



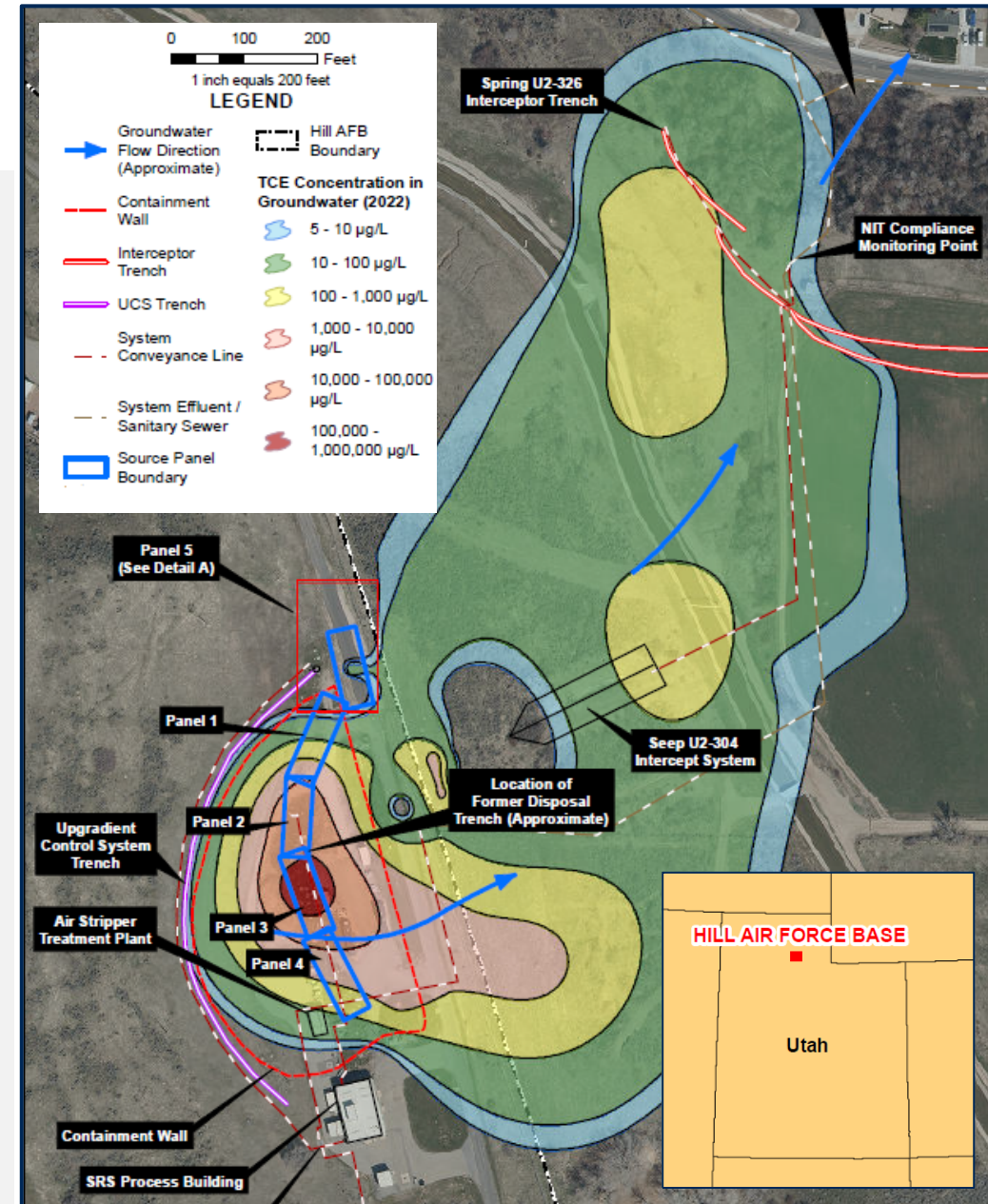
Utilizing Dye-Enhanced Laser-Induced Fluorescence Tooling with Soil Borings to Map Residual Free-Phase DNAPL at Former Solvent Disposal Trenches

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SITE BACKGROUND

- ▶ The site is located on the eastern side of Hill Air Force Base in Utah at two unlined chlorinated degreasing solvent disposal trenches.
- ▶ The quantities of released solvent are not known; however, approximately 44,500 gallons of free-phase dense nonaqueous phase liquid (DNAPL) have been recovered from the site since the early 1990s.
- ▶ The site has and continues to have active remediation at this site with minimal DNAPL recovery.
- ▶ A total of 56 wells have had historical detectible levels of DNAPL with 11 of the wells having measurable DNAPL in 2022 ranging from 0.04 to 0.27 feet thick.



DNAPL IN SOURCE AREA

Known

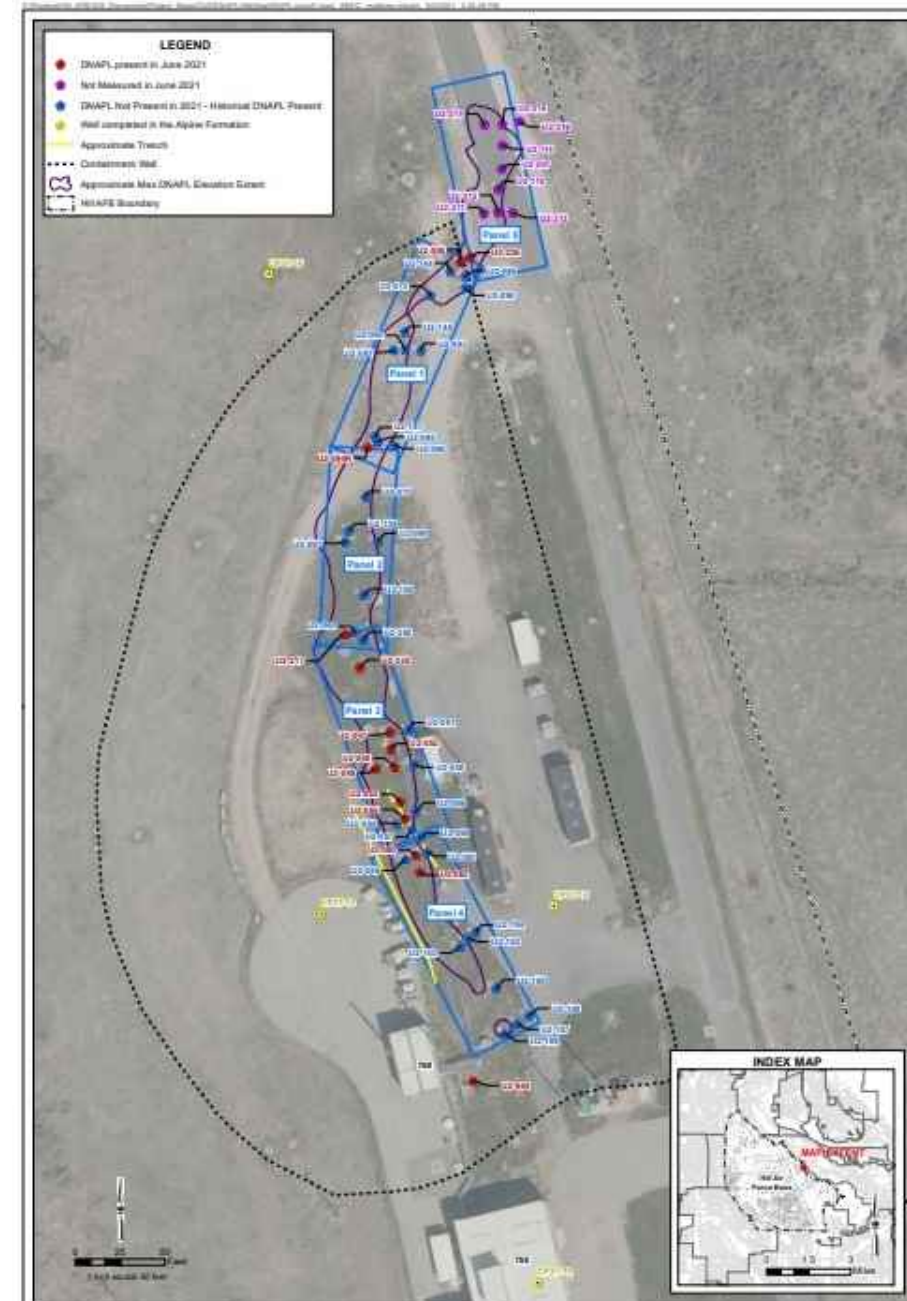
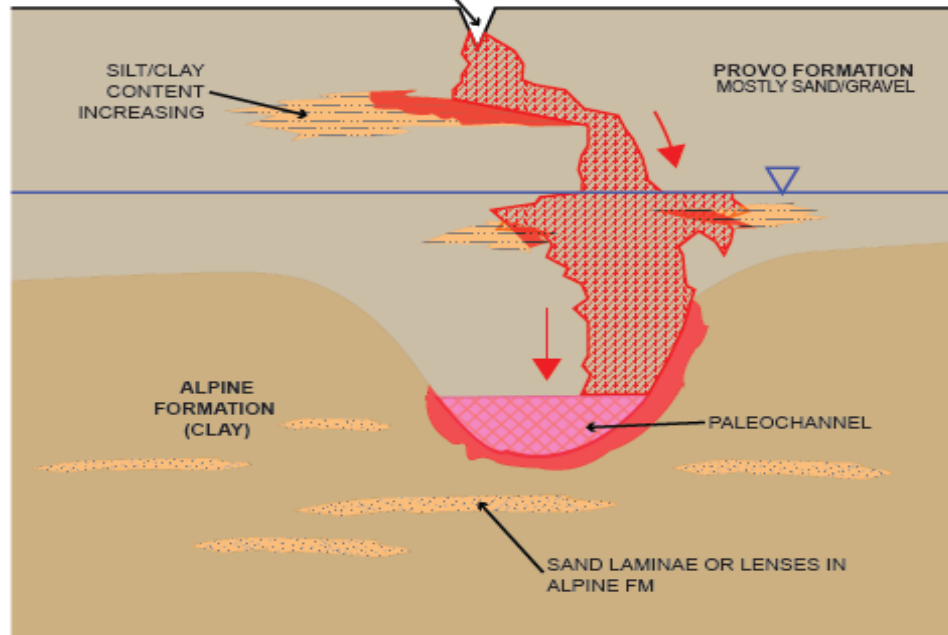
- Free-phase DNAPL accumulation in the paleochannel.
- Very high dissolved-phase TCE concentrations associated with the source area ($> 100,000 \mu\text{g/L}$) persist at the site.

Unknown

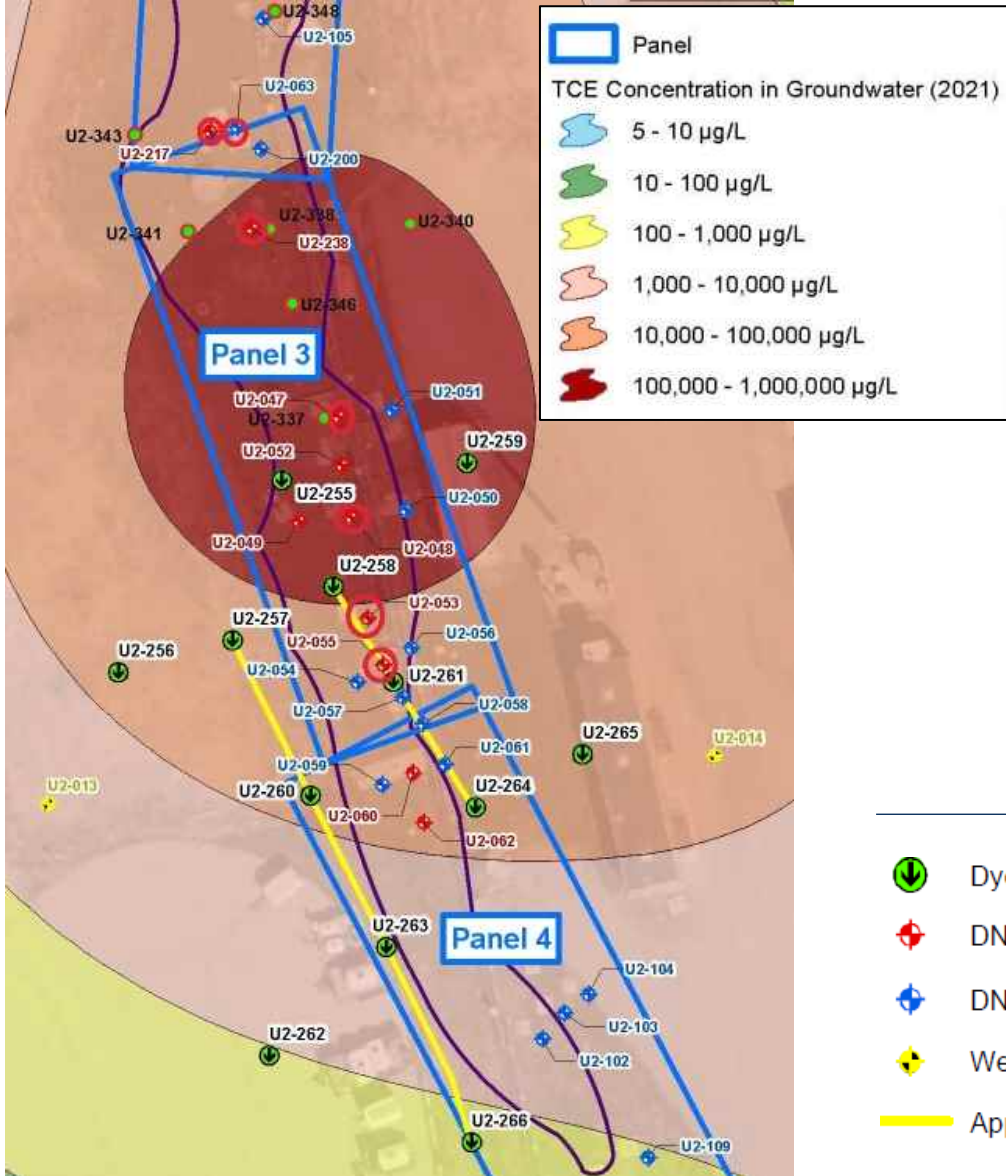
- Existence of free-phase or residual DNAPL in portion of overburden.
- Extent of residual DNAPL in the overburden/clay Interface.
- Existence or extent of residual DNAPL entrained in the Alpine Formation (clay).

Goal

- Data will be used to update an existing Conceptual Site Model, evaluate remedial alternatives, and, if warranted, propose an alternative remedial approach.



DNAPL INVESTIGATION



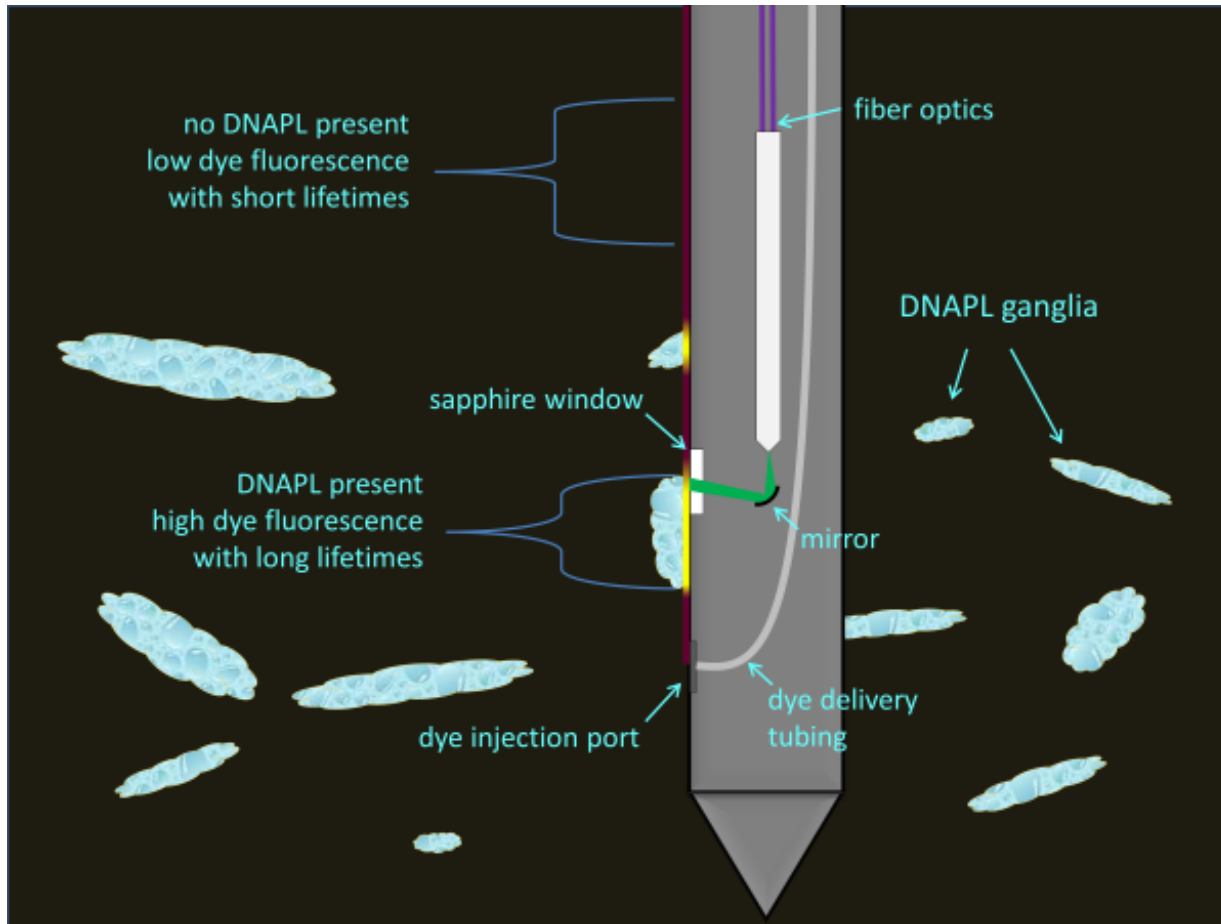
- ▶ Advanced a total of 19 dye-enhanced laser-induced fluorescence system (DyeLIF) borings into and around the paleochannel below the former DNAPL disposal area.
- ▶ Advance 4 conventional soil borings to verify residual or free-phase DNAPL occurrence by direct sampling, including dye shake test: U2-263, U2-266, U2-337, and U2-341
- ▶ Collect MIP/HPT in the dissolved-phase plume in support of this investigation. The MIP/HPT investigation is discussed in a different presentation.

LEGEND

- DyeLIF Location
 - DNAPL present in June 2021
 - DNAPL Not Present in 2021 - Historical DNAPL Present
 - Well completed in the Alpine Formation
 - Approximate Trench
 - DyeLIF step out location
 - Historic maximum extent of DNAPL
 - 2022 observable DNAPL
- MIP = Membrane Interface Probe*
HPT = Hydraulic Profiling Tool

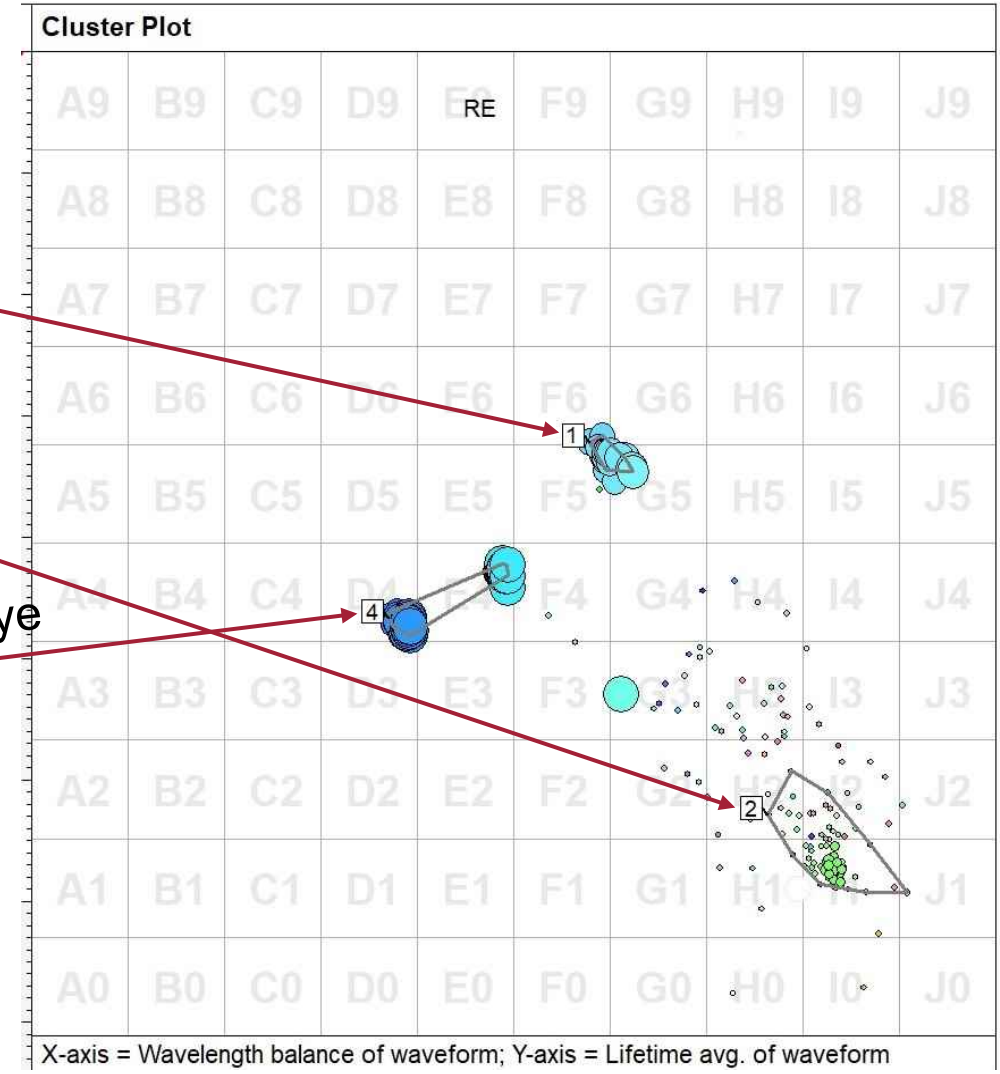
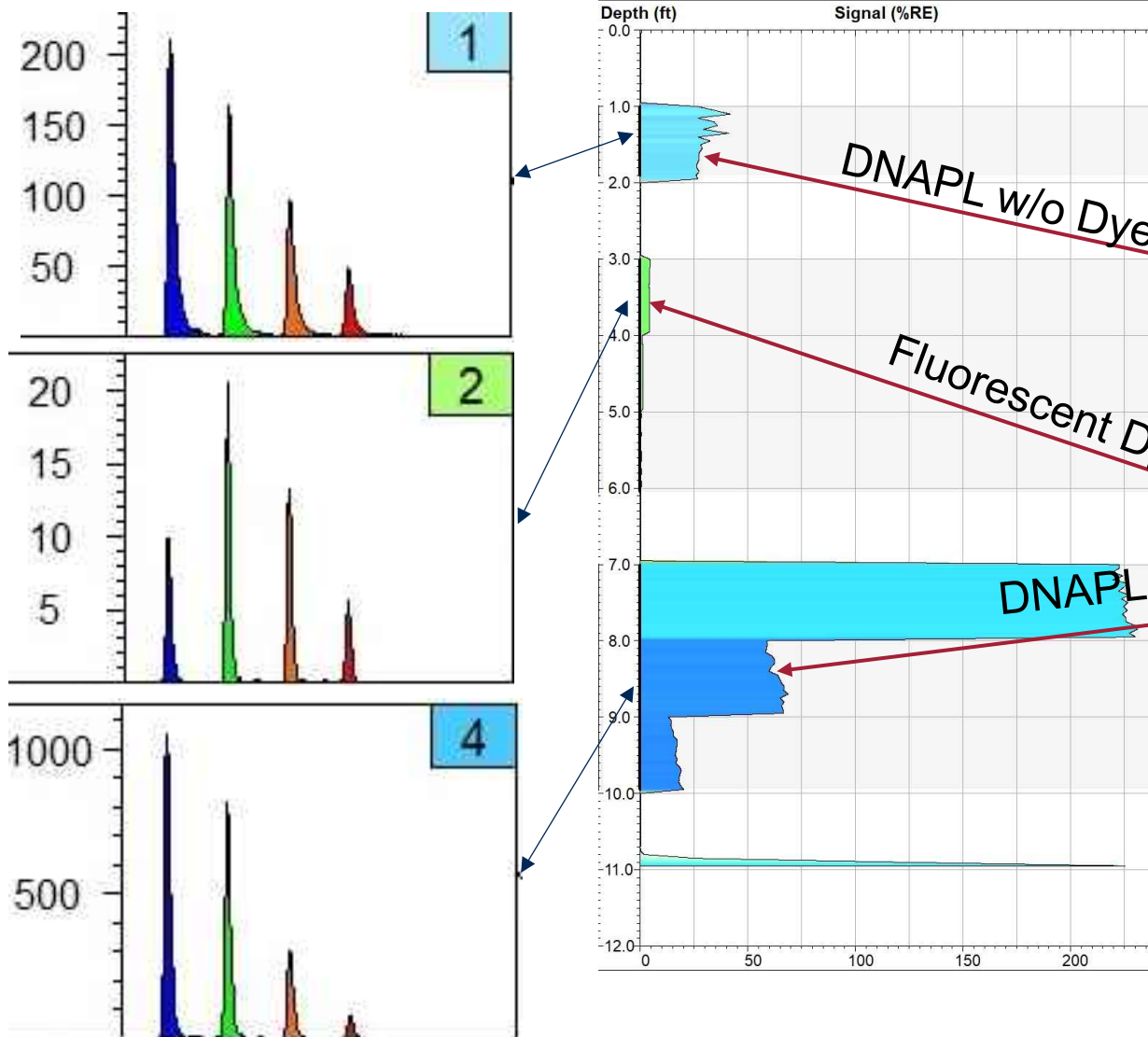


DYELIF OPTICAL SCREENING TOOL



- ▶ MIP is capable of real-time, high-resolution mapping of subsurface VOCs but **cannot differentiate** between dissolved/sorbed-phase contamination and DNAPL.
- ▶ The DyeLIF Optical Screening Tool:
 - ▶ Injects fluorescent hydrophobic dye through a small injection port.
 - ▶ The injected dye dissolves into the DNAPL (if present) and fluoresces in the presence of the laser light source.
 - ▶ A sapphire window detector determines if DNAPL is present.
 - Wavelength balance: Ratio of wave colors.
 - Lifetime average: Average time material stays in excited state prior to fluorescing.

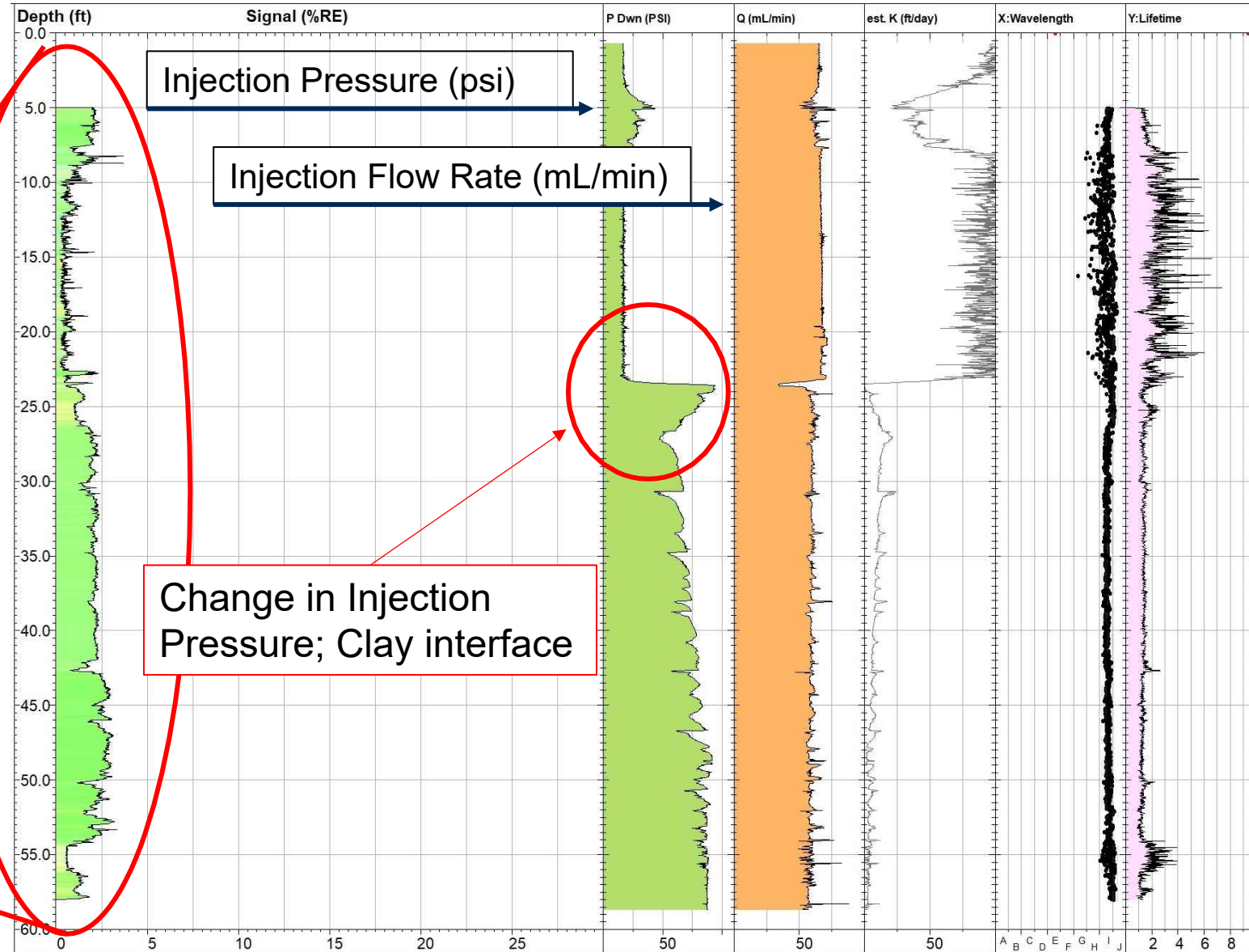
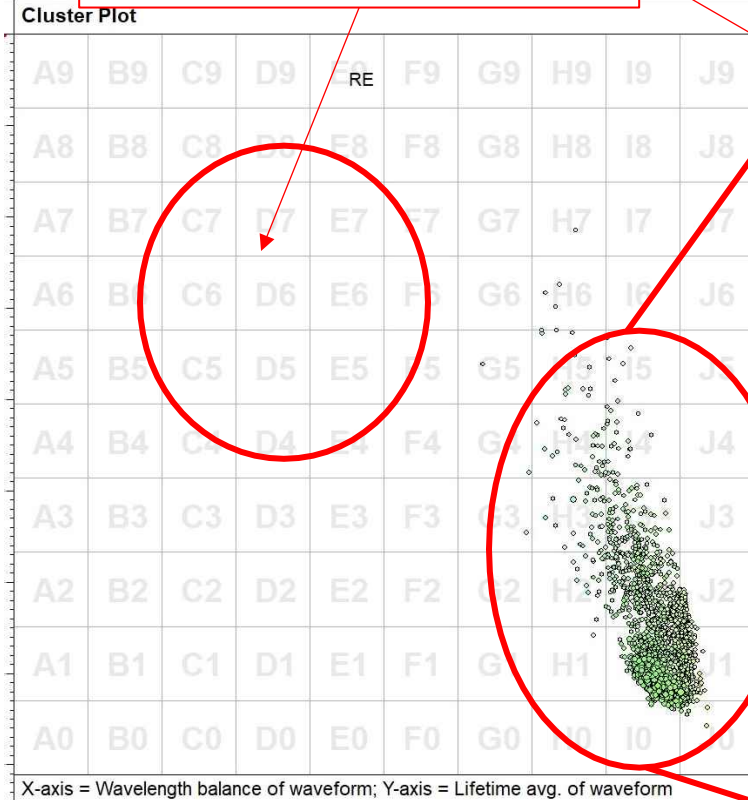
DYELIF BASELINE CALIBRATION DATA



DYELIF CLEAN DATA

WELL U2-340: TOP OF PALEOCHANNEL

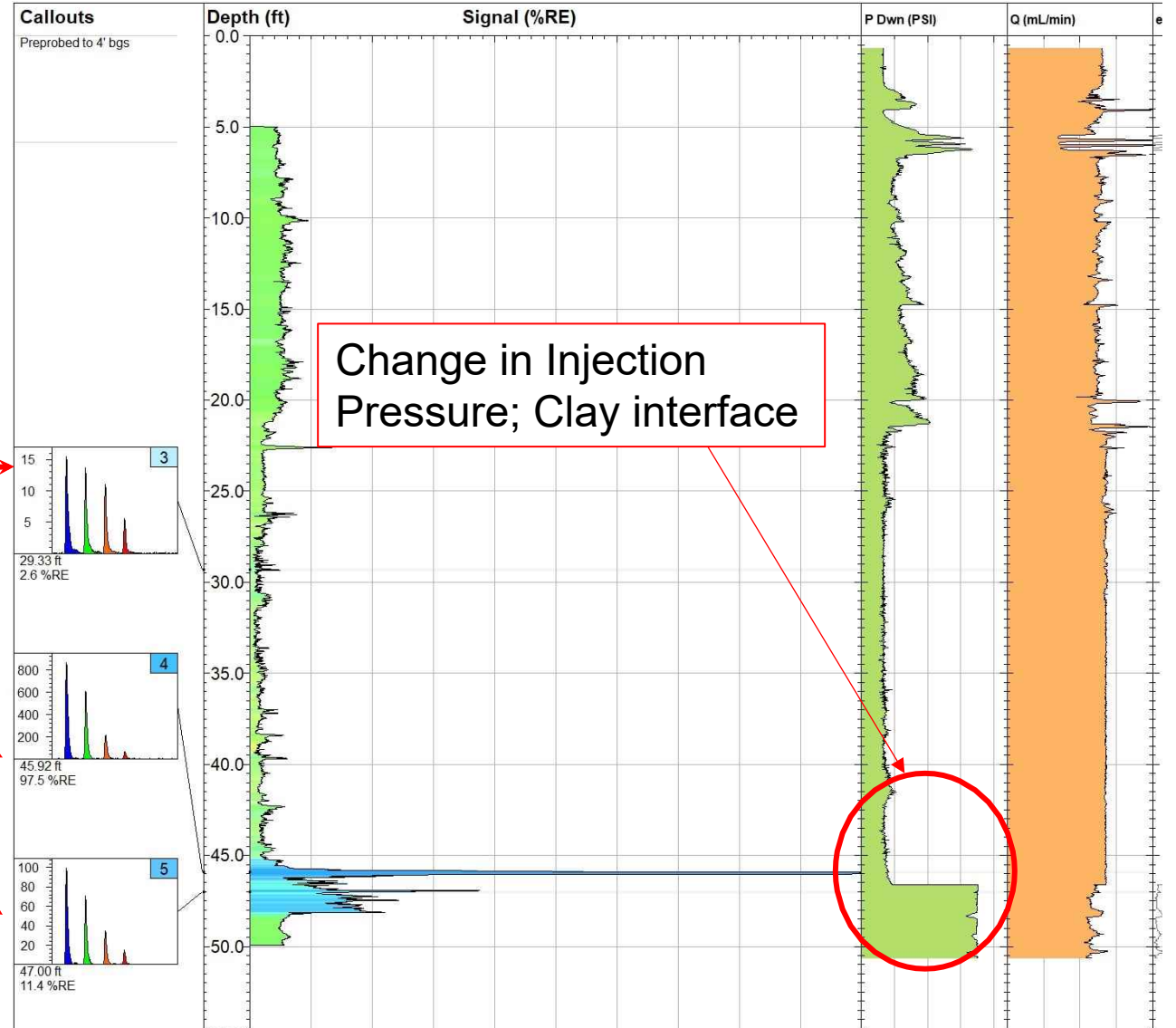
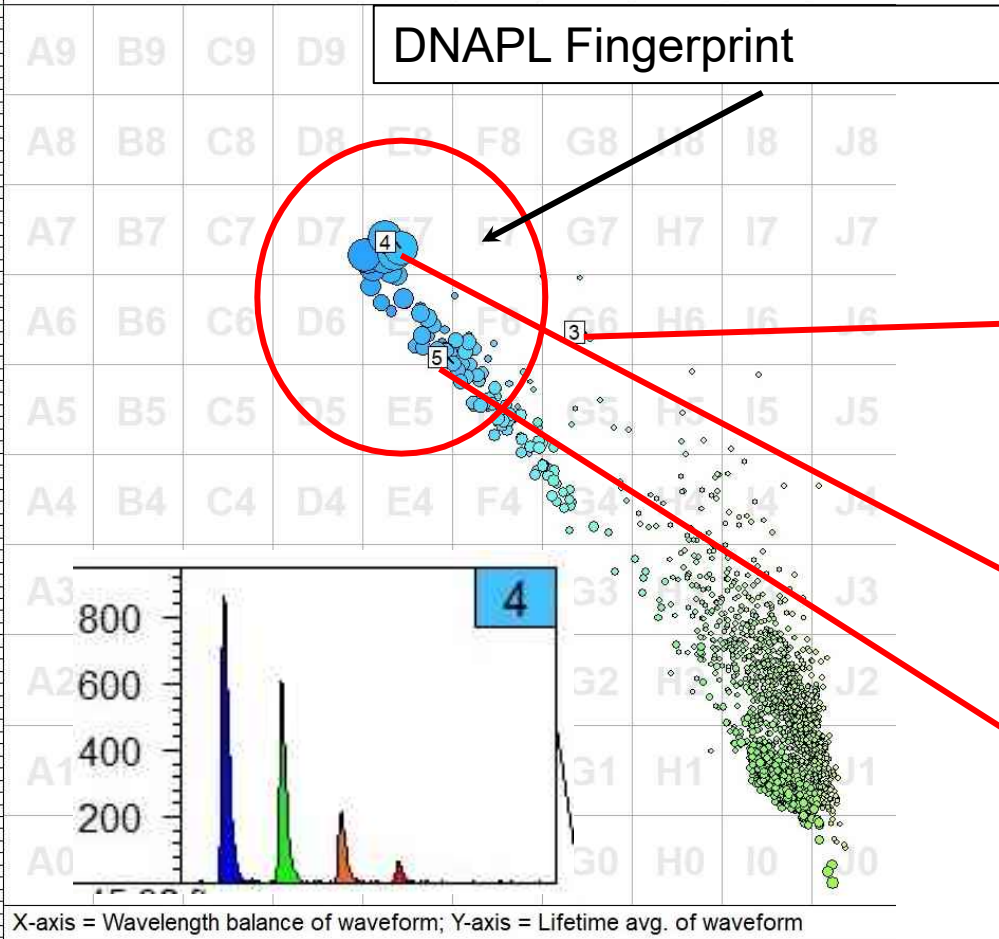
No DNAPL Fingerprint



DYELIF DNAPL-IMPACTED AREA

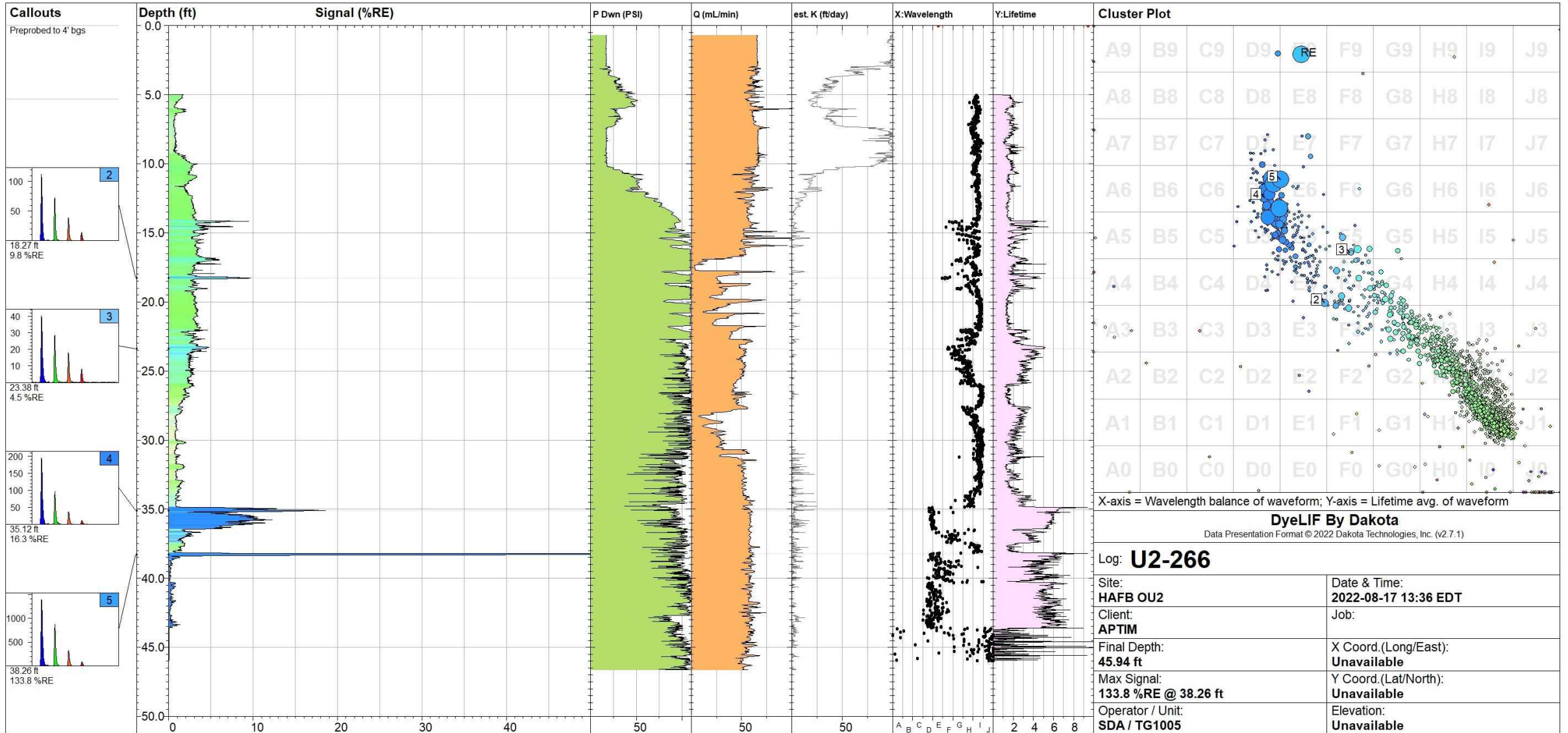
WELL U2-337: CENTER PALEOCHANNEL

Cluster Plot



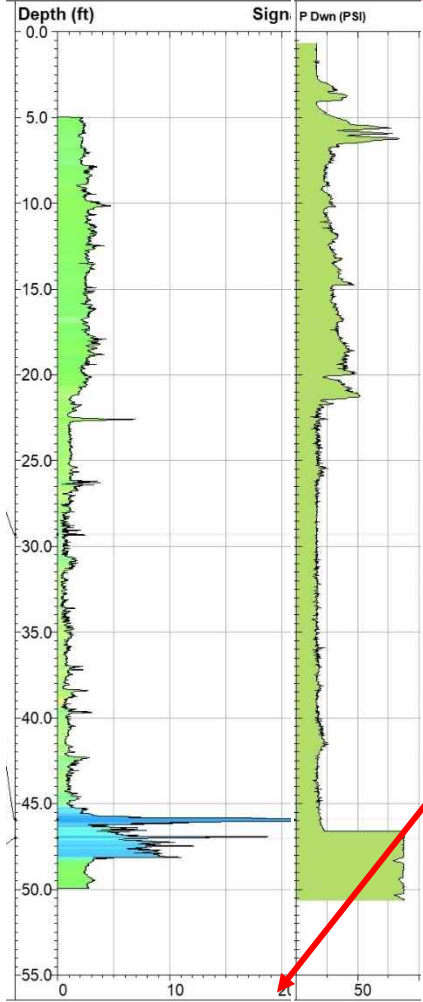
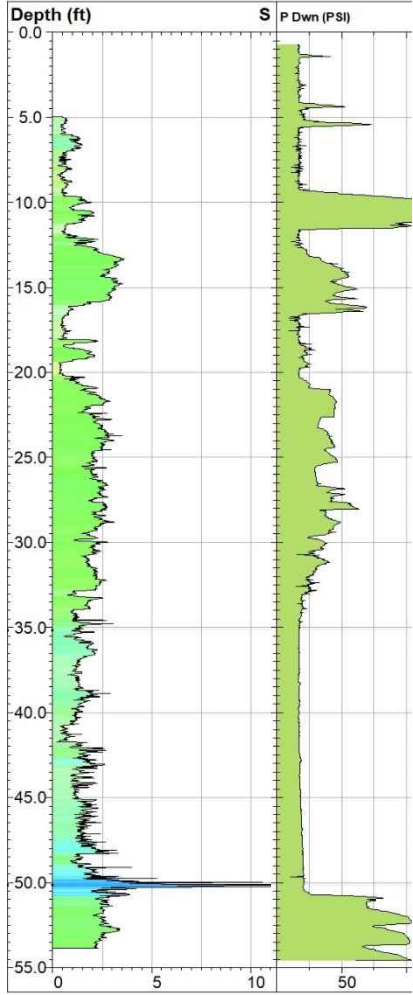
DYELIF DNAPL IN CLAY

WELL U2-266: TOP OF PALEOCHANNEL

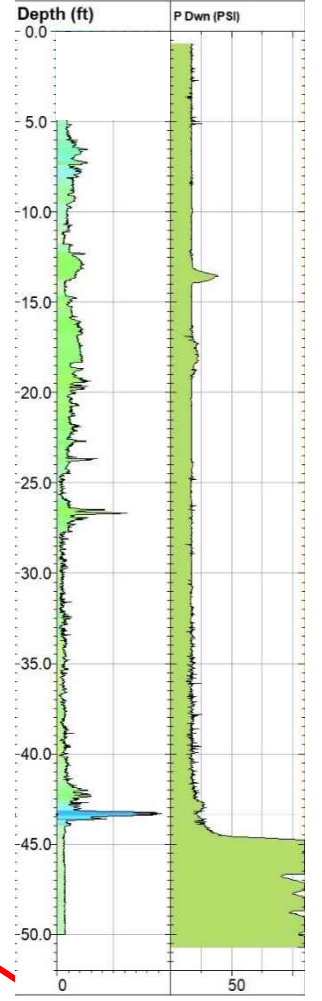
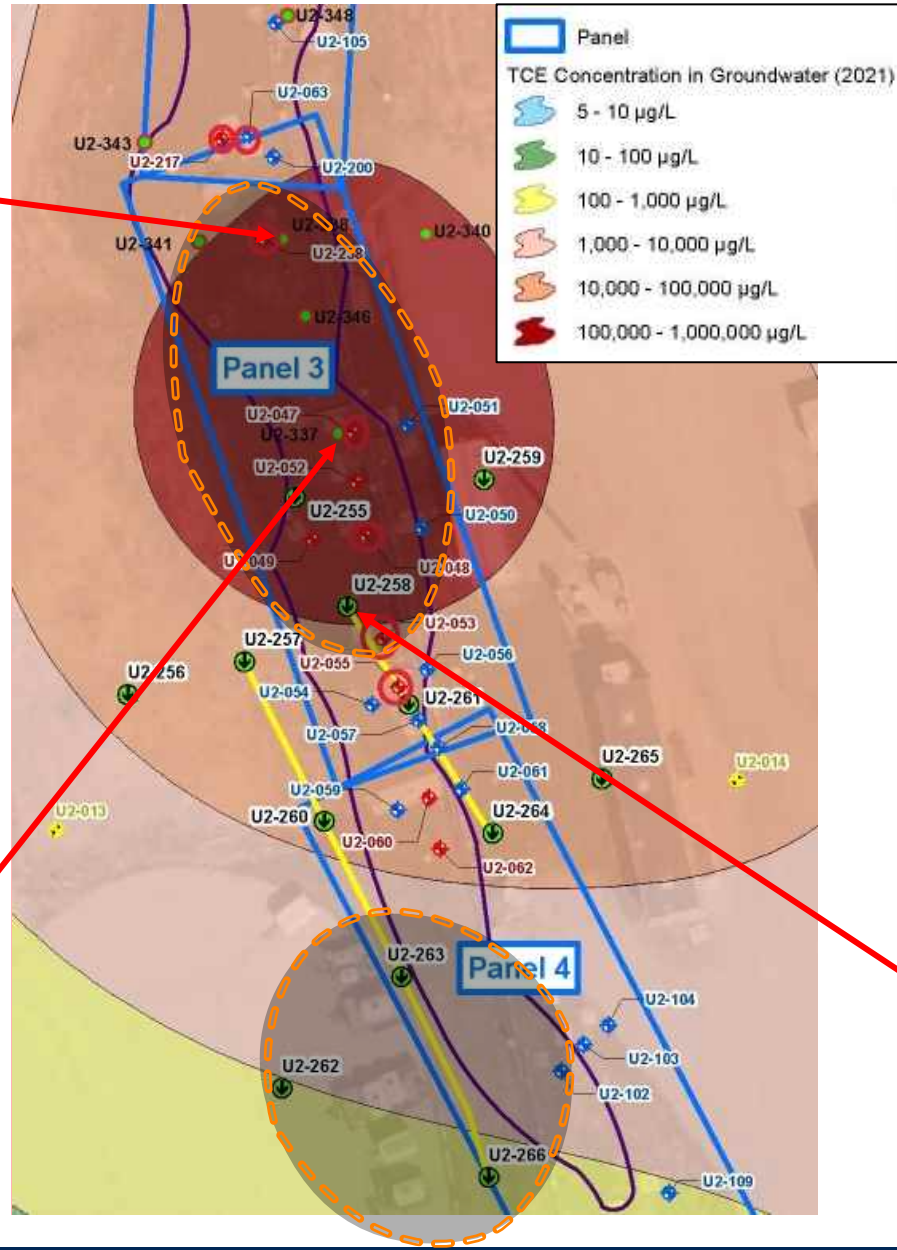


SITE DATA - DNAPL IN PALEOCHANNEL

U2-338



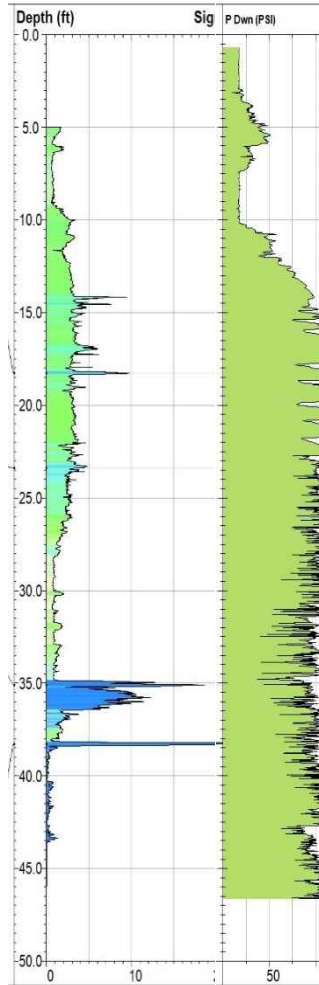
U2-337



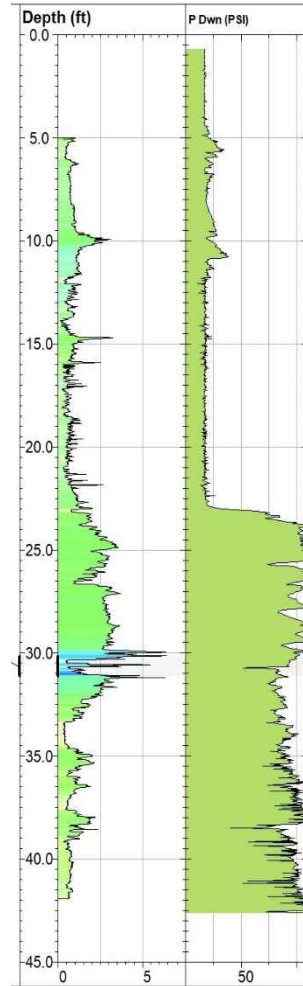
U2-258



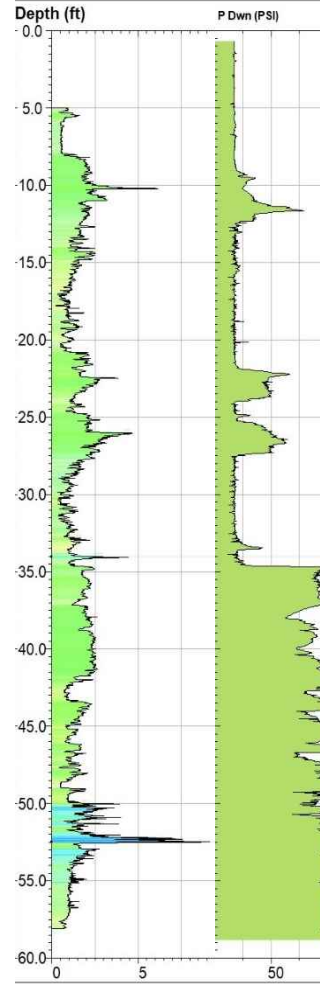
SITE DATA - DNAPL IN CLAY AREA



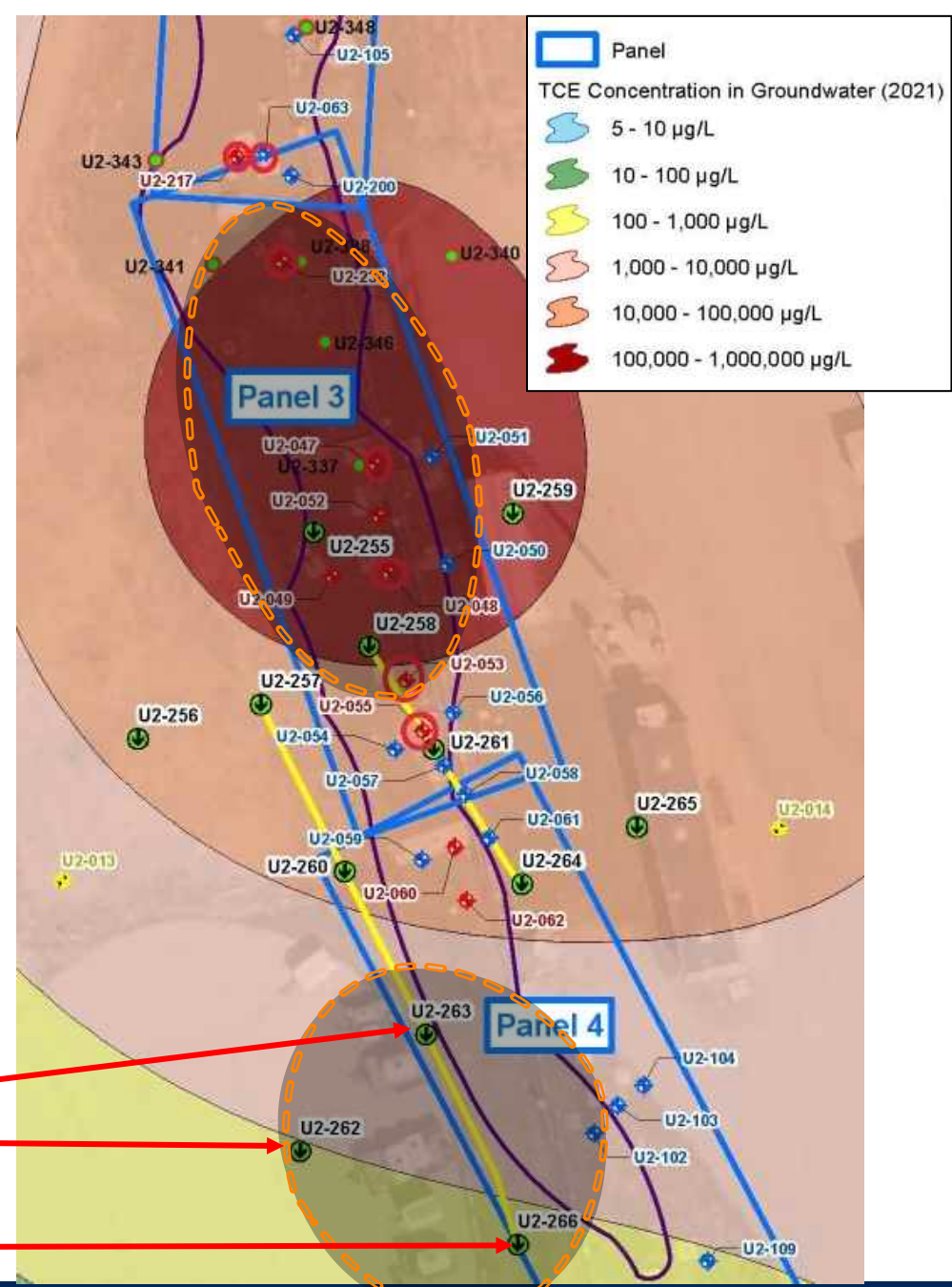
U2-266



U2-262



U2-263



CONFIRMATION - SOIL BORINGS AND SHAKE TEST

- ▶ Of the 19 DyeLIF locations, 4 were chosen for confirmation soil borings: U2-263, U2-266, U2-337, and U2-341
- ▶ Vertical screening of PIDs matched closely with DyeLIF observed DNAPL with PID being > 1,000 ppmv
- ▶ Oil-In-Soil™ shake test did not confirm presence of DNAPL, no noticeable changed colors
- ▶ Soil data collected just above perceived DNAPL confirmed elevated TCE impacts with higher concentrations observed in the clay-impacted samples
 - ▶ Bottom of Paleochannel
 - U2-337: (TCE @ 1,900 ug/kg)
 - U2-341: (TCE @ 1,900 ug/kg)
 - ▶ DNAPL in Clay
 - U2-263: (TCE @ 670,000 ug/kg)
 - U2-266: (TCE @ 250,000 ug/kg)



CONCLUSION

- ▶ DyeLIF was effective in locating residual DNAPL at this site
- ▶ Dye shake test did not work well in confirming the presence of DNAPL
- ▶ Confirmation soil borings did a good job of confirming the DyeLIF data

NEXT STEPS

- ▶ Complete Site Investigation Report considering all investigated work that has taken place at this site
- ▶ Refine existing Conceptual Site Model utilizing 3-D data modeling
- ▶ Complete a Remedy Evaluation and Recommendations Report considering the updated Conceptual Site Model
- ▶ If applicable, update remediation approach
 - ▶ Soil mixing
 - ▶ Thermal treatment



QUESTIONS

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