

PART 2 - ISCO



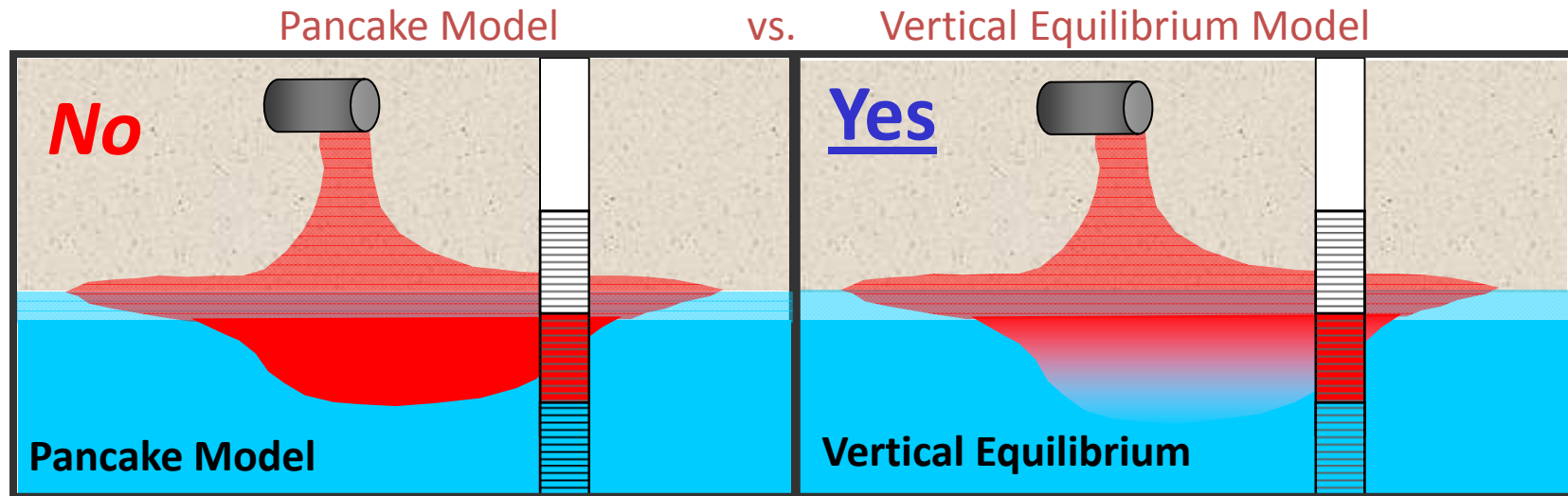
NEXT STEPS

- Develop Remedial Strategy (ISCO) in consideration of competing CSMs
- CSM 1 (Simplistic):
 - Residual NAPL: ‘Pancake’ Model
 - Bedrock as Equivalent Porous Medium (EPM)
- CSM2 (More Complex)
 - Residual NAPL: Vertical Equilibrium Model (VEM)
 - Bedrock: CSM considers Bedrock Complexity (GFM)
- *Remedial Implementation*
- *Evaluate Monitoring Data wrt CSM 1 and 2*
- *Determine Next Steps*

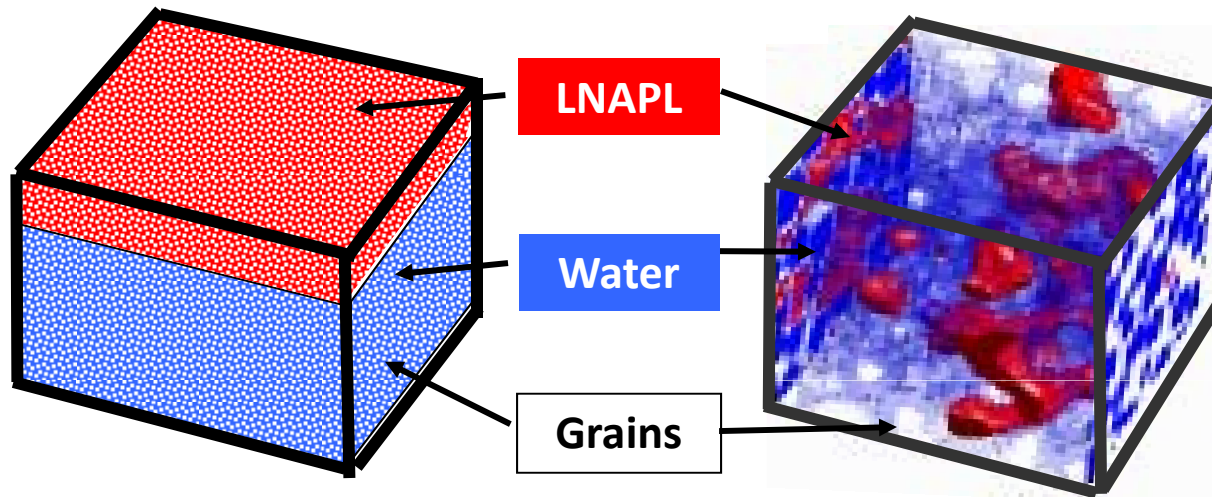
CSM Considerations

- Residual NAPL distribution
 - “Pancake Model”
 - Vertical Equilibrium Model
- Fracture System/GFM
 - Sub-horizontal “Sheeting Fractures”
 - West-Dipping Foliation Parallel Fractures
- GFM implications to CSM and ISCO effectiveness

Vertical LNAPL Distribution



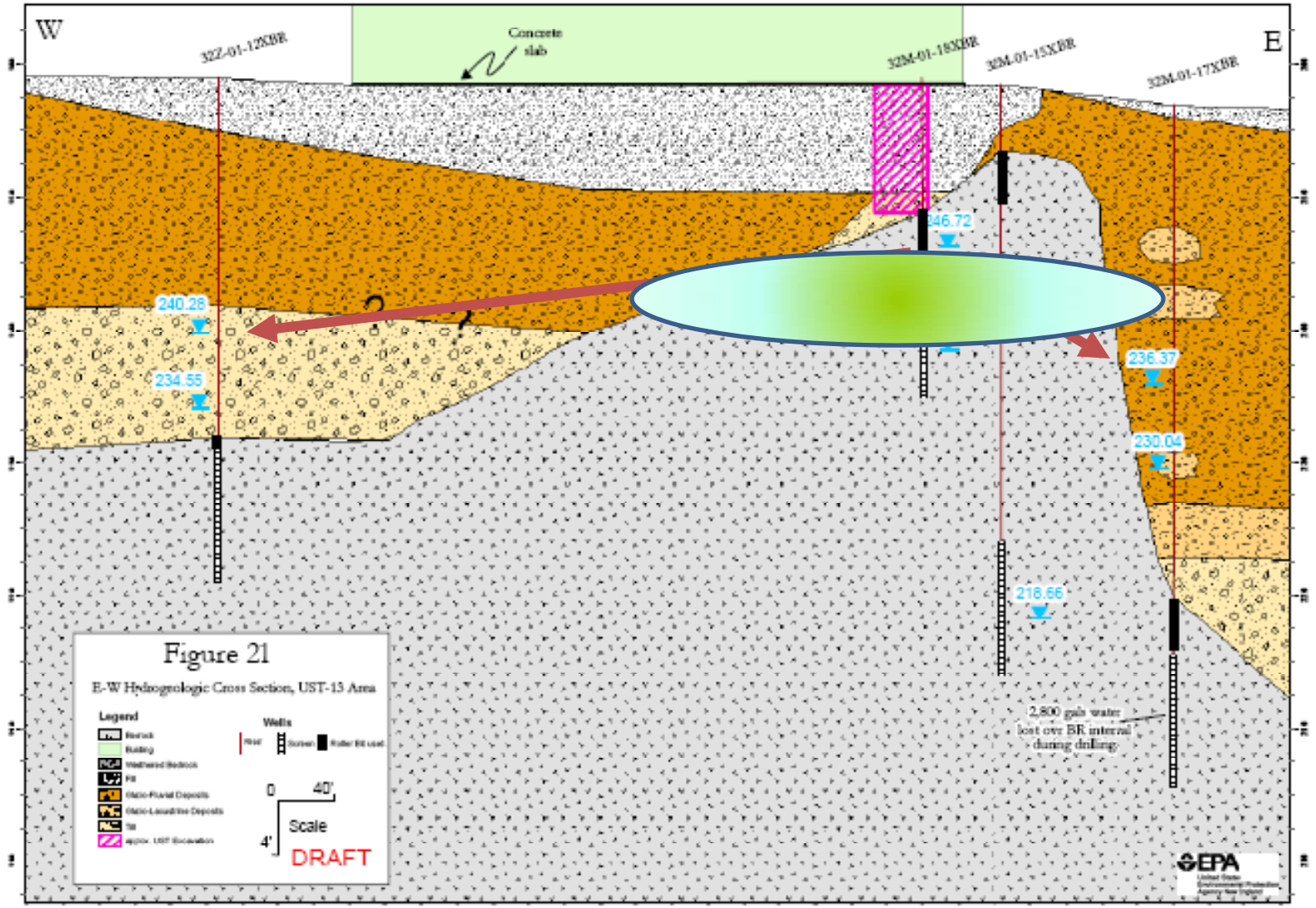
- Assumes LNAPL floats on water table
- Uniform LNAPL saturation



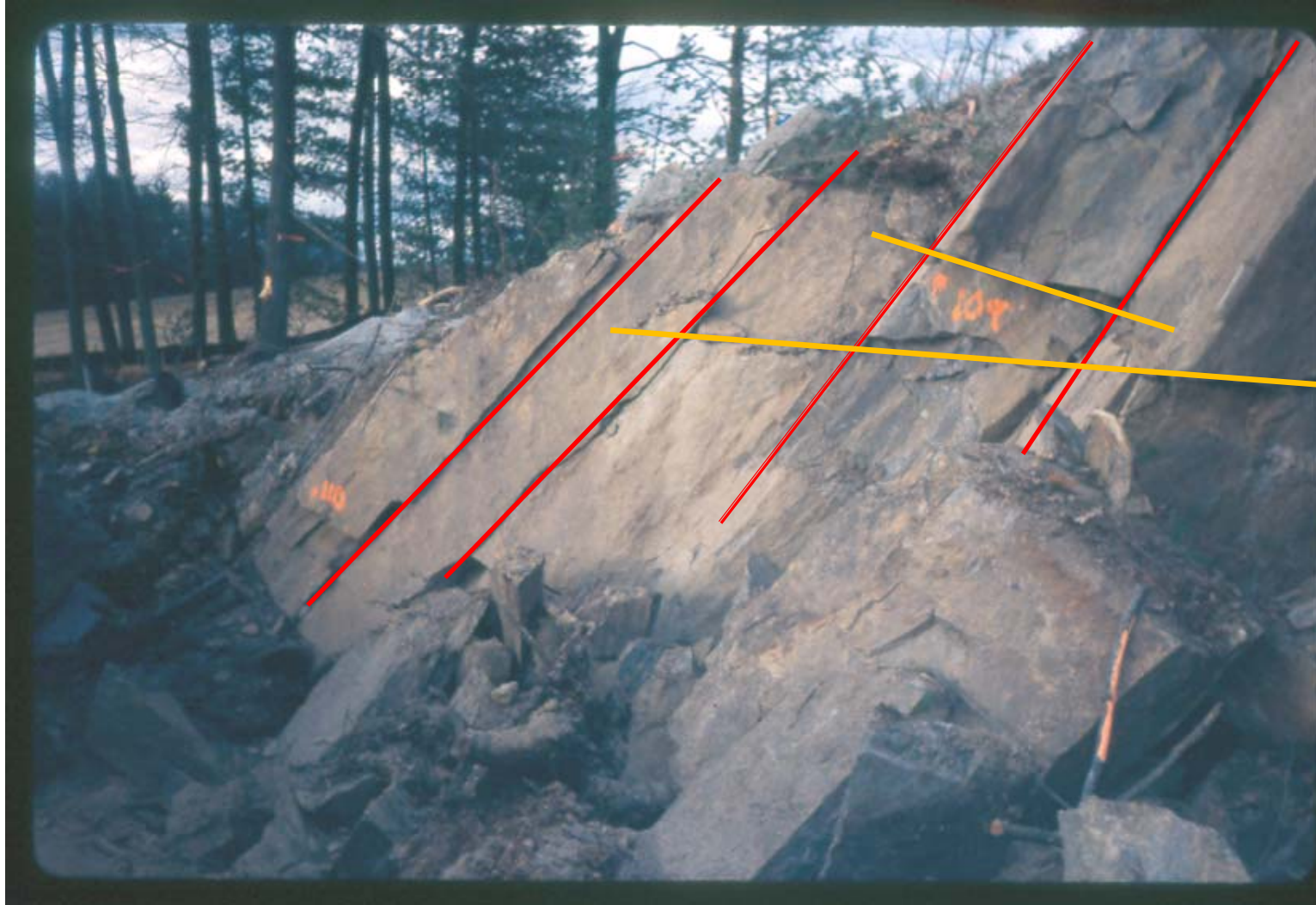
- LNAPL penetrates below water table
- LNAPL and water coexist in pores

“PANCAKE MODEL”

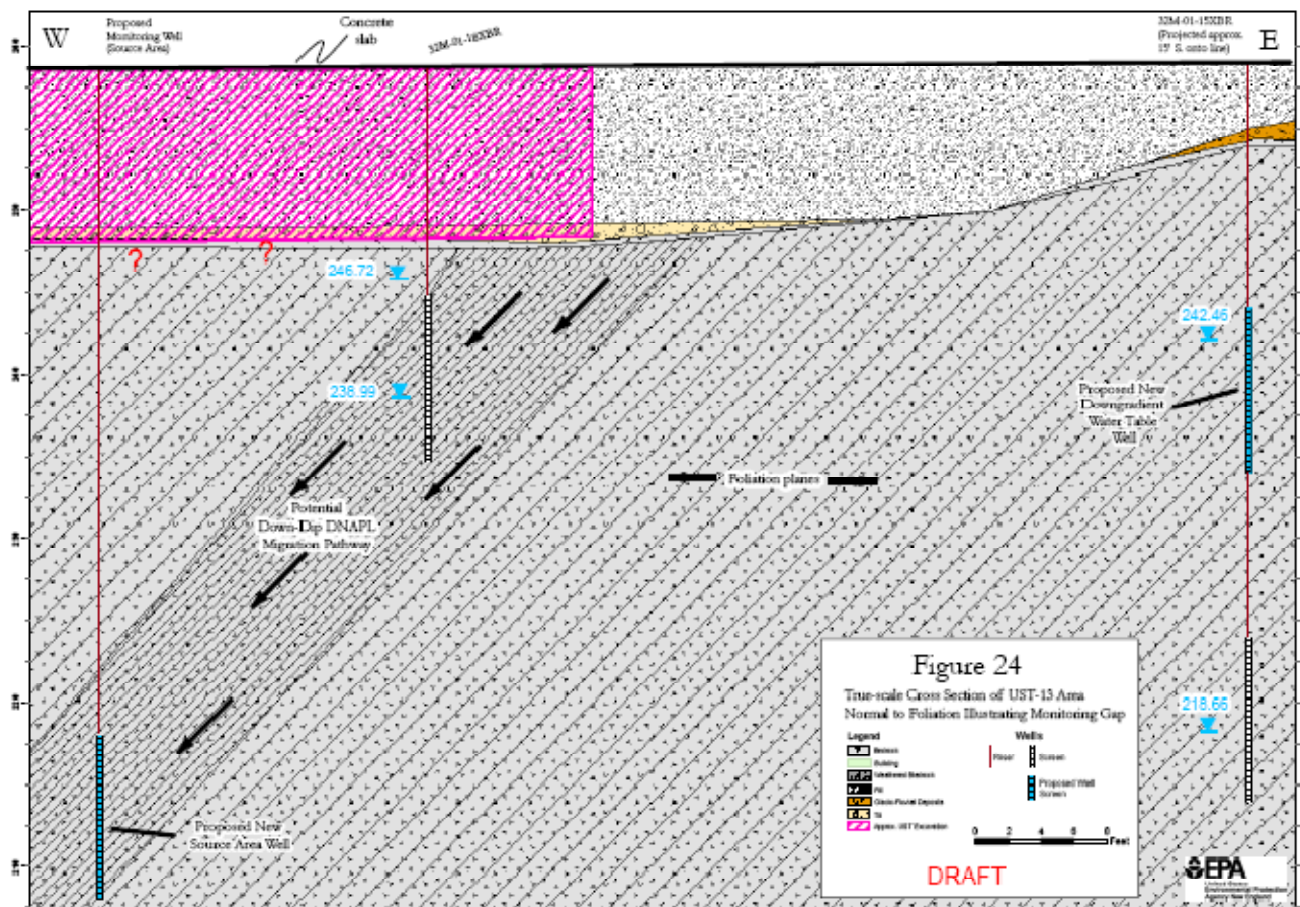
W-E Hydrogeologic Cross-Section UST 13 Area



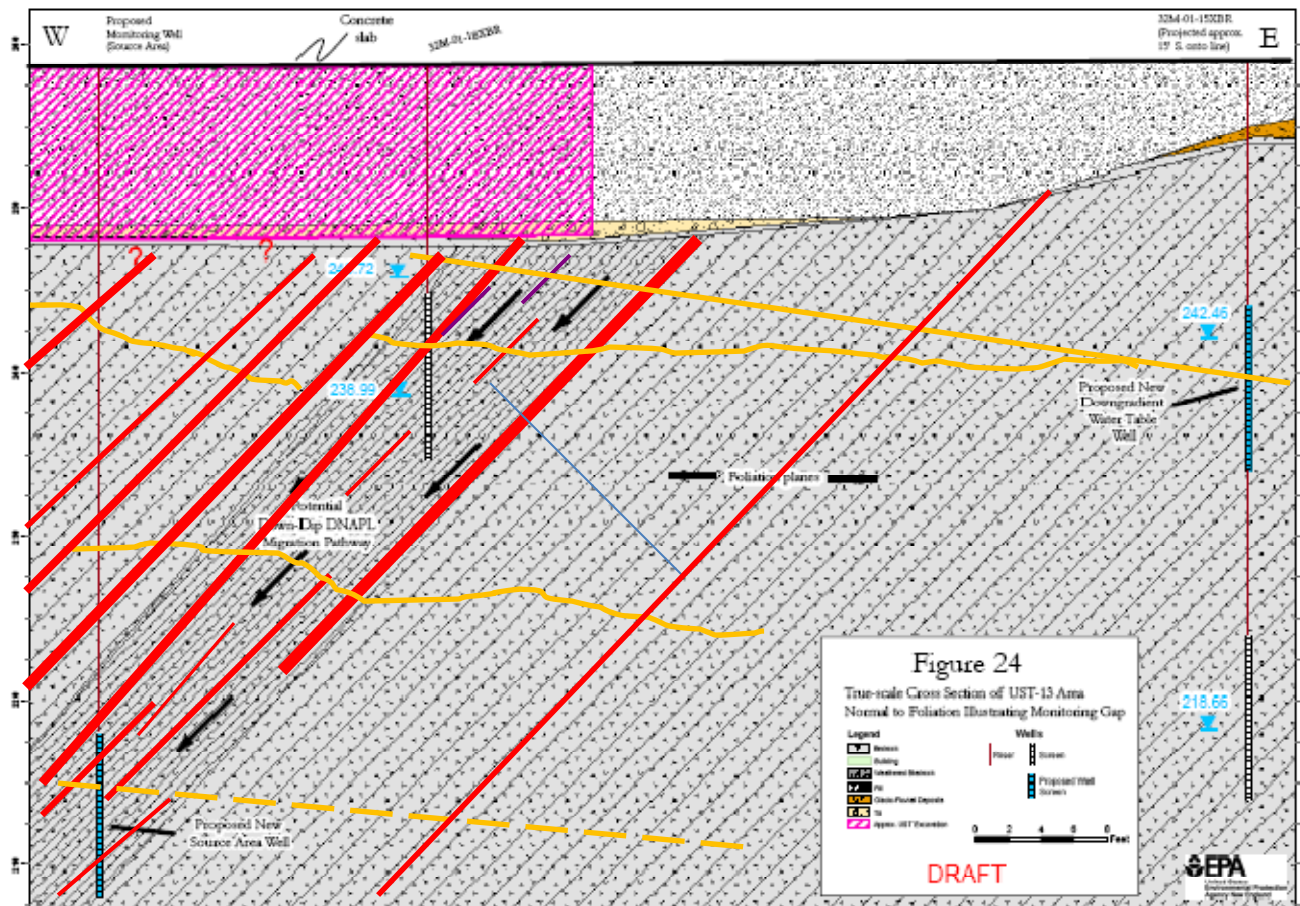
GFM - Observed Fracture System



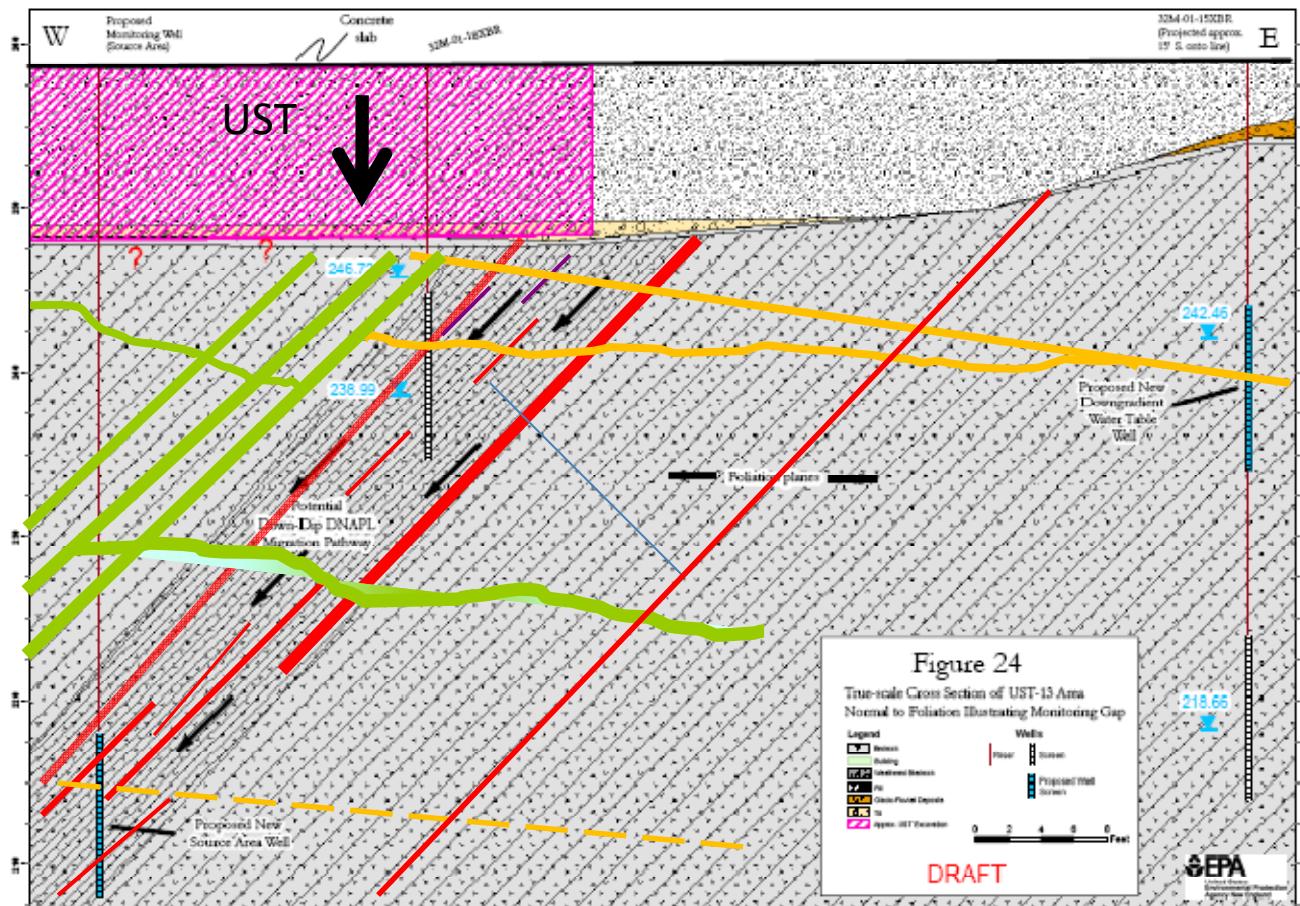
True-Scale Cross Section of UST-13 Area Normal to Foliation, Illustrating Monitoring Gap



Conceptual Fracture Network

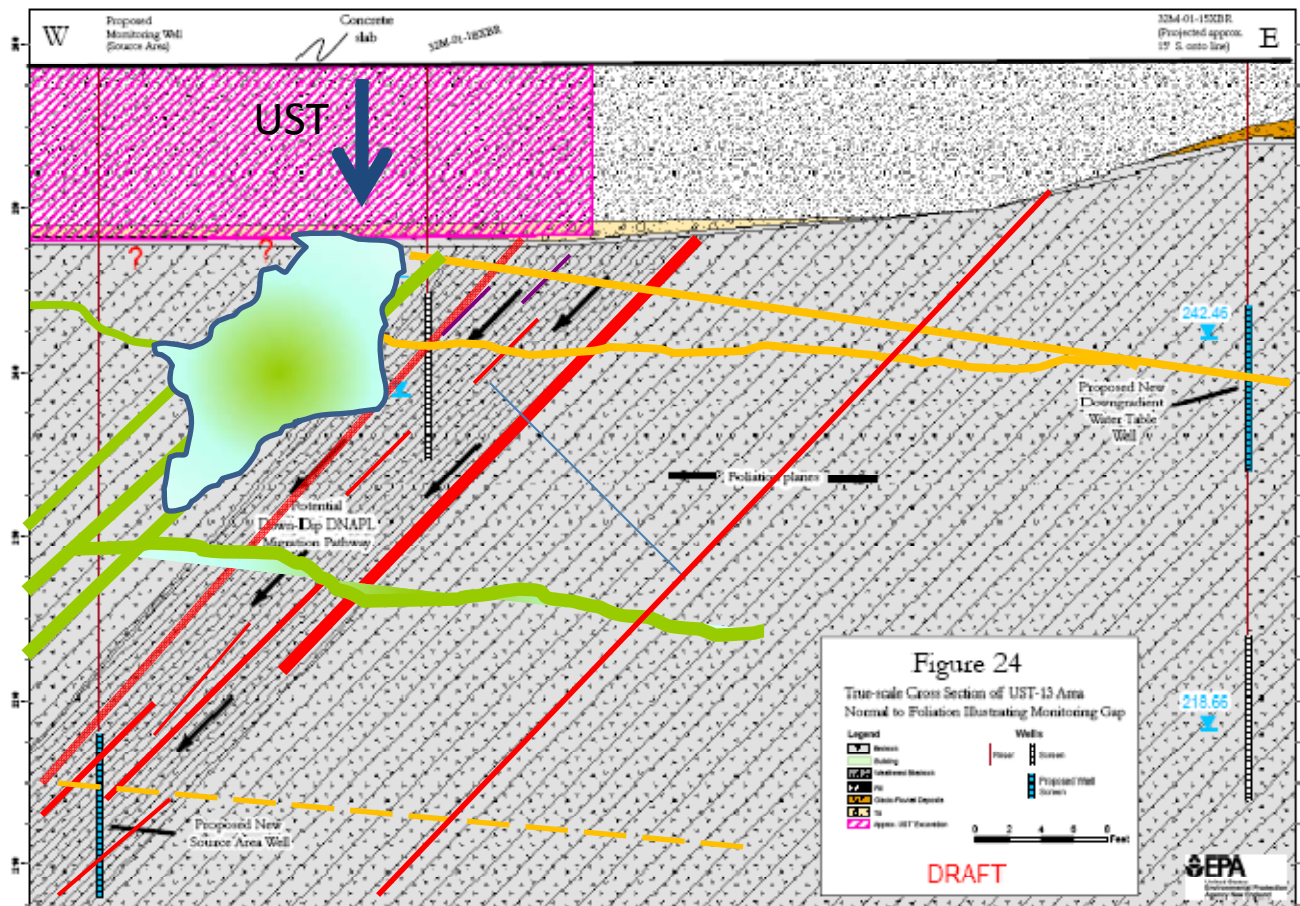


NAPL Pathway – Active Fractures Vertical Equilibrium Model



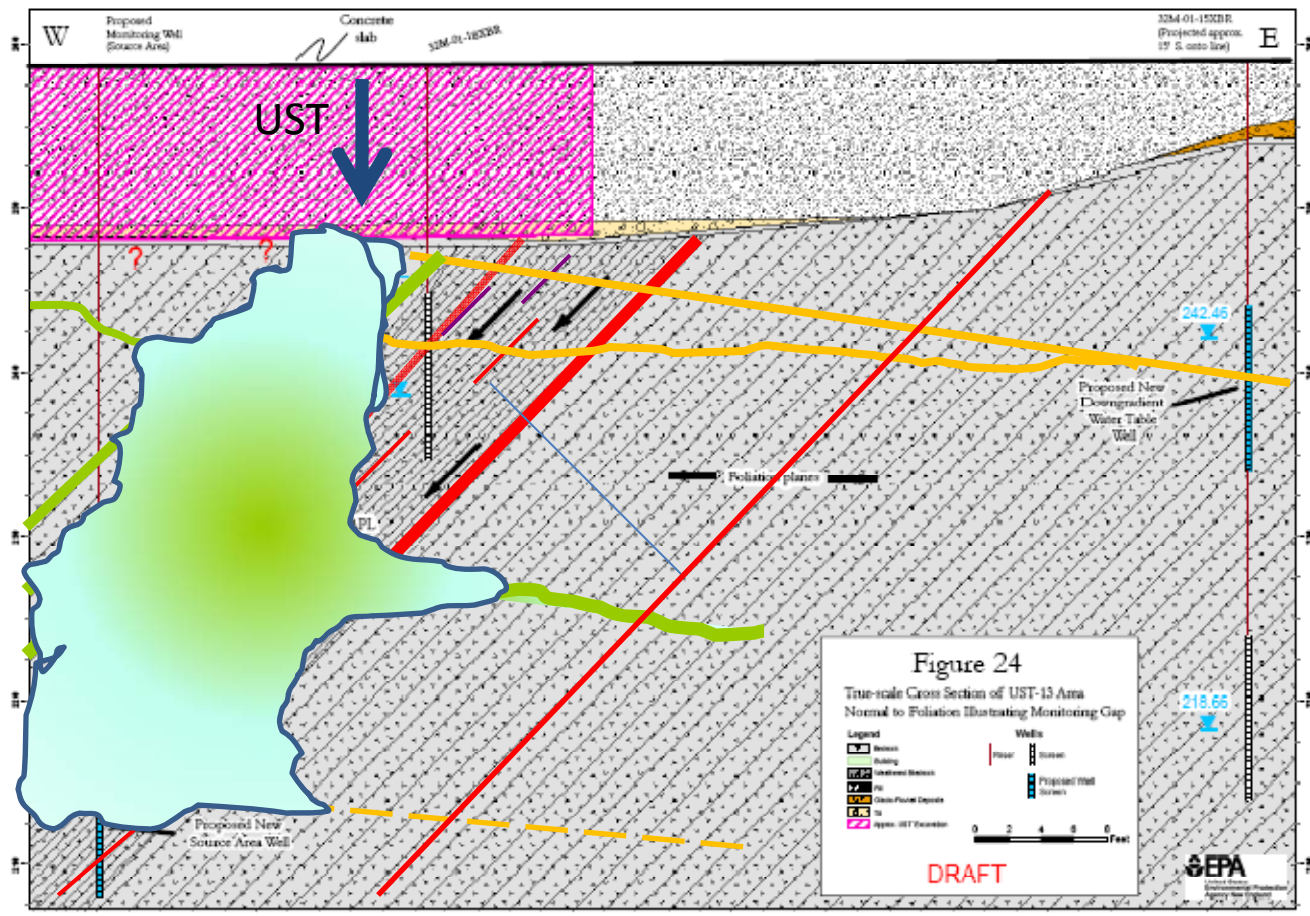
Vertical Equilibrium Model

Conceptual Smear Zone – High Water Table

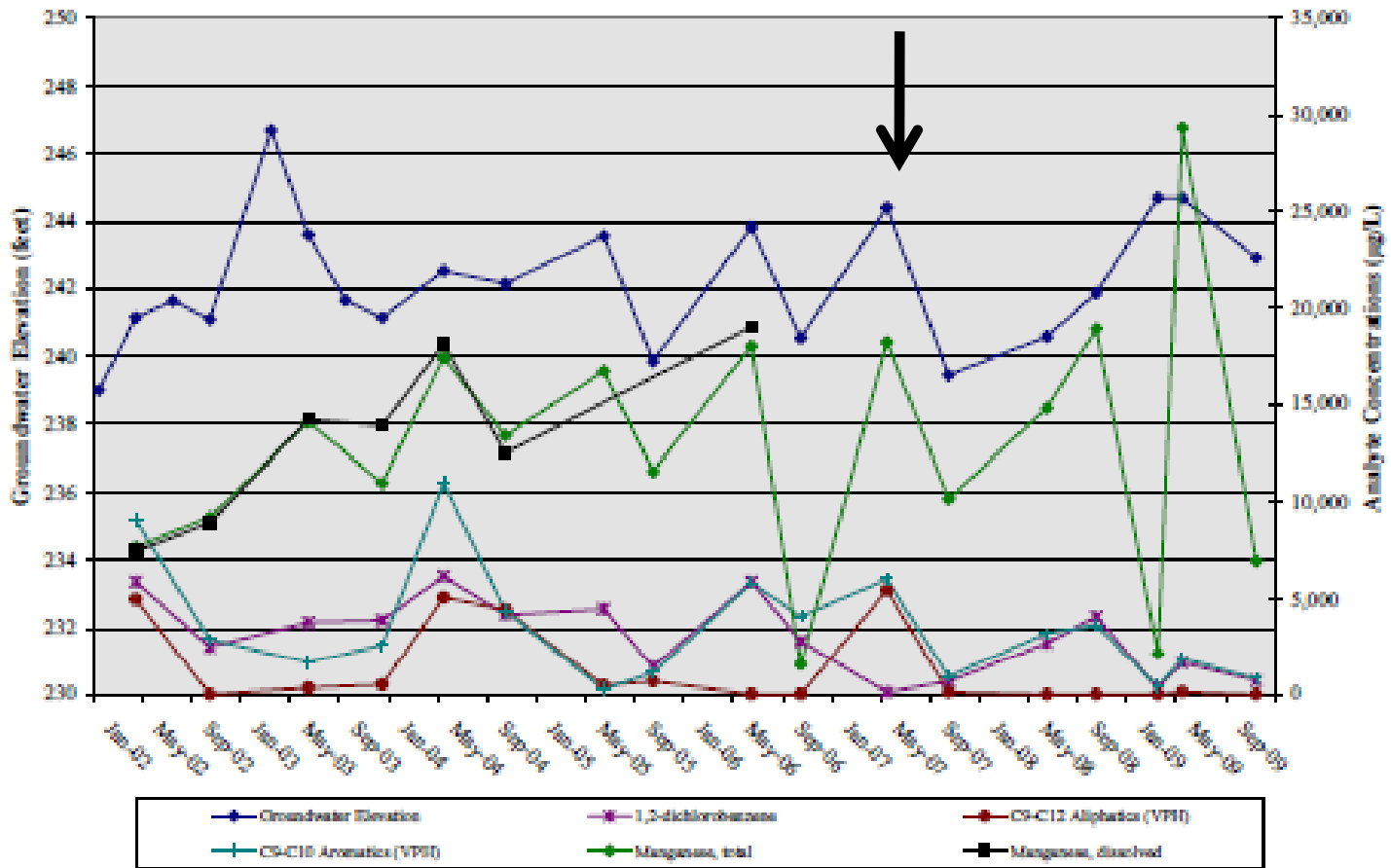


Vertical Equilibrium Model

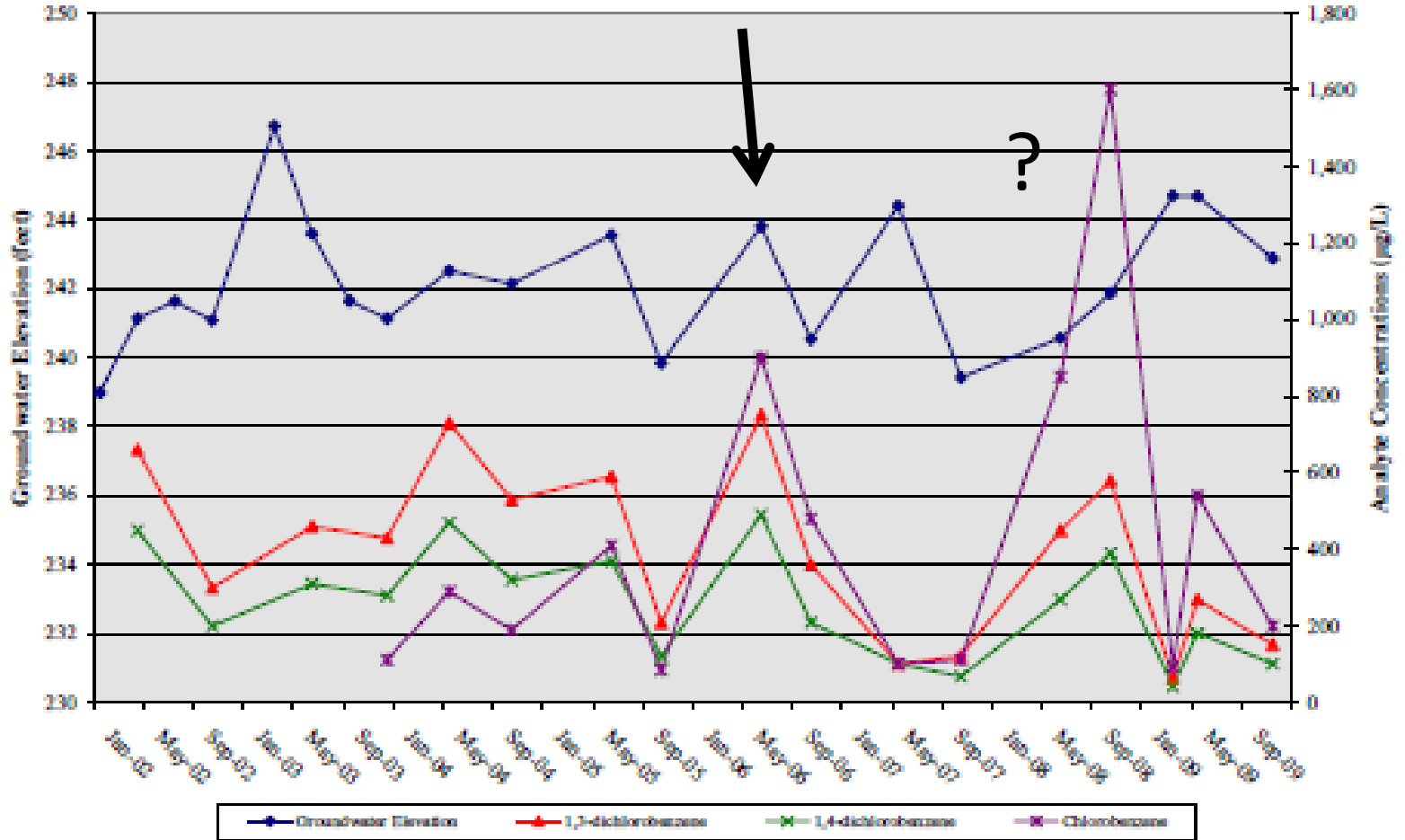
Conceptual Smear Zone – Low Water Table



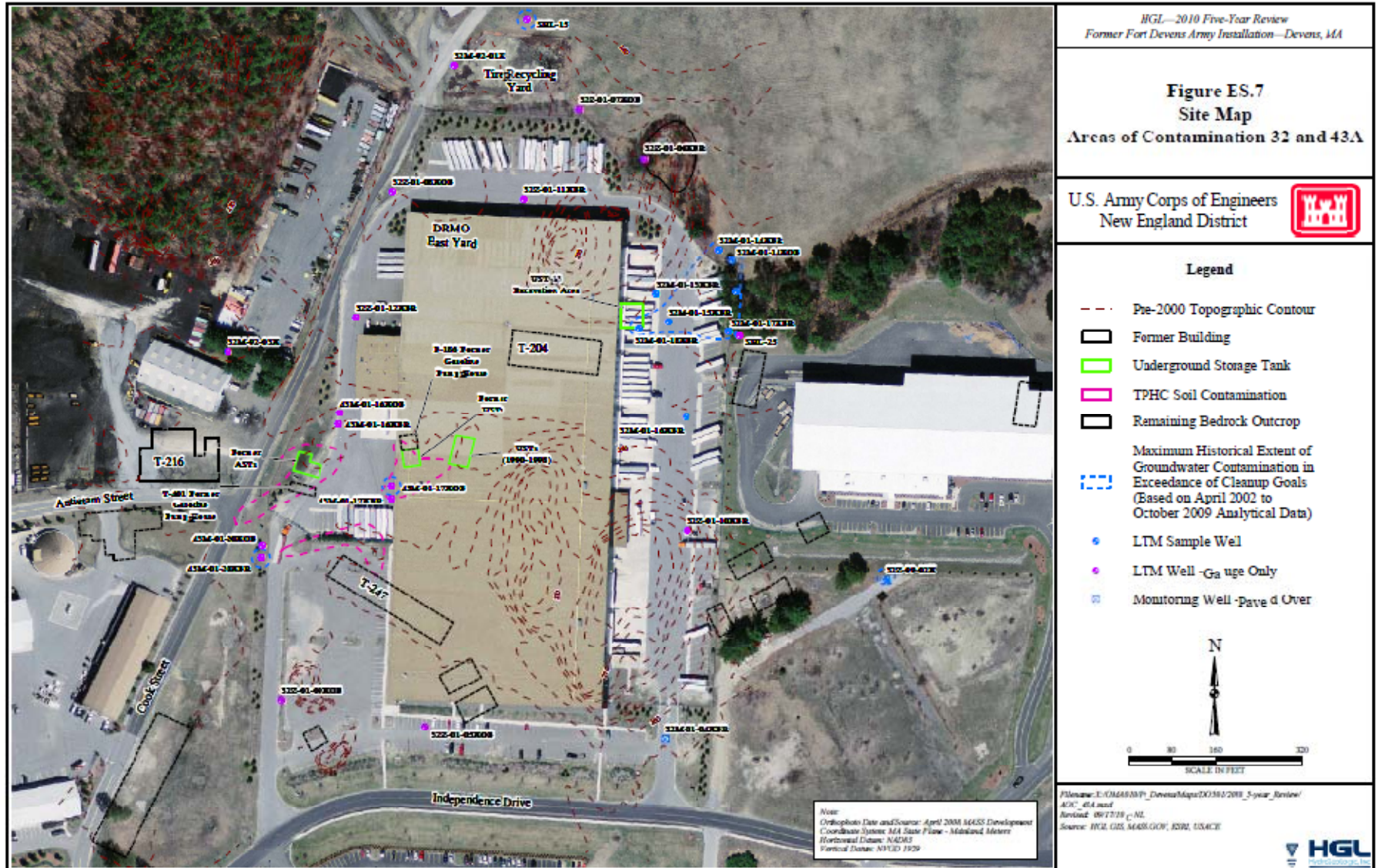
Groundwater Elevation and Analyte Concentrations - Well 32M-01-18XBR - AOCs 32 and 43A (1 of 3)



Groundwater Elevation and Analyte Concentrations - Well 32M-01-18XBR - AOCs 32 and 43A (2 of 3)



2009 Persulfate Injection



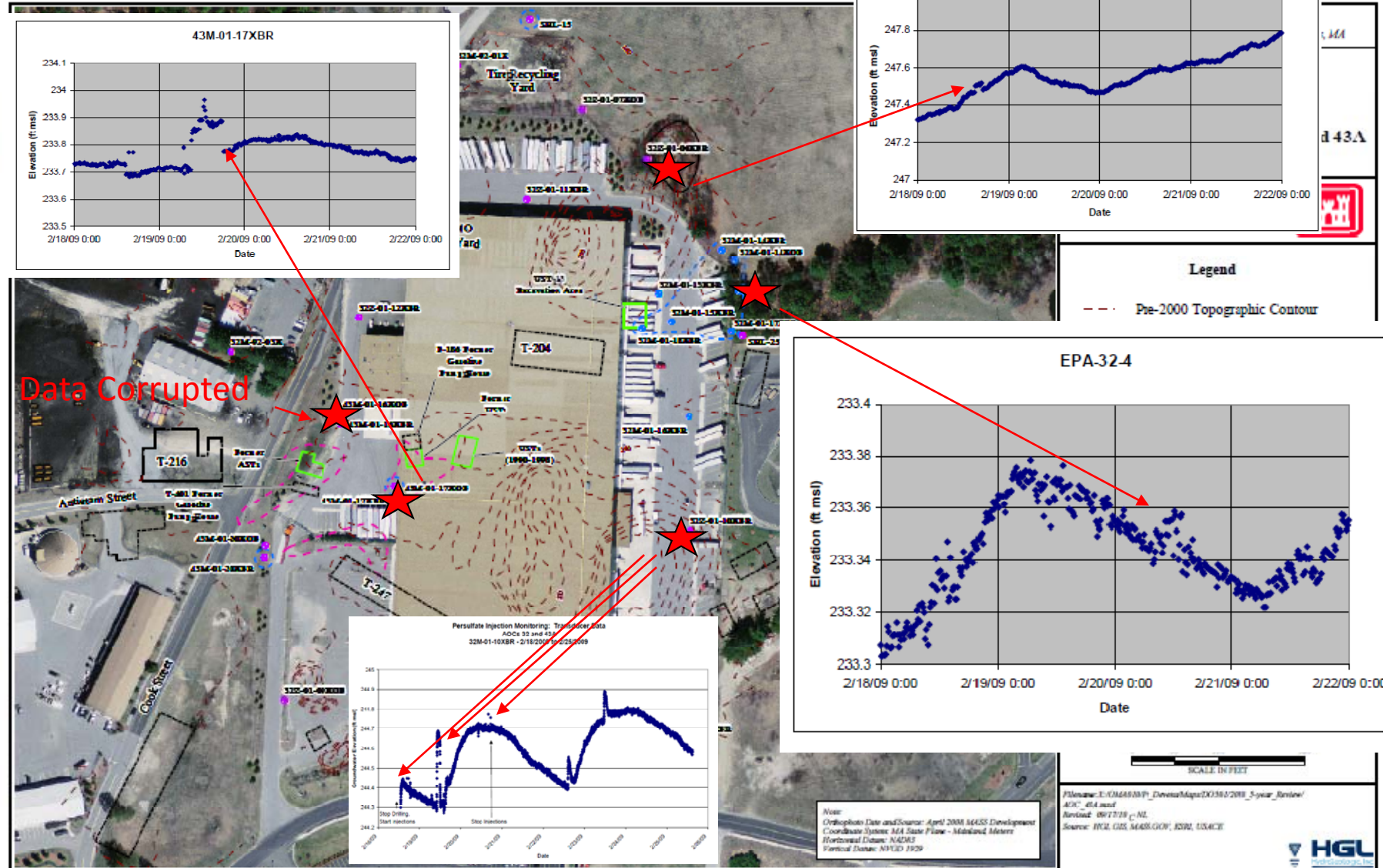
2009 Persulfate Injection

- Focus on “hotspot” near 32M-01-18XBR
 - 50 X 50 X 25 ft (10 ft. Saturated thickness)
 - 3 shallow bedrock injection wells installed around 32M-01-18XBR
- Overburden injection well installed on Top-of-bedrock in former tank grave
- 1800 gallons of water/sodium persulfate solution injected February 2009 (5000 lbs)
- sodium hydroxide used as catalyst
- ~ \$36,000 (Estimate)

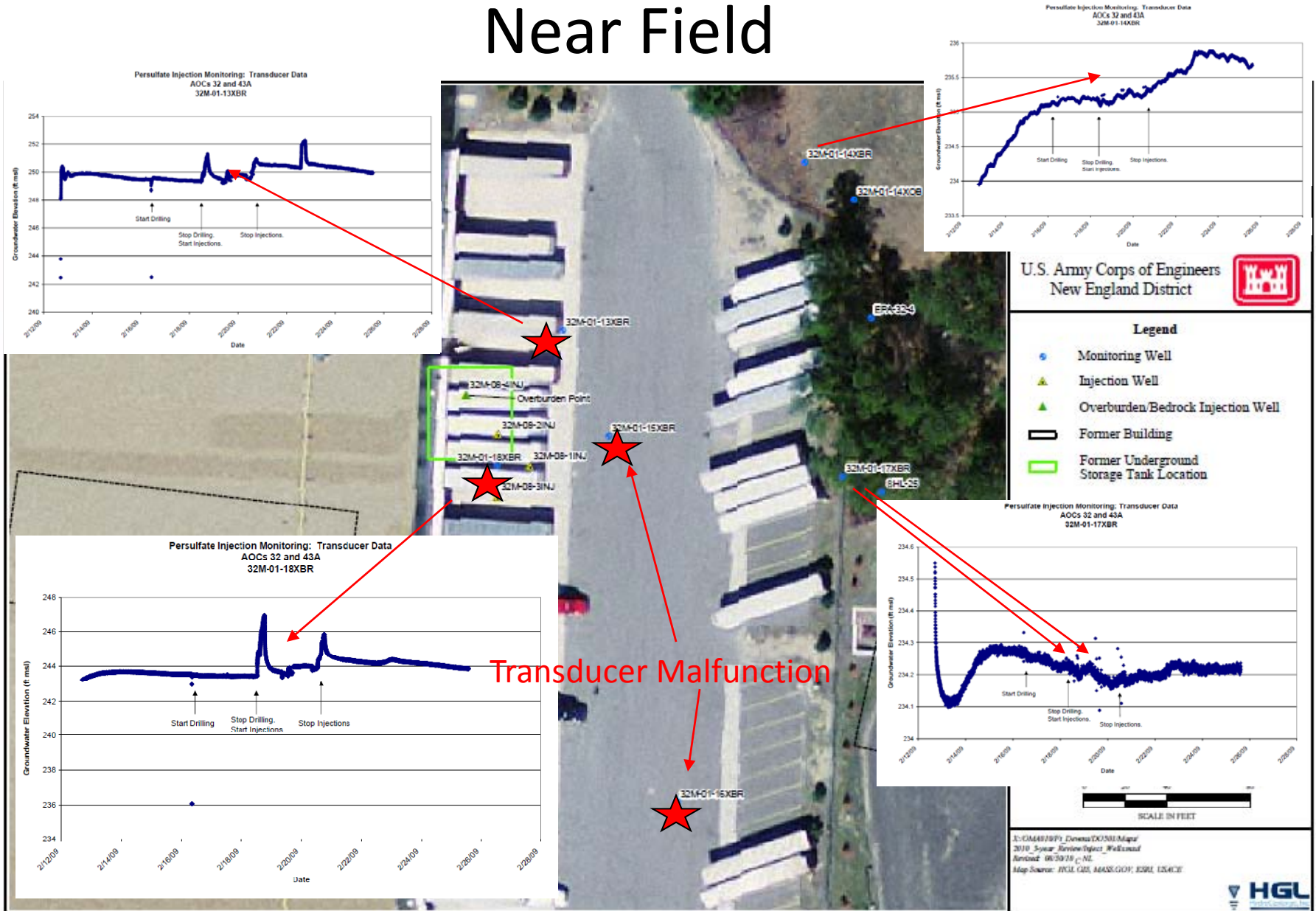
2009 Persulfate Injection



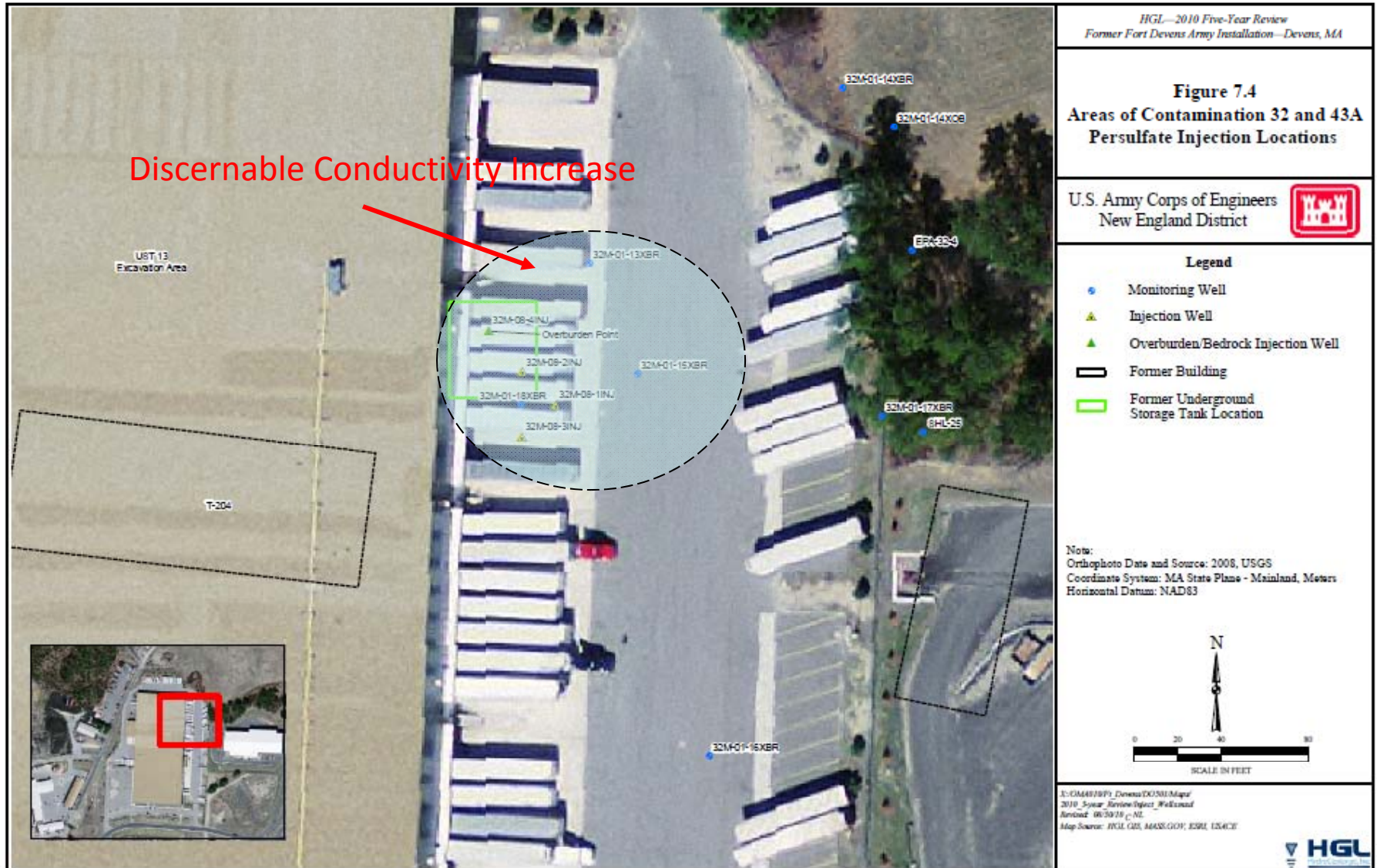
Injection Pressure Response Far Field



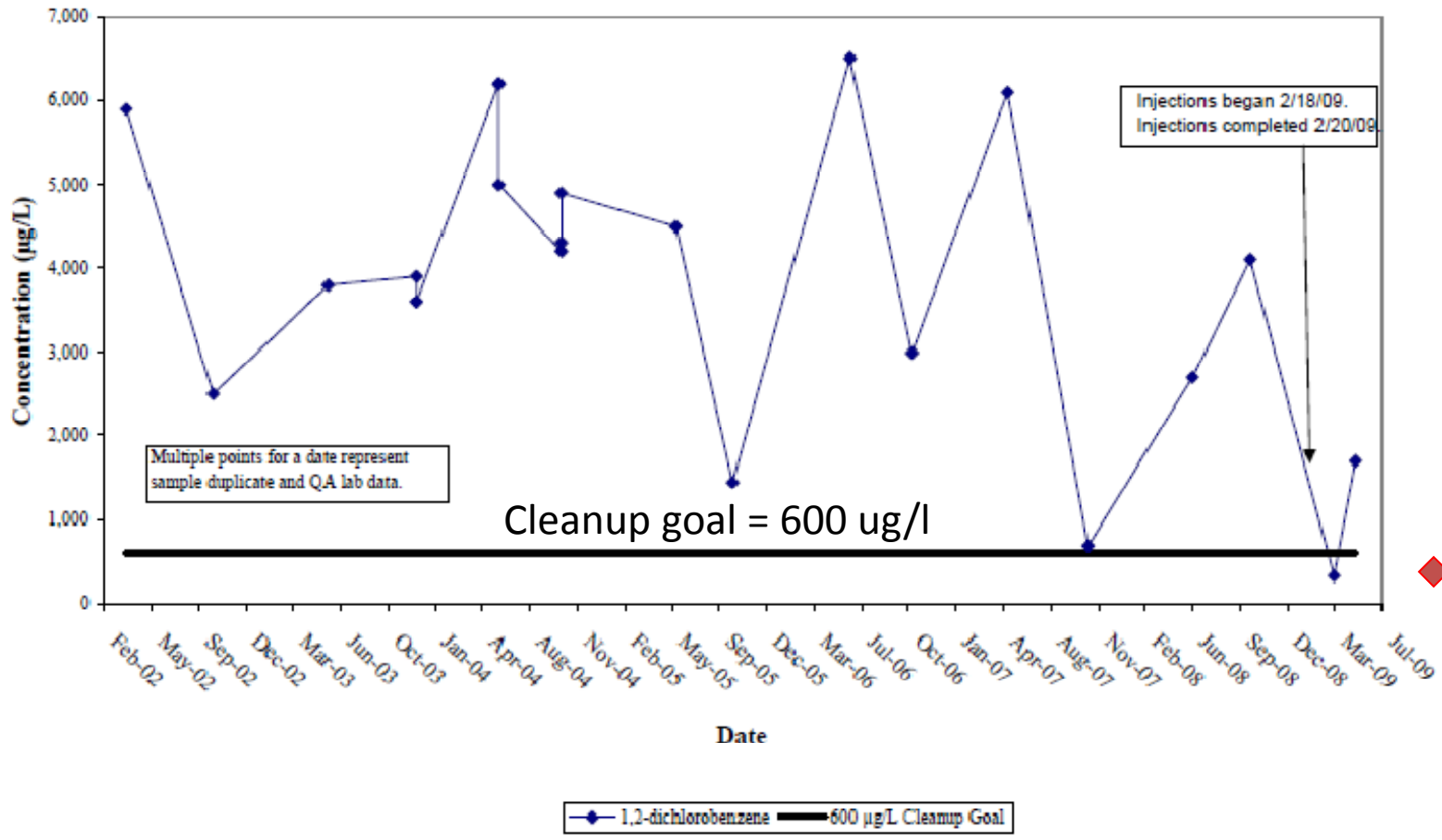
Injection Pressure Response Near Field



Injection Conductivity Response Near Field

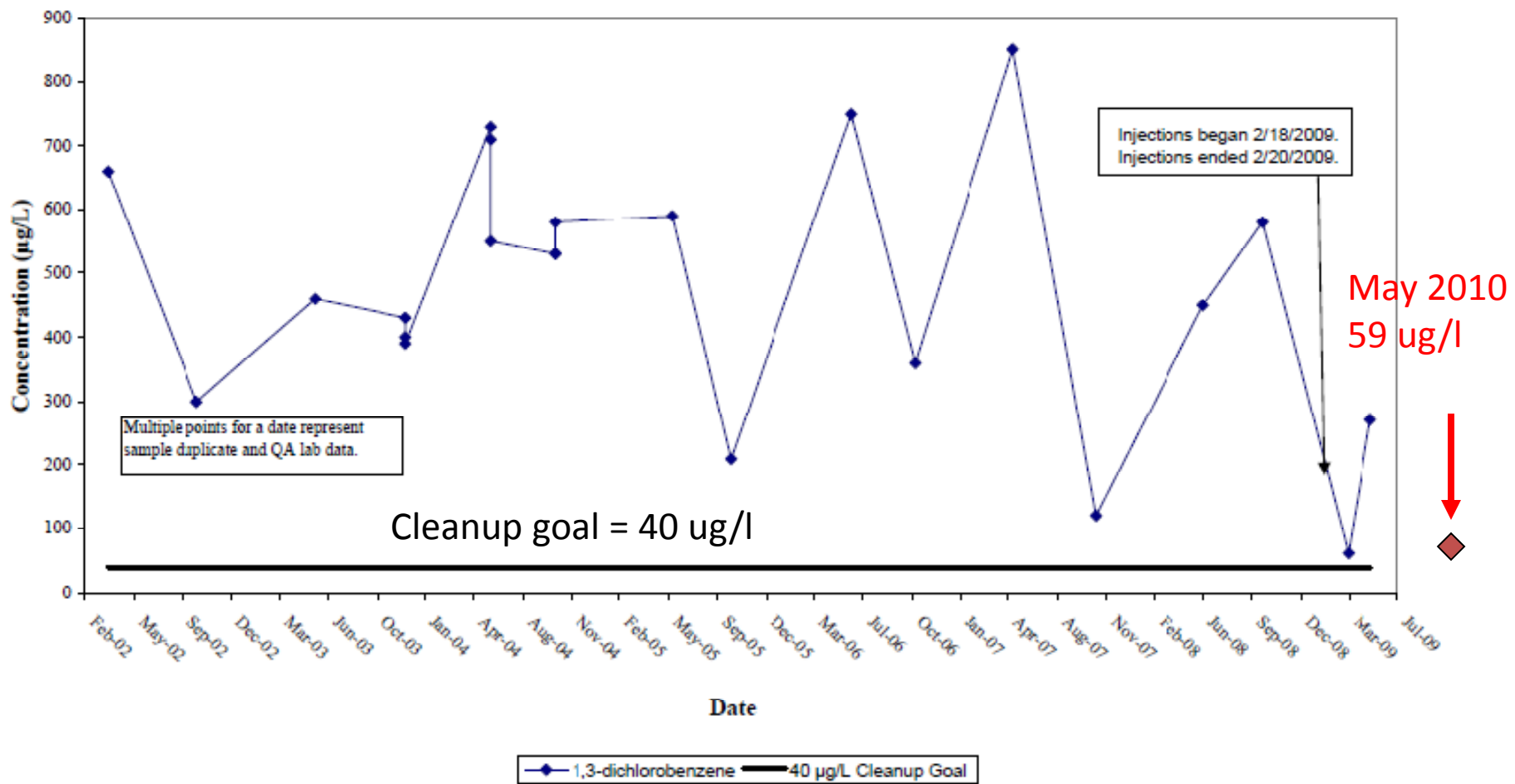


Long-Term Trends
1,2-Dichlorobenzene
Areas of Contamination 32 and 43A
Well 32M-01-18XBR

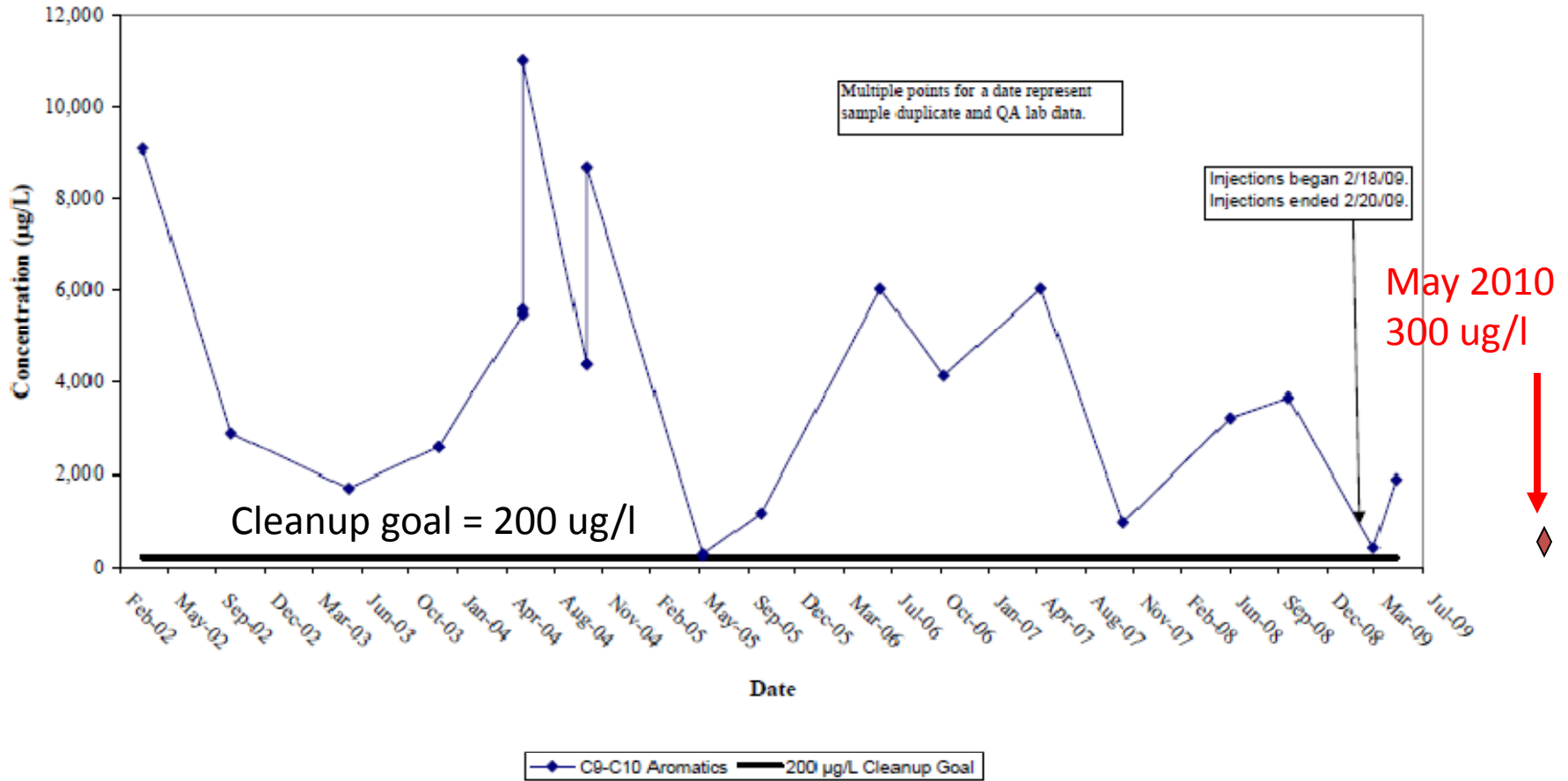


May 2010
300 µg/l

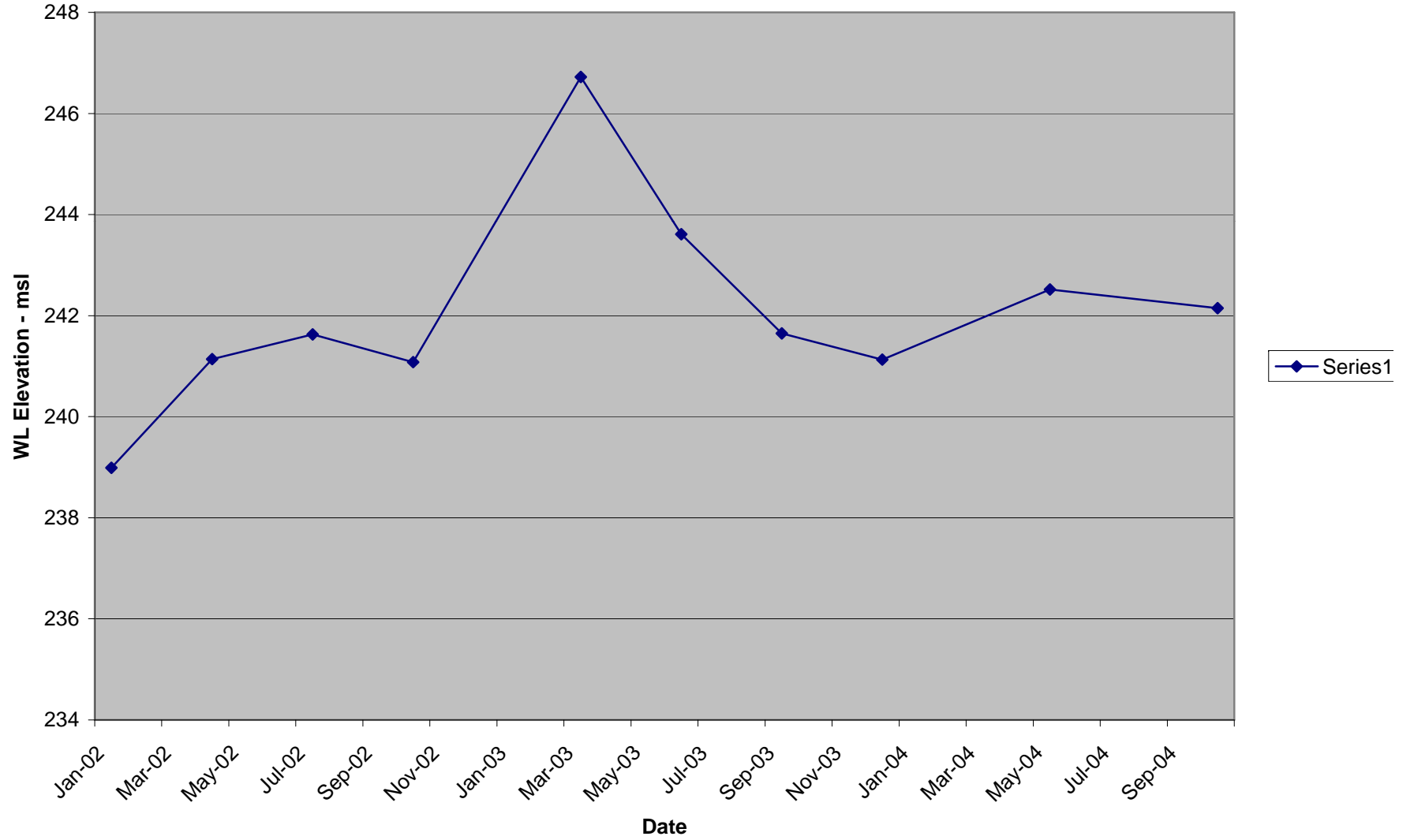
Long-Term Trends
1,3-Dichlorobenzene
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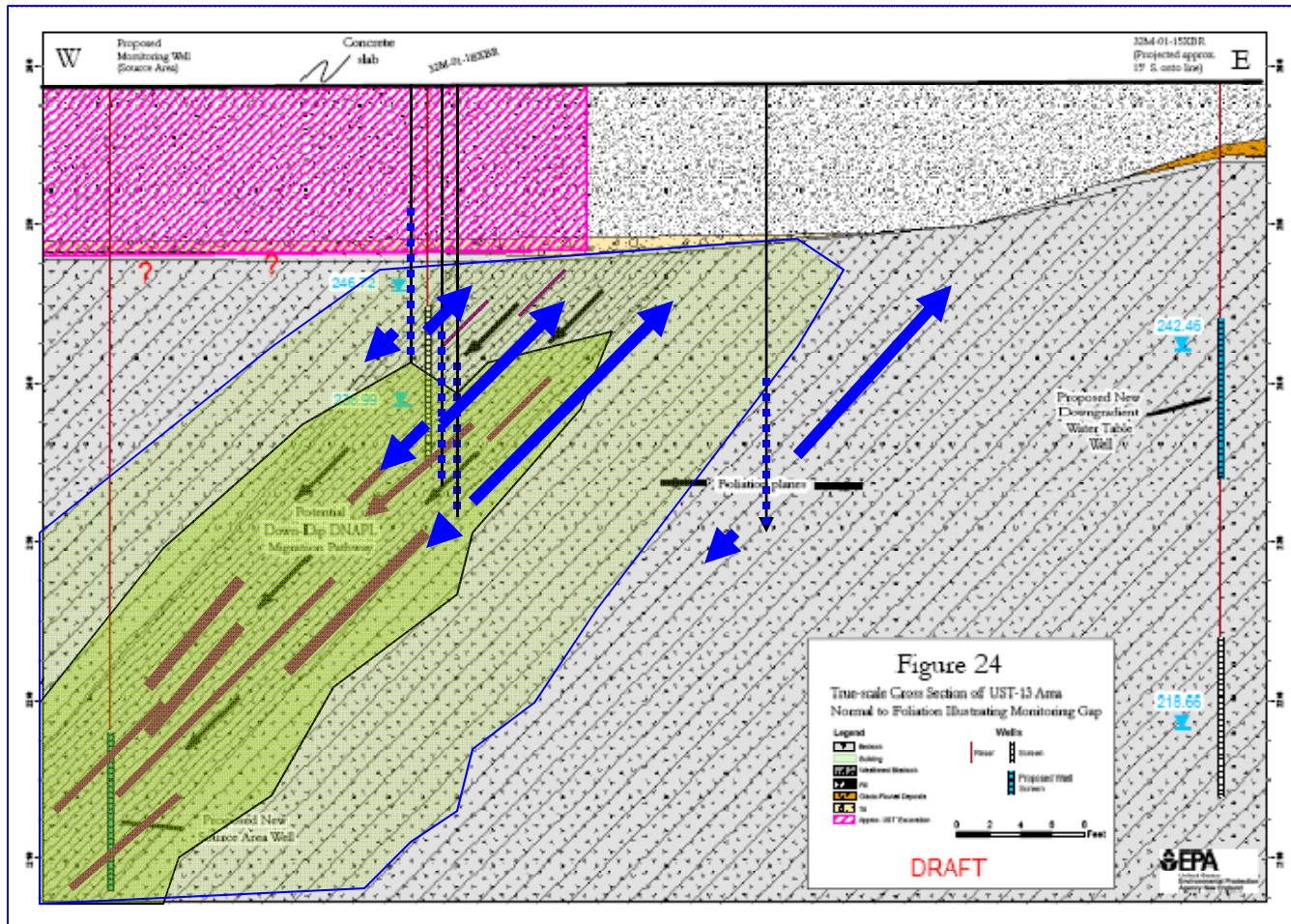
Long-Term Trends
C₉-C₁₀ Aromatics
Area of Contamination 32 and 43A
Well 32M-01-18XBR



Water Levels - 32M-01-18XBR



True-Scale Cross Section of UST-13 Area Normal to Foliation, Injection Wells Installed



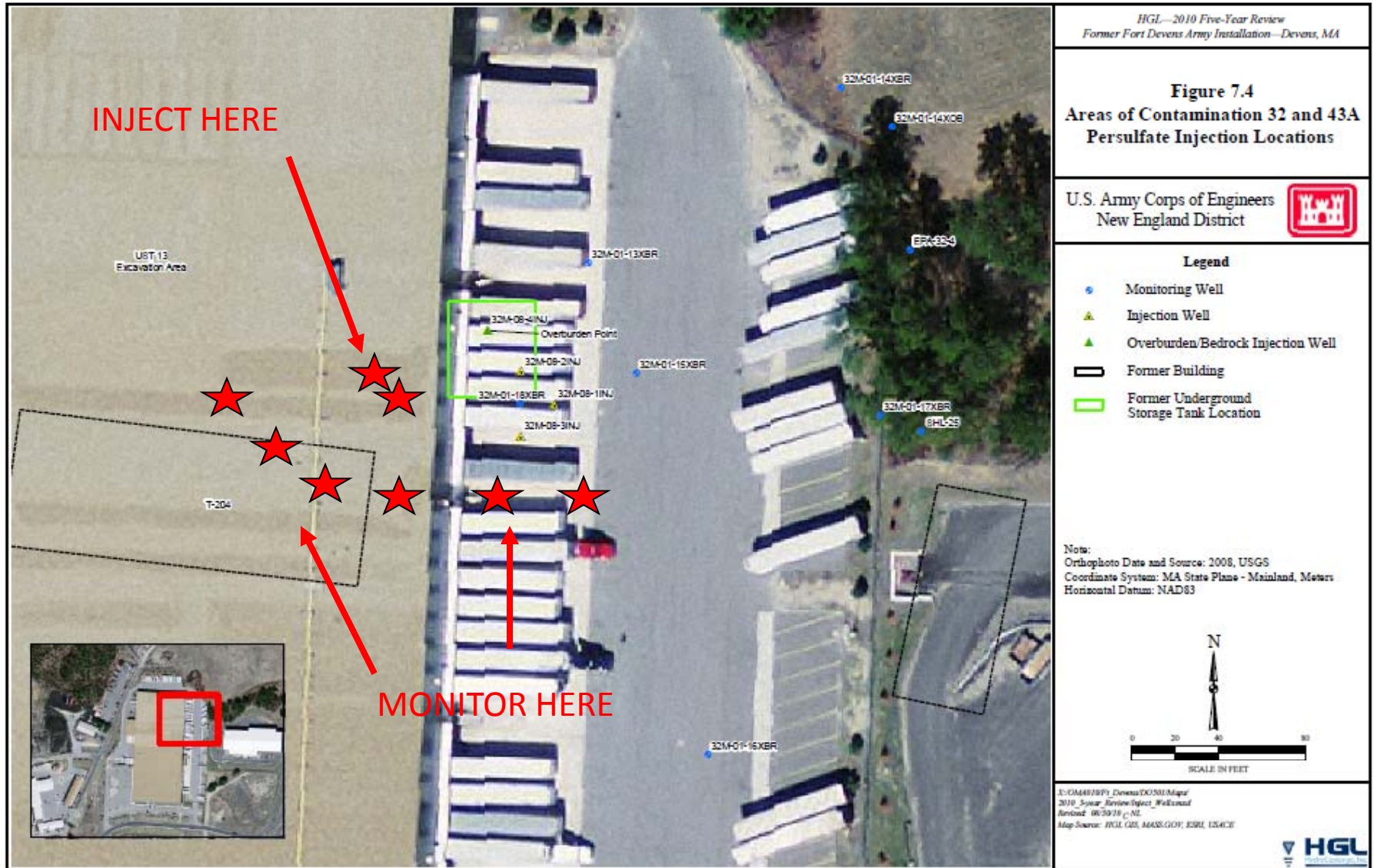
Questions for Ongoing LTM

- Is the apparent COC attenuation real?
- Or will the Oscillatory longer-term trends resume
- Does the site behave as a typical “drowned smear zone”?
- Delivery: Will future remedial efforts need to more carefully consider the bedrock fracture system?
- *Deliverance (Site Closure)*: How might one increase the oxidant contact with residual contaminants?

Next Steps

- Update CSM
 - Install Transducers to evaluate long-term water level trends
 - Improve Geologic-Fracture Model (GFM);
 - Evaluate COC trends wrt WLS and GFM
- Determine whether additional remedial measures are needed
- If necessary, Consider Injecting in down-dip directions (Likely Location of Residual Contaminants)
- Monitor in down gradient areas in consideration of bedrock ground water gradients and bedrock fabric

2009 Persulfate Injection



A photograph of a cracked, greyish-brown rock surface. The rock is covered in numerous small, irregular cracks and is speckled with lighter, yellowish-green patches. A pair of blue sunglasses with black frames is resting on the rock in the lower right quadrant. The sunglasses are open, and the lenses are visible. The background is a plain white surface.

- THANKS

- Question ??