Sources of Sampling Bias in Long-Screened Wells

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Presentation Outline

• Well Hydraulics During Sampling
• Sources of Sampling Bias
• Real World Examples
Well Hydraulics
Homogeneous Setting
No Vertical Gradient

Hydraulic Conductivity
10 ft/d

Q = 1.0 L/min

0.2 L/min
0.2 L/min
0.2 L/min
0.2 L/min
0.2 L/min
0.2 L/min
Well Hydraulics

Heterogeneous Setting
No Vertical Gradient

Q = 1.0 L/min

0.25 L/min

0.75 L/min

Hydraulic Conductivity (K)

K = 1 ft/d

K = 3 ft/d

Office of Research and Development
National Risk Management Research Laboratory/Ground Water & Ecosystems Restoration Division
Sampling Bias Related To

Dilution
Increased Complexity in Real World

Sample represents mixture of water controlled by geologic heterogeneity
The Average Borehole Concentration (ABC) applet demonstrates the effects of sampling with a single long-screened well from a depth-varying concentration, located in depth-varying hydraulic conductivity field. The applet demonstrates:

- The need for sampling at correct depths
- Concentration averages with various screen lengths at different depths
- Effect of hydraulic conductivity variation (check the Ignore Conductivity variation box)

http://www.epa.gov/athens/learn2model/part-two/onsite/abc.htm
Sampling Bias Related To

Vertical Ambient Flow
Ambient Conditions
Downward Vertical Gradient

Water Enters Screen

Result: Increased Complexity

Water Leaves Screen
Pertinent Literature


“Because of the increased probability of vertical concentration or hydraulic gradients within the open interval of long-screened (greater than 10 ft) wells, it is advisable to determine the zones of inflow and outflow within the screened or open interval of these wells using borehole flowmeter analysis …”
Case Study

Question: What do samples represent?
Case Study

Flow under pumping conditions

\[ Q = 9 \text{ L/min} \]
Conclusions

- Factors affecting water mixture include:
  - Geologic heterogeneity
  - Vertical hydraulic gradients
- Techniques can impact observed chemistry (particularly in complex settings)
- Bias likely to increase with screen length

**Result:**
Increasing need for complex studies to understand what samples represent in long-screened wells.