



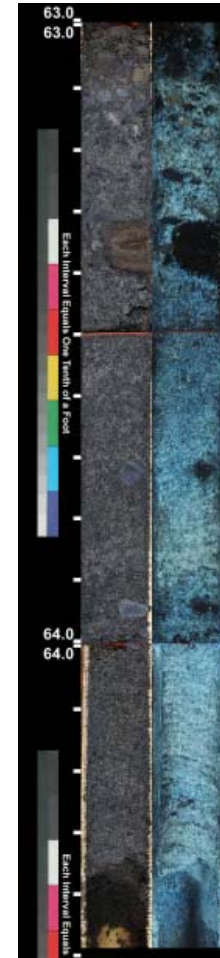
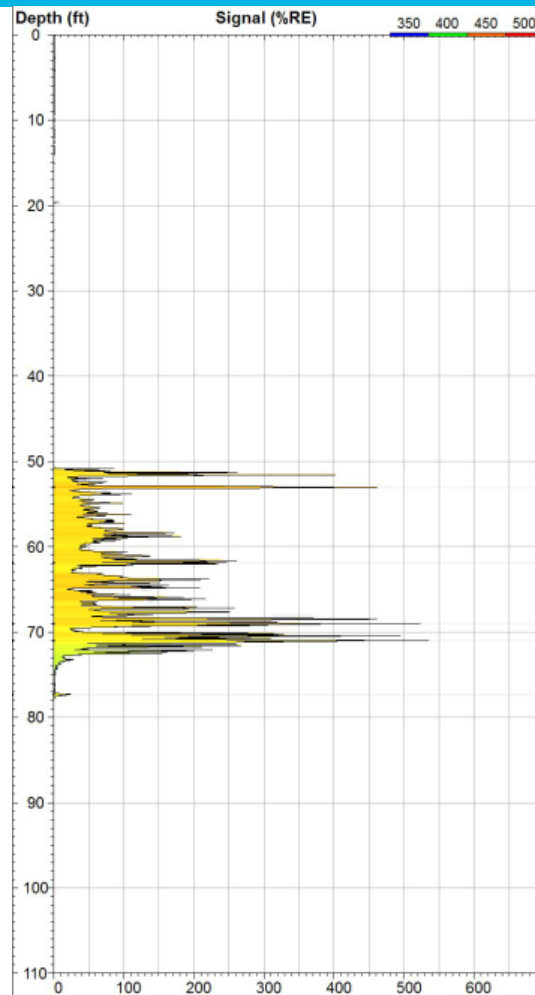
# Comparison of Laser Induced Fluorescence Profiles Following a Decade of LNAPL Recovery

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April 11, 2018

# Laser Induced Fluorescence

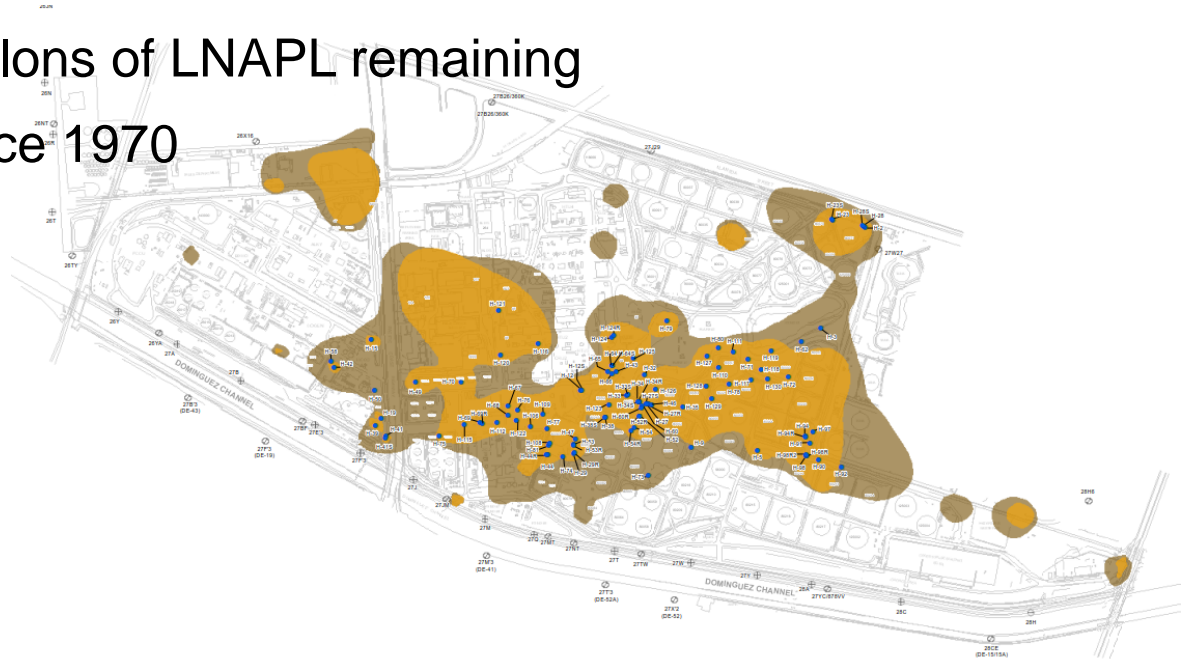


## Effects on LIF response

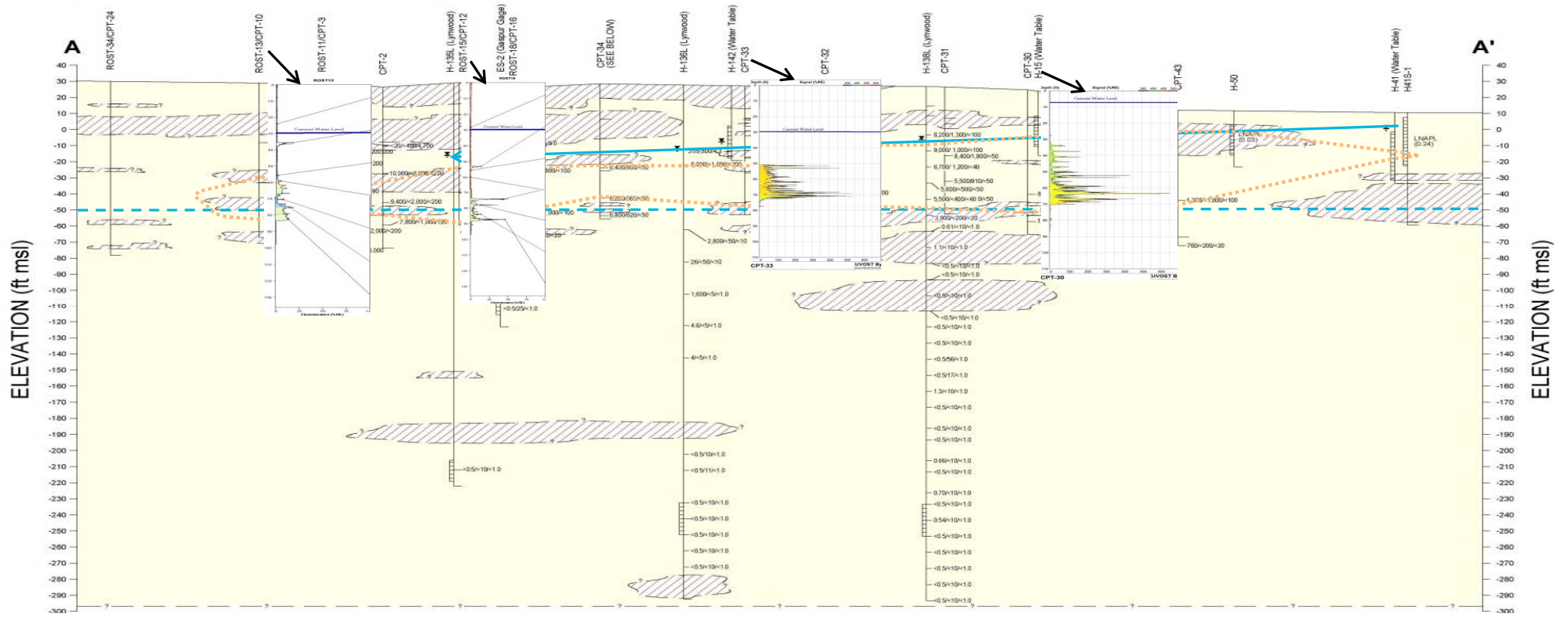
- Pore Fluid Saturation of LNAPL
- Soil Type (soil pore size)
- LNAPL Composition

# Active Southern California Refinery

- Started as refinery in 1923 and still operating
- LNAPL recovery started in 1985 and continues today using total fluid recovery
- Removed 36 million gallons of LNAPL to date
- Estimated 30 to 42 million gallons of LNAPL remaining
- Groundwater rose 40 feet since 1970

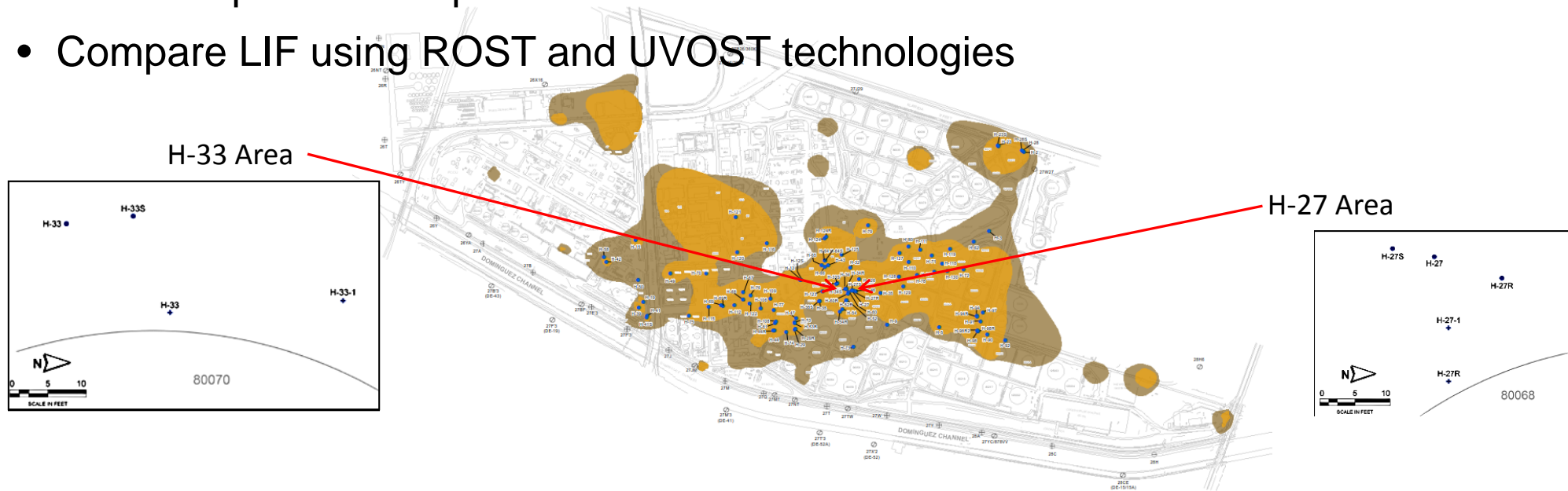


# Cross Section

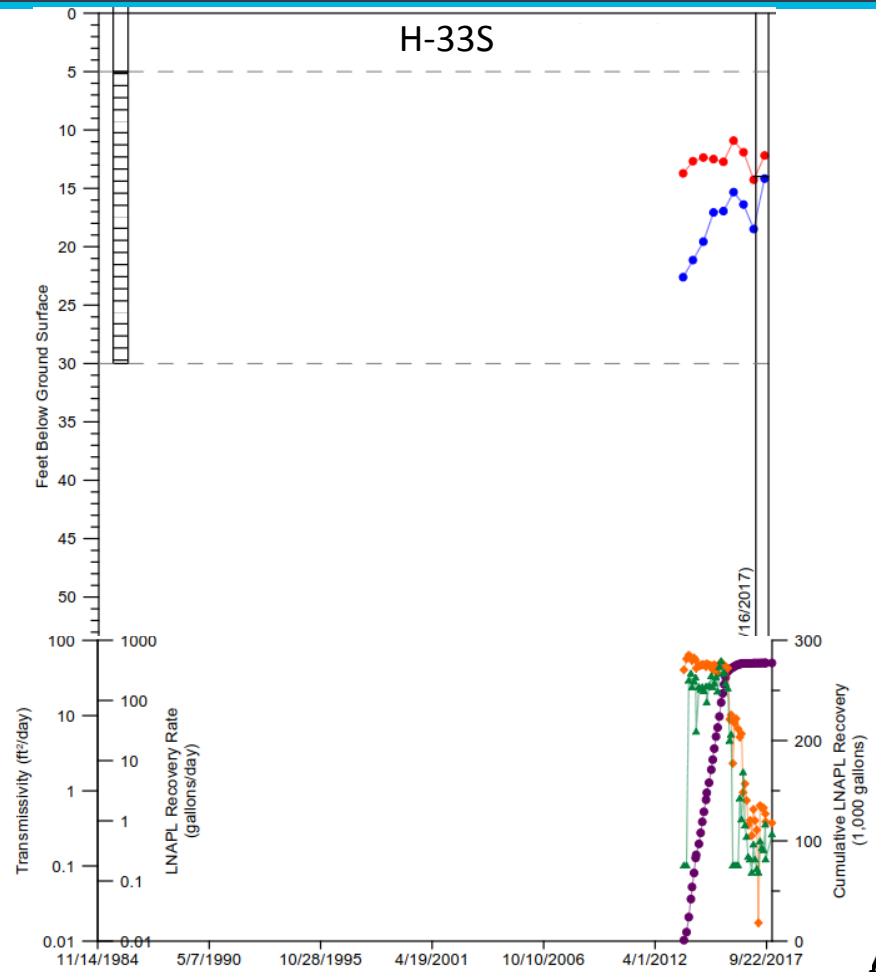
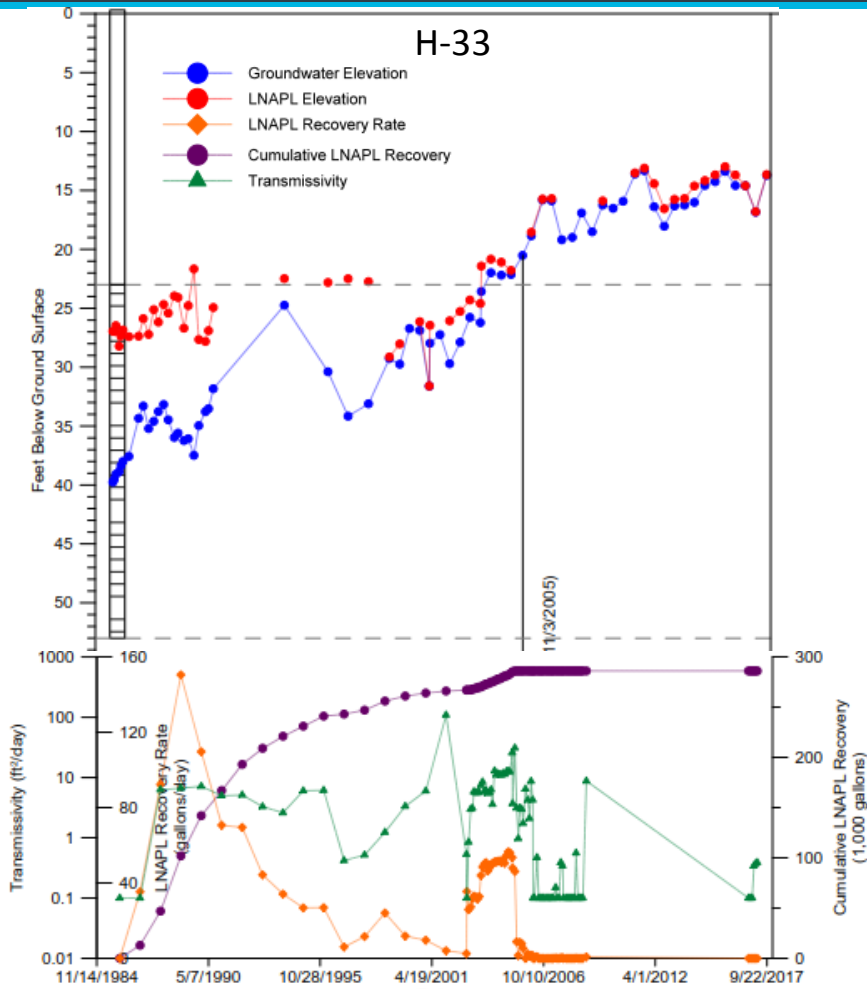


# Objectives of Test

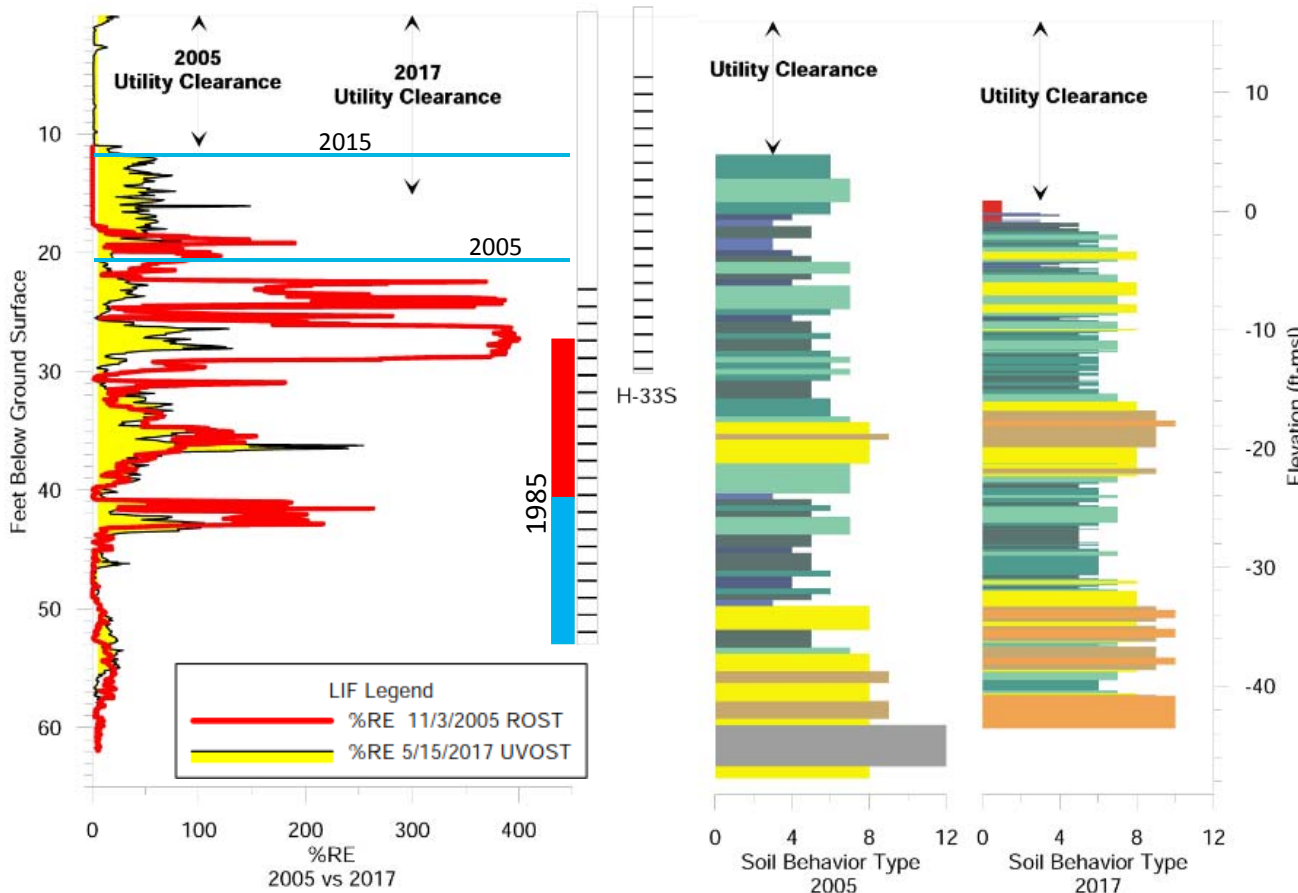
- Evaluate LIF, LNAPL transmissivity, and cumulative recovery curve to determine LNAPL recovery endpoint
- Compare LIF response after a significant amount of LNAPL has been removed and a drop in LNAPL production from the area
- Compare LIF using ROST and UVOST technologies



# H-33 Recovery Well

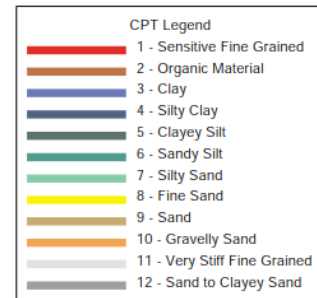


# H-33 Area

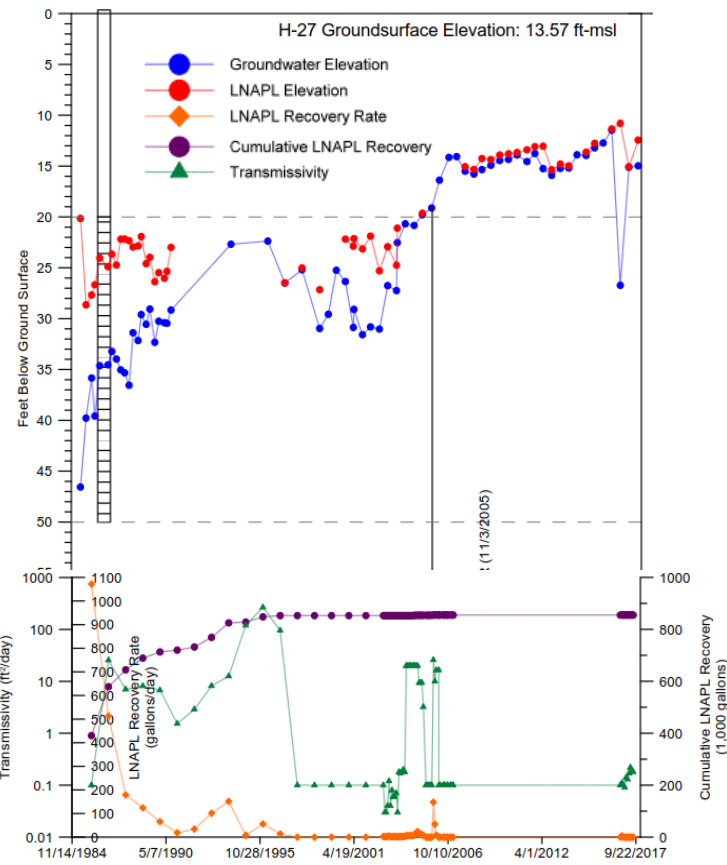


H-33  
 LNAPL Recovered 1985-2005 286,272 gal  
 LNAPL Recovered 2006-2017 168 gal  
 LNAPL thickness 2017 0.04 ft

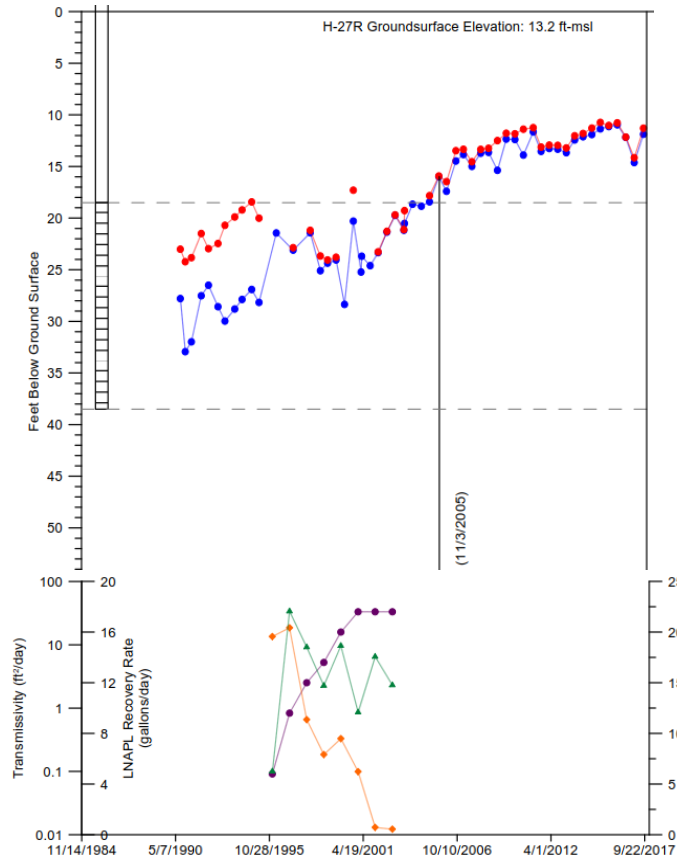
H-33S  
 LNAPL Recovered 2013-2017 277,200 gal  
 LNAPL thickness 2017 4.23 ft



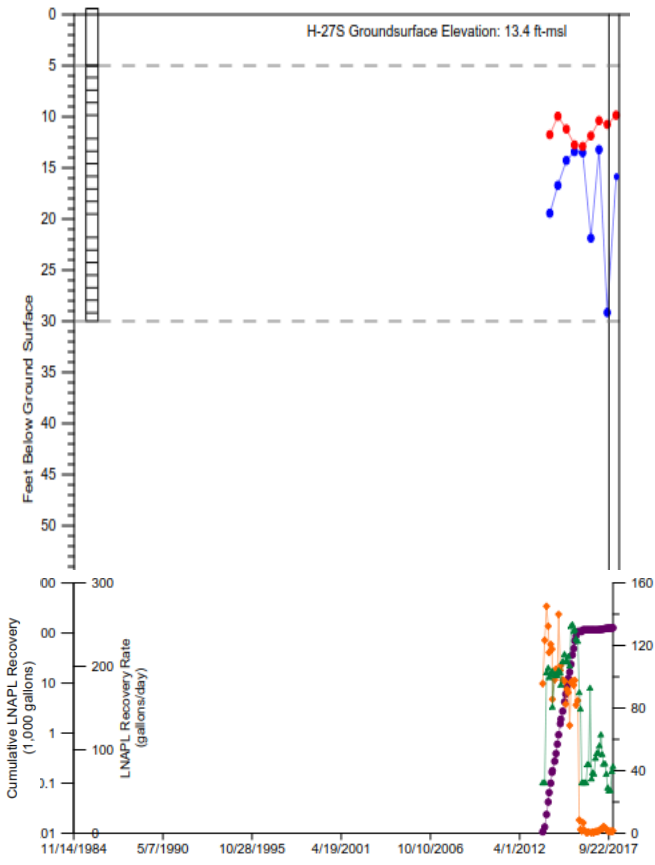
# H-27 Area Recovery Wells



H-27



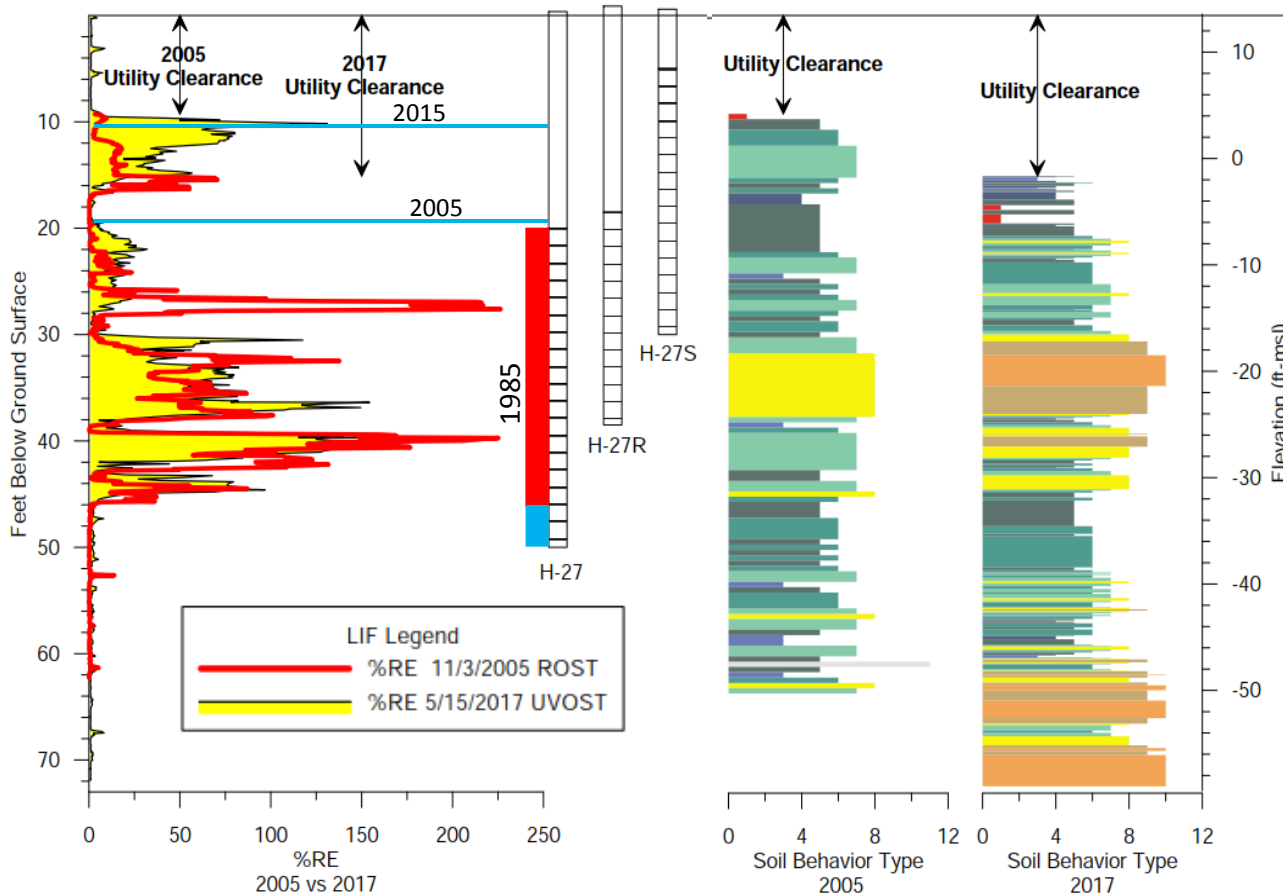
H-27R



H-27S



# H-27 Area



**H-27**  
 LNAPL Recovered 1985-2005 854,700 gal  
 LNAPL Recovered 2006-2017 504 gal  
 LNAPL thickness 2017 2.53 ft

**H-27R**  
 LNAPL Recovered 1990-2002 22,260 gal  
 LNAPL Recovered 2006-2017 0 gal  
 LNAPL thickness 2017 0.48 ft

**H-27S**  
 LNAPL Recovered 2013-2017 130,326 gal  
 LNAPL thickness 2017 18.39 ft

# Conclusions

- ROST and UVOST provide similar results
- High reflectance in sand is at or approaching residual saturation levels of LNAPL
- LIF is a great tool to determine LNAPL location in the formation
- LIF not a good tool to determine LNAPL recoverability
- Recoverable LNAPL primarily comes from the groundwater surface
- LNAPL thickness in well is not a good indicator of recoverability
- Transmissivity and cumulative recovery curves are better indicators of recovery end point than LIF or LNAPL thickness

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**Thank You!**

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