LRE Water, LLC
a Leonard Rice Engineers Company

Hydrogeology 101

TAGD Groundwater Summit

Board & Staff Training

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Common Questions

- How much water can I pump?
- How is the new well being drilled going to affect my well?
- How long will my well last?
- What is the quality of my groundwater?

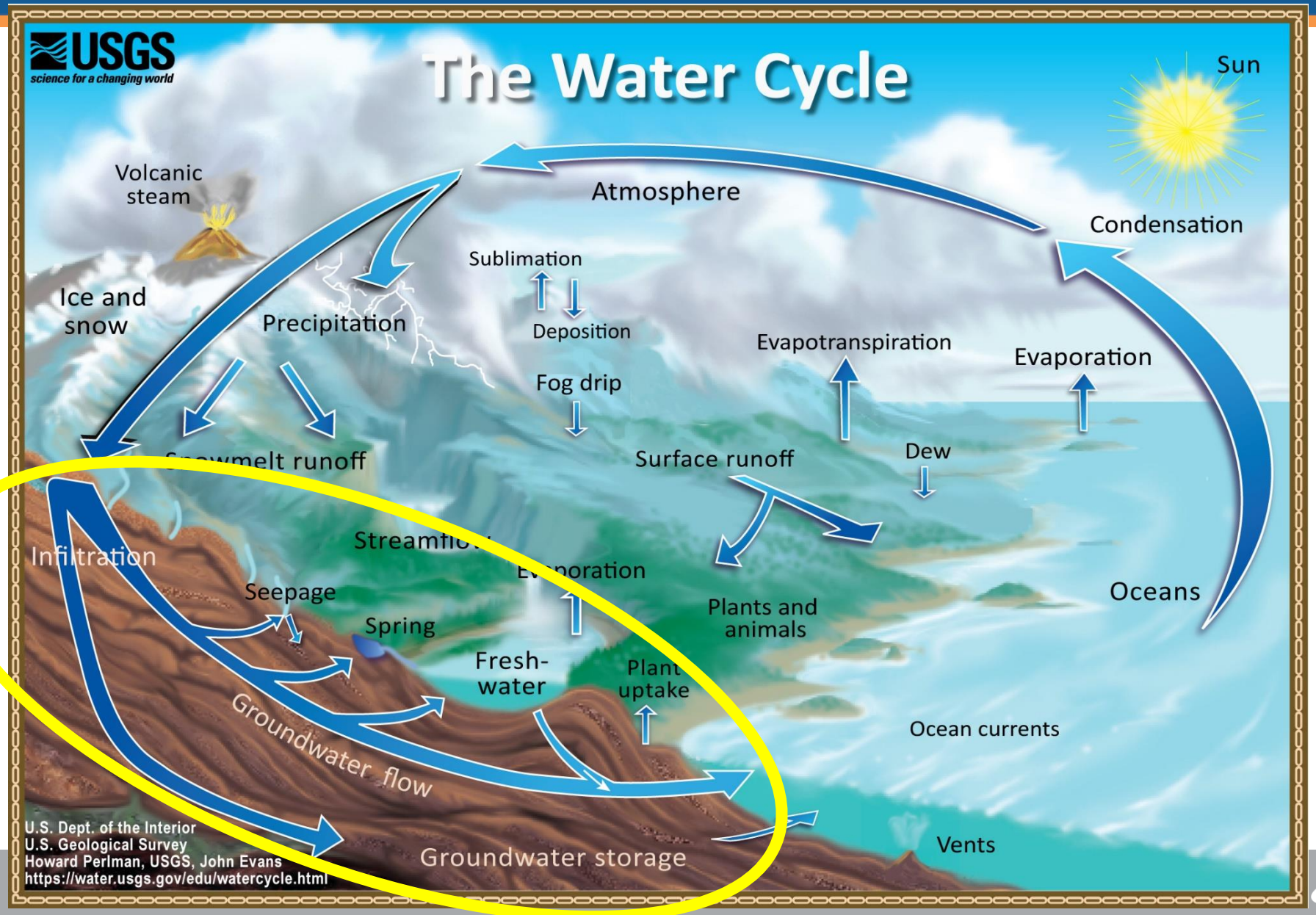
Groundwater Availability

Factors Affecting Groundwater Availability

- Geologic Structure and Rock Type
- Hydraulic Properties
- Existing Users
- Water Quality
- Regulatory Framework

Hydro 101

What is Groundwater?

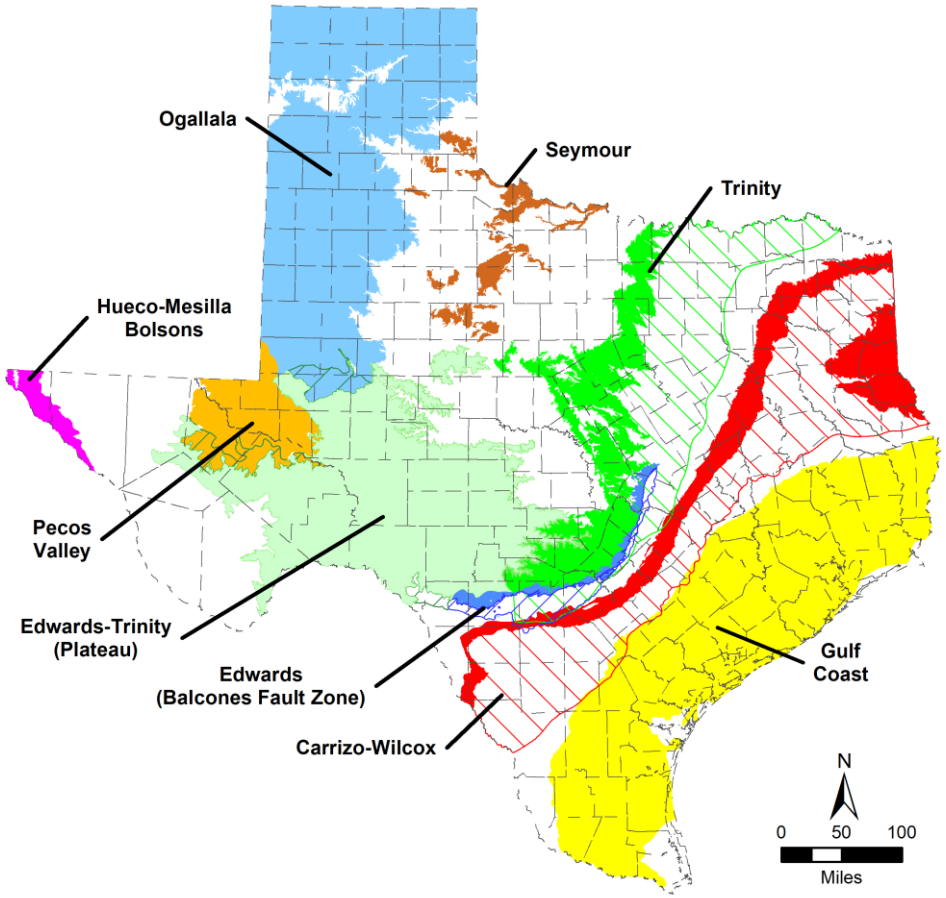


Terms Used During Presentation (with overly simplified definitions)

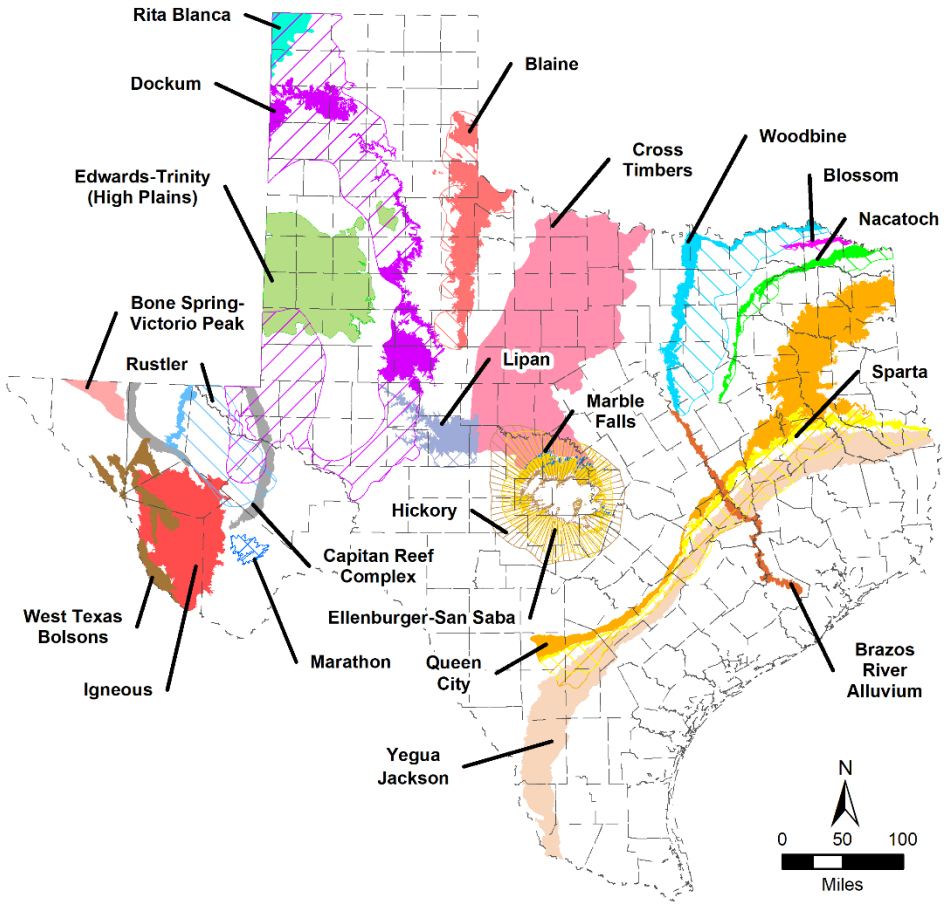
Permeability	How easily a fluid moves through a rock
Porosity	How much open space there is in a rock
Hydraulic Conductivity	Similar to permeability, but accounts for properties of the fluid
Transmissivity	Hydraulic conductivity times the aquifer thickness
Storage Coefficient	Amount of water released due to a change in water level
Specific Yield	Ratio of the volume of water that will drain from a volume of rock

Aquifers in Texas

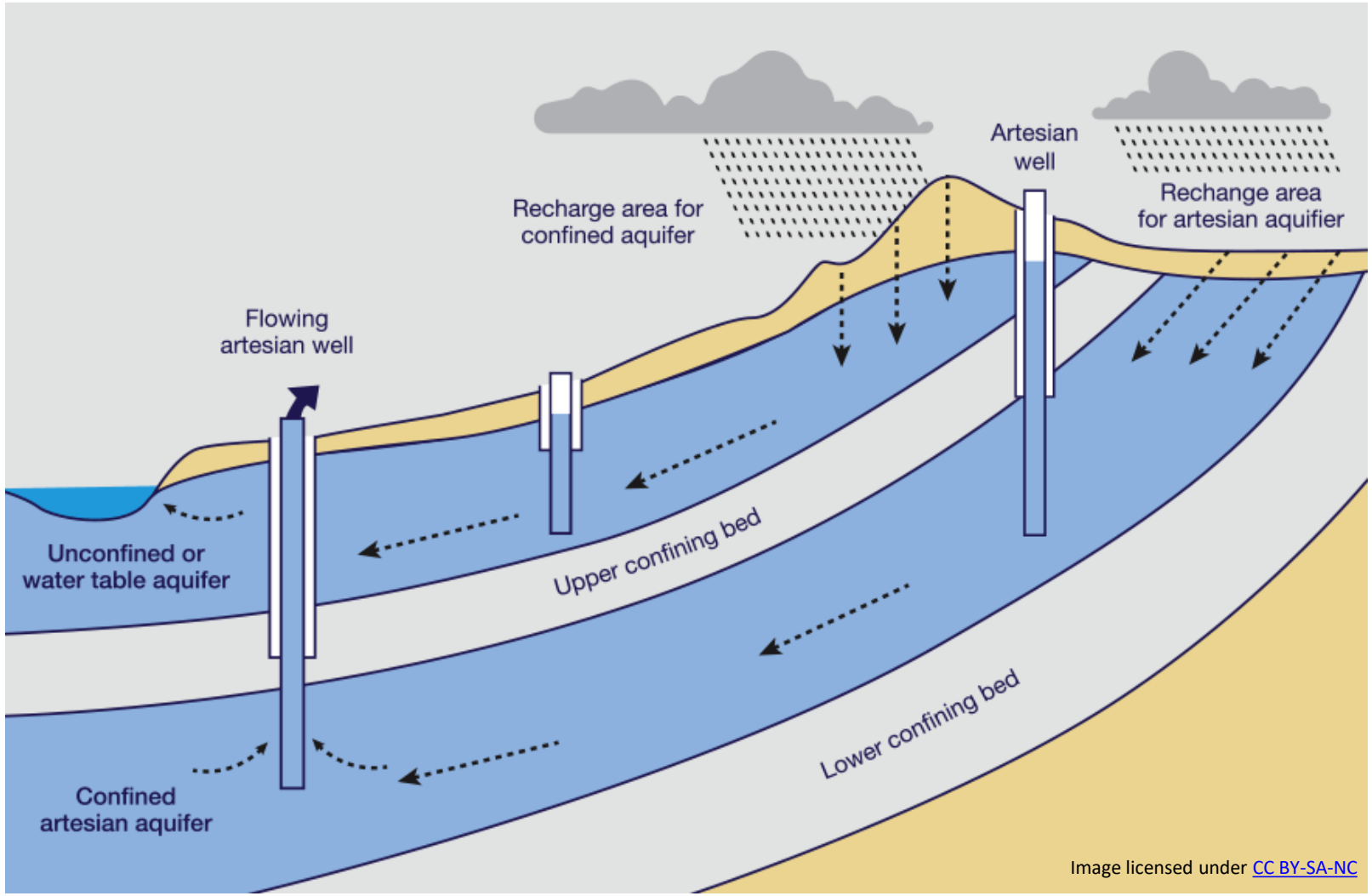
Major Aquifers



Minor Aquifers



Geologic Structure – Confined and Unconfined Aquifers



Rock Type

Sand and Gravel – Good Aquifer Material

- Good Permeability
- Good Porosity

Fractured Limestone – Possibly Good Aquifer Material

- Good Permeability
- Poor Porosity

Clay or Shale– Poor Aquifer Material

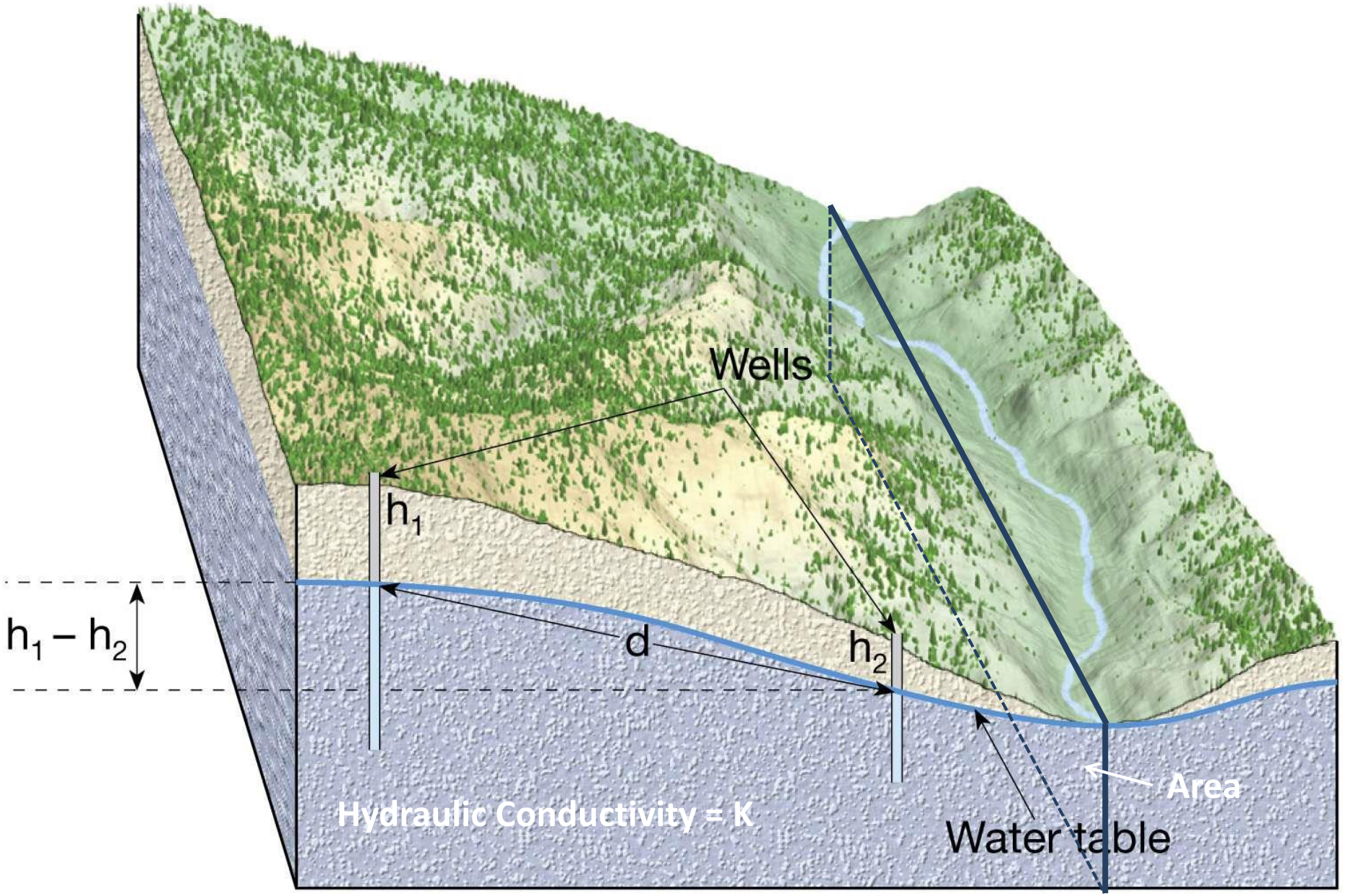
- Poor Permeability
- Good Porosity

Hydraulic Properties

Darcy's Law

$$Q = KIA$$

- Q: Flow
- K: Hydraulic Conductivity
- I: Gradient
- A: Area

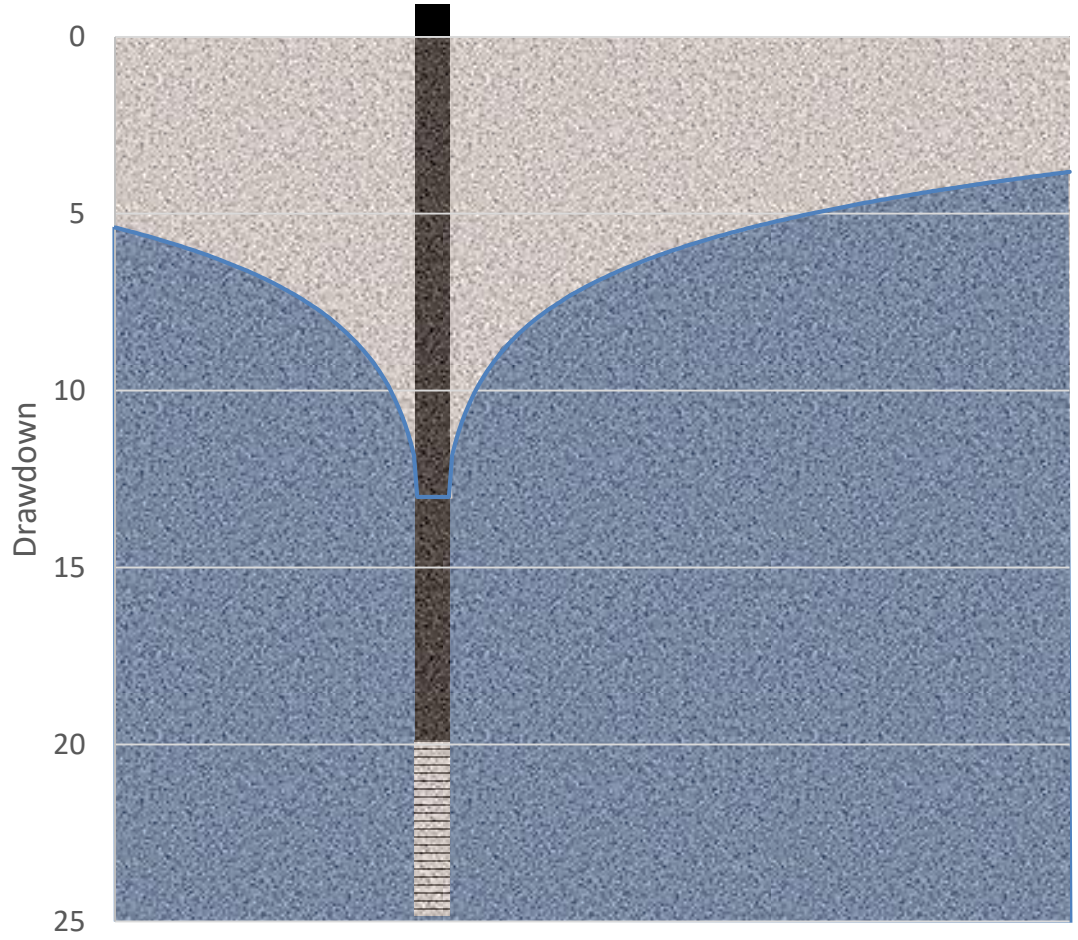


Q = KIA

$$\text{Hydraulic gradient} = \frac{h_1 - h_2}{d} = I$$

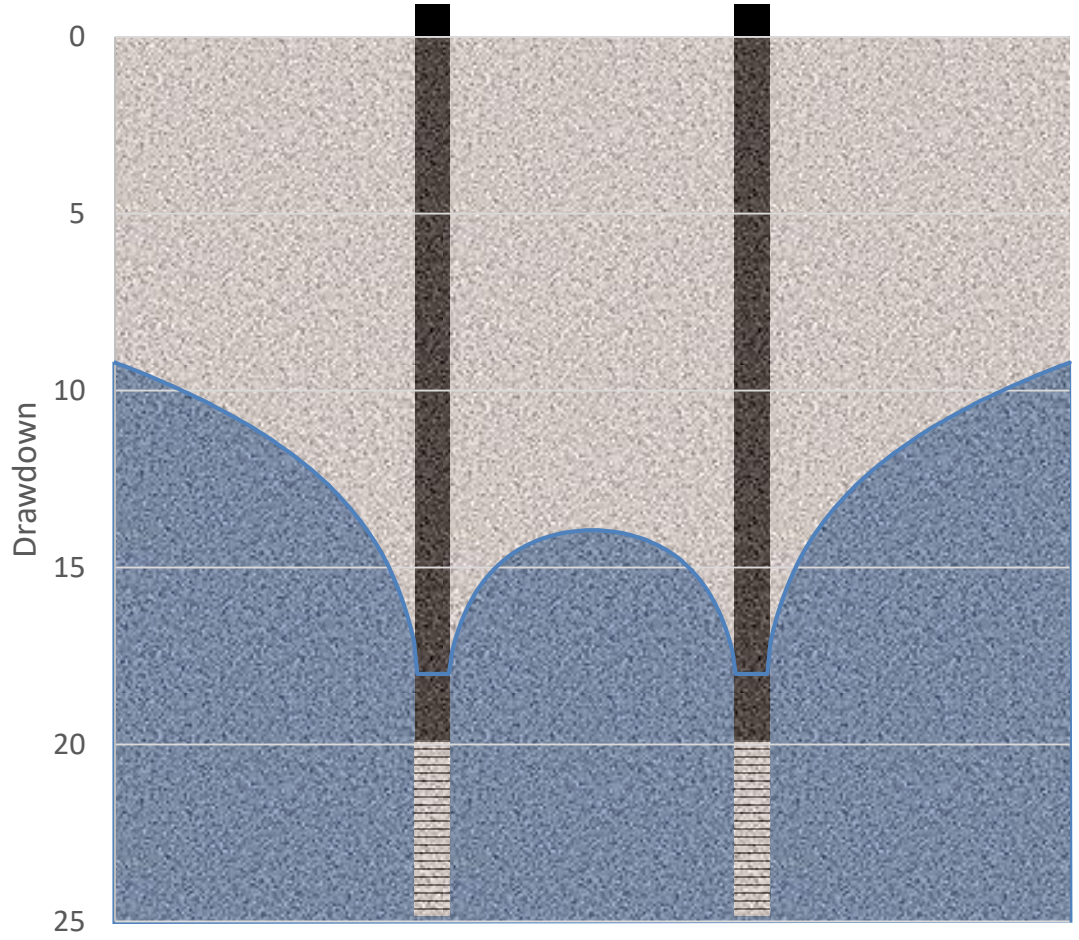
Existing User – Effects of Pumping

- To produce groundwater, water level declines must occur
- Can determine potential drawdown with 5 variables
  - Pumping rate
  - Transmissivity
  - Storage coefficient
  - Time
  - Distance



Existing User – Effects of Pumping

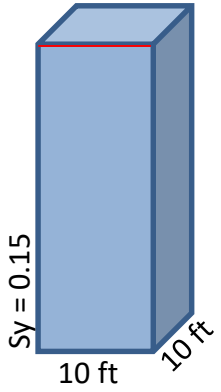
- Interference drawdown
- Modeling to predict water level declines
  - Analytic – e.g., Theis (1935)
  - Numeric – e.g., TWDB GAM



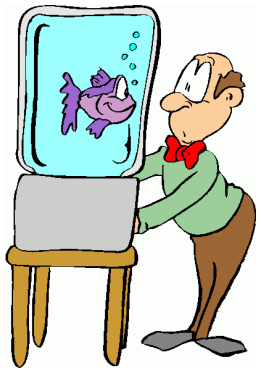
Water Level Change and Aquifer Storage

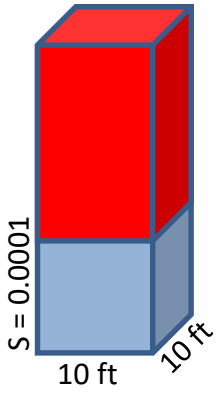
- Unconfined Aquifer
  - High storage coefficient or specific yield (e.g., 0.15)
  - Water level at atmospheric pressure
  - More water for smaller change in water level

- Confined Aquifer
  - Low storage coefficient (0.0001)
  - Aquifer under higher pressure
  - More change in water level for less water



½ inch of drawdown = happy fish

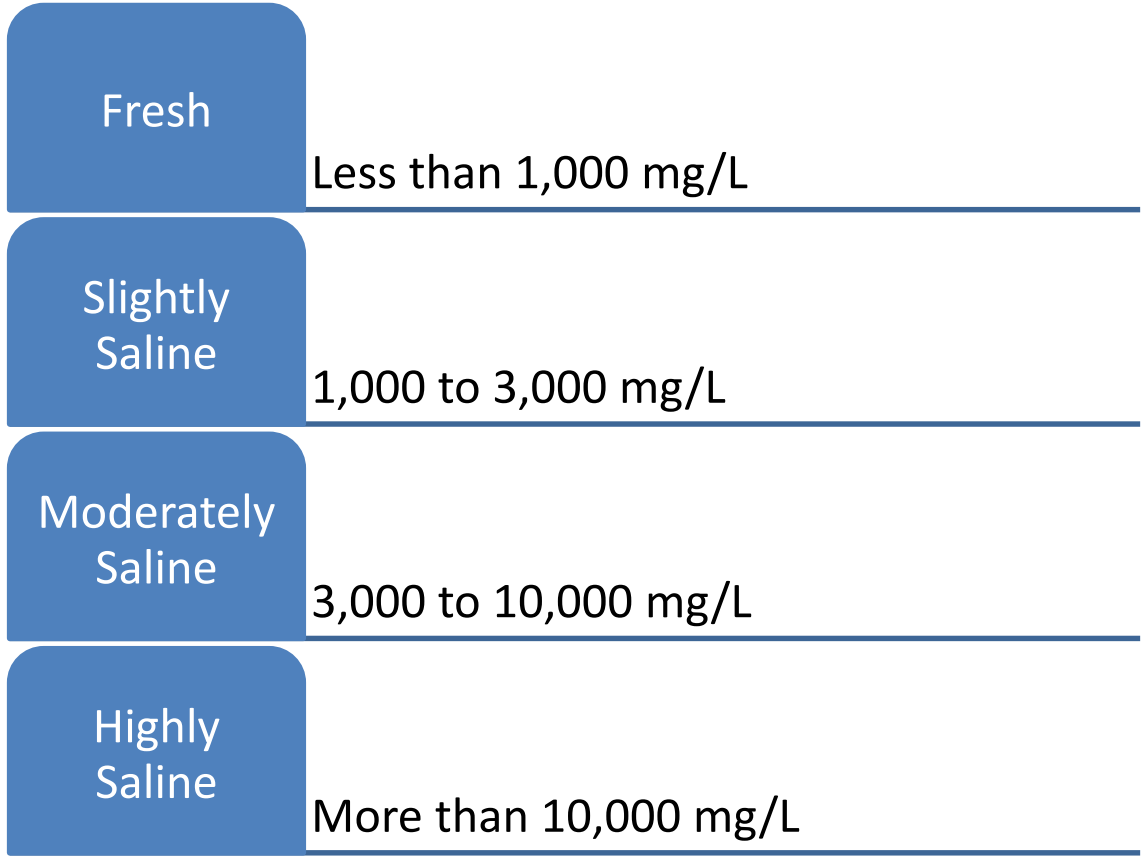




67 feet of drawdown = 5 gallons

Water Quality

- Total dissolved solids
- Rock type affects water quality
- Important that wells are completed properly



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Summary

- Groundwater is currently and will continue to be an important source of water for Texas

- Understanding how groundwater moves through aquifers will help you determine how much is available for a proposed use

Other Resources

- TWDB Groundwater Educational Videos: http://www.twdb.texas.gov/groundwater/video/index.asp

- National Ground Water Association: https://www.ngwa.org/what-is-groundwater/About-groundwater

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QUESTIONS

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