



SOIL PERMEABILITY

Colorado State University
Civil and Environmental Engineering
Center for Contaminant Hydrology

CCH

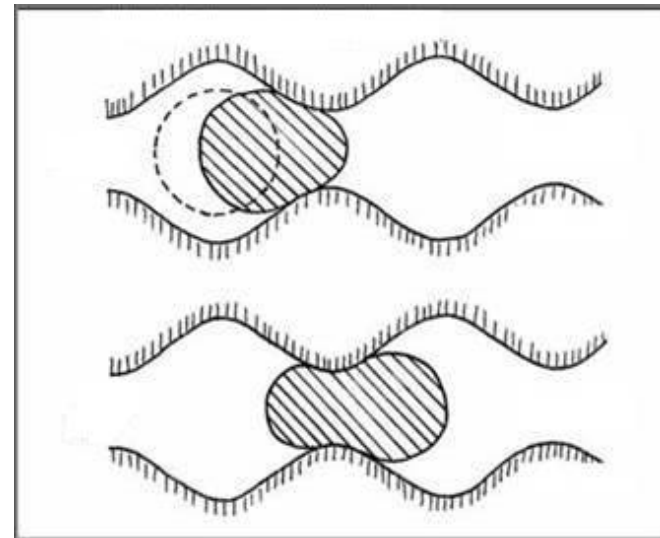
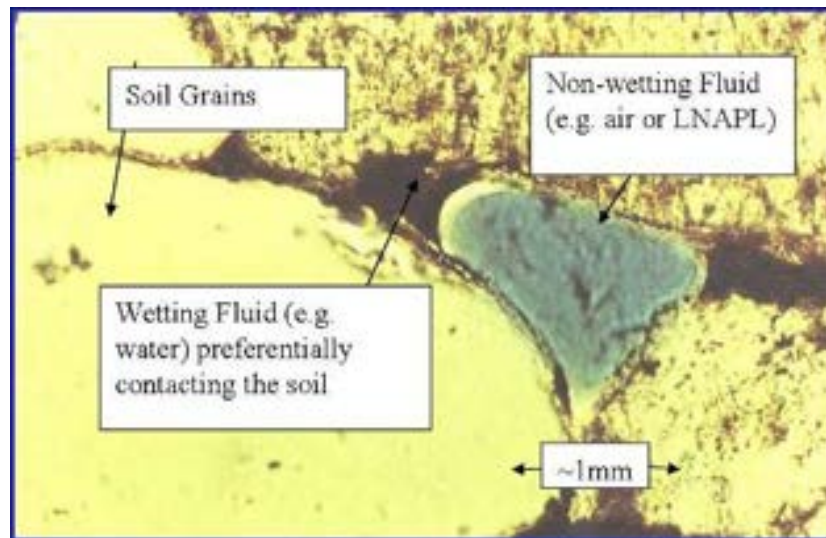


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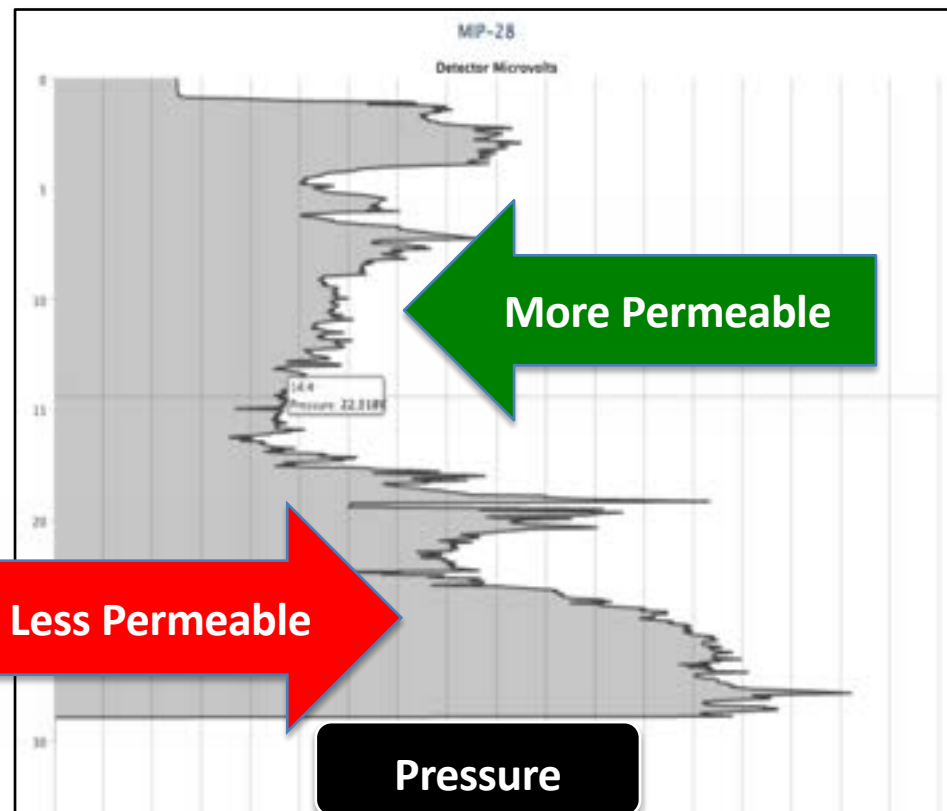
Fluid Transport and Pore Pressure



**PRESSURE NAPL must $\gg \gg$ PORE ENTRY PRESSURE
for NAPL migration**



Hydraulic Profiling Tool (HPT) to Measure Soil Pore Pressure

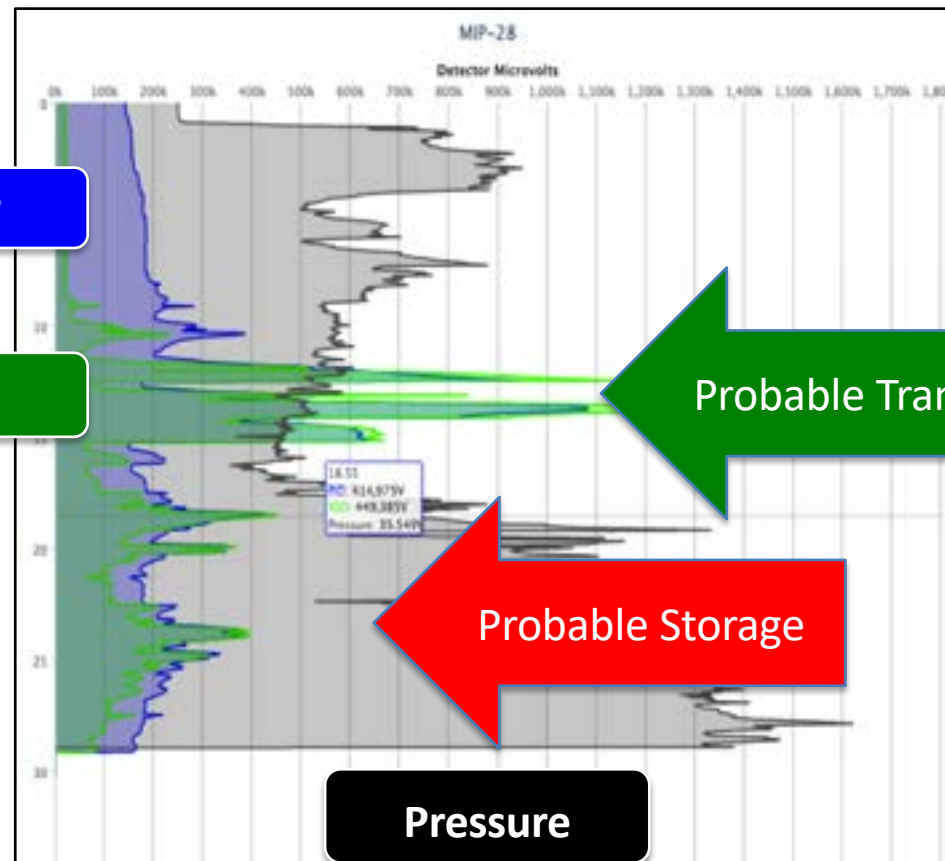
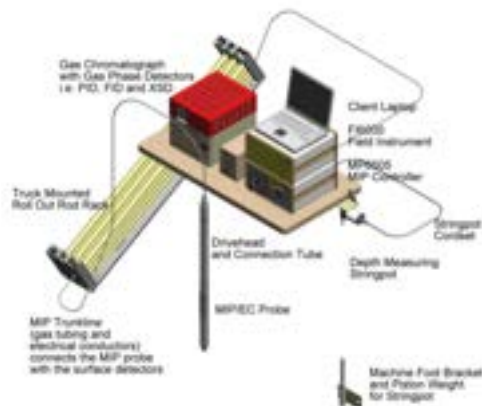




Combined Membrane Interface Probe and Hydraulic Profiling Tool (MiHpt)

Photo Ionization Detector

Halogen Specific Detector



Probable Transport

Probable Storage

Pressure



REPEATABILITY!



DYNAMIC WORK STRATEGIES NEED REAL TIME INFORMATION AND DECISION MAKING



Real-Time Reporting

The screenshot displays the 'smartdata' website interface. On the left, a 'LOG IN' form is visible with fields for 'Email address' (containing 'jschl@columbiatechnologies.com') and 'Password' (masked with dots). Below the password field is a note 'Minimum of 6 characters'. There are links for 'Forgot Password?' and 'Create An Account', a blue 'Login' button, and a red 'Sign in with Google' button. On the right, a laptop screen shows the 'Smart Data Solutions' dashboard. The dashboard features a map with various data points, a sidebar with navigation options like 'Dashboard', 'Reports', 'Data', 'Settings', 'Team Members', and 'Full Screen', and a bottom section with 'STATIONS: GAS DETECTOR VALUES' and a 'Start Data' button. The top of the website has the 'smartdata' logo, navigation links for 'Help Docs' and 'Contact Us', and the tagline 'REAL TIME DATA ACCURATE RESULTS' with a 'Learn More' button.



THE CRITICAL ROLE OF DISCRETE SATURATED SOIL SAMPLING



Systematic Screening

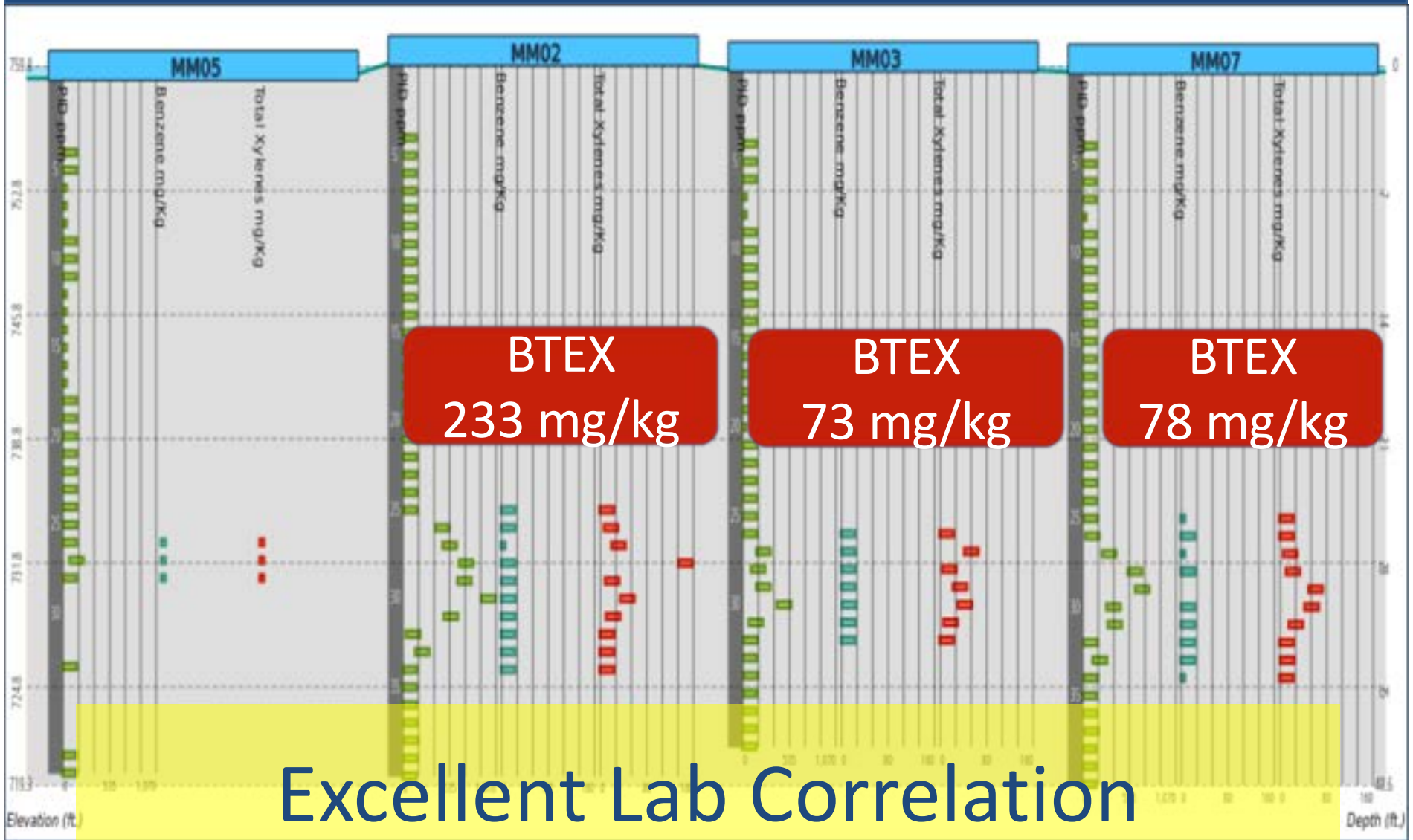


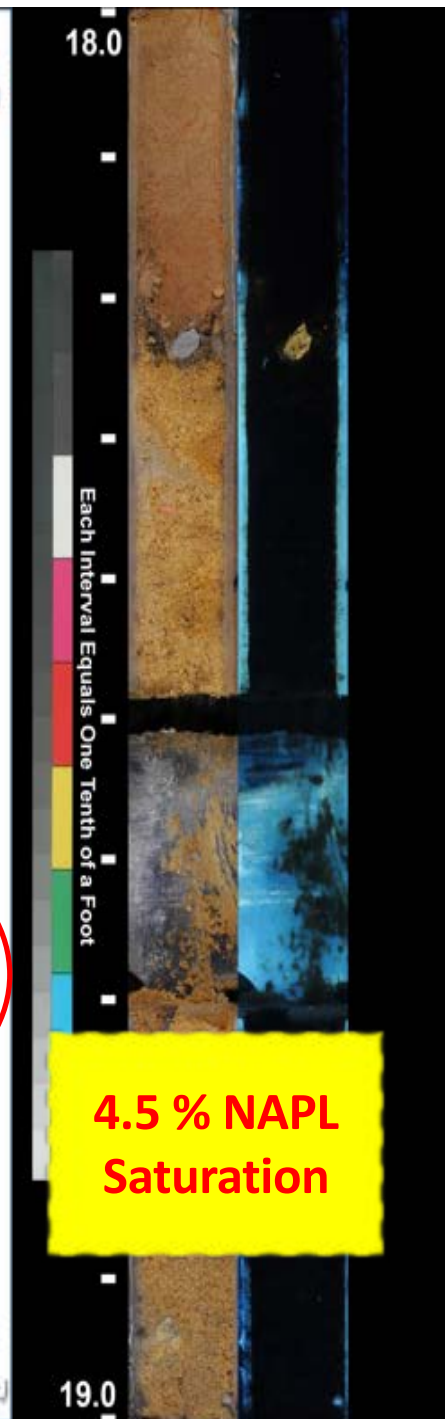
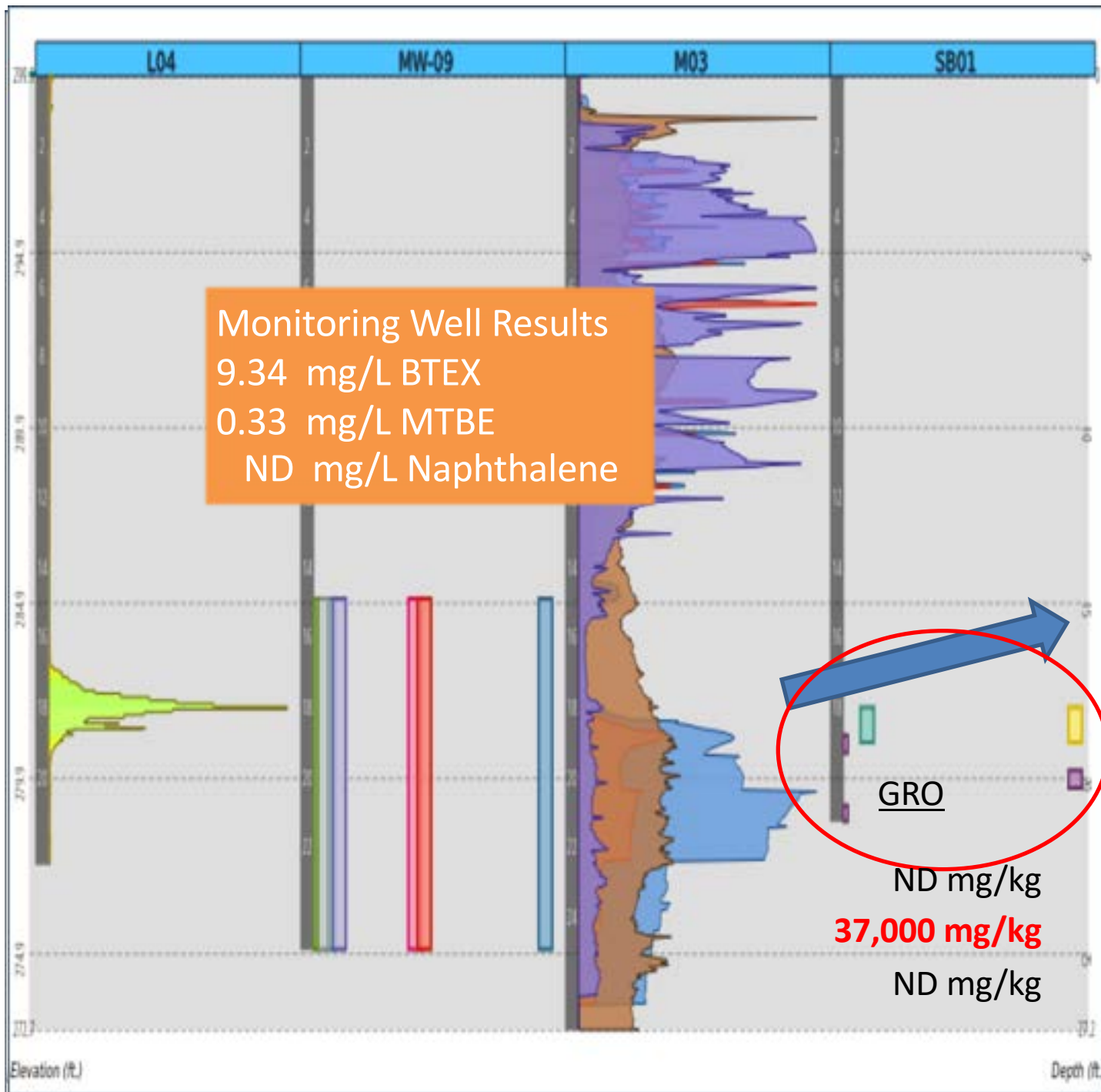


Systematic Sampling



Sealed & Preserved For Lab



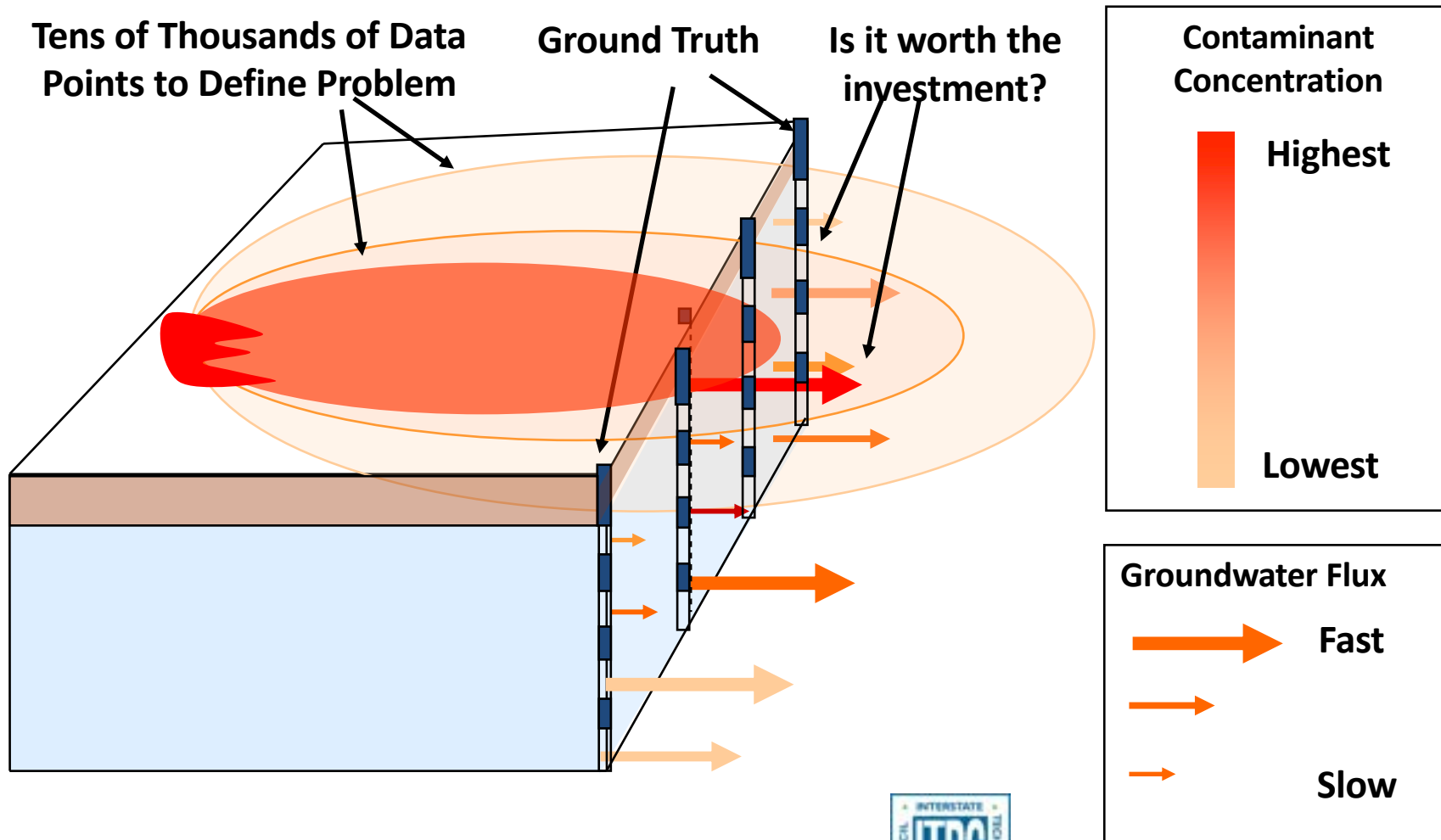


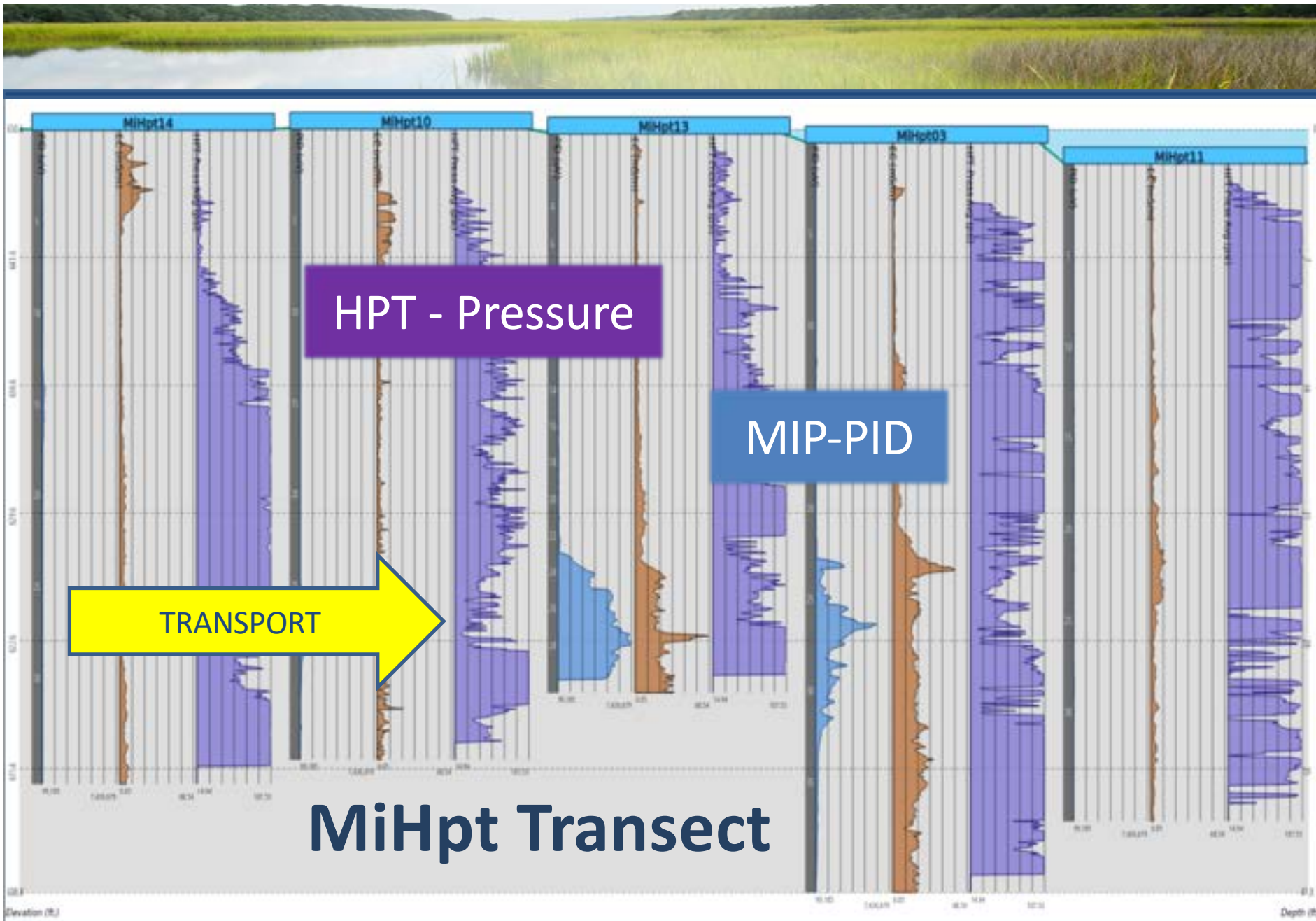


GROUNDWATER DISSOLVED PHASE CONTAMINATION



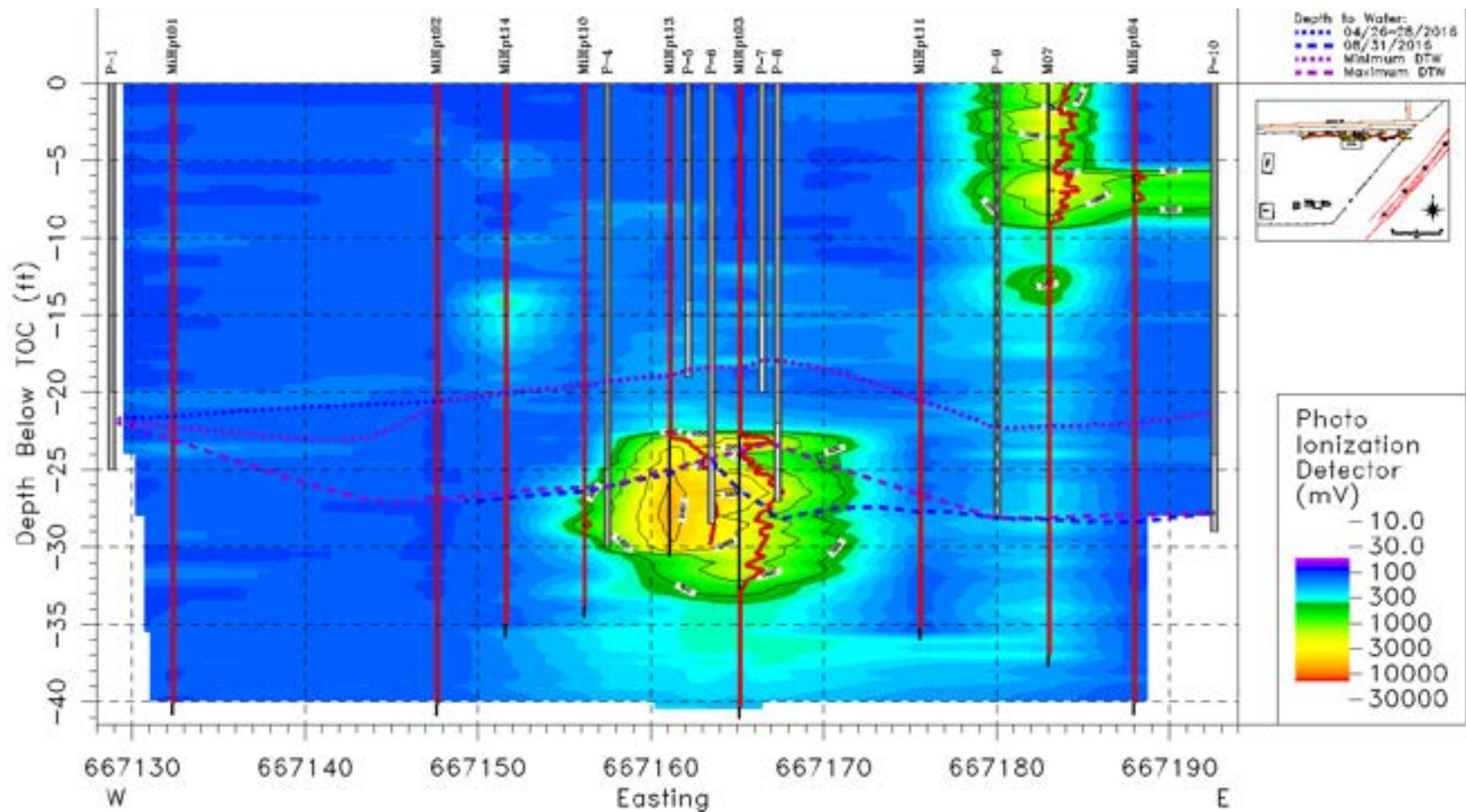
Mass vs Flow







Mass Transport Diagram





VAPOR PHASE CONTAMINATION AND NATURAL SOURCE ZONE DEPLETION

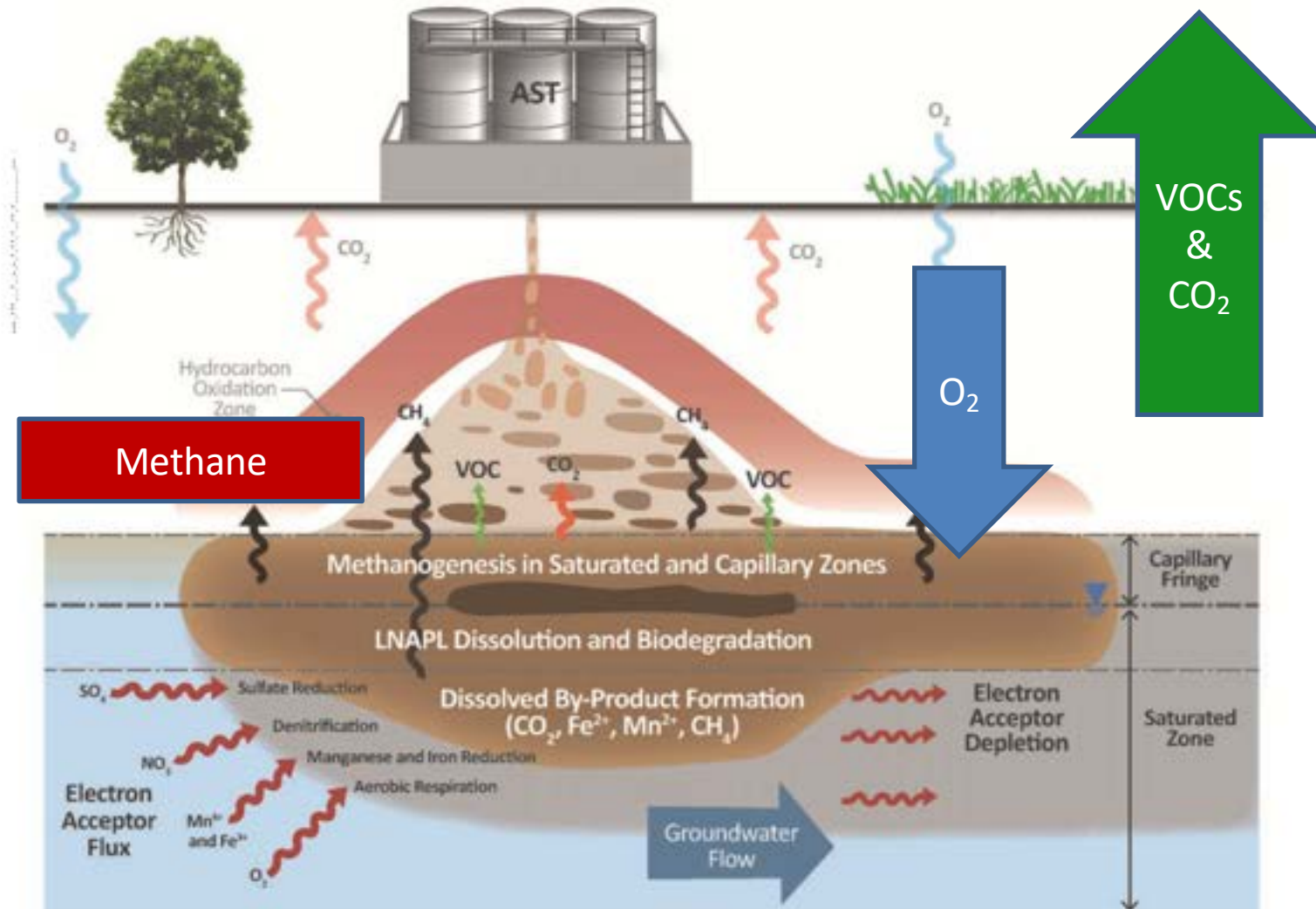
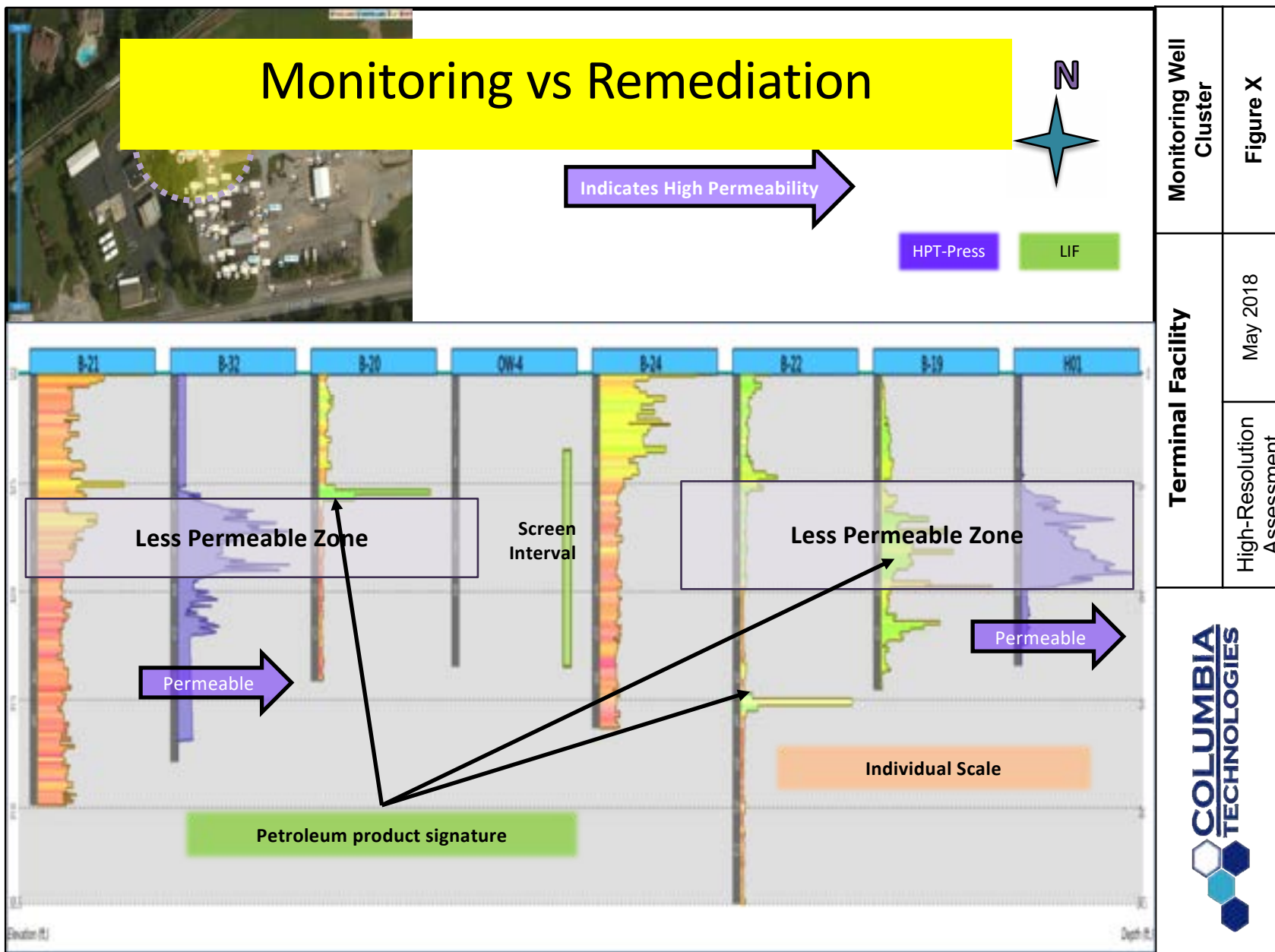


Figure 2-1—Conceptualization of Saturated Zone NSZD Processes



SPATIAL ALIGNMENT



Technology Summary

LCSM Component	“Type” of LNAPL Site	Concern	Scale Appropriate Technology	
Where is the Source?				
Soil Profile	• Residual • Mobile • Migrating	• Migration • Vapor Intrusion • Dissolved • Source Reduction	• CPT • HPT • Soil samples	• EC
LNAPL Distribution			• LIF • OIP • Soil Samples	• MIP
What is the Nature of the Source?				
Composition (Volatile, Biodegradable, Soluble)	• Residual • Mobile	• Vapor Intrusion • Dissolved • Source Reduction	• LIF • OIP • MIP • Soil sampling	
Mobile or Residual		• Source Reduction	• Soil sampling • LNAPL Transmissivity	



Key Takeaway Points

- **High-resolution**, i.e. scale appropriate information is critical to minimizing the uncertainty in the Site Conceptual Model
- **Remediation parameters** are not the same as risk parameters (i.e. BTEX in water does not represent TPH mass in soil)
- **Multiple lines of evidence** are required - One technology or approach will not provide all the answers needed for remedial design selection



Partnering for Smarter Sustainable Solutions

THINK.
RESTORE,
Sustainably



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