Collecting Soils for Site Characterization

Daniel Voisin, Senior Geologist
NEWMOA

Agenda

Problem Statement – Accounting for Soil Heterogeneity

Assessing Vertical Variability
- Direct Push
- Analyte Considerations
- Quality Control

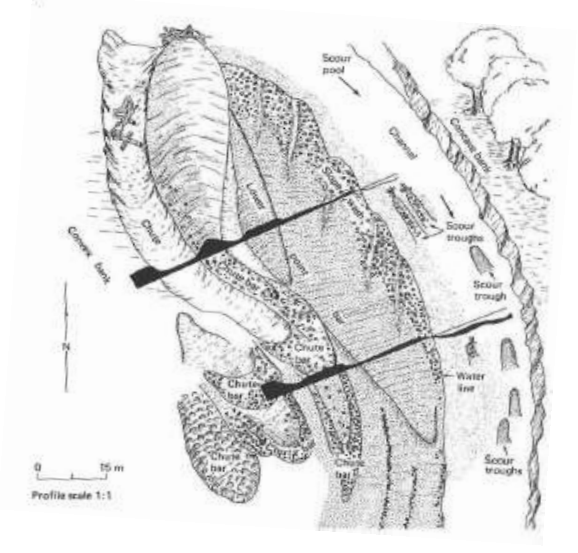
Surface Soil Sampling
- Compositing –vs- ISM
- Establishing Decision Units
- Lessons Learned

Soil Variability

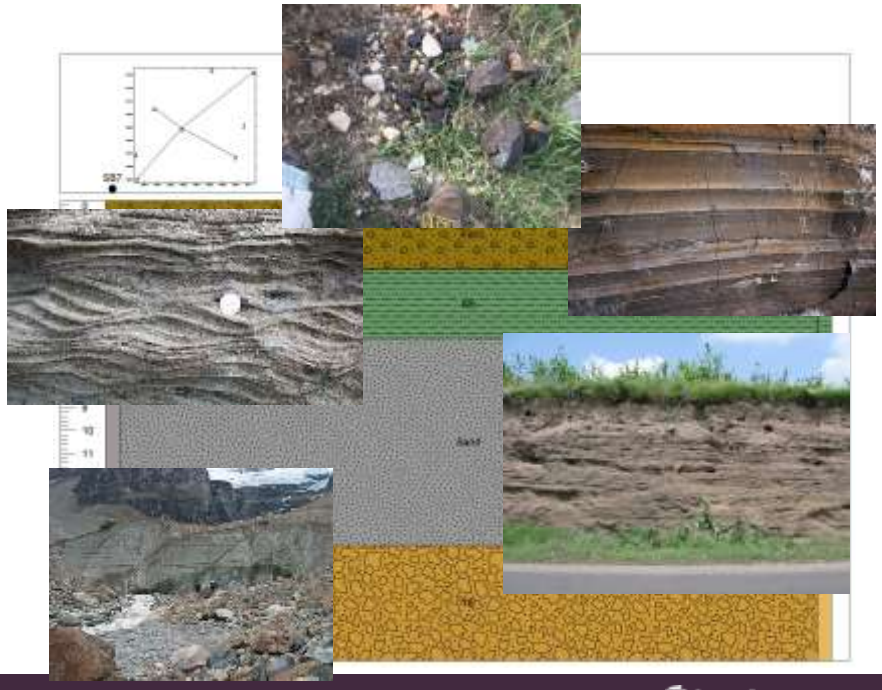
"Sedimentary environments that started out side-by-side will end up overlapping one another over time due to transgressions and regressions. The result is a vertical sequence of beds. The vertical sequence of facies mirrors the original lateral distribution of sedimentary environments."

Johannes Walther, 1894

Soil Variability



Point bar showing sediment bodies and related features. (Davis, 1992).



Soil Variability – Case Study

Soil Variability – Case Study

Vertical Variability

Direct Push Technologies
- Soil Coring
  - Macro Core
  - Closed Piston
  - Dual Tube

Direct Sensing
- Electrical Conductivity
- Hydraulic Conductivity Profiling
- Cone Penetrometer

Traditional Soil Sampling
- Split Spoon
- Thin Wall Sampling (Shelby)

Soil Coring – A Closer Look

Soil Coring

- Macro Core
  - Fast, widely available,
  - Low volume of IDW
  - Leaves an open bore hole
  - Does not work below water table
- Closed Piston
  - Discrete Intervals
  - Removes all tooling from the ground for each run
  - Minimizes cross contamination / slough
- Dual Tube
  - Leaves casing in ground for each drive, retracting core barrel through a center rod.
  - Slow
  - Capable of collecting a high volume of soil
  - Allows for construction of monitoring wells

Considerations

Volatile Organic Compounds

- Throttle back on productivity to prevent lack of quality
- Prevent loss of mass

Quality Control

- Decontamination Procedures
- Field Duplicates - BMPs

Budget versus Data

- Pair soil coring and lab analyses with direct sensing tools (MIP/UVOST) to gain better understanding of the site.
- Select an appropriate tool and sampling approach to match site conditions.

Surface Soil Assessment

How many samples are enough?

Problems with compositing

- Marginally increases spatial representation, but decreases sensitivity
- Largely out of favor with regulators.

Is compositing ever OK?

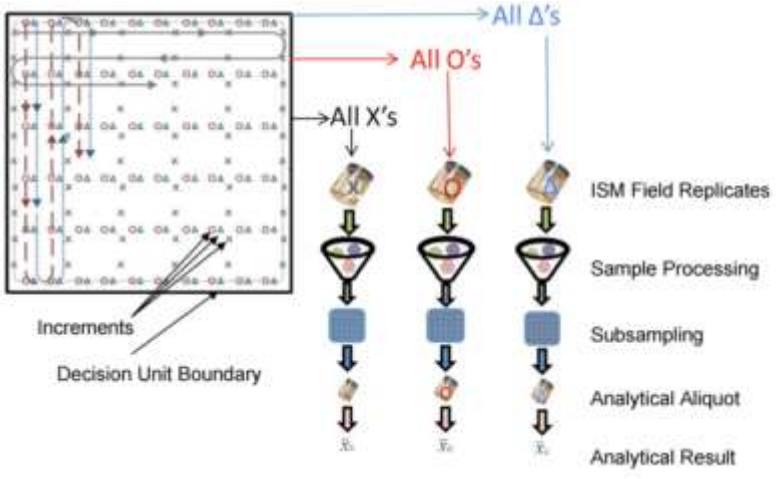
Incremental Sampling Methodology (ISM)

- Structured compositing methodology that addresses the inherent heterogeneity in soil
- Systematic Planning to mesh Objectives, CSM, and Method are imperative.

Cubbon, 2011

Incremental Sampling Methodology

Terminology



Incremental Sampling Methodology

Establishing Decision Units

ISM – Case Study

36-50 Lakeside Ave

- 16.5 acre Urban Site
- Manufacturing Facility until 2017
- Adjacent to:
  - Pine St. Canal Superfund
  - Former Defense Contractor
  - Public Bike Path
  - Rail Road

Planned Use:

- Business Incubator
- Commercial Offices
- Light Manufacturing
- Recreational Space with Lake Access
- Revised Layout of Parking and upgrades to utilities.

Scope of Work

Prior Work Indicated:

- PAHs in surface soil > RSL for industrial sites and > VT Urban Background
- CVOCs in soil gas > Residential, but < Industrial VISV
- PCBs in glazing of a few windows >TSCA walkaway.
- Groundwater Quality OK!

Scope:

- Targeted soil borings for proposed utility excavations
- Building Materials Assessment and further VI Assessment
- ISM of proposed parking lot.

15 STONE ENVIRONMENTAL

Analyte	EPA Res. RSL (mg/Kg)	EPA Ind. RSL (mg/Kg)	DU1-A	DU1-B	DU1-C
Benzo(a)anthracene	0.16	2.90	**0.20**		
Benzo(a)pyrene	0.16	2.90	**0.22**		
Benzo(b)fluoranthene	0.16	2.9	**0.27**		
Benzo(k)fluoranthene	1.6	29	**0.087**		
Chrysene	16	290	**0.23**		
Dibenz(a,h)anthracene	0.016	0.29	**0.064**		
Indeno(1,2,3-cd)pyrene	0.16	2.9	**0.20**		
B(a)P-TEQ	0.16	2.9	**0.35**		
B(a)P-TEQ 95% UCL	0.16	2.9			

Vermont SSV Residential: 0.076 mg/Kg;

Vermont SSV Industrial: 1.54 mg/Kg

Urban Background: 0.58 mg/Kg

16 STONE ENVIRONMENTAL

Analyte	EPA Res. RSL (mg/Kg)	EPA Ind. RSL (mg/Kg)	DU1-A	DU1-B	DU1-C
Benzo(a)anthracene	0.16	2.90	**0.20**	**0.17**	
Benzo(a)pyrene	0.16	2.90	**0.22**	**0.19**	
Benzo(b)fluoranthene	0.16	2.9	**0.27**	**0.24**	
Benzo(k)fluoranthene	1.6	29	**0.087**	**0.085**	
Chrysene	16	290	**0.23**	**0.19**	
Dibenz(a,h)anthracene	0.016	0.29	**0.064**	**0.026**	
Indeno(1,2,3-cd)pyrene	0.16	2.9	**0.20**	**0.17**	
B(a)P-TEQ	0.16	2.9	**0.35**	**0.28**	
B(a)P-TEQ 95% UCL	0.16	2.9			

Vermont SSV Residential: 0.076 mg/Kg;

Vermont SSV Industrial: 1.54 mg/Kg

Urban Background: 0.58 mg/Kg

17 STONE ENVIRONMENTAL

Analyte	EPA Res. RSL (mg/Kg)	EPA Ind. RSL (mg/Kg)	DU1-A	DU1-B	DU1-C
Benzo(a)anthracene	0.16	2.90	**0.20**	**0.17**	**2.3**
Benzo(a)pyrene	0.16	2.90	**0.22**	**0.19**	**2.2**
Benzo(b)fluoranthene	0.16	2.9	**0.27**	**0.24**	**2.7**
Benzo(k)fluoranthene	1.6	29	**0.087**	**0.085**	**1.0**
Chrysene	16	290	**0.23**	**0.19**	**2.2**
Dibenz(a,h)anthracene	0.016	0.29	**0.064**	**0.026**	**0.27**
Indeno(1,2,3-cd)pyrene	0.16	2.9	**0.20**	**0.17**	**1.6**
B(a)P-TEQ	0.16	2.9	**0.35**	**0.28**	**3.1**
B(a)P-TEQ 95% UCL	0.16	2.9			

Vermont SSV Residential: 0.076 mg/Kg;

Vermont SSV Industrial: 1.54 mg/Kg

Urban Background: 0.58 mg/Kg

18 STONE ENVIRONMENTAL

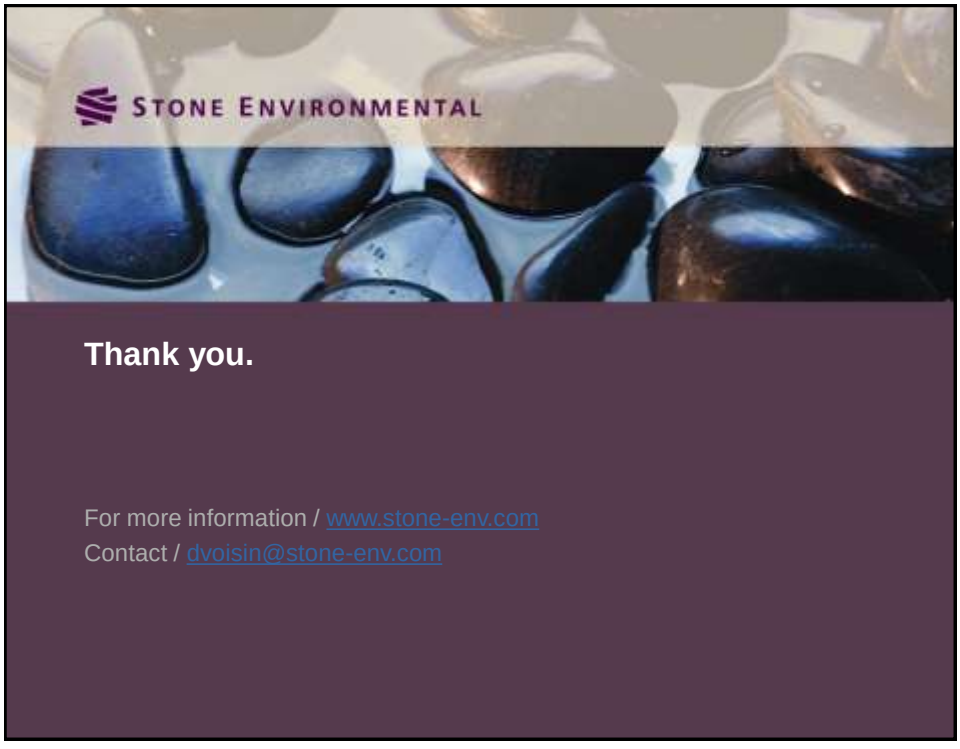
Analyte	EPA Res. RSL (mg/Kg)	EPA Ind. RSL (mg/Kg)	DU1-A	DU1-B	DU1-C
Benzo(a)anthracene	0.16	2.90	**0.20**	**0.17**	**2.3**
Benzo(a)pyrene	0.16	2.90	**0.22**	**0.19**	**2.2**
Benzo(b)fluoranthene	0.16	2.9	**0.27**	**0.24**	**2.7**
Benzo(k)fluoranthene	1.6	29	**0.087**	**0.085**	**1.0**
Chrysene	16	290	**0.23**	**0.19**	**2.2**
Dibenz(a,h)anthracene	0.016	0.29	**0.064**	**0.026**	**0.27**
Indeno(1,2,3-cd)pyrene	0.16	2.9	**0.20**	**0.17**	**1.6**
B(a)P-TEQ	0.16	2.9	**0.35**	**0.28**	**3.1**
B(a)P-TEQ 95% UCL	0.16	2.9		**5.4**	

Vermont SSV Residential: 0.076 mg/Kg;

Vermont SSV Industrial: 1.54 mg/Kg

Urban Background: 0.58 mg/Kg

Lessons Learned


STONE ENVIRONMENTAL
Thank you.
For more information / www.stone-env.com
Contact / dvoisin@stone-env.com