presented by Steven T. Finch, Jr. CPG, PG

JSAI

INTRODUCTION TO GROUNDWATER FLOW MODELS

LESS SALT. MORE WATER.
MSSC
Multi-State Salinity Coalition

2018 Annual Meeting

OUTLINE

- Ten Commandments for Hydrogeologists
- Groundwater Flow Modeling Concepts
  - Pressure Response Versus Travel Time
  - Head Gradients
  - Well Construction and data validity
  - Recharge Mechanisms
- Modeling Water Supply Strategies

TEN COMMANDMENTS For Hydrogeologist

from Dawn H. Garcia (1998)

I. Thou shall not assume isotropy, homogeneity, or uniform gradient without field evidence.

II. Thou shall not assume wells or streams to penetrate fully or flow systems to be two-dimensional.

III. Thou shall not use regional data to make site-specific judgements.

IV. Thou shall not use color graphics to enhance lousy science.

V. Thou shall not employ geostatistics to obfuscate poor interpretations or weak conclusions.

VI. Thou shall not rely on stochastic methods to disguise insufficient field data.

VII. Thou shall not place geochemical interpretations above hydraulic interpretations.

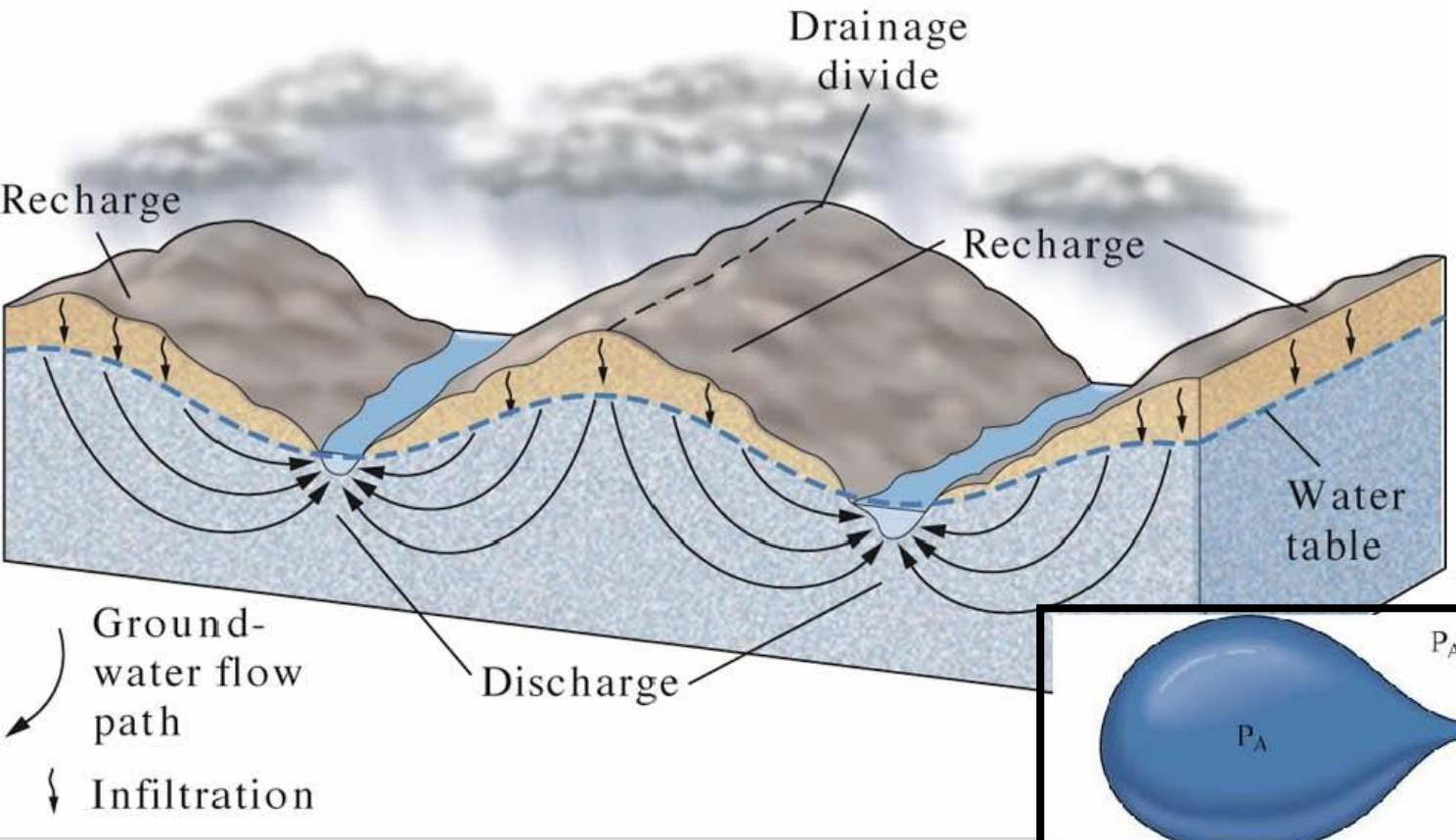
VIII. Thou shall never regard geophysics as the truth.

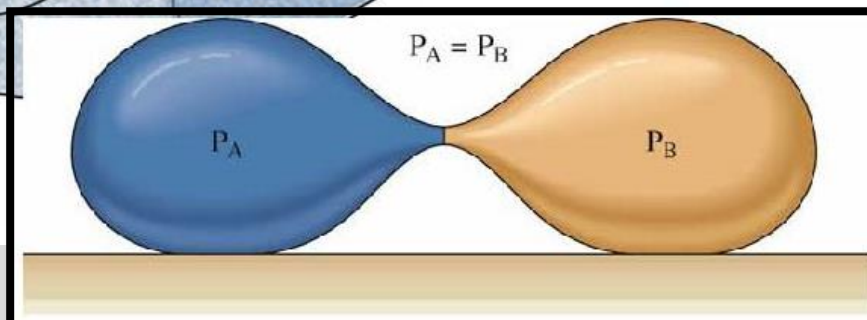
IX. Thou shall never use a contouring program to make a water-table map.

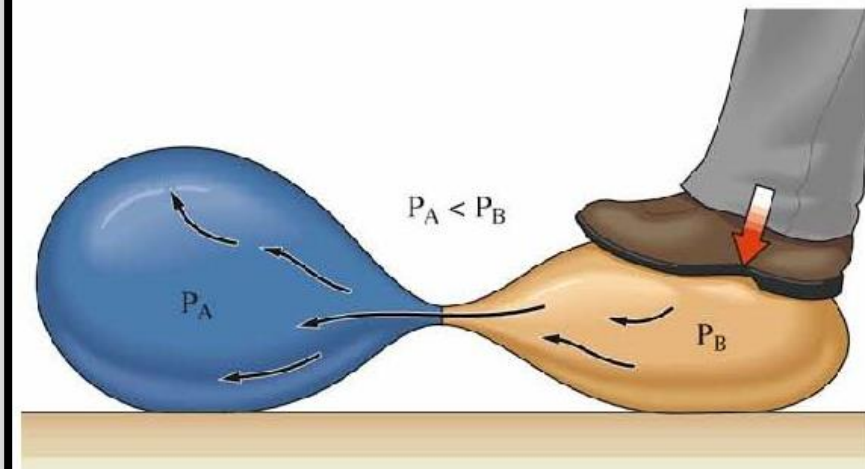
X. Thou shall never use more than three significant digits.

GROUNDWATER FLOW MODELING CONCEPTS

from Schaller (2009)



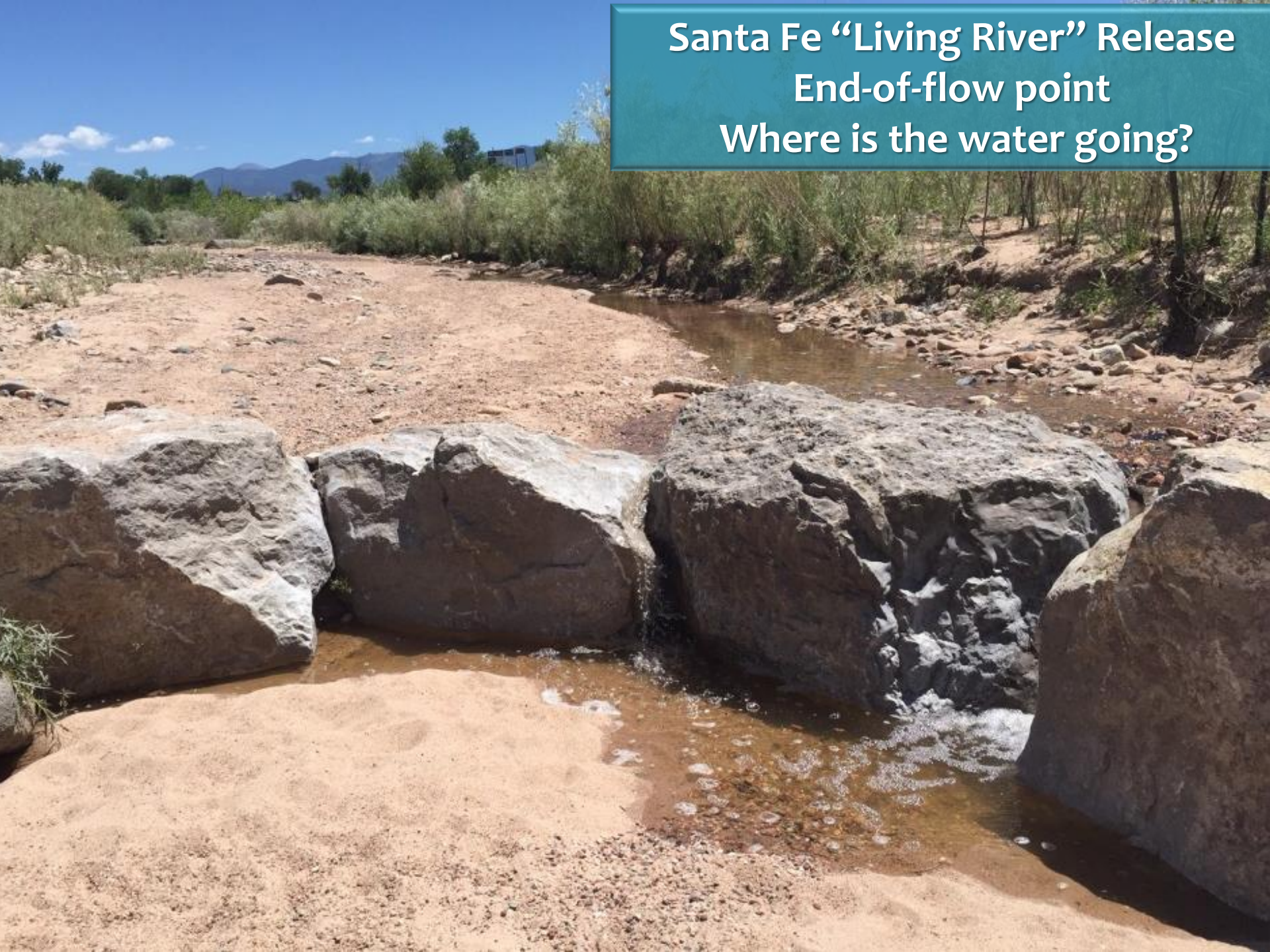




Differences in pressure (due to head) = groundwater flow

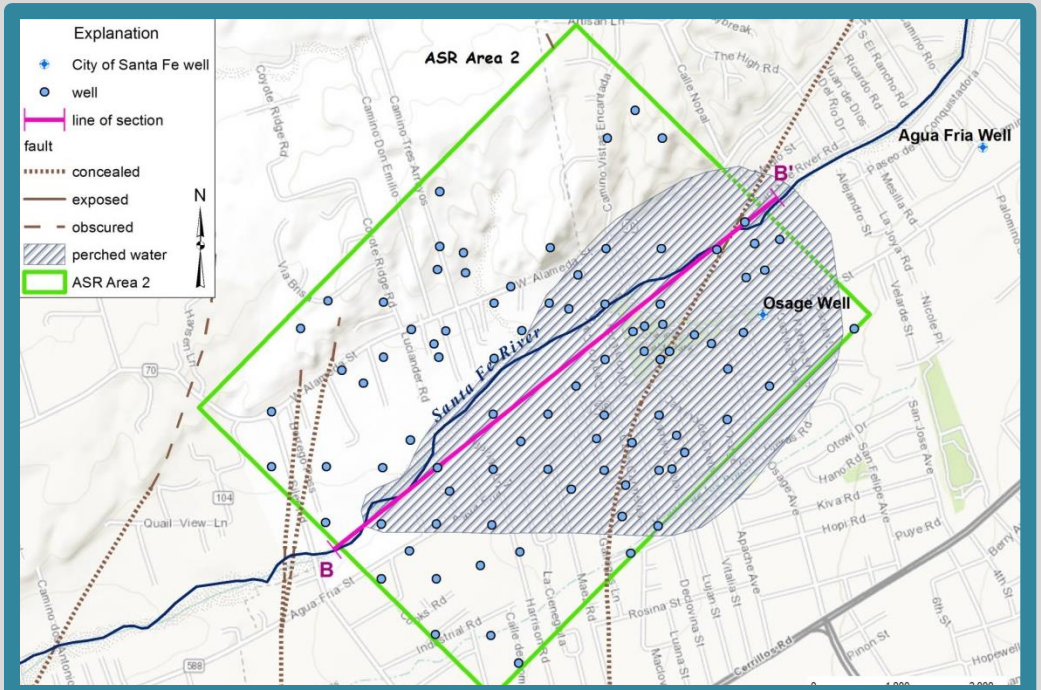
Recharge = P – ET

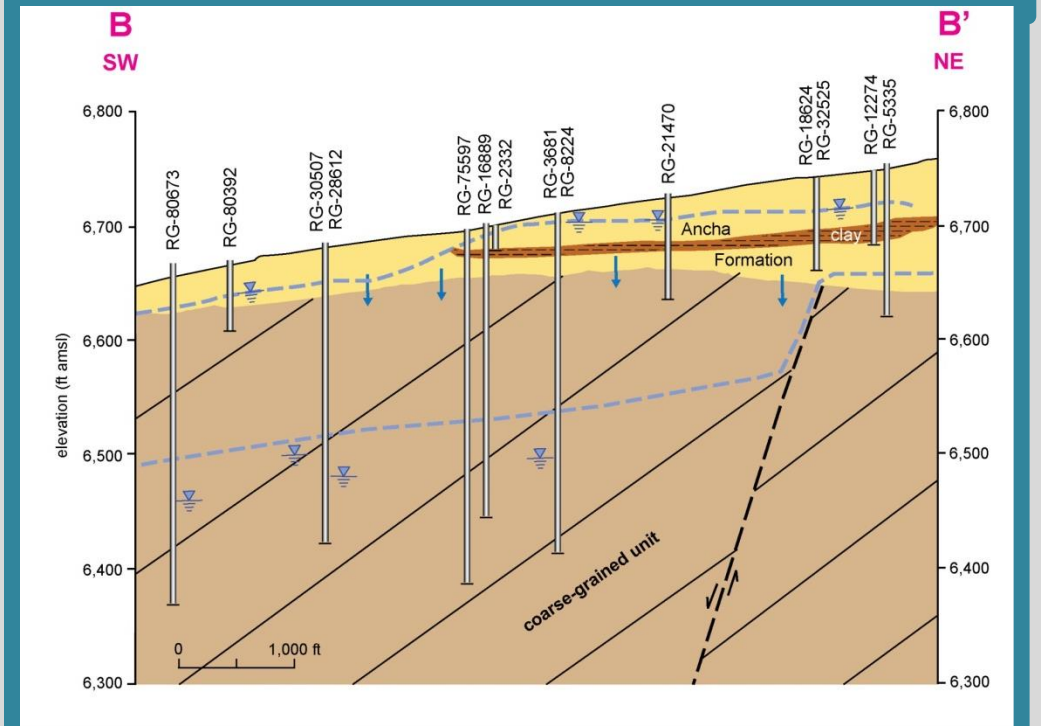
Discharge = Qr + Qg


Santa Fe “Living River” Release
End-of-flow point
Where is the water going?

MODELING ASR

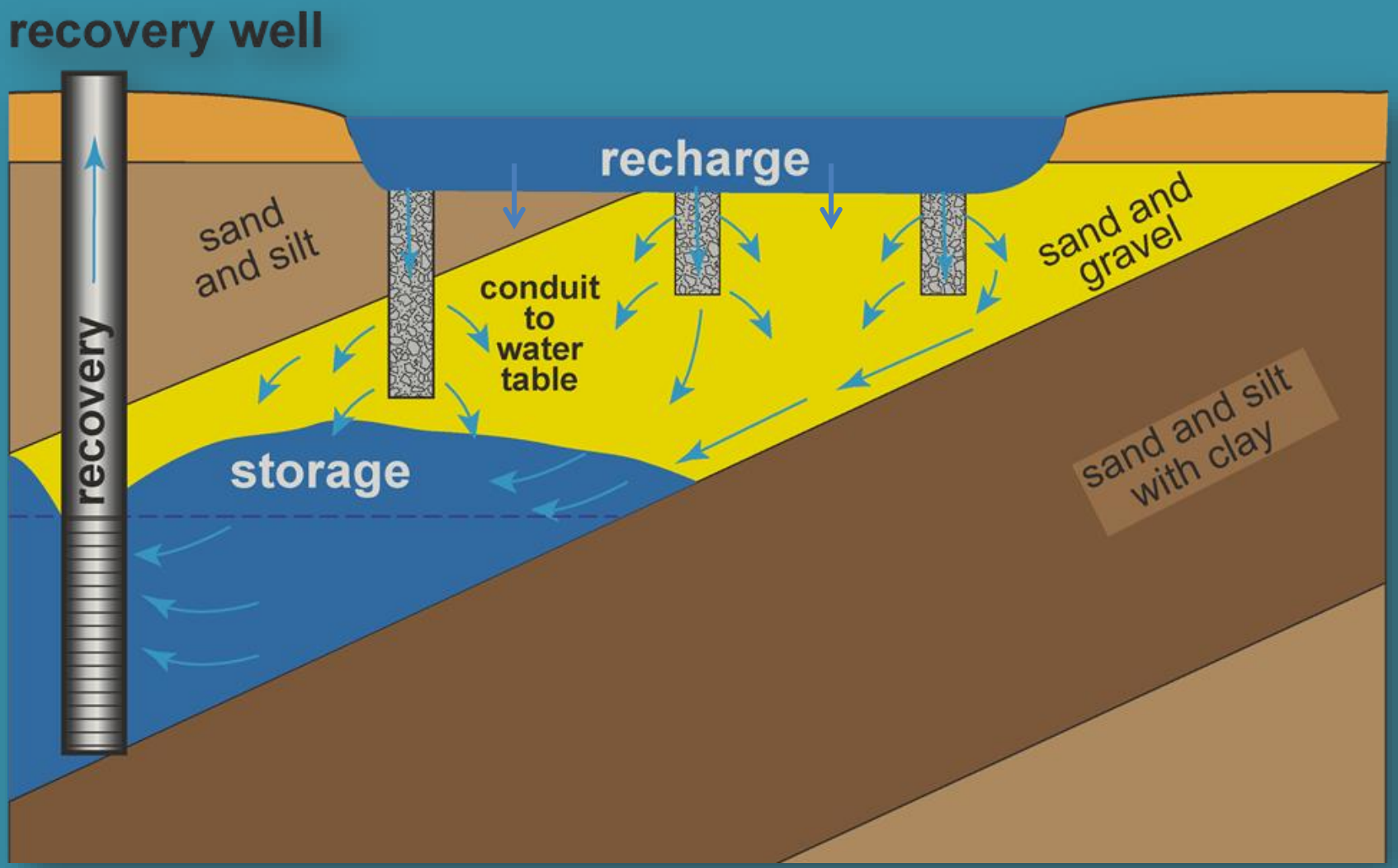
- Head Gradients
- Storage Capacity
- Recovery Efficiency



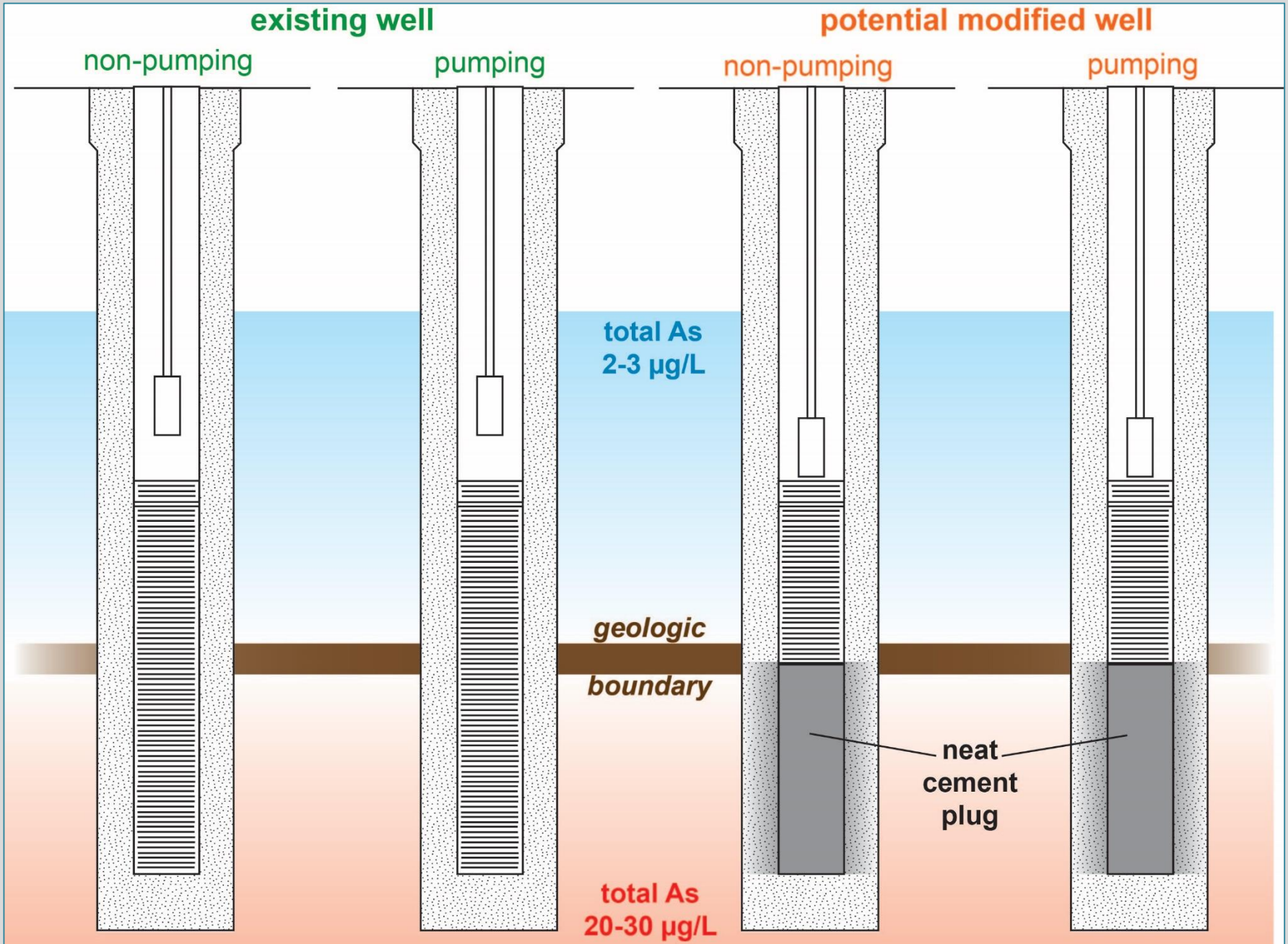


Infiltration Basin

modified with gravel filled boreholes



AQUIFER AND WELL HYDRAULICS CONCEPTUAL MODEL



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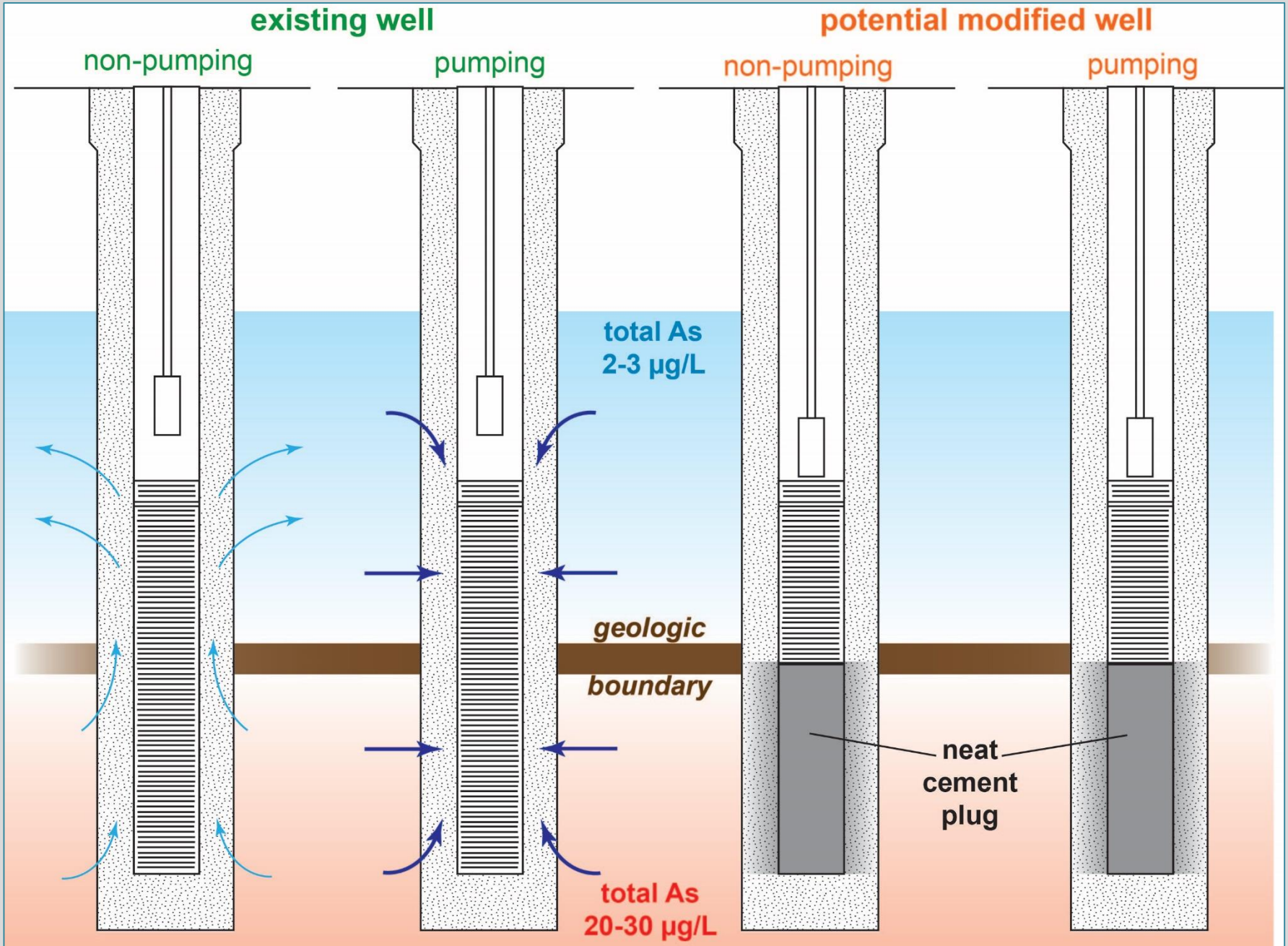

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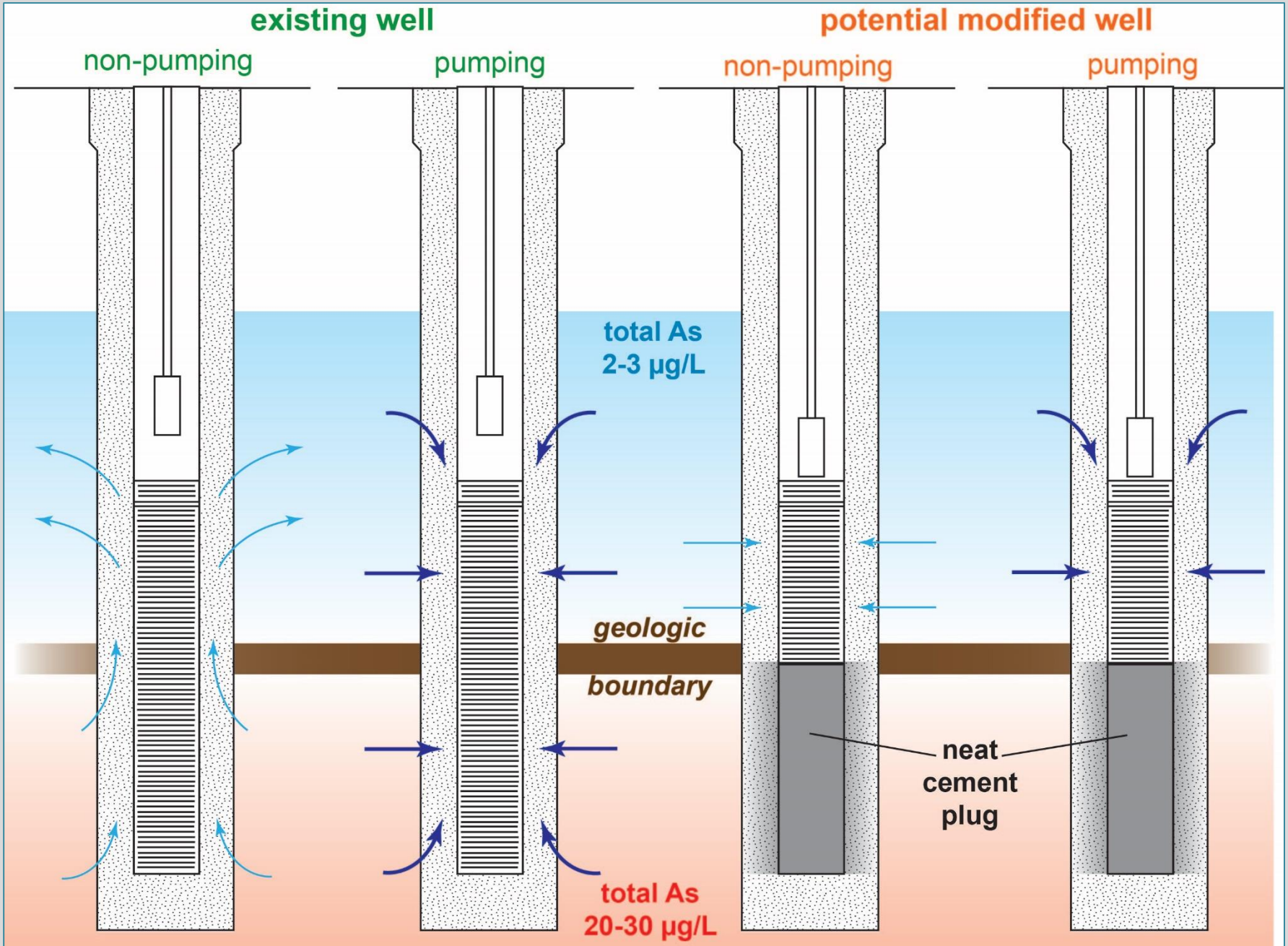
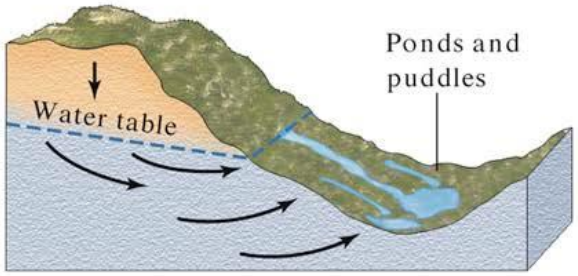
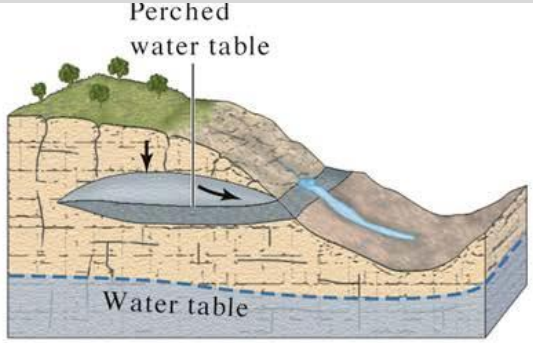
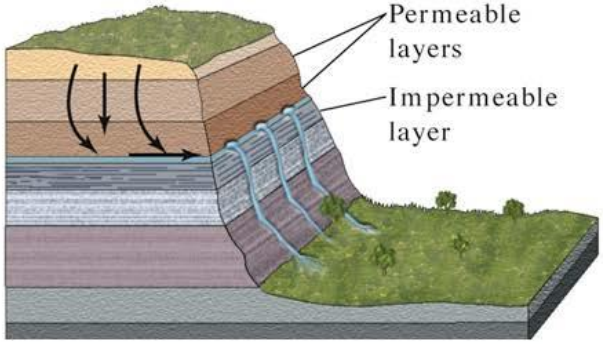
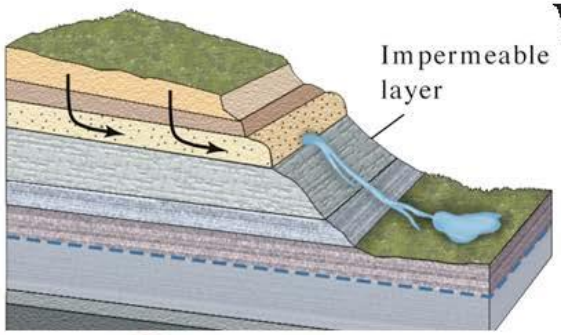


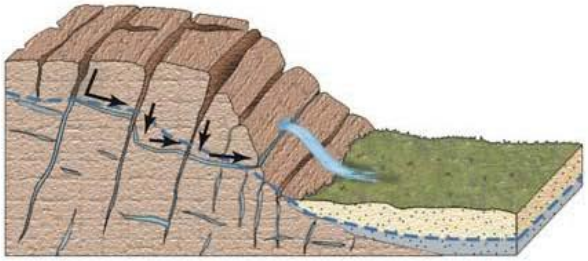


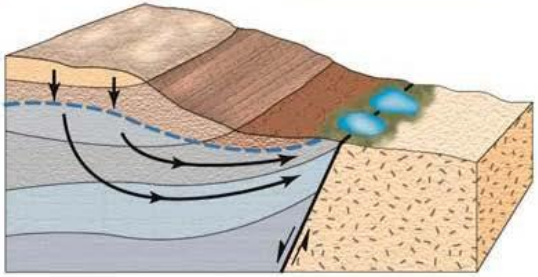


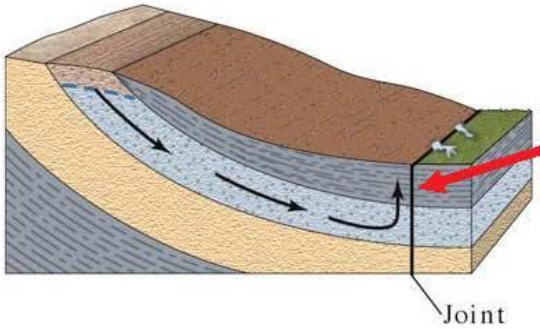
<u>Springs:</u> where Groundwater becomes surface water







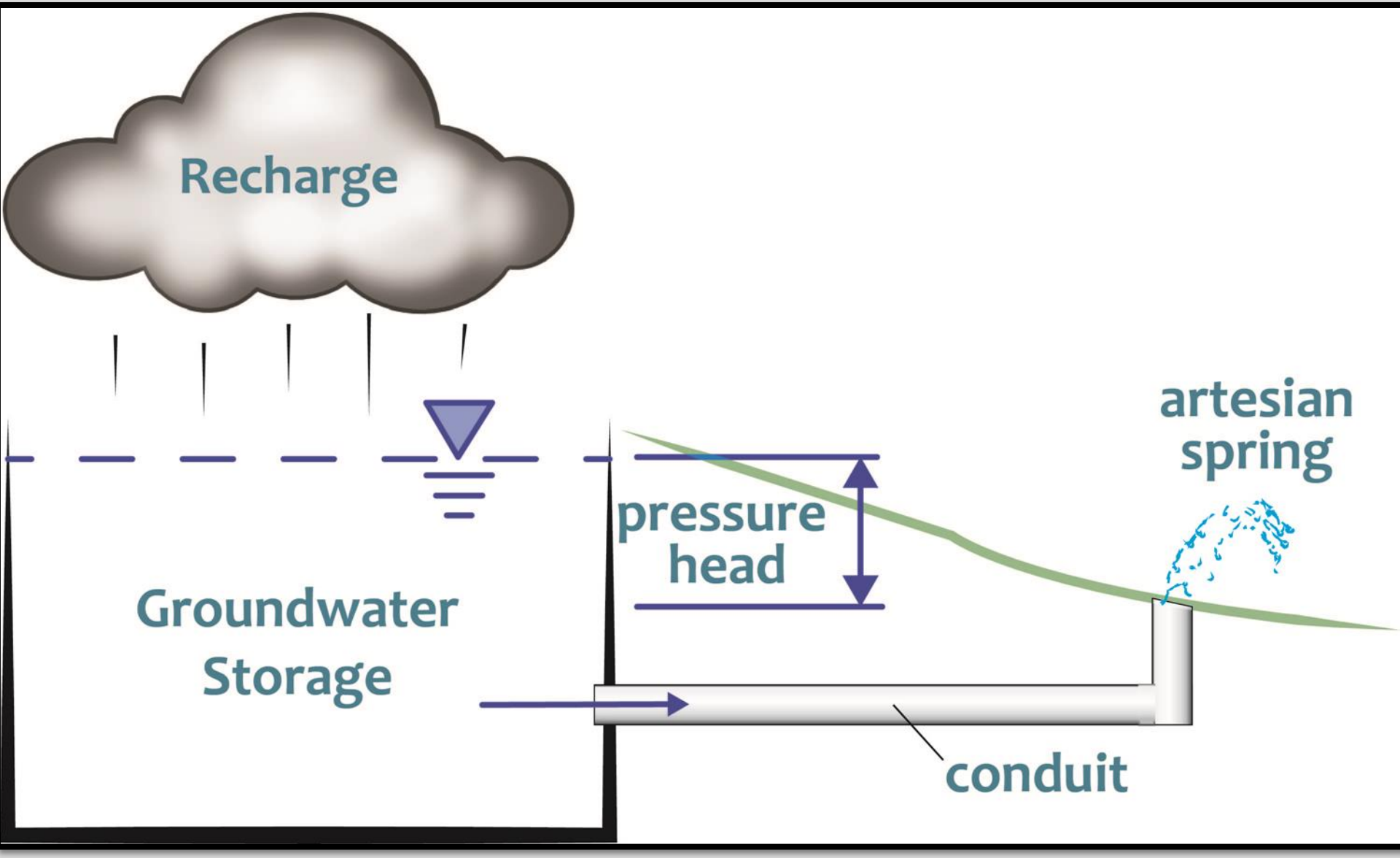




Artesian spring

from Schaller (2009)

IS IT RECHARGE OR GROUNDWATER STORAGE SUSTAINING THE SPRINGFLOW?

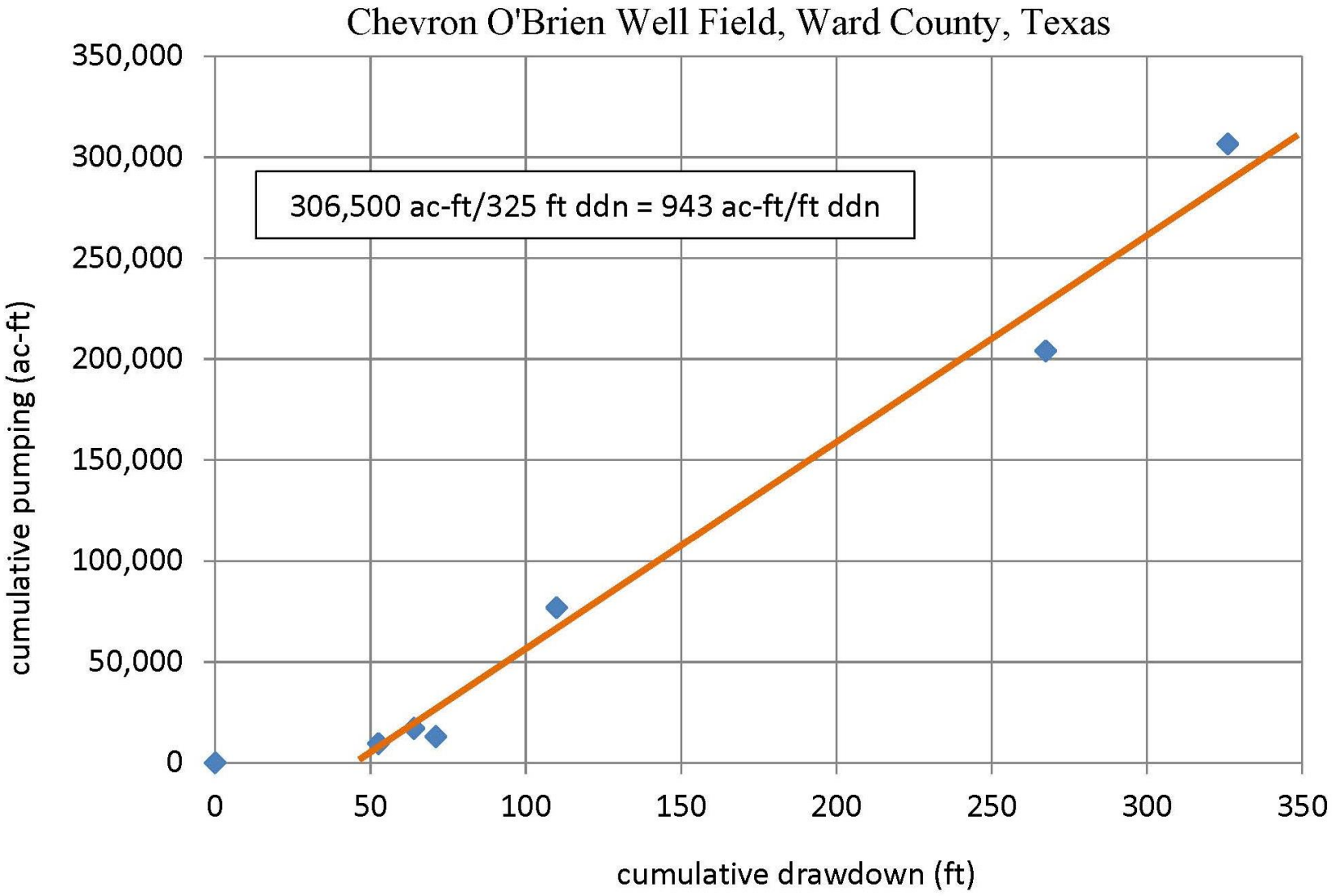


MODELING WATER SUPPLY STRATEGIES

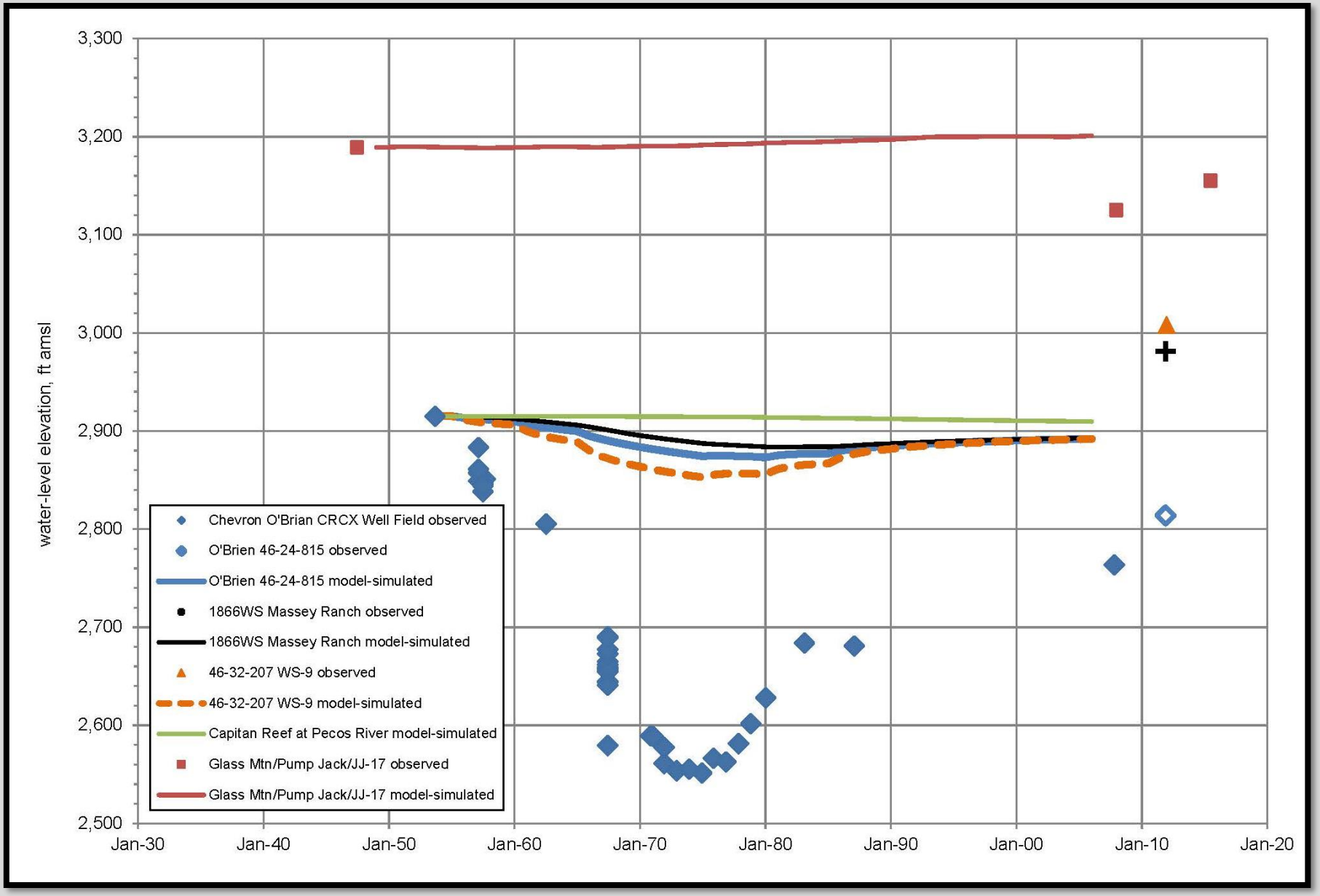
WHAT IS NEEDED TO GET THE JOB DONE?

HOW MUCH CAN I PUMP THIS BRACKISH AQUIFER?

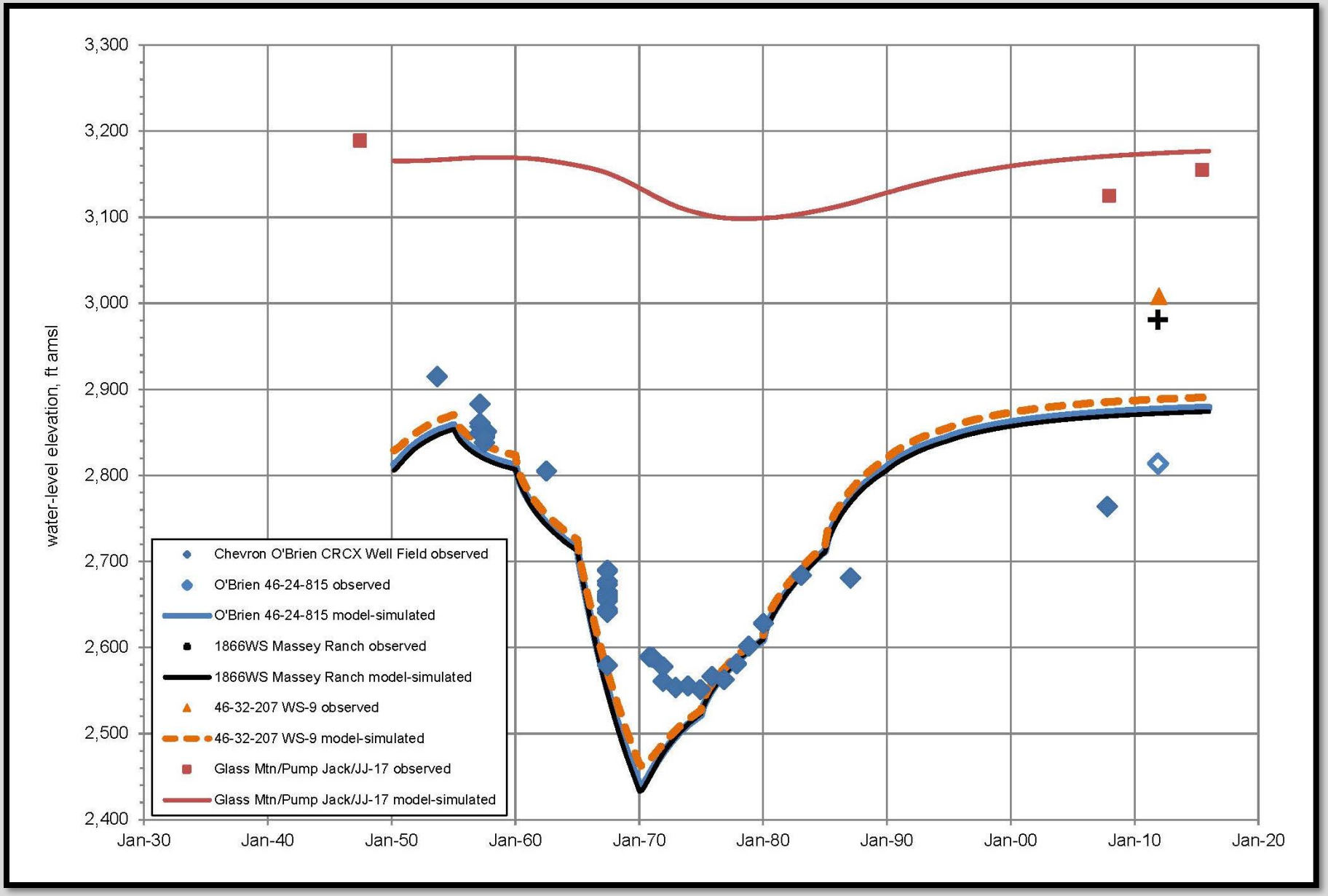
DATA ANALYSIS VS MODEL



BAD MODEL


water-level elevation, ft amsl
3,300
3,200
3,100
3,000
2,900
2,800
2,700
2,600
2,500
Jan-30
Jan-40
Jan-50
Jan-60
Jan-70
Jan-80
Jan-90
Jan-00
Jan-10
Jan-20
Chevron O'Brian CRCX Well Field observed
O'Brien 46-24-815 observed
O'Brien 46-24-815 model-simulated
1866WS Massey Ranch observed
1866WS Massey Ranch model-simulated
46-32-207 WS-9 observed
46-32-207 WS-9 model-simulated
Capitan Reef at Pecos River model-simulated
Glass Mtn/Pump Jack/JJ-17 observed
Glass Mtn/Pump Jack/JJ-17 model-simulated

GOOD MODEL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CONCLUSIONS

1. Understand Your Data
    a. Source of water and accounting method
    b. Locations for recharge and recovery
    c. Recharge and recovery methods
2. Conceptual Model that obeys the Ten Commandments for Hydrogeologist
3. Groundwater Flow Modelers are sometimes like Carpenters – they blame their tools