

# MiHpt

## Membrane Interface Probe + Hydraulic Profiling Tool



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**Geoprobe Systems®**

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**Klaus Weber**  
**NIRAS, Denmark**

**Mads Terkelsen**  
**Danish Capital Region**

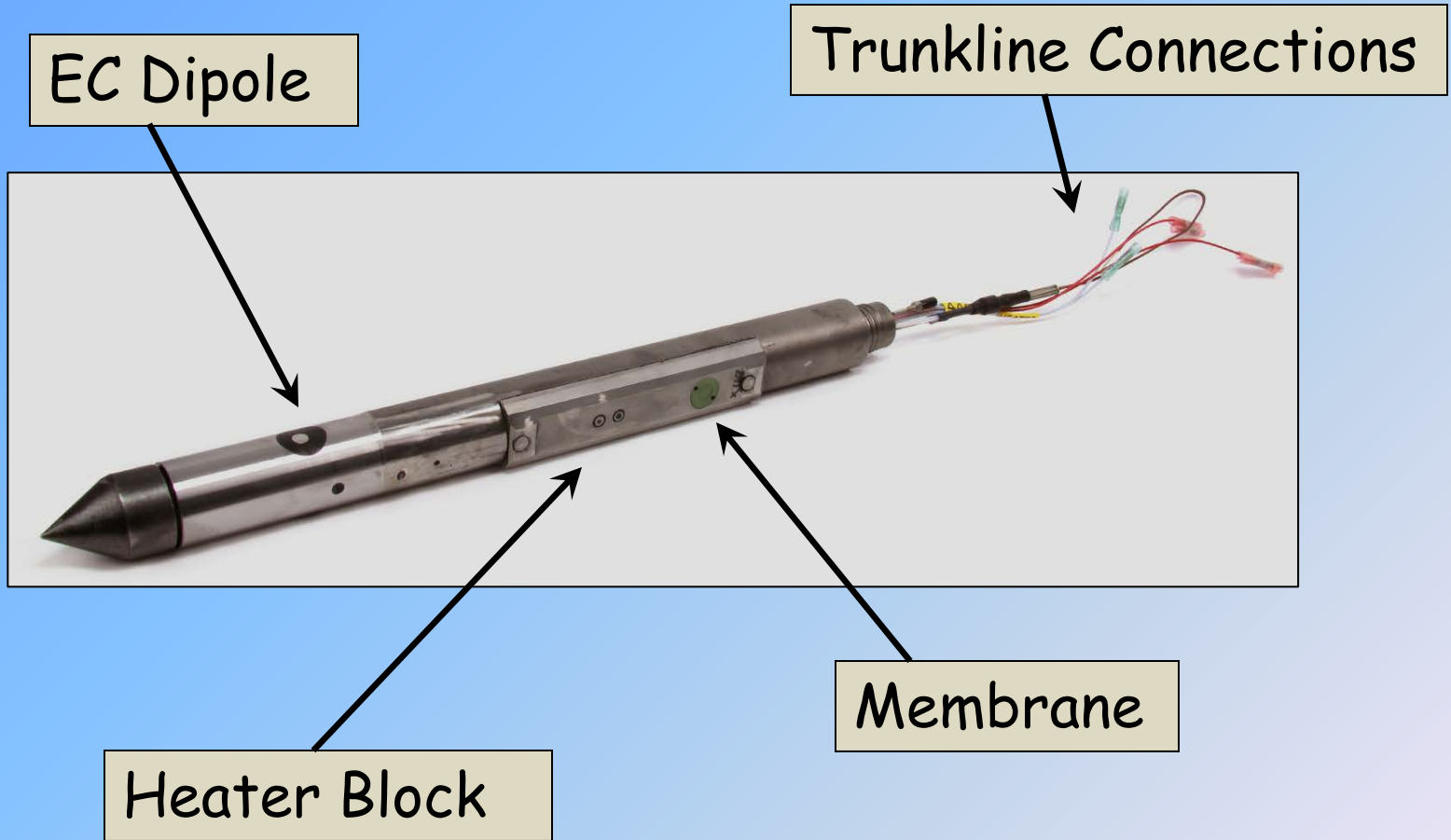


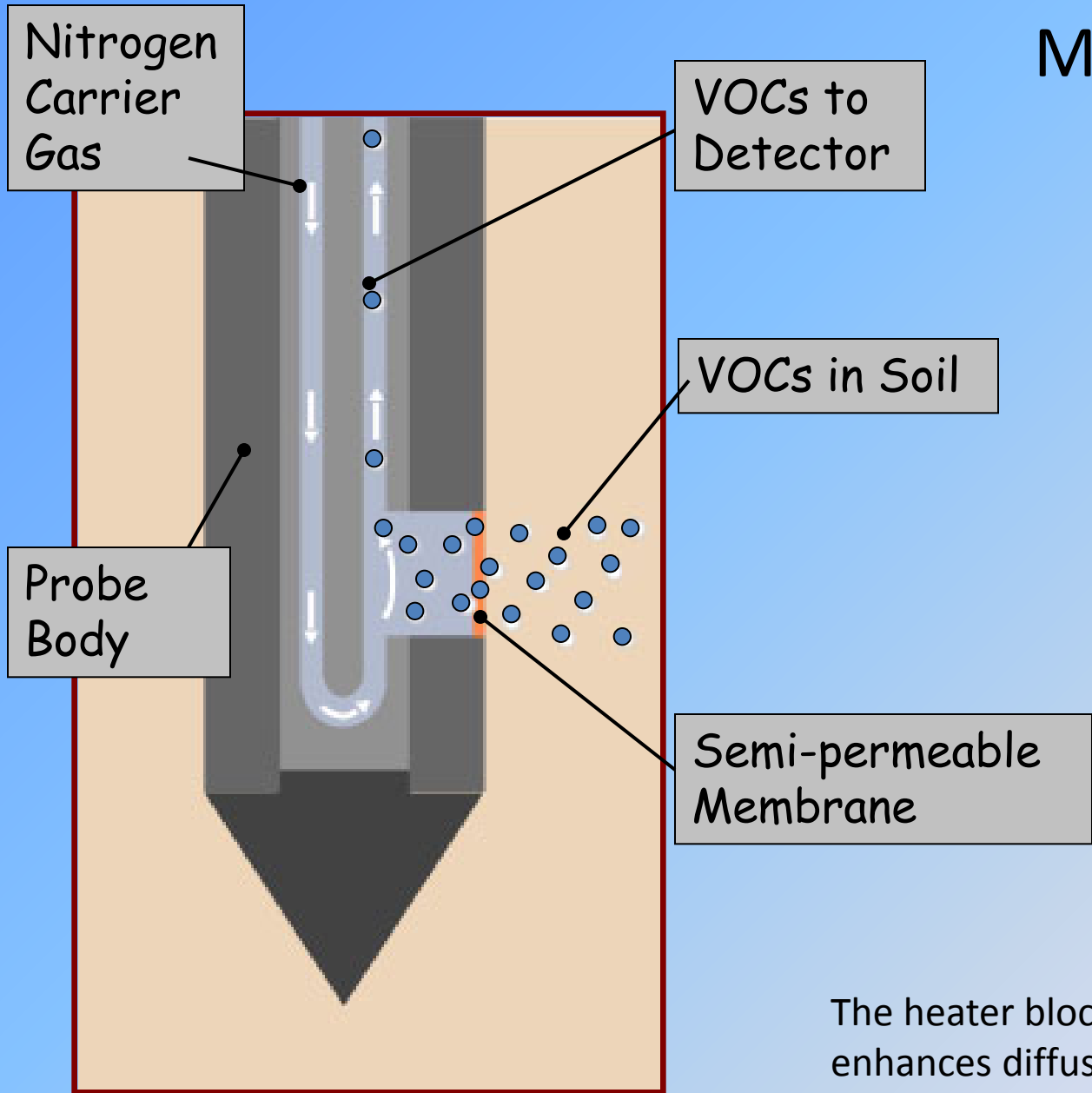
# Outline

- How Does MIP Work ? MIP Log
- How Does HPT Work? HPT Log
- The Combined MiHpt Probe & Log
- Cross Sections with MiHpt logs
- Developing a Conceptual Site Model



# The MIP Probe





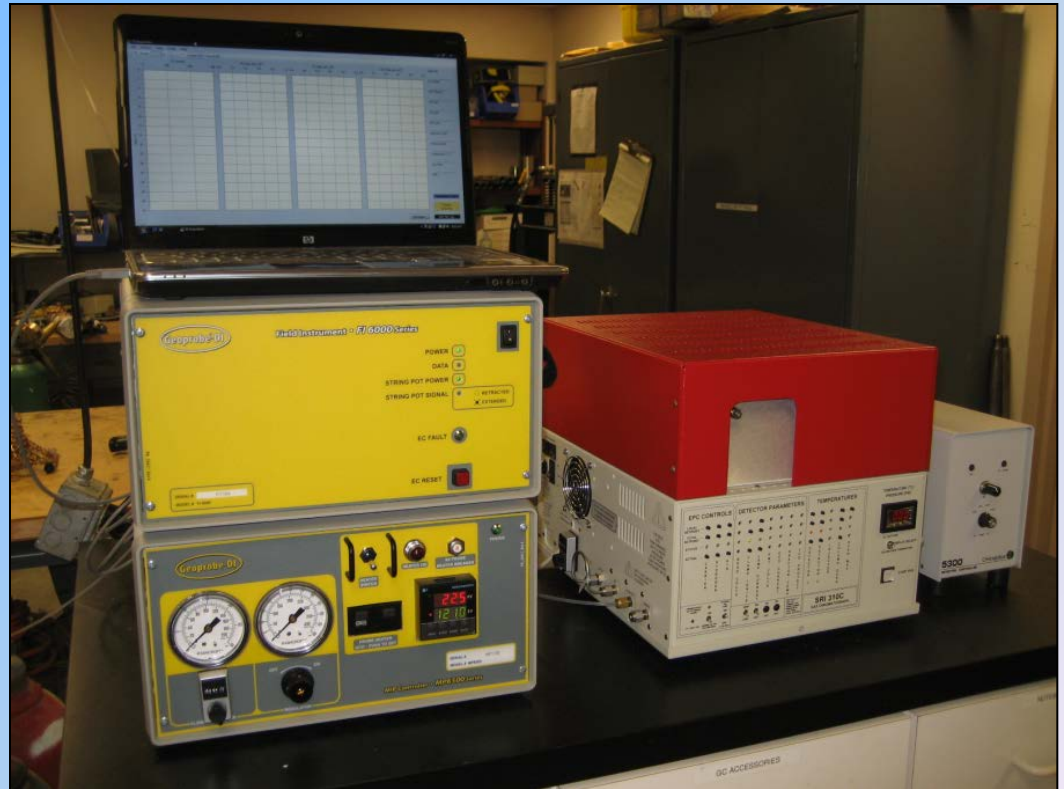
## MIP Principles of Operation:

VOCs diffuse under a concentration gradient

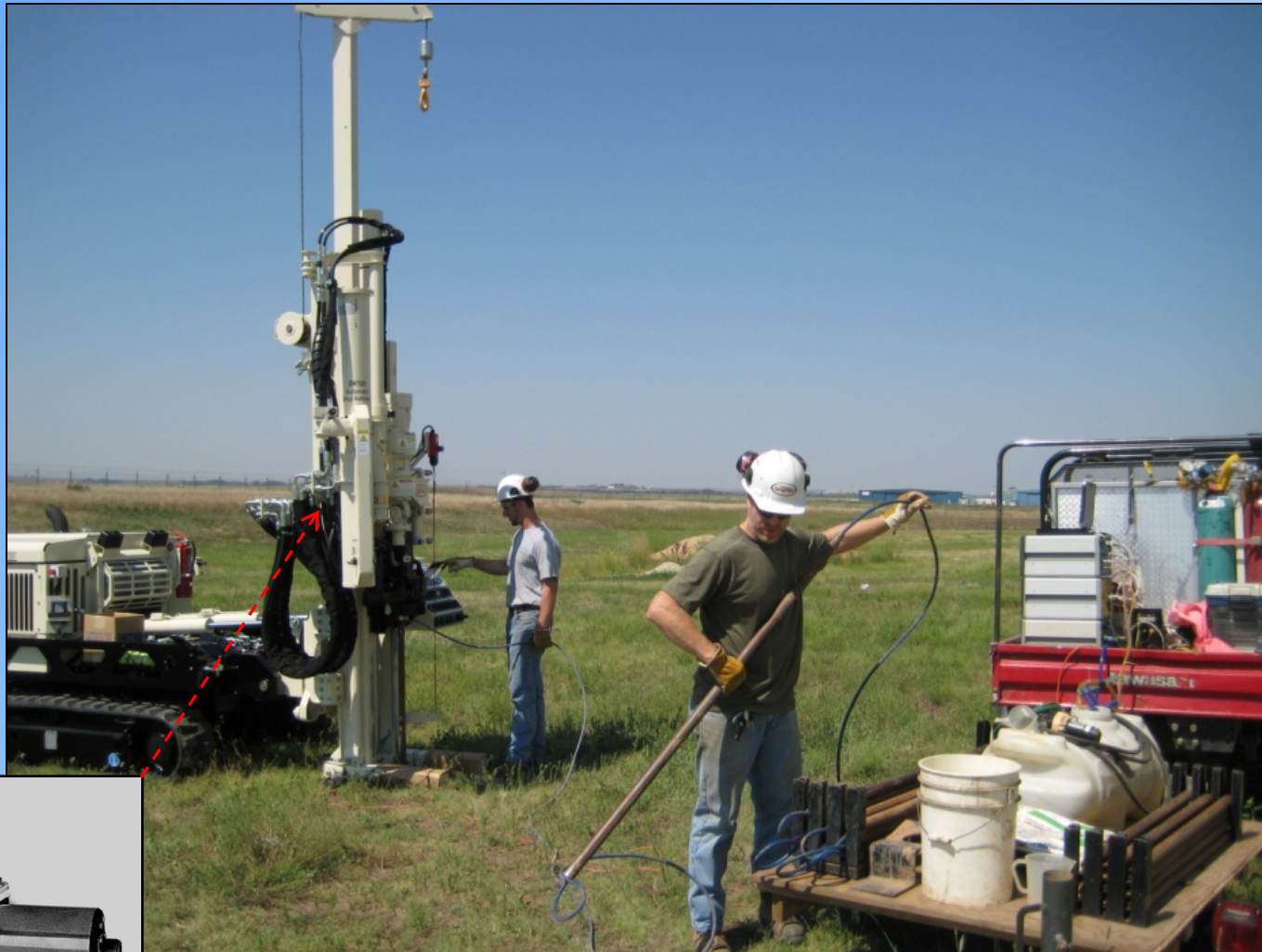
The heater block at ~100C enhances diffusion

# MIP Instrumentation

- Portable Computer
- FI6000 Field Instrument
- MIP Controller
- Gas Chromatograph with three detectors:
  - PID
  - FID
  - XSD (or ECD)



# MIP Field Operation



String pot tracks depth

Advance probe incrementally

# MIP QA/QC Field VOC Response Testing



Field standard  
(e.g. Benzene,  
TCE, PCE, etc.)



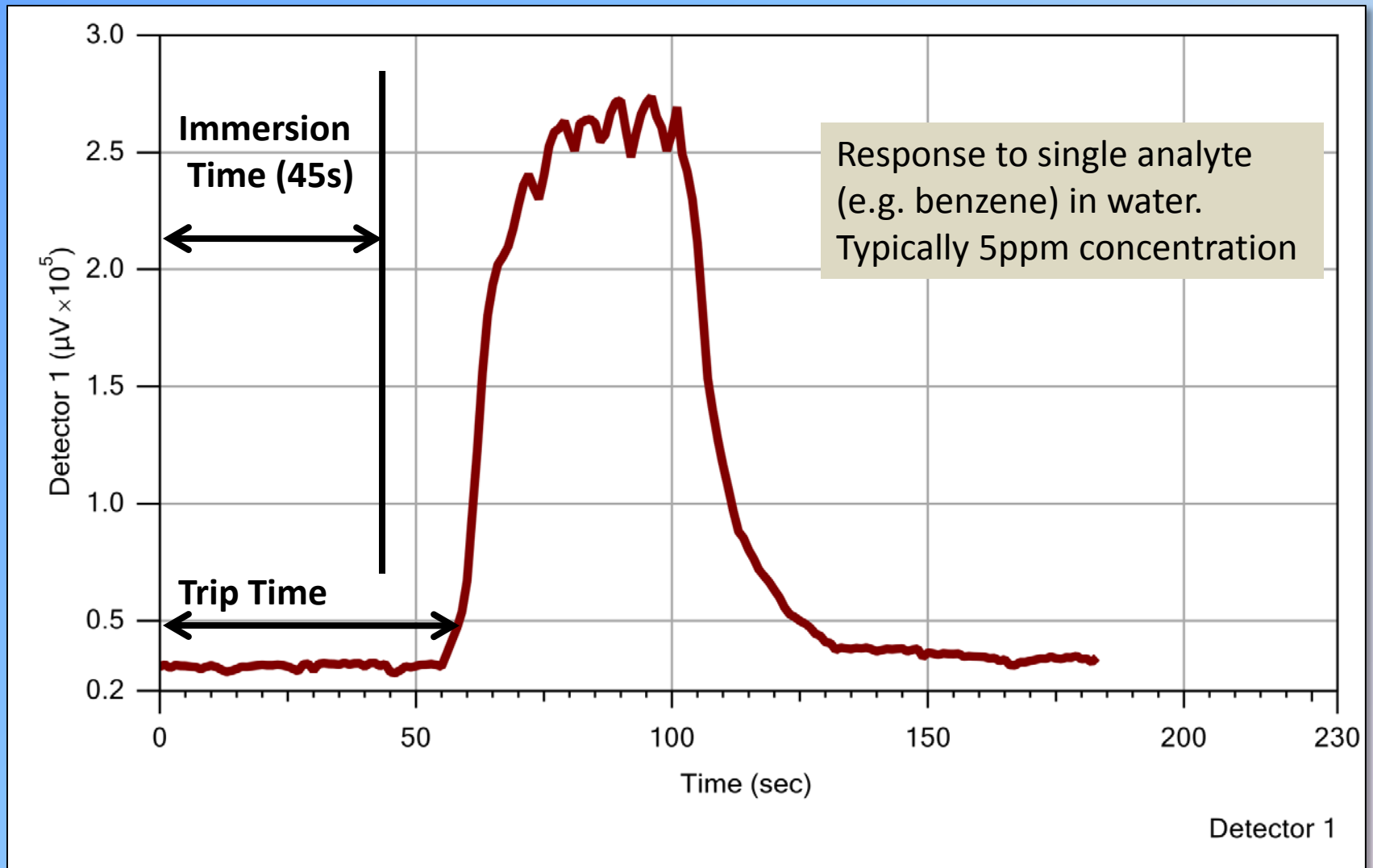
Field standard is injected  
into 500ml of clean water



The heated MIP probe is  
inserted into the working  
standard for 45 seconds

**NOT A CALIBRATION**

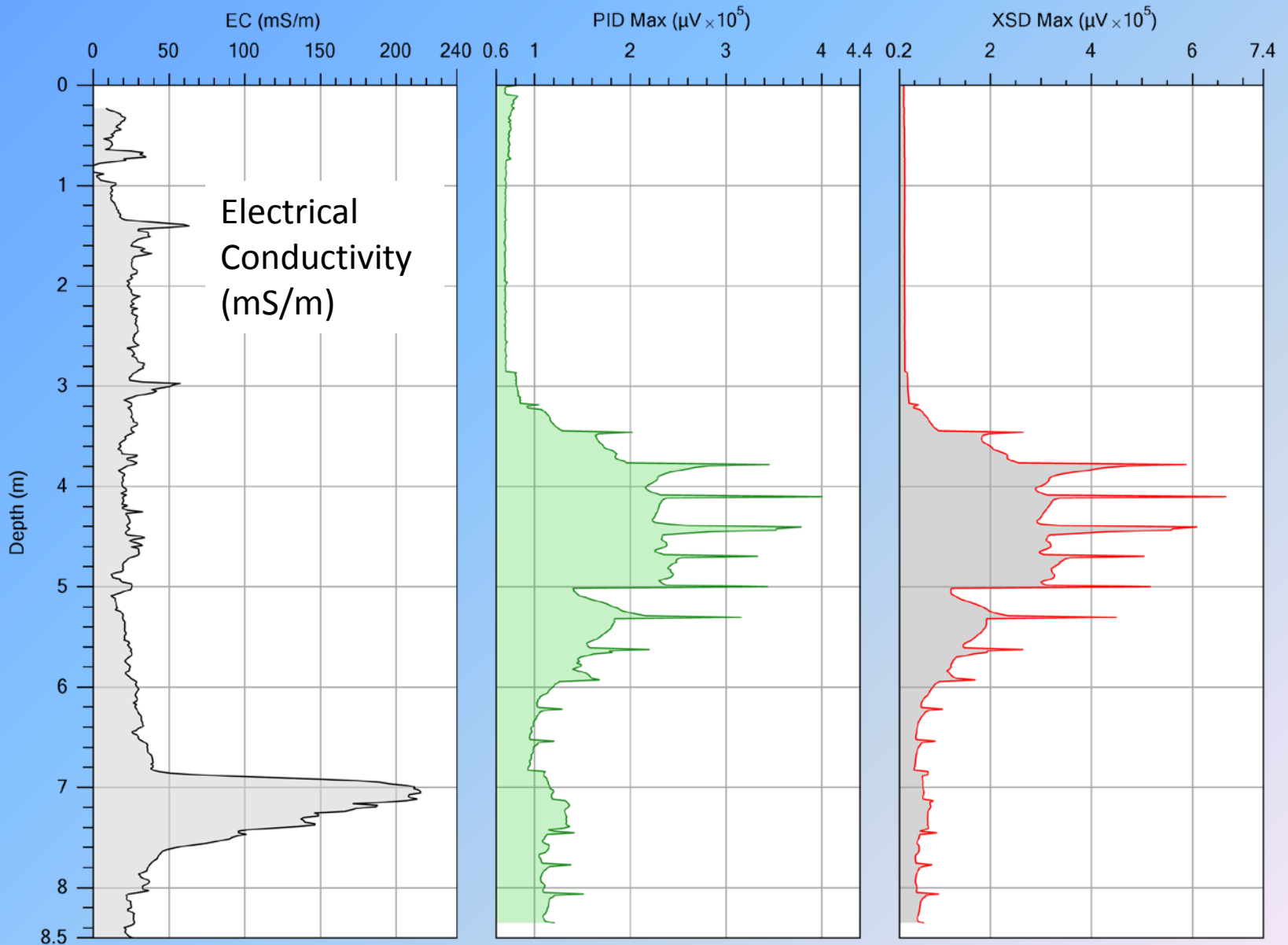
# Typical Response Test



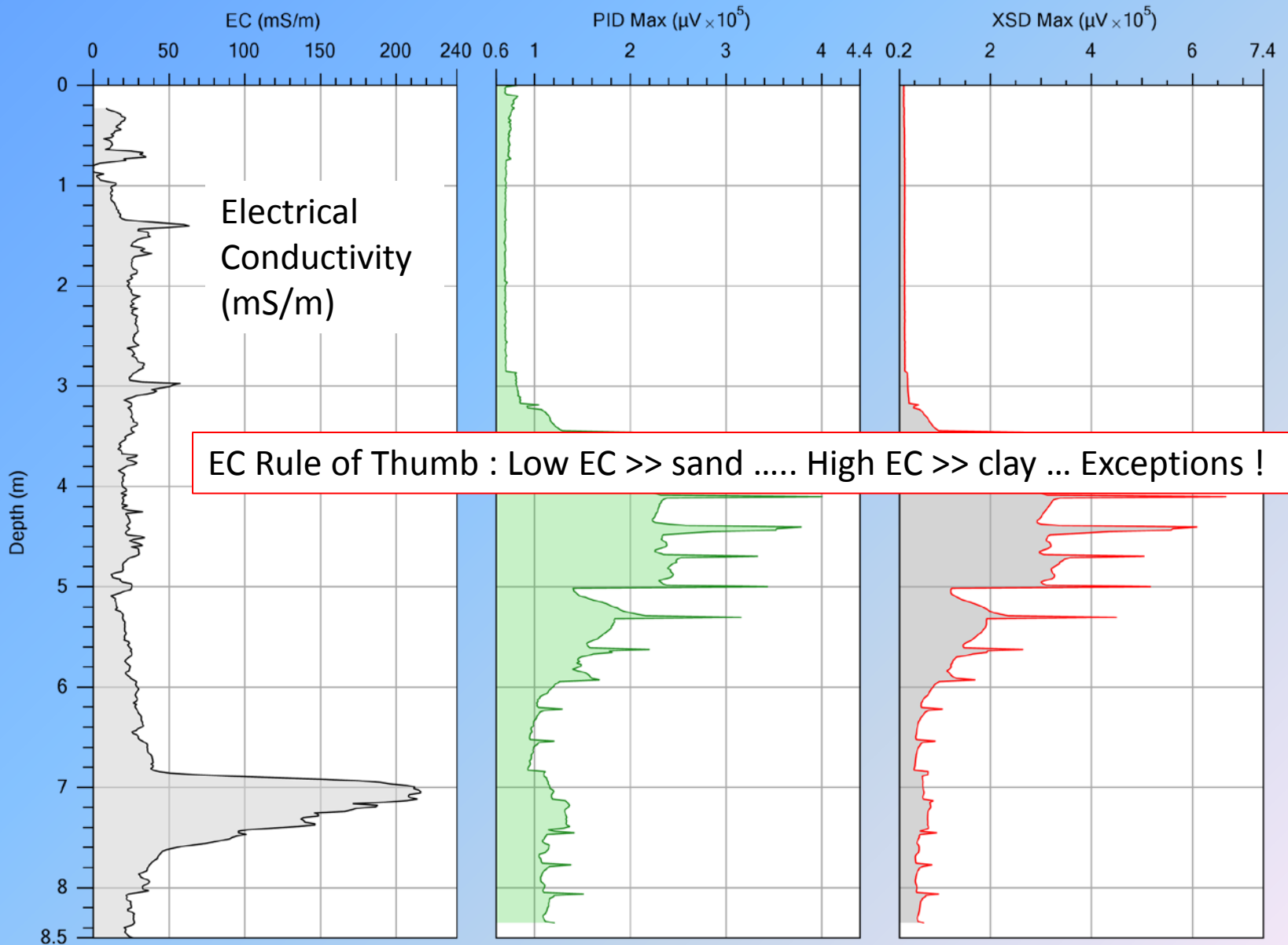
Trip time is entered into the acquisition software to correlate detector response with depth.



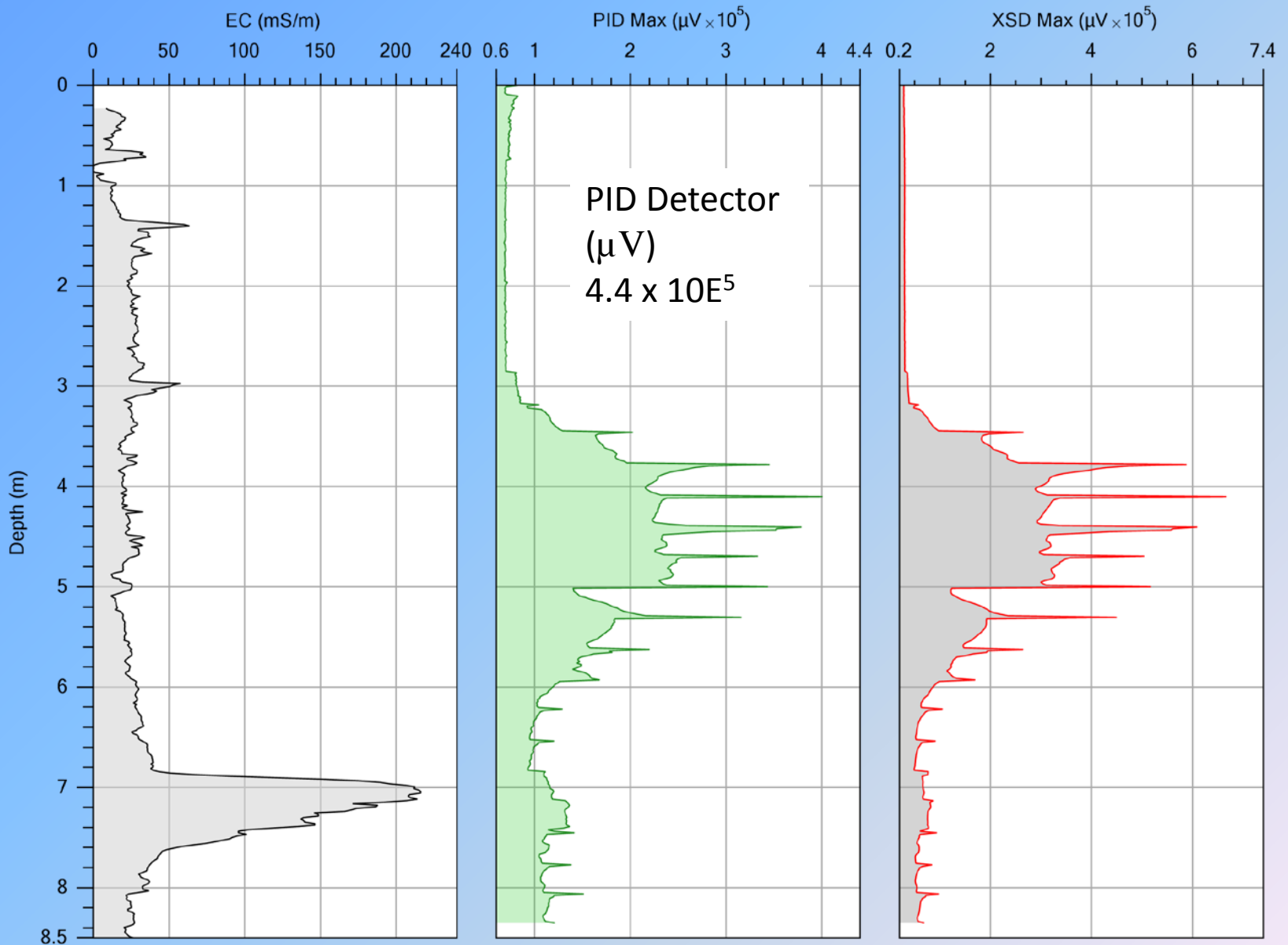
# Example MIP Log: Skuldelev SK05



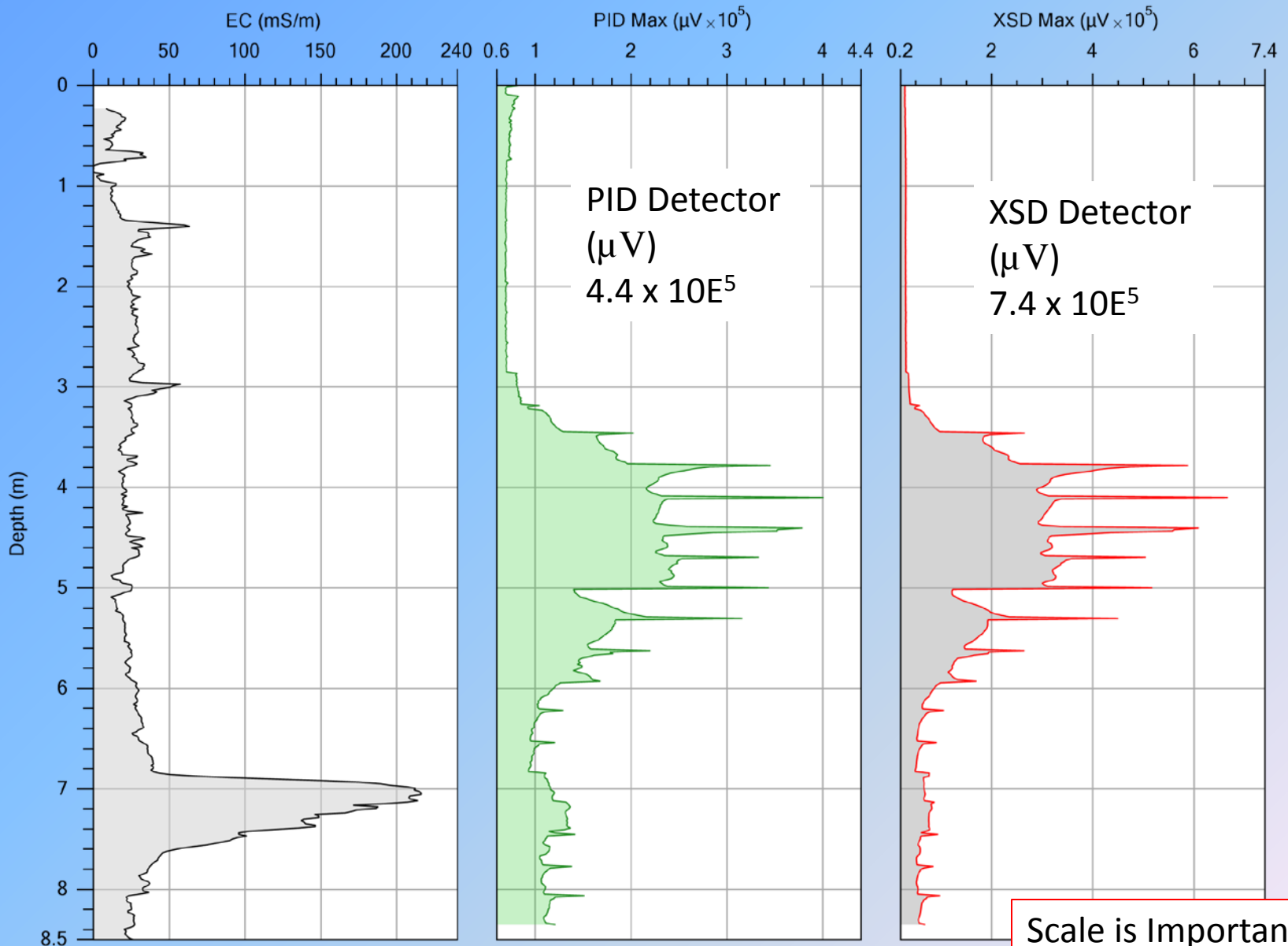
# Example MIP Log: Skuldelev SK05



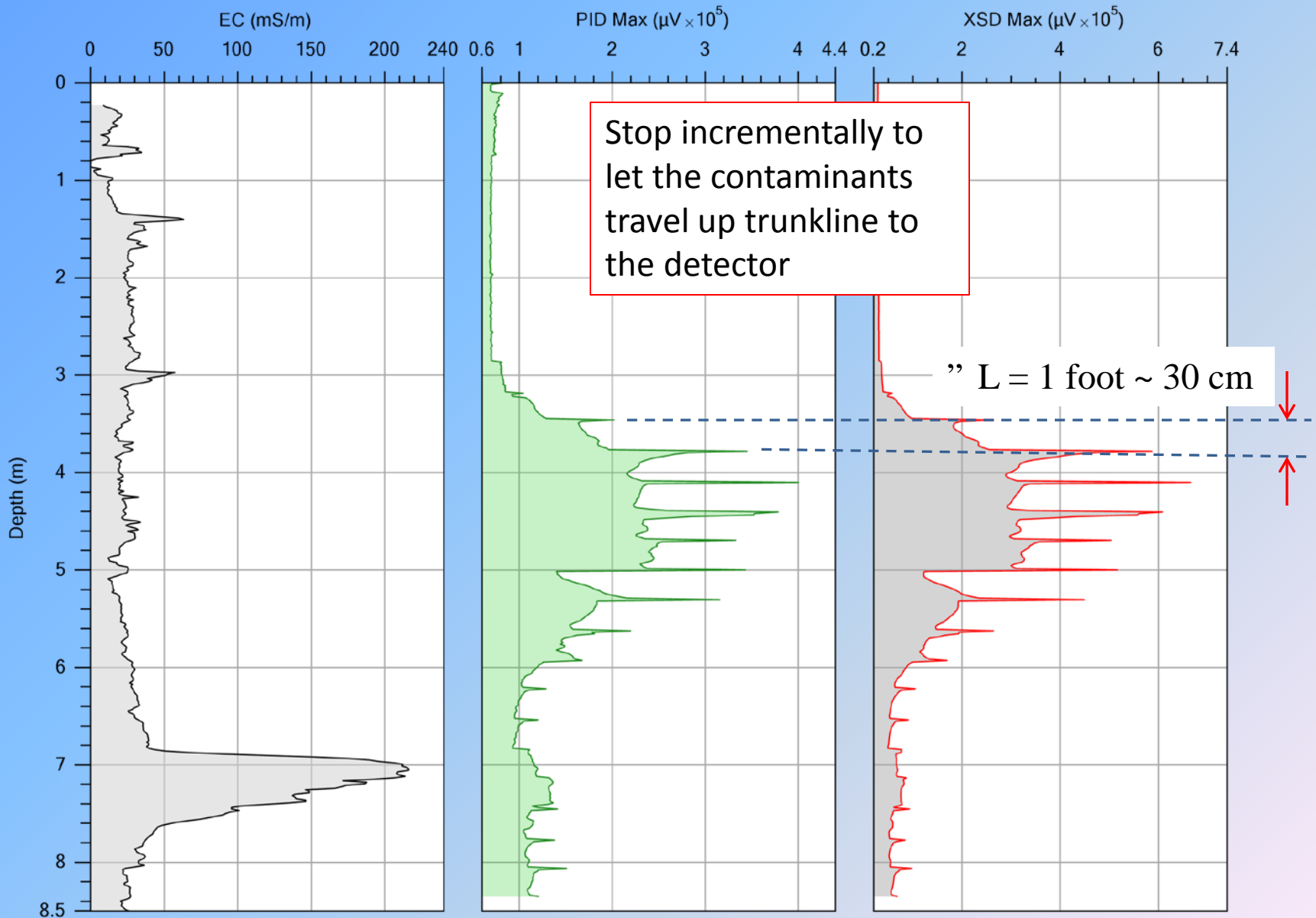
# Example MIP Log: Skuldelev SK05



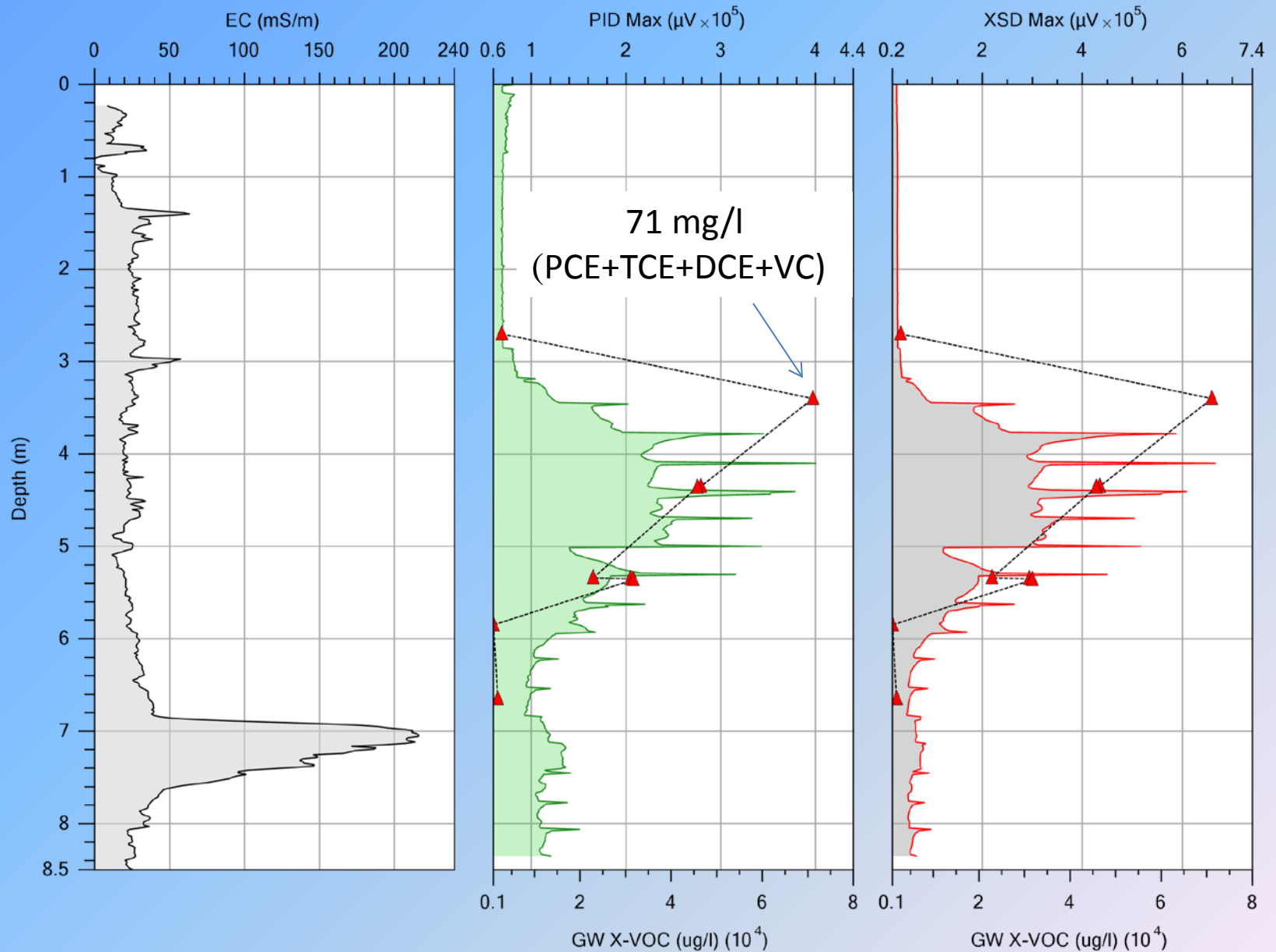
# Example MIP Log: Skuldelev SK05



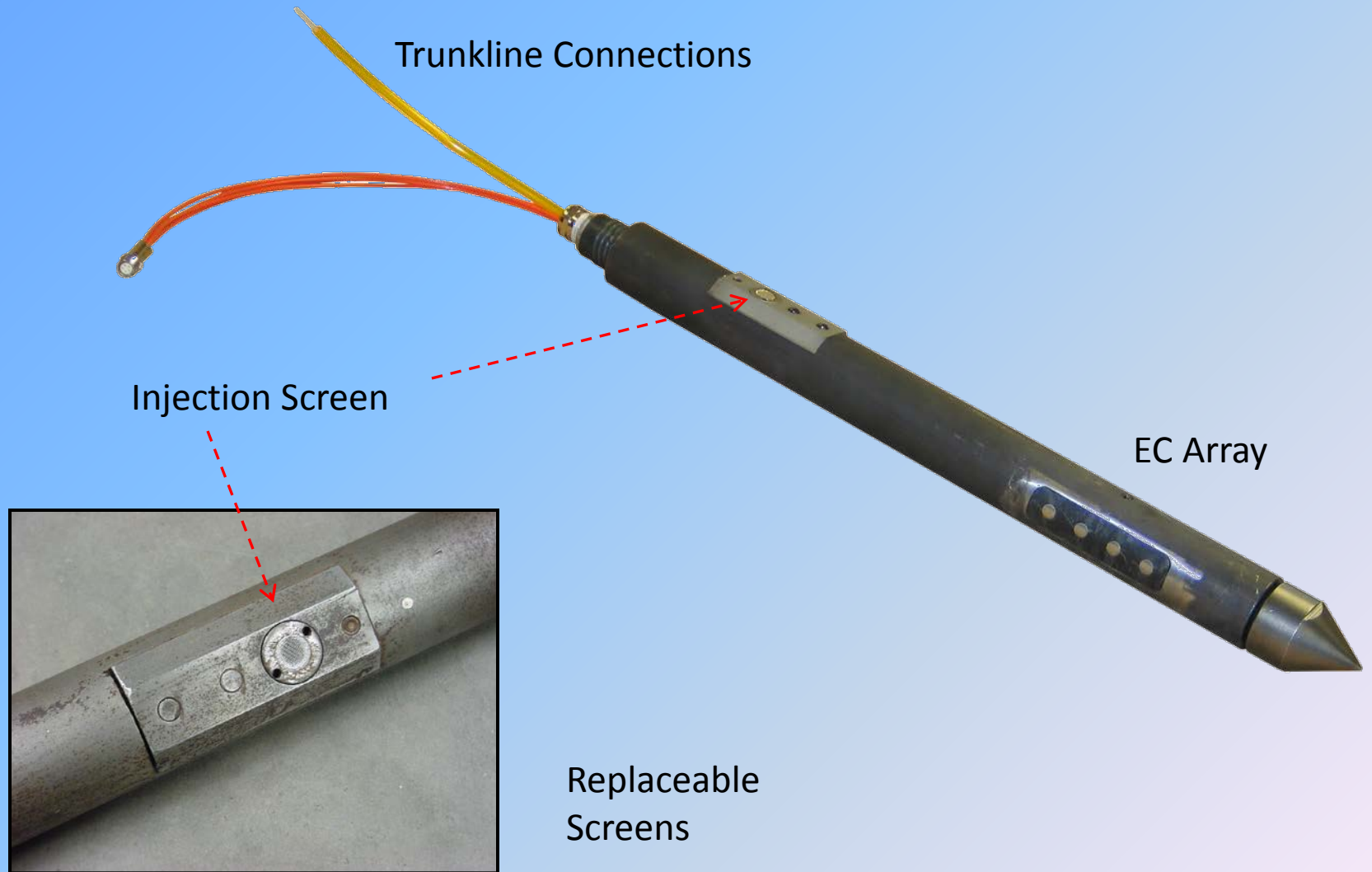
# Incremental Probing & Trip Time



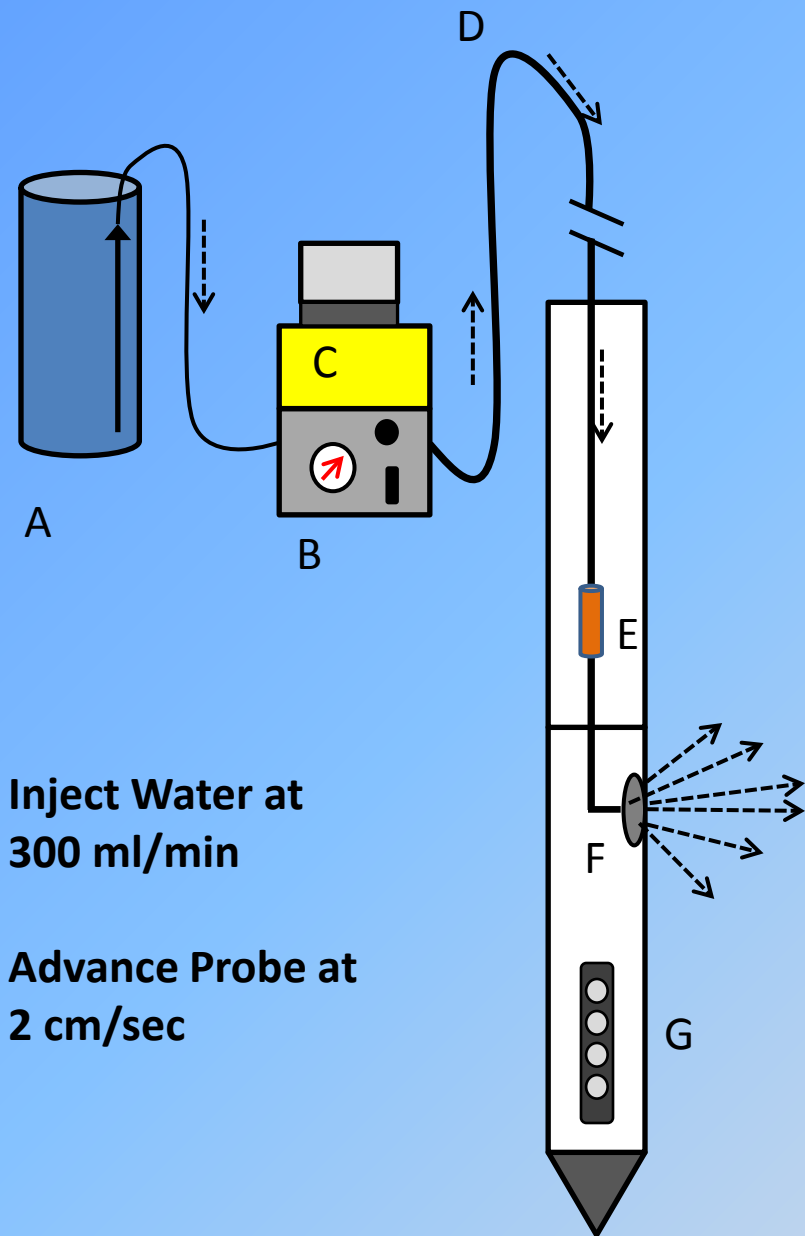
# Correlating MIP Detector to Groundwater Samples



# The HPT Probe & System



# HPT Principles of Operation



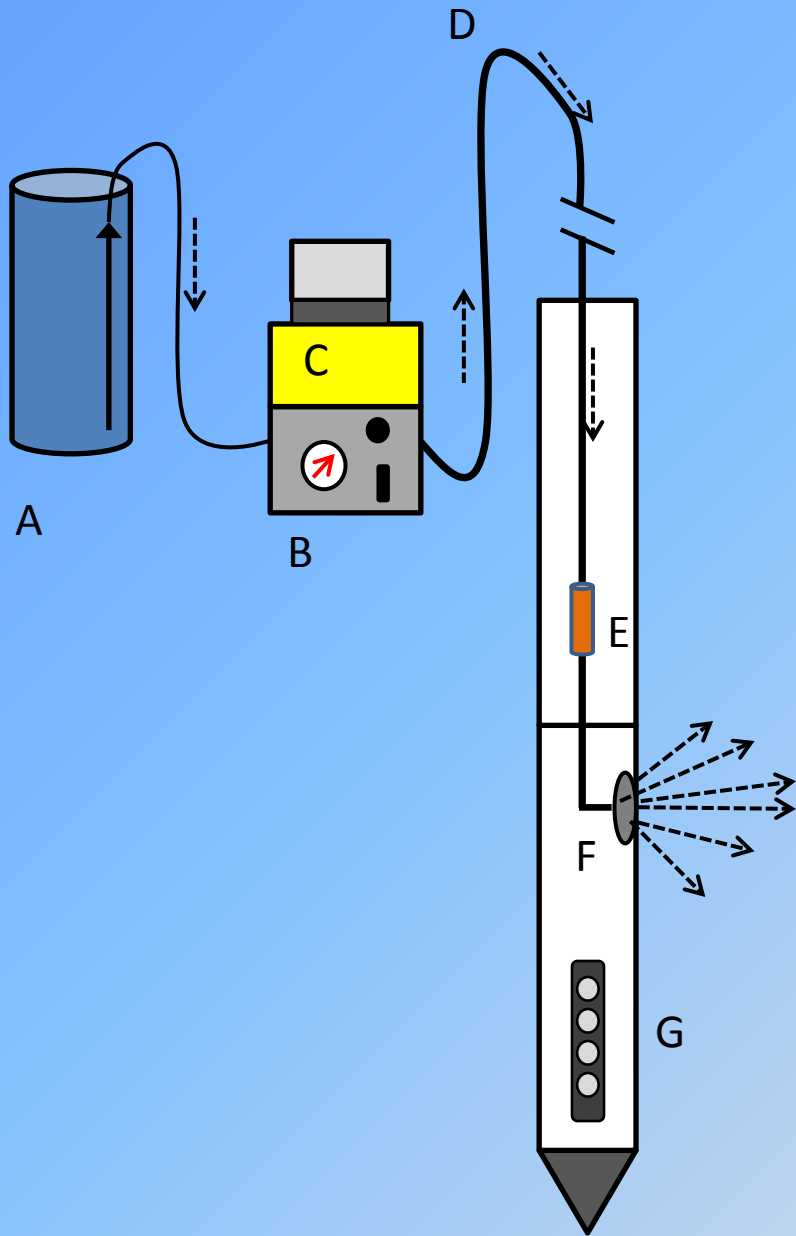
**Inject Water at  
300 ml/min**

**Advance Probe at  
2 cm/sec**

- A) Water Tank
- B) Pump & Flow Meter
- C) Electronics/computer
- D) Trunkline
- E) Pressure Sensor
- F) Screened Injection Port
- G) Elec. Conductivity Array



# HPT Interpretation



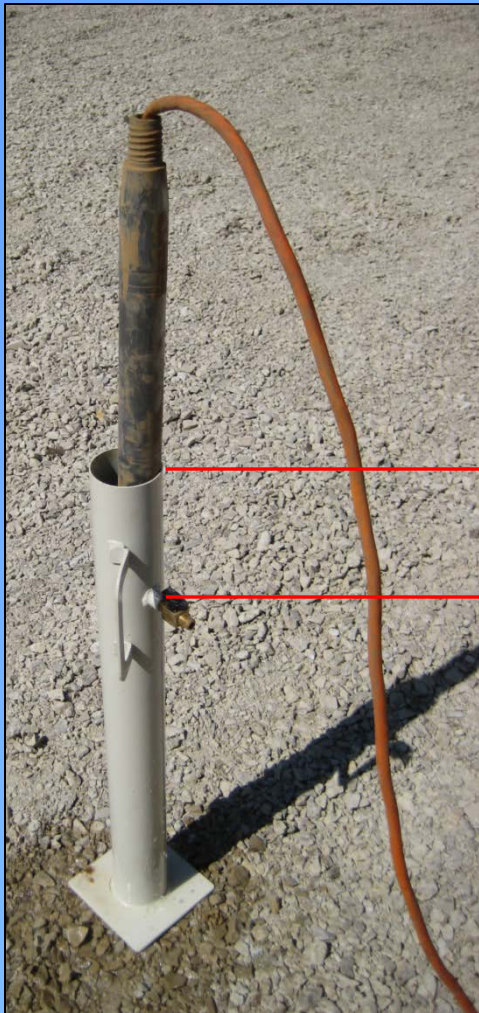
## HPT Pressure Rule of Thumb:

Hi Pressure >> Lo Permeability

Low Pressure >> Hi Permeability

# HPT QA/QC

HPT Probe in Reference Tube to Verify  
" 6" Water Pressure = 0.22 psi (1.52kPa)



Start New Log

### HPT Reference Test

	Flow (mL/min)	HPT (psi)	
Bottom	298.4	13.176	capture
Top	299.6	13.377	capture
Δ	<b>1.2</b>	<b>0.201</b>	
Top	0.0	12.989	capture
▶ Bottom	0.0	12.759	capture
Δ	<b>0.0</b>	<b>0.230</b>	<b>PASS</b>

HPT Press. (psi)  
**12.762**

HPT Flow (mL/min)  
**0.0**

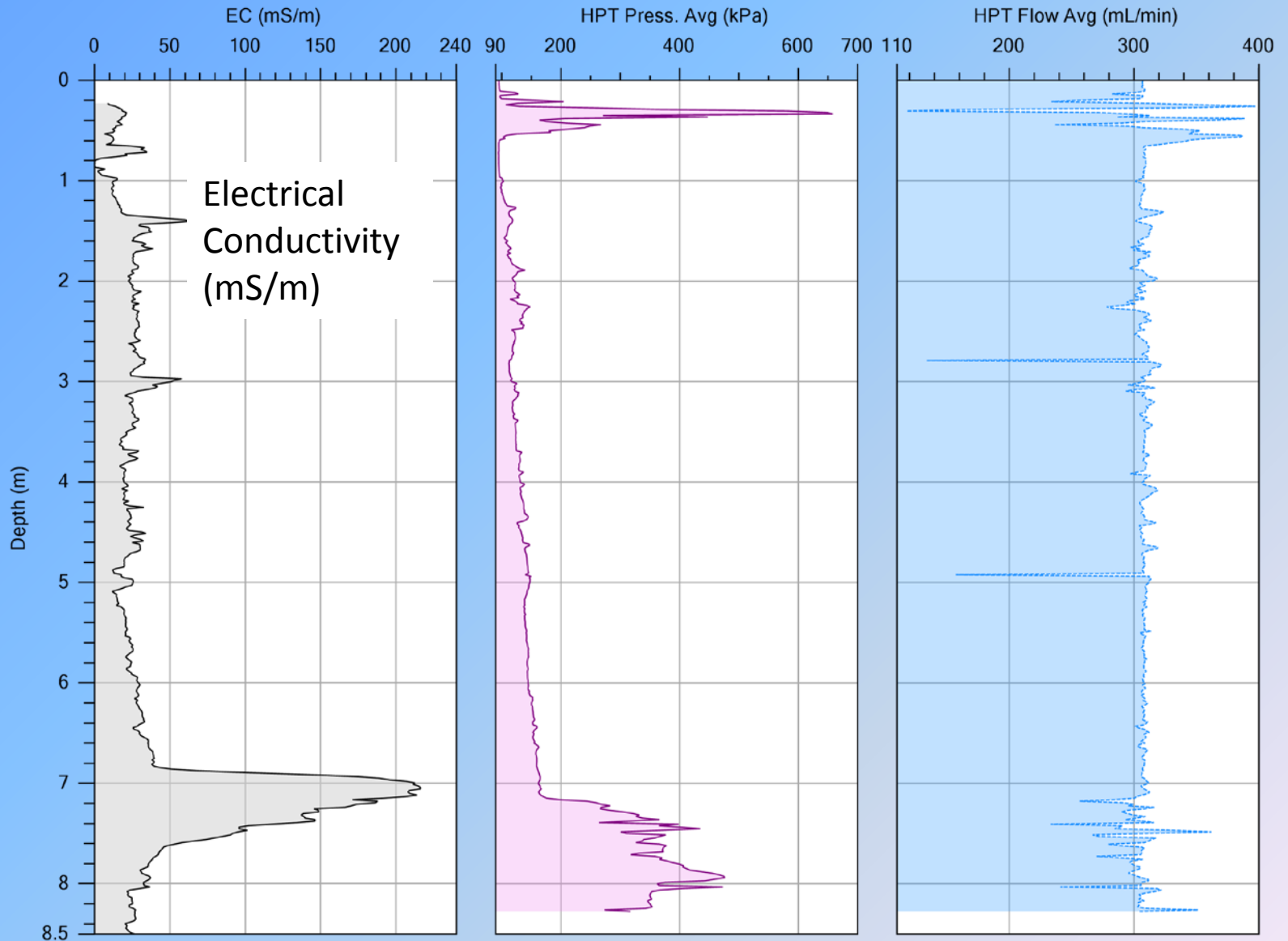
Clear Tests

No-Flow HPT Δ Target: 0.22 psi ± 10%

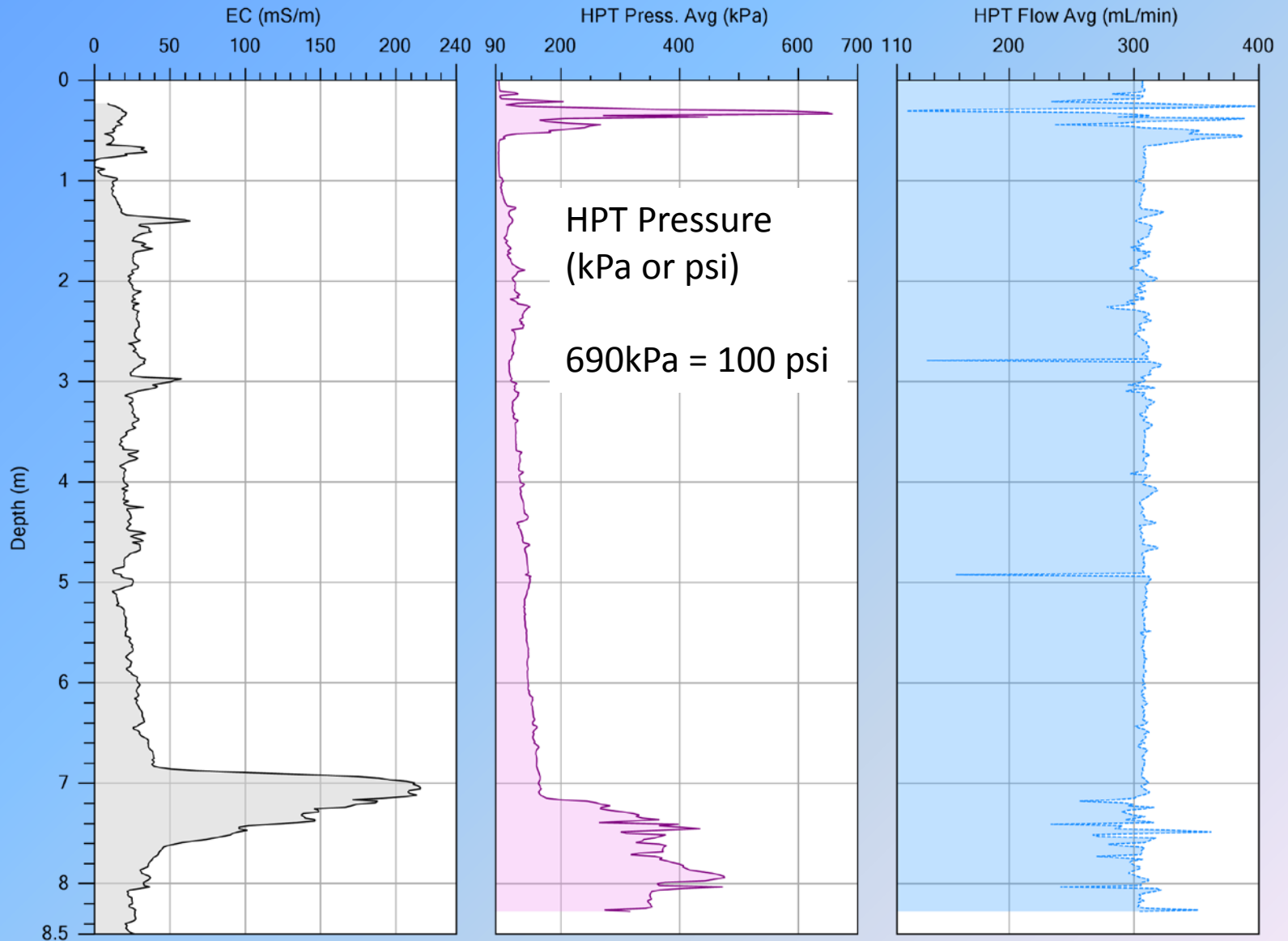
Cancel < Back Next > Finish

HPT Pressure Transducer Onscreen QA Report  
(data saved to log file)

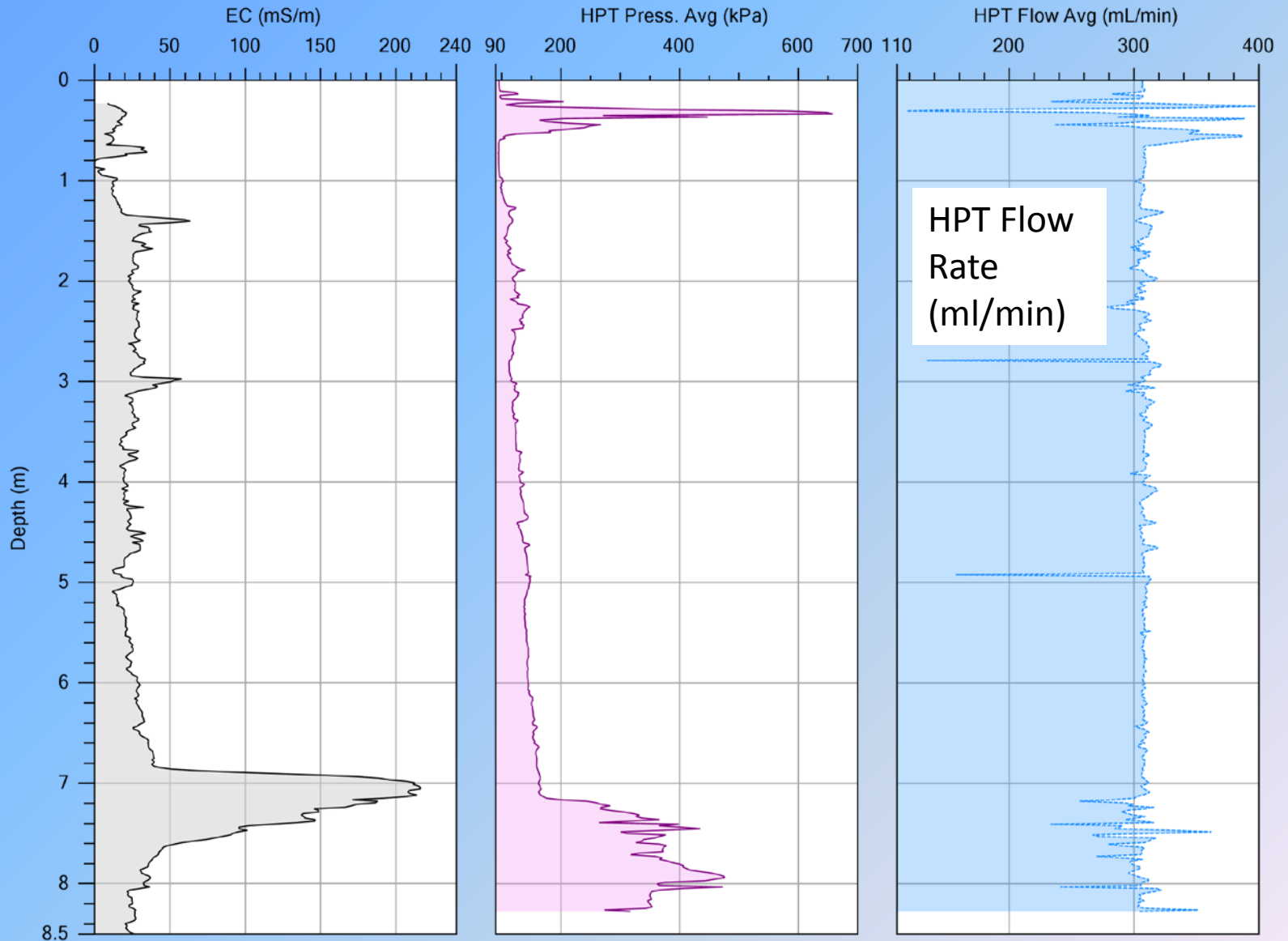
# Example HPT Log: Skuldelev SK05



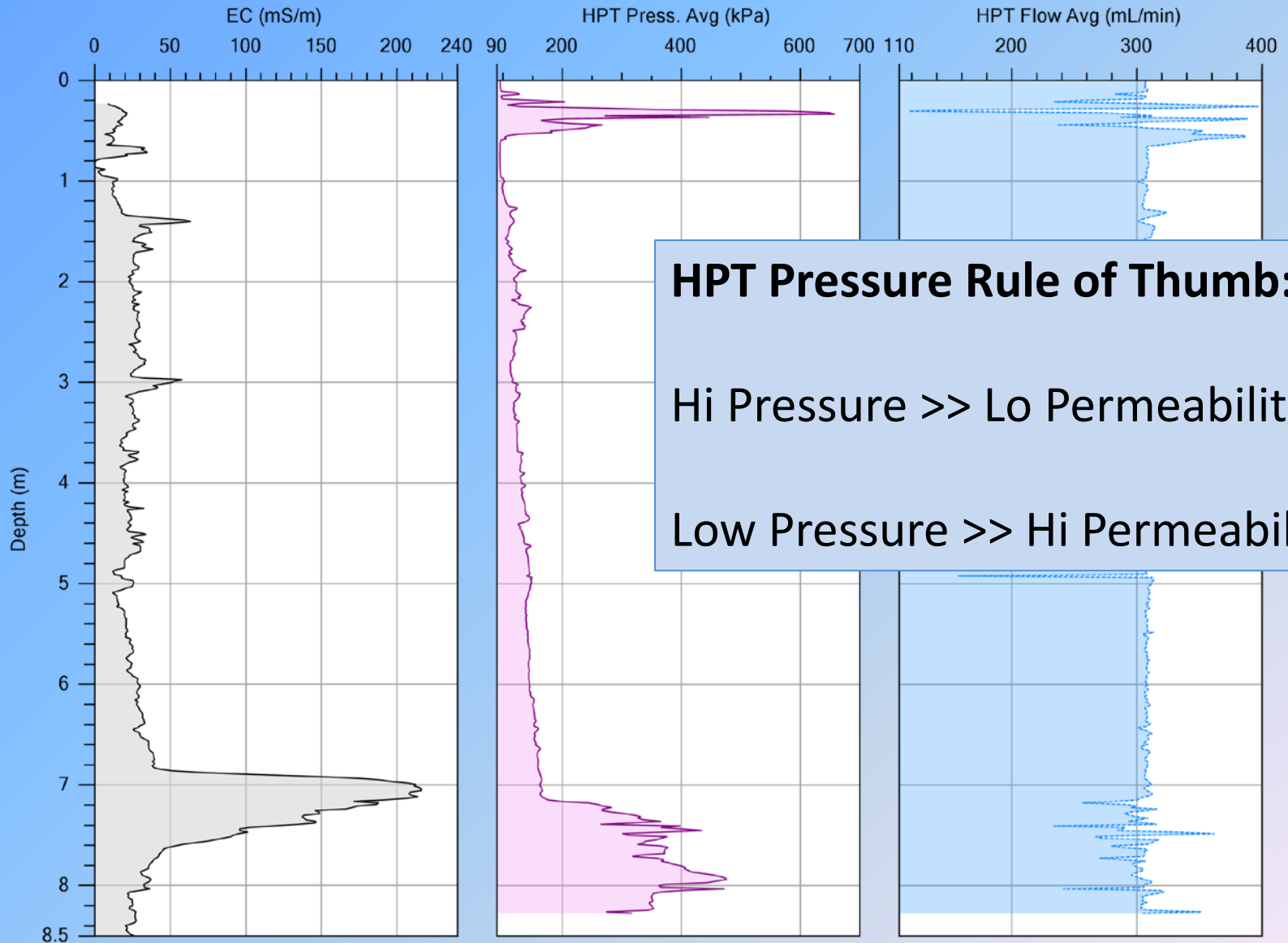
# Example HPT Log: Skuldelev SK05



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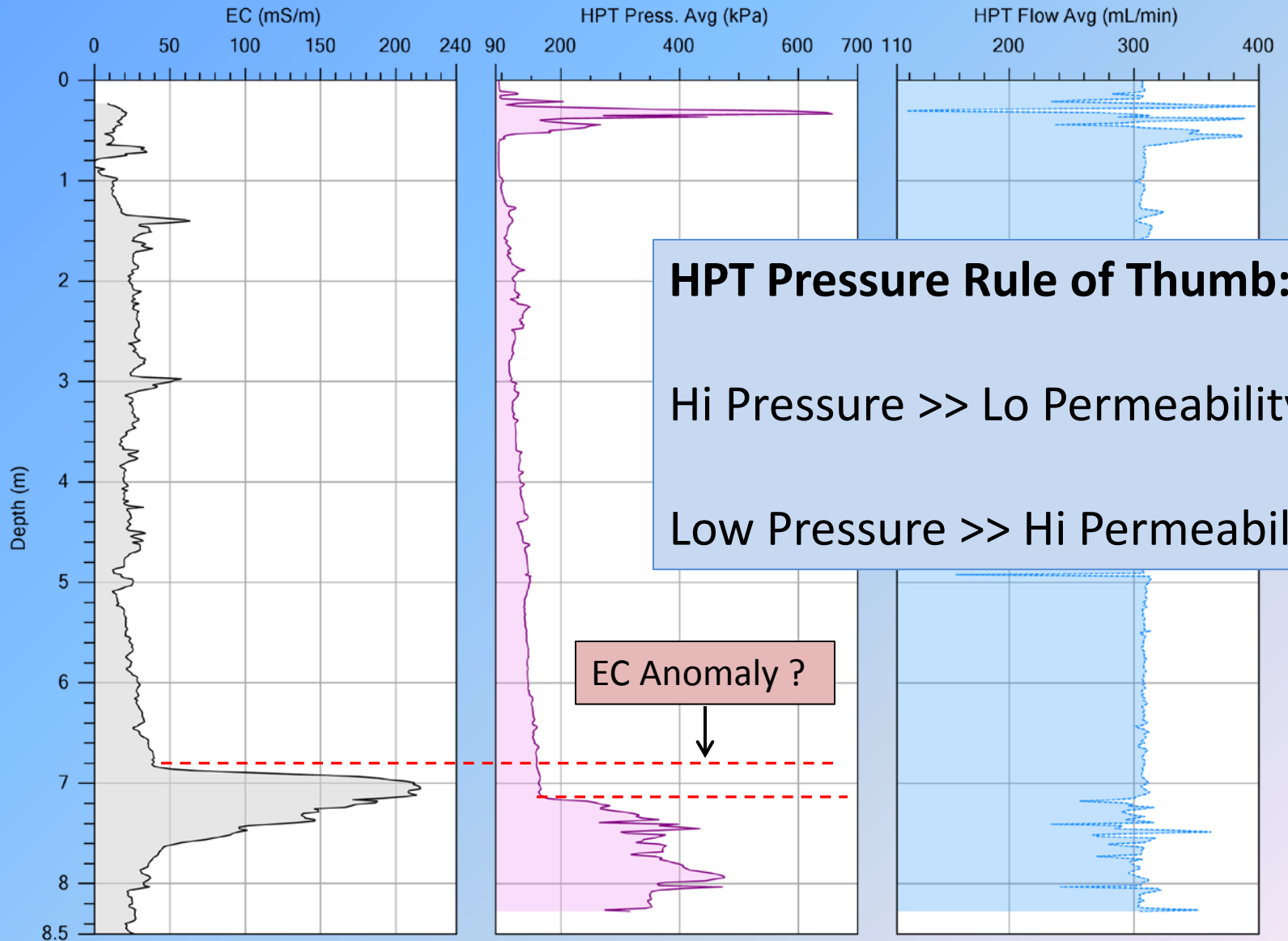


**HPT Pressure Rule of Thumb:**

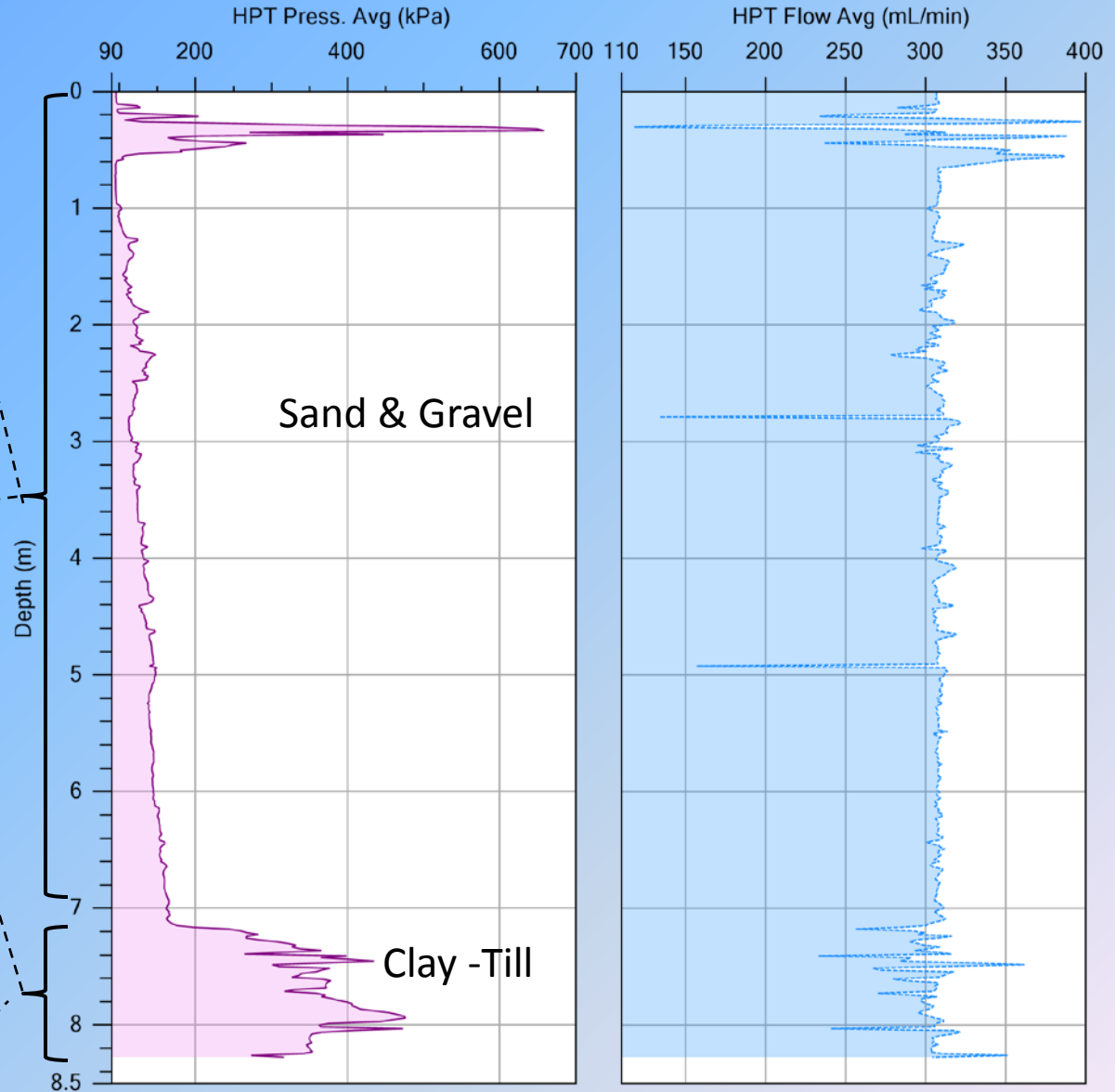
Hi Pressure >> Lo Permeability

Low Pressure >> Hi Permeability

# Example HPT Log : Skuldelev SK05

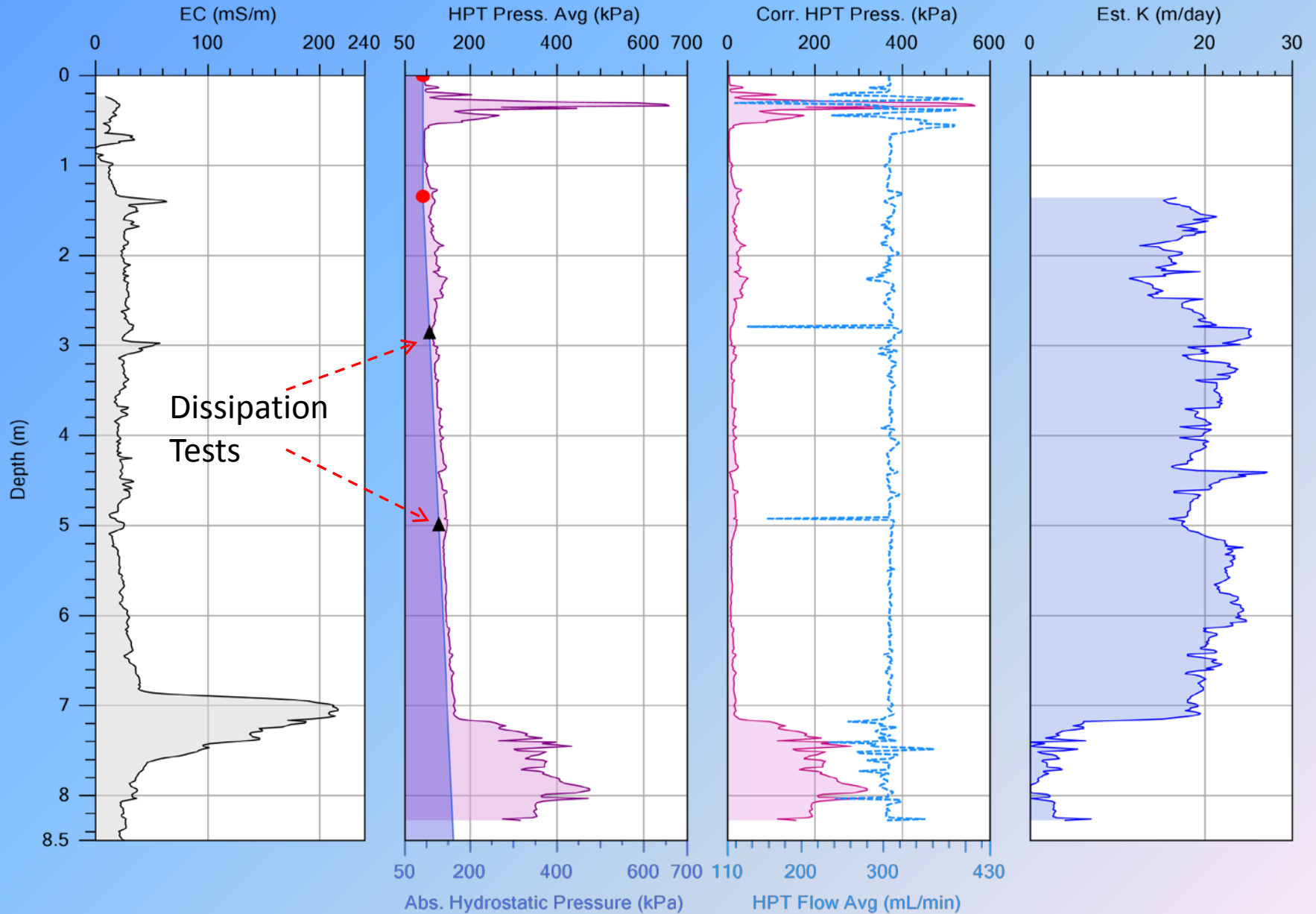


# Correlating HPT Pressure to Soil Cores

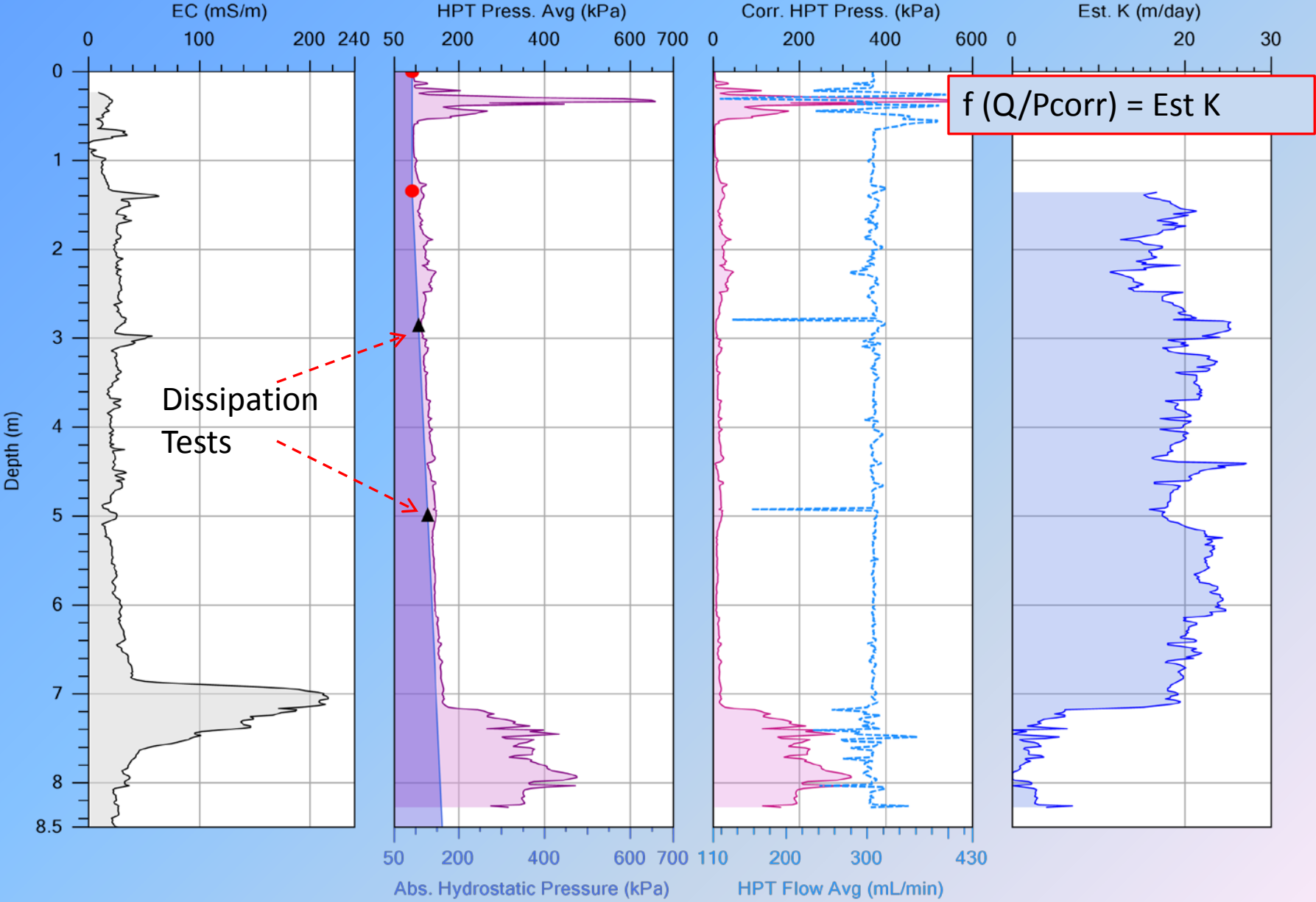




# HPT and Hydrostatic > Corrected Pressure > Est K



# HPT and Hydrostatic P > Corrected P > Est K



# Combining MIP and HPT Probes

**MiHpt**

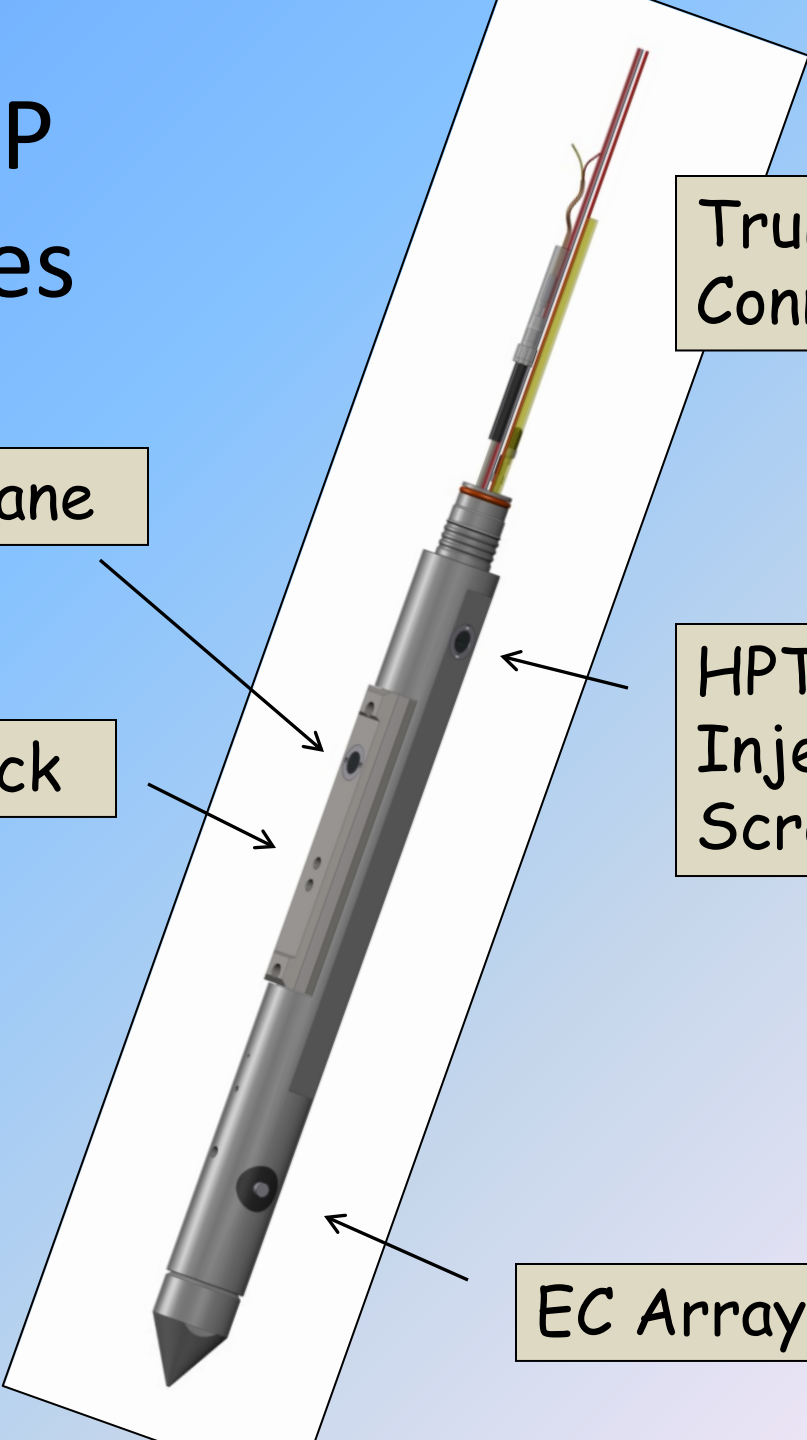
MIP Membrane

Heater Block

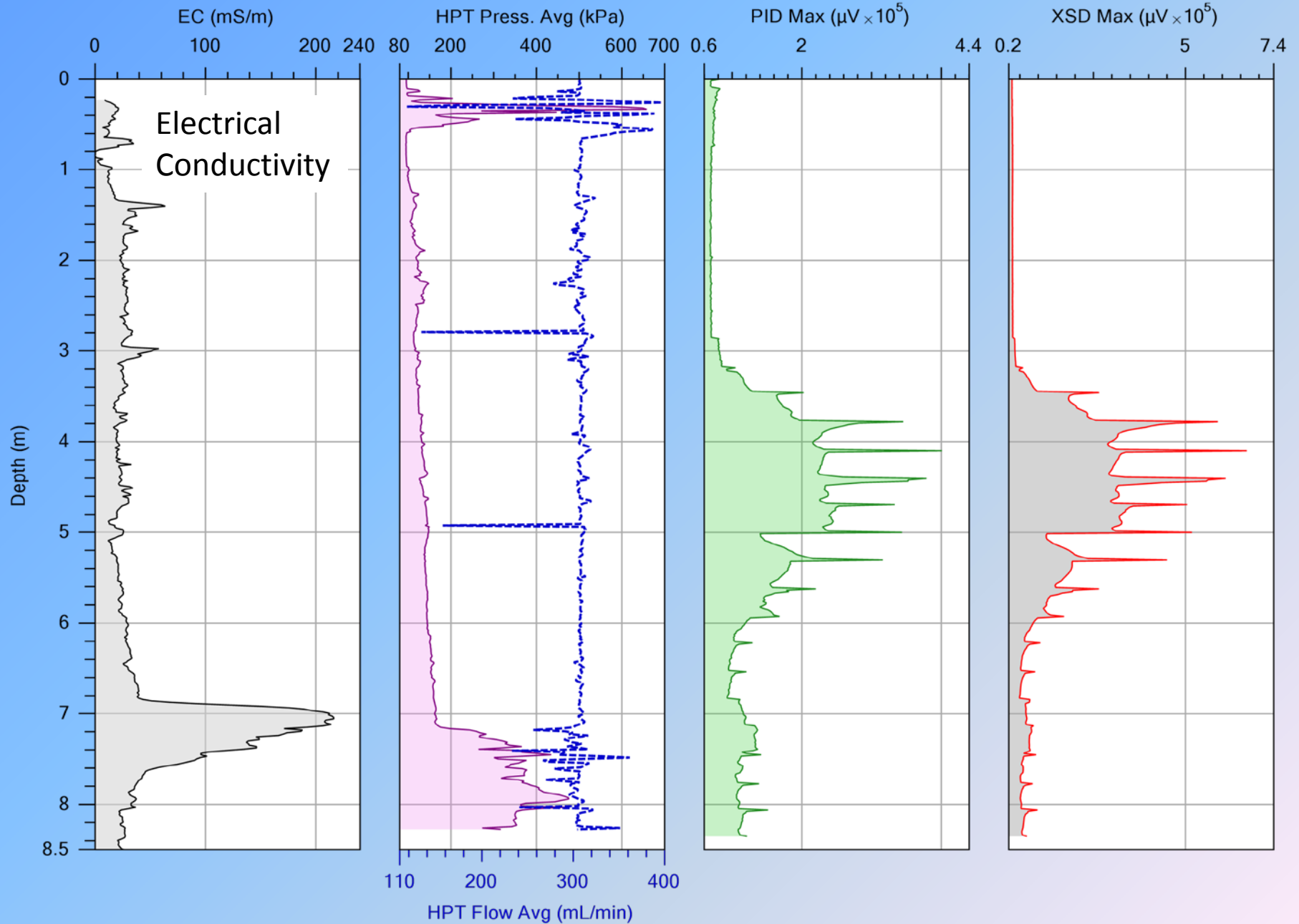
Trunkline Connections

HPT Injection Screen

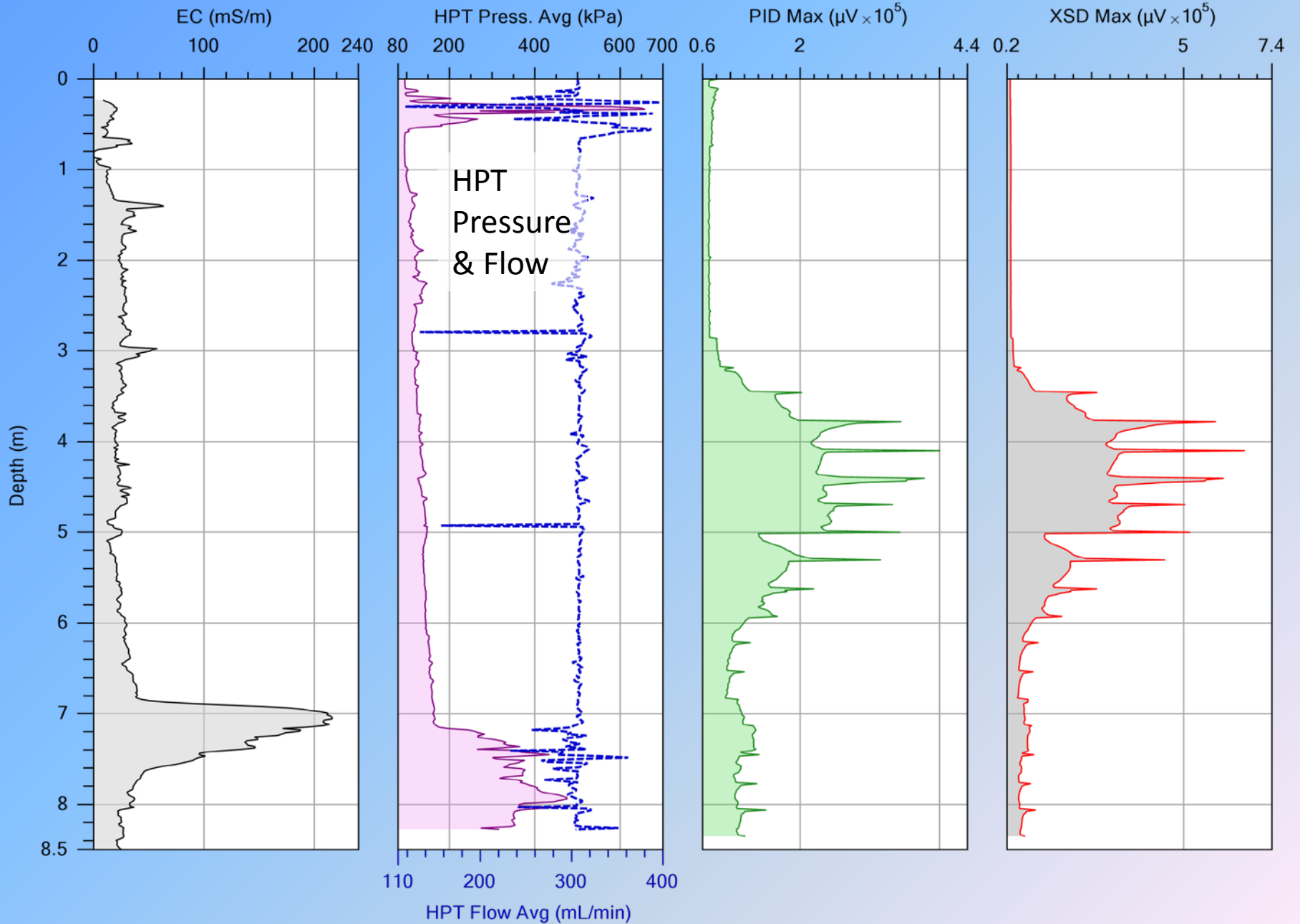
EC Array



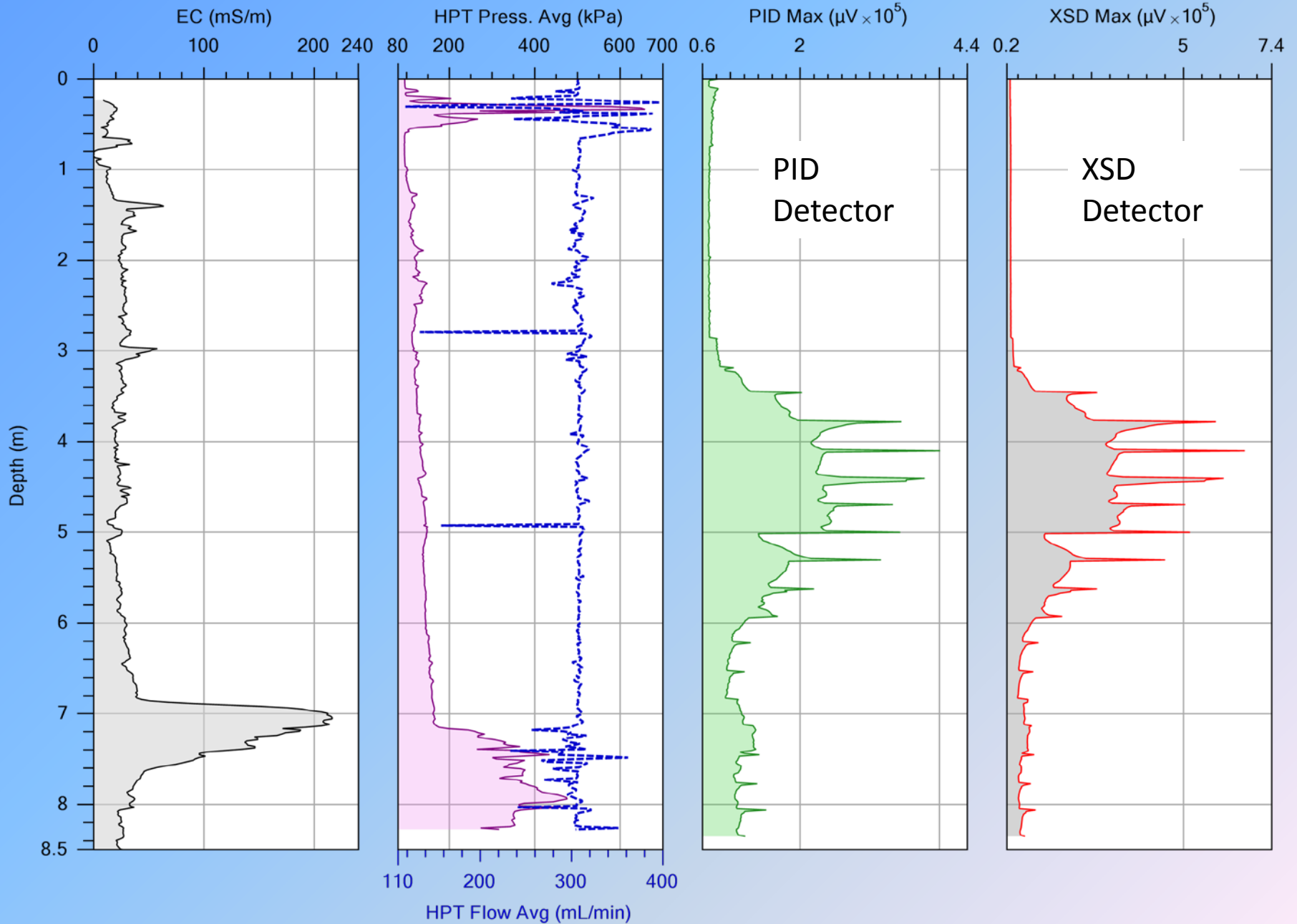
# The MiHpt Log: SK05 at Skuldelev



# The MiHpt Log



# The MiHpt Log



# Location of Skuldelev, Denmark



# Skuldelev Geology

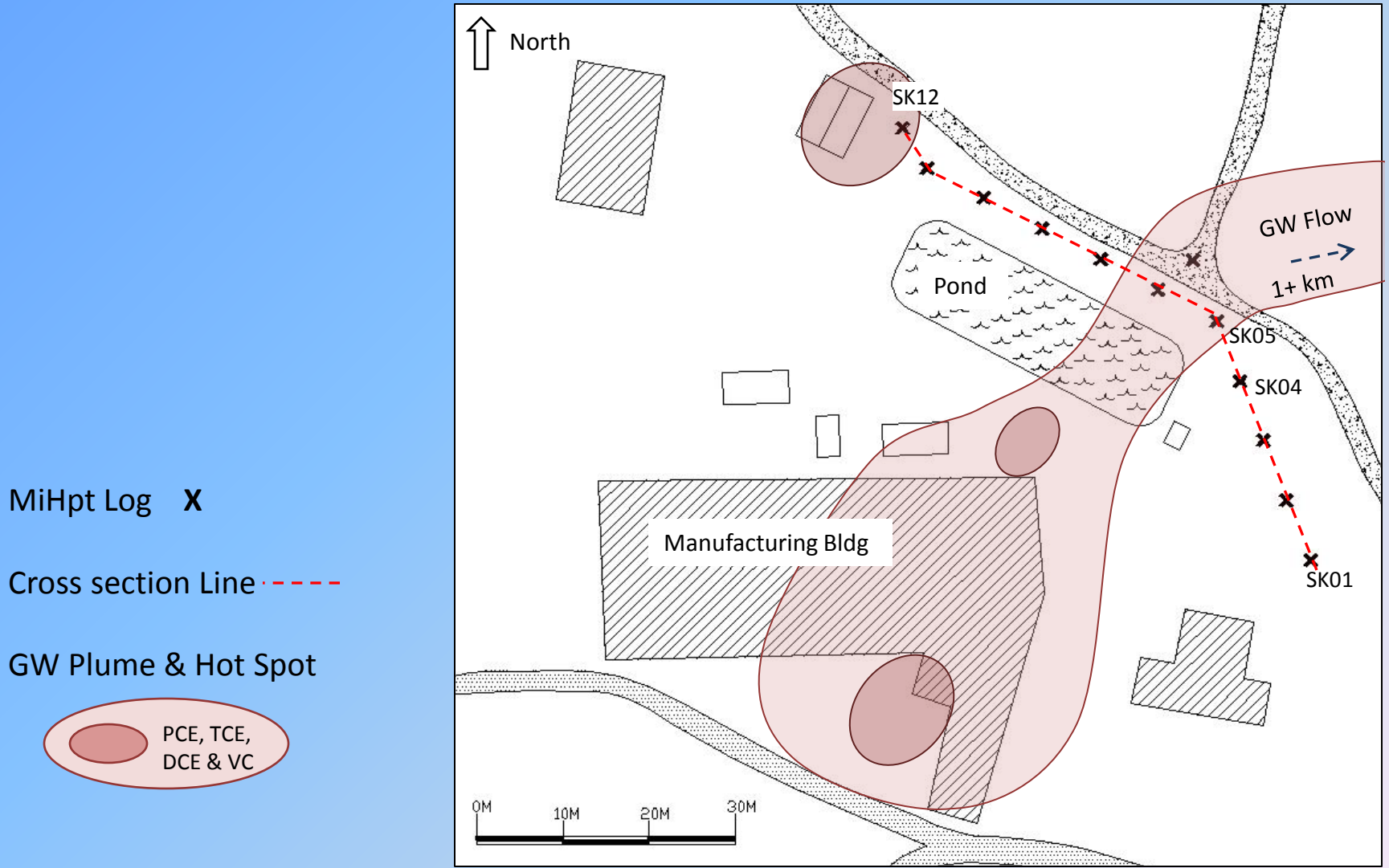


Glaciated Region

Site underlain by glacial till and related unconsolidated deposits



# Skuldelev Site Map



Logs are spaced 8 m (~25ft) apart.

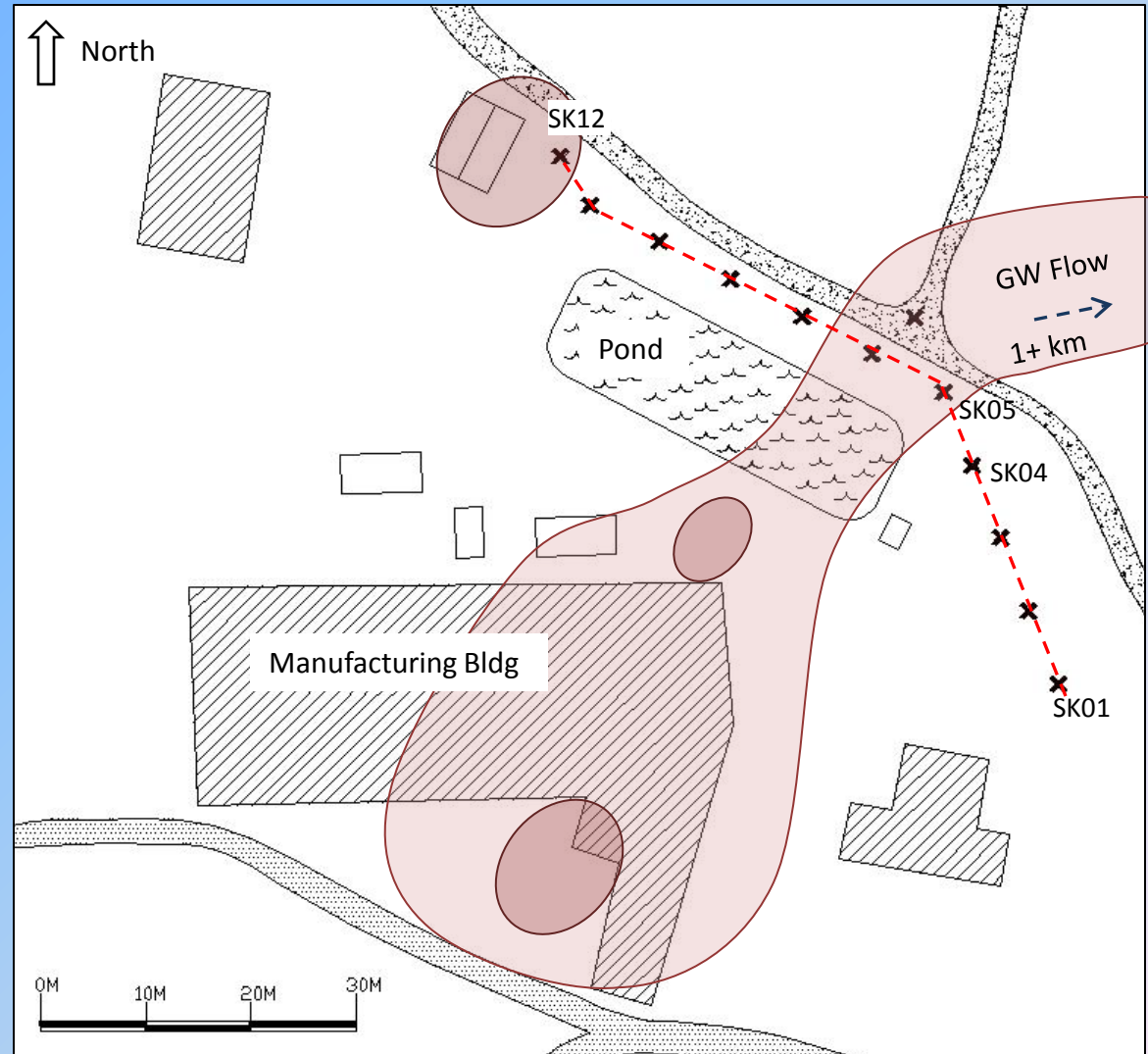
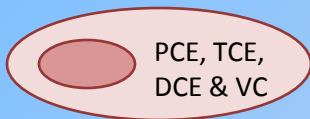
# Skuldelev Site Map

EC at this site did not differentiate between the clay-till and the sand & gravel

MiHpt Log X

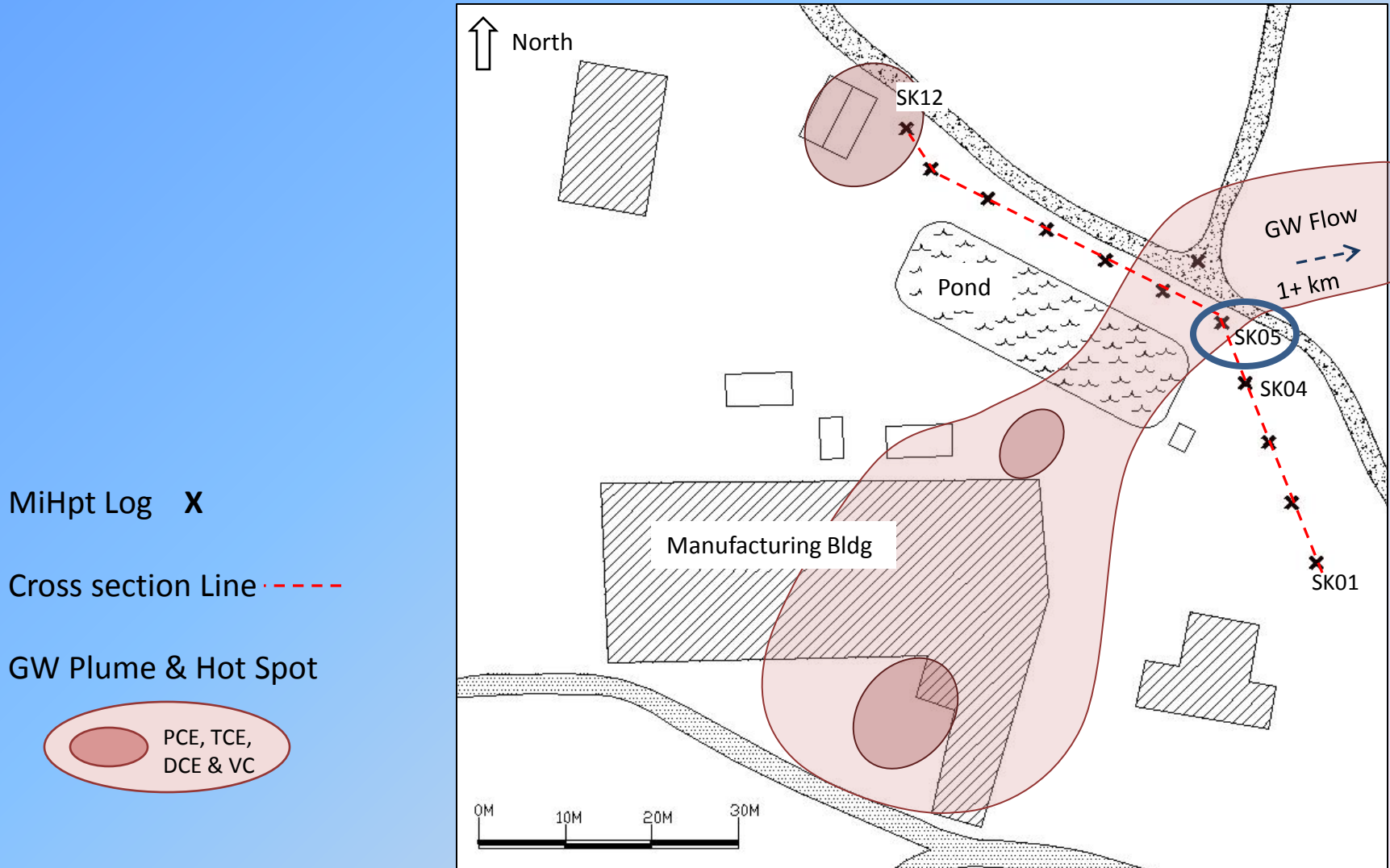
Cross section Line - - - -

GW Plume & Hot Spot



Logs are spaced 8 m (~25ft) apart.

# Skuldelev Log Location & Site Map



Logs are spaced 8 m (~25ft) apart.

# Skuldelev Log Location & Site Map



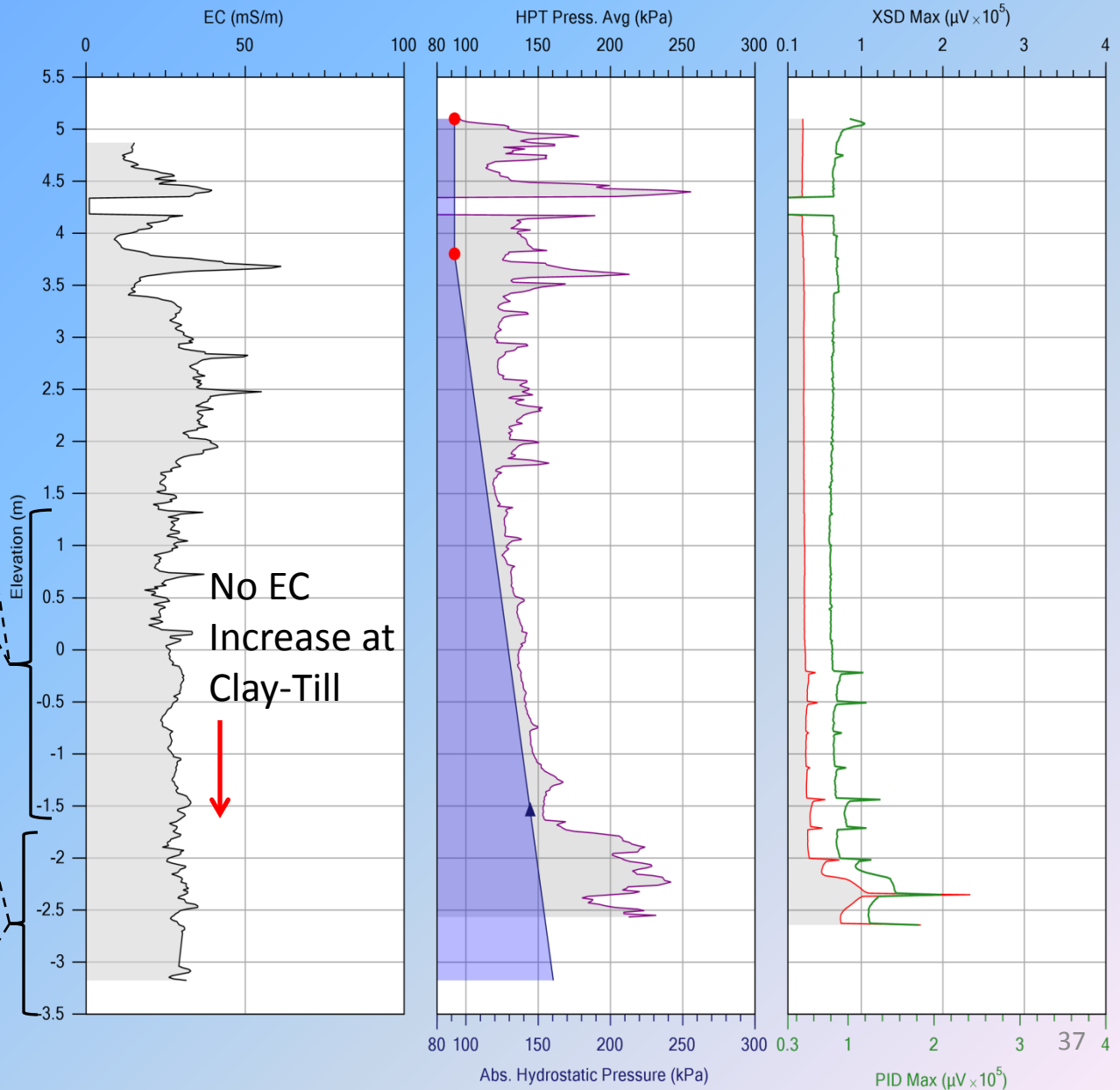
Logs are spaced 8 m (~25ft) apart.

# Skuldelev SK04 Location Log

## Sand & Gravel



## Clay-Till

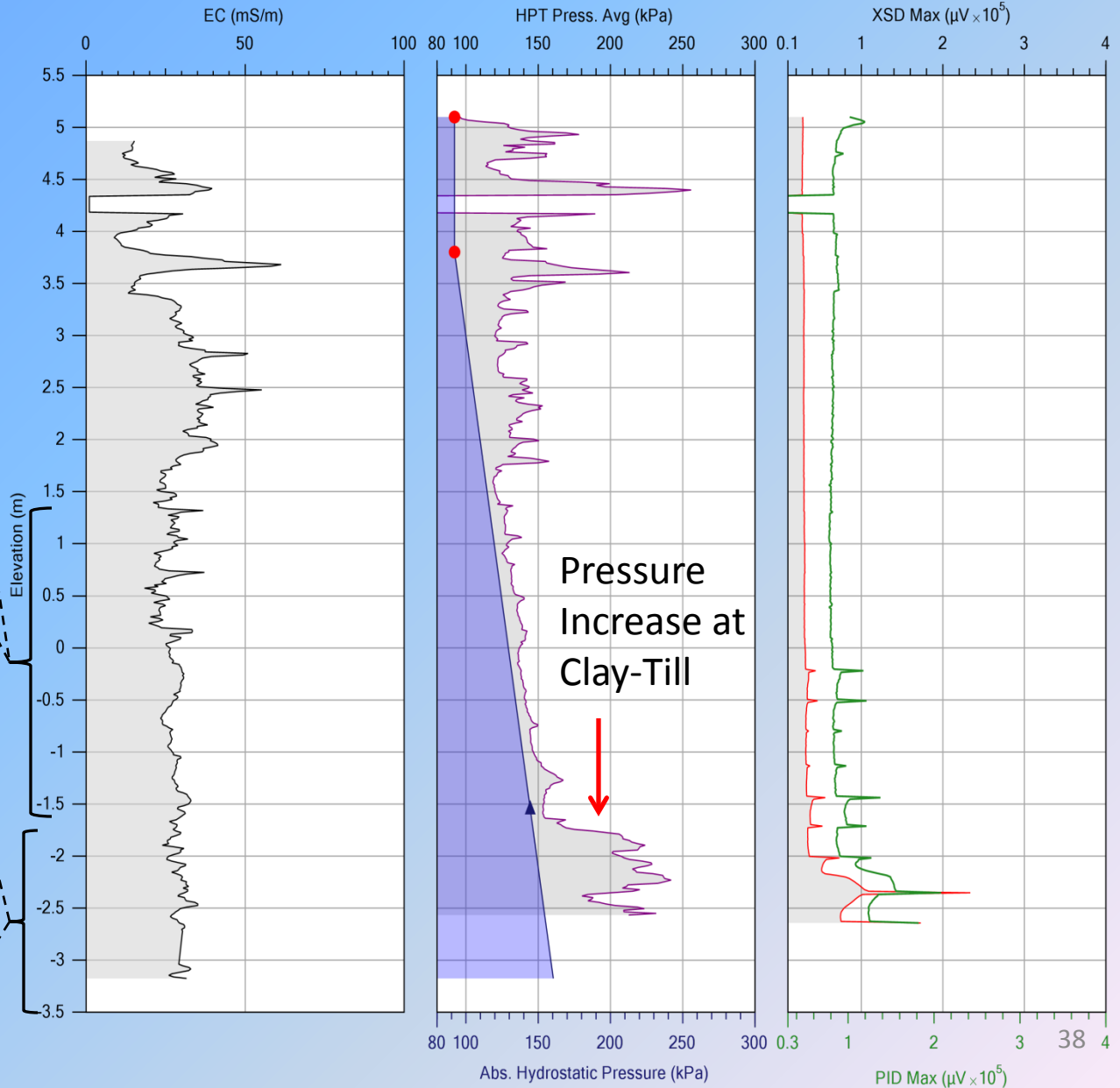


# Skuldelev SK04 Location Log

## Sand & Gravel



## Clay-Till

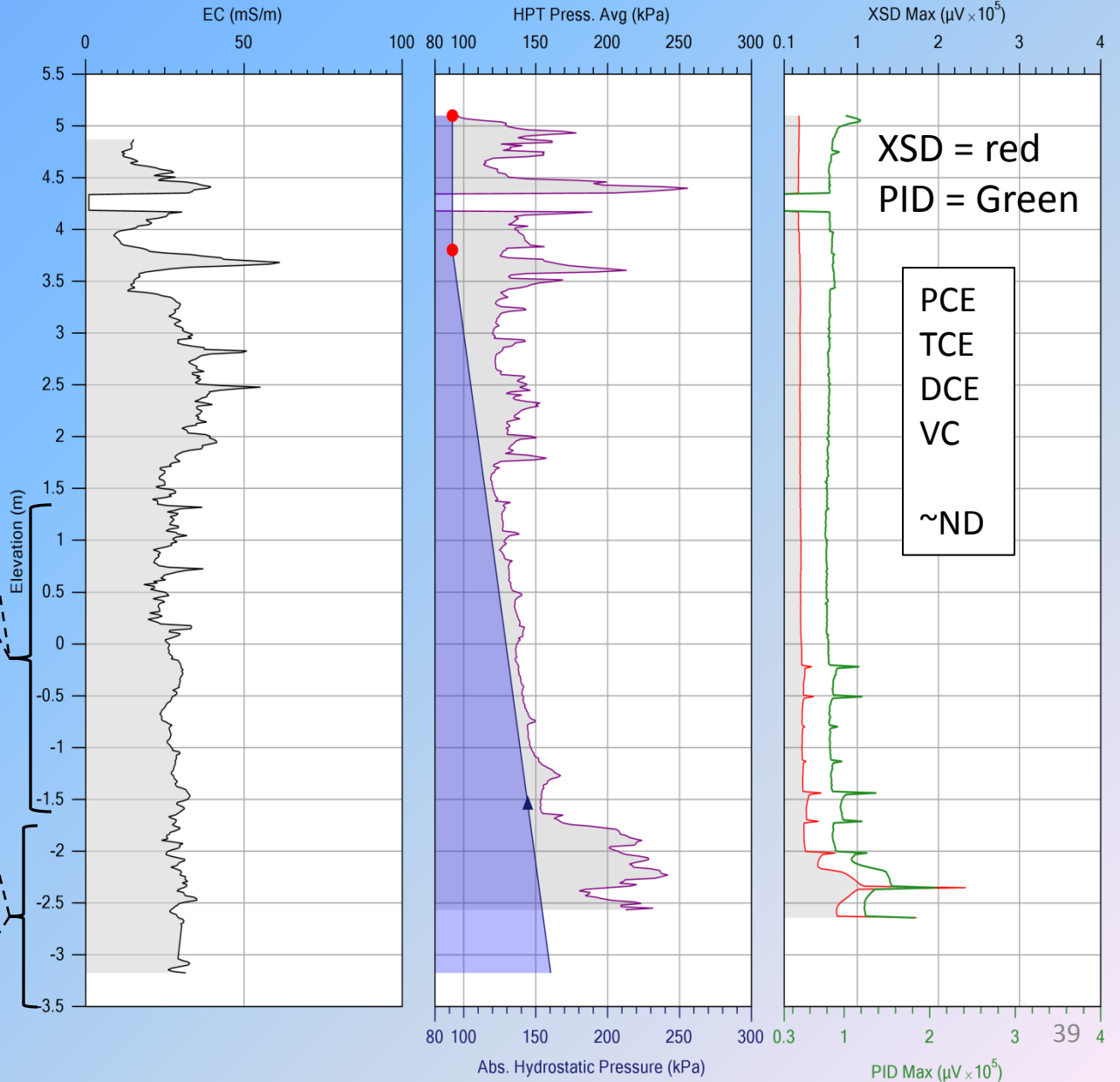


# Skuldelev SK04 Location Log

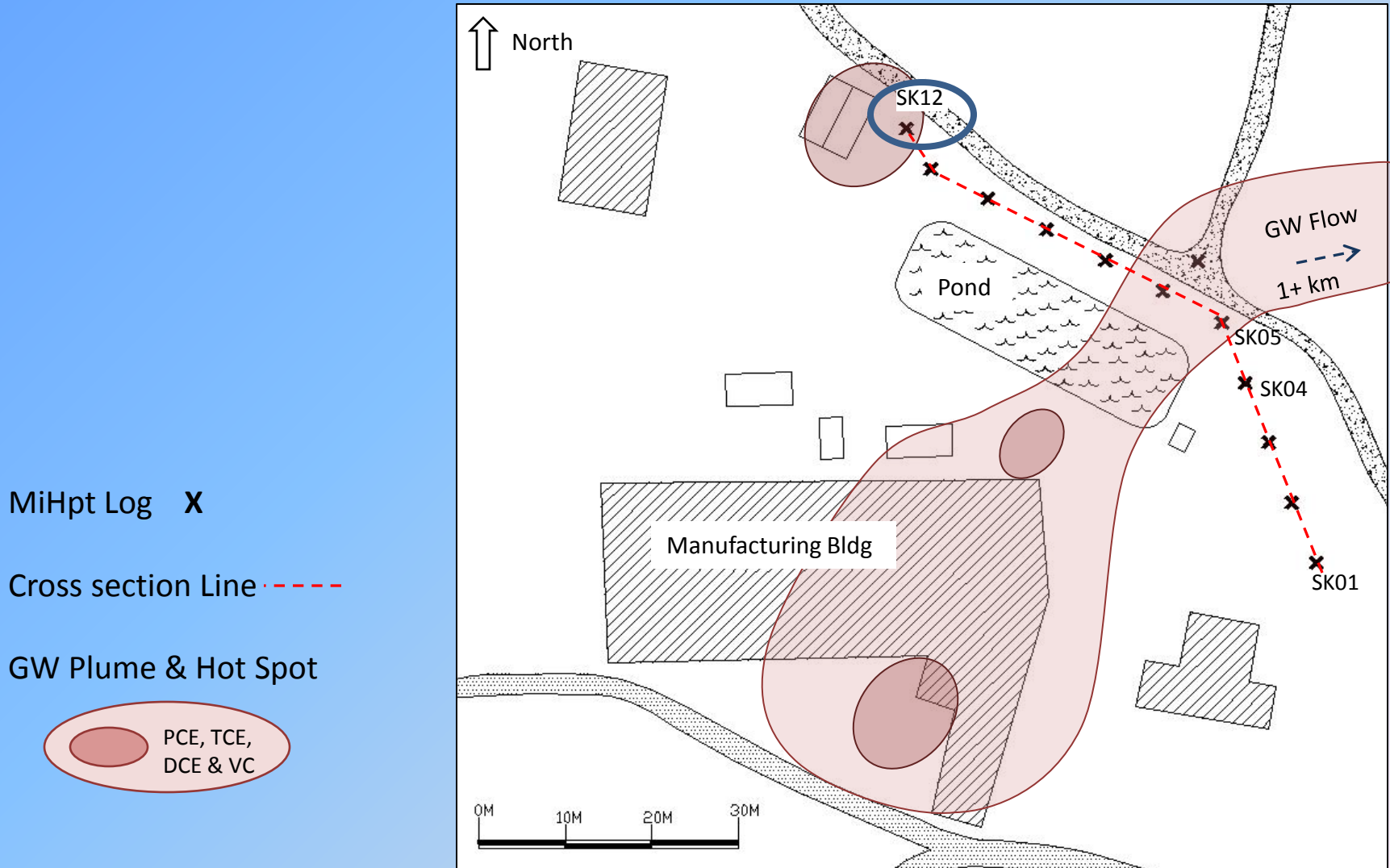
## Sand & Gravel



## Clay-Till



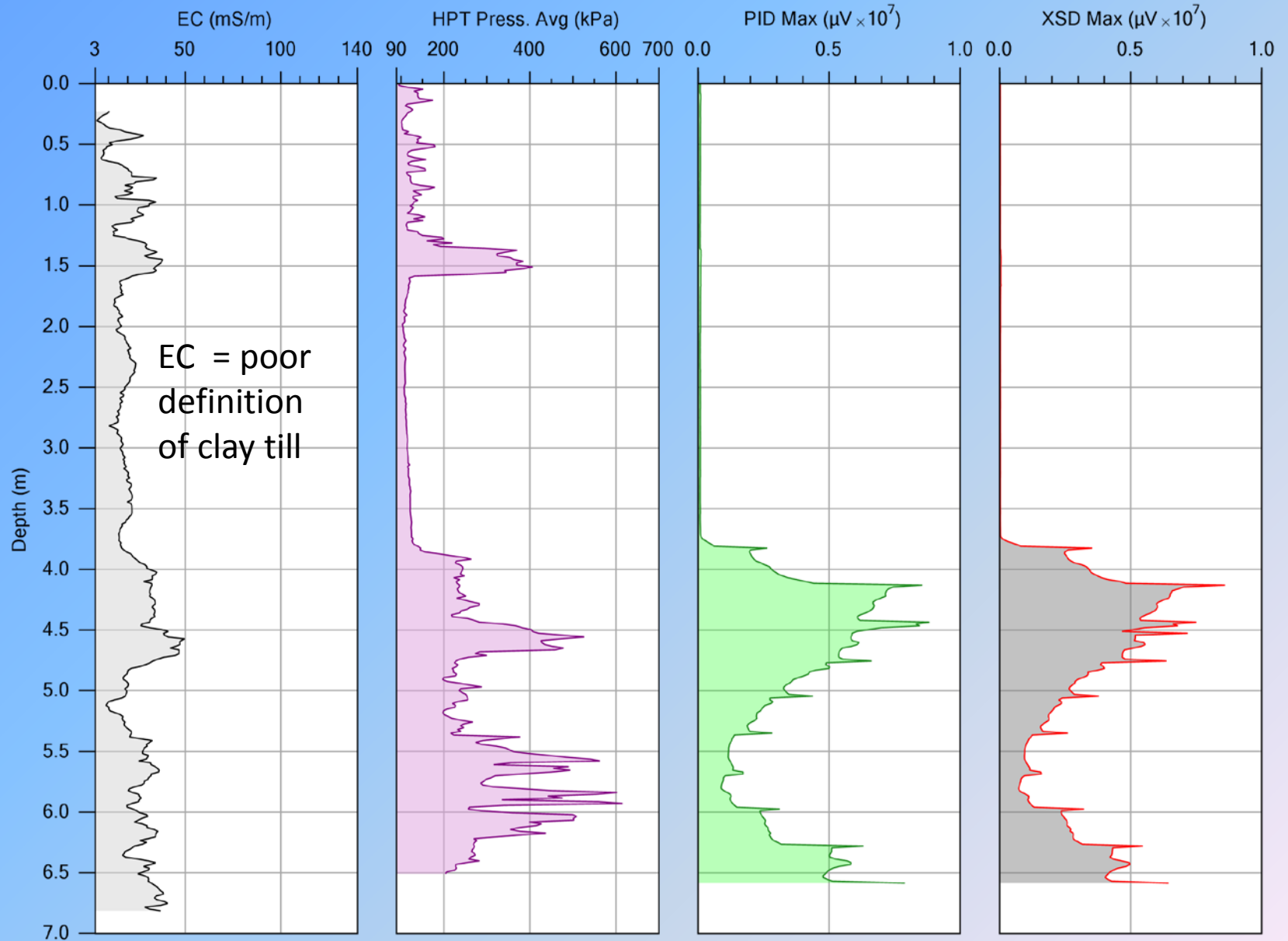
# Skuldelev Log Location & Site Map



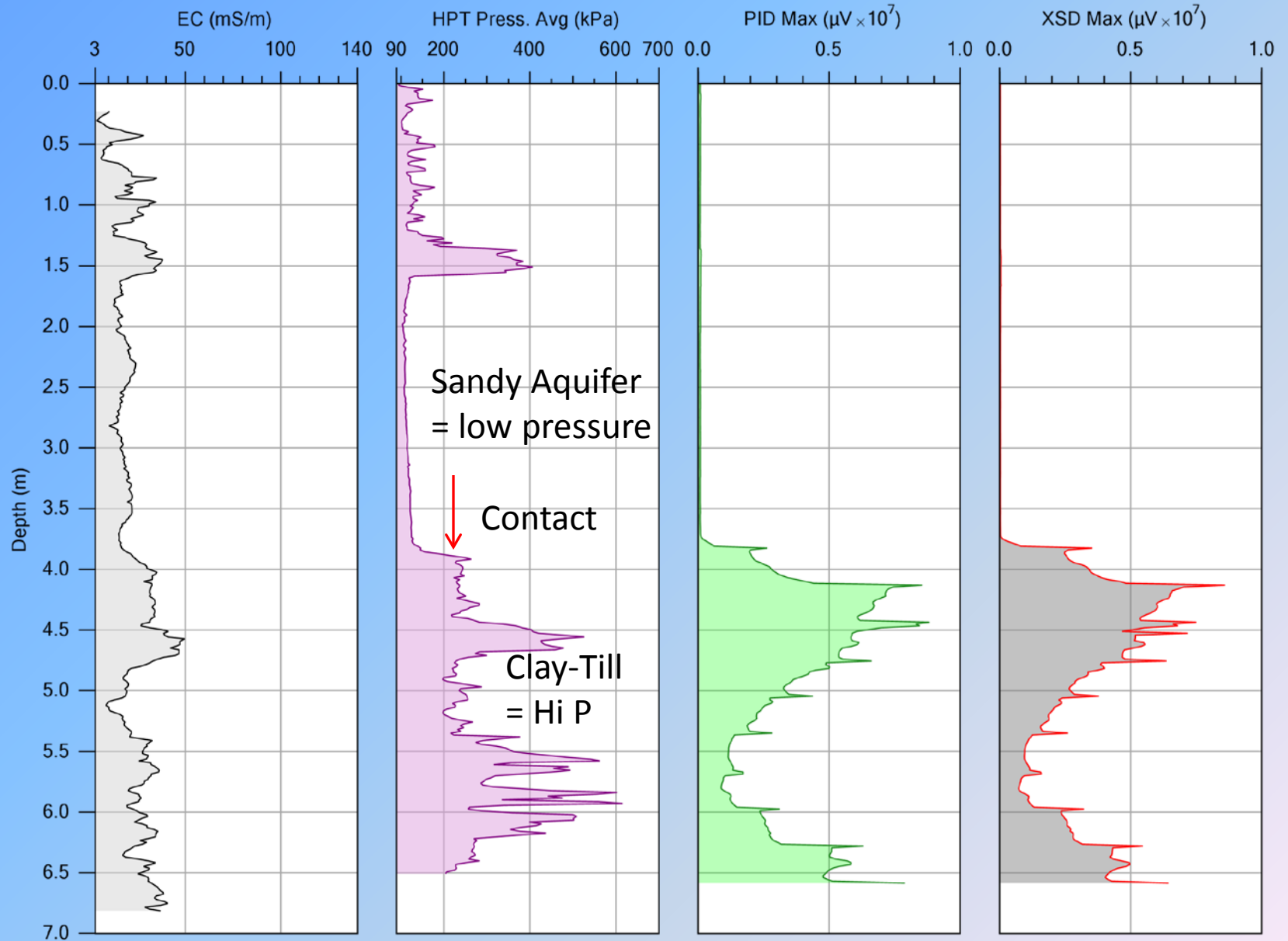
Logs are spaced 8 m (~25ft) apart.



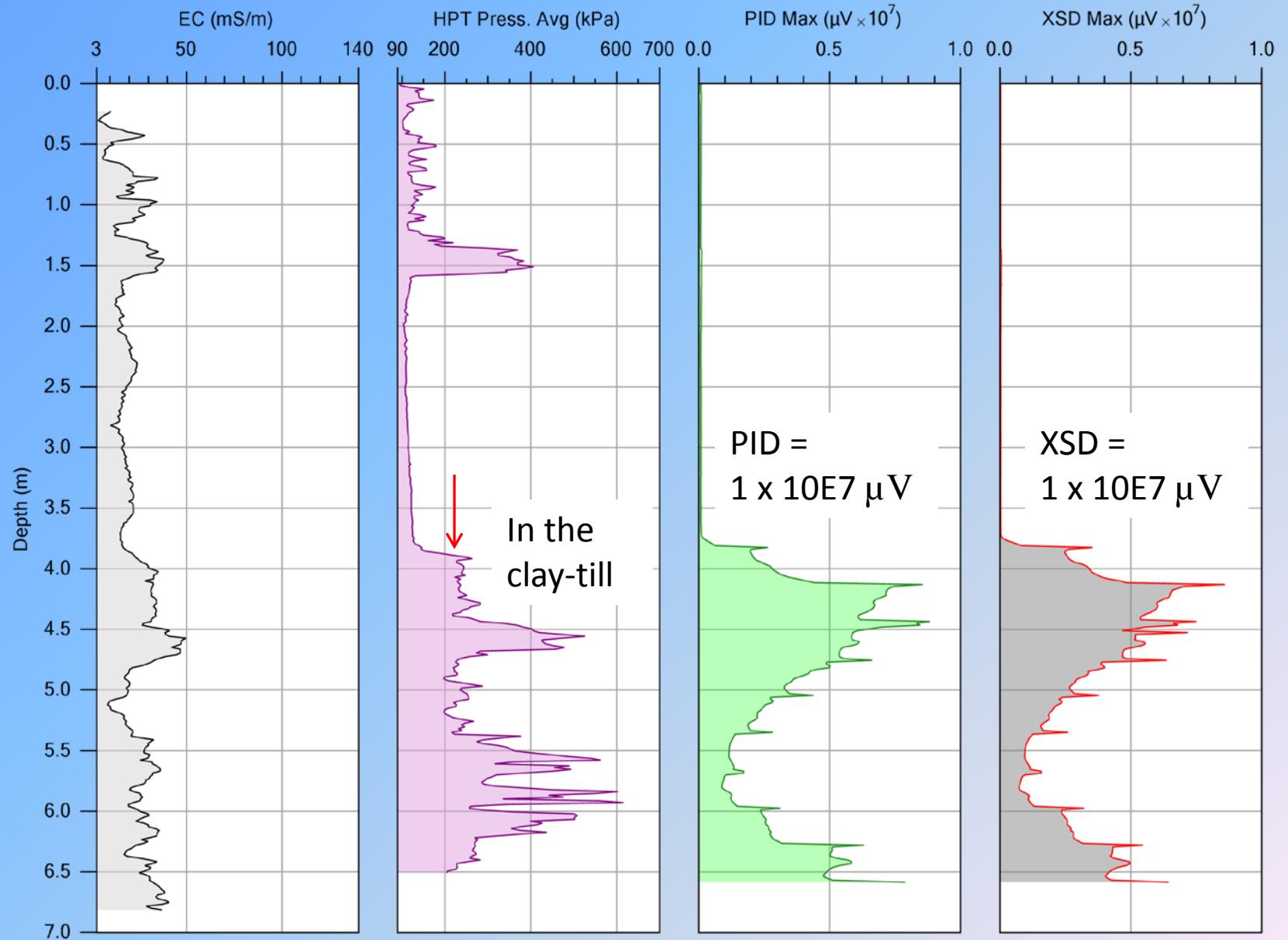
# Skudelev SK12 MiHpt Log



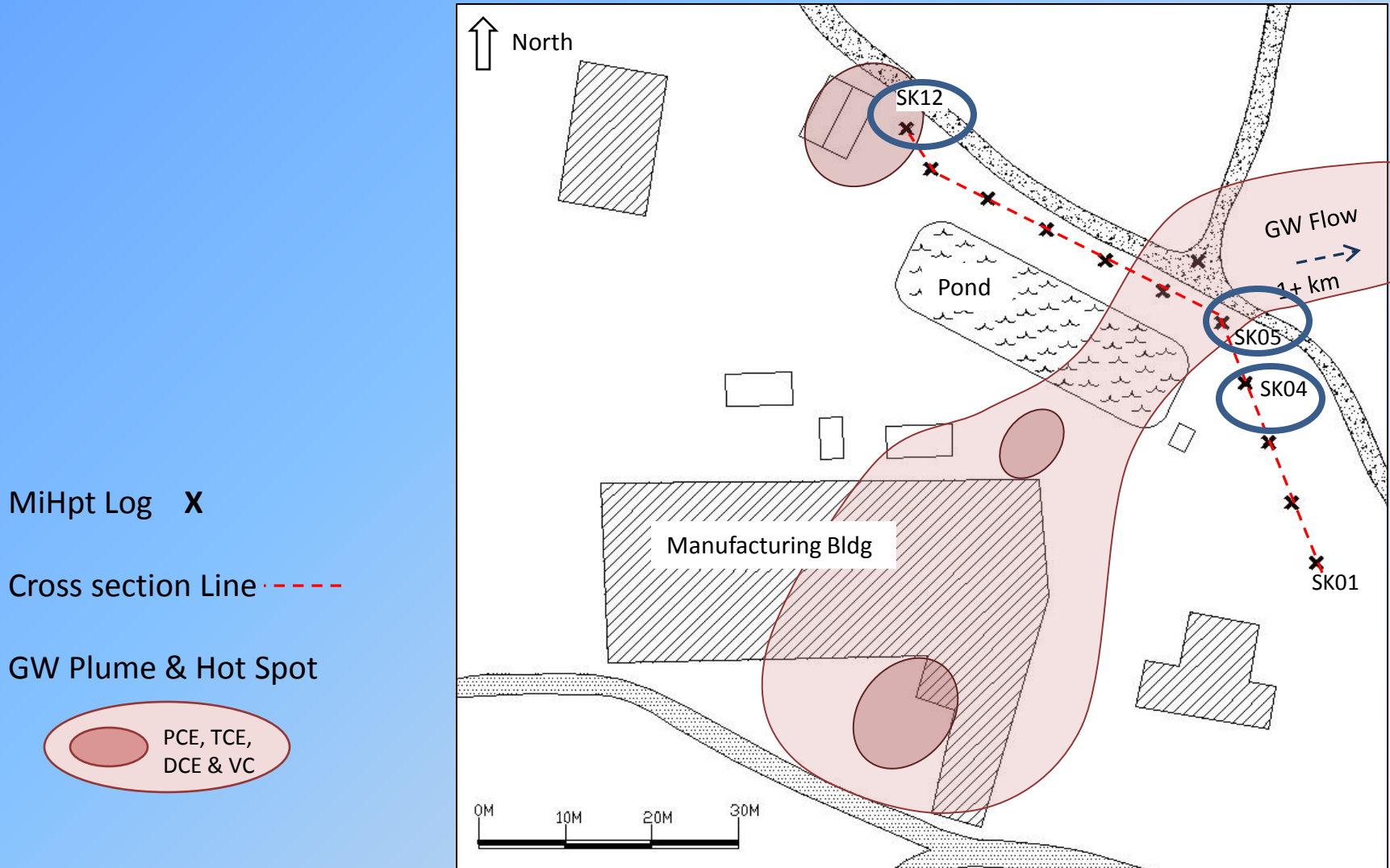
# Skudelev SK12 MiHpt Log



# Skudelev SK12 MiHpt Log

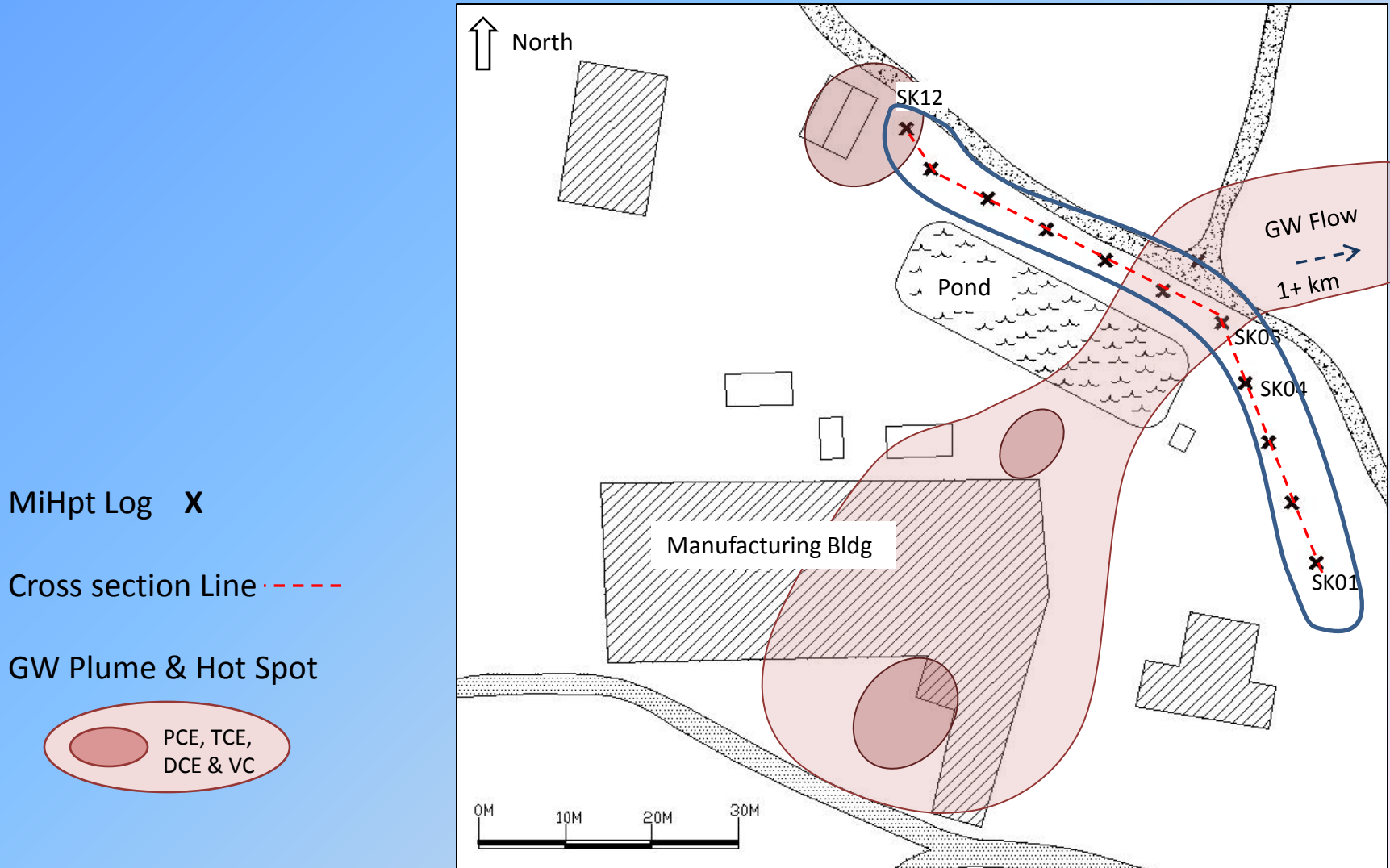


# Skuldelev : Cross Section



Logs are spaced 8 m (~25ft) apart.

# Skuldelev : Cross Section



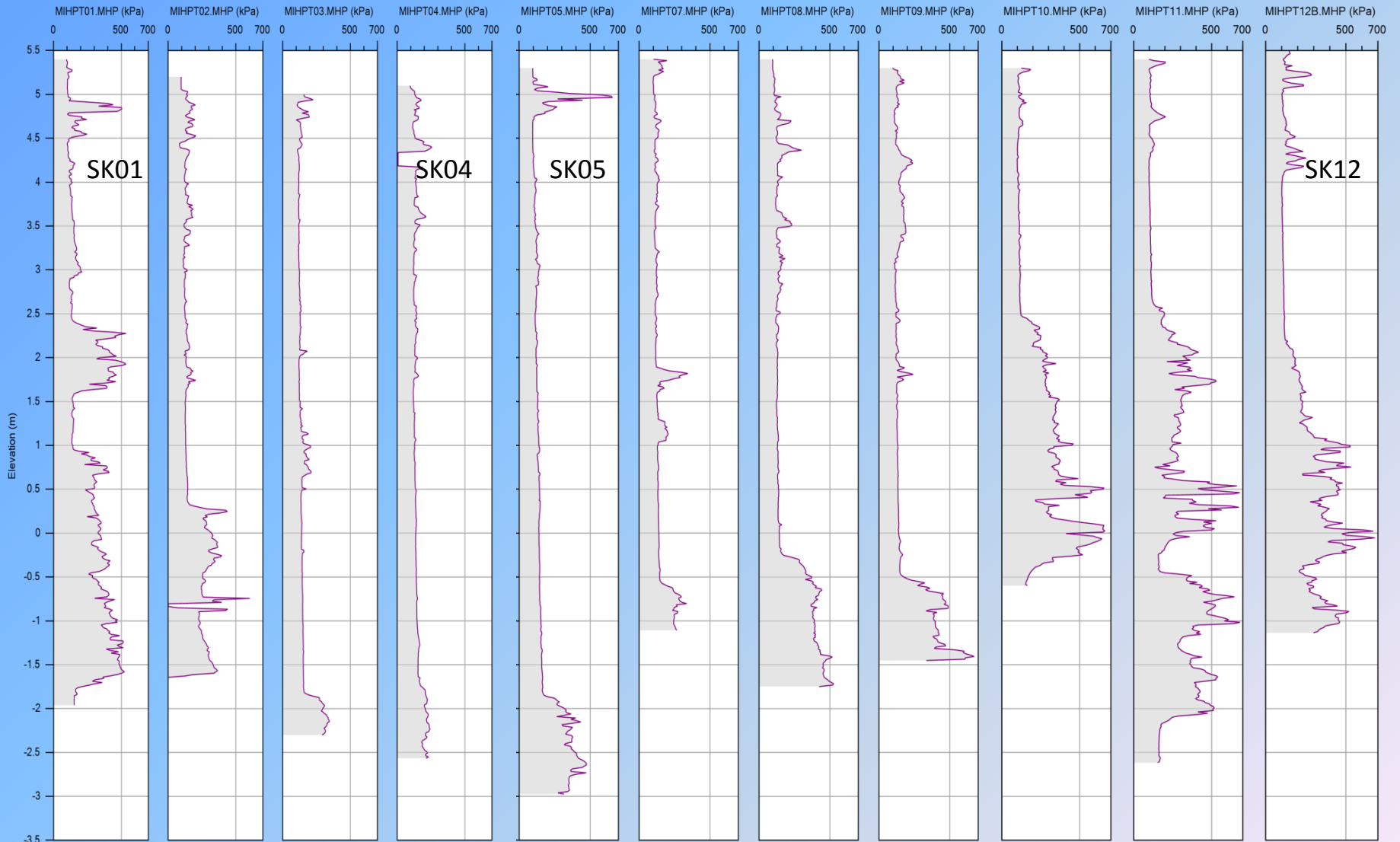
Logs are spaced 8 m (~25ft) apart.

# Skuldelev HPT Pressure X-Section

East

(Elevation Corrected)

West



HPT Press. Avg

(Facing ~ Southwest)

HPT Press. Avg

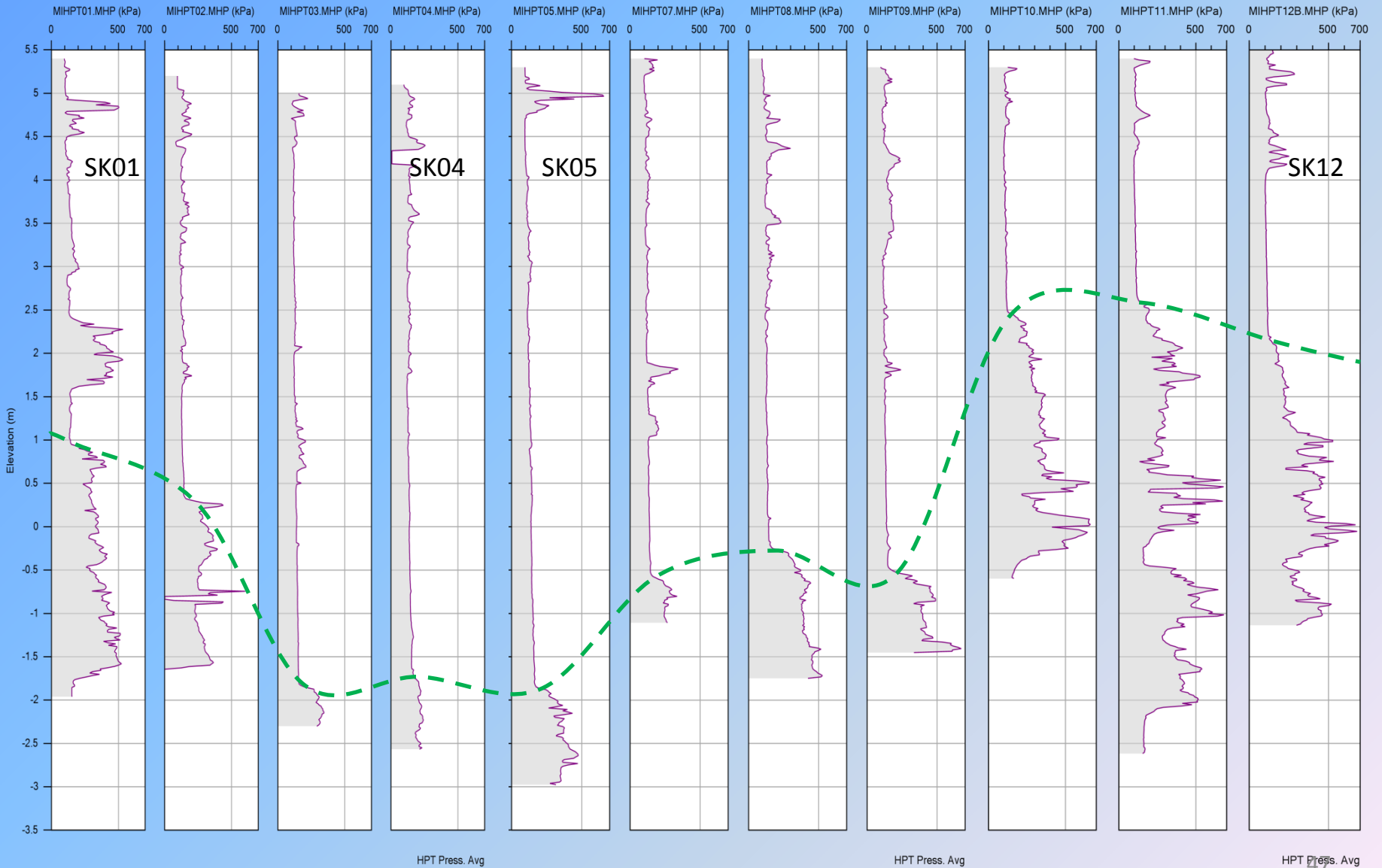
HPT Press. Avg

# Skuldelev HPT Pressure X-Section

East

(Elevation Corrected)

West



HPT Press. Avg

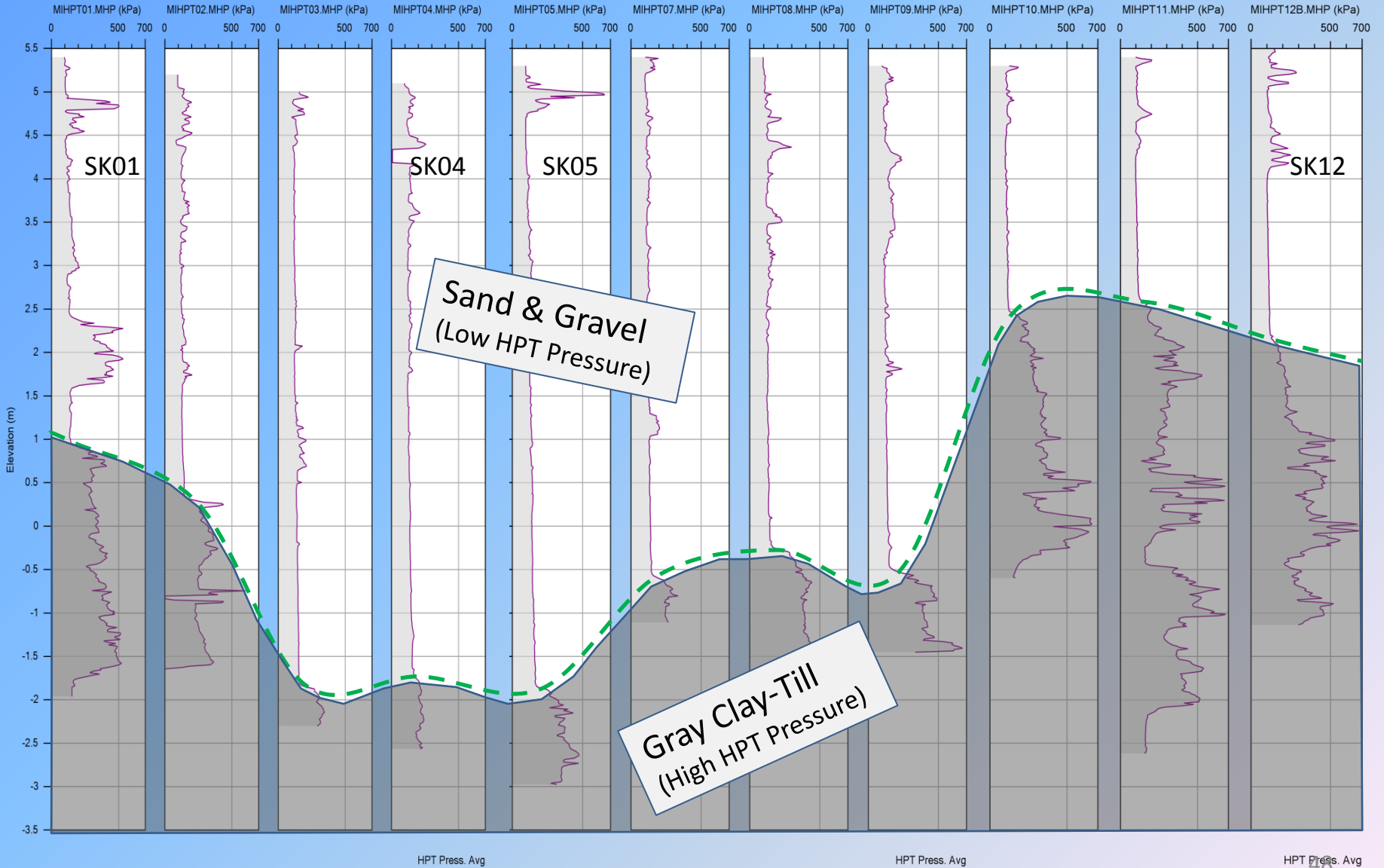
HPT Press. Avg

HPT Press. Avg

# Skuldelev HPT Pressure X-Section

East

West



HPT Press. Avg

HPT Press. Avg

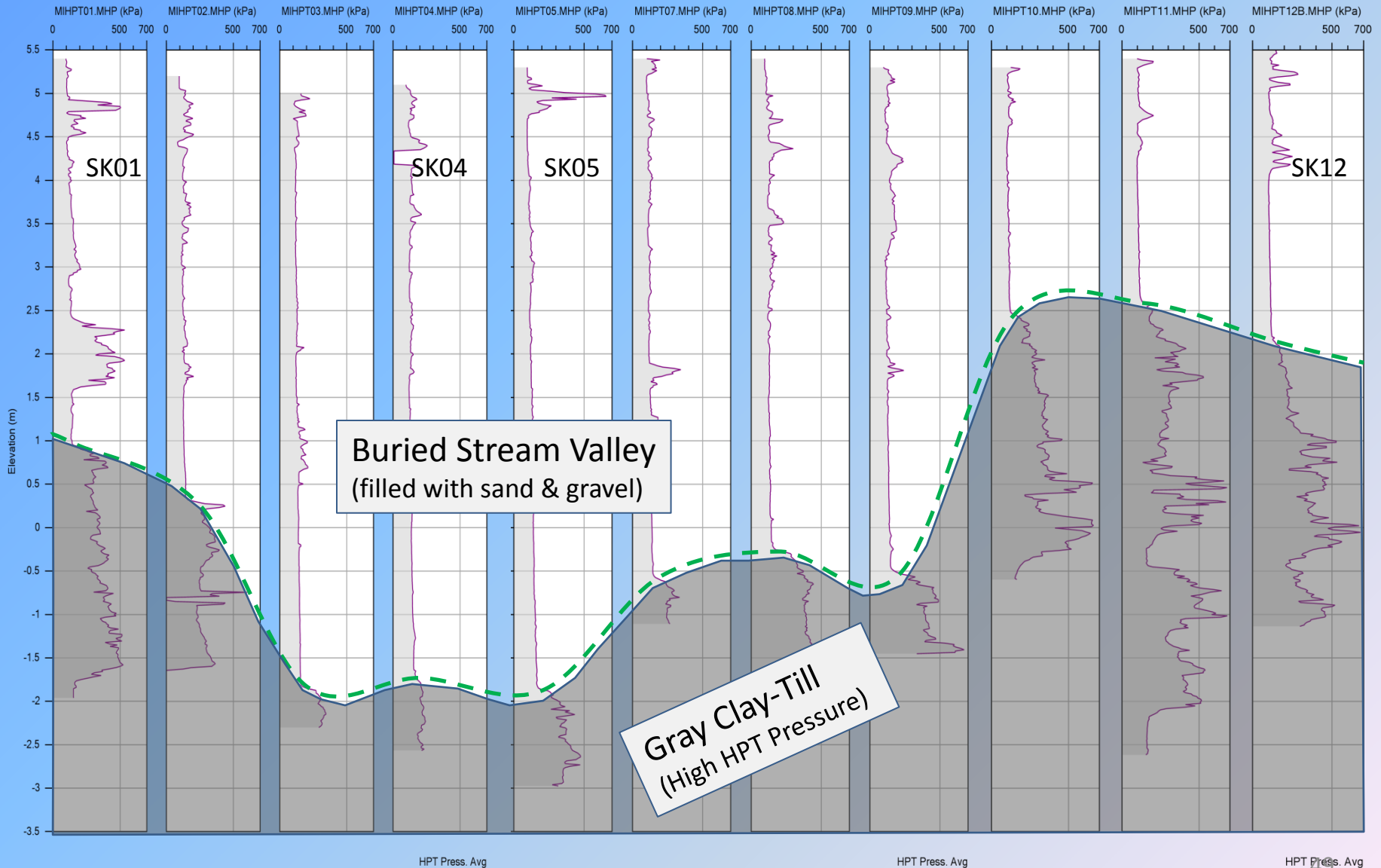
HPT Press. Avg



# Skuldelev HPT Pressure X-Section = hydrogeologic model = CSM

East

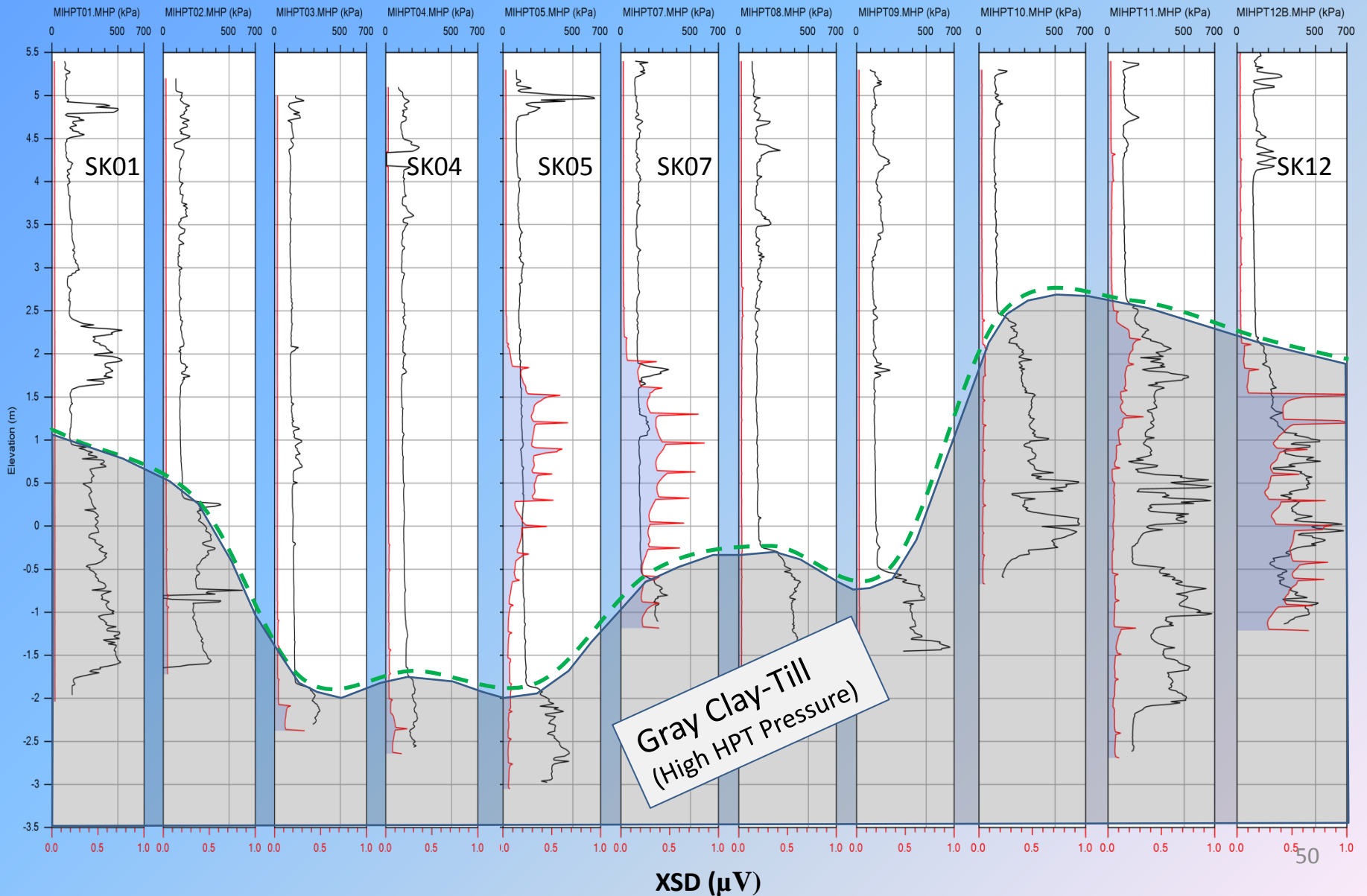
West



# Skuldelev HPT Pressure and XSD Cross Section

East

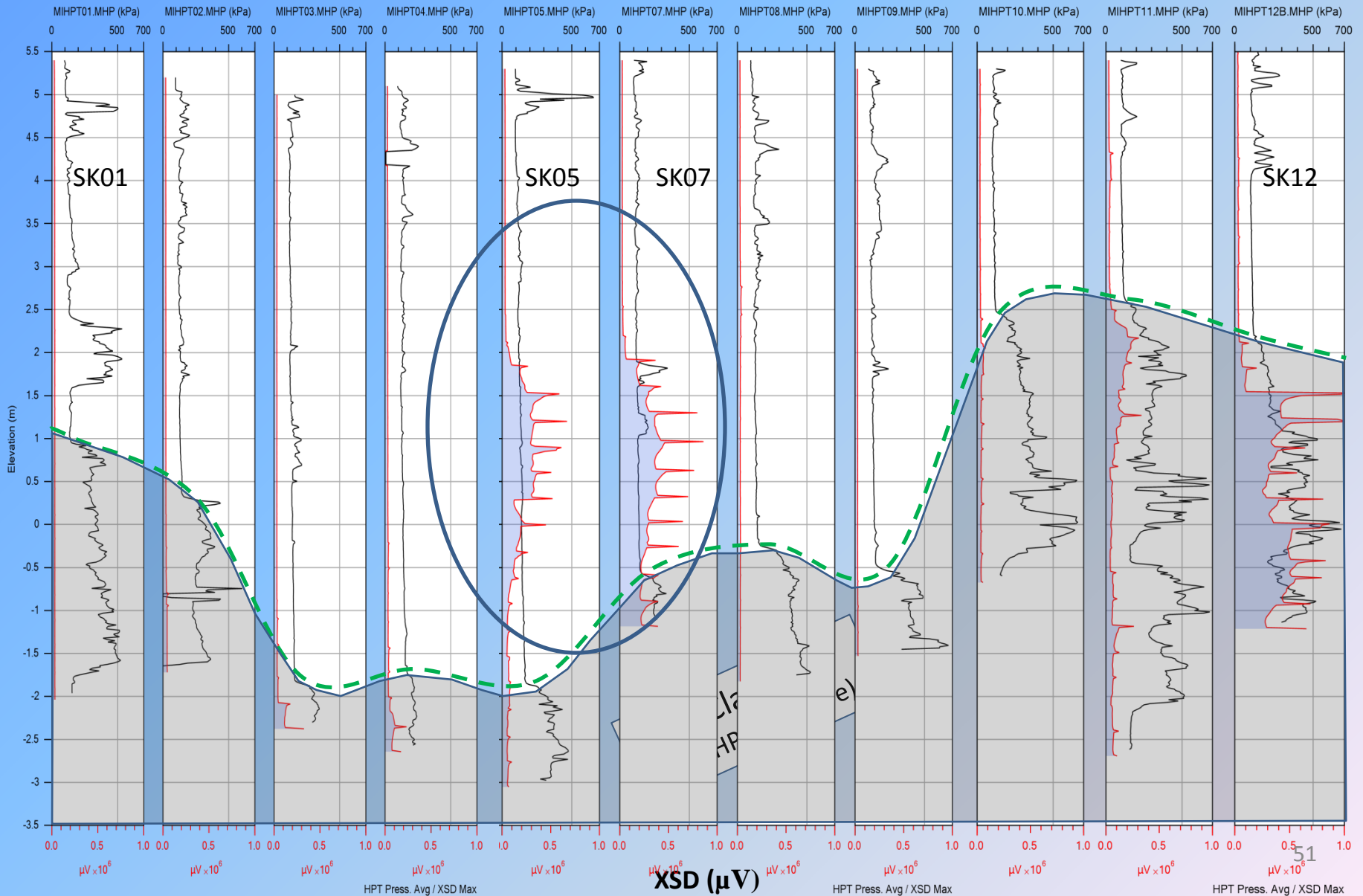
West



# Skuldelev HPT Pressure and XSD Cross Section

East

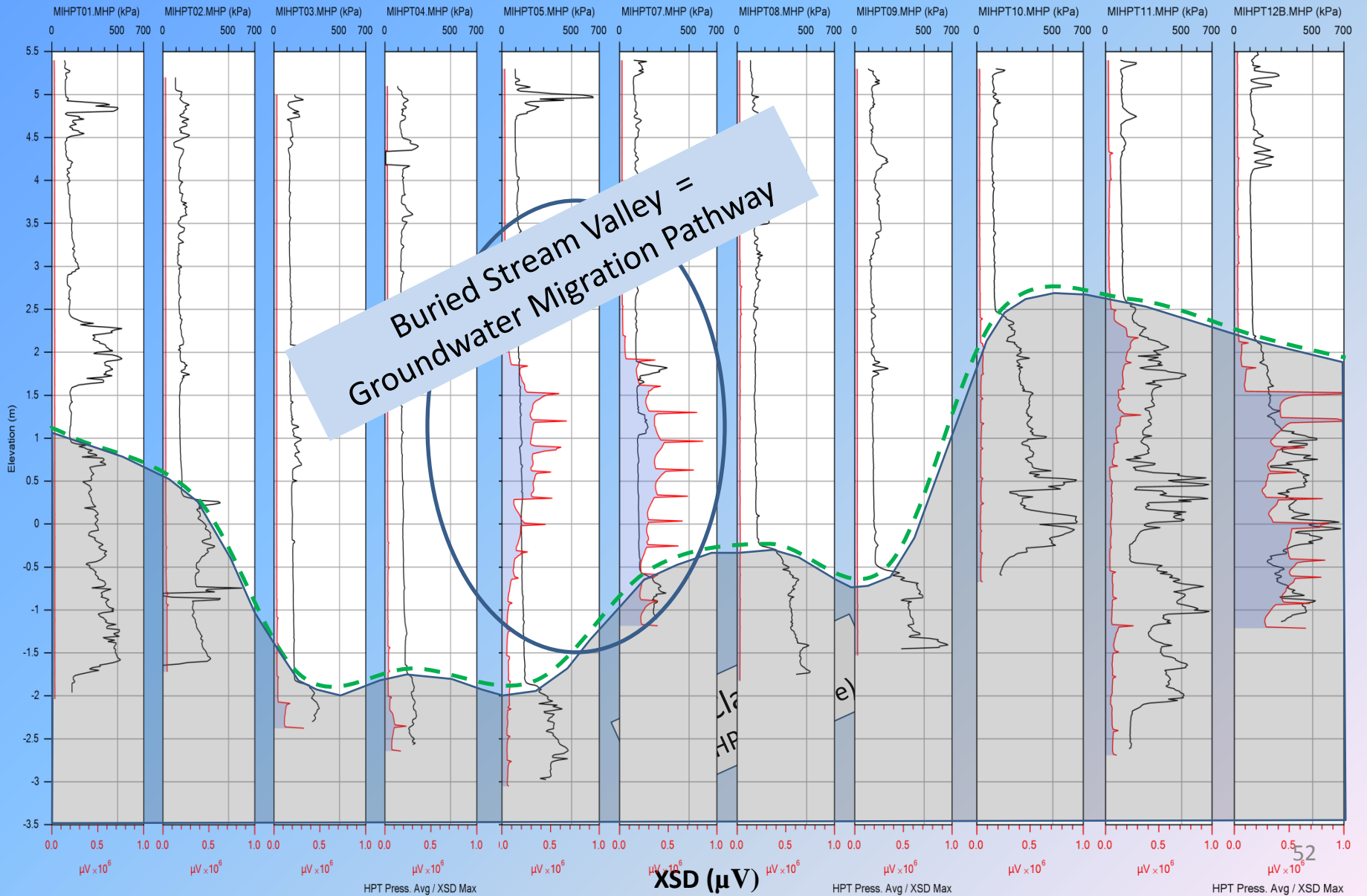
West



# Skuldelev HPT Pressure and XSD Cross Section

East

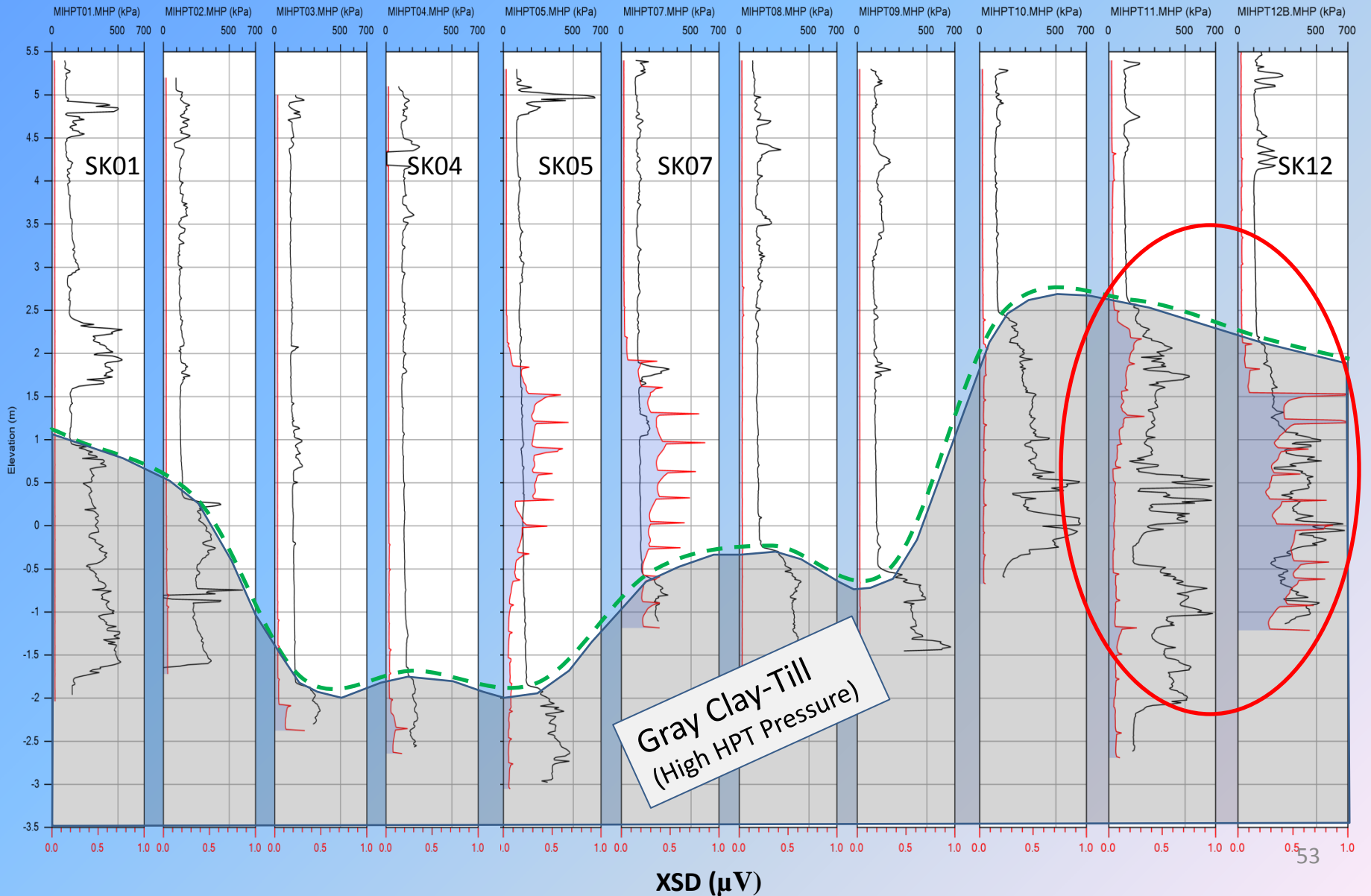
West



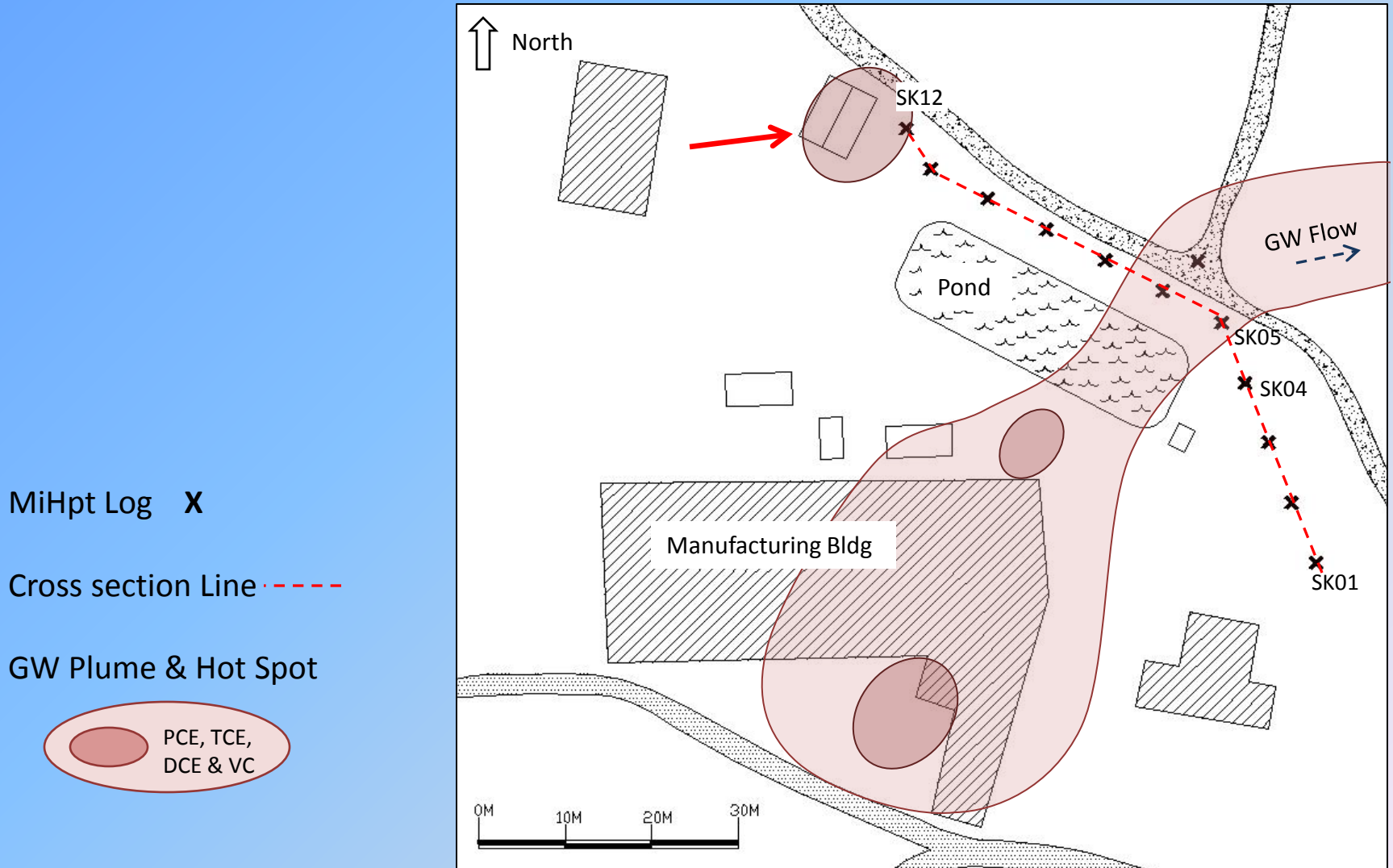
# Skuldelev HPT Pressure and XSD Cross Section

East

West

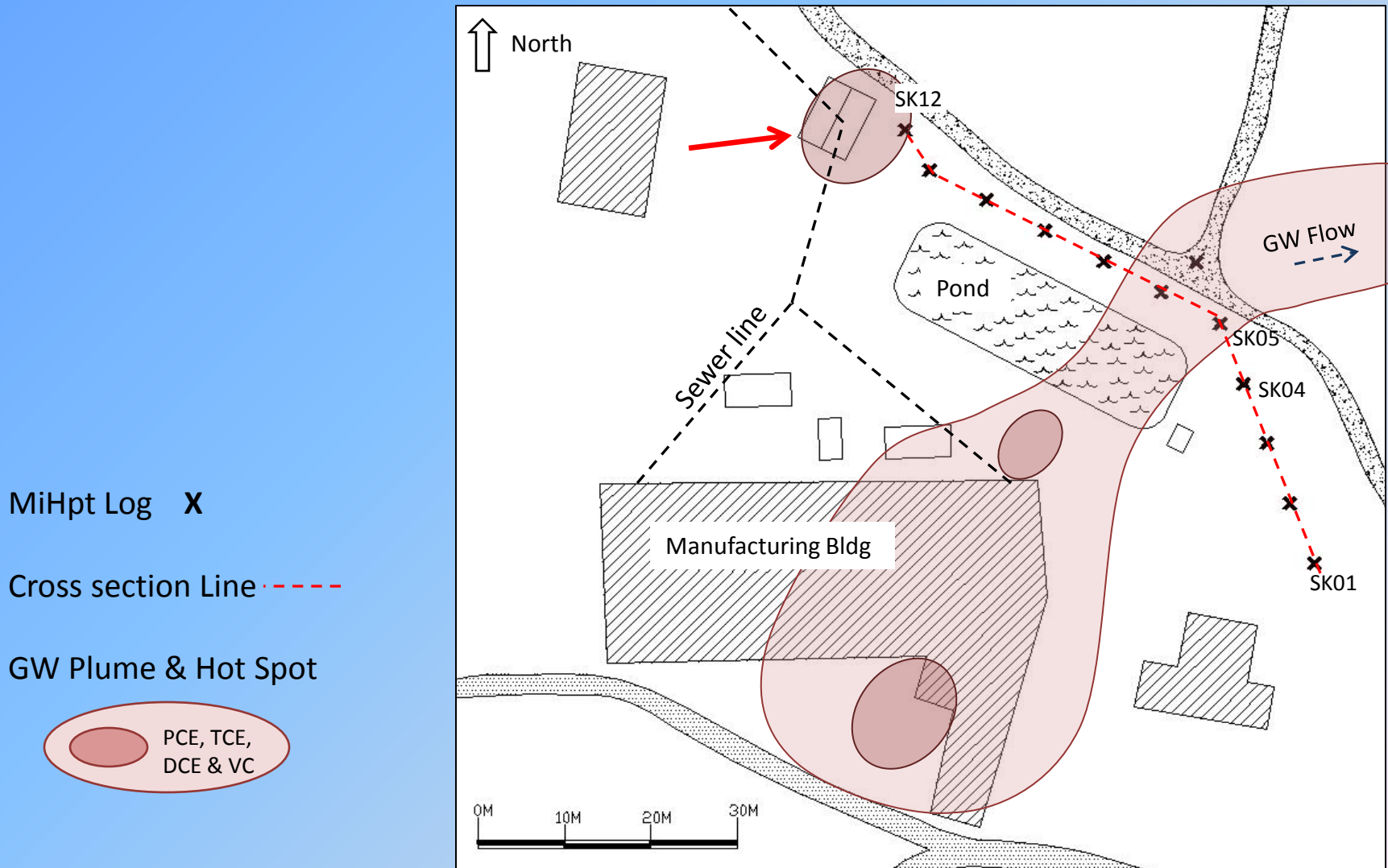


# Skuldelev Location & Site Map



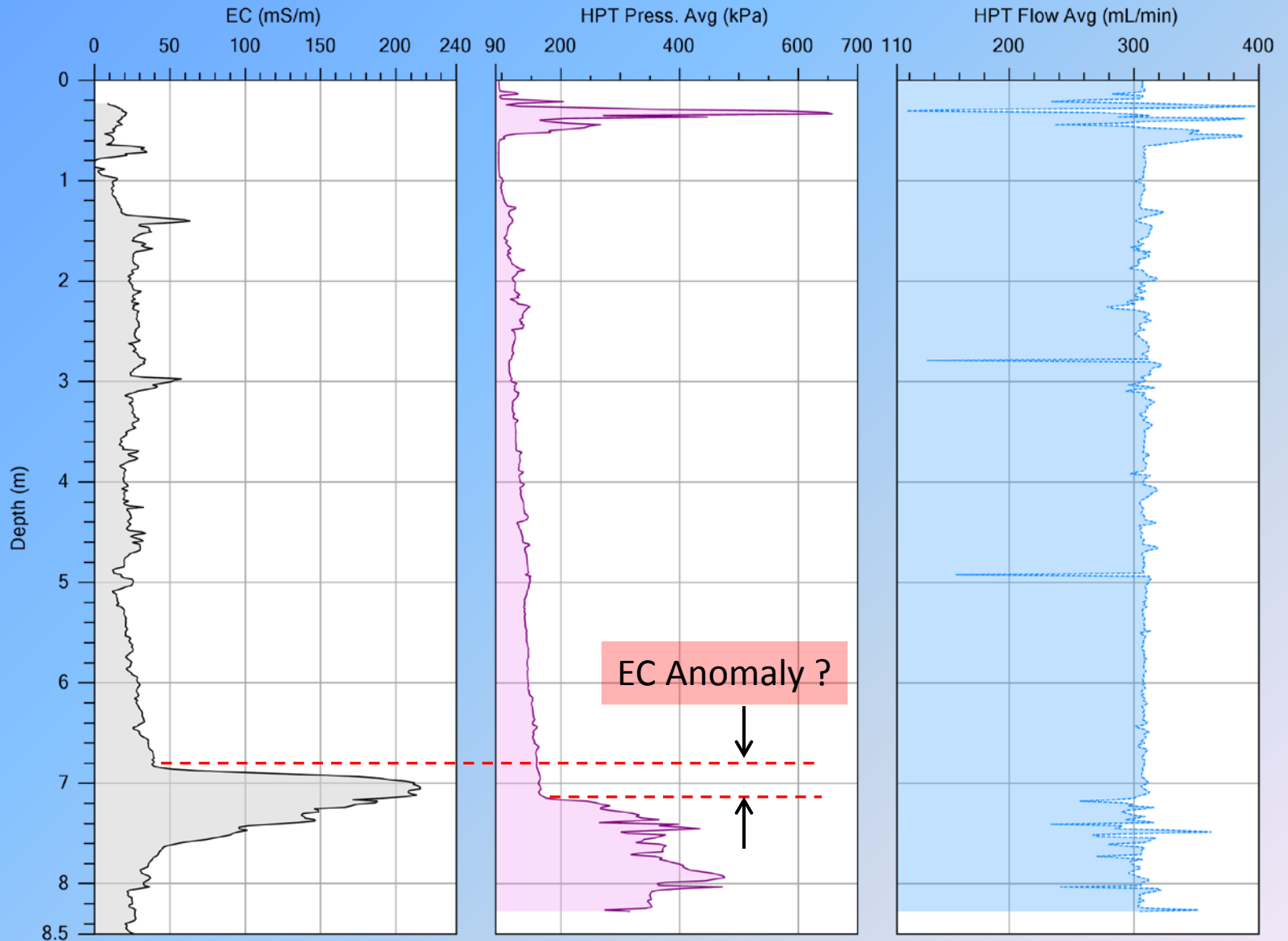
Logs are spaced 8 m (~25ft) apart.

# Skuldelev Location & Site Map



Logs are spaced 8 m (~25ft) apart.

# Example HPT Log: Skuldelev SK05

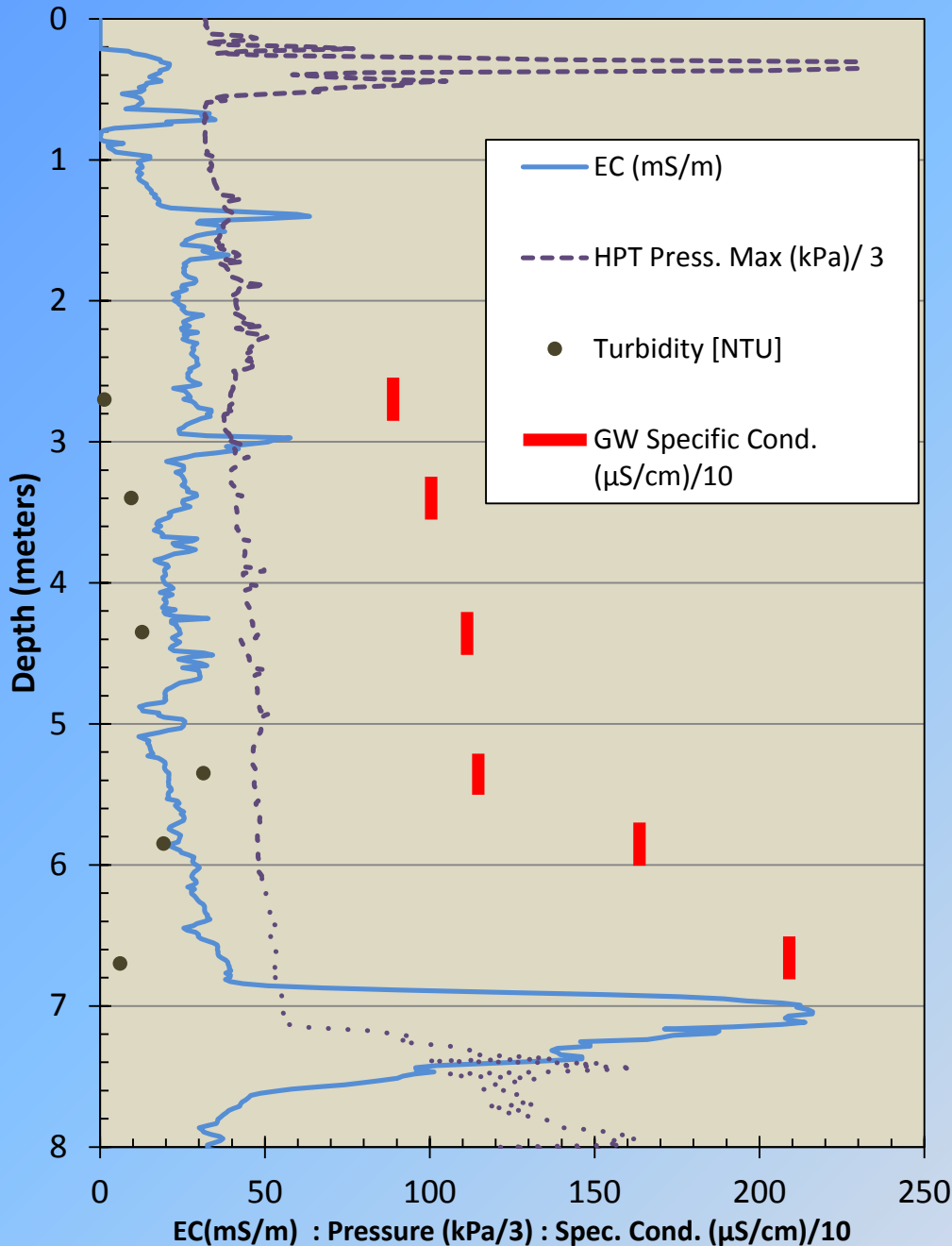




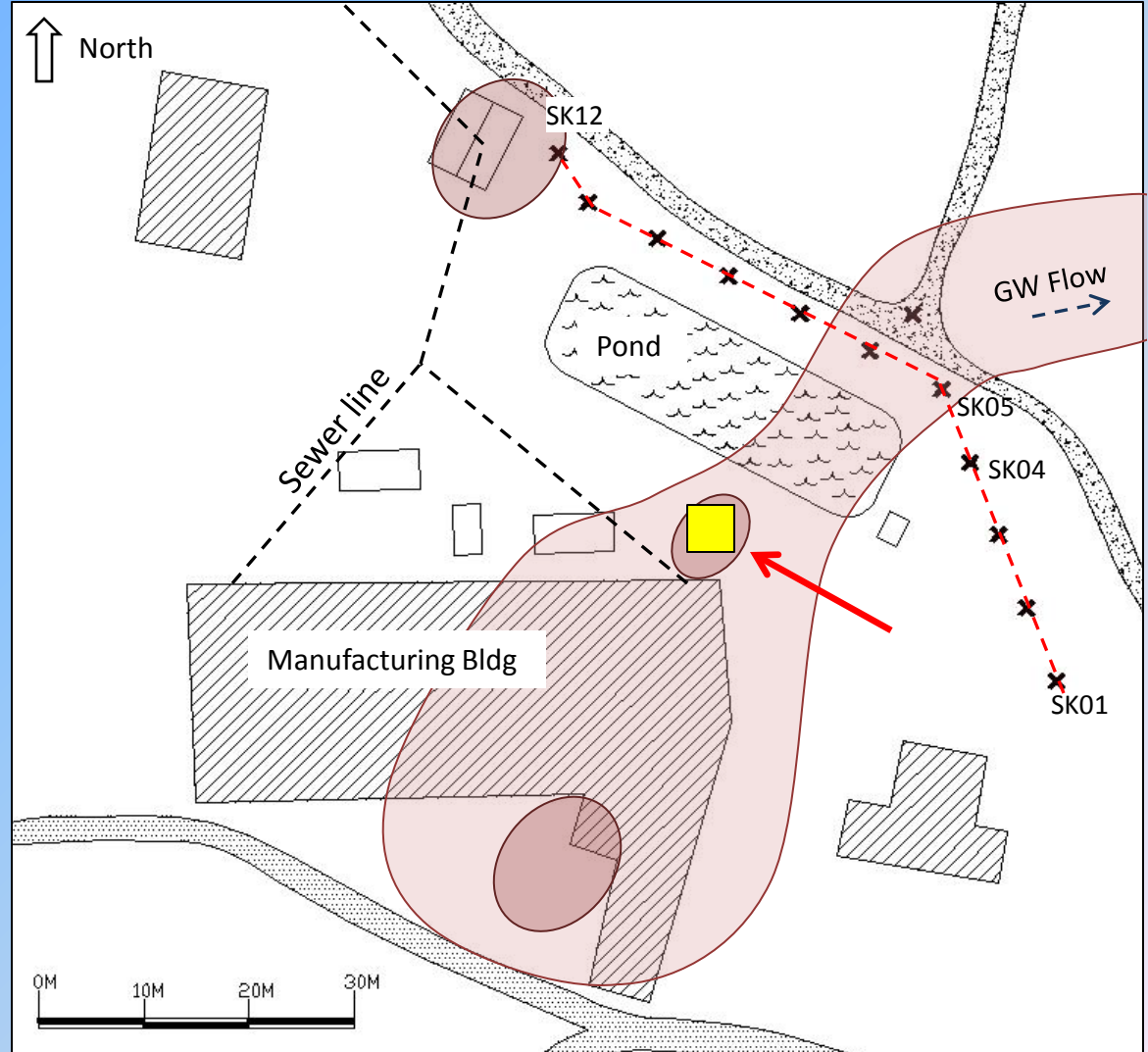
# SK05 Location

## EC & HPT Pressure

## Groundwater specific conductance



# Skuldelev Location & Site Map



MiHpt Log X

Cross section Line - - - -

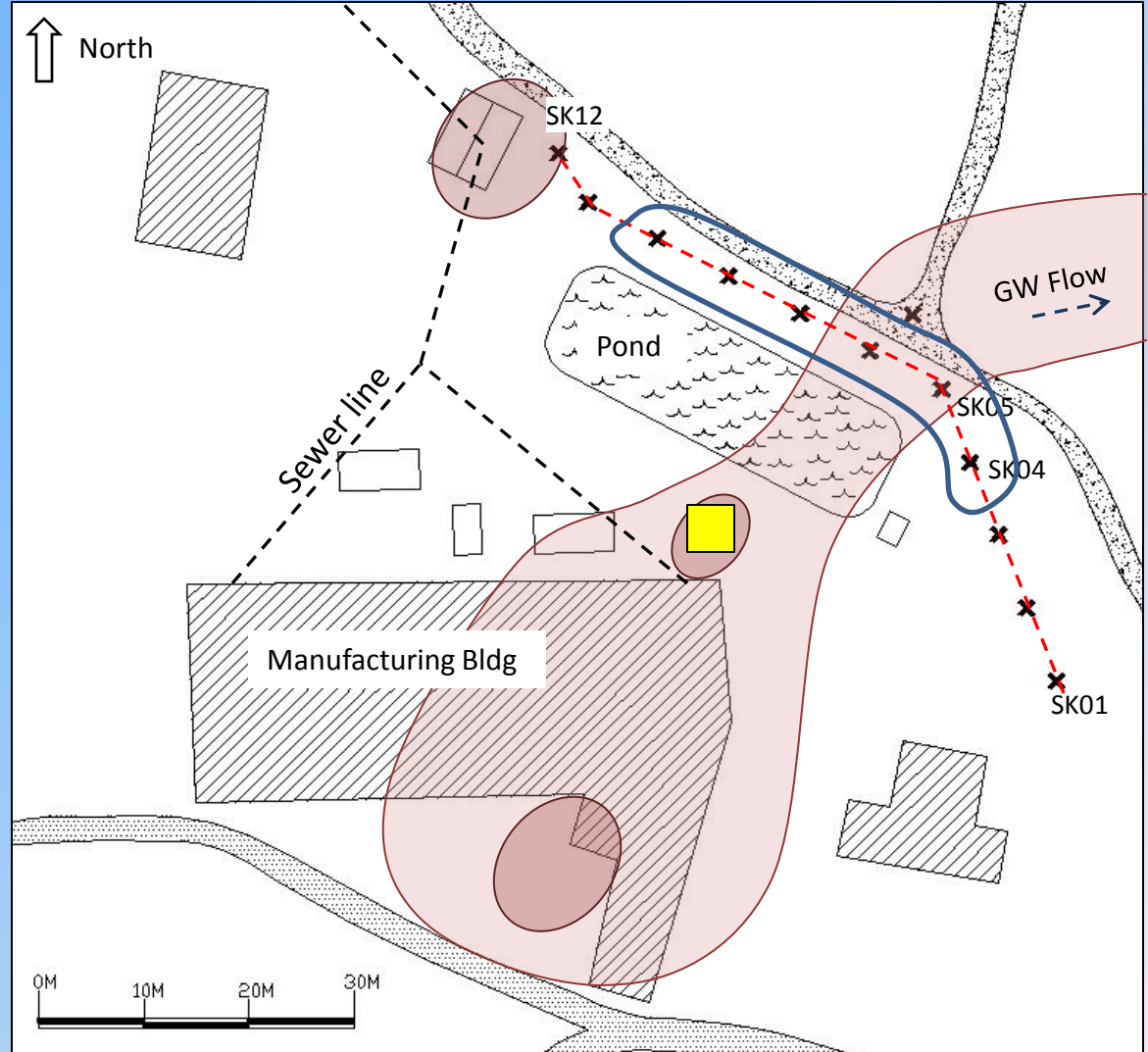
GW Plume & Hot Spot

PCE, TCE,  
DCE & VC

Persulfate Injection

Logs are spaced 8 m (~25ft) apart.

# Skuldelev Location & Site Map



MiHpt Log X

Cross section Line - - - -

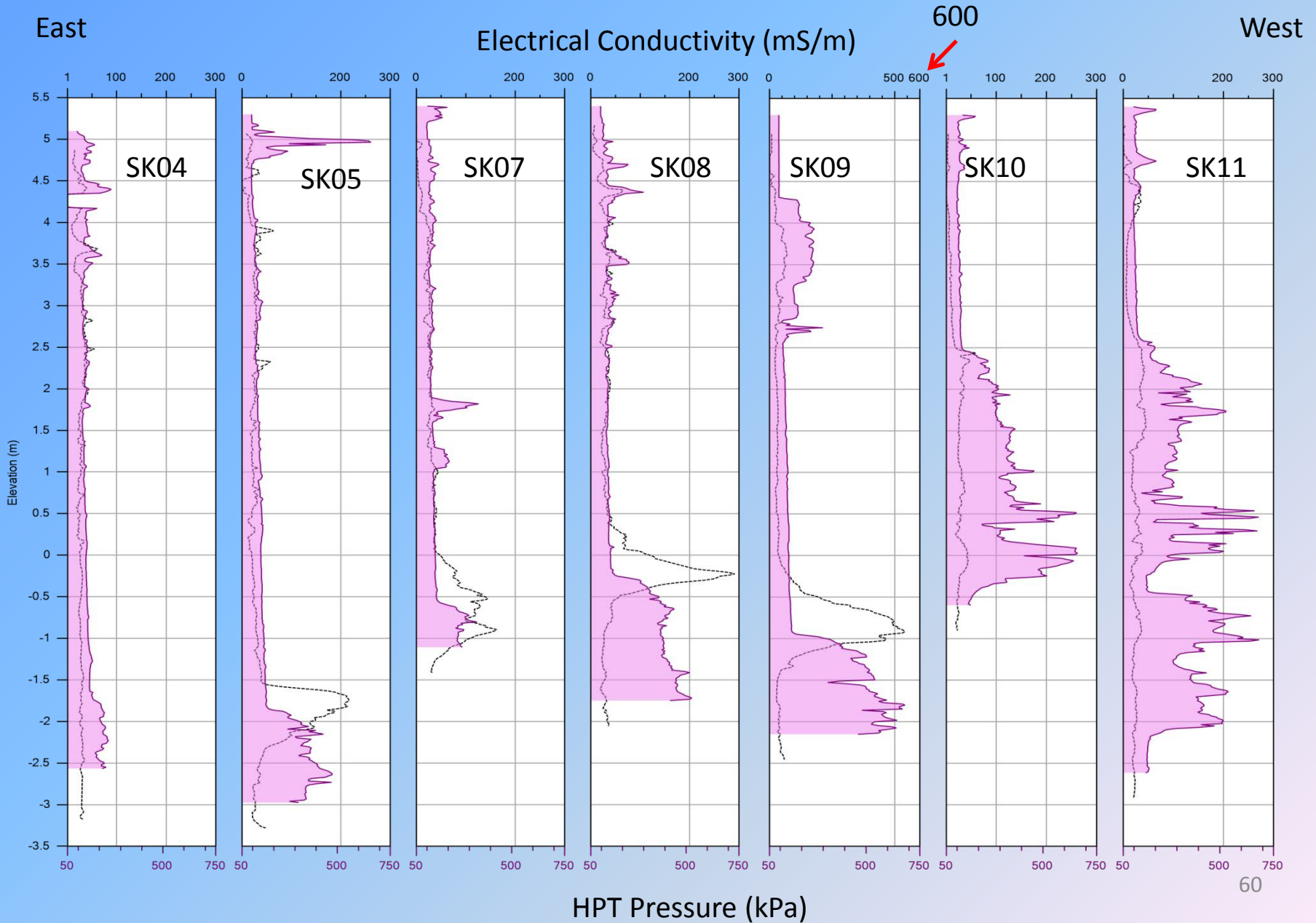
GW Plume & Hot Spot

PCE, TCE,  
DCE & VC

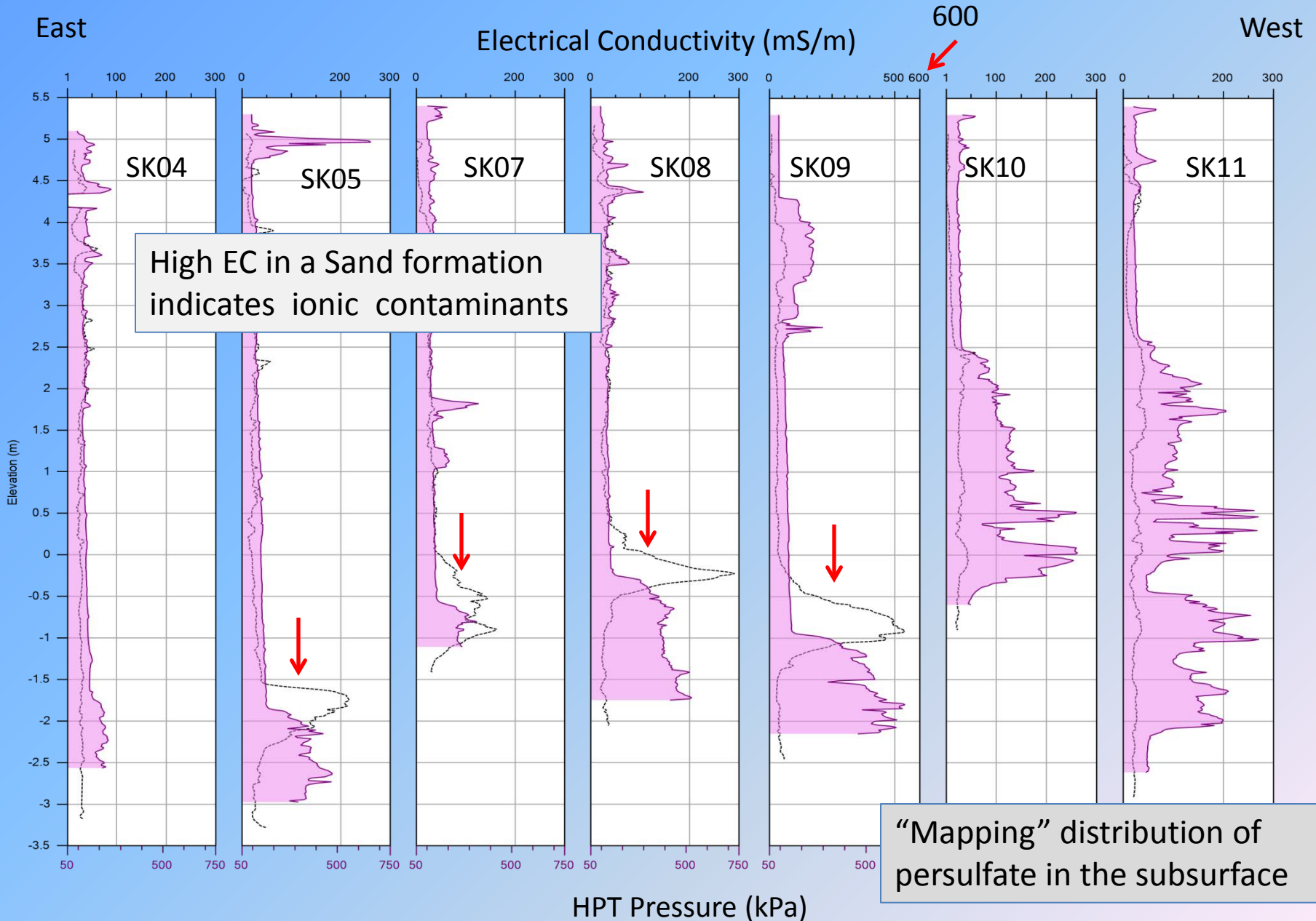
Persulfate Injection

Logs are spaced 8 m (~25ft) apart.

# Cross Section with HPT Pressure & EC



# Cross Section with HPT Pressure & EC



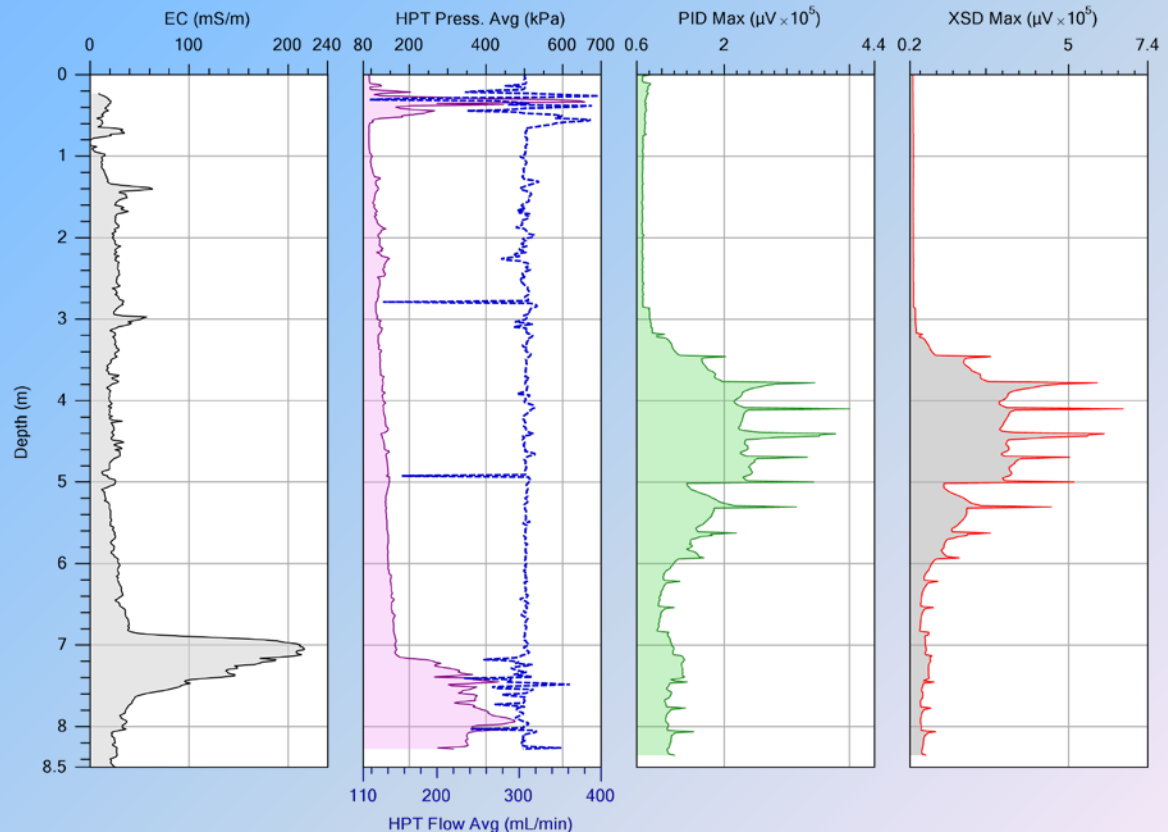
# MiHpt Summary

**Combined MIP + HPT Probe Simultaneously Provides:**

MIP Detector Logs (where is it ? how much?)

HPT Pressure Log (lithology, hydrostartigraphy)

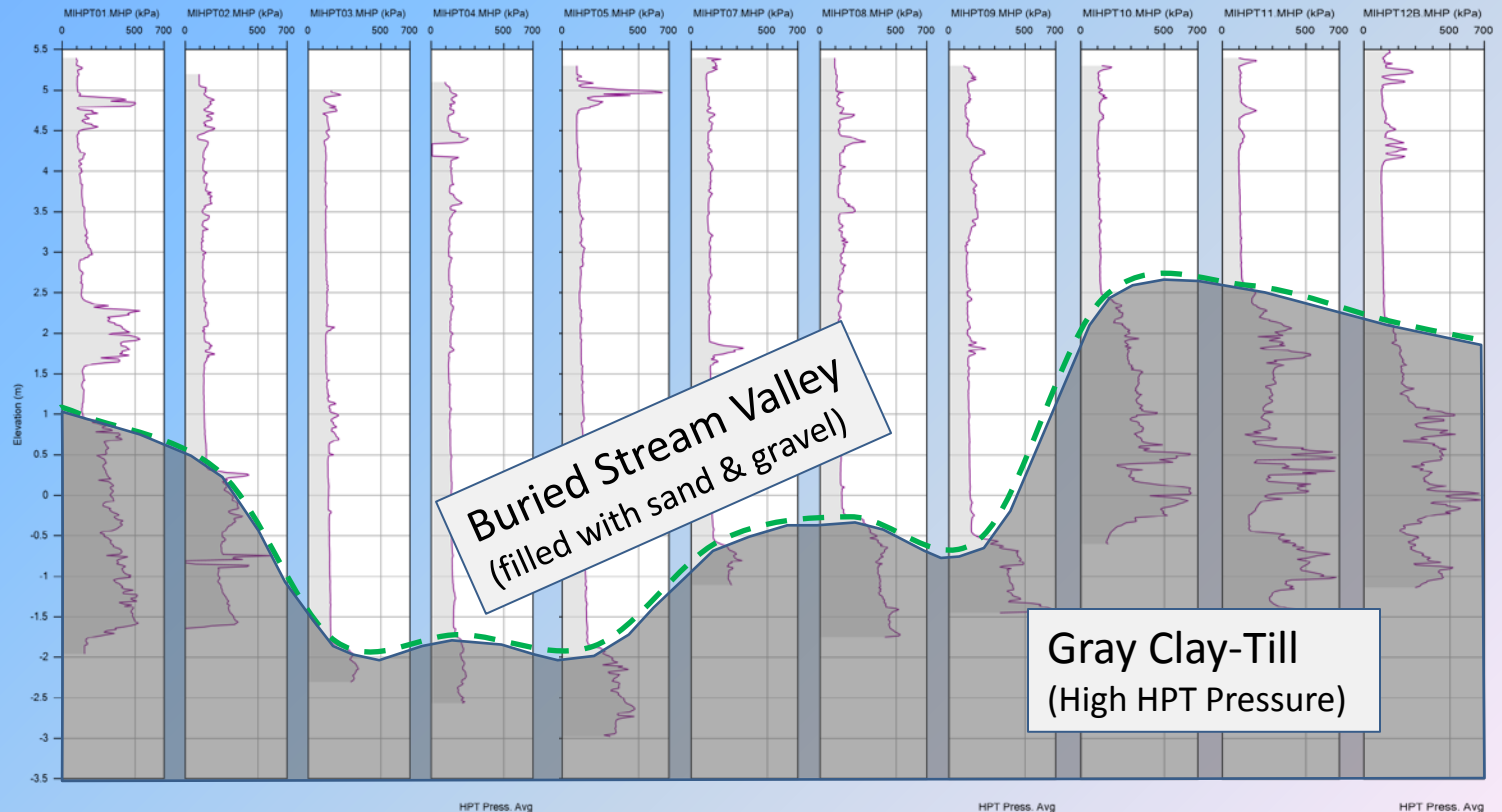
EC log



# MiHpt Summary

## Cross Sections with HPT Pressure Logs Provide:

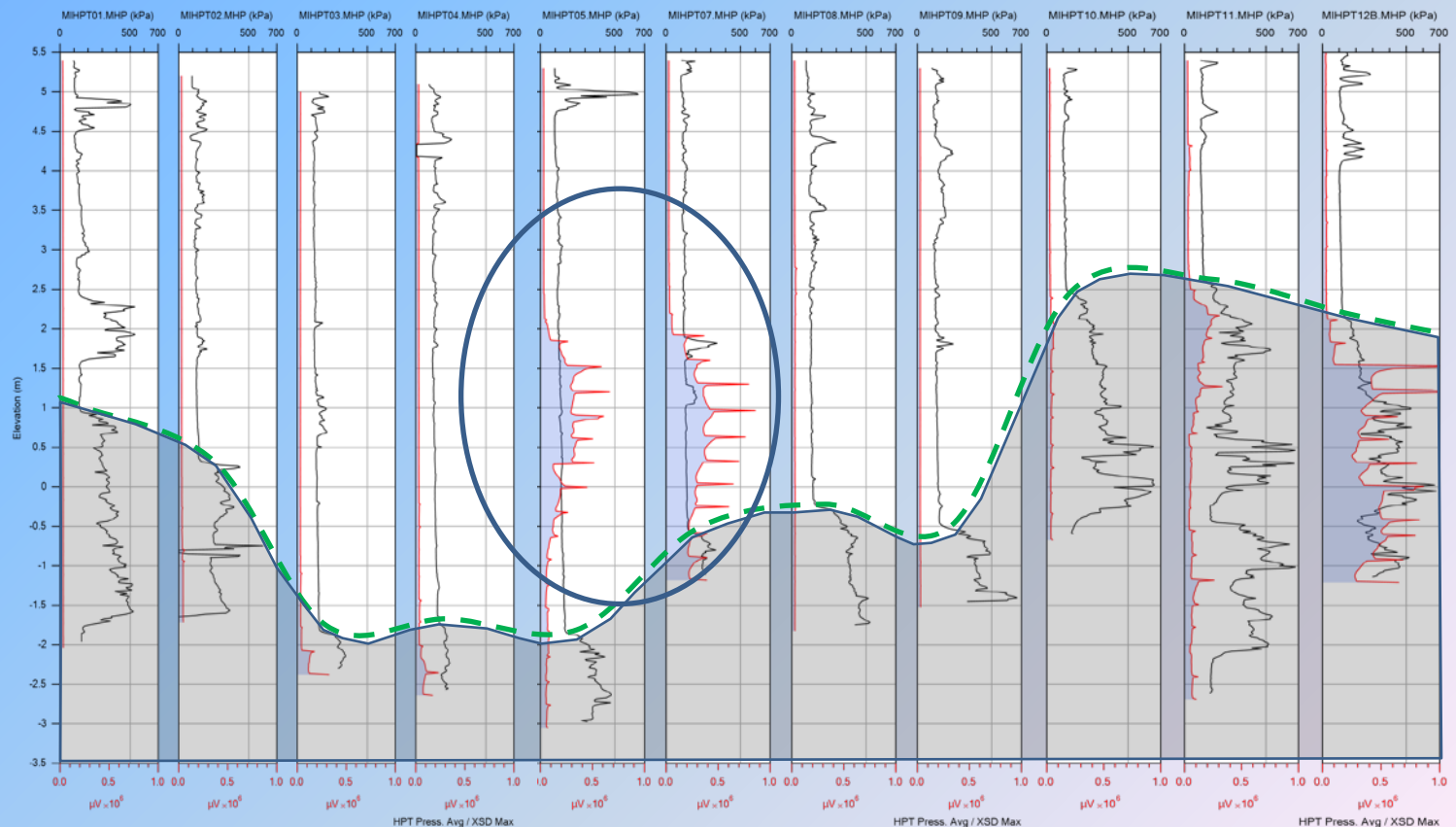
- Lithologic information
- Hydrogeologic model for the site
- Geologic cross sections



# MiHpt Summary

## Cross Sections with MIP Detector Logs and HPT P Logs:

- Lithologic control on contaminant migration (migration pathways)
- Conceptual site model development



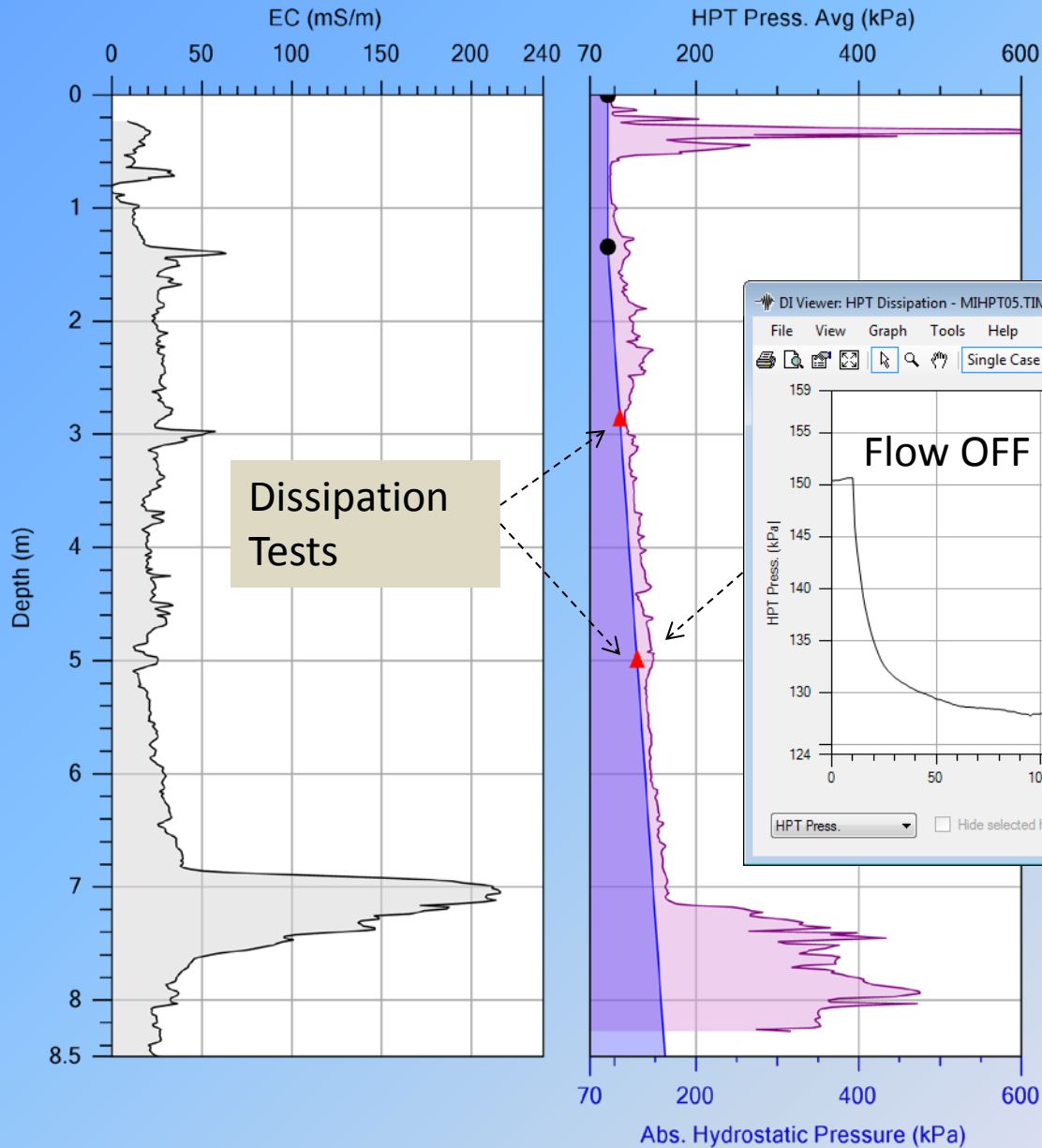


# MiHpt ... Q&A

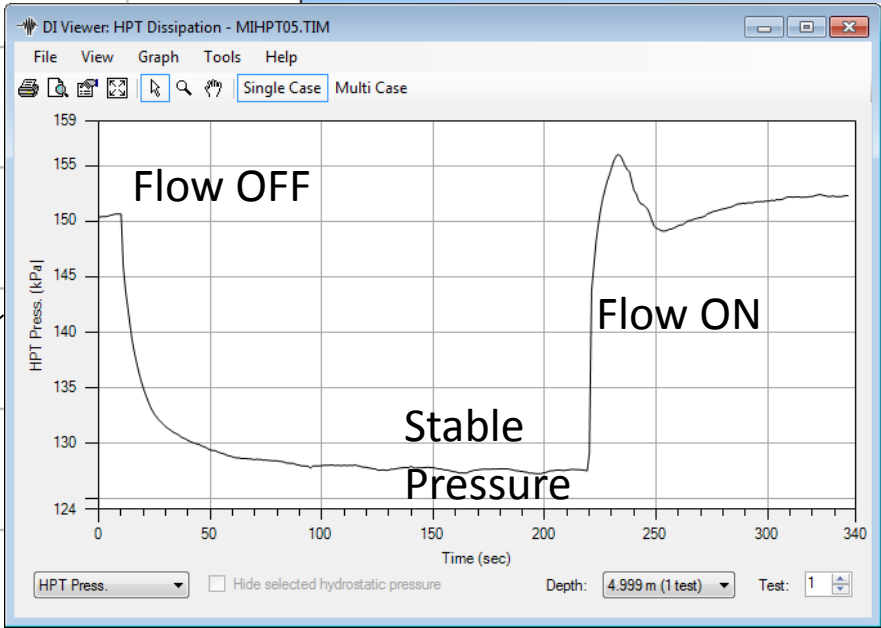


# Estimating Hydraulic Conductivity (K) from HPT Pressure and Flow Logs

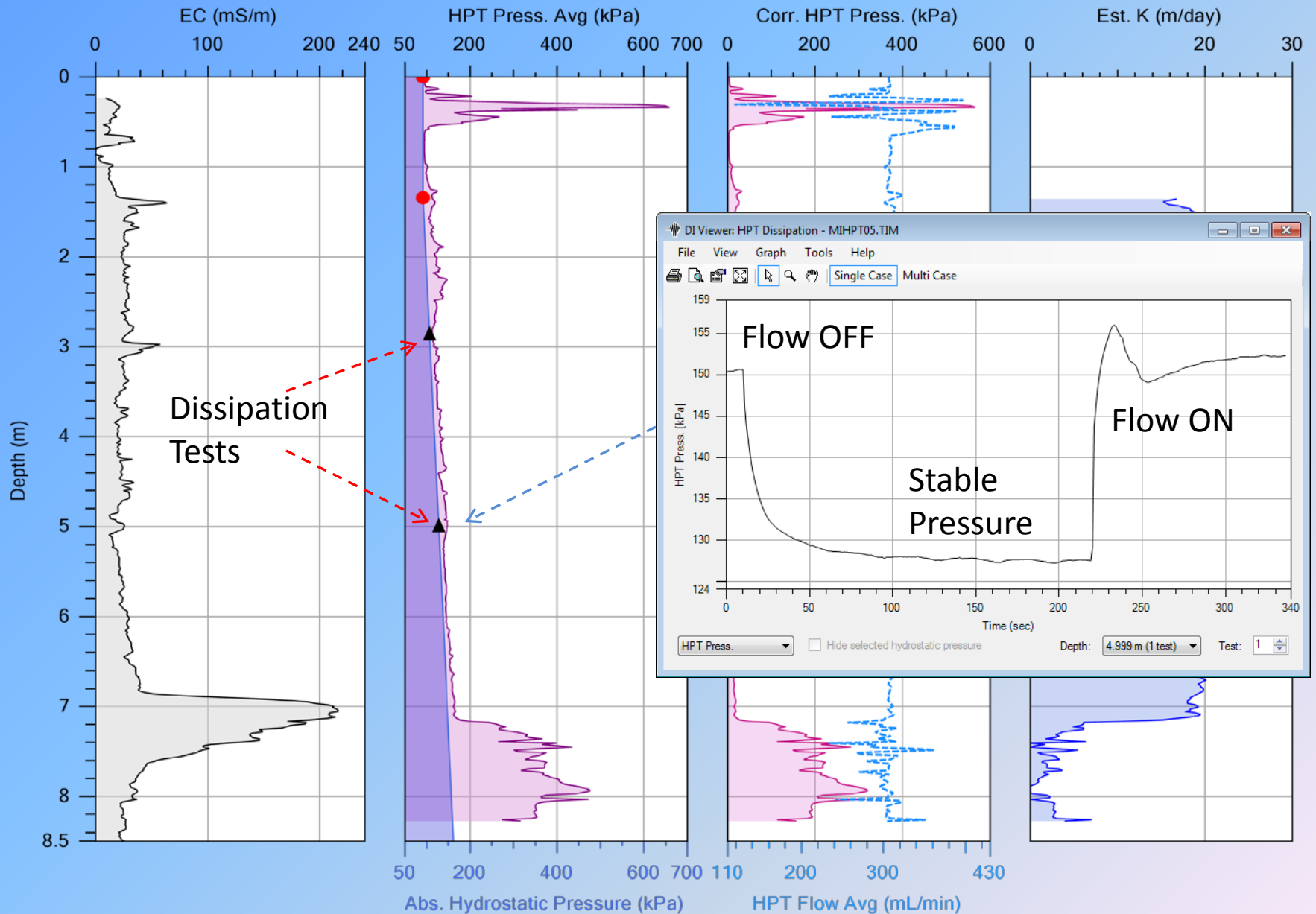
# HPT Dissipation Test



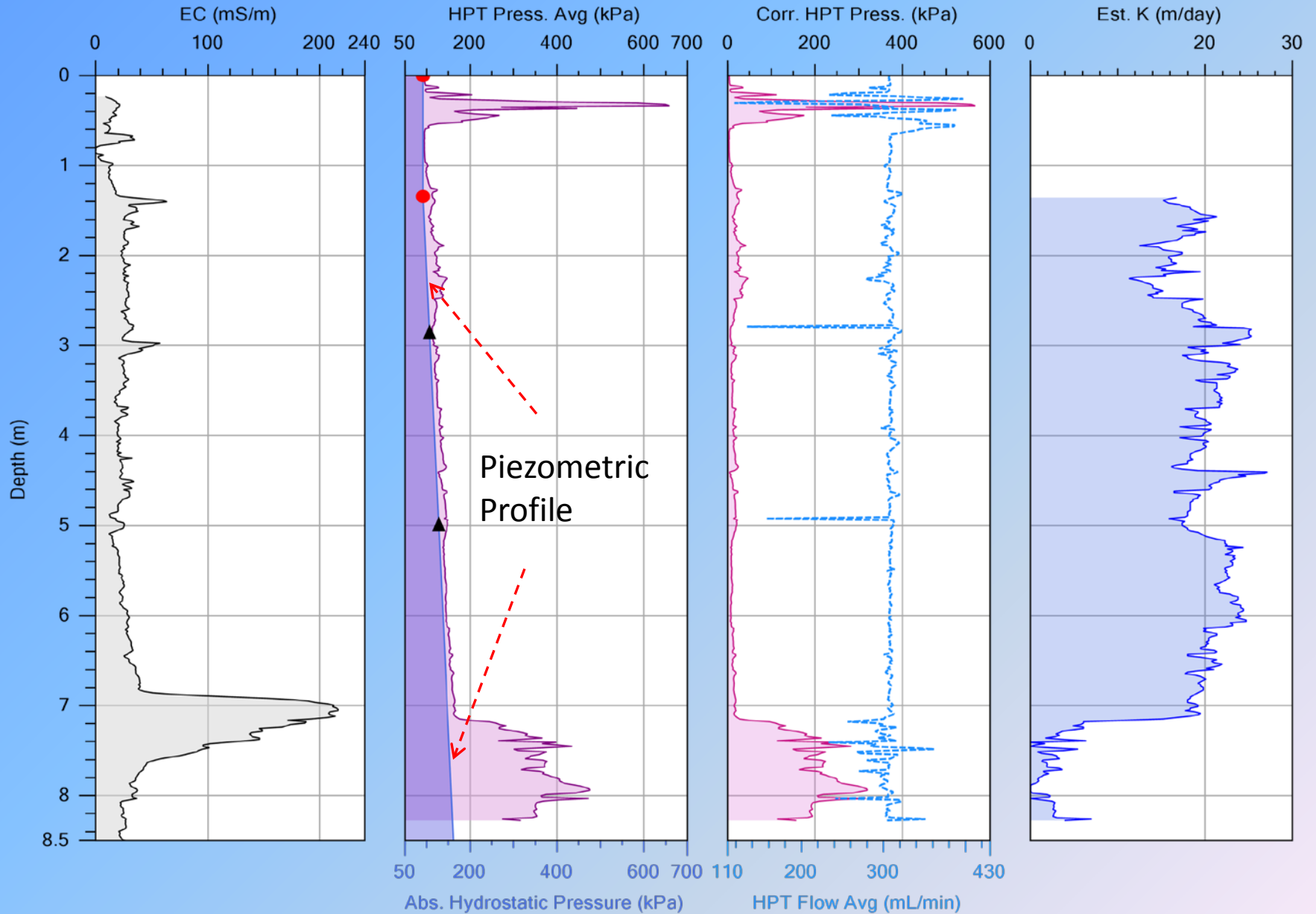
Dissipation Tests



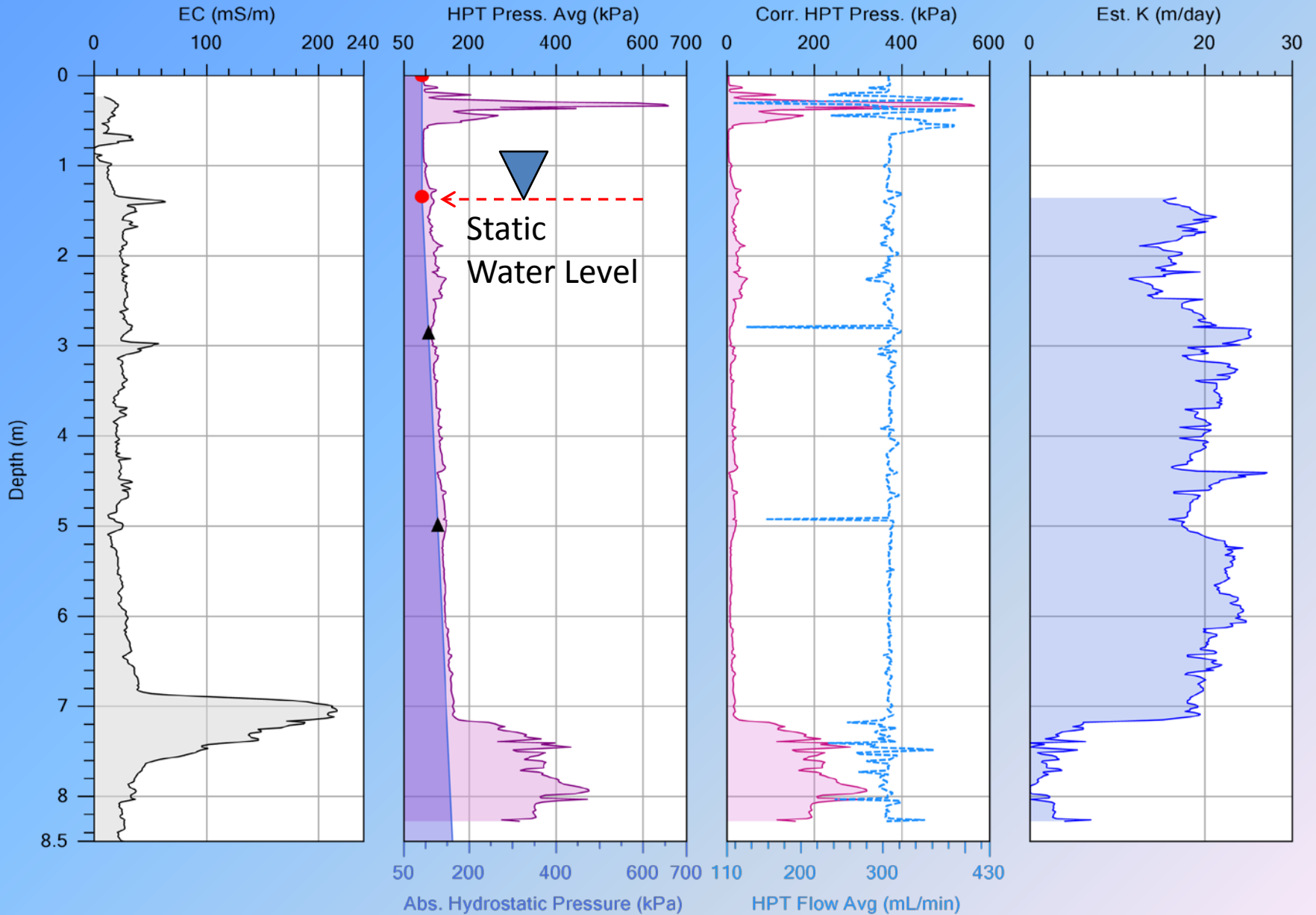
# HPT and Hydrostatic > Corrected Pressure > Est K



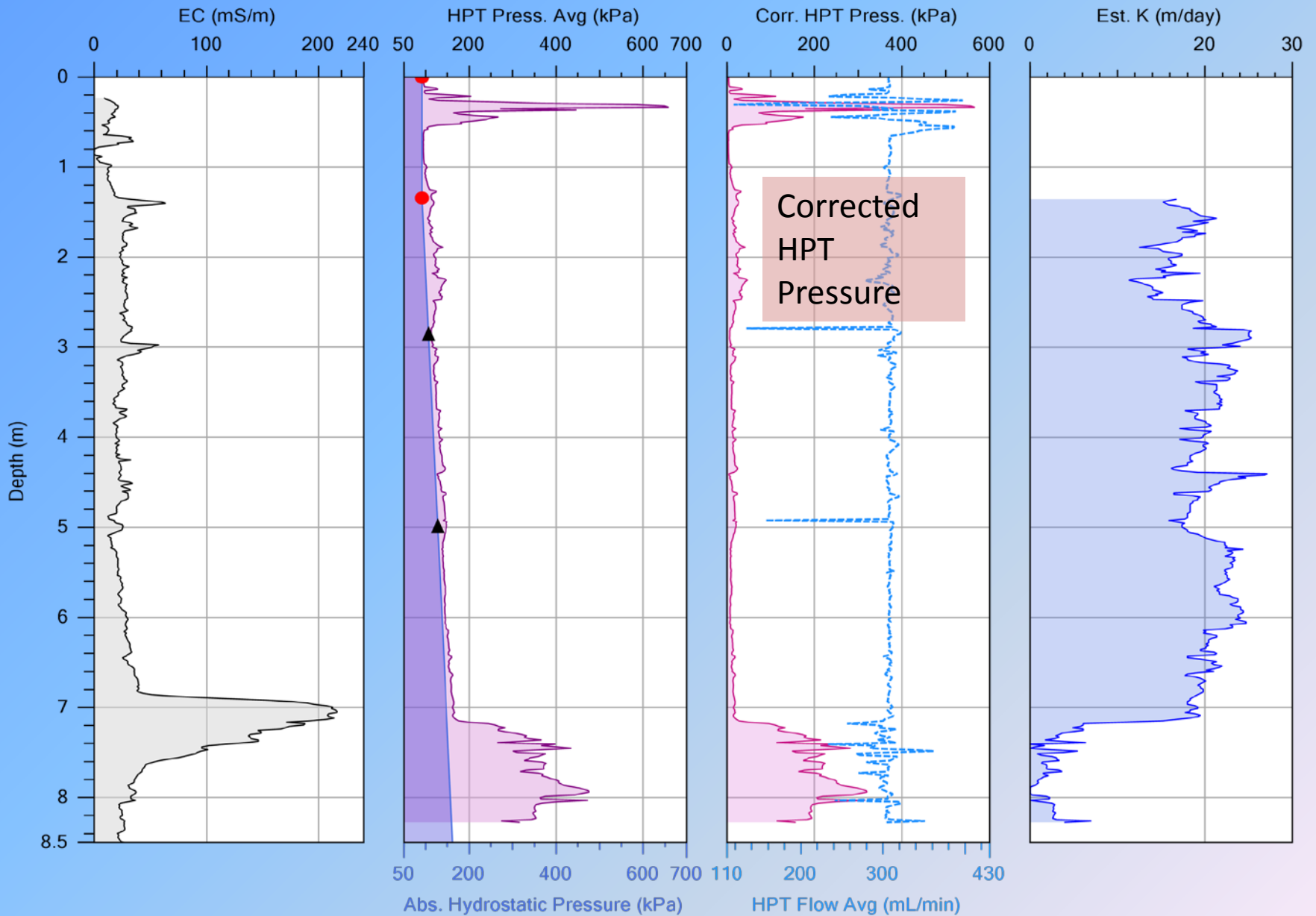
# HPT and Hydrostatic > Corrected Pressure > Est K



# HPT and Piezometric $P >$ Corrected $P >$ Est K



# HPT and Piezometric $P >$ Corrected $P >$ Est K



# HPT and Piezometric $P >$ Corrected $P >$ Est K

