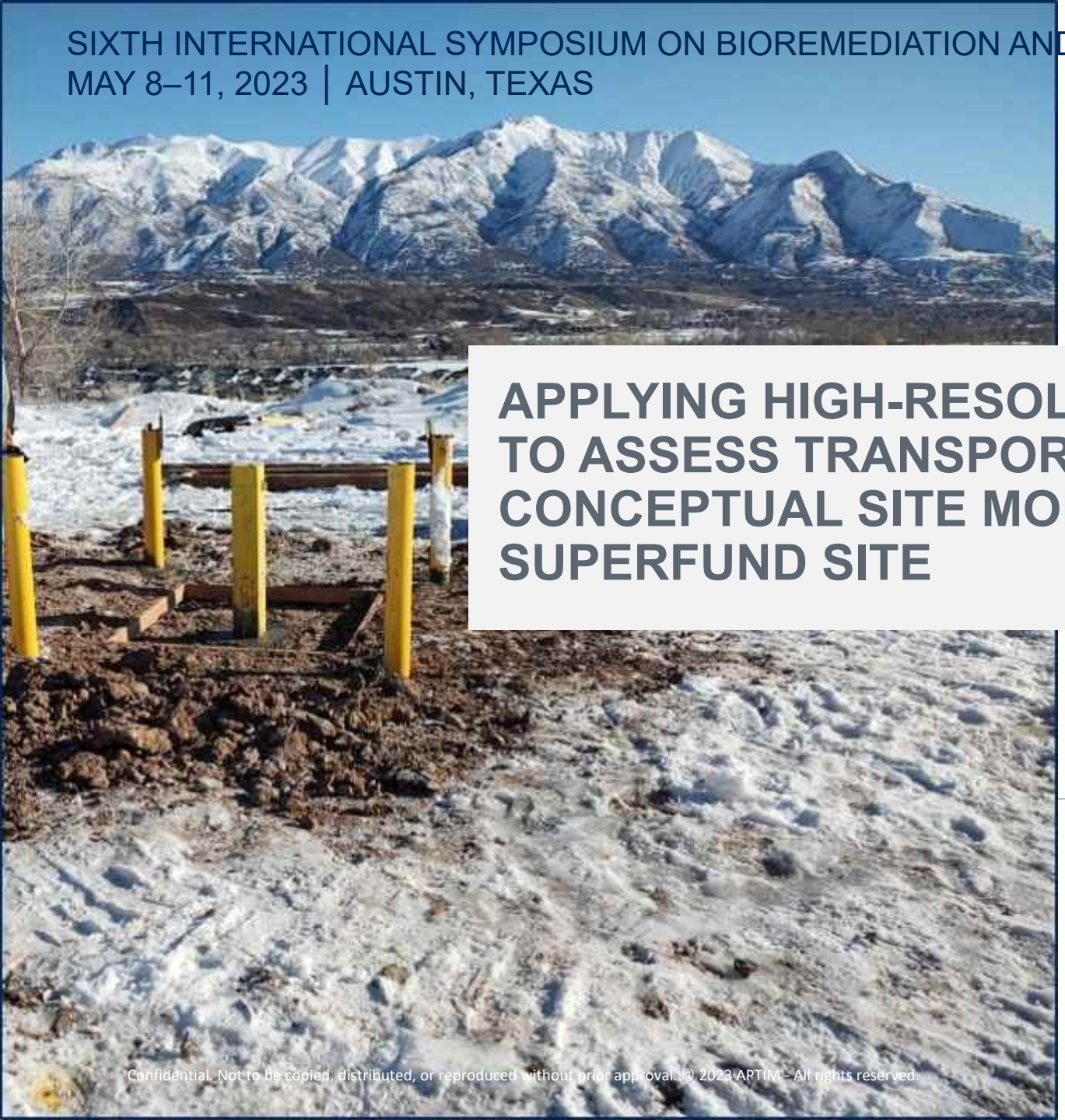
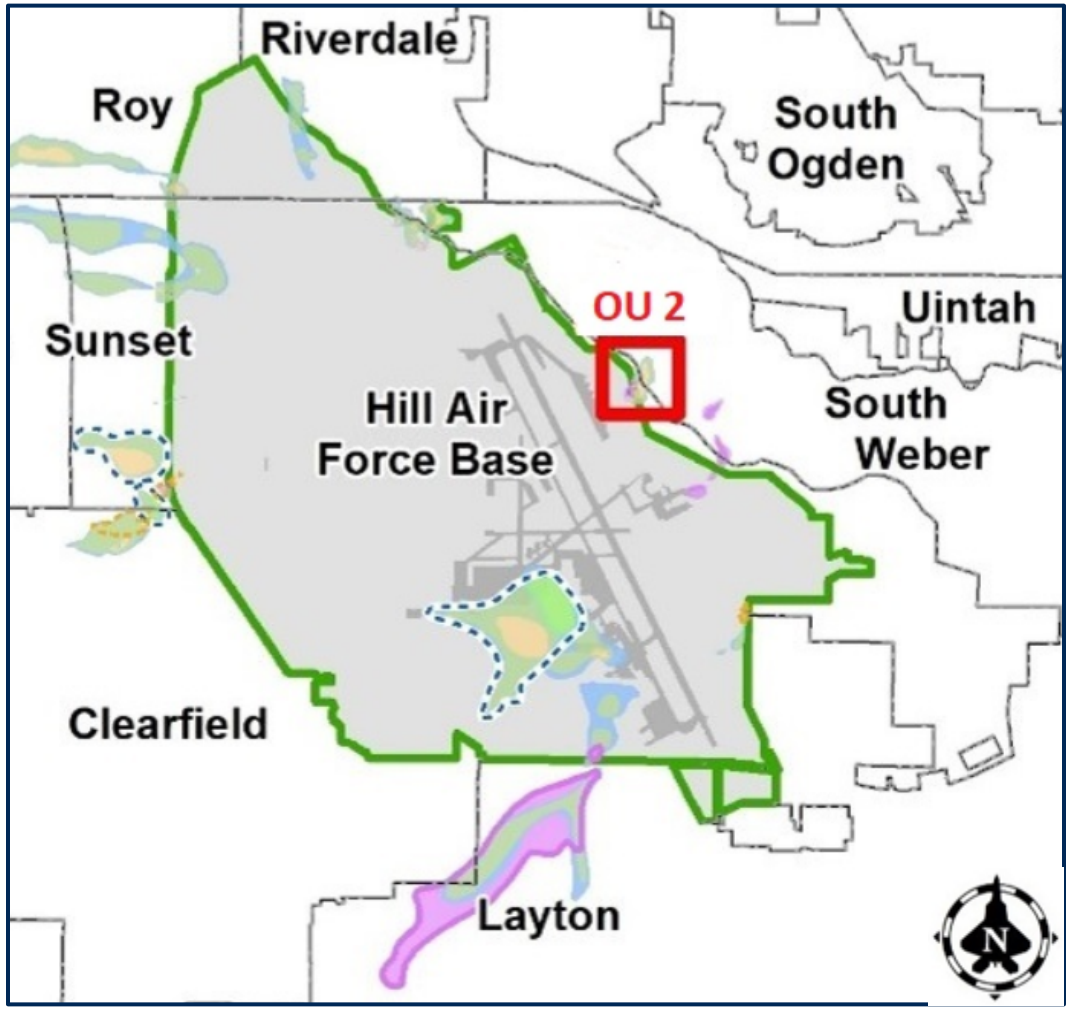
SIXTH INTERNATIONAL SYMPOSIUM ON BIOREMEDIATION AND SUSTAINABLE ENVIRONMENTAL TECHNOLOGIES
MAY 8–11, 2023 | AUSTIN, TEXAS



APPLYING HIGH-RESOLUTION SITE CHARACTERIZATION TO ASSESS TRANSPORT PATHWAYS AND UPDATE CONCEPTUAL SITE MODEL AT HILL AIR FORCE BASE SUPERFUND SITE

Jo Pavlowsky, PE (APTIM, Hill AFB, UT)
Ben Porter (APTIM, Canton, MA)
Jack Briegel (APTIM, Knoxville, TN)
Peifen Tamashiro, PG (AFCEC, Hill AFB, UT)

BACKGROUND: HILL AFB SUPERFUND SITE

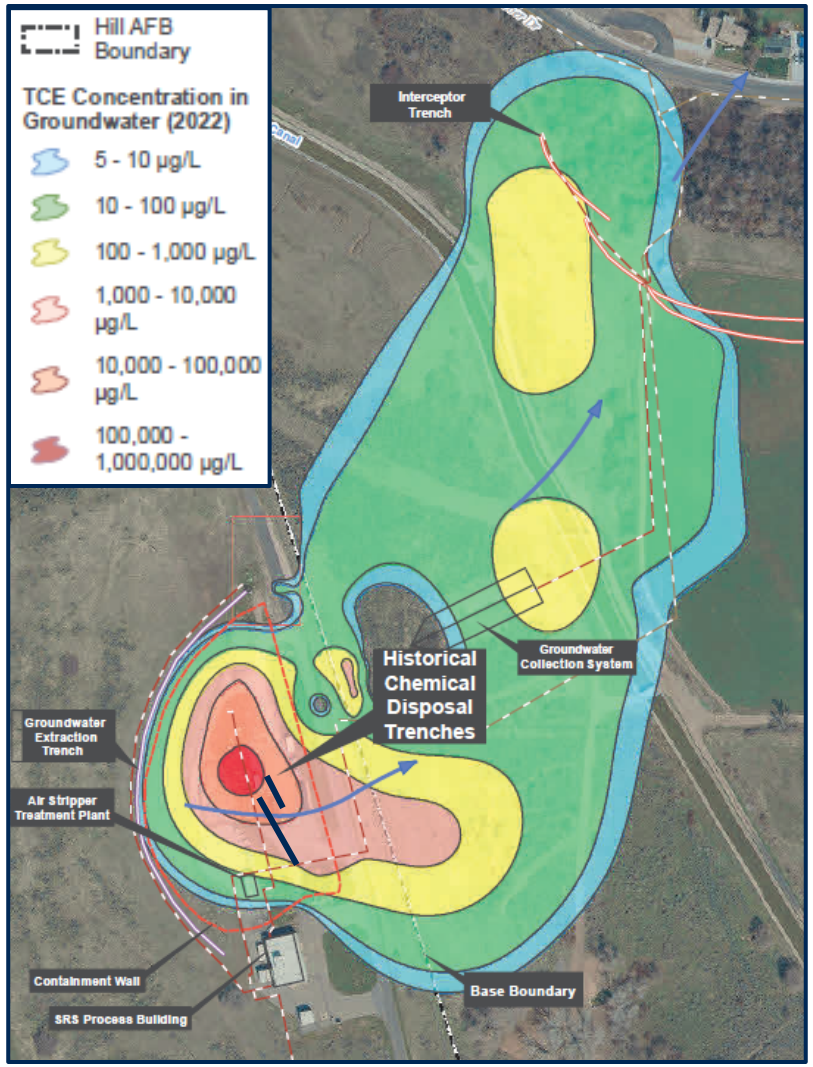


- Active 6,700-acre Air Force Base (AFB)
  - Army depot since 1920; heavy industrial ops since 1957
- Historical industrial operations generated chlorinated and non-chlorinated solvents, fuels and other petroleum products, acids, corrosives, and metals
- Prior to 1980, chemicals and wastes disposed in pits and landfills, forming numerous hazardous waste sites
- Added to National Priorities List in 1987
- 18 operable units (and counting)

BACKGROUND: OPERABLE UNIT 2

- Large quantities of solvents disposed to chemical pits (unlined trenches) in source area from 1960s to 1970s
- Estimated 50,000 gallons of spent chlorinated solvents dumped, forming existing dense non-aqueous phase liquid (DNAPL) source area (TCE [primarily], PCE, and 1,1,1-TCA)
- Downward movement of DNAPL restricted by buried clay paleochannel ("trough")
- Groundwater flow to northeast; TCE plume migrating downhill and off-Base to residential areas ("Non-Source Area")

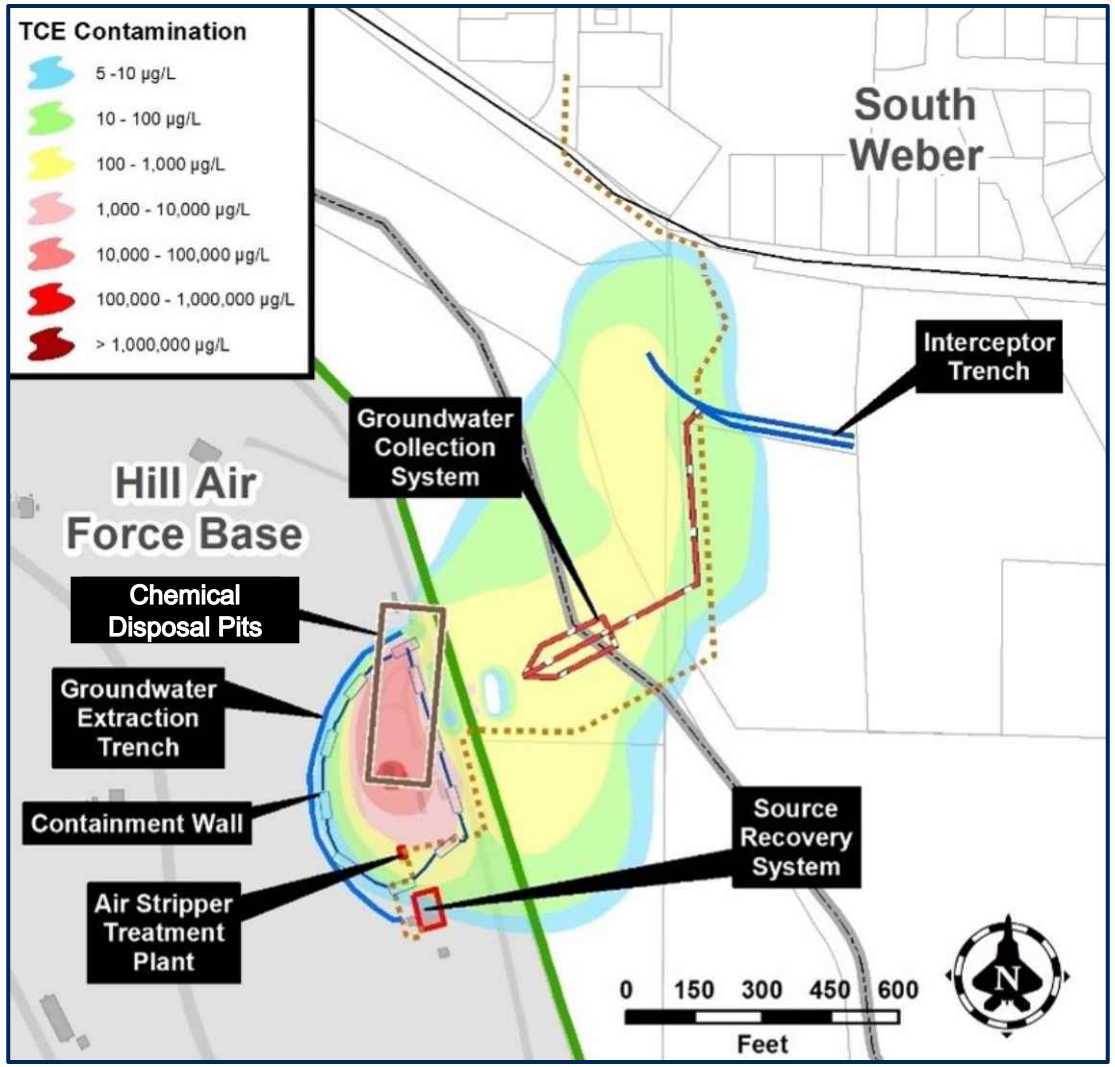
OU2 TCE PLUME (2022)



BACKGROUND: OPERABLE UNIT 2

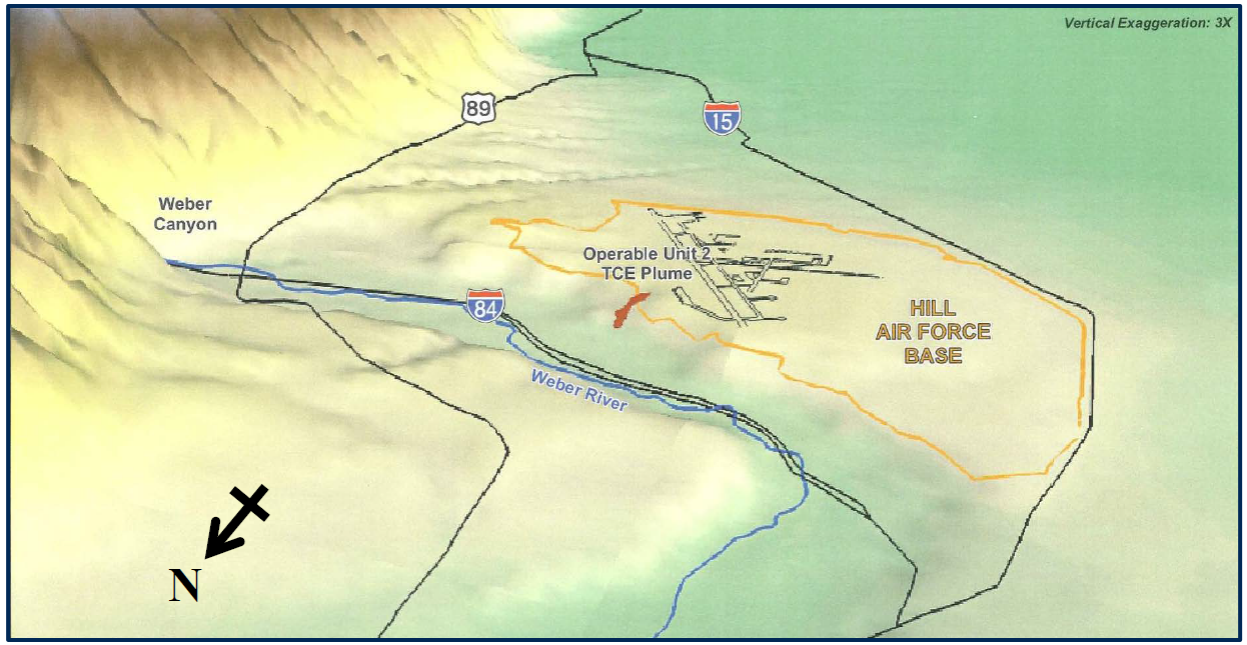
- Remedial Investigation (RI) in early 1990s
  - ROD signed in 1996
- Source Area Remedial Systems
  - Source Recovery System free-product and groundwater recovery well-field (1993)
    - 44,500 gal DNAPL removed to date
  - Containment wall: in-situ bentonite slurry and soil mixture, 1500 feet in length and 60-90 feet bgs (1996)
  - Upgradient Groundwater Extraction Trench (1996)
  - Air Stripper Treatment Plant (1996)

OU2 REMEDIAL SYSTEMS (2019 TCE PLUME)

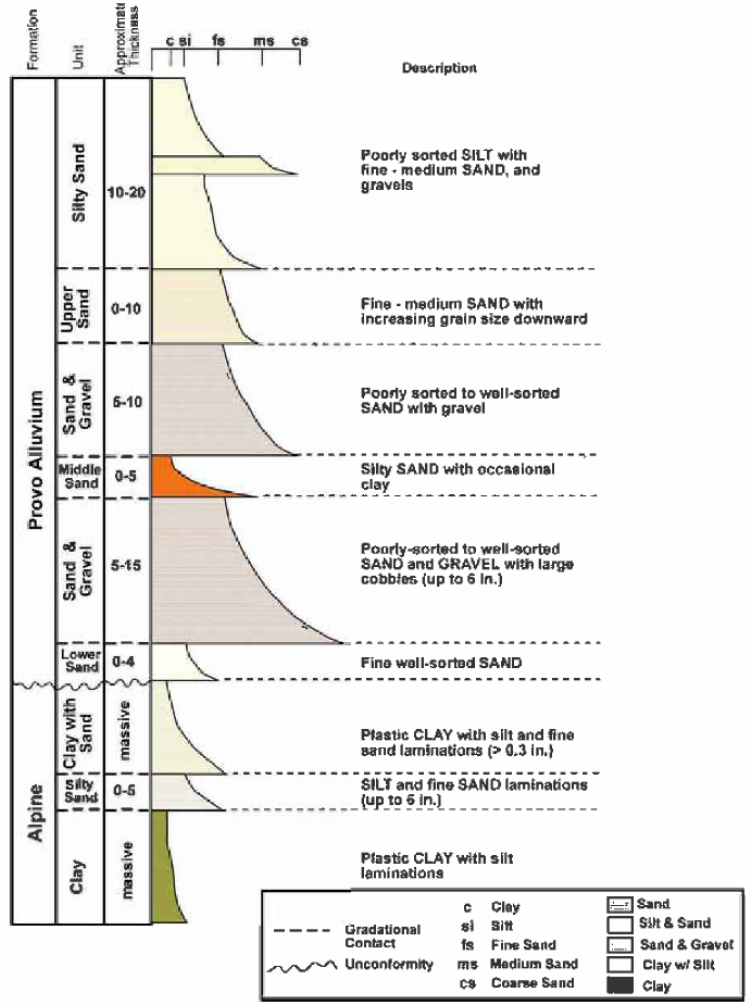


CONCEPTUAL SITE MODEL: GEOLOGY

- Geological Setting
  - Hill AFB Site located on plateau incised by Weber River, result of prehistoric Lake Bonneville formation and recession
- Lithology
  - Heterogenous; Depositional fluvial and lacustrine sediment from Weber River Delta; lenticular



STRATIGRAPHY (SOURCE AREA)

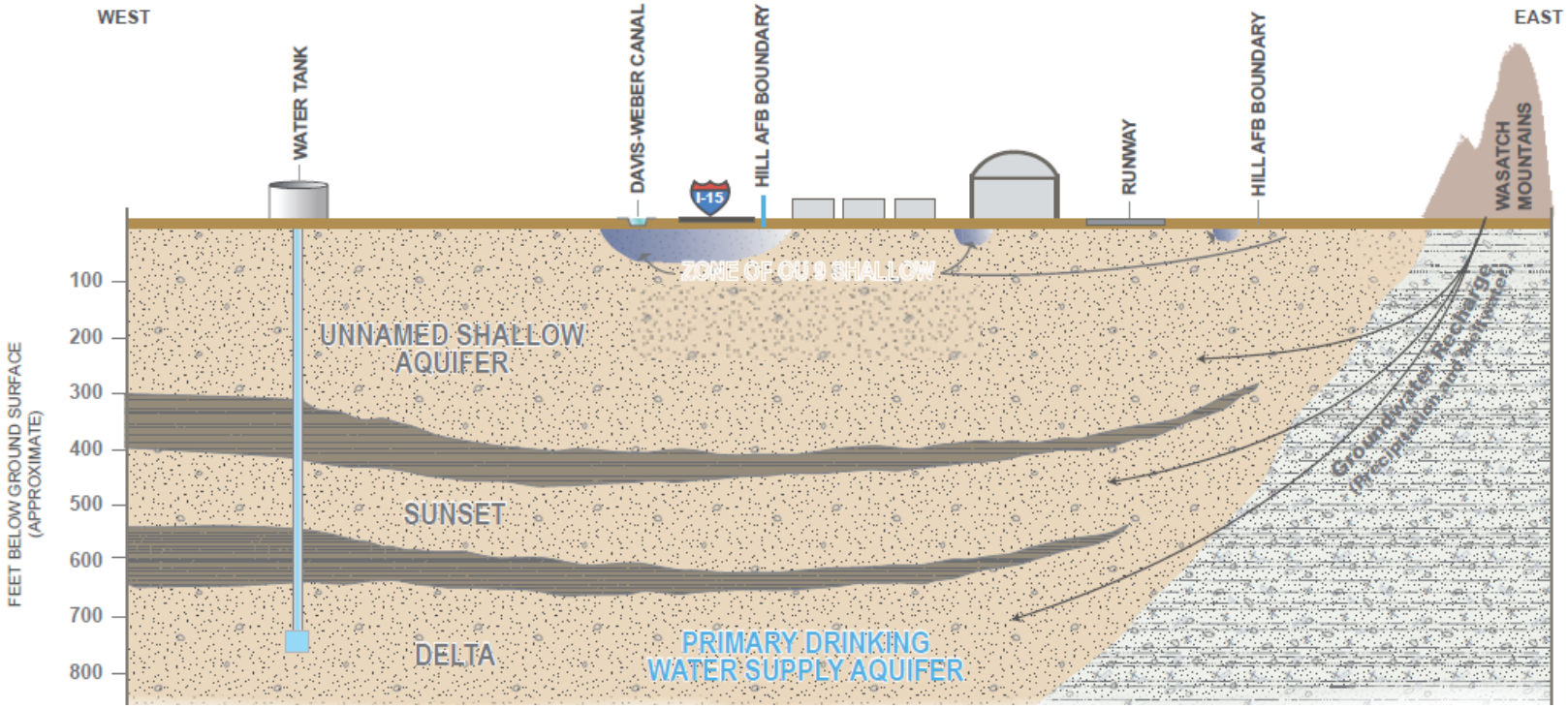


Sources: Conceptual Site Model OU2 Source Area (URS Corp and INTERA 2013) (Left): OU2 Performance Standard Verification Report (USAF 2012)

CONCEPTUAL SITE MODEL: HYDROGEOLOGY

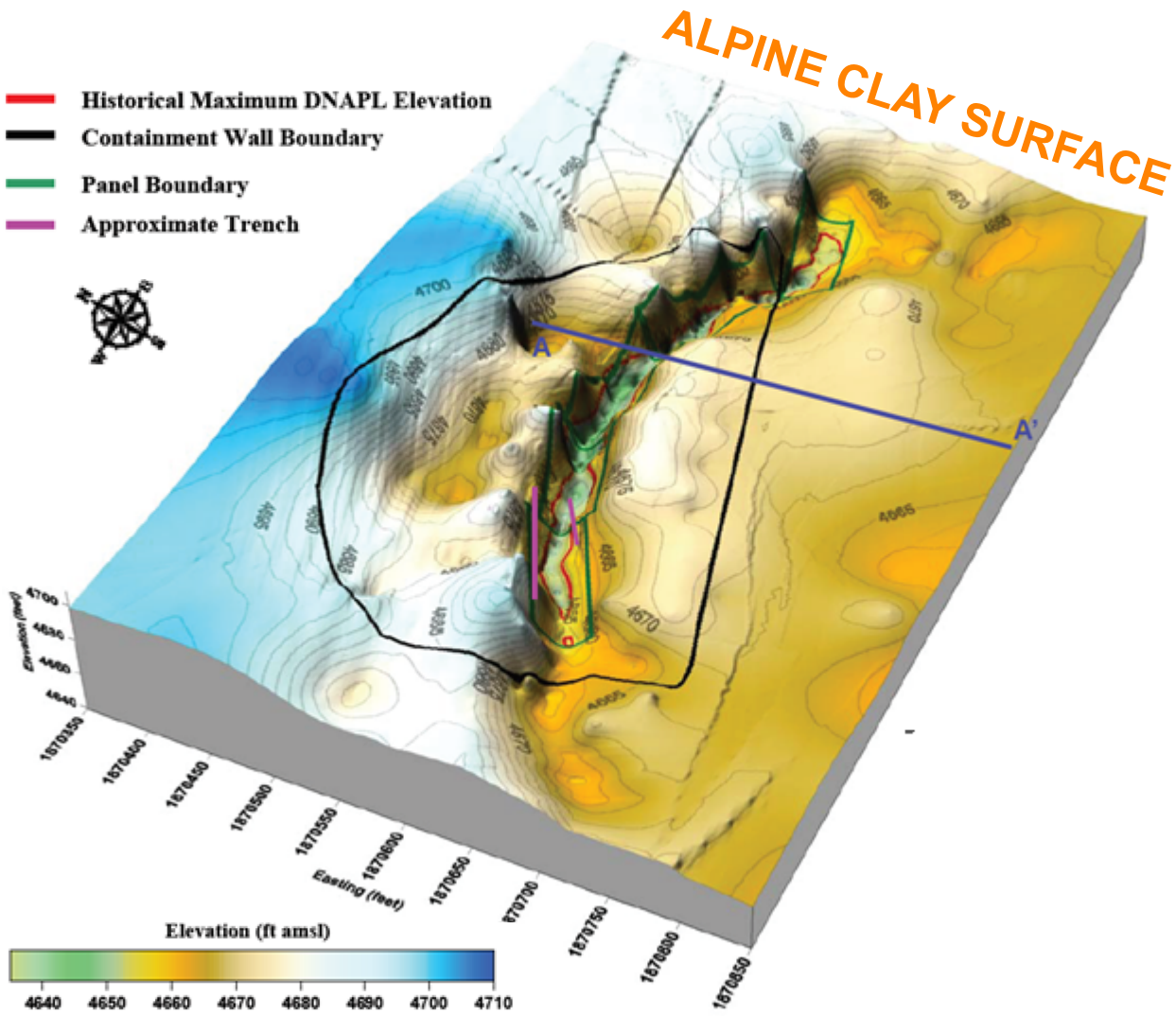
Two Hydrologic Units Underlying OU2:

- Shallow Aquifer System: Contaminated; semi- and un- confined
- Deep Delta Aquifer
  - Underlies Alpine Formation (aquitard)
  - Separate from shallow system
  - Regional water supply, no contamination



CONCEPTUAL SITE MODEL: CONTAMINANT FATE & TRANSPORT

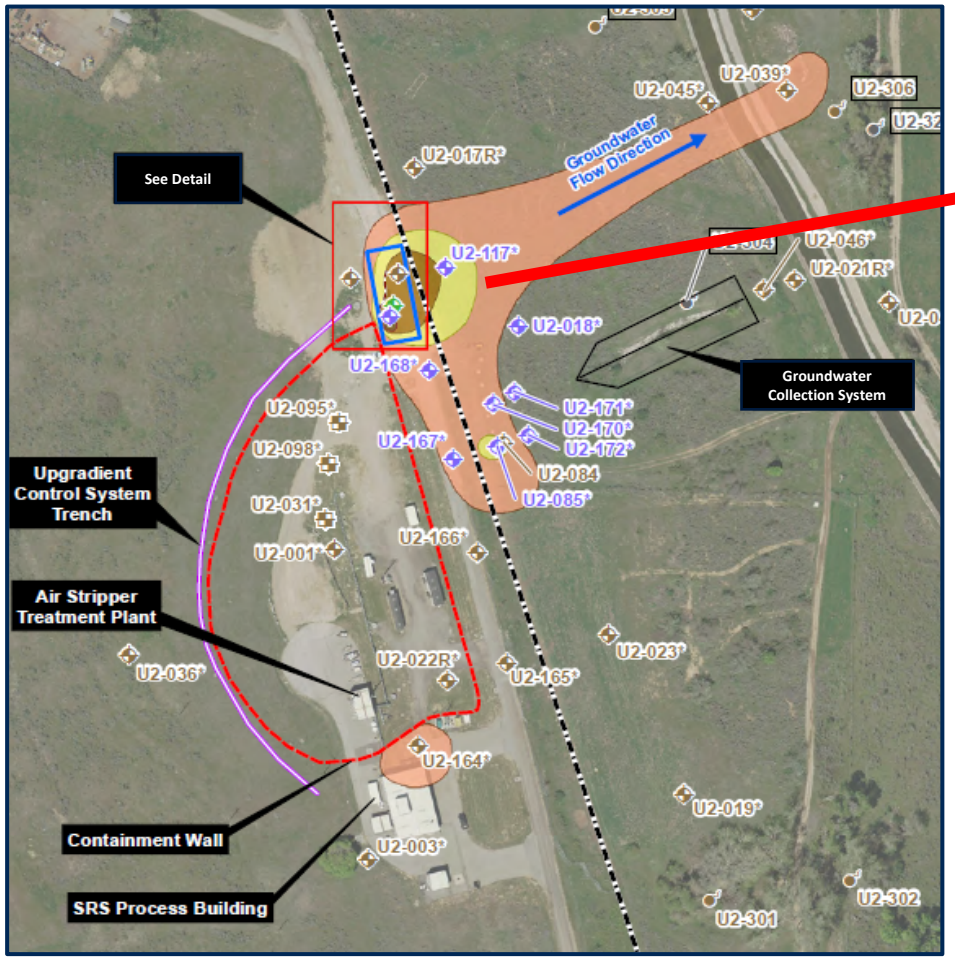
- Source Area situated in Provo Alluvium within buried channel incised into the underlying Alpine Clay unit
  - Clay unit understood as aquitard
- DNAPL accumulated in paleochannel sources the non-source plume
- Groundwater elevation within source area containment wall hydraulically controlled by groundwater extraction system to ensure inward gradient

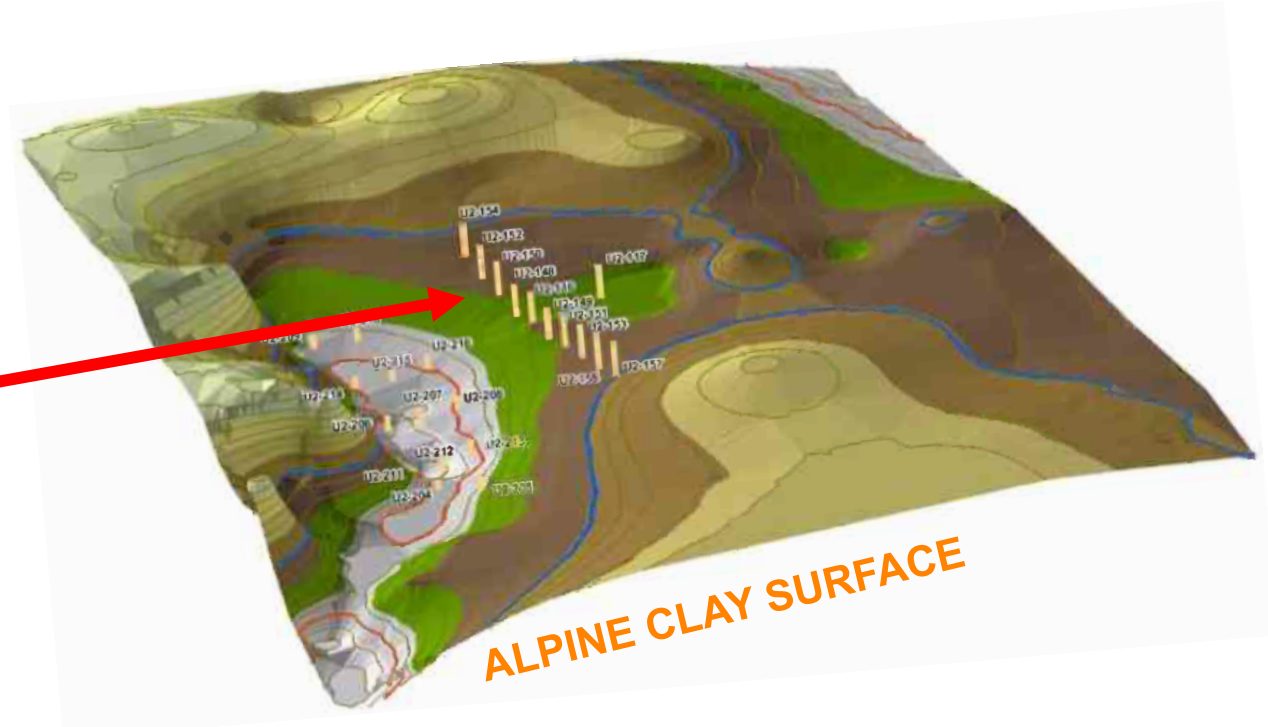


Source: Conceptual Site Model OU2 Source Area (URS Corp and INTERA 2013)

CONCEPTUAL SITE MODEL: CONTAMINANT FATE & TRANSPORT

VC PLUME MIGRATION (2019)



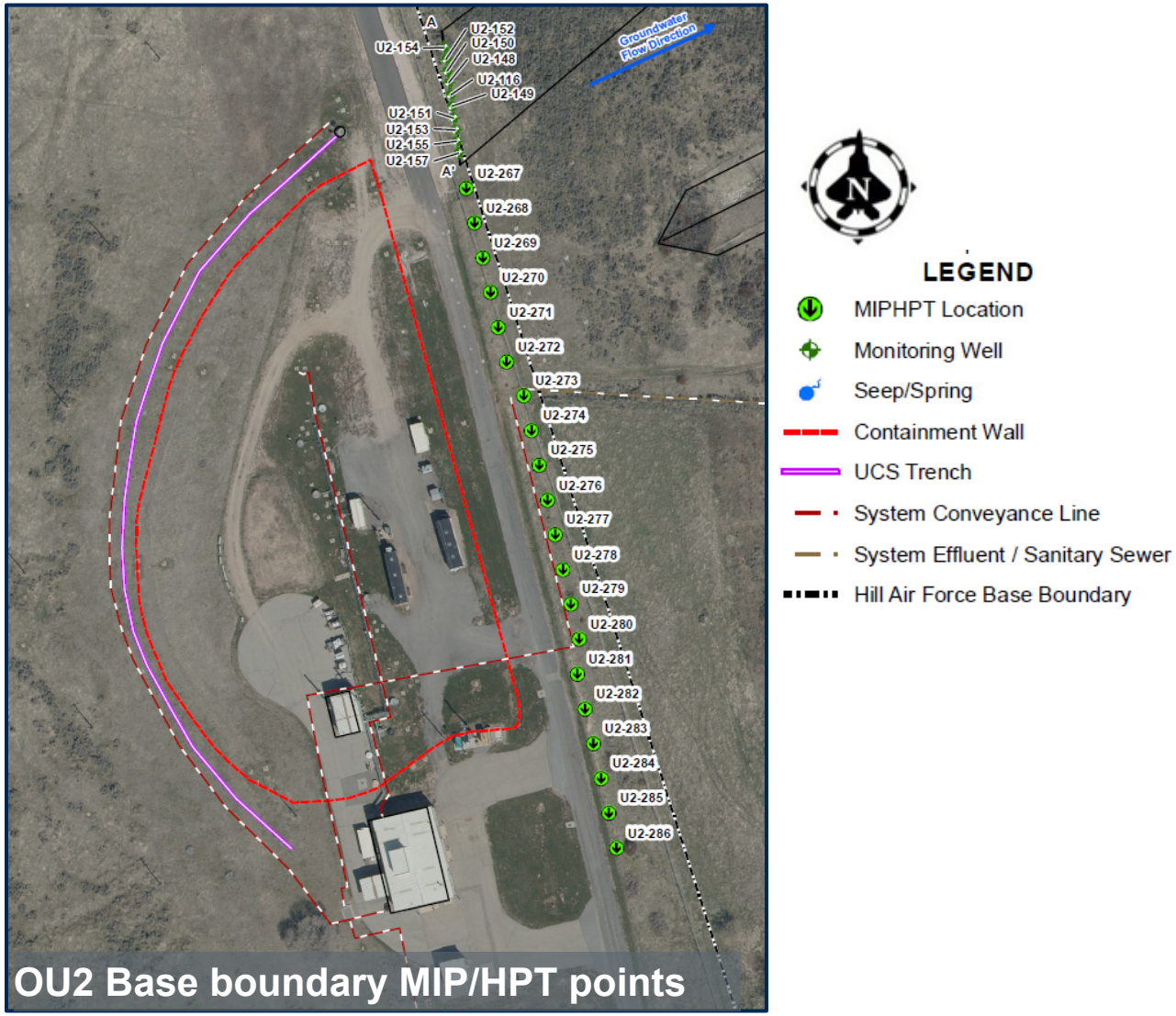


PLUME MIGRATING OFF-BASE THROUGH LOWER ELEVATION ALPINE CLAY "SPILLOVER" PATHWAY

SITE INVESTIGATION: SCOPE

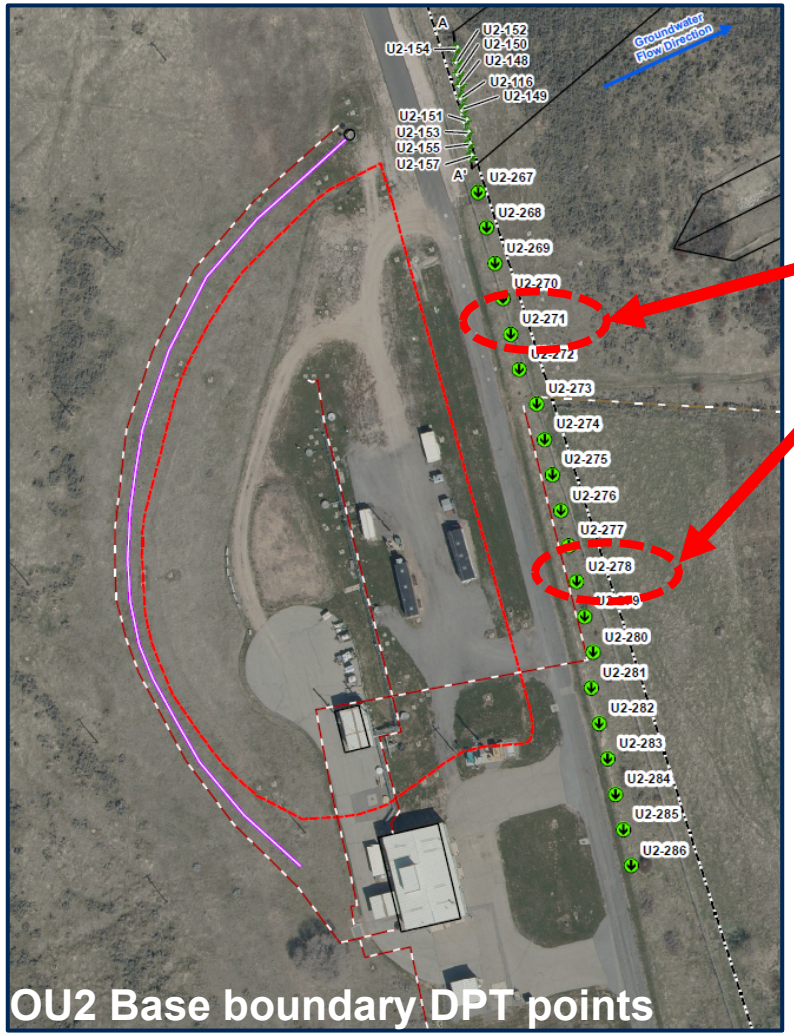
- Use HRSC techniques to assess potential transport pathways from the Source Area to the Non-source Area
  - On the lookout for:
    - Lower elevation spillover pathways in the Alpine Clay unit
    - Permeable pathways through the Alpine Clay “aquitard”
- Membrane interface probe/ hydraulic profiling tool (MIP/HPT) at 20 locations along Base boundary

Source: Low Level MIP (Geoprobe Environmental Technologies, 2023)



OU2 Base boundary MIP/HPT points

SITE INVESTIGATION: HRSC FIELD ACTIVITIES



OU2 Base boundary DPT points

LEGEND

- MIPHPT Location
- Monitoring Well
- Seep/Spring
- Containment Wall
- UCS Trench
- System Conveyance Line
- System Effluent / Sanitary Sewer
- Hill Air Force Base Boundary

Install two borings using standard methods to “ground-truth” MIP/HPT data:

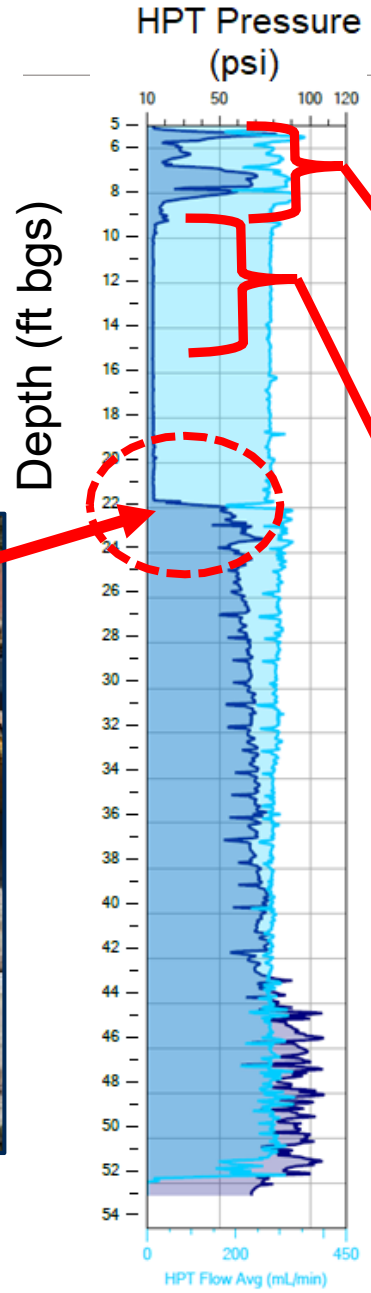
1. Collect VOC **soil** samples from select intervals using standard direct push (DPT) drilling methods
2. Collect VOC **groundwater** samples from installed monitoring wells using hollow stem auger drilling methods
3. Continuously log to 50 ft bgs for borehole lithology

Well install at U2-278

SITE INVESTIGATION: HPT RESULTS

PROVO ALLUVIUM AND ALPINE CLAY INTERFACE AT 22 FT BGS AT U2-271 (SOIL BORING)

- Sharp pressure increase on HPT log



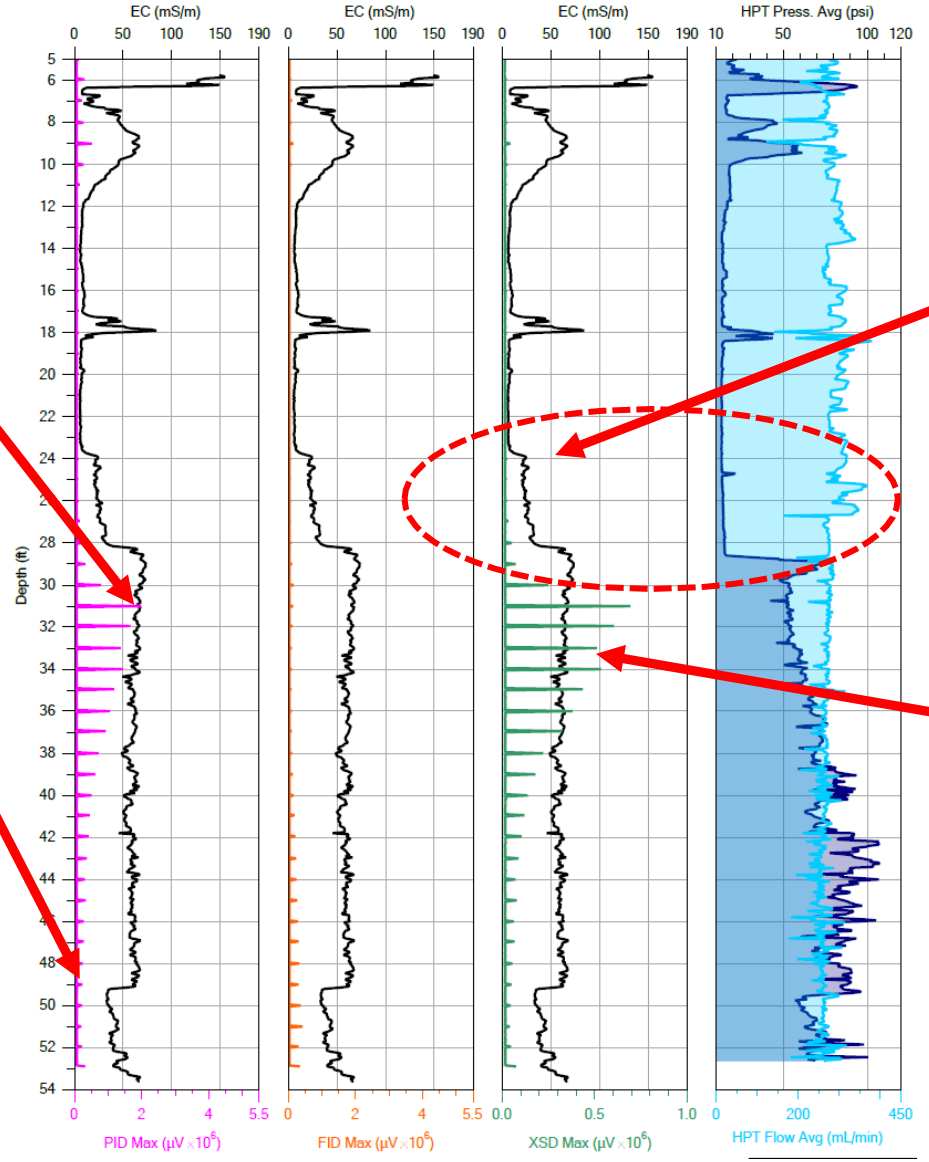
INTERFACE OF FINE-GRAINED UPPER AND WELL-SORTED LOWER PROVO ALLUVIUM AT U2-271

SITE INVESTIGATION: MIP/HPT RESULTS

U2-278 SOIL SAMPLING TCE CONCENTRATIONS

- 31 to 32 ft bgs: 1,600 ug/kg
- 49 to 50 ft bgs: ND

SAND LENSES OBSERVED IN SAMPLED CLAY INTERVAL



EC JUMP (WITHOUT HPT) INDICATES START OF WATER TABLE

- Water table overtops Provo/Alpine interface

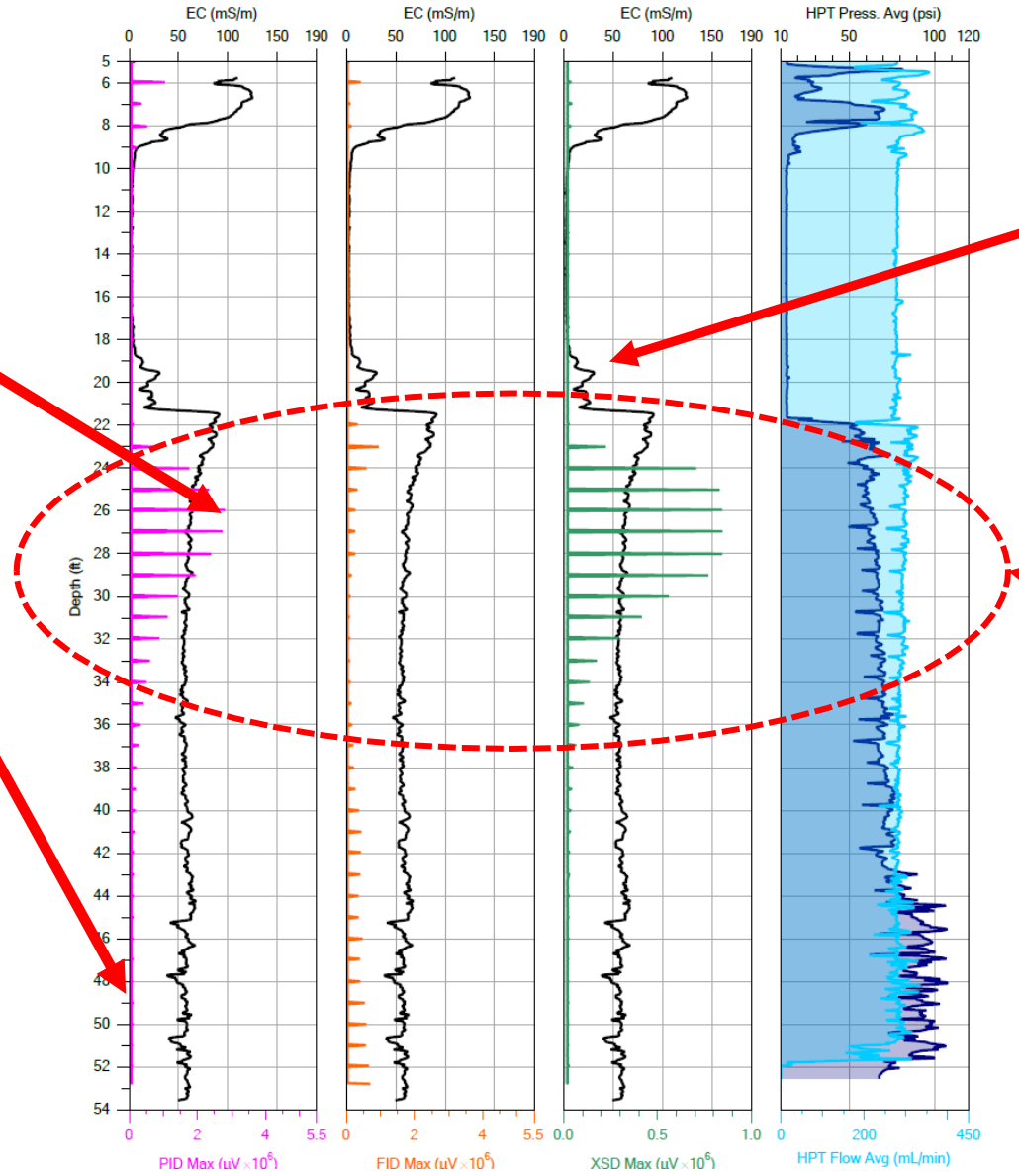
SPIKING ON PID AND XSD SENSORS WITHIN UPPER ALPINE CLAY UNIT

- No detections in permeable Provo sand/gravel zone

SITE INVESTIGATION: MIP/HPT RESULTS

U2-271 SOIL SAMPLING TCE CONCENTRATIONS

- 26 to 27 ft bgs: 18,000 ug/kg
- 49 to 50 ft bgs: ND



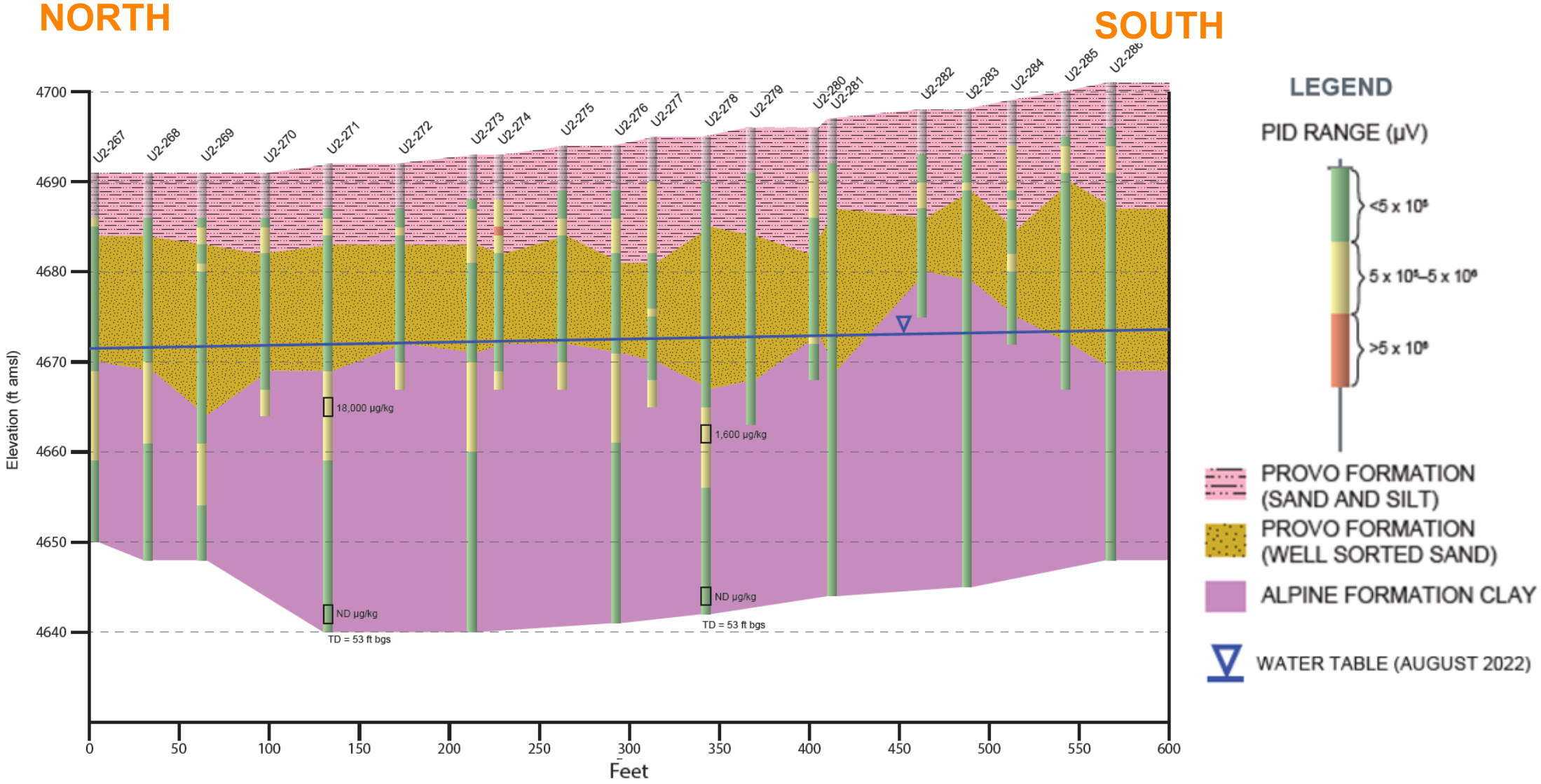
START OF WATER TABLE

- Wet sand confirmed above Provo/Alpine interface during logging

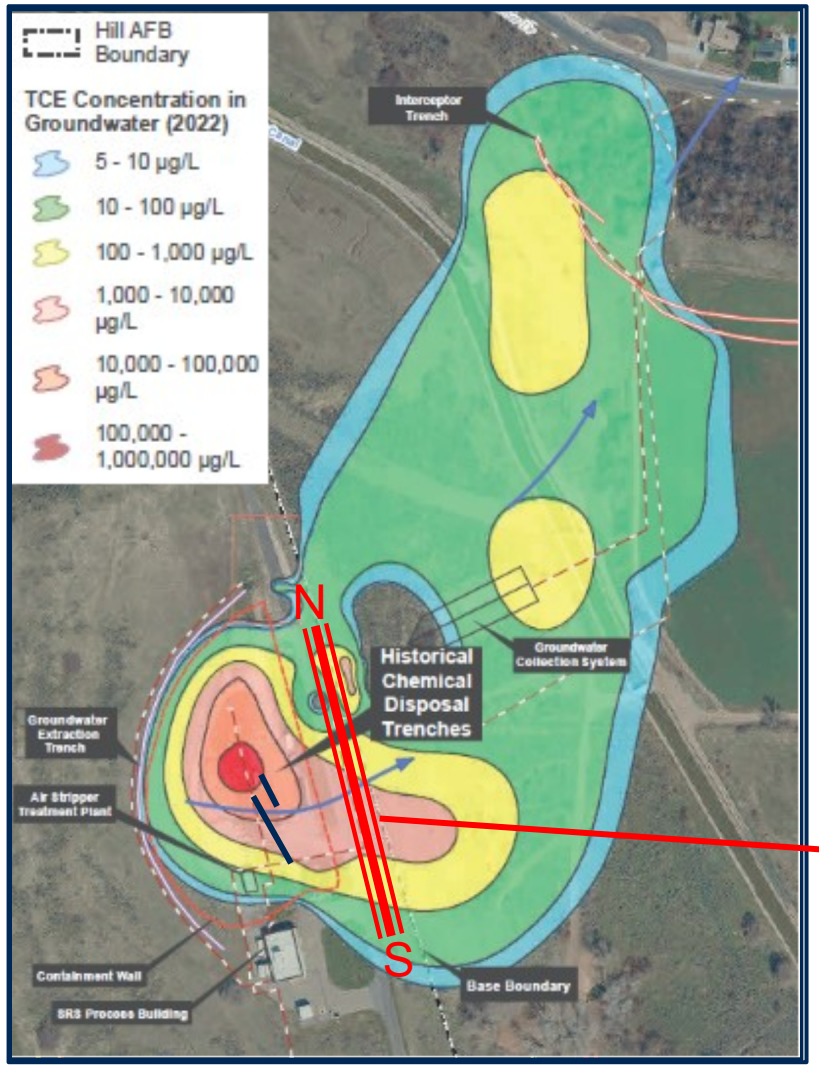
SPIKING ON ALL SENSORS (PID, FID, AND XSD) IN UPPER ALPINE CLAY

- No detections in permeable Lower Provo Alluvium

SITE INVESTIGATION: OU2 BASE BOUNDARY TRANSECT

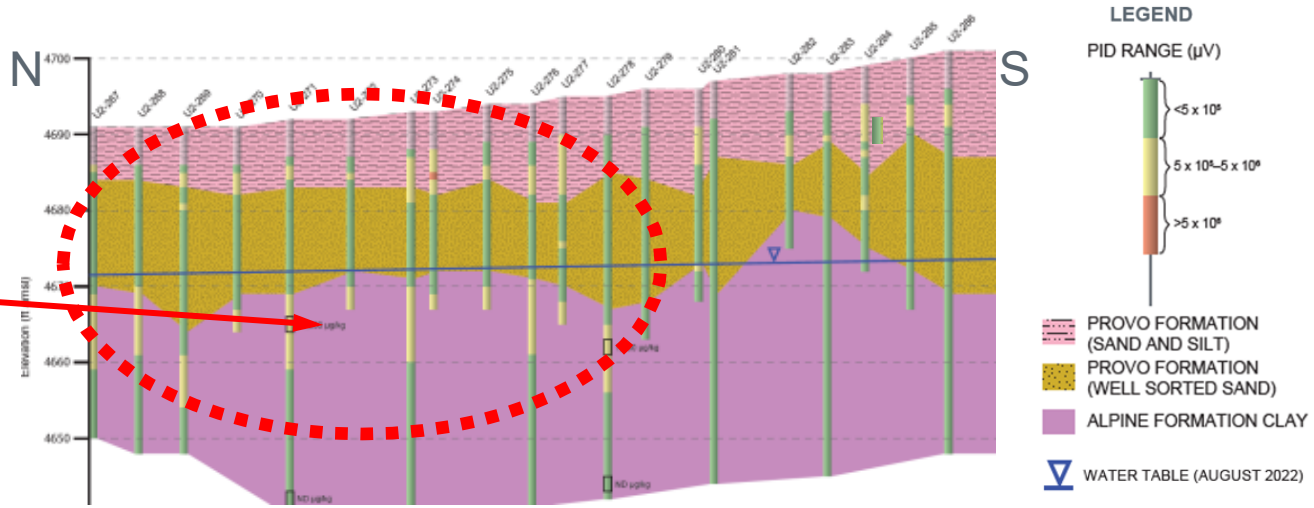


RESULTS AND DISCUSSION



- TCE primarily in Alpine Clay and fine-grained Upper Provo formations along Base boundary
  - Alpine Formation currently modeled as aquitard
- TCE largely absent in permeable Lower Provo formation
  - Presumably “washed out;” contamination moving slower through tighter formations

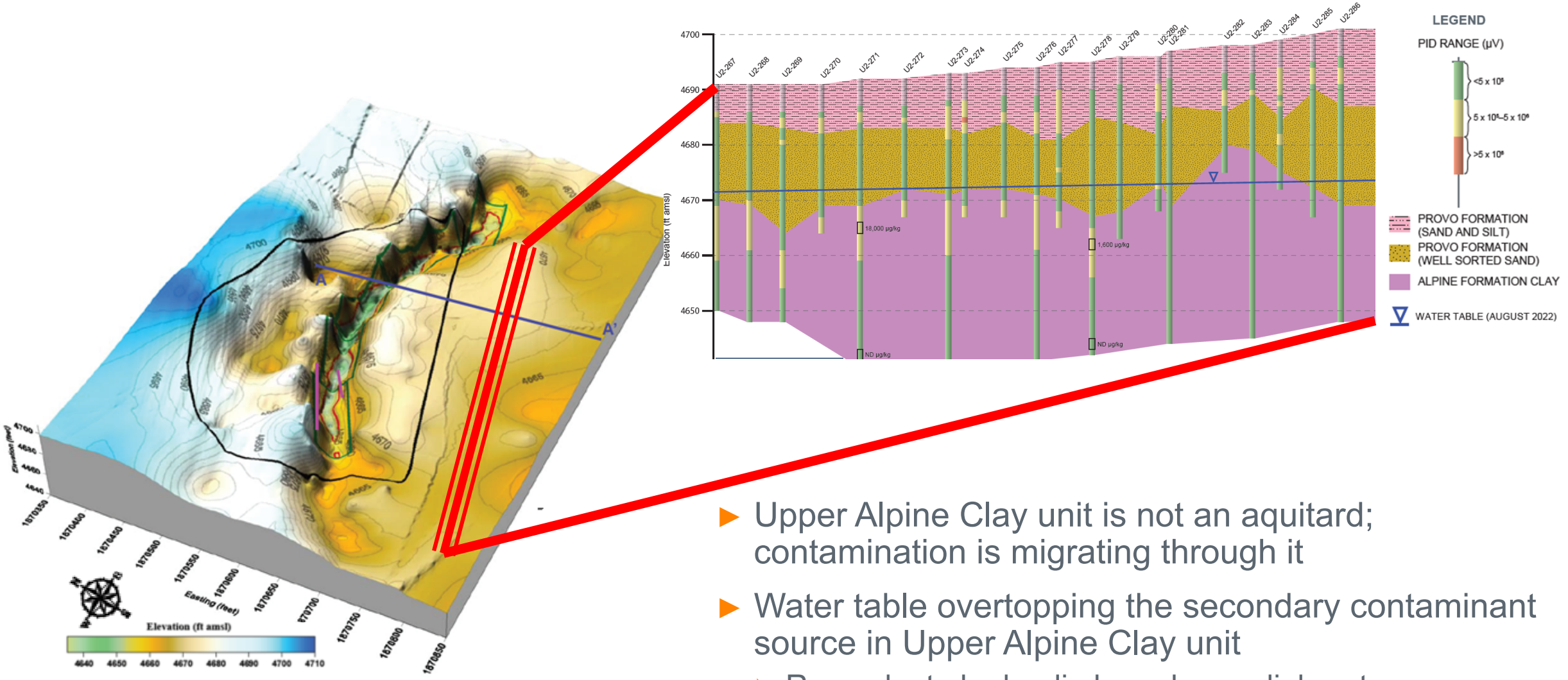
BASE BOUNDARY TRANSECT



RESULTS AND DISCUSSION

- Sand lenses observed within the upper Alpine Clay Formation during logging
  - Sand not included in current lithologic modeling
- Water table overtops Alpine Clay unit at Base boundary
  - Wetness (and DNAPL) observed above Provo/Alpine interface

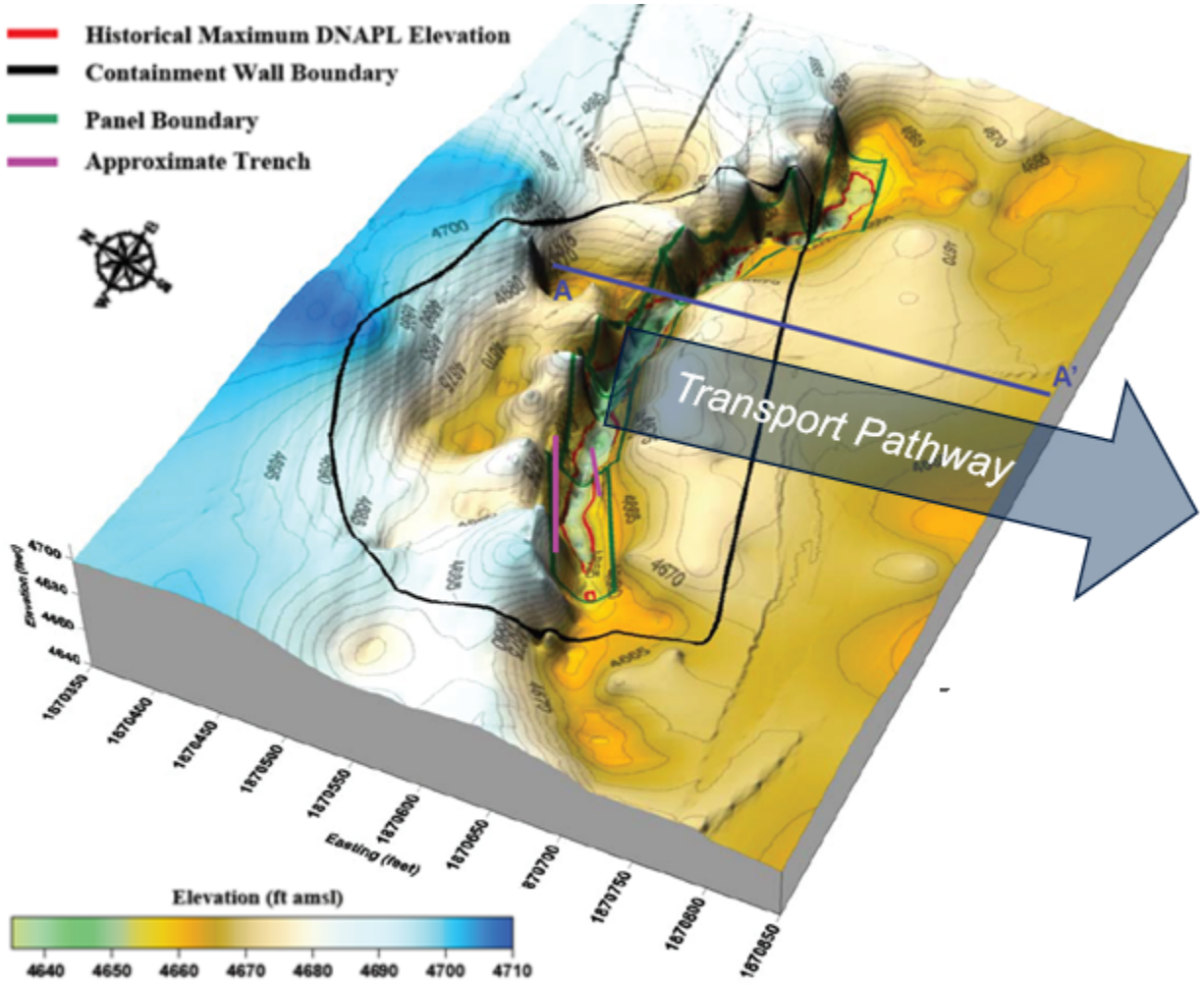
UPDATES TO CONCEPTUAL SITE MODEL



- Upper Alpine Clay unit is not an aquitard; contamination is migrating through it
- Water table overtopping the secondary contaminant source in Upper Alpine Clay unit
  - Re-evaluate hydraulic-based remedial system

Source: *Conceptual Site Model OU2 Source Area* (URS Corp and INTERA 2013)

OPERABLE UNIT 2: NEXT STEPS



- Complete the investigation
- Generate and update 3D contaminant fate and transport model with HRSC data and site investigation results
- Reevaluate OU2's existing remedy, based on new understanding of contaminant transport pathways from the Source Area

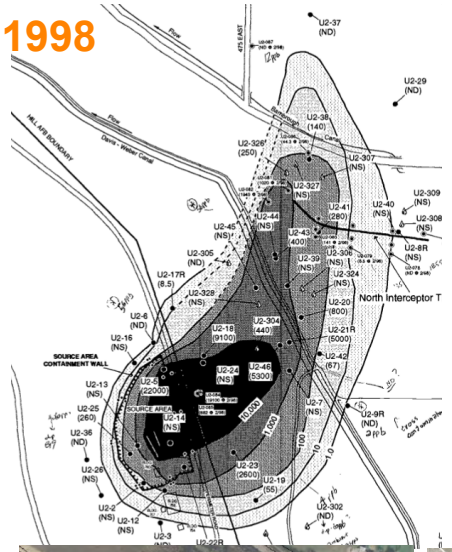
Source: *Conceptual Site Model OU2 Source Area* (URS Corp and INTERA 2013)

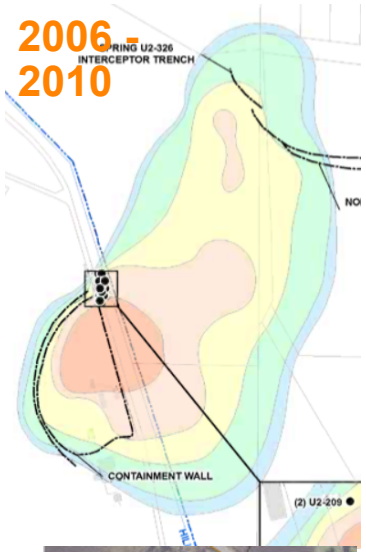
QUESTIONS

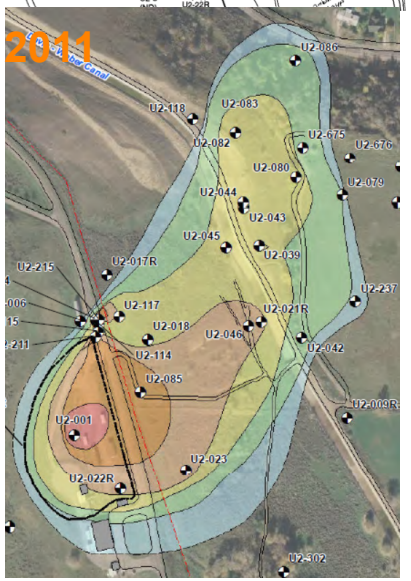
JO PAVLOWSKY, P.E.
Johanna.Pavlowsky@APTIM.com
Mobile: 314 833 7325

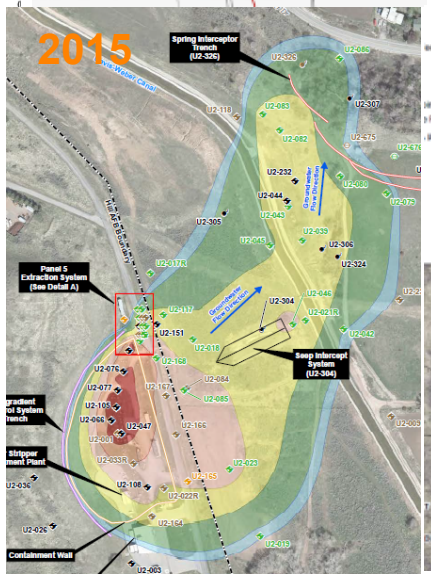
Expect the Extraordinary.

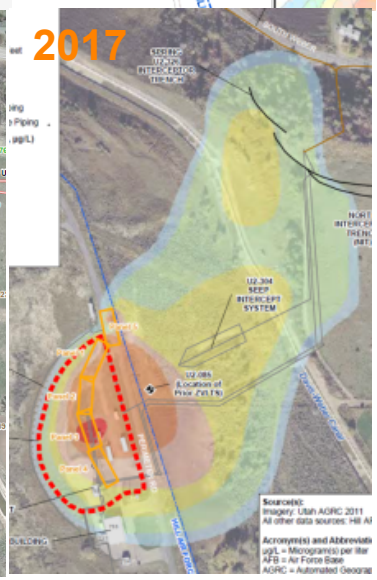
OU2 TCE PLUME (1998–2022)

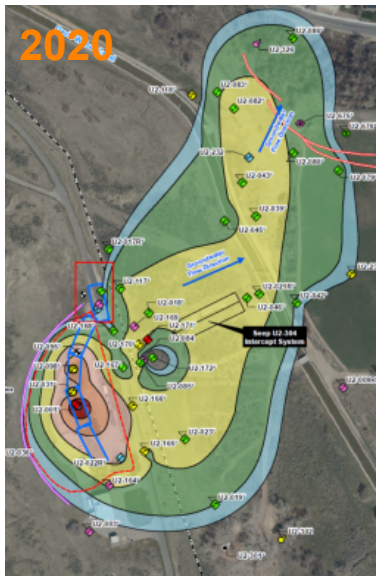


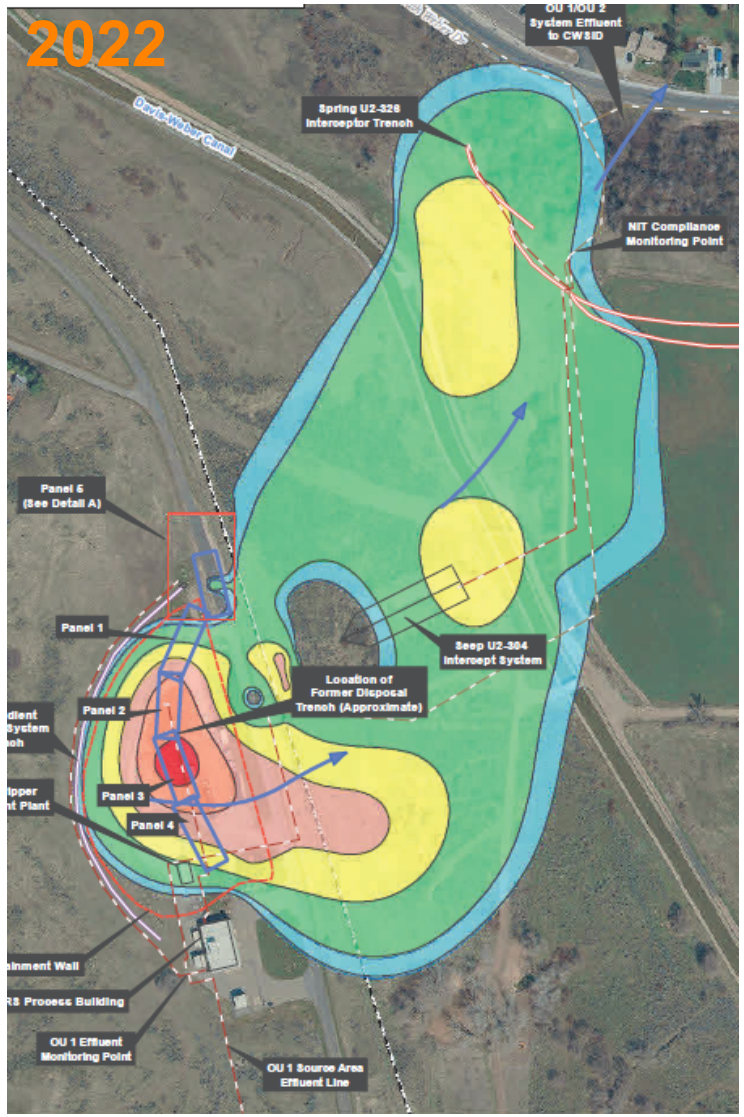






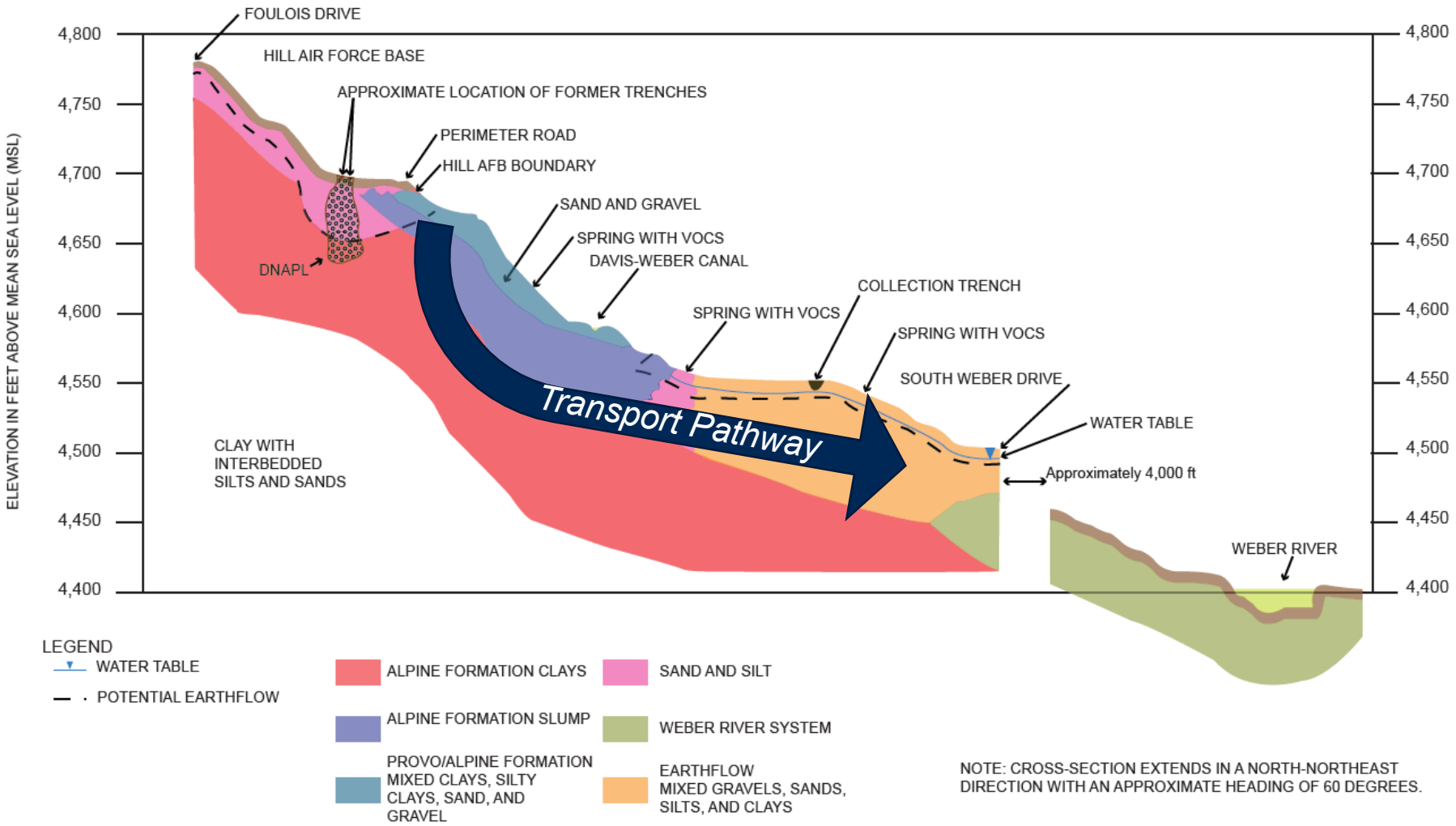




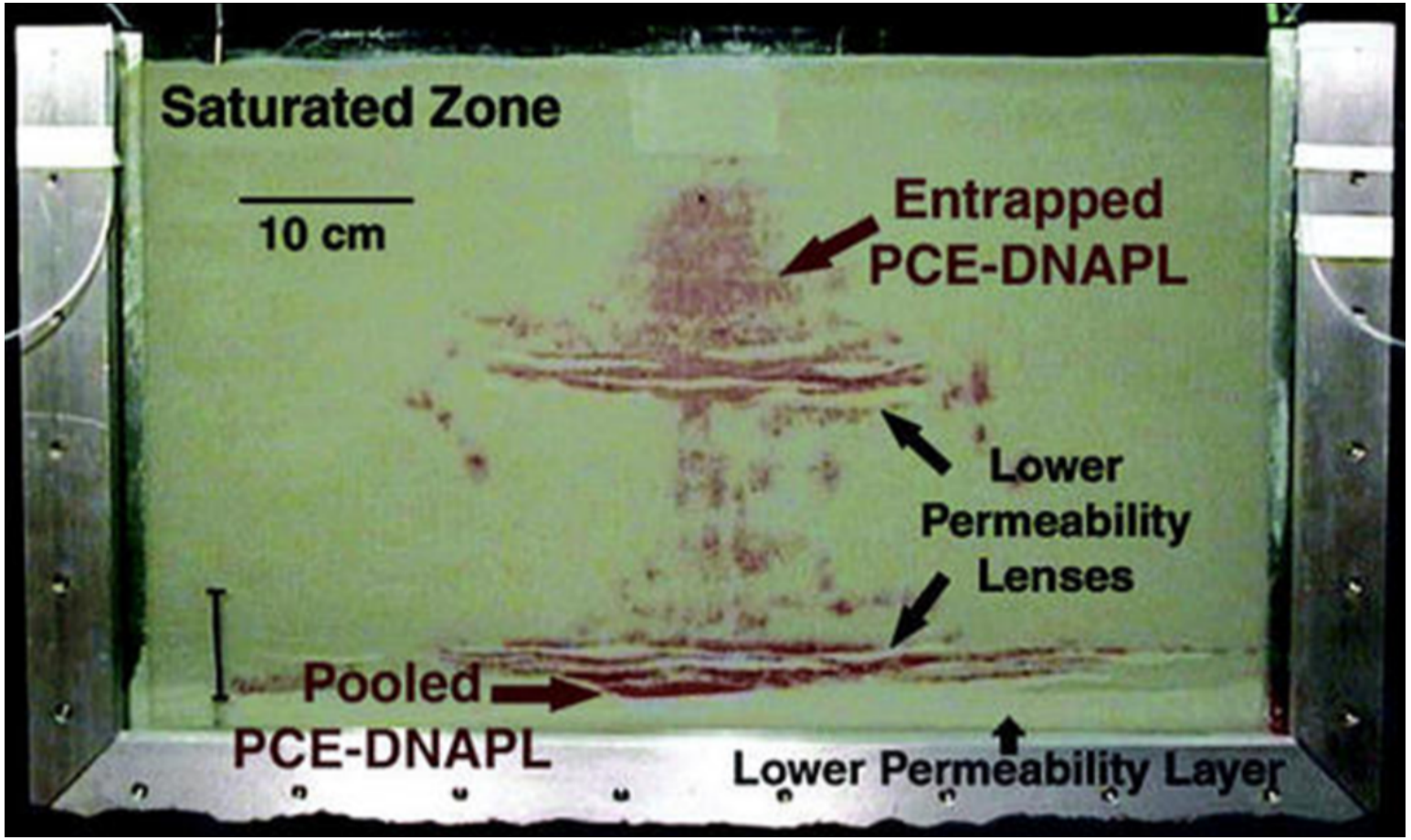


CONCEPTUAL SITE MODEL: CONTAMINANT FATE & TRANSPORT

OU 2 LOCATED WITHIN SOUTH WEBER LANDSLIDE COMPLEX



DNAPL MIGRATION THROUGH MEDIA



Source: *Dense Chlorinated Solvents in Porous and Fractured Media* (Schwile, 1988)