LNAPL Friction Point

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LNAPL Agenda

- Introduction
- Objective – determine if the nature and extent of LNAPL has been defined to the extent necessary to evaluate potential remedies
- What do we know about how the fuel migrated from the leaking pipes to the groundwater?
  - Two theories migration to groundwater
    - Migration through a “hole” in the clay
    - Stair-stepping
  - What did the two recent source area boreholes tell us?
- Characteristics and distribution of the residual LNAPL
  - Current distribution
  - Mobility
- Does the groundwater data support these conclusions?
  - Plume origin
  - Contaminant migration pathway
  - Source area plume foot print
- Is the level of information and degree of delineation suitable for the remedy selection process?
- Next steps

LNAPL Migration from the FFOR

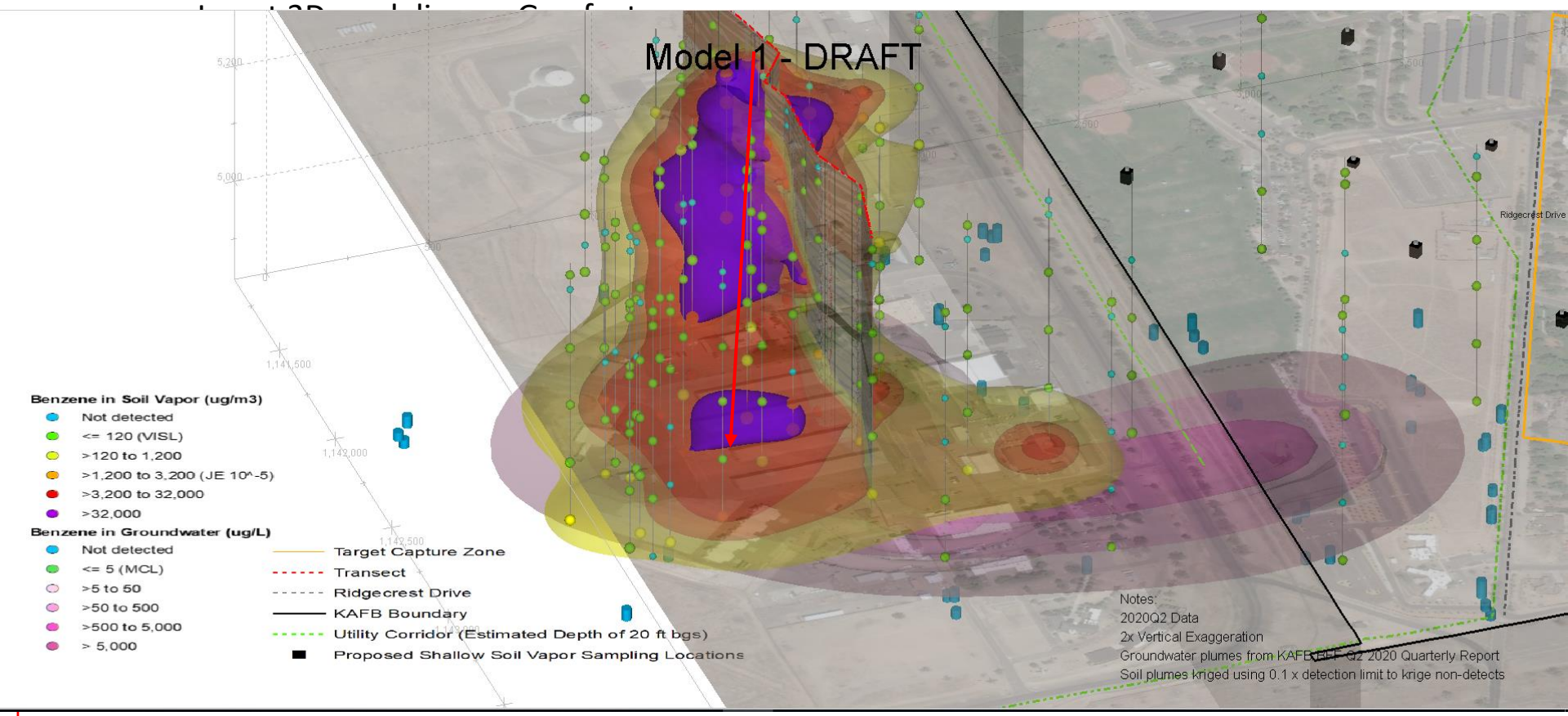
Two theories for LNAPL Migration to the Groundwater

- First Theory
  - Vertical Migration from the former fuel off-loading rack (FFOR) through a “hole” in the Clay
    - From the approved Data Gap WP - The source area contaminants descend essentially vertically from the surface to a depth of approximately 250-350 ft bgs where a distinct clay layer is present.
    - A vertical offset can be identified in the clay layer directly below the FFOR that likely creates a preferential pathway to vertical migration of contaminants.
    - Once contaminants reach the 250-300 foot depth range they appear to migrate predominantly downdip (to the east-southeast) on the lower clay layer and then generally vertically to the water table.
    - KAFB-106S10 was intended to identify the vertical discontinuity down to the groundwater table based on NMEDs sequence stratigraphy in the source area.
    - Significant clay layers were encountered.

LNAPL Migration from the FFOR cont.

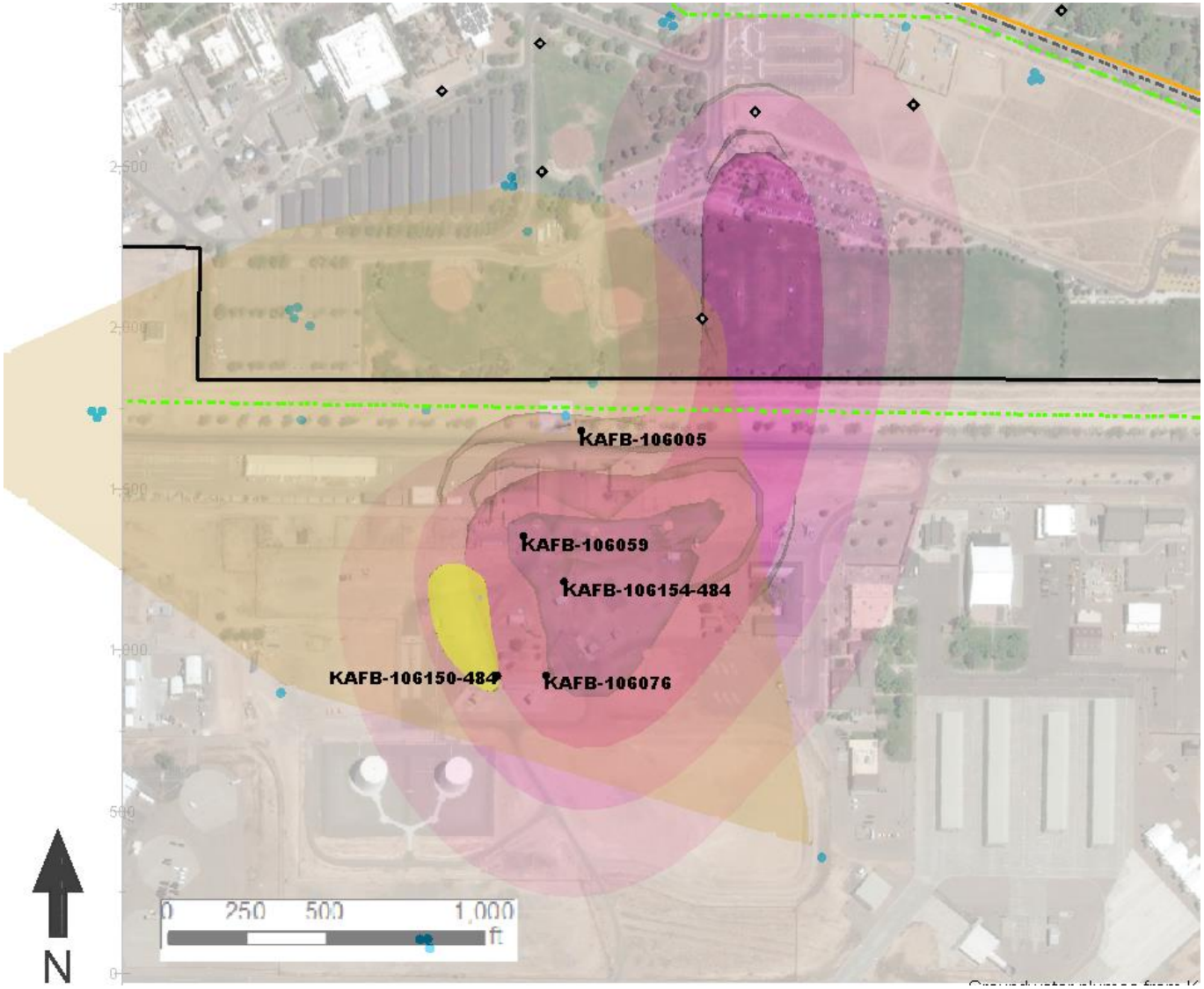
- Second Theory
  - Stair stepping from the FFOR through the Geo feature
    - The following narrative will be illustrated in the following slides
    - Based on the compiled data, the fuel released occurred in FFOR area now designated as the source area
    - Soil vapor data shows that LNAPL migrated to the southeast and stair stepped as it encountered less permeable strata dipping to the southeast
    - LNAPL would then have intercepted the 250 foot clay horizon in followed the thinning clay layer depression to the Geofeature
    - . The Geo feature as illustrated in USAF ESS analysis is a depression with the thinnest clay layer in proximity to the source area. Air Force is of the opinion that this is the most likely location for LNAPL to transition to the underlying formation
    - Once below the 250 clay, LNAPL would have continued a stair stepping migration to the southeast until it intercepted the groundwater table.
    - The following slides will illustrate the above concepts with synergy between soil vapor data, LNAPL detections and the dissolved paid phase plume showing the nature and extent of this 3 dimensional problem

LNAPL Migration from the FFOR cont.



Note: Soil vapor data has synergy with USAF ESS and CSM narrative. Soil vapor data suggest stair stepping to the southeast.

LNAPL Migration from the FFOR cont.



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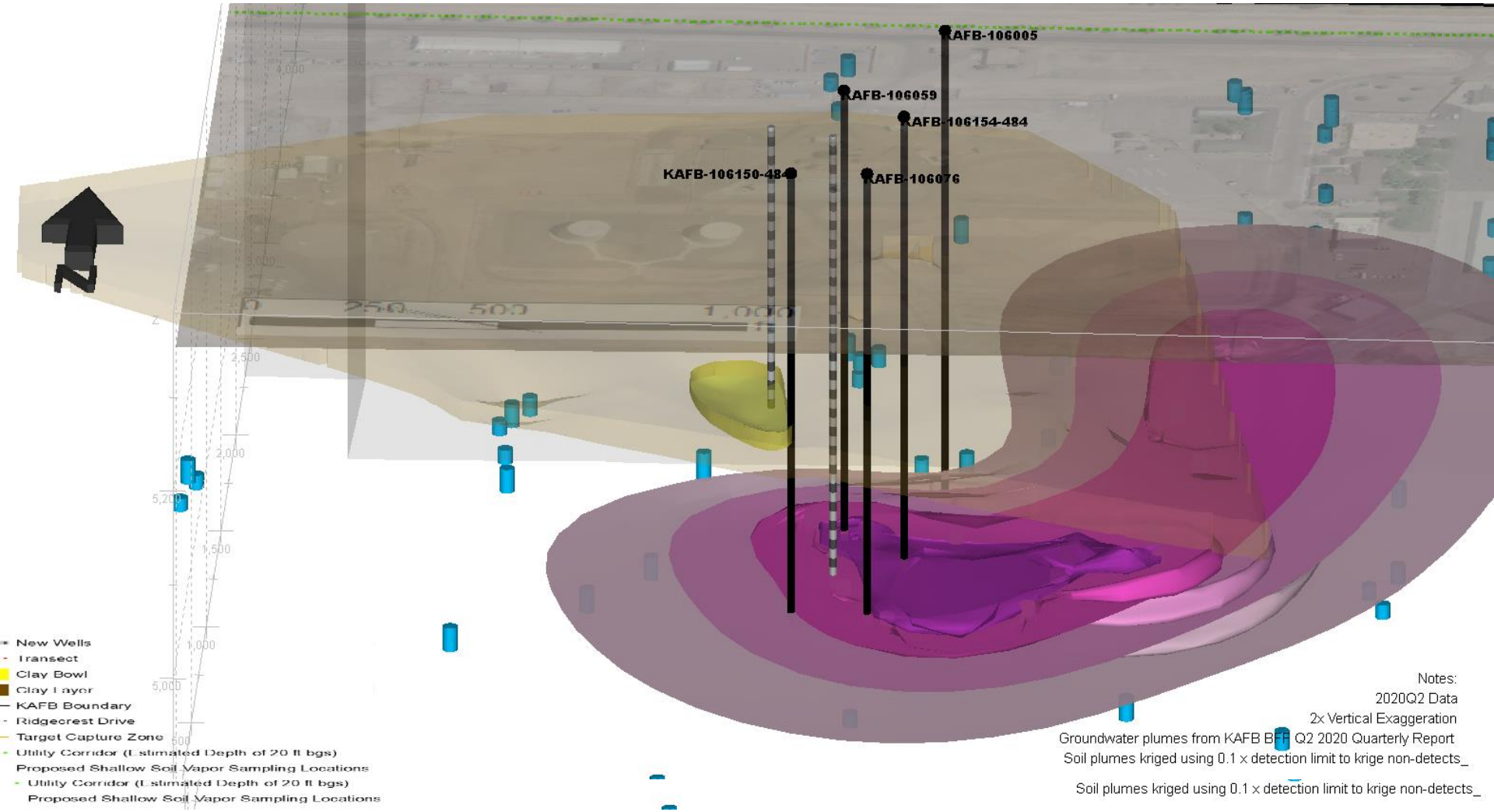
LNAPL Migration from the FFOR cont.



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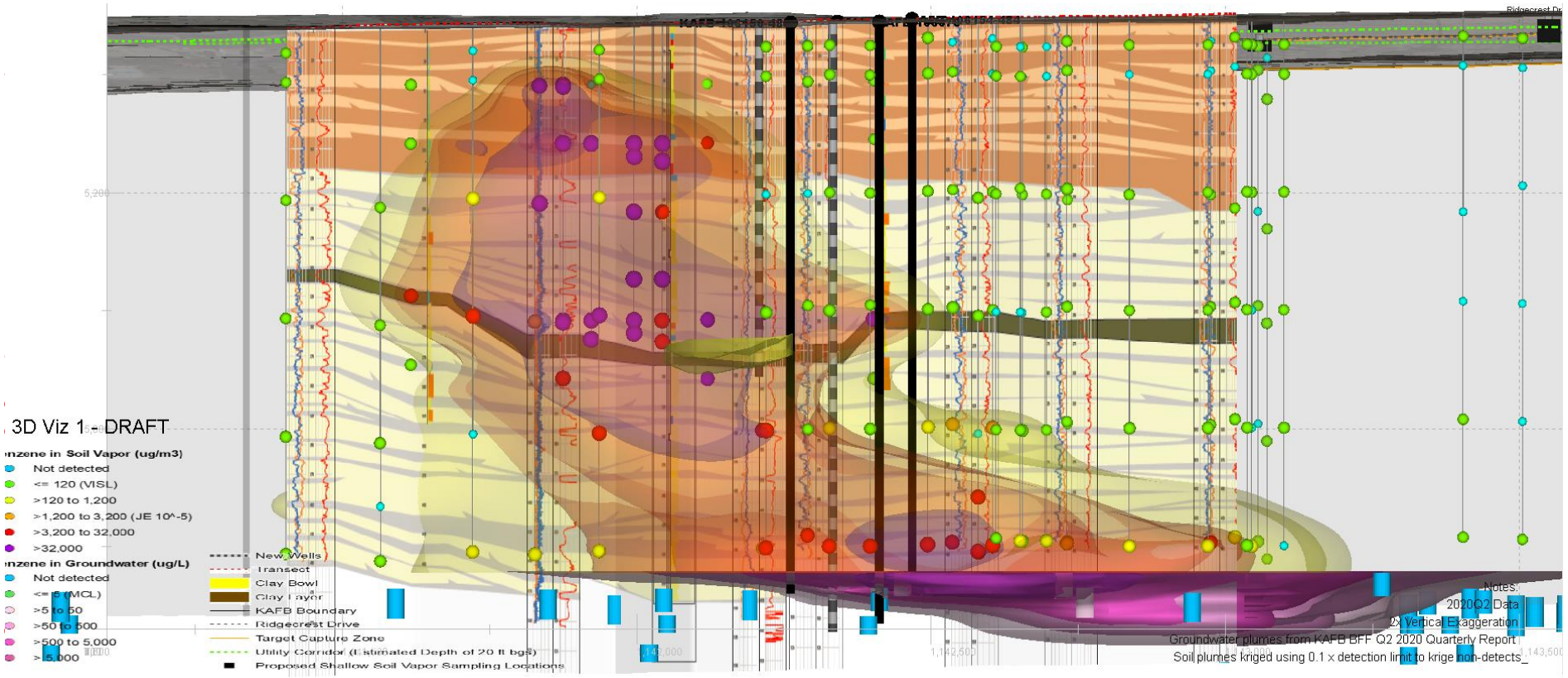

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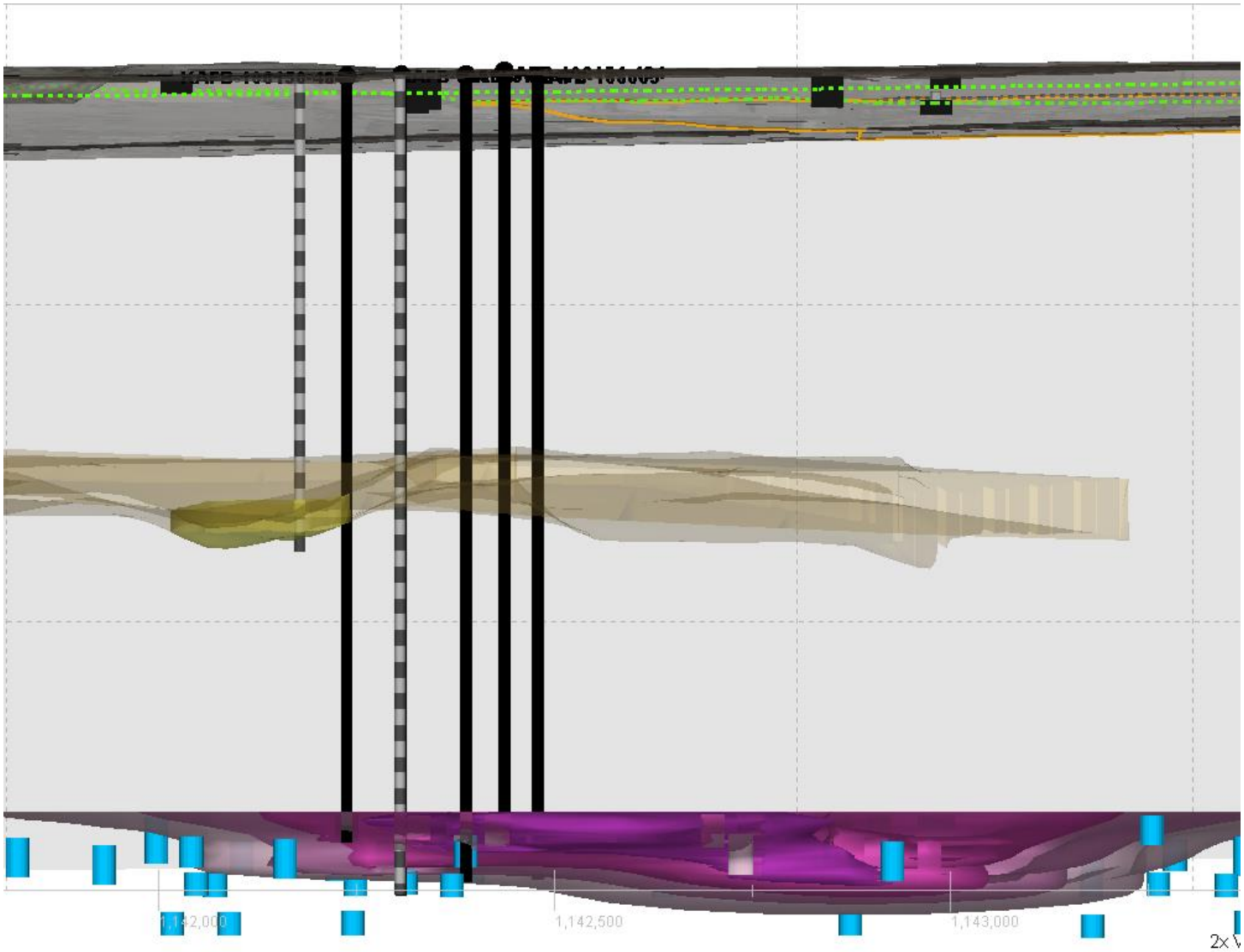
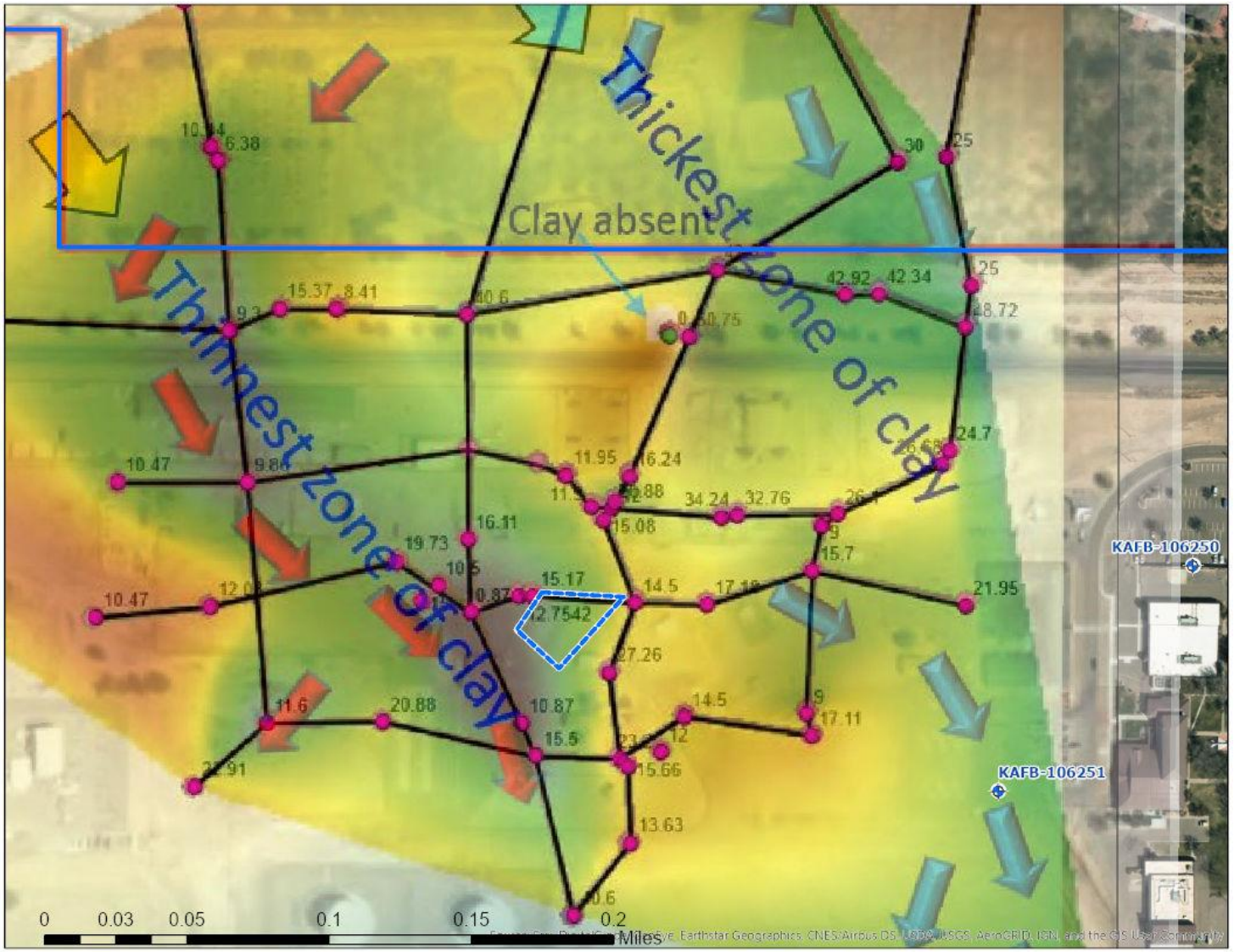


LNAPL Migration from the FFOR cont.



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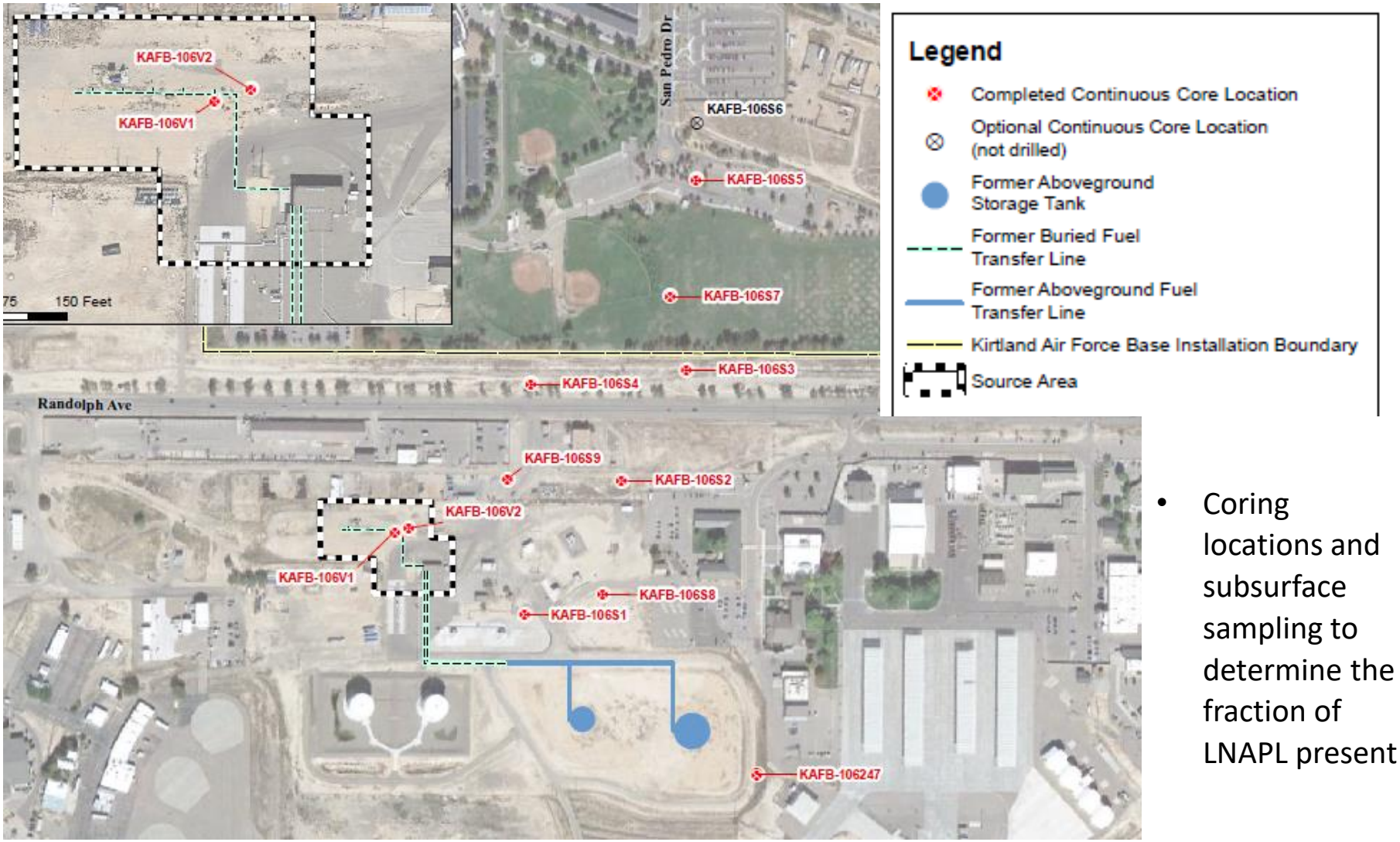
What did the two recent source area boreholes tell us?

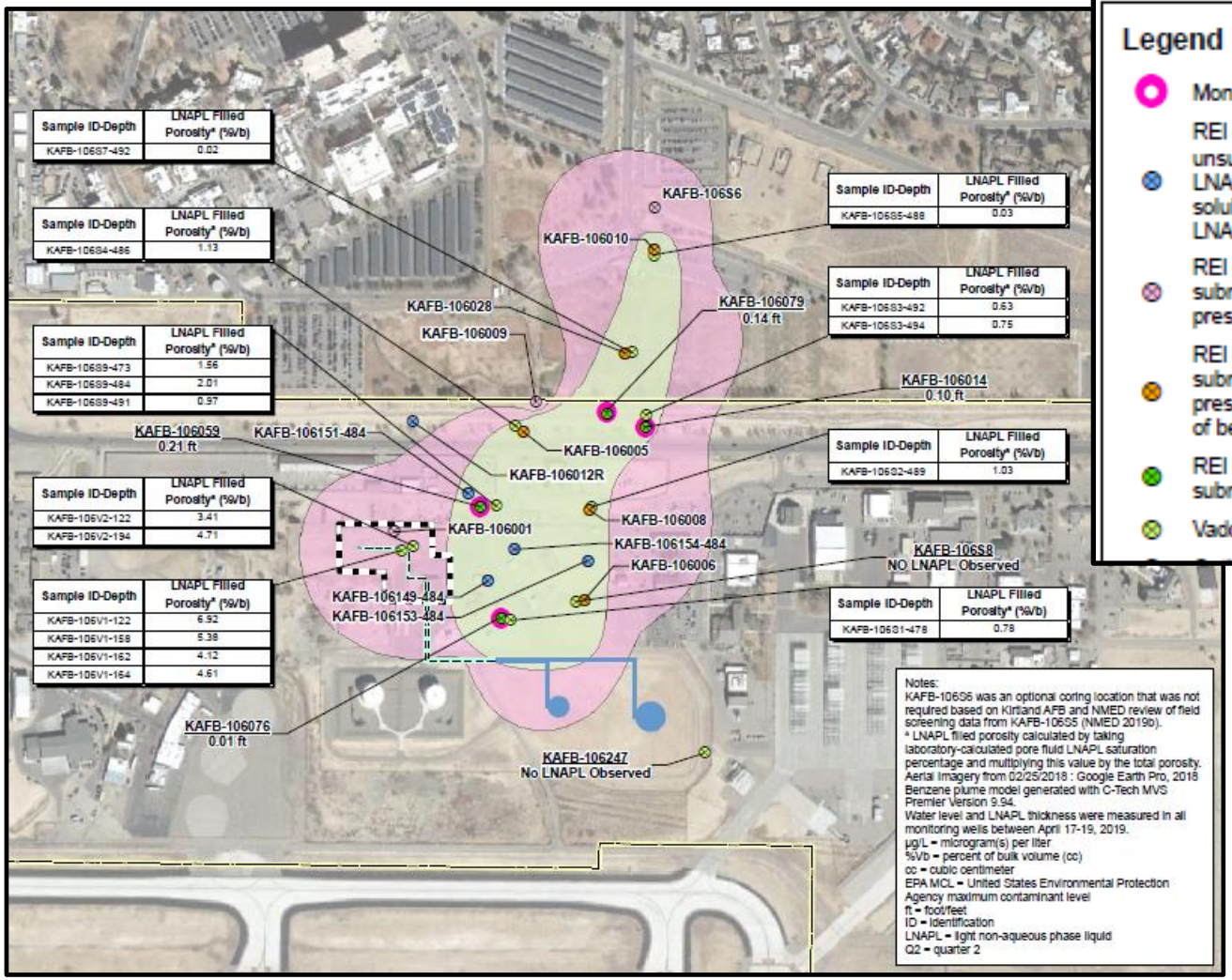
- Photoionization detector readings at KFAB-106V3 shows that LNAPL is not present on top of the 250 feet clay surface east of the source area at that location.
- PID readings continue to support the narrative that vapor migration is more prevalent laterally than vertically.
- Free product was not encountered at KAFB-106S10 northeast of known free product detections
- Additional lithology information from the installation of KAFB-106S10 well is nice to have but not necessary from a remedial perspective. Remediation of vapors in the vadose zone will be based on RBCs and not finding the “hole” in the clay horizon.

Characteristics and Distribution of the Residual LNAPL



- Coring locations and subsurface sampling to determine the fraction of LNAPL present

Characteristics and Distribution of the Residual LNAPL



- Highest residual LNAPL results detected on-base
- Bullhead Park values are two orders of magnitude less than on-base values.

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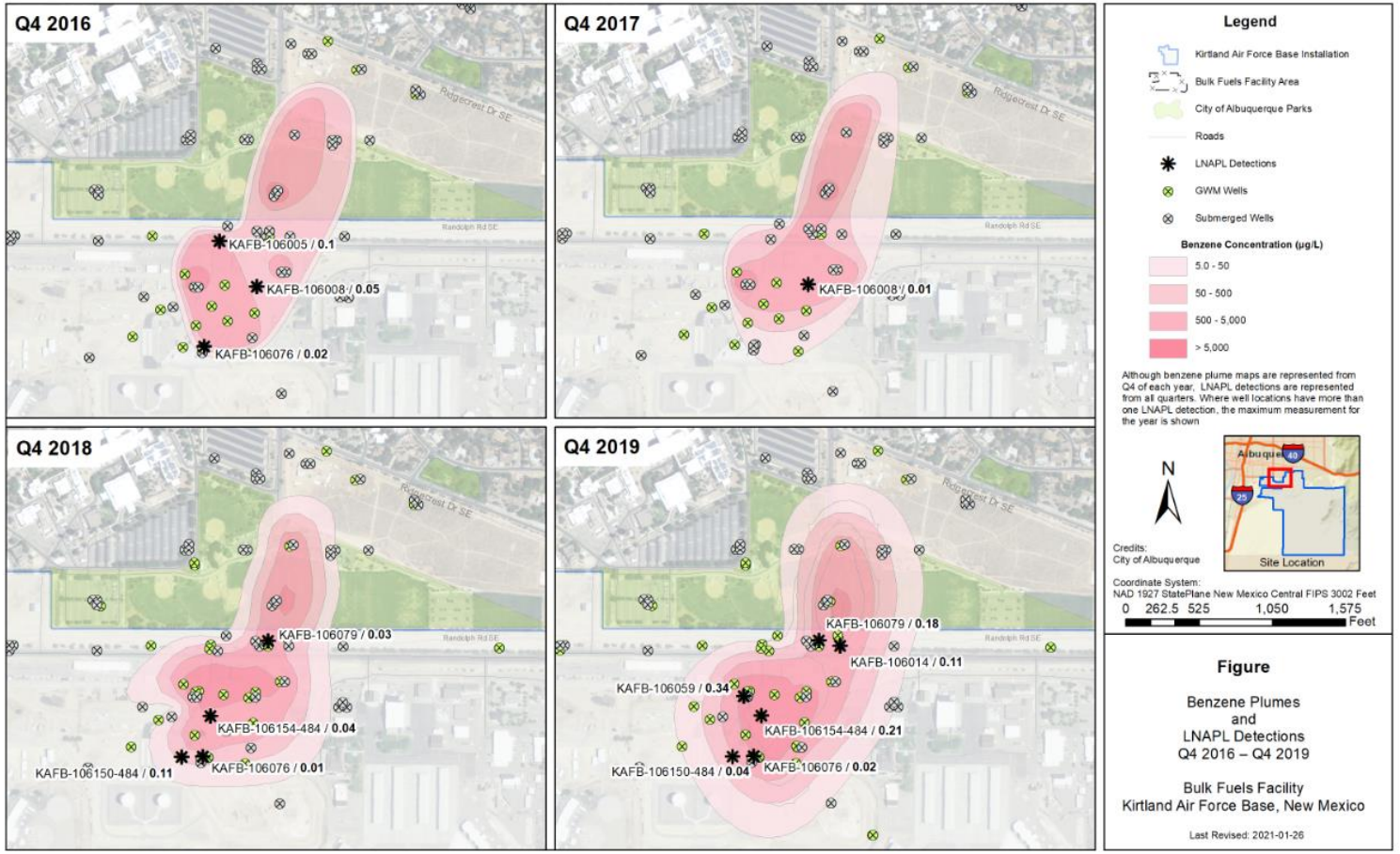
Does the Groundwater Data Support these Conclusions?



- Plume stability demonstrated overtime
- Despite increasing water levels, plume shape has remained constant
- Combined submerged and unsubmerged screened wells monitoring the 3D problem

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Current Distribution and Mobility

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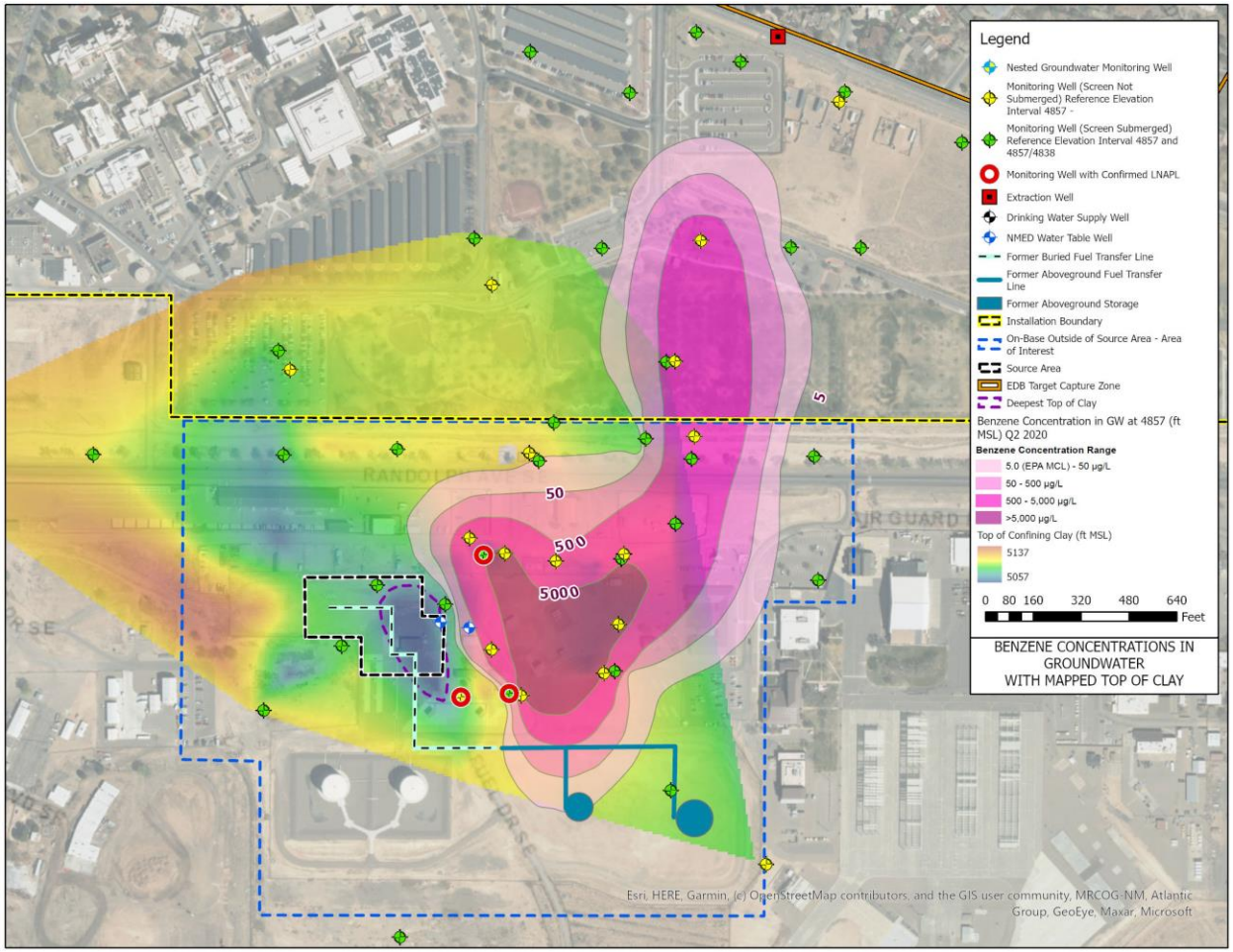
- LNAPL is present primarily in the source area ranging from 0.01 to 0.4 ft thick; with periodic detections up to the base perimeter
- Dissolved phase is well defined
  - Benzene data from Q2-2020
- Lithology is well defined
  - Key point of interest is on clay layer(s) ~ 245 to 265 ft bls
- Depth to groundwater has changed over time
  - Currently ~ 470 ft bls
- In 2021, LNAPL monitored with 20 on-base and 4 monitoring wells in Bullhead Park with unsubmerged screens.
- All wells will remain viable thru 2031.



✓ The combination of the soil vapor data, LNAPL detection locations, dissolved phase configuration and subsurface residual LNAPL sampling has delineated the problem to a degree the suitable for the remedy selection process.

Is the level of information and degree of delineation suitable for the remedy selection process?

- Extent of impacted soils, soil vapors, and groundwater contamination is well-defined
  - Sequence stratigraphy, soil vapor sampling, LNAPL detections, and groundwater sampling produce a highly refined CSM
- Soil vapor contamination defined and primarily on-base property. Soil vapor data illustrates the LNAPL migration pathway.
- Air Force believes that there is no risk to on- or off-base receptors.
- The investigation phase is complete and we have the data necessary to evaluate remedies
- Despite increasing water levels, the plume is stable with active monitoring both above and below the water table, soil vapor data, LNAPL detection locations, dissolved phase configuration and subsurface residual LNAPL sampling showing synergy.
- Level of information and degree of delineation is suitable for remedy selection process
- Due to the characteristics of the remaining element LNAPL – Air Force believes that the dimensions of the source area will remain constant as the water table continues to rise.