Site Characterization & Real-Time Data Collection: A Hands-On Workshop

High Resolution Site Characterization (HRSC) Direct-Sensing Tools, 3-Dimensional Data Visualization and Confirmation Sampling Tools

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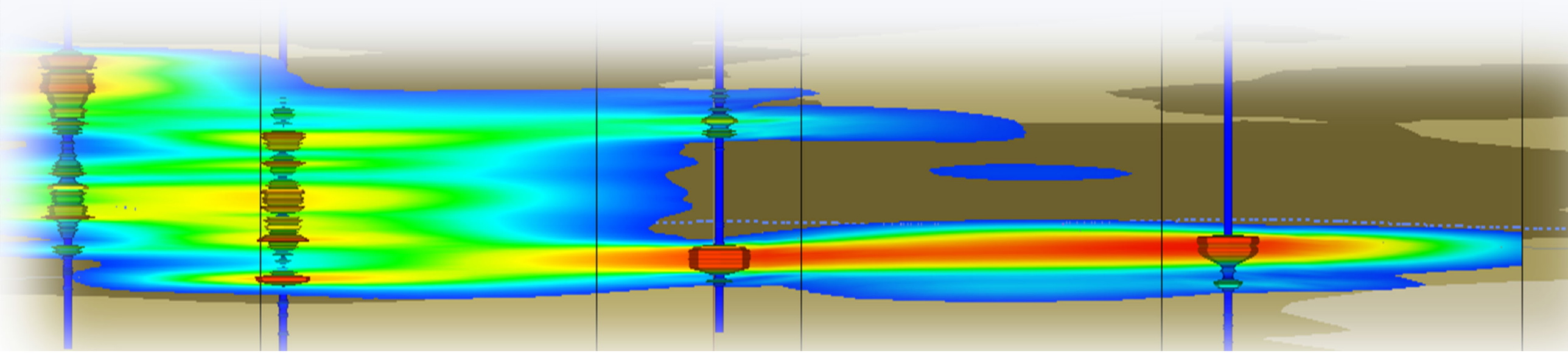
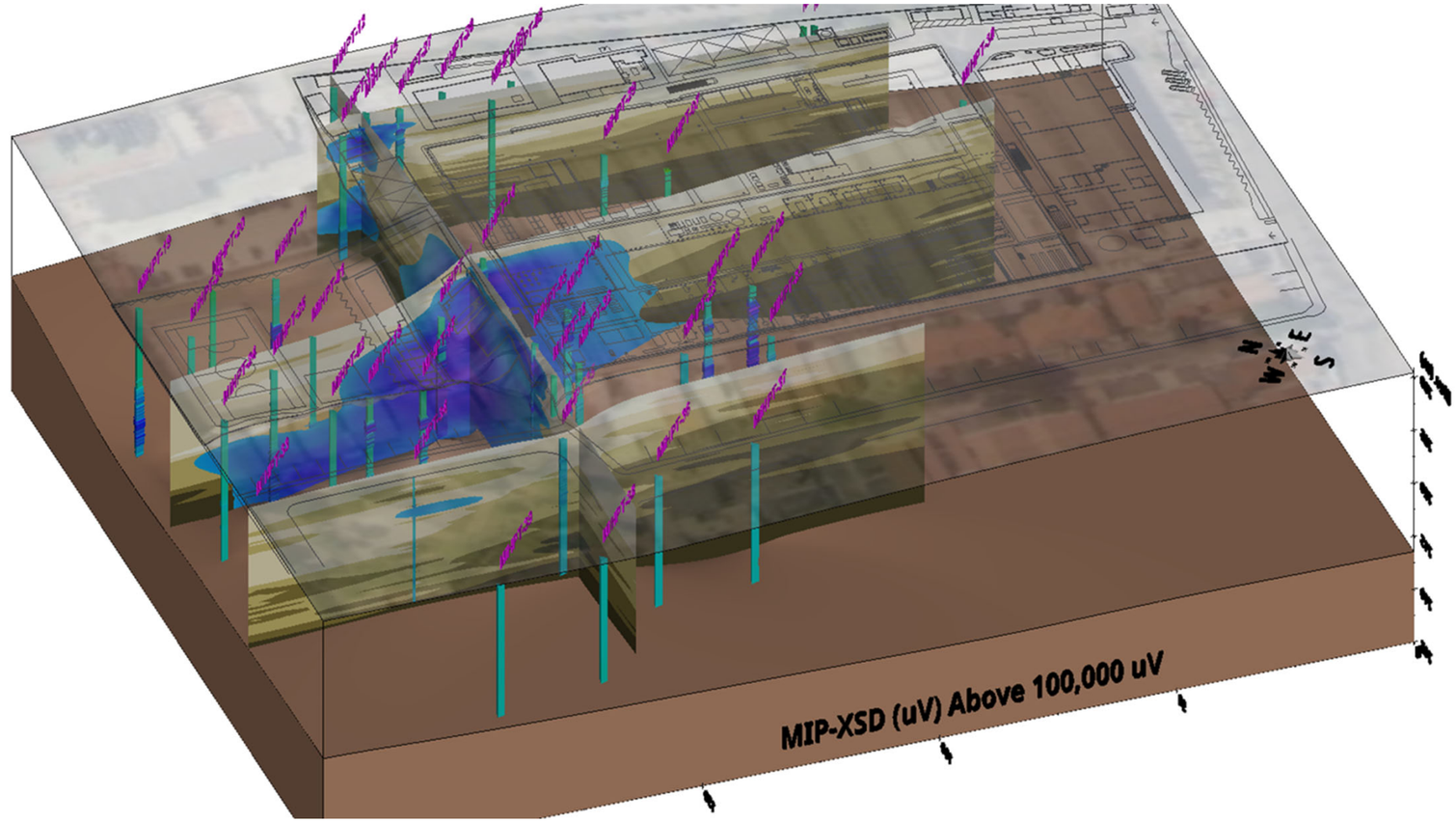
HRSC Specialists

NEWMOA
NORTHEAST WASTE MANAGEMENT OFFICIALS' ASSOCIATION

Why HRSC?





High Resolution Site Characterization (HRSC)

HRSC uses direct-sensing technologies aimed at maximizing data density at the lowest cost per data point, to generate a high-resolution three-dimensional volumetric image of contaminant impacts in relationship to lithology, backed up with targeted discrete confirmation sampling.

HRSC helps clients solve complex environmental problems

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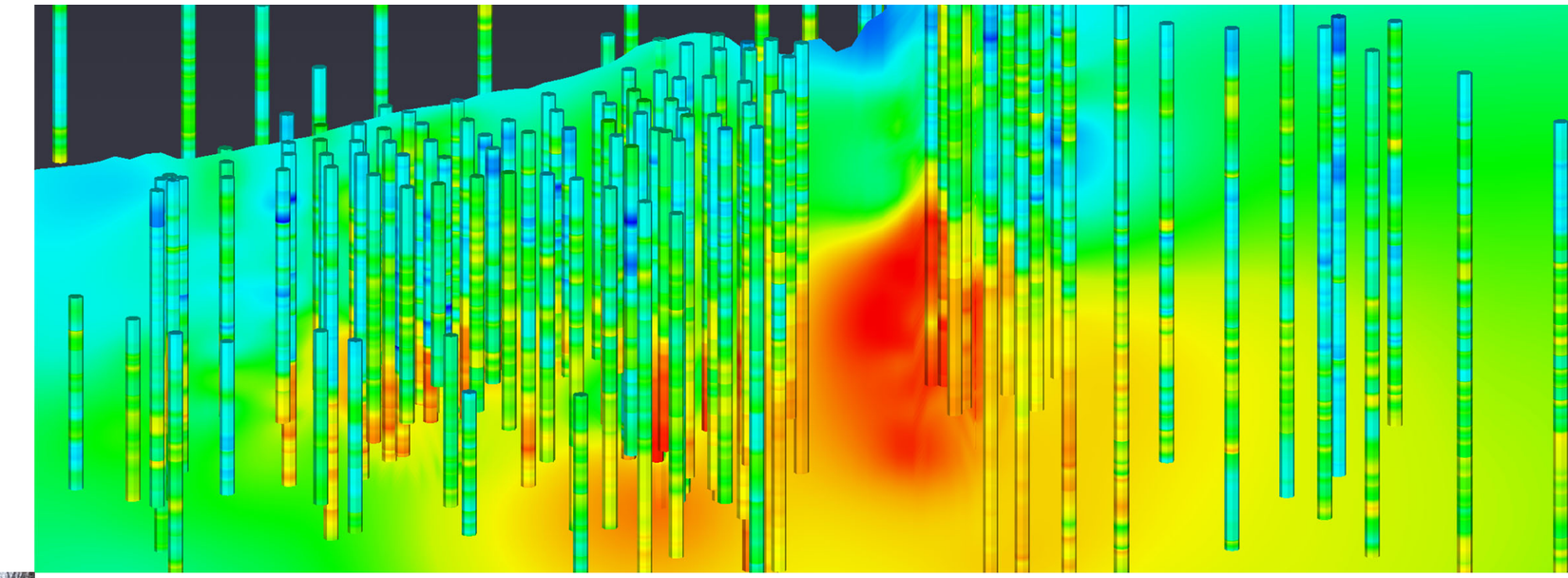
Key Takeaways!

- **HRSC can be used on any site:**
  - Dry Cleaner/Gas Station to Superfund Sites
- **Wells Can be Misleading!**
  - Wells are best for monitoring not delineation
- **Collecting representative confirmation soil samples can be challenging**
- **Failed Remediation??**
  - Often a result of under characterized heterogeneity
- **Direct-Sensing only <u>slightly</u> more expensive day rate - upside savings on life cycle costs!**

Direct-Sensing Tools



<u>Lithology Mapping Sensors</u>

- **Electrical Conductivity (EC)**
- **Hydraulic Profiling Tool (HPT)**

<u>Contaminant Mapping Sensors</u>

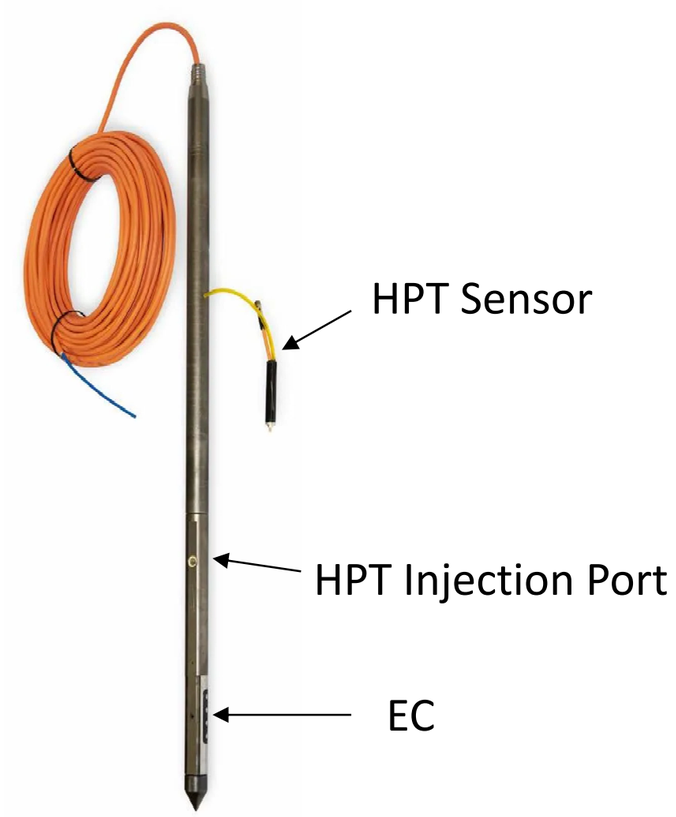
- **Optical Image Profiler (OIP)**
  - **OiHPT-UV**
  - **OiHPT-G**
  - **OiHPT-UVR**
- **Membrane Interface Probe (MIP)**
  - **MiHPT**
  - **Heated Trunkline (HTL) MIP**
  - **Low Level MIP (LL MIP)**

Electrical Conductivity and Hydraulic Profiling Tool (HPT)

- EC logs are used to define lithology based on bulk grain size measurements.

- The EC probe works by sending a current through the formation between two probe contacts. This current is measured along with the voltage and the conductivity is a ratio of current to voltage times a constant.

- EC can be affected by soil mineral content and pore water chemistry (brines, pH etc.)



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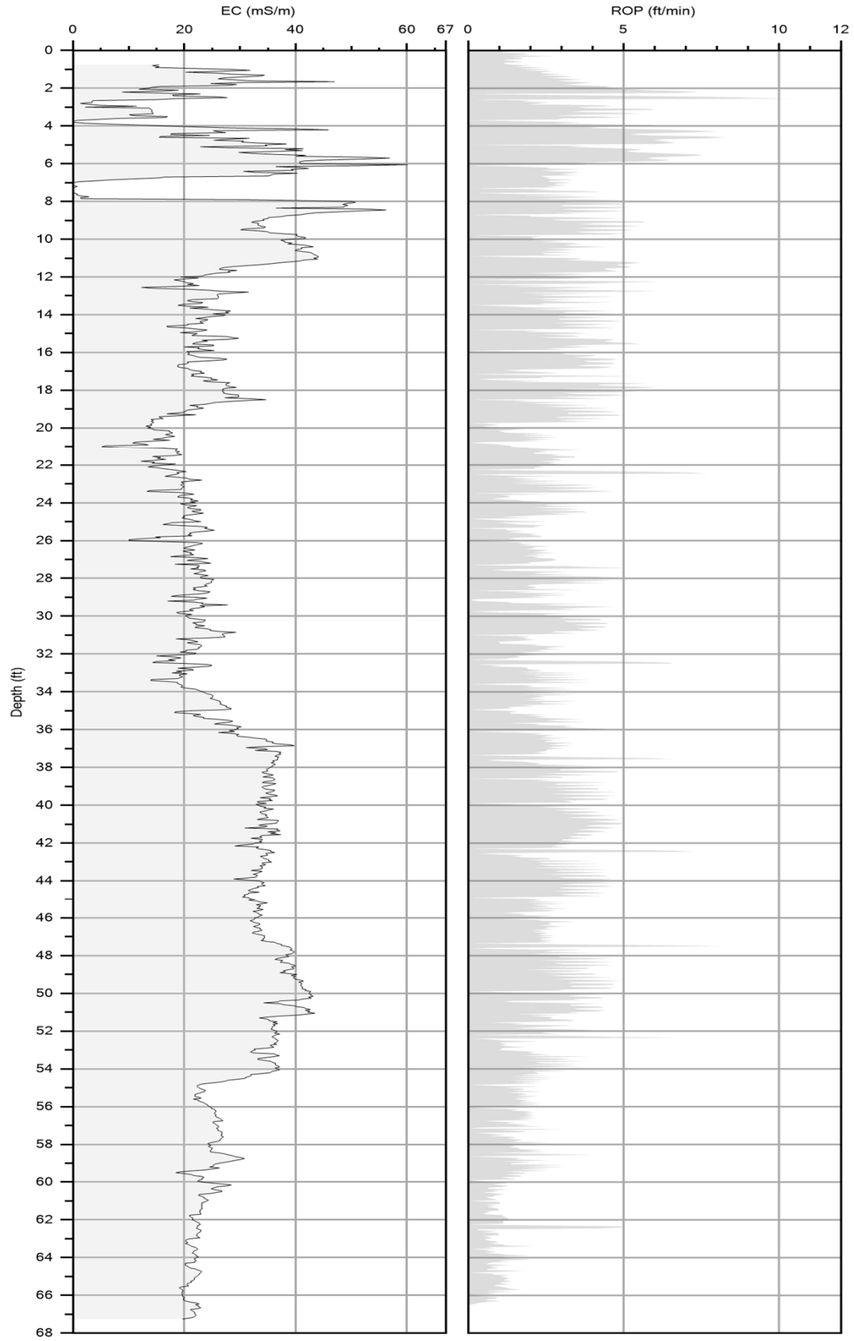
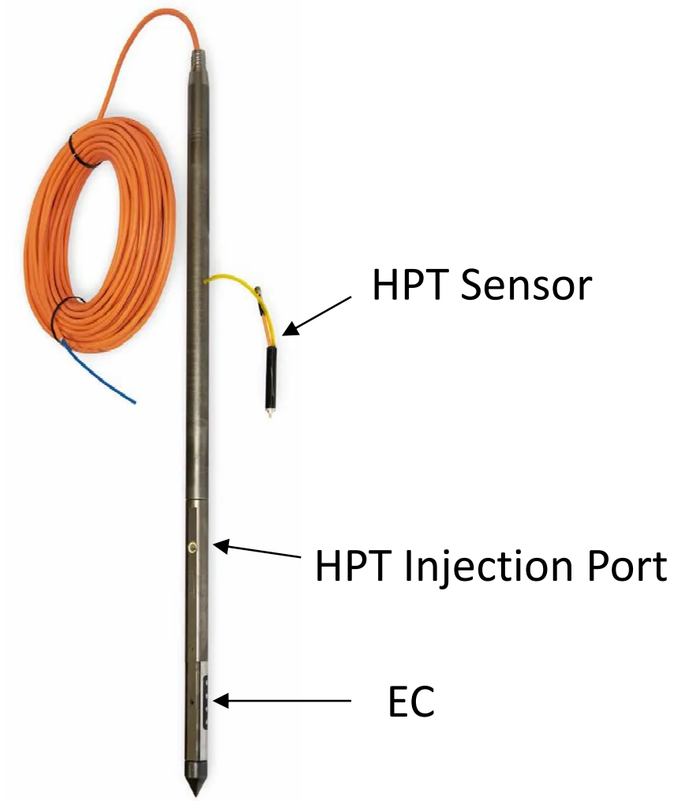


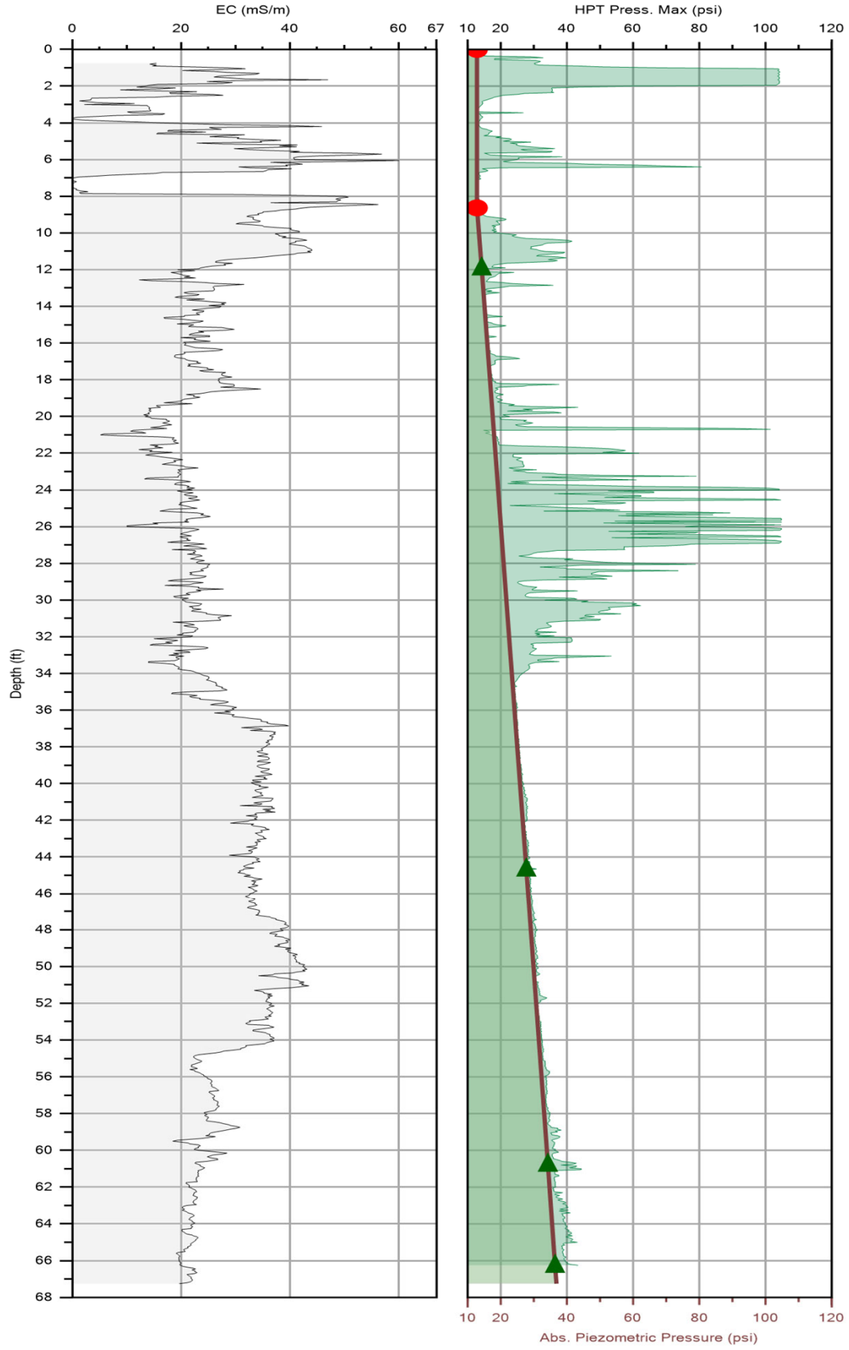
Electrical Conductivity and Hydraulic Profiling Tool (HPT)

- HPT is a downhole direct sensing tool that provides real-time profiles of soil permeability.

- HPT uses a sensitive downhole transducer to measure the pressure response of soil to the injection of water.

- Estimated Depth to Water and Est. K values





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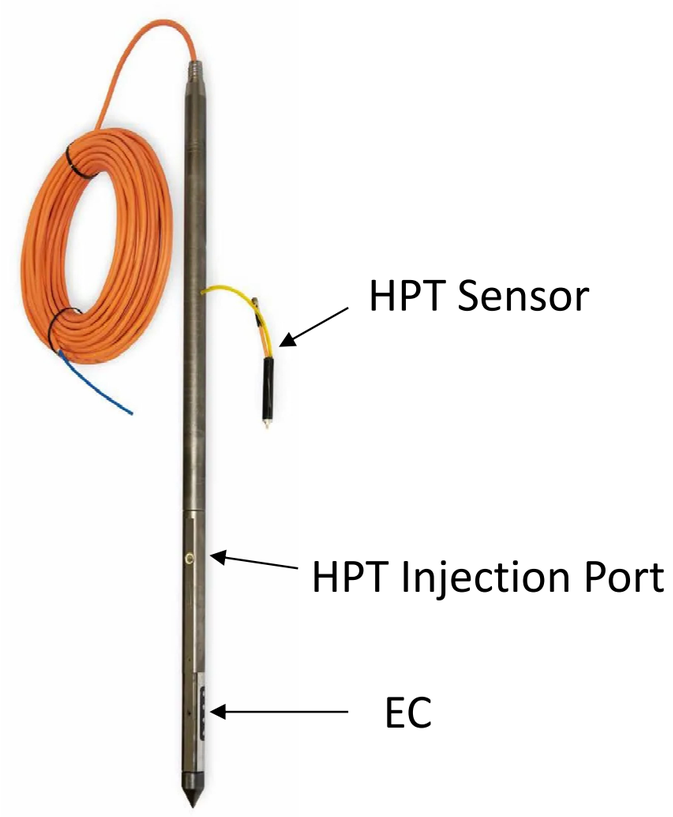
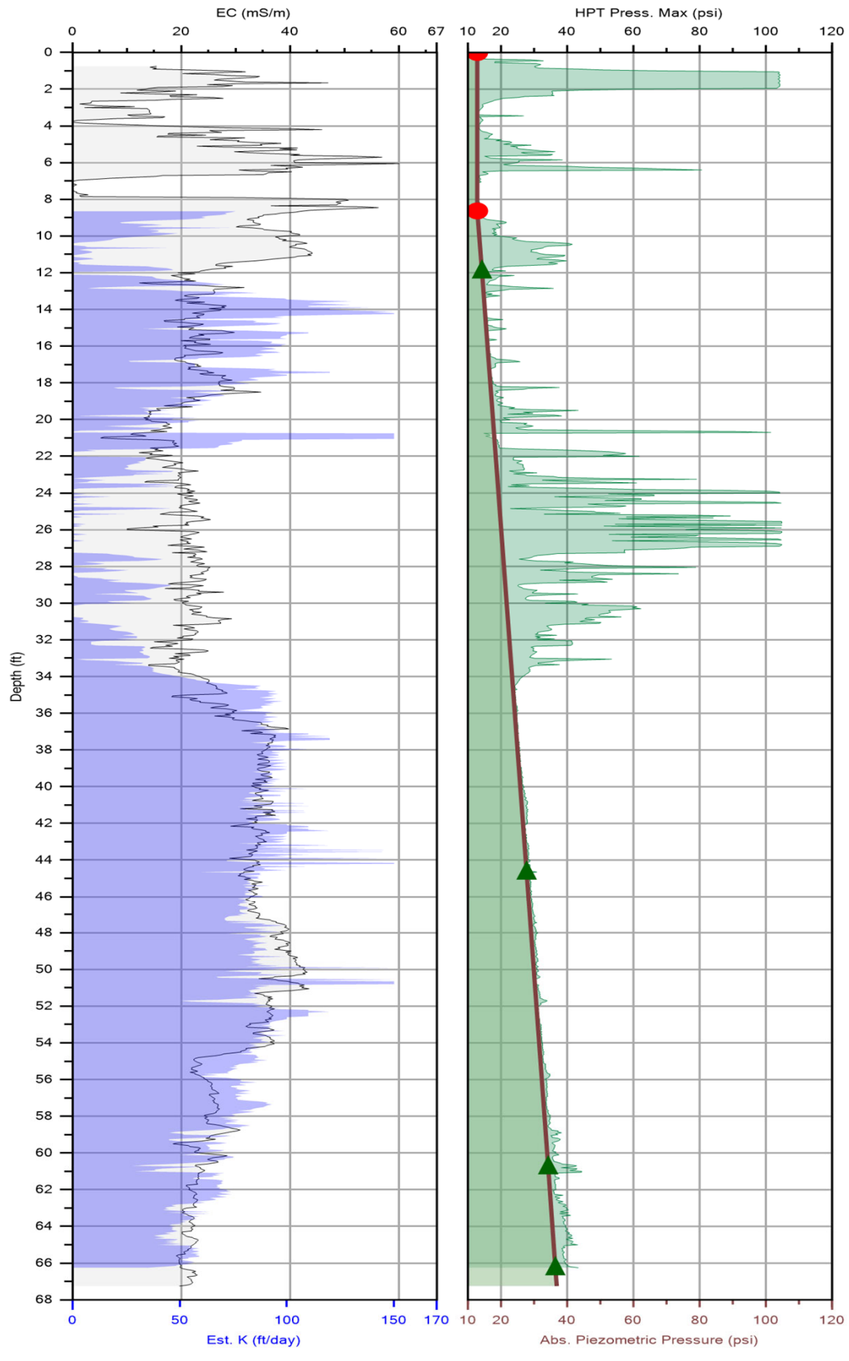
Electrical Conductivity and Hydraulic Profiling Tool (HPT)

- Determine soil lithology
- Identify injection intervals for remediation
- Identify zones that yield water for groundwater sample collection
  - VOCs
  - CVOCS
  - PFAs
- Identify metals/ash layers in historic fill





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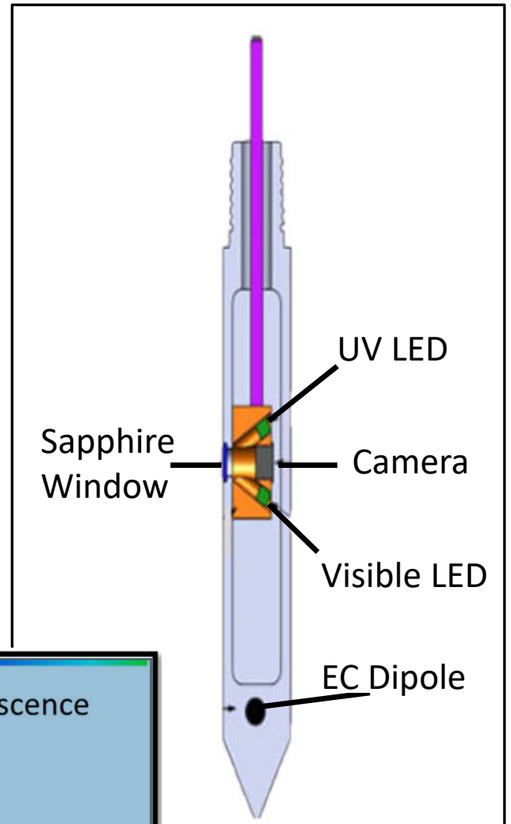
OIP Technology

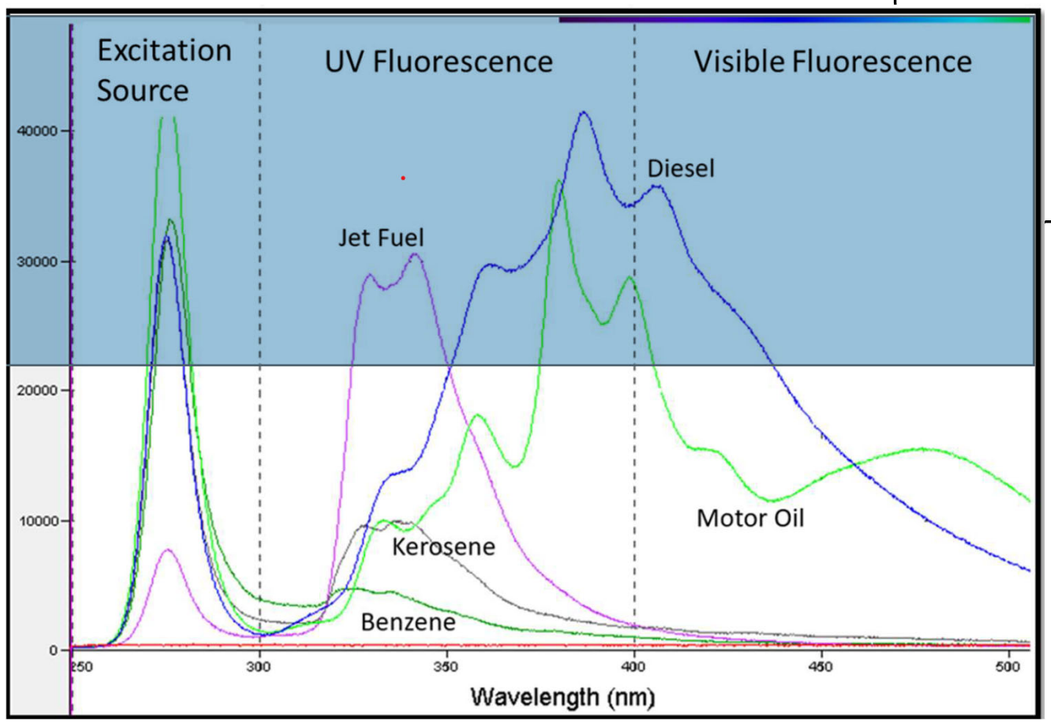
- Detects UV-induced fluorescence of PAHs
- 275nm UV (standard OIP) or 520 nm (OIP-G) directed at soil through sapphire window
- Camera takes image of soil and OIP interface analyzes for fluorescence

Average: 150-225’ per day

Residual and Free Phase Only

Detection Limits well below EPH/TPH criteria



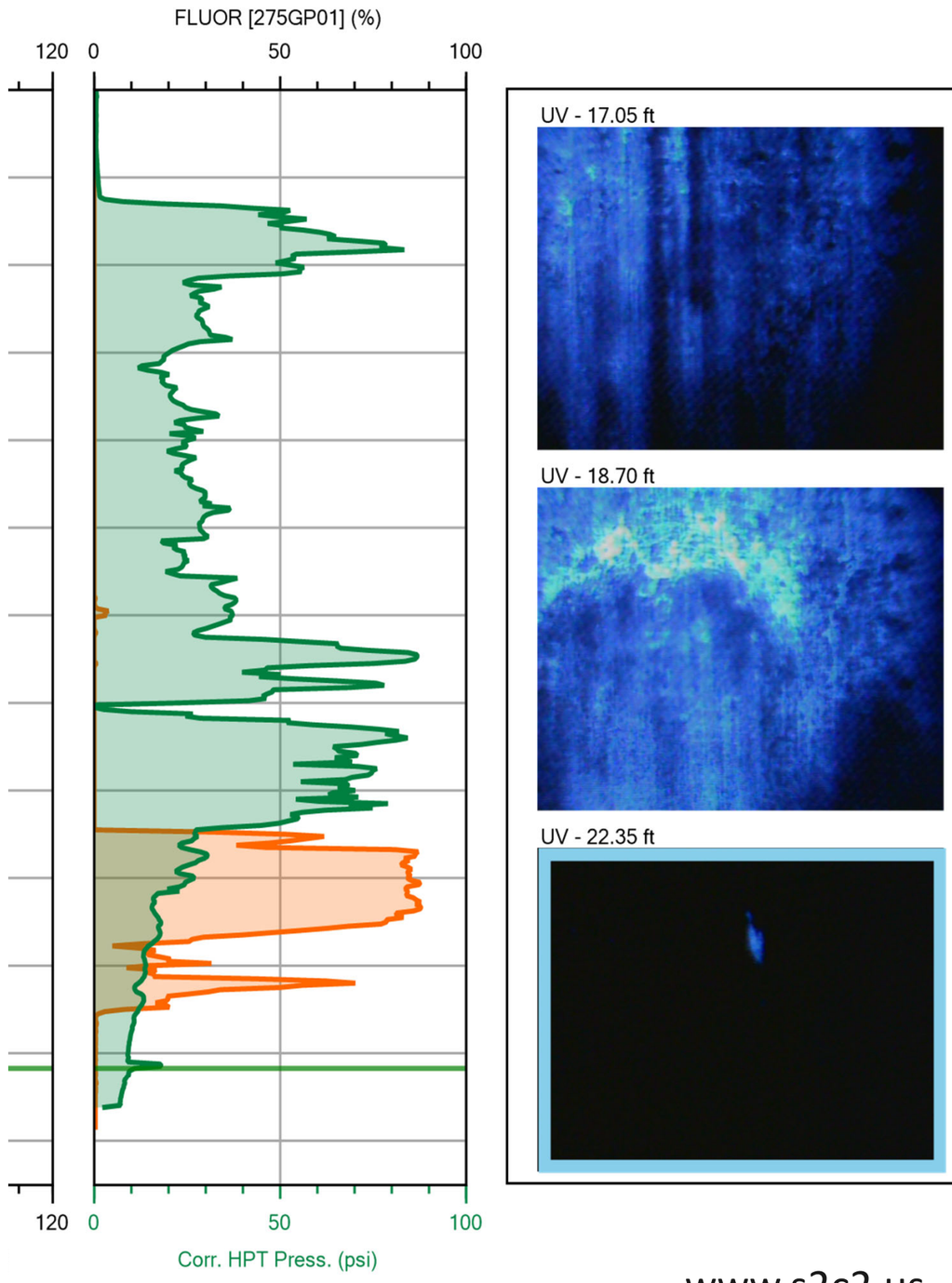


OIP Technology

- **OiHPT-UV** detects gasoline, diesel, jet fuel, motor, hydraulic and cutting oil.

- **OiHPT-G** detects Creosote, Coal Tars, Heavy Crude Oils, and Bunker Fuels.

- **OiHPT-UV R (Beta)** Better Resolution for Kerosene, Jet Fuel and BTEX compounds



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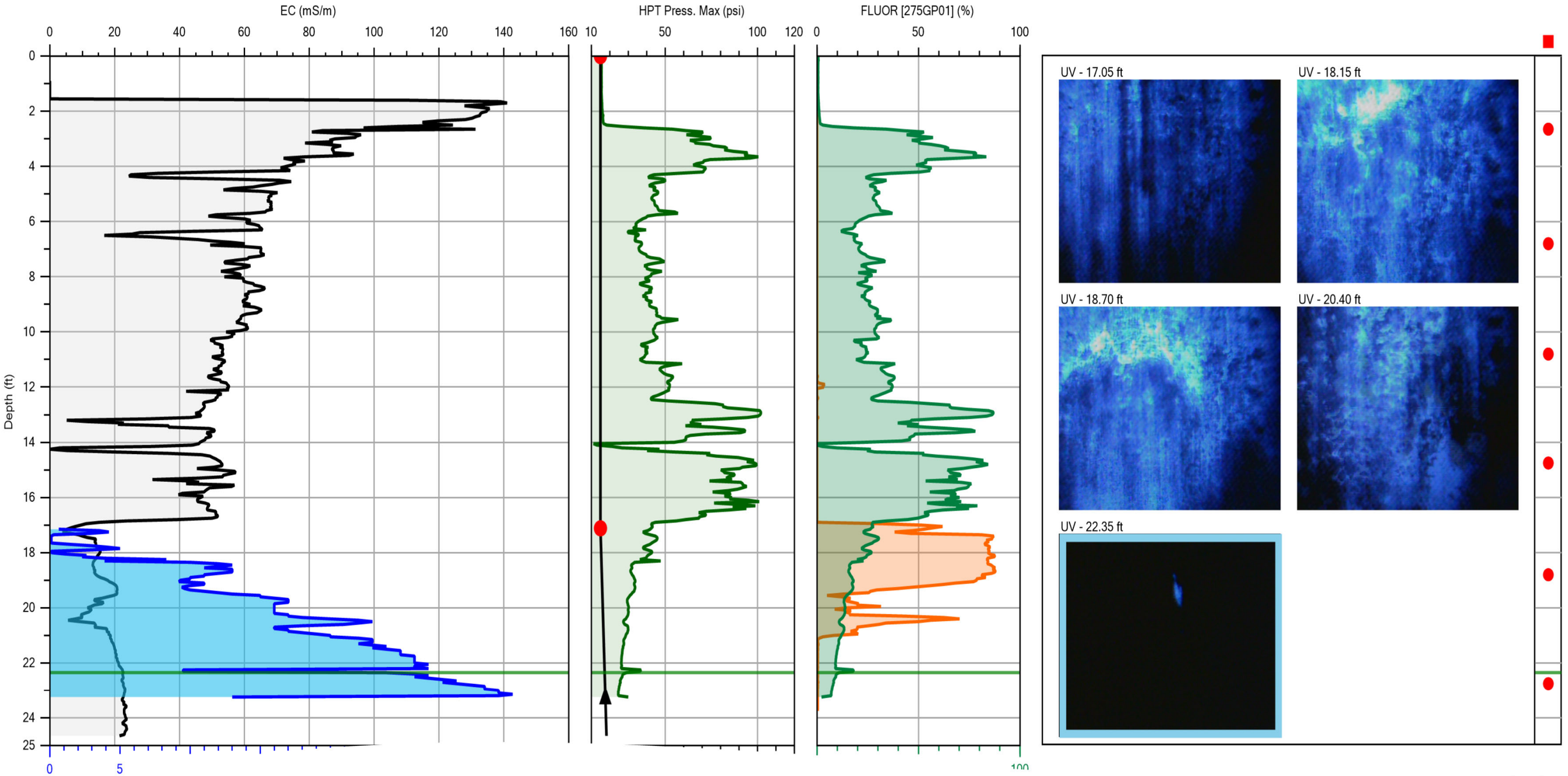
Optical Image Profiler with Hydraulic Profiling Tool (OiHPT) Log



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Membrane Interface Probe with Hydraulic profiling Tool (MiHPT)

Probe Options:

- MiHPT
- Heated Trunkline (HTL) MIP
- Low Level MIP (LL MIP)

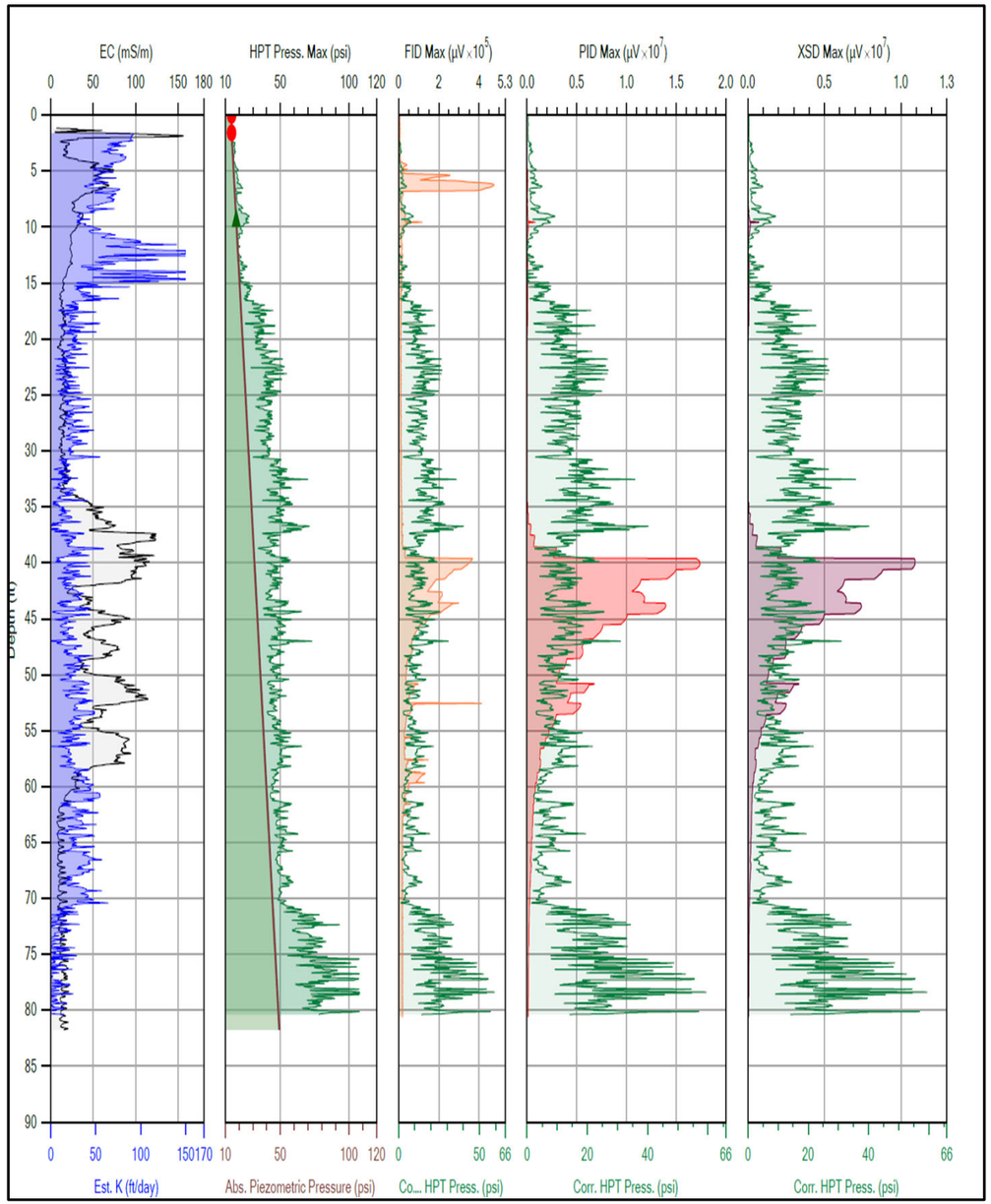
Data Generated:

- EC
- HPT
- FID
- PID
- XSD
- Est K.

20 Readings per foot

7200 Data Points per 60 foot boring!

Average 135-150’ per day



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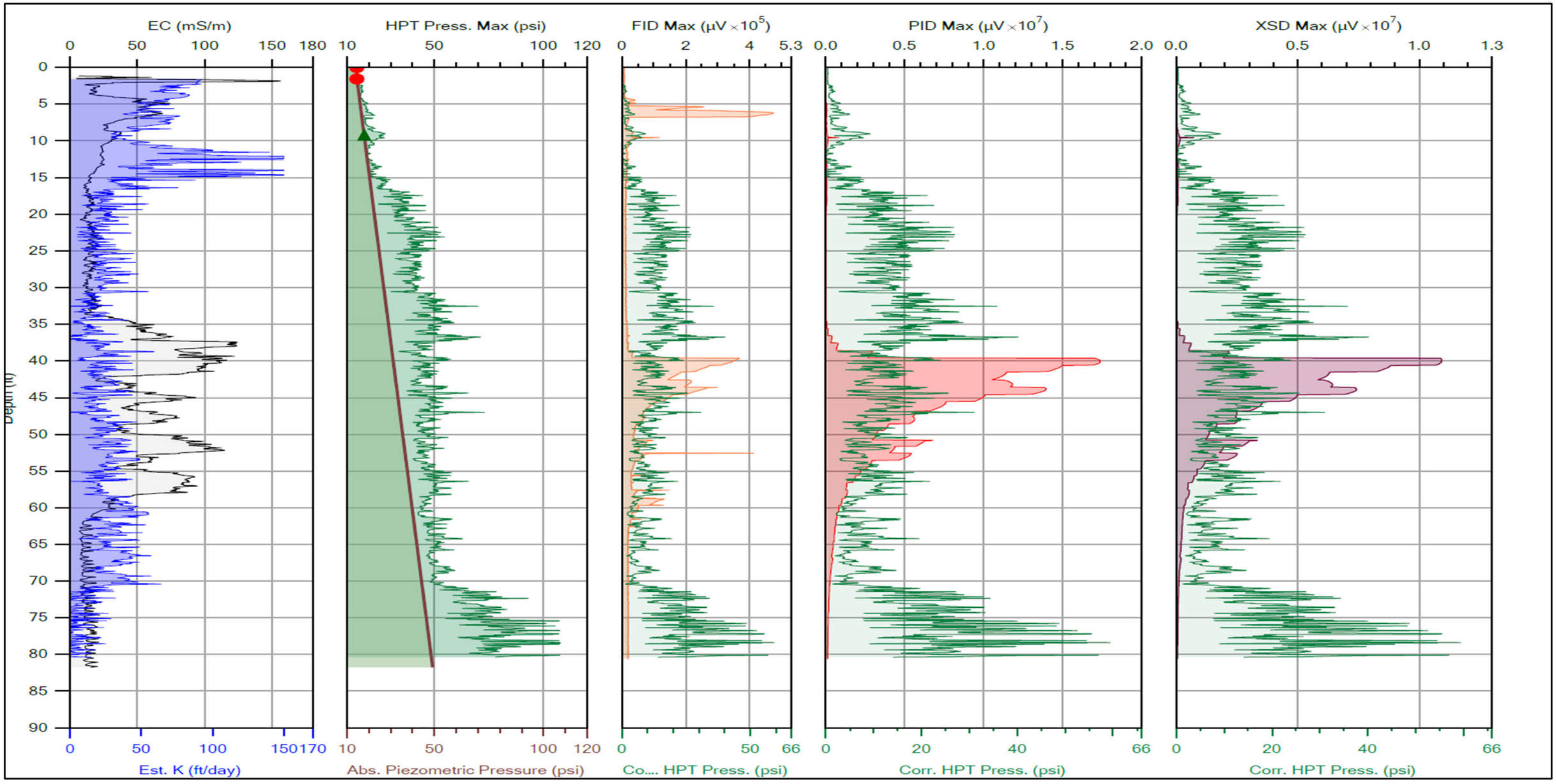
Membrane Interface Probe with Hydraulic profiling Tool (MiHPT)



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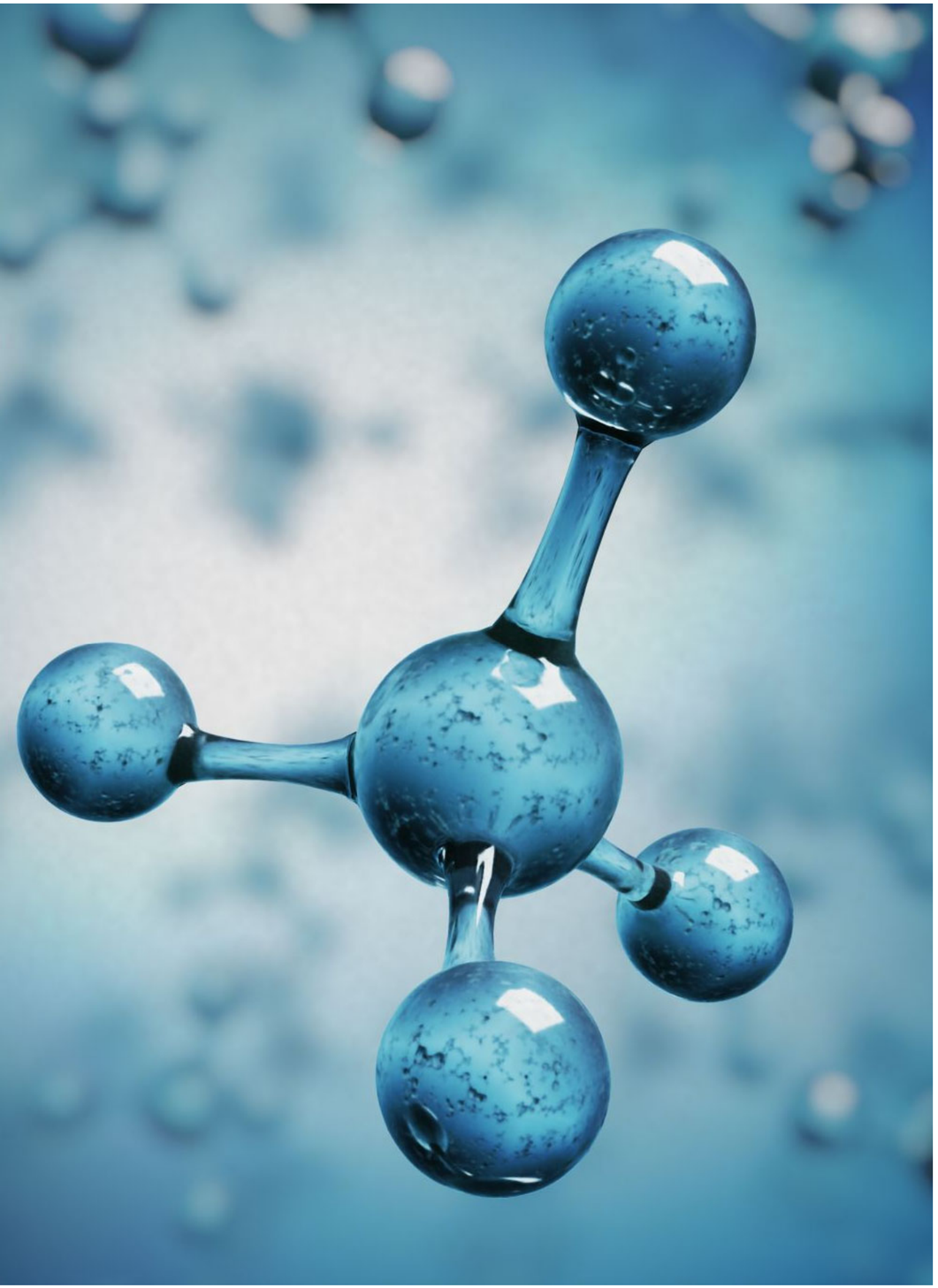

MIP Compounds of Concern

Logs relative concentration of VOCs with depth in soil

- CVOCs
  - MiHPT
- BTEX
  - MiHPT (Dissolved Phase only)
  - Heated Trunkline (No HPT)
- Chlorobenzene/Chlorotoluene
  - Heated Trunkline (No HPT)
- Others – Dependent on Boiling Point, Vapor Pressure and other chemical properties
  - Detectable Compounds by MIP.xlsx (geoprobe.com)
  - Ask Us

Detection limits: Product to <100ppb

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Direct-Push Confirmation Sampling

- Soil Sampling
  - MC5
  - 2.25” Dual Tube
  - 3.25” Dual Tube
- Groundwater Sampling
  - SP16/19/22
  - Temp Wells
  - Pre-Packed Monitoring Wells
  - PFAS

Critical that any sample collected represents the interval sampled!

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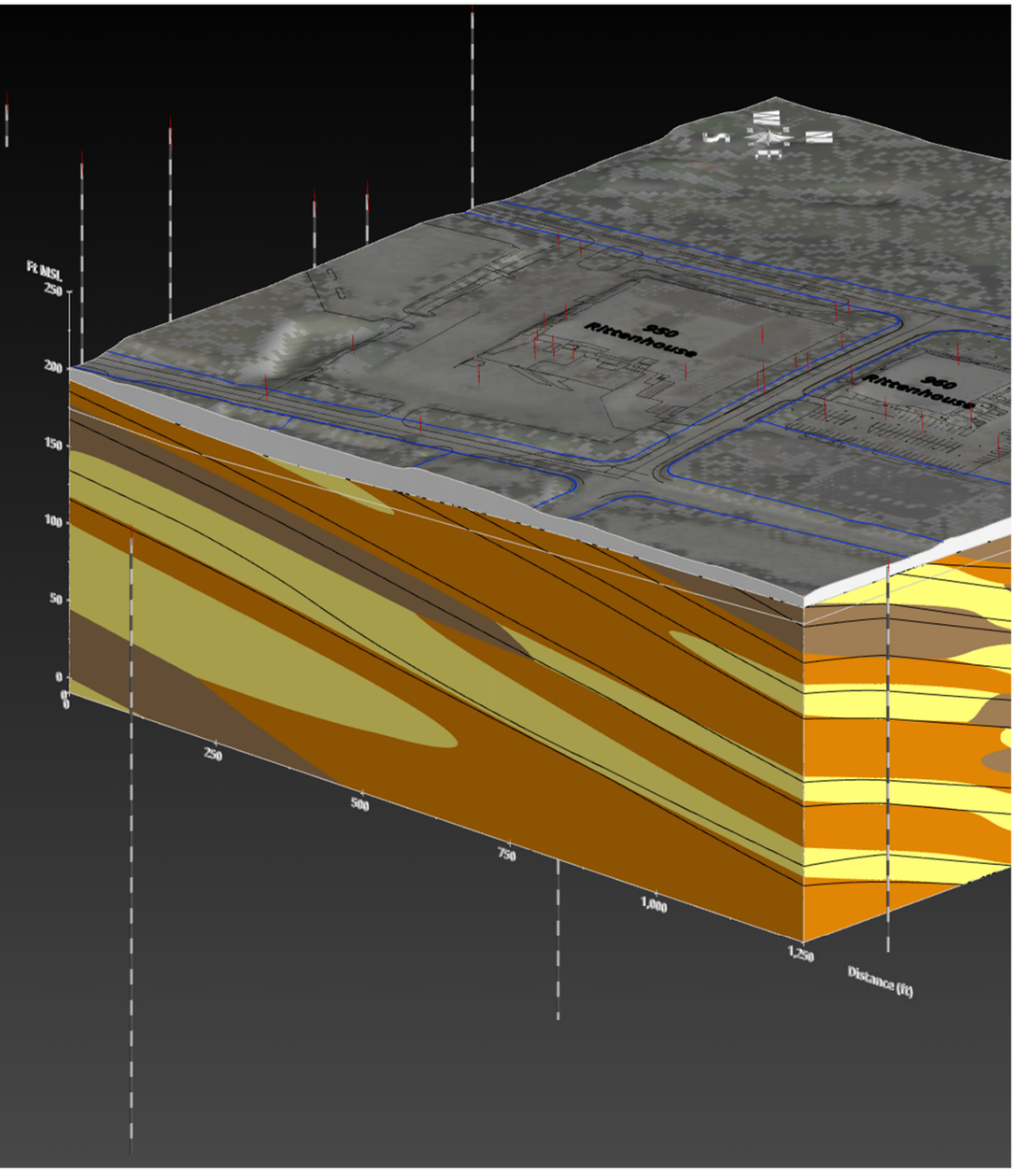

3-Dimensional Data Visualization and Analysis (3DVA)

- Complex Geologic Modeling: Bedrock, overburden, environmental sequence stratigraphy (Depositional Based Modeling)
- HRSC Data Evaluation and CSM Development
- Groundwater and Soil Analytical Data Evaluation and 3D CSM Development
- Volumetric Analysis and Mass Calculations
- Groundwater Plume Trend Analysis
- Database Management - EnviroData

Conceptual Site Model Development

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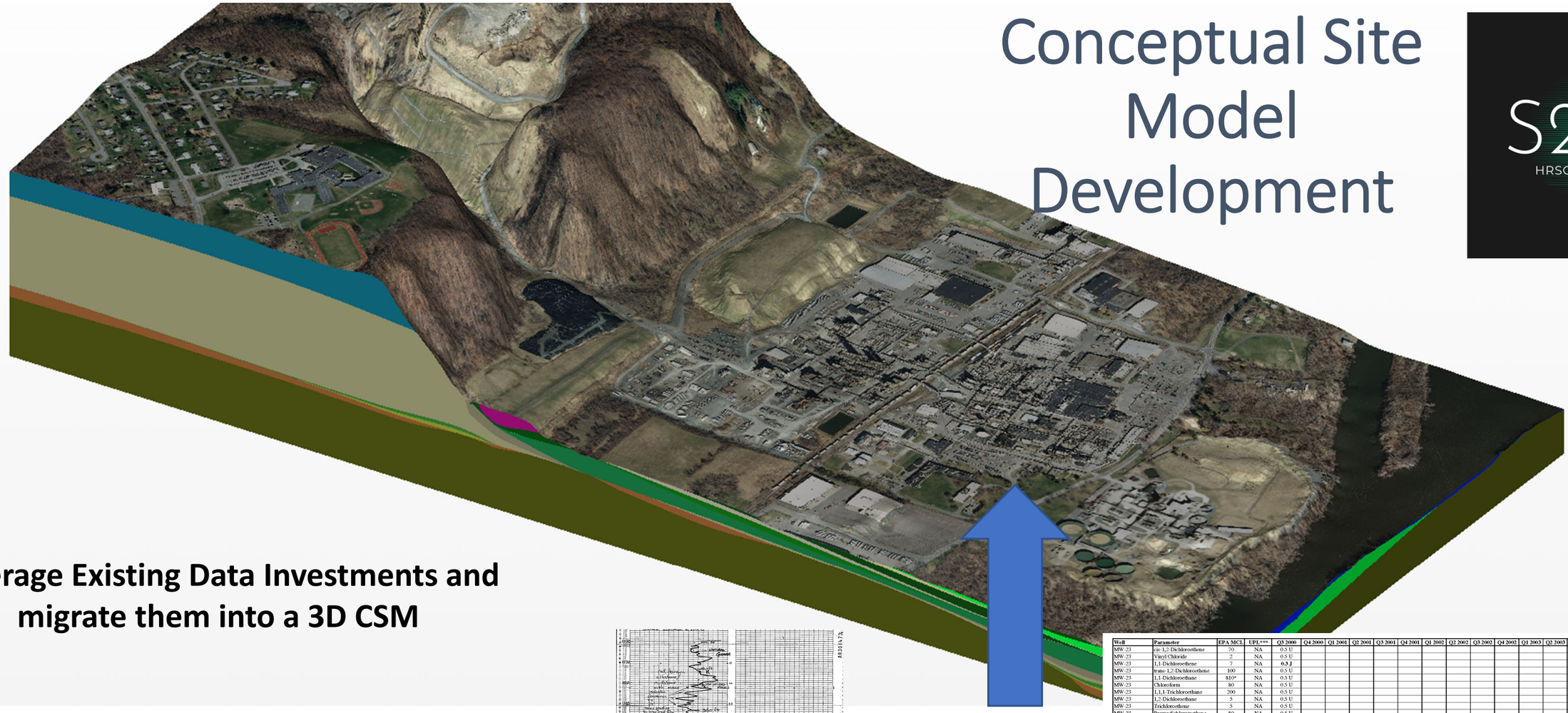
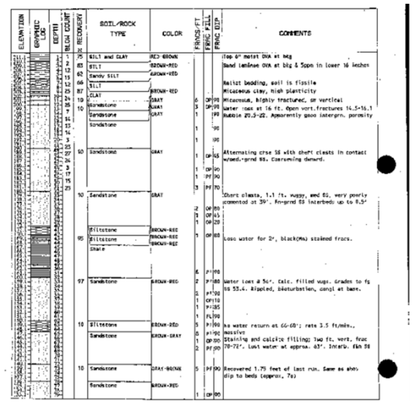


Leverage Existing Data Investments and migrate them into a 3D CSM



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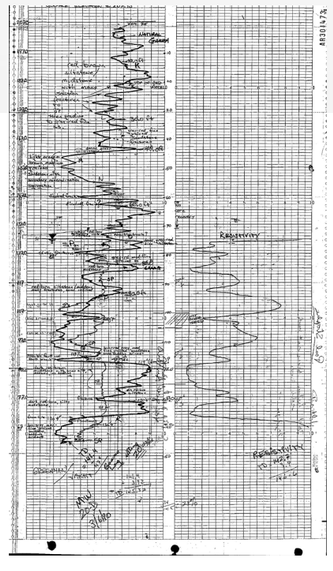

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Well	Parameter	EPA MCL	UPL***	Q3 2000	Q4 2000	Q1 2001	Q2 2001	Q3 2001	Q4 2001	Q1 2002	Q2 2002	Q3 2002	Q4 2002	Q1 2003	Q2 2003	Q3 2003	Q1 2004	Q3 2004
MW-23	cis-1,2-Dichloroethene	70	NA	0.5 U														
MW-23	Vinyl Chloride	2	NA	0.5 U														
MW-23	1,1-Dichloroethene	7	NA	**0.3 J**														
MW-23	trans-1,2-Dichloroethene	100	NA	0.5 U														
MW-23	1,1-Dichloroethane	810*	NA	0.5 U														
MW-23	Chloroform	80	NA	0.5 U														
MW-23	1,1,1-Trichloroethane	200	NA	0.5 U														
MW-23	1,2-Dichloroethane	5	NA	0.5 U														
MW-23	Trichloroethene	5	NA	0.5 U														
MW-23	Bromodichloromethane	80	NA	0.5 U														
MW-23	Tetrachloroethene	5	NA	0.5 U														
MW-23	Freon 113	NA	NA	0.5 U														
MW-24	cis-1,2-Dichloroethene	70	NA	**0.3 J**		**1.6**		**0.97**		**0.6**		**0.7**		**0.9**		0.5 U	0.5 U	0.5 U
MW-24	Vinyl Chloride	2	NA	0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	1,1-Dichloroethene	7	NA	**0.4 J**		**0.5**		**0.3 J**		**0.2 J**		**0.2 J**		**0.3 J**		0.5 U	0.5 U	0.5 U
MW-24	trans-1,2-Dichloroethene	100	NA	0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	1,1-Dichloroethane	810*	NA	0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	Chloroform	80	NA	0.5 U		**0.2 J**		**0.2 J**		**0.1 J**		**0.1 J**		**0.2 J**		0.5 U	0.5 U	0.5 U
MW-24	1,1,1-Trichloroethane	200	NA	0.5 U		**0.2 J**		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	1,2-Dichloroethane	5	NA	0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	Trichloroethene	5	3.43	**1.1**		**9.4**		**4.9**		**3.5**		**4.1**		**5.6**		0.5 U	0.5 U	**0.1 J**
MW-24	Bromodichloromethane	80	NA	0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-24	Tetrachloroethene	5	2.01	**1.7**		**3**		**1.4**		**1.3**		**1.3**		**1.9**		**0.5**	**0.1 J**	0.5 U
MW-24	Freon 113	NA	NA	**0.8**		NR		NR		**2.8**		NR		**5.1**		0.2 U	NR	0.5 U
MW-29	cis-1,2-Dichloroethene	70	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Vinyl Chloride	2	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	1,1-Dichloroethene	7	NA	**0.1 J**				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	trans-1,2-Dichloroethene	100	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	1,1-Dichloroethane	810*	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Chloroform	80	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	1,1,1-Trichloroethane	200	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	1,2-Dichloroethane	5	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Trichloroethene	5	NA	**0.1 J**				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Bromodichloromethane	80	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Tetrachloroethene	5	NA	0.5 U				0.5 U				0.5 U				0.5 U		0.5 U
MW-29	Freon 113	NA	NA	NR				NR				NR				NR		0.5 U
MW-30D	cis-1,2-Dichloroethene	70	43.8	**0.8**		0.5 U		**5.3**		**1.4**		**1.1**		0.5 U		**5.1**	**0.6**	**1.3**
MW-30D	Vinyl Chloride	2	NA	0.5 U		0.5 U		2.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-30D	1,1-Dichloroethene	7	1.61	**1.2**		0.5 U		**2.8**		**1.8**		**2.2**		0.5 U		**1.6**	**1.8**	**0.7**
MW-30D	trans-1,2-Dichloroethene	100	NA	0.5 U		0.5 U		2.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-30D	1,1-Dichloroethane	810*	NA	**0.2 J**		0.5 U		2.5 U		**0.2 J**		**0.4 J**		0.5 U		**0.3 J**	**0.6**	**0.1 J**
MW-30D	Chloroform	80	NA	**0.2 J**		0.5 U		2.5 U		**0.2 J**		**0.1 J**		0.5 U		**0.2 J**	**0.3 J**	**0.1 J**
MW-30D	1,1,1-Trichloroethane	200	NA	**0.5 J**		0.5 U		**0.7 J**		**0.9**		**1.1**		0.5 U		**1.2**	**1**	**0.5 J**
MW-30D	1,2-Dichloroethane	5	NA	0.5 U		0.5 U		2.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-30D	Trichloroethene	5	23	**42**		**0.6**		**420**		**45**		**35**		**2.6**		**22**	**17**	**13**
MW-30D	Bromodichloromethane	80	NA	0.5 U		0.5 U		2.5 U		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.5 U
MW-30D	Tetrachloroethene	5	19.8	**2.8**		0.5 U		**1.8 J**		**1.8**		**0.9**		0.5 U		**16**	**1.6**	**11**
MW-30D	Freon 113	NA	NA	**28**		NR		NR		**19**		NR		**0.4 J**		**21**	NR	**20**

Case Study – OiHPT, MiHPT, 3D CSM

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