



Partners for a Better Quality of Life

## Are Horizontal Wells Right for Development of Groundwater Resources in the Garber-Wellington Aquifer?



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## Today's Talk

- Directional Drilling Methods
- Garber-Wellington Geology
- Aquifer Geochemistry
- Well Design Considerations
- Final Thoughts and Comments

# Directional Drilling Methods



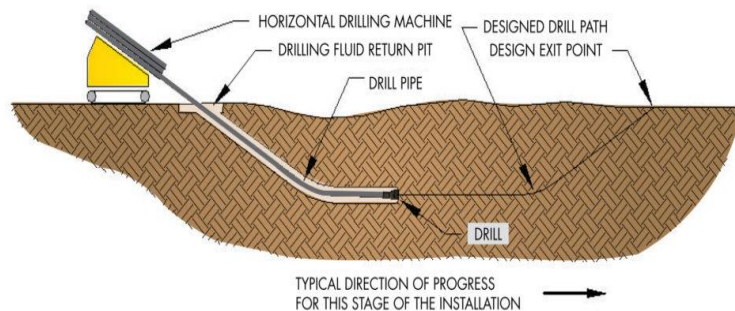
Continuous  
Entry-Exit  
Method

3-Step  
Process

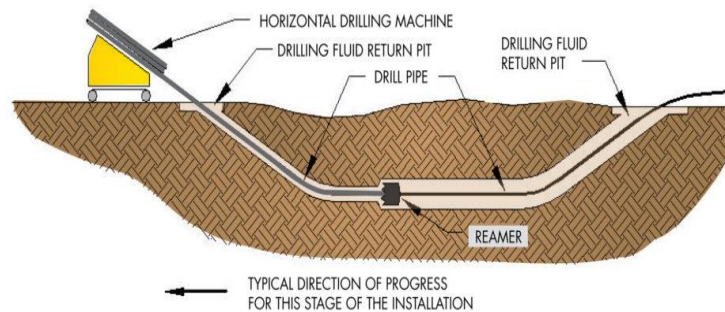
Depths  
Generally  
≤ 200'

Requires  
Large  
Location

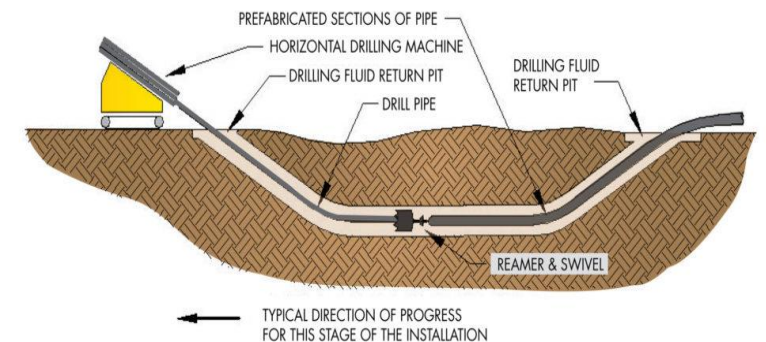
## FIRST STAGE - PILOT HOLE



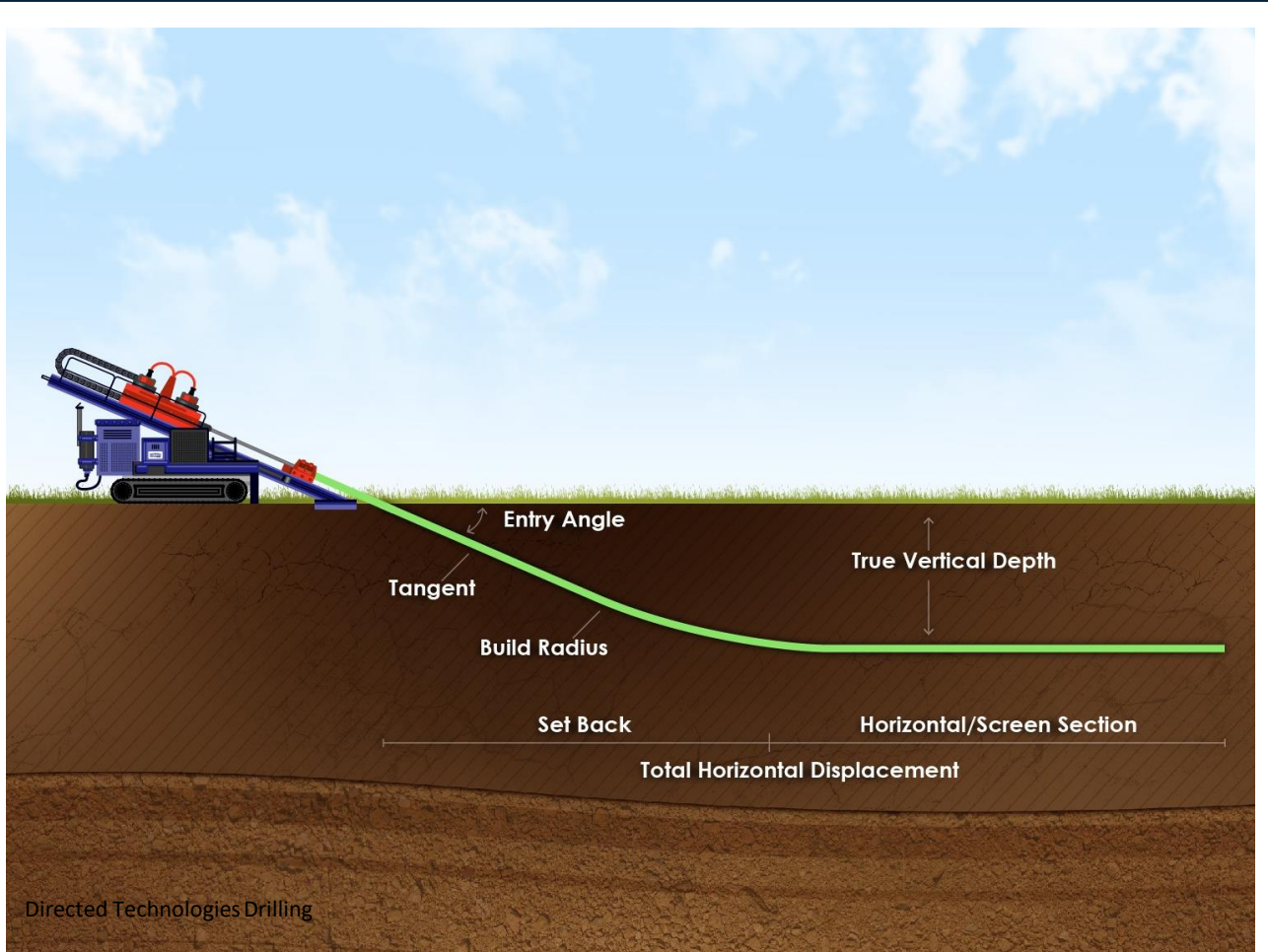
## SECOND STAGE - PRE-REAMING



## THIRD STAGE - PULLBACK



# Directional Drilling Methods



Blind  
Single-Ended  
Method

3-Step  
Process

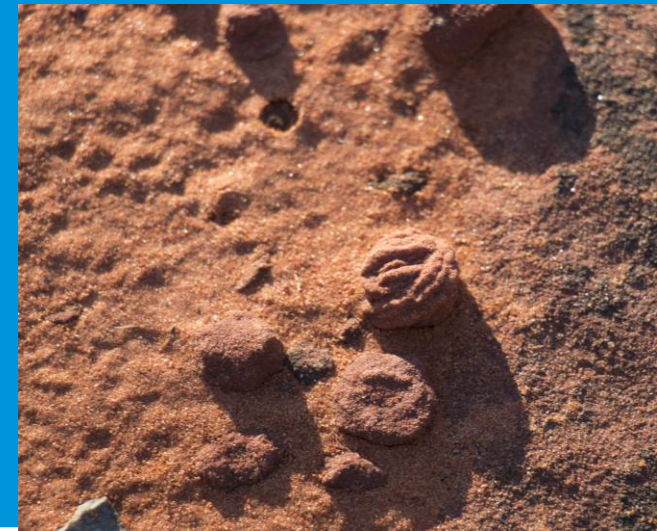
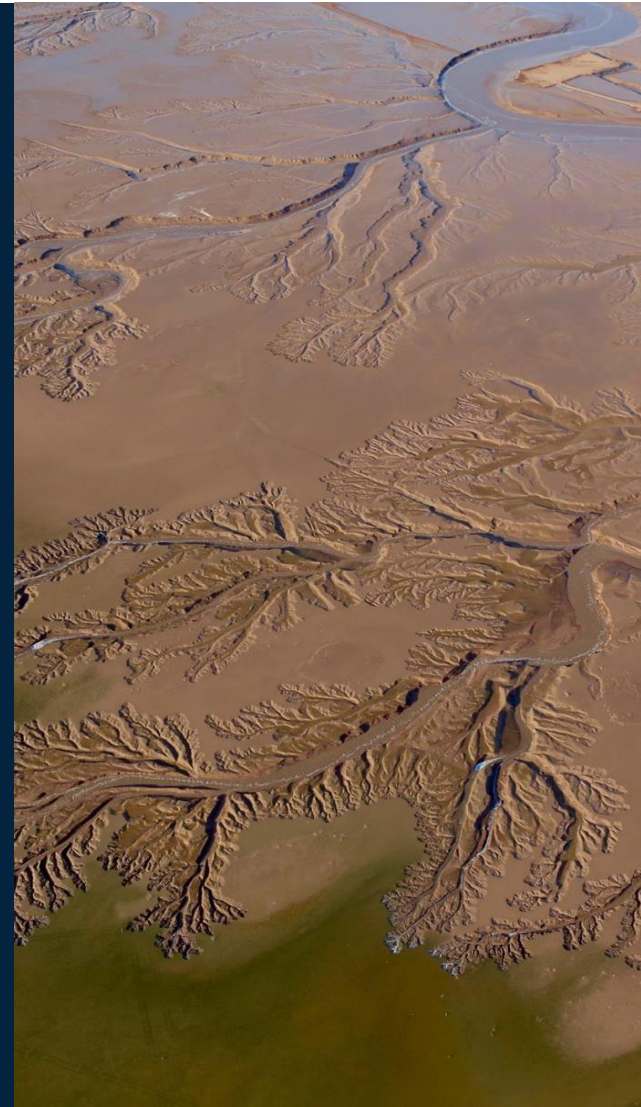
Smaller  
Location

Depths  
> 200'

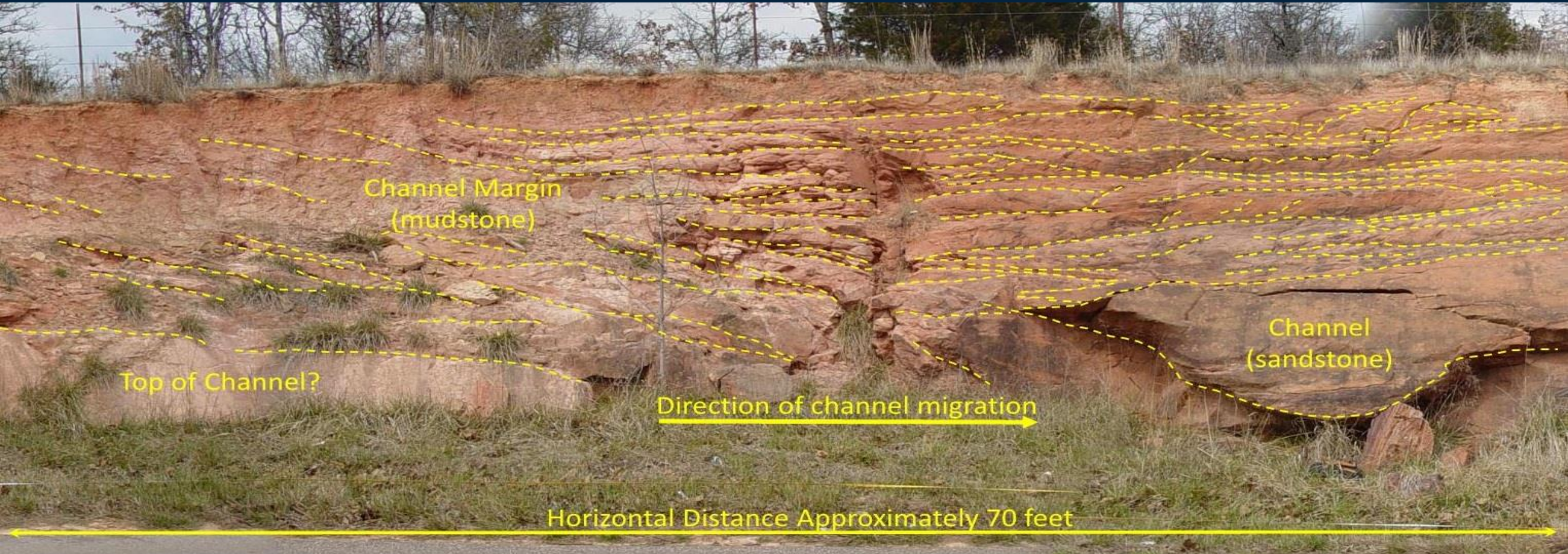
# Garber-Wellington Geology



- Must understand how geology will impact decisions related to mapping a target, selecting a well location and developing a well design
- Aquifer heterogeneity due to diversity of lithofacies
- Very fine to fine-grained sands with interbedded mudstone and siltstone



## Correlation and Mapping Challenges



# Garber-Wellington Geology



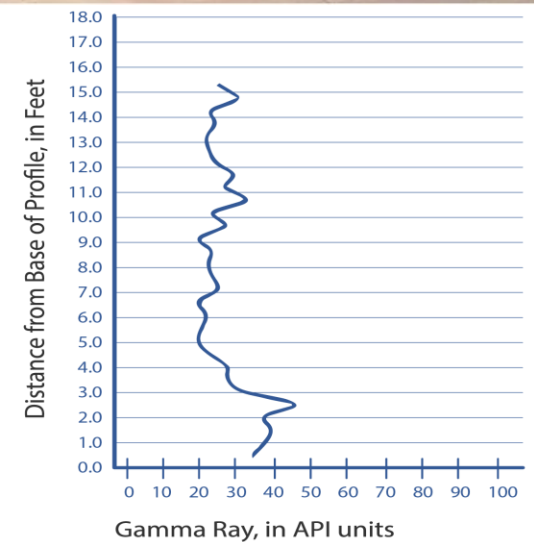
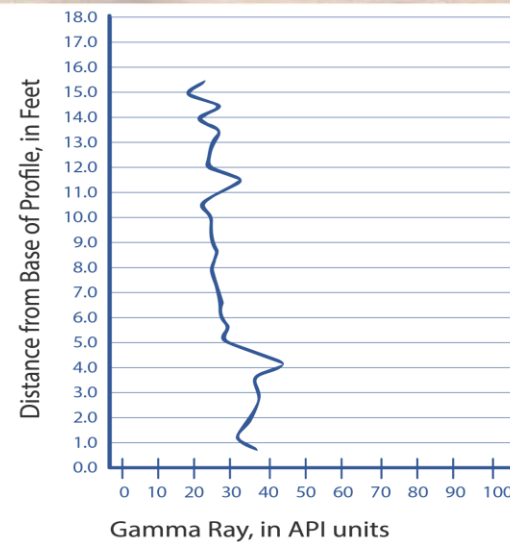
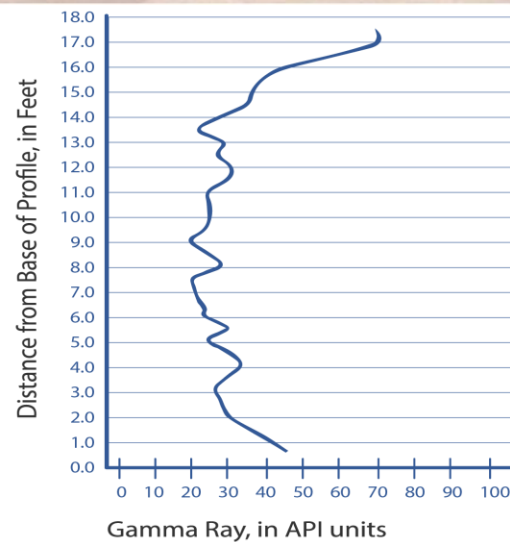
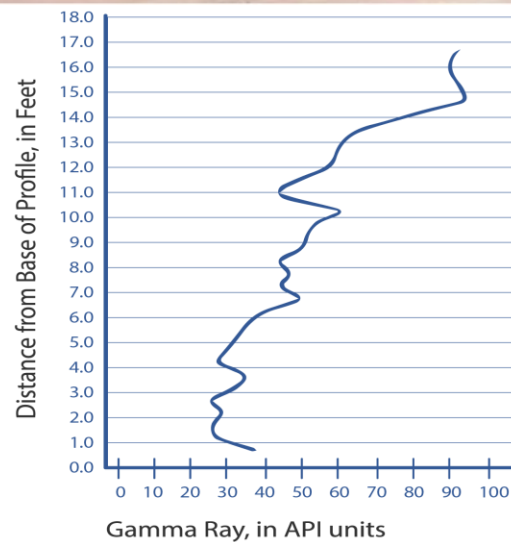
## Correlation Difficult – Even Across Short Distances

### Outcrop Gamma-ray Response of the Permian Garber-Wellington Aquifer, Central Oklahoma

Behind Best Western Inn • 2700 East 2<sup>nd</sup> Street • Edmond, Oklahoma



Gromadski, 2004



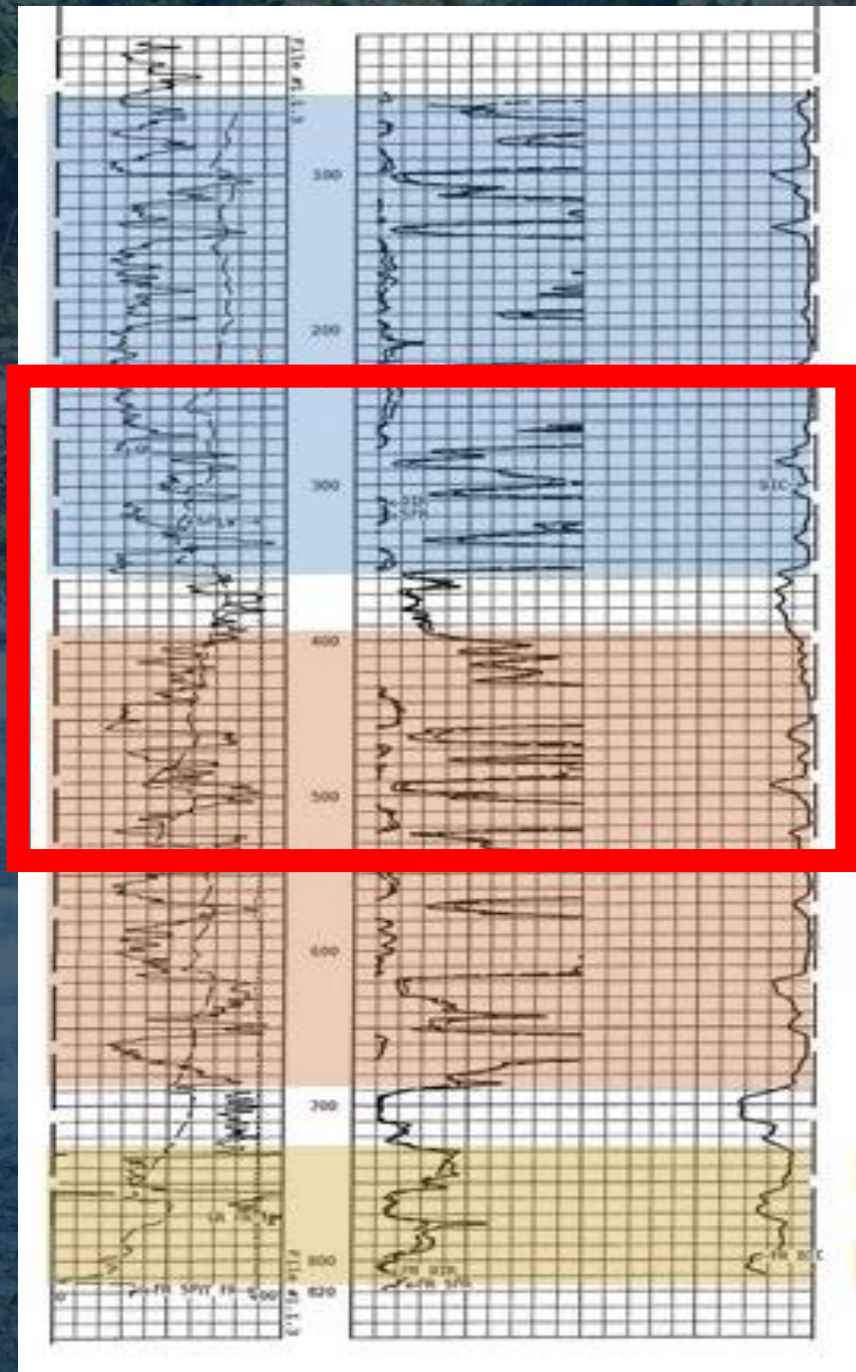
# Aquifer Geochemistry

Ca-Mg-HCO<sub>3</sub> Water  
pH ~7.3 – 8.0

**Target Interval →**

Na-HCO<sub>3</sub> Water  
pH ~8.3 – 9.3

Na-Cl-SO<sub>4</sub> Water  
pH ~8.3 – 8.9





# Well Design Considerations



- Gun-perforated wells: four 0.41-inch diameter holes per foot, phased 90°
- Screened wells: 91 in<sup>2</sup> per foot (0.020 aperture), continuous wire-wrap
- Impacts: drawdown, specific capacity, yield and well efficiency
- T = highly variable: 4,000 gpd/ft to < 1,500 gpd/ft
- Q = highly variable: < 100 gpm to > 400 gpm
- Horizontal well will also penetrate mudstones and siltstones, where K values drop to ~2.5 gpd/ft<sup>2</sup>



# Final Thoughts and Comments

- Has cost-benefit analysis been completed (i.e. how many vertical wells can be replaced with one horizontal well?)
- Doesn't look to be feasible to use natural formation materials as a filter pack?
- Can the horizontal portion of the well be landed in laterally continuous porous and permeable sandstone?
- Which horizontal drilling and completion method is best suited for my project and how large does my location need to be?
- Is there sufficient subsurface data (i.e. logs) to identify and map water-bearing sandstone targets in sufficient detail with a reasonable degree of certainty?
- What is the optimum well spacing between horizontal wells?



**Thank You**  
Questions?