



Scale Appropriate Groundwater Sampling



EPA

United States
Environmental Protection
Agency

Thanks to:

Steve Dymant, U.S. EPA ORD

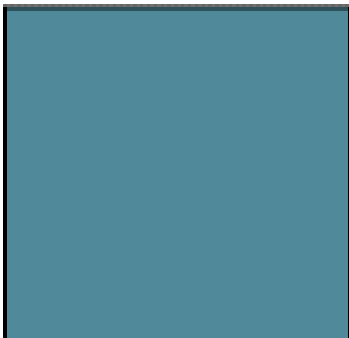
Seth Pitkin, Stone Environmental

Module Overview

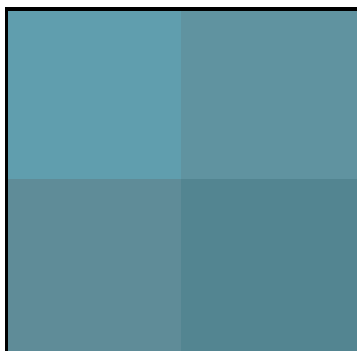
- ◆ **Sampling scale and data averaging**
- ◆ **Sampling coverage**
- ◆ **Depth integrated, flow weighted averaging**
- ◆ **Sampling methodology**
- ◆ **Relationship between hydraulic conductivity and contaminant concentrations**

High Resolution: Sampling Scale and Averaging

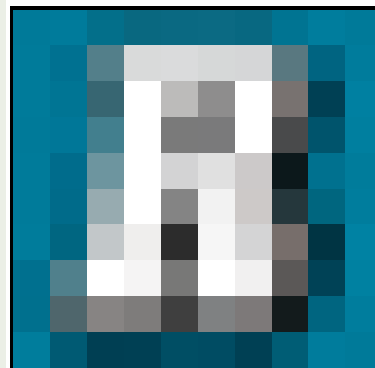
1 x 1



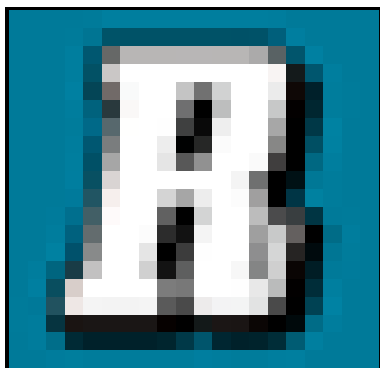
2 x 2



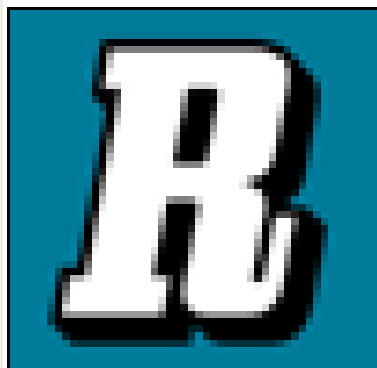
10 x 10



20 x 20



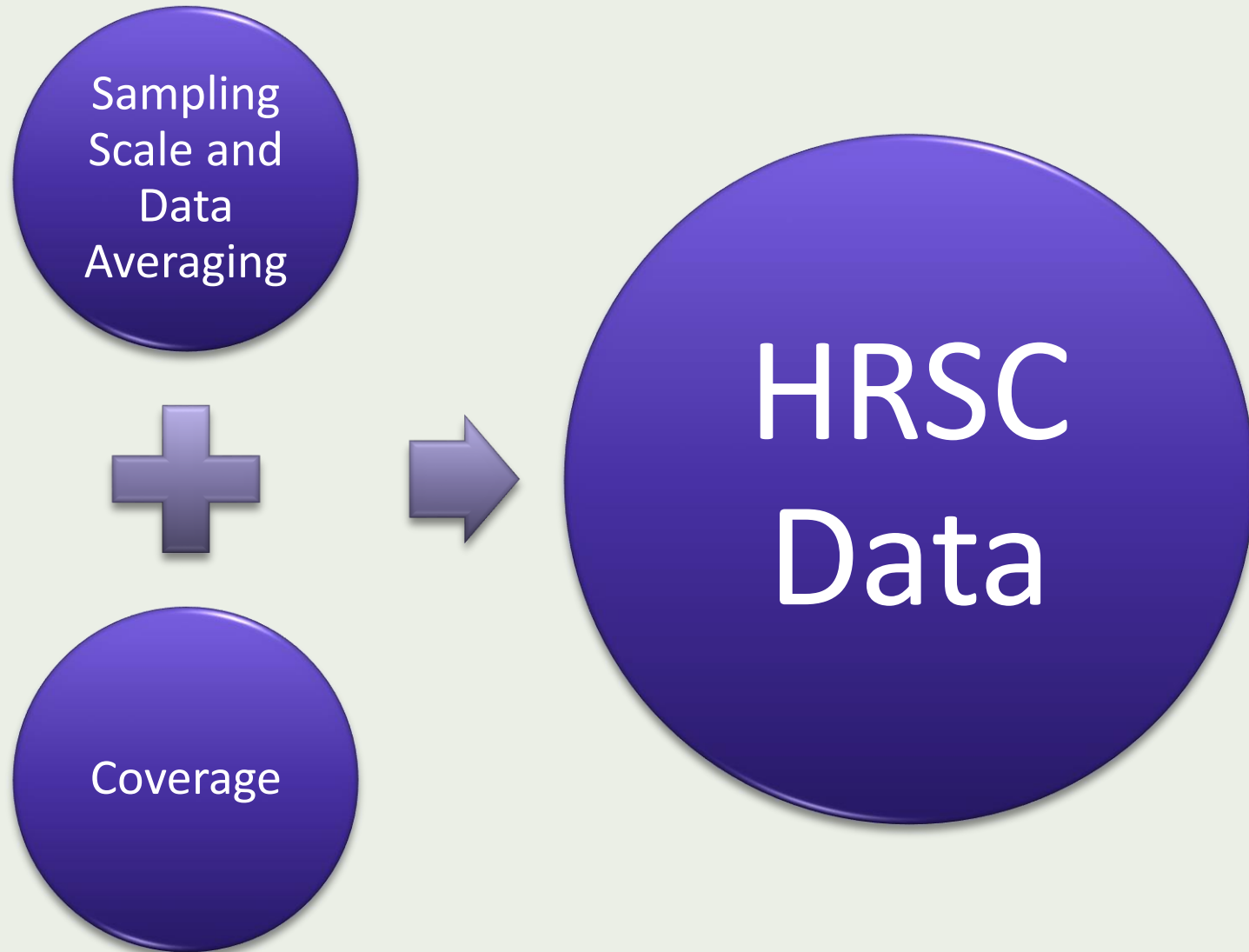
50 x 50



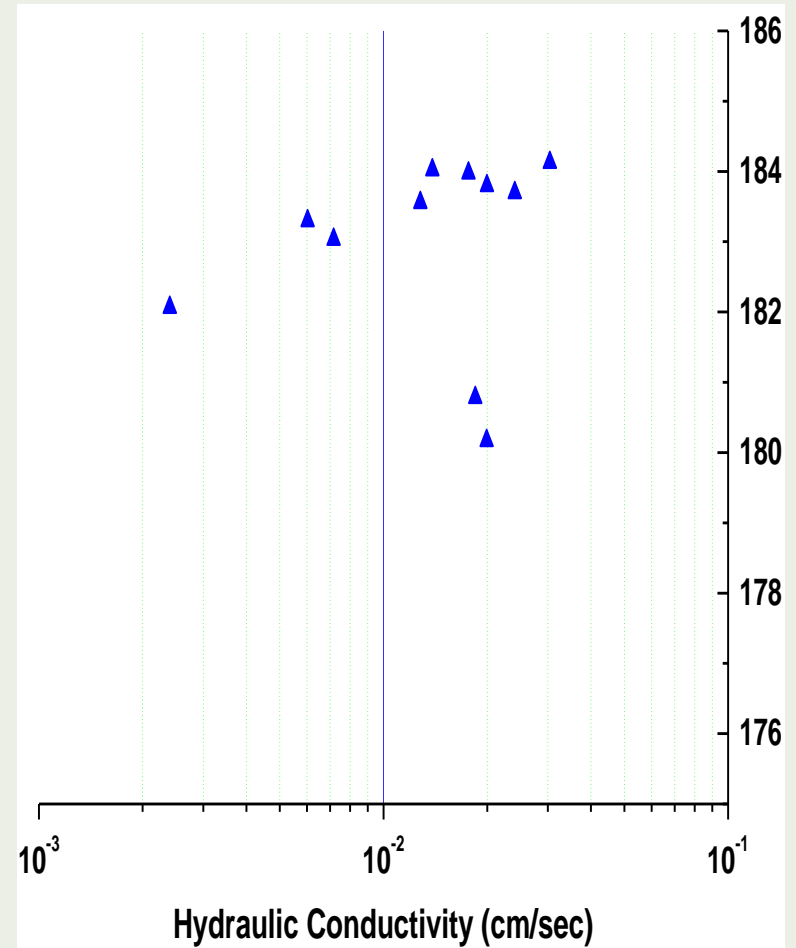
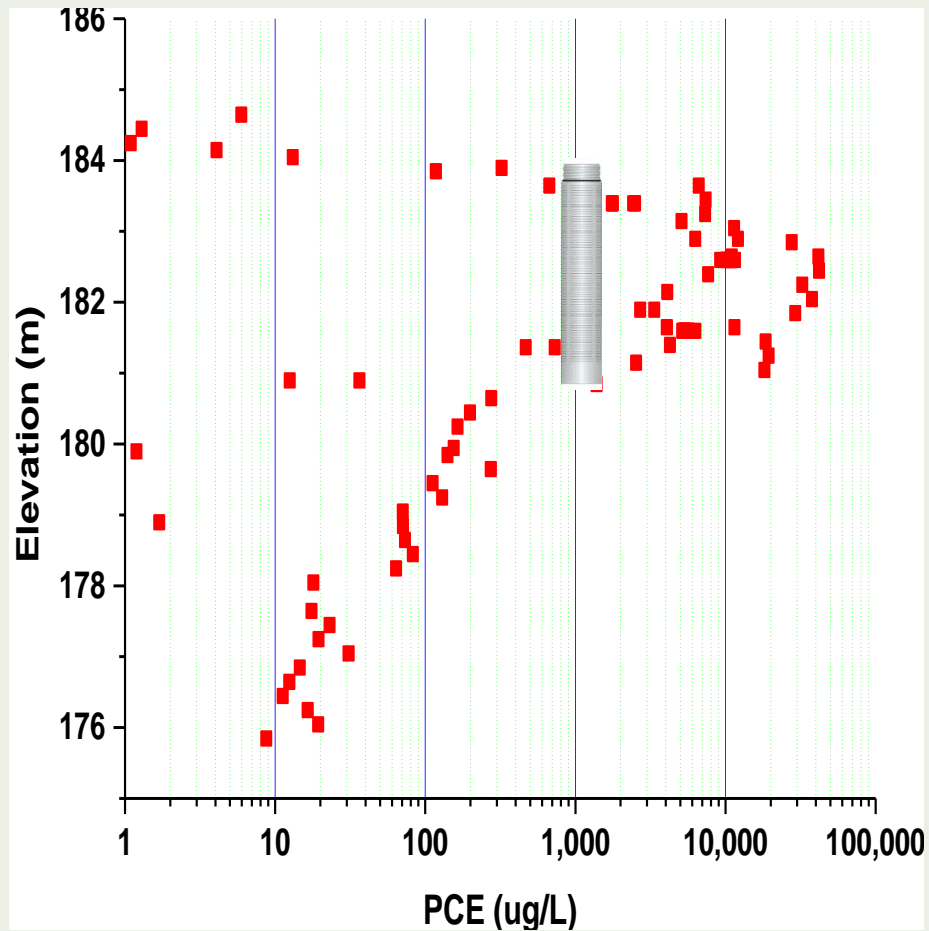
100 x 100



HRSC: Two Critical Issues

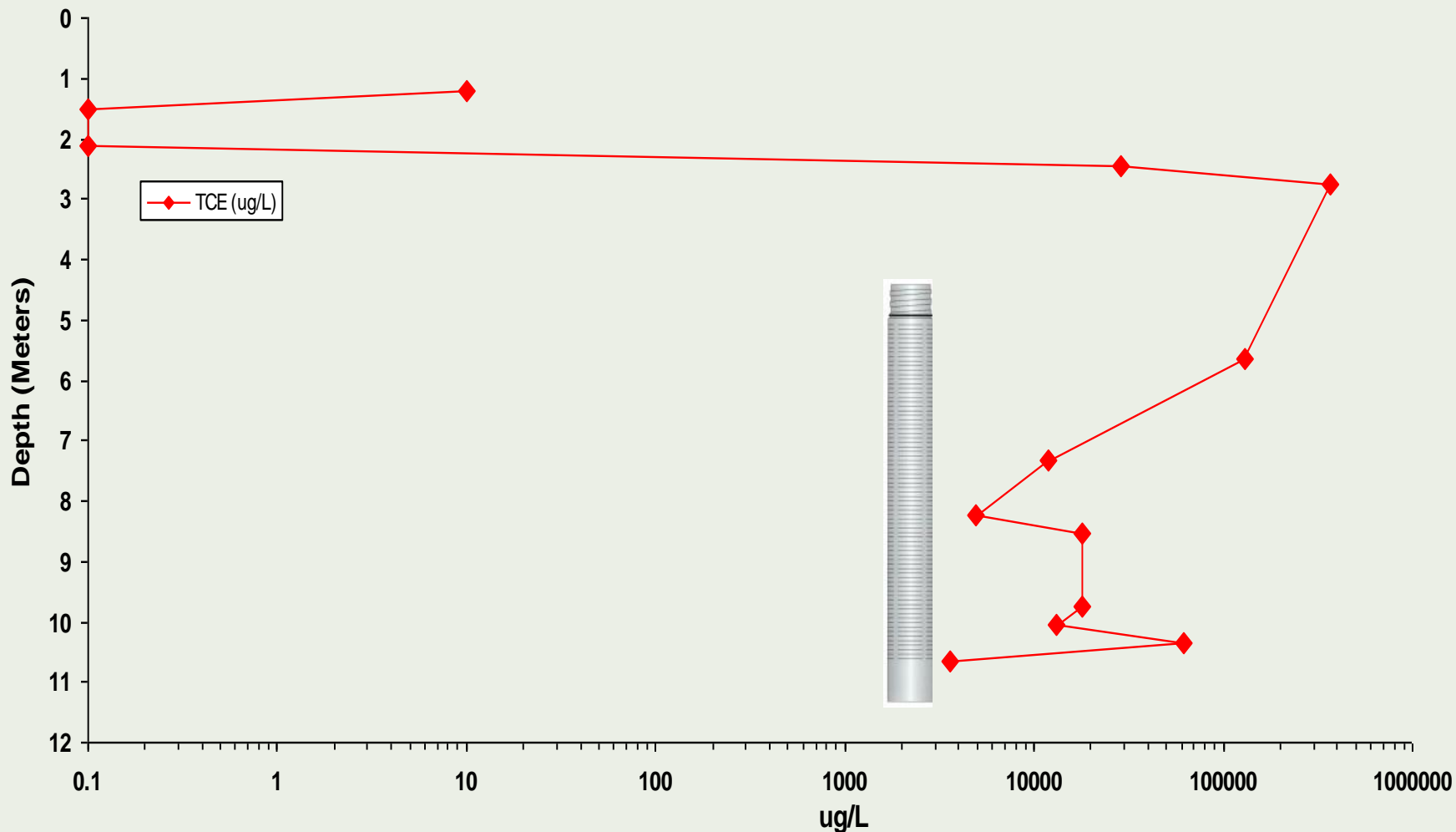


Sampling Scale and Averaging

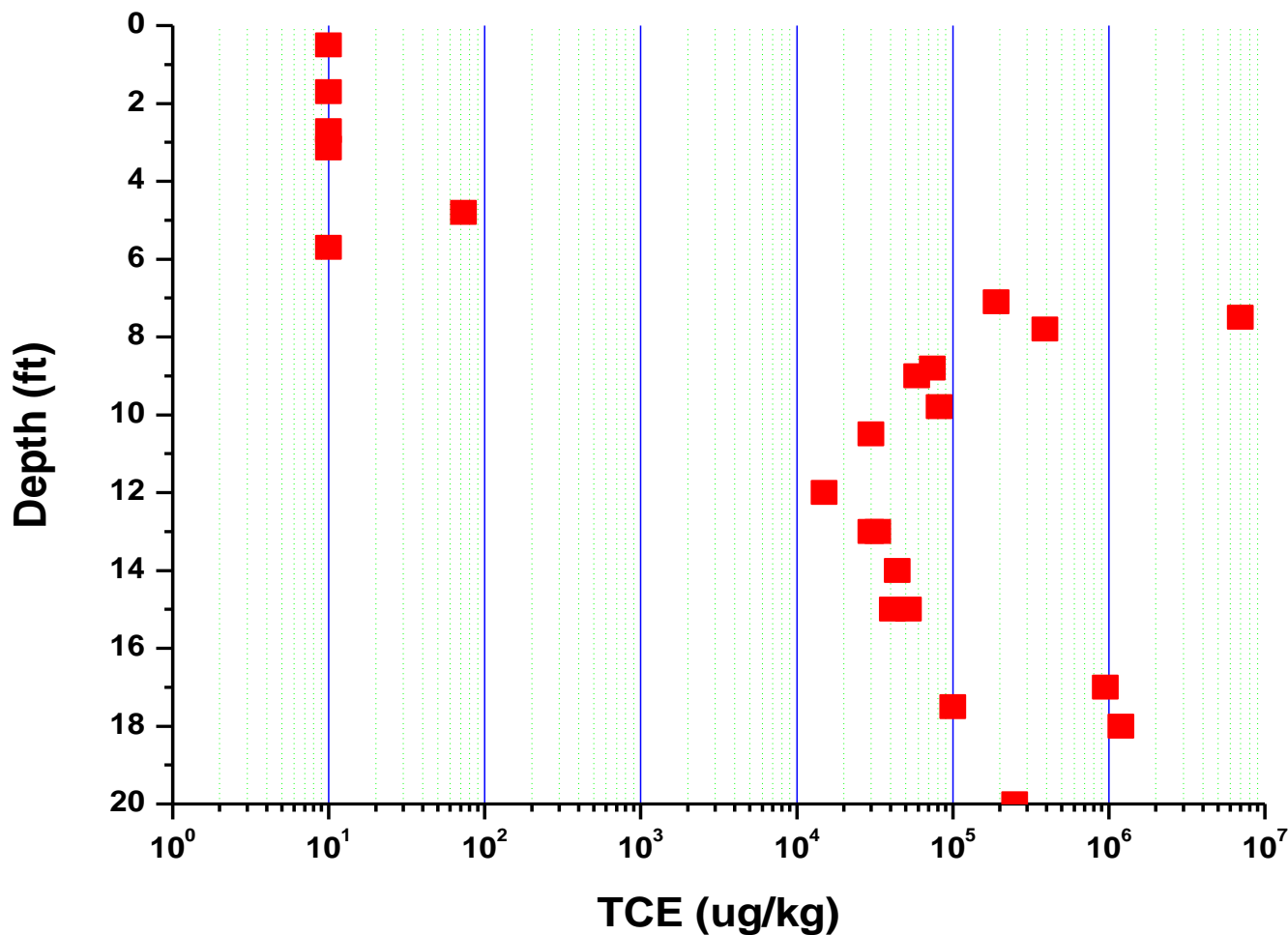


Variability Introduced by Well Sampling Method

(Pease AFB: Waterloo GW Profiler vs Well)

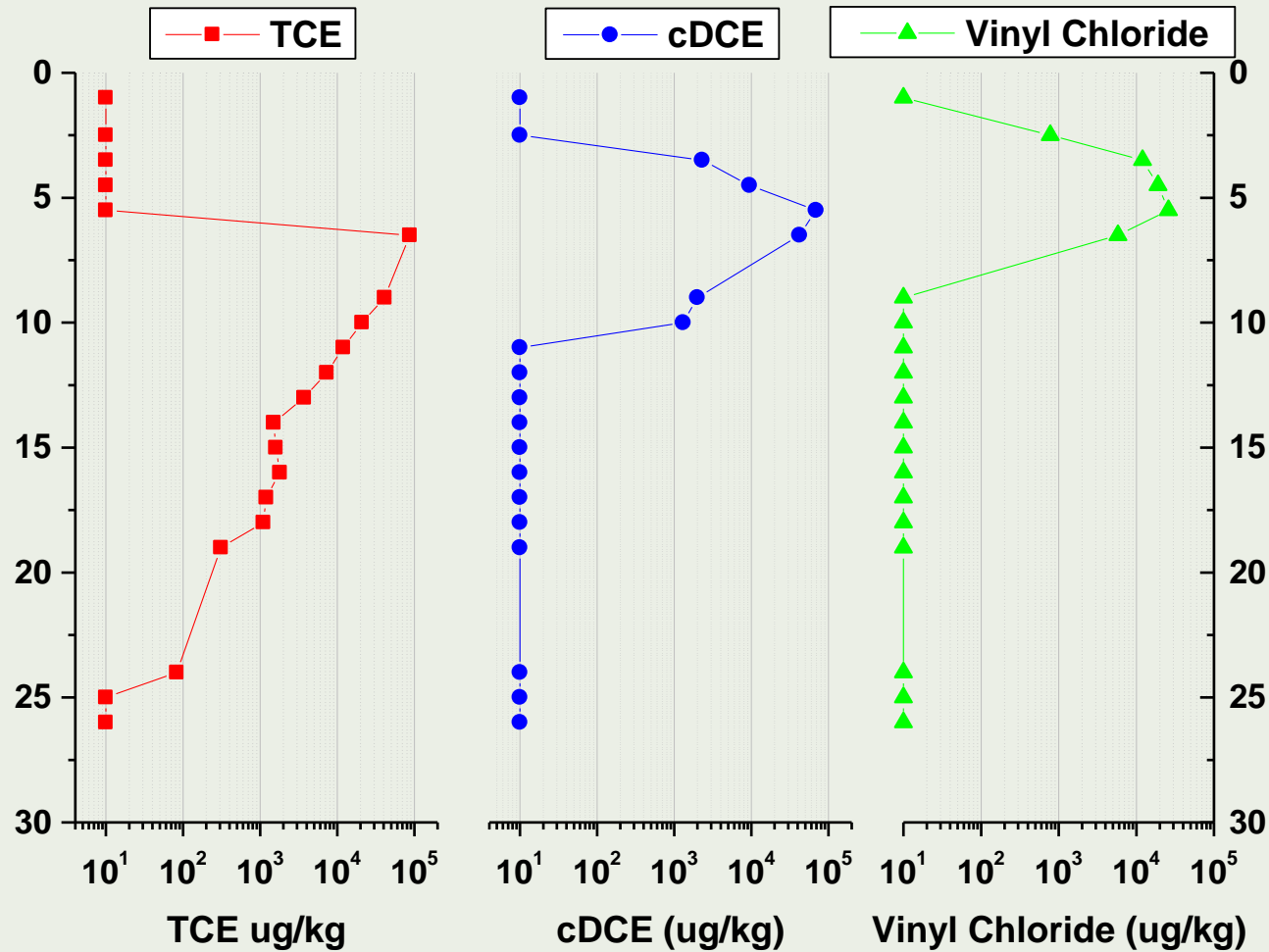


Soil Sub-Core Sampling: Near- Real Time, Closely Spaced Profile



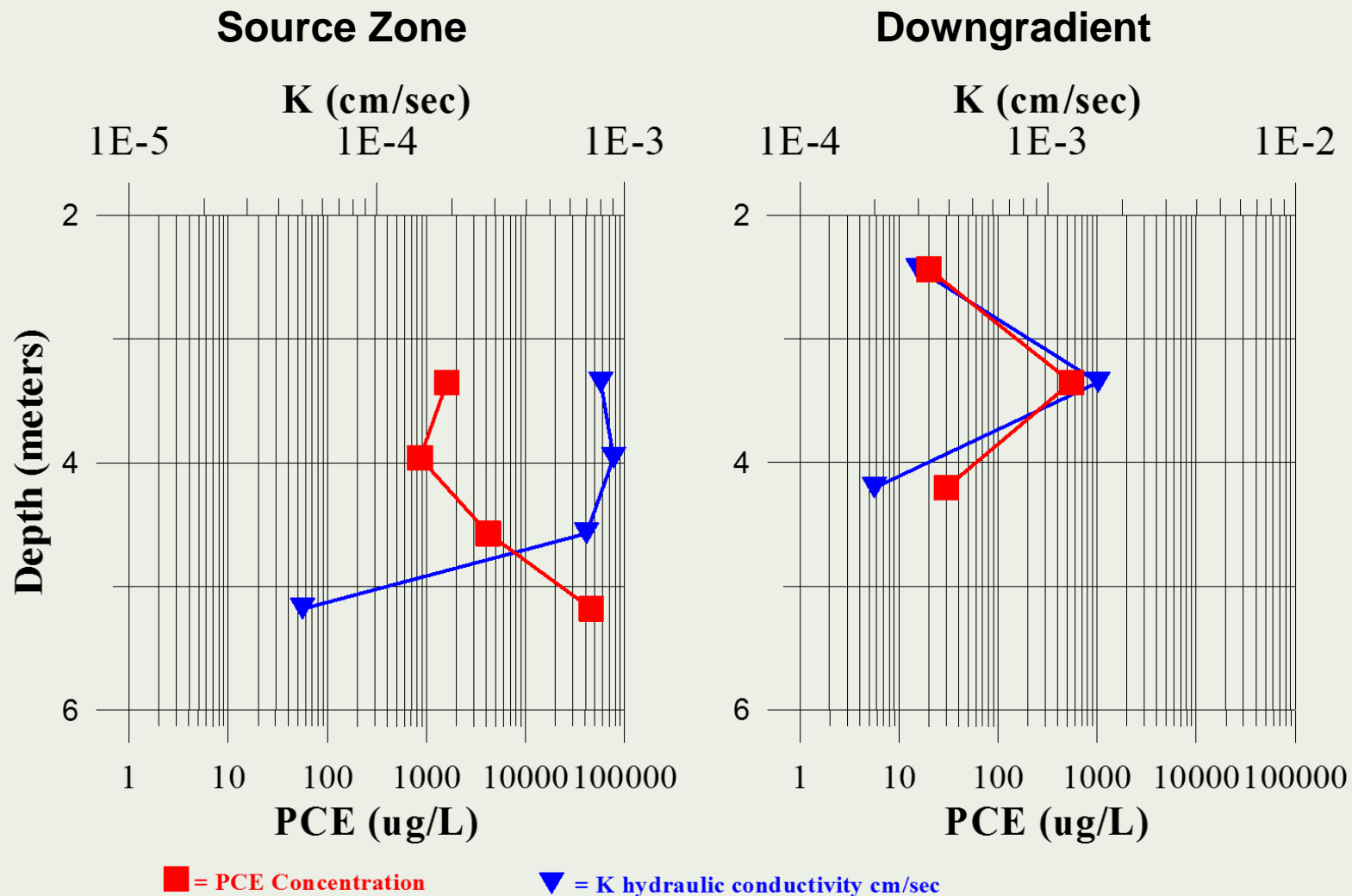
Source: Stone Environmental, Inc.

Spatial Variability in Natural Attenuation



Core 27

Source Accessibility and Transport Pathways



How Much is Enough? What is Right Vertical Spacing?

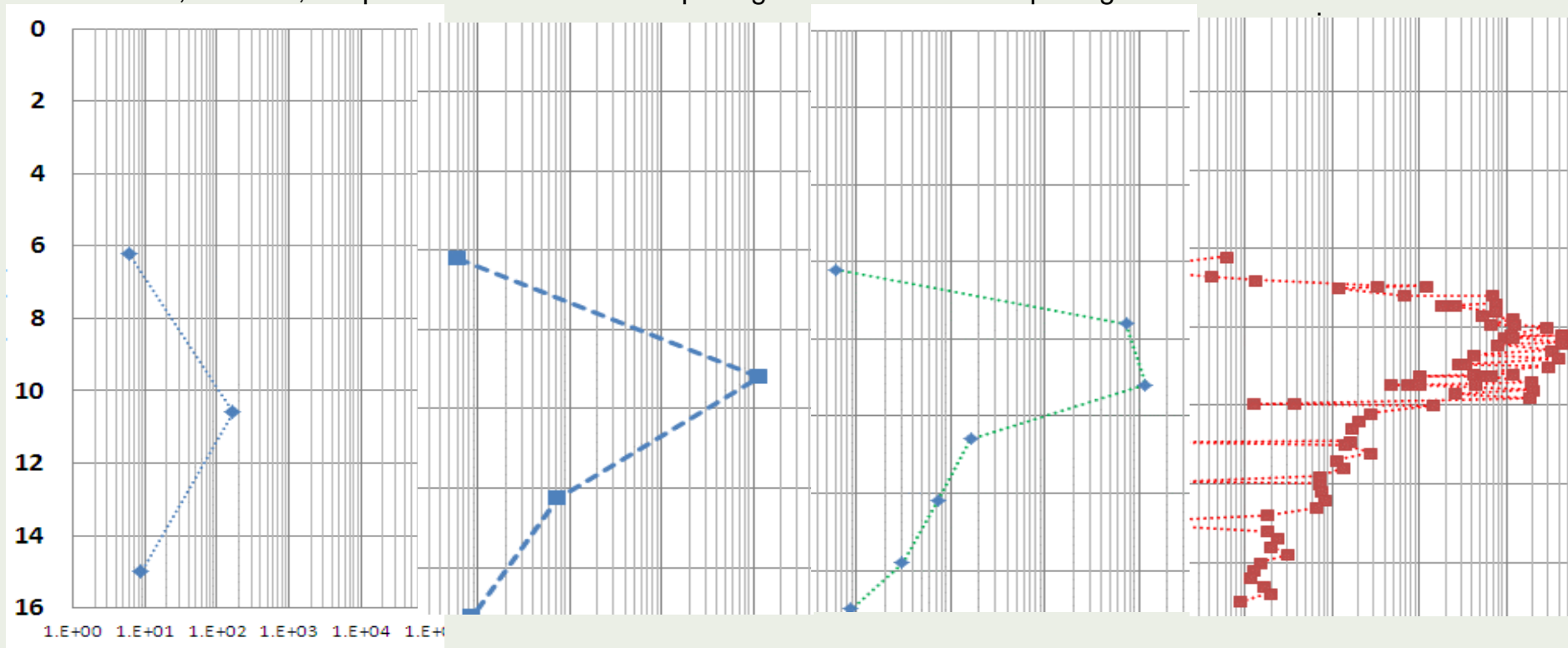
A Profile Through PCE Plume in Sandy Aquifer

Shallow, medium, deep

10 ft. vertical spacing

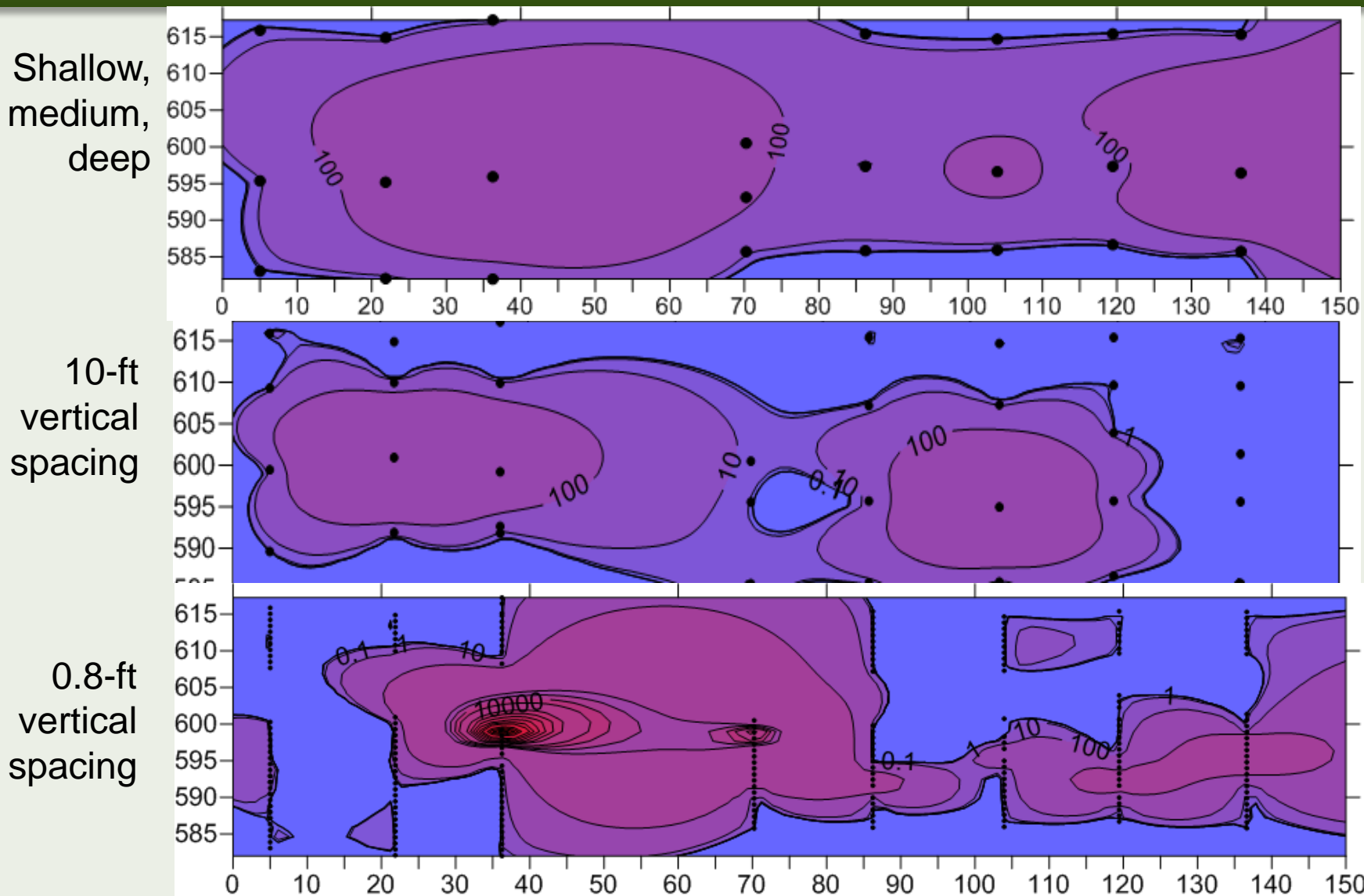
5 ft. vertical spacing

0.65 ft. vertical



PCE $\mu\text{g/L}$

Multi-Level Sampling Transect PCE in a Sandy Aquifer



In Review

- ◆ **Effective characterization efforts match the scale of measurement to the scale of variability of the property being measured**
- ◆ **Inappropriate data averaging occurs when the scale of variability outstrips the scale of measurement**
- ◆ **Proper measurement coverage ensures enough measurements are made at the correct vertical and horizontal locations**

Questions?



Disclaimer

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