROD, the cleanup levels for both COCs was a risk-based level of 17 µg/L. See discussion regarding the later development of RSLs for the COCs in section 4.7.5.2.

The baseline risk calculations in the RI indicated that unless remedial action is undertaken, future residential exposure to groundwater contaminated with TMBs may present an unacceptable non-cancer hazard greater than regulatory thresholds (i.e., HI >1) (AFCEE 1999).

Since the extent of groundwater contamination in the FS-13 area is limited, the contaminants are not migrating, and no surface water bodies are located nearby, no ecological risks associated with FS-13 were identified in the RI (AFCEE 1999).

A VI evaluation indicated the VI exposure pathway is insignificant at FS-13 (detected concentrations at the water table were below VI screening values) and no further monitoring or data collection is needed specific to VI at FS-13 (AFCEE 2012).

4.7.2.2 Response Actions

Fuel Line Repair: The area of the pipeline release was investigated upon discovery in 1972 and a section of pipe was replaced (AFCEE 2004).

Record of Decision: A final remedy for FS-13 groundwater was selected and documented in the *Final Record of Decision for the CS-4, CS-20, CS-21 and FS-13 Plumes* (AFCEE 2000). The selected remedy included LTM and ICs.

Explanations of Significant Differences: An ESD was completed in 2008 to modify the LUC language (previously called ICs in the ROD) and the site closure language (AFCEE 2008). A second ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to FS-13 groundwater with 1,2,4-TMB concentrations greater than the risk-based level of 17 µg/L.
- Prevent residential exposure to FS-13 groundwater with 1,3,5-TMB concentrations greater than the risk-based level of 17 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

4.7.2.3 Status of Implementation

The selected MNA remedy has progressed without issue with groundwater sampling being conducted on a periodic basis using direct-push borings (AFCEC 2022).

The FS-13 groundwater LUCs and their status are shown on Exhibit 4-7a.

Exhibit 4-7a LUC Status for FS-13 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
FS-13 Groundwater LUC Area (Figure 4-12)	Yes	Yes	• Prevent access to or use of the groundwater from the FS-13 plume area until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2013 and On-Going

As part of the LUC process specified in the ROD and subsequent ESD (AFCEE 2000, 2008), a private well verification survey was completed for FS-13 in March 2013 (AFCEC 2013). This private well verification survey concluded that no active or inactive water-supply or irrigation wells are located within the FS-13 LUC area.

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.7.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-7b). There were no issues and recommendations for FS-13 groundwater in the last five-year review.

Exhibit 4-7b Protectiveness Determination/Statement from the 2018 FYR – FS-13 Groundwater		
OU #	**Protectiveness Determination**	**Protectiveness Statement**
9 (FS-13 Groundwater)	Protective	**The remedy for the FS-13 groundwater plume is protective of human health and the environment.** Remediation is progressing as expected. The LUCs are in place and are functioning as intended. Through natural attenuation processes, groundwater cleanup levels are expected to be reached over time and monitoring data indicate the contaminants are not migrating beyond the FS-13 area.

4.7.4 Five-Year Review Process

4.7.4.1 Data Review

Data collected for the FS-13 groundwater are assessed under the SPEIM program as described in Section 2.5 and were reported in the *FS-13 (2021) Long Term Monitoring Results Project Note* during this FYR period (AFCEC 2022). Significant results from the data review follow:

- The natural attenuation remedy prevented migration of the former FS-13 plume and has significantly reduced its extent and COC concentrations (Figure 4-12).
- Due to changes in toxicity data for the COCs in 2017, EPA developed updated RSLs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB) which were adopted as the comparison values in the *FS-13 (2021) Long Term Monitoring Results Project Note* during this FYR period (AFCEC 2022). These updated RSLs have not been formally adopted as cleanup values for FS-13; therefore, this FYR uses the ESD's risk-based level of 17 µg/L for both 1,2,4-TMB and 1,3,5-TMB as a comparison value in this narrative.
- COC concentrations at the two direct-push boring locations sampled in 2021 were below the ESD's risk-based level of 17 µg/L for 1,2,4-TMB and 1,3,5-TMB at the shallowest screening interval (near top of water table). Samples were also taken at three deeper intervals at each location and results for COCs were ND. The current recommendation is to conduct follow-on sampling in approximately five years (AFCEC 2022).
- The groundwater data collected in 2021 indicate the site has reached its restoration goal. Due to the sparsity of data, the 2000 ROD did not provide an estimate of the

aquifer restoration timeframe for FS-13 (AFCEE 2000). Cost calculations in the ROD used an estimate of 20 years of LTM costs. The 20-year LTM estimate in the ROD matches the actual restoration timeframe (subject to future confirmation sampling).

- PFAS sampling in groundwater conducted in 2021 at the two FS-13 direct-push boring locations (at the same four intervals as COC sampling) indicates exceedances of PFOS, PFOA, PFNA and the PFAS6 screening standards at location 38DP0002 as detailed in Table 4-2. The PFAS detections are not related to the FS-13 fuel spill (which came from an underground leaking pipeline). Fire Department personnel have confirmed AFFF would not be applied in an underground leak situation.

4.7.4.2 Site Inspections

Refer to Section 2.3.

4.7.4.3 Interviews

Refer to Section 2.4.

4.7.5 Technical Assessment

4.7.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the LTM activities and the completion of the well verification/well determination portion of the LUCs have resulted in the remedy functioning as intended by the DDs. The groundwater data collected in 2021 indicate the site has reached its restoration goal. Due to the sparsity of data, the 2000 ROD did not provide an estimate of the aquifer restoration timeframe for FS-13 (AFCEE 2000). Cost calculations in the ROD used an estimate of 20 years of LTM costs. The 20-year LTM estimate in the ROD matches the actual restoration timeframe (subject to future confirmation sampling). Monitoring and evaluation activities are conducted and well documented.

4.7.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, however, the toxicity data for 1,2,4-TMB and 1,3,5-TMB has changed resulting in less stringent standards. This does not impact the protectiveness of the current RAOs.

Additionally, new PFAS standards do not affect the long-term protectiveness of the current remedy selection (see discussion in next paragraph).

New standards for PFAS (discussed in Section 2.1.2) have been developed. These changes are not expected to alter the short-term protectiveness of the remedy because LUCs in the area prevent exposure in drinking water. As discussed in Section 4.7.4.1, PFAS have been detected above screening levels in groundwater samples taken via direct-push methods at FS-13. Since the FS-13 site sits above the CS-10 groundwater plume and there is a recommendation in this FYR to investigate PFAS detected in CS-10 extraction wells (Section 4.3.6), it would be appropriate to manage the PFAS detected at FS-13 as part of the recommended CS-10 investigation and follow-on CERCLA requirements.

There are other changes in standards and TBCs that affect the FS-13 remedy. Specifically, EPA developed tap water screening levels for 1,2,4-TMB (56 µg/L) and 1,3,5-TMB (60 µg/L) (EPA 2017).

There were changes in toxicity parameters for 1,2,4-TMB and 1,3,5-TMB as follows:

- In June 2017, EPA finalized a new inhalation reference concentration (RfC) for 1,2,4-TMB. The new Integrated Risk Information System (IRIS) value replaces a Provisional Peer-Reviewed Toxicity Value (PPRTV) that was used previously and indicates that 1,2,4-TMB is less toxic from non-cancer health effects. This change would result in decreased non-cancer hazard from inhalation exposure to 1,2,4-TMB.
- In June 2017, EPA finalized an inhalation RfC for 1,3,5-TMB based on a new IRIS value. Previously, there was no RfC value for 1,3,5-TMB.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The RAOs documented in the ESD (AFCEE 2011) remain protective. As noted previously, EPA developed RSLs for the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD that can support future application of the three-step closeout process and the subsequent RACR for FS-13.

4.7.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.7.6 Issues/Recommendations

No specific recommendation or follow-up actions have been identified.

Other Findings

The following findings were identified during the FYR and clarify the approach for managing the PFAS groundwater detections at the FS-13 area and the updated toxicity for the COCs.

- The PFAS detections in the FS-13 area are not associated with the FS-13 fuel spill and should be addressed as part of Recommendation #7 (Section 4.3.6) to investigate PFAS detected in the CS-10 extraction wells.
- Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FS-13 groundwater that can support future application of the three-step closeout process and the subsequent RACR for FS-13.

4.7.7 Protectiveness Determination

The remedy for the FS-13 groundwater plume is protective of human health and the environment. Remediation through natural attenuation has resulted in all COC concentrations now detected at levels below cleanup standards cited in the 2011 ESD. The LUCs are in place and are functioning as intended to protect human health. The PFAS detected in the FS-13 area will be managed as part of a separate investigation (Recommendation #7, Section 4.3.6).

4.7.8 References

AFCEC. 2022 (July). *Fuel Spill-13 2021 Long Term Monitoring Results Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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AFCEE. 2012 (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

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EPA. 2017 (June). *Spreadsheet Comparison of the Previous Summary Table to the Current for TR=1E-06 and THQ=1.0*, http/epa.gov/risk/regional-screening-levels-rsls-whats-new.

4.8 FUEL SPILL-28 (FS-28) GROUNDWATER

4.8.1 Introduction

The FS-28 plume (OU 19) is a dissolved-phase groundwater plume located south of the JBCC boundary (Figure 4-13).

Land above the FS-28 plume is primarily a wooded conservation area used for recreational purposes. Agricultural use of land downgradient from the FS-28 plume includes the cultivation and harvesting of cranberries from the lowland bogs or river valleys. The land above the FS-28 plume can be characterized as a broad, flat, gently southward sloping glacial outwash plain (AFCEC 2018a).

The FS-28 plume is detached from its source area which remains unidentified. It is speculated that contamination was released at the ground surface from a fuel spill or spills on the JBCC, migrated through the vadose zone, and entered the groundwater at the water table. The dissolved phase contamination was then carried downgradient in groundwater in a southerly direction (AFCEE 1999b). The groundwater plume partially discharged to surface water in the Coonamessett River bog system.

4.8.2 Response Action Summary

4.8.2.1 Basis for Taking Action

The FS-28 groundwater COC is EDB. The FS-28 plume boundary is defined by the extent of groundwater containing EDB at concentrations exceeding the MMCL of 0.02 µg/L.

The baseline cancer risk calculations in the RI indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. In addition, acceptable risk thresholds were exceeded for cranberry workers and recreational waders (adult and child) exposed to surface water, and consumers of fish caught in the Coonamessett River. Ecological risks associated with the FS-28 groundwater plume were evaluated during the RI and no significant risk was identified (AFCEE 2000).

A VI evaluation indicated the VI exposure pathway is either incomplete or insignificant at FS-28 and no further monitoring or data collection is needed specific to VI at FS-28. (AFCEE 2012a).

4.8.2.2 Response Actions

Shellfish and Fish Sampling: A shellfish residue study was completed in August 1997. The study was planned and coordinated by several state agencies. Shellfish were collected from Green Pond (fed by Coonamessett River) and an appropriate reference area and analyzed for EDB by the Massachusetts Department of Public Health laboratory. No EDB was detected (AFCEE 1999a). In September 1997, fish were collected from Pond 14 (Coonamessett Reservoir Bog Pond). The fish were analyzed by the Massachusetts Department of Public Health laboratory and all samples were non-detect for EDB (AFCEE 1998).

Time Critical Removal Action: Numerous time critical actions were taken to address potential exposure to EDB including continued operation of the Coonamessett Water Supply Well (CWSW) wellhead treatment system (previously installed by AFCEC), connections to municipal water supply, providing bottled water, sampling private wells, construction of an extraction well and groundwater treatment system, and providing alternate water supply for agricultural uses (AFCEC 1999c).

Non-Time Critical Removal Action: Numerous non-time critical actions were also taken to address potential exposure to EDB including continued operation of the CWSW wellhead treatment system and the previously installed extraction well and groundwater treatment system, multi-media sampling to manage risk, construction of a shallow well-point system which was connected to the existing treatment system, and installation of earthen berms and vinyl sheet piles to separate the Coonamessett River from active cranberry bogs (AFCEC 1999a).

Final Record of Decision: A final remedy for FS-28 groundwater was selected and documented in the *Final Record of Decision for the Fuel Spill-28 and Fuel Spill-29 Plumes* (AFCEE 2000). The selected remedy included continued operation of the existing FS-28 treatment system, including the shallow well-points, continued operation of the CWSW

wellhead treatment system and continued maintenance of the earthen berms and vinyl sheet piles. The remedy also included ICs and LTM of the treatment systems and plume (AFCEE 2000).

Explanations of Significant Differences: An ESD was completed in 2008 to modify the LUC language (previously called ICs in the ROD) and the site closure language (AFCEE 2008). A second ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to FS-28 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
- Prevent worker contact and child and adult wader contact with Coonamessett River water containing unacceptable concentrations of EDB*.
- Prevent ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB*.

* Note that subsequent to the completion of the ROD, a screening-level human health risk evaluation was conducted to examine the potential for imminent human health risks from exposure to surface water containing EDB (Appendix D of AFCEE 2003). After a downward revision of EDB's toxicity in 2004, the health risk was recalculated as part of the 4th FYR completed in 2013 (AFCEC 2013). The recalculated RBC for EDB in surface water at FS-28 increased from 7.71 µg/L to 328 µg/L (under the "imminent risk to human health" scenario).

4.8.2.3 Status of Implementation

The FS-28 remedial system began operation in 1997 using one extraction well (EW-1) at a design flow rate of 600 gpm. In 1999 the system was expanded to include a shallow well-point system operating at 350 gpm (at which point the flow from EW-1 was reduced to 400 gpm). The system was further expanded in 2007 to include a second extraction well (EW-2) operating at 50 gpm. As remediation progressed, the shallow well point system and EW-

2 were shut down in 2010 and 2015, respectively. The EW-1 system has undergone various optimizations with the most recent scenario operating at a total flow rate of 200 gpm (AFCEC 2023). The remediation systems have eliminated the discharge of detectable concentrations of EDB to the surface water.

The FS-28 groundwater LUCs and their status are shown on Exhibit 4-8a.

Exhibit 4-8a

LUC Status for FS-28 Groundwater

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD/ESD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
FS-28 Groundwater LUC Area (Figure 4-13)	Yes	Yes	• Prevent access to, or use of, the groundwater from the FS-28 plume until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• Falmouth BOH Water Well Regulations – Sep 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program - 2011 and On-Going

As part of the LUC process specified in the ROD and subsequent ESD (AFCEE 2000, 2008), a private well verification survey was completed for FS-28 between April 2009 and August 2011 (AFCEE 2012b). No private wells that were identified presented an unacceptable exposure risk from the FS-28 plume. No private drinking water wells were identified and a total of seven private non-potable wells (used primarily for irrigation) were identified at six properties associated with FS-28.

Technical evaluations were completed for the seven private non-potable wells and determined that EDB at concentrations above the MMCL was not expected at any of the

locations. Subsequent sampling at six of the private non-potable wells was not required. One of the non-potable wells (APEMS ID 42524) was already part of the AFCEC sampling program and sampling continued until being curtailed in 2018 after a long history of no EDB detections (Appendix B).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined one new private irrigation well (APEMS ID 42575) was installed in the FS-28 groundwater LUC Area during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019). A determination was completed in 2021 and concluded that EDB at concentrations above the MMCL are not expected at this location and continued monitoring is not required (Appendix B).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

4.8.2.4 Remedy Operation and Maintenance

The FS-28 remedial system is operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. A single contractor conducted O&M activities during this FYR period.

Remedial system performance monitoring data and long-term plume monitoring data collected under the SPEIM/LTM program, which is further described in Section 2.5, are used to assess: (i) whether the remedial objectives and system performance metrics are being met; (ii) whether remediation is progressing as expected; and (iii) to identify and assess optimization opportunities.

A summary of significant O&M activities since the last FYR follows:

- The EW-1 flow rate was reduced from 400 gpm to 200 gpm in July 2019 (AFCEC 2020).

- On 09 November 2021, a fire occurred inside the electrical service panel mounted on the outside wall of the FS-28 treatment plant. The fire was limited to the interior of the panel but resulted in a loss of grid power to the plant's electrical system. On 10 November 2021, temporary power to the FS-28 plant was restored using a generator. The FS-28 treatment system operated on generator power until 16 December 2021 when the electrical panel replacement was completed and the plant was reconnected to grid power (AFCEC 2022).
- The total mass of EDB removed over the last five years (January 2018 – December 2022) from the FS-28 plume totals 0.117 lbs. The total mass of EDB removed from FS-28 over the lifetime of the system (October 1997 – December 2022) totals 15.29 lbs (AFCEC 2018b, AFCEC 2023).
- The operational data collected during 2022 indicates the annual average treatment system flow rate at FS-28 exceeded 99% of the design flow rate (AFCEC 2023).

4.8.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-8b) as well as the recommendation from the **last** FYR (Exhibit 4-8c) and the current status of the recommendation.

Exhibit 4-8b

Protectiveness Determination/Statement from the 2018 FYR – FS-28 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
19 (FS-28 Groundwater)	Short-term Protective	**The remedy for the FS-28 groundwater plume is protective of human health and the environment in the short-term.** The LUCs are in place and are functioning as intended. Current plume delineation indicates that the aquifer restoration timeframe identified in the ROD may not be met. For the remedy to be protective in the long-term, the aquifer restoration timeframe should be reassessed and an ESD issued, if necessary, to update the timeframe.

Exhibit 4-8c

Status of Recommendation from the 2018 FYR – FS-28 Groundwater

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description
19 (FS-28 Groundwater)	Restoration Timeframe Reassessment	Reassess aquifer restoration timeframe and present results.	Completed	See Below Discussion

Implementation Status: The aquifer restoration timeframe has been reassessed each year during this FYR period. In May 2022, AFCEC and the regulatory agencies agreed that an ESD was not necessary since aquifer restoration is being approached at FS-28 based on only two monitoring wells with EDB MMCL exceedances reported in 2022 (AFCEC 2023).

4.8.4 Five-Year Review Process

4.8.4.1 Data Review

Data collected for the FS-28 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and reported in the FS-28 SLRs during this FYR period (AFCEC 2023, 2022, 2021b, 2020, 2019). Significant results from the data review include:

- Plume migration is being controlled by the remaining extraction well in operation. Continued extraction and natural attenuation are reducing COC concentrations. The FS-28 plume boundary changes on a temporal basis are shown on Figure 4-14.
- At the beginning of this FYR period (February 2018) five FS-28 monitoring wells indicated MMCL (0.02 µg/L) exceedances of EDB with an average concentration of 0.072 µg/L. The highest EDB concentration (69MW1284B) was 0.16 µg/L (AFCEC 2019).
- At the end of this FYR period (September 2022) two FS-28 monitoring wells indicated MMCL (0.02 µg/L) exceedances of EDB with an average concentration of 0.039 µg/L. The highest EDB concentration (69MW1304) was 0.051 µg/L (AFCEC 2023).
- The groundwater data indicate groundwater restoration is nearly complete as a result of the active remediation and MNA components of the remedy. The ROD estimated a restoration timeframe of 2018.
- Annual surface water sampling results at three locations throughout the FYR period were all ND for EDB. Surface water sampling, which occurs in the month prior to cranberry harvesting, is planned to continue in 2023.
- The FS-28 plume boundary was updated and monitoring was discontinued at two trailing edge monitoring wells, the CWSW sentry well, and one irrigation well. (AFCEC 2019).

4.8.4.2 Site Inspections

Refer to Section 2.3.

4.8.4.3 Interviews

Refer to Section 2.4.

4.8.5 Technical Assessment

4.8.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the completion of the ROD in 2000, construction and startup of the remedial system expansion in 2007, and completion of the well verification/well determination portion of the LUCs in 2011 have resulted in the remedy at FS-28 functioning as intended by the DDs. The groundwater data indicate groundwater restoration is nearly complete as a result of the active remediation and MNA components of the remedy. The ROD estimated a restoration timeframe of 2018.

Plume and remedial system monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure protection of human health and the environment. Operational costs are appropriate for the remedy and a robust optimization program continues with the objective of reducing remedial system operational timeframes, the time to reach remedial goals (e.g., MMCLs), and reducing future costs. Monitoring and evaluation activities are continual and well-documented.

4.8.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, the RAOs developed for the final ROD (AFCEE 2000) and revised in the 2011 ESD (AFCEE 2011) are appropriate and remain valid for the current COC. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the FS-28 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at FS-28.

There are no changes in toxicity or other contaminant characteristics for the FS-28 groundwater COC.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The estimated restoration timeframe in the ROD was 2018. The groundwater data collected in 2022 indicates FS-28 restoration is nearly complete.

4.8.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.8.6 Issues/Recommendations

No specific recommendations or follow-up actions have been identified.

4.8.7 Protectiveness Determination

The remedy for the FS-28 groundwater plume is protective of human health and the environment. The remedial system is performing as expected. The LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved in the next 1-2 years.

4.8.8 References

AFCEC. 2023 (March). *Fuel Spill-28 2022 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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AFCEE. 2012a (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 1999a (November). *Final FS-28 Non-Time-Critical Removal Action Memorandum*. Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 1998 (November). *Letter from Massachusetts Division of Fisheries & Wildlife to Mr. Jim F. Snyder, AFCEE/MMR, Re: Draft Engineering Evaluation Cost Analysis and Execution Plan for Coonamessett River FS-28 Bog Separation Project*. Administrative Record #11671, AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

4.9 LANDFILL-1 (LF-1) GROUNDWATER

4.9.1 Introduction

The LF-1 plume (OU 16) is a dissolved-phase groundwater plume located in the western portion of JBCC with an off-base lobe located west of the JBCC boundary (Figure 4-15).

The area above the on-base portion of the LF-1 plume consists primarily of a housing area operated by the USCG and a cemetery operated by the U.S. Department of Veterans Affairs (VA). The land use above the plume in the off-base area is primarily residential and conservation. The groundwater plume extends to the west and discharges to surface water at Red Brook Harbor and previously to Squeteague Harbor.

The source area for the LF-1 groundwater is a solid waste landfill (also called LF-1) located in the southern portion of the JBCC. See Section 3.2 for further discussion regarding the LF-1 source area.

4.9.2 Response Action Summary

4.9.2.1 <u>Basis for Taking Action</u>

The LF-1 Groundwater COCs are PCE, TCE, vinyl chloride (VC), carbon tetrachloride (CCl_4), 1,4-dichlorobenzene (1,4-DCB), 1,1,2,2-TeCA, EDB and Mn. The LF-1 plume boundary is defined as the extent of groundwater containing PCE and TCE at concentrations exceeding their MCL of 5 µg/L (AFCEC 2023c). All cleanup levels are indicated in the RAOs listed in Section 4.9.2.2.

Future residential exposure to the LF-1 groundwater COCs (except Mn) presents an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. Future residential exposure to Mn in LF-1 groundwater results in a HI > 1 (AFCEE 1996). Ecological risks associated with the LF-1 groundwater plume as well as evaluations of contaminant body burdens in shellfish and sediment pore water have indicated no significant risk (AFCEE 2007).

A VI evaluation indicated an incomplete pathway for VI at LF-1 and no further monitoring or data collection is needed specific to VI at LF-1 (AFCEE 2012).

4.9.2.2 Response Actions

Interim Record of Decision (Source): An interim remedial action for the landfill was selected and documented in the *Record of Decision Interim Remedial Action, Main Base Landfill (AOC LF-1) Source Area Operable Unit* (ANG 1993) and is further discussed in Section 3.2.

Interim Record of Decision: An IROD was developed to implement a remedy to address LF-1 groundwater contamination (ANG 1995). In 1999, an interim groundwater treatment system with five extraction wells, a GAC treatment facility, and an infiltration gallery and two infiltration trenches began operation.

Final Record of Decision: A final remedy for LF-1 groundwater was selected and documented in the *Final Record of Decision for Landfill-1 Source Area and Groundwater* (AFCEE 2007). The selected remedy included the continued operation of the existing five extraction wells with an additional extraction well in the southern portion of the plume to improve plume capture in that area. The new extraction well and the southernmost original extraction well for LF-1 were connected to the HATF (which also treated water from numerous other plumes). The remedy included performance monitoring of the LF-1 plume and remedial system, LUCs, and the Bourne Water Provision[5].

Explanation of Significant Differences: An ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, and updated the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011a):

- Prevent residential exposure to LF-1 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to LF-1 groundwater with PCE concentrations greater than the MCL of 5 µg/L.

[5] This provision included a commitment for IRP funding for the Bourne Water District (BWD) to replace water from public water supply wells PWS-2 and PWS-5 which could potentially be impacted by the LF-1 plume (AFCEE 2007). BWD, using IRP funding, constructed a new public water supply well (Well No. 8, MassDEP ID No. 4036000-08G) and associated treatment facility (MassDEP ID No. 4036000-08T) (MassDEP 2014).

- Prevent residential exposure to LF-1 groundwater with CCl_4 concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to LF-1 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L.
- Prevent residential exposure to LF-1 groundwater with VC concentrations greater than the MCL of 2 µg/L.
- Prevent residential exposure to LF-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L.
- Prevent residential exposure to LF-1 groundwater with 1,4-DCB concentrations greater than the MMCL of 5 µg/L.
- Prevent residential exposure to LF-1 groundwater with Mn concentrations greater than the HA of 300 µg/L.
- Restore useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.
- Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or present a non-carcinogenic hazard index greater than 1.0.

4.9.2.3 Status of Implementation

The LF-1 remediation system has undergone various optimizations resulting in a total of seven extraction wells (including the integration of a CS-23 extraction well for LF-1 COCs) operating at a total design flow rate of 1,475 gpm at the start of this FYR period. The design flow was divided between the LF-1 treatment system (575 gpm) and the HATF (900 gpm). As remediation has progressed over this FYR period, two extraction wells have been shut down. The five remaining extraction wells are currently operating at a total design flow rate of 810 gpm with all extracted groundwater being treated at the HATF (AFCEC 2023c). Potential new COCs (1,4-dioxane and PFAS) may change the operational status of the LF-1 remediation system in the future. See Section 2.1 for further discussion regarding ECs.

The LF-1 groundwater LUCs and their status are shown on Exhibit 4-9a.

Exhibit 4-9a LUC Status for LF-1 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
LF-1 Groundwater LUC Area (Figure 4-15)	Yes	Yes	• Prevent access to or use of the groundwater from the LF-1 contaminated groundwater until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as the landfill cover system, the treatment systems, and monitoring wells.	• Falmouth BOH Water Well Regulations – Sep 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2012 and On-Going

As part of the LUC process specified in the ROD (AFCEE 2007), a private well verification survey was completed at LF-1 in 2012 (AFCEE 2013, 2011b). Two parcels were identified that had private wells used as a potable water supply. Both private wells had been sampled in 2010 and no LF-1 related COCs were detected. One of the private residential wells (APEMS ID 84394) was determined to be sufficiently outside of the LF-1 plume footprint and not anticipated to represent complete exposure pathway to the LF-1 plume; therefore, routine monitoring was not required. The second private well (APEMS ID 82191) was sampled until 2016 when the property was redeveloped and connected to municipal water (AFCEC 2018). APEMS ID 82191 is no longer tracked by AFCEC as it is not within the currently defined LF-1 LUC area.

During this FYR period, AFCEC evaluated a request from the VA Massachusetts National Cemetery to convert former LF-1 extraction well 27EW0005 to an irrigation well and to add an additional irrigation well to support cemetery operations. The cemetery is located

to the north of the LF-1 plume and is located on JBCC. The evaluations, completed after the FYR period, determined that the irrigation wells' operation within permitted limits are unlikely to draw in groundwater containing any of the LF-1 current COCs, PFAS, or 1,4-dioxane above risk-based drinking water standards or advisories nor have any effect on the ongoing remedial actions for the main body of the LF-1 plume located to the south (AFCEC 2023a, 2023b). In February 2023, MassDEP issued a Water Management Act permit to the VA with numerous conditions including the requirement to conduct irrigation well and monitoring well sampling for PFAS once irrigation well operations begin (MassDEP 2023).

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in the LF-1 Groundwater LUC Area during this FYR period (AFCEC 2023c, 2022, 2021b, 2020, 2019).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

Although LF-1 Groundwater LUC areas have not yet been formally established for 1,4-dioxane or PFAS contamination (i.e., through a DD), AFCEC has administratively imposed interim LUCs to evaluate any potential exposure to these contaminants. For LF-1, the existing LUC areas for the current COCs fully encompass the areas where 1,4-dioxane or PFAS have been detected in groundwater and there are no private wells currently operating that are impacted. These activities are discussed in Section 2.2.3.2.

4.9.2.4 Remedy Operations & Maintenance

The LF-1 remedial system is operated and maintained under an approved O&M Plan (AFCEC 2021a). The O&M Plan is updated on an annual basis and includes operational requirements, a summary of the operational history of the systems, and details of any system modifications, optimizations, or improvements. A single contractor conducted O&M activities during this FYR period.

Remedial system performance monitoring data and long-term plume monitoring data collected under the SPEIM/LTM program, which is further described in Section 2.5, are used to assess: (i) whether the remedial objectives and system performance metrics are being met; (ii) whether remediation is progressing as expected; and (iii) to identify and assess optimization opportunities.

A summary of significant O&M activities since the last FYR follows:

- Extraction well 27EW0005 was shut down and flow was reduced at 27EW0007 in 2019 which allowed the total flow (reduced from 1,475 gpm to 985 gpm) to be directed to the HATF accompanied by a shutdown of the LF-1 treatment plant, reinjection well and infiltration gallery/trenches (AFCEC 2020, 2019). The treated groundwater is now reinjected through the HATF trenches located approximately 1 mile southeast of the former locations north of the LF-1 treatment plant (Figure 4-15).
- Further optimizations resulted in the shutdown of 27EW0007 and a reduced design flow of 810 gpm from the five remaining extraction wells. The flow reduction resulted in the shutdown of one GAC train at HATF (AFCEC 2022, 2021b).
- The HATF pilot test to evaluate improving the bed life of the GAC continued through 2022 (AFCEC 2023c).
- The total mass of COCs removed over the last five years (January 2018 – December 2022) from the LF-1 plume totals 117.2 lbs. The total mass of COCs removed from LF-1 over the lifetime of the system (August 1999 – December 2022) totals 900.7 lbs (AFCEC 2018, AFCEC 2023c).
- The operational data collected during 2022 indicates annual average treatment system flow rates at LF-1 exceeded 100% of design flow rates (AFCEC 2023c).

4.9.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-9b) as well as the recommendations from the **last** FYR (Exhibit 4-9c) and the current status of those recommendations.

Exhibit 4-9b Protectiveness Determination/Statement from the 2018 FYR – LF-1 Groundwater		
OU #	**Protectiveness Determination**	**Protectiveness Statement**
16 (LF-1 Groundwater)	Short-term Protective	**The remedy for the LF-1 groundwater plume is protective of human health and the environment in the short-term.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended for current COCs. Through the combination of the active treatment by the remedial systems and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. Since the LUCs are in place and are functioning as intended to prevent exposure and there are no current plans to use the portion of the aquifer where LF-1 contamination remains for water supply, the remedy remains protective for current COCs. For the remedy to be protective in the long-term, a streamlined Supplemental FS should be completed that evaluates remedial alternatives for groundwater to address ECs, and remedial actions taken as necessary.

Exhibit 4-9c Status of Recommendations from the 2018 FYR – LF-1 Groundwater				
OU #	**Issue**	**Recommendations**	**Current Status**	**Current Implementation Status Description**
16 (LF-1 Groundwater)	Emerging Contaminants	Develop a Supplemental FS report	Ongoing	See Below Discussion

Implementation Status: The *Draft Supplemental Feasibility Study Report for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Landfill-1* was submitted to the regulatory agencies on 12 January 2022. AFCEC is addressing the regulatory comments on the Draft Supplemental FS which is planned for completion in 2023. Further discussion regarding ECs can be found at Section 2.1.

4.9.4 Five-Year Review Process

4.9.4.1 Data Review

Data collected for the LF-1 groundwater plume are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the LF-1 Plume SLRs during this

FYR period (AFCEC 2023c, 2022, 2021b, 2020, 2019). Significant results from the data review include:

- Migration of the on-base portion of LF-1 beyond the base boundary is being controlled by the remaining extraction wells in operation. Continued extraction and natural attenuation are reducing COC concentrations in most cases. The off-base portion of LF-1 relies on MNA and has diminished in size and COC concentrations significantly. The LF-1 plume boundary changes on a temporal basis are shown on Figure 4-16 while LF-1 concentration trends in select monitoring wells are shown on Figure 4-17.
- The LF-1 southern and northern plume lobes, located west of the base boundary extraction fence, are addressed through MNA. The ROD-estimated cleanup date for these areas is 2027. The southern lobe COC concentrations were confirmed to be below the MCL in 2017. The northern lobe's attenuation is progressing (Figure 4-15 and 4-16) and has a projected cleanup date of 2029 (AFCEC 2023).
- TCE, the predominant COC in the LF-1 plume, was detected above the MCL (5 µg/L) in nine monitoring wells at the beginning of this FYR period (May/June 2018) at an average concentration of 23.3 µg/L. The highest TCE concentration in the monitoring network was 110 µg/L at 27MW2135A (AFCEC 2019).
- At the end of the FYR period (June 2022), TCE was detected above the MCL in eight monitoring wells at an average concentration of 24.3 µg/L. The highest TCE concentration in the monitoring network was again 110 µg/L at 27MW2135A (AFCEC 2023c).
- Surface water sampling frequency at Red Brook and Squeteague Harbors was reduced from annual to biennial in 2018 (AFCEC 2019b). The most recent sampling results (2021) were ND for all COCs (AFCEC 2022).
- A monitoring network optimization was completed in 2019 resulting in the addition of annual monitoring at two monitoring wells, adjusting the monitoring frequency at three monitoring wells and three extraction wells, and discontinuing monitoring at extraction well 27EW0005 (shut down) (AFCEC 2019).
- PFAS sampling and analysis in the HATF GAC systems are being conducted and the GAC exchange procedures have been modified to prevent the release of treated groundwater with PFAS concentrations in excess of the PFAS6 MMCL through the HATF groundwater infiltration systems. Potential aquifer impacts from PFAS released in the HATF effluent are being addressed as part of the *Draft Supplemental Feasibility Study Report for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Landfill-1* comment resolution process.

4.9.4.2 Site Inspections

Refer to Section 2.3.

4.9.4.3 Interviews

Refer to Section 2.4.

4.9.5 Technical Assessment

4.9.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the completion of the ROD in 2007, construction of the remedial system in 1999, remedial system expansion in 2006, continued operation of the remedial system, and completion of the well verification portion of the LUCs in 2011 have resulted in the remedy at LF-1 functioning as intended by the DDs for COCs. The remedial system is containing the plume at the base boundary, while the off-base portions of the plume relying solely on MNA have achieved their cleanup levels or are approaching their cleanup levels in a timeframe commensurate with the ROD date for these areas (2027).

Plume and remedial system monitoring is being conducted under the Site-wide SPEIM/LTM (see Section 2.5) and LUC (see Section 2.2) programs and risk management measures are in place to ensure protection of human health and the environment. Operational costs are appropriate for the remedy and a robust optimization program continues. Monitoring and evaluation activities are continual and well-documented.

4.9.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

No, there have been changes in potential standards and TBCs. While the RAOs developed for the ROD (AFCEE 2007) and revised in the 2011 ESD (AFCEE 2011a) are appropriate and remain valid for the current COCs, new 1,4-dioxane and PFAS standards affect the long-term protectiveness of the current remedy selection.

New standards for 1,4-dioxane and PFAS (discussed in Sections 2.1.1 and 2.1.2, respectively) have been developed. These changes are not expected to alter the short-term

protectiveness of the remedy because, as discussed in Section 2.2.3.2, the USAF has imposed interim LUCs to prevent exposure to PFAS and 1,4-dioxane exceedances in drinking water that are believed to be associated with the LF-1 plume. The recommendation from the 2018 FYR to complete a Supplemental FS to address known PFAS and 1,4-dioxane detections in groundwater remains valid and will be included in this FYR. See Section 4.9.3 for the current status of this recommendation.

There are no changes in toxicity or other contaminant characteristics for the LF-1 groundwater COCs. For 1,1,2,2-TeCA, the current MCP GW-1 standard of 2 µg/L from the ROD and ESD has been compared to EPA's Tap Water RSL of 7.6 µg/L (at a 10^{-4} carcinogenic risk) and has been determined to be protective.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The restoration timeframes from the ROD indicate COC concentrations are expected to reach cleanup levels by approximately 2027 downgradient of the extraction wells and by approximately 2045 for the entire plume (AFCEE 2007). Data trends indicate the approximate timeframe will be achieved for the off-base area downgradient of the extraction wells. The remainder of the plume (area upgradient of the extraction fence) is generally attenuating as it migrates toward the base boundary extraction fence with the exception of a low conductivity area around 27MW2135A where TCE groundwater concentrations are in excess of 100 µg/L. A future DD to address ECs, as recommended, will address the overall restoration timeframe at LF-1 and include any timeframe changes.

4.9.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.9.6 Issues/Recommendations

Exhibit 4-9d Issue/Recommendation #8: LF-1 Groundwater				
OU 16 (LF-1 Groundwater)	**Issue Category: Emerging Contaminants**			
	Issue: Emerging contaminants, specifically PFAS and 1,4-dioxane, exceed screening standards in groundwater within the legacy LF-1 plume area.			
	Recommendation: Finalize the *Draft Supplemental Feasibility Study Report for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Landfill-1, Joint Base Cape Cod*. Develop a DD to establish additional COCs and RAOs as appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	8/25/2024

4.9.7 Protectiveness Determination

The remedy for the LF-1 groundwater plume is protective of human health and the environment in the short-term. The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. For the remedy to be protective in the long-term, a DD should be issued which specifies the remedial actions required to address 1,4-dioxane and PFAS.

4.9.8 References

AFCEC. 2023a (April). *Draft Well Determination 27EW0005 (Irrigation Well).* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2023b (April). *Draft Well Determination VAIW-03 (Irrigation Well).* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2023c (March). *LF-1 2022 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2020 (April). *LF-1/CS-23 2019 Summary Letter Report.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2013 (June). 2012 *Confirmation of Private Well Operational Status: LF-1/ CS-23 Private Well Land Use Control Area Project Note*. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

AFCEE. 2012 (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2011a (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation.* Prepared by CH2M HILL for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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_____. 2007 (October). *Final Record of Decision for Landfill-1 Source Area and Groundwater*. Prepared by Jacobs Engineering Group Inc. for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1996 (April). *Final Remedial Investigation Main Base Landfill (AOC LF-1) and Hydrogeologic Region 1 Study*. Prepared by HAZWRAP for AFCEE/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

ANG. 1995 (September). *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at JBCC, Cape Cod MA.* Prepared by Stone & Webster Environmental & Technology Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

_____. 1993 (January). *Record of Decision Interim Remedial Action Main Base Landfill (AOC LF-1) Source Area Operable Unit, Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared for Hazardous Waste Remedial Actions Program, Oak Ridge, Tennessee, by ABB Environmental Services, Inc.

MassDEP. 2023 (February). *Water Management Act Permit #: 9P4-4-22-036.02*, Massachusetts National Cemetery.

_____. 2014 (April). *Letter to Bourne Water District, RE: Public Water Supply Bourne Water District PWS ID#4036000* from MassDEP Drinking Water Program.

4.10 STORM DRAIN-5 (SD-5) GROUNDWATER

4.10.1 Introduction

The SD-5 groundwater site (OU 13 and 20) was a dissolved-phase groundwater plume located in the southeast corner of the JBCC and had extended off-base. The groundwater contamination at SD-5 has not been delineated as a contiguous plume since 2005 due to its limited extent (AFCEC 2023). The remaining sampling locations are shown on Figure 4-18.

The area above the on-base portions of the SD-5 area (SD-5 North) consists primarily of the airfield and associated facilities. The off-base area south of the JBCC boundary (SD-5 South) is primarily residential and undeveloped woodland. Ashumet Pond and Johns Pond to the south are used for fishing, swimming, and boating (AFCEC 2018).

The source of the SD-5 plume was the result of releases from a leaching well at the Non-Destructive Inspection Laboratory, a Corrosion Control Shop, and sumps in two aircraft hangers (AFCEE 2006) located on JBCC.

4.10.2 Response Action Summary

4.10.2.1 Basis for Taking Action

The SD-5 Groundwater COC is TCE (AFCEE 2006) with an MCL of 5 µg/L.

The baseline cancer risk calculations indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater at SD-5 may present an excess lifetime cancer risk greater than the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. An ecological risk assessment was conducted for SD-5 groundwater and no ecological risks were identified (AFCEE 2006).

A VI evaluation indicated the VI exposure pathway is either incomplete or insignificant at SD-5 and no further monitoring or data collection is needed specific to VI at SD-5 (AFCEE 2012).

4.10.2.2 Response Actions

SD-5 Source Area Remedial Actions: A removal action at the SD-5 source area (OU 5)

consisted of excavation and off-site disposal of contaminated soil between June and October 2001 and SVE operations between August 2002 and August 2003. The *Area of Contamination Storm Drain-5/Fuel Spill-5 Source Area Remedial Action Report* (AFCEE 2005) describes the removal action while a later technical memorandum established UU/UE conditions for the SD-5 source area (AFCEC 2016).

Interim Record of Decision: An IROD was developed to implement a remedy to address SD-5 groundwater (OU 13 and 20) contamination (ANG 1995). Three interim groundwater treatment systems operated under the IROD between August 1997 and February 2004 (AFCEC 2021b).

Final Record of Decision: The final remedy for the SD-5 plume (OU 13 and 20) was determined in the *Final Record of Decision for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm Drain-5* and consisted of LTM with LUCs (AFCEE 2006).

Explanation of Significant Differences (2011): An ESD was completed in 2011 that clarified the inclusion of MNA as a component of the selected remedy, slightly modified the phrasing of the RAOs, added the private well verification process under LUCs, and added the steps to achieve site closure (i.e., the three-step process). The resulting RAOs are as follows (AFCEE 2011):

- Prevent residential exposure to SD-5 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Restore useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Explanation of Significant Differences (2014): An ESD was completed in 2014 which extended the estimated aquifer restoration timeframe from 2008 (AFCEE 2006) to 2022 (AFCEC 2014).

4.10.2.3 Status of Implementation

The selected MNA remedy has progressed without issue with monitoring being conducted on a biennial basis for select monitoring wells (AFCEC 2023, 2021b, 2019b).

The SD-5 groundwater LUCs and their status are shown on Exhibit 4-10a.

Exhibit 4-10a LUC Status for SD-5 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD/ESD**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
SD-5 Groundwater LUC Area (Figure 4-18)	Yes	Yes	• Prevent access to or use of the groundwater from the SD-5 contaminated groundwater until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.	• Mashpee BOH Moratorium on Groundwater Wells – Apr 1998, Amended July 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Dig Safe Registration and Review – On-Going • Private Well LUC Program, 2013 and On-Going

As part of the LUC process specified in the first ESD (AFCEE 2011), a private well verification survey was completed at SD-5 between November 2012 and July 2013 (AFCEC 2013). No active private drinking water wells or non-potable wells were identified. An evaluation in 2015 concluded there is no potential risk of exposure to contaminated groundwater at SD-5 through the use of private wells in the SD-5 LUC area (AFCEC 2015).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells were installed in

the SD-5 Groundwater LUC Area during this FYR period (AFCEC 2022, 2021a, 2020, 2019a).

4.10.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-10b). There were no issues and recommendations for SD-5 groundwater in the last FYR.

Exhibit 4-10b

Protectiveness Determination/Statement from the 2018 FYR – SD-5 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
13 and 20 (SD-5 Groundwater)	Protective	**The remedy for the SD-5 groundwater plume is protective of human health and the environment.** The LTM program is ongoing and the LUCs are in place and are functioning as intended. Through pre-ROD operation of the SD-5 remedial system and natural attenuation processes, groundwater cleanup levels have been achieved at SD-5N and are expected to be achieved at SD-5S. Since the LUCs are in place and are functioning as intended and there are no current plans to use this portion of the aquifer for water supply, the remedy remains protective.

4.10.4 Five-Year Review Process

4.10.4.1 Data Review

Data collected for SD-5 groundwater are continually assessed under the SPEIM program as described in Section 2.5 and reported in the *Storm Drain-5 Long Term Monitoring Program Biennial Project Notes* during this FYR period (AFCEC 2023, 2021b, 2019b). Significant results from the data review follow:

- Plume migration was controlled through the operation of the interim groundwater treatment systems (now shut down). The small amount of remaining mass will be reduced through natural attenuation.
- Three monitoring wells were sampled biennially in the SD-5 LTM program during this FYR period (AFCEC 2023, 2021b, 2019b).
- The sampling event conducted in August 2022 indicated one MCL (5 µg/L) exceedance of TCE at 28MW0035B at a concentration of 5.8 µg/L (AFCEC 2023). SD-5 concentration trends are shown on Figure 4-18.

- The ESD-estimated timeframe for plume cleanup is 2022 and the data indicate the MNA remedy has progressed in accordance with this timeframe.
- The three-step process to close SD-5 for current COCs is being initiated (AFCEC 2023).

4.10.4.2 Site Inspections

Refer to Section 2.3.

4.10.4.3 Interviews

Refer to Section 2.4.

4.10.5 Technical Assessment

4.10.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the LTM activities and the implementation of the LUCs at SD-5 have resulted in the remedy functioning as intended by the DDs. The ESD-estimated timeframe for plume cleanup is 2022 and the data indicate the MNA remedy has progressed in accordance with this timeframe. The three-step process to reach site closure has begun.

4.10.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The RAOs developed for the final ROD (AFCEE 2006) and revised in the 2011 ESD (AFCEE 2011) are appropriate and remain valid for the current COC. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the SD-5 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at SD-5 and any PFAS in the area will be managed under the Flight Line Operable Unit response (see Section 2.1.2).

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The restoration timeframe was updated to 2022 via issuance of an ESD (AFCEC 2014) and

data indicate restoration is nearing completion.

4.10.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.10.6 Issues/Recommendations

No specific recommendation or follow-up actions have been identified.

4.10.7 Protectiveness Determination

The remedy for the SD-5 groundwater plume is protective of human health and the environment. The LTM program is ongoing and the LUCs are in place and are functioning as intended to protect human health. Through pre-ROD operation of the SD-5 remedial system and natural attenuation processes, groundwater cleanup levels have been achieved at SD-5N and nearly achieved at SD-5S.

4.10.8 References

AFCEC. 2023 (February). *Storm Drain-5 Long Term Monitoring 2022 Biennial Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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4.11 FIRE TRAINING AREA-2/LANDFILL-2 (FTA-2/LF-2)

4.11.1 Introduction

The FTA-2/LF-2 groundwater plume (OU 5) is a dissolved-phase groundwater plume located in the southeast portion of JBCC (Figure 4-19).

The land above the FTA-2/LF-2 plume consists primarily of un-paved, grassed areas that are mowed and maintained adjacent to the airfield. The southern portion of the plume area has some larger scrub pine and vegetation typical of Cape Cod (AFCEC 2018a).

The sources of the FTA-2/LF-2 plume are a fire training area (FTA-2, operated from 1948-1956), a landfill (LF-2, operated from 1940-1944), and the Western Aquafarm, which operated from 1950-1960 and housed USTs containing various petroleum products (AFCEC 2016).

4.11.2 Response Action Summary

4.11.2.1 Basis for Taking Action

The FTA-2/LF-2 groundwater COCs are C_5-C_8 aliphatic, C_9-C_{12} aliphatic, and C_9-C_{10} aromatic VPH ranges; the C_{11}-C_{22} aromatic EPH range; 1,2,4-TMB; 1,3,5-TMB; and 2-methylnaphthalene (AFCEC 2016). All cleanup levels are indicated in the RAOs listed in Section 4.11.2.2.

A screening-level human-health risk assessment indicated the COCs may pose a potential future risk to human receptors assuming the groundwater is used for drinking water purposes. A screening ecological risk evaluation for groundwater was not needed because contaminated groundwater is approximately 40-50 ft bgs on base and is not expected to discharge to the nearest surface water/sediment receptors, which are over 1,500 ft downgradient (AFCEC 2016).

VI impacts from VOCs in soil and groundwater are unlikely for existing buildings and current land use at FTA-2/LF-2. However, a VI risk could not be ruled out for future land use due to the presence of petroleum compounds in shallow groundwater (AFCEC 2016). VI risks to potential future buildings at FTA-2/LF-2 are being mitigated by application of

LUCs (see Section 4.11.2.3).

4.11.2.2 Response Actions

UST Removals: Six 25,000-gallon USTs and approximately 450 cubic yards of contaminated soil were removed from Western Aquafarm[6] in 1994 in accordance with Commonwealth of Massachusetts Regulations (ANG 1995).

Record of Decision: A source area remedy for FTA-2/LF-2 was selected and documented in the *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas* (AFCEE 1998). The selected remedy called for biosparging to address the soil COCs ethylbenzene and total xylenes. A biosparge/soil vapor extraction system operated at FTA-2/LF-2 from 2001 to 2003 (AFCEC 2016). The FTA-2/LF-2 source area FYR evaluation is located at Section 3.3.

Record of Decision Amendment: A groundwater remedy for FTA-2/LF-2 was selected and documented in the *Final Fire Training Area-2/Landfill-2 Record of Decision Amendment* (AFCEC 2016). The selected remedy calls for MNA with LUCs. The associated RAOs are as follows:

- Prevent residential exposure to site groundwater with EPH/VPH concentrations greater than the MCP GW-1 cleanup standards of:
  - 300 µg/L for C_5-C_8 aliphatic hydrocarbons
  - 200 µg/L for C_9-C_{10} aromatic hydrocarbons
  - 700 µg/L for C_9-C_{12} aliphatic hydrocarbons
  - 200 µg/L for C_{11}-C_{22} aromatic hydrocarbons
- Prevent residential exposure to site groundwater with 1,2,4-TMB concentrations greater than the risk-based concentration (RBC) of 19 µg/L.
- Prevent residential exposure to site groundwater with 1,3,5-TMB concentrations greater than the RBC of 19 µg/L.

[6] Groundwater contamination that could potentially be associated with the Western Aquafarm site (now closed) is being managed as part of the FTA-2/LF-2 groundwater plume remedy (AFCEC 2016).

- Prevent residential exposure to site groundwater with 2-methylnaphthalene concentrations greater than the MCP GW-1 standard of 10 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

The remedy components include the following:

- Monitoring of key FTA-2/LF-2 monitoring wells for VOCs (including the TMB isomers) by EPA Method 8260C and EPH/VPH by MassDEP method, and geochemical parameters (e.g., dissolved iron, sulfate, nitrate, and dissolved oxygen) to document redox conditions.
- Post sampling data transmittals and annual monitoring reports would be produced to document site conditions and progress relating to MNA.
- Remedy completion will be demonstrated when the temporal average groundwater concentrations at individual wells are less than or equal to applicable groundwater cleanup standards based on data from three consecutive annual monitoring periods.
- Regular monitoring network inspection and maintenance would be conducted to maintain the integrity of monitoring wells and following remedy completion, wells will be decommissioned in accordance with MassDEP protocols.
- LUCs restricting use of groundwater for water supply on-base and in nearby areas would remain in place until RAOs are achieved.

4.11.2.3 Status of Implementation

The selected MNA remedy has progressed with groundwater sampling being conducted on an annual or biennial basis for select monitoring wells (AFCEC 2023, 2022b, 2021b, 2019a, 2018b).

The FTA-2/LF-2 groundwater LUCs and their status are shown on Exhibit 4-11a.

Exhibit 4.11a LUC Status for FTA-2/LF-2 Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD Amendment**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
FTA-2/LF-2 Groundwater LUC Area (Figure 4-19)	Yes	Yes	• Prevent access to or use of the groundwater from the FTA-2/LF-2 plume LUC area until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of any current or future groundwater monitoring system. • Evaluate potential VI exposure risks at future buildings in the FTA-2/LF-2 source areas (as shown in the 4th Five-Year Review) and over the FTA-2/LF-2 plume, if constructed.	• MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Private Well LUC Program - 2014 and On-Going • Dig Safe Registration and Review – On-Going

To ensure that the LUCs obtain the performance objectives the USAF has established a private-well verification LUC area for the area above or within the project path of the FTA-2/LF-2 plume (Figure 4-19). AFCEC conducted a private well verification and well determination survey for this area in June 2014 and no water supply wells were identified (AFCEC 2016).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

Based on the implementation of other LUCs (i.e. MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells or new facilities

(which would trigger a VI evaluation) were installed in the FTA-2/LF-2 Groundwater LUC Area during this FYR period (AFCEC 2022a, 2021a, 2020, 2019b).

4.11.3 Progress Since Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-11b). There were no issues and recommendations for FTA-2/LF-2 groundwater in the last FYR.

Exhibit 4-11b

Protectiveness Determination/Statement from the 2018 FYR – FTA-2/LF-2 Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
5 (FTA-2/LF-2 Groundwater)	Protective	**The remedy for the FTA-2/LF-2 is protective of human health and the environment.** The LTM program is in place and is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended.

4.11.4 Five-Year Review Process

4.11.4.1 Data Review

Data collected for FTA-2/LF-2 groundwater are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the FTA-2/LF-2 LTM Program Project Notes during this FYR period (AFCEC 2023, 2022b, 2021b, 2019a, 2018b). Significant results from the data review follow:

- The MNA remedy is functioning as the plume has not migrated and COC concentrations are generally trending downward with some COC increases as discussed below. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR.
- Due to changes in toxicity data for the COCs in 2017, EPA developed updated RSLs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB) which were adopted as the comparison values for FTA-2/LF-2 reporting during this FYR period (AFCEC 2019a). These updated RSLs have not been formally adopted as cleanup values for FTA-2/LF-2; therefore, this FYR uses the ROD Amendment's risk-based level of 17 µg/L for both 1,2,4-TMB and 1,3,5-TMB as a comparison value in this narrative.

- Sampling conducted in 2020 and 2021 indicated the leading edge monitoring well (39MW0008) COC concentrations were below groundwater cleanup standards and the plume boundary was shortened by approximately 900 ft (AFCEC 2022b, 2021b). Sampling conducted at 39MW0008 in 2022 indicated a C_5–C_8 aliphatic (VPH) concentration of 600 µg/L which is above the GW-1 standard of 300 µg/L. VPH concentration trends at FTA-2/LF-2 are shown on Figure 4-20. A determination regarding re-extending the plume boundary will be made after new data are collected in 2023 (AFCEC 2023).
- The TMB concentrations at monitoring well 39MW0002 (located at the LF-2 source area) have increased during this FYR period; 1,2,4-TMB increased from 780 µg/L in 2018 to 910 µg/L in 2022 and 1,3,5-TMB increased from 440 µg/L in 2018 to 450 µg/L in 2022. These TMB concentrations exceed the risk-based level of 17 µg/L for 1,2,4-TMB and 1,3,5-TMB by more than an order of magnitude. The TMB concentrations observed at 39MW0002 attenuate to much lower concentrations at the next downgradient monitoring well (39MW410A) with 1,2,4-TMB at 26 µg/L and 1,3,5-TMB at 4.9 µg/L (AFCEC 2023). TMB concentration trends at FTA-2/LF-2 are shown on Figure 4-21 using the non-adopted RSLs as a basis.

4.11.4.2 Site Inspections

Refer to Section 2.3.

4.11.4.3 Interviews

Refer to Section 2.4.

4.11.5 Technical Assessment

4.11.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the MNA monitoring program is demonstrating attenuation of the FTA-2/LF-2 groundwater plume. The geochemical monitoring component of the MNA program described in the ROD Amendment has not been implemented and a finding has been included in this FYR to conduct geochemical monitoring in future monitoring. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR. The LUC component of the remedy has restricted use of the FTA-2/LF-2 groundwater for water supply use.

4.11.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

No. The current MCP GW-1 standards for the 4 EPH/VPH COCs from the ROD Amendment have been compared to EPA's comparative tap water TPH RSLs and are not protective in the long-term. This issue impacts the protectiveness of the current RAOs.

There are changes in standards and TBCs that affect the FTA-2/LF-2 remedy. Specifically, EPA tap water screening levels for 1,2,4-TMB (56 µg/L) and 1,3,5-TMB (60 µg/L) were developed (EPA 2017).

There were changes in toxicity parameters for 1,2,4-TMB and 1,3,5-TMB as follows:

- In June 2017, EPA finalized a new inhalation RfC for 1,2,4-TMB. The new IRIS value replaces a PPRTV that was used previously and indicates that 1,2,4-TMB is less toxic from non-cancer health effects. This change would result in decreased non-cancer hazard from inhalation exposure to 1,2,4-TMB (EPA 2022).
- In June 2017, EPA finalized an inhalation RfC for 1,3,5-TMB based on a new IRIS value. Previously, there was no RfC value for 1,3,5-TMB (EPA 2022).

There is also a change related to the use of MCP GW-1 standards for EPH/VPH and 2-methylnaphthalene from the ROD Amendment. The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the FTA-2/LF-2 ROD Amendment. As indicated in Exhibit 4-11c below, the tap water RSLs are lower than the MCP GW-1 standards. The MCP GW-1 standard for 2-methylnaphthalene of 10 µg/L is protective since it is less than the EPA Tap Water RSL of 36 µg/L.

Exhibit 4-11c

FTA-2/LF-2: Comparison of MCP GW-1 EPH/VPH and EPA Tap Water RSLs

COC from ROD Amendment	MCP GW-1 Cleanup Level (µg/L])	EPA Terminology for Comparative TPH Fraction	EPA Regional Screening Level Resident Tap Water (µg/L) HQ=1	Is EPA RSL Lower than GW-1?
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	300	Aliphatic Low	28	Yes
C_9-C_{12} Aliphatic Hydrocarbons	700	N/A	N/A	N/A
C_9-C_{10} Aromatic Hydrocarbons	200	Aromatic Medium	57	Yes
C_{11}-C_{22} Aromatic Hydrocarbons	200	Aromatic High	6	Yes

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the FTA-2/LF-2 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at FTA-2/LF-2 and any PFAS in the area will be managed under the Flight Line Operable Unit response (see Section 2.1.2).

The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR.

The RAOs documented in the ROD Amendment (AFCEC 2016) are not protective in the long-term. This FYR includes a recommendation to develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. As noted previously, EPA developed RSLs for two of the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR also includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD.

4.11.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.11.6 Issues/Recommendations

Exhibit 4-11d Issue/Recommendation #9: FTA-2/LF-2 Groundwater				
OU 5 (FTA-2/LF-2 Groundwater)	**Issue Category: Cleanup Levels**			
	Issue: The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the FTA-2/LF-2 ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C_5-C_8 Aliphatic Hydrocarbons (300 µg/L) v. EPA Aliphatic Low RSL (28 µg/L) GW-1 C_9-C_{10} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L) GW-1 C_{11}-C_{22} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L)			
	Recommendation: Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

Other Findings

The following are findings that were identified during the FYR and may improve site understanding, MNA expectations, and formalize updated toxicity information.

- Future FTA-2/LF-2 LTM Program Project Notes should discuss the ROD Amendment remedy's inclusion of MNA geochemical monitoring and include an assessment of geochemical monitoring data.
- The TMB exceedances at monitoring well 39MW0002 (discussed in Section 4.11.4.1) attenuate within the footprint of the FTA-2/LF-2 plume and do not present a protectiveness concern. However, the data indicate a continuing, low-level

leaching source may exist which would not follow the source aspect of the CSM (i.e., soils no longer pose a leaching threat). At the conclusion of the next FYR period (2022-2027) the site will be in the 12th year of an estimated 20-year MNA remedy and the TMB concentrations should be evaluated to determine if an attenuation pattern exists (as seen for the other COCs).

- Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FTA-2/LF-2 groundwater and establish a new MNA timeframe.

4.11.7 Protectiveness Determination

The remedy for FTA-2/LF-2 is protective of human health and the environment in the short-term. The LTM program is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended to prevent exposure to contaminated groundwater. For the remedy to be protective in the long-term, an ESD should be issued which replaces the current GW-1 EPH/VPH groundwater cleanup standards with federal risk-based standards (for those TPH fractions which have comparative values between the MCP and the EPA RSLs).

4.11.8 References

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_____. 2022a (October). *Annual Land Use Control (LUC) Letter Report for 2021.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022b (July). *Fire Training Area-2 (FTA-2)/Landfill-2 (LF-2) 2022 Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021a (July). *Annual Land Use Control (LUC) Letter Report for 2020.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021b (May). *Fire Training Area-2 (FTA-2)/Landfill-2 (LF-2) 2021 Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020 (August). *Annual Land Use Control (LUC) Letter Report for 2019.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019a (May). *Fire Training Area-2 (FTA-2)/Landfill-2 (LF-2) 2019 Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

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AFCEE. 1998 (September). *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source Areas*. Prepared by HLA for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (August). *Closure Report – Aqua Fuel Farm – Tank Removal and Site Restoration, Otis Air National Guard Base.* Prepared by Environic Solutions, Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2022 (June) *EPA FYR Technical Assessment Region 1 FY2022 Supplemental Template with PFAS revision 060122*, EPA internal guidance shared with AFCEE/JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2017 (June). *Spreadsheet Comparison of the Previous Summary Table to the Current for TR=1E-06 and THQ=1.0*, http/epa.gov/risk/regional-screening-levels-rsls-whats-new.

4.12 PETROLEUM FUELS STORAGE AREA (PFSA)

4.12.1 Introduction

The PFSA groundwater plume (OU 5) is a dissolved-phase groundwater plume located in the southeast portion of JBCC (Figure 4-22).

The land above the PFSA plume is primarily undeveloped protected open space (Orenda Wildlife Trust and Mashpee Conservation Commission). A residential area, commonly referred to as Briarwood, is located downgradient of the open space, to the north of Johns Pond (AFCEC 2018a).

The source of the PFSA groundwater plume is the PFSA which was formerly occupied by ASTs, pump houses, and fuel distribution lines (all now demolished) and formerly served as the storage and distribution center for JP-4 jet fuel, aviation gasoline, motor gasoline, and No. 2 fuel oil for the JBCC from the 1950s until 2009. The PFSA site has been the location of several fuel spills, including the FS-10 and FS-11 releases in the 1960s (AFCEC 2016).

4.12.2 Response Action Summary

4.12.2.1 Basis for Taking Action

The PFSA groundwater COCs are C_5-C_8 aliphatic, C_9-C_{12} aliphatic, and C_9-C_{10} aromatic VPH ranges; the C_{11}-C_{22} aromatic EPH range; 1,2,4-TMB; 1,3,5-TMB; and 2-methylnaphthalene (AFCEC 2016). All cleanup levels are indicated in the RAOs listed in Section 4.12.2.2.

A screening level human-health risk assessment indicated the PFSA COCs are present at concentrations greater than groundwater standards and RBCs and, therefore, could pose a risk to human health if the groundwater was used as a future drinking water source. Regarding ecological risk, a Stage I screening analysis indicated no “significant risk of harm to the environment” after comparing EPH/VPH and VOC data from the PFSA plume against MCP Method 1 GW-3 groundwater standards (AFCEC 2016).

VI impacts from VOCs in soil and groundwater are not expected for existing buildings and

current land use at PFSA (AFCEC 2016). VI risks to potential future buildings at PFSA are being mitigated by application of LUCs (see Section 4.12.2.3).

4.12.2.2 Response Actions

Pre-Record of Decision: A number of spill responses and infrastructure modification and demolition projects at PFSA are described in Section 3.4.

Record of Decision: A source area remedy for PFSA was selected and documented in the *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas* (AFCEE 1998). The remedy called for biosparging with off-gas collection and treatment and the COCs were limited to ethylbenzene and total xylenes in soil. A biosparge/soil vapor extraction system operated at PFSA from 2001 to 2008 followed by biosparging only from 2008 to 2010 (AFCEC 2016).

Record of Decision Amendment: A groundwater remedy for PFSA was selected and documented in the *Final Petroleum Fuels Storage Area Record of Decision Amendment* (AFCEC 2016). The selected remedy calls for MNA with LUCs. The associated RAOs are as follows:

- Prevent residential exposure to site groundwater with EPH/VPH concentrations greater than the MCP GW-1 cleanup standards of:
  - 300 µg/L for C_5-C_8 aliphatic hydrocarbons
  - 200 µg/L for C_9-C_{10} aromatic hydrocarbons
  - 700 µg/L for C_9-C_{12} aliphatic hydrocarbons
  - 200 µg/L for C_{11}-C_{22} aromatic hydrocarbons
- Prevent residential exposure to site groundwater with 1,2,4-TMB concentrations greater than the RBC of 19 µg/L.
- Prevent residential exposure to site groundwater with 1,3,5-TMB concentrations greater than the RBC of 19 µg/L.

- Prevent residential exposure to site groundwater with 2-methylnaphthalene concentrations greater than the MCP GW-1 standard of 10 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

The remedy components include the following:

- Monitoring of key PFSA monitoring wells for VOCs (including the TMB isomers) by EPA Method 8260C and EPH/VPH carbon ranges (and 2-methylnaphthalene) by MassDEP method, and geochemical parameters (e.g., dissolved iron, sulfate, nitrate, and dissolved oxygen) to document redox conditions.
- Post sampling data transmittals and annual monitoring reports would be produced to document site conditions and progress relating to MNA.
- Remedy completion will be demonstrated when the temporal average groundwater concentrations at individual wells are less than or equal to applicable groundwater cleanup standards based on data from three consecutive annual monitoring periods.
- Monitoring well inspection and maintenance will be performed annually and decommissioning of each well will be conducted as per MassDEP protocol as the monitoring network is optimized and wells are no longer needed.
- LUCs, including maintenance of a private well verification area, to restrict use of groundwater for water supplies both on-base and in nearby areas would remain in place until RAOs are achieved.
- CERCLA five-year reviews will be performed to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use concentrations in soil and groundwater.

4.12.2.3 Status of Implementation

The selected MNA remedy has progressed with groundwater sampling being conducted on an annual or biennial basis for select monitoring wells (AFCEC 2023, 2022b, 2021b, 2020b, 2019b, 2018b).

The PFSA groundwater LUCs and their status are shown on Exhibit 4-12a.

Exhibit 4-12a LUC Status for PFSA Groundwater				
Media, engineered controls, and areas that do not support UU/UE based on current conditions	**LUCs Needed**	**LUCs Called for in the ROD Amendment**	**LUC Objectives**	**Title of LUC Instrument Implemented and Date (or planned)**
PFSA Groundwater LUC Area (Figure 4-22)	Yes	Yes	• Prevent access to or use of the groundwater from the PFSA plume area until the groundwater no longer poses an unacceptable risk. • Maintain the integrity of any current or future groundwater monitoring system • Evaluate potential VI exposure risks at future buildings, if constructed, and mitigate exposure risk if necessary.	• Mashpee BOH Moratorium on Groundwater Wells – Apr 1998, Amended July 1999 • MassDEP Drinking Water Permit – On-Going • JBCC Drinking Water Well Prohibition – Aug 2006 (Initial) and Jan 2023 (Most Recent Update) • Private Well LUC Program - 2014 and On-Going • Dig Safe Registration and Review – On-Going

To ensure that the LUCs obtain the performance objectives the USAF has established a private-well verification LUC area for the areas that are above or within the projected path of the PFSA plume (Figure 4-22). AFCEC conducted a private well verification and well determination survey for this area in June 2014 and no water supply wells were identified (AFCEC 2016).

The private well verification process used at JBCC is further described in Section 2.2.2 and a listing of private well status in relation to current COCs, sorted by groundwater plume, can be found at Table 2-1. A discussion of LUCs on a Site-wide basis can be found at Section 2.2.

Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells or new facilities (which would trigger a VI evaluation) were installed in the PFSA Groundwater LUC Area during this FYR period (AFCEC 2023, 2022a, 2021a, 2020a, 2019a).

4.12.3 Progress Since the Last Review

This section includes the protectiveness determination and statement from the **last** FYR (Exhibit 4-12b). There were no issues and recommendations for PFSA groundwater in the last FYR.

Exhibit 4-12b

Protectiveness Determination/Statement from the 2018 FYR – PFSA Groundwater

OU #	Protectiveness Determination	Protectiveness Statement
5 (PFSA Groundwater)	Protective	**The remedy for the PFSA groundwater is protective of human health and the environment.** The LTM program is in place and is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended.

4.12.4 Five-Year Review Process

4.12.4.1 Data Review

Data collected for PFSA groundwater are continually assessed under the SPEIM program as described in Section 2.5 and were reported in the PFSA LTM Program Project Notes during this FYR period (AFCEC 2023, 2022b, 2021b, 2020b, 2019b, 2018b). Significant results from the data review follow:

- The MNA remedy is functioning as the plume has not migrated and COC concentrations are generally trending downward. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends.
- The PFSA monitoring wells in the source area have indicated variable, but generally decreasing, concentration trends for COCs during this FYR period. Monitoring well 24MW412A has the highest COC concentrations in 2022 with C_9–C_{10} aromatic (VPH) at 1,000 µg/L (GW-1 standard of 200 µg/L) and 1,2,4-TMB at

410 µg/L (risk based level of 17 µg/L) (AFCEC 2023). Concentration trends for VPH and TMBs at PFSA are shown on Figures 4-23 and 4-24, respectively.

- Due to changes in toxicity data for the COCs in 2017, EPA developed updated RSLs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB) which were adopted as the comparison values for PFSA during this FYR period (AFCEC 2019a). These updated RSLs have not been formally adopted as cleanup values for PFSA; therefore, this FYR uses the ROD Amendment's risk-based level of 17 µg/L for both 1,2,4-TMB and 1,3,5-TMB as a comparison value in this narrative.

4.12.4.2 Site Inspections

Refer to Section 2.3.

4.12.4.3 Interviews

Refer to Section 2.4.

4.12.5 Technical Assessment

4.12.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the MNA monitoring program is demonstrating attenuation of the PFSA groundwater plume. The geochemical monitoring component of the MNA program described in the ROD Amendment has not been implemented and a finding has been included in this FYR to conduct geochemical monitoring in future monitoring. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends. The LUC component of the remedy has restricted use of the PFSA groundwater for water supply use.

4.12.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

No. The current MCP GW-1 standards for the 4 EPH/VPH COCs from the ROD Amendment have been compared to EPA's comparative tap water TPH RSLs and are not protective in the long-term. This issue impacts the protectiveness of the current RAOs.

There are changes in standards and TBCs that affect the PFSA groundwater remedy. Specifically, EPA tap water screening levels for 1,2,4-TMB (56 µg/L) and 1,3,5-TMB (60

µg/L) were developed (EPA 2017).

There were changes in toxicity parameters for 1,2,4-TMB and 1,3,5-TMB as follows:

- In June 2017, EPA finalized a new inhalation RfC for 1,2,4-TMB. The new IRIS value replaces a PPRTV that was used previously and indicates that 1,2,4-TMB is less toxic from non-cancer health effects. This change would result in decreased non-cancer hazard from inhalation exposure to 1,2,4-TMB (EPA 2022).
- In June 2017, EPA finalized an inhalation RfC for 1,3,5-TMB based on a new IRIS value. Previously, there was no RfC value for 1,3,5-TMB (EPA 2022).

There is also a change related to the use of MCP GW-1 standards for EPH/VPH and 2-methylnaphthalene from the ROD Amendment. The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the PFSA ROD Amendment. As indicated in Exhibit 4-12c below, the tap water RSLs are lower than the MCP GW-1 standards. The MCP GW-1 standard for 2-methylnaphthalene of 10 µg/L is protective since it is less than the EPA Tap Water RSL of 36 µg/L.

Exhibit 4-12c

PFSA: Comparison of MCP GW-1 EPH/VPH and EPA Tap Water RSLs

COC from ROD Amendment	MCP GW-1 Cleanup Level (µg/L])	EPA Terminology for Comparative TPH Fraction	EPA Regional Screening Level Resident Tap Water (µg/L) HQ=1	Is EPA RSL Lower than GW-1?
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	300	Aliphatic Low	28	Yes
C_9-C_{12} Aliphatic Hydrocarbons	700	N/A	N/A	N/A
C_9-C_{10} Aromatic Hydrocarbons	200	Aromatic Medium	57	Yes
C_{11}-C_{22} Aromatic Hydrocarbons	200	Aromatic High	6	Yes

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the PFSA remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at the PFSA and any PFAS in the area will be managed under the Flight Line Operable Unit response (see Section 2.1.2).

The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends.

The RAOs documented in the ROD Amendment (AFCEC 2016) are not protective in the long-term. This FYR includes a recommendation to develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. As noted previously, EPA developed RSLs for two of the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD.

4.12.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

4.12.6 Issues/Recommendations

Exhibit 4-12d Issue/Recommendation #10: PFSA Groundwater				
OU 5 (PFSA Groundwater)	**Issue Category: Cleanup Levels**			
	Issue: The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the PFSA ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C_5-C_8 Aliphatic Hydrocarbons (300 µg/L) v. EPA Aliphatic Low RSL (28 µg/L) GW-1 C_9-C_{10} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L) GW-1 C_{11}-C_{22} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L)			
	Recommendation: Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

Other Findings

The following findings were identified during the FYR and may improve site understanding, MNA expectations, and will formalize updated toxicity information.

- Future PFSA Long Term Monitoring Program Project Notes should discuss the ROD Amendment remedy's inclusion of MNA geochemical monitoring and include an assessment of geochemical monitoring data.
- Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for PFSA groundwater and establish a new MNA timeframe.

4.12.7 Protectiveness Determination

The remedy for the PFSA is protective of human health and the environment in the short-term. The LTM program is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended to prevent exposure to contaminated groundwater. For the remedy to be protective in the long-term, an ESD should be issued which replaces the current GW-1 EPH/VPH groundwater cleanup standards with federal risk-based standards (for those TPH fractions which have comparative values between the MCP and the EPA RSLs).

4.12.8 References

AFCEC. 2023 (February). *Petroleum Fuel Storage Area 2023 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022a (October). *Annual Land Use Control (LUC) Letter Report for 2021.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022b (July). *Petroleum Fuel Storage Area 2022 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021a (July). *Annual Land Use Control (LUC) Letter Report for 2020.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021b (May). *Petroleum Fuel Storage Area 2021 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020a (August). *Annual Land Use Control (LUC) Letter Report for 2019.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020b (March). *Petroleum Fuel Storage Area 2020 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019a (April). *Annual Land Use Control (LUC) Letter Report for 2018.* Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019b (March). *Petroleum Fuel Storage Area 2019 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2018a (September). *Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site, Otis Air National Guard Base, MA.* Prepared by AFCEE/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2018b (May). *Petroleum Fuel Storage Area 2018 Annual Long Term Monitoring Program Project Note.* Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2016 (September). *Final Petroleum Fuels Storage Area Record of Decision Amendment.* Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

AFCEE. 1998 (September). *Record of Decision for Areas of Contamination FTA-2/ LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source Areas*. Prepared by HLA for AFCEE/JBCC Installation Restoration Program, Otis ANG Base, MA.

EPA. 2022 (June) *EPA FYR Technical Assessment Region 1 FY2022 Supplemental Template with PFAS revision 060122*, EPA internal guidance shared with AFCEE/JBCC Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2017 (June). *Spreadsheet Comparison of the Previous Summary Table to the Current for TR=1E-06 and THQ=1.0*, http/epa.gov/risk/regional-screening-levels-rsls-whats-new.

5.0 MUNITIONS RESPONSE SITES REQUIRING FIVE-YEAR REVIEW

This section presents the MRS for which a FYR is required. Only one MRS, the Mock Village, is evaluated in this FYR and is included on Table 1-2.

The following MRSs were closed with No Further Action Response Planned Decision Documents as listed on Table 1-1b.

- Former Otis Bomb Storage Magazines
- Otis Target Butt

The following MRSs are undergoing various stages of investigation and do not yet have DDs.

- Ordnance Area 1
- Skeet Range
- DoD Property/Old Grenade Courts Munitions Response Area (MRA)[7]
- Non-DoD Property/Old Grenade Courts MRA
- Rocket Range/Old K Range MRA
- Carolina Road/Old K Range MRA
- Rocket Range Firing Line/Old K Range MRA
- Remaining Lands/Old K Range MRA
- Skeet and Trap Range/Otis Gun Club MRA
- Pistol Range/Otis Gun Club MRA
- No Further Action Area/Otis Gun Club MRA
- Former Ammunition Supply Point – West
- Former Ammunitions Supply Point - East

[7] A Munitions Response Area (MRA) is an area known or suspected to contain unexploded ordnance, discarded military munitions, or munitions constituents. An MRA is comprised of one or more Munitions Response Sites (MRS) (DoD 2007). If the MRA contains only one MRS, the MRA and MRS have the same title.

5.1 MOCK VILLAGE

5.1.1 Introduction

The 1.9-acre Mock Village MRS (OU 29) is located in the northeast area of JBCC on the Camp Edwards portion of the base (Figure 5-1).

The MRS was used to simulate a German village and was used as an urban training complex by the MAARNG from 1943 through the early 1950s. Soldiers were trained in street reconnaissance, urban fighting techniques, clearing houses and villages, and booby traps.

Based on a review of historical aerial imagery, the former building structures were demolished prior to 1966. Since then, the MRS has become non-operational and has not been used for any purpose. In addition, there has been no development of the site. Currently, remnants of the timber-reinforced and earthen dugouts are present onsite and the remainder of the site has become forested with dense trees and thick underbrush. The land is currently undeveloped forest with no recreational use and is located in the vicinity of the USCG antenna arrays, which have associated hazards. There are no anticipated changes for use of the MRS, and the projected future land use of the MRS is anticipated to remain consistent with the current use.

Munitions permitted for battle simulations at the Mock Village MRS included blocks of trinitrotoluene (TNT) and pyrotechnics. Instructors were allowed to use fragmentation hand grenades (live grenades) in the advanced demonstrations; however, there is no indication that these were used. Since personnel were raising and lowering targets during training, it is unlikely that live ordnance would have been used. The trainees (attacking troops) were allowed to use practice or blank ammunition, including practice hand grenades and weapons (machine guns) with blank ammunition (AFCEC 2022).

5.1.2 Response Action Summary

5.1.2.1 <u>Basis for Taking Action</u>

Based on a review of the historical use of the site for training, previous investigations, and current/future use of the MRS, it has been determined that there is a low probability of

encountering MEC at the MRS. Since 100% of the site was not investigated with digital geophysical methods, there is a small possibility that MEC could be found. If MEC is found at a future time and is breached or has leaked explosive filler, or an item requires detonation-in-place, the soil beneath the item may be investigated to determine if the item is a source of munitions constituents. The possible receptors associated with potential MEC at the MRS include installation personnel, contractors, and trespassers. (AFCEC 2022)

5.1.2.2 Response Actions

Record of Decision: The final remedy for the Mock Village MRS as described in the *Record of Decision Mock Village Munitions Response Site (EPA Operable Unit 29)* (AFCEC 2022) is LUCs with unexploded ordnance (UXO) construction support. The RAOs for the Mock Village are as follows:

- Reduce the risk of direct contact by current and anticipated future human receptors to potential MEC in the surface and subsurface soil.
- Prevent the release of contamination from the detonation or deterioration [from] an accumulation of MEC in a quantity sufficient to result in a total excess lifetime cancer risk greater than the target risk range of 10-4 to 10-6, and/or a non-cancer Hazard Index greater than 1.0.

The remedy components include:

- Development of public education materials detailing the appropriate response action if potential munitions items are discovered on the site. Education materials include site signage and pamphlets.
- Installation of warning signs.
- Annual inspection of signage.
- Notifications of LUCs to the appropriate real estate office (i.e., USCG).
- Geophysical surface sweeps for MEC (annual for the first three years with reevaluation of frequency at the end of three years).
- Monitoring of advance tenant notifications for upcoming work and DigSafe® requests and providing UXO construction support (as necessary).
- UXO construction support (on-call) component during intrusive activities at the site.

5.1.2.3 Status of Implementation

The Mock Village ROD was signed in April 2022 and this FYR addresses the period until 30 September 2022. The Warning Sign component of the LUC remedy (Figure 5-2) has been completed and the other LUC components are on-going or future events (Exhibit 5-1). The Draft LUCIP update, to include the Mock Village LUC requirements, was submitted to EPA and MassDEP in August 2023 for review.

Exhibit 5-1
LUC Status for Mock Village MRS

Media, engineered controls, and areas that do not support UU/UE based on current conditions	LUCs Needed	LUCs Called for in the ROD	LUC Objectives	Title of LUC Instrument Implemented and Date (or planned)
Mock Village MRS (Figure 5-1)	Yes	Yes	• Provide education and awareness regarding the low probability of encountering MEC. • Provide a strategy for dealing with any MEC found at the MRS.	• Public education materials (UXO awareness pamphlet distributed in 2022) • Warning Signs (installed in 2022) • LUC notifications to USCG real estate office (annual starting in 2022) • Geophysical surface sweeps for MEC (annual starting in 2022) • Monitor tenant requests and DigSafe (on-going) • UXO Construction Support (on-call)

5.1.3 Progress Since The Last Review

This is the first FYR for the Mock Village MRS and there are no previous FYR recommendations.

5.1.4 Five-Year Review Process

5.1.4.1 Data Review

The first post-ROD annual LUC inspection and annual magnetometer-assisted MEC sweep at the Mock Village MRS was conducted on 22 August 2022. A team of two UXO Technicians inspected all UXO warning signs and completed a MEC surface sweep and visual survey of approximately 1.9 miles of transects. All UXO warning signs were in good condition and remain visible. A small amount of vegetation was removed surrounding UXO warning signs to further improve visibility. During the MEC surface sweep the UXO team identified the previously documented timber-reinforced earthen dugouts at the Mock Village MRS. The team did not observe any MEC or munitions debris (AFCEC 2023).

5.1.4.2 Site Inspections

An SI in support of this FYR was completed for the Mock Village MRS on 27 October 2022. The focus of the SI was to assess general site conditions and to determine whether the LUCs described in Exhibit 5-1 are in place. Based on the SI, land use at the site remains consistent with the assumptions used in the hazard assessment and the additional signage required by the ROD has been installed and no concerns regarding protectiveness were identified.

5.1.4.3 Interviews

Refer to Section 2.4.

5.1.5 Technical Assessment

5.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes. The LUCs are in place and working as intended.

5.1.5.2 Question B: Are the exposure assumptions, toxicity data, cleanup level, and RAOs used at the time of the remedy selection still valid?

Yes. The land use at this MRS has not changed since the ROD was finalized in April 2022.

5.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information impacting the protectiveness of the remedy has come to light. A discussion regarding potential climate change impacts can be found at Section 2.7.

5.1.6 Issues/Recommendations

No specific recommendation or follow-up actions have been identified.

5.1.7 Protectiveness Statement

The remedy for the Mock Village MRS is protective of human health and the environment. No changes in site conditions were observed during the site visit and the LUCs are in place and are being implemented.

5.1.8 References

AFCEC. 2023 (April). *Mock Village Munitions Response Site 2022 Annual Land Use Control Inspection and Munitions and Explosives of Concern Sweep Project Note, Otis Air National Guard Base, MA.* Prepared by EA Engineering, Science, and Technology, Inc. for AFCEC/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2022 (April). *Mock Village ROD, Otis Air National Guard Base, MA.* Prepared by EA Engineering, Science, and Technology, Inc. for AFCEC/JBCC, Installation Restoration Program, Otis ANG Base, MA.

DOD. 2007 (April). *Munitions Response Site Prioritization Protocol Primer*, Office of the Deputy Under Secretary of Defense (Installations and Environment) Office of Environmental Management.

6.0 NEXT REVIEW

The next five-year review report for the Joint Base Cape Cod Superfund Site is required five years from the completion date of this review and will address the time period from 1 Oct 2022 to 30 Sep 2027.

FIGURES

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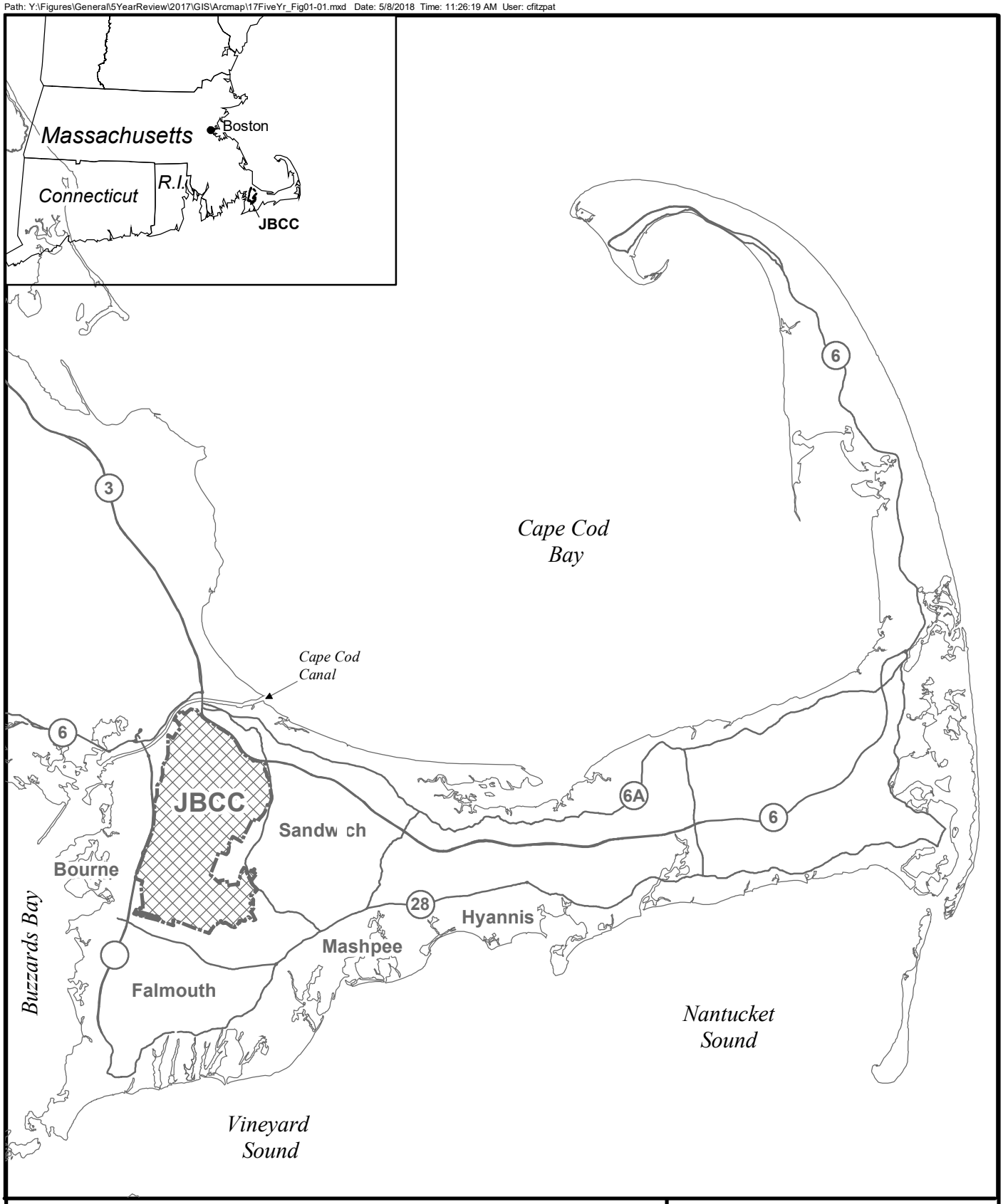

Data Source: AFCEC, April 2018
JBCC Boundary from Massachusetts Air National Guard 2011

Legend

Joint Base Cape Cod

0 3 6 Miles

FIGURE 1-1

JOINT BASE CAPE COD
CAPE COD, MASSACHUSETTS
AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

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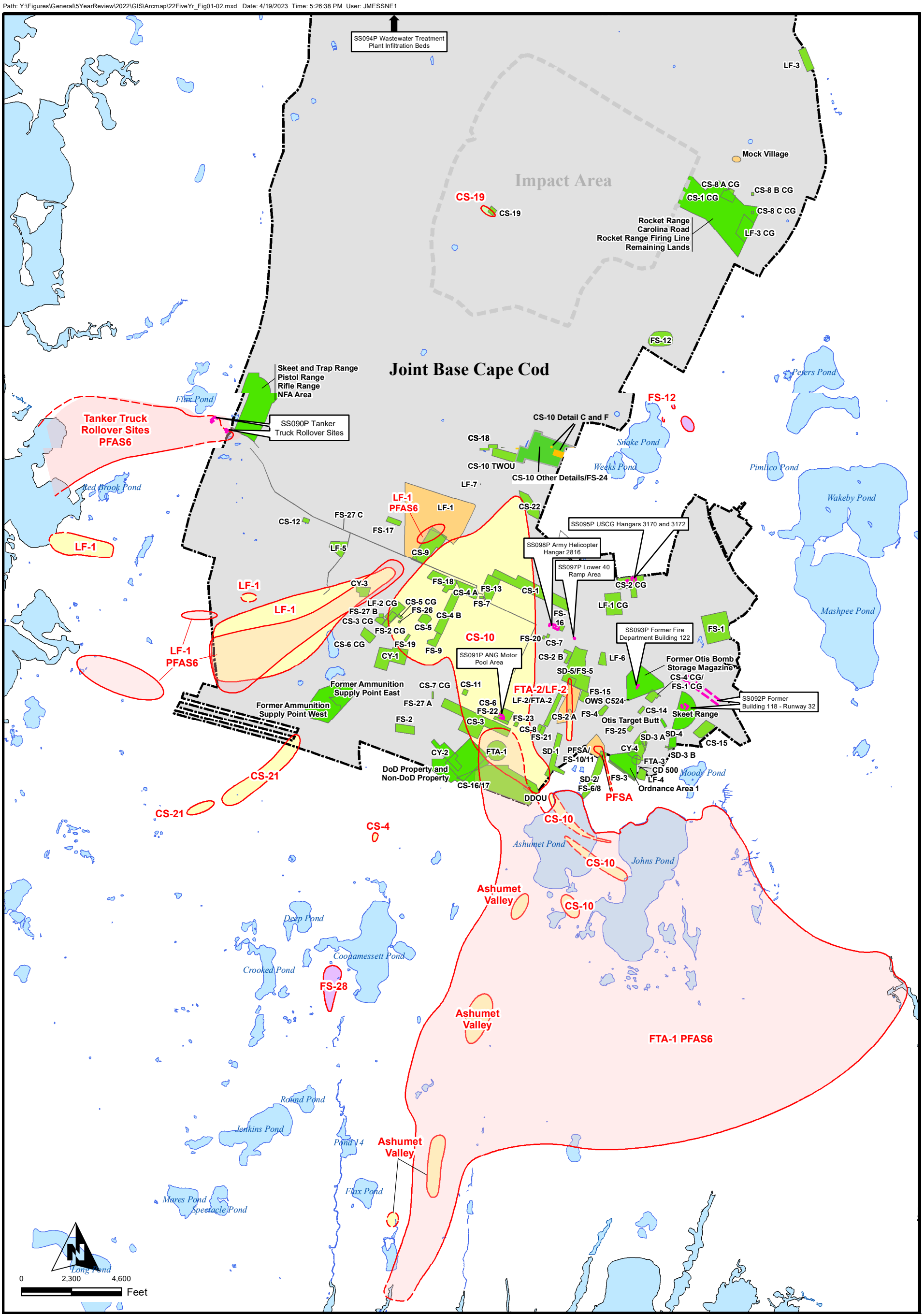

Legend

- Joint Base Cape Cod Boundary
- Plume Boundary (Dashed Where Inferred)
- Impact Area
- IRP Source Areas and Munitions Response Sites Undergoing Five-Year Review
- IRP Source Areas and Munitions Response Sites Not Subject to Five-Year Review
- Approximate PFAS Site Boundary

Groundwater Plumes

- EDB Plume - Represent an exceedance of Ethylene Dibromide (1,2-dibromoethane), EDB MMCL = 0.02 µg/L
- TCE/PCE Plume - Represent an exceedance of Trichloroethene (TCE) and/or Tetrachloroethene (PCE), TCE and PCE MCL = 5.0 µg/L
- Explosives Plume Concentrations Above EPA Risk-Based Level = 0.6 µg/L, Royal Demolition Explosive (RDX)
- PFAS6 Plume - Represent an Exceedance of the PFAS6 MMCL (sum of PFOS, PFOA, PFHxS, PFNA, PFHpA, and PFDA) = 0.02 µg/L

Data Source: AFCEC, April 2023
JBCC Boundary from Massachusetts Air National Guard 2011

FIGURE 1-2

ALL JBCC CERCLA SITE LOCATIONS

AFCEC - Joint Base Cape Cod

6th Five Year Review 2017-2022

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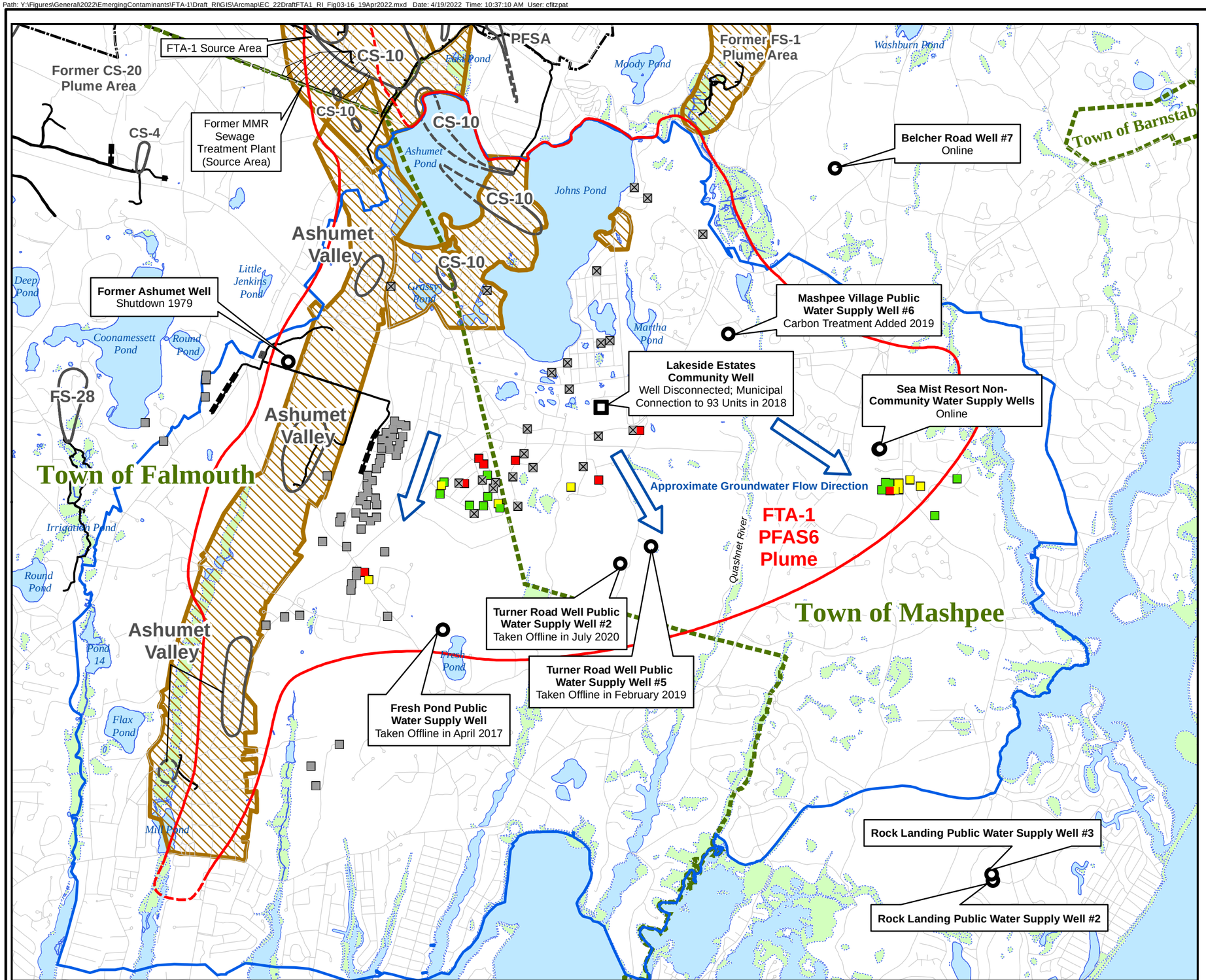

Legend

- Joint Base Cape Cod Boundary
- PCE/TCE Plume Boundary (Dashed Where Inferred)
- FTA-1 PFAS6 Plume Boundary (Dashed Where Inferred)
- Town Boundary
- Infiltration Trench
- Bog/Wetland
- Ashumet and Johns Ponds Private Well Outreach Area
- Land Use Control Area
- Community Water Supply Well
- Public Water Supply Well
- Private Residential Well

Sum of PFAS6 Detections in Private Wells (Latest Available PFAS6 Result for Locations in the Residential Well Monitoring Program):

- No Detection
- At or Below MassDEP PFAS6 MMCL
- Above MassDEP PFAS6 MMCL (Receiving Bottled Water and/or Municipal Water Connection)
- Residential Well Connected to Municipal Water
- Residential Well No Longer Sampled. Monitoring Data Indicate Location No Longer Impacted By Historic AV Plant Effluent Discharge Through Infiltration Trenches. PFOS/PFOA Consistently Below EPA HA and PFAS6 Consistenly Below MMCL.

EPA HA = Environmental Protection Agency Health Advisory (Final EPA HA [PFOS + PFOA] = 0.07 µg/L, which was promulgated by EPA on 19 May 2016

MMCL = Massachusetts Maximum Contaminant Level (MassDEP PFAS6 MMCL [sum of PFOS, PFOA,PFHxS, PFNA, PFHpA, and PFDA] = 0.02 µg/L

0 1,400 2,800 Feet

Data Source:
AFCEC, March 2022
JBCC Boundary from Massachusetts Air National Guard 2011

FIGURE 2-1

Ashumet Valley/FTA-1 PFAS Plume and Private Well Outreach Area

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

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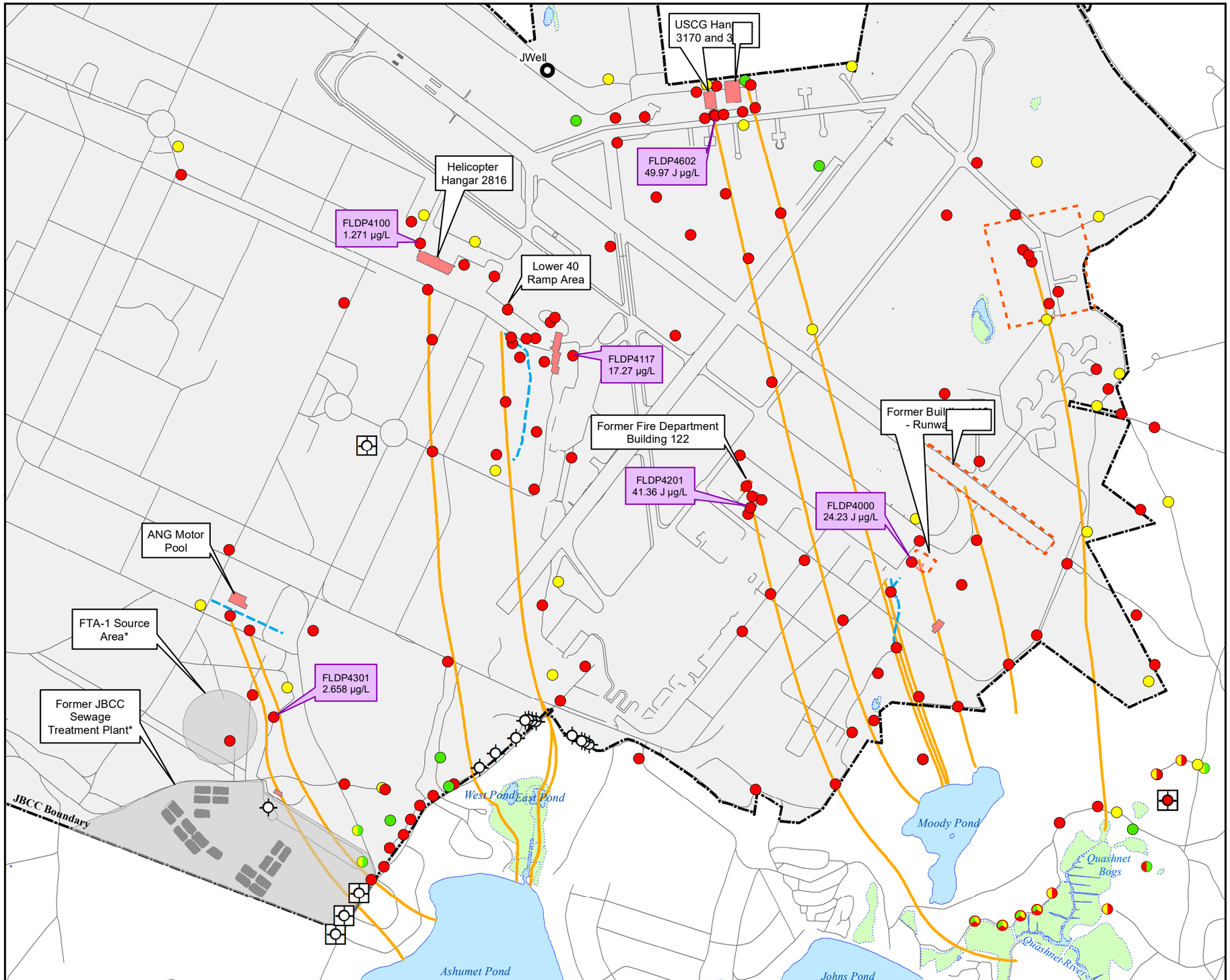


Legend

- Groundwater Model Particle Track
- Storm Drainage Ditch
- Approximate Site Boundary
- Joint Base Cape Cod Boundary
- Existing Structure
- Former Structure
- Abandoned Cranberry Bog/Wetland
- Abandoned Sewage Treatment Beds
- Public Water Supply Well
- Extraction Well (Off)
- Reinjection Well (On)
- Reinjection Well (Off)
- 49.97 J µg/L — Highest PFAS6 Concentration in Groundwater (µg/L) Detected to Date During RI

Sum of PFAS6 Detections in Groundwater From Flight Line Area Site Inspections:

- PFAS6 = 0
- PFAS6 Greater Than 0 and At or Below the MMCL
- PFAS6 Above the MMCL

MassDEP PFAS6 MMCL (sum of PFOS, PFOA, PFHxS, PFNA, PFHpA, and PFDA) = 0.02 µg/L
MMCL = Massachusetts Maximum Contaminant Level

*Sites Being Investigated Under the FTA-1 Remedial Investigation

N

0 630 1,260 Feet

Data Source:
AFCEC, May 2023
JBCC Boundary from Massachusetts Air National Guard 2011

FIGURE 2-2

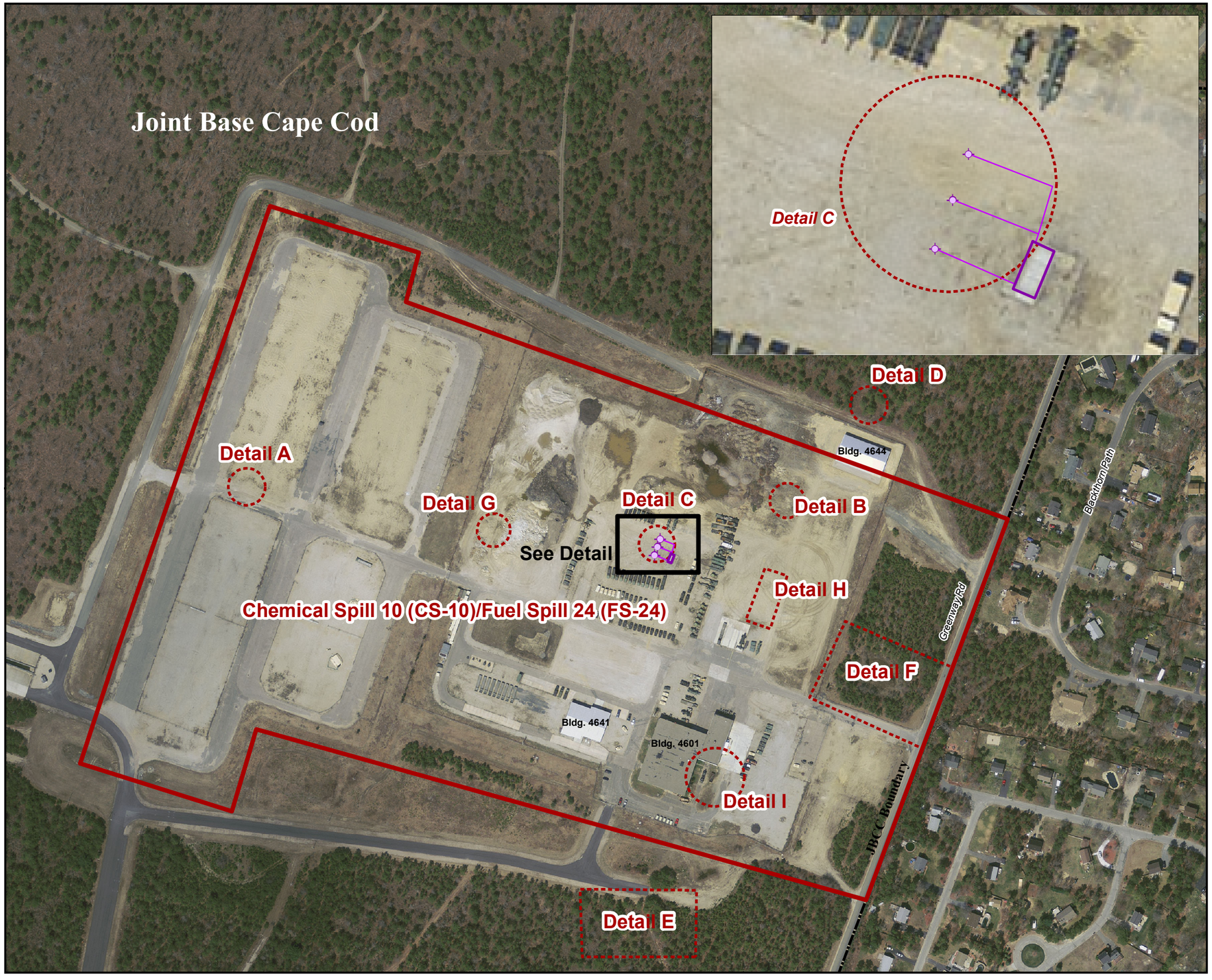
FLIGHT LINE OPERABLE UNIT SITES

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

ch2m

Path: Y:\Figures\General\5YearReview\2017\GIS\Arcmap\17FiveYr_Fig04-01_rev.mxd Date: 5/31/2018 Time: 2:43:03 PM User: JMESSNE1



Legend

- Soil Vapor Extraction (SVE) Well (now removed)
- Joint Base Cape Cod Boundary
- SVE System Pipeline (now removed)
- Source Area
- Source Area Detail
- SVE System Treatment Facility(now removed)

N

0 125 250 Feet

Data Source: AFCEC, April 2018
JBCC Boundary from Massachusetts Air National Guard 2011
2009 Aerial Photography from MassGIS

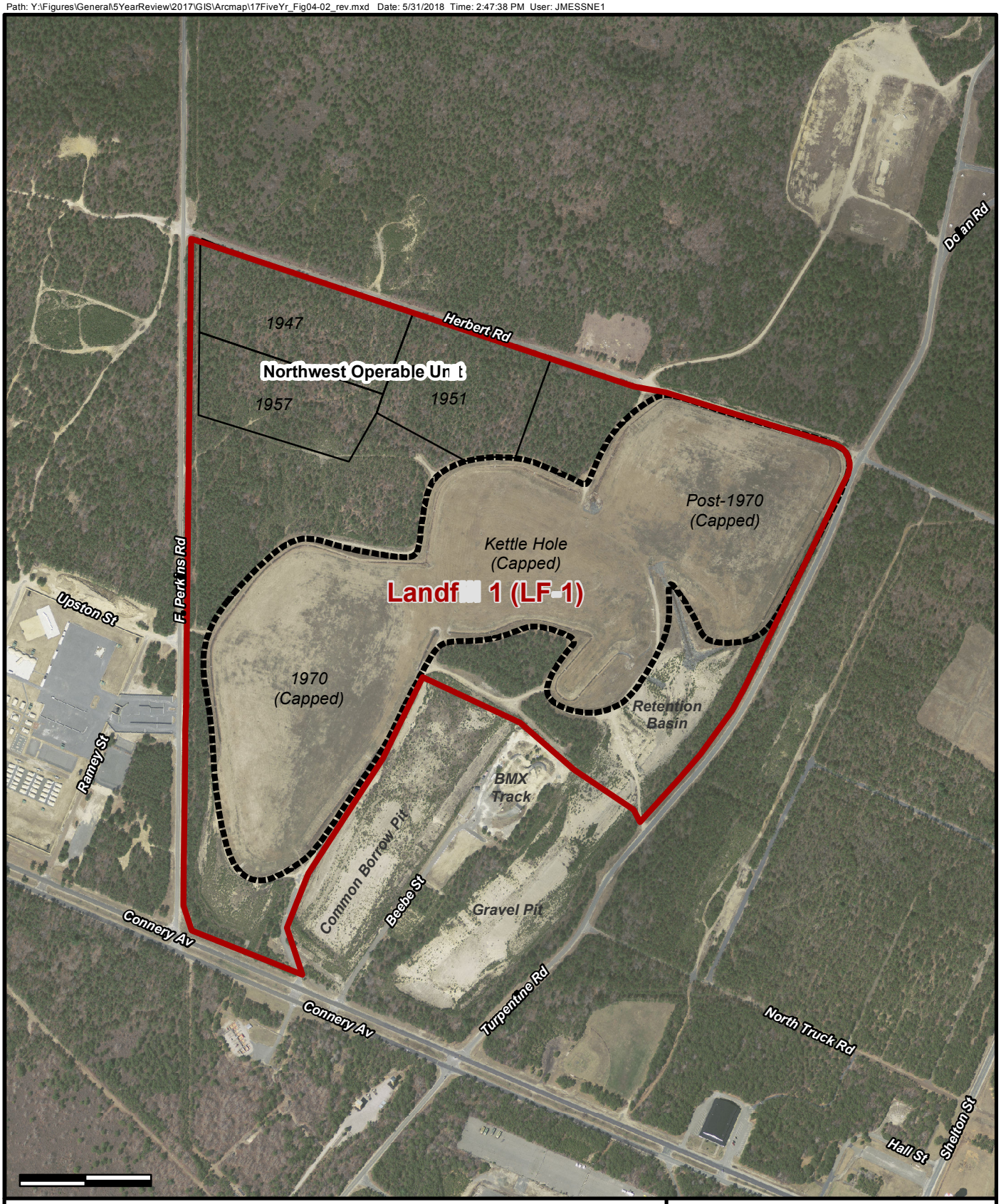
FIGURE 3-1

CS-10 SOURCE AREA

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\General\5YearReview\2017\GIS\Arcmap\17FiveYr_Fig04-02_rev.mxd Date: 5/31/2018 Time: 2:47:38 PM User: JMESSNE1



Legend

- Source Area Boundary
- Capped Area
- Northwest Operable Unit

Data Source: AFCEC, April 2018
2009 Aerial Photography from MassGIS

FIGURE 3-2

LF-1 SOURCE AREA

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\General\5YearReview\2017\GIS\Arcmap\17FiveYr_Fig04-03_rev.mxd Date: 5/31/2018 Time: 2:02:56 PM User: JMESSNE1

Legend

Joint Base Cape Cod Boundary

Source Area Boundary

Data Source: AFCEC, April 2018
JBCC Boundary from Massachusetts Air National Guard 2011
2009 Aerial Photography from MassGIS

N

0 200 400 Feet

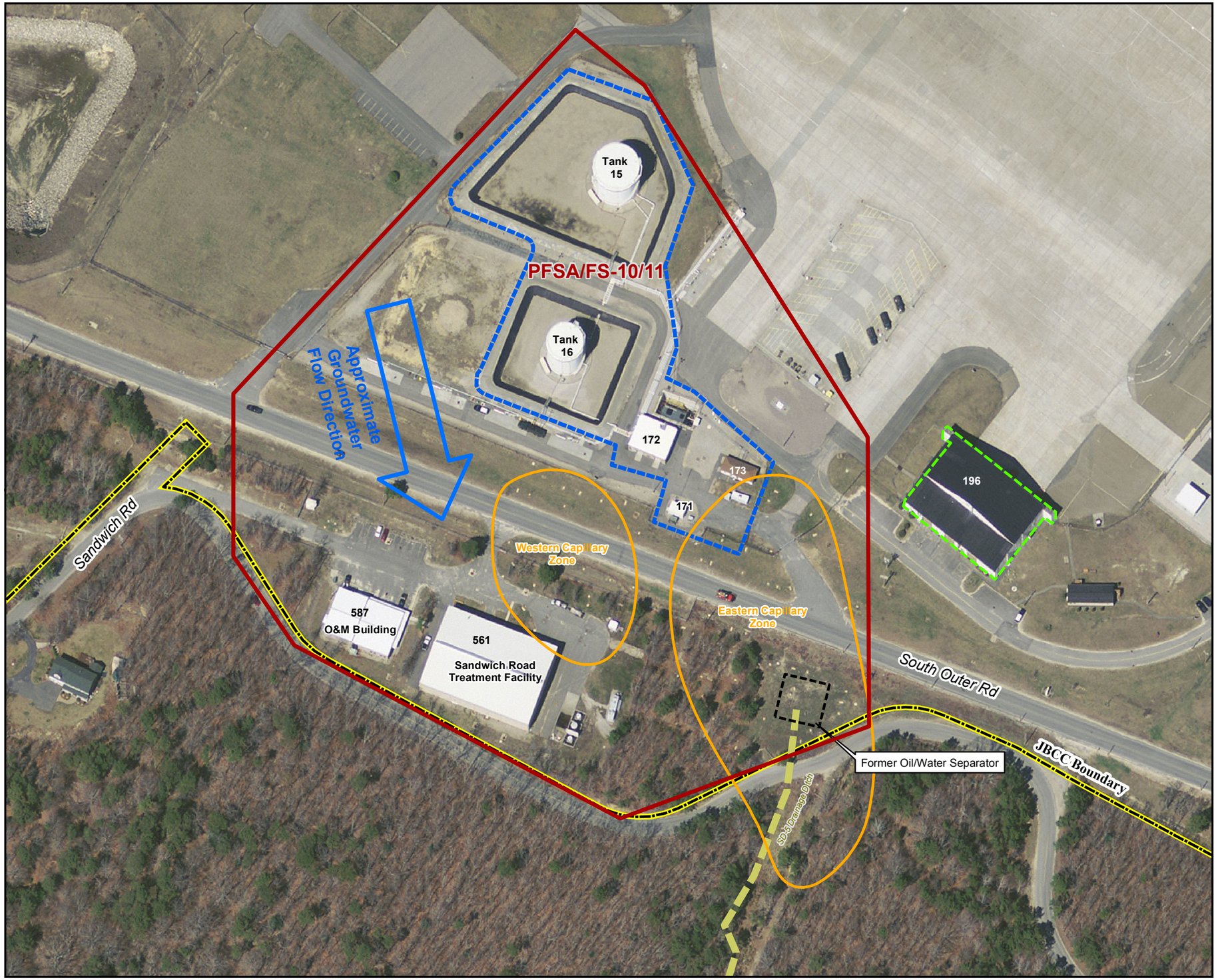
FIGURE 3-3

FTA-2/LF-2 SOURCE AREA

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\General\5YearReview\2017\GIS\Arcmap\17FiveYr_Fig04-05_GIS10_4.mxd Date: 5/31/2018 Time: 4:22:53 PM User: JMESSNE1



Legend

- Joint Base Cape Cod Boundary
- Source Area Boundary
- PFSA Structures Demolished January/February 2011
- Building 196 Demolished Summer 2011
- 587 Building Number
- Approximate Historic Extent of Soil Contamination*
- Drainage Ditch

*Defined in *Operations and Maintenance Manual Biosparge/Vapor Recovery System for PFSA*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Massachusetts Military Reservation, Cape Cod, MA, May 2003.

N

0 60 120 Feet

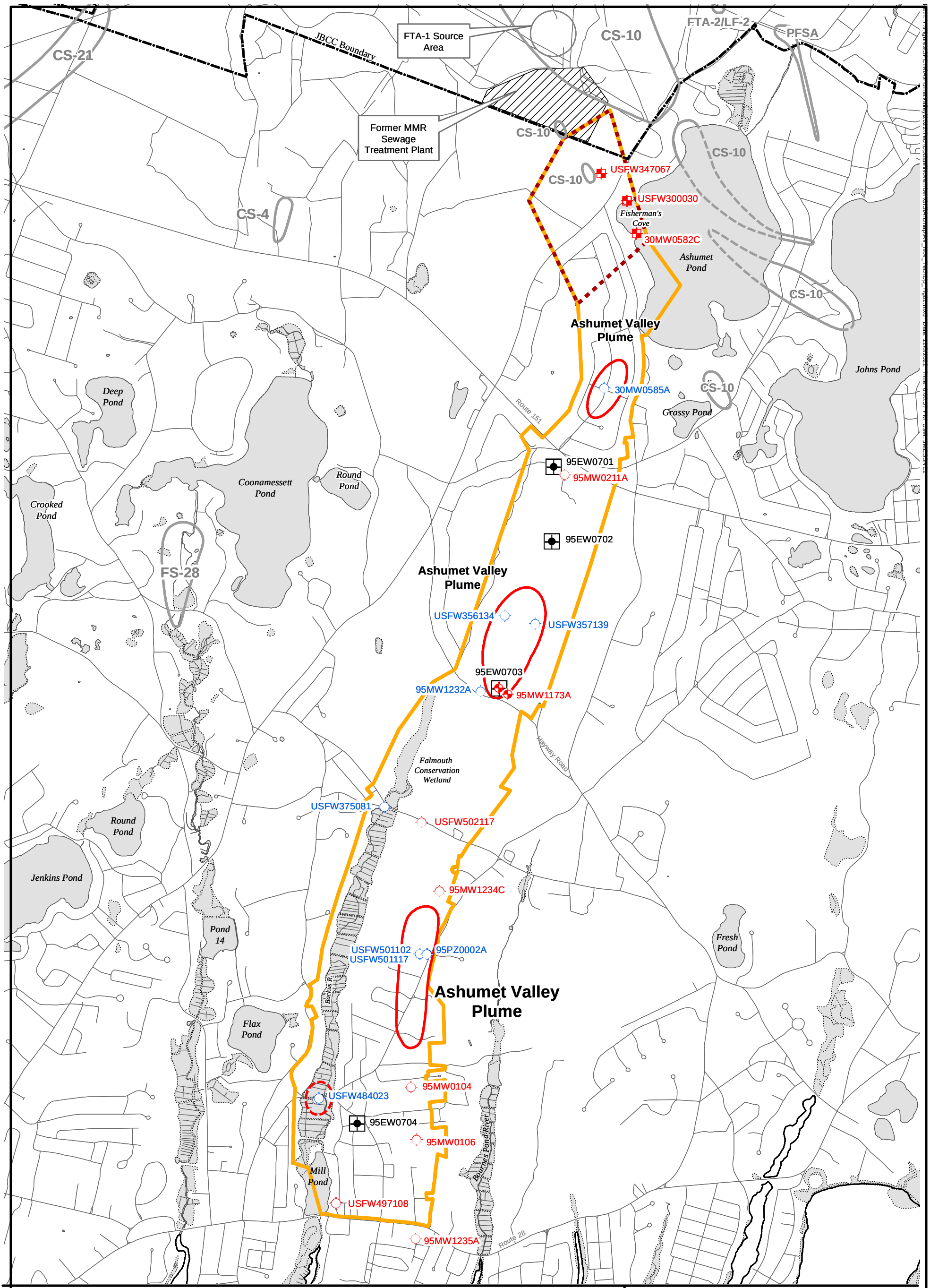
Data Source:
AFCEC, April 2018
2009 Aerial Photography from MassGIS
JBCC Boundary from Massachusetts Air National Guard 2011
Numbers for Historic Tanks from Overall Demolition Plan OTS-120-104, Date May 22, 2009

FIGURE 3-4

PFSA (FS-10/FS-11) SOURCE AREA

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022



Legend

- Joint Base Cape Cod Boundary
- Ashumet Valley Plume Boundary (Dashed Where Inferred)
- Other Plume Boundary (Dashed Where Inferred)
- Manganese LTM Area
- Land Use Control Boundary
- Bog/Wetland
- Monitoring Well
- Extraction Well (On)
- Extraction Well (Off)
- Manganese LTM Monitoring Well

Sampling Frequency

- Annual
- Triennial

Data Source: AFCEC, November 2022
JBCC Boundary from Massachusetts Air National Guard 2011

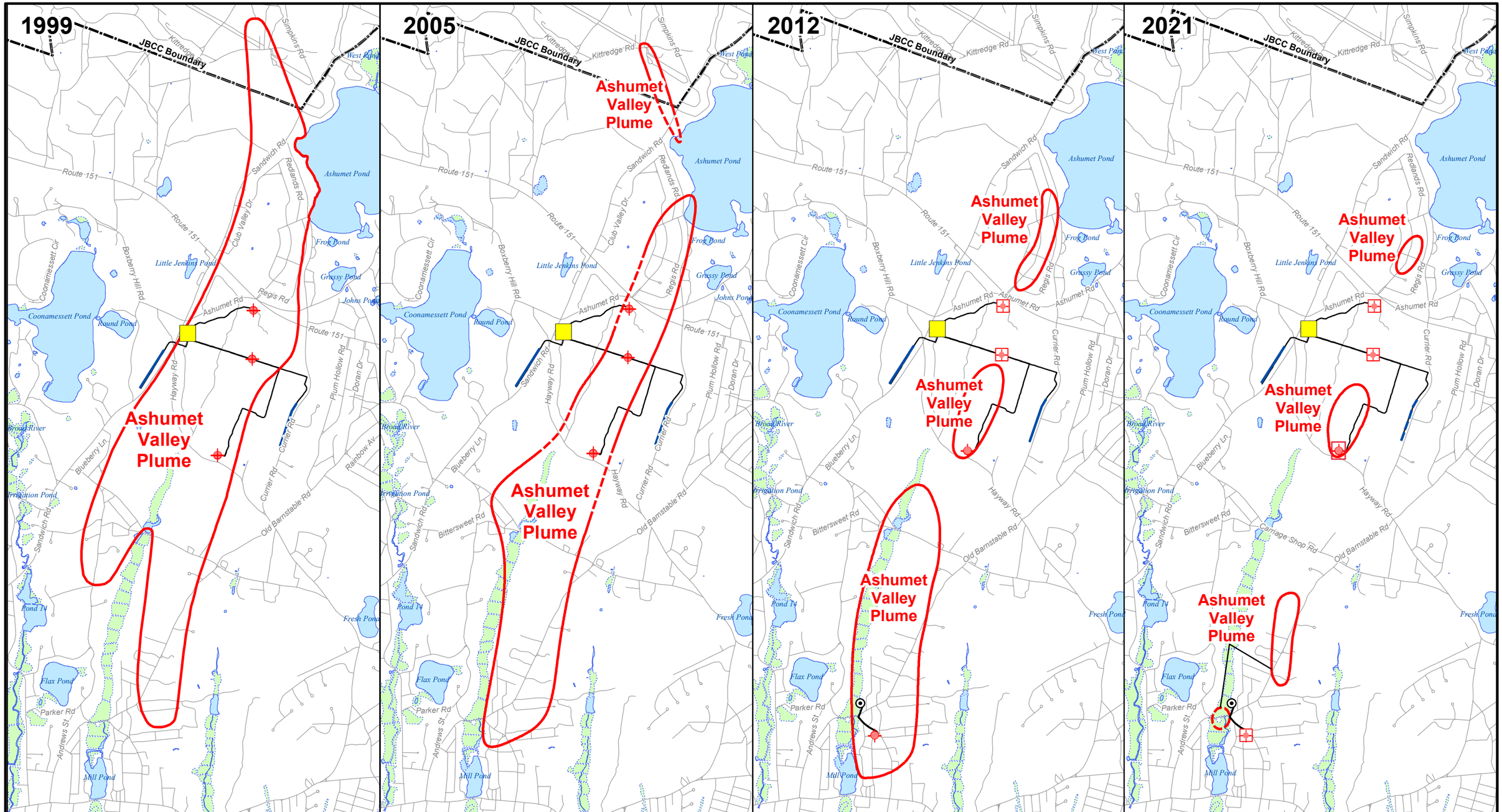
0 875 1,750 Feet

FIGURE 4-1

ASHUMET VALLEY SPEIM/LTM MONITORING NETWORK

AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\AshumetValley\2021\SLR\GIS\Arcmap\AV_2021_SLR_Fig04.mxd Date: 2/28/2022 Time: 9:40:01 AM User: cfitzpat



Legend

- Plume Boundary (Dashed Where Inferred)
- Treatment System Piping
- Infiltration Trench
- Joint Base Cape Cod Boundary
- Bog/Wetland
- Extraction Well (On)
- Extraction Well (Off)
- Treatment Facility
- Outflow Bubbler

Data Source: AFCEC, March 2022
JBCC Boundary from Massachusetts Air National Guard 2011

N

0 1,600 3,200 Feet

FIGURE 4-2

ASHUMET VALLEY PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

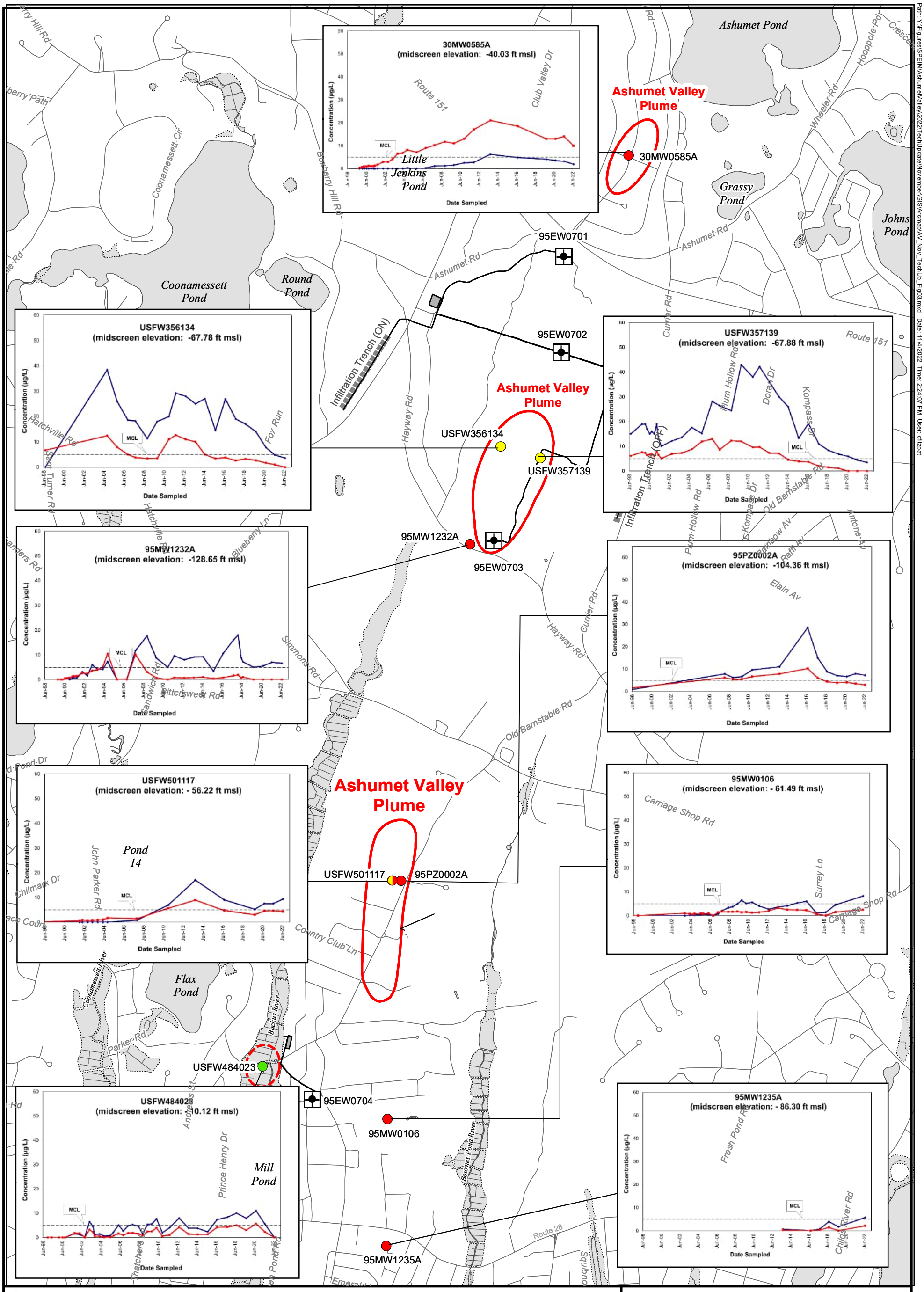


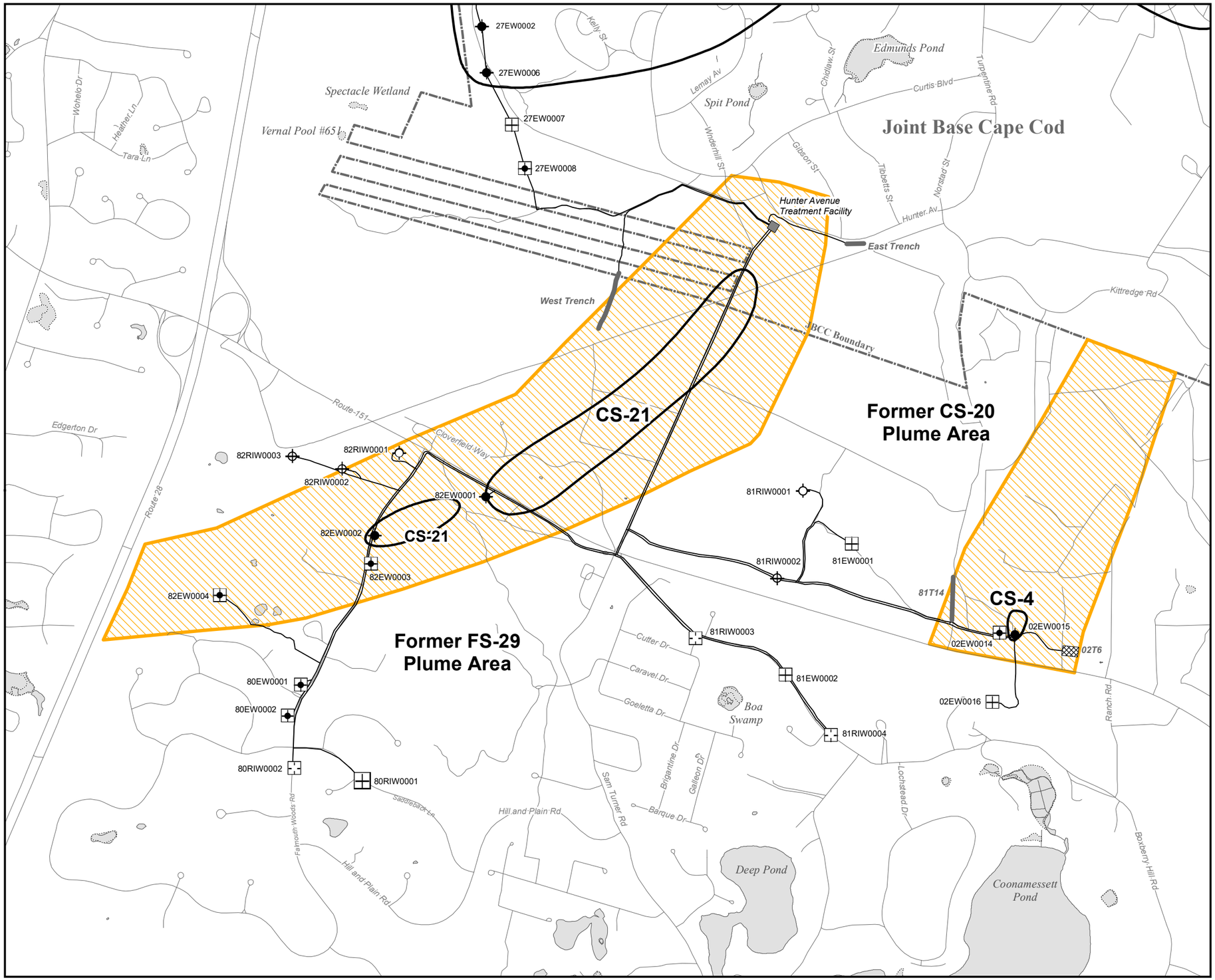
FIGURE 4-3

ASHUMET VALLEY 2022 PCE/TCE DETECTIONS AND CONCENTRATION TRENDS

AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

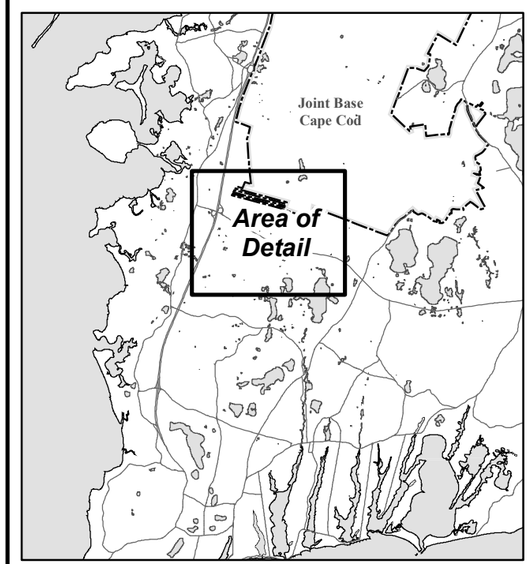
Path: Y:\Figures\PEIM\Ashumet Valley\2022\TechUpdate\November\GIS\Arcmap\AV_Nov_TechUp_Fig03.mxd Date: 11/4/2022 Time: 2:24:07 PM User: dfizpat

Path: Y:\Figures\SWOU\2022\SLR\GIS\Arcmap\SWP_22SLR_Fig01.mxd Date: 2/1/2023 Time: 10:04:26 AM User: JMESSNE1



Legend

- Extraction Well
- Reinjection Well
- Extraction Well (Off)
- Reinjection Well (Off)
- Infiltration Gallery
- Treatment Plant
- Infiltration Trench
- Joint Base Cape Cod Boundary
- Southwest Plume Boundary
- Treatment System Piping
- Land Use Control Area



0 650 1,300 Feet

Data Source: AFCEC, February 2023
JBCC Boundary from Massachusetts Air National Guard 2011

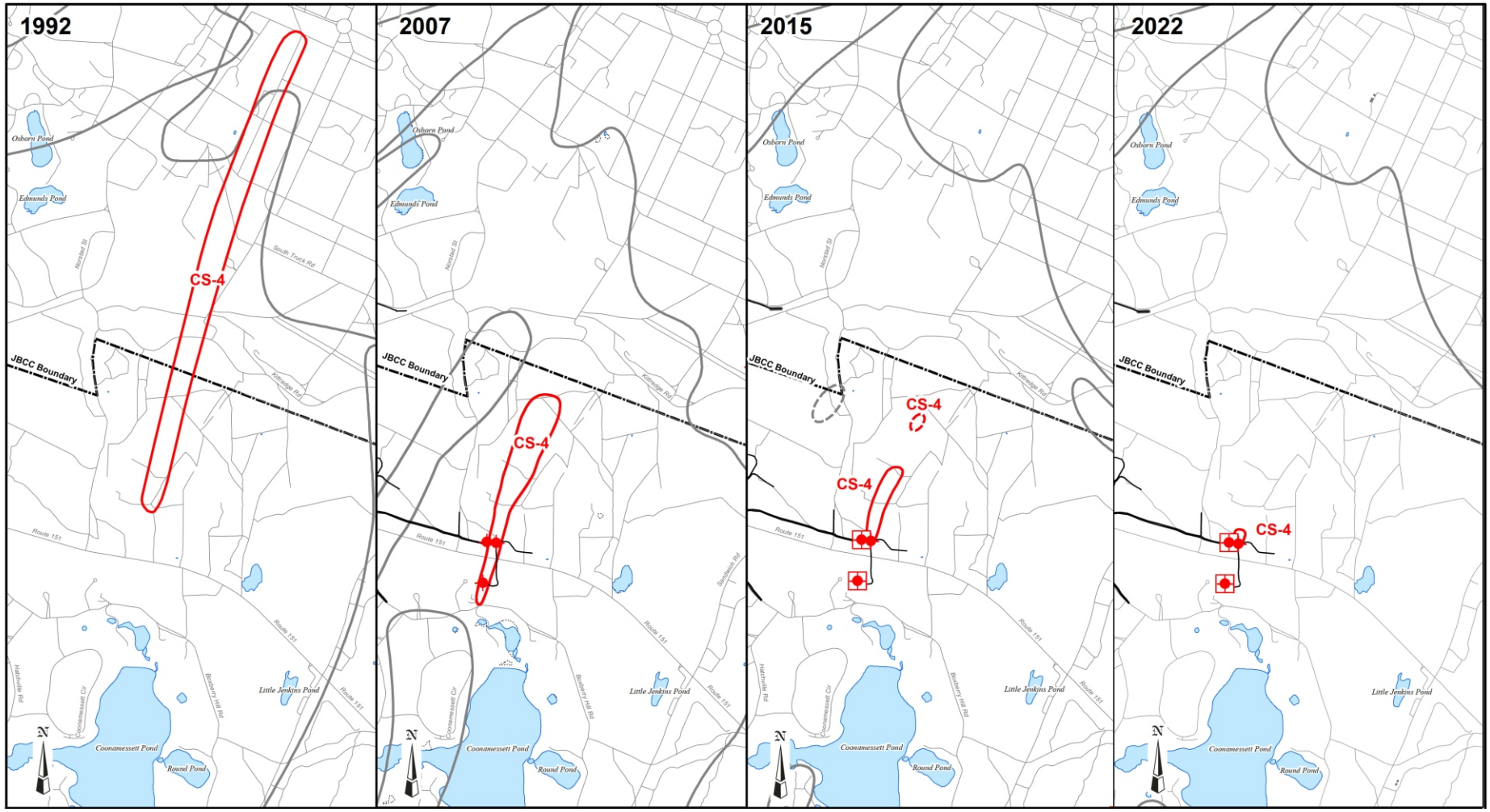
FIGURE 4-4

SOUTHWEST PLUMES REMEDIAL SYSTEM AND HUNTER AVENUE TREATMENT FACILITY

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Y:\Figures\SPEIM\SWOU\2022\SLR\Corel\SWP_22SLR_Fig04.cdr 02/01/2023 jem



Legend

- Extraction Well (On)
- Extraction Well (Off)
- Plume Boundary
- Treatment System Piping
- Joint Base Cape Cod Boundary

Data Source: AFCEC, February 2023

N

0 2,000 Feet

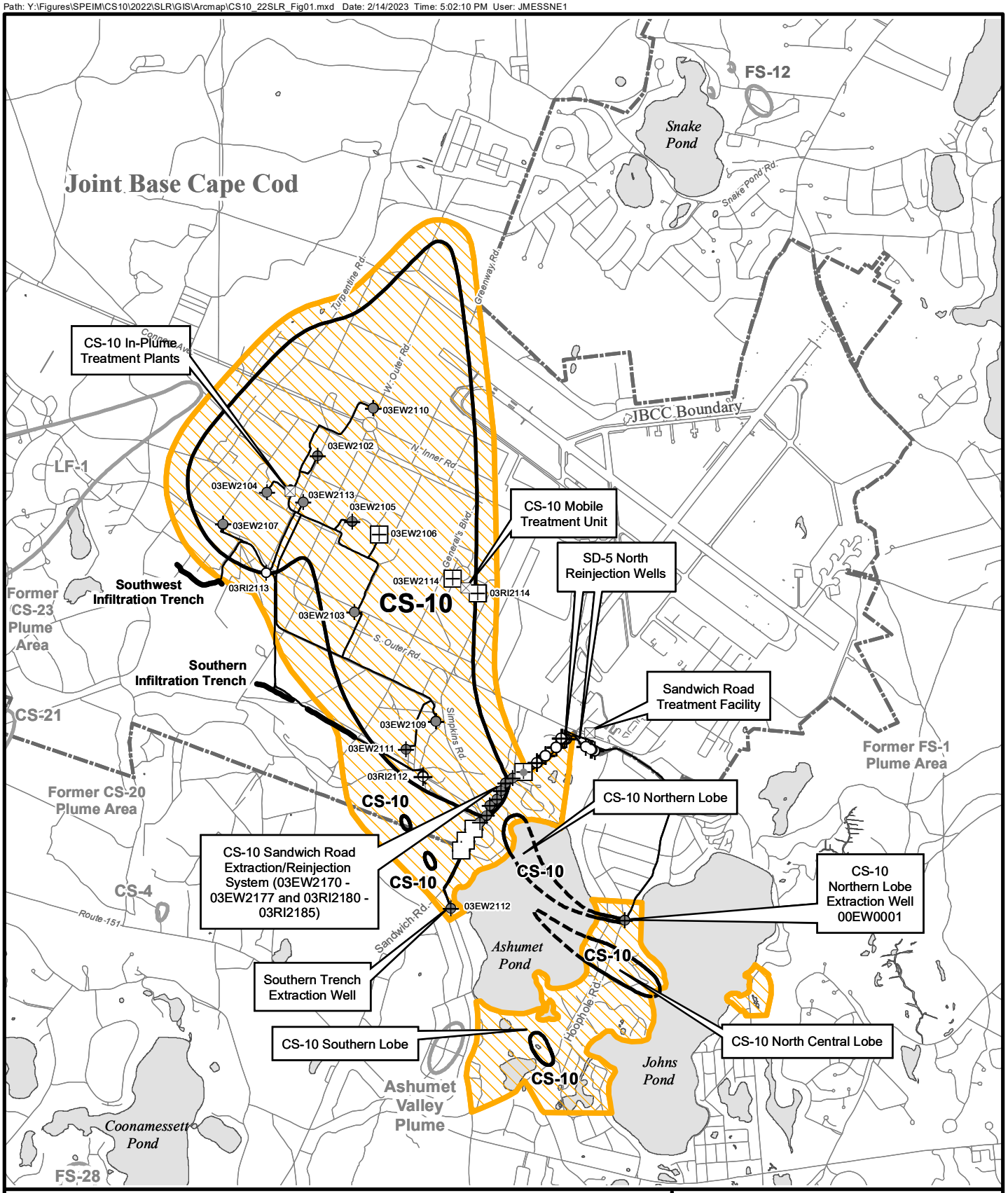
FIGURE 4-5

CS-4 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\CS10\2022\SLR\GIS\Arcmap\CS10_22SLR_Fig01.mxd Date: 2/14/2023 Time: 5:02:10 PM User: JMESSNE1



Legend

- CS-10 Plume Boundary (Dashed Where Inferred)
- Other Plume Boundary (Dashed Where Inferred)
- Joint Base Cape Cod
- Treatment System Piping
- Infiltration Trench
- Extraction Well (On)
- Extraction Well (Off)
- Reinjection Well (On)
- Reinjection Well (Off)
- Treatment Facility
- Land Use Control Area

Data Source: AFCEC, February 2023
JBCC Boundary from Massachusetts Air National Guard 2011

N

0 1,600 3,200 Feet

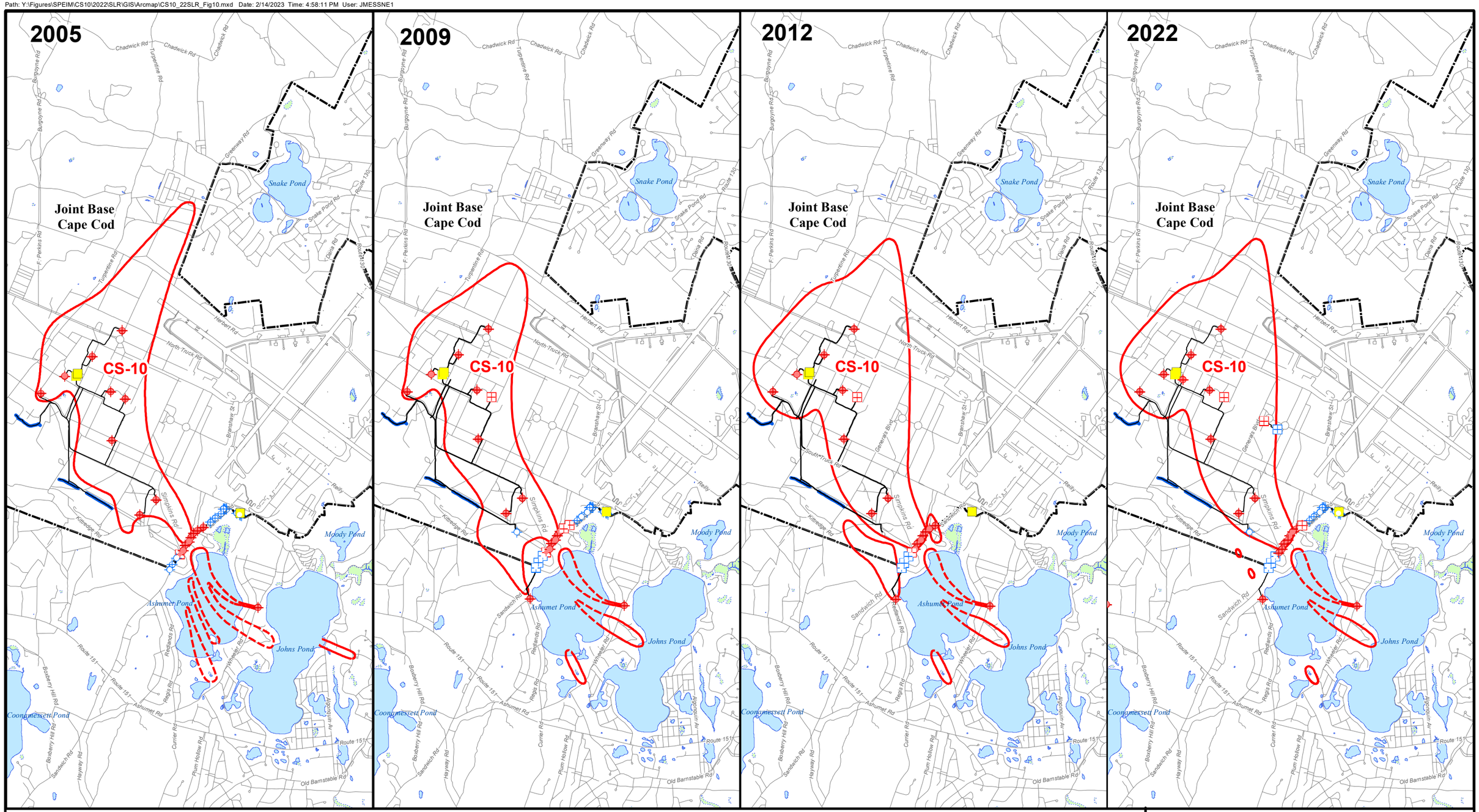
FIGURE 4-6

CS-10 GROUNDWATER PLUME AND TREATMENT SYSTEMS

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\CS10\2022\SLR\GIS\Arcmap\CS10_22SLR_Fig10.mxd Date: 2/14/2023 Time: 4:58:11 PM User: JMESSNE1



Legend

- Plume Boundary (Dashed Where Inferred)
- Treatment System Piping
- Infiltration Trench
- Joint Base Cape Cod Boundary
- Bog/Wetland
- Reinjection Well (On)
- Reinjection Well (Off)
- Extraction Well (On)
- Extraction Well (Off)
- Treatment Facility

Data Source: AFCEC, February 2023
JBCC Boundary from Massachusetts Air National Guard 2011

N

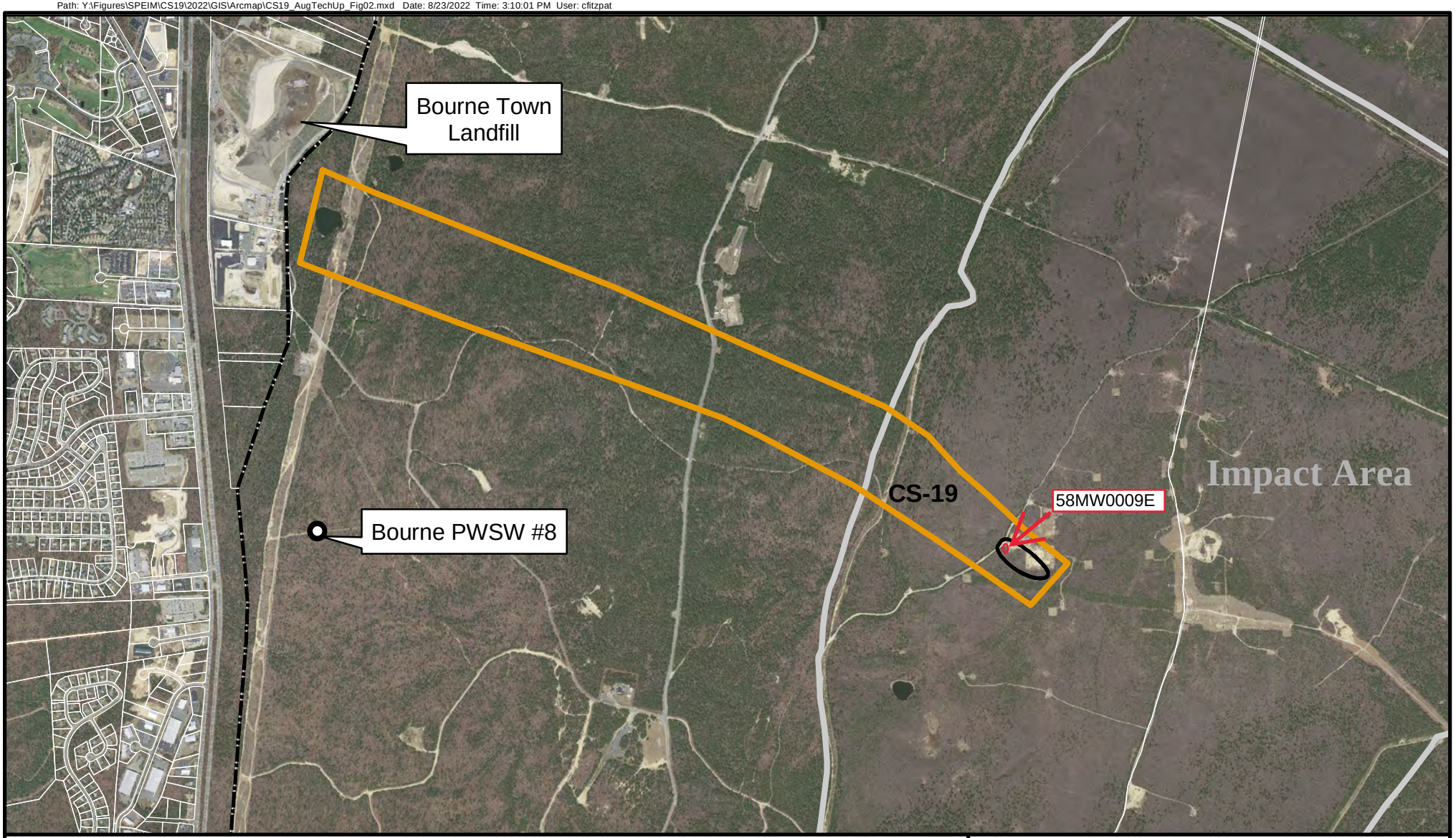
0 2,300 4,600 Feet

FIGURE 4-7

CS-10 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\CS19\2022\GIS\Arcmap\CS19_AugTechUp_Fig02.mxd Date: 8/23/2022 Time: 3:10:01 PM User: cfitzpat



Legend

- Joint Base Cape Cod Boundary
- Plume Boundary
- LUC Boundary
- Impact Area
- Parcel
- Public Water Supply Well

Data Source: AFCEC, August 2022
JBCC Boundary from Massachusetts Air National Guard 2011
2009 Aerial Photography from MassGIS

N

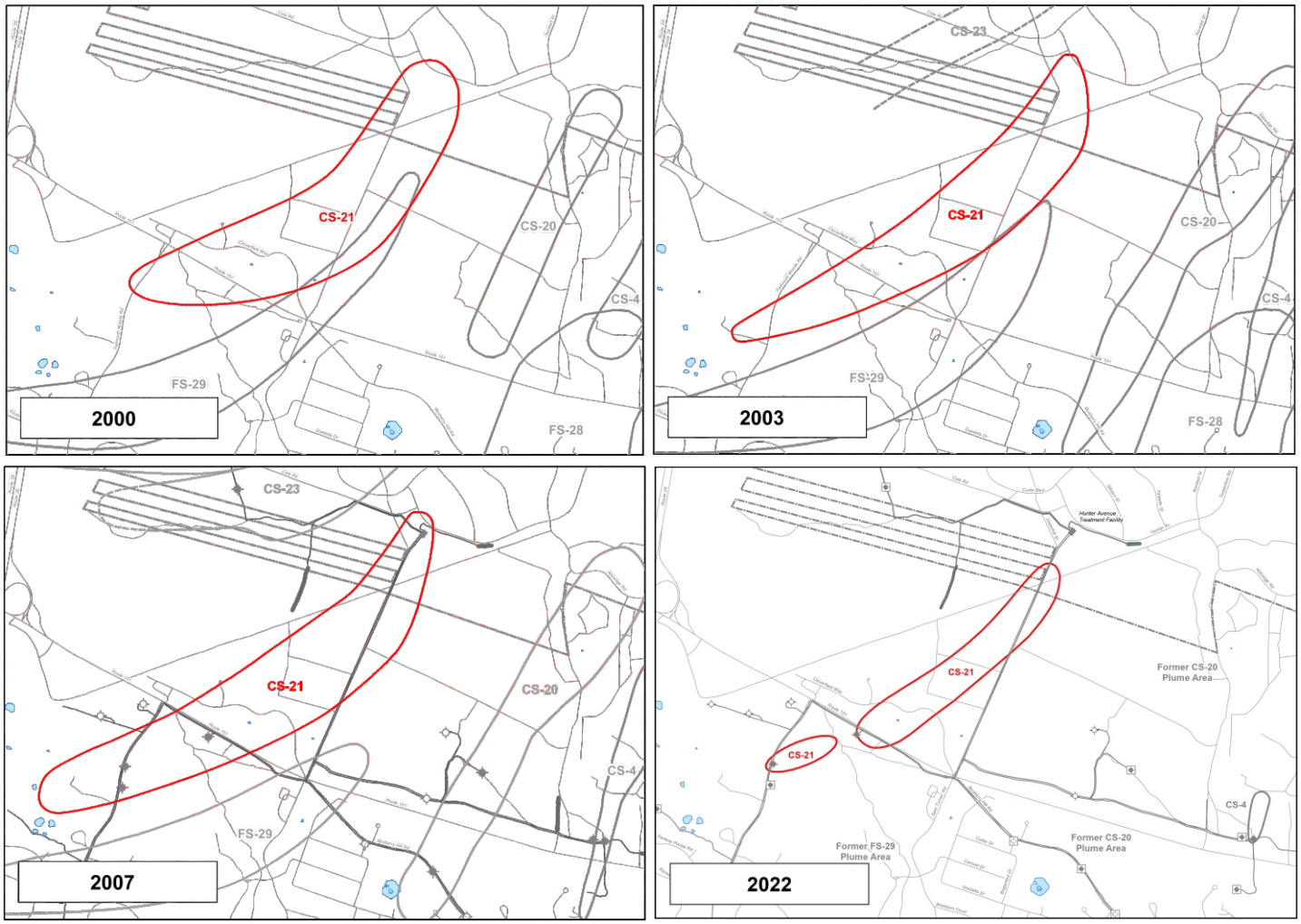
0 900 1,800 Feet

FIGURE 4-8

CS-19 PLUME AND LAND USE CONTROL BOUNDARY

AFCEC - Joint Base Cape Cod
6th Five-Year Review, 2017-2022

Y:\Figures\SPEIM\SWOU\2022\SLR\Corel\SWP_22SLR_Fig05.cdr 02/01/2023 jem



Legend

- Joint Base Cape Cod Boundary
- CS-21 Plume Boundary
- Other Plume Boundary
- Infiltration Gallery
- Treatment System Pipeline
- Extraction Well (On)
- Extraction Well (Off)
- Reinjection Well (Off)
- Reinjection Well (Off)

Data Source: AFCEC, February 2023

N

0 1,200 Feet

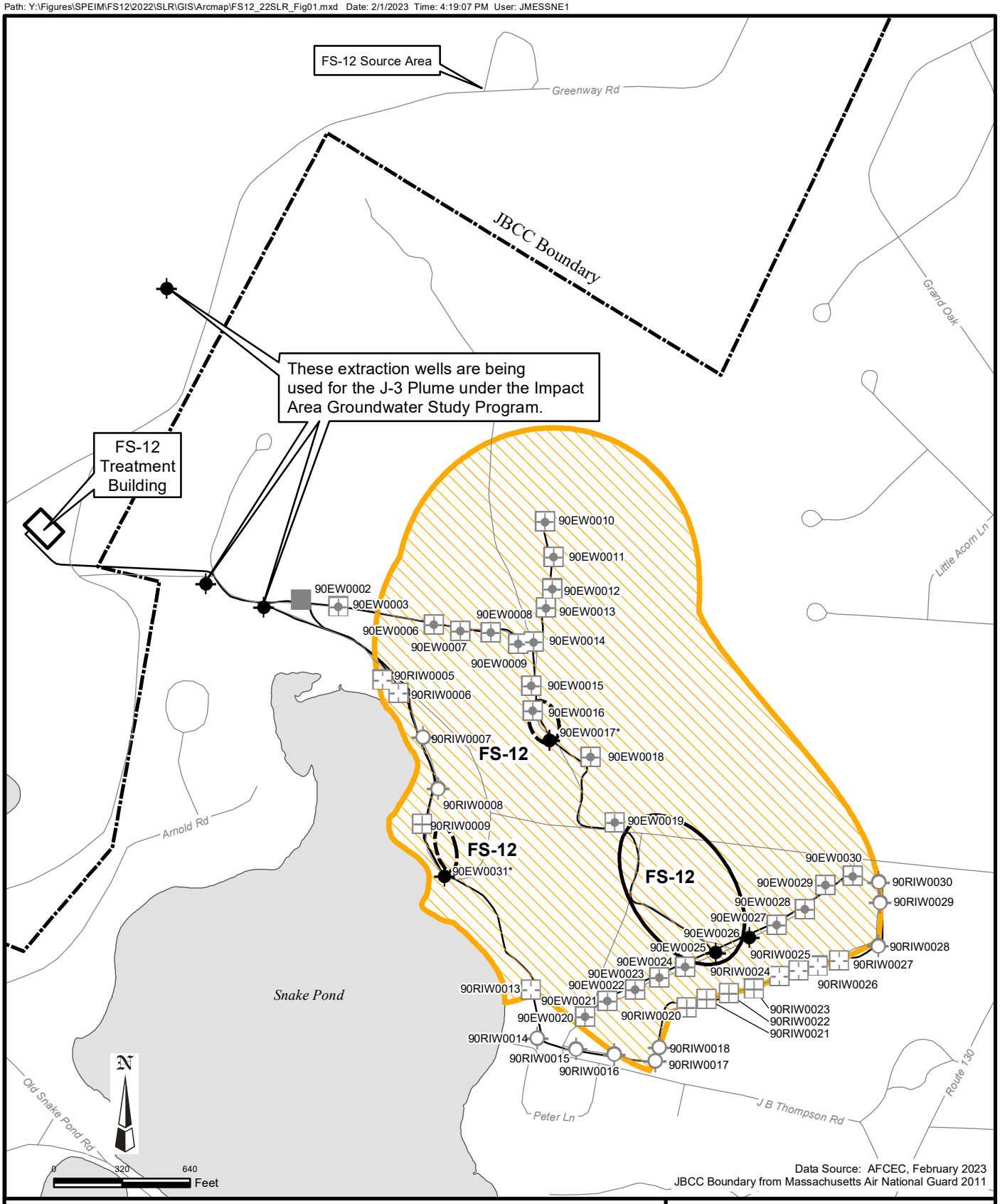
FIGURE 4-9

CS-21 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\FS12\2022\SLR\GIS\Arcmap\FS12_22SLR_Fig01.mxd Date: 2/1/2023 Time: 4:19:07 PM User: JMESSNE1



Legend

- Extraction Well (On)
- Extraction Well (Off)
- Reinjection Well (On)
- Reinjection Well (Off)
- Plume Boundary (Dashed Where Inferred)
- JBCC Boundary
- Pipeline
- Treatment Plant
- Land Use Control Area

* 90EW0017 and 90EW0031 operated using an alternating one month on/one month off cyclic pumping schedule.

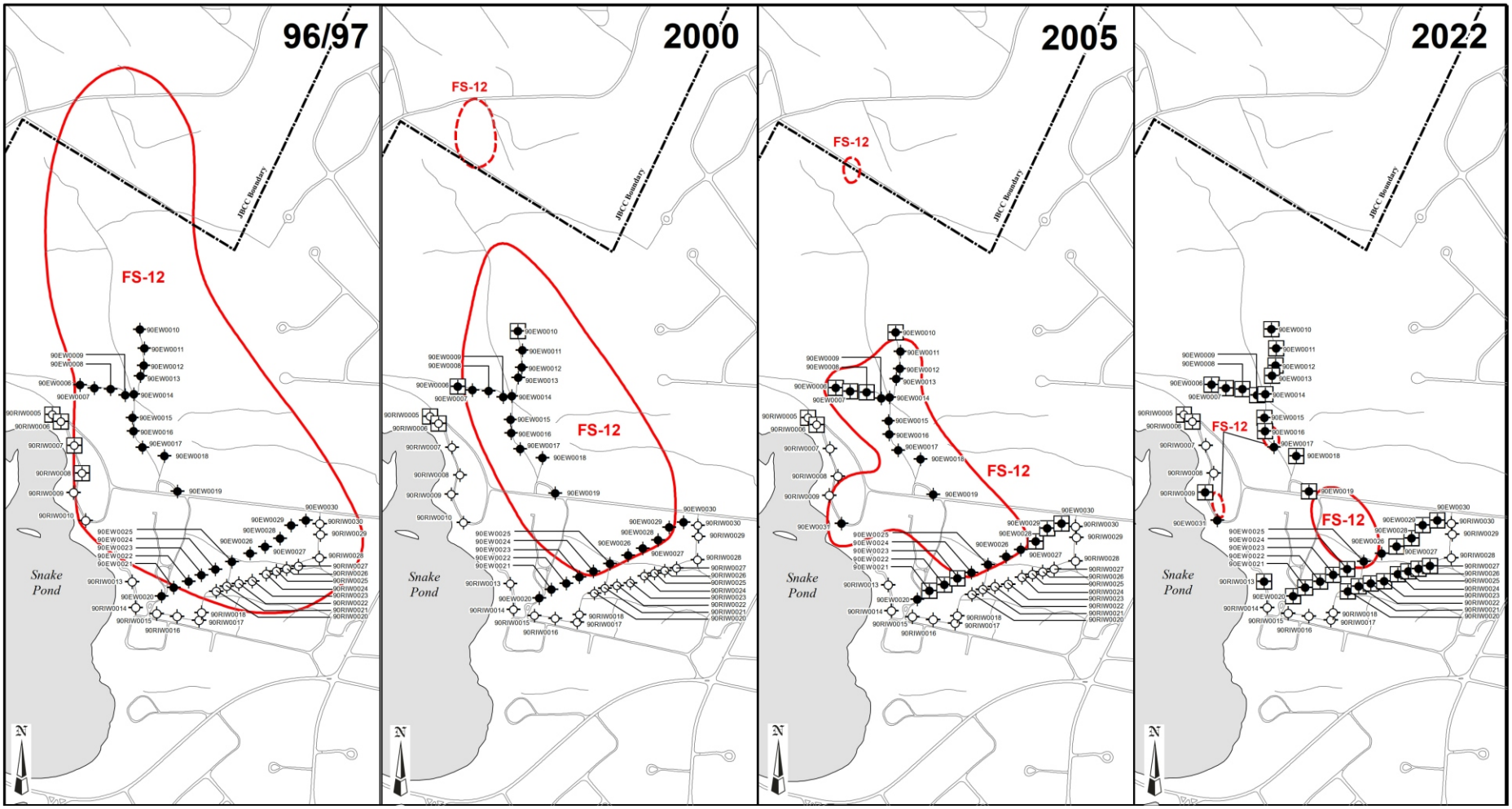
FIGURE 4-10

FS-12 GROUNDWATER PLUME AND TREATMENT SYSTEM

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Y:\Figures\SPEIM\FS12\2022\SLR\Corel\FS12_22SLR_Fig04.cdr 02/02/2023 jem



Legend

- Reinjection Well
- Extraction Well
- Extraction Well (Off)
- Reinjection Well (Off)
- Joint Base Cape Cod Boundary
- Plume Boundary (Dashed Where Inferred)

Data Source: AFCEC, February 2023

N

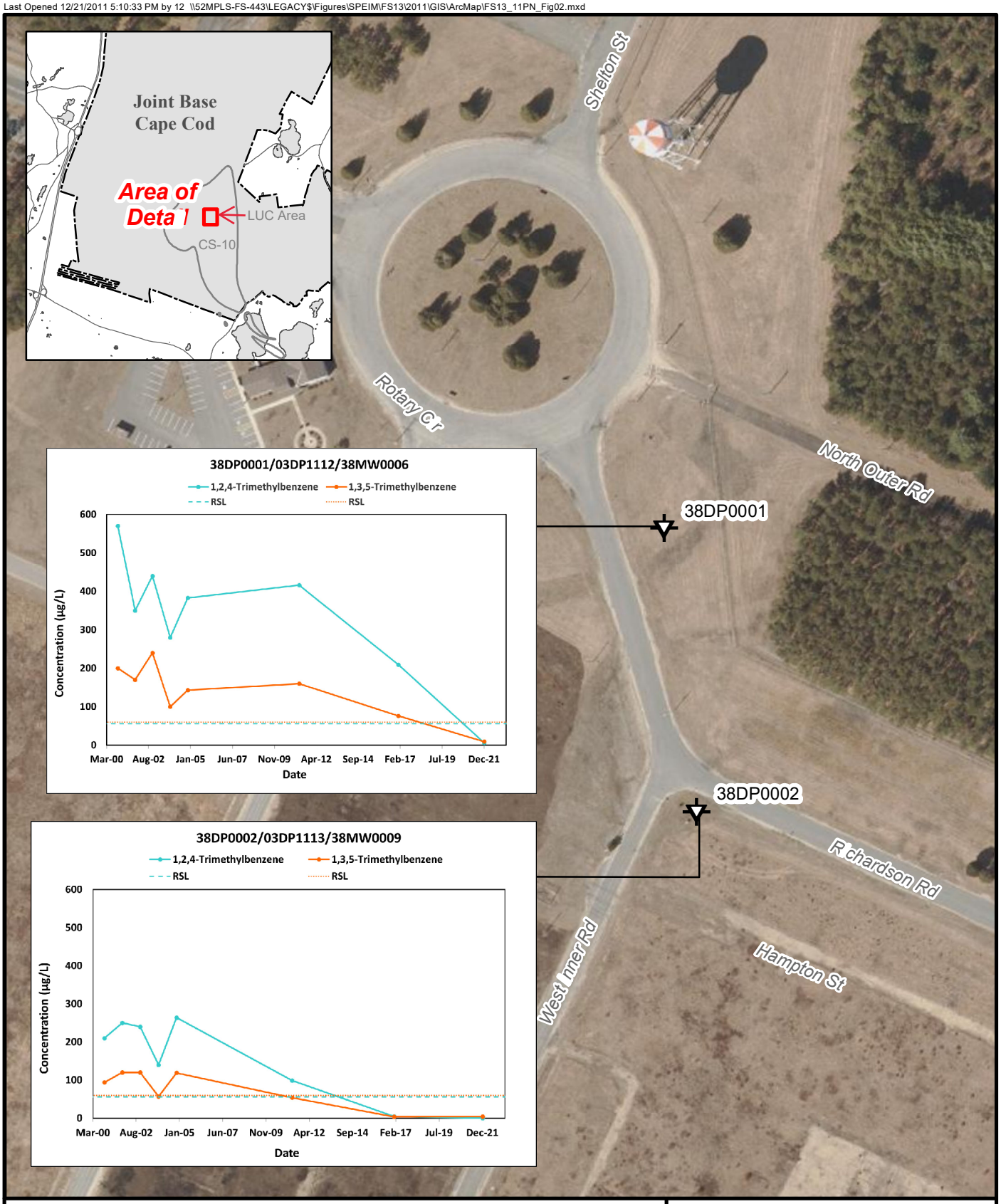
0 1,000 Feet

FIGURE 4-11

FS-12 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022



Legend

Direct Push Location

Data Source: AFCEC, May 2022
2019 Aerial Imagery from MassGIS

N

0 80 160 Feet

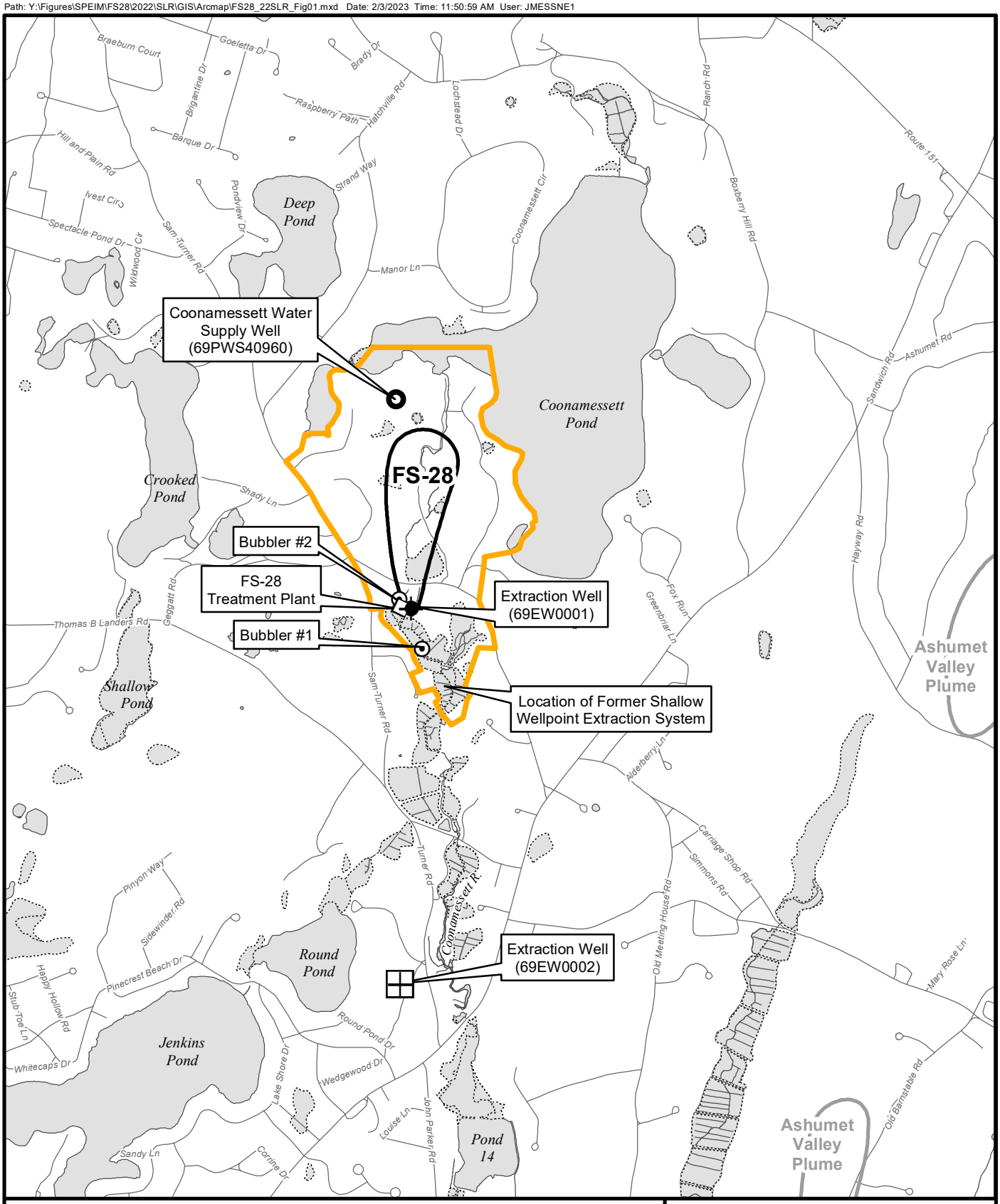
FIGURE 4-12

FS-13 LTM TMB CONCENTRATION TRENDS

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\FS28\2022\SLR\GIS\Arcmap\FS28_22SLR_Fig01.mxd Date: 2/3/2023 Time: 11:50:59 AM User: JMESSNE1



Legend

Data Source: AFCEC, February 2023

- Extraction Well (On)
- Extraction Well (Off)
- Public Water Supply Well
- Bubbler
- Plume Boundary (Dashed Where Inferred)
- Other Plume Boundary (Dashed Where Inferred)
- Land Use Control Area
- Bog/Wetland

N

0 800 1,600 Feet

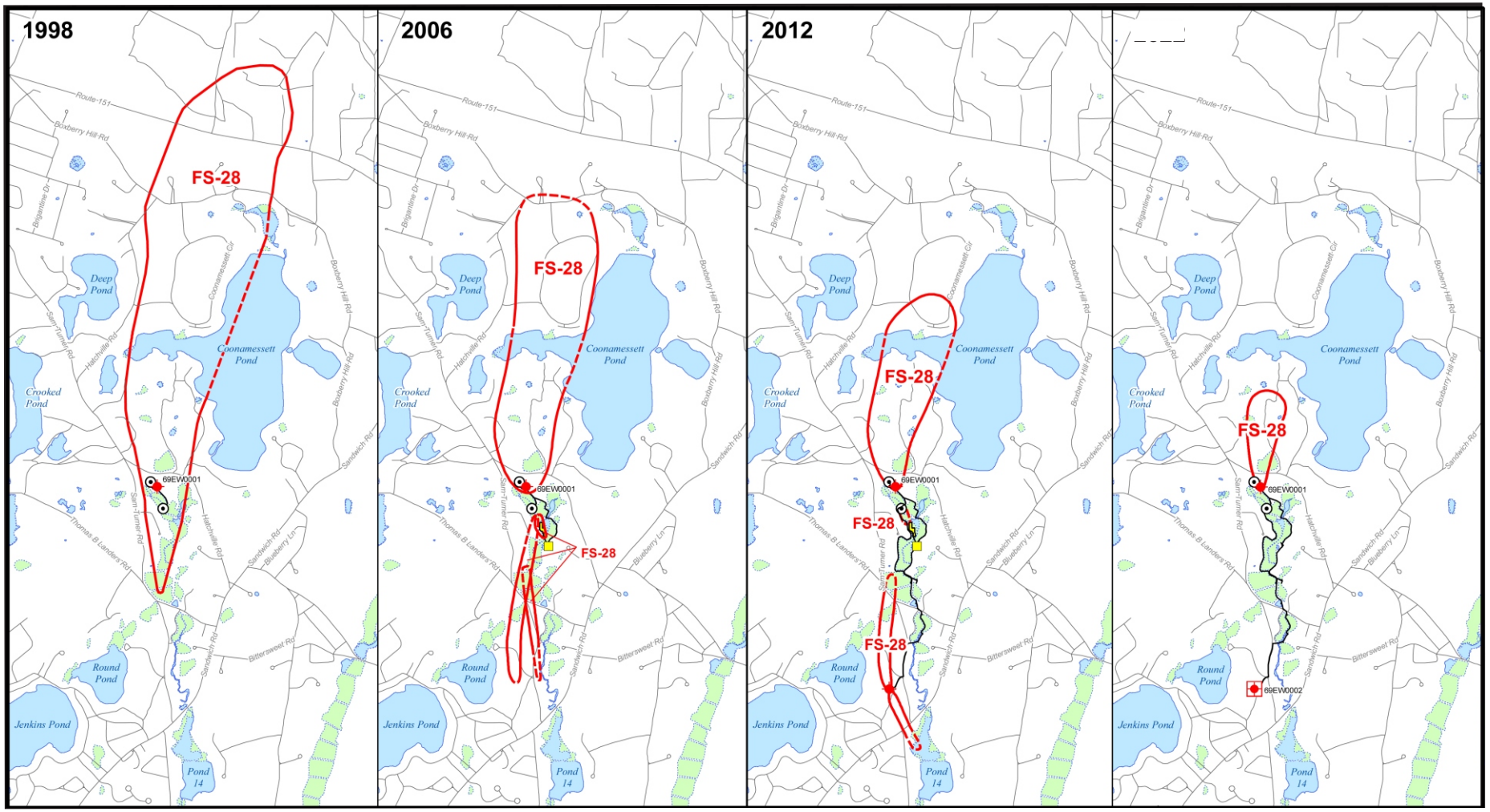
FIGURE 4-13

FS-28 GROUNDWATER PLUME AND TREATMENT SYSTEM

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Y:\Figures\SPEIM\FS28\2022\SLR\Corel\FS28_22SLR_Fig04.cdr 02/03/2023 jem



Legend

- Extraction Well (Off)
- Extraction Well (69EW0001 installed 1997; 69EW0002 installed 2007)
- Shallow Wellpoints (Installed 1999; Decommissioned 2010)
- FS-28 Treatment Facility
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEC, February 2023

N

0 2,000 Feet

FIGURE 4-14

FS-28 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\LF1\2022\SLR\GIS\Arcmap\LF1_22SLR_Fig01.mxd Date: 2/1/2023 Time: 11:22:01 AM User: JMESSNE1

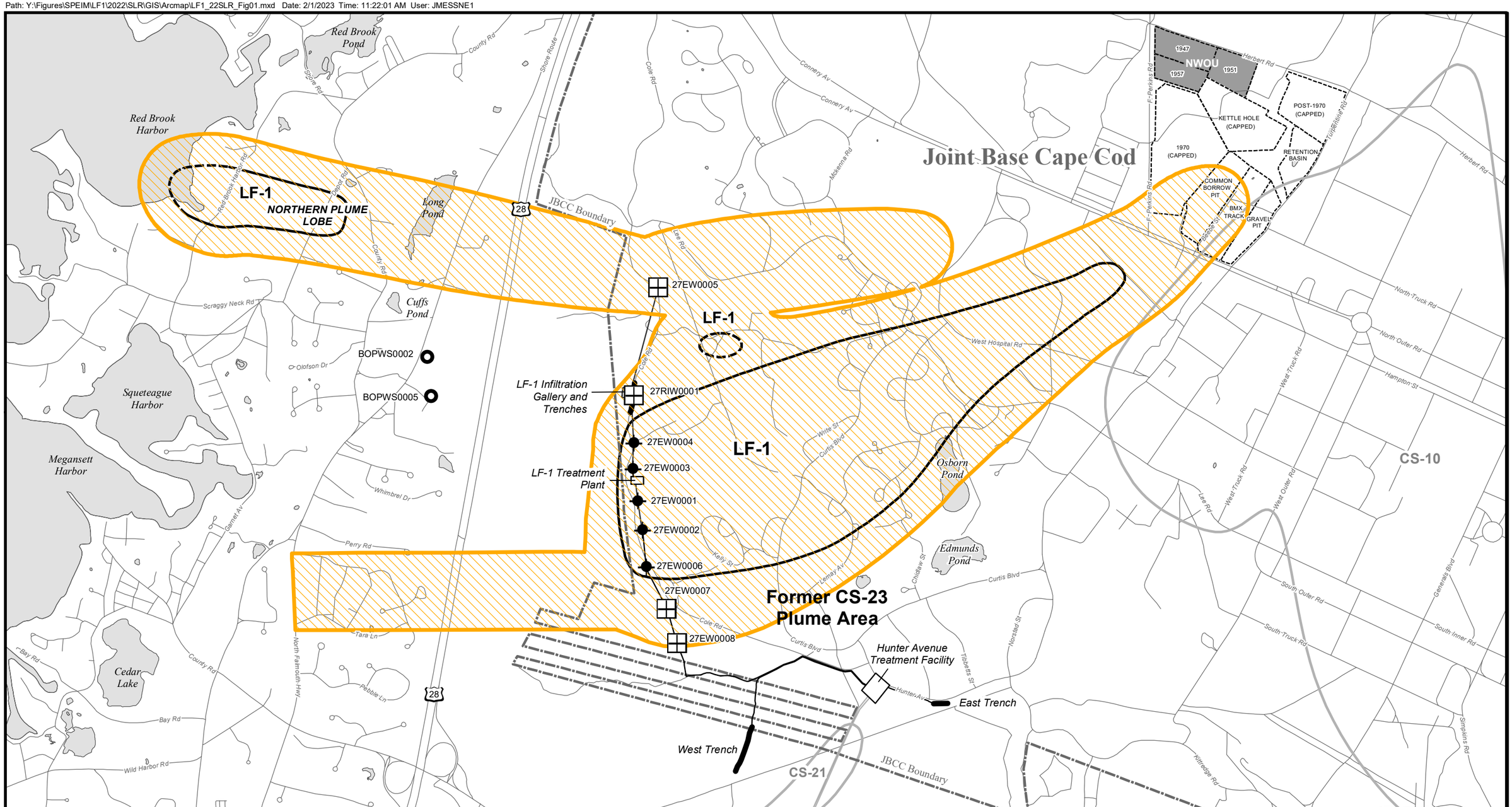


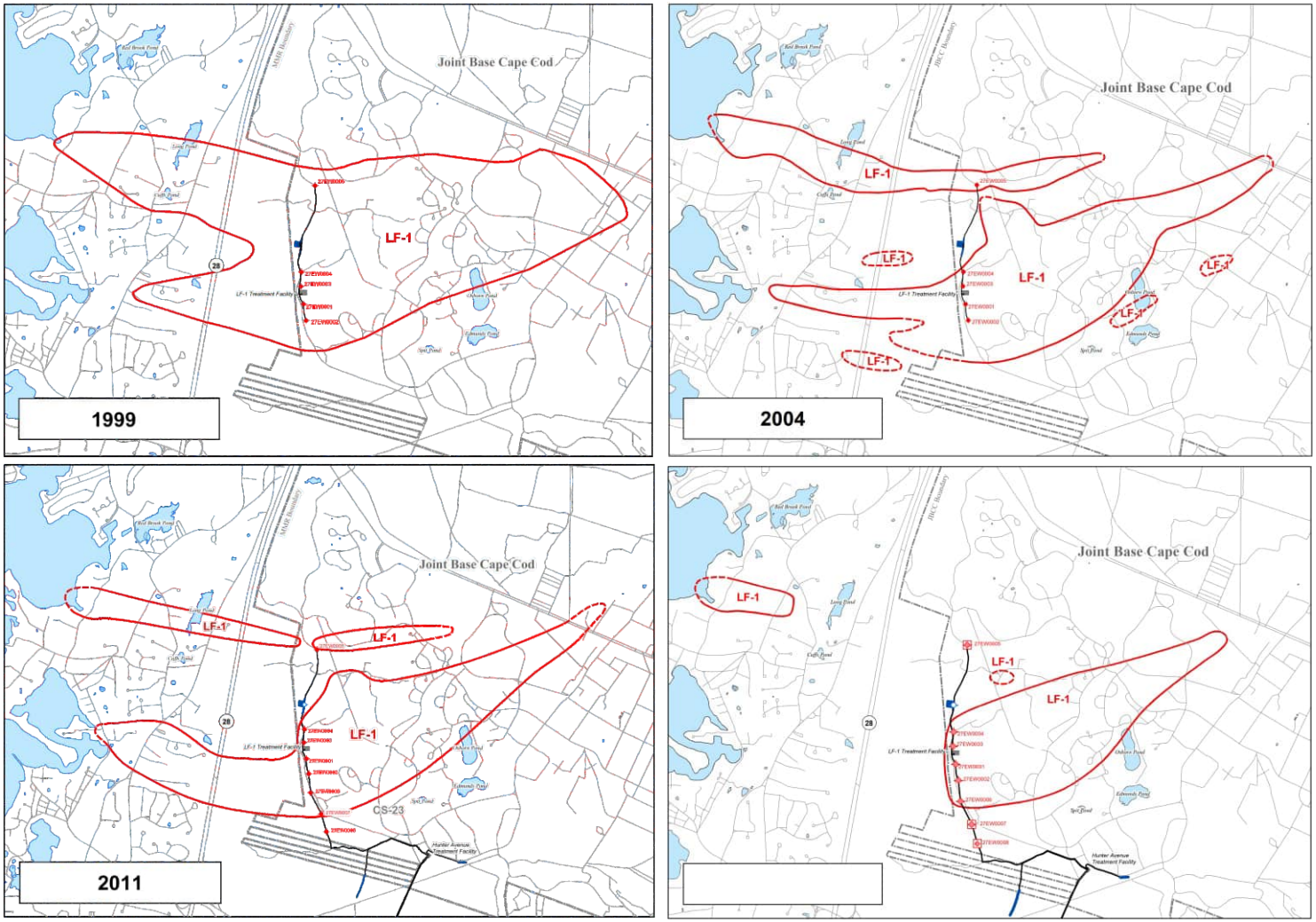
FIGURE 4-15

LF-1 GROUNDWATER PLUME AND LF-1 AND HUNTER AVENUE TREATMENT SYSTEMS

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Y:\Figures\SPEIM\LF1\2022\SLR\Corel\LF1_21SLR_Fig04.cdr 02/01/2023 jem



Legend

- Joint Base Cape Cod Boundary
- Plume Boundary (Dashed Where Inferred)
- Treatment System Piping
- Infiltration Trench
- Reinjection Well (On)
- Reinjection Well (Off)
- Extraction Well (On)
- Extraction Well (Off)

Data Source: AFCEC, February 2023

N

0 2,000 Feet

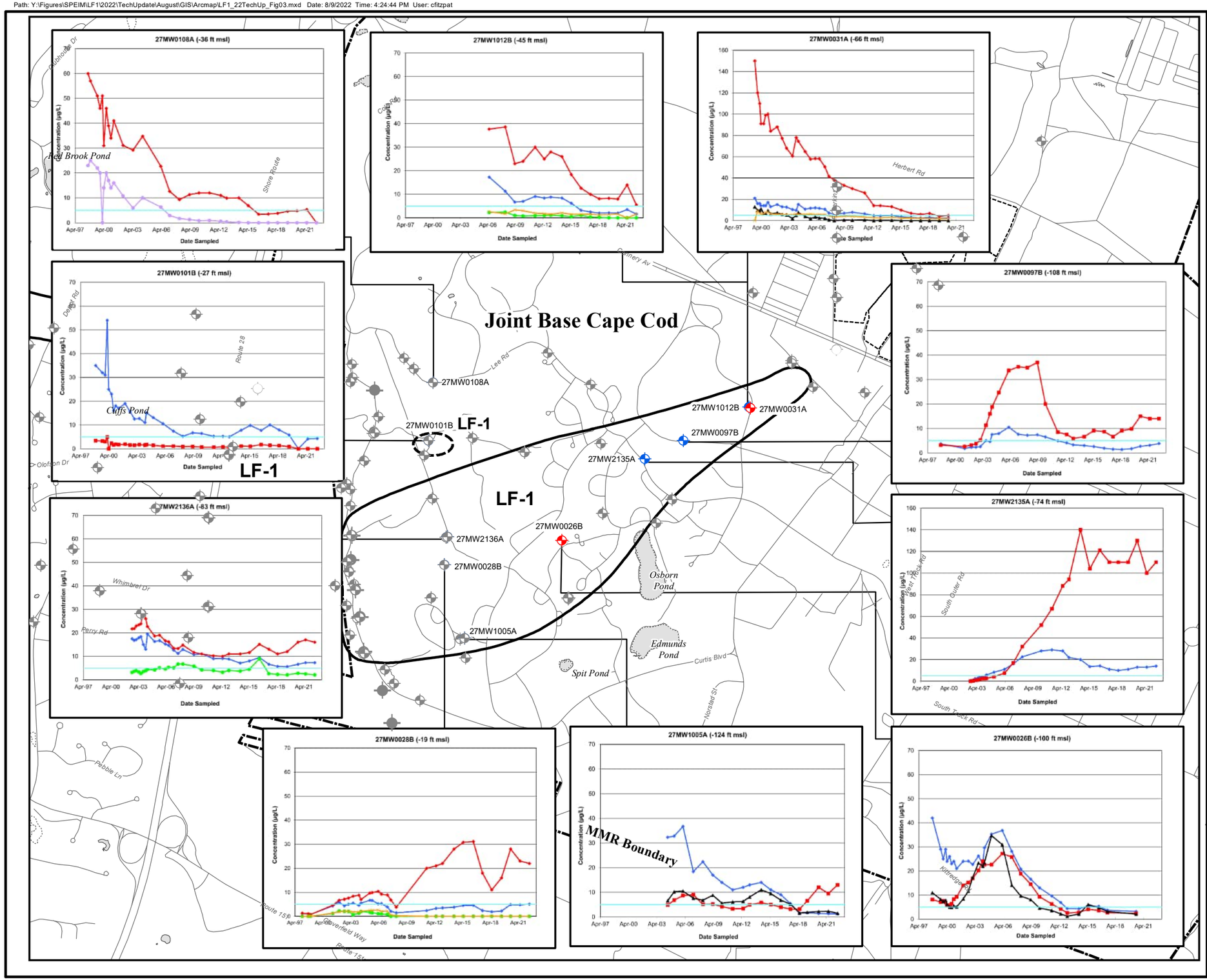
FIGURE 4-16

LF-1 PLUME BOUNDARY TEMPORAL CHANGES

AFCEC - Joint Base Cape Cod

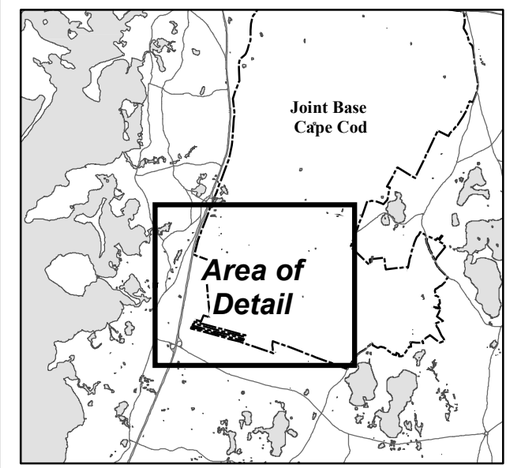
6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\LF1\2022\TechUpdate\August\GIS\Arcmap\LF1_22TechUp_Fig03.mxd Date: 8/9/2022 Time: 4:24:44 PM User: cfitzpat



Legend

- Joint Base Cape Cod Boundary
- Plume Boundary (Dashed Where Inferred)
- Landfill Cap Cell
- Monitoring Well (Annual)
- Monitoring Well (Triennial)
- PCE
- TCE
- CCl_4
- VC
- 1,4-DCB
- 1,1,2,2-TeCA
- PCE, TCE, CCl_4 MCL and 1,4-DCB MMCL = 5 µg/L



0 960 1,920 Feet

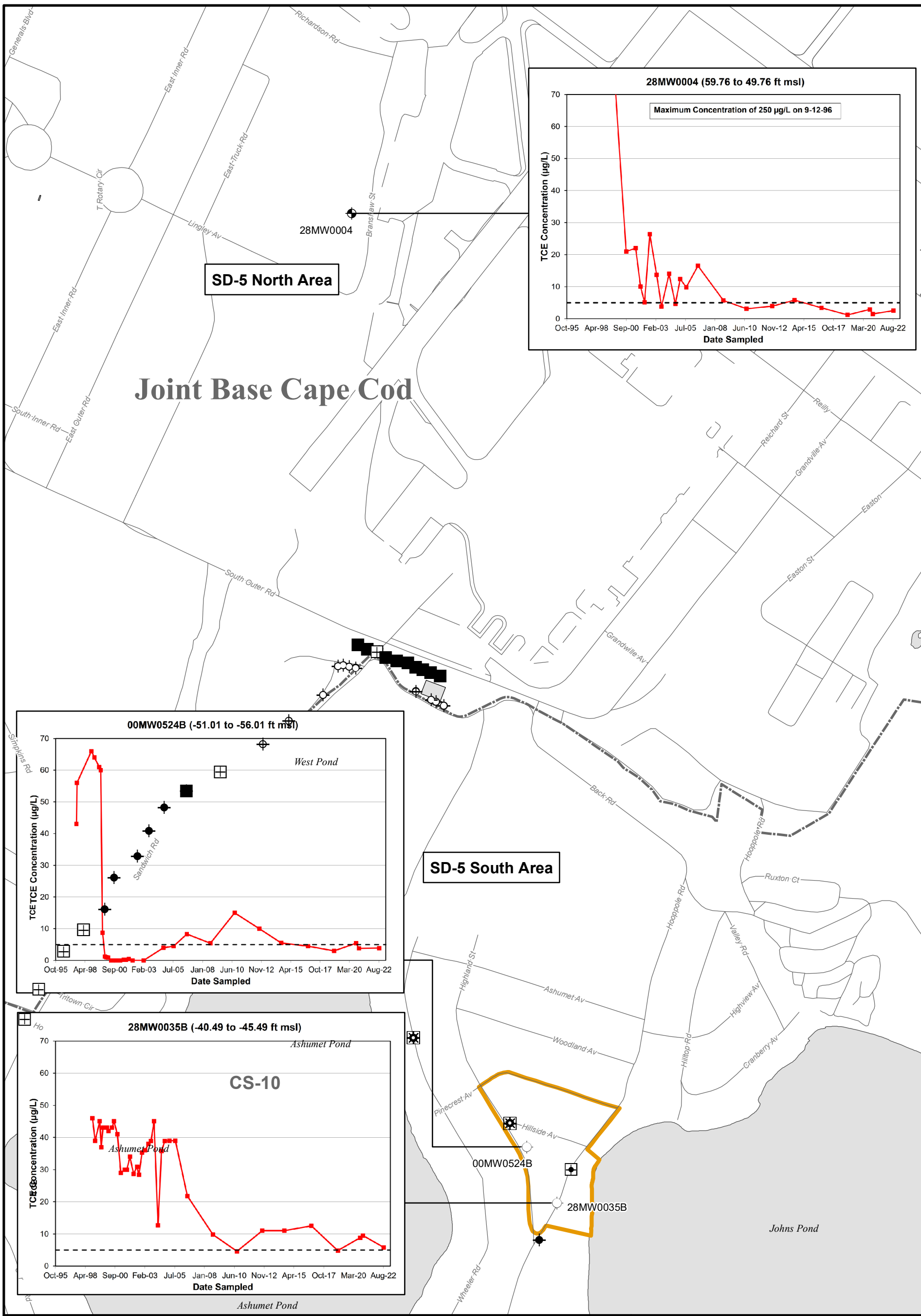
Data Source: AFCEC, August 2022
JBCC Boundary from Massachusetts Air National Guard 2011

FIGURE 4-17

SELECT LF-1 CONCENTRATION TRENDS

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022



Legend

- Monitoring Well
- Extraction Well (Off)
- Extraction Well (On)
- Reinjection Well (On)
- Treatment Plant
- Recirculating Well (Off)
- Joint Base Cape Cod Boundary
- Land Use Control Boundary

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011

0 330 660 Feet

FIGURE 4-18

TCE CONCENTRATION TRENDS IN THE SD-5 LTM NETWORK WELLS

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIMS\SD5\2022\PN\GIS\Arcmap\SD5_22PN_Fig01.mxd Date: 1/25/2023 Time: 5:17:03 PM User: JMESSNE1

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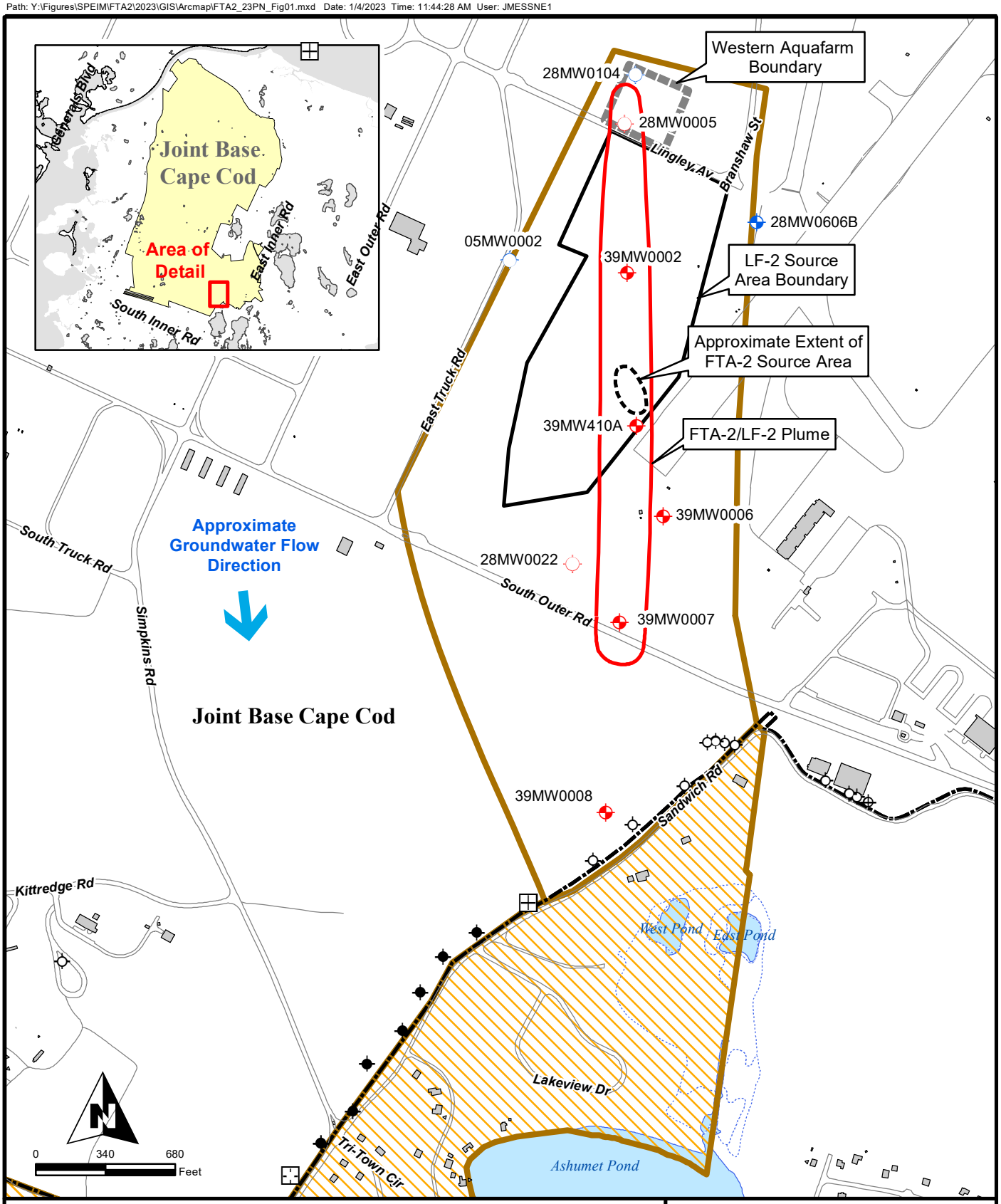


Legend

- Joint Base Cape Cod Boundary
- FTA-2/LF-2 Plume Boundary
- FTA-2/LF-2 LUC Area
- Existing CS-10 LUC Area
- Structure
- LF-2 Boundary
- FTA-2 Source Area
- Annual Monitoring Well
- Biennial Monitoring Well

CS-10 Sandwich Road Treatment Facility Wells:

- Reinjection Well (On)
- Extraction Well (On)
- Reinjection Well (Off)
- Extraction Well (Off)

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011

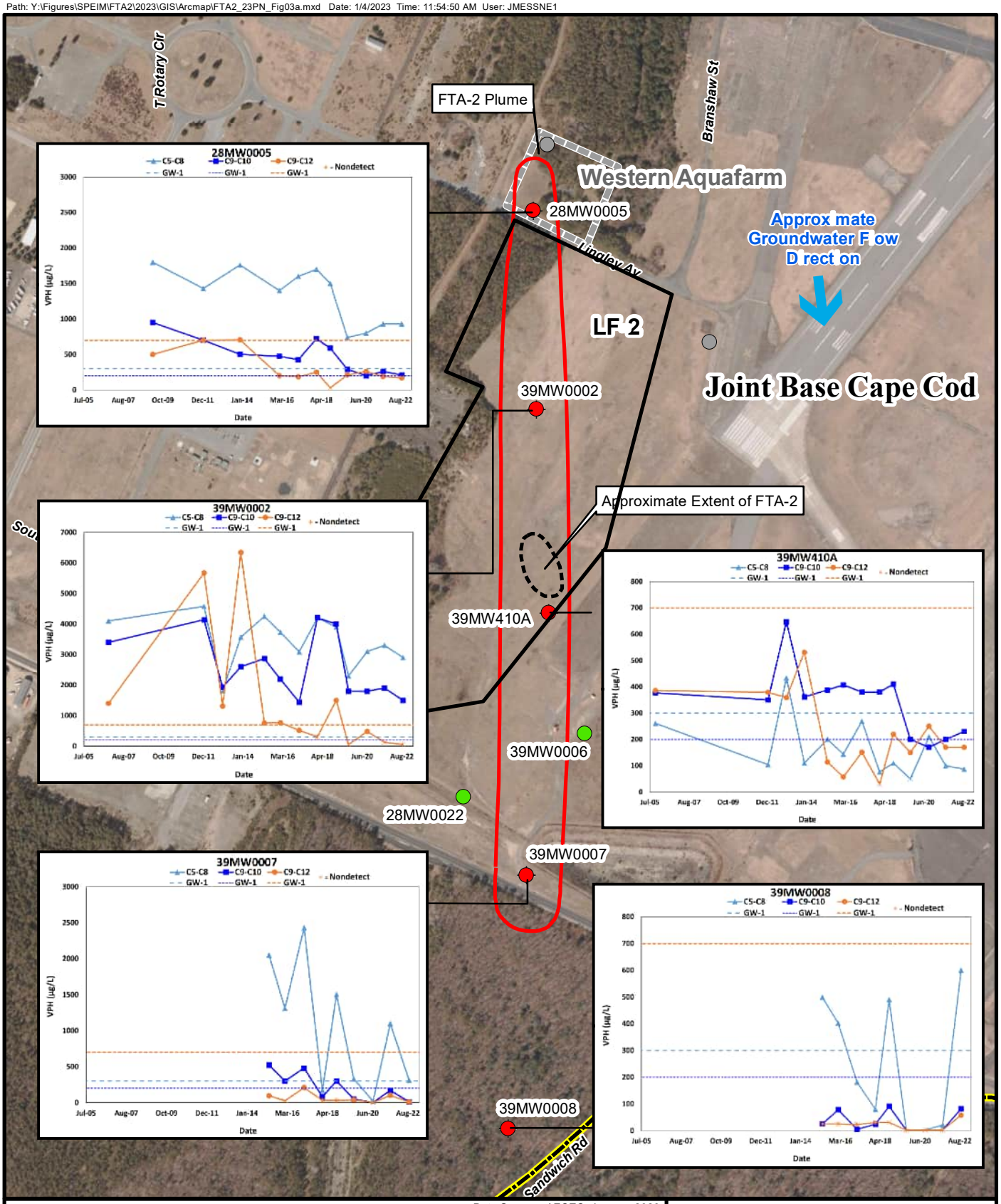
FIGURE 4-19

FTA-2/LF-2 PLUME BOUNDARY AND MONITORING NETWORK

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\FTA2\2023\GIS\Arcmap\FTA2_23PN_Fig03a.mxd Date: 1/4/2023 Time: 11:54:50 AM User: JMESSNE1



Legend

- LF-2 Boundary
- FTA-2 Source Area
- Western Aquafarm
- Biennial Monitoring Well Not Sampled
- No Detections
- One or More COC Detections Above VPH GW-1
- Joint Base Cape Cod Boundary
- FTA-2/LF-2 Plume Boundary

Note: Nondetect results are plotted as one half of the laboratory detection limit/limit of quantitation for all carbon ranges.

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011
2019 Aerial Imagery from MassGIS

0 250 500 Feet

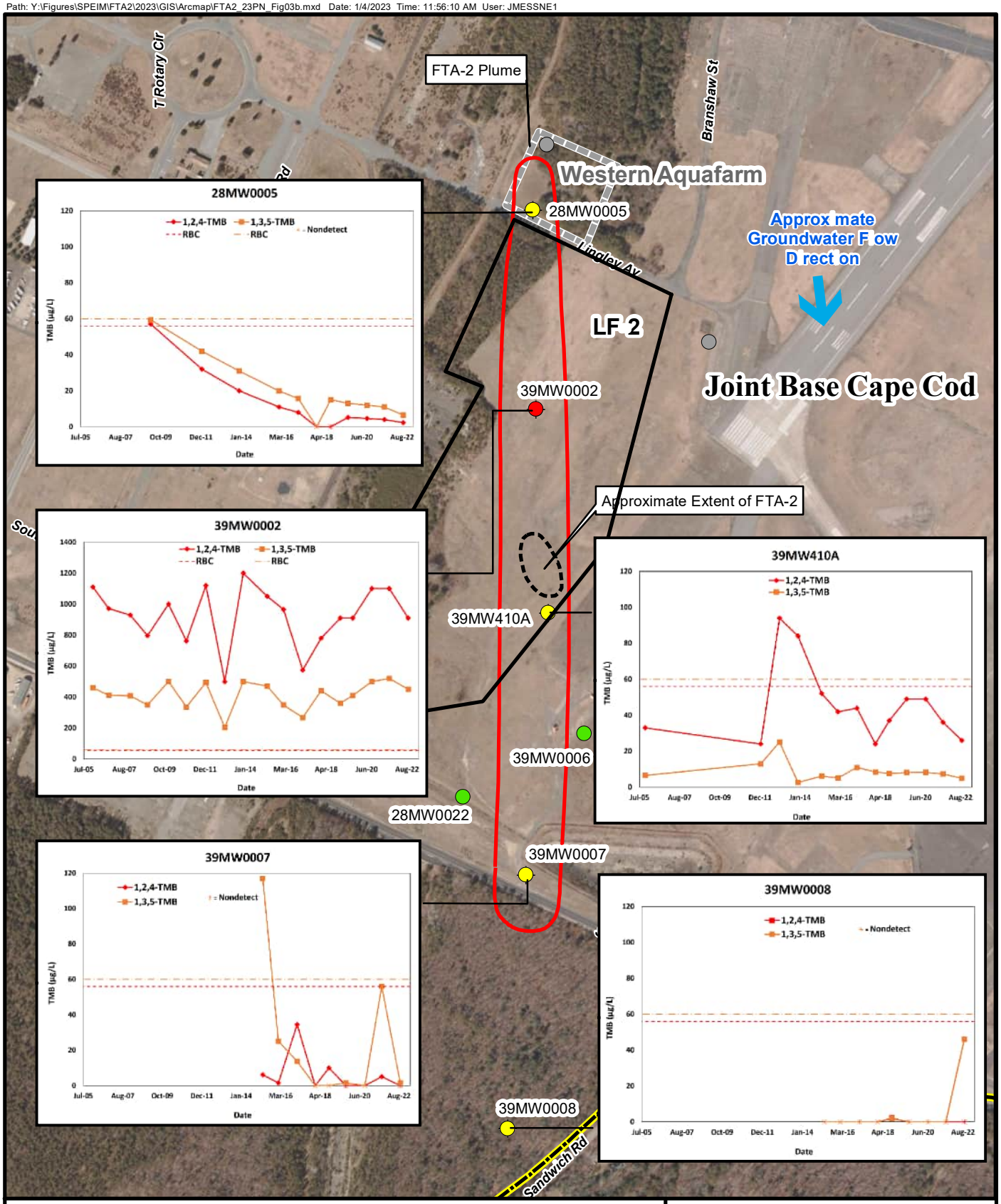
FIGURE 4-20

VPH CONCENTRATIONS IN FTA-2/LF-2 GROUNDWATER

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\FTA2\2023\GIS\Arcmap\FTA2_23PN_Fig03b.mxd Date: 1/4/2023 Time: 11:56:10 AM User: JMESSNE1



Legend

- LF-2 Boundary
- FTA-2 Source Area
- Western Aquafarm
- Biennial Monitoring Well Not Sampled
- No Detections
- One or More COC Detections At or Below TMB RSL
- One or More COC Detections Above TMB RSL
- Joint Base Cape Cod Boundary
- FTA-2/LF-2 Plume Boundary

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011
2019 Aerial Imagery from MassGIS

Note: Nondetect results are plotted as one half of the laboratory detection limit/limit of quantitation for TMBs.

0 250 500 Feet

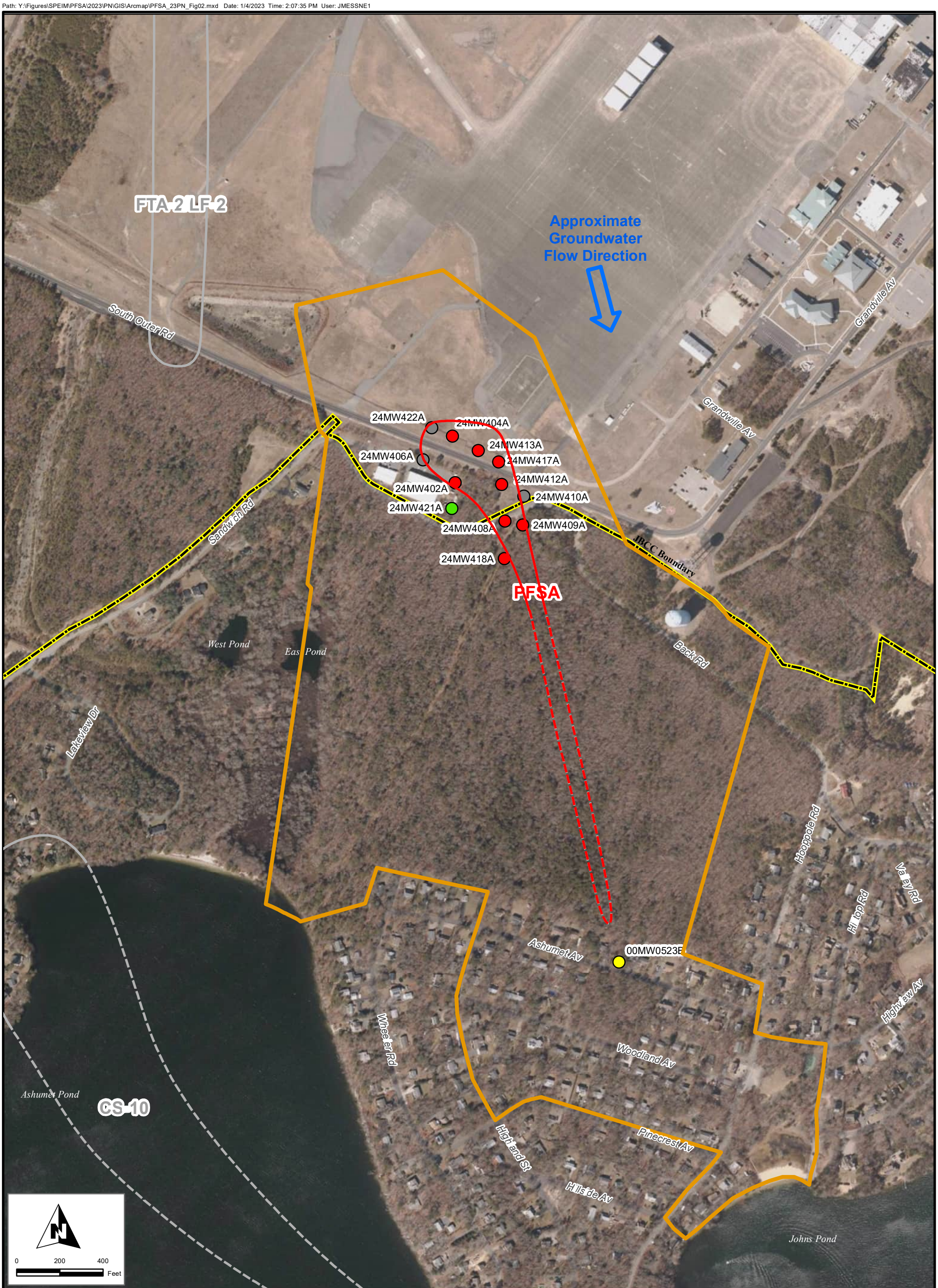
FIGURE 4-21

TMB CONCENTRATIONS IN FTA-2/LF-2 GROUNDWATER

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\PFSA\2023\PN\GIS\Arcmap\PFSA_23PN_Fig02.mxd Date: 1/4/2023 Time: 2:07:35 PM User: JMESSNE1



Legend

- Joint Base Cape Cod Boundary
- PFSA Plume Boundary (Dashed Where Inferred)
- Other Plume Boundary (Dashed Where Inferred)
- PFSA Land Use Control Area
- One or More COCs Detected Above RSL/GW-1
- One or More COCs Detected At or Below RSL/GW-1
- No Detections
- Biennial Monitoring Well Not Sampled

Note: GW1 = Groundwater-1
RSL = Regional Screening Level

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011
2019 Aerial Imagery from MassGIS

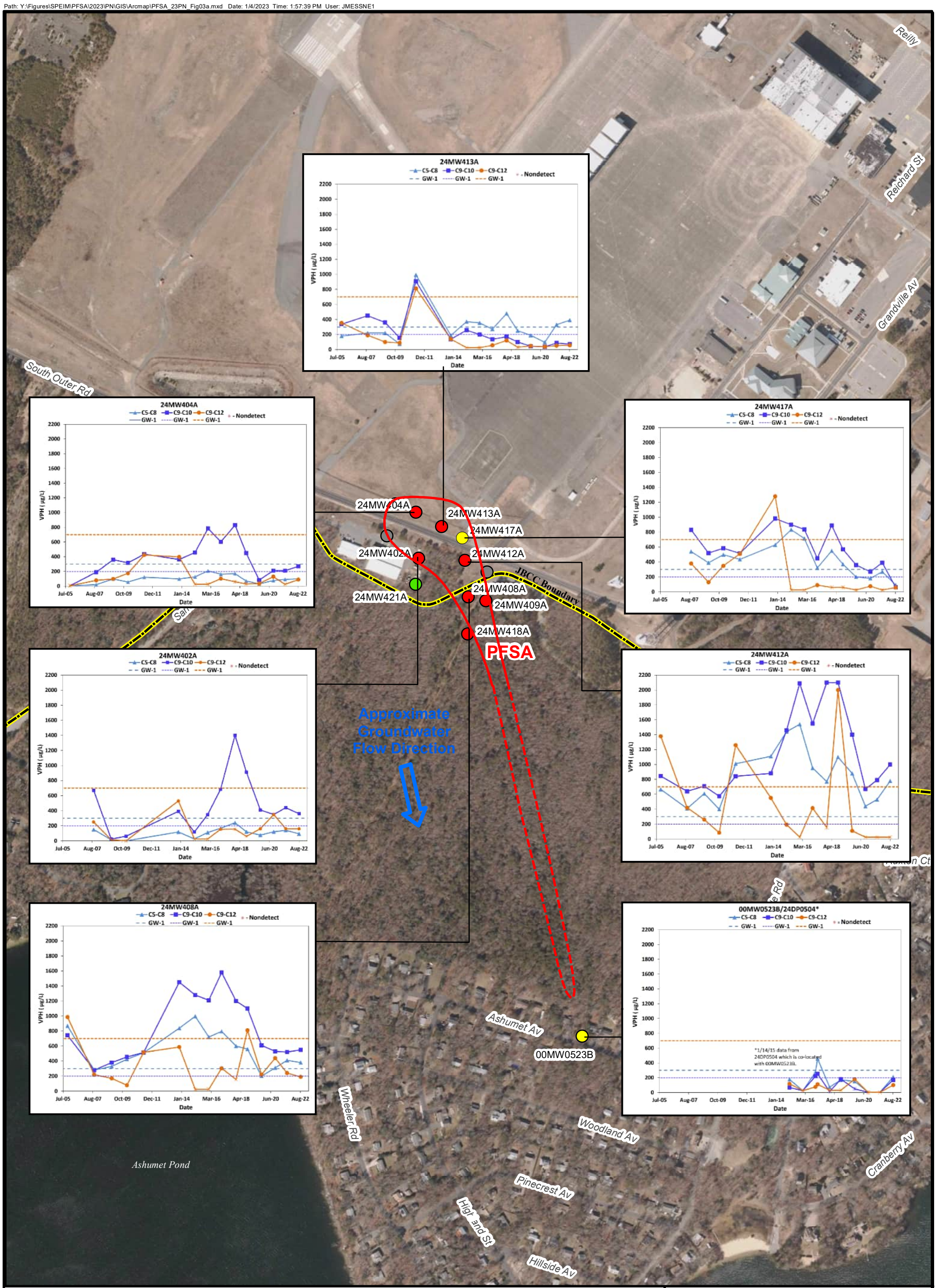
FIGURE 4-22

PFSA COC DETECTIONS IN GROUNDWATER

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\PFSA\2023\PN\GIS\Arcmap\PFSA_23PN_Fig03a.mxd Date: 1/4/2023 Time: 1:57:39 PM User: JMESSNE1



Legend

- Joint Base Cape Cod Boundary
- PFSA Plume Boundary (Dashed Where Inferred)
- One or More COCs Detected Above VPH GW-1
- One or More COCs Detected At or Below VPH GW-1
- No Detections
- Biennial Monitoring Well Not Sampled

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011
2019 Aerial Imagery from MassGIS

0 200 400 Feet

Note: Nondetect results are plotted as one half of the laboratory detection limit/limit of quantitation for all carbon ranges.

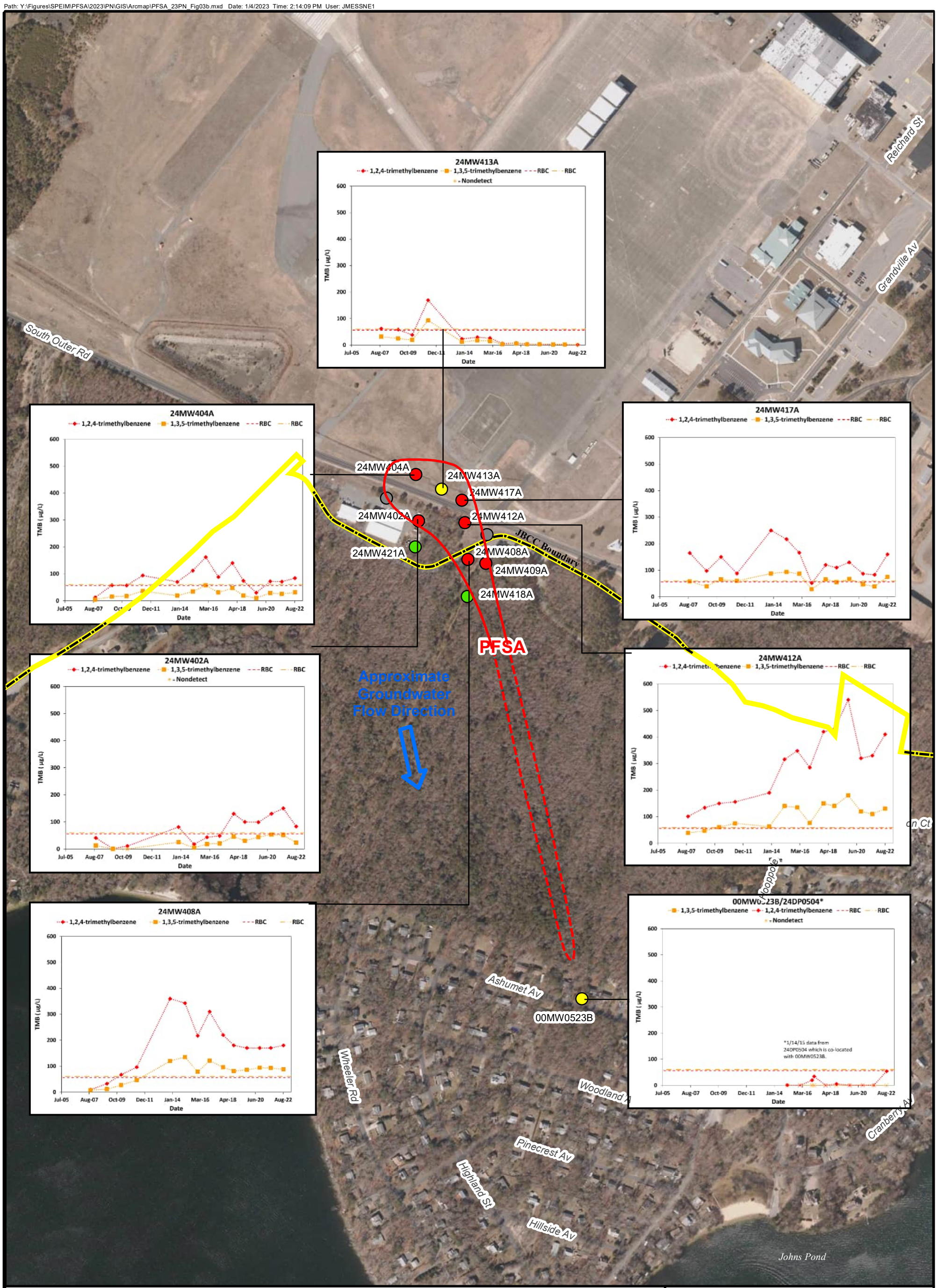
FIGURE 4-23

VPH CONCENTRATIONS IN PFSA GROUNDWATER

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Path: Y:\Figures\SPEIM\PFSA\2023\PN\GIS\Arcmap\PFSA_23PN_Fig03b.mxd Date: 1/4/2023 Time: 2:14:09 PM User: JMESSNE1



Legend

- Joint Base Cape Cod Boundary
- PFSA Plume Boundary (Dashed Where Inferred)
- One or More COCs Detected Above TMB RSL
- One or More COCs Detected At or Below TMB RSL
- No Detections
- Biennial Monitoring Well Not Sampled

Data Source: AFCEC, January 2023
JBCC Boundary from Massachusetts Air National Guard 2011
2019 Aerial Imagery from MassGIS 2019

0 200 400 Feet

Note: Nondetect results are plotted as one half of the laboratory detection limit/limit of quantitation for TMBs.

FIGURE 4-24

TMB CONCENTRATIONS IN PFSA GROUNDWATER

AFCEC - Joint Base Cape Cod

6th Five-Year Review, 2017-2022

Mock Village Munitions Response Site
Joint Base Cape Cod, Massachusetts
6th Five-Year Review, 2017-2022

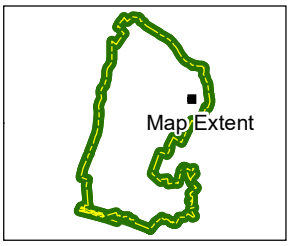
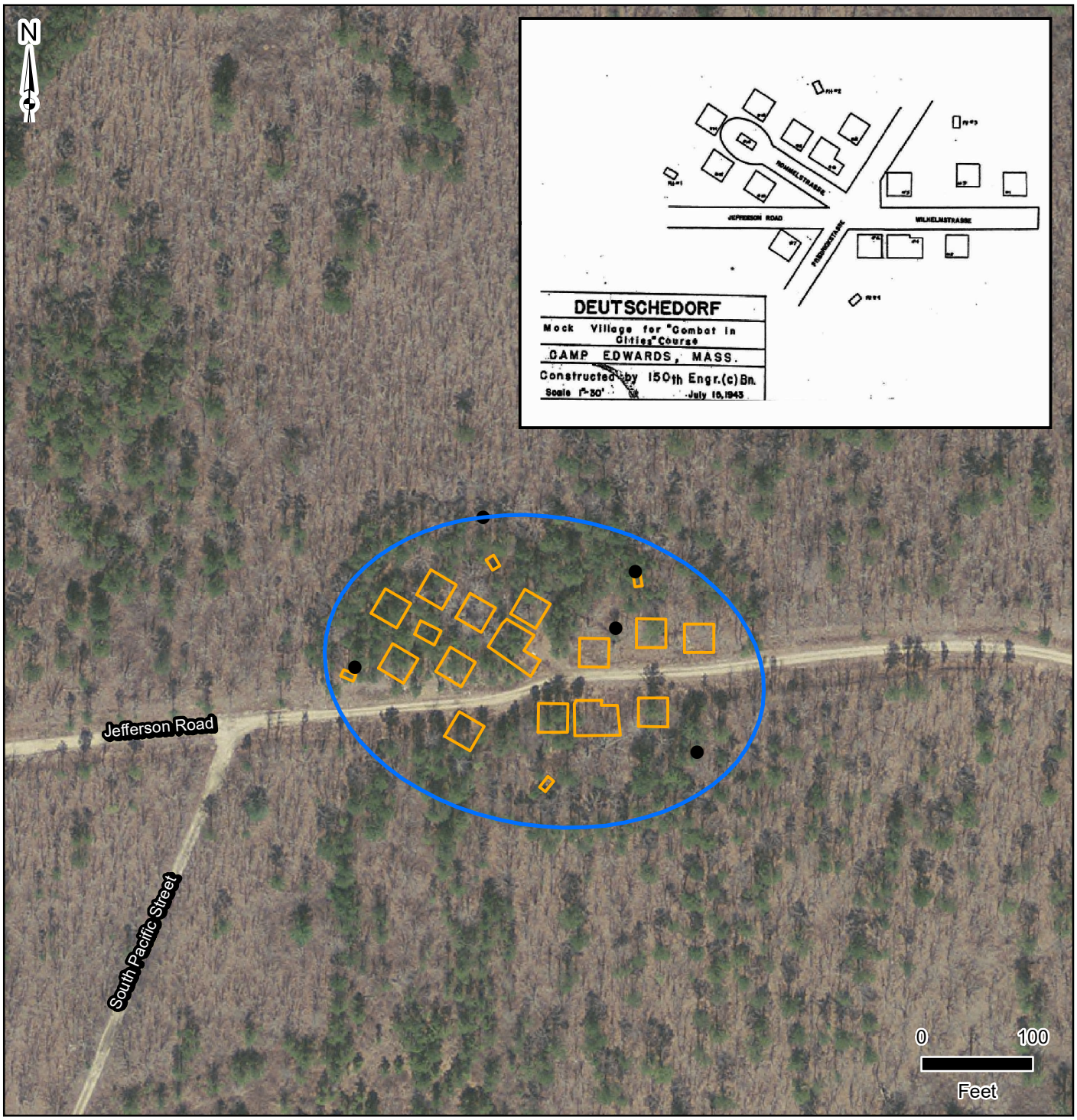


Figure 5-1
Historical Mock Village MRS Layout



Legend

- Installation Boundary
- Mock Village MRS Boundary
- Approximate Former Building Location
- Approximate Location of Observation Pits

Notes:
1. MRS = Munitions Response Site

Service Layer Credits: Aerial MassGIS 2009
Final CSE Phase II Report for Joint Base Cape Cod, Massachusetts. February 2018.

Document Path: \\lovetongis\GISdata\Federal\Northeast\Massachusetts\JBCapeCod\MXD\MockVillage_RIFS\Figure 1-2 Historical MRS Layout.mxd

Mock Village Munitions Response Site
Joint Base Cape Cod, Massachusetts
6th Five-Year Review, 2017-2022

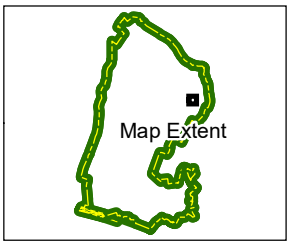
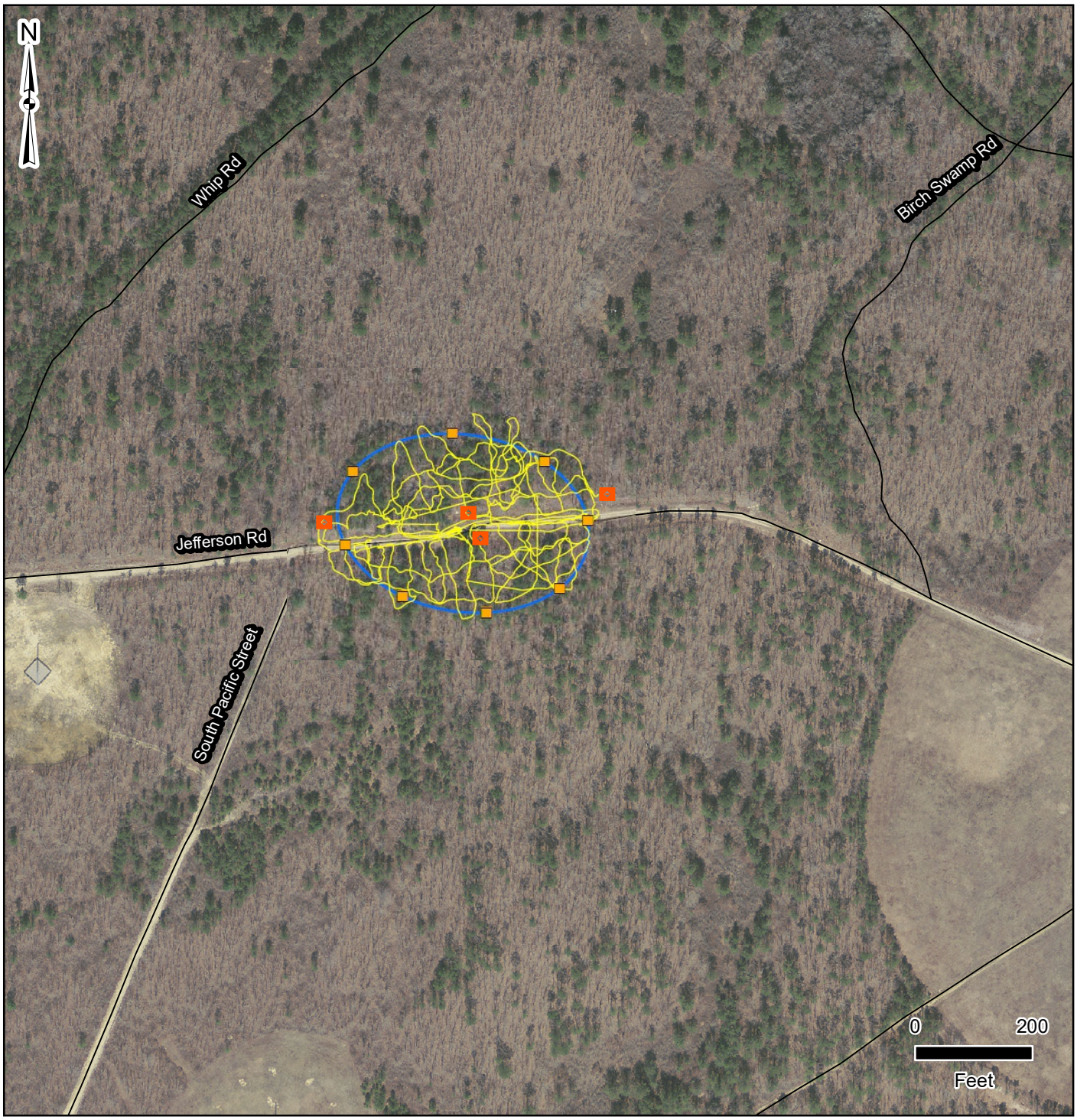


Figure 5-2
Mock Village MRS LUC Area



Legend

- Installation Boundary
- Mock Village MRS/LUC Boundary
- Road
- Original Sign Location
- Additional Sign Location
- Magnetometer Assisted MEC Surface Sweep

Notes:
1. MRS = Munitions Response Site
2. LUC = Land Use Controls

Service Layer Credits: ESRI Street Map, 2016
Final CSE Phase II Report for Joint Base Cape Cod, Massachusetts, February 2018.

Document Path: \\lovetongis\GISdata\Federal\Northeast\Massachusetts\JBCapeCod\MXD\MockVillage_RIFS\Figure 11-1 Alternative 2 Land Use Controls.mxd

TABLES

Table 1-1a
Summary of All Sites No Longer Requiring a Five-Year Review
6th Five-Year Review, 2017-2022

Site*	Reference Document
2nd Five-Year Review	
CS-2	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-3	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-3 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-5 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-7	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-7 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-8	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-9	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-10 Tank Wash OU	2nd Five-Year Review (1998-2002), AFCEE 2003
CS-12	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-2	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-14	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-15	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-16	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-17	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-19	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-20	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-21	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-23	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-26	2nd Five-Year Review (1998-2002), AFCEE 2003
FS-27	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-1 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-2 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-3	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-3 CG	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-4	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-5	2nd Five-Year Review (1998-2002), AFCEE 2003
LF-6	2nd Five-Year Review (1998-2002), AFCEE 2003
3rd Five-Year Review	
CS-1 CG	3rd Five-Year Review (2002-2007), AFCEE 2008
CS-4	3rd Five-Year Review (2002-2007), AFCEE 2008
CS-8 CG	3rd Five-Year Review (2002-2007), AFCEE 2008
CS-22	3rd Five-Year Review (2002-2007), AFCEE 2008
FS-13	3rd Five-Year Review (2002-2007), AFCEE 2008
4th Five-Year Review	
CS-18	4th Five-Year Review (2007-2012), AFCEC 2013
CS-19	4th Five-Year Review (2007-2012), AFCEC 2013
FS-1	4th Five-Year Review (2007-2012), AFCEC 2013
FS-9	4th Five-Year Review (2007-2012), AFCEC 2013
5th Five-Year Review	
CS-1	5th Five-Year Review (2012-2017), AFCEC 2018
CS-11	5th Five-Year Review (2012-2017), AFCEC 2018
CS-14	5th Five-Year Review (2012-2017), AFCEC 2018
CS-15	5th Five-Year Review (2012-2017), AFCEC 2018
CS-16	5th Five-Year Review (2012-2017), AFCEC 2018
CS-17	5th Five-Year Review (2012-2017), AFCEC 2018
CS-2 CG	5th Five-Year Review (2012-2017), AFCEC 2018
CS-4 CG	5th Five-Year Review (2012-2017), AFCEC 2018
CS-5	5th Five-Year Review (2012-2017), AFCEC 2018
CS-6	5th Five-Year Review (2012-2017), AFCEC 2018
CS-6 CG	5th Five-Year Review (2012-2017), AFCEC 2018
CY-1	5th Five-Year Review (2012-2017), AFCEC 2018
CY-2	5th Five-Year Review (2012-2017), AFCEC 2018
CY-3	5th Five-Year Review (2012-2017), AFCEC 2018
CY-4	5th Five-Year Review (2012-2017), AFCEC 2018
DDOU	5th Five-Year Review (2012-2017), AFCEC 2018
FS-1 CG	5th Five-Year Review (2012-2017), AFCEC 2018
FS-2 CG	5th Five-Year Review (2012-2017), AFCEC 2018

Table 1-1a
Summary of All Sites No Longer Requiring a Five-Year Review
6th Five-Year Review, 2017-2022

Site*	Reference Document
FS-3	5th Five-Year Review (2012-2017), AFCEC 2018
FS-4	5th Five-Year Review (2012-2017), AFCEC 2018
FS-5	5th Five-Year Review (2012-2017), AFCEC 2018
FS-6	5th Five-Year Review (2012-2017), AFCEC 2018
FS-7	5th Five-Year Review (2012-2017), AFCEC 2018
FS-8	5th Five-Year Review (2012-2017), AFCEC 2018
FS-12	5th Five-Year Review (2012-2017), AFCEC 2018
FS-18	5th Five-Year Review (2012-2017), AFCEC 2018
FS-22	5th Five-Year Review (2012-2017), AFCEC 2018
FS-25	5th Five-Year Review (2012-2017), AFCEC 2018
FTA-1 **	5th Five-Year Review (2012-2017), AFCEC 2018
FTA-3	5th Five-Year Review (2012-2017), AFCEC 2018
SD-1	5th Five-Year Review (2012-2017), AFCEC 2018
SD-2	5th Five-Year Review (2012-2017), AFCEC 2018
SD-3	5th Five-Year Review (2012-2017), AFCEC 2018
SD-4	5th Five-Year Review (2012-2017), AFCEC 2018
SD-5	5th Five-Year Review (2012-2017), AFCEC 2018
CD-500	5th Five-Year Review (2012-2017), AFCEC 2018
OWS C524	5th Five-Year Review (2012-2017), AFCEC 2018
6th Five-Year Review	
CS-20 (Groundwater)	6th Five-Year Review (2017-2022)
CS-23 (Groundwater)	6th Five-Year Review (2017-2022)
FS-1 (Groundwater)	6th Five-Year Review (2017-2022)
FS-29 (Groundwater)	6th Five-Year Review (2017-2022)
LF-7	6th Five-Year Review (2017-2022)
MB701 - Former Otis Bomb Storage Magazines (MRS)	6th Five-Year Review (2017-2022)
ML701 - Otis Target Butt (MRS)	6th Five-Year Review (2017-2022)

* = Sites listed are IRP Source Area sites unless indicated otherwise.

** = Closed for existing COCs. Currently being investigated under a Supplemental Remedial Investigation for PFAS.

Key:

COC = contaminant of concern

CG = U.S. Coast Guard

CS = Chemical Spill

CY = Coal Yard

DDOU = Drum Disposal Operable Unit

FS = Fuel Spill

FTA = Fire Training Area

IRP = Installation Restoration Program

LF = Landfill

MRS = Munitions Response Site

OU = operable unit

OWS= oil water seperator

PFAS = per- and polyfluoroalkyl substances

SD = Storm Drain

Air Force Center for Engineering and the Environment (AFCEE) 2003 (May). Final 2nd Five-Year Review, 1998-2002 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA. Prepared by AFCEE/MMR and Portage Environmental, Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

AFCEE 2008 (September). Final 3rd Five-Year Review, 2002-2007 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA. Prepared by Engineering Strategies Corporation, Portage and CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

Air Force Civil Engineer Center (AFCEC) 2013 (September). Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

AFCEC 2018 (September). Final 5th Five-Year Review, 2012-2017 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA. Prepared by AFCEC/JBCC, Installation Restoration Program, Otis ANG Base, MA.

Table 1-1b
Sites Determined to No Longer Require a Five-Year Review (2017-2022)
6th Five-Year Review, 2017-2022

Site	Reference Document	Summary rationale why UU/UE was appropriate and why Five-Year Reviews are no longer required
IRP Sites		
CS-20 Groundwater	*Final Chemical Spill-20 Remedial Action Completion Report* (AFCEC 2021a)	The three-step process to site closure (a requirement in all the JBCC IRP groundwater site RODs and associated ESDs) demonstrated that the RAOs for CS-20 have been met, the site meets a condition of No Significant Risk for UU/UE, and it is economically feasible to achieve background conditions.
CS-23 Groundwater	*Final Chemical Spill-23 Remedial Action Completion Report* (AFCEC 2021b)	The three-step process to site closure demonstrated that the RAOs for CS-23 have been met, the site meets a condition of No Significant Risk for UU/UE, and it is economically feasible to achieve background conditions.
FS-1 Groundwater	*Final Fuel Spill-1 Remedial Action Completion Report* (AFCEC 2022a)	The three-step process to site closure demonstrated that the RAOs for FS-1 have been met, the site meets a condition of No Significant Risk for UU/UE, and it is economically feasible to achieve background conditions. Note that PFAS groundwater exceedances in the FS-1 area are being managed under the Flight Line Area Operable Unit.
FS-29 Groundwater	*Final Fuel Spill-29 (FS-29) Remedial Action Completion Report (RACR)* (AFCEC 2021c)	The three-step process to site closure demonstrated that the RAOs for FS-29 have been met, the site meets a condition of No Significant Risk for UU/UE, and it is economically feasible to achieve background conditions.
LF-7	*Final Removal Action Completion Report LF-7 Radar Tube Burial Site* (AFCEC 2022b)	Based on the results of the excavation activities (i.e., absence of a monolith), final gamma count rate survey, and the results from the stockpiled soil sampling, LUCs, annual surveys, and Five-Year Reviews are no longer required, and the site is available for UU/UE.
Munitions Response Sites		
Former Otis Bomb Storage Magazines	*Final Decision Document No Further Response Action Planned (NFRAP) Former Otis Bomb Storage Magazines* (AFCEC 2020)	No explosive safety hazards or MC risks to human health or the environment have been identified. Based on these results, No Further Action was approved, and the site is considered UU/UE for MMRP with no land use controls for MEC and MC.
Otis Target Butt	*Final Decision Document No Further Response Action Planned (NFRAP) Otis Target Butt* (AFCEC 2019)	No explosive safety hazards or MC risks to human health or the environment have been identified. Based on these results, No Further Action was approved, and the site is considered UU/UE for MMRP with no land use controls for MC.

Key:
AFCEC = Air Force Civil Engineer Center
CS = Chemical Spill
ESD = Explanation of Significant Differences
FS = Fuel Spill
IRP = Installation Restoration Program
JBCC = Joint Base Cape Cod
LF = landfill
LUC = land use control
MC = munitions constituents
MEC = munitions and explosives of concern
MMRP = Military Munitions Response Program
RACR = Remedial Action Completion Report
RAO = remedial action objective
ROD = Record of Decision
PFAS = per- and polyfluoroalkyl substances
UU/UE = unlimited use and unrestricted exposure

Table 1-1b
Sites Determined to No Longer Require a Five-Year Review (2017-2022)
6th Five-Year Review, 2017-2022

References:

AFCEC. 2022a (October). *Final Fuel Spill-1 Remedial Action Completion Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2022b (May). *Final Removal Action Completion Report LF-7 Radar Tube Burial Site.* Prepared by APTIM for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021a (October). *Final Chemical Spill-20 Remedial Action Completion Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021b (October). *Final Chemical Spill-23 Remedial Action Completion Report*. Prepared by EA Engineering, Science and Technology and CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2021c (January). *Final Fuel Spill-29 (FS-29) Remedial Action Completion Report (RACR)*. Prepared by AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2020 (April). *Final Decision Document No Further Response Action Planned (NFRAP) Former Otis Bomb Storage Magazines*. Prepared by EA Engineering, Science and Technology for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2019 (November). *Final Decision Document No Further Response Action Planned (NFRAP) Otis Target Butt*. Prepared by EA Engineering, Science and Technology for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

Table 1-1c
Summary of Open Sites Not Addressed in the Five-Year Review
6th Five-Year Review, 2017-2022

Site Name	Site ID
MMRP	
Ordnance Area 1 MRS	MB702
Skeet Range MRS	TS701
DoD Property MRS/Old Grenade Courts MRA	MMR-003-R-01
Non-DoD Property MRS/Old Grenade Courts MRA	MMR-003-R-02
Rocket Range MRS/Old K Range MRA	MMR-004-R-01
Carolina Road MRS/Old K Range MRA	MMR-004-R-02
Rocket Range Firing Line MRS/Old K Range MRA	MMR-004-R-03
Remaining Lands MRS/Old K Range MRA	MMR-004-R-04
Skeet and Trap Range MRS/Otis Gun Club MRA	MMR-009-R-01
Pistol Range MRS/Otis Gun Club MRA	MMR-009-R-02
Rifle Range MRS/Otis Gun Club MRA	MMR-009-R-03
NFA Area MRS/Otis Gun Club MRA	MMR-009-R-04
Former Ammunition Supply Point - West MRS	MMR-010-R-01
Former Ammunition Supply Point - East MRS	MMR-011-R-01
IRP - PFAS Sites	
FTA-1 PFAS Site and Plume*	FT055P-SUB
LF-1 PFAS Plume**	LF006P-SUB
Tanker Truck Rollover Sites and Plume	SS090P
ANG Motor Pool Area***	SS091P
Former Building 118 - Runway 32***	SS092P
Former Fire Department Building 122***	SS093P
Wastewater Treatment Plant Infiltration Beds	SS094P
USCG Hangars 3170 and 3172***	SS095P
Lower 40 Ramp Area***	SS097P
Army Helicopter Hangar 2816***	SS098P

* FTA-1 source area meets UU/UE criteria for existing COCs. FTA-1 (Ashumet Valley) groundwater is addressed in Section 4.1 for current COCs. FTA-1 source area and groundwater are currently being investigated under a Supplemental RI for PFAS.

** LF-1 source area is addressed in Section 3.2. LF-1 groundwater is addressed in Section 4.9 for current COCs. LF-1 groundwater remedies for PFAS are being evaluated in a Supplemental FS.

***= Being addressed as part of the Flight Line Area Operable Unit. The plume has not yet been characterized.

Key:
ANG = Air National Guard
COC = contaminants of concern
DoD = Department of Defense
FTA = Fire Training Area
IRP = Installation Restoration Program
LF = Landfill
MMRP = Military Munitions Response Program
MRA = Munitions Response Area
MRS = Munitions Response Site
NFA = No Further Action
PFAS = per- and polyfluoroalkyl substances
RI = Remedial Investigation
USCG = United States Coast Guard
UU/UE = unlimited use and unrestricted exposure

Table 1-2
Decision Summary of IRP Source Area Sites and MRSs Addressed in this Five-Year Review
6th Five-Year Review, 2017-2022

Site Number or Site Name	Final Decision Document			ESDs or Amendments?	Remedy Components	Reviewed in FYR Section
	Title	Issue Date	AR #			
CS-10 (Details C and F)	*Record of Decision Area of Contamination CS-10/FS-24 Source Areas*	1999	12435	2003 ESD 2011 ESD	Detail C: Soil Vapor Extraction System and LUCs Detail F: Excavation (not implemented due to potential ecological impacts) and LUCs	3.1
LF-1	*Final Record of Decision for the LF 1 Source Area and Groundwater*	2007	18664	2013 ESD	Landfill Cap monitoring and maintenance and LUCs	3.2
FTA-2/LF-2	*Record of Decision for Areas of Contamination FTA-2/LF 2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas*	1998	11609	2016a Amendment	Biosparge Treatment System and LUCs	3.3
PFSA (Sites FS-10/FS-11)	*Record of Decision for Areas of Contamination FTA-2/LF 2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas*	1998	11609	2016b Amendment	Biosparge Vapor Recover Treatment System and LUCs	3.4
Mock Village MRS	*Final Record of Decision Mock Village Munitions Response Site (EPA Operable Unit 29)*	2022	616878	None	LUCs with UXO Construction Support	5.1

Key:
AR = Administrative Record
CS = Chemical Spill
EPA = Environmental Protection Agency
ESD = Explanation of Significant Differences
FS = Fuel Spill
FTA-2 = Fire Training Area 2
IRP = Installation Restoration Program
LF = Landfill
LUC = Land Use Control
MRS = Munitions Response Site
PFSA = Petroleum Fuels Storage Area
SD = Storm Drain
UXO = unexploded ordnance

2016a Amendment = AFCEC. 2016a (September). *Final Fire Training Area-2/Landfill-2 Record of Decision Amendment*. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANGB, MA.

2016b Amendment = AFCEC. 2016b (September). *Final Petroleum Fuels Storage Area Record of Decision Amendment*. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANGB, MA.

2013 ESD = AFCEC. 2013 (September). *Final Explanation of Significant Differences for the Landfill 1 (LF-1) Source Area at the Massachusetts Military Reservation*. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis ANGB, MA.

2011 ESD = AFCEE. 2011 (September). *Explanation of Significant Differences Areas of Contamination CS 10/FS-24, FS-1, and FS-9*, AFCEE/MMR, Otis ANGB, MA.

2003 ESD = AFCEE. 2003a (February). *Explanation of Significant Differences Areas of Contamination CS 10 (A, B, & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD 3/FTA-3/CY-4*. Prepared by Portage Environmental Inc. for AFCEE/MMR Installation Restoration Program, Otis ANGB, MA.

Table 1-3
Decision Summary of Groundwater Sites Addressed in this Five-Year Review
6th Five-Year Review, 2017-2022

Site	Final Decision Document			ESDs or Amendments?	Remedy Components	Reviewed in FYR Section
	Title	Issue Date	AR #			
Ashumet Valley	*Final Record of Decision for Ashumet Valley Groundwater*	2009	18977	2011 ESD	ETI/ETD, SPEIM, LUCs, MNA, FYR	4.1
CS-4	*Final Record of Decision for the CS-4, CS-20, CS-21, and FS 13 Plumes*	2000	13425	2008 ESD 2011 ESD	ETI, SPEIM, LUCs, MNA, FYR	4.2
CS-10	*Final Record of Decision for Chemical Spill-10 Groundwater*	2009	18995	2011 ESD 2014a ESD 2021 ESD	ETI/ETR, SPEIM, LUCs, MNA, FYR	4.3
CS-19	*Final Chemical Spill-19 Record of Decision*	2009	19039	2011 ESD	LUCs, MNA, FYR	4.4
CS-21	*Final Record of Decision for the CS-4, CS-20, CS-21, and FS 13 Plumes*	2000	13425	2008 ESD 2011 ESD	ETR, SPEIM, LUCs, MNA, FYR	4.5
FS-12	*Final Record of Decision for Fuel Spill-12 Groundwater*	2006	18419	2011 ESD	ETR, SPEIM, LUCs, MNA, FYR	4.6
FS-13	*Final Record of Decision for the CS-4, CS-20, CS-21, and FS 13 Plumes*	2000	13425	2008 ESD 2011 ESD	LTM, LUCs, MNA, FYR	4.7
FS-28	*Final Record of Decision for the Fuel Spill-28 and Fuel Spill 29 Plumes*	2000	13649	2008 ESD 2011 ESD	ETD, SPEIM, LUCs, MNA, FYR	4.8
LF-1	*Final Record of Decision for Landfill-1 Source Area and Groundwater*	2007	18664	2011 ESD	ETI/ETR, SPEIM, LUCs, MNA, FYR	4.9
SD-5	*Final Record of Decision for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm Drain-5*	2006	18420	2011 ESD 2014b ESD	LTM, LUCs, MNA, FYR	4.10
FTA-2/LF-2	*Final Fire Training Area-2/Landfill-2 Record of Decision Amendment*	2016	540120		LUCs, MNA, FYR	4.11
PFSA (FS-10/FS-11)	*Final Petroleum Fuel Storage Area Record of Decision Amendment*	2016	540119		LUCs, MNA, FYR	4.12

Key:

AR = Administrative Record
CS = Chemical Spill
ESD = Explanation of Significant Differences
ETD = extraction, treatment, and discharge
ETI = extraction, treatment, and infiltration
ETR = extraction, treatment, and reinjection
FYR = five-year review
FTA = Fire Training Area
FS = Fuel Spill
LF = Landfill
LUC = Land Use Control
MNA = monitored natural attenuation
SD = Storm Drain
SPEIM = system performance and ecological impact monitoring

2021 ESD = AFCEC. 2021 (January). *Final Explanation of Significant Differences. For 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA.* Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANGB, MA.

2014a ESD = AFCEC. 2014 (September). *Final Chemical Spill-10 Groundwater Explanation of Significant Differences.* Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANGB, MA.

2014b ESD = AFCEC. 2014 (September). *Final Storm Drain-5 Groundwater Explanation of Significant Differences.* Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANGB, MA.

2011 ESD = AFCEE. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation* . Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANGB, MA.

2008 ESD = AFCEE. 2008 (September). *Final Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, Fuel Spill-13, Fuel Spill-28, and Fuel Spill-29 Groundwater Plumes. Prepared by Jacobs Engineering Group, Inc for AFCEE/MMR, Installation Restoration Program, Otis ANGB, MA.*

Table 1-4
Issue Description and Recommendations/Follow-Up Actions
6th Five-Year Review, 2017-2022

Site Name	Issue Category	Issue Summary	Recommendation # and FYR Section	Recommendation/Follow-Up Action Summary	Recommended Implementation Date	Recommended Completion Date
Source Area Sites						
CS-10 Detail C and F	Human Health Risk	There is no LUC to control the VI pathway which may present an unacceptable risk.	Recommendation #1, Section 3.1.6	Evaluate the VI risk using soil gas data at Detail C and F. If an unacceptable VI risk exists, prepare a DD (as part of Recommendation #4) to add a RAO which addresses VI and either add a LUC to control the potential VI pathway or require a remedial action to address the VI risk.	Underway	October 2026
CS-10 Detail C and F	Changed Site Conditions	There may be an on-going contaminant source to Detail F soil/sediment from the storm drain coating.	Recommendation #2, Section 3.1.6	Evaluate the PCB and EPH/VPH impacts to the soil at the Detail F outfall area. Prepare a DD (as part of Recommendation #4) and conduct additional remedial measures to address the source material as necessary to ensure protectiveness.	Underway	October 2026
CS-10 Detail C and F	Cleanup Levels	The recommendation from the 2018 FYR to assess residual contaminants in soil/sediment (discussed in Section 3.1.3) has not been completed. Current cleanup levels cited in the 2003 and 2011 ESDs are based on MassDEP standards or are outdated.	Recommendation #3, Section 3.1.6	Once an assessment of residual contaminants has been completed, develop federal risk-based standards for those contaminants that present an unacceptable risk and preclude a UU/UE designation. Engage regulatory stakeholders to determine which updated standards will be adopted for use in executing Recommendation #4 (preparing a DD).	Underway	October 2026
CS-10 Detail C and F	Land Use Controls	The recommendation from the 2018 FYR to assess residual contaminants in soil/sediment (discussed in Section 3.1.3) has not been completed. The LUC language in the ROD is not specific and needs to be updated to reflect the LUC standards used at JBCC. JBCC DDs prepared after the CS-10 Source Area ROD use LUC language that provide more robust protectiveness by including specificity regarding the Dig-Safe process and requirements for an annual LUC evaluation and regulatory notification of changes in land use, land ownership, or LUC modification/termination.	Recommendation #4, Section 3.1.6	In conjunction with Recommendations #1, #2 and #3, complete the additional assessment and determine whether Details C and F meet UU/UE closure requirements when applying updated cleanup standards (i.e., Recommendation #3). Prepare a DD to update the RAOs, cleanup levels and LUC language, as appropriate, recognizing that both Detail C and F may not achieve UU/UE closure.	Underway	October 2026

Table 1-4
Issue Description and Recommendations/Follow-Up Actions
6th Five-Year Review, 2017-2022

Site Name	Issue Category	Issue Summary	Recommendation # and FYR Section	Recommendation/Follow-Up Action Summary	Recommended Implementation Date	Recommended Completion Date
FTA-2/LF-2	Changed Site Conditions	New contaminants not included as COCs in the ROD were identified in 2003 soil sampling and reported in the 2014 RAR and evaluated as part of this FYR (See Section 3.3.4.1). The 2003 contaminant concentrations for various PAHs in soil exceed current industrial screening standards.	Recommendation #5, Section 3.3.6	Conduct an assessment of the post-ROD shallow soil data collected at the site, collect additional data as necessary, and determine if there is an unacceptable human health risk. If required, develop a DD to add soil COCs and an RAO(s) to address potential direct human exposure to soil contaminants < 15 ft bgs.	October 2024	December 2026
Groundwater Sites						
Ashumet Valley	Emerging contaminants	Emerging contaminants, specifically PFAS and 1,4-dioxane, exceed screening standards in groundwater beyond the footprint of the current AV plume area.	Recommendation #6, Section 4.1.6	Finalize the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* and the *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod.* Develop a DD to establish additional COCs and RAOs as appropriate.	Underway	May 2025
CS-10	Emerging contaminants	Emerging contaminants, specifically PFAS, exceed the PFAS6 MMCL in numerous CS-10 extraction wells and in groundwater in the FS-13 area (which overlies the CS-10 plume). These PFAS detections may not be related to CS-10.	Recommendation #7, Section 4.3.6	Conduct an investigation of the PFAS detected in the CS-10 extraction wells and in groundwater near FS-13. Engage regulatory and AF program stakeholders regarding the appropriate reporting mechanism (e.g., expansion of on-going Flight Line OU RI, CS-10 Supplemental RI). Develop a DD to establish additional COCs and RAOs as appropriate.	August 2024	October 2027
LF-1	Emerging contaminants	Emerging contaminants, specifically PFAS and 1,4-dioxane, exceed screening standards in groundwater within the legacy LF-1 plume area.	Recommendation #8, Section 4.9.6	Finalize the *Draft Supplemental Feasibility Study Report for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Landfill-1, Joint Base Cape Cod*. Develop a DD to establish additional COCs and RAOs as appropriate.	Underway	August 2024

Table 1-4
Issue Description and Recommendations/Follow-Up Actions
6th Five-Year Review, 2017-2022

Site Name	Issue Category	Issue Summary	Recommendation # and FYR Section	Recommendation/Follow-Up Action Summary	Recommended Implementation Date	Recommended Completion Date
FTA-2/LF-2	Cleanup Level	The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the FTA-2/LF-2 ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C5-C8 Aliphatic Hydrocarbons (300µg/L) v. EPA Aliphatic Low RSL (28 µg/L); GW-1 C9-C10 Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L); GW-1 C11-C22 Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L).	Recommendation #9, Section 4.11.6	Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.	August 2024	October 2026
PFSA (FS-10/FS-11)	Cleanup Level	The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the PFSA ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C5-C8 Aliphatic Hydrocarbons (300µg/L) v. EPA Aliphatic Low RSL (28 µg/L); GW-1 C9-C10 Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L); GW-1 C11-C22 Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L).	Recommendation #10, Section 4.12.6	Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.	August 2024	October 2026

Key:
ARAR = Applicable or Relevant and Appropriate Requirements
AV = Ashumet Valley
CS = Chemical Spill
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC = contaminant of concern
DD = decision document
EPA = Environmental Protection Agency
EPH = extractable petroleum hydrocarbon
ESD = explanation of significant difference
FS = Fuel Spill; Feasibility Study

Table 1-4
Issue Description and Recommendations/Follow-Up Actions
6th Five-Year Review, 2017-2022

Site Name	Issue Category	Issue Summary	Recommendation # and FYR Section	Recommendation/Follow-Up Action Summary	Recommended Implementation Date	Recommended Completion Date

FYR = Five-Year Review
LF = Landfill
LUC = Land Use Control
MMCL = Massachusetts Maximum Contaminant Level
PAH = polynuclear aromatic hydrocarbon
PCB = polychlorinated biphenyls
PFAS = per- and polyfluorinated alkyl substances
PFAS6 = the total sum of the concentrations of six PFAS
PFSA = Petroleum Fuel Storage Area
RAO = remedial action objective
RACR = Remedial Action Completion Report
RDX = Royal Demolition Explosive or hexahydro-1,3,5-trinitro-1,3,5-triazine
RI = remedial investigation
ROD = Record of Decision
RSL = regional screening level
TMB - trimethylbenzene
UU/UE = unlimited use and unrestricted exposure
VI = vapor intrusion
VPH = volatile petroleum hydrocarbon

Table 1-5
Other Findings
6th Five-Year Review, 2017-2022

Site Name	Discussed in FYR Section	Other Finding Description
Groundwater Sites		
CS-19	4.4.6	Prepare an ESD to document an upward change in the RDX cleanup level for CS-19 groundwater and establish a new MNA timeframe if justified by the remaining RDX concentrations.
FS-13	4.7.6	The PFAS detections in the FS-13 area are not associated with the FS-13 fuel spill and should be addressed as part of Recommendation #7 (Section 4.3.6) to investigate PFAS detected in the CS-10 extraction wells.
FS-13	4.7.6	Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FS-13 groundwater that can support future application of the three-step closeout process and the subsequent RACR for FS-13.
FTA-2/LF-2	4.11.6	Future FTA-2/LF-2 LTM Program Project Notes should discuss the ROD Amendment remedy's inclusion of MNA geochemical monitoring and include an assessment of geochemical monitoring data.
FTA-2/LF-2	4.11.6	The TMB exceedances at monitoring well 39MW0002 (discussed in Section 4.11.4.1) attenuate within the footprint of the FTA-2/LF-2 plume and do not present a protectiveness concern. However, the data indicate a continuing, low-level leaching source may exist which would not follow the source aspect of the CSM (i.e., soils no longer pose a leaching threat). At the conclusion of the next FYR period (2022-2027) the site will be in the 12th year of an estimated 20-year MNA remedy and the TMB concentrations should be evaluated to determine if an attenuation pattern exists (as seen for the other COCs).
FTA-2/LF-2	4.11.6	Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FTA-2/LF-2 groundwater and establish a new MNA period.
PFSA (FS-10/FS-11)	4.12.6	Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for PFSA groundwater and establish a new MNA period.
PFSA (FS-10/FS-11)	4.12.6	Future PFSA Long Term Monitoring Program Project Notes should discuss the ROD Amendment remedy's inclusion of MNA geochemical monitoring and include an assessment of geochemical monitoring data.

Key:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC = contaminant of concern
CS = Chemical Spill
CSM = conceptual site model
FS = Fuel Spill
FYR = five-year review
LF = Landfill
LUC = Land Use Control
MNA = monitored natural attenuation
PAH = polynuclear aromatic hydrocarbon
PFAS = per- and polyfluorinated alkyl substances
PFSA = Petroleum Fuel Storage Area
RI = remedial investigation
ROD = Record of Decision
TMB = trimethylbenzene

Table 1-6
Summary of Protectiveness Statements
6th Five-Year Review, 2017-2022

Site Name	FYR Section Number	Protectiveness Statements
Source Area Sites		
CS-10 Detail C and F	3.1.7	**The remedies for CS-10 source area Details C and F are protective of human health and the environment in the short-term under the current land use scenario.** The remedy is protective in the short-term since access to the site is controlled by base security and a fence that effectively limits potential human exposure. However, for the remedies to be protective in the long-term the VI pathway must be evaluated using updated procedures and the LUC language must be updated to address the VI pathway if necessary. Additionally, a potential new contaminant source from the Detail F storm drain should be evaluated and updated cleanup standards must be developed to ensure protectiveness. Finally, the LUC language must be updated to be consistent with other JBCC DDs if contaminants left in place exceed current updated cleanup standards. This determination will be based on the results of a data evaluation using updated cleanup standards in conjunction with any additional remedial measures taken.
LF-1	3.2.7	**The remedy for the LF-1 source area is protective of human health and the environment under the current land use scenario.** Groundwater monitoring under the LF-1 SPEIM/LTM program (discussed in Section 4.9) does not indicate the LF-1 source area is acting as a continuing source of groundwater contamination for current COCs and the landfill cap prevents contact with contaminated soil. Therefore, the landfill cap remedy at LF-1 is operating as expected. In addition, the LUCs are in place and are functioning as intended. Additional activities to address ECs in groundwater are needed as discussed in Section 4.9.
FTA-2/LF-2	3.3.7	**The remedy for the FTA-2/LF-2 source area is protective of human health and the environment in the short short-term.** Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants. If workers excavate in the area, a Dig Safe notification would be sent to the IRP office for evaluation. A Record of Notice of Landfill Operation has been filed with the real property office. Since the ROD does require LUCs and has an appropriate LUC objective, the lack of a specific RAO to address human exposure to site contaminates in soil does not affect current protectiveness. However, in order for the remedy to be protective in the long-term, AFCEC must conduct an assessment of the post-ROD shallow soil data collected at the site, collect additional data as necessary, and determine if there is an unacceptable human health risk.
PFSA (FS-10/FS-11)	3.4.7	**The remedy for the PFSA source area is protective of human health and the environment.** Access to the site is controlled by current flight line security measures which include fencing and 24-hour security that effectively limits potential human exposure to site contaminants.
Groundwater Sites		
AV	4.1.7	**The remedy for the AV groundwater plume is protective of human health and the environment in the short-term.** The remedial system performed as expected and the LUCs are in place and are functioning as intended for current COCs. Through natural attenuation processes, groundwater cleanup levels for current COCs are expected to be achieved. As of June 2023, the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* is nearing completion and site risks have been sufficiently characterized and the *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* haves been submitted for regulatory review but not been finalized. Although interim LUCs and multiple removal actions have been implemented to prevent exposure to drinking water with PFAS exceedances, for the remedy to be protective in the long-term, a DD and subsequent remedial actions are required to address PFAS.
CS-4	4.2.7	**The remedy for the CS-4 groundwater plume is protective of human health and the environment.** The remedial system performed as expected and LUCs are functioning as intended to protect human health. Through natural attenuation processes, groundwater cleanup levels for the remaining COCs are expected to be achieved in the next 1-2 years.

Table 1-6
Summary of Protectiveness Statements
6th Five-Year Review, 2017-2022

Site Name	FYR Section Number	Protectiveness Statements
CS-10	4.3.7	**The remedy for the CS-10 groundwater plume is protective of human health and the environment in the short-term.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial systems and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. For the remedy to be protective in the long-term, an investigation of PFAS in the CS-10 extraction wells and in groundwater near FS-13 should be conducted and follow-on CERCLA requirements should be implemented, as necessary.
CS-19	4.4.7	**The remedy for the CS-19 groundwater plume is protective of human health and the environment.** Remediation is progressing faster than expected. The LUCs are in place and are functioning as intended to protect human health. Through natural attenuation processes groundwater cleanup levels are expected to be achieved earlier than the timeframe approximated in the ROD (i.e., 2037).
CS-21	4.5.7	**The remedy for the CS-21 groundwater plume is protective of human health and the environment.** The remedial system is performing as expected. The LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved within the timeframe approximated in the ROD.
FS-12	4.6.7	**The remedy for the FS-12 groundwater plume is protective of human health and the environment.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved. Current groundwater data and modeling indicate the aquifer restoration timeframe of 2030 identified in the ROD may will not be met. The restoration timeframe will be re-assessed in the next FYR.
FS-13	4.7.7	**The remedy for the FS-13 groundwater plume is protective of human health and the environment.** Remediation through natural attenuation has resulted in all COC concentrations now detected at levels below cleanup standards cited in the 2011 ESD. The LUCs are in place and are functioning as intended to protect human health. The PFAS detected in the FS-13 area will be managed as part of a separate investigation (Recommendation #7, Section 4.3.6).
FS-28	4.8.7	**The remedy for the FS-28 groundwater plume is protective of human health and the environment.** The remedial system is performing as expected. The LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, groundwater cleanup levels are expected to be achieved in the next 1-2 years.
LF-1	4.9.7	**The remedy for the LF-1 groundwater plume is protective of human health and the environment in the short-term.** The remedial system is performing as expected and the LUCs are in place and are functioning as intended to protect human health. Through the combination of the active treatment by the remedial system and natural attenuation processes, existing groundwater cleanup levels are expected to be achieved. For the remedy to be protective in the long-term, a DD should be issued which specifies the remedial actions required to address 1,4-dioxane and PFAS.
SD-5	4.10.7	**The remedy for the SD-5 groundwater plume is protective of human health and the environment.** The LTM program is ongoing and the LUCs are in place and are functioning as intended to protect human health. Through pre-ROD operation of the SD-5 remedial system and natural attenuation processes, groundwater cleanup levels have been achieved at SD-5N and nearly achieved at SD-5S.
FTA-2/LF-2	4.11.7	**The remedy for FTA-2/LF-2 is protective of human health and the environment in the short-term.** The LTM program is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended to prevent exposure to contaminated groundwater. For the remedy to be protective in the long-term, an ESD should be issued which replaces the current GW-1 EPH/VPH groundwater cleanup standards with federal risk-based standards (for those TPH fractions which have comparative values between the MCP and the EPA RSLs).

Table 1-6
Summary of Protectiveness Statements
6th Five-Year Review, 2017-2022

Site Name	FYR Section Number	Protectiveness Statements
PFSA	4.12.7	**The remedy for the PFSA is protective of human health and the environment.** The LTM program is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended to prevent exposure to contaminated groundwater. For the remedy to be protective in the long-term, an ESD should be issued which replaces the current GW-1 EPH/VPH groundwater cleanup standards with federal risk-based standards (for those TPH fractions which have comparative values between the MCP and the EPA RSLs).
Munitions Response Sites		
Mock Village	5.1.7	**The remedy for the Mock Village MRS is protective of human health and the environment.** No changes in site conditions were observed during the site visit and the LUCs are in place and are being implemented.

Key:

AV = Ashumet Valley
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC = contaminant of concern
CS = Chemical Spill
CSM = conceptual site model
DD = decision document
FS = Fuel Spill
FTA = Fire Training Area
JBCC = Joint Base Cape Cod
LF = Landfill
LTM = long term monitoring
LUC = land use control
MRS = munitions response site
PFAS = per- and polyfluoroalkyl substances
PFSA = Petroleum Fuels Storage Area
RAL = remedial action level
RAO = remedial action objective
RDX = Royal Demolition Explosive or hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD = Record of Decision
RSL = regional screening level
SD = Storm Drain
SPEIM = System Performance and Ecological Impact Monitoring
TMB = trimethylbenzene
UU/UE = unlimited use and unrestricted exposure
UXO = unexploded ordnance
VI = vapor intrusion
µg/L = micrograms per liter

Table 1-7
Sitewide Protectiveness Statement
6th Five-Year Review, 2017-2022

Protectiveness Statement
The Remedial Actions taken are currently protective of human health and the environment; however, the follow-up actions listed in Table 1-4 for the following sites need to be completed to ensure long-term protectiveness: CS-10 Source Area Detail C and F; FTA-2/LF-2 Source Area; Ashumet Valley Groundwater; CS-10 Groundwater; LF-1 Groundwater; FTA-2/LF-2 Groundwater; and PFSA (FS-10/FS-11) Groundwater.

Table 1-8
EPA SEMS Operable Unit Number and Document Section
6th Five-Year Review, 2017-2022

OU#	Site Name	Document Section
1	FS-12	4.6
2	CS-4	4.2
5	FTA-2/LF-2, PFSA/FS-10/FS-11	3.3, 3.4, 4.11, 4.12
7	LF-1 Landfill Cap	3.2
8	CS-10 Source Area	3.1
9	Southwest Operable Unit (CS-4, CS-21, FS-13)	4.2, 4.5, 4.7
13	SD-5 North	4.10
14	CS-10 Sandwich Road	4.3
15	Ashumet Valley Groundwater	4.1
16	LF-1 Groundwater	4.9
19	FS-28	4.8
20	SD-5 South	4.10
21	CS-10 In-Plume	4.3
22	CS-10 Southwest	4.3
24	CS-19	4.4
29	Mock Village	5.1

Note: Table 1-8 depicts OUs addressed in this FYR.

Key:
CS = Chemical Spill
EPA = U.S. Environmental Protection Agency
FS = Fuel Spill
FTA = Fire Training Area
LF = Landfill
OU = Operable Unit
PFSA = Petroleum Fuel Storage Area
SD = Storm Drain
SEMS = Superfund Enterprise Management System

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	42800	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	Yes	Well formerly plumbed to clothes washing machine, not used as a source of potable water. Well no longer plumbed to house per owner feedback to annual mailing. Well sampled for PFAS in 2014: Sum of PFAS6 greater than MMCL
AV	39900	Falmouth	Active Irrigation Well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2013. Technical evaluation completed in 2013 and no unacceptable exposure to COCs. No further evaluation or sampling required for original COCs. Addressed in 2018 FYR.
AV	39788	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	42775	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	45208	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	46926	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	46964	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	46976	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	46987	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	46989	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	47105	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	50107	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	50111	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	50575	Falmouth	Confirmed that no well present	Yes	Owner unsure if well is present	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
AV	39851	Falmouth	Operational irrigation well	Yes	Routine Sampling needed to demonstrate no impact from COCs.	Yes	Sampling of this well discontinued in 2018. Monitoring data confirmed no impacts from COCs and the technical evaluation was updated in 2018. No further evaluation or sampling required for original COCs.
AV	39835	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in late 2016. Technical evaluation completed in 2017 and no unacceptable exposure to COCs. Well sampled for PFAS in 2017: Sum of PFAS6 greater than MMCL. No further evaluation or sampling required for original COCs. Addressed in 2018 FYR.
AV	39899	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2013. Technical evaluation completed in 2013 and no unacceptable exposure to COCs. No further evaluation or sampling required for original COCs. Addressed in 2018 FYR.
AV	47065	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2020. Technical evaluation completed in 2020 and no unacceptable exposure to COCs. Well sampled for PFAS in 2020: sum of PFAS6 = 0.
AV	39797	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2021. Technical evaluation completed in 2021 and no unacceptable exposure to COCs. Well sampled for PFAS in 2021: sum of PFAS6 less than MMCL. No further evaluation or sampling required for original COCs.
AV	39665	Falmouth	Operational irrigation well	Yes	Well reportedly not present on property	Yes	Well was restarted for irrigation in 2021. Technical evaluation completed in 2021 and no unacceptable exposure to COCs. Well sampled for PFAS in 2021: sum of PFAS6 greater than MMCL. No further evaluation or sampling required for original COCs.
AV	39663	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2021. Technical evaluation completed in 2021 and no unacceptable exposure to COCs. Well sampled for PFAS in 2021: sum of PFAS6 greater than MMCL. No further evaluation or sampling required for original COCs.
AV	39898	Falmouth	Operational irrigation well	Yes	Outreach not achieved	Yes	New owner confirmed a well is present in 2014 and they would like to restart for irrigation purposes. Technical evaluation completed in 2017 and no unacceptable exposure to COCs. Well sampled for PFAS in 2015: Sum of PFAS6 greater than MMCL.
AV	39655	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39658	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39668	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39669	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39674	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39676	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39697	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39698	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39701	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39706	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	39713	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39763	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39770	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39774	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39779	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39786	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39787	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39790	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39791	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39794	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39800	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39802	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39804	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39820	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39829	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39841	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39842	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39860	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39895	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39896	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39903	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39905	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39911	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42777	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42778	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42783	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42789	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42793	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42801	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	42802	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42807	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42808	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42814	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42815	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	43894	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	43897	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	45143	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	46914	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	46971	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47029	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47030	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47062	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47079	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47080	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82528	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82529	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82533	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82628	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39660	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39667	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39688	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39691	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39692	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39693	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39773	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39775	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39785	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39796	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	39813	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39817	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39819	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39821	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39824	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39825	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39827	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39834	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39844	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39850	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39853	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39854	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39857	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39883	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39884	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	39901	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42779	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42784	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42787	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42790	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42809	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42812	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	42813	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	43920	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	45216	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	46950	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	47031	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	50576	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	50577	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	50578	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82530	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82532	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify non-operational status.
AV	82448	Falmouth	Operational drinking water well	No	No risk of exposure to COCs.	No	No further evaluation or sampling required. Well sampled for PFAS 2013-2016: Sum of PFAS6 = 0. Sampling for PFAS discontinued in 2017.
AV	82448	Falmouth	Operational Irrigation Well	No	No risk of exposure to COCs.	No	No further evaluation or sampling required. Note this is an irrigation well on the same parcel that has a private drinking water well that has also been evaluated. Wells were sampled for PFAS 2013-2016: Sum of PFAS6 = 0. Sampling for PFAS discontinued in 2017.
AV	39659	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39677	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39689	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39690	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39695	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39696	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39700	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39708	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39711	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39772	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39831	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39846	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39847	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39855	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39892	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39902	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39910	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	42792	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	45155	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	45194	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	46967	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	47028	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	47077	Falmouth	Operational irrigation well	NA	No risk of exposure to COCs.	Yes	Four (4) cranberry bog irrigation wells that are no longer monitored per a 2019 SPEIM Network Optimization.
AV	50090	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	50604	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	82368	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	82470	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
AV	39683	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39776	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39783	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39789	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39793	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39808	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39828	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	39909	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	42782	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
AV	42786	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	42805	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	45173	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	45174	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	46373	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	47089	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	50608	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	50609	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	50613	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	82520	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	82531	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
AV	82630	Falmouth	Unknown if well is present.	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.
CS-10	31343	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	Yes	Former drinking water well now used solely for irrigation. AFCEC connected to municipal water in 2018. Well sampled for PFAS in 2016: sum of PFAS6 greater than MMCL.
CS-10	39868	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	Yes	Former drinking water well now used solely for irrigation. AFCEC connected to municipal water in 2017. Well sampled for PFAS 2016-2017: sum of PFAS6 greater than MMCL.
CS-10	30518	Mashpee	Operational irrigation well	Yes	No well on property.	Yes	New irrigation well installed 2018. AFCEC provided well determination to Mashpee Board of Health stating no concerns from COCs, but PFAS present in shallow groundwater. Recommend Technical Evaluation be prepared.
CS-10	39919	Falmouth	Operational irrigation well	Yes	No well on property.	Yes	New irrigation well installed 2018. AFCEC provided well determination to Mashpee Board of Health stating no concerns from COCs, but PFAS present in shallow groundwater. Recommend Technical Evaluation be prepared.
CS-10	31704	Mashpee	Operational Irrigation Well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2015. Technical evaluation completed in 2016 and no unacceptable exposure to COCs. No further evaluation or sampling required for original COCs. Addressed in 2018 FYR.
CS-10	30589	Mashpee	Operational Irrigation Well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	New irrigation well installed 2019. Technical evaluation completed in 2019 and no unacceptable exposure to COCs.
CS-10	30643	Mashpee	Operational irrigation well	Yes	Owner unsure if well is present	Yes	Well was restarted for irrigation in 2016. Technical evaluation completed in 2016 and no unacceptable exposure to COCs. No further evaluation or sampling required for original COCs. Addressed in 2018 FYR.
CS-10	30055	Mashpee	No well is present.	Yes	Outreach not achieved	Yes	Confirmed that no well present based on property owner feedback subsequent to initial determination
CS-10	29952	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	29992	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	29996	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30025	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30350	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30419	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30425	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30499	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30515	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30581	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30621	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30627	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30630	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30658	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30679	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30741	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30747	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30828	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30870	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30918	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	30977	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31023	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
CS-10	31082	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31083	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31102	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31124	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31151	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31207	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31213	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31240	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31242	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31321	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31342	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31356	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31433	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31444	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31454	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31462	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31466	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31479	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31487	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31523	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31533	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31609	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31629	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31671	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31672	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31692	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31713	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31729	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	31750	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	39761	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	39869	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	39871	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	39877	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-10	29857	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29886	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29948	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29995	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30007	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30024	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30455	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
CS-10	30482	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30497	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30576	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30597	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30611	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30640	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30670	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31045	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31109	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31248	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31324	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31610	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31734	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29757	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29883	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29910	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29935	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30004	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30043	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30058	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30081	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30338	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30353	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30385	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30420	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30465	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30504	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30574	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30617	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
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Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
CS-10	30644	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30645	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30692	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30715	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30831	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	30847	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31058	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31173	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31217	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31362	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31380	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31402	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31403	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31411	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31441	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31519	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31526	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31589	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	31829	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	39866	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	39920	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-10	29870	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	30349	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	30501	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31143	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31186	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31387	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31501	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31519	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	31702	Mashpee	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	39874	Falmouth	Owner unsure if well is present	Yes	Owner unsure if well is present	No	Annual letters are mailed to verify no change in status.
CS-10	29983	Mashpee	Owner unsure if well is present	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.
CS-10	30077	Mashpee	Owner unsure if well is present	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
CS-10	30629	Mashpee	Owner unsure if well is present	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.
CS-10	30836	Mashpee	Owner unsure if well is present	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.
CS-10	31593	Mashpee	Owner unsure if well is present	Yes	Outreach not achieved	No	Annual letters are mailed to verify no change in status.
CS-21	39561	Falmouth	Operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	Yes	Well was restarted for irrigation in 2013. Technical Evaluation completed in 2013 and no unacceptable exposure to COCs. No further evaluation or sampling required. Addressed in 2018 FYR.
CS-21	82381	Falmouth	Operational irrigation well	Yes	Annual Sampling needed to demonstrate no impact from COCs.	Yes	Sampling of these golf course irrigation wells (69IG0015/69IG0016) discontinued in 2016 with regulatory agency concurrence.
CS-21	39565	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39567	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39570	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39572	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39582	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39583	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
CS-21	39562	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39574	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39584	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39566	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39578	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39580	Falmouth	Well Abandoned in place	Yes	Well abandoned in place. No risk of exposure to groundwater.	No	No further evaluation or sampling required.
CS-21	39581	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
CS-21	39586	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
FS-12	65850	Sandwich	Four non-operational irrigation wells	Yes	Wells are not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
FS-28	42524	Falmouth	Operational irrigation well	Yes	Routine Sampling needed to demonstrate no impact from COCs.	Yes	Well determination was updated in 2018. No further evaluation or sampling is required.
FS-28	42575	Falmouth	Operational irrigation well	Yes	No well is present.	Yes	New irrigation well installed in 2021. Technical evaluation completed in 2021 and no unacceptable exposure to COCs. No further evaluation or sampling required.
FS-28	38240	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	Annual letters are mailed to verify no change in status.
FS-28	42602	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	Annual letters are mailed to verify no change in status.
FS-28	42551	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
FS-28	42552	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
FS-28	42631	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	84394	Falmouth	Operational drinking water well	No	No risk of exposure to COCs.	No	No further evaluation or sampling required.
LF-1	37352	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
LF-1	37374	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
LF-1	37436	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
LF-1	37441	Falmouth	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
LF-1	37328	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37334	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
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Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
LF-1	37336	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37337	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37342	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37344	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37345	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37347	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37348	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37349	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37351	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37354	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37357	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37364	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37369	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37373	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37375	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37377	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37378	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37381	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37382	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37387	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37439	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37440	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37442	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37453	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	37458	Falmouth	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81369	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81387	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81422	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81433	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.

Table 2-1
Summary of Private Wells Within IRP Plume LUC Areas
6th Five-Year Review, 2017-2022

Plume	APEMS ID	Parcel City	Current Well Status	Municipal Water Account	Initial Determination	Change in Status or Determination	Comment
LF-1	81443	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81515	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	81520	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
LF-1	82259	Bourne	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30117	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30145	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30163	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30189	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30197	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30116	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30140	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30144	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30152	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30156	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30185	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
SD5	30329	Mashpee	Non-operational irrigation well	Yes	Well is not used. No risk of exposure to groundwater.	No	Annual letters are mailed to verify no change in status.
PFSA	30130	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.
PFSA	30149	Mashpee	Operational irrigation well	Yes	No risk of exposure to COCs.	No	No further evaluation or sampling required.

The remedial actions at the FS-1, FS-29, CS-23 and CS-20 plumes have been completed and no unacceptable residual risks to human health or the environment from plume COCs exist.

APEMS = Air Force Parcel and Easement Management System
AV = Ashumet Valley
COC = contaminant of concern
CS = chemical spill
COC = contaminant of concern
LF = landfill
NA = not applicable - parcel containing commercial cranberry bog with no residential structures.
FS = Fuel Spill
MMCL = Massachusetts Maximum Contaminant Level
PFAS = per- and polyfluoroalkyl substances
SD = storm drain
SPEIM = System Performance and Ecological Impact Monitoring

Indicates APEMS IDs that are discussed in 6th FYR, 2017-2022

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601004	3	SW8270	2-METHYLNAPHTHALENE	450	0.45	1	3000	N	1.8
TP1601	11/12/2003	TP1601004	3	SW8270	2-METHYLNAPHTHALENE	500	0.5	1	3000	N	1.8
TP1601	11/12/2003	TP1601004	3	SW8270	ACENAPHTHENE	5200	**5.2**	4	45000	**Y**	
TP1601	11/12/2003	TP1601004	3	SW8270	ACENAPHTHENE	4500	**4.5**	4	45000	**Y**	
TP1601	11/12/2003	TP1601004	3	SW8270	ACENAPHTHYLENE	65	0.065	1	N/A	N	
TP1601	11/12/2003	TP1601004	3	SW8270	ANTHRACENE	7800	7.8	5000	230000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	ANTHRACENE	9400	9.4	5000	230000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(a)ANTHRACENE	19000	19	300	21	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(a)ANTHRACENE	16000	16	300	21	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(a)PYRENE	15000	**15**	30	2.1	**Y**	0.64
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(a)PYRENE	17000	**17**	30	2.1	**Y**	0.64
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(b)FLUORANTHENE	16000	16	300	21	N	1.35
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(b)FLUORANTHENE	19000	19	300	21	N	1.35
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(g,h,i)PERYLENE	5400	5.4	5000	N/A	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(g,h,i)PERYLENE	11000	11	5000	N/A	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(k)FLUORANTHENE	13000	13	3000	210	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BENZO(k)FLUORANTHENE	7400	7.4	3000	210	N	
TP1601	11/12/2003	TP1601004	3	SW8270	BIPHENYL (DIPHENYL)	150	**0.15**	0.05	200	**Y**	
TP1601	11/12/2003	TP1601004	3	SW8270	CARBAZOLE	4200		N/A	N/A		
TP1601	11/12/2003	TP1601004	3	SW8270	CARBAZOLE	3600		N/A	N/A		
TP1601	11/12/2003	TP1601004	3	SW8270	CHRYSENE	15000	15	3000	2100	N	
TP1601	11/12/2003	TP1601004	3	SW8270	CHRYSENE	18000	18	3000	2100	N	
TP1601	11/12/2003	TP1601004	3	SW8270	DIBENZ(a,h)ANTHRACENE	5500	**5.5**	30	2.1	**Y**	0.11
TP1601	11/12/2003	TP1601004	3	SW8270	DIBENZ(a,h)ANTHRACENE	2400	**2.4**	30	2.1	**Y**	0.11
TP1601	11/12/2003	TP1601004	3	SW8270	DIBENZOFURAN	1600		N/A	N/A		
TP1601	11/12/2003	TP1601004	3	SW8270	DIBENZOFURAN	1900		N/A	N/A		
TP1601	11/12/2003	TP1601004	3	SW8270	DI-n-OCTYLPHTHALATE	91		N/A	N/A		
TP1601	11/12/2003	TP1601004	3	SW8270	FLUORANTHENE	45000	450	5000	30000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	FLUORANTHENE	37000	370	5000	30000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	FLUORENE	4000	4	5000	30000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	FLUORENE	4600	4.6	5000	30000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	INDENO(1,2,3-c,d)PYRENE	12000	12	300	21	N	
TP1601	11/12/2003	TP1601004	3	SW8270	INDENO(1,2,3-c,d)PYRENE	6600	6.6	300	21	N	
TP1601	11/12/2003	TP1601004	3	SW8270	NAPHTHALENE	960	0.96	4	8.6	N	
TP1601	11/12/2003	TP1601004	3	SW8270	NAPHTHALENE	830	0.83	4	8.6	N	
TP1601	11/12/2003	TP1601004	3	SW8270	PHENANTHRENE	30000	**30**	20	N/A	**Y**	
TP1601	11/12/2003	TP1601004	3	SW8270	PHENANTHRENE	36000	**36**	20	N/A	**Y**	
TP1601	11/12/2003	TP1601004	3	SW8270	PYRENE	32000	32	5000	23000	N	
TP1601	11/12/2003	TP1601004	3	SW8270	PYRENE	37000	37	5000	23000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	2-METHYLNAPHTHALENE	510	0.51	1	3000	N	1.8

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601006	5	SW8270	2-METHYLNAPHTHALENE	660	0.66	1	3000	N	1.8
TP1601	11/12/2003	TP1601006	5	SW8270	ACENAPHTHENE	5500	**5.5**	4	45000	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	ACENAPHTHENE	4300	**4.3**	4	45000	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	ANTHRACENE	7500	7.5	5000	230000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	ANTHRACENE	9700	9.7	5000	230000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(a)ANTHRACENE	17000	17	300	21	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(a)ANTHRACENE	14000	14	300	21	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(a)PYRENE	12000	**12**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(a)PYRENE	16000	**16**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(b)FLUORANTHENE	16000	16	300	21	N	1.35
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(b)FLUORANTHENE	15000	15	300	21	N	1.35
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(g,h,i)PERYLENE	5400	5.4	5000	N/A	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(g,h,i)PERYLENE	9800	9.8	5000	N/A	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(k)FLUORANTHENE	9900	9.9	3000	210	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BENZO(k)FLUORANTHENE	6300	6.3	3000	210	N	
TP1601	11/12/2003	TP1601006	5	SW8270	BIPHENYL (DIPHENYL)	210	**0.21**	0.05	200	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	BIPHENYL (DIPHENYL)	170	**0.17**	0.05	200	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	CARBAZOLE	3700		N/A	N/A		
TP1601	11/12/2003	TP1601006	5	SW8270	CARBAZOLE	4600		N/A	N/A		
TP1601	11/12/2003	TP1601006	5	SW8270	CHRYSENE	16000	16	3000	2100	N	
TP1601	11/12/2003	TP1601006	5	SW8270	CHRYSENE	13000	13	3000	2100	N	
TP1601	11/12/2003	TP1601006	5	SW8270	DIBENZ(a,h)ANTHRACENE	2400	**2.4**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601006	5	SW8270	DIBENZ(a,h)ANTHRACENE	4700	**4.7**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601006	5	SW8270	DIBENZOFURAN	2100		N/A	N/A		
TP1601	11/12/2003	TP1601006	5	SW8270	DIBENZOFURAN	1700		N/A	N/A		
TP1601	11/12/2003	TP1601006	5	SW8270	FLUORANTHENE	32000	320	5000	30000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	FLUORANTHENE	42000	420	5000	30000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	FLUORENE	4900	4.9	5000	30000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	FLUORENE	4000	4	5000	30000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	INDENO(1,2,3-c,d)PYRENE	6300	6.3	300	21	N	
TP1601	11/12/2003	TP1601006	5	SW8270	INDENO(1,2,3-c,d)PYRENE	11000	11	300	21	N	
TP1601	11/12/2003	TP1601006	5	SW8270	NAPHTHALENE	1000	1	4	8.6	N	
TP1601	11/12/2003	TP1601006	5	SW8270	NAPHTHALENE	1300	1.3	4	8.6	N	
TP1601	11/12/2003	TP1601006	5	SW8270	PHENANTHRENE	36000	**36**	20	N/A	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	PHENANTHRENE	28000	**28**	20	N/A	Y	
TP1601	11/12/2003	TP1601006	5	SW8270	PYRENE	33000	33	5000	23000	N	
TP1601	11/12/2003	TP1601006	5	SW8270	PYRENE	27000	27	5000	23000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	2-METHYLNAPHTHALENE	780	0.78	1	3000	N	1.8
TP1601	11/12/2003	TP1601008	7	SW8270	2-METHYLNAPHTHALENE	1000	1	1	3000	N	1.8
TP1601	11/12/2003	TP1601008	7	SW8270	ACENAPHTHENE	9900	**9.9**	4	45000	Y	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601008	7	SW8270	ACENAPHTHENE	7100	**7.1**	4	45000	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	ACENAPHTHYLENE	91	0.091	1	N/A	N	
TP1601	11/12/2003	TP1601008	7	SW8270	ANTHRACENE	12000	12	5000	230000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	ANTHRACENE	18000	18	5000	230000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(a)ANTHRACENE	34000	**34**	300	21	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(a)ANTHRACENE	24000	**24**	300	21	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(a)PYRENE	23000	**23**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(a)PYRENE	32000	**32**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(b)FLUORANTHENE	30000	**30**	300	21	Y	1.35
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(b)FLUORANTHENE	32000	**32**	300	21	Y	1.35
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(g,h,i)PERYLENE	7300	7.3	5000	N/A	N	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(g,h,i)PERYLENE	19000	19	5000	N/A	N	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(k)FLUORANTHENE	24000	24	3000	210	N	
TP1601	11/12/2003	TP1601008	7	SW8270	BENZO(k)FLUORANTHENE	9800	9.8	3000	210	N	
TP1601	11/12/2003	TP1601008	7	SW8270	BIPHENYL (DIPHENYL)	250	**0.25**	0.05	200	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	PHTHALATE	160	0.16	N/A	160	No	0.96
TP1601	11/12/2003	TP1601008	7	SW8270	CARBAZOLE	6300		N/A	N/A		
TP1601	11/12/2003	TP1601008	7	SW8270	CARBAZOLE	8800		N/A	N/A		
TP1601	11/12/2003	TP1601008	7	SW8270	CHRYSENE	33000	33	3000	2100	N	
TP1601	11/12/2003	TP1601008	7	SW8270	CHRYSENE	24000	24	3000	2100	N	
TP1601	11/12/2003	TP1601008	7	SW8270	DIBENZ(a,h)ANTHRACENE	3400	**3.4**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601008	7	SW8270	DIBENZ(a,h)ANTHRACENE	9000	**9**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601008	7	SW8270	DIBENZOFURAN	3700		N/A	N/A		
TP1601	11/12/2003	TP1601008	7	SW8270	DIBENZOFURAN	2700		N/A	N/A		
TP1601	11/12/2003	TP1601008	7	SW8270	DI-n-OCTYLPHTHALATE	120		N/A	N/A		
TP1601	11/12/2003	TP1601008	7	SW8270	FLUORANTHENE	56000	560	5000	30000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	FLUORANTHENE	84000	840	5000	30000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	FLUORENE	6300	6.3	5000	30000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	FLUORENE	8700	8.7	5000	30000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	INDENO(1,2,3-c,d)PYRENE	8800	8.8	300	21	N	
TP1601	11/12/2003	TP1601008	7	SW8270	INDENO(1,2,3-c,d)PYRENE	20000	20	300	21	N	
TP1601	11/12/2003	TP1601008	7	SW8270	NAPHTHALENE	1400	1.4	4	8.6	N	
TP1601	11/12/2003	TP1601008	7	SW8270	NAPHTHALENE	2000	2	4	8.6	N	
TP1601	11/12/2003	TP1601008	7	SW8270	PHENANTHRENE	68000	**68**	20	N/A	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	PHENANTHRENE	46000	**46**	20	N/A	Y	
TP1601	11/12/2003	TP1601008	7	SW8270	PYRENE	69000	69	5000	23000	N	
TP1601	11/12/2003	TP1601008	7	SW8270	PYRENE	49000	49	5000	23000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	2-METHYLNAPHTHALENE	790	0.79	1	3000	N	1.8
TP1601	11/12/2003	TP1601010	9	SW8270	2-METHYLNAPHTHALENE	780	0.78	1	3000	N	1.8
TP1601	11/12/2003	TP1601010	9	SW8270	ACENAPHTHENE	11000	**11**	4	45000	Y	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601010	9	SW8270	ACENAPHTHENE	9600	**9.6**	4	45000	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	ACENAPHTHYLENE	100	0.1	1	N/A	N	
TP1601	11/12/2003	TP1601010	9	SW8270	ANTHRACENE	18000	18	5000	230000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	ANTHRACENE	21000	21	5000	230000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(a)ANTHRACENE	36000	**36**	300	21	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(a)ANTHRACENE	32000	**32**	300	21	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(a)PYRENE	30000	**30**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(a)PYRENE	32000	**32**	30	2.1	Y	0.64
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(b)FLUORANTHENE	32000	**32**	300	21	Y	1.35
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(b)FLUORANTHENE	44000	**44**	300	21	Y	1.35
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(g,h,i)PERYLENE	9200	9.2	5000	N/A	N	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(g,h,i)PERYLENE	19000	19	5000	N/A	N	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(k)FLUORANTHENE	23000	23	3000	210	N	
TP1601	11/12/2003	TP1601010	9	SW8270	BENZO(k)FLUORANTHENE	12000	12	3000	210	N	
TP1601	11/12/2003	TP1601010	9	SW8270	BIPHENYL (DIPHENYL)	360	**0.36**	0.05	200	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	PHTHALATE	130	0.13	N/A	160	No	0.96
TP1601	11/12/2003	TP1601010	9	SW8270	CARBAZOLE	8800		N/A	N/A		
TP1601	11/12/2003	TP1601010	9	SW8270	CARBAZOLE	9700		N/A	N/A		
TP1601	11/12/2003	TP1601010	9	SW8270	CHRYSENE	35000	35	3000	2100	N	
TP1601	11/12/2003	TP1601010	9	SW8270	CHRYSENE	31000	31	3000	2100	N	
TP1601	11/12/2003	TP1601010	9	SW8270	DIBENZ(a,h)ANTHRACENE	4200	**4.2**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601010	9	SW8270	DIBENZ(a,h)ANTHRACENE	9800	**9.8**	30	2.1	Y	0.11
TP1601	11/12/2003	TP1601010	9	SW8270	DIBENZOFURAN	4100		N/A	N/A		
TP1601	11/12/2003	TP1601010	9	SW8270	DIBENZOFURAN	3800		N/A	N/A		
TP1601	11/12/2003	TP1601010	9	SW8270	DI-n-OCTYLPHTHALATE	140		N/A	N/A		
TP1601	11/12/2003	TP1601010	9	SW8270	FLUORANTHENE	88000	880	5000	30000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	FLUORANTHENE	73000	730	5000	30000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	FLUORENE	9700	9.7	5000	30000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	FLUORENE	8600	8.6	5000	30000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	INDENO(1,2,3-c,d)PYRENE	11000	11	300	21	N	
TP1601	11/12/2003	TP1601010	9	SW8270	INDENO(1,2,3-c,d)PYRENE	22000	**22**	300	21	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	NAPHTHALENE	1700	1.7	4	8.6	N	
TP1601	11/12/2003	TP1601010	9	SW8270	NAPHTHALENE	1600	1.6	4	8.6	N	
TP1601	11/12/2003	TP1601010	9	SW8270	PHENANTHRENE	74000	**74**	20	N/A	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	PHENANTHRENE	60000	**60**	20	N/A	Y	
TP1601	11/12/2003	TP1601010	9	SW8270	PYRENE	71000	71	5000	23000	N	
TP1601	11/12/2003	TP1601010	9	SW8270	PYRENE	64000	64	5000	23000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	2-METHYLNAPHTHALENE	810	0.81	1	3000	N	1.8
TP1601	11/12/2003	TP1601012	11	SW8270	2-METHYLNAPHTHALENE	780	0.78	1	3000	N	1.8
TP1601	11/12/2003	TP1601012	11	SW8270	ACENAPHTHENE	10000	**10**	4	45000	Y	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
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Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601012	11	SW8270	ACENAPHTHENE	9300	**9.3**	4	45000	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	ACENAPHTHYLENE	190	0.19	1	N/A	N	
TP1601	11/12/2003	TP1601012	11	SW8270	ANTHRACENE	19000	19	5000	230000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	ANTHRACENE	21000	21	5000	230000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(a)ANTHRACENE	35000	**35**	300	21	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(a)ANTHRACENE	32000	**32**	300	21	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(a)PYRENE	30000	**30**	30	2.1	**Y**	0.64
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(a)PYRENE	32000	**32**	30	2.1	**Y**	0.64
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(b)FLUORANTHENE	29000	**29**	300	21	**Y**	1.35
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(b)FLUORANTHENE	42000	**42**	300	21	**Y**	1.35
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(g,h,i)PERYLENE	8700	8.7	5000	N/A	N	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(g,h,i)PERYLENE	18000	18	5000	N/A	N	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(k)FLUORANTHENE	25000	25	3000	210	N	
TP1601	11/12/2003	TP1601012	11	SW8270	BENZO(k)FLUORANTHENE	14000	14	3000	210	N	
TP1601	11/12/2003	TP1601012	11	SW8270	BIPHENYL (DIPHENYL)	360	**0.36**	0.05	200	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	PHTHALATE	200	0.2	N/A	160	N	0.96
TP1601	11/12/2003	TP1601012	11	SW8270	CARBAZOLE	7600		N/A	N/A		
TP1601	11/12/2003	TP1601012	11	SW8270	CARBAZOLE	8400		N/A	N/A		
TP1601	11/12/2003	TP1601012	11	SW8270	CHRYSENE	34000	34	3000	2100	N	
TP1601	11/12/2003	TP1601012	11	SW8270	CHRYSENE	31000	31	3000	2100	N	
TP1601	11/12/2003	TP1601012	11	SW8270	DIBENZ(a,h)ANTHRACENE	4000	**4**	30	2.1	**Y**	0.11
TP1601	11/12/2003	TP1601012	11	SW8270	DIBENZ(a,h)ANTHRACENE	9400	**9.4**	30	2.1	**Y**	0.11
TP1601	11/12/2003	TP1601012	11	SW8270	DIBENZOFURAN	4000		N/A	N/A		
TP1601	11/12/2003	TP1601012	11	SW8270	DIBENZOFURAN	3700		N/A	N/A		
TP1601	11/12/2003	TP1601012	11	SW8270	DI-n-OCTYLPHTHALATE	210		N/A	N/A		
TP1601	11/12/2003	TP1601012	11	SW8270	FLUORANTHENE	71000	710	5000	30000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	FLUORANTHENE	89000	890	5000	30000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	FLUORENE	9600	9.6	5000	30000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	FLUORENE	8700	8.7	5000	30000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	INDENO(1,2,3-c,d)PYRENE	11000	11	300	21	N	
TP1601	11/12/2003	TP1601012	11	SW8270	INDENO(1,2,3-c,d)PYRENE	21000	21	300	21	N	
TP1601	11/12/2003	TP1601012	11	SW8270	NAPHTHALENE	1400	1.4	4	8.6	N	
TP1601	11/12/2003	TP1601012	11	SW8270	NAPHTHALENE	1600	1.6	4	8.6	N	
TP1601	11/12/2003	TP1601012	11	SW8270	PHENANTHRENE	61000	**61**	20	N/A	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	PHENANTHRENE	74000	**74**	20	N/A	**Y**	
TP1601	11/12/2003	TP1601012	11	SW8270	PYRENE	65000	65	5000	23000	N	
TP1601	11/12/2003	TP1601012	11	SW8270	PYRENE	70000	70	5000	23000	N	
TP1601	11/12/2003	TP1601014	13	SW8270	FLUORANTHENE	150	1.5	5000	30000	N	
TP1601	11/12/2003	TP1601014	13	SW8270	PHENANTHRENE	110	0.11	20	N/A	N	
TP1601	11/12/2003	TP1601014	13	SW8270	PYRENE	120	0.12	5000	23000	N	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
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Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1601	11/12/2003	TP1601016	15	SW8270	FLUORANTHENE	80	0.8	5000	30000	N	
TP1602	11/12/2003	TP1602004	3	SW8270	FLUORANTHENE	120	1.2	5000	30000	N	
TP1602	11/12/2003	TP1602004	3	SW8270	PHENANTHRENE	110	0.11	20	N/A	N	
TP1602	11/12/2003	TP1602004	3	SW8270	PYRENE	110	0.11	5000	23000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	2-METHYLNAPHTHALENE	5400	**5.4**	1	3000	**Y**	1.8
TP1602	11/12/2003	TP1602016	15	SW8270	2-METHYLNAPHTHALENE	7000	**7**	1	3000	**Y**	1.8
TP1602	11/12/2003	TP1602016	15	SW8270	ACENAPHTHENE	55000	**55**	4	45000	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	ACENAPHTHENE	72000	**72**	4	45000	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	ANTHRACENE	140000	140	5000	230000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	ANTHRACENE	100000	100	5000	230000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(a)ANTHRACENE	170000	**170**	300	21	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(a)ANTHRACENE	220000	**220**	300	21	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(a)PYRENE	200000	**200**	30	2.1	**Y**	0.64
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(a)PYRENE	160000	**160**	30	2.1	**Y**	0.64
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(b)FLUORANTHENE	180000	**180**	300	21	**Y**	1.35
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(b)FLUORANTHENE	200000	**200**	300	21	**Y**	1.35
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(g,h,i)PERYLENE	110000	110	5000	N/A	N	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(g,h,i)PERYLENE	50000	50	5000	N/A	N	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(k)FLUORANTHENE	91000	91	3000	210	N	
TP1602	11/12/2003	TP1602016	15	SW8270	BENZO(k)FLUORANTHENE	140000	140	3000	210	N	
TP1602	11/12/2003	TP1602016	15	SW8270	BIPHENYL (DIPHENYL)	2000	**2**	0.05	200	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	CARBAZOLE	71000		N/A	N/A		
TP1602	11/12/2003	TP1602016	15	SW8270	CARBAZOLE	55000		N/A	N/A		
TP1602	11/12/2003	TP1602016	15	SW8270	CHRYSENE	160000	160	3000	2100	N	
TP1602	11/12/2003	TP1602016	15	SW8270	CHRYSENE	220000	220	3000	2100	N	
TP1602	11/12/2003	TP1602016	15	SW8270	DIBENZ(a,h)ANTHRACENE	58000	**58**	30	2.1	**Y**	0.11
TP1602	11/12/2003	TP1602016	15	SW8270	DIBENZ(a,h)ANTHRACENE	30000	**30**	30	2.1	**Y**	0.11
TP1602	11/12/2003	TP1602016	15	SW8270	DIBENZOFURAN	22000		N/A	N/A		
TP1602	11/12/2003	TP1602016	15	SW8270	DIBENZOFURAN	28000		N/A	N/A		
TP1602	11/12/2003	TP1602016	15	SW8270	FLUORANTHENE	550000	**5500**	5000	30000	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	FLUORANTHENE	400000	4000	5000	30000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	FLUORENE	49000	49	5000	30000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	FLUORENE	64000	64	5000	30000	N	
TP1602	11/12/2003	TP1602016	15	SW8270	INDENO(1,2,3-c,d)PYRENE	130000	**130**	300	21	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	INDENO(1,2,3-c,d)PYRENE	64000	**64**	300	21	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	NAPHTHALENE	19000	**19**	4	8.6	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	NAPHTHALENE	14000	**14**	4	8.6	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	PHENANTHRENE	480000	**480**	20	N/A	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	PHENANTHRENE	350000	**350**	20	N/A	**Y**	
TP1602	11/12/2003	TP1602016	15	SW8270	PYRENE	430000	430	5000	23000	N	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
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Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1602	11/12/2003	TP1602016	15	SW8270	PYRENE	330000	330	5000	23000	N	
TP1603	11/12/2003	TP1603004	3	SW8270	FLUORANTHENE	96	0.96	5000	30000	N	
TP1603	11/12/2003	TP1603004	3	SW8270	PHENANTHRENE	85	0.085	20	N/A	N	
TP1603	11/12/2003	TP1603004	3	SW8270	PYRENE	100	0.1	5000	23000	N	
TP1603	11/12/2003	TP1603012	11	SW8270	ACENAPHTHENE	370	0.37	4	45000	N	
TP1603	11/12/2003	TP1603012	11	SW8270	ANTHRACENE	650	0.65	5000	230000	N	
TP1603	11/12/2003	TP1603012	11	SW8270	BENZO(a)ANTHRACENE	1200	1.2	300	21	N	
TP1603	11/12/2003	TP1603012	11	SW8270	BENZO(a)PYRENE	1100	1.1	30	2.1	N	0.64
TP1603	11/12/2003	TP1603012	11	SW8270	BENZO(b)FLUORANTHENE	940	0.94	300	21	N	1.35
TP1603	11/12/2003	TP1603012	11	SW8270	BENZO(g,h,i)PERYLENE	700	0.7	5000	N/A	N	
TP1603	11/12/2003	TP1603012	11	SW8270	BENZO(k)FLUORANTHENE	900	0.9	3000	210	N	
TP1603	11/12/2003	TP1603012	11	SW8270	CARBAZOLE	330		N/A	N/A		
TP1603	11/12/2003	TP1603012	11	SW8270	CHRYSENE	1200	1.2	3000	2100	N	
TP1603	11/12/2003	TP1603012	11	SW8270	DIBENZ(a,h)ANTHRACENE	190	0.19	30	2.1	N	0.11
TP1603	11/12/2003	TP1603012	11	SW8270	DIBENZOFURAN	140		N/A	N/A		
TP1603	11/12/2003	TP1603012	11	SW8270	FLUORANTHENE	2900	29	5000	30000	N	
TP1603	11/12/2003	TP1603012	11	SW8270	FLUORENE	300	0.3	5000	30000	N	
TP1603	11/12/2003	TP1603012	11	SW8270	INDENO(1,2,3-c,d)PYRENE	680	0.68	300	21	N	
TP1603	11/12/2003	TP1603012	11	SW8270	NAPHTHALENE	78	0.078	4	8.6	N	
TP1603	11/12/2003	TP1603012	11	SW8270	PHENANTHRENE	2400	2.4	20	N/A	N	
TP1603	11/12/2003	TP1603012	11	SW8270	PYRENE	2500	2.5	5000	23000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	2-METHYLNAPHTHALENE	9300	**9.3**	1	3000	**Y**	1.8
TP1603	11/12/2003	TP1603014	13	SW8270	2-METHYLNAPHTHALENE	9600	**9.6**	1	3000	**Y**	1.8
TP1603	11/12/2003	TP1603014	13	SW8270	ACENAPHTHENE	71000	**71**	4	45000	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	ACENAPHTHENE	81000	**81**	4	45000	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	ACENAPHTHYLENE	690	0.69	1	N/A	N	
TP1603	11/12/2003	TP1603014	13	SW8270	ANTHRACENE	150000	150	5000	230000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	ANTHRACENE	120000	120	5000	230000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(a)ANTHRACENE	210000	**210**	300	21	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(a)ANTHRACENE	230000	**230**	300	21	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(a)PYRENE	190000	**190**	30	2.1	**Y**	0.64
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(a)PYRENE	200000	**200**	30	2.1	**Y**	0.64
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(b)FLUORANTHENE	210000	**210**	300	21	**Y**	1.35
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(b)FLUORANTHENE	290000	**290**	300	21	**Y**	1.35
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(g,h,i)PERYLENE	55000	55	5000	N/A	N	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(g,h,i)PERYLENE	100000	100	5000	N/A	N	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(k)FLUORANTHENE	140000	140	3000	210	N	
TP1603	11/12/2003	TP1603014	13	SW8270	BENZO(k)FLUORANTHENE	87000	87	3000	210	N	
TP1603	11/12/2003	TP1603014	13	SW8270	BIPHENYL (DIPHENYL)	3100	**3.1**	0.05	200	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	BIPHENYL (DIPHENYL)	2900	**2.9**	0.05	200	**Y**	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
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Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1603	11/12/2003	TP1603014	13	SW8270	CARBAZOLE	67000		N/A	N/A		
TP1603	11/12/2003	TP1603014	13	SW8270	CARBAZOLE	76000		N/A	N/A		
TP1603	11/12/2003	TP1603014	13	SW8270	CHRYSENE	230000	230	3000	2100	N	
TP1603	11/12/2003	TP1603014	13	SW8270	CHRYSENE	200000	200	3000	2100	N	
TP1603	11/12/2003	TP1603014	13	SW8270	DIBENZ(a,h)ANTHRACENE	26000	**26**	30	2.1	**Y**	0.11
TP1603	11/12/2003	TP1603014	13	SW8270	DIBENZ(a,h)ANTHRACENE	43000	**43**	30	2.1	**Y**	0.11
TP1603	11/12/2003	TP1603014	13	SW8270	DIBENZOFURAN	32000		N/A	N/A		
TP1603	11/12/2003	TP1603014	13	SW8270	DIBENZOFURAN	28000		N/A	N/A		
TP1603	11/12/2003	TP1603014	13	SW8270	FLUORANTHENE	390000	3900	5000	30000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	FLUORANTHENE	580000	**5800**	5000	30000	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	FLUORENE	71000	71	5000	30000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	FLUORENE	63000	63	5000	30000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	INDENO(1,2,3-c,d)PYRENE	65000	**65**	300	21	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	INDENO(1,2,3-c,d)PYRENE	120000	**120**	300	21	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	NAPHTHALENE	19000	**19**	4	8.6	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	NAPHTHALENE	21000	**21**	4	8.6	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	PHENANTHRENE	330000	**330**	20	N/A	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	PHENANTHRENE	510000	**510**	20	N/A	**Y**	
TP1603	11/12/2003	TP1603014	13	SW8270	PYRENE	390000	390	5000	23000	N	
TP1603	11/12/2003	TP1603014	13	SW8270	PYRENE	470000	470	5000	23000	N	
TP1603	11/12/2003	TP1603016	15	SW8270	FLUORANTHENE	92	0.92	5000	30000	N	
TP1604	11/12/2003	TP1604008	7	SW8270	DI-n-OCTYLPHTHALATE	280					
TP1604	11/12/2003	TP1604008	7	SW8270	FLUORANTHENE	57	0.57	5000	30000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	2-METHYLNAPHTHALENE	23000	**23**	1	3000	**Y**	1.8
TP1604	11/12/2003	TP1604010	9	SW8270	2-METHYLNAPHTHALENE	22000	**22**	1	3000	**Y**	1.8
TP1604	11/12/2003	TP1604010	9	SW8270	ACENAPHTHENE	170000	**170**	4	45000	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	ACENAPHTHENE	180000	**180**	4	45000	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	ACENAPHTHYLENE	1800	**1.8**	1	N/A	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	ANTHRACENE	330000	330	5000	230000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	ANTHRACENE	330000	330	5000	230000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(a)ANTHRACENE	530000	**530**	300	21	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(a)ANTHRACENE	530000	**530**	300	21	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(a)PYRENE	490000	**490**	30	2.1	**Y**	0.64
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(a)PYRENE	470000	**470**	30	2.1	**Y**	0.64
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(b)FLUORANTHENE	430000	**430**	300	21	**Y**	1.35
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(b)FLUORANTHENE	720000	**720**	300	21	**Y**	1.35
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(g,h,i)PERYLENE	120000	120	5000	N/A	N	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(g,h,i)PERYLENE	250000	250	5000	N/A	N	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(k)FLUORANTHENE	380000	**380**	3000	210	**Y**	
TP1604	11/12/2003	TP1604010	9	SW8270	BENZO(k)FLUORANTHENE	250000	**250**	3000	210	**Y**	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1604	11/12/2003	TP1604010	9	SW8270	BIPHENYL (DIPHENYL)	7300	**7.3**	0.05	200	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	CARBAZOLE	180000		N/A	N/A		
TP1604	11/12/2003	TP1604010	9	SW8270	CARBAZOLE	170000		N/A	N/A		
TP1604	11/12/2003	TP1604010	9	SW8270	CHRYSENE	500000	500	3000	2100	N	
TP1604	11/12/2003	TP1604010	9	SW8270	CHRYSENE	510000	510	3000	2100	N	
TP1604	11/12/2003	TP1604010	9	SW8270	DIBENZ(a,h)ANTHRACENE	80000	**80**	30	2.1	Y	0.11
TP1604	11/12/2003	TP1604010	9	SW8270	DIBENZ(a,h)ANTHRACENE	130000	**130**	30	2.1	Y	0.11
TP1604	11/12/2003	TP1604010	9	SW8270	DIBENZOFURAN	74000		N/A	N/A		
TP1604	11/12/2003	TP1604010	9	SW8270	DIBENZOFURAN	78000		N/A	N/A		
TP1604	11/12/2003	TP1604010	9	SW8270	FLUORANTHENE	1200000	**12000**	5000	30000	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	FLUORANTHENE	1300000	**13000**	5000	30000	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	FLUORENE	160000	160	5000	30000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	FLUORENE	170000	170	5000	30000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	INDENO(1,2,3-c,d)PYRENE	160000	**160**	300	21	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	INDENO(1,2,3-c,d)PYRENE	270000	**270**	300	21	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	NAPHTHALENE	53000	**53**	4	8.6	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	NAPHTHALENE	49000	**49**	4	8.6	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	PHENANTHRENE	1200000	**1200**	20	N/A	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	PHENANTHRENE	1000000	**1000**	20	N/A	Y	
TP1604	11/12/2003	TP1604010	9	SW8270	PYRENE	1100000	1100	5000	23000	N	
TP1604	11/12/2003	TP1604010	9	SW8270	PYRENE	1100000	1100	5000	23000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	2-METHYLNAPHTHALENE	2000	**2**	1	3000	Y	1.8
TP1604	11/12/2003	TP1604012	11	SW8270	2-METHYLNAPHTHALENE	2100	**2.1**	1	3000	Y	1.8
TP1604	11/12/2003	TP1604012	11	SW8270	ACENAPHTHENE	18000	**18**	4	45000	Y	
TP1604	11/12/2003	TP1604012	11	SW8270	ACENAPHTHENE	17000	**17**	4	45000	Y	
TP1604	11/12/2003	TP1604012	11	SW8270	ACENAPHTHYLENE	390	0.39	1	N/A	N	
TP1604	11/12/2003	TP1604012	11	SW8270	ANTHRACENE	34000	34	5000	230000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	ANTHRACENE	38000	38	5000	230000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(a)ANTHRACENE	52000	**52**	300	21	Y	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(a)ANTHRACENE	56000	**56**	300	21	Y	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(a)PYRENE	47000	**47**	30	2.1	Y	0.64
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(a)PYRENE	51000	**51**	30	2.1	Y	0.64
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(b)FLUORANTHENE	46000	**46**	300	21	Y	1.35
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(b)FLUORANTHENE	54000	**54**	300	21	Y	1.35
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(g,h,i)PERYLENE	18000	18	5000	N/A	N	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(g,h,i)PERYLENE	29000	29	5000	N/A	N	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(k)FLUORANTHENE	39000	39	3000	210	N	
TP1604	11/12/2003	TP1604012	11	SW8270	BENZO(k)FLUORANTHENE	26000	26	3000	210	N	
TP1604	11/12/2003	TP1604012	11	SW8270	BIPHENYL (DIPHENYL)	860	**0.86**	0.05	200	Y	
TP1604	11/12/2003	TP1604012	11	SW8270	BIPHENYL (DIPHENYL)	810	**0.81**	0.05	200	Y	

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
6th Five-Year Review, 2017-2022

Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1604	11/12/2003	TP1604012	11	SW8270	CARBAZOLE	18000		N/A	N/A		
TP1604	11/12/2003	TP1604012	11	SW8270	CARBAZOLE	16000		N/A	N/A		
TP1604	11/12/2003	TP1604012	11	SW8270	CHRYSENE	50000	50	3000	2100	N	
TP1604	11/12/2003	TP1604012	11	SW8270	CHRYSENE	54000	54	3000	2100	N	
TP1604	11/12/2003	TP1604012	11	SW8270	DIBENZ(a,h)ANTHRACENE	11000	**11**	30	2.1	**Y**	0.11
TP1604	11/12/2003	TP1604012	11	SW8270	DIBENZ(a,h)ANTHRACENE	11000	**11**	30	2.1	**Y**	0.11
TP1604	11/12/2003	TP1604012	11	SW8270	DIBENZOFURAN	8600		N/A	N/A		
TP1604	11/12/2003	TP1604012	11	SW8270	DIBENZOFURAN	9400		N/A	N/A		
TP1604	11/12/2003	TP1604012	11	SW8270	FLUORANTHENE	140000	1400	5000	30000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	FLUORANTHENE	130000	1300	5000	30000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	FLUORENE	18000	18	5000	30000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	FLUORENE	19000	19	5000	30000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	INDENO(1,2,3-c,d)PYRENE	30000	**30**	300	21	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	INDENO(1,2,3-c,d)PYRENE	22000	**22**	300	21	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	NAPHTHALENE	5100	**5.1**	4	8.6	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	NAPHTHALENE	4800	**4.8**	4	8.6	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	PHENANTHRENE	120000	**120**	20	N/A	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	PHENANTHRENE	130000	**130**	20	N/A	**Y**	
TP1604	11/12/2003	TP1604012	11	SW8270	PYRENE	110000	110	5000	23000	N	
TP1604	11/12/2003	TP1604012	11	SW8270	PYRENE	110000	110	5000	23000	N	
TP1604	11/12/2003	TP1604014	13	SW8270	2-METHYLNAPHTHALENE	310	0.31	1	3000	N	1.8
TP1604	11/12/2003	TP1604014	13	SW8270	ACENAPHTHENE	1400	1.4	4	45000	N	
TP1604	11/12/2003	TP1604014	13	SW8270	ANTHRACENE	2200	2.2	5000	230000	N	
TP1604	11/12/2003	TP1604014	13	SW8270	BENZO(a)ANTHRACENE	3200	3.2	300	21	N	
TP1604	11/12/2003	TP1604014	13	SW8270	BENZO(a)PYRENE	2800	**2.8**	30	2.1	**Y**	0.64
TP1604	11/12/2003	TP1604014	13	SW8270	BENZO(b)FLUORANTHENE	2800	2.8	300	21	N	1.35
TP1604	11/12/2003	TP1604014	13	SW8270	BENZO(g,h,i)PERYLENE	1600	1.6	5000	N/A	N	
TP1604	11/12/2003	TP1604014	13	SW8270	BENZO(k)FLUORANTHENE	2200	2.2	3000	210	N	
TP1604	11/12/2003	TP1604014	13	SW8270	BIPHENYL (DIPHENYL)	90	**0.09**	0.05	200	**Y**	
TP1604	11/12/2003	TP1604014	13	SW8270	CARBAZOLE	1200		N/A	N/A		
TP1604	11/12/2003	TP1604014	13	SW8270	CHRYSENE	3300	3.3	3000	2100	N	
TP1604	11/12/2003	TP1604014	13	SW8270	DIBENZ(a,h)ANTHRACENE	620	0.62	30	2.1	N	0.11
TP1604	11/12/2003	TP1604014	13	SW8270	DIBENZOFURAN	630		N/A	N/A		
TP1604	11/12/2003	TP1604014	13	SW8270	FLUORANTHENE	7800	78	5000	30000	N	
TP1604	11/12/2003	TP1604014	13	SW8270	FLUORENE	1200	1.2	5000	30000	N	
TP1604	11/12/2003	TP1604014	13	SW8270	INDENO(1,2,3-c,d)PYRENE	1800	1.8	300	21	N	
TP1604	11/12/2003	TP1604014	13	SW8270	NAPHTHALENE	650	0.65	4	8.6	N	
TP1604	11/12/2003	TP1604014	13	SW8270	PHENANTHRENE	7700	7.7	20	N/A	N	
TP1604	11/12/2003	TP1604014	13	SW8270	PYRENE	6500	6.5	5000	23000	N	
TP1604	11/12/2003	TP1604016	15	SW8270	2-METHYLNAPHTHALENE	100	0.1	1	3000	N	1.8

Table 3-1
Post-ROD Soil Sampling FTA-2/LF-2 Test Pit 16
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Location	Date	Sample Id	Depth (ft bgs)	Test	Analyte	Result (µg/kg)	Result Used in Comparison (mg/kg)	MCP S-3/GW-1 Standard (mg/kg)	EPA Industrial Soil RSL (TR=1E-06, HQ=1) (mg/kg)	Exceed?	Maximum Concentration used in HH PRA (ROD 1998) (mg/kg)
TP1604	11/12/2003	TP1604016	15	SW8270	ACENAPHTHENE	550	0.55	4	45000	N	
TP1604	11/12/2003	TP1604016	15	SW8270	ANTHRACENE	970	0.97	5000	230000	N	
TP1604	11/12/2003	TP1604016	15	SW8270	BENZO(a)ANTHRACENE	1500	1.5	300	21	N	
TP1604	11/12/2003	TP1604016	15	SW8270	BENZO(a)PYRENE	1300	1.3	30	2.1	N	0.64
TP1604	11/12/2003	TP1604016	15	SW8270	BENZO(b)FLUORANTHENE	1200	1.2	300	21	N	1.35
TP1604	11/12/2003	TP1604016	15	SW8270	BENZO(g,h,i)PERYLENE	830	0.83	5000	N/A	N	
TP1604	11/12/2003	TP1604016	15	SW8270	BENZO(k)FLUORANTHENE	1100	1.1	3000	210	N	
TP1604	11/12/2003	TP1604016	15	SW8270	CARBAZOLE	490		N/A	N/A		
TP1604	11/12/2003	TP1604016	15	SW8270	CHRYSENE	1500	1.5	3000	2100	N	
TP1604	11/12/2003	TP1604016	15	SW8270	DIBENZ(a,h)ANTHRACENE	290	0.29	30	2.1	N	0.11
TP1604	11/12/2003	TP1604016	15	SW8270	DIBENZOFURAN	270		N/A	N/A		
TP1604	11/12/2003	TP1604016	15	SW8270	FLUORANTHENE	3800	38	5000	30000	N	
TP1604	11/12/2003	TP1604016	15	SW8270	FLUORENE	510	0.51	5000	30000	N	
TP1604	11/12/2003	TP1604016	15	SW8270	INDENO(1,2,3-c,d)PYRENE	900	0.9	300	21	N	
TP1604	11/12/2003	TP1604016	15	SW8270	NAPHTHALENE	330	0.33	4	8.6	N	
TP1604	11/12/2003	TP1604016	15	SW8270	PHENANTHRENE	3500	3.5	20	N/A	N	
TP1604	11/12/2003	TP1604016	15	SW8270	PYRENE	3200	3.2	5000	23000	N	

KEY:
µg = micrograms
bgs = below ground surface
EPA = Environmental Protection Agency
ft = feet
HH PRA = human health preliminary risk assessment
HQ = hazard quotient
kg = kilograms
MCP = Massachusetts Contingency Plan
mg = milligrams
ROD = Record of Decision
RSL = regional screening level
TR = target cancer risk

Post-ROD result exceeds MCP and/or EPA industrial standard

Post-ROD result exceeds maximum concentration used in HH PRA

Table 4-1
PFAS Results from CS-10 Extraction Wells
6th Five-Year Review, 2017-2022

Location	Date	Test	Analyte	Result (µg/L)	RL (µg/L)	Screening Std (µg/L)	Type	Standard Exceeded?
03EW2102	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0005	0.005	0.601	RSL	N
03EW2102	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2102	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
03EW2102	07/19/2021	LC0012	(PFHxSA)	0.0021	0.005	0.039	RSL	N
03EW2102	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2102	07/19/2021	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0016	0.005	0.004	RSL	N
03EW2102	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
03EW2102	07/19/2021	LC0012	PFAS6 SUM	0.0021	0.005	0.02	MMCL	N
03EW2103	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0004	0.005	0.601	RSL	N
03EW2103	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2103	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0064	0.005	0.02	MMCL	N
03EW2103	07/19/2021	LC0012	(PFHxSA)	0.0031	0.005	0.039	RSL	N
03EW2103	**07/19/2021**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.02**	**0.005**	**0.006**	**RSL**	**Y**
03EW2103	**07/19/2021**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.0076**	**0.005**	**0.004**	**RSL**	**Y**
03EW2103	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0042	0.005	0.006	RSL	N
03EW2103	**07/19/2021**	**LC0012**	**PFAS6 SUM**	**0.0413**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2104	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0009	0.005	0.601	RSL	N
03EW2104	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2104	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0011	0.005	0.02	MMCL	N
03EW2104	07/19/2021	LC0012	(PFHxSA)	0.0054	0.005	0.039	RSL	N
03EW2104	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2104	07/19/2021	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0038	0.005	0.004	RSL	N
03EW2104	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0013	0.005	0.006	RSL	N
03EW2104	07/19/2021	LC0012	PFAS6 SUM	0.0092	0.005	0.02	MMCL	N
03EW2105	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0005	0.005	0.601	RSL	N
03EW2105	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2105	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0018	0.005	0.02	MMCL	N
03EW2105	07/19/2021	LC0012	(PFHxSA)	0.0024	0.005	0.039	RSL	N
03EW2105	**07/19/2021**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.0092**	**0.005**	**0.006**	**RSL**	**Y**
03EW2105	**07/19/2021**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.0053**	**0.005**	**0.004**	**RSL**	**Y**
03EW2105	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0032	0.005	0.006	RSL	N
03EW2105	**07/19/2021**	**LC0012**	**PFAS6 SUM**	**0.0201**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2107	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0018	0.005	0.601	RSL	N
03EW2107	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2107	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0035	0.005	0.02	MMCL	N
03EW2107	07/19/2021	LC0012	(PFHxSA)	0.016	0.005	0.039	RSL	N
03EW2107	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	0.0015	0.005	0.006	RSL	N
03EW2107	**07/19/2021**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.021**	**0.005**	**0.004**	**RSL**	**Y**
03EW2107	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0046	0.005	0.006	RSL	N
03EW2107	**07/19/2021**	**LC0012**	**PFAS6 SUM**	**0.0451**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2109	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0003	0.005	0.601	RSL	N
03EW2109	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2109	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0014	0.005	0.02	MMCL	N
03EW2109	07/19/2021	LC0012	(PFHxSA)	0.0039	0.005	0.039	RSL	N
03EW2109	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2109	**07/19/2021**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.0057**	**0.005**	**0.004**	**RSL**	**Y**
03EW2109	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0006	0.005	0.006	RSL	N
03EW2109	07/19/2021	LC0012	PFAS6 SUM	0.0096	0.005	0.02	MMCL	N
03EW2110	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.002	0.005	0.601	RSL	N
03EW2110	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2110	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0009	0.005	0.02	MMCL	N
03EW2110	07/19/2021	LC0012	(PFHxSA)	0.0051	0.005	0.039	RSL	N

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Location	Date	Test	Analyte	Result (µg/L)	RL (µg/L)	Screening Std (µg/L)	Type	Standard Exceeded?
03EW2110	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	0.0047	0.005	0.006	RSL	N
03EW2110	07/19/2021	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0017	0.005	0.004	RSL	N
03EW2110	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
03EW2110	07/19/2021	LC0012	PFAS6 SUM	0.0098	0.005	0.02	MMCL	N
03EW2111	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.001	0.005	0.601	RSL	N
03EW2111	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2111	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0043	0.005	0.02	MMCL	N
03EW2111	07/19/2021	LC0012	(PFHxSA)	0.027	0.005	0.039	RSL	N
03EW2111	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2111	**07/19/2021**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.067**	**0.005**	**0.004**	**RSL**	**Y**
03EW2111	**07/19/2021**	**LC0012**	**PERFLUOROOCTANOIC ACID (PFOA)**	**0.011**	**0.005**	**0.006**	**RSL**	**Y**
03EW2111	**07/19/2021**	**LC0012**	**PFAS6 SUM**	**0.1093**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2113	07/19/2021	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0009	0.005	0.601	RSL	N
03EW2113	07/19/2021	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2113	07/19/2021	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0012	0.005	0.02	MMCL	N
03EW2113	07/19/2021	LC0012	(PFHxSA)	0.0078	0.005	0.039	RSL	N
03EW2113	07/19/2021	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2113	07/19/2021	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0023	0.005	0.004	RSL	N
03EW2113	07/19/2021	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0009	0.005	0.006	RSL	N
03EW2113	07/19/2021	LC0012	PFAS6 SUM	0.0101	0.005	0.02	MMCL	N
03EW2170	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2170	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0012	0.005	0.601	RSL	N
03EW2170	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2170	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0016	0.005	0.02	MMCL	N
03EW2170	10/04/2022	LC0012	(PFHxSA)	0.012	0.005	0.039	RSL	N
03EW2170	**10/04/2022**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.015**	**0.005**	**0.006**	**RSL**	**Y**
03EW2170	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.013**	**0.005**	**0.004**	**RSL**	**Y**
03EW2170	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0025	0.005	0.006	RSL	N
03EW2170	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.0425**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2171	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2171	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.00055	0.005	0.601	RSL	N
03EW2171	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2171	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.001	0.005	0.02	MMCL	N
03EW2171	10/04/2022	LC0012	(PFHxSA)	0.01	0.005	0.039	RSL	N
03EW2171	10/04/2022	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2171	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.018**	**0.005**	**0.004**	**RSL**	**Y**
03EW2171	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0017	0.005	0.006	RSL	N
03EW2171	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.028**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2172	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2172	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.00089	0.005	0.601	RSL	N
03EW2172	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2172	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
03EW2172	10/04/2022	LC0012	(PFHxSA)	0.028	0.005	0.039	RSL	N
03EW2172	10/04/2022	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
03EW2172	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.023**	**0.005**	**0.004**	**RSL**	**Y**
03EW2172	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0017	0.005	0.006	RSL	N
03EW2172	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.051**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2173	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N

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Location	Date	Test	Analyte	Result (µg/L)	RL (µg/L)	Screening Std (µg/L)	Type	Standard Exceeded?
03EW2173	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0014	0.005	0.601	RSL	N
03EW2173	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2173	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0022	0.005	0.02	MMCL	N
03EW2173	10/04/2022	LC0012	(PFHxSA)	0.016	0.005	0.039	RSL	N
03EW2173	**10/04/2022**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.0065**	**0.005**	**0.006**	**RSL**	**Y**
03EW2173	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.12**	**0.005**	**0.004**	**RSL**	**Y**
03EW2173	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0052	0.005	0.006	RSL	N
03EW2173	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.1499**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2174	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2174	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0017	0.005	0.601	RSL	N
03EW2174	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2174	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0039	0.005	0.02	MMCL	N
03EW2174	10/04/2022	LC0012	(PFHxSA)	0.012	0.005	0.039	RSL	N
03EW2174	**10/04/2022**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.022**	**0.005**	**0.006**	**RSL**	**Y**
03EW2174	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.021**	**0.005**	**0.004**	**RSL**	**Y**
03EW2174	**10/04/2022**	**LC0012**	**PERFLUOROOCTANOIC ACID (PFOA)**	**0.0067**	**0.005**	**0.006**	**RSL**	**Y**
03EW2174	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.0656**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2175	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2175	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0011	0.005	0.601	RSL	N
03EW2175	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2175	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0017	0.005	0.02	MMCL	N
03EW2175	10/04/2022	LC0012	(PFHxSA)	0.013	0.005	0.039	RSL	N
03EW2175	10/04/2022	LC0012	PERFLUORONONANOIC ACID (PFNA)	0.0033	0.005	0.006	RSL	N
03EW2175	10/04/2022	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0029	0.005	0.004	RSL	N
03EW2175	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0022	0.005	0.006	RSL	N
03EW2175	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.0214**	**0.005**	**0.02**	**MMCL**	**Y**
03EW2176	10/04/2022	LC0012	HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPODA)	ND	0.005	0.006	RSL	N
03EW2176	10/04/2022	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0011	0.005	0.601	RSL	N
03EW2176	10/04/2022	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
03EW2176	10/04/2022	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0013	0.005	0.02	MMCL	N
03EW2176	10/04/2022	LC0012	(PFHxSA)	0.0095	0.005	0.039	RSL	N
03EW2176	10/04/2022	LC0012	PERFLUORONONANOIC ACID (PFNA)	0.0058	0.005	0.006	RSL	N
03EW2176	**10/04/2022**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.005**	**0.005**	**0.004**	**RSL**	**Y**
03EW2176	10/04/2022	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0015	0.005	0.006	RSL	N
03EW2176	**10/04/2022**	**LC0012**	**PFAS6 SUM**	**0.0203**	**0.005**	**0.02**	**MMCL**	**Y**

MMCL = Massachusetts Maximum Contaminant Level (additional discussion at Section 2.1)
RSL = Regional Screening Level (additonal discussion at Section 2.1)
PFAS = per- and polyfluoroalkyl substances

Table 4-2
PFAS Results from FS-13 Direct-Push Locations
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Location	Date	Depth (ft bgs)	Test	Analyte	Result	RL	Screening Std (µg/L)	Type	Standard Exceeded ?
38DP0001	12/13/2021	72.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0006	0.005	0.601	RSL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	0.0014	0.005	0.039	RSL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0001	12/13/2021	72.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	72.5	LC0012	PFAS6 SUM	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0003	0.005	0.601	RSL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	ND	0.005	0.039	RSL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0001	12/13/2021	82.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	82.5	LC0012	PFAS6 SUM	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	ND	0.005	0.601	RSL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	0.0012	0.005	0.039	RSL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0001	12/13/2021	92.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	92.5	LC0012	PFAS6 SUM	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0013	0.005	0.601	RSL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	0.0077	0.005	0.02	MMCL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	0.0057	0.005	0.039	RSL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0001	12/13/2021	102.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	0.0049	0.005	0.006	RSL	N
38DP0001	12/13/2021	102.5	LC0012	PFAS6 SUM	0.0183	0.005	0.02	MMCL	N
38DP0002	12/14/2021	72.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	0.0031	0.005	0.601	RSL	N
38DP0002	12/14/2021	72.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	72.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	72.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	0.034	0.005	0.039	RSL	N
38DP0002	12/14/2021	72.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0002	**12/14/2021**	**72.5**	**LC0012**	**PERFLUOROOCTANE SULFONIC ACID (PFOS)**	**0.0069**	**0.005**	**0.004**	**RSL**	**Y**
38DP0002	12/14/2021	72.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0002	**12/14/2021**	**72.5**	**LC0012**	**PFAS6 SUM**	**0.0409**	**0.005**	**0.02**	**MMCL**	**Y**
38DP0002	12/14/2021	82.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	ND	0.005	0.601	RSL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	0.001	0.005	0.039	RSL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUORONONANOIC ACID (PFNA)	ND	0.005	0.006	RSL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	0.0013	0.005	0.004	RSL	N
38DP0002	12/14/2021	82.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0002	12/14/2021	82.5	LC0012	PFAS6 SUM	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	92.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	ND	0.005	0.601	RSL	N
38DP0002	12/14/2021	92.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	92.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	92.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	ND	0.005	0.039	RSL	N
38DP0002	**12/14/2021**	**92.5**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.022**	**0.005**	**0.006**	**RSL**	**Y**
38DP0002	12/14/2021	92.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0002	12/14/2021	92.5	LC0012	PERFLUOROOCTANOIC ACID (PFOA)	ND	0.005	0.006	RSL	N
38DP0002	**12/14/2021**	**92.5**	**LC0012**	**PFAS6 SUM**	**0.022**	**0.005**	**0.02**	**MMCL**	**Y**
38DP0002	12/14/2021	102.5	LC0012	PERFLUOROBUTANE SULFONIC ACID (PFBSA)	ND	0.005	0.601	RSL	N
38DP0002	12/14/2021	102.5	LC0012	PERFLUORODECANOIC ACID (PFDA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	102.5	LC0012	PERFLUOROHEPTANOIC ACID (PFHPA)	ND	0.005	0.02	MMCL	N
38DP0002	12/14/2021	102.5	LC0012	PERFLUOROHEXANE SULFONIC ACID (PFHxSA)	ND	0.005	0.039	RSL	N
38DP0002	**12/14/2021**	**102.5**	**LC0012**	**PERFLUORONONANOIC ACID (PFNA)**	**0.063**	**0.005**	**0.006**	**RSL**	**Y**
38DP0002	12/14/2021	102.5	LC0012	PERFLUOROOCTANE SULFONIC ACID (PFOS)	ND	0.005	0.004	RSL	N
38DP0002	**12/14/2021**	**102.5**	**LC0012**	**PERFLUOROOCTANOIC ACID (PFOA)**	**0.012**	**0.005**	**0.006**	**RSL**	**Y**
38DP0002	**12/14/2021**	**102.5**	**LC0012**	**PFAS6 SUM**	**0.075**	**0.005**	**0.02**	**MMCL**	**Y**

MMCL = Massachusetts Maximum Contaminant Level (additional discussion at Section 2.1)
RSL = Regional Screening Level (additonal discussion at Section 2.1)
PFAS = Per- and Polyfluoroalkyl Substances

APPENDICES

Appendix A 6th Five-Year Review Newspaper Announcement

Appendix B Well Determinations in Support of Land Use Control Program (Redacted)

Appendix C Regulatory Comment Resolution Documentation, EPA Concurrence Letter, MassDEP Response to Memorandum of Resolution

APPENDIX A

6th Five-Year Review Newspaper Announcement

NEWS RELEASE **May 2, 2023**

2017-2022 Five Year Review Underway for the Installation Restoration Program (IRP) at Joint Base Cape Cod (JBCC)

The Air Force Civil Engineer Center (AFCEC) manages the IRP which is charged with investigating and cleaning up contaminated soil and groundwater under the requirements of Superfund and has initiated the sixth Five Year Review (FYR) at JBCC.

The objective of the FYR is to make protectiveness determinations for each of the sites and groundwater plumes that have Decision Documents (DDs) or Records of Decisions (RODs). For emerging contaminants there is one 1,4-dioxane DD and presently no final DDs or RODs for per- and polyfluoroalkyl substances (PFAS). Investigations to define the nature and extent of PFAS from JBCC are ongoing as well as an evaluation of alternatives related to the protectiveness of remedies. The FYR will be coordinated with the U.S. Environmental Protection Agency and Massachusetts Department of Environmental Protection.

The FYR document will be finalized by the end of September 2023 and will be placed in the main Upper Cape libraries of Falmouth, Mashpee, Bourne and Sandwich. It will be announced by a news release and paid advertisements. The final FYR will be placed on AFCEC's online administrative record located at: https://ar.afcec-cloud.af.mil/

For more program information please visit AFCEC's webpage at:
https://www.massnationalguard.org/JBCC/afcec.html
Questions? Please contact Doug Karson, (508) 524-9206, douglas.karson@us.af.mil

APPENDIX B

Well Determinations in Support of

Land Use Control Program

(Redacted)

WELL DETERMINATION (Revised 2018)

ADDRESS: xxxxxxxxxxx, Falmouth MA

APEMS ID: 39851

WELL STATUS: ACTIVE

WELL USE: Outdoor uses

SUMMARY: According to the property owner response (attached), this residence is connected to the Falmouth municipal water supply. This residence receives a water bill from the Town of Falmouth. However, there is a private well located on this property that is used for outdoor purposes. The total depth of this well is unknown. Depth to water in this area is approximately 10 ft bgs (+45 ft msl). This property is located within the LTM area of the Ashumet Valley LUC, approximately 1,000 feet north and outside of the Ashumet Valley Plume boundary. Additionally, the private well on this property is located approximately 150 feet to the southwest of the CS-10 Southern Trench Lobe extraction well, 03EW2112 (See location map, attached).

DATA REVIEW:

☑ SPEIM monitoring data are available in the vicinity of this well [see attached map and cross sections].

- 03MW1046A,B,C [vertical profiling and monitoring data; AV cross section A-A']
- 03MW1058A,B,C [vertical profiling and monitoring data; CS-10 cross section A-A']
- 95MW0109A,B,C [monitoring data; CS-10 cross section A-A']
- Water table elevation is approximately 45 ft msl.

☑ Groundwater vertical profiling for PCE and TCE was conducted in 2008 at a boring located adjacent to APEMS 39851 (03MW1046A). PCE and TCE were not detected at concentrations greater than the MCL at that time. Groundwater vertical profiling at a boring located approximately 300 feet upgradient of APEMS 39851 (03MW1058A) in 2009 indicated that TCE concentrations greater than the MCL are present at an elevation range of -65 ft msl to -85 ft msl in the aquifer (maximum TCE concentration of 25 µg/L; CS-10 Cross Section A-A'). Groundwater sampling upgradient of 03MW1058A at monitoring wells 03MW1023C and 95MW0109A indicate that higher TCE concentrations (up to 63 µg/L) are located upgradient of 03MW1058A. Therefore, an extraction well (03EW2112) was installed in the vicinity of 03MW1046A (adjacent to APEMS 39851) in anticipation of capturing the TCE observed at upgradient locations.

Although field sampling and monitoring data indicated that APEMS 39851 was downgradient of the CS-10 Southern Trench Lobe at the time of the initial well determination in 2012, plume transport simulations predicted that the CS-10 Southern Trench Lobe will migrate to extraction well 03EW2112 at an approximate elevation range of -65 to -85 ft msl in the aquifer. APEMS 39851 is located within the capture zone of CS-10 extraction well 03EW2112 and the depth of the private well is unknown. Therefore, uncertainty existed regarding the potential for impacts to this well from the nearby CS-10 Southern Trench Lobe. In addition, this private irrigation well is located within an area of elevated manganese concentrations in groundwater (i.e., the manganese LTM area) associated with the Ashumet Valley plume.

☑ At the time the initial well determination was completed in 2012, no historic sampling results were available for the private irrigation well at APEMS 39851. Routine sampling of this well has been conducted since 2013 to obtain a data set that could be used to evaluate the potential impacts from the CS-10 southern lobe and/or dissolved manganese associated with the Ashumet Valley LTM area to this private irrigation well. This well has been sampled once for manganese and four times over the past five years for VOC analysis (see attached table). Manganese was detected in 2013 at a concentration that was greater than the Health Advisory of 300 µg/L. However, since this well is used as a source for non-potable water, further sampling for manganese was not warranted (see attached e-mail dated 05/16/2014). No PCE or TCE was detected in water samples collected from this well over the past five years.

It is noted that the concentration of TCE at 03MW1046B increased from nondetect to 18 µg/L in 2017, however TCE was not detected at the shallower well 03MW1046C, which is likely screened at an elevation between the TCE detected at 03MW1046B and the bottom of the private irrigation well at APEMS 39851. A review of the current SPEIM monitoring data indicate that there is approximately 100 feet of clean water between the top of the CS-10 southern lobe and the bottom of the private well at APEMS 39851 (assuming the depth of the private irrigation well at APEMS 39851 is screened within 30 feet of the water table, similar to known well depths reported in the area).

DETERMINATION:

The private well at APEMS 39851 is located over 1,000 feet north of the Ashumet Valley Plume trailing edge. Therefore, current or potential impacts to this well from the Ashumet Valley plume are unlikely. However, this property is located over the leading edge of the CS-10 Southern Trench Lobe. SPEIM data indicate that the top of CS-10 Southern Trench Lobe is located approximately 100 feet below the assumed depth of the private irrigation well at APEMS 39851 (based on the November 217 sampling data at 03MW1046A,B,C) and is predicted to remain at a similar elevation as it naturally attenuates and/or migrates to 03EW2112. Based on a review of the SPEIM groundwater monitoring data and the analytical results of samples collected from the private irrigation well at APEMS 39851, intermittent pumping of this well for outdoor irrigation purposes is unlikely to result in an unacceptable exposure to manganese or PCE and TCE.

PATH FORWARD: No further sampling is needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXX, Falmouth MA

APEMS ID: 39663

WELL STATUS: ACTIVE

WELL USE: Residential Irrigation/Outdoor uses

SUMMARY: In May 2021 the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) was notified by the property owner that they plan to restart the private well on this property for outdoor irrigation purposes. At the time of the initial well verification effort, which was completed in 2008 (see survey form), the owner indicated that they did not know if a well exists on the property and that the residence is connected to the Falmouth municipal water supply, and receives a water bill from the Falmouth Water Department.

The total depth of this private irrigation well is approximately 63 feet below ground surface (ft bgs). Based on measurements in nearby groundwater monitoring wells, the depth to water beneath this property is approximately 40 ft bgs, or +40 feet mean sea level (ft msl). Therefore, the bottom of the private well at APEMS 39663 is assumed to be approximately 23 ft below the water table or approximately +17 ft msl.

The Ashumet Valley plume in the vicinity of APEMS 39663 is defined as the area of groundwater that is impacted by tetrachloroethane (PCE) and trichloroethene (TCE) at concentrations above their Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) (see location map). Additionally, the Ashumet Valley plume is currently undergoing a Supplemental Remedial Investigation (RI) for 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS), which have been reported in the Ashumet Valley plume at concentrations greater than applicable drinking water health advisories and risk-based values (see attached table). 1,4-Dioxane and PFAS are potential contaminants of concern that have been identified at Ashumet Valley subsequent to issuance of the Ashumet Valley Record of Decision (ROD) in 2009.

DATA REVIEW:

- ☑ Groundwater samples were collected from the recently restarted residential irrigation well at APEMS 39663 on 21 May 2021 to support this technical evaluation. Groundwater samples were analyzed for volatile organic compounds (to determine the possible presence of PCE and TCE), 1,4-dioxane, and PFAS. PCE, TCE, and 1,4-dioxane were not detected (see attached summary tables). Several PFAS were detected in the sample collected on 21 May 2021. The sum of perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) is less than the U.S. Environmental Protection Agency (EPA) Lifetime Health Advisory (LHA) of 0.07 µg/L and the sum of the six PFAS (PFAS6) is above the Massachusetts MCL (MMCL) of 0.02 µg/L. The concentration of perfluorobutane sulfonic acid (PFBS) is less than the EPA Regional Screening Level (RSL) of 0.602 µg/L for tap water exposure.
- ☑ System Performance and Ecological Impact Monitoring (SPEIM) data are available in the vicinity of this well [see attached map].
  - 95DP0234 [vertical profiling data; table attached]
  - 30MW0584A,B,C [monitoring data; table attached]
  - 95MW1170B [monitoring data; table attached]
  - 30MW0585A,B,C [monitoring data, table attached]

- Cross Section C-C' of Ashumet Valley Plume [figure attached]
- Water table elevation is approximately +40 ft msl.

☑ The Ashumet Valley PCE/TCE plume was very well characterized and monitored in the area near APEMS 39663 as illustrated by the number of monitoring wells and borings listed above that were sampled by AFCEC. The PCE/TCE plume was formerly defined beneath the Regis Road area (see plume boundary temporal change figure). However, concentrations of PCE and TCE at most monitoring wells located in the vicinity of this property have since decreased below MCLs. Available groundwater monitoring data indicate that only a relatively narrow plume of TCE remains deep in the aquifer in this area. The top of the TCE plume is at approximately 120 ft bgs (-40 ft msl) at 30MW0585A. The TCE plume in the vicinity of APEMS 39663 is expected to remain at depth and naturally attenuate to concentrations below cleanup standards over time.

☑ A Supplemental RI for 1,4-dioxane and PFAS was initiated for the Ashumet Valley plume in 2015 after it was determined that these compounds are present in groundwater at Ashumet Valley. Concentrations of PFOS and PFOA are less than the EPA LHA of 0.07 µg/L for the sum of these two compounds at 30MW0585A (121 ft bgs) but exceed the LHA at 30MW0585B (81.5 ft bgs). In addition, PFOS and PFOA have been detected in Ashumet Pond surface water at concentrations that exceed the LHA of 0.07 µg/L. Water from Ashumet Pond is known to recharge the shallow aquifer to the south and east of the pond (i.e., below the area where Club Valley Drive is located). Exceedances of the 1,4-dioxane risk-based concentration (RBC) in groundwater near Club Valley Drive appear to be co-located with the remnants of the Ashumet Valley TCE plume at 30MW585A.

DETERMINATION: PCE, TCE, and 1,4-dioxane were not detected in the 21 May 2021 groundwater sample collected from the private irrigation well at APEMS 39663. However, PFAS were detected at concentrations that are less than the EPA LHA of 0.07 µg/L for the sum of PFOS and PFOA and the EPA RSL of 0.602 µg/L for PFBS. However, the sum of the six PFAS regulated in Massachusetts drinking water exceed the MMCL of 0.02 µg/L. All these advisories, standards, and screening levels assume the groundwater is used for consumptive purposes.

These sampling data support the current conceptual site model that PCE, TCE, and 1,4-dioxane are not present in shallow groundwater beneath APEMS 39663 and that the vestiges of the remaining northern plume lobe at Ashumet Valley will remain at depth in the aquifer and continue to attenuate with time. Data collected to date under the Supplemental RI for PFAS indicate that shallow groundwater in the vicinity of APEMS 39663 Drive has been impacted from recharge of the shallow aquifer by Ashumet Pond. Because the evaluation of 1,4-dioxane and PFAS in groundwater near this neighborhood is still ongoing and the sum of PFAS6 exceed the MMCL, the irrigation well should not be used as a source of drinking water at this time.

However, according to the 2021 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MDPH) has determined that occasional exposure to PFOS and PFOA from non-consumptive recreational use (i.e., non-consumptive uses such as swimming, wading, boating, or catch-and-release fishing) is not expected to result in any adverse health effects. In addition, according to the MassDEP 2020 Fact Sheet *PFAS in Drinking Water: Questions and Answers for Consumers*, the risk from the occasional consumption of produce grown in soil or irrigated with water contaminated with PFAS is likely to be low.

WELL DETERMINATION

Therefore, the occasional use of the irrigation well water for outdoor purposes such as watering lawns/shrubbery/vegetable gardens and washing cars is not expected to result in an unacceptable exposure risk to PFAS at this time.

PATH FORWARD: No further sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXXX, Falmouth MA

APEMS ID: 39665

WELL STATUS: ACTIVE

WELL USE: Residential Irrigation/Outdoor uses

SUMMARY: In May 2021 the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) was notified by the property owner that they plan to restart the private well on this property for outdoor irrigation purposes. At the time of the initial well verification effort, which was completed in 2008 (see survey form), the owner indicated that no well existed on the property and that the residence is connected to the Falmouth municipal water supply, and receives a water bill from the Falmouth Water Department.

The total depth of this private irrigation well is approximately 57 feet below ground surface (ft bgs). Based on measurements in nearby groundwater monitoring wells, the depth to water beneath this property is approximately 40 ft bgs, or +40 feet mean sea level (ft msl). Therefore, the bottom of the private well at APEMS 39665 is assumed to be approximately 17 ft below the water table or approximately +23 ft msl.

The Ashumet Valley plume in the vicinity of APEMS 39665 is defined as the area of groundwater that is impacted by tetrachloroethane (PCE) and trichloroethene (TCE) at concentrations above their Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) (see location map). Additionally, the Ashumet Valley plume is currently undergoing a Supplemental Remedial Investigation (RI) for 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS), which have been reported in the Ashumet Valley plume at concentrations greater than applicable drinking water health advisories and risk-based values (see attached table). 1,4-Dioxane and PFAS are potential contaminants of concern that have been identified at Ashumet Valley subsequent to issuance of the Ashumet Valley Record of Decision (ROD) in 2009.

DATA REVIEW:

- ☑ Groundwater samples were collected from the recently restarted residential irrigation well at APEMS 39665 on 24 May 2021 to support this technical evaluation. Groundwater samples were analyzed for volatile organic compounds (to determine the possible presence of PCE and TCE), 1,4-dioxane, and PFAS. PCE, TCE, and 1,4-dioxane were not detected (see attached summary tables). Several PFAS were detected in the sample collected on 24 May 2021. The sum of perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) is less than the U.S. Environmental Protection Agency (EPA) Lifetime Health Advisory (LHA) of 0.07 µg/L and the sum of the six PFAS (PFAS6) is above the Massachusetts MCL (MMCL) of 0.02 µg/L. The concentration of perfluorobutane sulfonic acid (PFBS) is less than the EPA Regional Screening Level (RSL) of 0.602 µg/L for tap water exposure.
- ☑ System Performance and Ecological Impact Monitoring (SPEIM) data are available in the vicinity of this well [see attached map].
  - 95DP0234 [vertical profiling data; table attached]
  - 30MW0584A,B,C [monitoring data; table attached]
  - 95MW1170B [monitoring data; table attached]
  - 30MW0585A,B,C [monitoring data, table attached]

- Cross Section C-C' of Ashumet Valley Plume [figure attached]
- Water table elevation is approximately +40 ft msl.

☑ The Ashumet Valley PCE/TCE plume was very well characterized and monitored in the area near APEMS 39665 as illustrated by the number of monitoring wells and borings listed above that were sampled by AFCEC. The PCE/TCE plume was formerly defined beneath the Regis Road area (see plume boundary temporal change figure). However, concentrations of PCE and TCE at most monitoring wells located in the vicinity of this property have since decreased below MCLs. Available groundwater monitoring data indicate that only a relatively narrow plume of TCE remains deep in the aquifer in this area. The top of the TCE plume is at approximately 120 ft bgs (-40 ft msl) at 30MW0585A. The TCE plume in the vicinity of APEMS 39665 is expected to remain at depth and naturally attenuate to concentrations below cleanup standards over time.

☑ A Supplemental RI for 1,4-dioxane and PFAS was initiated for the Ashumet Valley plume in 2015 after it was determined that these compounds are present in groundwater at Ashumet Valley. Concentrations of PFOS and PFOA are less than the EPA LHA of 0.07 µg/L for the sum of these two compounds at 30MW0585A (121 ft bgs) but exceed the LHA at 30MW0585B (81.5 ft bgs). In addition, PFOS and PFOA have been detected in Ashumet Pond surface water at concentrations that exceed the LHA of 0.07 µg/L. Water from Ashumet Pond is known to recharge the shallow aquifer to the south and east of the pond (i.e., below the area where Club Valley Drive is located). Exceedances of the 1,4-dioxane risk-based concentration (RBC) in groundwater near Club Valley Drive appear to be co-located with the remnants of the Ashumet Valley TCE plume at 30MW585A.

DETERMINATION: PCE, TCE, and 1,4-dioxane were not detected in the 24 May 2021 groundwater sample collected from the private irrigation well at APEMS 39665. However, PFAS were detected at concentrations that are less than the EPA LHA of 0.07 µg/L for the sum of PFOS and PFOA and the EPA RSL of 0.602 µg/L for PFBS. However, the sum of the six PFAS regulated in Massachusetts drinking water exceed the MMCL of 0.02 µg/L. All these advisories, standards, and screening levels assume the groundwater is used for consumptive purposes.

These sampling data support the current conceptual site model that PCE, TCE, and 1,4-dioxane are not present in shallow groundwater beneath APEMS 39665 and that the vestiges of the remaining northern plume lobe at Ashumet Valley will remain at depth in the aquifer and continue to attenuate with time. Data collected to date under the Supplemental RI for PFAS indicate that shallow groundwater in the vicinity of APEMS 39665 has been impacted from recharge of the shallow aquifer by Ashumet Pond. Because the evaluation of 1,4-dioxane and PFAS in groundwater near this neighborhood is still ongoing, the irrigation well should not be used as a source of drinking water at this time.

However, according to the 2021 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MDPH) has determined that occasional exposure to PFOS and PFOA from non-consumptive recreational use (i.e., non-consumptive uses such as swimming, wading, boating, or catch-and-release fishing) is not expected to result in any adverse health effects. In addition, according to the MassDEP 2020 Fact Sheet *PFAS in Drinking Water: Questions and Answers for Consumers*, the risk from the occasional consumption of produce grown in soil or irrigated with water contaminated with PFAS is likely to be low.

WELL DETERMINATION

Therefore, the occasional use of the irrigation well water for outdoor purposes such as watering lawns/shrubbery/vegetable gardens and washing cars is not expected to result in an unacceptable exposure risk to PFAS at this time.

PATH FORWARD: No further sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXX, Falmouth MA

APEMS ID: 39797

WELL STATUS: ACTIVE

WELL USE: Residential Irrigation/Outdoor uses

SUMMARY: In May 2021 the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) was notified by the property owner that they had restarted the private well on this property for outdoor irrigation purposes. At the time of the initial well verification effort, which was completed in 2008 (see survey form), the owner indicated that the well was inactive, that the residence is connected to the Falmouth municipal water supply, and receives a water bill from the Falmouth Water Department.

The total depth of this private irrigation well is unknown. However, based on measurements in nearby groundwater monitoring wells, the depth to water beneath this property is approximately 40 feet below ground surface (ft bgs), or +40 feet mean sea level (ft msl). Based on information obtained from the AFCEC private well monitoring program and a review of residential well construction records at the Massachusetts Department of Environmental Protection (MassDEP) WellSearch database, private residential wells are typically screened within the first 30 ft of groundwater in the communities surrounding JBCC. Therefore, the depth of the private well at 68 Regis Road is assumed to be approximately 30 ft below the water table or approximately +10 ft msl.

The Ashumet Valley plume in the vicinity of APEMS 39797 is defined as the area of groundwater that is impacted by tetrachloroethane (PCE) and trichloroethene (TCE) at concentrations above their Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) (see location map). Additionally, the Ashumet Valley plume is currently undergoing a Supplemental Remedial Investigation (RI) for 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS), which have been reported in the Ashumet Valley plume at concentrations greater than applicable drinking water health advisories and risk-based values (see attached table). 1,4-Dioxane and PFAS are potential contaminants of concern that have been identified at Ashumet Valley subsequent to issuance of the Ashumet Valley Record of Decision (ROD) in 2009.

DATA REVIEW:

☑ Groundwater samples were collected from the recently restarted residential irrigation well at APEMS 39797 on 24 May 2021 to support this technical evaluation. Groundwater samples were analyzed for volatile organic compounds (to determine the possible presence of PCE and TCE), 1,4-dioxane, and PFAS. PCE, TCE, and 1,4-dioxane were not detected (see attached summary tables). Several PFAS were detected in the sample collected on 24 May 2021. The sum of perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) is less than the U.S. Environmental Protection Agency (EPA) Lifetime Health Advisory (LHA) of 0.07 µg/L and the sum of the six PFAS (PFAS6) is below the Massachusetts MCL (MMCL) of 0.02 µg/L. The concentration of perfluorobutane sulfonic acid (PFBS) is less than the EPA Regional Screening Level (RSL) of 0.602 µg/L for tap water exposure.

WELL DETERMINATION

☑ System Performance and Ecological Impact Monitoring (SPEIM) data are available in the vicinity of this well [see attached map].

- 95DP0234 [vertical profiling data; table attached]
- 30MW0584A,B,C [monitoring data; table attached]
- 95MW1170B [monitoring data; table attached]
- 30MW0585A,B,C [monitoring data, table attached]
- Cross Section C-C' of Ashumet Valley Plume [figure attached]
- Water table elevation is approximately +40 ft msl.

The Ashumet Valley PCE/TCE plume was very well characterized and monitored in the area near !t9a{ оφтφт as illustrated by the number of monitoring wells and borings listed above that were sampled by AFCEC. The PCE/TCE plume was formerly defined beneath the !t9a{ оφтφт area (see plume boundary temporal change figure). However, concentrations of PCE and TCE at most monitoring wells located in the vicinity of this property have since decreased below MCLs. Available groundwater monitoring data indicate that only a relatively narrow plume of TCE remains deep in the aquifer in this area. The top of the TCE plume is at approximately 120 ft bgs (-40 ft msl) at 30MW0585A. The TCE plume in the vicinity of !t9a{ оφтφт is expected to remain at depth and naturally attenuate to concentrations below cleanup standards over time.

A Supplemental RI for 1,4-dioxane and PFAS was initiated for the Ashumet Valley plume in 2015 after it was determined that these compounds are present in groundwater at Ashumet Valley. Concentrations of PFOS and PFOA are less than the EPA LHA of 0.07 µg/L for the sum of these two compounds at 30MW0585A (121 ft bgs) but exceed the LHA at 30MW0585B (81.5 ft bgs). In addition, PFOS and PFOA have been detected in Ashumet Pond surface water at concentrations that exceed the LHA of 0.07 µg/L. Water from Ashumet Pond is known to recharge the shallow aquifer to the south and east of the pond (i.e., below the area where APEMS 39797 is located). Exceedances of the 1,4-dioxane risk-based concentration (RBC) in groundwater near APEMS 39797 appear to be co-located with the remnants of the Ashumet Valley TCE plume at 30MW585A.

DETERMINATION: PCE, TCE, and 1,4-dioxane were not detected in the 24 May 2021 groundwater sample collected from the private irrigation well at APEMS 39797. However, PFAS were detected at concentrations that are less than the EPA LHA of 0.07 µg/L for the sum of PFOS and PFOA, the MMCL of 0.02 µg/L for the sum of six PFAS (PFAS6), and the EPA RSL of 0.602 µg/L for PFBS. All these advisories, standards, and screening levels assume the groundwater is used for consumptive purposes.

These sampling data support the current conceptual site model that PCE, TCE, and 1,4-dioxane are not present in shallow groundwater beneath APEMS 39797 and that the vestiges of the remaining northern plume lobe at Ashumet Valley will remain at depth in the aquifer and continue to attenuate with time. Data collected to date under the Supplemental RI for PFAS indicate that shallow groundwater in the vicinity of APEMS 39797 has been impacted from recharge of the shallow aquifer by Ashumet Pond. Because the evaluation of 1,4-dioxane and PFAS in groundwater near this neighborhood is still ongoing, the irrigation well should not be used as a source of drinking water at this time.

However, according to the 2021 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MassDPH) has determined that occasional exposure to PFOS and PFOA from non-consumptive recreational use (i.e., non-consumptive uses such as swimming, wading, boating, or catch-and-release fishing) is not expected to result in any adverse health effects. In addition, according

WELL DETERMINATION

to the MassDEP 2020 Fact Sheet *PFAS in Drinking Water: Questions and Answers for Consumers*, the risk from the occasional consumption of produce grown in soil or irrigated with water contaminated with PFAS is likely to be low.

Therefore, the occasional use of the irrigation well water for outdoor purposes such as watering lawns/shrubbery/vegetable gardens and washing cars is not expected to result in an unacceptable exposure risk to PFAS at this time.

PATH FORWARD: No further sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXXXXX, Falmouth MA

APEMS ID: 47065

WELL STATUS: ACTIVE

WELL USE: Residential Irrigation/Outdoor Uses

SUMMARY: In September 2020, the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) was notified by the property owner that they would like to restart the inactive private well on this property for outdoor irrigation purposes. At the time of the initial well verification effort completed in 2008 (see parcel summary report), the owner indicated that the well was inactive, that the residence is connected to the Falmouth municipal water supply, and receives a water bill from the Falmouth Water Department.

The total depth of this private irrigation well is unknown. However, based on depth to water measured in nearby groundwater monitoring wells, the depth to water beneath this property is approximately twenty-seven feet below ground surface (ft bgs), or +12 feet mean sea level (ft msl). Based on information obtained from the AFCEC private well monitoring program and a review of residential well construction records at the MassDEP WellSearch database, private residential wells are typically screened within the first 30 feet of groundwater in the communities surrounding JBCC. Therefore, the depth of the private well at APEMS 47065 is assumed to be approximately 30 ft below the water table or -18 ft msl.

The Ashumet Valley plume in the vicinity of APEMS 47065 is currently defined as the area of groundwater that is impacted by trichloroethene (TCE) and tetrachloroethane (PCE) at concentrations above their maximum contaminant level (MCL) of 5 micrograms per liter (µg/L) (see location map). Additionally, the Ashumet Valley plume is currently undergoing a Supplemental Remedial Investigation for 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS), which have been reported in the Ashumet Valley plume at concentrations greater than applicable drinking water health advisories and risk-based values (see attached table). 1,4-Dioxane and PFAS are potential contaminants of concern that have been identified at Ashumet Valley subsequent to issuance of the Ashumet Valley Record of Decision (ROD) in 2009.

DATA REVIEW:

- ☑ Groundwater samples were collected from the residential irrigation well at APEMS 47065 on 18 September 2020 to support this technical evaluation. Groundwater samples were analyzed for volatile organic compounds (to determine the possible presence of PCE and TCE), 1,4-dioxane and PFAS. PCE, TCE, 1,4-dioxane, perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) were not detected (see attached summary table). Three other PFAS were detected in the sample, but at very low estimated concentrations including perfluorobutane sulfonic acid (PFBS) at 0.0006J µg/L which is well below the EPA Regional Screening Level of 40 µg/L for PFBS.

WELL DETERMINATION

☑ System Performance and Ecological Impact Monitoring (SPEIM) data for PCE and TCE are available at groundwater monitoring wells located in the vicinity of this property (see location map).

- USFW6600037 (11.55 ft msl)
- USFW6600085 (-37.62 ft msl)
- USFW6600102 (-54.57 ft msl)
- USFW6600118 (-70.31)
- USFW6600138 (-90.55 ft msl)
- USFW484023 (-10.12 ft msl)
- USFW484078 (-57.36 ft msl)
- 95MW0103 (-55.25 ft msl)
- 95MW0104 (-59.06 ft msl)
- 95MW0106 (-59 ft msl)
- 95MW1236A (-61 ft msl)
- 6 nearby groundwater vertical profile borings (95DP0207, 95DP0222, 95DP0223, 95DP0224, 95DP0231, and 95DP0232)

The Ashumet Valley PCE/TCE plume was very well characterized and monitored in the area near APEMS 47065 as illustrated by the number of monitoring wells and borings listed above that were sampled by AFCEC. The plume was formerly defined beneath Pine Ridge Road area (see plume boundary temporal change figure). However, concentrations of PCE and TCE at most monitoring wells located in the vicinity of this property have since decreased below MCLs and, therefore, the plume has not been defined in the area near Pine Ridge Road since 2012. As of August 2020, the closest exceedance of an MCL (TCE at 5.7 µg/L and PCE at 11 µg/L) is reported at monitoring well USFW484023, which is located approximately 800 feet southwest and downgradient of APEMS 47065.

☑ A Supplemental Remedial Investigation (RI) for 1,4-dioxane and PFAS was initiated for the Ashumet Valley plume in 2015 after it was determined that these compounds are present in groundwater at Ashumet Valley. 1,4-Dioxane and the sum of PFOS and PFOA at monitoring wells located upgradient and downgradient of APEMS 47065 are either non-detect or present at concentrations less than the EPA risk-based concentration of 0.46 µg/L for 1,4-dioxane and the EPA Lifetime Health Advisory of 0.07 µg/L for the sum of PFOS and PFOA in drinking water (see attached maps showing 1,4-dioxane and PFOS/PFOA detections in groundwater). PFOS/PFOA have not been detected at upgradient monitoring wells USFW660037 (14 ft msl) and USFW660085 (-36 ft msl), which are screened at an elevation similar to the irrigation well at APEMS 47065 (approximately -18 ft msl). Exceedances of the 1,4-dioxane and PFOS/PFOA cleanup values in groundwater near APEMS 47065 appear to be co-located with the remnants of the Ashumet Valley PCE/TCE plume which is currently defined approximately 1,000 feet northeast and 800 feet southwest of APEMS 47065. It is noted that MassDEP recently issued a Massachusetts Maximum Contaminant Level (MMCL) of 0.02 µg/L for the sum of 6 PFAS under the state Drinking Water Program. AFCEC is currently assessing the applicability of this MMCL in the overall JBCC

WELL DETERMINATION

Cleanup Program. However, since the irrigation well located at this parcel is not being used as a source of drinking water, the state PFAS MMCL does not apply.

DETERMINATION: Groundwater analytical data collected at the irrigation well located at APEMS 47065 indicate that PCE, TCE, 1,4-dioxane, PFOS, and PFOA were not detected. Three PFAS were detected in a sample collected from this well on 18 September 2020, but at very low estimated concentrations that are well below applicable cleanup values assuming groundwater is used as a drinking water source. These sampling data support the current conceptual site model that the Ashumet Valley PCE/TCE plume is no longer present beneath the Pine Ridge Road area and that the vestiges of the remaining southern plume lobe at Ashumet Valley will remain at depth in the aquifer and continue to attenuate with time. Data collected to date under the Supplemental RI for 1,4-dioxane and PFAS indicate that the concentrations of 1,4-dioxane and the sum of PFOS and PFOA at monitoring wells near APEMS 47065 are either not detected and/or at concentrations that are less than applicable groundwater cleanup standards or advisories for drinking water. Therefore, intermittent use of this well for outdoor purposes (including irrigation) is not expected to draw in groundwater containing contaminants at concentrations above standards/health advisories.

PATH FORWARD: No further sampling or evaluation needed.

ROUTINE SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXX, Mashpee MA

APEMS ID: 30518

WELL STATUS: ACTIVE

WELL USE: Outdoor uses

SUMMARY: According to Mashpee Water District records, this residence is connected to the Mashpee municipal water supply and receives a water bill from the Mashpee Water District. In August 2018, the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) received a Dig Safe® notification for a planned installation of an irrigation well at XXXXXXXX. At that time, AFCEC notified the Mashpee Board of Health (BOH) that there were no concerns that this proposed irrigation well would draw groundwater associated with the nearby Chemical Spill-10 (CS-10) groundwater plume, which is defined by the contaminants of concern (COCs), tetrachloroethane (PCE) and trichloroethene (TCE). However, this proposed irrigation well would potentially receive groundwater derived from Ashumet Pond, which has concentrations of per-and polyfluoroalkyl substances (PFAS) above the EPA 2016 Lifetime Health Advisory (LHA) for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in drinking water. During this initial notification to the BOH, AFCEC noted that a remedial investigation was underway in 2018 to define the magnitude and extent of PFAS migrating from the Fire Training Area-1 (FTA-1) site. AFCEC would generate a technical evaluation for this new irrigation well once a Conceptual Site Model (CSM) for PFAS in area groundwater was developed and more information regarding the risks from exposure to PFAS-impacted groundwater through a non-consumptive exposure scenario were available. This technical evaluation is being generated to support the protectiveness determination for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five Year Review process for the CS-10 groundwater remedy and to document the potential for impact by PFAS in nearby groundwater from the FTA-1 site. According to the well completion report (attached) the residential irrigation well at XXXXXXXX was installed on 02 August 2018 and the depth is approximately 40 feet (ft) below ground surface (bgs) (or +26 ft mean sea level [msl]). Depth to water in this area is approximately 20 ft bgs (or +46 ft msl). This well is screened in the first 20 feet of the unconfined aquifer. This property is located downgradient of Ashumet Pond, above the southern edge of the CS-10 North Central lobe. Shallow groundwater beneath this property is primarily derived by recharge from Ashumet Pond.

DATA REVIEW:

☑ CS-10 plume characterization and monitoring data are available in the vicinity of this planned residential irrigation well [see attached location map and cross section]. Data from the following select locations in the area were used to define the extent of the plume and provide trend analysis for the plume in the vicinity of this residence.

- 03DP0012 [vertical profiling data]
- 03DP0026 [vertical profiling data]
- 03DP0028 [vertical profiling data]
- 00MW0581A,B [monitoring data]
- 00MW0582A [monitoring data]
- 03MW1008 A,B [monitoring data]
- 03MW1009A,B [monitoring data]
- 00MW0607A,B [monitoring data]
- 03MW2620A,B [monitoring data]

WELL DETERMINATION

- ☑ The CS-10 North Central lobe is a northwest-southeast trending plume lobe that is migrating in a southeasterly direction between Ashumet and Johns Ponds. The North Central lobe is defined primarily by exceedances of the TCE maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). PCE is also a COC at the CS-10 North Central lobe; however PCE contamination in the CS-10 plume is not widespread and when present, the PCE detections are located within the TCE plume boundaries. The top of the North Central lobe was delineated in 2005 at an elevation of approximately -30 ft msl along the northern edge (03DP0028) and progressively gets deeper in the aquifer to the south toward this residence (approximately -100 ft msl at 03DP0011; See cross section F-F'). The width of the North Central lobe is constrained by non-detects and concentrations below the reporting limit of 1 µg/L reported during vertical profiling and/or groundwater sampling at monitoring wells located to the north (00MW0581A,B, 00MW0565, and 03MW2617A,B) and to the south (00MW0607A,B). The North Central lobe is predicted to stay at depth in the aquifer between Ashumet and Johns Ponds, slowly migrate to the southeast, and eventually attenuate in the aquifer to the southeast. This prediction is supported by System Performance and Ecological Impact Monitoring (SPEIM) data, which indicate that the plume is staying at depth.

- ☑ FTA-1 PFAS Groundwater Plume. This property is located on the downgradient side of Ashumet Pond (i.e. portion of the aquifer that is recharged from surface water in Ashumet Pond). Because the private irrigation well at this residence is screened within 30 feet of the water table, this irrigation well will pump water that is derived from the pond. The sum of six PFAS regulated in Massachusetts drinking water (PFAS6[1]) reported in Ashumet Pond surface water in 2017 ranged between 0.2029J µg/L to 0.3861J µg/L. The sum of PFAS six in shallow groundwater downgradient of Ashumet Pond (i.e. first 30 feet below the water table) ranged from 0.0106J µg/L to 0.1004J µg/L (95DP4007, table attached).

DETERMINATION:

CS-10 TCE/PCE Plume: The bottom elevation of the residential irrigation well at this residence is approximately +26 ft msl. The top of the CS-10 North Central lobe is at an approximate elevation of -30 ft msl in the vicinity of the residence. Therefore, the top of the CS-10 North Central lobe is approximately 56 feet below the bottom of the residential irrigation well (cross section F-F'). Therefore, intermittent use of this well for outdoor irrigation purposes is not expected to result in exposure to the CS-10 groundwater plume (TCE and PCE). This finding is supported by historic and current sampling of private residential wells located in the area of the CS-10 North Central lobe.

FTA-1 PFAS Plume: PFAS have been detected in shallow groundwater (i.e., first 30 feet below the water table) downgradient of Ashumet Pond at concentrations ranging from 0.0106J µg/L to 0.1004J µg/L (95DP4007, table attached), which are lower than those reported in Ashumet Pond. According to the 2021 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MassDPH) has determined that occasional exposure to PFAS from non-consumptive recreational use at concentrations reported in Ashumet Pond surface water is not expected to result in any adverse health effects. In addition, according to the Massachusetts Department of Environmental Protection (MassDEP) 2023 Fact Sheet *PFAS in Drinking Water: Questions and Answers for Consumers*, the risk from the occasional consumption of produce grown in soil or irrigated with water contaminated with PFAS is likely to be low. Therefore, the occasional use of the irrigation

[1] On 02 October 2020, the Massachusetts Department of Environmental Protection (MassDEP) issued a drinking water MMCL of 0.02 µg/L for the total sum of the six PFAS regulated in Massachusetts drinking water (PFOS, PFOA, perfluorohexane sulfonic acid [PFHxS], perfluorononanoic acid [PFNA], perfluoroheptanoic acid [PFHpA], and perfluorodecanoic acid [PFDA] (i.e., PFAS6).

well water for outdoor purposes such as watering lawns/shrubbery/vegetable gardens and washing cars is not expected to result in an unacceptable exposure risk to PFAS.

Please note this well should not be used as a source of drinking water.

PATH FORWARD: No further sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXX, Mashpee MA

APEMS ID: 30589

WELL STATUS: POTENTIAL NEW INSTALL

WELL USE: IRRIGATION

SUMMARY: According to the initial LUC survey response (attached) and a review of Mashpee Water District records, this residence is connected to the Mashpee municipal water supply. This residence receives a water bill from the Mashpee Water District. A DigSafe™ notification for the installation of a new residential irrigation well was received on 06 June 2019 (#20192313090; attached). According to the drilling contractor the depth of this residential irrigation well is anticipated to be approximately 50 feet (ft) below ground surface (+30 ft mean sea level [msl]). Depth to water in this area is approximately 43 ft below ground surface (+40 ft msl). This property is located downgradient of Ashumet Pond, above the southern edge of the Chemical Spill-10 (CS-10) North Central lobe. Shallow groundwater beneath APEMS ID 30589 is primarily derived by recharge from Ashumet Pond.

DATA REVIEW:

☑ CS-10 plume characterization and monitoring data are available in the vicinity of this planned residential irrigation well [see attached map, cross section, table and trend plots]. Data from the following select locations in the area were used to define the extent of the plume and provide trend analysis for the plume in the vicinity of APEMS ID 30589.

- 03DP0028 [vertical profiling data]
- 03DP0011 [vertical profiling]
- 00MW0581A,B [monitoring data]
- 00MW0582A [monitoring data]
- 03MW0565 [monitoring data]
- 03MW2617A,B [vertical profiling and monitoring data]
- 03MW1008 A,B [monitoring data]
- 03MW1009A,B [monitoring data]
- 00MW0608A [monitoring data]
- 00MW0607A,B [monitoring data]
- 00MW2620A [monitoring data]
- 03MW2620A,B [monitoring data]

☑ The CS-10 North Central lobe is a northwest-southeast trending plume lobe that is migrating in a southeasterly direction between Ashumet and Johns Ponds. The North Central lobe is defined primarily by exceedances of the trichloroethene (TCE) maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). Tetrachloroethylene (PCE) is also a contaminant of concern (COC) at the CS-10 North Central lobe; however PCE contamination in the CS-10 plume is not widespread and when present, the PCE detections are located within the TCE plume boundaries. The top of the North Central lobe was delineated in 2005 at an elevation of approximately -40 ft msl along the northern edge (03DP0028) and progressively gets deeper in the aquifer to the south toward APEMS ID 30589 (approximately -110 ft msl at 03DP0011; See cross section F-F'). The width of the North Central lobe is constrained by non-detects and concentrations below the reporting limit of 1 µg/L reported during vertical profiling and/or groundwater sampling at monitoring wells located to the north (00MW0581A,B, 00MW0565, and 03MW2617A,B) and to the south (00MW0607A,B; see table). The North Central lobe is predicted to stay at depth in the aquifer between Ashumet and Johns Ponds, slowly migrate to the southeast, and eventually attenuate in the aquifer to the southeast. This prediction is supported by System

Performance and Ecological Impact Monitoring (SPEIM) data, which indicate that the plume is staying at depth (sub-MCL TCE concentrations at 03MW1009B [see trend plot]), which is screened above the plume and MCL exceedances at 03MW1009A which is screened at depth and is within the plume and the fact that TCE concentrations in all North Central Lobe monitoring wells appear to be decreasing (see trend plots, attached).

☑ Emerging Contaminants. This property is located on the downgradient side of Ashumet Pond (i.e. portion of the aquifer characterized by downward vertical gradients due to recharge of the aquifer from surface water at the downgradient eastern side of the pond). Therefore, the private irrigation well at APEMS ID 30589 will likely pump shallow groundwater water that is derived from the pond. Several per-and polyfluoroalkyl substances (PFAS) were detected in Ashumet Pond surface water in 2016. Specifically, the sum of perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) were reported in Ashumet Pond at concentrations greater than the United States Environmental Protection Agency (EPA) drinking water Lifetime Health Advisory (LHA) of 70 µg/L. Sampling of groundwater of monitoring wells 03MW2620B and 00MW0607B, which are located near APEMS ID 30589 confirmed that PFOS and PFOA are present in deeper groundwater at concentrations greater than the EPA LHA in the area between Ashumet and Johns Ponds.
1,4-Dioxane was also recently detected within the North Central Lobe of the CS-10 groundwater plume. Sampling of groundwater of monitoring wells 03MW2620A, 03MW1008A/B, and 00MW0582A, which are located near APEMS ID 30589, confirmed that 1,4-dioxane is present within the CS-10 North Central Lobe, but at concentrations that are less than the Massachusetts Department of Environmental Protection (MassDEP) GW-1 standard.

DETERMINATION: The bottom elevation of the planned residential irrigation well at this property is anticipated to be at approximately +30 ft msl. The top of the CS-10 North Central lobe is at an approximate elevation of -40 ft msl in the vicinity of APEMS ID 30589. Therefore, the top of the CS-10 North Central lobe is approximately 70 feet below the bottom of this planned residential irrigation well (cross section F-F'). If this residential irrigation well is installed at an approximate depth of 50 ft bgs, intermittent use of this well for outdoor irrigation purposes is not expected to result in exposure to the CS-10 groundwater plume (TCE, PCE and 1,4-dioxane).

PFOS and PFOA have been detected in shallow groundwater downgradient of Ashumet Pond at concentrations greater than the drinking water LHA of 0.07 µg/L. According to the 2019 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MassDPH) has determined that occasional exposure to PFOS and PFOA from recreational use is not expected to result in any adverse health effects. Therefore, incidental use of this irrigation well (which is expected to result in similar exposures as those assumed for recreational use of the pond) is not expected to result in an unacceptable exposure risk to groundwater containing PFOS or PFOA.

Please note this well should not be used as a source of drinking water nor should it be used for routine irrigation of home-grown produce (i.e. fruits and vegetables) because the rate of uptake of PFAS by various edible plants is not yet known.

PATH FORWARD: No further sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXXXX, Falmouth MA

APEMS ID: 39919

WELL STATUS: ACTIVE

WELL USE: Outdoor uses

SUMMARY: According to Falmouth Water Department records, this residence is connected to the Falmouth municipal water supply and receives a water bill from the Falmouth Water Department. In August 2018, the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) received a Dig Safe® notification for a planned installation of an irrigation well at XXXXXXXX (also known as XXXXXXXXX). At that time, AFCEC notified the Falmouth Board of Health (BOH) that there are no concerns that this proposed irrigation well would draw groundwater associated with the nearby Chemical Spill-10 (CS-10) groundwater plume, which is defined by the contaminants of concern (COCs), tetrachloroethane (PCE) and trichloroethene (TCE). However, this proposed irrigation well would potentially receive groundwater derived from Ashumet Pond, which has concentrations of per-and polyfluoroalkyl substances (PFAS) above the EPA 2016 Lifetime Health Advisory (LHA) for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in drinking water. During this initial notification to the BOH, AFCEC noted that a remedial investigation was underway in 2018 to define the magnitude and extent of PFAS migrating from the Fire Training Area-1 (FTA-1) site. AFCEC would generate a technical evaluation for this new irrigation well once a Conceptual Site Model (CSM) for PFAS in area groundwater was developed and more information regarding the risks from exposure to PFAS-impacted groundwater through a non-consumptive exposure scenario were available. This technical evaluation is being generated to support the protectiveness determination for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five Year Review process for the CS-10 groundwater remedy and to document the potential for impact by PFAS in nearby groundwater from the FTA-1 site.

According to the well completion report (attached) the residential irrigation well at XXXXXXXXX (also known as XXXXXXXXXX) was installed on 30 May 2018 and the depth is approximately 45 feet (ft) below ground surface (bgs) (or +11 ft mean sea level [msl]). Depth to water in this area is approximately 25 ft bgs (or +40 ft msl). This well is screened in the first 30 feet of the unconfined aquifer. This property is located downgradient of Ashumet Pond, to the southwest of the southern edge of the CS-10 Southern lobe (See location map). Shallow groundwater beneath XXXXXXXXXXX is primarily derived by recharge from Ashumet Pond.

DATA REVIEW:

☑ Monitoring data are available for the CS-10 Southern lobe [see attached location map and cross section].

- 00MW0589A,B,C [monitoring data]
- 00MW0606A,B [vertical profiling and monitoring data]
- 03MW1014A,B [vertical profiling and monitoring data]
- 03MW1015A,B [vertical profiling and monitoring data]

☑ The CS-10 Southern lobe is located close to the top of bedrock, deep in the aquifer at an elevation range of approximately -180 to -260 ft msl (230-310 ft bgs; see cross section C-C' showing plume monitoring data as of 2005). The CS-10 Southern lobe is currently defined primarily by TCE

concentrations that are greater than the maximum contaminant level (MCL) of 5 micrograms per liter (µg/L) at monitoring wells 00MW0606A (-256 ft msl) and 03MW2622A (-225 ft msl). PCE is also a COC at the CS-10 Southern lobe but it is generally detected at lower concentrations than TCE. The CS-10 Southern lobe is predicted to stay at depth in the aquifer, slowly migrate to the south-southeast, and eventually attenuate at depth in the aquifer. This prediction is supported by monitoring data from 00MW0589B and 00MW0606B, which indicate that the plume is staying at depth.

☑ FTA-1 PFAS Groundwater Plume. This property is located on the downgradient side of Ashumet Pond (i.e. portion of the aquifer that is recharged from surface water in Ashumet Pond). Because the private irrigation well at XXXXXXXXXXX is screened within 30 feet of the water table, this irrigation well will likely pump shallow groundwater water that is derived from the pond. The sum of six PFAS regulated in Massachusetts drinking water (PFAS6[1]) reported in Ashumet Pond surface water in 2017 ranged between 0.2029J µg/L to 0.3861J µg/L. The sum of PFAS six in shallow groundwater near XXXXXXXXXX (i.e. first 30 feet below the water table) ranged from 0.0106J µg/L to 0.1004J µg/L (95DP4007, table attached).

DETERMINATION:

CS-10 PCE/TCE Plume: The bottom elevation of the residential irrigation well at this property is screened well above the top of the CS-10 Southern lobe. The bottom of this well is screened at an elevation of approximately 11 ft msl and the top of the CS-10 Southern lobe is at an approximate elevation of -180 ft msl. Therefore, the bottom of this private well is approximately 191 feet above the CS-10 Southern lobe in addition to being approximately 500 feet southwest of the plume boundary (See location map and cross section C-C'). Intermittent use of this well for outdoor irrigation purposes is not expected to result in exposure to the CS-10 groundwater plume (TCE and PCE). This finding is supported by historic and current sampling of private residential wells located in the area of the CS-10 Southern lobe.

FTA-1 PFAS Plume: PFAS have been detected in shallow groundwater (i.e. first 30 feet below the water table) downgradient of Ashumet Pond at concentrations ranging from 0.0106J µg/L to 0.1004J µg/L (95DP4007, table attached), which are lower than those reported in Ashumet Pond. According to the 2021 *Recreational Use of Water Bodies on or Near Joint Base Cape Cod* community fact sheet, the Massachusetts Department of Public Health (MassDPH) has determined that occasional exposure to PFAS from non-consumptive recreational use at concentrations reported in Ashumet Pond surface water is not expected to result in any adverse health effects. In addition, according to the Massachusetts Department of Environmental Protection (MassDEP) 2023 Fact Sheet *PFAS in Drinking Water: Questions and Answers for Consumers*, the risk from the occasional consumption of produce grown in soil or irrigated with water contaminated with PFAS is likely to be low. Therefore, the occasional use of the irrigation well water for outdoor purposes such as watering lawns/shrubbery/vegetable gardens and washing cars is not expected to result in an unacceptable exposure risk to PFAS.

Please note this well should not be used as a source of drinking water.

[1] On 02 October 2020, the Massachusetts Department of Environmental Protection (MassDEP) issued a drinking water MMCL of 0.02 µg/L for the total sum of the six PFAS regulated in Massachusetts drinking water (PFOS, PFOA, perfluorohexane sulfonic acid [PFHxS], perfluorononanoic acid [PFNA], perfluoroheptanoic acid [PFHpA], and perfluorodecanoic acid [PFDA] (i.e., PFAS6).

WELL DETERMINATION

PATH FORWARD: No sampling needed.

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☒ **Yes** ☐ **No**

WELL DETERMINATION

ADDRESS: XXXXXXXX, Falmouth MA

APEMS ID: 42524

WELL STATUS: ACTIVE

WELL USE: Agricultural Irrigation

SUMMARY: According to property owner response (attached), this residence is connected to the Falmouth municipal water supply. This residence receives a water bill from the Town of Falmouth. However, there is one irrigation well located on this property that is used for greenhouse crop irrigation and crop washing. The depth of this well is reported to be 90 ft bgs [~-27 ft msl].

DATA REVIEW:

☑ SPEIM monitoring data are available in the vicinity of this well [see attached map].

— 69MW1501 [-27.5 ft msl,]

No EDB has been reported at 69MW1501 (data attached), which is screened at a similar depth to 69IG0100 and is located near 69IG0100; both wells are located to the west of the FS-28 plume.

☑ Sampling results are available for this private well (attached). 69IG0100 was sampled quarterly from 2008 through 2015, then semiannually since 2016. One sub-MMCL detection (0.012 µg/L) was reported in December 2010. However, no EDB has been detected in twenty-five samples collected subsequent to that detection.

☑ Groundwater monitoring beneath this property began in 1998 with the sampling of monitoring well 69MW1501 shortly after the FS-28 EDB groundwater plume was delineated. A groundwater pump and treat remedial system was installed to the south of the property and began operation in October 1997. Since that time, the extent of the FS-28 plume has significantly decreased (see attached map).

DETERMINATION: This agricultural irrigation well is located approximately 500 feet outside the footprint of the FS-28 plume and screened shallower in the aquifer than where the plume has been detected. Routine sampling of the well since 2008 resulted in one detection only (December 2010 at 0.012 µg/L). No EDB has been detected during historic monitoring of a nearby groundwater monitoring well 69MW1501. Based on a review of data collected from wells on this property and the overall progress observed in the cleanup of the FS-28 groundwater plume, pumping of this well for irrigation purposes will not result in any risk of exposure to plume-related contaminants at this time.

PATH FORWARD: No further sampling is needed**.**

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☐ **Yes** ☒ **No**

WELL DETERMINATION

ADDRESS: XXXXXX, Falmouth MA

APEMS ID: 42575

WELL STATUS: ACTIVE

WELL USE: Private Irrigation/outdoor use

SUMMARY: In August 2020 the Air Force Civil Engineer Center (AFCEC) at Joint Base Cape Cod (JBCC) received Dig Safe® notification #2020351460, which indicated that the property owner was planning to have a private residential irrigation well installed on their property. At the time of the initial private well survey completed as part of the 2009 well verification effort (attached), the owner indicated that the residence is connected to the Falmouth municipal water supply and receives a water bill from the Falmouth Water Department.

APEMS 42575 is located adjacent to Coonamessett Pond and to the east of the Fuel Spill-28 Ethylene Dibromide (EDB) groundwater plume. The total depth of this new irrigation well is unknown. However, the depth to water beneath this property is approximately ten feet below ground surface (ft bgs), or +30 feet mean sea level (ft msl). Based on information obtained from the AFCEC private well monitoring program and a review of residential well construction records at the MassDEP WellSearch database, private residential wells are typically screened within the first 30 feet of groundwater in the communities surrounding JBCC. Therefore, the depth of the private irrigation well at APEMS 42575 is assumed to be approximately 30 ft below the water table or approximately 0 ft msl.

DATA REVIEW:

☑ Characterization and monitoring data are available in the vicinity of this parcel [see attached map, trend plots, cross-section and data tables].

- 69MW1313 [-202 ft msl]. Groundwater monitoring data
- 69MW1310 [-147 ft msl]. Groundwater monitoring data
- 69DP0106. Groundwater vertical profiling data
- 69DP0160. Groundwater vertical profiling data
- Surface Water sampling data from 47 locations throughout Coonamessett Pond; results from the 7 locations closest to the APEMS 42575 parcel are included in the attached supporting data.

The FS-28 EDB plume is located to the west of this property and much deeper in the aquifer than the assumed depth of the planned irrigation well. The FS-28 plume was initially characterized in 1998, prior to startup of the groundwater treatment system (see temporal change figure). At that time, the top of the FS-28 plume was located approximately 500 feet west (cross-gradient) of the subject property and approximately 150 ft bgs (approximately -120 ft msl). Since operation of the groundwater pump and treat system began in 2000, the footprint of the FS-28 plume has decreased in size and the top of the plume is now approximately 500 feet west (cross-gradient) of the subject parcel and approximately 240 ft bgs (approximately -210 ft msl).

WELL DETERMINATION

As noted, this parcel is located adjacent to the southwestern shore of Coonamessett Pond and downgradient of the hydraulic hinge-line for this pond. Therefore, shallow groundwater beneath the property is primarily derived from pond water recharging the aquifer. Coonamessett Pond surface water has been sampled 71 times from 47 total locations between 1996 and 2010 and no EDB has ever been detected.

DETERMINATION: This newly installed private irrigation well is located approximately 500 feet outside the footprint of the FS-28 plume, which is expected to remain deep in the aquifer and contract as the plume migrates south for capture by extraction well 69EW0001. The elevation of the private irrigation well at APEMS 42575 is likely to be no deeper than approximately 0 ft msl and the top of the FS-28 plume in the area to the west is approximately -210 ft msl. The irrigation well on this property is located outside of the FS-28 plume and is expected to remain outside of the plume. Additionally, the irrigation well is expected to draw in shallow groundwater derived from pond surface water recharge which has been sampled extensively with no detections of EDB. It is unlikely that intermittent operation of this private well will draw in groundwater containing detectable concentrations of EDB.

PATH FORWARD: No further evaluation or sampling is required**.**

SAMPLING NEEDED: ☐ **Yes** ☒ **No**

RE-EVALUATE IN NEXT 5-YEAR REVIEW: ☐ **Yes** ☒ **No**

APPENDIX C

Regulatory Comment Resolution Documentation

EPA Concurrence Letter

MassDEP Response to Memorandum of Resolution

DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER
INSTALLATION RESTORATION PROGRAM
OTIS AIR NATIONAL GUARD BASE, MA 02542-1320

16 Aug 2023

AFCEC/JBCC
322 East Inner Road
Otis ANG Base, MA 02542-1320

Mr. Robert Lim
United States Environmental Protection Agency, Region One
5 Post Office Square – Suite 100
Mail Code 0SRR7-3
Boston, MA 02109-3912

Mr. Leonard Pinaud
Massachusetts Department of Environmental Protection, Southeast Region
20 Riverside Drive
Lakeville, MA 02347

Dear Mr. Lim and Mr. Pinaud:

Attached please find the Air Force Civil Engineer Center's Response to Comments Letter (RCL) on the ***Draft 6th Five Year Review, 2017 – 2022 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA.***

We look forward to your comments/approval as soon as possible to allow time to obtain signatures and finalize the report by 30 Sept 2023.

Reviewer comments should be sent directly to Ms. Rose Forbes, with a copy to Ms. Jennifer DeAngelis. Comments or concurrence should be submitted via email to the following addresses:

rose.forbes@us.af.mil
jennifer.deangelis.ctr@us.af.mil

If you have any questions, please contact me at (508) 968-4670, extension 5613.

Sincerely,

FORBES.ROSE.H.1036416218 Digitally signed by FORBES.ROSE.H.1036416218 Date: 2023.08.16 11:46:50 -04'00'

ROSE FORBES, P.E.
Remediation Program Manager

THE AIR FORCE CIVIL ENGINEER CENTER
RESPONSES TO EPA COMMENTS ON THE
DRAFT 6TH FIVE YEAR REVIEW, 2017–2022 JOINT BASE CAPE COD (JBCC)
SUPERFUND SITE OTIS AIR NATIONAL GUARD BASE, MA
DATED JUNE 2023

GENERAL COMMENTS:

1. Per EPA guidance OLEM-9200.0-89 dated January 20, 2016 (https://semspub.epa.gov/work/HQ/100000001.pdf), add a next review section at the end of the document.

   Response: Concur. A "Next Review" section has been added as Section 6.0.

2. **FTA-1 / Ashumet Valley** – Consideration should be given to adding an entry for FTA-1 source area as the draft RI Report and draft FS present source area information separately from groundwater. This would be consistent with LF-1 which has a source area and groundwater entry in this five-year review.

   Response: The RAOs for the FTA-1 source area were achieved and the site was declared UU/UE for existing COCs as documented in the 5th Five-Year Review. Once FTA-1 has a decision document with new RAOs for PFAS, it will be appropriate to include a standard five-year review assessment (presumably in the next five-year review). The LF-1 source area is included in this review because it does not meet UU/UE conditions.

3. **#Responses to Question B** - For Question B, please begin each response with a simple Yes or No followed by the supporting text. Question B response for some Source Area sections are clear and answer the question - explicitly stating no changes in TBCs, risk methods, etc (e.g. Section 3.2.5.2 on PDF pg. 64/304) while others don't quite address the full question and are brief (e.g. Section 3.1.5.2). For a sufficient and satisfactory response, please update the text to be consistent and make sure the responses for Question B are clear and answer the question. A fully sufficient and satisfactory response addresses the following: Changes in standards and TBCs; Changes in Toxicity and Other Contaminants; Changes in Risk Assessment Methods; Changes in Exposure Pathways; Progress towards meeting RAOs
   - Examples that don't fully address all of Question B or are brief:
     - Section 3.1.5.2 – Question B for CS-10 Source Area (PDF pg54/304)

"No. The exposure assumptions and associated RAOs (AFCEE 1999) do not include the potential VI pathway identified in the VI screening evaluation conducted in 2014 (AFCEC 2014).

The RAOs do not address the potential of an on-going source. As discussed in Sections 3.1.3 and 3.1.4.1 the coating material in the storm drain leading to Detail F was determined to contain PCB (aroclor-1260) and TPH concentrations in excess of the MassDEP S-1/GW- 1 standards and may be an on-going source to soil/sediment contamination

Additionally, in some cases the cleanup levels selected in the 1999 ROD and subsequent ESDs are based on outdated toxicity data and/or risk methodologies. Specific COCs requiring an update are summarized in Exhibit 3-1g."

- Section 3.2.5.2, Question B for LF-1 Source: "*The current RAOs (AFCEE 2007) are appropriate. There are no COCs associated with the LF-1 source remedy; therefore, toxicity data, exposure assumptions and cleanup levels are not applicable."[end]*

- <u>Example of better response: Section 4.4.5.2 – Question B for CS-19 (PDF page 119/304)</u>

  "No other changes during this FYR period affect protectiveness at the site.

  There are changes in standards and TBCs related to the CS-19 remedy. Specifically, the EPA tap water screening level for RDX was changed from 0.7 µg/L to 0.97 µg/L (EPA 2018). EPA's new RDX tap water screening level of 0.97 µg/L (which applies to groundwater at CS-19) was integrated into the CS-19 LTM program in 2020. New PFAS standards (discussed in Section 2.1) are not a concern at CS-19.

  There were changes in toxicity parameters for RDX. In August 2018, EPA revised the non-cancer oral RfD and the cancer oral slope factor. These new values indicate that RDX is now less toxic from cancer and non-cancer health effects. These toxicity changes would result in decreased cancer risk and decreased non-cancer hazard from exposure to RDX (EPA 2022).

  There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

  The RAOs documented in the ESD (AFCEE 2011) remain protective and do not need to be changed. The "Other Findings"section may include a recommendation to revise the RDX cleanup level called for in the 2011 ESD based on EPA's revision of the RSL. This would also likely result in a reduction in the MNA period.

<u>Response</u>: The response provided in Section 3.1.5.2, Question B for CS-10 source has been updated. See response to Specific Comment #19.

Section 3.2.5.2 – Question B for LF-1 Source. A "Yes" has been added to the first sentence of the response to Question B. The response provided in Section 3.2.5.2 addresses the exposure assumptions, toxicity data, cleanup levels, and RAO elements asked in Question B. Additional narratives for each factor are not appropriate since there are no COCs.

4. Chemical Acronyms - Under Basis for Taking Action section for each Source Area, please define the chemical instead of using the abbreviated form, especially if it is the first time being discussed. For example, in Section 4.7.2.2., 1,2,4-TMB is introduced but not defined (pdf page 142/304)

Response: Chemical acronyms are spelled out in the first use in the document and are included in the Acronyms and Abbreviations list at the front of the document. The example cited at Section 4.7.2.2 for 1,2,4-TMB has a first use at Section 4.7.2.1 where trimethylbenzene is spelled out.

5. Some Source Areas (such as Section 4.8 and 4.9) sections appear to provide an incomplete picture of the site. For instance, it is not until the Data Review Section that it is let known surface water efforts are reduced in frequency or were discontinued. Prior to the Data Review section not much is mentioned about the surface water/it's connection to GW - so it can feel disconnected and "sudden" when there isn't context beforehand. A streamlined approach to the FYR can preclude details about other media or bodies of water and feel disconnected. Suggest to add background information or text, in particular for Sections 4.8 and 4.9 re: surface water.

Response: Concur. A sentence regarding plume discharge to surface water has been added to Sections 4.8.1 and 4.9.1.

6. #Note that in a number of older RODs Massachusetts Contingency Plan (MCP) standards have been cited at the basis for certain cleanup standards. However, the MCP at 40.0111 states: "The Department shall deem response actions at a disposal site subject to CERCLA adequately regulated for purposes of compliance with 310 CMR 40.0000." Therefore, the AF should assess whether cleanup standards based on MCP standards are protective compared with federal risk-based standards.

Response: Noted. Assessments have been included for individual sites in response to EPA's Specific Comments.

SPECIFIC COMMENTS:

1. Page 1-2, Section 1.0, Top of Page – Add a sentence stating the number of sites not reviewed because remedies have not been finalized and/or sites are under investigation.

Response: Concur. The following sentence has been added to Section 1.0: "There are 24 sites that were not reviewed because remedies have not been finalized and/or the sites are under investigation (Table 1-1c)."

2. Page 1-4, Section 1.3, Para 1, 2nd Sentence – Change "MRSs" to "MRS" since only Mock Village is part of five-year review.

Response: Concur. Change made.

THE AIR FORCE CIVIL ENGINEER CENTER
RESPONSES TO EPA COMMENTS ON THE
DRAFT 6TH FIVE YEAR REVIEW, 2017–2022 JOINT BASE CAPE COD (JBCC)
SUPERFUND SITE OTIS AIR NATIONAL GUARD BASE, MA
DATED JUNE 2023

3. Page 1-4, Section 1.3, Para 1, 3rd Sentence – Change "CERCLIS" to "SEMS" which means "Superfund Enterprise Management System".

Response: Concur. Change made at requested location. Also, SEMS was added to the Acronym and Abbreviation List and the Table 1-8 title.

4. Page 1-5, Exhibit 1-1, Review Status, Author Name – The author name should not be various. There should be one name from AF.

Response: Concur. The primary author's name has been provided.

5. Page 1-5, Exhibit 1-1, Review Period – The dates entered should not reflect the entire five years but should reflect the start of the review and the statutory date of the review.

Response: Concur. Dates changed to 01 June 2022 – 30 September 2023.

6. Page 1-5, Exhibit 1-1 – In addition to the current summary form, additional tables should be added for "Issues/Recommendations," "Protectiveness Statements," and "Sitewide Protectiveness Statement" (see additional attachment for format).

Response: Table 1-4 and Table 1-6 for Issues/Recommendations and Protectiveness Determinations, respectively, are already included in the document. A new Table 1-7 has been added to include the following Sitewide Protectiveness Statement: The Remedial Actions taken are currently protective of human health and the environment; however, the follow-up actions listed in Table 1-4 for the following sites need to be completed to ensure long-term protectiveness: CS-10 Source Area Detail C and F; FTA-2/LF-2 Source Area; Ashumet Valley Groundwater; CS-10 Groundwater; LF-1 Groundwater; FTA-2/LF-2 Groundwater; and PFSA (FS-10/FS-11) Groundwater.

7. Page 2-7, Section 2.2.2, Para 1, 2nd Sentence – Since the acronym DD is defined previously, delete "decision documents."

Response: Concur. A new first use for "decision document" was found imbedded in an EPA citation on Page 2-1. The first use originally on Page 2-7 has been changed to DD.

8. Page 2-9, Section 2.2.2, Last Para, 4th Sentence – Change "Appendix C" to "Appendix B."

Response: Concur. Change made to Appendix B.

9. Page 2-10, Section 2.2.3.1, Para 1, Last Sentence – Clarify if private well verification survey only addressed legacy COCs (VOCs) or if it included PFAS and 1,4-Dioxane.

Response: Concur. Revised sentence reads, "As part of the LUC process specified in the ROD (AFCEE 2009), a private well verification survey found no private drinking water wells with an unacceptable exposure risk from the AV plume legacy COCs."

10. Page 2-13, Section 2.2.3.3, 9th Sentence – At end of the sentence, add "as part of a CERCLA non-time time-critical removal action (add reference)."

Response: Concur. Revised sentence reads, "Seven of the residences had detections in excess of the 2016 lifetime HA and/or MassDEP PFAS6 MMCL and were provided with a water filtration system and/or bottled water and were subsequently connected to municipal water by AFCEC in January 2022 as part of a CERCLA non-time time-critical removal action (AFCEC 2022c)."

11. #Page 2-14, Section 2.2.3.4 – Describe the expansion of the OU to include the wastewater treatment plant (WWTP), the sewer lines between the source areas and the WWTP, and the WWTP infiltration beds, due to high levels of PFAS detected throughout the system. Also note that EPA and the State have requested that the AFCEC establish interim LUCs to prevent disruption of the AFCEC's investigations and of any future remedial action that may be required.

Response: No changes made. The current description is appropriate for the FYR. Further description gets ahead of future decisions on what the OU will include with regards to the WWTP. Comment regarding interim LUCs is noted.

12. Page 2-15, Section 2.4 – Since it was decided not to conduct interviews, add a statement on how the AF will notify the community of the results of the five-year review.

Response: Concur. The following sentence has been added at the end of Section 2.4: "A required fact sheet summarizing the findings and conclusions of the Five-Year Review will be produced and distributed."

13. #Page 2-18, Section 2.7, Para 2, 2nd Sentence - Second sentence should read "EPA's Environmental Justice Screening and Mapping Tool," so delete the extra "and." While the tool appears not have identified a wildfire risk, the Base is located in coastal forested and open habitats susceptable to and adapted to fire.

Response: Concur. The "and" was removed. Comment regarding forest fire danger is noted.

14. #Page 3-1, Section 3.0 – Identify areas by Operable Unit #.

Response: Concur. OU #s have been added at Section 3.0.

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15. #Page 3-2, Section 3.1.2.1, Para 2 – Note the CERCLA 5YR does not assess the protectiveness of the TPH remedy.

Response: The TPH remedy (now EPH/VPH) is part of the CERCLA ROD and is addressed. The petroleum releases at this site, and others, are included in the CERCLA remedies in accordance with the JBCC FFA.

16. #Page 3-4, Exhibit 3-1a – The MCP should not be used as a cleanup standard for Massachusetts CERCLA sites. Need to reassess based on federal risk-based standards.

Response: In accordance with EPA's FYR guidance, Exhibit 3-1a indicates the current COCs in soil for CS-10 Detail C. No change is made.

17. #Page 3-5, Exhibits 3-1b & 3-1c – The MCP should not be used as a cleanup standard for Massachusetts CERCLA sites. Need to reassess based on federal risk-based standards

Response: In accordance with EPA's FYR guidance, Exhibits 3-1b and 3-1c indicate the current COCs for soil and sediment, respectively, at CS-10 Detail F. No change is made.

18. Page 3-8, Exhibit 3-1f – Unclear why an ESD is needed to update the LUC plan. If the remedy already requires LUCs to maintain the protectiveness of the remedy, changing the type of LUC used or updating LUC procedures would not warrant an ESD (maybe a Memo to the File).
Recommend assessing whether the cited MCP standards should be replaced with federal risk-based standards (or at least doing an assessment that documents that both would endup with the same cleanup standard).

Response: In accordance with EPA's FYR guidance, Exhibit 3-1f indicates the recommendations made in the last FYR. No change is made.

19. Page 3-10, Section 3.1.5.2, CS-10 Source Area - _Response to Question B can better answer the question and be more direct. See General Comment above.

Response: Section 3.1.5.2, Question B response has been updated and also addresses General Comment #3 and Specific Comments #21, #22, and #23 as follows:

"No. The current exposure assumptions, cleanup levels, and RAOs are not valid and need to be updated after further evaluation.

There are changes in standards and TBCs that affect the CS-10 Detail C and F remedy. In some

cases the cleanup levels selected in the 1999 ROD and subsequent ESDs are based on outdated toxicity data and/or risk methodologies. There is also a change related to the use of MCP S-1/GW-1 standards for EPH/VPH from the ESDs. The EPA has RSLs for total petroleum hydrocarbon fractions which align with 5 of the 6 EPH/VPH MCP S-1/GW-1 standards cited in the 2003 and 2011 ESDs. Specific COCs requiring an update are summarized in Exhibit 3-1g. The MassDEP S-1/GW-1 and EPA RSLs are shown for comparison purposes. Two current COCs (C_9-C_{18} Aliphatic Hydrocarbons and C_{11}-C_{22} Aromatic Hydrocarbons) have a comparative EPA RSL (shown in bold) that is lower than the current cleanup level. A recommendation has been included to develop (and adopt by ESD as deemed appropriate) federal risk-based standards based on current site data.

Exhibit 3-1g

CS-10 Detail C and F Cleanup Levels Requiring Evaluation/Update

COC	Current Cleanup Level from ROD or ESD (µg/kg)	Media	Detail C or Detail F	2022 MassDEP S-1/GW-1 (µg/kg)	May 2023 EPA RSL (TR = 1E-04, HQ=1) (µg/kg)
VOCs					
Methylene Chloride	10*	Soil	Detail F	100	290 (risk-based SSL)
PCE	10*	Soil	Detail C	1,000	510 (risk-based SSL)
EPH/VPH					
C_5-C_8 Aliphatic Hydrocarbons	100,000	Soil/Sediment	Both	100,000	250,000
C_9-C_{12} Aliphatic Hydrocarbons	1,000,000	Soil/Sediment	Both	1,000,000	N/A
C_9-C_{18} Aliphatic Hydrocarbons	1,000,000	Soil/Sediment	Both	1,000,000	**96,000**
C_{19}-C_{36} Aliphatic Hydrocarbons	3,000,000	Soil	Detail C	3,000,000	230,000,000
C_{19}-C_{36} Aliphatic Hydrocarbons	2,500,000**	Soil/Sediment	Detail F	3,000,000	230,000,000

C_9-C_{10} Aromatic Hydrocarbons	100,000	Soil/Sediment	Both	100,000	300,000
C_{11}-C_{22} Aromatic Hydrocarbons	1,000,000	Soil	Detail C	1,000,000	**18,000**
C_{11}-C_{22} Aromatic Hydrocarbons	200,000**	Soil/Sediment	Detail F	1,000,000	**18,000**
SVOC					
2-Methylnaphthalene	700	Soil	Detail F		240,000
INORGANICS					
Manganese	274,000***	Soil	Detail F	N/A	1,800,000

* These VOC cleanup levels were based on a leaching-based STCL developed in 1996.
** These levels were established in the 2003 ESD. The 2011 ESD updated the cleanup levels for these two COCs at other CS-10 details but did not include Detail F.
*** This COC cleanup level was based on a human health risk-based STCL developed in 1996.

There are changes in risk assessment methods or exposure pathways that effect the protectiveness of the CS-10 Detail C and F remedy. As discussed in Section 3.1.3, the risk assessment methods used in 2014 to evaluate potential VI risk are no longer valid.

The RAOs do not address the potential of an on-going source. As discussed in Sections 3.1.3 and 3.1.4.1 the coating material in the storm drain leading to Detail F was determined to contain PCB (aroclor-1260) and TPH concentrations in excess of the MassDEP S-1/GW-1 standards and may be an on-going source to soil/sediment contamination. Additionally, the exposure assumptions and associated RAOs (AFCEE 1999) do not include the potential VI pathway identified in the VI screening evaluation conducted in 2014 (AFCEC 2014). This FYR includes recommendations to address the potential VI issue and the potential on-going source."

20. #Page 3-10, Section 3.1.5.2, Heading Title – Change "cleanup level" to "cleanup levels"

Response: Concur. Change made to "cleanup levels".

21. Page 3-10, Section 3.1.5.2, Exhibit 3-1g - In November 2022, the EPA RSL updates (click here to see) included changes in toxicity values to Petroleum Hydrocarbons Aliphatic

Low, Aromatic Low, Aromatic Medium and Aromatic High. Source Areas such as Section 3.1 CS-10 Source; Section 4.11 FTA2-LF-2; and 4.12 PFSA list their respective COCs to include C5-C8 aliphatic, C9-C12 aliphatic, etc. Please update Question B response to include these toxicity changes.

Response: Concur. A revised response to Question B has been developed that acknowledges that EPA RSLs exist for certain TPH fractions. See response to Specific Comment #19.

22. #Page 3-11, Section 3.1.5.2, Exhibit 3-1g – Note that cleanup levels should not be based on either the MCP or screening levels. Federal risk-based cleanup standards need to be developed.

Response: Noted. The revised response to Question B includes RSLs as a protectiveness comparison (see response to Specific Comment #19). The decision regarding whether it's appropriate to develop and adopt federal risk-based standards for this site will be made by project managers as all the recommendations (Section 3.1.6) are implemented.

23. #Page 3-11, Section 3.1.6 – Add a recommendation to revise cleanup levels to be based on federal risk-based standards, not the MCP or screening levels. It is unclear how this may impact the protectiveness of the remedy (as to whether it need to be added to the Protectiveness Statement in Section 3.1.7).

Response: Concur. A new recommendation #3 has been added as Exhibit 3-1j and included on Table 1-4 as follows: "Once an assessment of residual contaminants has been completed, develop federal risk-based standards for those contaminants that remain at the site and preclude a UU/UE designation. Engage regulatory stakeholders to determine which updated standards will be adopted for use in executing Recommendation #4 (preparing a DD)." For two COCs (C_9-C_{18} Aliphatic Hydrocarbons and C_{11}-C_{22} Aromatic Hydrocarbons), the EPA RSL is lower than the MassDEP S-1/GW-1 standards. As a result, the CS-10 Detail Cand F Protectiveness Statement in Section 3.1.7 has been revised as follows (changes underlined): "**The remedies for CS-10 source area Details C and F are protective of human health and the environment in the short-term under the current land use scenario.** The remedy is protective in the short-term since access to the site is controlled by base security and a fence that effectively limits potential human exposure. However, for the remedies to be protective in the long-term the VI pathway must be evaluated using updated procedures and the LUC language must be updated to address the VI pathway if necessary. Additionally, a potential new contaminant source from the Detail F storm drain should be evaluated <u>and updated cleanup standards must be developed to ensure protectiveness</u>. Finally, the LUC language must be updated to be consistent with other JBCC DDs if contaminants left in place exceed <u>updated</u> cleanup standards. This determination will be based on the results of a data evaluation using updated cleanup standards in conjunction with any additional remedial measures taken.

THE AIR FORCE CIVIL ENGINEER CENTER
RESPONSES TO EPA COMMENTS ON THE
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DATED JUNE 2023

24. Page 3-12, Section 3.1.6, Exhibit 3-1h – Instead of "Land Use Controls," change "Issue Category" to "Human Health Risk."

Response: Concur. The Issue Category has been changed to Human Health Risk.

25. #Page 3-15, Section 3.2.1, Para 4 – Are there any current plans for solar development on the site?

Response: No. The previous solar project is mentioned at Section 3.2.3 and includes statement that the solar project is no longer being planned. No change made.

26. #Page 3-17, Section 3.2.2.2, Para 1 – In the last sentence change "has been prepared" to "was issued." Was O&M requirements for the LF-1 ROD cap also extended to include O&M requirements for the NWOU cap?

Response: Concur. Change to "was issued" was made. The O&M requirements required for the landfill cover system on the 1970 Cell, Post-1970 Cell, and the Kettle Hole were not extended to the NWOU area (which has a soil and vegetative cover).

27. #Page 3-17, Exhibit 3-2a – Note that the "LUCs called for in the ROD" only addressed the capped landfill and not the NWOU area. Add that the subsequent ESD extended the LUCs to the NWOU.

Response: Concur. Since the narrative at Section 3.2.2.2 is clear about the ESD extending the LUCs to the NWOU, the only change to Exhibit 3-2a is re-naming the "LUCs Called for in the ROD" column to "LUCs Called for in the ROD and ESD".

28. #P**age 3-29, Exhibit 3-2c** – Spell out "ECs."

Response: No change made. This exhibit depicts the Protectiveness Statement from the last FYR.

29. Page 3-20, Section 3.2.5.1 - Question A summary should start with an affirmative yes or no, so add "Yes." at the beginning.

Response: A "Yes" has been added at the beginning of the response.

30. #Page 3-20, Section 3.2.5.2, Heading Title – Change "cleanup level" to "cleanup levels." Answer Question B as "No."

Response: Partially concur. Change made to "cleanup levels". The response is kept as "Yes" since the RAO portion of the question is still applicable.

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31. Page 3-20, Section 3.2.5.2, Para 1, 2nd Sentence – At the beginning of the sentence, add "Because the remedy for LF-1 source area is landfill cap."

Response: Concur. "Because the remedy for the LF-1 source area is a landfill cap" has been added to the second sentence.

32. #Page 3-21, Section 3.2.7 – In the last sentence change "ECs" to "Emerging Contaminants (ECs)."

Response: ECs have been previously defined. No change made.

33. Page 3-21, Section 3.2.7, Para 1, 1st Sentence– Given that the landfill cap is separate from the groundwater, EPA believes that the remedy is protective. Therefore, in the 1st sentence, delete "in the short-term," and in the last sentence, delete "For the remedy to be protective in the long-term."

Response: Concur. The recommended deletions have been made.

34. Page 3-25, Section 3.3.2.3, Exhibit 3-3a - The CS-10 Source Area LUC instruments include annual fence inspection, maintenance, and repair based on a finding to update the LUCIP. Has there been a similar finding for the fence at FTA-2/LF-2? If the associated 1998 ROD includes language about inspecting/maintaining engineered controls such as fences, then a similar update should be included. Are there Dig Safe restrictions on the area?

Response: The 1998 ROD did not include any language regarding fence inspections, maintenance, or repairs. Dig Safe provisions are not part of the source area requirements, but were added in the 2016 ROD amendment when a groundwater remedy was implemented (see Section 4.11). Currently, the RAO for the source area only addresses the leaching potential from FTA-2. If a DD is required as described in the recommendation for the FTA-2/LF-2 source area (Section 3.3.6), then appropriate RAOs and a remedy with LUCs would be prescribed to address a human exposure concern at the source area.

35. #Page 3-25, Section 3.3.2.4, Exhibit 3-3b – In the last sentence of the Protectiveness Statement replace "deed restriction" with "Record of Notice of Landfill Operation.".

Response: In accordance with EPA's FYR guidance, Exhibit 3-3b indicates the recommendations made in the last FYR. To avoid confusion in this instance, Record of Notice of Landfill Operation has been inserted in brackets.

36. Page 3-26, Section 3.3.4.1, Para 2 - Text in parentheses is confusing – almost implies that EPH/VPH could be COCs but are not since it wasn't memorialized in the ROD. *"The 2003 confirmation soil sampling included the EPH/VPH analytes (which were not*

regulated contaminants at the time of the ROD).”

Response: Concur. The information in parenthesis has been removed.

37. #Page 3-27, Section 3.3.5.1 – MCP standards and screening levels should not be used to determine UU/UE (federal risk-based standards should be used).

Response: Concur. The reference to MCP standards has have been removed from this section.

38. Page 3-27, Section 3.3.5.2, Heading Title – Change “cleanup level” to “cleanup levels”.

Response: Concur. Change made to “cleanup levels”.

39. Page 3-28, Section 3.3.5.2, Question B, Para 3 - Please add language from the FY23 Technical template. The following statement is not fully correct, “There have been no changes in toxicity for the current COCs…” There were toxicity changes to Ethylbenzene. The RfD reflected in the RSL calculator is 0.05 mg/kg-d, which is based on a subchronic RfD value (vs chronic RfD of 0.1 mg/kg-d). Recommended EPA language for this change is below.

> **2021 Updated Recommendations on the Use of Chronic or Subchronic Noncancer values**
> In 2021, a memorandum was released from the Office of Land and Emergency Management (OLEM) regarding the use of subchronic toxicity values rather than the chronic noncancer value for 19 chemicals. This recommendation is based on OLEM’s Human Health Regional Risk Assessment Forum’s (OHHRRAF) Toxicity Workgroup evaluation of the toxicity of 32 chemicals. The OHHRRAF Toxicity Workgroup identified 21 oral and 11 inhalation noncancer toxicity values where a subchronic toxicity value was lower than its corresponding chronic toxicity value. After review of relevant information, the OHHRRAF recommended use of the subchronic toxicity value rather than the chronic value for 19 of the 32 chemicals, as follows below.
>
> - *Subchronic inhalation RfC selected for the following chemicals (CASRN):*
> - *Acrylic acid (79-10-7)*
> - *2-Ethoxyethanol (110-80-5)*
> - *Ethyl-chloride (75-00-3)*
> - *2-Methoxyethanol (109-86-4)*
> - *Subchronic oral RfD selected for the following chemicals (CASRN):*
> - *Acrylonitrile (107-13-1)*
> - *Allyl alcohol (107-18-6)*
> - *Atrazine (1912-24-9)*
> - *Bromodichloromethane (75-27-4)*
> - *Cadmium (7440-43-9)*
> - *p-Chloroaniline (106-47-8)*
> - *p-Cresol (106-44-5)*
> - *Ethyl acetate (141-78-6)*

- *Ethylbenzene (100-41-4)*
- *Ethylene glycol (107-21-1)*
- *Heptachlor (76-44-8)*
- *Hexachlorobenzene (118-74-1)*
- *Hexachlorocyclohexane, gamma (58-89-9)*
- *1,2,4,5-Tetrachlorobenzene (95-94-3)*

OHHRRAF recommended the chronic inhalation noncancer value for the following chemicals: ammonia, chlordane, 1,1-dichloroethylene, methyl tert-butyl ether, nitromethane, and vinyl acetate.

OHHRRAF recommended the chronic oral noncancer value for the following chemicals: acrylamide, acrylic acid, 1,1-biphenyl, cyclohexanone, endosulfan, ethylene glycol monobutyl ether, and pentachlorophenol.

Response: Concur. Section 3.3.5.2, Paragraph 3, now reads: "There have been changes in toxicity for ethylbenzene, which is one of the current COCs. In 2021, a memorandum was released from the Office of Land and Emergency Management (OLEM) regarding the use of subchronic toxicity values rather than the chronic noncancer value for 19 chemicals. This recommendation is based on OLEM's Human Health Regional Risk Assessment Forum's (OHHRRAF) Toxicity Workgroup evaluation of the toxicity of 32 chemicals. The OHHRRAF Toxicity Workgroup identified 21 oral and 11 inhalation noncancer toxicity values where a subchronic toxicity value was lower than its corresponding chronic toxicity value. After review of relevant information, the OHHRRAF recommended use of the subchronic toxicity value rather than the chronic value for 19 of the 32 chemicals, including ethylbenzene. The EPA's MCL-based soil screening level for ethylbenzene is 780 µg/kg which is higher than the current leaching based cleanup level of 700 µg/kg; therefore, the current cleanup level is protective" Note that this same change was made to the PFSA Source Area at Section 3.4.5.2.

40. #Page 3-28, Section 3.3.5.2, Question B, Para 3 – Replace the entire paragraph with: "New contaminants not included as COCs in the ROD were identified in 2003 soil sampling and reported in the 2014 Remedial Action Report. In order to assess whether an unacceptable human health risk is posed by the contaminants, an assessment of the post-ROD shallow soil data collected at the site is required to determine if there is an unacceptable human health risk."

Response: Concur. The recommended language has been inserted at Section 3.3.5.2, Paragraph 4 (vs. Paragraph 3 as cited in the comment).

41. Page 3-29, Section 3.3.7, Para 1, Last Sentence - For clarity and consistency with the previous sections, please revise the last sentence as follows: "Since the ROD does require LUCs and has an appropriate LUC objective, the lack of a specific RAO to address human exposure in soil does not affect current protectiveness. However, in order for the remedy to be protective in the long-term, AFCEC must conduct an assessment of the post-ROD shallow

soil data collected at the site, collect additional data as necessary, and determine if there is an unacceptable human health risk."

Response: Concur. The recommended language has been inserted at Section 3.3.7, Paragraph 1, last sentence.

42. Page 3-30, Section 3.4.1, Para 3 - The text below could be clearer and should be revised to answer the type of current land use (i.e., residential, industrial).
"*Current land use in this area is expected to be maintained for the foreseeable future while the airfield and runways are in use and remedial actions are on-going (AFCEC 2018).*."

Response: Concur. The sentence now reads: "The current industrial land use in this area is expected to be maintained for the foreseeable future while the airfield and runways are in use and remedial actions are ongoing (AFCEC 2018)."

43. Page 3-33, Section 3.4.2.3, Para 1, Last Sentence - Exhibit 3-4a. Same comment as above. The CS-10 Source Area LUC instruments include annual fence inspection, maintenance, and repair based on a finding to update the LUCIP. Has there been a similar finding for the fence at the PFSA source area? If the associated 1998 ROD includes language about inspecting/maintaining engineered controls such as fences, then a similar update should be included. Are there Dig Safe restrictions on the area?

Response: The 1998 ROD did not include any language regarding fence inspections, maintenance, or repairs. Dig Safe provisions are not part of the source area requirements, but were added in the 2016 ROD amendment when a groundwater remedy was implemented (see Section 4.12). The RAO for the source area only addresses the leaching potential from PFSA.

44. #Page 3-34, Section 3.4.5.2, Heading Title – Change "cleanup level" to "cleanup levels" Answer Question B - "Yes."

Response: Concur. Change has been made to "cleanup levels" and "Yes" has been added to the Question B response.

45. Page 4-1, Section 4.1.1 – Given that PFAS is mentioned in subsequent pages (e.g., page 4-5, last paragraph), suggest adding a brief statement that fieldwork for the the PFAS plume has been completed and as of the preparation of this five-year review, the draft RI report was submitted but has not been finalized.

Response: No change made. The PFAS topic has been adequately presented at Section 4.1.3 and Section 2.1.

46. Page 4-5, Section 4.1.2.3, Para 3, Last Sentence – Change Appendix C to Appendix B.

Response: Concur. Changed to Appendix B.

47. Page 4-5, Section 4.1.2.3, Para 5 - The text below in underline states AFCEC determined the wells were suitable for irrigation/outdoor uses. Suggestion to clarify (i.e., by what standards, were compared against RSLs recreator scenario?).

"*During this FYR period, in response to AFCEC's private well verification annual mailings, four property owners (APEMS IDs 39663, 39665, 39797, 47065) notified AFCEC that they planned to restart their non-operational irrigation wells. AFCEC sampled these irrigation wells and prepared well determinations (Appendix C) that concluded the wells are suitable for irrigation/outdoor purposes (AFCEC 2022a, 2021a).*"

Response: No change made. The data review sections of the determinations at Appendix B indicate the comparisons made at each location.

48. #Page 4-6, Exhibit 4-1b: Update this sentence with the current information about the status of the Supplemental RI: "Additional information is being collected through a Supplemental RI, tentatively scheduled for completion in September 2019 but dependent upon results obtained during the investigation, and is expected to be followed by an eventual ROD Amendment and development of a LUC area for ECs.

Response: No changes made. In accordance with EPA's FYR guidance, Exhibit 4-1b indicates the recommendations made in the last FYR. The Implementation Status section following Exhibits 4-1b and 4-1c explains the Supplemental RI status.

49. #Page 4-8, Exhibit 4-1c: In the second row the issue isn't Emerging Contaminants since the issue involves elevated detections of PCE. Unclear why the * text says the issues were merged.

Response: No changes made. In accordance with EPA's FYR guidance, Exhibit 4-1c indicates the status of recommendations made in the last FYR. The * text indicates the issues were merged in the last FYR but are separated for clarity in the current FYR.

50. #Page 4-8, Section 4.1.4.1 – Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following sentence regarding PCE and TCE has been added to Section 4.1.4.1: "PCE and TCE concentrations are expected to reach MCLs within the next two to three years (2024-2025) which is within the restoration timeframe estimate of approximately 2021 for the VOC plume presented in the 2009 ROD (AFCEC 2023)." For manganese, the following sentence has been added to Section 4.1.4.1: "Manganese

concentrations are dissipating to below the EPA HA over time as oxygenated water migrates into the area (AFCEC 2023). Specific restoration timeframes for manganese have not been modeled.

51. #Page 4-9, Section 4.1.5.1 – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD.

Response: Concur. The following sentence has been added to Section 4.1.5.1: "Cleanup levels have been achieved for thallium and the remaining COCs' cleanup levels are on a path to be achieved in a reasonable timeframe."

52. Page 4-9, Section 4.1.5.2 – Check EPA supplemental guidance for presenting PFAS discussion.

Response: The EPA supplemental guidance was used to develop Sections 2.1, 2.1.2, 2.1.2.1, and 2.1.2.2. Section 2.0 presents an overview of global issues or activities that are common to many of the sites addressed in this FYR, including the PFAS topic.

53. #Page 4-10, Section 4.1.5.2, Para 3 – Also discuss that thallium has already achieved cleanup standards and what the status of when manganese will achieve cleanup standards.

Response: Concur. The following sentences have been added to Section 4.1.5.2: "In 2011 thallium was no longer detected and thallium monitoring was discontinued (AFCEC 2023). Manganese concentrations are dissipating to below the EPA HA over time as oxygenated water migrates into the area (AFCEC 2023). Continued manganese monitoring will indicate if the restoration timeframe for manganese will significantly exceed the 2021 restoration timeframe cited in the ROD."

54. Page 4-11, Section 4.1.6, Exhibit 4-1d – Is "Milestone Date" AF's projected date for finalization of a DD? Do we need dates for each recommendation? Should a Proposed Plan be added? Should a public comment period for a PP be included in recommendations and due dates?

Response: The projected milestone date shown is for a DD. It is inherent that the CERCLA process will be followed (i.e., a proposed plan). Any other dates are more appropriately applied through the interactive meetings with the regulatory agencies and the FFA.

55. #Page 4-14, Section 4.2.2.1, Para 1 – Regarding the fourth sentence, as previously noted MCP standards should not be used as cleanup levels. The Air Force should determine what a federal risk-based standard would be for 1,1,2,2-TeCA.

Response: Noted. The current cleanup level for 1,1,2,2-TeCA from the MCP is included in the ROD and ESDs and has been determined to be protective when compared to the EPA Tap Water RSL. This information has been added to Section 4.2.5.2, Question B to be consistent with other changes in the FYR as a result of EPA comments regarding the use of MCP standards. Section 4.2.5.2 has been changed as follows (changes underlined):

"Yes. The RAOs developed for the final ROD (AFCEE 2000) and revised in the 2011 ESD (AFCEE 2011) are appropriate and remain valid for the current COCs. The current MCP GW-1 standard for 1,1,2,2-TeCA from the ROD and ESDs has been compared to EPA's RSL and has been determined to be protective. No other changes during this FYR period affect protectiveness at the site.

There are no changes in standards and TBCs that affect the CS-4 remedy. New PFAS standards (discussed in Section 2.1) are not a concern at CS-4.

There are no changes in toxicity or other contaminant characteristics for the CS-4 groundwater COCs. For 1,1,2,2-TeCA, the current MCP GW-1 standard of 2 µg/L from the ROD and ESDs has been compared to EPA's Tap Water RSL of 7.6 µg/L (at a 10^{-4} carcinogenic risk) and has been determined to be protective.

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the remedy.

The estimated restoration timeframe in the ROD was 2017. Groundwater data indicates CS-4 restoration will be achieved in the next 1-2 years."

56. #Page 4-16, 3rd bullet – See previous comments concerning citing MCP cleanup standards.

Response: Noted. This section of the FYR lists the current RAOs. See additional response at Specific Comment #55.

57. #Page 4-18, Section 4.2.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following sentences have been added to Section 4.2.4.1: "The estimated restoration timeframe in the ROD was 2017. Groundwater data indicates CS-4 restoration will be achieved in the next 1-2 years."

58. #Page 4-19, Section 4.2.5.1 – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD.

Response: Concur. The following sentence has been added to Section 4.2.5.1: "Cleanup levels have been achieved for all COCs except PCE which is on a path to be achieved in a reasonable timeframe."

59. #Page 4-20, Section 4.2.5.2 – Need to answer "yes" to the question.

Response: Concur. "Yes" has been added to the Question B response.

60. #Page 4-20, Section 4.2.5.2, Para 5 – To be consistent with the Protective Statement in Section 4.2.5.7 change "in the 2023 timeframe" to "in the next 1-2 years."

Response: Concur. Section 4.2.5.2, Para 5 has been changed to "in the next 1-2 years".

61. Page 4-20, Section 4.2.6 – Suggest adding a follow-up action of conduct monitoring and three-step process to reach remedial action completion.

Response: No change made. Continued monitoring and the three-step process are a ROD requirement and are part of the CERCLA process at JBCC.

62. Page 4-20, Section 4.2.7 – Suggest adding further context for no active remediation and reliance on MNA to reach cleanup levels in entirety of the CS-4 plume. Is there a figure? How many monitoring wells remain above cleanup levels?

Response: No change made. The Protectiveness Determination is supported by the responses to Question A and Question B which are supported by the Data Review. The Data Review (second bullet) states :"At the end of the FYR period, only one monitoring well (02MW1253) indicated an MCL exceedance (PCE at 8.2 µg/L) (AFCEC 2023)." The small, remaining plume is shown in Figures 4-4 and 4-5.

63. Page 4-23, Section 4.3.1, Para 1– The first sentence should add "VOC." Later in this paragraph, a brief sentence should be added to explain the presence of 1,4-Dioxane plume within the VOC plume.

Response: No change made. Section 4.3.2.1 explains the COCs, including 1,4-dioxane and its location within the boundaries of the CS-10 TCE plume.

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64. #Page 4-24, Section 4.3.2.2 – For each response action discussed identify which OU it was in.

Response: Concur. The appropriate OUs have been added to the text in Section 4.3.2.2.

65. Page 4-26, Section 4.3.2.3 – Suggest adding a brief sentence stating the estimated cleanup timeframe for CS-10.

Response: Concur, but in a different location. A sentence regarding cleanup timeframes has been added to Section 4.3.2.2 under the *Final Record of Decision* subsection as follows: "The predicted restoration timeframe for the main body of the CS-10 plume was 2094, while the leading edge restoration timeframe was predicted to be 2046." A separate clause was added to Section 4.3.2.2 under the *Explanation of Significant Differences (2014)* subsection as follows: "The 2014 ESD (OU 14, 21, and 22) documented changes to the CS-10 CSM, modified the remedy to more aggressively remove contaminants, and amended the predicted aquifer restoration timeframe for the main body of CS-10 from 2094 (as presented in the ROD) to 2060."

66. #Page 4-29, Section 4.3.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following sentences have been added to Section 4.3.4.1: "Two of the leading edge lobes, the NCL and SL, rely solely on MNA and continue to see decreasing concentrations of TCE in the monitoring network. The highest TCE concentration in the NCL at the beginning of this FYR period (Oct 2017) was 31 µg/L at monitoring well 03MW2620A (AFCEC 2018B). The highest TCE concentration at the end of the FYR period (Oct 2022) was 22 µg/L also in 03MW2620A (AFCEC 2023). The highest TCE concentration in the SL at the beginning of this FYR period (Oct 2017) was 14 µg/L at monitoring well 00MW0606A (AFCEC 2018B). The highest TCE concentration at the end of the FYR period (Oct 2022) was 5.8 µg/L also in 00MW0606A (AFCEC 2023)."

67. #Page 4-30, Section 4.3.5.1 – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD.

Response: Concur. The following sentences have been added to Section 4.3.5.1: "Two of the leading edge lobes, the NCL and SL, rely solely on MNA. Decreasing concentrations of TCE in the monitoring network at these areas demonstrate the MNA remedy is effective at restoring this portion of the aquifer."

68. Page 4-32, Section 4.3.6, Exhibit 4-3d – Suggest changing to solely "PFAS" since an ESD adding 1,4-Dioxane as a COC to CS-10 has been completed.

Response: No change made. 1,4-Dioxane is not mentioned in Exhibit 4-3d.

69. Page 4-32, Section 4.3.7, Para 1, Last Sentence – To complete the circle, suggest adding a statement about investigation of PFAS at FS-13 being rolled into CS-10 PFAS investigation.

Response: Concur. The last sentence in Section 4.3.7 now reads as follows: "For the remedy to be protective in the long-term, an investigation of PFAS in the CS-10 extraction wells and in groundwater near FS-13 should be conducted and follow-on CERCLA responses should be implemented, as necessary." Also, the related recommendation for CS-10 has been updated as follows:

Exhibit 4-3d **Issue/Recommendation #7: CS-10 Groundwater**				
14, 21 and 22 (CS-10 Groundwater)	**Issue Category: Emerging Contaminants**			
	Issue: Emerging contaminants, specifically PFAS, exceed the PFAS6 MMCL in numerous CS-10 extraction wells and in groundwater in the FS-13 area (which overlies the CS-10 plume). These PFAS detections may not be related to CS-10.			
	Recommendation: Conduct an investigation of the PFAS detected in the CS-10 extraction wells and in groundwater near FS-13. Engage regulatory and AF program stakeholders regarding the appropriate reporting mechanism (e.g., expansion of on-going Flight Line OU RI, CS-10 Supplemental RI). Develop a DD to establish additional COCs and RAOs as appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2027

70. #Page 4-35, Section 4.4.1 – Confirm there were no burn pits in the disposal area, where AFFF may have been used (and therefore the groundwater assessed for PFAS).

Response: The site was reported to be used for disposal from approximately 1967 to 1968, which pre-dates the use of AFFF. The dates of use have been added to Section 4.4.1.

71. #Page 4-37, Section 4.4.2.3, Last Para – Paragraph can be removed since no private wells within the OU.

Response: Concur. The last paragraph in Section 4.4.2.3 has been removed.

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72. #Page 4-38, Section 4.4.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following sentence has been added after the data comparison: "This data indicates the MNA remedy will achieve the estimated date of cleanup (2037)."

73. #Page 4-38, Section 4.4.4.1, Bullets 2&3 – The 2011 ESD set the RDX RG at 0.6 µg/L, so discuss whether monitoring wells exceeded that standard rather than the RSLs. If the change in the RSL requires changing the cleanup standard upward (so wouldn't impact the current remedy's protectiveness) that should be discussed in "Other Findings" as a recommendation to issue a new CERCLA decision document to make the change.

Response: Concur. The data comparison now reads as follows: "At the end of the FYR period, RDX was detected above the EPA risk-based value of 0.6 µg/L in two of eight monitoring wells (maximum concentration at monitoring well 58MW0009E with RDX at 1.3 µg/L) (AFCEC 2022)." The comment regarding an "Other Finding" and CERCLA decision document is noted and addressed at Specific Comment #76.

74. #Page 4-39, Section 4.4.5.1 – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Note if the cleanup level for RDX is changed through a new CERCLA decision document then the MNA period will also need to be recalculated.

Response: Concur. The following sentence has been added to the response at Section 4.4.5.1: "The data evaluation indicates the MNA remedy will achieve the estimated date of cleanup (2037)." With only one monitoring well indicating an RDX concentration above the "future" cleanup value, recalculation of a revised MNA period appears unnecessary. The CS-19 plume is clearly approaching restoration.

75. #Page 4-39, Section 4.4.5.2 – Answer the question "Yes." See previous comment concerning changes to the RSLs did not change the cleanup standard required under the 2011 ESD. A new CERCLA decision document would need to be issued to make the change. The last paragraph in particular needs to be revised because a Technical Memorandum is not sufficient to change the cleanup standard (would need an ESD).

Response: Concur. The first paragraph and last two paragraphs of Section 4.4.5.2 now read as follows: "Yes, however, the toxicity data for RDX has changed resulting in a less stringent standard. This change does not impact the protectiveness of the current RAOs. No other changes during this FYR period affect protectiveness at the site."

"The RAOs documented in the ESD (AFCEE 2011) remain protective. As noted previously, in 2018 EPA updated the RSL for RDX in tap water (originally 0.6 µg/L then updated by

EPA to 0.7 µg/L in 2017) to 0.97 µg/L. This FYR includes a finding to document an upward change in the RDX cleanup level in an ESD that can support future application of the three-step closeout process and the subsequent Remedial Action Completion Report (RACR)."

The groundwater comparison level (i.e., current RDX risk-based level of 0.6 µg/L) is expected to be achieved earlier than the timeframe approximated in the ROD (by 2037).

76. Page 4-40, Section 4.4.6, Exhibit 4-4c – An upward projected change in cleanup level is not considered an issue that affects protectiveness, therefore a recommendation to prepare an ESD to document an upward change in the RDX cleanup level for CS-19 and recalculate the MNA period should be identified as an "Other Finding."

Response: Concur. The recommendation has been deleted and replaced with an "Other Finding" which reads: "Prepare an ESD to document an upward change in the RDX cleanup level for CS-19 groundwater and establish a new MNA timeframe if justified by the remaining RDX concentrations."

77. #Page 4-40, Section 4.4.7 – Remove the last sentence..

Response: Concur. The last sentence in Section 4.4.7 has been removed.

78. #Page 4-47, Section 4.5.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: The first bullet in section 4.5.4.1 currently states "Continued extraction and natural attenuation are reducing COC concentrations" and is followed by a discussion of TCE concentration changes and is supported by Figure 4-9. Additional text has been added as follows: "The estimated restoration timeframe in the ROD was 2025. Groundwater data indicates CS-21 restoration will be achieved in this approximate timeframe."

79. #Page 4-48, Section 4.5.5.1 Question A – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Add a statement on whether or not the remedy will achieve cleanup by the predicted date in the ROD.

Response: Concur. The first paragraph of Section 4.5.5.1 now reads (changes underlined): "Yes, the completion of the ROD in 2000, construction and startup of the remedial system in 2006, continued operation of the remedial system in conjunction with MNA, and completion of the well verification/well determination portion of the LUCs have resulted in the remedy at CS-21 functioning as intended by the DDs. The estimated restoration timeframe in the ROD was 2025. Groundwater data indicates CS-21 restoration will be achieved in this approximate timeframe."

THE AIR FORCE CIVIL ENGINEER CENTER
RESPONSES TO EPA COMMENTS ON THE
DRAFT 6TH FIVE YEAR REVIEW, 2017–2022 JOINT BASE CAPE COD (JBCC)
SUPERFUND SITE OTIS AIR NATIONAL GUARD BASE, MA
DATED JUNE 2023

80. #Page 4-49, Section 4.5.5.2 – Answer the question "Yes."

Response: Concur. "Yes" has been added to Section 4.5.5.2.

81. #Page 4-52, Section 4.6.1, Para 3 – Discuss whether the State is overseeing cleanup of the petroleum under State authority and, if so, the status of that cleanup.

Response: No change made. The State is not overseeing the cleanup of FS-12. Associating petroleum responses to the protectiveness purpose of the FYR would require documenting the history of the application of the petroleum exclusion and its relation to the JBCC FFA, a topic which has not been discussed in the 5 previous FYRs.

82. Page 4-52, Section 4.6.2.1, Para 2, Last Sentence – Clarify also that human health recreational scenario also didn't pose a risk for taking action.

Response: No change made. The basis for taking action with regards to human health is discussed (future residential exposure to FS-12 groundwater). Inserting discussion of non-applicable exposure scenarios is not necessary in a FYR (and was not even done in the ROD).

83. #Page 4-57, Section 4.6.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)). [If there also a concurrent State petroleum cleanup] Discuss the impact of the State petroleum cleanup on the MNA CERCLA contaminant trends.

Response: Concur. The MNA status is discussed in the last bullet of Section 4.6.4.1. However, additional sentences have been added which read: "The cleanup timeframe at FS-12 had been estimated to extend to 2105 based on post-ROD data collected deeper in the aquifer (AFCEC 2016). As described in the last FYR, the FS-12 remediation system was optimized with the goal of shortening the cleanup timeframe. Groundwater model transport simulations (based on the optimized FS-12 system) indicate that much of the FS-12 plume is now predicted to be remediated within the timeframe established by the ROD (approximately 2030)." See response to Specific Comment #81 regarding State petroleum cleanup.

84. #Page 4-58, Section 4.6.5.1 Question A - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD (in particular why the current cleanup estimate is nine years beyond the ROD estimate). Add a statement on whether or not the remedy will achieve cleanup by the predicted date in the ROD.

Response: No definitive statement regarding whether the remedy will achieve the predicted date in the ROD can be made. Additional discussion has been added to Section 4.6.5.1 which reads: "Post-ROD data collected in 2015 indicated an estimated cleanup timeframe of 2105. A system optimization and associated groundwater model transport simulations indicate that much of the FS-12 plume is now predicted to be remediated within the timeframe established by the ROD (approximately 2030). The treatment system is predicted to shut down sometime between 2034 and 2039, at which time the remedy is expected to transition to MNA alone to address a small area of low concentration EDB that is predicted to remain at depth in the aquifer upgradient of extraction wells 90EW0025 and 90EW0026."

85. #Page 4-58, Section 4.6.5.2, Question B – Answer the question "Yes."

Response: Concur. "Yes" has been added to Section 4.6.5.2.

86. #Page 4-59, Section 4.6.7 – In the third sentence change "may not be met" to "will not be met."

Response: Concur. The third sentence in Section 4.6.7 (and a similar sentence in Section 4.6.5.2) have been changed to read: "Current groundwater data and modeling indicate the aquifer restoration timeframe of 2030 identified in the ROD will not be met."

87. #Page 4-61, Section 4.7.1, Para 3 – Discuss whether the State is overseeing cleanup of the petroleum under State authority and, if so, the status of that cleanup.

Response: No change made. The State is not overseeing the cleanup of FS-12. Associating petroleum responses to the protectiveness purpose of the FYR would require documenting the history of the application of the petroleum exclusion and its relation to the JBCC FFA, a topic which has not been discussed in the 5 previous FYRs.

88. Page 4-62, Section 4.7.2.1, Para 2 – Clarify why VI pathway is insignificant (e.g., add a parenthetical stating depth to groundwater).

Response: Concur. A parenthetical has been added to Section 4.7.2.1 which reads: "(detected concentrations at the water table were below VI screening values)".

89. #Page 4-63, Exhibit 4-7a – Why is the Private Well LUC Program listed if the plume is entirely on-Base?

Response: Exhibit 4-7a depicts the information from the DDs. Applying private well LUCs to FS-13 may have been a very conservative approach.

90. #Page 4-64, Section 4.7.4.1 - Need to discuss the status of MNA (updated modelling,

estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. A new bullet has been added which reads: "The groundwater data collected in 2021 indicate the site has reached its restoration goal. Due to the sparsity of data, the 2000 ROD did not provide an estimate of the aquifer restoration timeframe for FS-13 (AFCEE 2000). Cost calculations in the ROD used an estimate of 20 years of LTM costs. The 20-year LTM estimate in the ROD matches the actual restoration timeframe (subject to future confirmation sampling).

91. #Page 4-64, Section 4.7.4.1, Bullets 2&3 – The 2011 ESD set the RGs for the two COCs at 17 µg/L, so discuss whether monitoring wells exceeded that standard rather than the RSLs. If the change in the RSL requires changing the cleanup standard upward (so wouldn't impact the current remedy's protectiveness) that should be discussed in "Other Findings" as a recommendation to issue a new CERCLA decision document to make the change.

Response: Concur. The data comparison now reads as follows: "COC concentrations at the two direct-push boring locations sampled in 2021 were below the ESD's risk-based level of 17 µg/L for 1,2,4-TMB and 1,3,5-TMB at the shallowest screening interval (near top of water table)." The comment regarding an "Other Finding" and CERCLA decision document is noted and addressed at Specific Comment #96.

92. Page 4-65, Section 4.7.5.1 – Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Note if the cleanup level for the two COCs is changed through a new CERCLA decision document then the MNA period will also need to be recalculated.

Response: Concur. The following sentences have been added to Section 4.7.5.1: "The groundwater data collected in 2021 indicate the site has reached its restoration goal. Due to the sparsity of data, the 2000 ROD did not provide an estimate of the aquifer restoration timeframe for FS-13 (AFCEE 2000). Cost calculations in the ROD used an estimate of 20 years of LTM costs. The 20-year LTM estimate in the ROD matches the actual restoration timeframe (subject to future confirmation sampling)." The site has reached its restoration goal and a recalculation of the MNA period (which was not established in the ROD due to sparsity of data) is not necessary.

93. #Page 4-65, Section 4.7.5.1 Question A - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Note if the cleanup level for the two COCs is changed through a new CERCLA decision document then the MNA period will also need to be recalculated.

Response: See the response to comment #92.

94. #Page 4-65, Section 4.7.5.2 – Answer the question "Yes." See previous comment concerning changes to the RSLs did not change the cleanup standard required under the 2011 ESD. A new CERCLA decision document would need to be issued to make the change.

Response: Concur. The first paragraph in Section 4.7.5.2 now reads: "Yes, however, the toxicity data for 1,2,4-TMB and 1,3,5-TMB has changed resulting in less stringent standards. This does not impact the protectiveness of the current RAOs. Additionally, new PFAS standards do not affect the long-term protectiveness of the current remedy selection (see discussion in next paragraph)."

95. #Page 4-66, Section 4.7.5.2, The last paragraph in particular needs to be revised because the changes to the RSLs do not change the remedy's cleanup standards (would need an ESD).

Response: Concur. The last paragraph in Section 4.7.5.2 now reads: "The RAOs documented in the ESD (AFCEE 2011) remain protective. As noted previously, EPA developed RSLs for the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD that can support future application of the three-step closeout process and the subsequent RACR for FS-13.

96. Page 4-67, Section 4.7.6, Exhibit 4-7c – An upward projected change in cleanup level is not considered an issue that affects protectiveness, therefore a recommendation to prepare an ESD to document an upward change in the cleanup level and a recalculation of the MNA period for FS-13 should be identified as an "Other Finding."

Response: Concur. The recommendation has been deleted and replaced with an "Other Finding" as follows: "Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FS-13 groundwater that can support future application of the three-step closeout process and the subsequent RACR for FS-13." The site has reached its restoration goal and a recalculation of the MNA period is not necessary.

Note the first "Other Finding" regarding PFAS has been updated as follows: "The PFAS detections in the FS-13 area are not associated with the FS-13 fuel spill and should be addressed as part of Recommendation #7 (Section 4.3.6) to investigate PFAS detected in the CS-10 extraction wells."

97. #Page 4-67, Section 4.7.7 – The Protectiveness Statement needs to be based on whether the current remedy is protective based on the cleanup standards under the 2011 ESD, not the revised RSLs.

Response: Concur. Section 4.7.7 now reads: "**The remedy for the FS-13 groundwater plume is protective of human health and the environment.** Remediation through natural

attenuation has resulted in all COC concentrations now detected at levels below cleanup standards cited in the 2011 ESD. The LUCs are in place and are functioning as intended to protect human health. The PFAS detected in the FS-13 area will be managed as part of a separate investigation (Recommendation #7, Section 4.3.6)."

98. #Page 4-69, Section 4.8.1, Para 3 – Discuss whether the State is overseeing cleanup of the petroleum under State authority and, if so, the status of that cleanup.

Response: No change made. The State is not overseeing the cleanup of FS-12. Associating petroleum responses to the protectiveness purpose of the FYR would require documenting the history of the application of the petroleum exclusion and its relation to the JBCC FFA, a topic which has not been discussed in the 5 previous FYRs.

99. #Page 4-71, Section 4.8.2.2 – Concerning the cleanup standard identified in the first bullet, is achieving the MMCL more stringent than the risk-based standard(s) required for the River water to prevent both human exposure risk and contamination of fish tissue above consumption risk levels?

Response: Yes, the MMCL (0.02 µg/L) is orders of magnitude more stringent than the risk-based screening level established for EDB in surface water (328 µg/L). A note has been added at the end of the RAOs listed in Section 4.8.2.2 which reads: "Note that subsequent to the completion of the ROD, a screening-level human health risk evaluation was conducted to examine the potential for imminent human health risks from exposure to surface water containing EDB (Appendix D of AFCEE 2003). After a downward revision of EDB's toxicity in 2004, the health risk was recalculated as part of the 4th FYR completed in 2013 (AFCEC 2013). The recalculated RBC for EDB in surface water at FS-28 increased from 7.71 µg/L to 328 µg/L (under the "imminent risk to human health" scenario)." The additional references have also been added to the References section for FS-28. The referenced documents assessed multiple exposure scenarios including fish consumption and dermal contact for waders/cranberry workers. The lowest calculated RBC among the exposure scenarios was selected (in this case, 328 µg/L, based on the fish consumption exposure).

100. Page 4-71, Section 4.8.2.3 – Suggest adding sentence(s) addressing affect of pump and treat on the surface water and the reduction/elimination of surface water sampling since one of the FS-28 RAOs relate to surface water.

Response: Concur. The following sentence has been added to Section 4.8.2.3: "The remediation systems have eliminated the discharge of detectable concentrations of EDB to the surface water."

101. #Page 4-72, Exhibit 4-8a – There are no LUCs identified in the Exhibit to prevent worker contact and child and adult wader contact with Coonamessett River water containing

unacceptable concentrations of EDB or prevent ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB (until the water no longer poses a risk).

Response: Correct. No LUCs are (or were) required since detected concentrations of EDB in surface water were well below the RBCs cited in Specific Comment #99.

102. #Page 4-73, Section 4.8.2.4, 2nd bullet - Is it known whether AFFF was used to extinguish the electrical fire and whether that caused a PFAS release?

Response: It is known that no AFFF was applied. The fire had put itself out by the time fire services arrived at the site.

103. #Page 4-75, Section 4.8.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)). Regarding the fourth bullet – is surface water monitoring still being conducted or has it been discontinued based on the ND results. Has fish tissue monitoring been done (if so, describe)?

Response: Concur. The following bullet has been added to Section 4.8.4.1: "The groundwater data indicate groundwater restoration is nearly complete as a result of the active remediation and MNA components of the remedy. The ROD estimated a restoration timeframe of 2018." Regarding the fourth bullet, the following has been added: "Surface water sampling, which occurs in the month prior to cranberry harvesting, is planned to continue in 2023." Regarding fish tissue monitoring, a new entry was added to Section 4.8.2.2 Response Actions: "Shellfish and Fish Sampling: A shellfish residue study was completed in August 1997. The study was planned and coordinated by several state agencies. Shellfish were collected from Green Pond (fed by Coonamessett River) and an appropriate reference area and analyzed for EDB by the Massachusetts Department of Public Health laboratory. No EDB was detected (AFCEE 1999a). In September 1997, fish were collected from Pond 14 (Coonamessett Reservoir Bog Pond). The fish were analyzed by the Massachusetts Department of Public Health laboratory and all samples were non-detect for EDB (AFCEE 1998)."

104. #Page 4-75, Section 4.8.5.1 - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Also need to describe how LUCs to prevent contact with River water and consumption of fish from the River are being implemented and enforced. If there are no LUCs to address the river water contact and fish consumption RAOs and those media still pose a risk then the answer to the question should be "No."

Response: Concur. The following sentences have been added to Section 4.8.5.1: "The groundwater data indicate groundwater restoration is nearly complete as a result of the active

remediation and MNA components of the remedy. The ROD estimated a restoration timeframe of 2018." The surface water media (including fish) does not present a risk.

105. #Page 4-76, Section 4.8.5.2 – Answer the question "Yes."

Response: Concur. "Yes" has been added to Section 4.8.5.2.

106. #Page 4-77, Section 4.8.6 – If LUCs are not in place to address river water exposure and fish consumption risks (if they are still present) then an Issue and Recommendation is to establish the required LUCs.

Response: The surface water media (including fish) does not present a risk. See response to Specific Comment #99.

107. #Page 4-77, Section 4.8.7 – As already noted, the remedy is not protective if exposure risks to river water and from consumption of fish (if still present) are not in place and being enforced. If fish tissue consumption still poses a risk, need to discuss how long after groundwater cleanup standards are achieved will fish tissue no longer pose a consumption risk.

Response: The surface water media (including fish) does not present a risk. See response to Specific Comments #99 and #103.

108. #Page 4-79, Section 4.9.2.1, Para 3 – Is the statement there is no VI risk inconsistent with the RAO that states "Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and **inhalation**)"?

Response: There is no inconsistency. The RAO cited relates to non-residential exposure to groundwater (e.g., irrigation well at a greenhouse) through the dermal contact, ingestion, and inhalation exposure routes. The VI topic relates to in-situ contaminated groundwater that could volatilize through the vadose zone into buildings.

109. #Page 4-81, Section 4.9.2.2, 2nd bullet - As previously noted MCP standards should not be used as cleanup levels. The Air Force should determine what a federal risk-based standard would be for 1,1,2,2-TeCA.

Response: Noted. The current cleanup level for 1,1,2,2-TeCA from the MCP is included in the ROD and ESDs and has been determined to be protective when compared to the EPA Tap Water RSL. This information has been added to Section 4.9.5.2, Question B to be consistent with other changes in the FYR as a result of EPA comments regarding the use of MCP standards. The following sentence has been added to Section 4.9.5.2: "For 1,1,2,2-TeCA, the current MCP GW-1 standard of 2 µg/L from the ROD and ESD has been compared to EPA's

Tap Water RSL of 7.6 µg/L (at a 10^{-4} carcinogenic risk) and has been determined to be protective."

110. #Page 4-82, Exhibit 4-9a – Other than the listed well restrictions, has a LUC been established to "Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10-4 to 10-6 or present a non-carcinogenic hazard index greater than 1.0." In particular is there a VI LUC to address the identified inhalation risk?

Response: See response to Specific Comment #108. The private well LUC program and its associated well determinations (where a non-residential well would be identified) address this RAO.

111. Page 4-84, Section 4.9.2.4, Para 2, Bullet 1 – Add a statement on where treated water is reinjected compared to prior location with the switch to the HATF.

Response: Concur. The following statement has been added to Bullet 1 in Section 4.9.2.4: "The treated groundwater is now reinjected through the HATF trenches located approximately 1 mile southeast of the former locations north of the LF-1 treatment plant (Figure 4-15)."

112. #Page 4-86, Section 4.9.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following bullet has been added to Section 4.9.4.1: "The LF-1 southern and northern plume lobes, located west of the base boundary extraction fence, are addressed through MNA. The ROD-estimated cleanup date for these areas is 2027. The southern lobe COC concentrations were confirmed to be below the MCL in 2017. The northern lobe's attenuation is progressing (Figure 4-15 and 4-16) and has a projected cleanup date of 2029 (AFCEC 2023)".

113. #Page 4-87, Section 4.9.5.1 - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Also need to describe how LUCs to prevent non-residential inhalation risks are being implemented and enforced. If there are no LUCs that address non-residential, non-drinking water risks then the answer to the question should be "No."

Response: Concur. The following statement at Section 4.9.5.1 has been revised to read (change underlined): "The remedial system is containing the plume at the base boundary, <u>while the off-base portions of the plume relying solely on MNA have achieved their cleanup levels or are approaching their cleanup levels in a timeframe commensurate with the ROD</u>

date for these areas (2027).” No change made regarding the LUC comment. See response to Specific Comment #110.

114. #Page 4-91, Section 4.10.2.2 – Identify if the listed response actions were taken in both OUs comprising the area or just one of the OUs.

Response: Concur. The OU notations have been inserted.

115. #Page 4-91, Section 4.10.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The following bullet has been added to Section 4.10.4.1: “The ESD-estimated timeframe for plume cleanup is 2022 and the data indicate the MNA remedy has progressed in accordance with this timeframe.”

116. #Page 4-92, Section 4.10.5.1 - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD.

Response: Concur. The following sentence has been added to Section 4.10.5.1: “The ESD-estimated timeframe for plume cleanup is 2022 and the data indicate the MNA remedy has progressed in accordance with this timeframe.”

117. Page 4-96, Section 4.10.6 – Change “recommendation” to “issue”.

Response: No change. The current language for Section 4.10.6 is used for other sites with no issues/recommendations.

118. #Page 4-98, Section 4.11.2.1, Para 3 – Regarding the last sentence, there is no discussion of VI LUCs in Section 4.11.2.3.

Response: The VI LUC objective is included in Section 4.11.2.3, Exhibit 4.11a. The associated LUC is the Dig Safe review. A clarifying statement has been added to the last sentence in Section 4.11.2.3 as follows (change underlined): “Based on the implementation of other LUCs (i.e. MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells or new facilities (which would trigger a VI evaluation) were installed in the FTA-2/LF-2 Groundwater LUC Area during this FYR period (AFCEC 2022a, 2021a, 2020, 2019b).

119. #Page 4-99, Section 4.11.2.2, Para 1 – Were any of the UST found to be leaking, necessitating also the removal of contaminated soil?

Response: There was some soil removal associated with the transfer lines. Paragraph 1 in Section 4.11.2.2 now reads (change underlined): "Six 25,000-gallon USTs and approximately 450 cubic yards of contaminated soil were removed from Western Aquafarm in 1994 in accordance with Commonwealth of Massachusetts Regulations (ANG 1995).

120. #Page 4-99, Section 4.11.2.2, Bullets 1&4 - As previously noted MCP standards should not be used as cleanup levels. The Air Force should determine what a federal risk-based standards would be for the COCs with MCP cleanup standards.

Response: Noted. This section indicates the current RAOs.

121. #Page 4-101, Exhibit 4-11a – The Exhibit needs to include the VI LUCs.

Response: See response to Specific Comment #118.

122. #Page 4-102, Section 4.11.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The first bullet in Section 4.11.4.1 now reads (changes underlined): "The MNA remedy is functioning as the plume has not migrated and COC concentrations are generally trending downward with some COC increases as discussed below. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR.

123. #Page 4-103, Section 4.11.5.1, Question A - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Add a statement on whether or not the remedy will achieve cleanup by the predicted date in the ROD.

Response: Concur. The following sentence has been added to Section 4.11.5.1: "The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR." A definitive statement regarding the achievement of the cleanup date (2035) cannot be made at this time.

124. #Page 4-103, Section 4.11.5.2, Question B - Answer the question "No." See previous comment concerning changes to the RSLs did not change the cleanup standard required under the 2011 ESD. A new CERCLA decision document would need to be issued to make the change. The last paragraph in particular needs to be revised because a Technical Memorandum is not sufficient to change the cleanup standard (would need an ESD). In November 2022, the EPA RSL updates (click here to see) included changes in toxicity values to Petroleum Hydrocarbons Aliphatic Low, Aromatic Low, Aromatic Medium and Aromatic High. Source Areas such as Section 3.1 CS-10 Source; Section 4.11 FTA2-LF-2; and 4.12

PFSA list their respective COCs to include C5-C8 aliphatic, C9-C12 aliphatic, etc. Please update Question B response to include these toxicity changes.

Response: Concur. The revised response to Section 4.11.5.2, Question B reads as follows:

"No. The current MCP GW-1 standards for the 4 EPH/VPH COCs from the ROD Amendment have been compared to EPA's comparative tap water TPH RSLs and are not protective in the long-term. This issue impacts the protectiveness of the current RAOs.

There are changes in standards and TBCs that affect the FTA-2/LF-2 remedy. Specifically, EPA tap water screening levels for 1,2,4-TMB (56 µg/L) and 1,3,5-TMB (60 µg/L) were developed (EPA 2017).

There were changes in toxicity parameters for 1,2,4-TMB and 1,3,5-TMB as follows:

- In June 2017, EPA finalized a new inhalation RfC for 1,2,4-TMB. The new IRIS value replaces a PPRTV that was used previously and indicates that 1,2,4-TMB is less toxic from non-cancer health effects. This change would result in decreased non-cancer hazard from inhalation exposure to 1,2,4-TMB (EPA 2022).
- In June 2017, EPA finalized an inhalation RfC for 1,3,5-TMB based on a new IRIS value. Previously, there was no RfC value for 1,3,5-TMB (EPA 2022).

There is also a change related to the use of MCP GW-1 standards for EPH/VPH and 2-methylnaphthalene from the ROD Amendment. The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the FTA-2/LF-2 ROD Amendment. As indicated in Exhibit 4-11c below, the tap water RSLs are lower than the MCP GW-1 standards. The MCP GW-1 standard for 2-methylnaphthalene of 10 µg/L is protective since it is less than the EPA Tap Water RSL of 36 µg/L.

Exhibit 4-11c FTA-2/LF-2: Comparison of MCP GW-1 EPH/VPH and EPA Tap Water RSLs				
COC from ROD Amendment	**MCP GW-1 Cleanup Level (µg/L])**	**EPA Terminology for Comparative TPH Fraction**	**EPA Regional Screening Level Resident Tap Water (µg/L) HQ=1**	**Is EPA RSL Lower than GW-1?**
EPH/VPH				
C_5-C_8 Aliphatic Hydrocarbons	300	Aliphatic Low	28	Yes
C_9-C_{12} Aliphatic Hydrocarbons	700	N/A	N/A	N/A
C_9-C_{10} Aromatic Hydrocarbons	200	Aromatic Medium	57	Yes
C_{11}-C_{22} Aromatic Hydrocarbons	200	Aromatic High	6	Yes

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the FTA-2/LF-2 remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at FTA-2/LF-2 and any PFAS in the area will be managed under the Flight Line Operable Unit response (see Section 2.1.2).

The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears achievable; however, a finding has been noted to evaluate attenuation at the next FYR.

The RAOs documented in the ROD Amendment (AFCEC 2016) are not protective in the long-term. This FYR includes a recommendation to develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. As noted previously, EPA developed RSLs for two of the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR also includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD."

125. #Page 104, Section 4.11.5.2, Question B, Para 1 - The paragraph needs to be revised because a Technical Memorandum is not sufficient to change the cleanup standard (would need an ESD)**.**

Response: See response to Specific Comment #124.

126. #Page 4-105, Section 4.11.6, Exhibit 4-11c, Recommendation - An upward projected change in cleanup level is not considered an issue that affects protectiveness, therefore a recommendation to prepare an ESD to document an upward change in the cleanup levels and to recalculate the MNA period for FTA-2/LF-2 should be identified as an "Other Finding."

Response: Concur. The recommendation regarding TMBs has been deleted and replaced with an "Other Finding" which reads: "Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for FTA-2/LF-2 groundwater and establish a new MNA timeframe." A new recommendation regarding EPH/VPH has been added:

Exhibit 4-11d **Issue/Recommendation #9: FTA-2/LF-2 Groundwater**				
OU 5 (FTA-2/LF-2 Groundwater)	**Issue Category: Cleanup Levels**			
	Issue: The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the FTA-2/LF-2 ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C_5-C_8 Aliphatic Hydrocarbons (300µg/L) v. EPA Aliphatic Low RSL (28 µg/L) GW-1 C_9-C_{10} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L) GW-1 C_{11}-C_{22} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L)			
	Recommendation: Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

127. #Page 4-106, Section 4.11.7 – Remove the second sentence.

Response: Concur. The second sentence has been removed. Based on the revised response to Question B (Specific Comment #124), the Protectiveness Determination at Section 4.11.7 has been revised as follows: "**The remedy for FTA-2/LF-2 is protective of human health and**

the environment in the short-term. The LTM program is being conducted to monitor remedial progress and the LUCs are in place and are functioning as intended to prevent exposure to contaminated groundwater. For the remedy to be protective in the long-term, an ESD should be issued which replaces the current GW-1 EPH/VPH groundwater cleanup standards with federal risk-based standards (for those TPH fractions which have comparative values between the MCP and the EPA RSLs)."

128. #Page 4-108, Section 4.12.1 - Discuss whether the State is overseeing cleanup of the petroleum under State authority and, if so, the status of that cleanup.

Response: No change made. The State is not overseeing the cleanup of FS-12. Associating petroleum responses to the protectiveness purpose of the FYR would require documenting the history of the application of the petroleum exclusion and its relation to the JBCC FFA, a topic which has not been discussed in the 5 previous FYRs.

129. #Page 4-108, Section 4.12.2.1, Para 2 – Eco-risk screening should be based on federal eco-risk standards not MCP Method 1 GW-3 standards.

Response: This section cites work already documented in a ROD Amendment. Attenuation of the PFSA plume has demonstrated the contaminants are not going to reach Johns Pond surface water (which was the basis of the potential ecological impacts). No further ecological evaluation is warranted at this time.

130. #Page 4-109, Section 4.12.2.1, Para 1 – Regarding the last sentence, there is no discussion of VI LUCs in Section 4.12.2.3.

Response: The VI LUC objective is included in Section 4.12.2.3, Exhibit 4.12a. The associated LUC is the Dig Safe review. A clarifying statement has been added to the last sentence in Section 4.12.2.3 as follows (change underlined): "Based on the implementation of other LUCs (i.e., MassDEP Drinking Water Permit and Dig Safe reviews), AFCEC determined that no new drinking water wells or new facilities <u>(which would trigger a VI evaluation)</u> were installed in the PFSA Groundwater LUC Area during this FYR period (AFCEC 2023, 2022a, 2021a, 2020a, 2019a).

131. #Page 4-109, Section 4.12.2.2, Bullet 1 - As previously noted MCP standards should not be used as cleanup levels. The Air Force should determine what a federal risk-based standards would be for the COCs with MCP cleanup standards.

Response: Noted. This section indicates the current RAOs.

THE AIR FORCE CIVIL ENGINEER CENTER
RESPONSES TO EPA COMMENTS ON THE
DRAFT 6TH FIVE YEAR REVIEW, 2017–2022 JOINT BASE CAPE COD (JBCC)
SUPERFUND SITE OTIS AIR NATIONAL GUARD BASE, MA
DATED JUNE 2023

132. #Page 4-110, Section 4.12.2.2, Bullet 1 - As previously noted MCP standards should not be used as cleanup levels. The Air Force should determine what a federal risk-based standards would be for the COCs with MCP cleanup standards.

Response: Noted. This section indicates the current RAOs.

133. #Page 4-111, Exhibit 4-12a – The Exhibit needs to include the VI LUCs.

Response: See response to Specific Comment #130.

134. #Page 4-112, Section 4.12.4.1 - Need to discuss the status of MNA (updated modelling, estimated date of cleanup consistent with the ROD estimate (throughout the OU)).

Response: Concur. The first bullet in Section 4.12.4.1 now reads (changes underlined): "The MNA remedy is functioning as the plume has not migrated and COC concentrations are generally trending downward. The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends."

135. #Page 4-113, Section 4.12.5.1, Question A - Need to describe how the MNA remedy is meeting expectations for achieving groundwater cleanup standards, as identified in the ROD/ESD. Add a statement on whether or not the remedy will achieve cleanup by the predicted date in the ROD.

Response: Concur. The following sentence has been added to Section 4.12.5.1: "The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends." A definitive statement regarding the achievement of the cleanup date (2035) cannot be made at this time.

136. #Page 4-113, Section 4.12.5.2, Question B - Answer the question "No." See previous comment concerning changes to the RSLs did not change the cleanup standard required under the 2011 ESD. A new CERCLA decision document would need to be issued to make the change. The second paragraph in particular needs to be revised because a Technical Memorandum is not sufficient to change the cleanup standard (would need an ESD). In November 2022, the EPA RSL updates (click here to see) included changes in toxicity values to Petroleum Hydrocarbons Aliphatic Low, Aromatic Low, Aromatic Medium and Aromatic High. Source Areas such as Section 3.1 CS-10 Source; Section 4.11 FTA2-LF-2; and 4.12 PFSA list their respective COCs to include C5-C8 aliphatic, C9-C12 aliphatic, etc. Please update Question B response to include these toxicity changes.

Response: Concur. The revised response to Section 4.12.5.2, Question B reads as follows::

"No. The current MCP GW-1 standards for the 4 EPH/VPH COCs from the ROD Amendment have been compared to EPA's comparative tap water TPH RSLs and are not protective in the long-term. This issue impacts the protectiveness of the current RAOs.

There are changes in standards and TBCs that affect the PFSA groundwater remedy. Specifically, EPA tap water screening levels for 1,2,4-TMB (56 µg/L) and 1,3,5-TMB (60 µg/L) were developed (EPA 2017).

There were changes in toxicity parameters for 1,2,4-TMB and 1,3,5-TMB as follows:

- In June 2017, EPA finalized a new inhalation RfC for 1,2,4-TMB. The new IRIS value replaces a PPRTV that was used previously and indicates that 1,2,4-TMB is less toxic from non-cancer health effects. This change would result in decreased non-cancer hazard from inhalation exposure to 1,2,4-TMB (EPA 2022).
- In June 2017, EPA finalized an inhalation RfC for 1,3,5-TMB based on a new IRIS value. Previously, there was no RfC value for 1,3,5-TMB (EPA 2022).

There is also a change related to the use of MCP GW-1 standards for EPH/VPH and 2-methylnaphthalene from the ROD Amendment. The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the PFSA ROD Amendment. As indicated in Exhibit 4-12c below, the tap water RSLs are lower than the MCP GW-1 standards. The MCP GW-1 standard for 2-methylnaphthalene of 10 µg/L is protective since it is less than the EPA Tap Water RSL of 36 µg/L.

Exhibit 4-12c

PFSA: Comparison of MCP GW-1 EPH/VPH and EPA Tap Water RSLs

COC from ROD Amendment	MCP GW-1 Cleanup Level (µg/L])	EPA Terminology for Comparative TPH Fraction	EPA Regional Screening Level Resident Tap Water (µg/L) HQ=1	Is EPA RSL Lower than GW-1?
EPH/VPH				

C_5-C_8 Aliphatic Hydrocarbons	300	Aliphatic Low	28	Yes
C_9-C_{12} Aliphatic Hydrocarbons	700	N/A	N/A	N/A
C_9-C_{10} Aromatic Hydrocarbons	200	Aromatic Medium	57	Yes
C_{11}-C_{22} Aromatic Hydrocarbons	200	Aromatic High	6	Yes

There are no changes in risk assessment methods or exposure pathways that effect the protectiveness of the PFSA remedy. New PFAS standards (discussed in Section 2.1) are currently not a concern at the PFSA and any PFAS in the area will be managed under the Flight Line Operable Unit response (see Section 2.1.2).

The aquifer restoration timeframe of 2035 cited in the 2016 ROD Amendment appears supported with current data trends.

The RAOs documented in the ROD Amendment (AFCEC 2016) are not protective in the long-term. This FYR includes a recommendation to develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. As noted previously, EPA developed RSLs for two of the COCs (56 µg/L for 1,2,4-TMB and 60 µg/L for 1,3,5-TMB). This FYR includes a finding to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels in an ESD."

137. #Page 4-114, Section 4.12.6, Exhibit 4-12c - Recommendation - An upward projected change in cleanup level is not considered an issue that affects protectiveness, therefore a recommendation to prepare an ESD to document an upward change in the cleanup levels for PFSA and recalculate the MNA period should be identified as an "Other Finding."

Response: Concur. The recommendation regarding TMBs has been deleted and replaced with an "Other Finding" which reads: "Prepare an ESD to document an upward change in the 1,2,4-TMB and 1,3,5-TMB cleanup levels for PFSA groundwater and establish a new MNA timeframe." A new recommendation related to EPH/VPH has been added:

Exhibit 4-12d **Issue/Recommendation #10: PFSA Groundwater**				
OU 5 (PFSA Groundwater)	**Issue Category: Cleanup Levels**			
	Issue: The EPA has tap water RSLs for total petroleum hydrocarbon fractions which align with 3 of the 4 EPH/VPH MCP GW-1 standards cited in the PFSA ROD Amendment. The EPA's tap water RSLs are lower (more protective) than the current MCP GW-1 standards from the ROD Amendment: GW-1 C_5-C_8 Aliphatic Hydrocarbons (300µg/L) v. EPA Aliphatic Low RSL (28 µg/L) GW-1 C_9-C_{10} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic Medium (57 µg/L) GW-1 C_{11}-C_{22} Aromatic Hydrocarbons (200 µg/L) v. EPA Aromatic High (6 µg/L)			
	Recommendation: Develop federal risk-based standards for the TPH fractions (aliphatic low, aromatic medium, and aromatic high) that align with 3 of the current EPH/VPH COCs (based on MCP GW-1 standards) and document the stricter federal risk-based standards in an ESD. The ESD should also address a likely change in aquifer restoration timeframe and LUC area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	10/25/2026

138. #Page 4-115, Section 4.12.7 – Remove the second sentence.

Response: Concur. The second sentence has been removed.

139. Figures, General – a) When figures show contaminant detections (i.e., PFAS in Fig 2-1), the legend should clearly explain the numeric level each color represents (ND at what limit; <20ppt, >=20 ppt). Only using qualitative descriptions is confusing. b) The figure symbology is also inconsistent. For example, the Figure 2-1 PFAS concentrations are symbolized by exceedance of the PFAS MMCL but Fig 2-2 uses the LHA. Is there a reason for this? c) Several figures show plume boundaries – it would be helpful to state in the legend what number was used to draw the line (detection? Cleanup level/standard exceedances?) d) Several figures are symbolized completely or mostly in grayscale – it would be helpful to use contrasting colors to show different map elements (fig 4-6 is a good example of this – the line symbols are only different by thickness, which makes it very confusing to interpret)

Response: a) Figure 2-1: The PFAS MMCL level of 0.02 µg/L is defined in the legend. The red, green, yellows are then defined from the MMCL basis. b) In response to MassDEP Comment #1, Figure 2-2 has been replaced to indicate exceedances compared to the MMCL. c) The JBCC standard is to depict all plumes based on an appropriate cleanup level. d) As a general response, the figures used in the FYR come from JBCC reports and are used in stakeholder meetings and have been deemed appropriate. The additional labels on Figure 4-6

for infiltration trenches, treatment plants, extraction wells, and plume lobes are all intended to assist with the interpretation (i.e., system piping runs between labeled system components).

140. #Figure 1-2 – In the legend change "Explosives Plume Concentrations Above EPA Regional Screening Level = ~~0.97~~ 0.7 µg/L, Royal Demolition Explosive (RDX). Until an ESD or tech memo is issued, the delineation should be based on the ESD cleanup standard not the revised RSL.

Response: Concur. The Figure 1-2 legend has been changed to indicate "Explosives Plume Concentrations Above EPA Risk-Based Level = 0.6 µg/L, Royal Demolition Explosive (RDX). The former RSL of 0.7 µg/L cited in the comment had not been formally added through a DD.

141. #Figure 2-2 – Flight Line OU figure need to be expanded to include the sewer system leading to the WWTP and infiltration beds..

Response: No change made. No agreement exists between the Air Force and EPA regarding the sewer system's inclusion in the Flight Line OU.

142. Figure 4-3 – Note needed to identify values for cleanup level.

Response: Concur. The MCL level is noted on the trend graphs, but a "5 µg/L" has been added after the term MCL in the legend.

143. Figure 4-6 – Update this figure to add the outline of the 1,4-Dioxane portion of this plume or add a new figure to present this info.

Response: As with other plume figures with multiple COCs, the CS-10 figure does not indicate the extent of other COCs that fall within the overall plume boundary. A new bullet has been added to Section 4.3.4.1 as follows: "1,4-Dioxane was detected above the risk-based RG of 0.46 µg/L in 3 on-base monitoring wells in the most recent sampling event (October/November 2022) with a maximum concentration of 2 µg/L at 03MW1066C." A figure from the CS-10 ESD indicating the extent of 1,4-dioxane has been included in this RCL for information.

144. Figure 4-8 – If possible add symbols for monitoring wells. In particular, add 58MW0009E which is identified in Section 4.4.4.1 (Bullet 3) as only well with detection above 0.97 ppb EPA RSL.

Response: Note per Specific Comment #73, the information in Bullet 3 has changed. Monitoring well 58MW0009E has been added to the figure.

145. Figure 4-9 – If possible, color code the extraction and reinjection wells because they are not discernable with the scale of the figure because they are either too small or gray.

Response: The intention of Figure 4-9 is to show the plume shape changing over time and requires a smaller scale. The CS-21 extraction and reinjection wells are clearly shown on Figure 4-4.

146. Figure 5-2 – If possible, mark where sweeps were completed at the site.

Response: The sweeps have been added to Figure 5-2.

147. Table 1-1c – Given that PFAS has been detected at this plume, CS-10 should be added to the list of PFAS Sites.

Response: The Air Force has not yet identified CS-10 as a PFAS site. The recommendation to proceed with an investigation of the PFAS detected in CS-10 extraction wells is being made in this FYR.

148. Table 1-4 – Edit Table based on text comments. Suggest adding an entry for FTA-1 source area.

Response: See response to General Comment #2.

149. Table 1-4, CS-19 - See specific comment on page 4-40, Section 4.4.6, Exhibit 4-4c. Delete entry and create a new table to collect "Other Findings".

Response: Concur. The revised CS-19 issue addressed in Specific Comment #76 will be moved to the existing Table 1-5, Other Findings.

150. Table 1-4, FS-13 - See specific comment on page 4-67, Section 4.7.6, Exhibit 4-7c. Delete entry and create a new table to collect "Other Findings".

Response: Concur. The revised FS-13 issue addressed in Specific Comment #96 will be moved to the existing Table 1-5, Other Findings.

151. Table 1-4, FTA-2/LF-2 - See specific comment on page 4-105, Section 4.11.6, Exhibit 4-11c. Delete entry and create a new table to collect "Other Findings".

Response: Concur. The revised FTA-2/LF-2 issue addressed in Specific Comment #126 will be moved to the existing Table 1-5, Other Findings.

152. Table 1-4, PFSA (FS-10/FS-11) – See specific comment on page 4-114, Section 4.12.6, Exhibit 4-12c. Delete entry and create a new table to collect "Other Findings".

Response: Concur. The revised PFSA (FS-10/FS-11) issue addressed in Specific Comment #137 will be moved to the existing Table 1-5, Other Findings.

153. #Table 1-5 – Edit Table based on text comments.

Response: Concur. Table 1-5, Other Findings, will include those items addressed in Specific Comments #76, #96, #126, and #137.

154. #Table 1-6 – Edit Table based on text comments.

Response: Concur. Table 1-6, Protectiveness Statements, will include those items addressed in earlier comments.

155. Table 1-6, LF-1 Source Area – This should be "Protective" since the landfill cap is a cover and has no bearing on the groundwater cleanup. There is an entry for LF-1 Groundwater which is has a determination of "Short-term Protective"

Response: Concur. Table 1-6, Protectiveness Statements, will include the revised LF-1 Source statement addressed in Specific Comment #33.

156. Table 1-6, Page 1 of 3, AV, 4th Sentence – Break up into two sentences or state that "as of June 2023, the RI report and the FS have been submitted for regulatory review but not been finalized."

Response: Concur. The 4th sentence in the AV Groundwater Protectiveness Determination reads as follows (also at Section 4.1.7): "As of June 2023, the *Draft Supplemental Remedial Investigation for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* and the *Draft Supplemental Feasibility Study Report for Per- and Polyfluoroalkyl Substances at Fire Training Area-1, Joint Base Cape Cod* have been submitted for regulatory review but not been finalized."

157. Table 1-6, Page 2 of 3, FS-12, Last Sentence – In addition to "restoration timeframe," optimization of treatment system should also be considered.

Response: No change made. As discussed in Section 2.5 and Section 4.6.2.4, continual system optimizations are already part of the SPEIM/LTM program at JBCC.

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DATED JUNE 2023

1. Page 2-14, Section 2.2.3.4, Flight Line Area Operable Unit:
   The text indicates, **"This OU was created to encompass PFAS contamination in groundwater from six PFAS source areas (Table 1-1c, Figure 2-2)."** MassDEP notes that Figure 2-2, *Flight Line Operable Unit Site Locations* is based on data collected through February 2021 and is not color-coded to detections relative to the PFAS6 Massachusetts Maximum Contaminant Level (MMCL). The Report covers the period from October 2017 through September 2022. MassDEP recommends replacing Figure 2-2 with an updated version based on data through August 2022 (as provided at the AFCEC IRP Technical Update meeting on August 25, 2022).

   Response: Concur. An updated version of Figure 2-2 has been inserted.

2. Page 4-5, Section 4.1.2.3, AV Groundwater, Status of Implementation:
   The text states, **"During this FYR period, in response to AFCEC's private well verification annual mailings, four property owners (APEMS IDs 39663, 39665, 39797, 47065) notified AFCEC that they planned to restart their non-operational irrigation wells. AFCEC sampled these irrigation wells and prepared well determinations (Appendix C) that concluded the wells are suitable for irrigation/outdoor purposes (AFCEC 2022a, 2021a)."** MassDEP recommends changing the reference Appendix C to Appendix B since that is the designation in the Report Table of Contents and on the Appendix cover page. Additionally, MassDEP was informed by the AFCEC in 2022 that a recently issued Air Force policy prohibits the sharing of any information regarding private well locations and sampling/analytical data for residential wells with MassDEP since the information would include Personally Identifiable Information. MassDEP no longer receives any residential well information from the AFCEC. This severely impacts MassDEP's ability to assess actual or potential impacts of JBCC groundwater contamination to potential receptors. Therefore, MassDEP cannot confirm the findings of any of the AFCEC's well determinations performed after 2021.

   Response: The reference to Appendix C has been changed to Appendix B. While MassDEP is correct that Air Force policy prohibits the sharing of any information regarding private well locations and sampling/analytical data for residential wells with MassDEP. Air Force legal counsel recently clarified that Air Force policy also allows personally identifiable information to be shared with consent of the property owner. AFCEC will contact property owners to obtain consent for AFCEC to share the private well data with MassDEP.

3. Page 4-9, Section 4.1.4.1, AV Groundwater, Data Review:
   The text states, **"Determinations for private irrigation wells located at APEMS IDs 39851, 39663, 39665, 39797, and 47065 (discussed in Section 4.1.2.3) remain valid as there were no changes in the conceptual site model (CSM) for the AV plume COCs**

since the most recent determinations." MassDEP no longer receives any residential well information from the AFCEC based on the recently issued Air Force policy prohibiting the sharing of private well location information. Therefore, MassDEP cannot confirm the findings of any of the AFCEC's well determinations performed after 2021.

Response: See Response to MassDEP Comment #2.

4. Page 4-27, Section 4.3.2.3, CS-10 Groundwater, Status of Implementation:
The text states, **"During this FYR period, in response to AFCEC's private well verification annual mailings, three property owners (APEMS IDs 30518, 30589, and 39919) notified AFCEC that they planned to install new irrigation wells. A well determination for APEMS ID 30589 (Appendix C) concluded the well is suitable for irrigation/outdoor purposes. Well determinations for APEMS IDs 30518 and 39919 are pending. Note that the PFAS in this area would be from the FTA-1 PFAS groundwater plume (Figure 2- 1)."** MassDEP no longer receives any residential well information from the AFCEC based on the recently issued Air Force policy prohibiting the sharing of private well location information. Therefore, MassDEP cannot confirm the findings of any of the AFCEC's well determinations performed after 2021.

Response: See Response to MassDEP Comment #2.

5. Page 4-76, Section 4.8.5.2, FS-28 Groundwater, Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?: The text indicates, **"New PFAS standards (discussed in Section 2.1) are currently not a concern at FS-28."** MassDEP notes that there has not been any sampling and analysis of the groundwater in the FS-28 area for PFAS6. The FS-28 groundwater plume is detached from the source area, and nothing is known about characteristics of the fuel spill that caused the FS-28 plume. Therefore, sampling and analysis of FS-28 groundwater wells for PFAS6 should be performed as part of the closure process (please refer to FS-29 closure).

Response: Comment noted. Planning for the closure process at FS-28 will be done in coordination with the regulatory agencies and will meet regulatory requirements.

6. Page 5-4, Section 5.1.2.3, Mock Village, Status of Implementation:
The text states, **"The Warning Sign component of the LUC remedy (Figure 5-2) has been completed and the other LUC components are on-going or future events (Exhibit 5-1)."** The *Final Record of Decision Mock Village Munitions Response Site (EPA Operable Unit 29)* dated April 2022, stated that a Land Use Control Implementation Plan (LUCIP) will be prepared and will contain information about implementation and maintenance of Land Use Controls (LUCs) and enforcement actions, including periodic inspections of the LUCs to ensure the continued protectiveness of the selected remedy.

THE AIR FORCE CIVIL ENGINEER CENTER
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SUPERFUND SITE OTIS AIR NATIONAL GUARD BASE, MA
DATED JUNE 2023

Please clarify if the LUCIP has been updated to include specific information related to each LUC component for the Mock Village Munitions Response Site. Please also include this information in Section 5.1.2.3.

Response: The Draft LUCIP update, to include the Mock Village LUC requirements, will be submitted to EPA and MassDEP in August 2023 for review. This information will be added to Section 5.1.2.3 of the FYR.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
BOSTON, MA 02109

Via Electronic Mail

Date: See signature stamp below

Rose H. Forbes, P.E.
Remediation Program Manager
HQ AFCEC/JBCC
322 East Inner Road
Otis ANG Base, MA 02542-5028

Re: *Draft 6th Five Year Review, 2017-2022 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA*

Dear Ms. Forbes:

EPA has completed its review of the Response to Comments Letter dated August 16, 2023 on *Draft 6th Five Year Review, 2017-2022 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA*, and the revised text and tables.

We have no comments on the RCL and have a comment on a revised table.

Table 1-6, Page 1 of 3, Source Area Sites, LF-1 – Delete "short term" per response to Specific comment 33.

Please contact me by email or by phone at (617) 918-1392 should you have any immediate questions.

Sincerely,

Robert Lim, Remedial Project Manager
Federal Facilities & Housatonic River Section

cc: Anni Loughlin/EPA
David Peterson/EPA-ORC
Len Pinaud/MassDEP

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

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Maura T. Healey
Governor

Kimberley Driscoll
Lieutenant Governor

Rebecca L. Tepper
Secretary

Bonnie Heiple
Commissioner

September 14, 2023

Air Force Civil Engineer Center/JBCC
Attn: Rose Forbes
Remediation Program Manager
322 East Inner Road
Otis ANG Base, Massachusetts 02542

RE: **BOURNE – BWSC**
Release Tracking Number: 4-0000037
Joint Base Cape Cod (JBCC)
Draft 6th Five Year Review, 2017 – 2022
Joint Base Cape Cod (JBCC) Superfund Site
Otis Air National Guard Base, MA - MOR,
Comments

Dear Ms. Forbes:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the Air Force Civil Engineer Center (AFCEC) Memorandum of Resolution (MOR) dated September 1, 2023, issued for MassDEP comments dated August 18, 2023, for the document **"Draft 6th Five Year Review, 2017 – 2022 Joint Base Cape Cod (JBCC) Superfund Site Otis Air National Guard Base, MA"** dated June 2023 (the Report). In addition, MassDEP has reviewed the redlined version of the Report (the revised Report) dated September 2023. The revised Report evaluates the performance of environmental remediation implemented by the AFCEC for the Installation Restoration Program at JBCC to determine if the remedies are and will continue to be protective of human health and the environment. MassDEP accepts the protectiveness determinations in the revised Report, noting the following concerns which are necessary to resolve.

1. The MassDEP comment stated, in part *"MassDEP requests that the AFCEC contact those property owners whose private wells the AFCEC has sampled since May 2022. MassDEP also requests that – regardless of whether the property owner gives consent with respect to their private well data – the AFCEC provide the name of the street associated with the private wells sampled since May 2022."* and *"…MassDEP seeks clarification from the AFCEC on whether and how the AFCEC advises the property owner of his or her option to provide their consent to disclosure, and whether and how the AFCEC provides a form or other means for the property owner to do so. To the extent the AFCEC has already received consent from property owners, MassDEP requests those forms or other confirmations of consent that would allow MassDEP to contact those owners…"*

   The AFCEC response states **"AFCEC is contacting the property owners and will work to gain approval and release private well data to the MassDEP in accordance with current guidance. This issue is being addressed separately from the completion of the 6th Five-Year Review."**

MassDEP appreciates the AFCEC response, however, the AFCEC response does not address several of the MassDEP requests: (1) for the AFCEC to provide the names of the streets associated with the private wells sampled since May 2022; (2) for clarification from the AFCEC on whether and how the AFCEC advises the property owner of his or her option to provide their consent to disclosure; (3) whether and how the AFCEC provides a form or other means for the property owner to do so; and (4) to the extent the AFCEC has already received consent from property owners, for the AFCEC to provide those forms or other confirmations of consent that would allow MassDEP to contact those owners. Please provide a response to the MassDEP requests.

2. Page 4-27, Section 4.3.2.3, CS-10 Groundwater, Status of Implementation of the Report states **"During this FYR period, in response to AFCEC's private well verification annual mailings, three property owners (APEMS IDs 30518, 30589, and 39919) notified AFCEC that they planned to install new irrigation wells. A well determination for APEMS ID 30589 (Appendix C) concluded the well is suitable for irrigation/outdoor purposes. Well determinations for APEMS IDs 30518 and 39919 are pending. Note that the PFAS in this area would be from the FTA-1 PFAS groundwater plume (Figure 2- 1)."** Please forward the well determinations for APEMS IDs 30518 and 39919 for MassDEP review.

   Regarding the AFCEC well determination for APEMS ID 30589, the Report states, **"Shallow groundwater beneath APEMS ID 30589 is primarily derived by recharge from Ashumet Pond"; "PFOS and PFOA have been detected in shallow groundwater downgradient of Ashumet Pond at concentrations greater than the drinking water LHA of 0.07 ug/L."** and **"…incidental use of this irrigation well…is not expected to result in an unacceptable exposure risk…"**. However, no sampling of the well was performed and the AFCEC has determined that no further sampling for this well is needed. Additionally, the Report states **"Please note that this well should not be used as a source of drinking water nor should it be used for routine irrigation of home-grown produce (i.e., fruits and vegetables) because the rate of uptake of PFAS by various edible plants is not yet known."** Please sample APEMS ID 30589 to determine if the well is contaminated with PFAS6.

Please incorporate this letter into the Administrative Record for the Five-Year Review 2017-2022. If you have any questions regarding this matter, please contact me at (617) 694-2644.

Sincerely,

Leonard J. Pinaud, Chief
Federal Site Management
Bureau of Waste Site Cleanup

Ec: Upper Cape Select Boards
Upper Cape Boards of Health
JBCC Cleanup Team
MassDEP Boston/Southeast Region