



Multiple Lines of Evidence Approaches to Vertical Communication Evaluation

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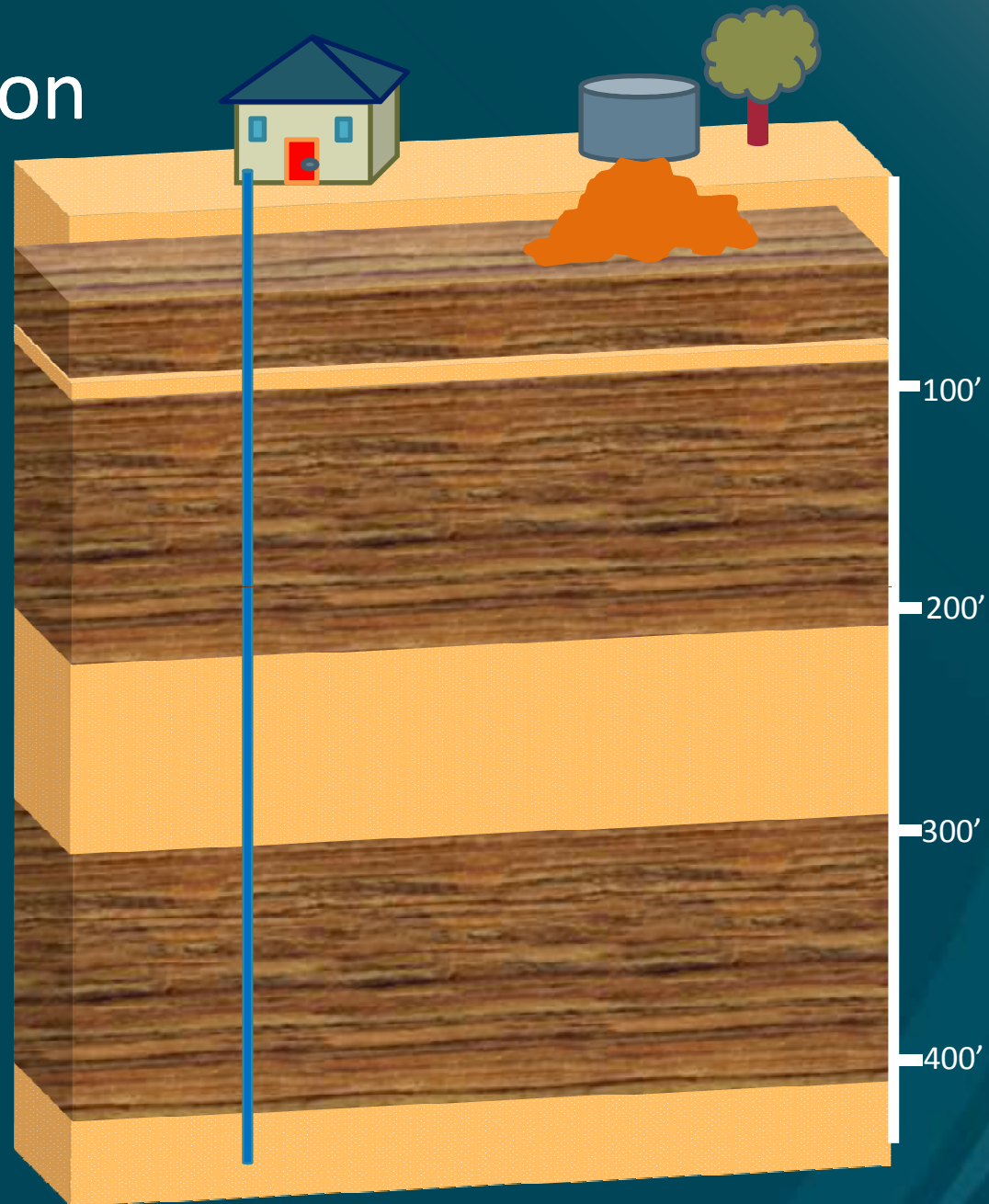
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Introduction



Outline

- Introduction
- Multiple Lines of Evidence
 - Soil Logging
 - Gamma Logging
 - Potentiometric Monitoring
 - Geochemical Analysis
 - Aquifer Pumping Tests
- Key Takeaways

Introduction

○ Relevance

- Exposure pathway protection / elimination
 - Deep aquifer systems can be shown to be naturally protected
 - Surficial spills would not create a risk to potential receptor
- Path to spill closure
 - Risk-based approaches can be taken
 - Deed recordation / land use classification
- Targeted remediation
 - Focus on actual receptors and pathways
 - Remediation approach can be refined

Soil Logging

○ Physically identify and categorize aquitard materials

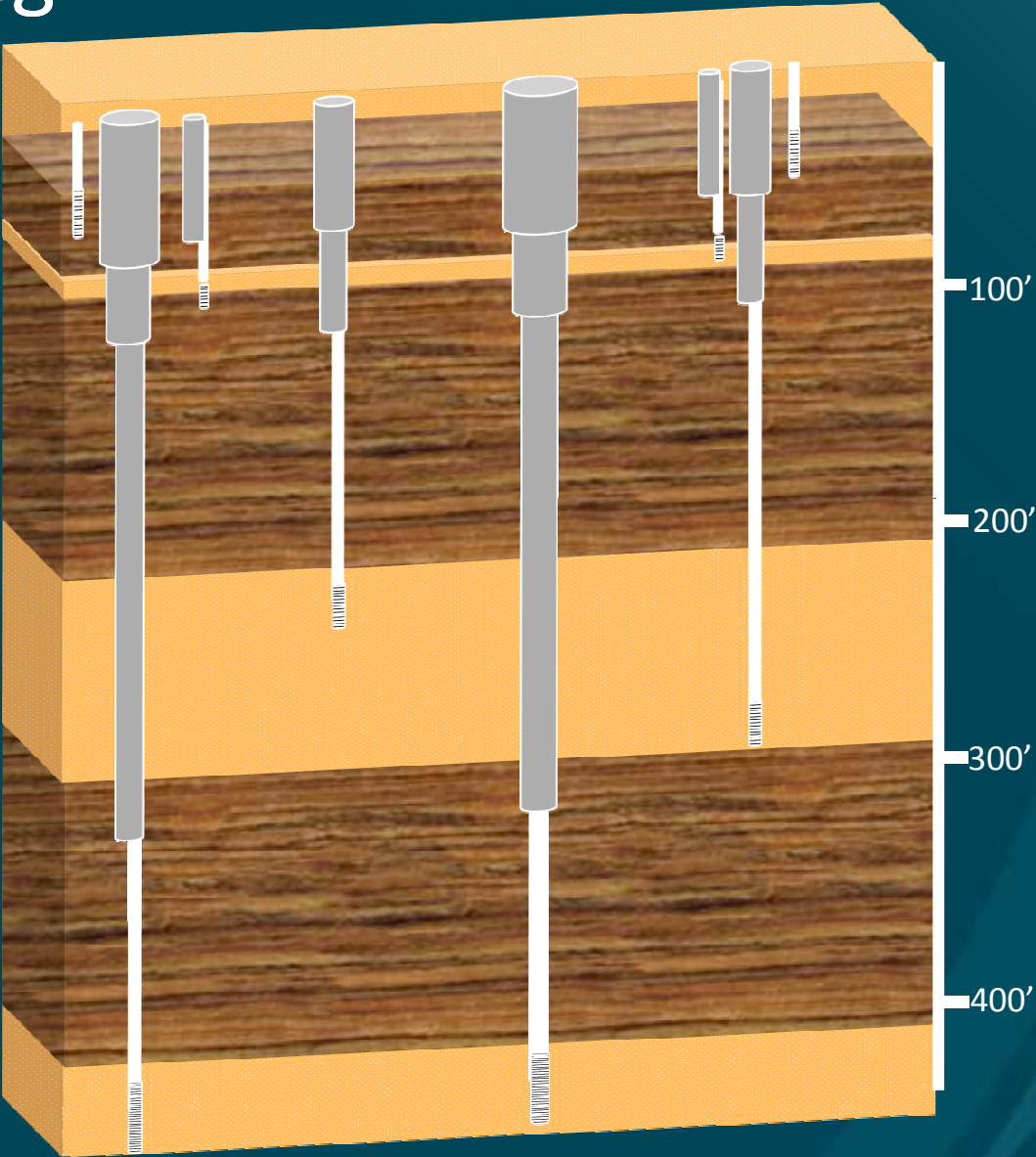
○ Geology

- Sand
- Silt
- Clay
- Bedrock
- Caliche
- Peat
- Fill



○ Dynamic soil sampling interval protocol

Soil Logging



Gamma Logging

- Radiation detection of varying strata
- Downhole probe detects gamma radiation of soils in monitoring wells
- Real-time logging

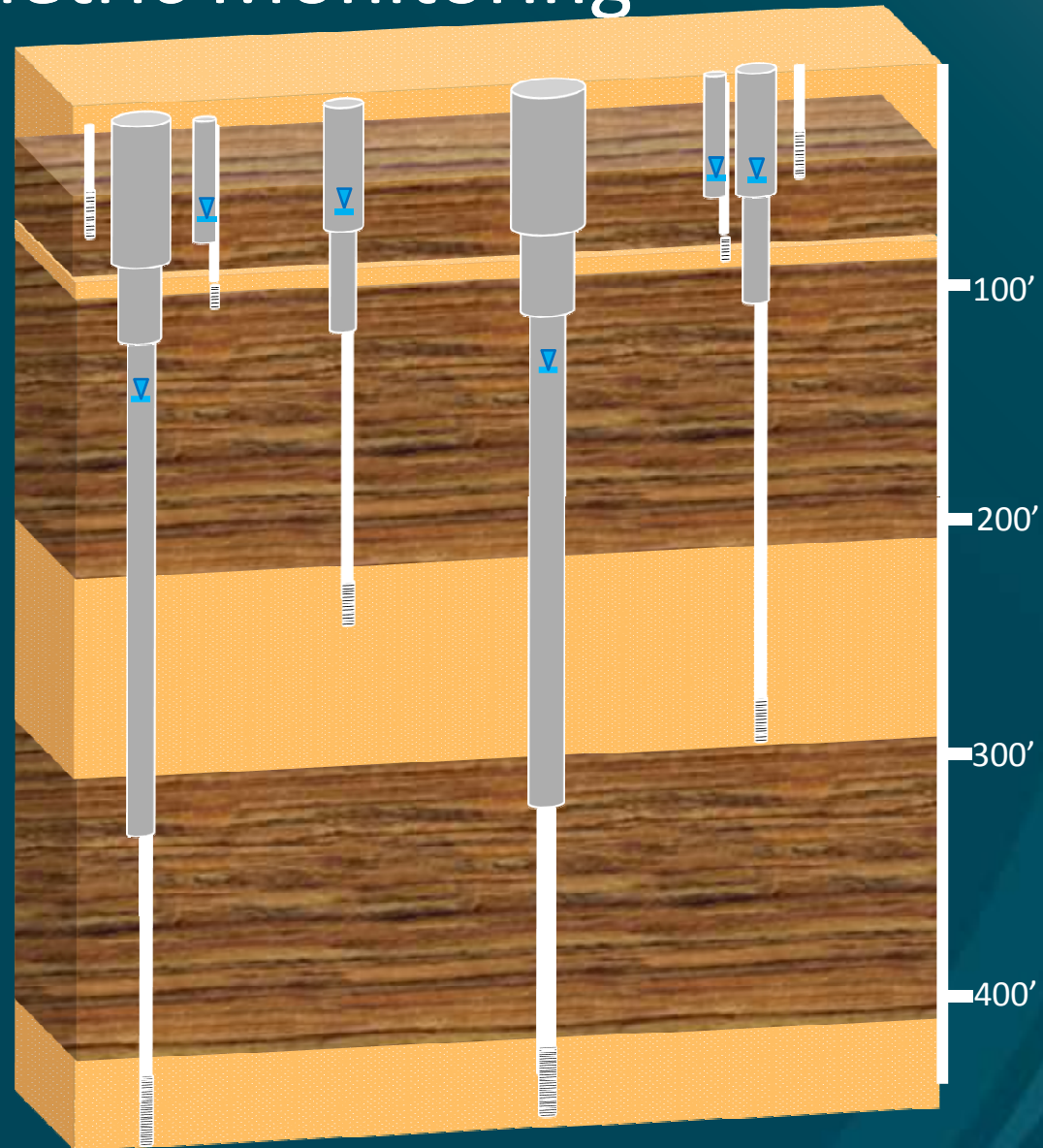


Potentiometric Monitoring

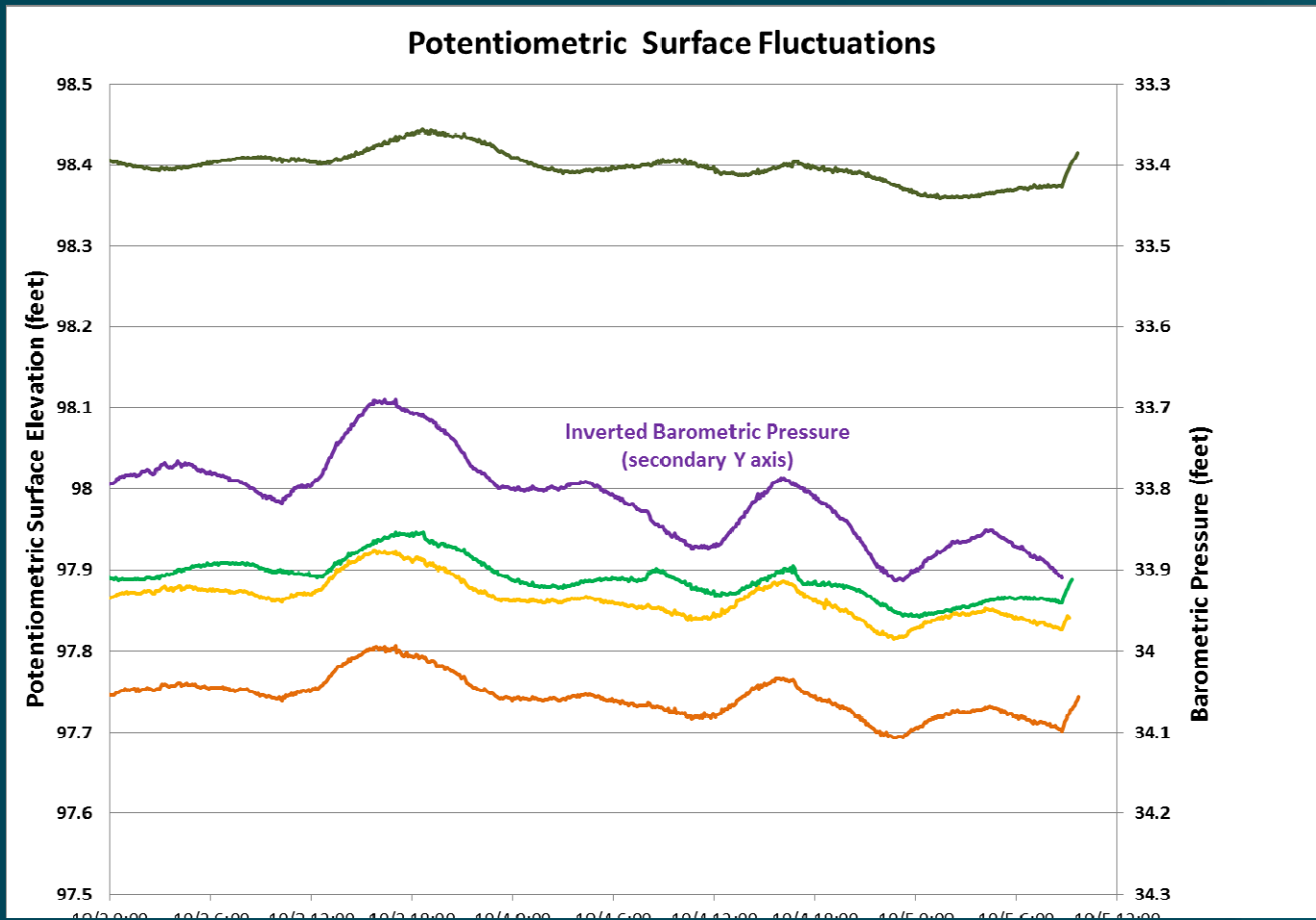
- Data logging pressure transducers deployed in monitoring wells over long-term period (several months)
- Assess natural changes due to barometric pressure
- Watch for potential “drainage” from shallower aquifer into deeper aquifer
- Weather monitoring to record intensity and duration of rainfall events
- Recharge rates after rainfall events may differ based on regional aquifer outcroppings



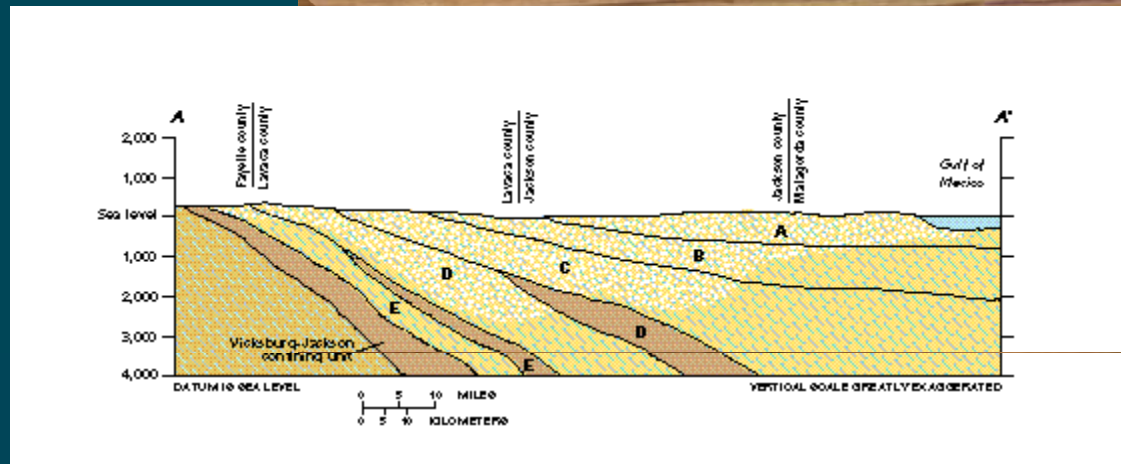
Potentiometric Monitoring



Potentiometric Monitoring

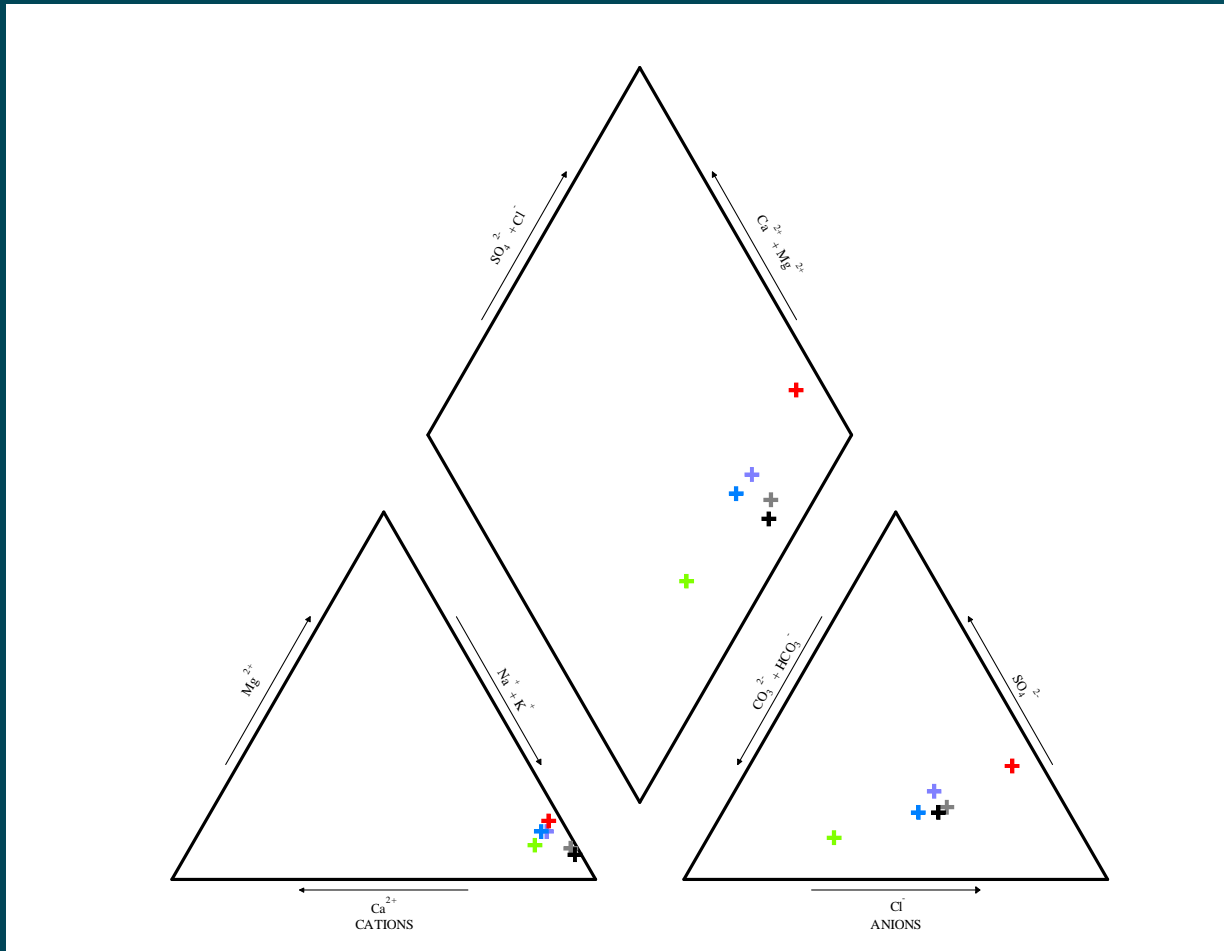


Potentiometric Monitoring



- Rise in potentiometric surface in deeper units may be due to rain events at regional outcroppings.

Geochemical Analysis

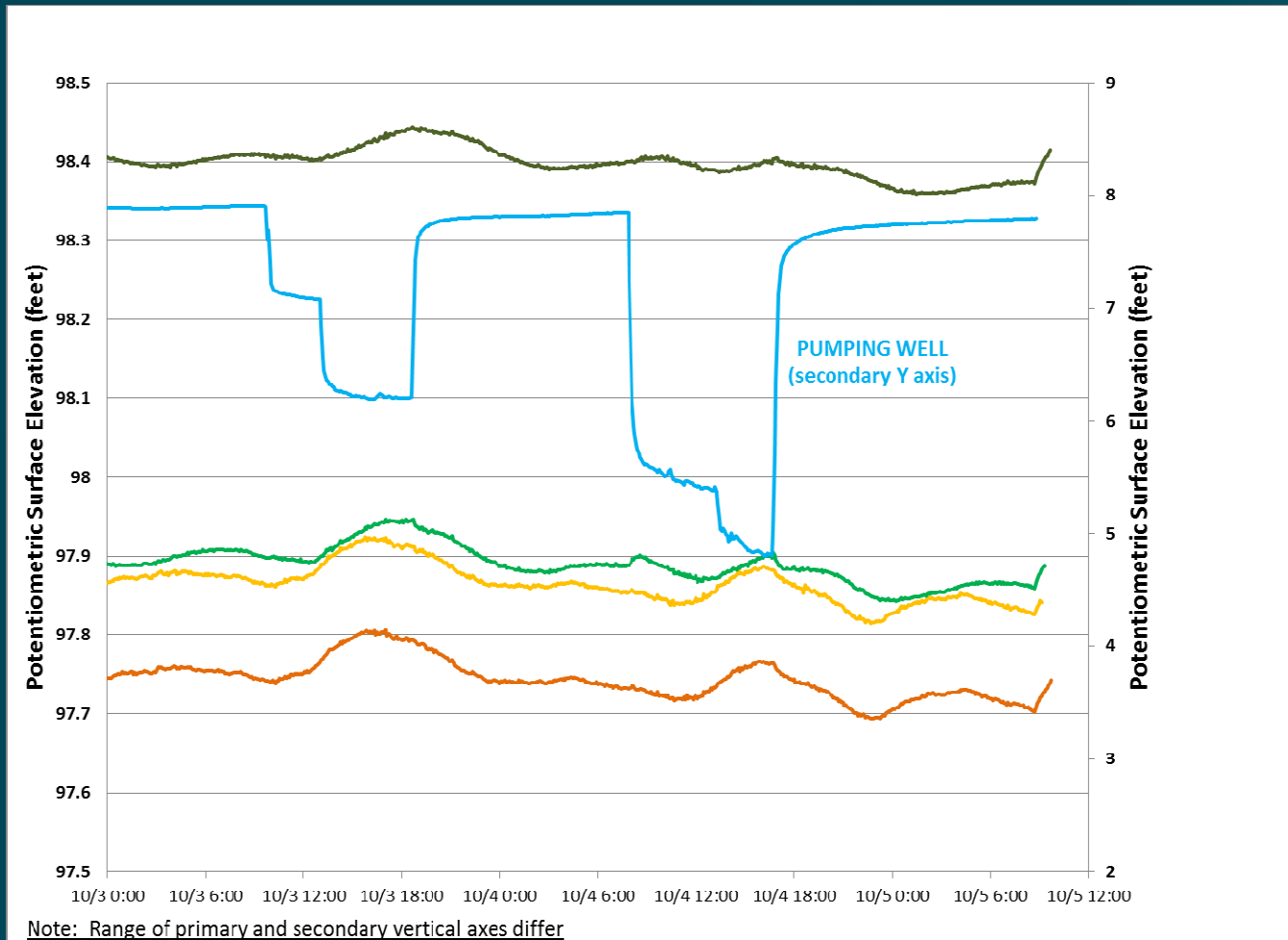


Aquifer Pumping Tests

- Stressing deeper aquifer to observe hydraulic response in shallower aquifers
- Combine with geochemical analysis to determine if water chemistry changes during course of pumping
- Simulate impossibly worst-case scenario of continuous high pumping rate over the course of a few days



Aquifer Pumping Tests



Key Takeaways

- Tools are available to assess vertical communication, or lack thereof
- Refined assessment leads to refined remediation and project approach strategies
- Potential for reducing project lifecycle and overall project cost
- All avenues to explore – physical, chemical, mechanical
- You cannot prove a negative but you can show many lines of evidence for it!

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