Welcome

Environmental Advisory Board (EAB) Meeting

Robins Air Force Base

February 2, 2023

Welcome and Program Introduction

Ms. Shan Williams
EAB Installation Co-chair

Acronyms and Abbreviations

- AS/SVE – Air Sparge/Soil Vapor Extraction
- BTEX – Benzene, Toluene, Ethylbenzene, Xylene
- CAP – Corrective Action Plan
- COC – Contaminant of Concern
- EFR – Enhanced Fluid Recovery
- GA EPD – Georgia Environmental Protection Division
- HVR – High Vacuum Recovery
- LNAPL – Light Non-Aqueous Phase Liquid
- µg/kg – micrograms per kilogram
- µg/L – micrograms per liter
- MFR – Modified Fenton's Reagent
- MNA – Monitored Natural Attenuation
- NFA – No Further Action
- PID – Photoionization Detector

Acronyms and Abbreviations

- RCRA – Resource Conservation and Recovery Act
- ROST – Rapid Optical Screening Tool
- RL – Remediation Level
- RFI – RCRA Facility Investigation
- SEAR – Surfactant-Enhanced Aquifer Remediation
- SSI – Supplemental Site Investigation
- SURFAC – Surfactant-enhanced LNAPL Recovery
- SWMU – Solid Waste Management Unit
- TOC – Total Organic Carbon
- TPH – Total Petroleum Hydrocarbon
- UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan
- UIC – Underground Injection Control

Solid Waste Management Unit (SWMU) 28 (CG028) Update on Progress

Elizabeth Rhine
Bhate Technical Lead

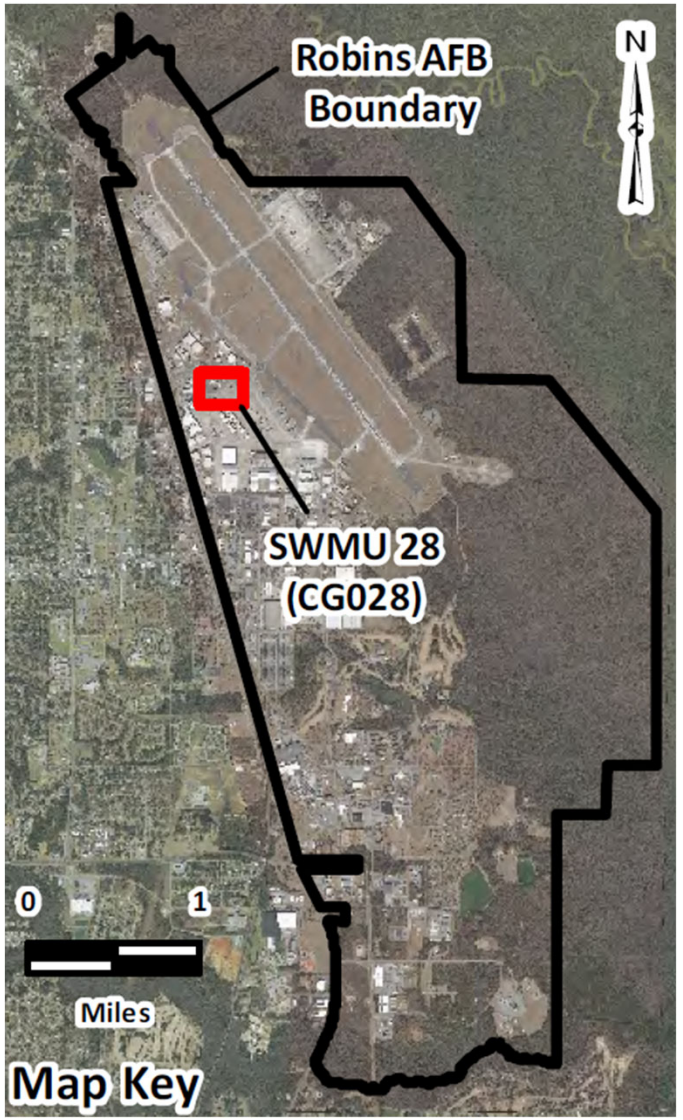
2 February 2023

Overview

- Background
- Prior Remedial Actions
- High Vacuum Recovery (HVR) Pilot Test
- Supplemental Site Investigation (SSI)
- Next Steps

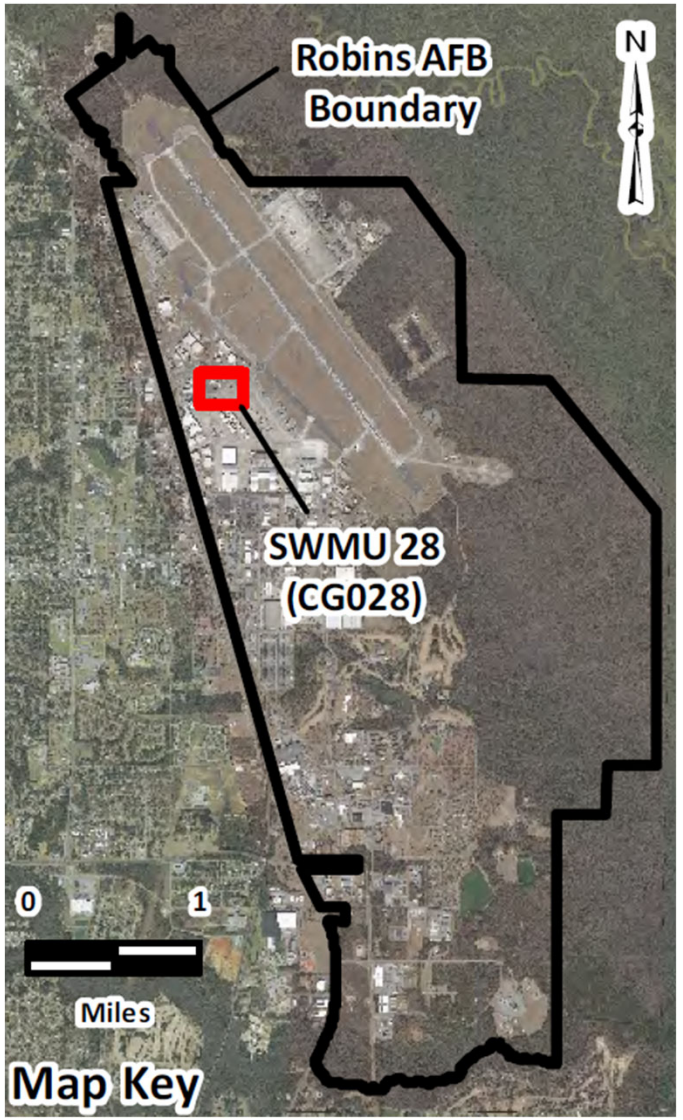
Background

- SWMU 28 was originally identified in February 1990 when purge fluid was observed in an excavation during valve maintenance at Building 45
- Leak in valve near former subgrade fuel line connecting to defueling sump DF2
- Defueling sumps were earthen
- Belt skimmers installed in 1990



Background

- Primary contaminants of concern (COCs) in groundwater are **benzene**, 1,1-dichloroethene, 1,2,4-trimethlybenzene, 1,3,5-trimethylbenzene, acenaphthylene, indeno(1,2,3-cd)pyrene, 1-methylnaphthalene, 2-methylnaphthalene, and **naphthalene**

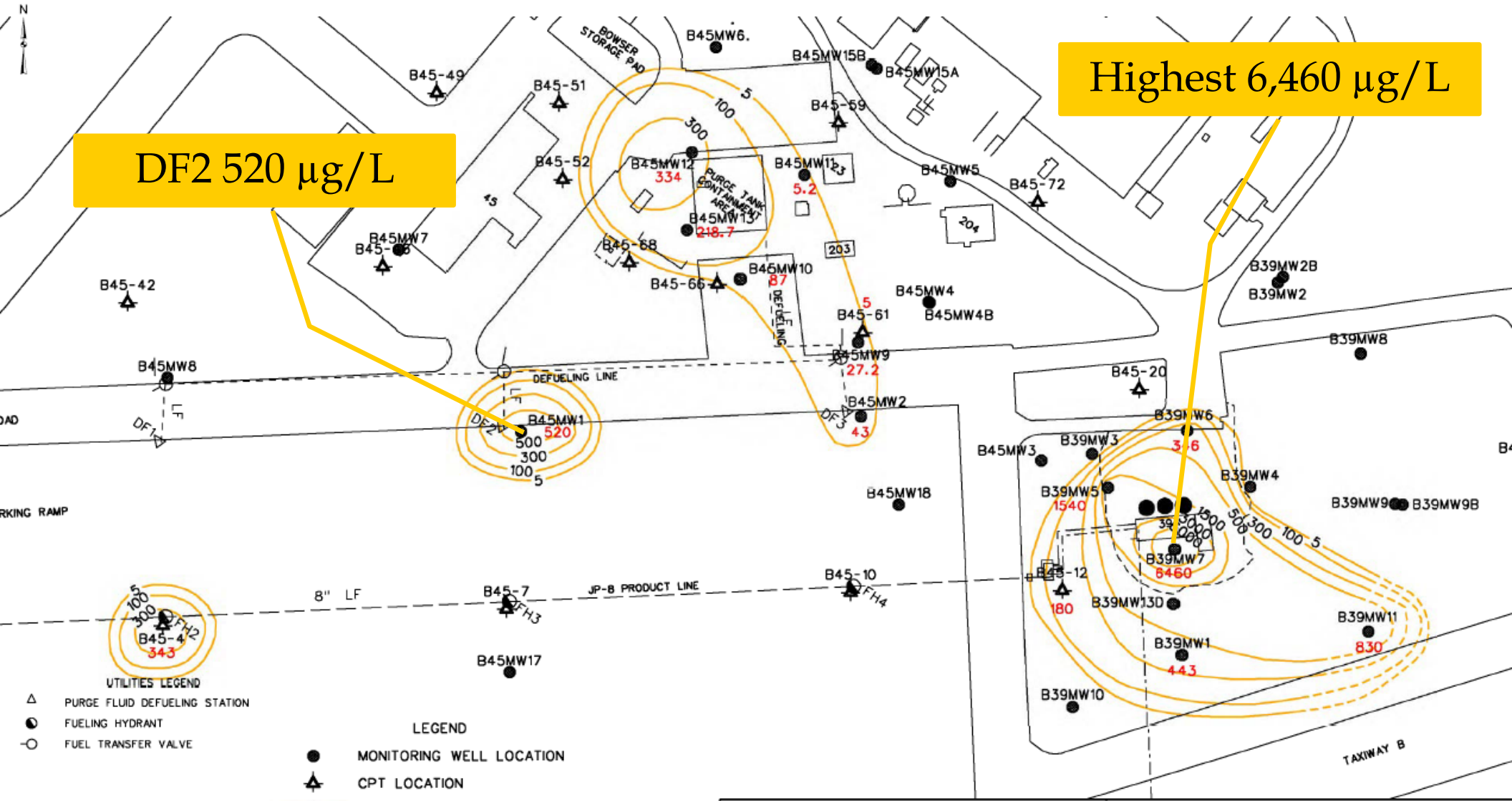


Background

Total BTEX in Smear Zone (1999)

DF2 520 µg/L

Highest 6,460 µg/L



Rapid Optical Screening Tool (ROST™) Investigation
(Earth Tech, August 2000)

BTEX – Benzene, Toluene, Ethylbenzene, Xylene
µg/L – milligrams per liter

Prior Remedial Actions

- **February 1999 – Belt skimmers and manual recovery initiated**
  - **Continued under 2004 Corrective Action Plan (CAP)**
  - **4,700 gallons of free product reportedly removed**
  - **Paused July 2012 to prepare for enhanced fluid recovery (EFR)**

Prior Remedial Action

- **2004 CAP**
  - **Passive recovery to reduce light non-aqueous phase liquid (LNAPL or free product) to <0.01 feet**
  - **Reduce COCs to Remediation Levels (RLs) for groundwater**
  - **Monitored Natural Attenuation (MNA)**
- **2012 Revised CAP**
  - **Enhanced Fluid Recovery (EFR)**
  - **Surfactant-enhanced LNAPL recovery (SURFAC®)**
  - **RLs for groundwater updated for unrestricted use**
  - **LNAPL goal was to reduce to non-detect**

Prior Remedial Actions

- EFR under 2012 CAP
- Seven EFR Events
  - August 2012, January 2013, April 2013, April 2014, August 2014, September 2014, February 2015
- Five SURFAC® Events
  - November 2013, January 2014, June 2014, August 2014, September 2014

Prior Remedial Actions

- Surfactant-Enhanced Aquifer Remediation (SEAR)
- Pilot Study
  - December 2016 – February 2017
- Subsequent SEAR Events
  - May – August 2017
  - Followed by potable water flush and groundwater extraction November – December 2017

Prior Remedial Actions

- Passive skimmers and socks installed in 13 wells with >0.1 feet of LNAPL
  - February 2017
- Supplemented with vacuum extraction event on select wells in DF2 area
  - September 2018 (MW31 and MW67)
  - December 2018 (MW67)
  - Skimmers and socks continued to operate in other wells with measurable LNAPL until November 2021
- HVR event in March 2021

Prior Remedial Actions

LNAPL + Benzene (March 2021)

Legend

B45MW2 2.1 — Monitoring Well Identification; Concentration (µg/L)

Benzene Concentration >5 µg/L

LNAPL Thickness >0.00 feet

LNAPL Thickness >0.10 feet

Monitoring Well (by Aquifer Designation)

Upper Providence (Top)

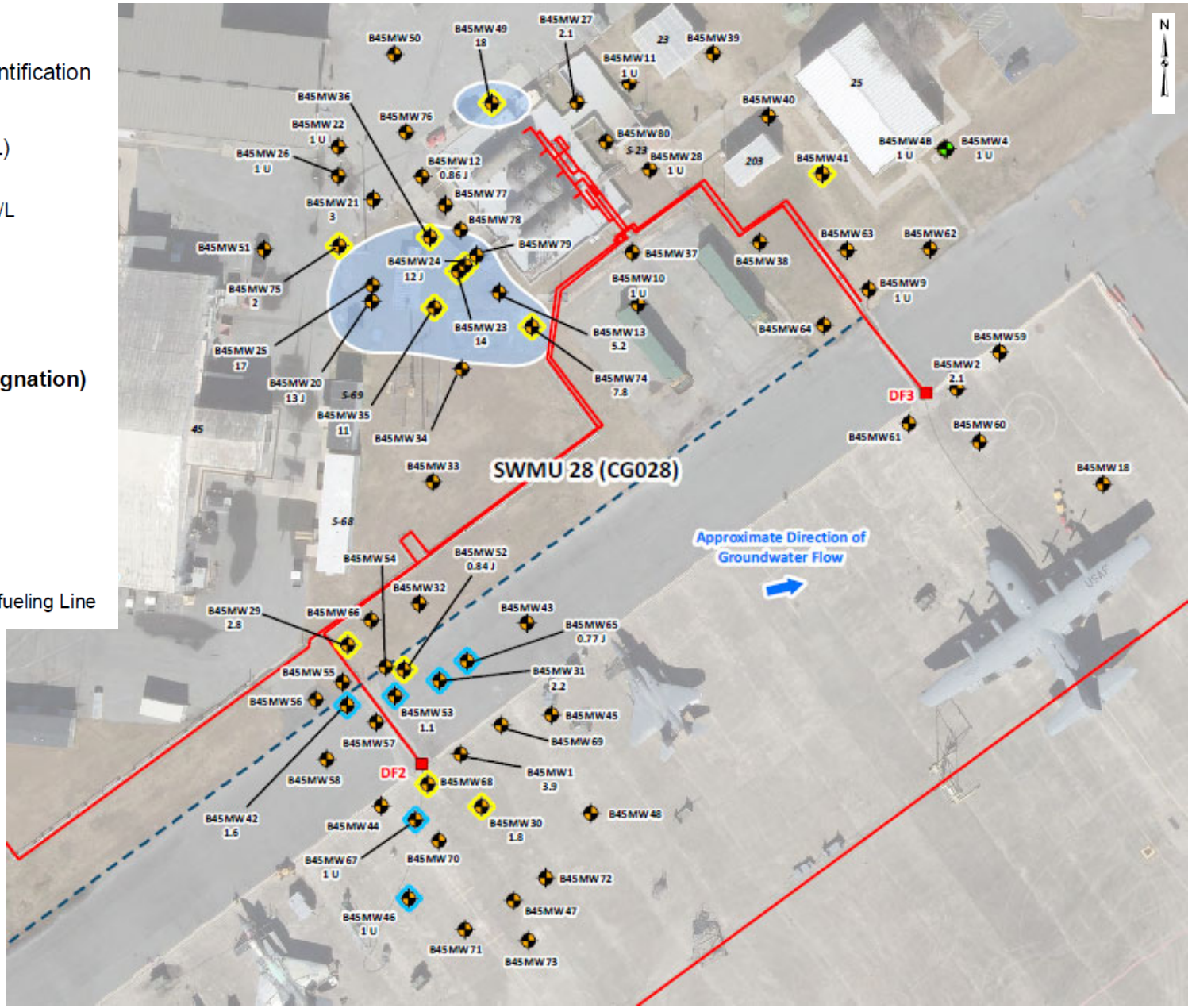
Upper Providence (Middle)

Other Site Features

Defueling Station

Fuel Line

Abandoned Belowground Defueling Line



Prior Remedial Actions

LNAPL + Naphthalene (March 2021)

Legend

B45MW2
260 J

Monitoring Well Identification

Concentration (µg/L)

Naphthalene Concentration >12.9 µg/L

LNAPL Thickness >0.00 feet

LNAPL Thickness >0.10 feet

Monitoring Well (by Aquifer Designation)

Upper Providence (Top)

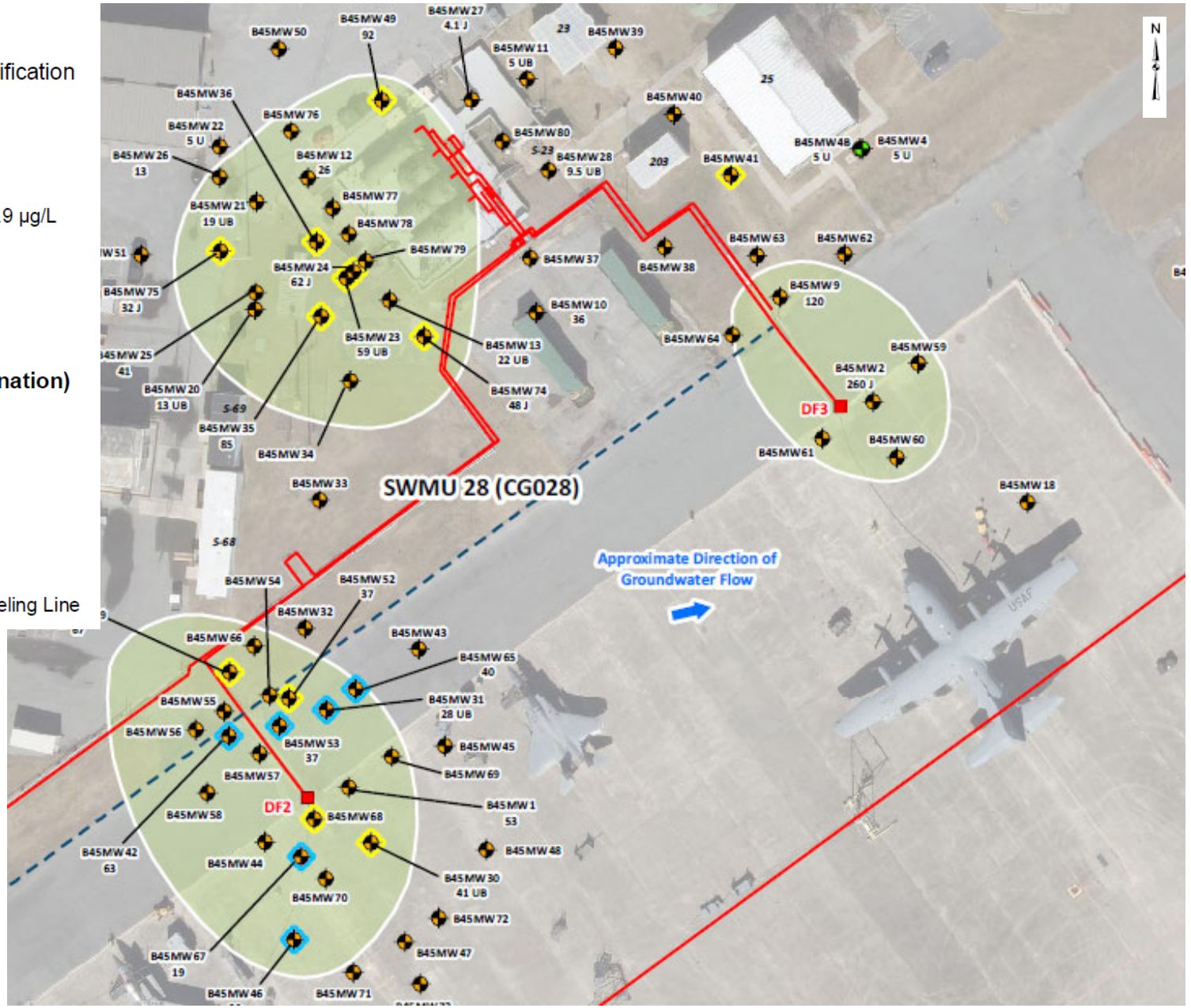
Upper Providence (Middle)

Other Site Features

Defueling Station

Fuel Line

Abandoned Belowground Defueling Line

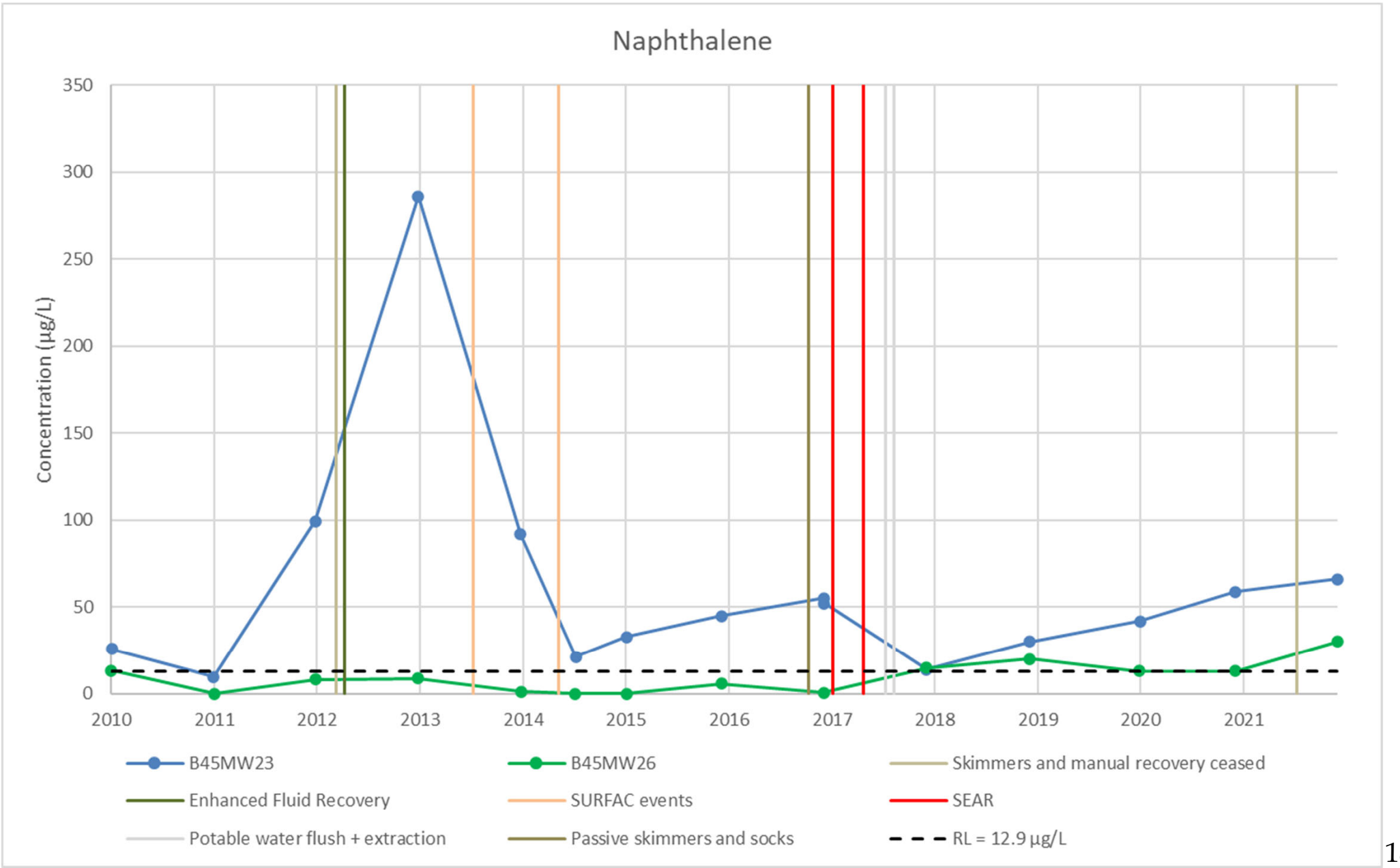


Prior Remedial Actions

Benzene Concentrations

Prior Remedial Actions

Naphthalene Concentrations

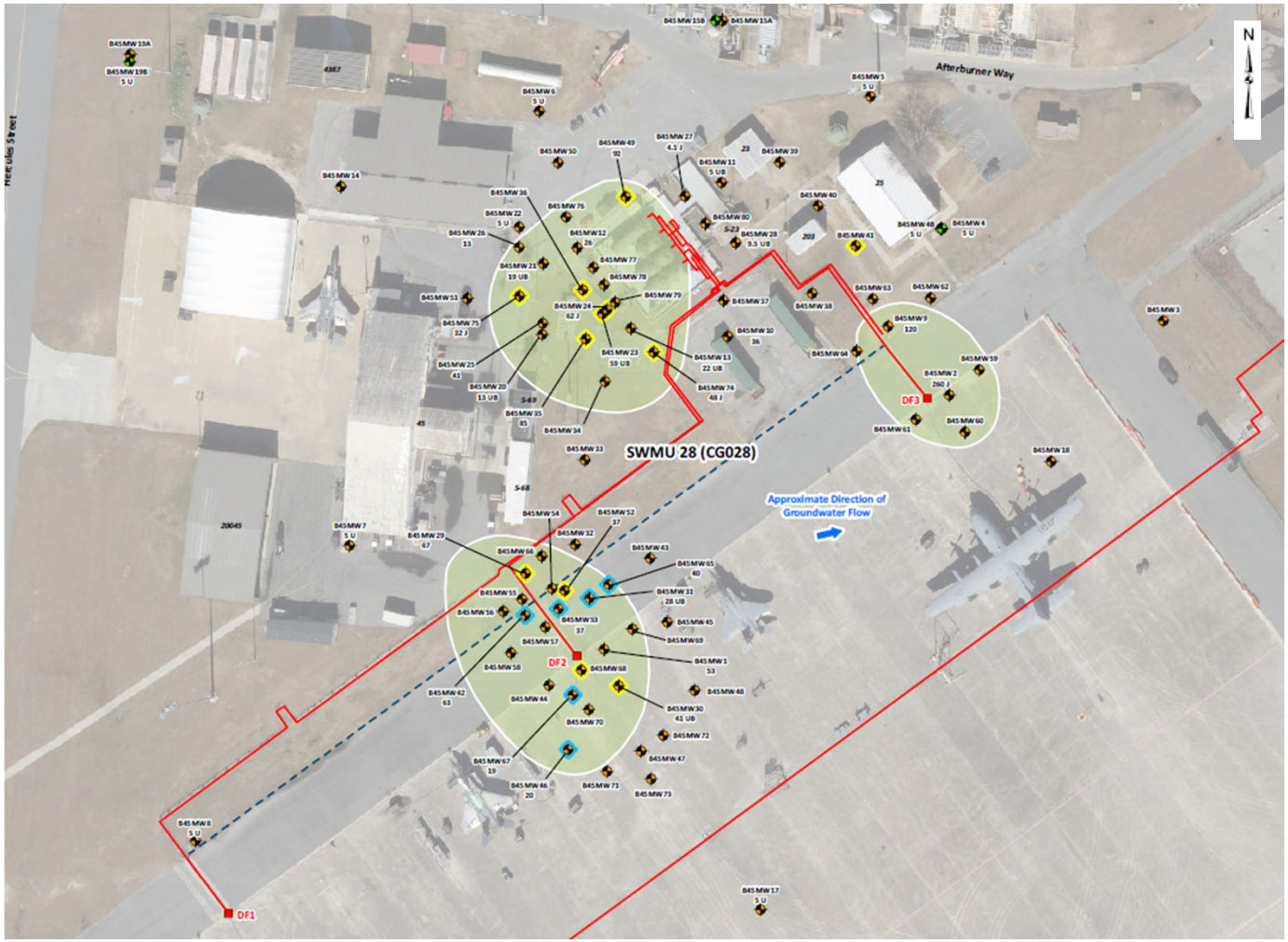


HVR Pilot Test

- **FRUITS® process**
  - **Removes free product**
  - **Removes contaminated groundwater**
  - **Soil vapor extraction**
- **Pilot test conducted in March 2021**
  - **Group 1: B45MW30, B45MW42, B45MW46, B45MW67**
  - **Group 2: B45MW31, B45MW42, B45MW52, B45MW53, B45MW65**
  - **Group 3: B45MW24, B45MW35, B45MW49, B45MW74, B45MW75**

HVR Pilot Test

Plume Reduction: March 2021 Naphthalene Plume



Legend

B45MW2
260 J

Monitoring Well Identification

Concentration (µg/L)

Naphthalene Concentration >12.9 µg/L

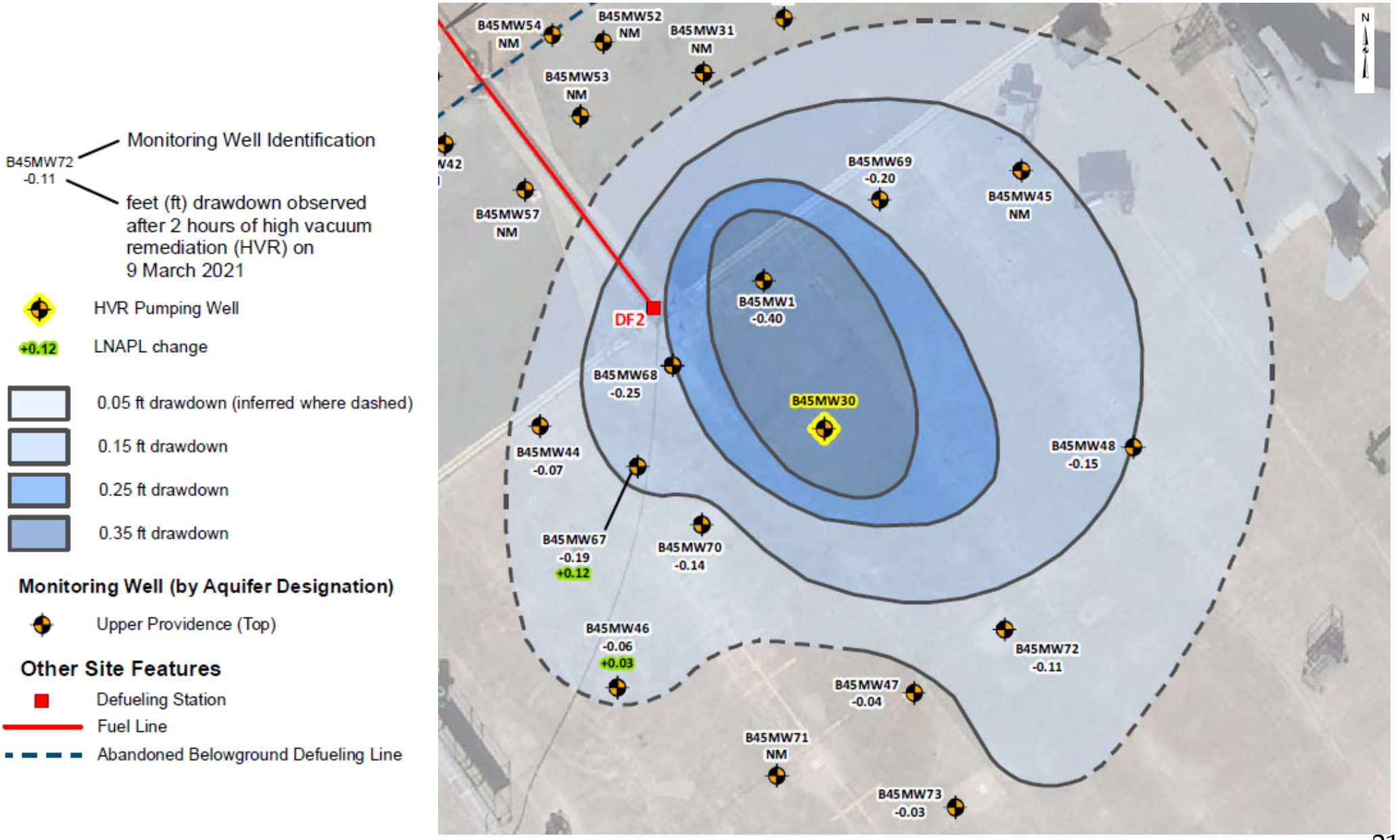
Monitoring Well (by Aquifer Designation)

Upper Providence (Top)

Upper Providence (Middle)

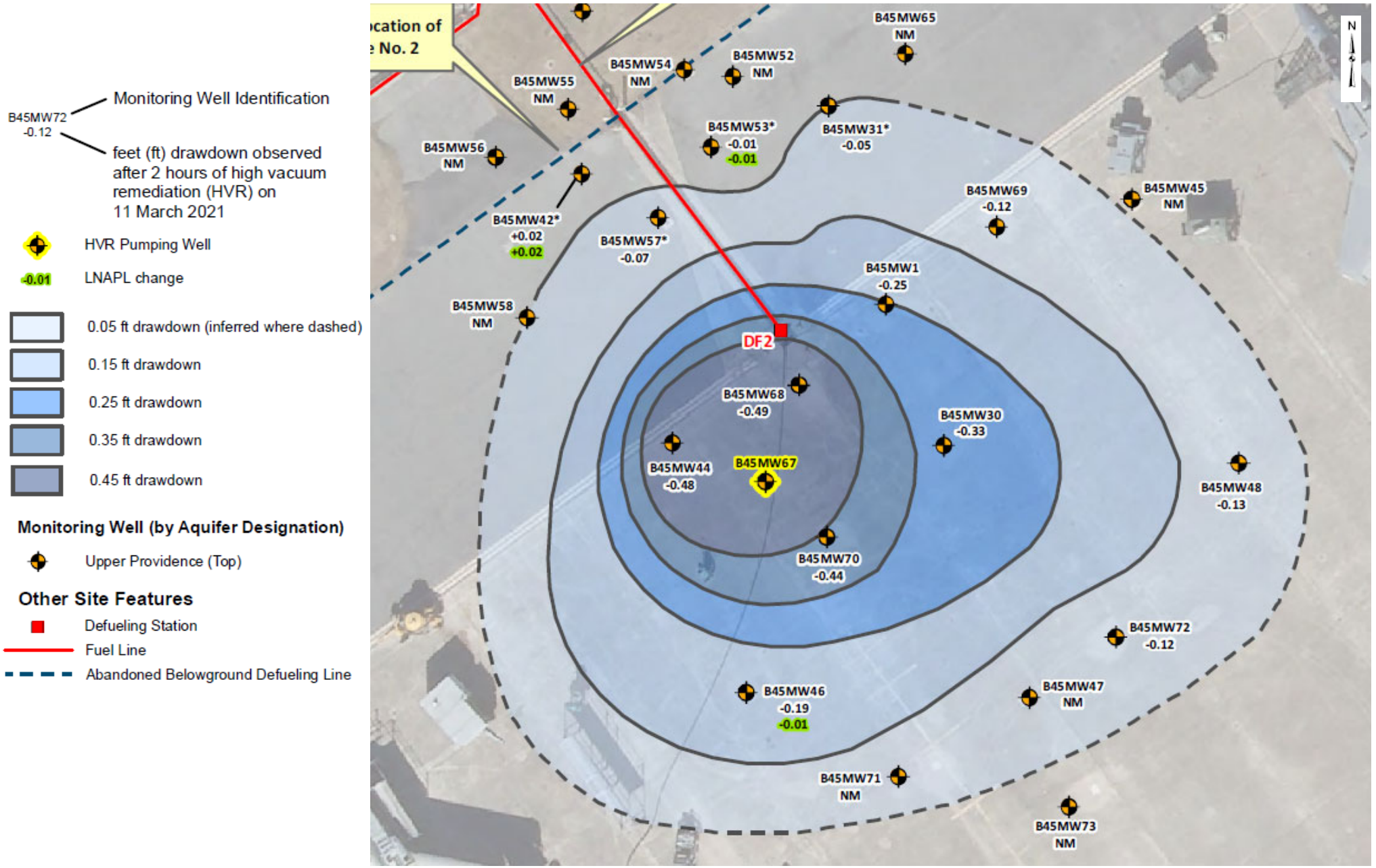
HVR Pilot Test

Drawdown Group 1: B45MW30 (March 2021)



HVR Pilot Test

Drawdown Group 1: B45MW67 (March 2021)



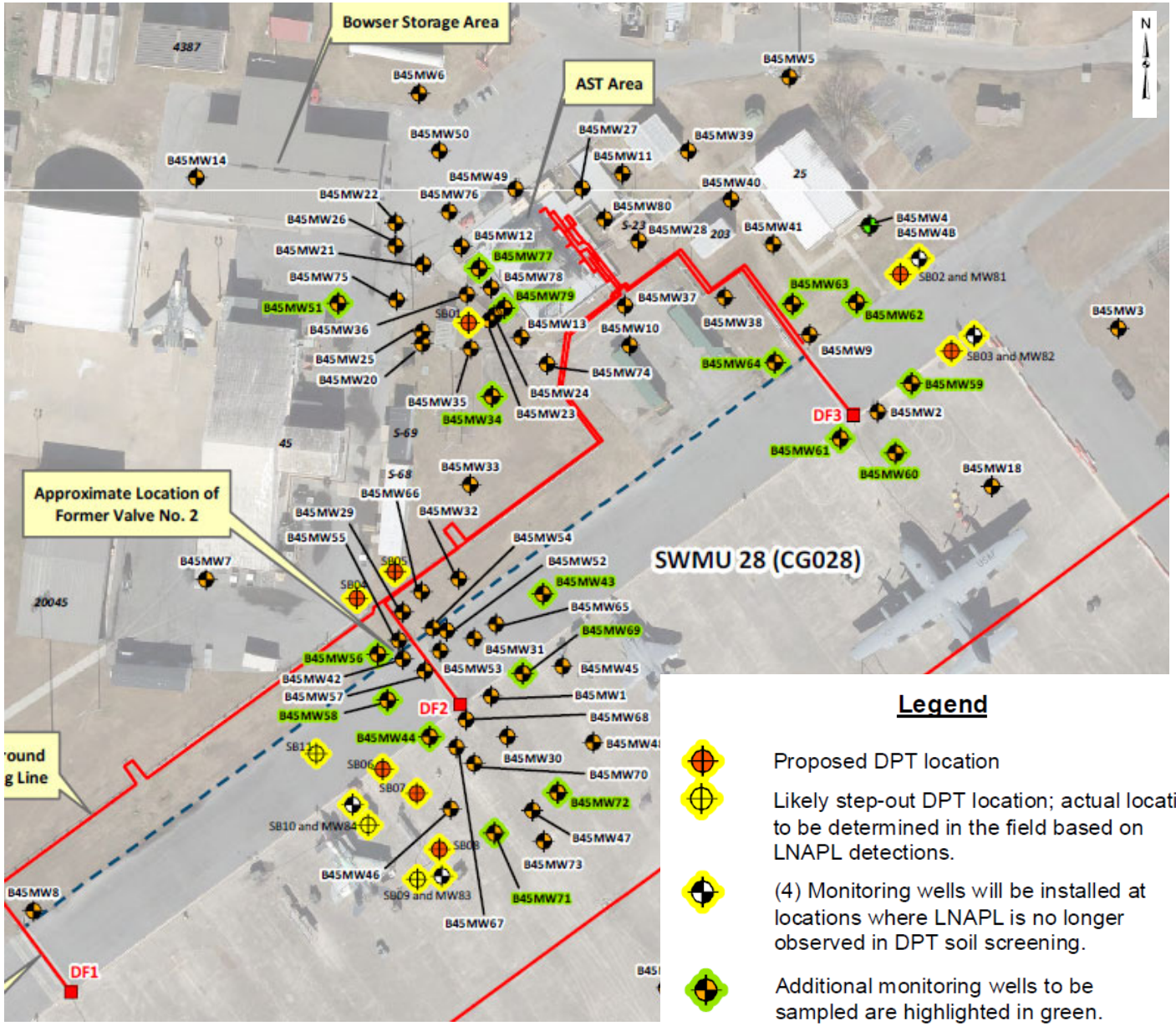
Supplemental Site Investigation (SSI)

- SSI Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) approved May 2022
- Delineation of plume
  - Soil sampling
  - Four new monitoring wells
  - Sample existing wells not previous sampled due to free product
- Pilot Test to evaluate Modified Fenton's Reagent (MFR) in areas where LNAPL <0.1 feet thick
- Expand HVR test to include a 5-day event

SSI

Soil and Groundwater Locations

- 8 soil borings
  - Step-outs anticipated but not needed
- 4 monitoring wells
- 17 existing wells
  - Previously not sampled due to LNAPL
  - Removed LNAPL
  - Sampled groundwater



SSI

Soil Sampling Results

- **MFR characterization**
  - **Analyzed SB-01 near Building 45 area for total organic carbon (TOC) and total petroleum hydrocarbon (TPH)**
  - **Also analyzed soil from SB-02 and SB-10 near DF2 for TOC and TPH**
  - **Data used to calculate necessary chemicals for MFR**

SSI
Soil Sampling Results

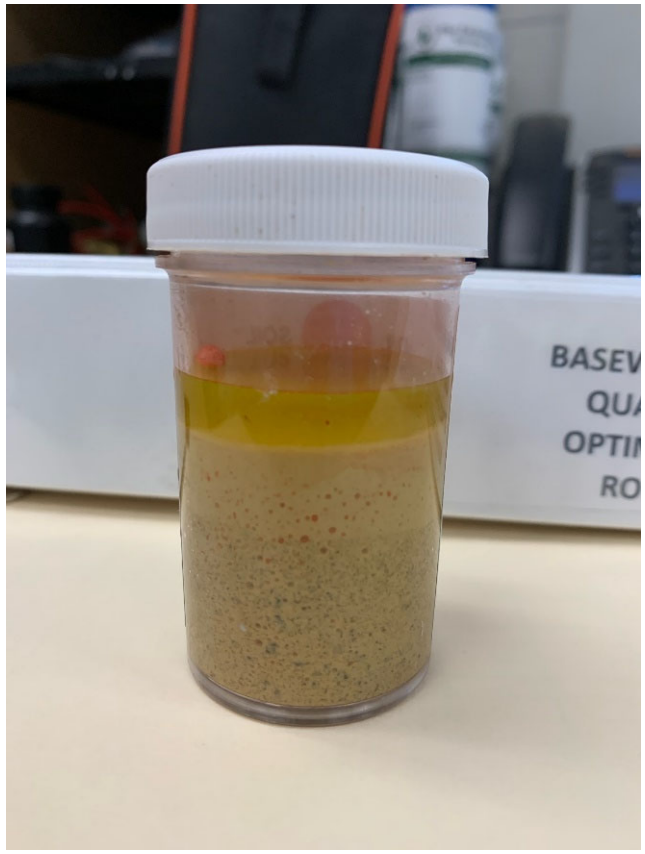
- **LNAPL investigation in DF2 and DF3 areas**
  - **7 soil boring locations**
  - **Screened with oil and gas hydrophobic dye test kits**
    - Scope was to offset and collect additional samples if LNAPL was observed; LNAPL not observed in DF2 or DF3 areas
  - **Screened with photoionization detector (PID)**
    - Samples collected where PID readings were highest
    - Analyzed for COCs
  - **RLs not exceeded for any COC in soil**

SSI

Oil and Gas Screening in Soil

- **Free product observed in SB-01**
- **None observed in DF2 or DF3 area borings**

Control with drop of gasoline



SB-01 after 3 hours of settling

SSI

Groundwater Results

- Sampled existing wells in March 2022
  - Including some wells with LNAPL
  - Results of dissolved COCs not indicative of free product
  - Non-aqueous phase liquid with low concentrations of COCs
- Installed four monitoring wells in August 2022
  - Benzene non-detect in all four wells
  - Naphthalene below RL in all four wells
- Updated benzene and naphthalene plume maps

SSI

LNAPL (2021-2022 Average) and Benzene Plume (March and August 2022)

B45MW13
7.9

Monitoring Well Identification

Concentration (µg/L)

Benzene Concentration >5 µg/L

LNAPL Thickness Sheen or <=0.01 feet

LNAPL Thickness >0.01 feet

Monitoring Well (by Aquifer Designation)

Upper Providence (Top)

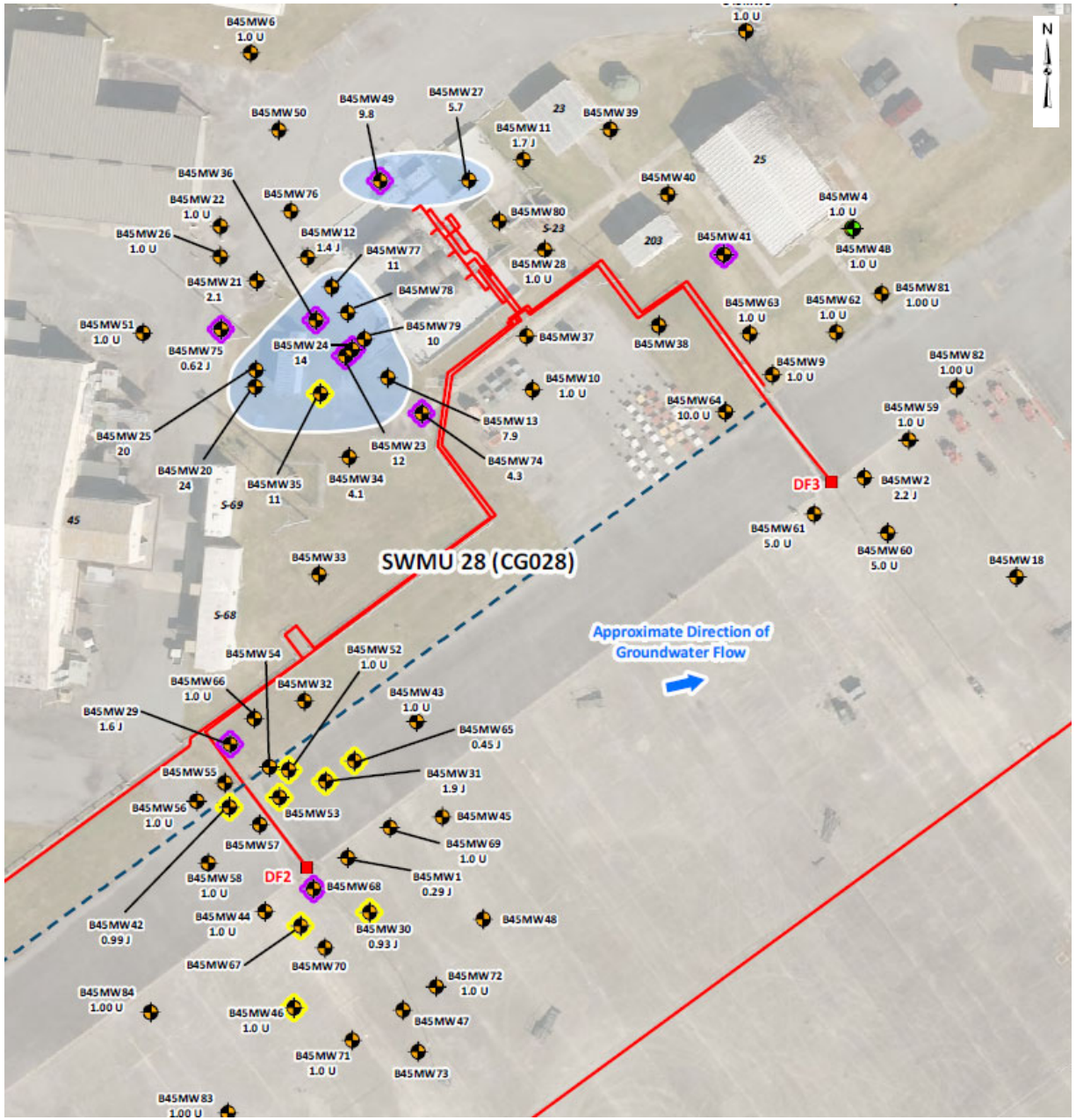
Upper Providence (Middle)

Other Site Features

Defueling Station

Fuel Line

Abandoned Belowground Defueling Line



SSI

LNAPL (2021-2022 Average) and Naphthalene (March and August 2022)

B45MW4
0.51

Monitoring Well Identification

Concentration (µg/L)

Naphthalene Concentration >12.9 µg/L

LNAPL Thickness Sheen or <=0.01 feet

LNAPL Thickness >0.01 feet

Monitoring Well (by Aquifer Designation)

Upper Providence (Top)

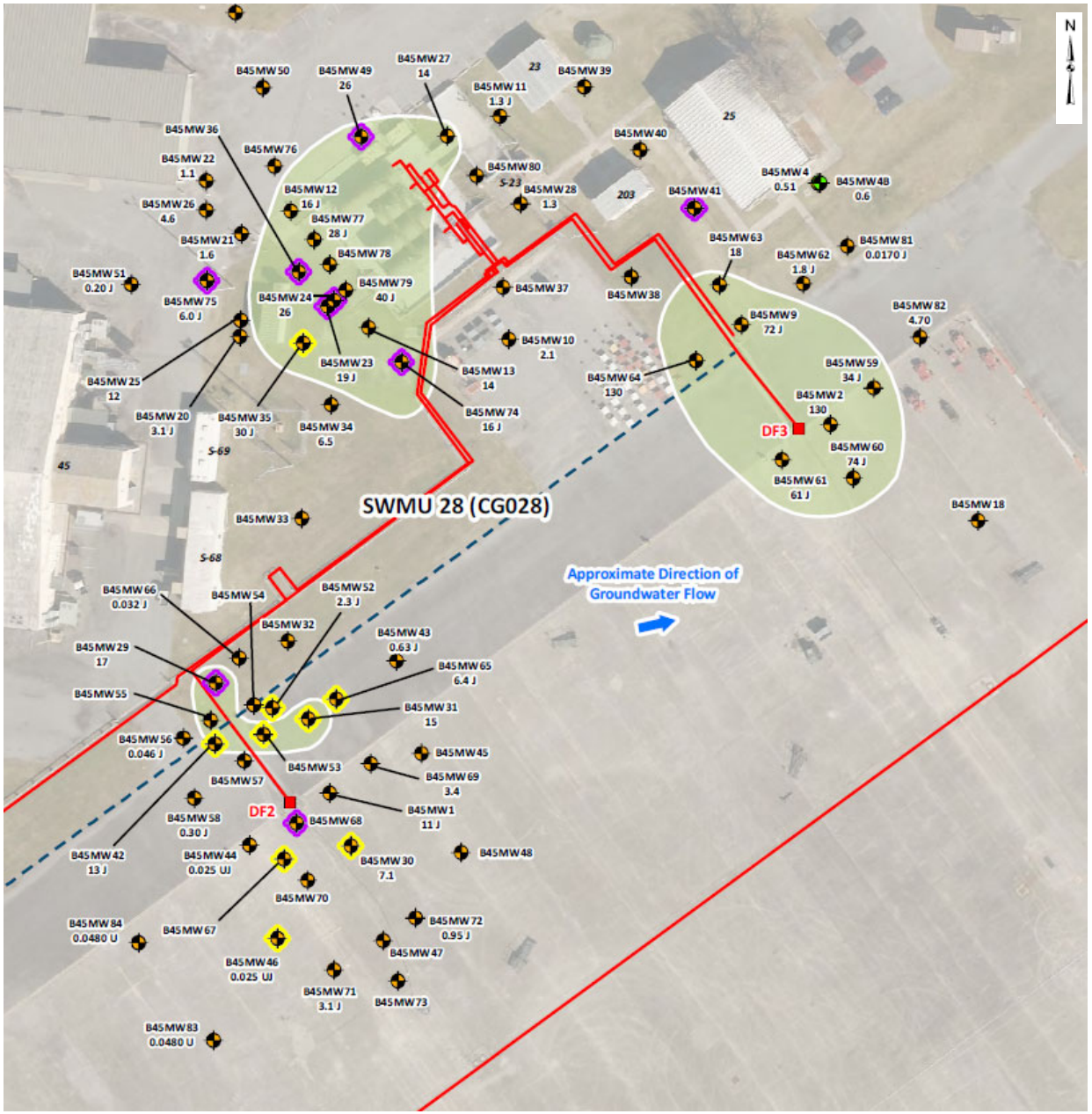
Upper Providence (Middle)

Other Site Features

Defueling Station

Fuel Line

Abandoned Belowground Defueling Line



SSI
MFR Injections

- Chelated iron followed by hydrogen peroxide
- Treatment mechanism is desorption followed by aqueous treatment
- Promotes distribution in formation and enhances desorption of mass from soil
- Reaction generates hydroxyl radicals
  - Highest oxidation potential of the available oxidizers
  - Also generates superoxide anions
- Grid injection pattern provides greater coverage

SSI
Comparison of Oxidants

Oxidizing Species	Oxidation Potential (volts)
Hydroxyl Radical	2.8
Sulfate Radical	2.6
Ozone	2.07
Persulfate	2.01
Hydrogen Peroxide	1.77
Perhydroxyl Radical	1.7
Permanganate	1.69

Where does the hydroxyl radical come from?

- **Fenton's reaction chemistry**
- **Must be generated in the field**

SSI
MFR Pilot Test

- Injection events
  - November 2022 (Desorption Phase)
  - December 2022 (Aqueous Treatment Phase)
  - January 2023 (Polishing Phase)
- First event to desorb contaminants from soil and drive them into dissolved phase
- Second event to oxidize dissolved phase contaminants
- Third event to polish

SSI

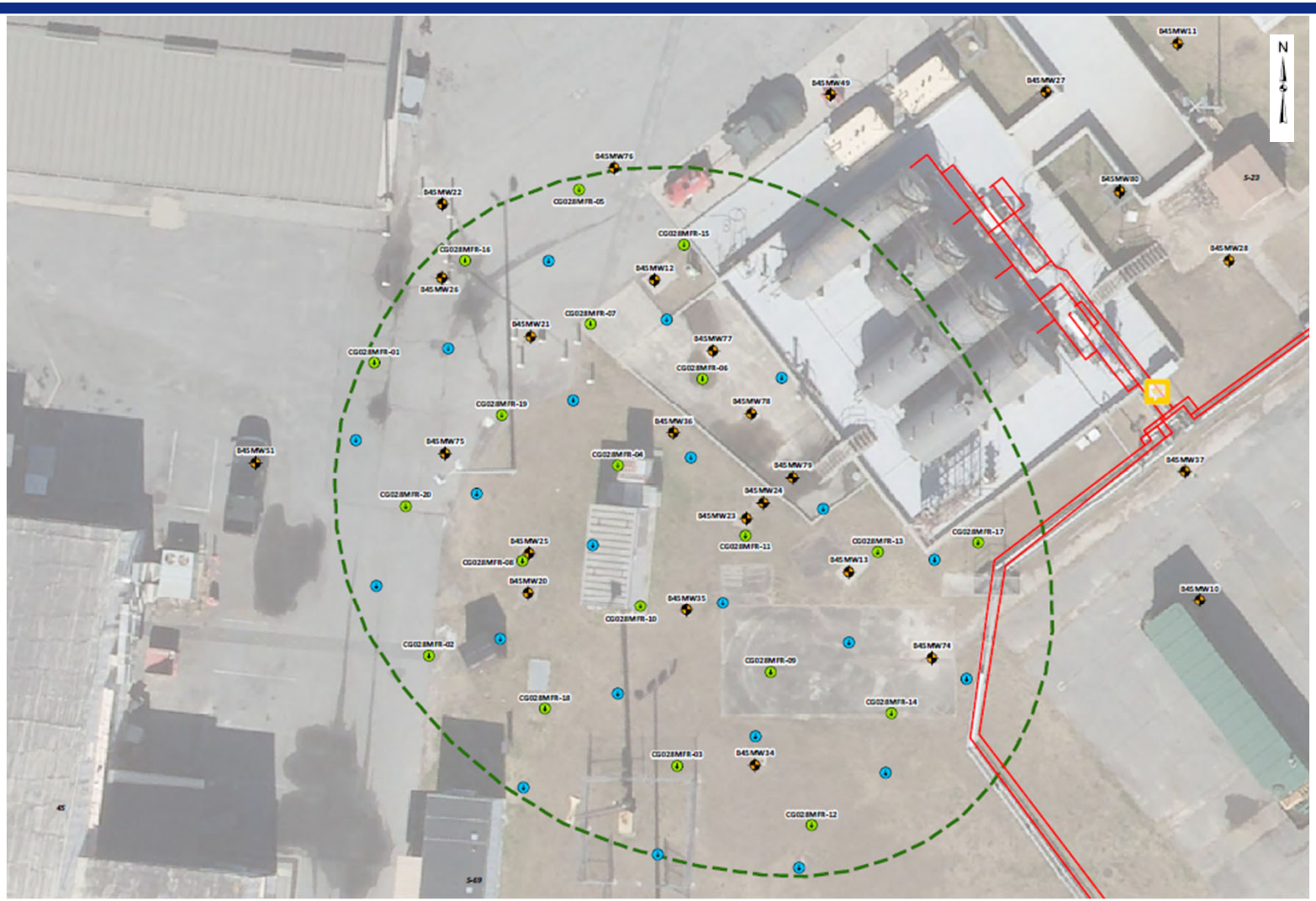
MFR Pilot Test

SSI
MFR Pilot Test

SSI
MFR Pilot Test

SSI

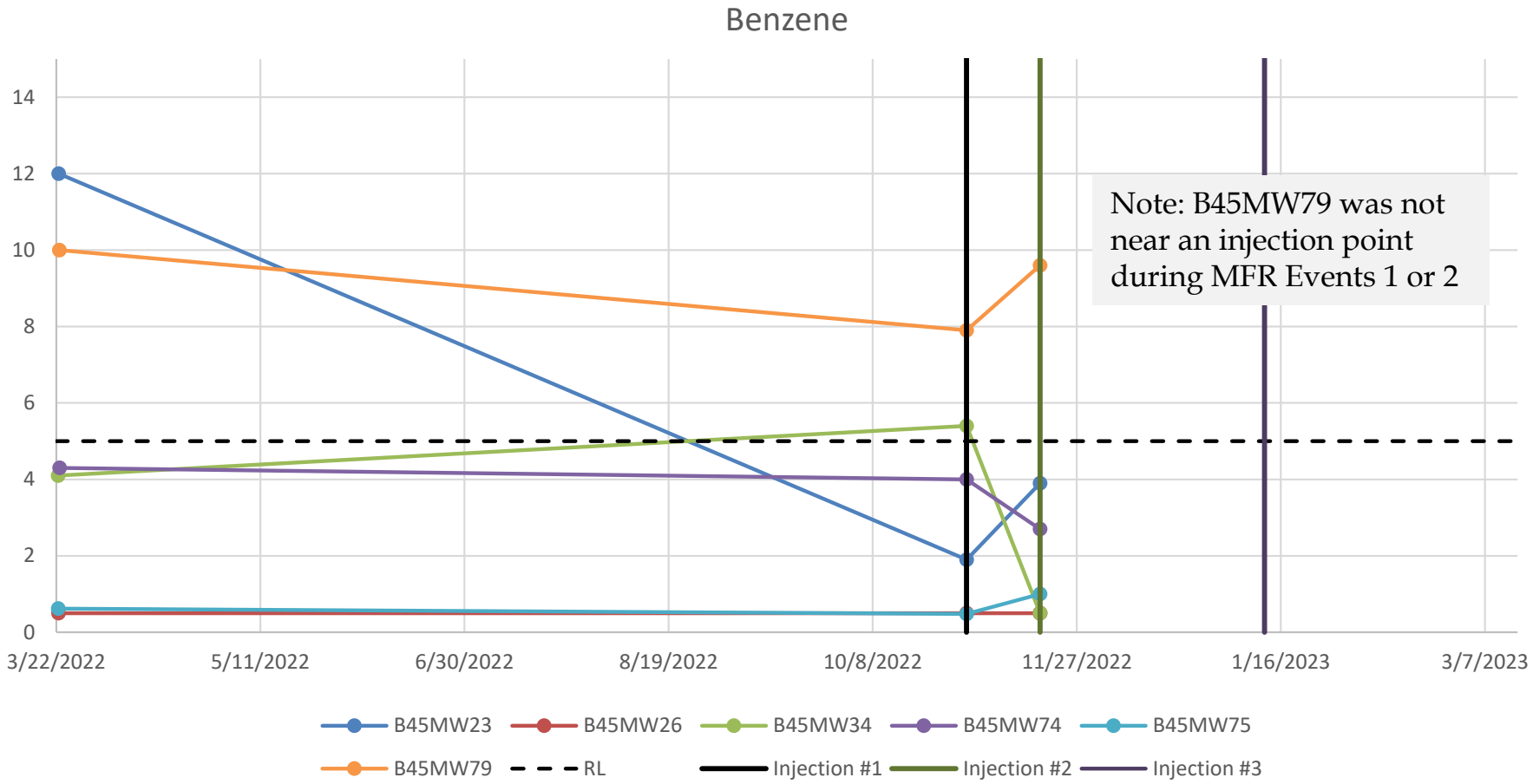
Locations of Injection Wells and Injection Points



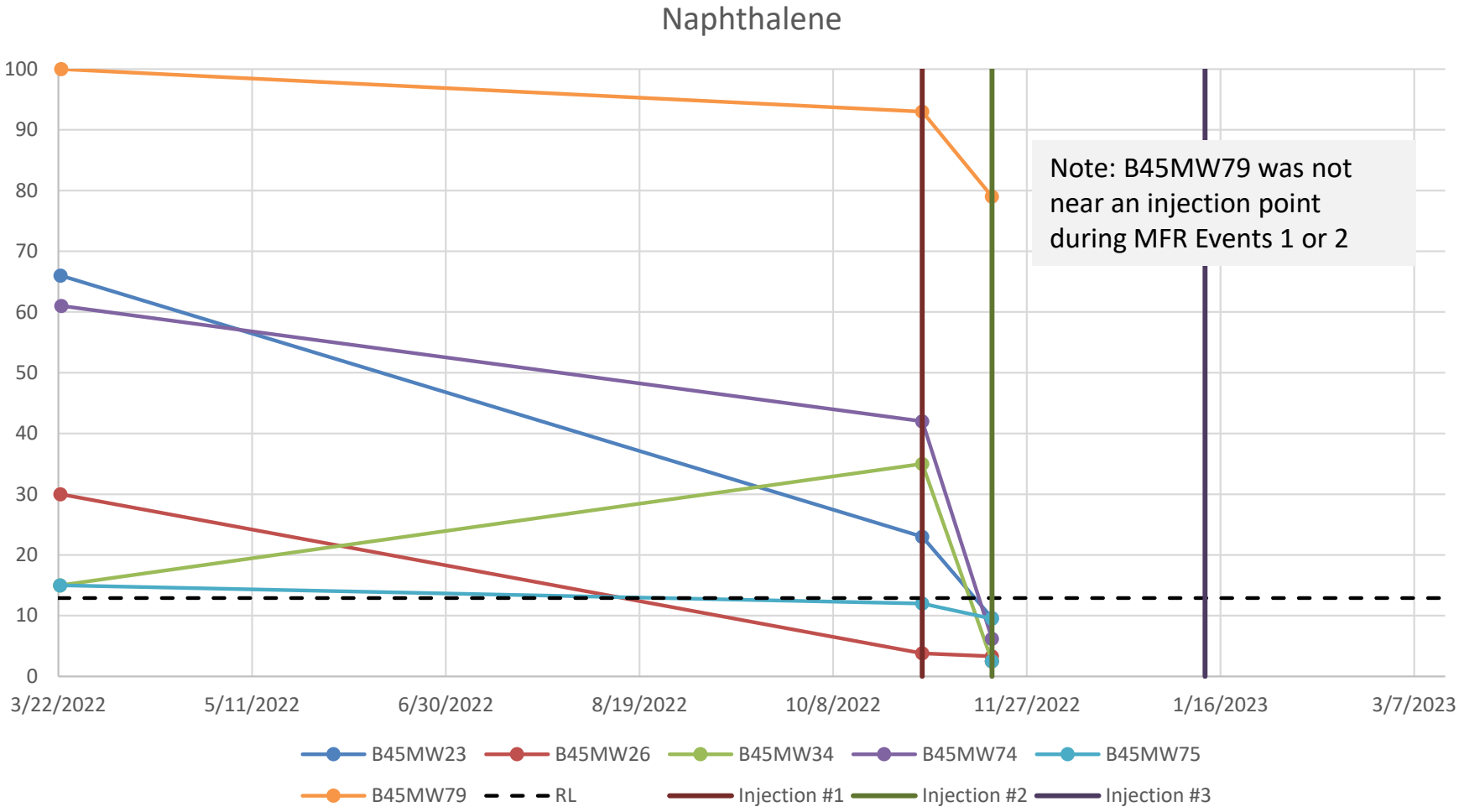
Legend

- Proposed DPT Injection Point - Event 1
- Proposed DPT Injection Point - Event 2
- Target Treatment Zone

SSI
Trend Plot for Benzene



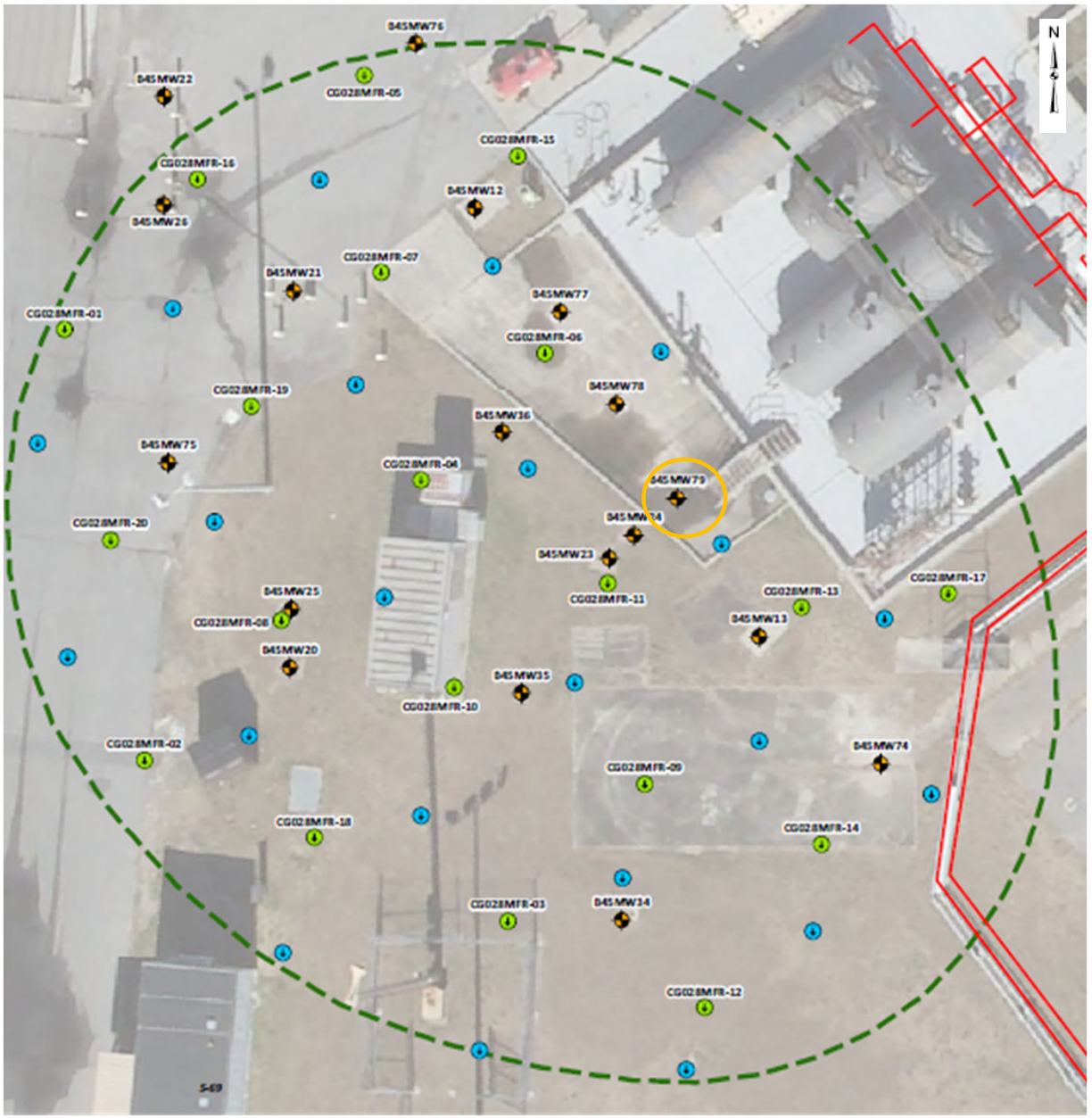
SSI
Trend Plot for Naphthalene



SSI

Locations of Injection Wells and Injection Points

- Note B45MW79 exhibited less reduction in benzene concentration
- This was addressed in Injection Event 3 and may be revisited during full-scale



Legend

- Proposed DPT Injection Point - Event 1
- Proposed DPT Injection Point - Event 2
- Target Treatment Zone

Next Steps

- Next post-injection sampling event coincides with basewide sampling event (March/April 2023)
- Conduct extended 5-day HVR event to reduce LNAPL to <0.01 feet in DF2 area
- Prepare CAP Addendum and Remedial Design/Remedial Action Work Plan to apply MFR to DF1 and DF2 areas
  - May require Underground Injection Control (UIC) permit if full-scale injection event takes more than 90 days

SWMU 61
(CG503)
Update on Progress

Elizabeth Rhine
Bhate Technical Lead

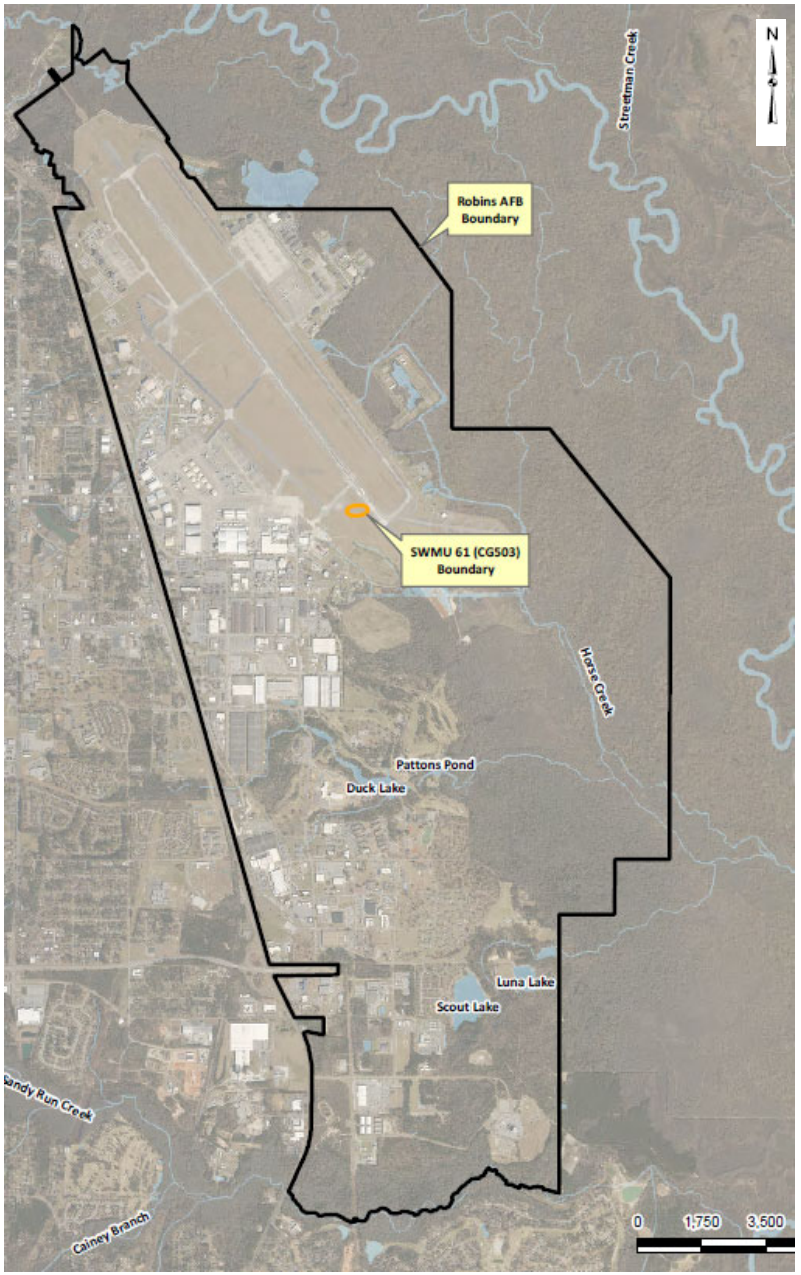
2 February 2023

Overview

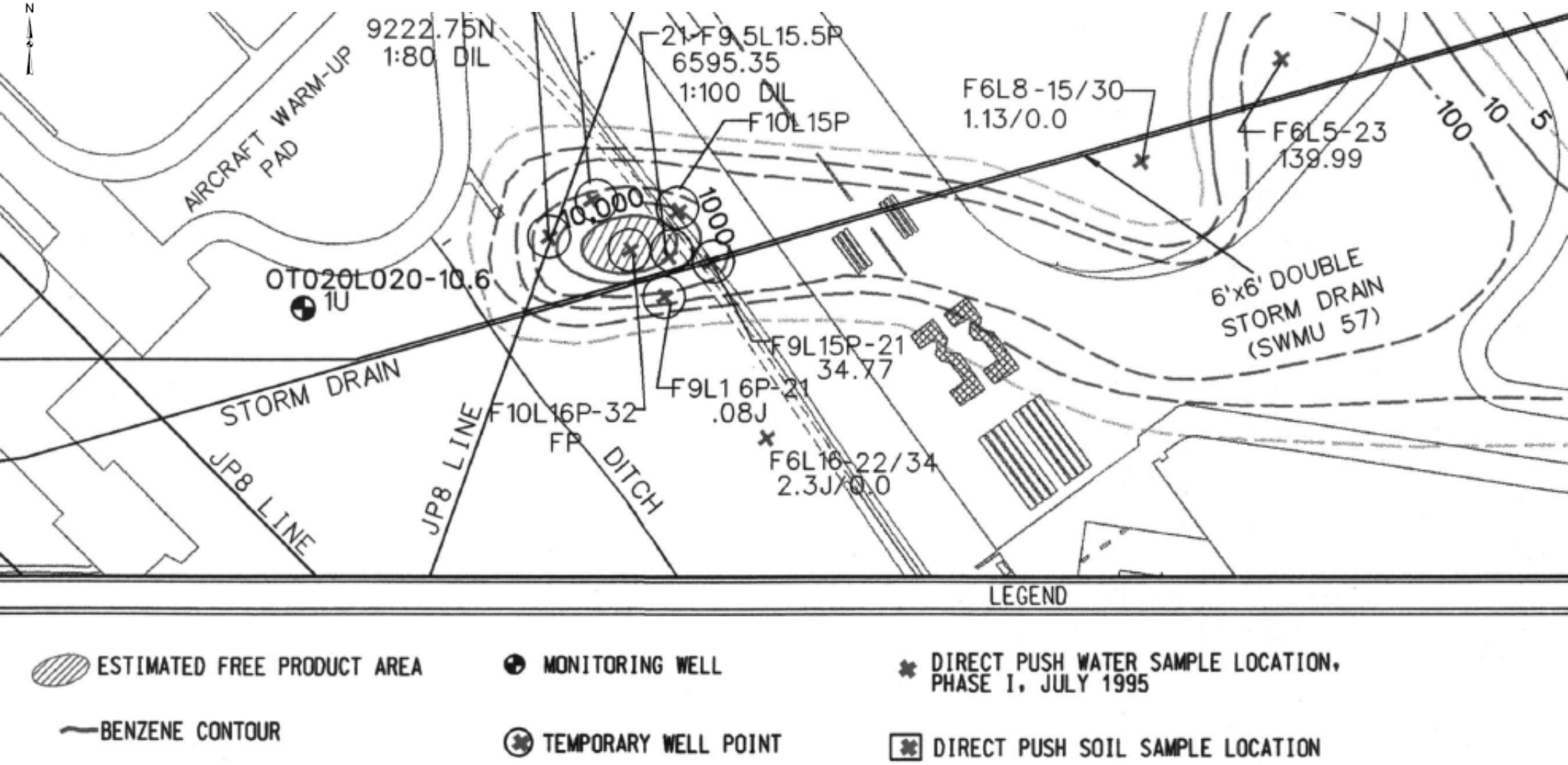
- Background
- Prior Remedial Actions
- CAP Addendum
- MFR Injection
- Next Steps

Background

- Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) in 1999
  - Goal of RFI was to delineate vertical and horizontal extent of dissolved phase contamination
  - Activities included soil sampling, groundwater profiling with cone penetrometer testing rig, monitoring well sampling, and free product measurements
- Primary contaminant of concerns in groundwater are **benzene**, 1,3,5-trimethylbenzene, ethylbenzene, and **naphthalene**



Background
Potential Assessment Report



(HAZWRAP, August 1997)

Prior Remedial Actions

- **Phase II RCRA Facility Investigation for 24 SWMUs**
  - **September 1998 – June 1999**
  - **Rapid Optical Screening Tool (ROST™)**
  - **Identified free product and LNAPL residuals**

Prior Remedial Actions

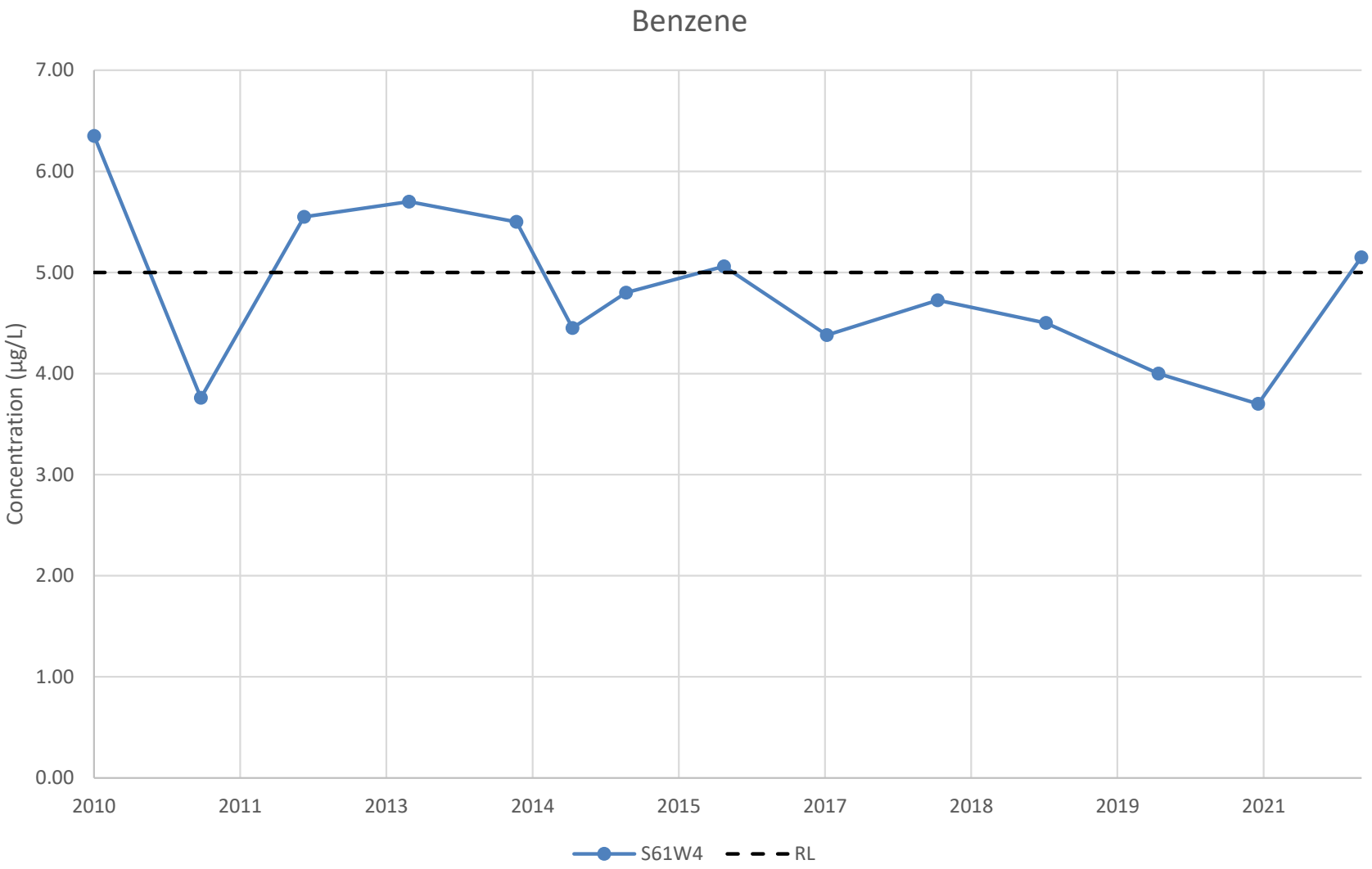
- CAP approved August 2002 for Air Sparge/Soil Vapor Extraction (AS/SVE)
  - Reduce potential sources of groundwater contamination (i.e., residual and free-phase contaminants)
  - Reduce COC concentrations in groundwater to values less than site-specific RLs
  - Minimize the migration of groundwater contaminants from commingled SWMU 57 and SWMU 61 plumes into adjacent wetland
- AS/SVE effectively reduced COCs to below RLs
  - However, COCs exceeded RLs in 2012

Prior Remedial Actions
Corrective Action Optimization

- Benzene and 1,3,5-trimethylbenzene concentrations in monitoring well S61W4 were detected above RLs in 2012 and remained slightly above RLs in 2013
- Oxygen emitters installed in five new injection wells in December 2013/January 2014
- TersOX™ injected into 81 temporary injection points in January 2014
- Hydrogen peroxide injected into five injection wells from June – August 2018
- Oxygen emitters reinstalled December 2018

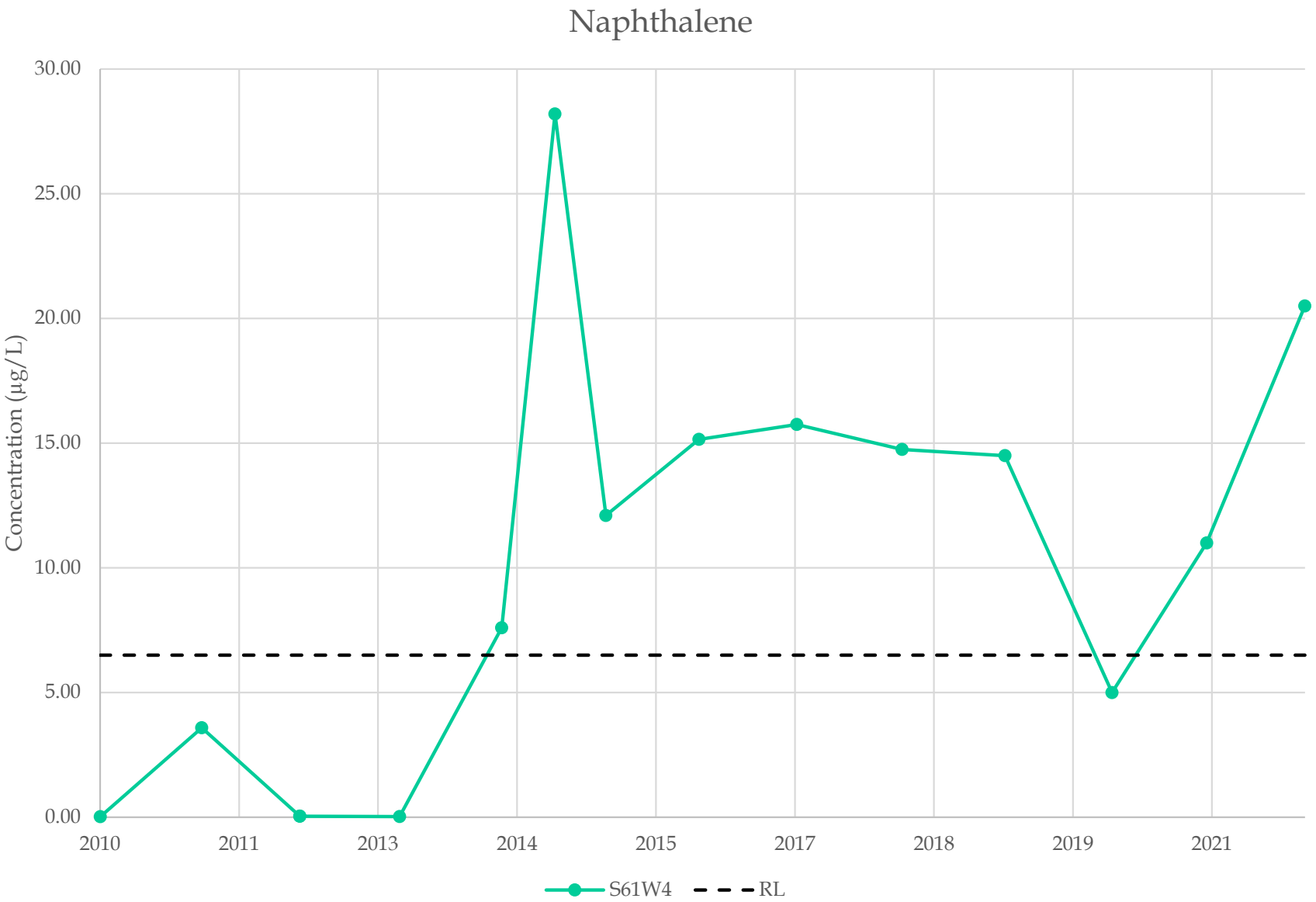
Prior Remedial Actions

Benzene Concentration Trends



Prior Remedial Actions

Naphthalene Concentration Trends

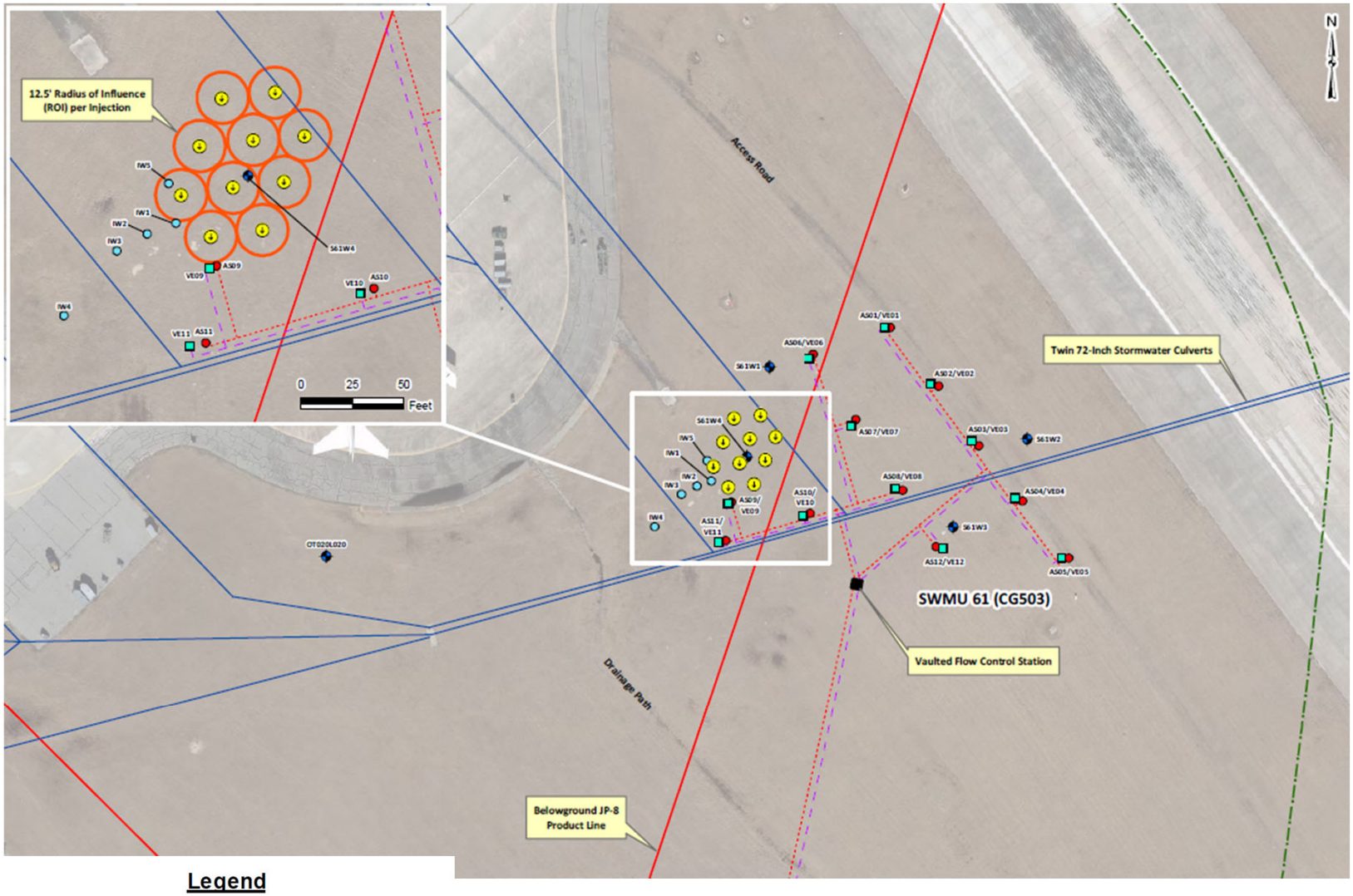


CAP Addendum

- Draft Final CAP Addendum and Remedial Design/Remedial Action Work Plan both approved by Georgia Environmental Protection Division (GA EPD) in December 2022
- MFR selected as a complementary remedial action to achieve site closure
  - Dissolved oxygen typically <0.5 mg/L even with emitters installed
  - MFR is compatible with emitters
- Injections January 2023
  - 10 injection points in vicinity of S61W4

MFR Injections

Locations of Injection Wells and Injection Points



Legend

Proposed MFR Location

Monitoring Well (by Aquifer Designation)

Upper Providence

Next Steps

- Continue groundwater sampling in 30 days, then quarterly for 1 year (i.e., 5 sampling events)
- Conduct 2nd MFR injection event, if necessary
- Continue annual sampling and reporting
- When COCs are <RLs for 3 consecutive annual sampling events, No Further Action (NFA) will be recommended
- Annual sampling will continue until GA EPD approves NFA

Questions?

Elizabeth Rhine

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864.982.9890

New Business
and
Program Closing

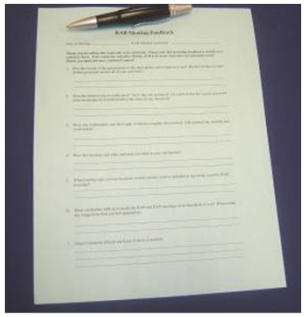
Ms. Shan Williams
EAB Installation Co-chair

Next EAB Meeting

Thursday, May 4, 2023

Please…

Complete the meeting evaluation and feedback form and return to sign-in table or leave at seat



Leave your name tag at the sign-in table or seat for the next meeting

Thank you!