# Ultraviolet Induced Florescence Cone Penetration Testing for PHC Characterization

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### Acknowledgements

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## OUTLINE

 Technology Description Case History #1: Flare Pit in Clay and Till Wide variety of petroleum hydrocarbons (PHCs) Significant aromatic fraction (BTEX and PAHs) Case History #2: Condensates in Silty Sand A Narrow range of PHCs ( $\sim C_4$  to  $C_9$ ) Very low BTEX component, no PAHs

## **UVIF-CPT** Probe



## **Soil Behavior Type Chart**

**Non-Normalized Classification Chart** Cone Resistance (bar) q<sub>t</sub> Friction Ratio (%), R<sub>f</sub>

Zone	q <sub>t</sub> / N	Soil Behavior Type
1 2 3 4 5 6 7 8 9 10 11 12	2 1 1.5 2 2.5 3 4 5 6 1 2	sensitive fine grained organic material clay silty clay to clay clayey silt to silty clay sandy silt to clayey silt silty sand to sandy silt sand to silty sand gravelly sand to sand very stiff fine grained * sand to clayey sand *

\* overconsolidated or cemented

## **UVIF Response**

- Aromatic hydrocarbons mixed with soil and groundwater fluoresce when irradiated by ultra violet light.
  - cannot detect dissolved contaminants
- UVIF intensity (in volts) can indicate lateral and vertical extent of contamination
- More elaborate systems can analyze the signal spectrometrically to determine contaminant type



### **Data Presentation**

#### Site: Operating Wood Preserving Facility, Washington



### Deployment

Can be pushed by a 20T Cone truck
\* wheeled or tracked

Can be pushed on the back of a drill rig
Cone system may be in
<u>dedicated 3/4T ConeTec truck</u>
rented SUV

#### **Data Presentation**

 During push a computer screen with all plots may be viewed

#### UVIF output is shown continually on LED

Data is recorded to file every 2.5 cm

### **Case Histories**

Characterised 4 sites in past 2 years:
Two flare pits in Swan Hills area AB

Battery site SE of Edmonton

Condensate spill SE AB

### **Flare Pit Case History**





## SAMPLE DATA SET (CPT 3)





## **UVIF Response in Condensate**



## **SARA Analysis for Aromatics**

Saturates

straight, branched and cyclic alkanes and alkenes

#### Aromatics

mono and polycyclic aromatic hydrocarbons lacking heteroatoms

#### Resins

Polar 1

Low MW amorphous polymers of various PHCs
Polar 2

-N, and -S substituted heterocyclic aromatics

#### Asphaltenes

Complex highly condensed, high MW PHCs

## **SARA Analysis Consequence**

- UVIF may be generated by Aromatic, Polar 2 and part of Asphaltene fraction
  - SARA analysis of former flare pit soil gave:
    - Saturates55%Aromatics17%Polar 19%Polar 29%Asphaltenes<10%.</td>

Regulated aromatic compounds << 1%</p>

 UVIF approach may provide additional insight for hydrocarbon impact delineation.

## SUMMARY

- UVIF can be a useful tool to delineate PHC contamination
  - very useful for flare pits, diesel spills, creosote
  - not very useful for natural gas condensates
  - may assist in locating samples for lab analysis
- CPT provides significant insight into stratigraphy
- Together, insight into contaminant migration may be developed



## **Tracked Rig and 3/4T ConTec Truck**

