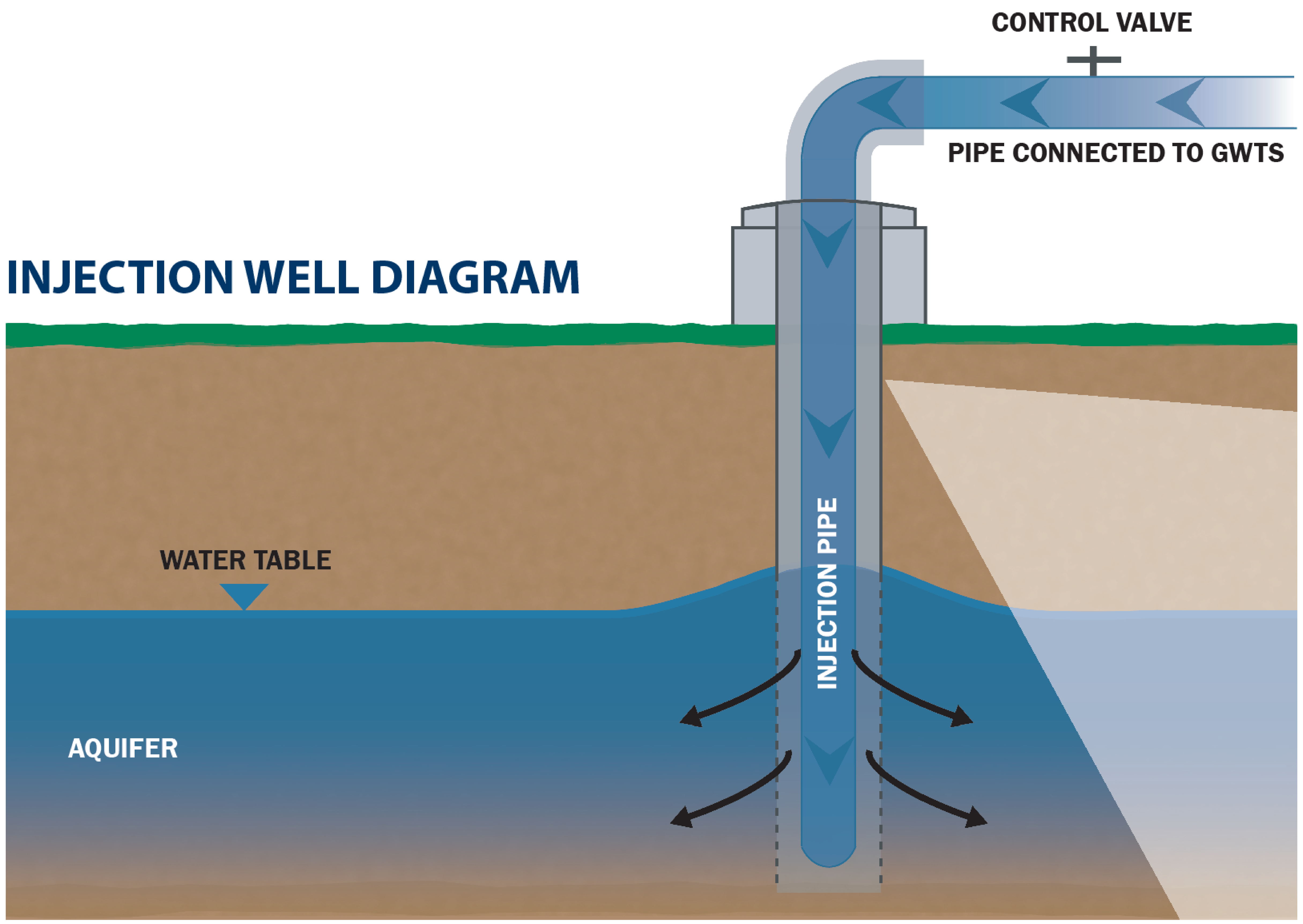
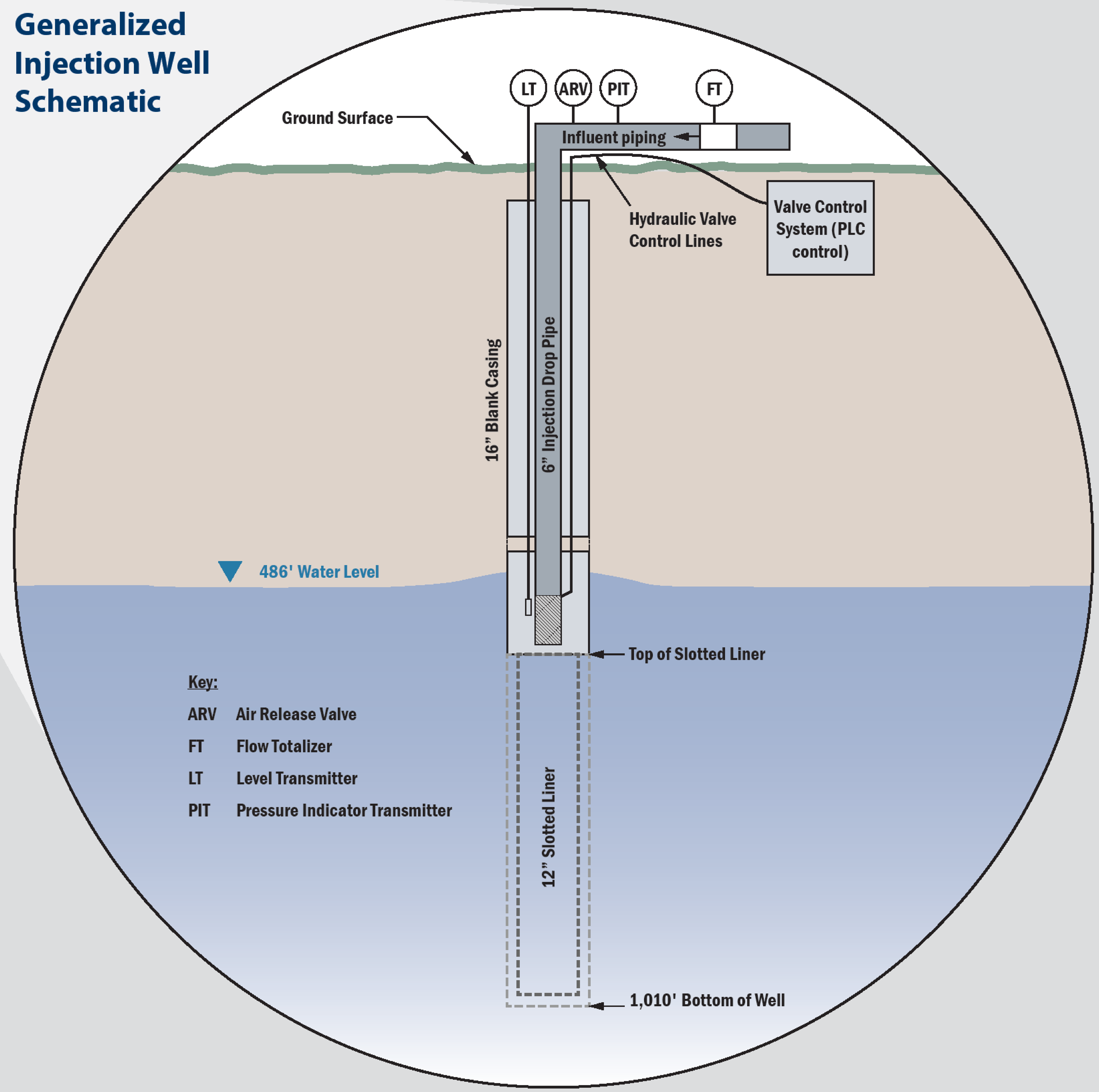
Gravity-Fed Injection of Treated Water

INJECTION WELL DIAGRAM



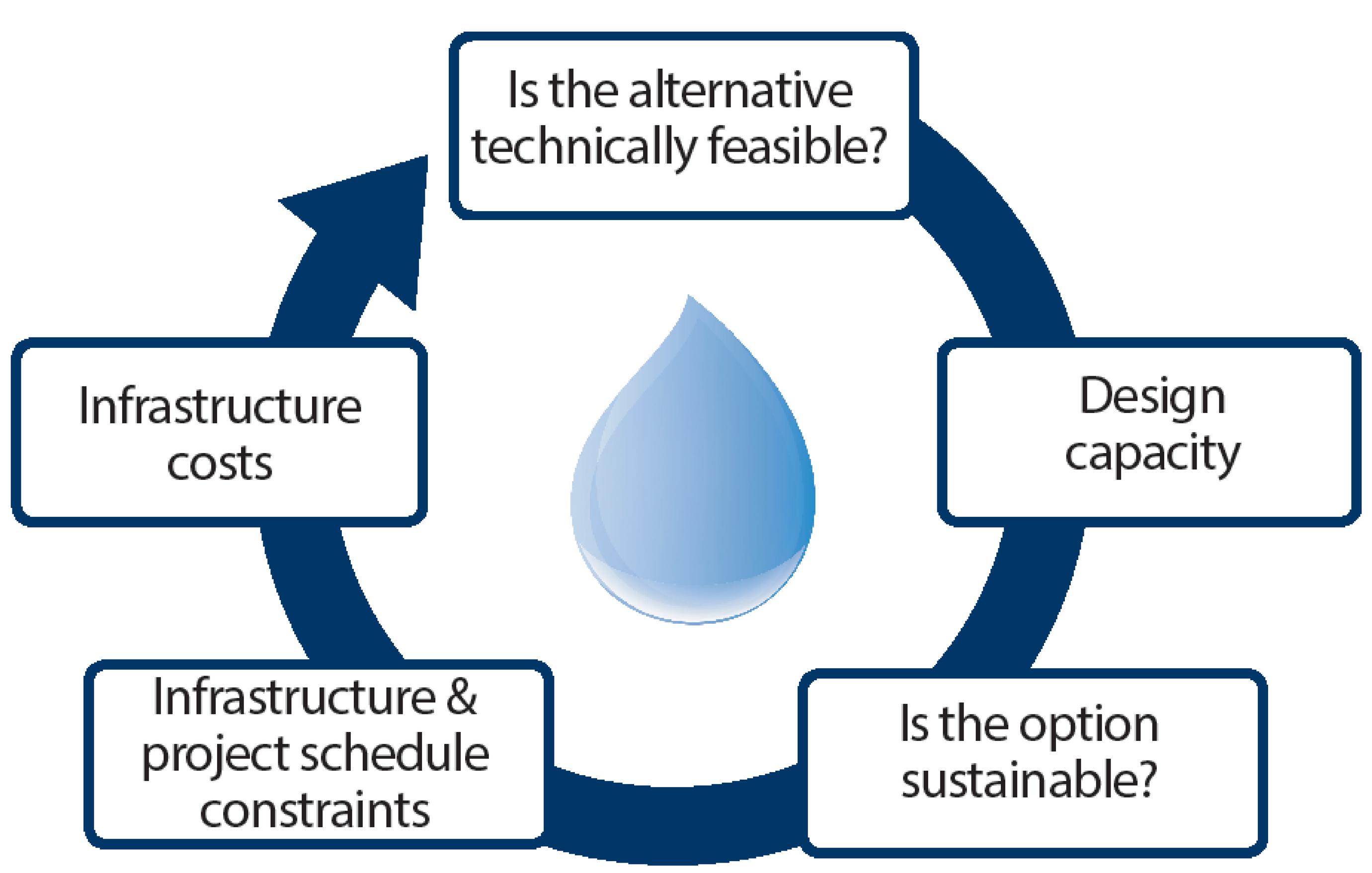
An injection well is used to place fluid underground into aquifers and/or geologic formations. In the case of the Kirtland AFB Bulk Fuels Facility remediation project, the injection wells use gravity to drop treated water out of the bottom of a pipe, into the aquifer. The water has been treated to drinking water standards and becomes part of the water in the aquifer. The volume and rate of water injected is controlled at the Groundwater Treatment System (GWTS) facility and is monitored with high accuracy instrumentation to evaluate well and aquifer response to injection.

Generalized Injection Well Schematic



Beneficial Use of Treated Water

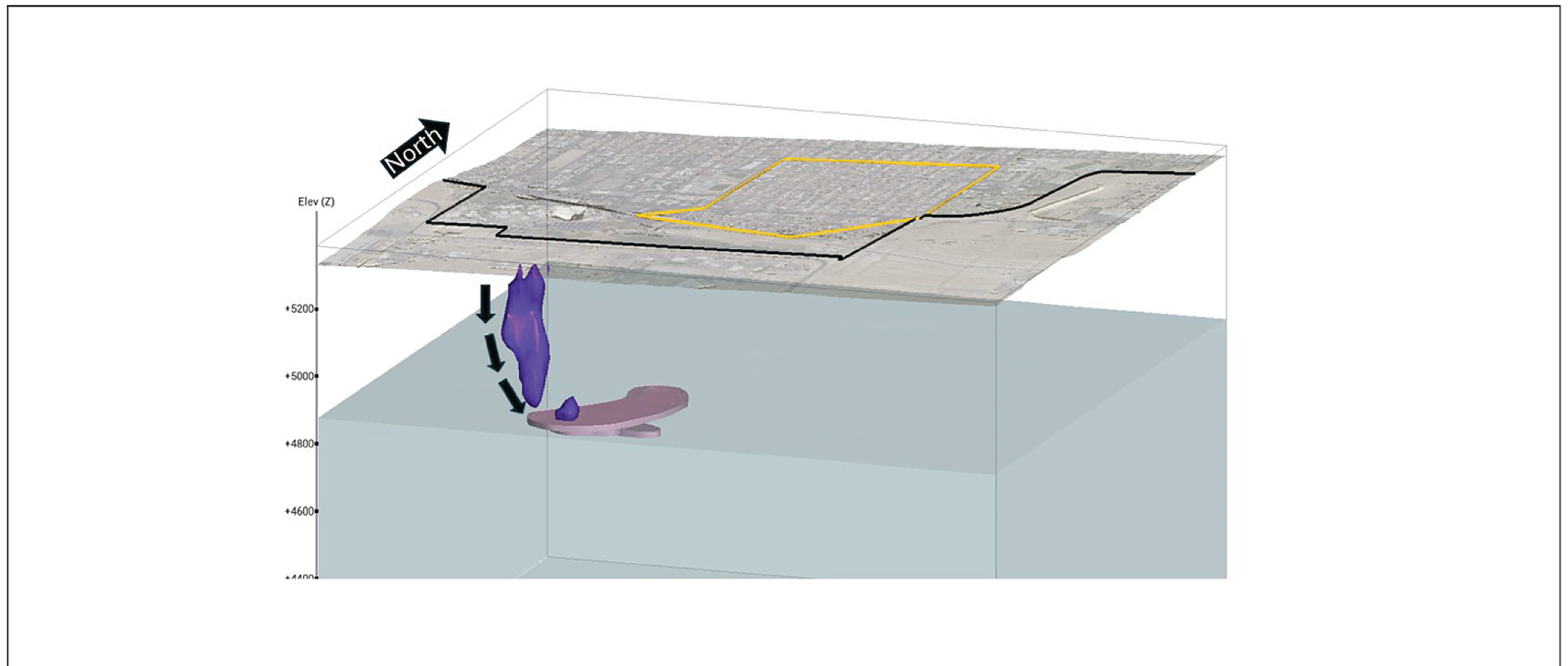
Different options (e.g., infiltration galleries, surface application such as irrigation, retention ponds, injection, etc.) were considered for discharging water treated from the full-scale groundwater treatment facility. These options were evaluated using the beneficial reuse criteria below.



Based on evaluation, which included an understanding of how water moves through soil, two options were identified as viable methods for discharging treated water: 1.) use of the Kirtland AFB Golf Course pond to hold water for irrigation use on the golf course and 2.) use of a gravity-fed well to inject water into the aquifer.

Benzene Plume and Residual Light Non-Aqueous Phase Liquid (LNAPL) Extent

Downward Migration Pathway of Benzene



Legend

- KAFB Boundary
- Target Capture Zone

Visualization of Q4 2023 Benzene Groundwater Plume

- >5 ug/L (MCL)

4Q 2023 Benzene in Soil Vapor >32,000 ug/m3

- >32,000
- Migration direction

Notes

The benzene soil gas plume was interpolated using 10% of the detection limit as the value for non-detects. Concentrations are shown as well screens below ground surface.

> = greater than
KAFB = Kirtland Air Force Base
MCL = maximum contaminant level
Q = Quarter
RCRA = Resource Conservation and Recovery Act
SWMU = Solid Waste Management Unit
ug/L = micrograms per liter
ug/m3 = micrograms per cubic meter

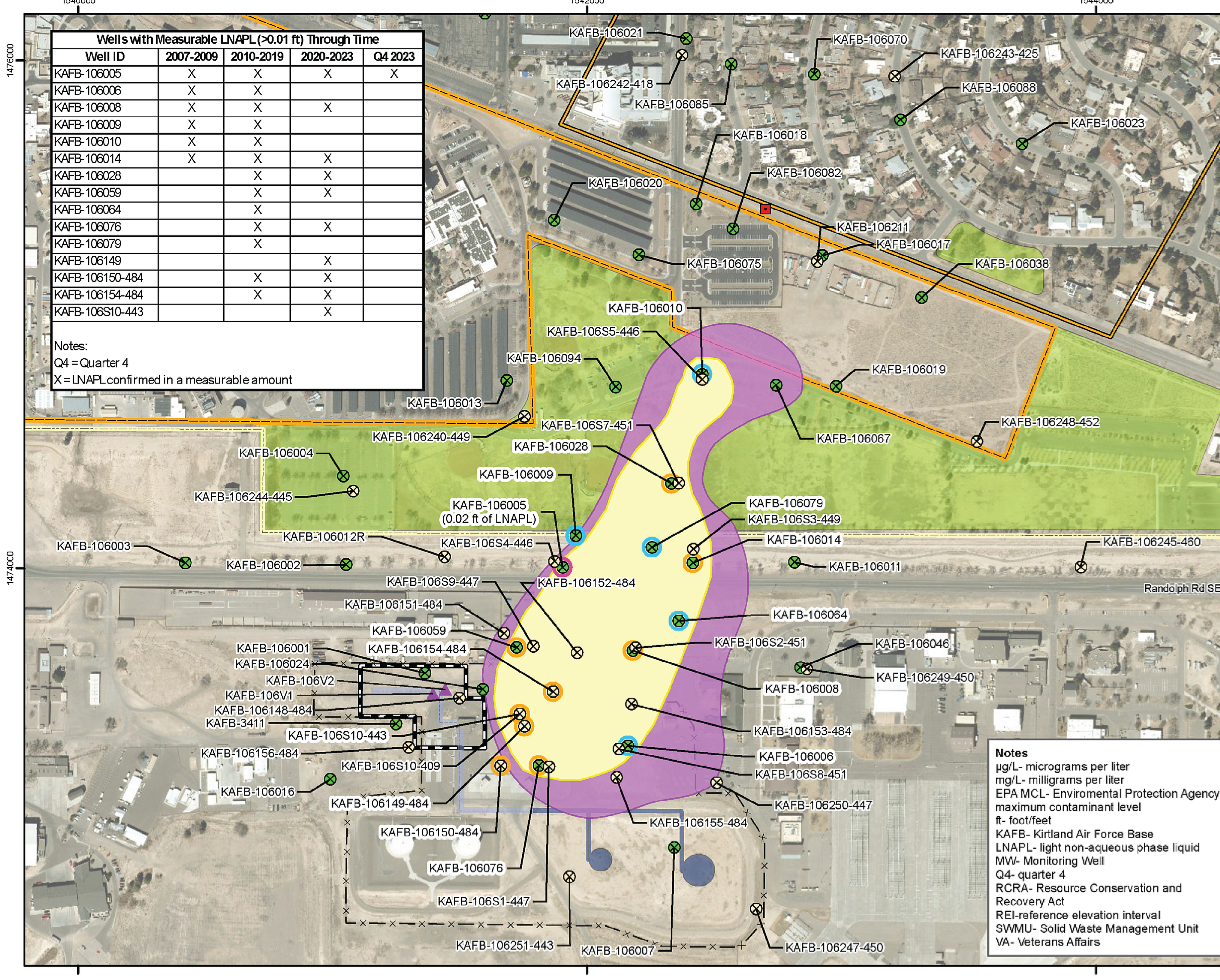
Figure 6-45

Downward Migration Pathway of Benzene

RCRA Facility Investigation
Phase II Report
SWMU ST-106/SS-111
Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 06/22/2024

Horizontal LNAPL Extent



Wells with Measurable LNAPL (>0.01 ft) Through Time

Well ID	2007-2009	2010-2019	2020-2023	Q4 2023
KAFB-106005	X	X	X	X
KAFB-106006	X	X		
KAFB-106008	X	X	X	
KAFB-106009	X	X		
KAFB-106010	X	X		
KAFB-106014	X	X	X	
KAFB-106028		X	X	
KAFB-106059		X	X	
KAFB-106064		X		
KAFB-106076		X	X	
KAFB-106079		X		
KAFB-106149			X	
KAFB-106150-484		X	X	
KAFB-106154-484		X	X	
KAFB-106S10-443			X	

Notes:
Q4 = Quarter 4
X = LNAPL confirmed in a measurable amount

Legend

- Monitoring Well with Confirmed LNAPL in Q4 2023
- Wells with LNAPL last measured between 2020 and 2023
- Wells with LNAPL last measured between 2010 and 2019
- REI 4857 MW (Screen not submered)
- REI 4857 and 4857/4838 MW (Screen Submerged)
- Extraction Wells
- Soil Vapor Monitoring Location
- Kirtland Air Force Base Installation
- VA Boundary
- Interim Measure Operational Area
- City of Albuquerque Park
- Source Area
- Bulk Fuels Facility Area
- Approximate LNAPL Footprint (Benzene concentration greater than effective solubility of benzene, 1.43 mg/L)
- Benzene Plume, Q4 2023 > 5 µg/L (EPA MCL)
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer
- Former Aboveground Storage Tank

Site Location

Revision Date: 1/8/2025

N

0 200 400 800 Feet

1 inch = 417 feet

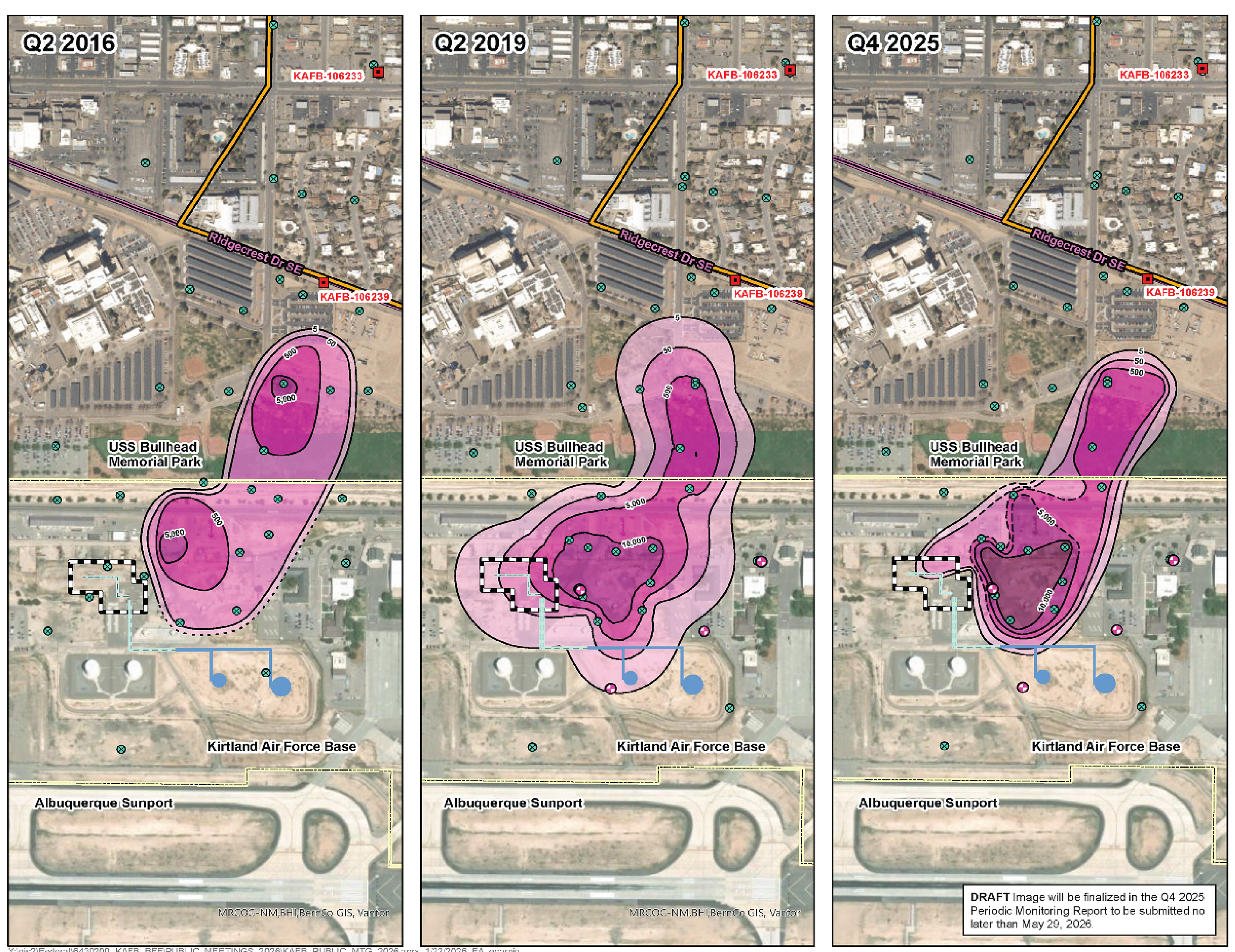
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

RCRA FACILITY INVESTIGATION
PHASE II REPORT
SWMU ST-106/SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 6-64

GROUNDWATER MONITORING WELLS WITH MEASURABLE LIGHT NON-AQUEOUS PHASE LIQUID, Q4 2023

Benzene Plume Footprint (over time)



Legend

- Groundwater Monitoring Well (174 wells total)
- Extraction Well
- Most Recently Installed Well (2020-2021)
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Benzene Concentration Isocontour (µg/L) (dashed where inferred)
- Interim Measure Operational Area
- Installation Fence Boundary
- Source Area

Measured Benzene Concentration Range

- 5.0 (EPA MCL) - 50 µg/L
- 50 - 500 µg/L
- 500 - 5,000 µg/L
- 5,000 - 10,000 µg/L
- > 10,000 µg/L

Kirtland AFB

N

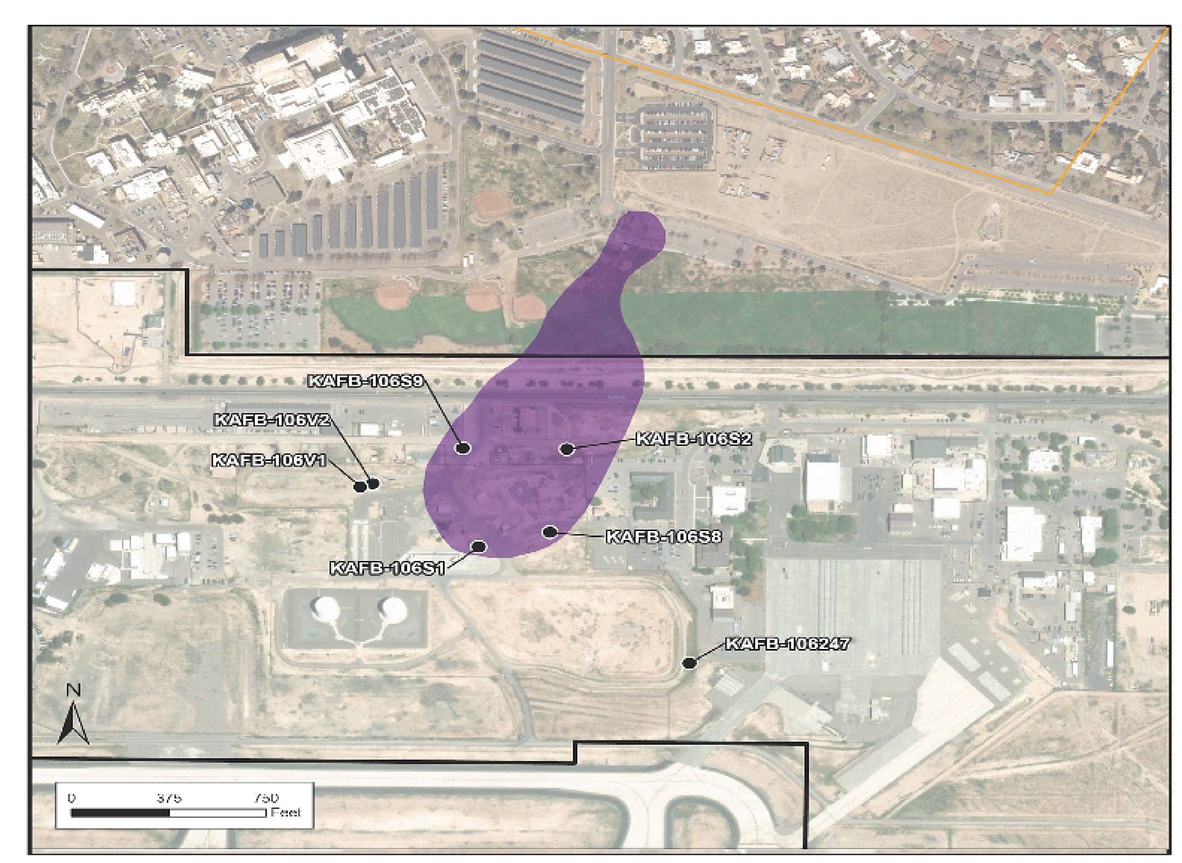
0 300 600 1,200 Feet

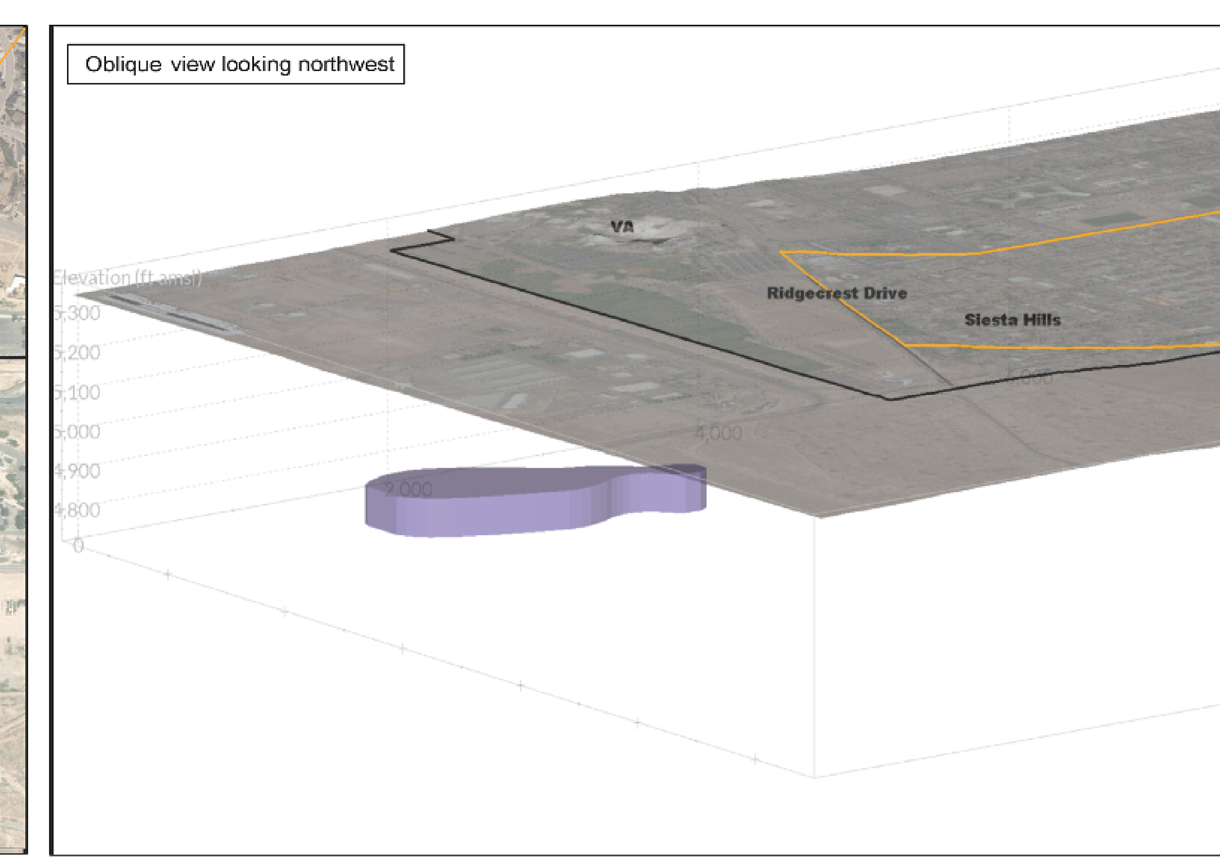
1:7,200

Projection: NAD83 State Plane New Mexico Central FIPS 3002 Feet

Notes:
Plumes depicted are at the water table, not REI.
J = denotes the analyte was positively identified, but the associated numerical value is estimated.
Unlabeled wells are non-detect for benzene.
Acronyms:
µg/L = micrograms per liter
EPA MCL = United States Environmental Protection Agency maximum contaminant level
ft = foot/feet
NA = not analyzed
ND = nondetect
Q2 = quarter 2
Q4 = quarter 4
REI = reference elevation interval

Vertical LNAPL Smear Zone





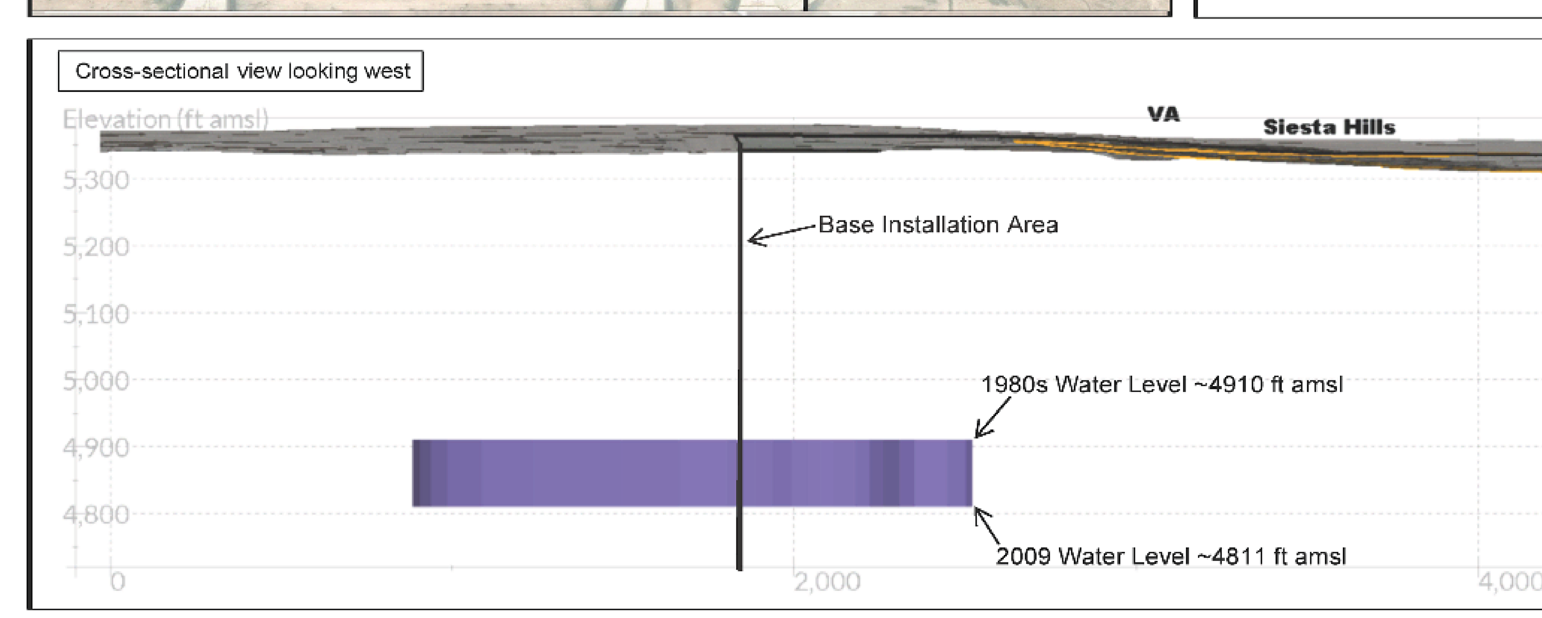


Figure 7-16

Vertical LNAPL Smear Zone Location

Legend

- Vertical LNAPL Smear Zone
- Well Location
- Kirtland Air Force Base Installation Area
- Groundwater AOI 4 (Interim Measure Operational Area)

DRAFT

Site Location

Revision Date: 12/31/2025

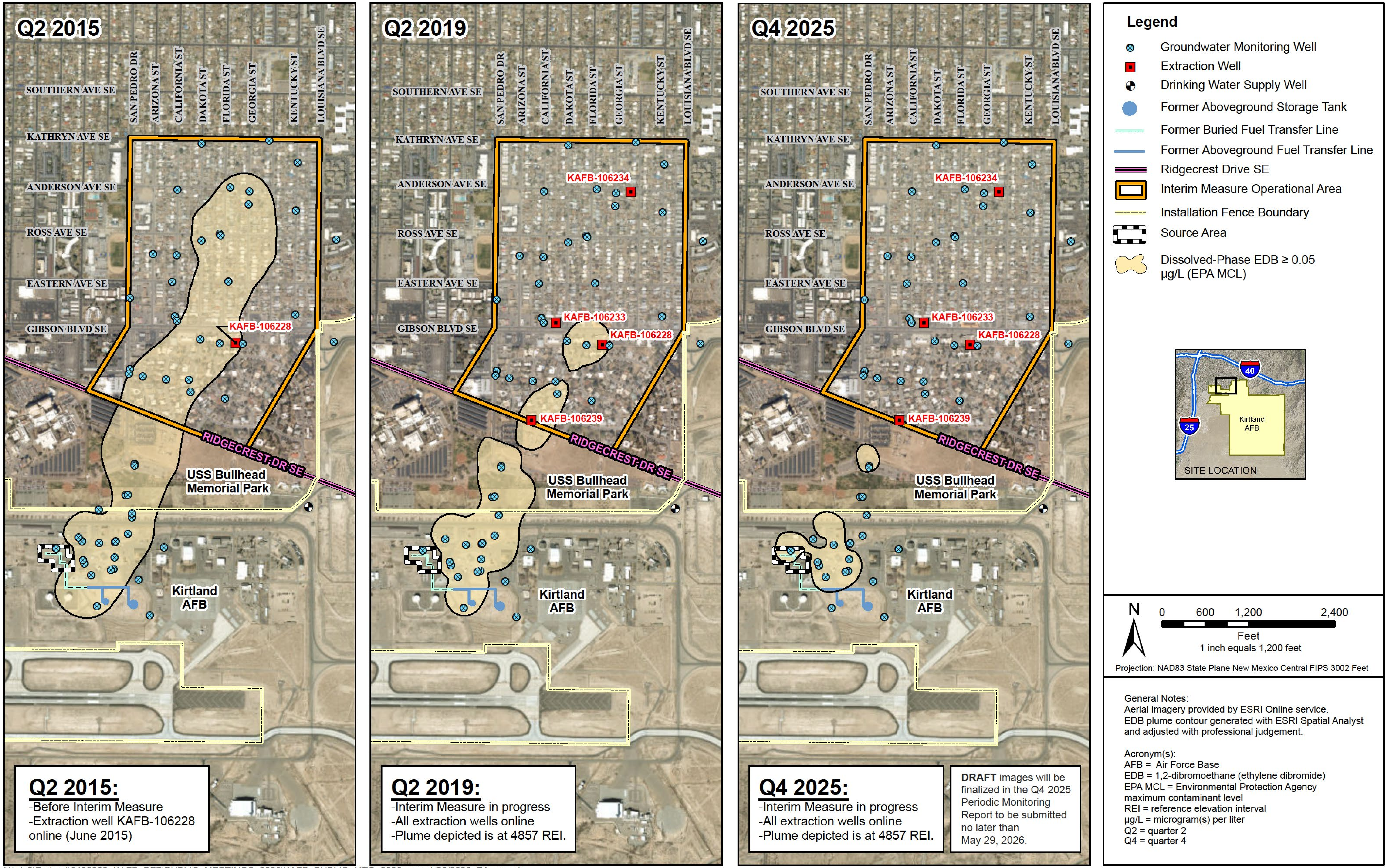
Notes

AOI - area of interest

ft amsl - feet above mean sea level

EDB Plume Footprint (over time)

Comparison of Dissolved-Phase EDB in the Interim Measure Operational Area Between Q2 2015 and Q4 2025



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Groundwater Standards for clean-up at the Bulk Fuels Facility Project

New Mexico Environment Department (NMED) Promulgated Standard for Groundwater Cleanup

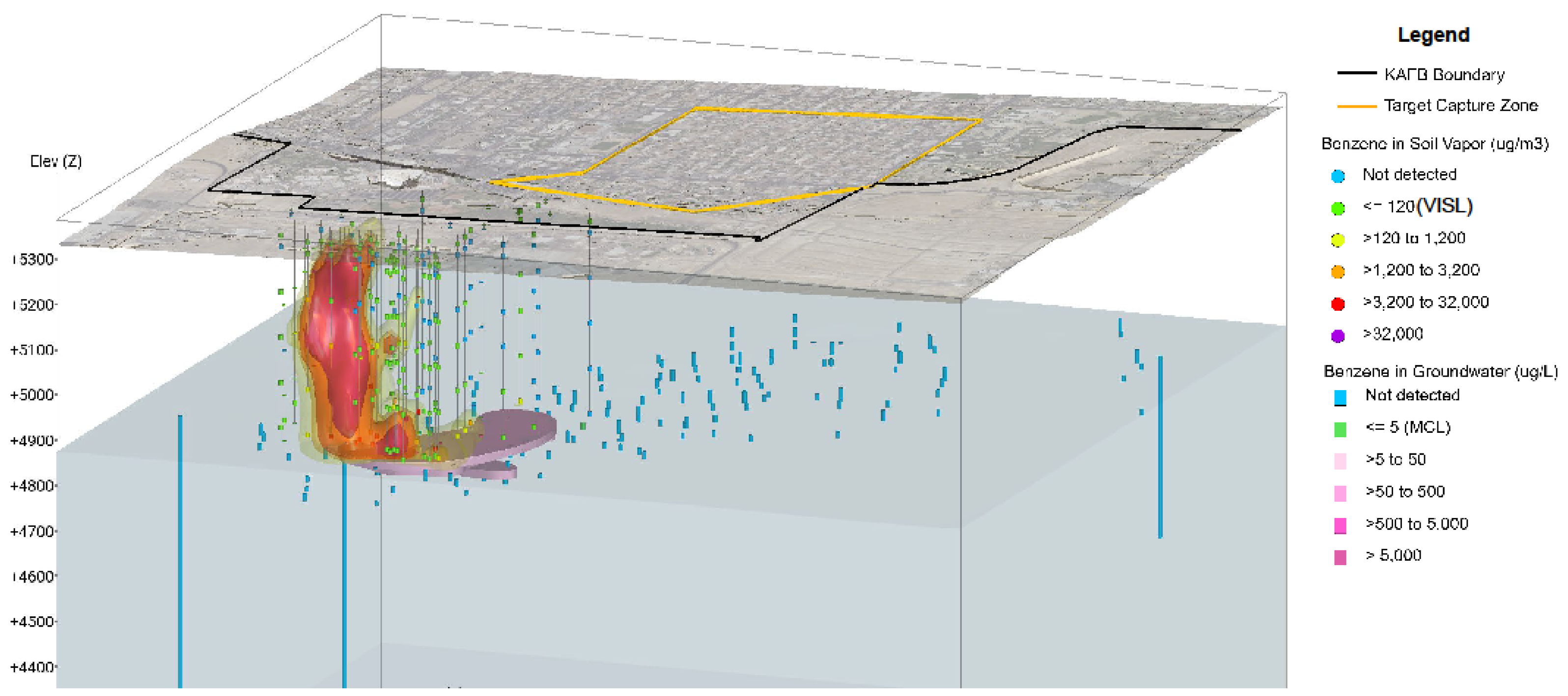
- NMED regulates groundwater at Kirtland AFB with the Resource Conservation and Recovery Act Permit:
- The Permit requires the cleanup levels for groundwater shall be the New Mexico Water Quality Control Commission (WQCC) water quality standards and the drinking water Maximum Contaminant Levels (MCLs) adopted by Environmental Protection Agency (EPA) under the Federal Safe Drinking Water Act.
- If both a WQCC standard and a MCL have been established for a contaminant, then the most stringent of the two levels shall be the cleanup level for that contaminant."

Uses of the Safe Drinking Water Act standard (MCLs)

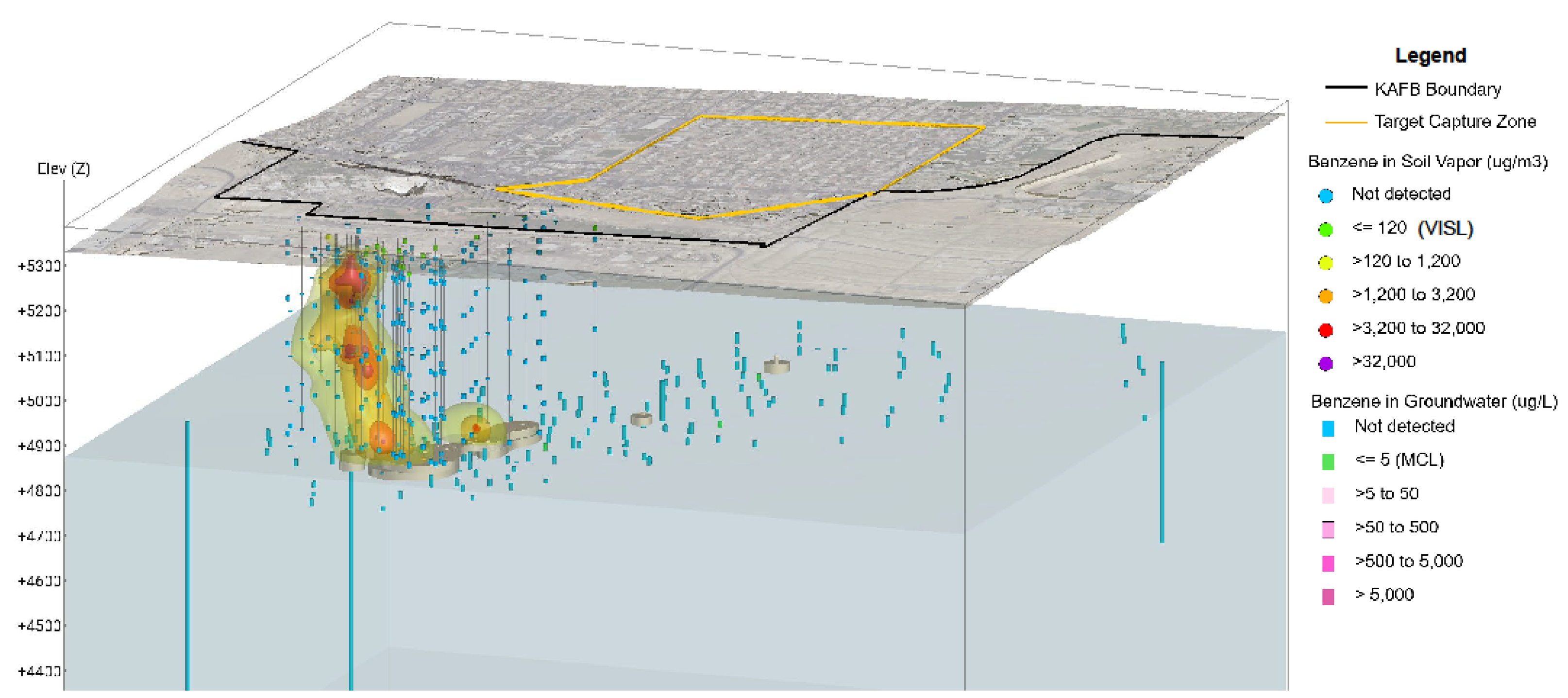
- Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. Thus, MCLs are used locally and nationally to ensure that tap water is safe to drink. MCLs limit the amount of certain contaminants in water provided by public water systems.
- MCL uses for restoration (clean-up) activities
  - Delineate the groundwater contamination: show the entire area of groundwater that is at or above the Safe Drinking Water Act Standard
  - Objectively quantify risk to drinking water supply
  - Target contamination above these standards with remedial technologies
  - Demonstrate if a site can be clean closed or requires additional corrective actions

Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report Submitted to NMED on April 30, 2025 and Revisions Submitted to NMED on January 30, 2026.

Quarter 4 2023 Benzene
Soil Vapor and Groundwater Plumes



Quarter 4 2023 1,2-Dibromoethane (EDB)
Soil Vapor and Groundwater Plumes



Draft images will be finalized in the Phase II RFI Report to be submitted no later than April 30, 2025

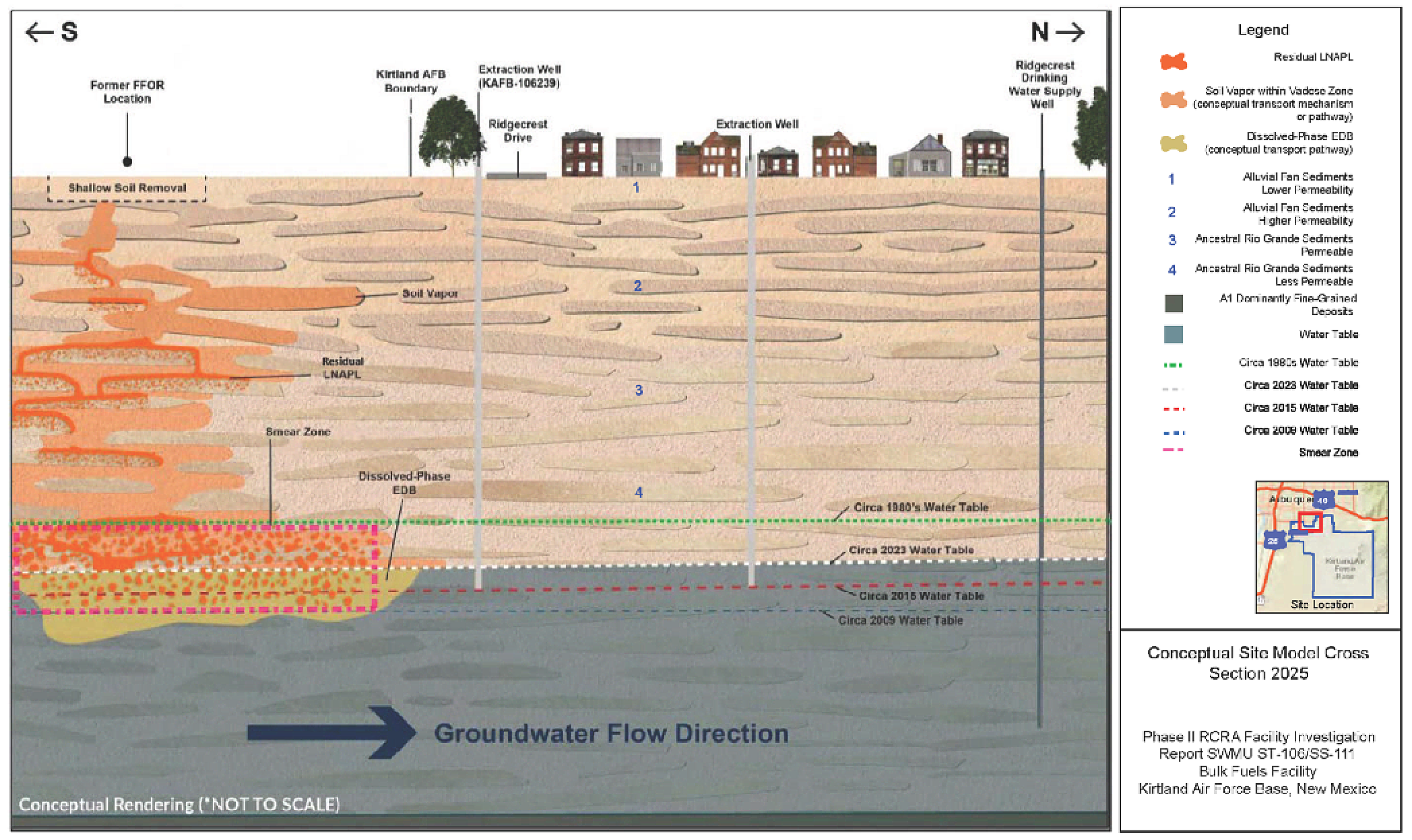
PHASE II RFI REPORT OBJECTIVES

- Conclude the investigation phase by refining the nature and extent of contaminants of potential concern (COPCs) to the degree necessary to evaluate remedies in a Corrective Measures Evaluation (CME).
- Address the two data gaps detailed in the Phase I RFI Report (2018):
  - *Light non-aqueous phase liquid (LNAPL): Due to the rising groundwater levels, it is unclear how much and where the LNAPL remains vertically smeared beneath the water table, how weathered the existing LNAPL is, and how that may be contributing to the dissolved contamination in the groundwater.*
  - *Groundwater: Changes in dissolved-phase concentrations and apparent configuration could be influenced by the rising water table...*

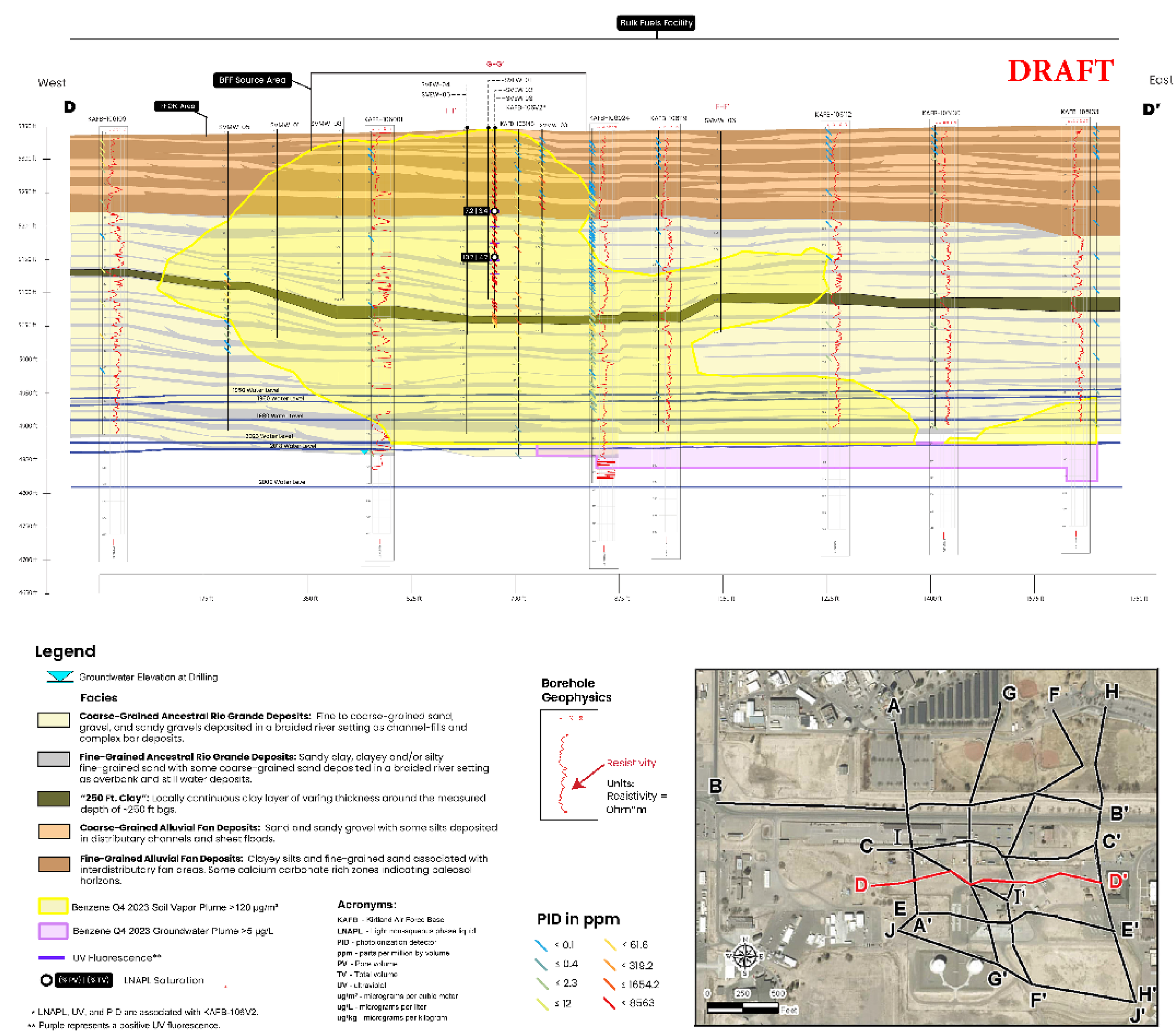
PHASE II RFI REPORT CONCLUSIONS

- Phase I RFI Data Gaps Addressed:
  - LNAPL addressed with eight years of soil vapor monitoring (SVM), and groundwater monitoring (GWM), results of 10 soil corings in source area, and 32 LNAPL gauging events
  - Shallow Groundwater: addressed with 22 shallow groundwater monitoring wells installed; continued refinement with 2 additional proposed monitoring wells
- Phase II RFI supports the Phase I RFI evaluations/conclusions. Nature and extent of groundwater and soil vapor COPCs were refined since the Phase I RFI Report with:
  - 23 newly installed nested groundwater monitoring wells (GWMWs)
  - 11 newly installed nested soil vapor monitoring wells (SVMWs)
  - 32 GWM events and 18 SVM events were conducted and presented in the Phase II RFI Report
- Phase II RFI updated conceptual site model and is consistent with Phase I RFI conceptual site model

Updated Conceptual Site Model 2025



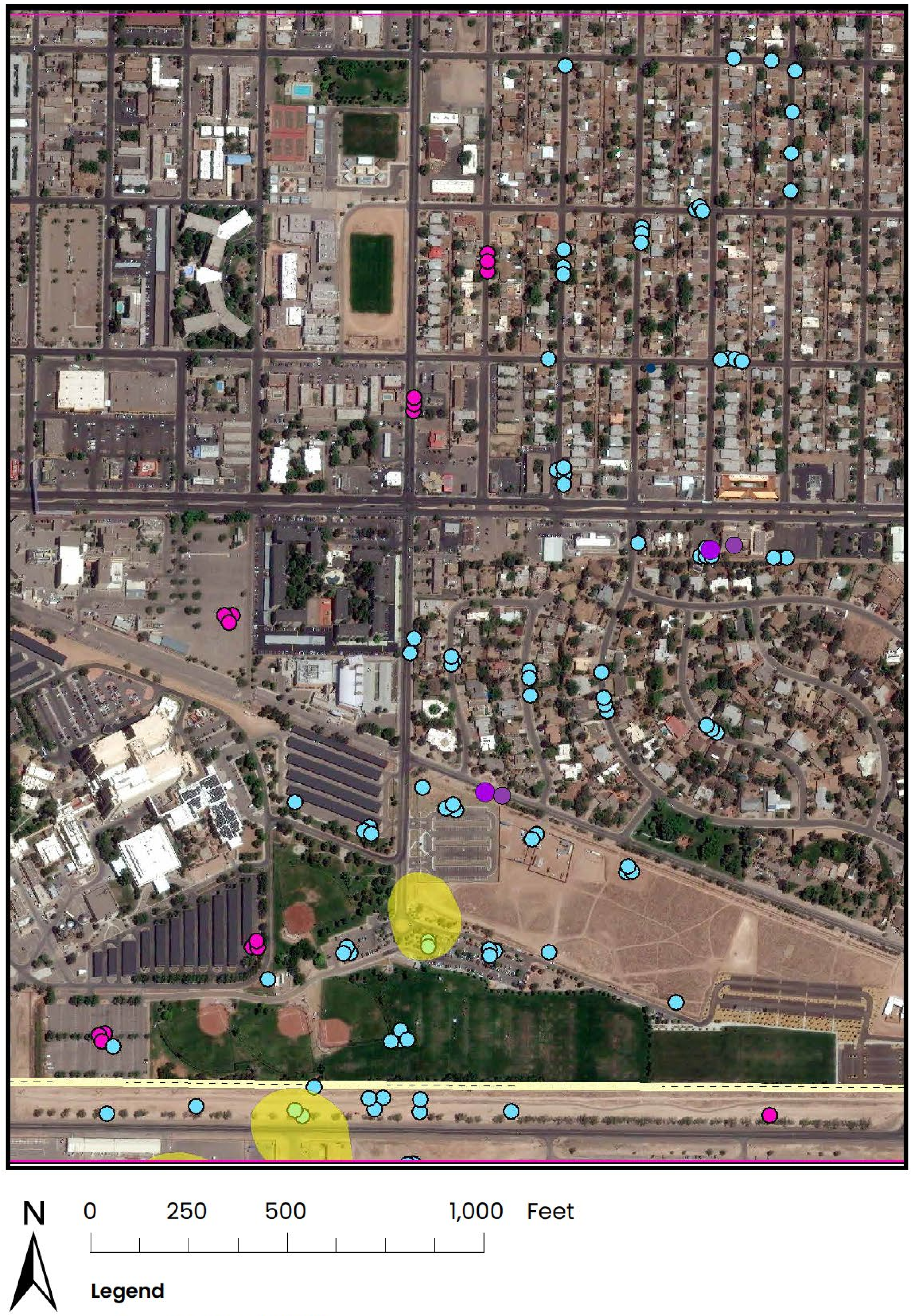
Cross Section D-D' with Benzene Soil Vapor and Groundwater Plume Shells



PHASE II RFI REPORT RECOMMENDATIONS

1. Continue GWM and SVM and the groundwater treatment system interim measure to control the migration of the dissolved-phase contaminant plume.
2. Collect and analyze additional LNAPL samples when sufficient quantities are present.
3. Install additional step-out wells as needed in the future due to changing groundwater gradients, the rising water table, or other changes to site conditions throughout the corrective action process. These additional step-out wells will not impact the evaluation of remedies.
4. Upon NMED's anticipated concurrence that the data presented defines the nature and extent of contamination to the degree necessary to inform the CME, conclude the investigation phase and begin the corrective measure evaluation phase.

The Kirtland Bulk Fuels Facility Leak: A Conceptual Model

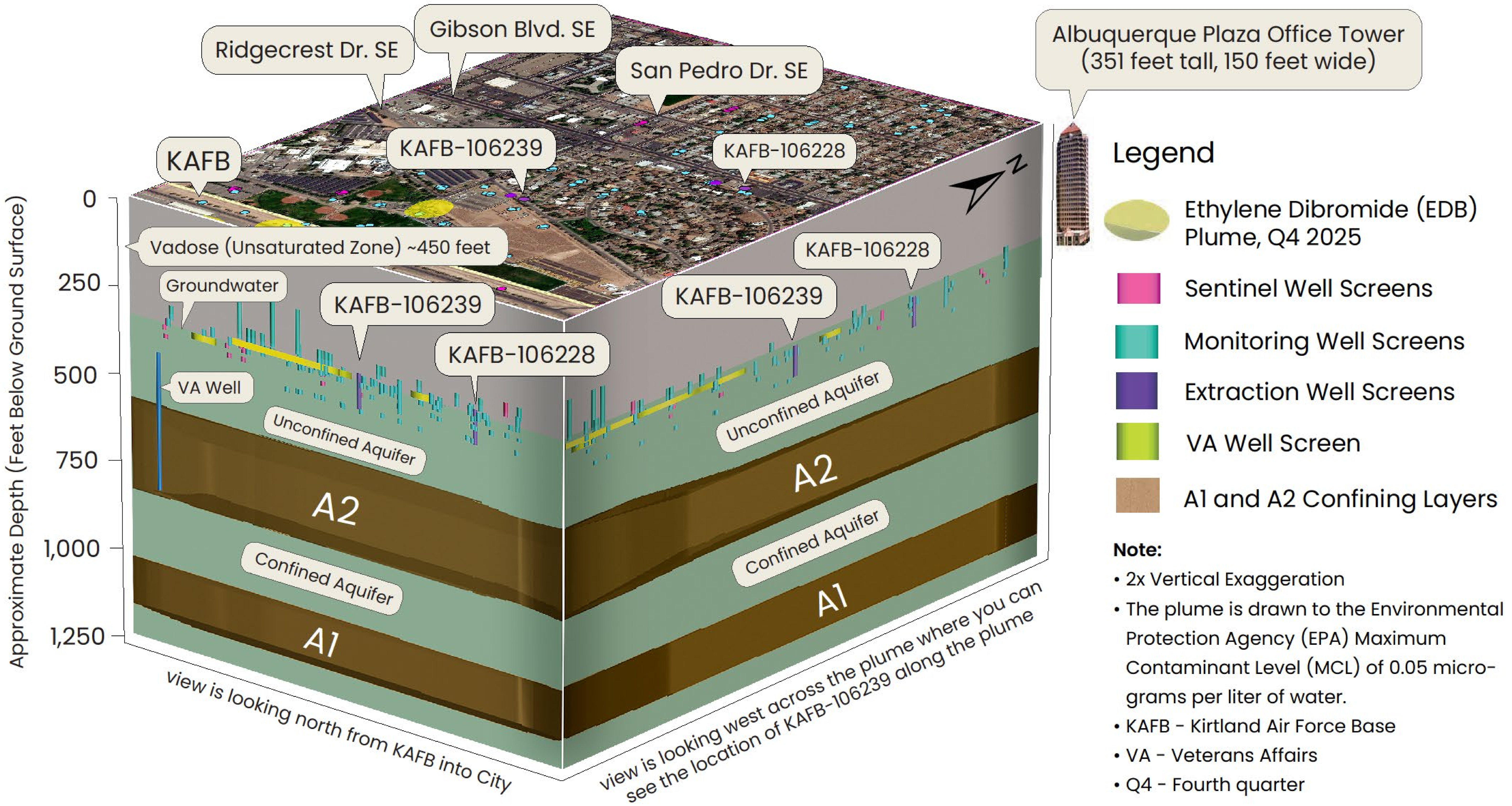


Note:
- VA Well location not shown.
- The plume is drawn to the Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 0.05 micrograms per liter of water. Plume data from Q4 2025

Key Elements to Monitor and Protect Our Water Supply

- VA drinking water is sampled on a monthly basis since March 2006 to present. No EDB contamination has been detected in any monthly drinking water sample. All sample results have met drinking water standards.
- Sentinel wells, installed between 2014 – 2016, are located between the plume and the VA drinking water well to provide an "early warning system." No EDB contamination has been detected in any quarterly water sample. All sample results have met drinking water standards.
- Monitoring wells between the plume and the VA drinking water well are sampled multiple times each year and are used to identify horizontal and vertical plume boundaries.
- Groundwater flow is generally to the east, away from the VA drinking water well.
- A2 and A1 are "confining layers" of soil in deep groundwater. These layers provide a natural barrier for drinking water wells that are screened below these non-permeable layers.

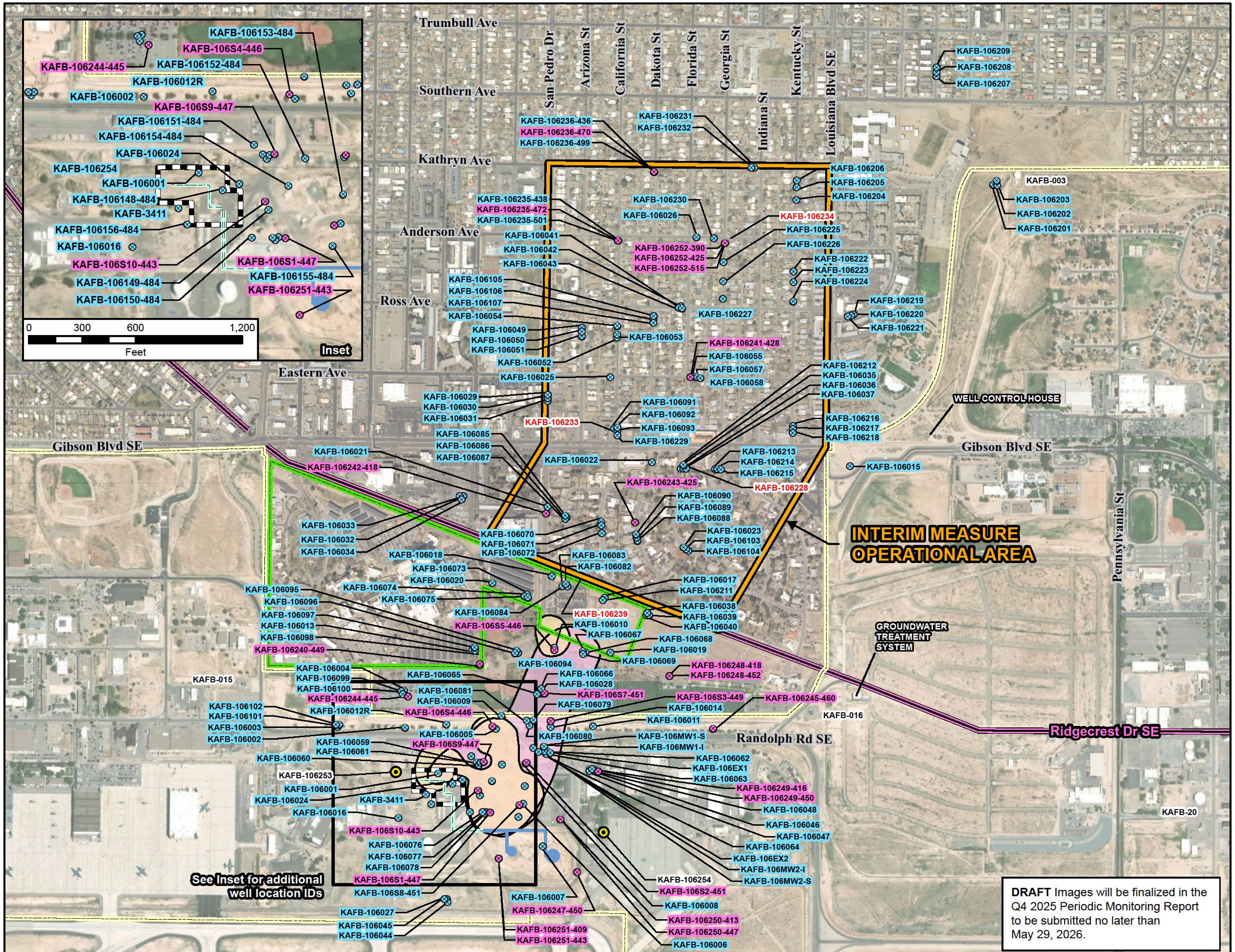
Note: Block diagram (below) is represented in 2x exaggeration to help show plume thickness.



Note:
- 2x Vertical Exaggeration
- The plume is drawn to the Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 0.05 micrograms per liter of water.
- KAFB - Kirtland Air Force Base
- VA - Veterans Affairs
- Q4 - Fourth quarter

DRAFT Image will be finalized in the Q4 2025 Periodic Monitoring Report to be submitted no later than May 29, 2026.

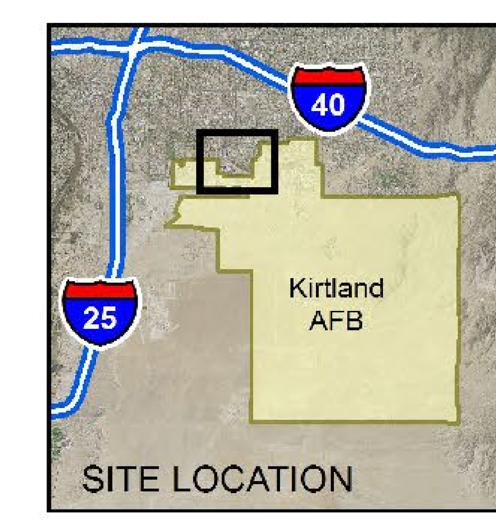
Proposed and Current Groundwater Monitoring Wells



DRAFT Images will be finalized in the Q4 2025 Periodic Monitoring Report to be submitted no later than May 29, 2026.

Legend

- Groundwater Monitoring Well
- Groundwater Monitoring Well Installed within the past 10 years
- Proposed Groundwater Monitoring Well
- Drinking Water Supply Well
- Extraction Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Ridgecrest Drive SE
- Interim Measure Operational Area
- Installation Fence Boundary
- Source Area
- VA Boundary
- EDB Plume Q4 2025 (> 0.05 µg/L) depicted at REI 4857
- Benzene Plume Q4 2025 (> 5.0 µg/L) depicted at REI 4857
- KAFB-106203 Groundwater Monitoring Well Identifier
- KAFB-106203 Groundwater Monitoring Well Installed within the past 10 years Identifier
- KAFB-106234 Extraction Well Identifier
- KAFB-106253 Proposed Well Identifier



N

0 500 1,000 2,000
Feet
1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS 3002 Feet

Notes:
The Interim Measure Operational Area is located north of Ridgecrest Drive SE and contains four extraction wells. These wells are designed to hydraulically control the distal portion of the dissolved-phase EDB plume. The source area plume is located to the south of Ridgecrest Drive SE.
Aerial Imagery: ESRI service layer (MRCOG-NM, NHI, BernCo GIS, Maxar).
Drinking water supply well ST106VA2 is not shown on this figure per request of the Raymond G. Murphy Veterans Affairs Medical Center.
AFB = Air Force Base
EDB = 1,2-dibromoethane (ethylene dibromide)
Q4 = quarter 4
REI = reference elevation interval
SE = southeast
VA = Veterans Affairs
ID = identification

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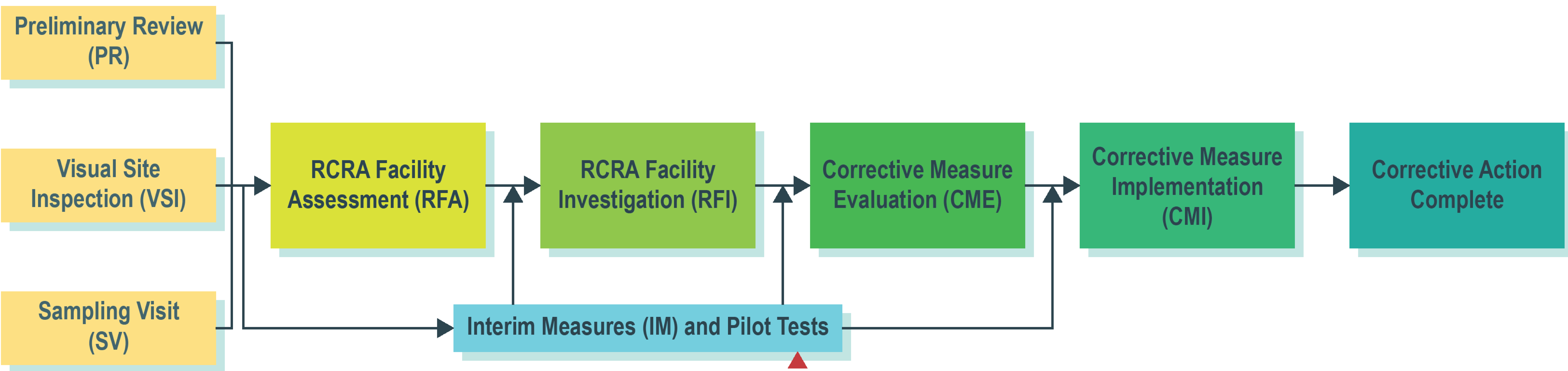
RCRA Corrective Action Process



- Installed over 240 groundwater and soil vapor monitoring wells.
- Collected over 11,000 groundwater, soil vapor, groundwater treatment plant and drinking water samples since 2016.

- Soil Excavation - Approximately 4,786 tons of contaminated soil removed (3,000 cubic yards).
- Soil Vapor Extraction - Approximately 775,000 equivalent gallons of fuel removed.
- Pump and Treat - Over 2,000,000,000 gallons of groundwater treated.

WE ARE HERE

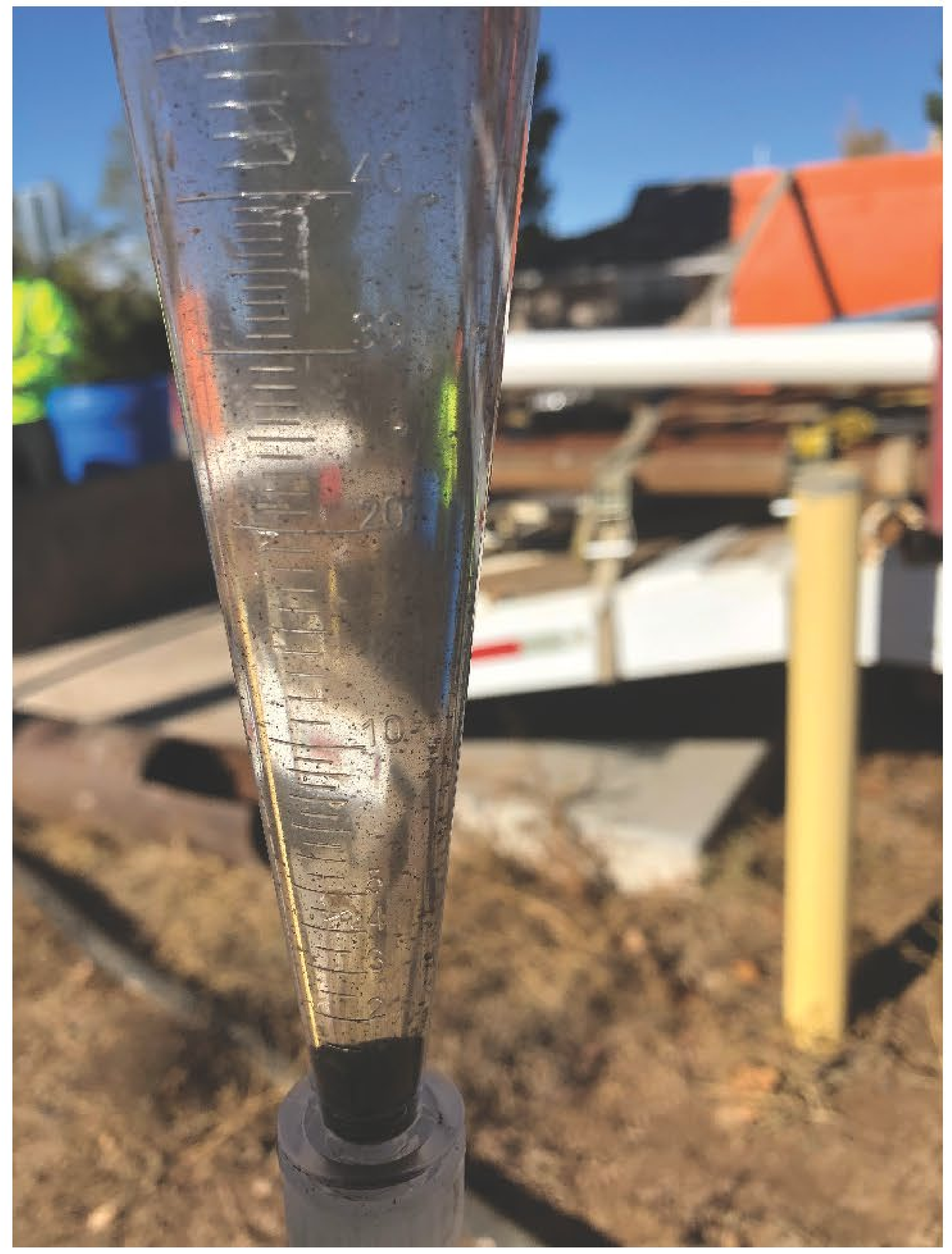
Current Step:
RFI: The goal is to collect sufficient investigatory data to define the nature and extent of contamination for all impacted media to the degree necessary to inform the final remedy selection.

Next Step:
CME: The goal is to utilize RFI data collected to evaluate multiple remedial technologies for regulatory review and selection.
Then the regulator selects a proposed remedy or remedies, seeks public comment, and addresses public comments. Then the final remedy/remedies will be selected for implementation.

*Image adapted from California Department of Toxic Substances Control (https://dtsc-topock.com/resource-conservation-and-recovery-act)

Recent Field Work

Extraction well KAFB-106239 turbidity after initial three bails



Extraction well KAFB-106239 final turbidity

Passive samplers wedged in KAFB-106S2 (photo from downhole camera)

Passive samplers successfully removed

Golf course main pond tumbleweed removal

KAFB-106024 failed pump removal

Extraction well KAFB-106239 rehabilitation

Removing the failed pump in KAFB-106024

Q2 gauging well

Sampling Comparison Study

- In July 2025, NMED issued an approval with modifications for the Groundwater Sampling Method Comparison Study Supplemental Investigation Work Plan
- Objective is to compare trends between passive and low-flow groundwater sampling methodologies
- Groundwater samples are collected concurrently from KAFB-106S2-451, KAFB-106S5-446, KAFB-106S7-451, and KAFB-106089 using both passive and low-flow sampling methods
- Eight quarters of comparison study sampling began in Q3 2025. Preliminary data collected prior to NMED approval using the same methods will be used to supplement the study
- The analytical data obtained from this sampling method comparison study will be used to compare trends between passive and low-flow sampling methods at the Bulk Fuels Facility Site

ASTM D7929-20 Section X3.1.1 Procedure	Supplemental Investigation Work Plan Section 5.4 Procedure	Variation
Passive sampler and pump deployed	Passive sampler and pump deployed simultaenously	No difference.
Passive sampler is fully submerged and left in the well for the proper equilibration period prior to sampling	Passive sampler is fully submerged and left in the well for the proper equilibration period prior to sampling (at least 14 days)	No difference.
Samples collected from the same depth	Passive samples collected below the pump inlet depth	Due to the well casing diameter, the pump and passive samplers cannot be placed at the same depth at the same time. Passive samplers will be hung 0.2 feet below the pump, minimizing the difference in depth.
Avoid disturbance to the water column when removing the passive sampler	Low-flow sample collected prior to passive sample to minimize disturbance to the water column	Due to the depth to groundwater at this site (approximately 450 ft bgs), it is difficult to install or remove equipment without significantly disturbing the water column. To eliminate the risk of disturbing the water column, the entire sampling assembly will be installed prior to the passive sampling equilibration time, and will not be removed until after low-flow sampling is complete.
Collect passive sample prior to pumped sample	Low-flow sample collected prior to passive sample	Because the passive samplers will be hung below the pump, they cannot be retrieved without also removing the pump. To minimize disturbance to the water column, low-flow samples will be collected first and then the entire sampling assembly will be retrieved to collect passive samples.

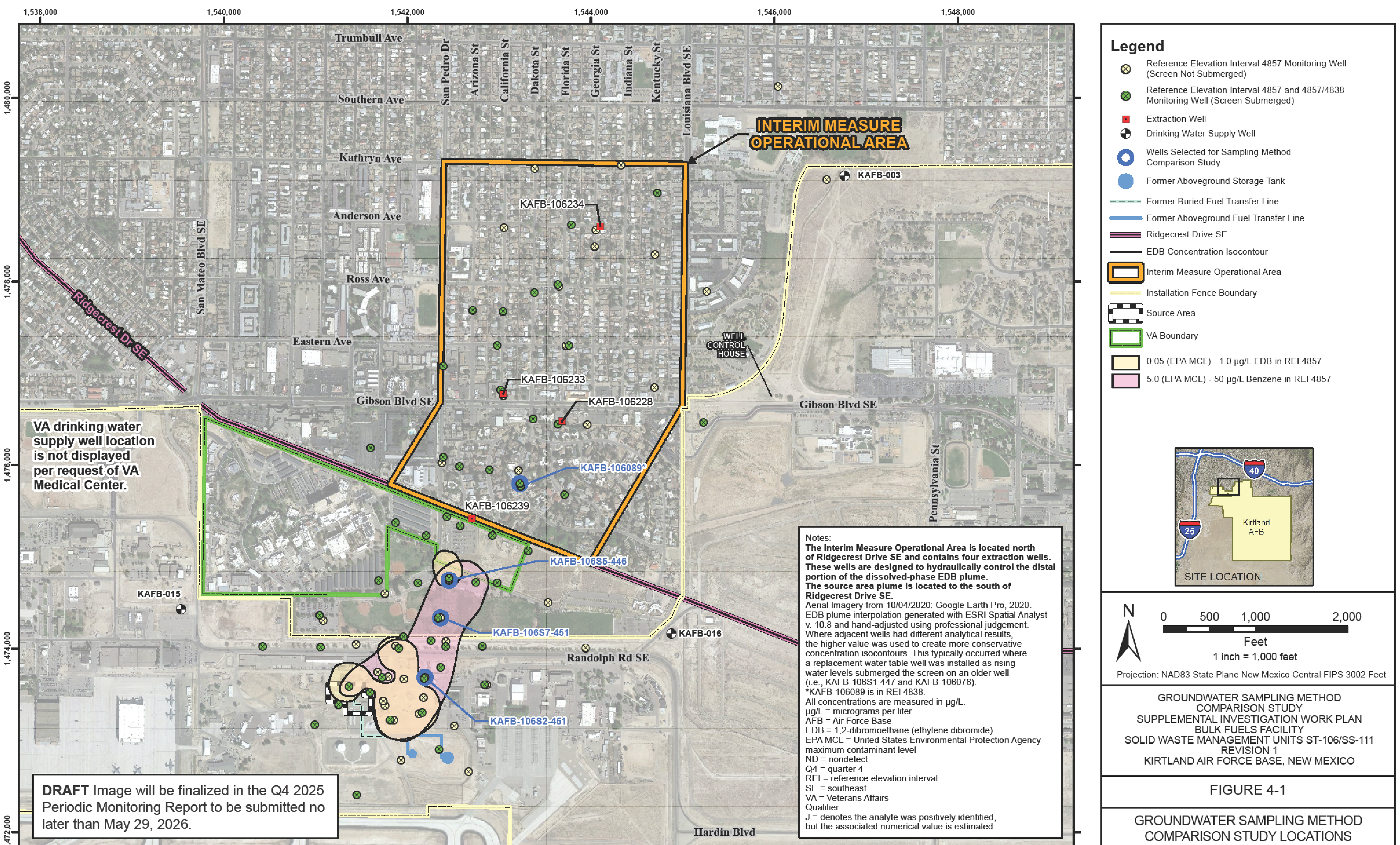
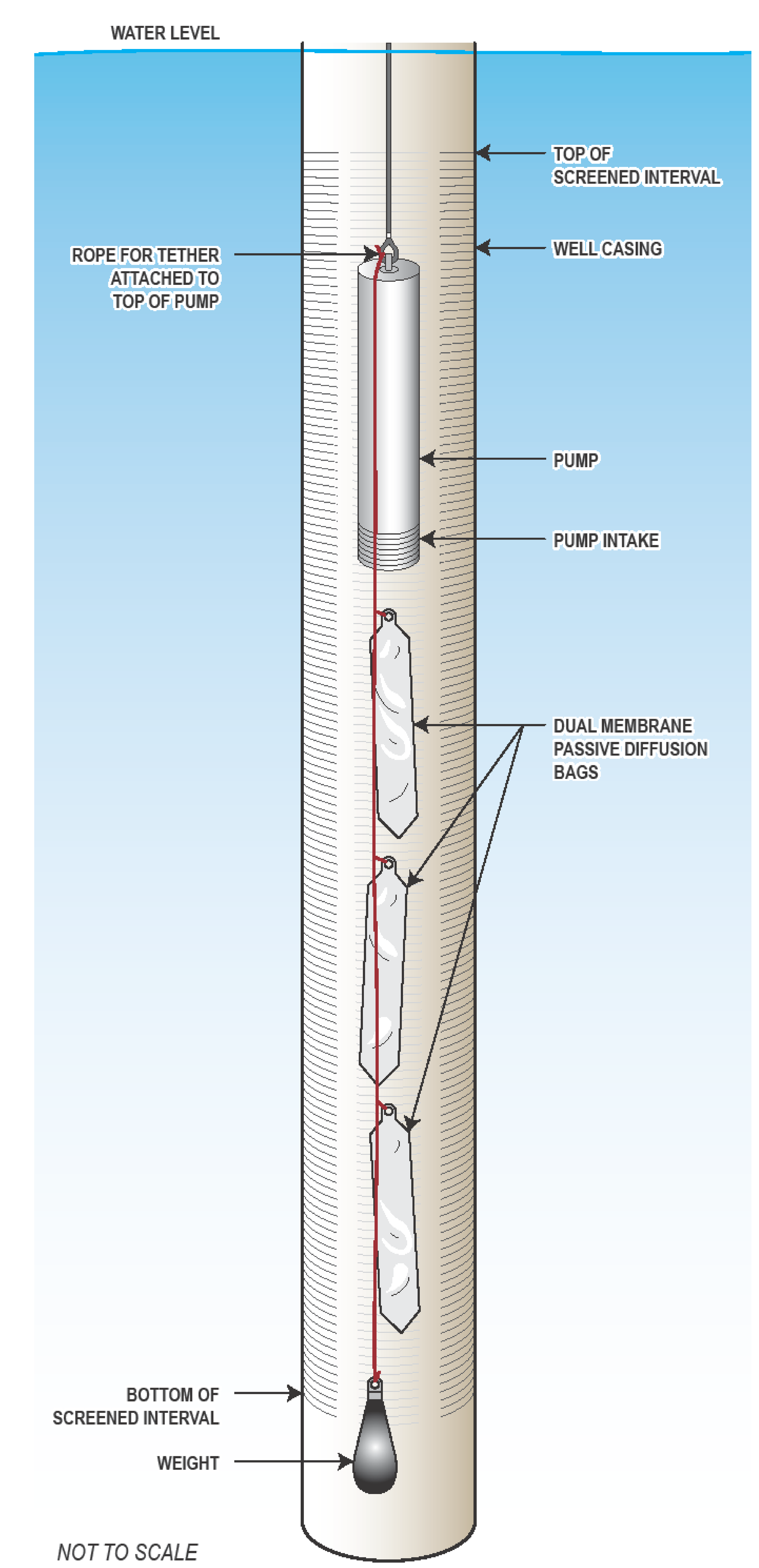


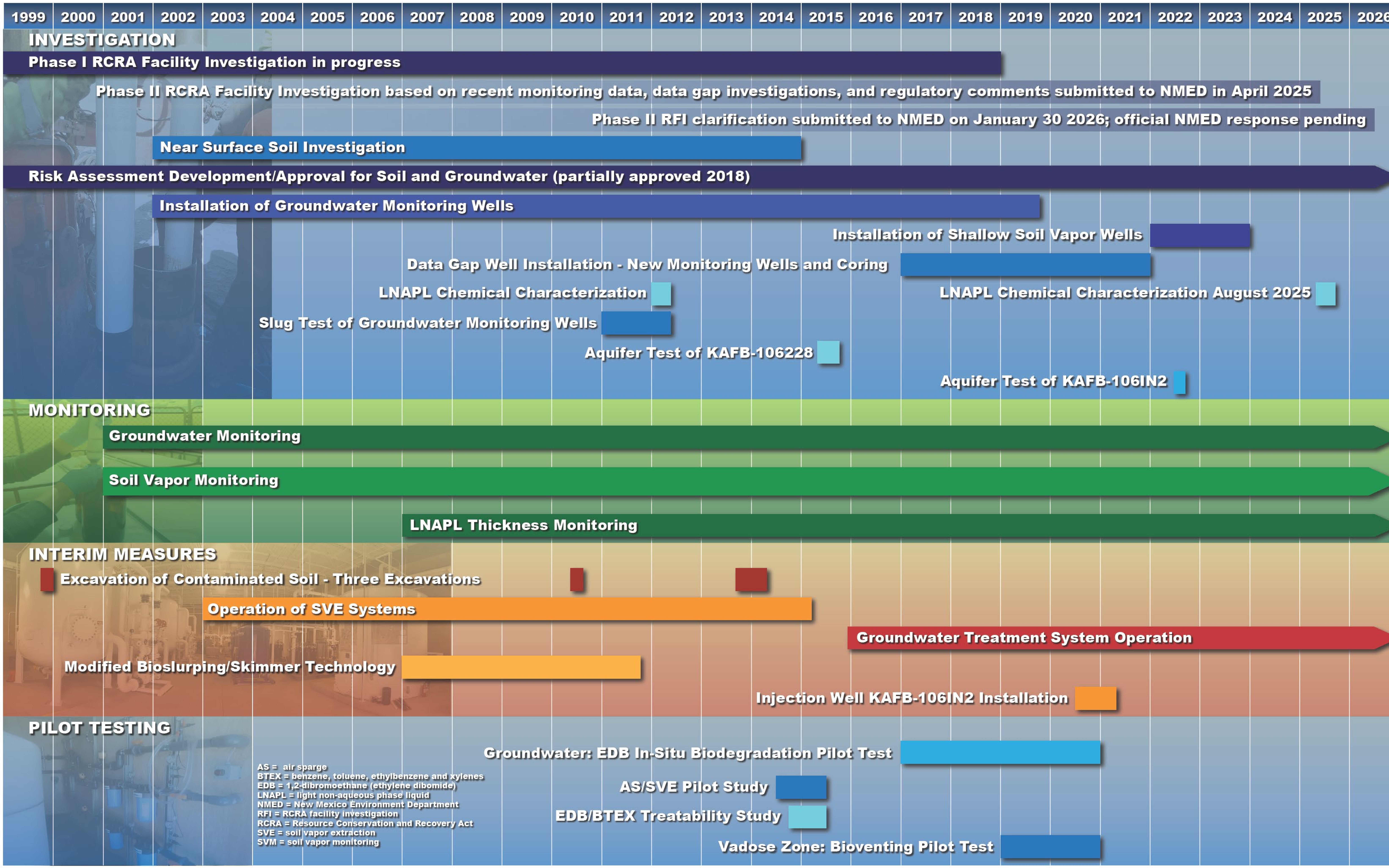
FIGURE 4-1

GROUNDWATER SAMPLING METHOD COMPARISON STUDY LOCATIONS



Sampling Assembly

Site Activity Timeline



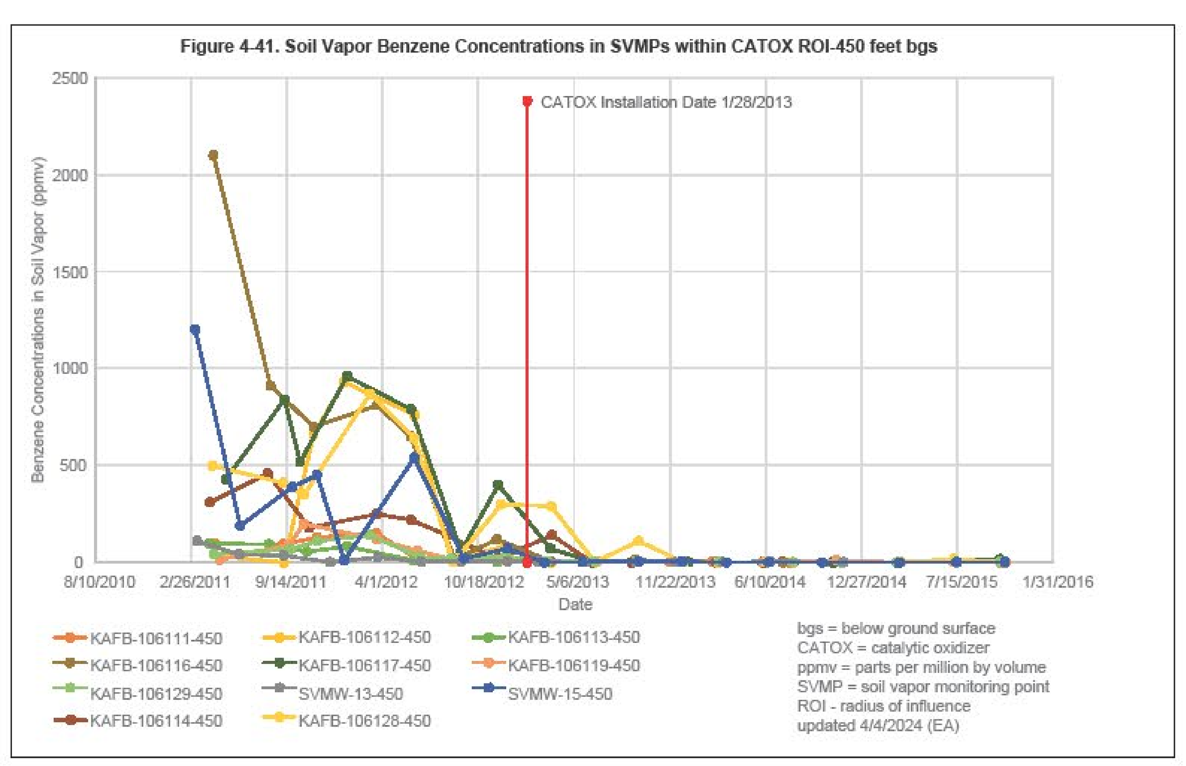
Soil Vapor Extraction (SVE) and Vadose Zone Interim Measure (IM) Summary

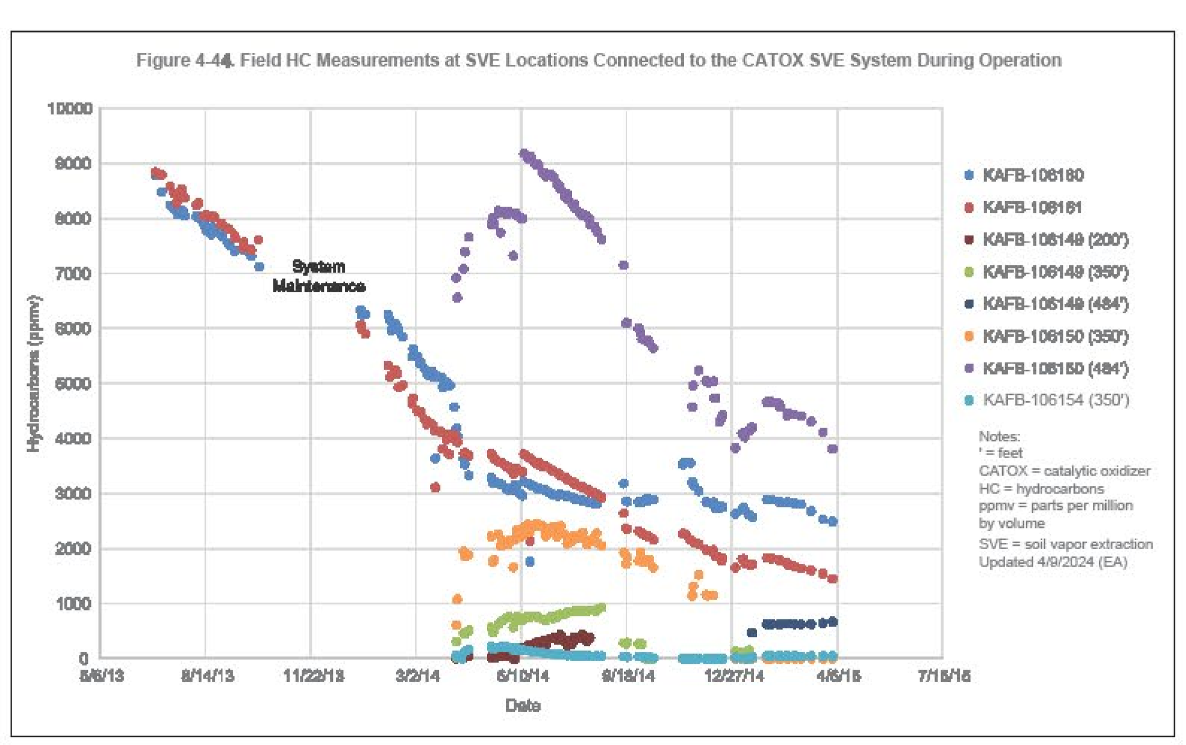
Several forms of IM performed between (2003-2015)

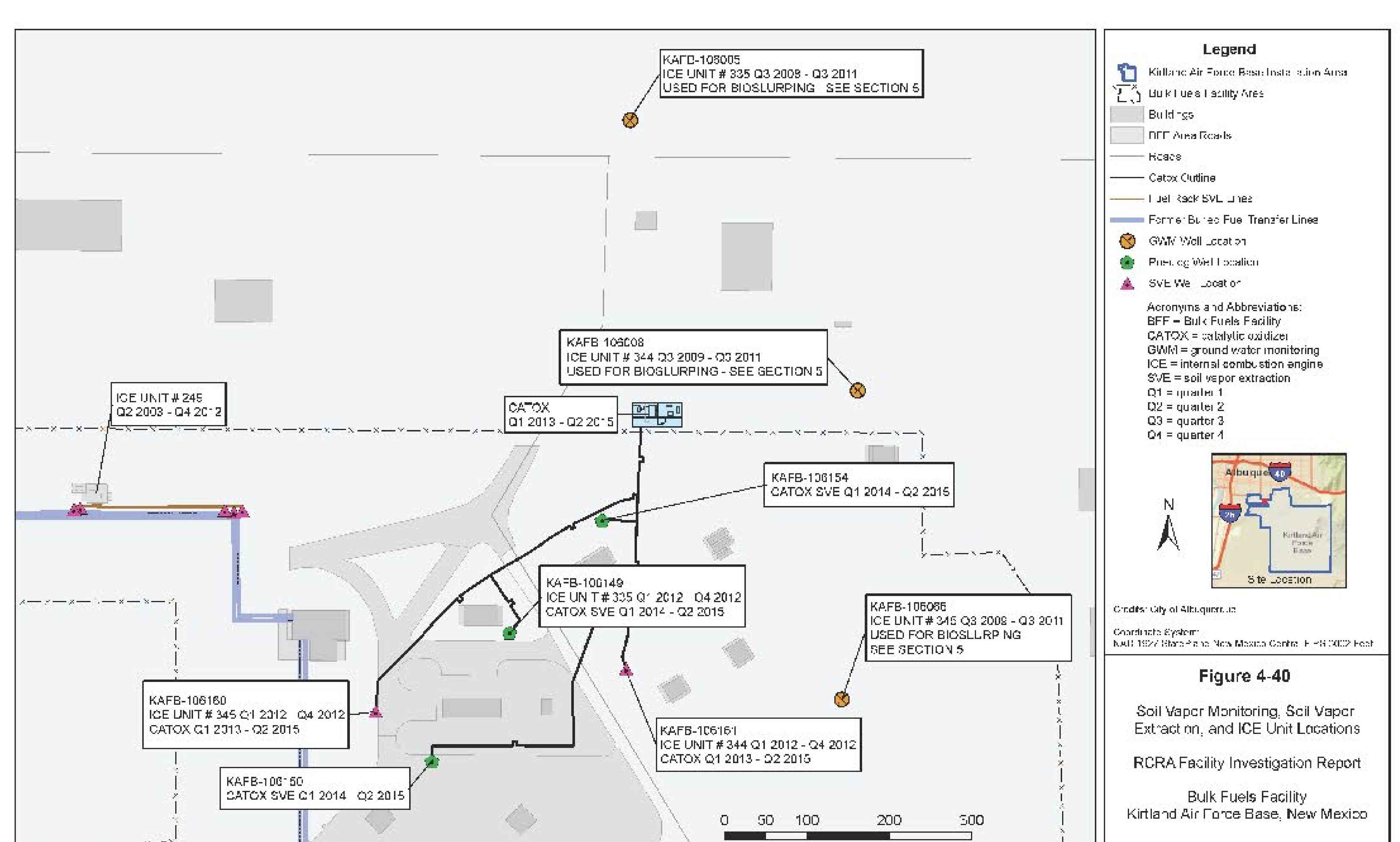
- Internal combustion engine (2003-2012; targeted where fuel was released)
- Skimmer pumps (2007-2008; following the first discovery of fuel at the water table in 2007; 280 gallons removed)
- Modified Bioslurping (2008-2011; targeted fuel at the water table)
- Catalytic oxidizer (2013-2015; utilized five SVE wells across vadose zone)
- 567,050 equivalent gallons of fuel removed from vadose zone through bioslurping and SVE
- 209,000 gallons of fuel biodegraded due to SVE operation
- On October 21, 2015, during a technical working group meeting attended by Air Force, NMED, and other stakeholders, it was decided to deactivate the CATOX SVE due to low vapor recovery and high supplemental fuel consumption
- Since SVE shutdown, semi-annual soil vapor monitoring has been conducted to define the nature and extent of soil vapor contamination under steady-state conditions
- SVE technologies will be evaluated in the CME Phase

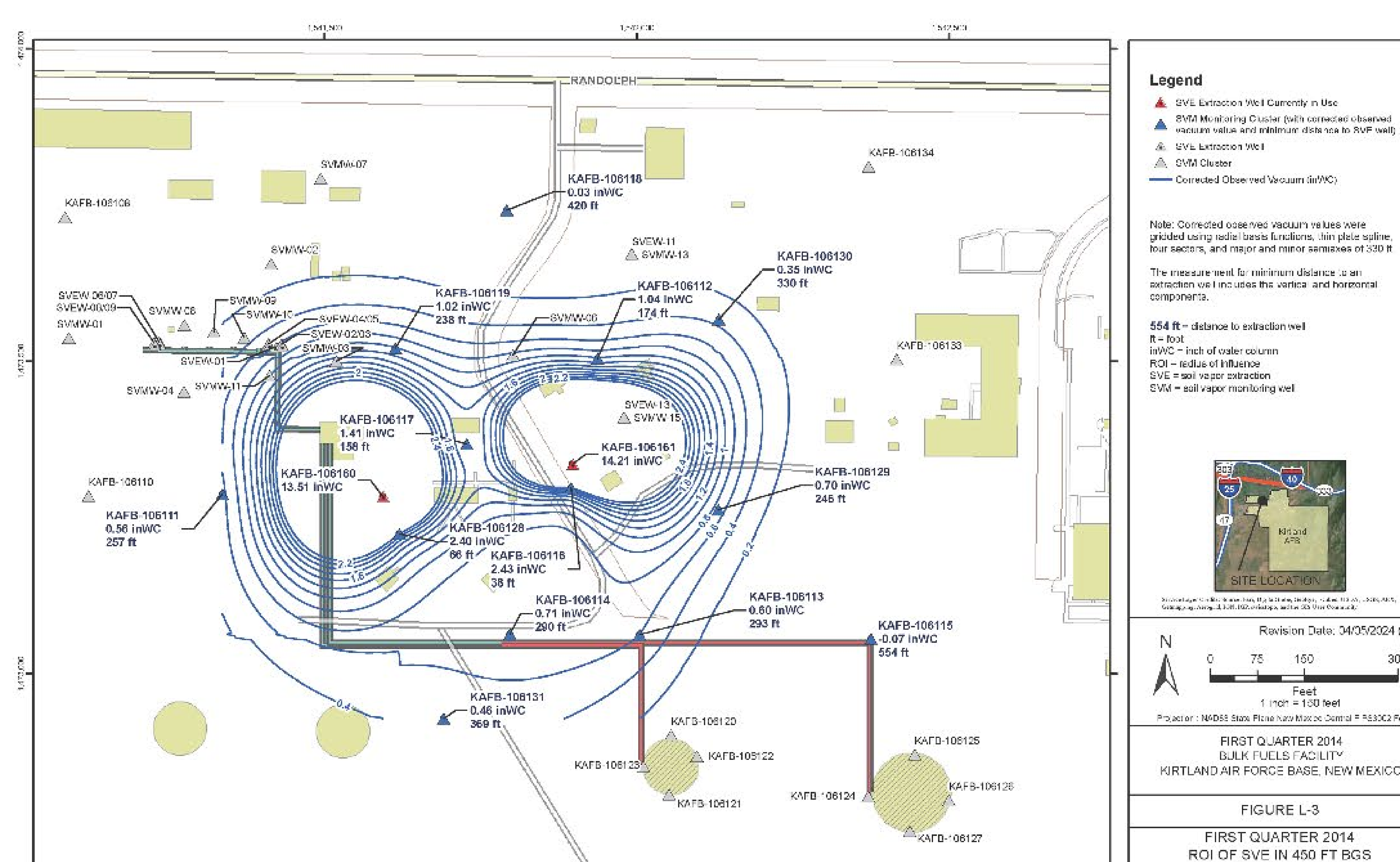
Approximately 775,000 equivalent gallons of fuel removed due to SVE, skimmer pump, and bioslurping.

The results of this interim measure will be evaluated during the corrective measures evaluation to determine the feasibility of this remedial technology for full scale implementation.

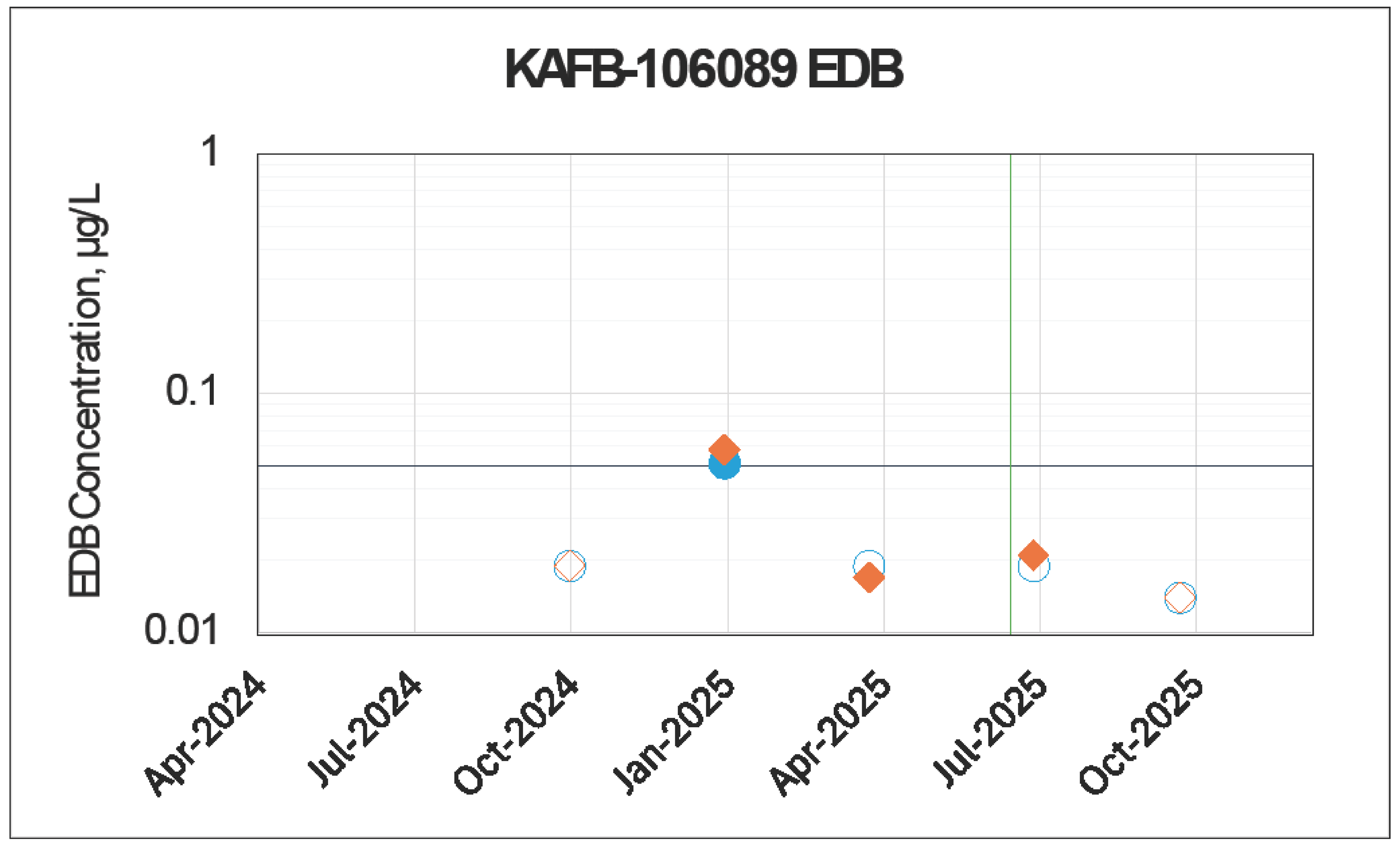


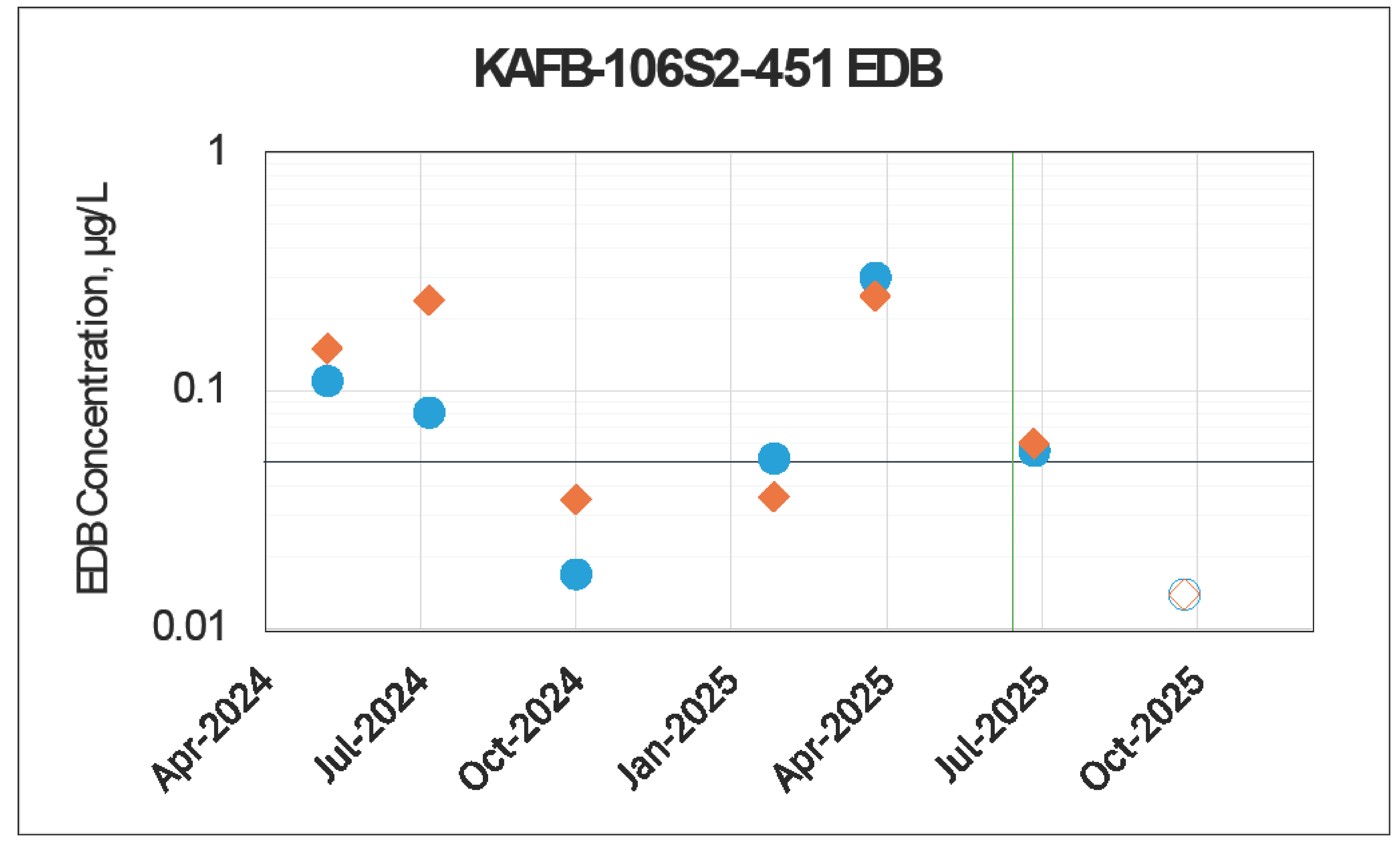


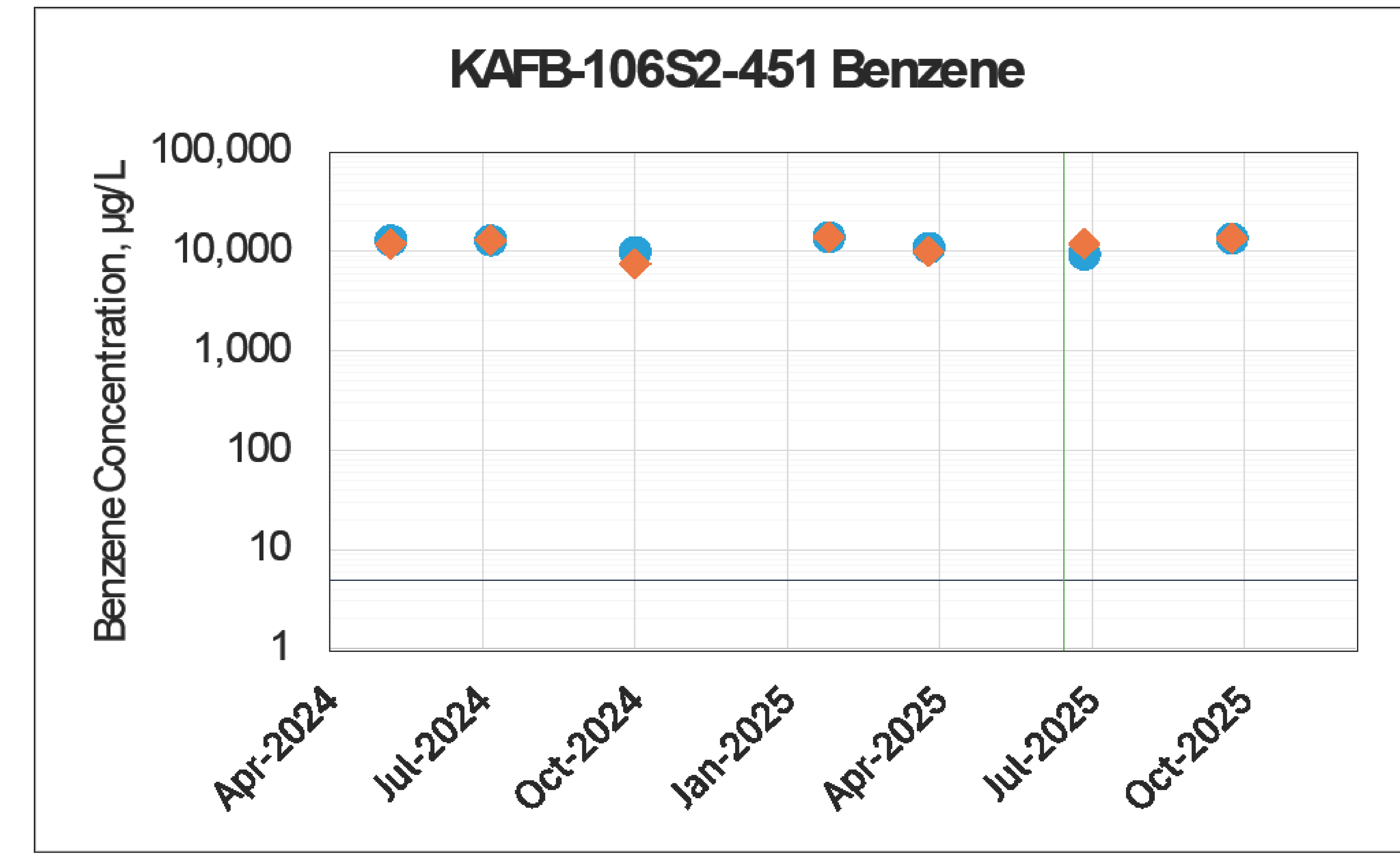


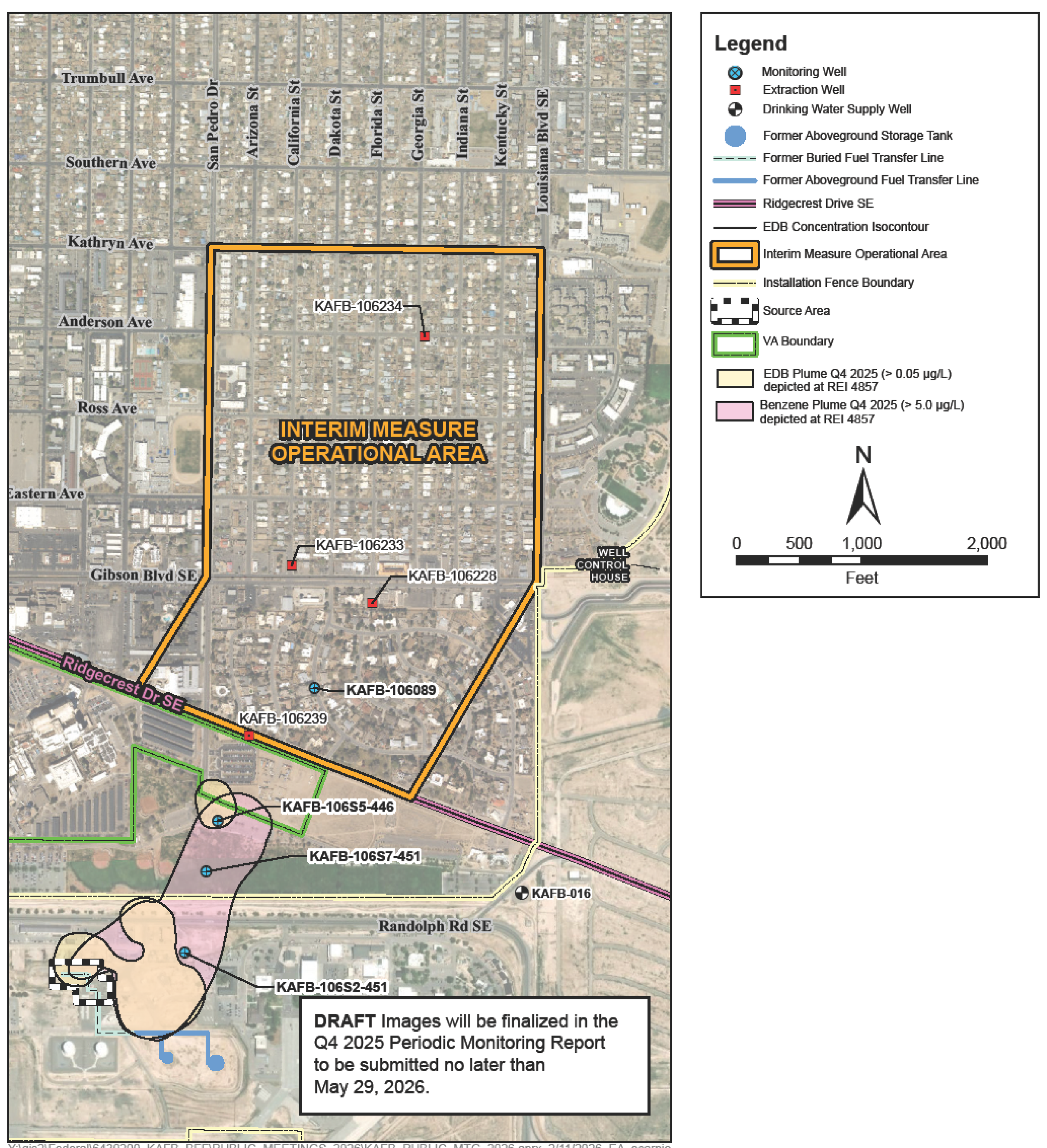


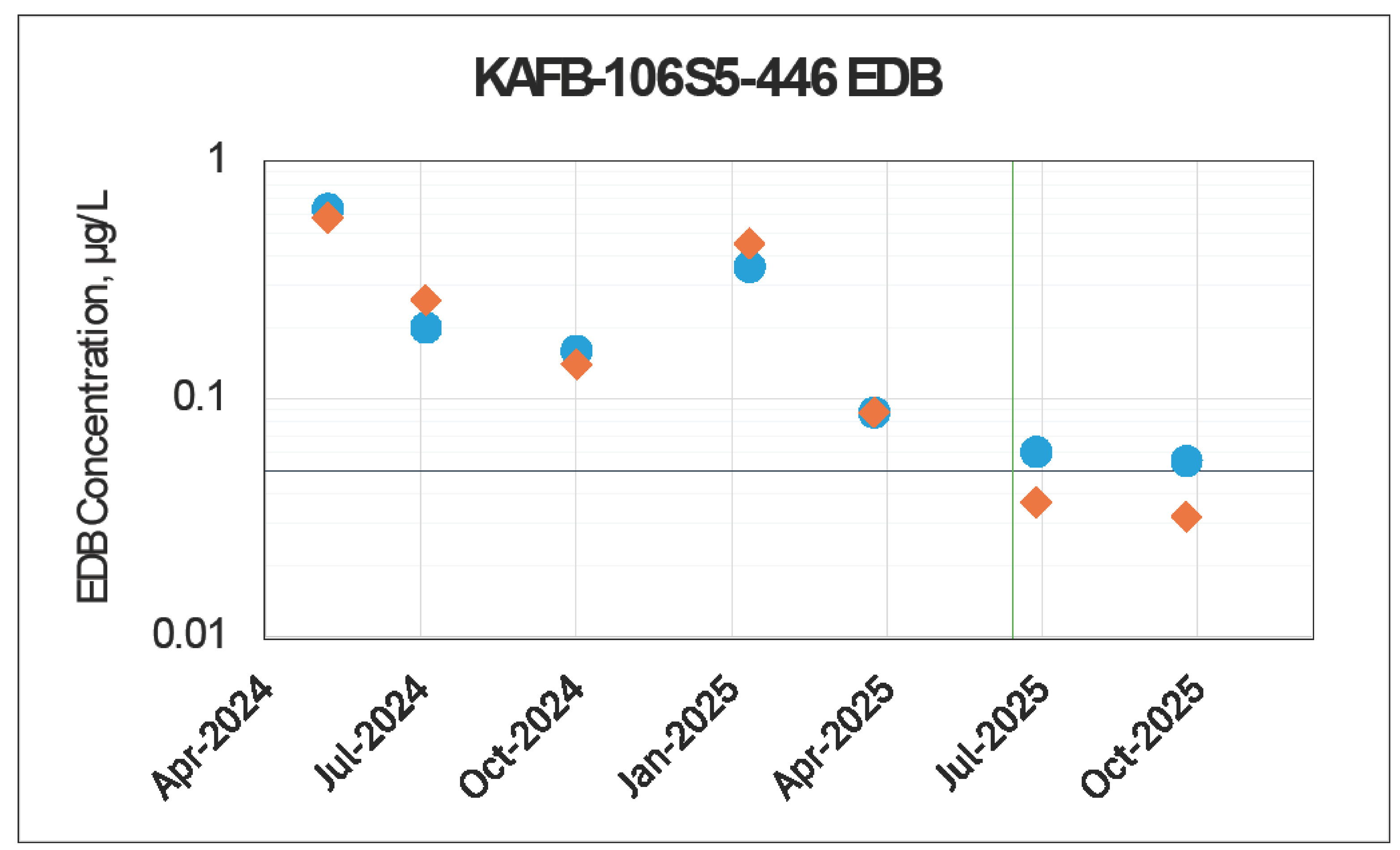
Time Series Graphs for Comparison Study Wells to Date

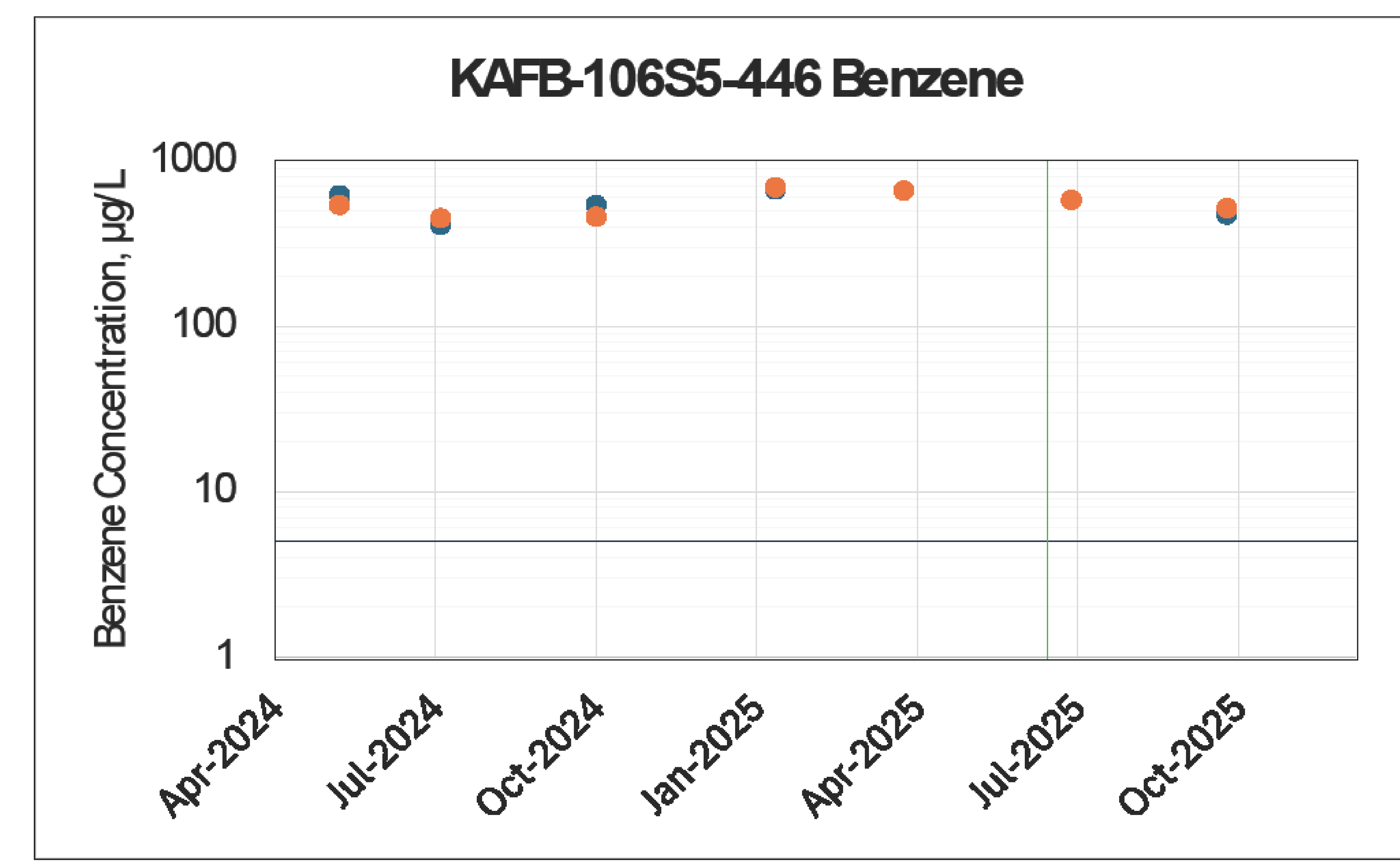


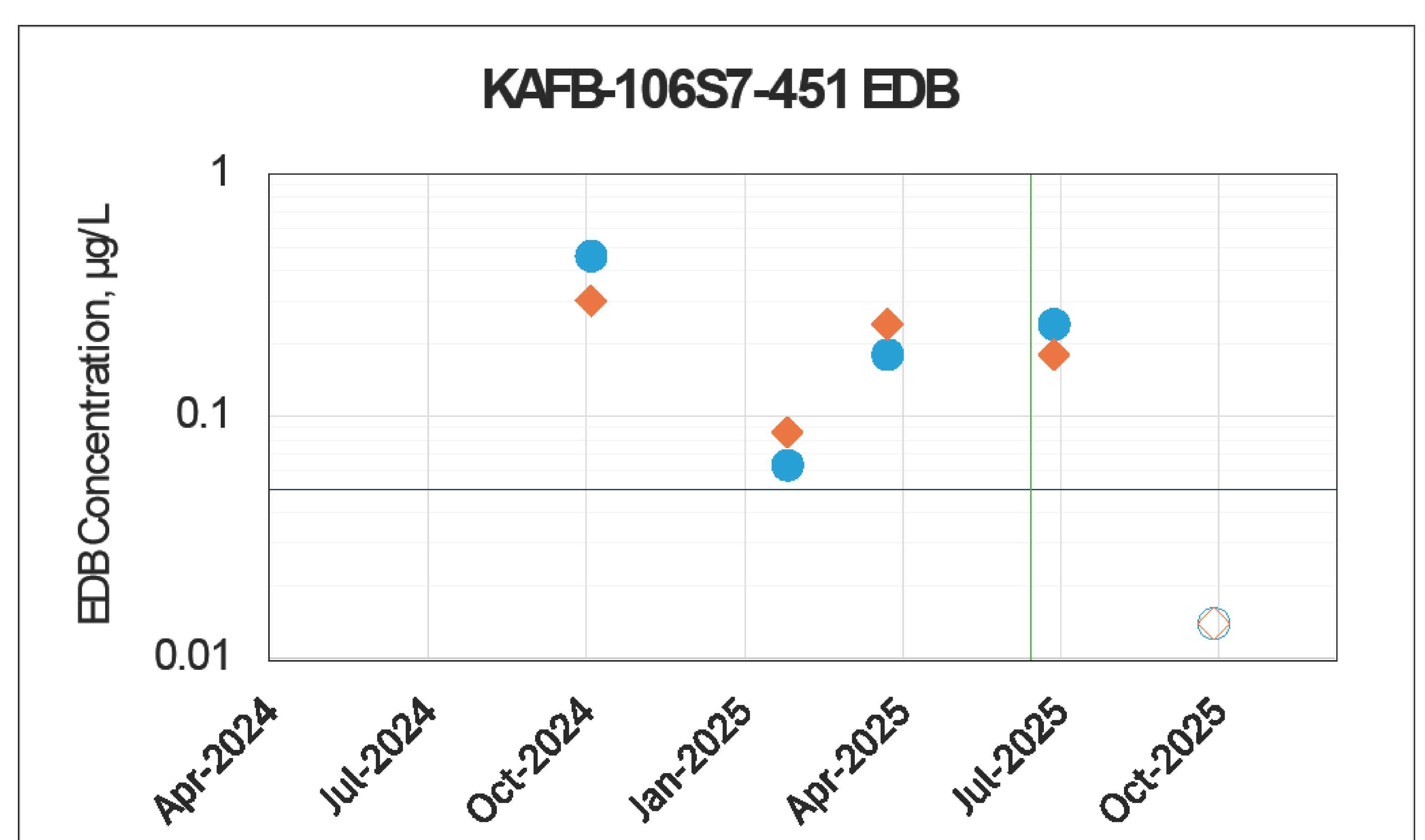


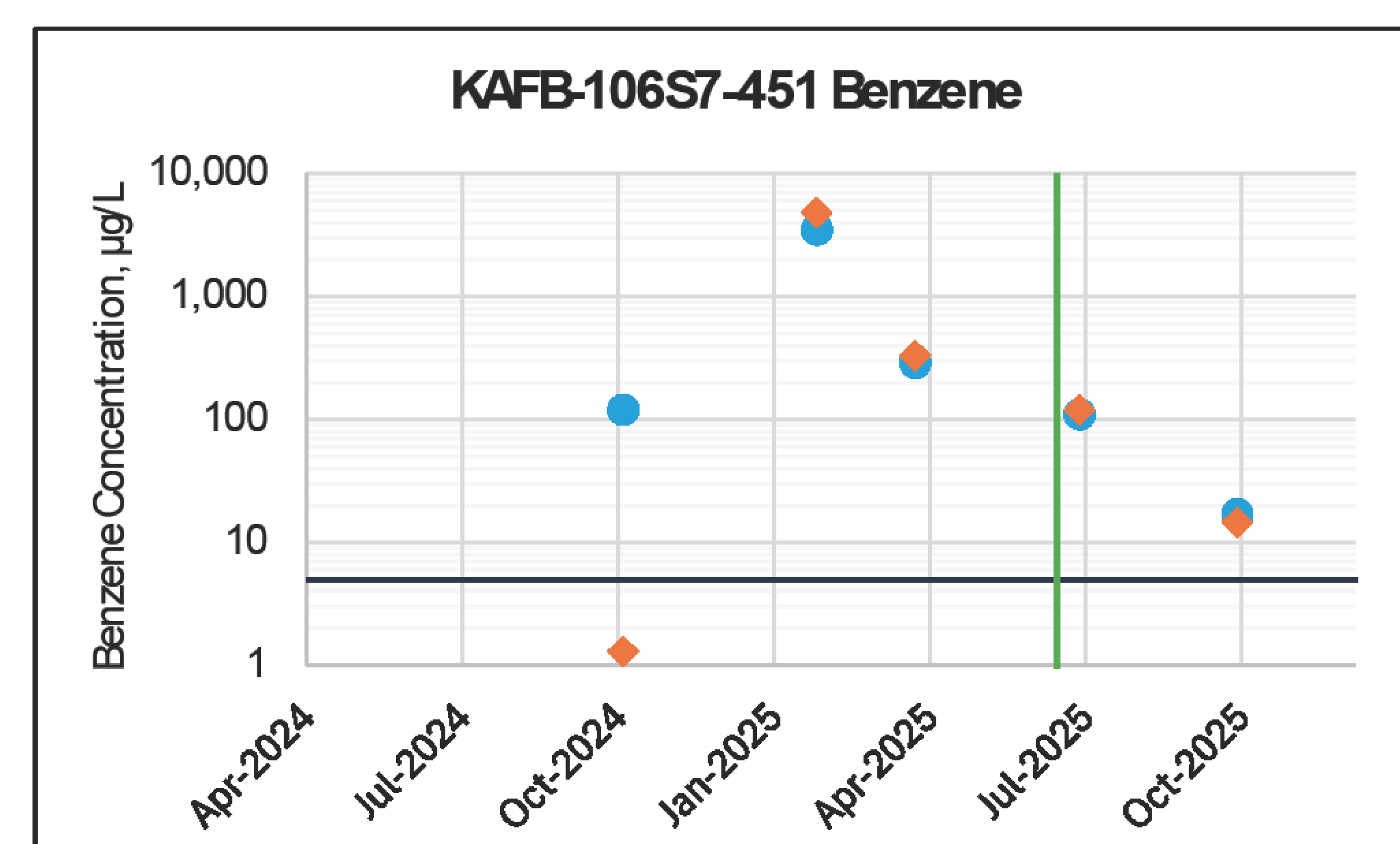












Notes:
All benzene results for KAFB-106089 were non-detect.
Open symbols indicate non-detect result at the LOD concentration.
Eight quarters of comparison study sampling began in Q3 2025.
Preliminary data collected prior to NMED approval using the same methods will be used to supplement the study.

EDB = 1,2-dibromoethane (ethylene dibromide)
LOD = limit of detection
MCL = maximum contaminant level
EPA = U.S. Environmental Protection Agency
NMED = New Mexico Environment Department
Q3 = quarter 3
Q4 = quarter 4
µg/L = microgram(s) per liter

- ● Passive sampling data
- ◆ Low-flow sampling data
- EPA MCL
- NMED approval with modifications, official start of study

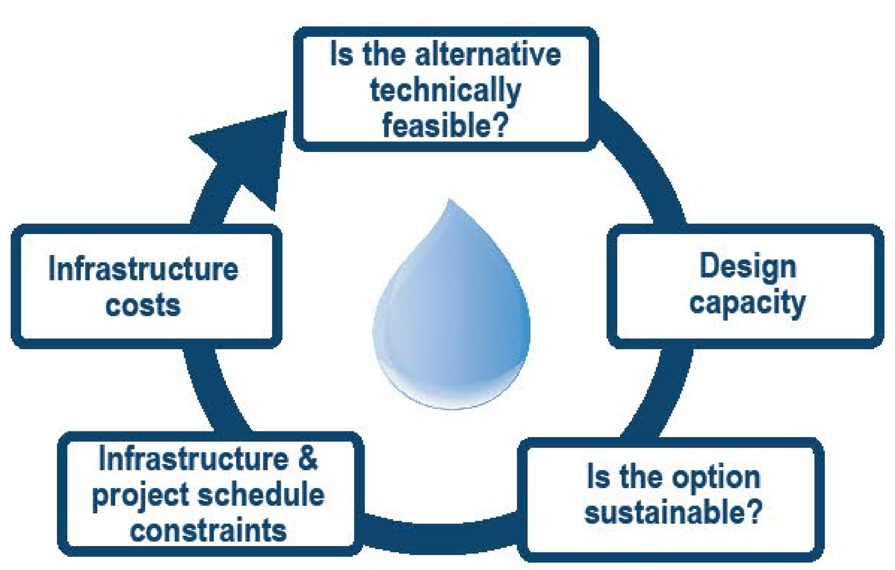
Treated Effluent Disposition Locations

Treated effluent quantities discharged as of 2/2/2026:

- 2,414,134,400 total gallons treated
- 1,327,539,665 treated gallons discharged to Golf Course Main Pond
- 666,973,335 treated gallons discharged to KAFB-007
- 419,621,400 treated gallons discharged to KAFB-106IN2

BENEFICIAL USE OF TREATED WATER

Different options (e.g., infiltration galleries, surface application such as irrigation, retention ponds, injection, etc.) were considered for discharging water treated from the full-scale groundwater treatment facility. These options were evaluated using the beneficial reuse criteria below.



Based on evaluation, which included an understanding of how water moves through soil, two options were identified as viable methods for discharging treated water: 1.) use of the Kirtland AFB Golf Course pond to hold water for irrigation use on the golf course and 2.) use of a gravity-fed well to inject water into the aquifer.