Building Water Resiliency: ASR Project Updates City of Temple and Fort Hood

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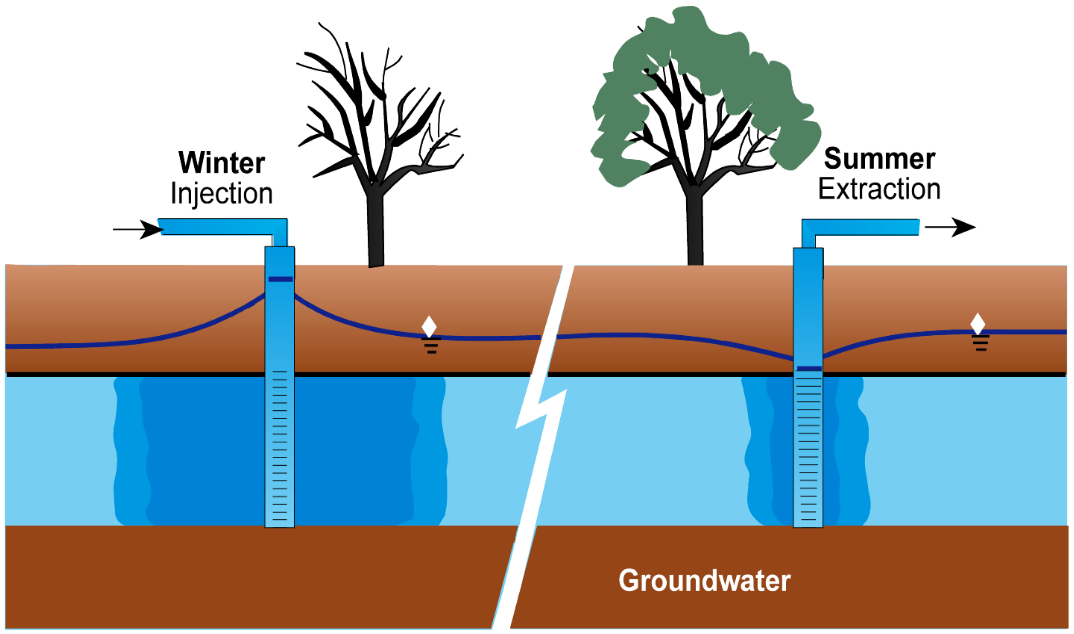
INTERA

Outline

- Need For Resiliency
- ASR Concepts
- Why the Hosston Aquifer?
- Fort Hood: Phased ASR Implementation
- City of Temple: Evaluating ASR Wellfield Layouts and Options for using Advance Treated Wastewater



Acknowledgements

- Fort Hood ASR
  - Fort Hood
  - Bell County WCID#1
  - Clearwater Underground Water Conservation District
  - Killeen EDC
  - City of Harker Heights
  - City of Copperas Cove
  - Copperas Cove Chamber
  - CDM Smith
- Temple/Rowan Lower Trinity Well
  - City of Temple
  - Rowan
  - Billy Gamblin of Gamblin Engineering Group
  - KPA Engineers

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Need for Resiliency

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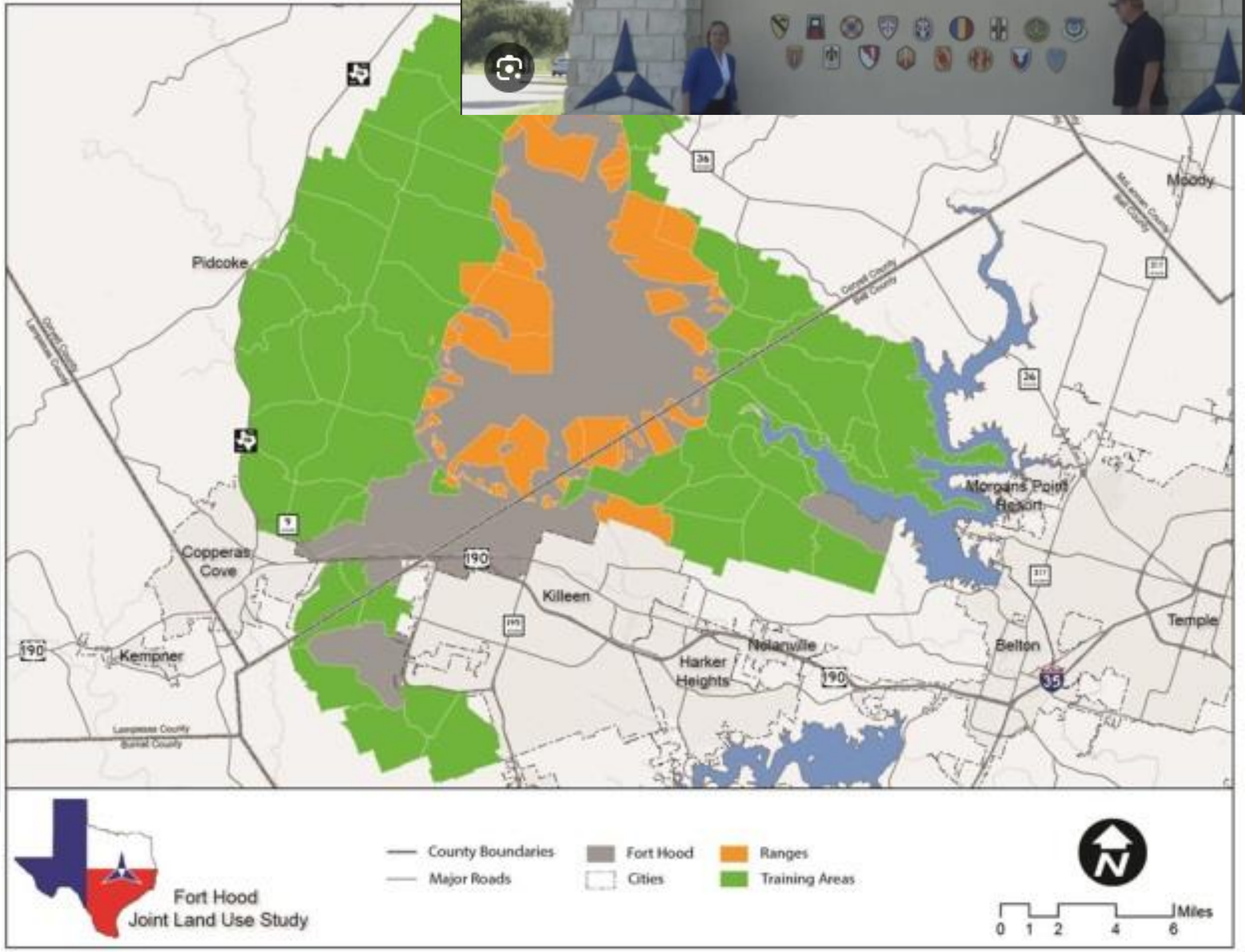
Background: Fort Hood

- Establishment Year: 1942
- Size: Approximately 214,968 acres
- Active Duty Personnel: Around 36,000
- Primary Purpose: It serves as a key location for U.S. Army's armored operations, combat training, and mobilization.



Project Objectives: Fort Hood

- Provide the Army with a redundant source of drinking water, located on post, and available for use in case of drought or emergency
- Increase Fort Hood's resiliency in support of Soldiers, units and families
- Provides value to neighboring communities by reducing water demand in times of need

(Photo Credit: Sgt. Kaden Pitt)

From 2025 FCTX ASR Concept, Brian Dosa, Director of the Directorate of Public Works

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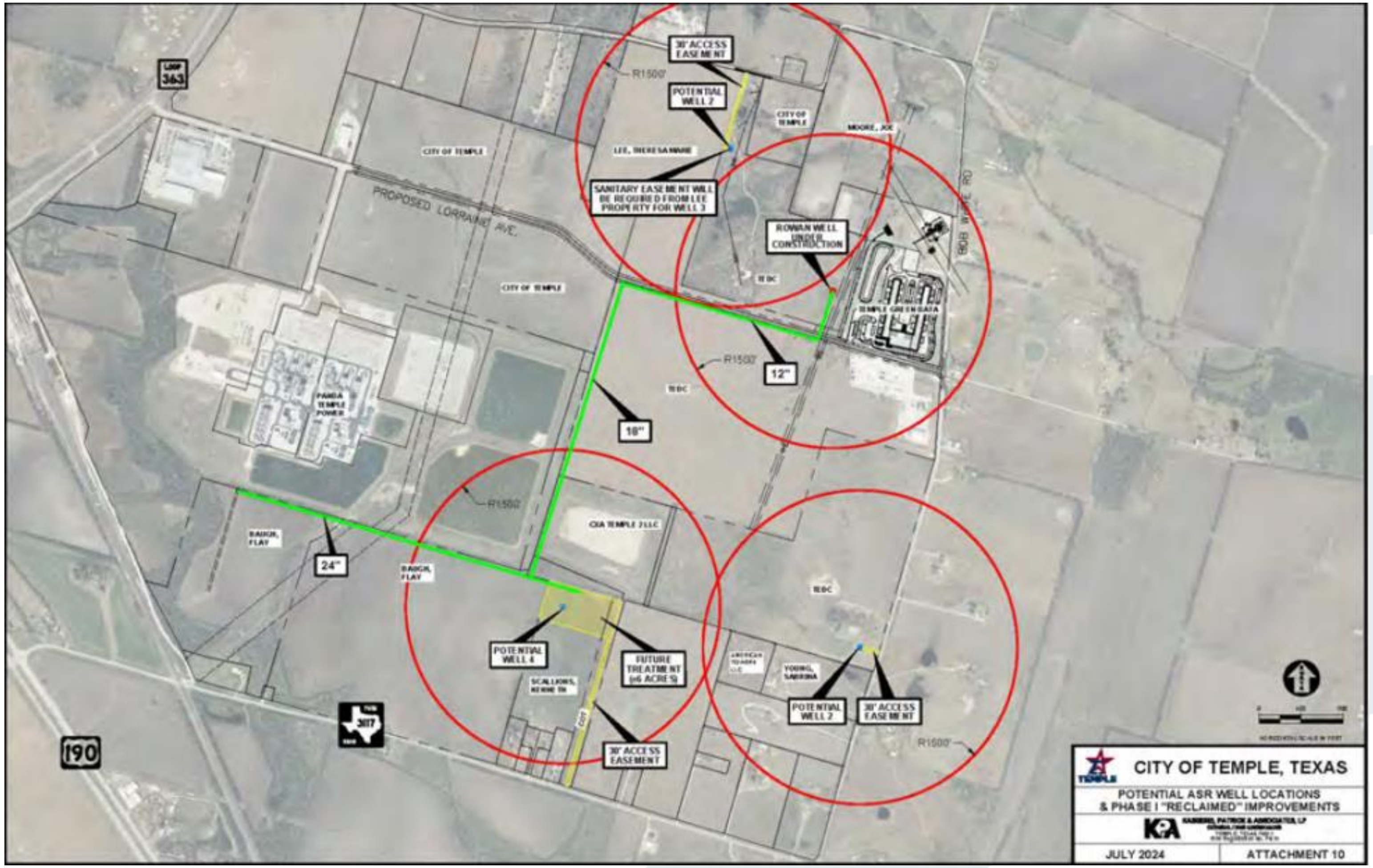
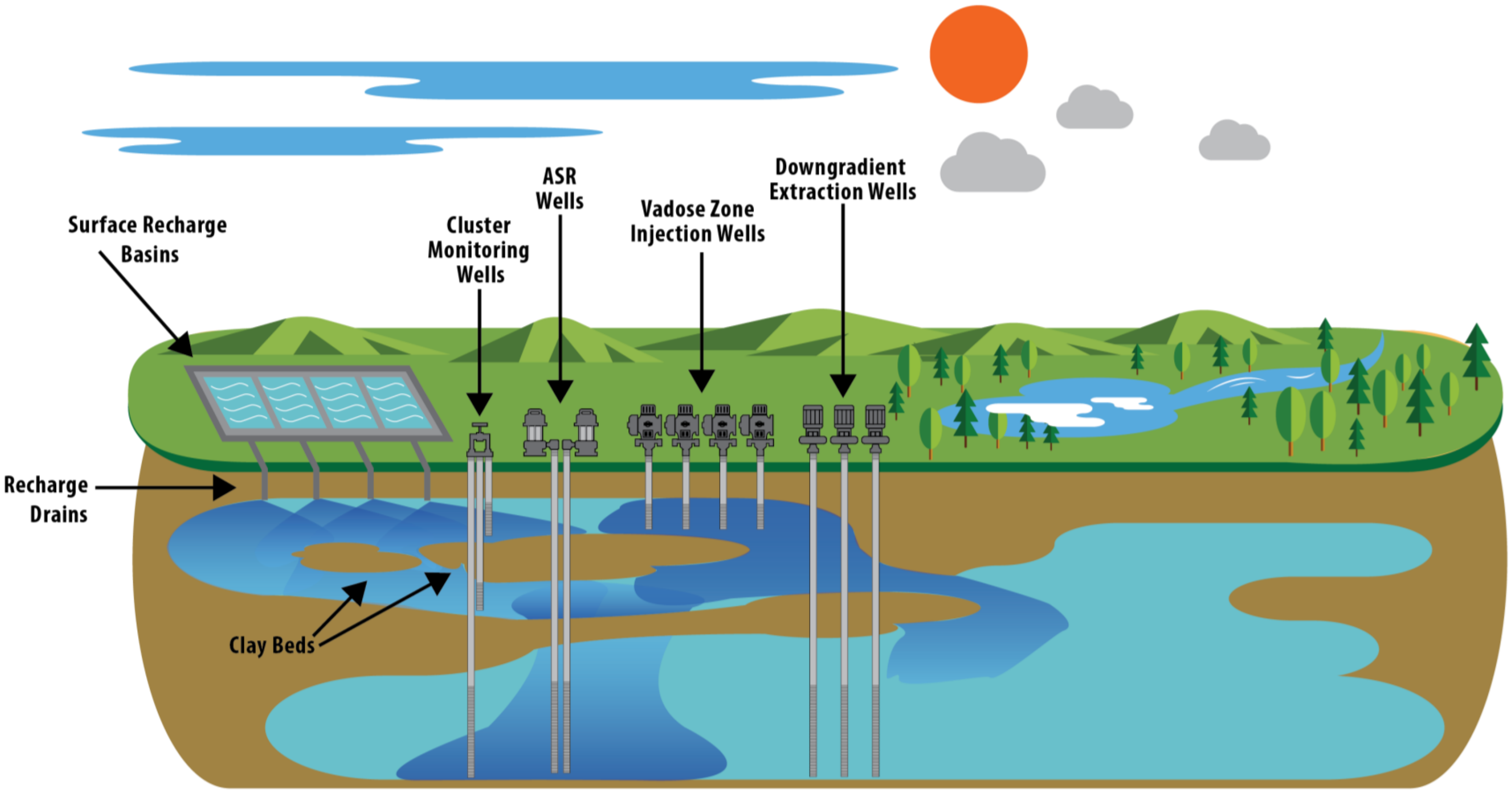
Project Objectives: City of Temple, Developing ASR to meet Significant Industrial Demand



- Long-term, surface water resources may struggle to meet projected peak week industrial demands
- A practical solution, use treated wastewater for non-potable industrial use
- ASR will balance demand variability by storing water when available and recover during high demand periods
- Design and permitting in place for a four-well ASR system, initially using treated surface water and later converted to reclaim water recharge when permit steps are in place

ASR Concepts

Aquifer Storage Recovery (ASR) Defined



- *ASR is one of several managed aquifer recharge (MAR) technologies tailored to the hydrogeologic environment*
- *Typically, a multi-purpose well is used to store water in an aquifer, and the water is then retrieved when needed using the same well*

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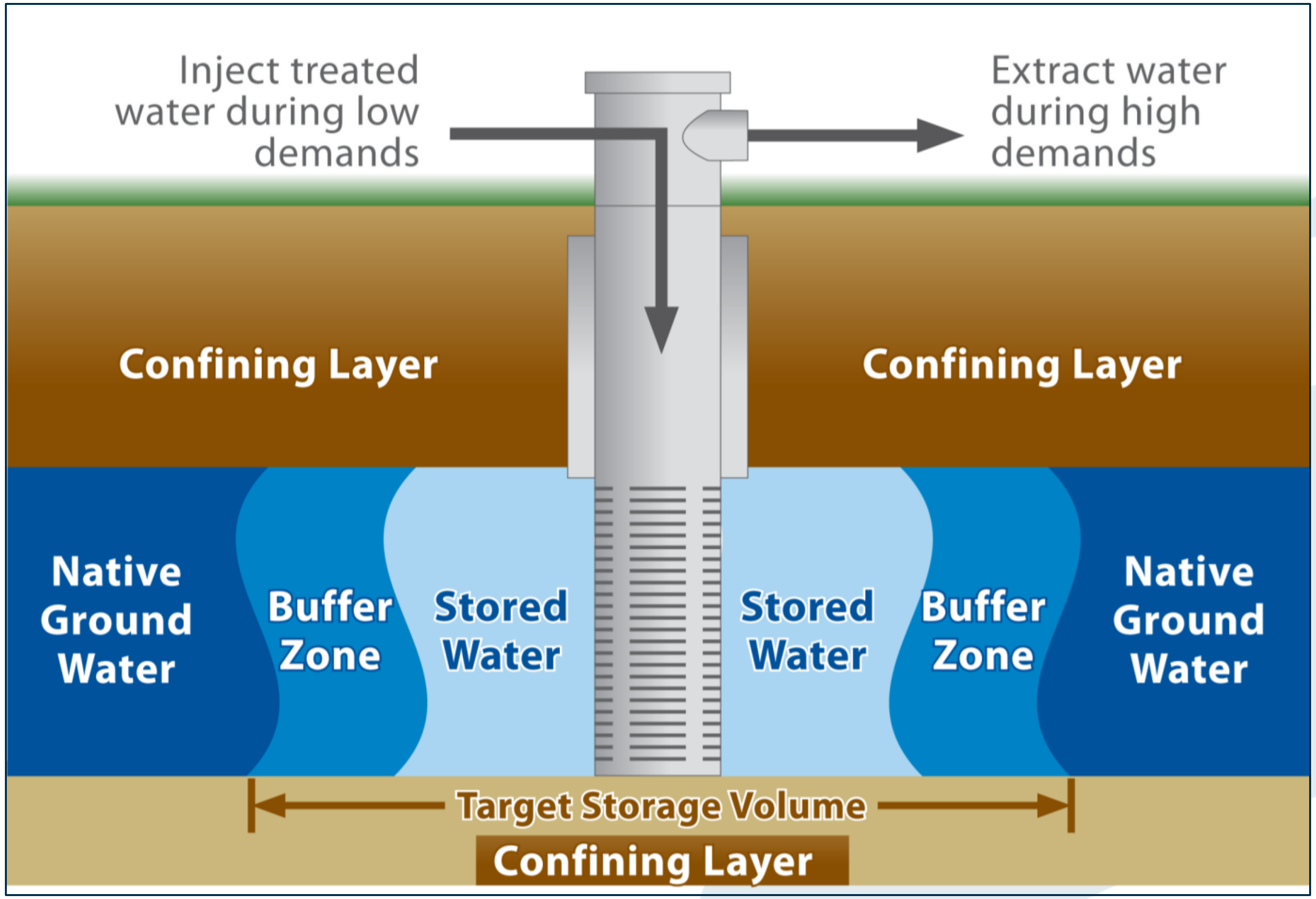
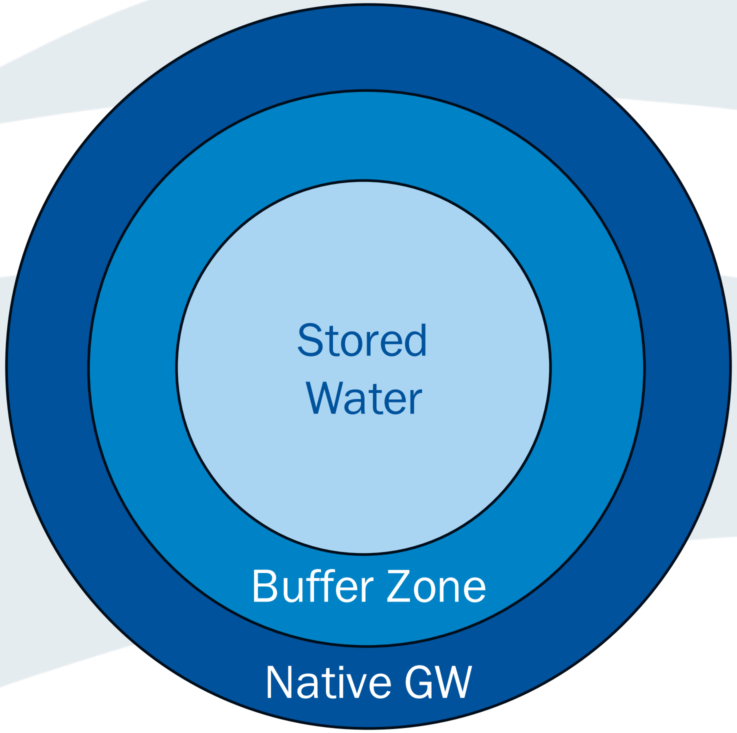
ASR: Concepts

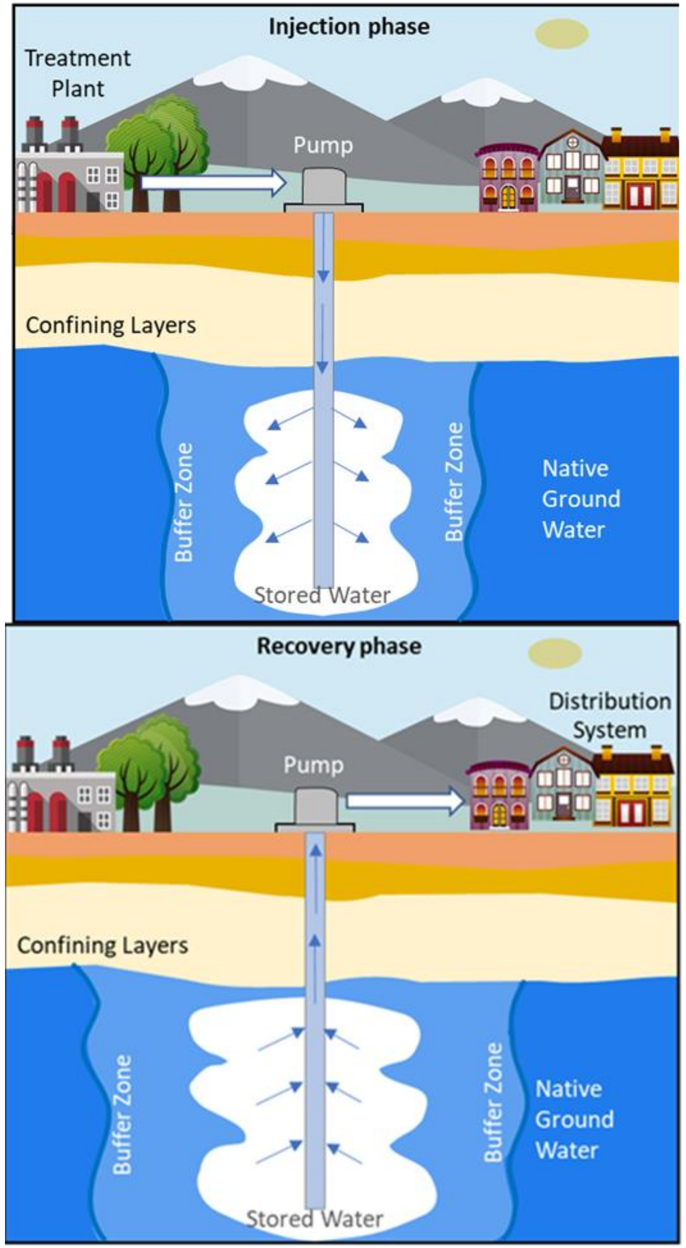
Aquifer Storage and Recovery [30 TAC §331.2(8)]: "The injection of water into a geologic formation, group of formations, or part of a formation that is capable of underground storage of water for later retrieval and beneficial use."

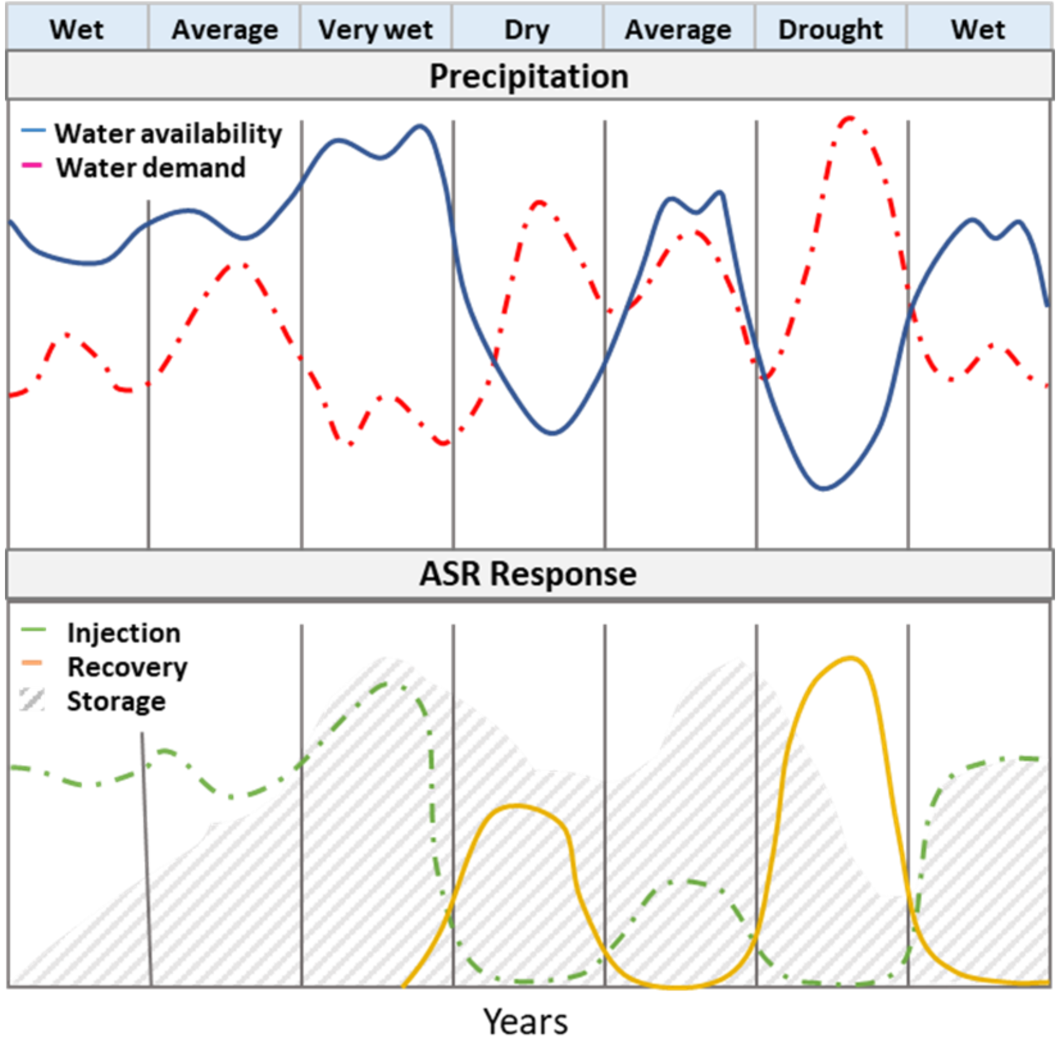


Top View of ASR "Bubble"

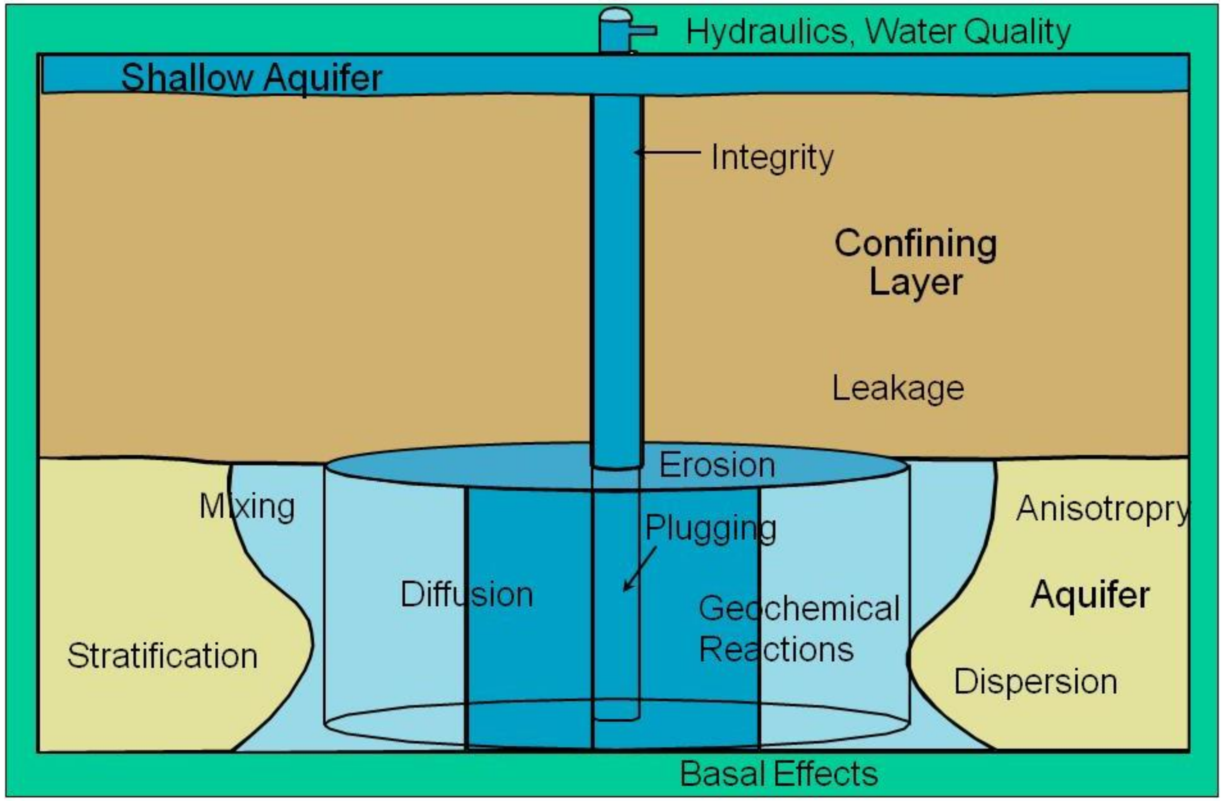


ASR Operation Example





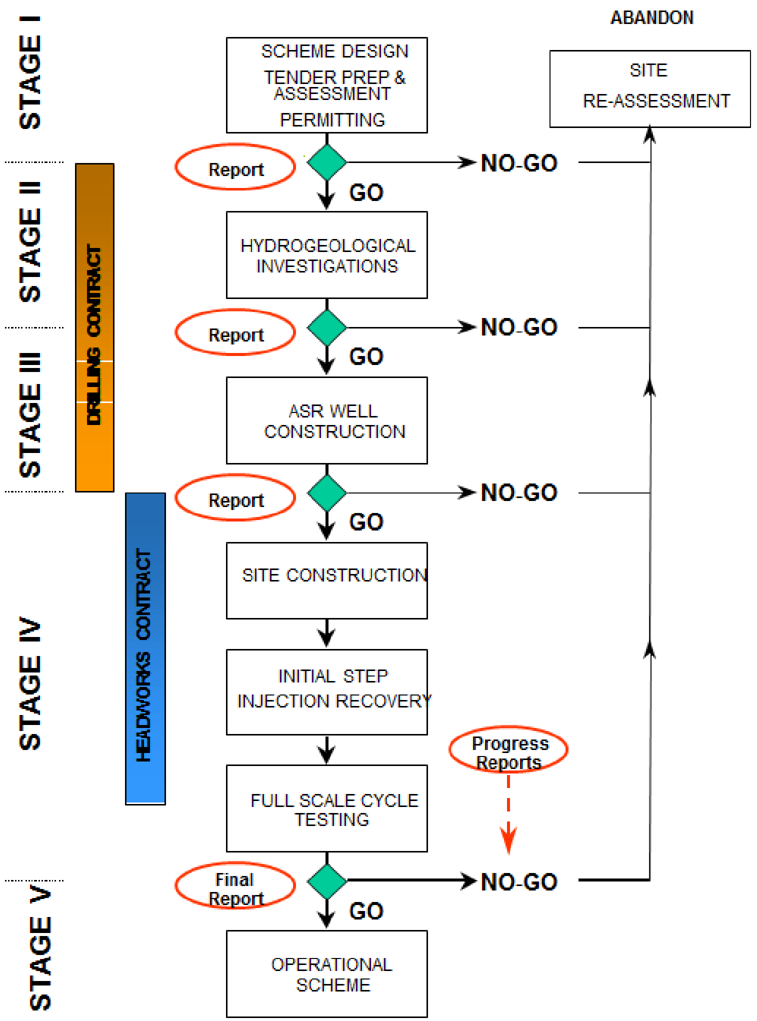
Implementation



“Concept is simple, but carefully phased implementation is preferable to ensure technical challenges are overcome”

The Approach for ASR / MAR

- Planning / Concept
  - Integrated Water Resource Planning, incl Climate Change Scenarios
  - Source Water Evaluations (Stormwater Capture, Reclaim Water)
  - ASR Workshops
  - Water Demand Projections
  - Defining Recharge Objectives
  - Hydrogeologic Evaluations, Geophysics
  - Groundwater Modeling
  - Geochemical Modeling
  - Engineering, incl Planning Level Costs
- Implementation
  - Design ("Groundwater Engineering")
  - Permitting and Stakeholder Participation
  - Test Drilling, ASR Wells
  - Facility Construction
  - Start-Up, System Integration, (Pilot) Testing and Reporting
  - Operational Guidance / Training



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Why the Lower Trinity/Hosston?

Hosston Aquifer: We are still learning

- **Important Note: The "Hosston" and the "Lower Trinity" are names for the same aquifer**
- At the Fort Hood site, the characteristics of the Hosston were largely unknown prior to the aquifer testing program
- At the Temple site, we knew the Hosston was likely to be productive, but how productive?
- Suitability for ASR first explored during the county-wide ASR study commissioned by CUWCD and other key stakeholders in Bell County

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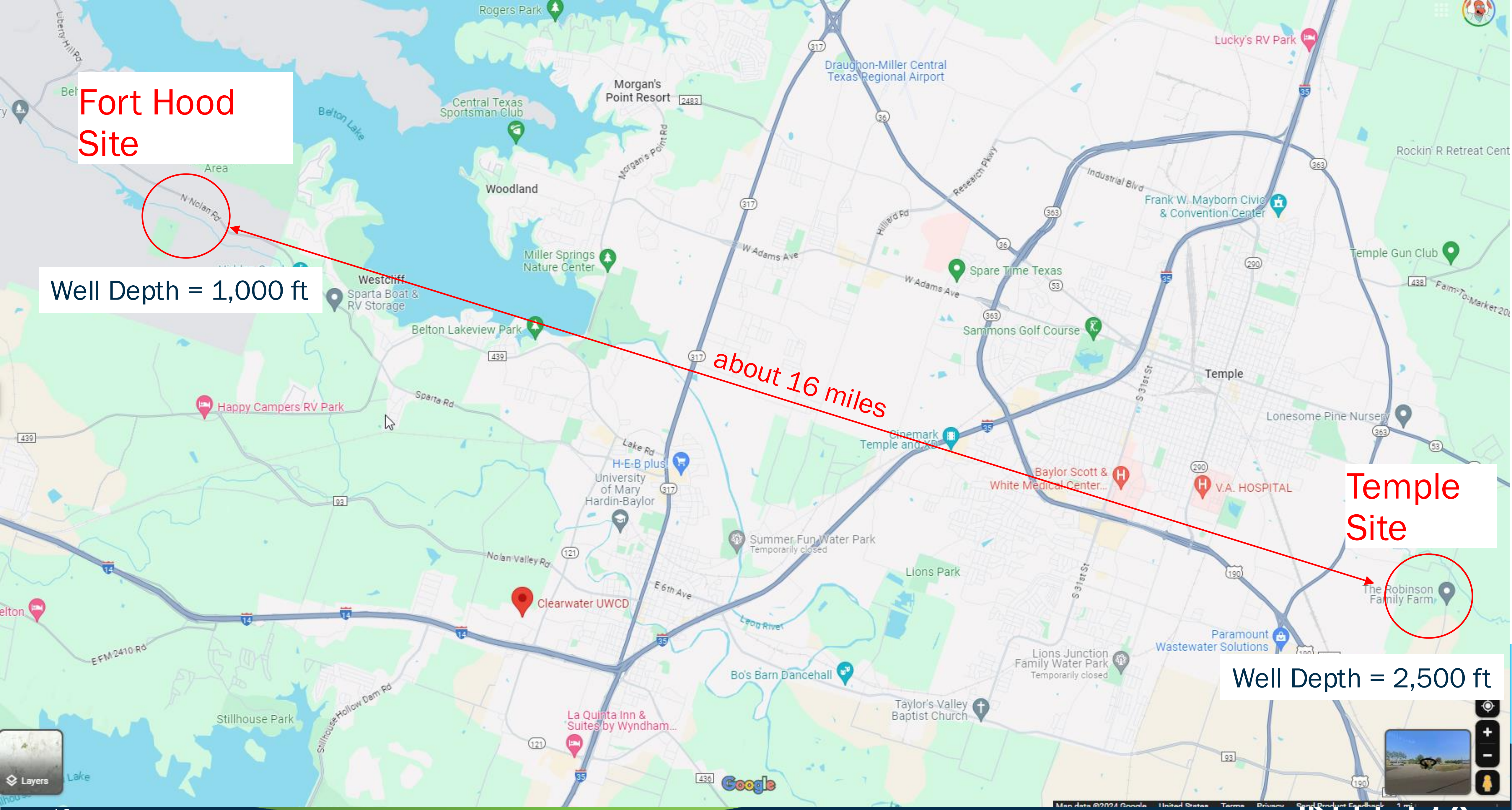
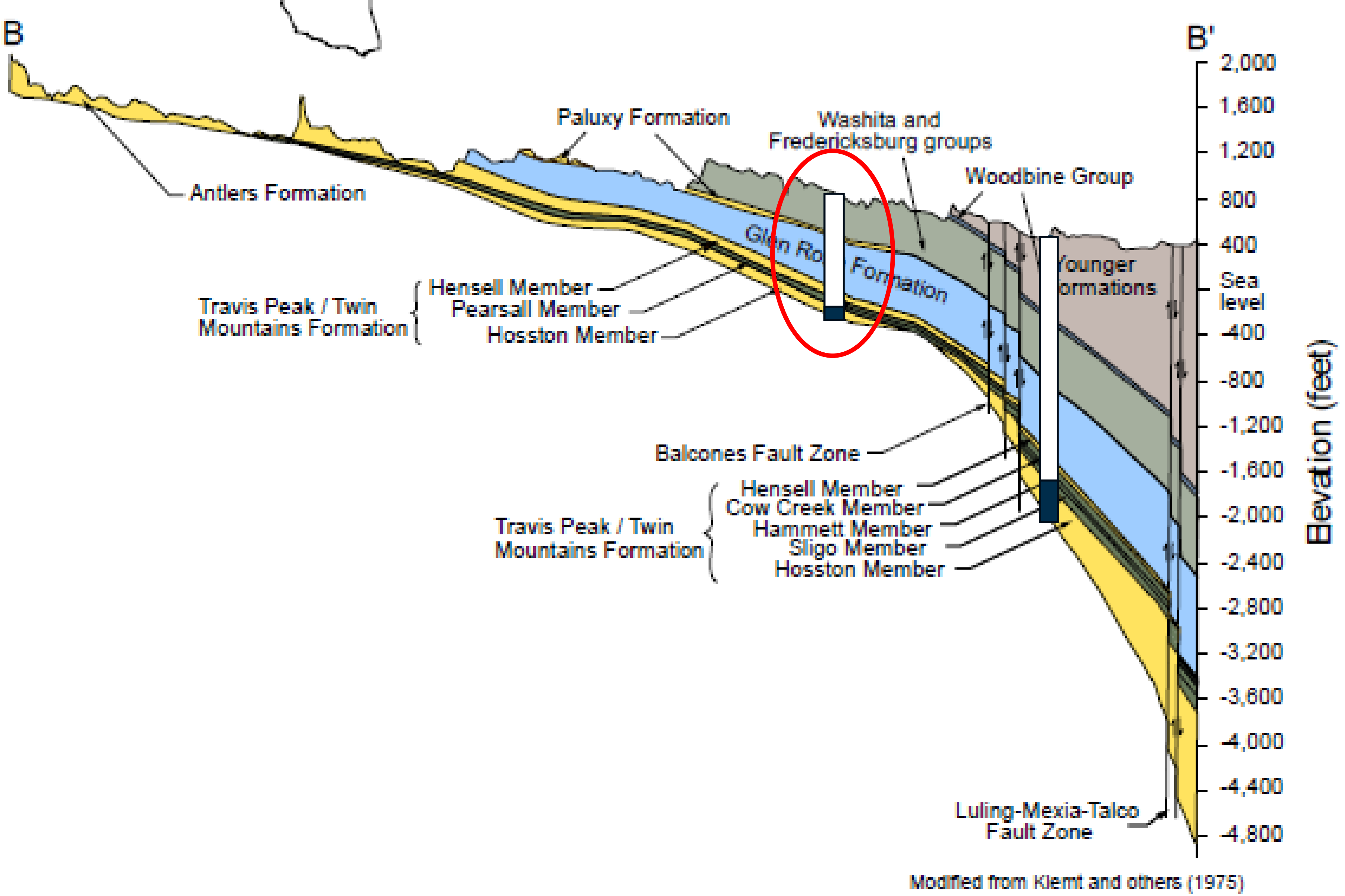

Fort Hood Site
Well Depth = 1,000 ft
about 16 miles
Temple Site
Well Depth = 2,500 ft
Rogers Park
Lucky's RV Park
Draughon-Miller Central Texas Regional Airport
Morgan's Point Resort
Central Texas Sportsman Club
Belton Lake
Woodland
Industrial Blvd
Frank W. Mayborn Civic & Convention Center
Rockin' R Retreat Cent
Temple Gun Club
Miller Springs Nature Center
W Adams Ave
Spare Time Texas
Westcliff
Sparta Boat & RV Storage
Belton Lakeview Park
Sammons Golf Course
Temple
Lonesome Pine Nursery
Happy Campers RV Park
Sparta Rd
Lake Rd
H-E-B plus!
University of Mary Hardin-Baylor
Cinemark Temple and XD
Baylor Scott & White Medical Center...
V.A. HOSPITAL
Summer Fun Water Park
Temporarily closed
Nolan Valley Rd
Lions Park
The Robinson Family Farm
Clearwater UWCD
E 6th Ave
Paramount Wastewater Solutions
Lions Junction Family Water Park
Temporarily closed
E FM 2410 Rd
Bo's Barn Dancehall
Taylor's Valley Baptist Church
Stillhouse Park
La Quinta Inn & Suites by Wyndham...
Layers



This dip section is north of Bell County, but reasonably representative

Figure 2.2.3 Cross sections of the stratigraphic units in the study area (after George and others, 2011; Bené and others, 2004; Nordstrom, 1982; Klemt and others, 1975).

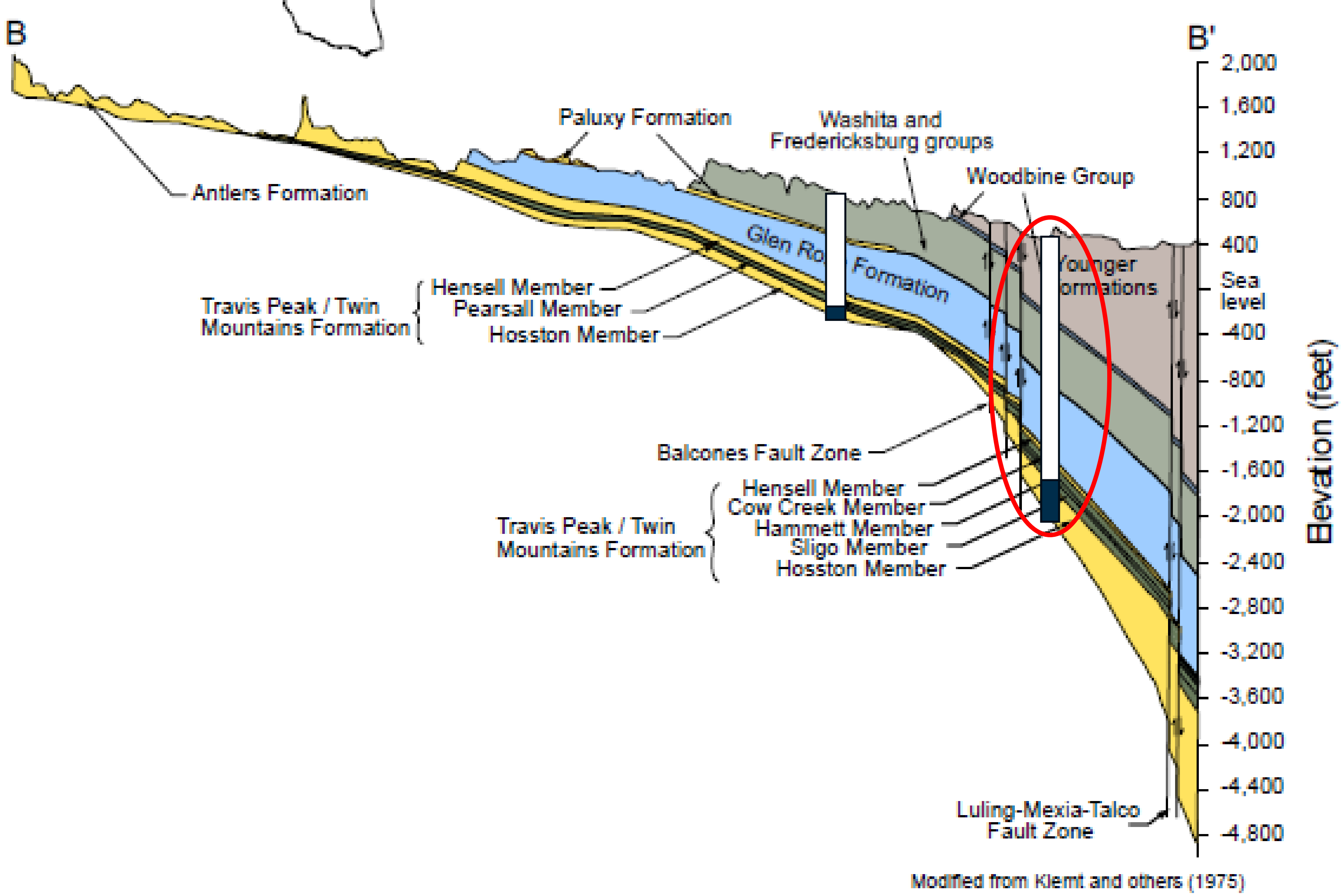
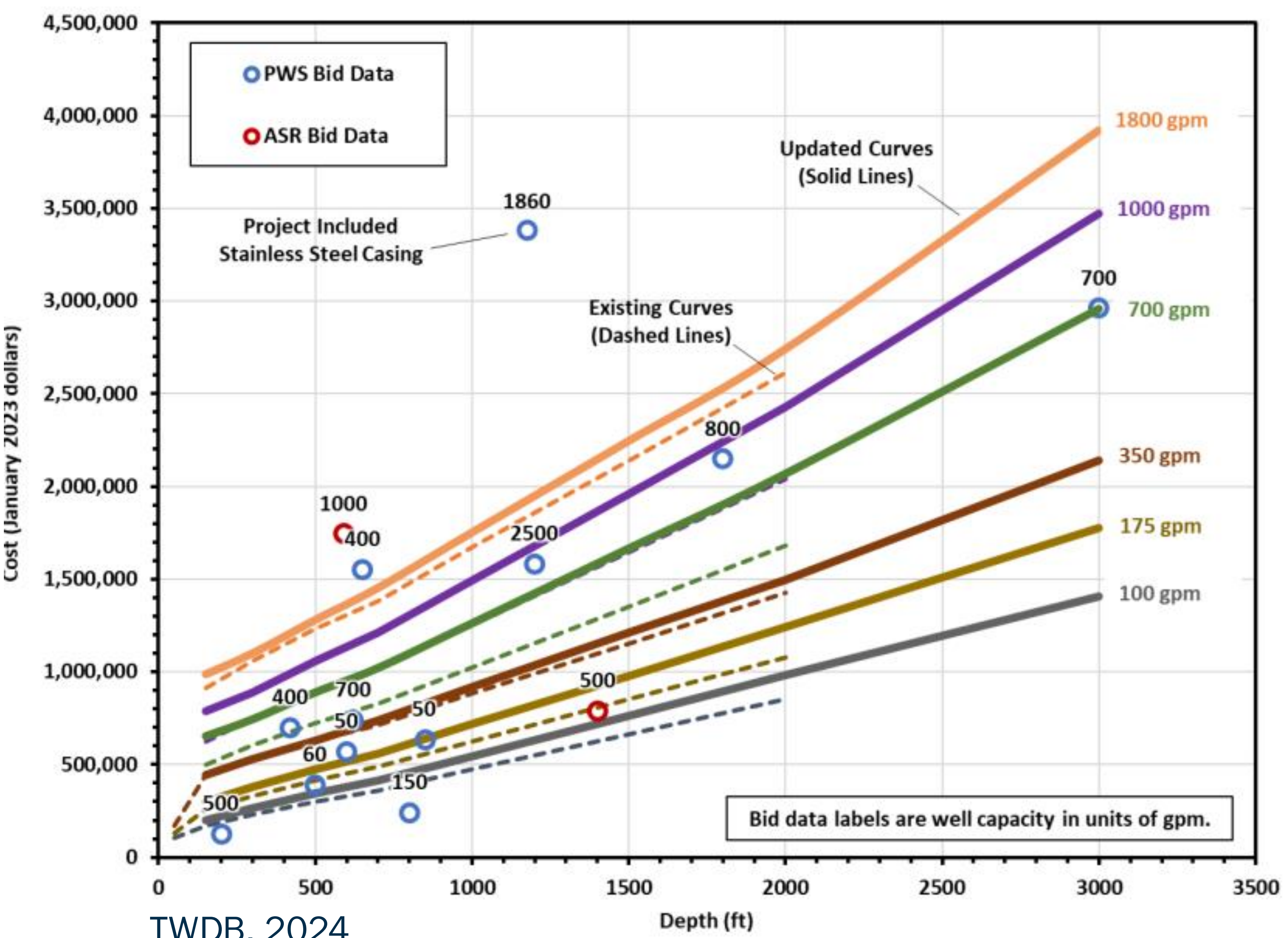


Figure 2.2.3 Cross sections of the stratigraphic units in the study area (after George and others, 2011; Bené and others, 2004; Nordstrom, 1982; Klemt and others, 1975).

This dip section is north of Bell County, but reasonably representative

Comparison

- Ft Hood
  - Lower per-well rates
  - “Easy” drilling
  - UCM estimate ~$1 millon/well (cheaper for multi-well program)
- Temple
  - Higher productivity, more “large project” potential
  - Challenging to drill (fewer contractors available with capabilities)
  - UCM estimate >$3 million/well



TWDB, 2024

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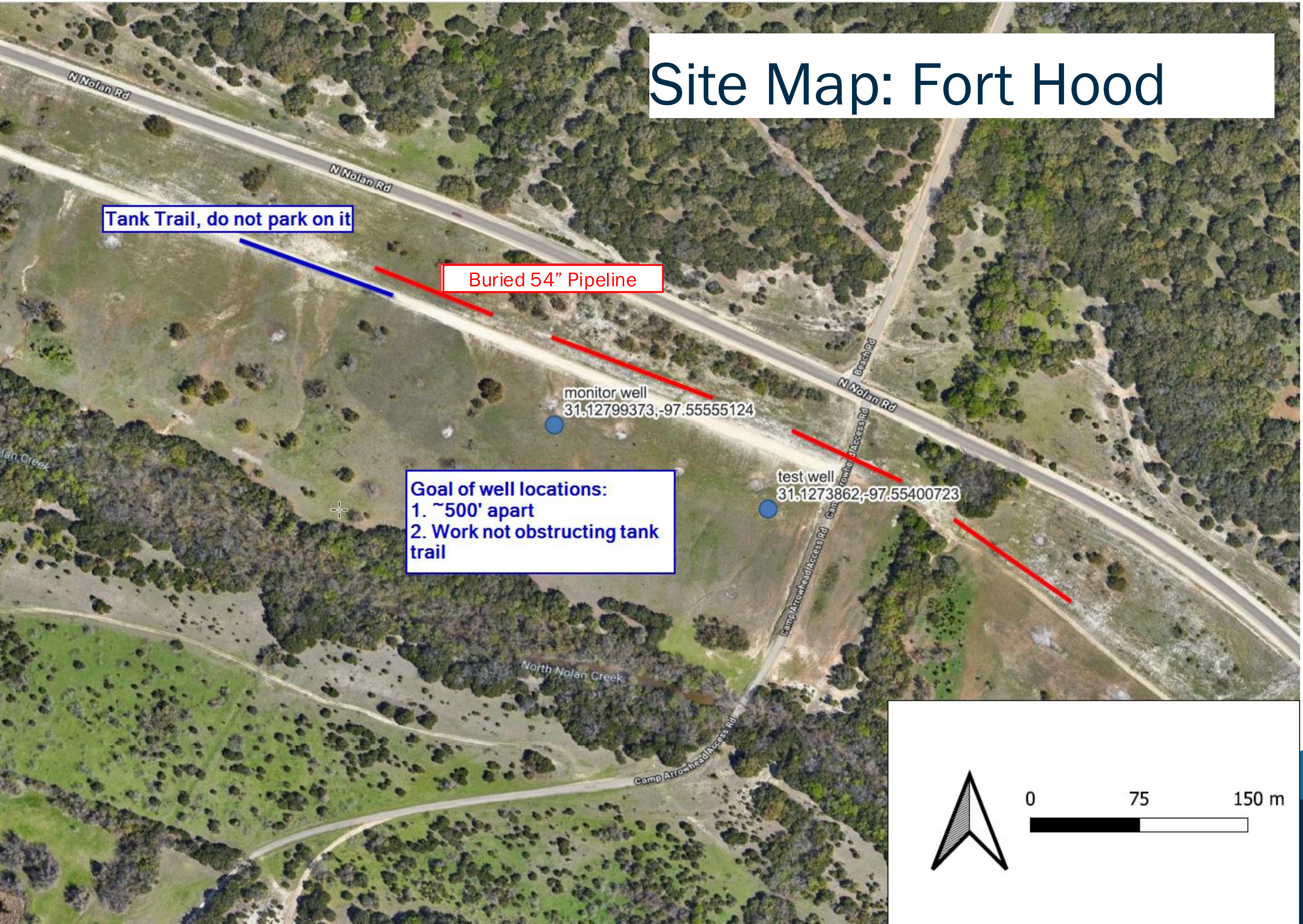
Fort Hood

Site Map: Fort Hood



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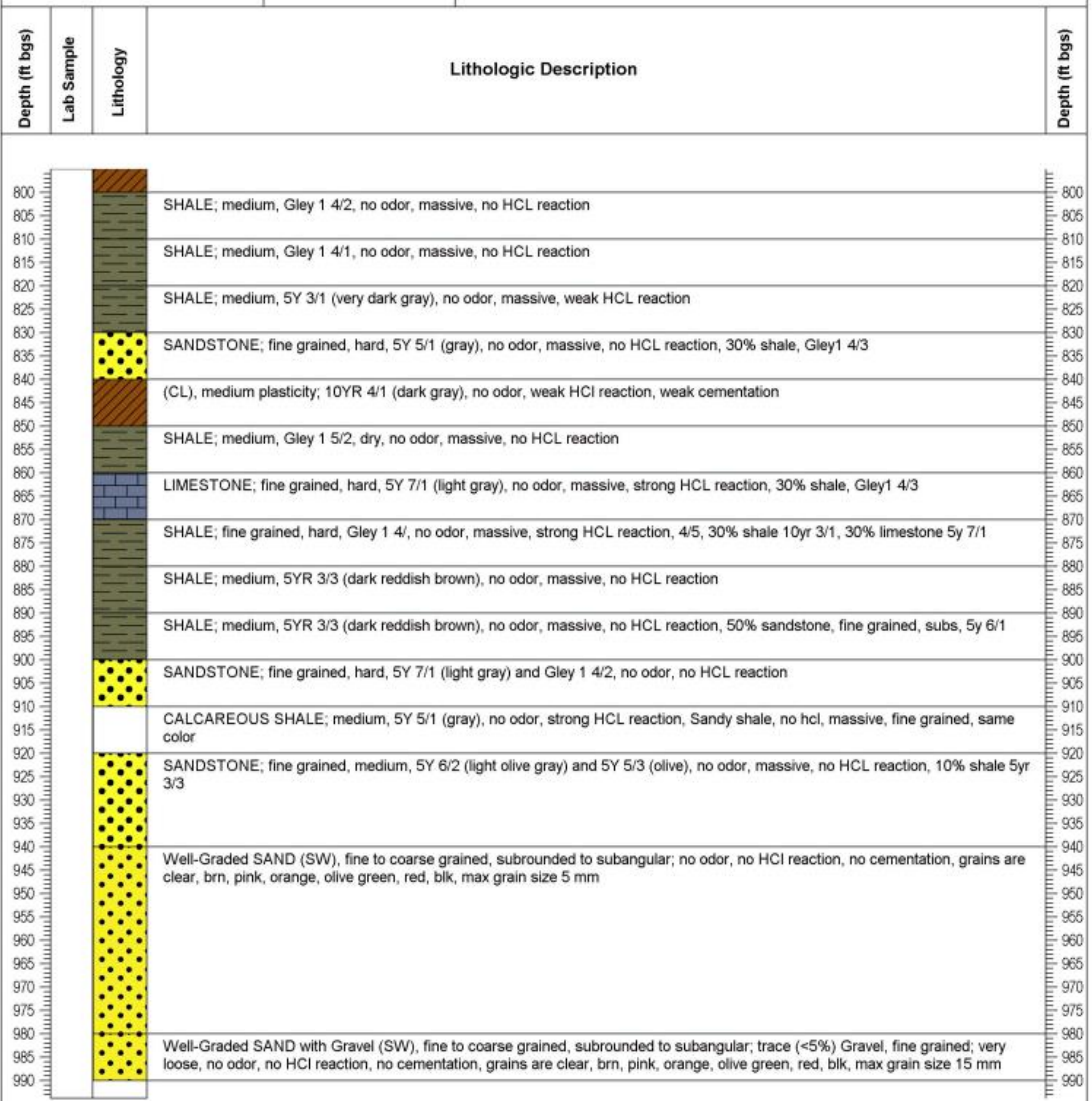
Monitor Well: Findings

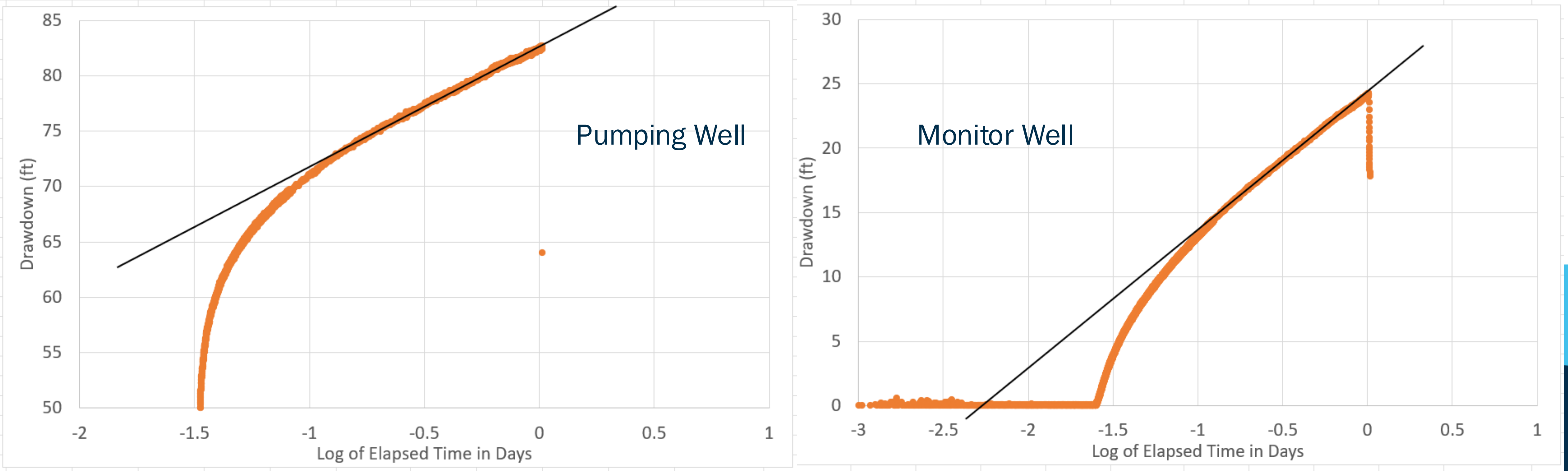
- Four-inch exploratory well marked a decision point on whether to proceed with the pumping well
- We found no “fatal flaws”
  - **Potential fatal flaw #1:** The Hosston/Lower Trinity is not present, or very thin.
  - *Finding: The Hosston is present (although deeper than expected), and a minimum 60' thick.*
  - **Potential fatal flaw #2:** The lithology in the Hosston has high percentage of clays/shales.
  - *Finding: Composed of well-sorted, fairly clean sand.*
  - **Potential fatal flaw #3:** The static water level is too deep
  - *Finding: The static water level is 485' below ground surface, leaving 430' of available drawdown for production*

Lithologic Log from Monitor Well Bottom 100’



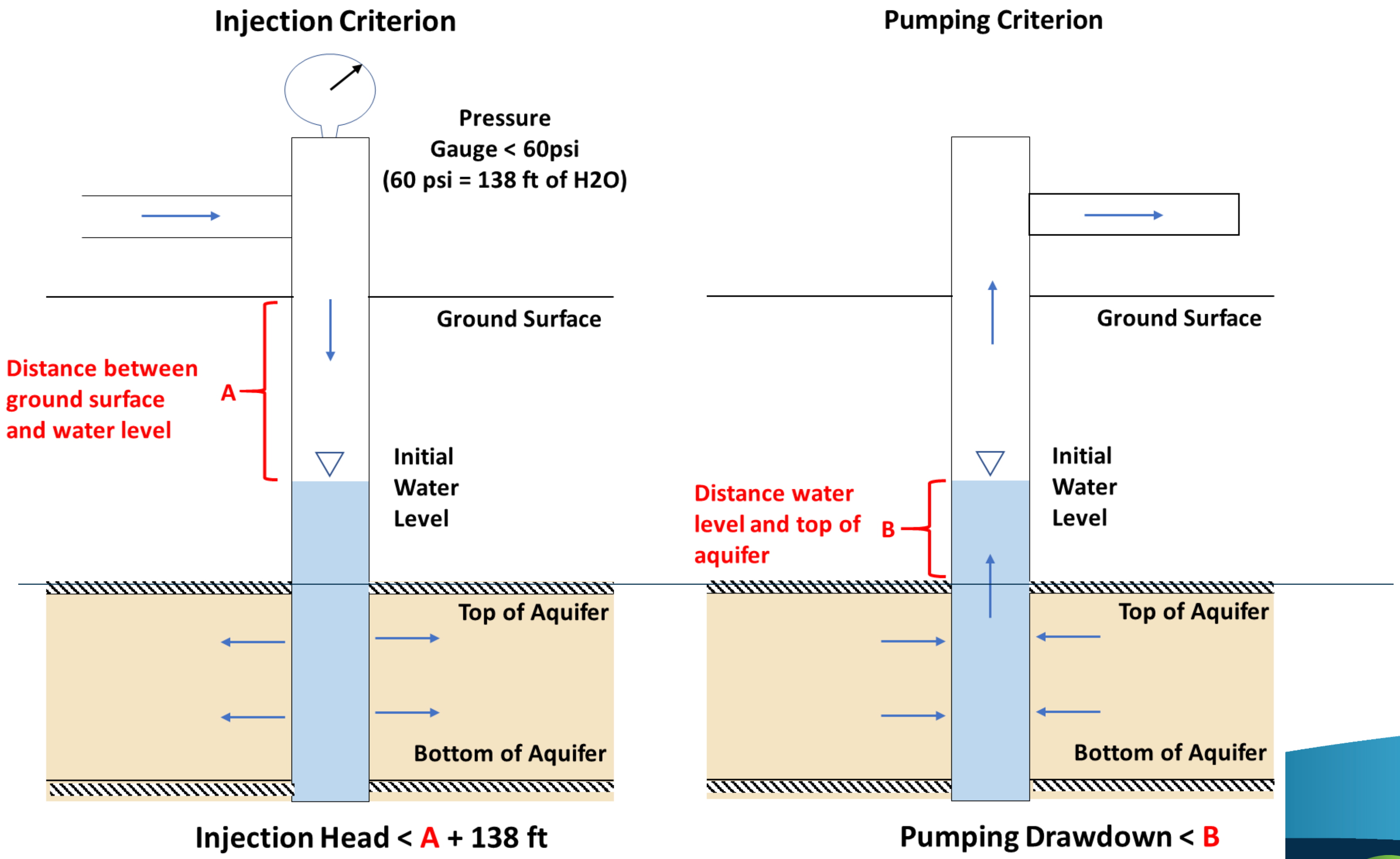
Production Well

- 8" production well, SDR-17 PVC
- Well produced 250 gpm, estimated maximum around 400 gpm
- Hydraulic Conductivity = 10 ft/d
- Storativity = 3.2×10^{-5}

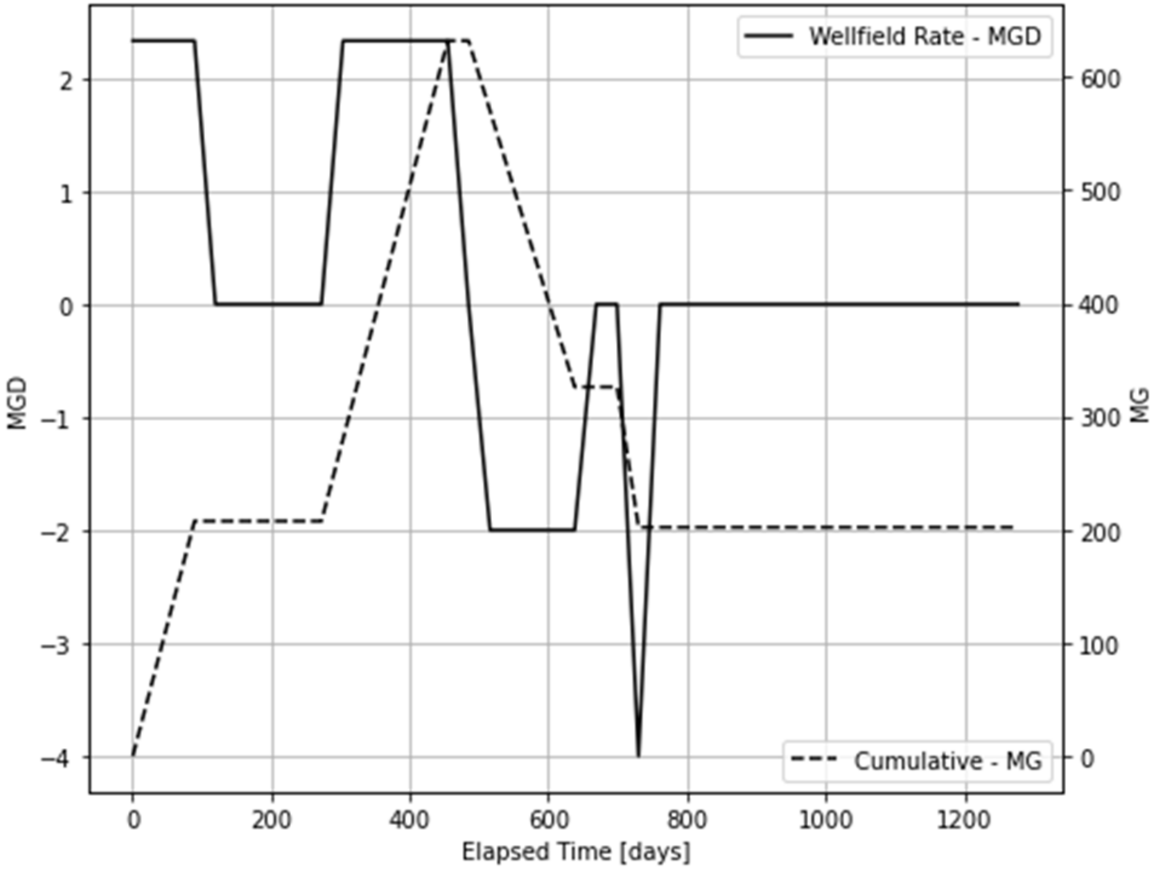


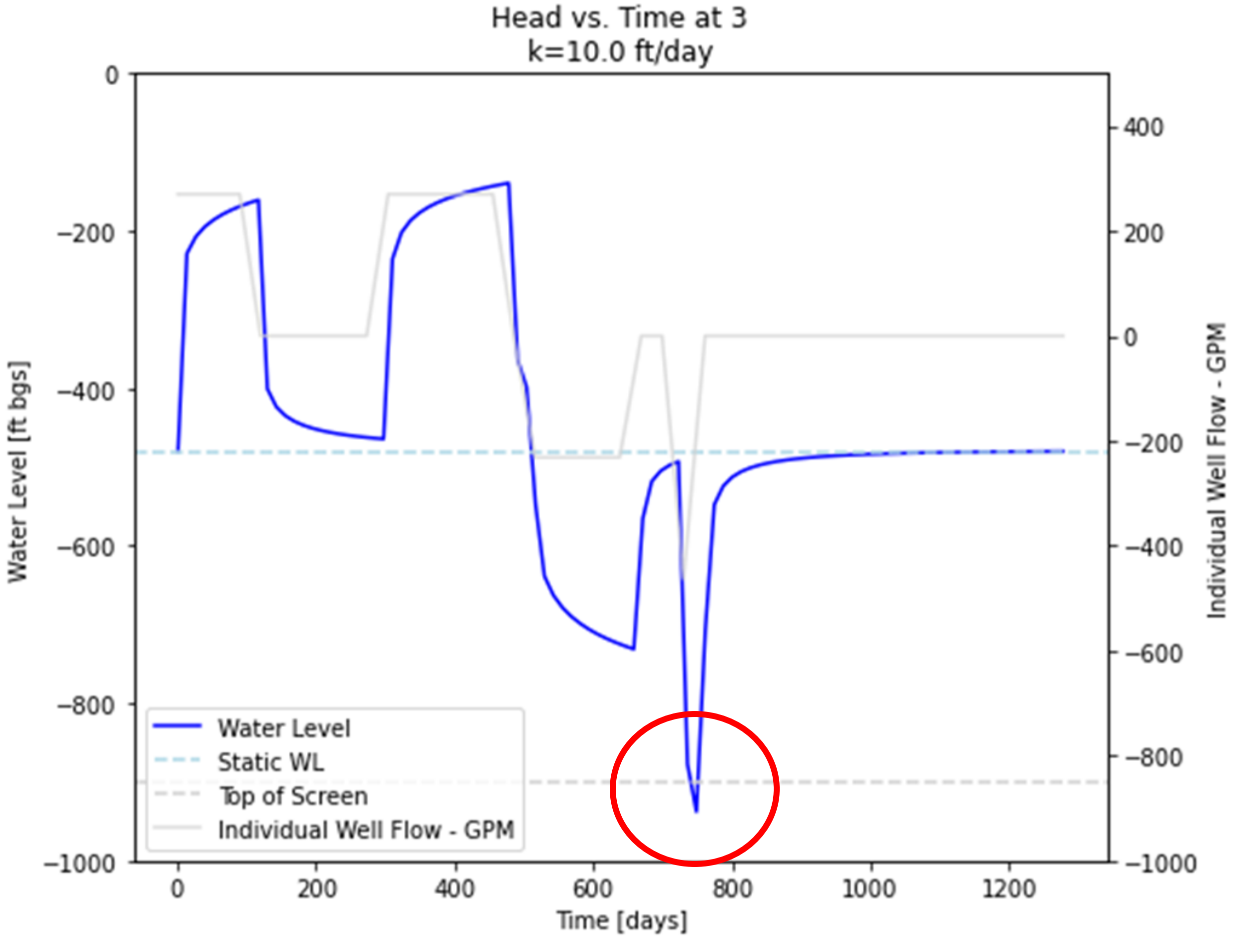
ASR Hydraulics

Lower Trinity top ~900 bgs



Initial Configuration
1,000 ft well spacing, 6 wells





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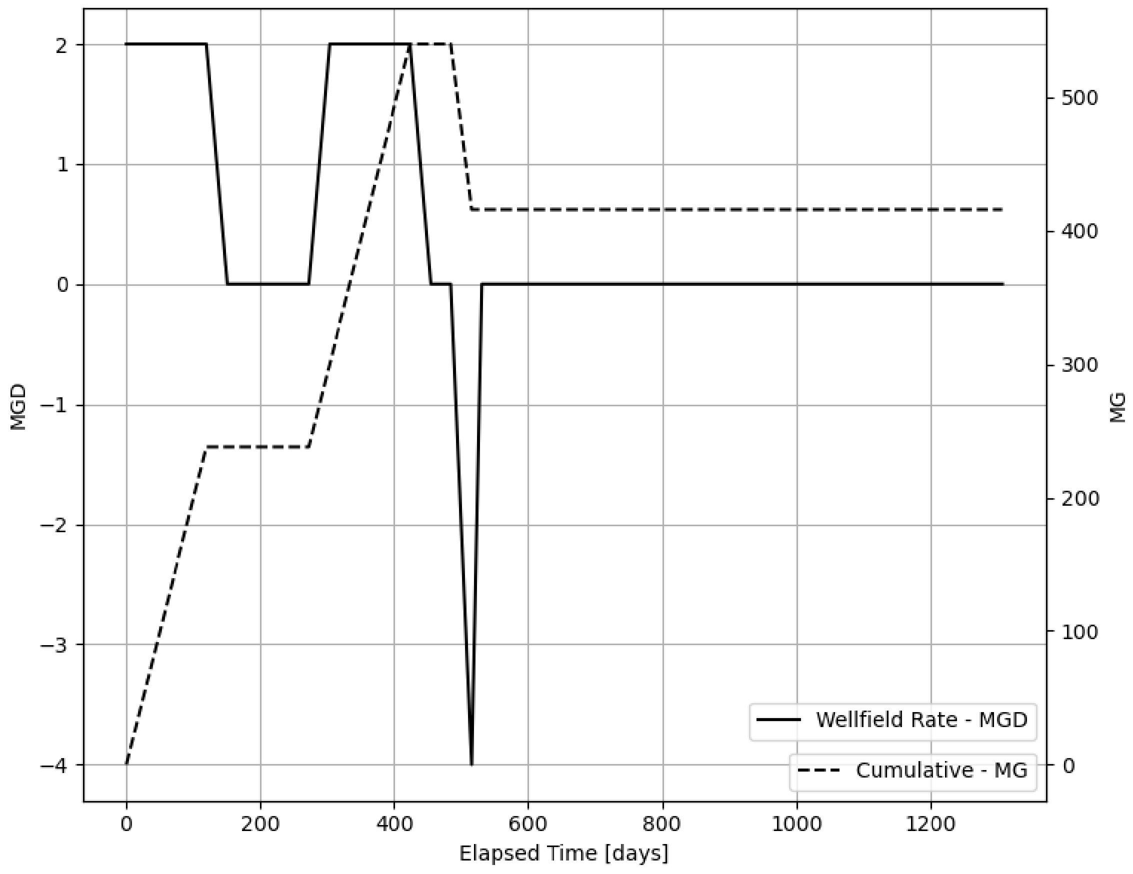
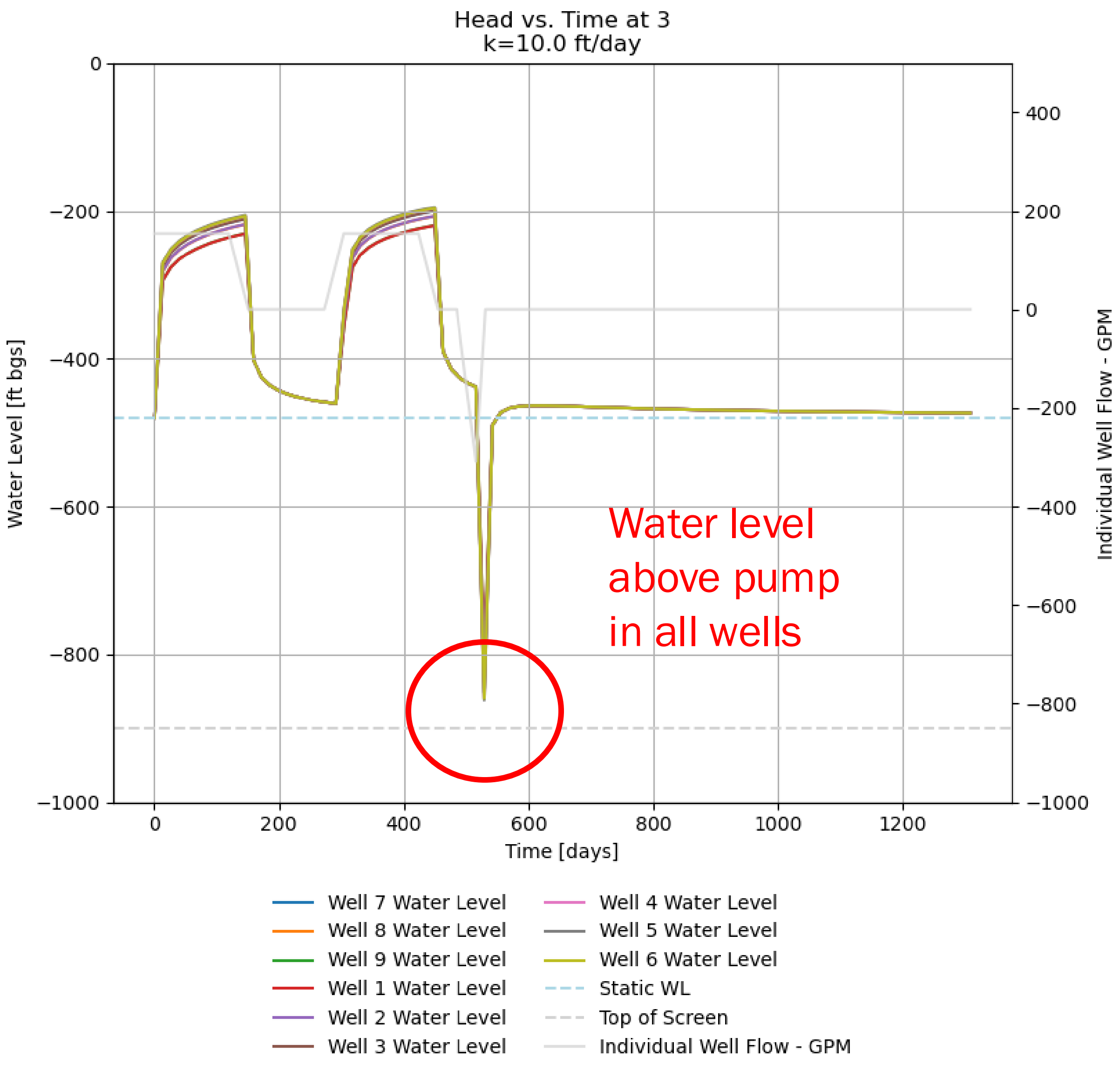
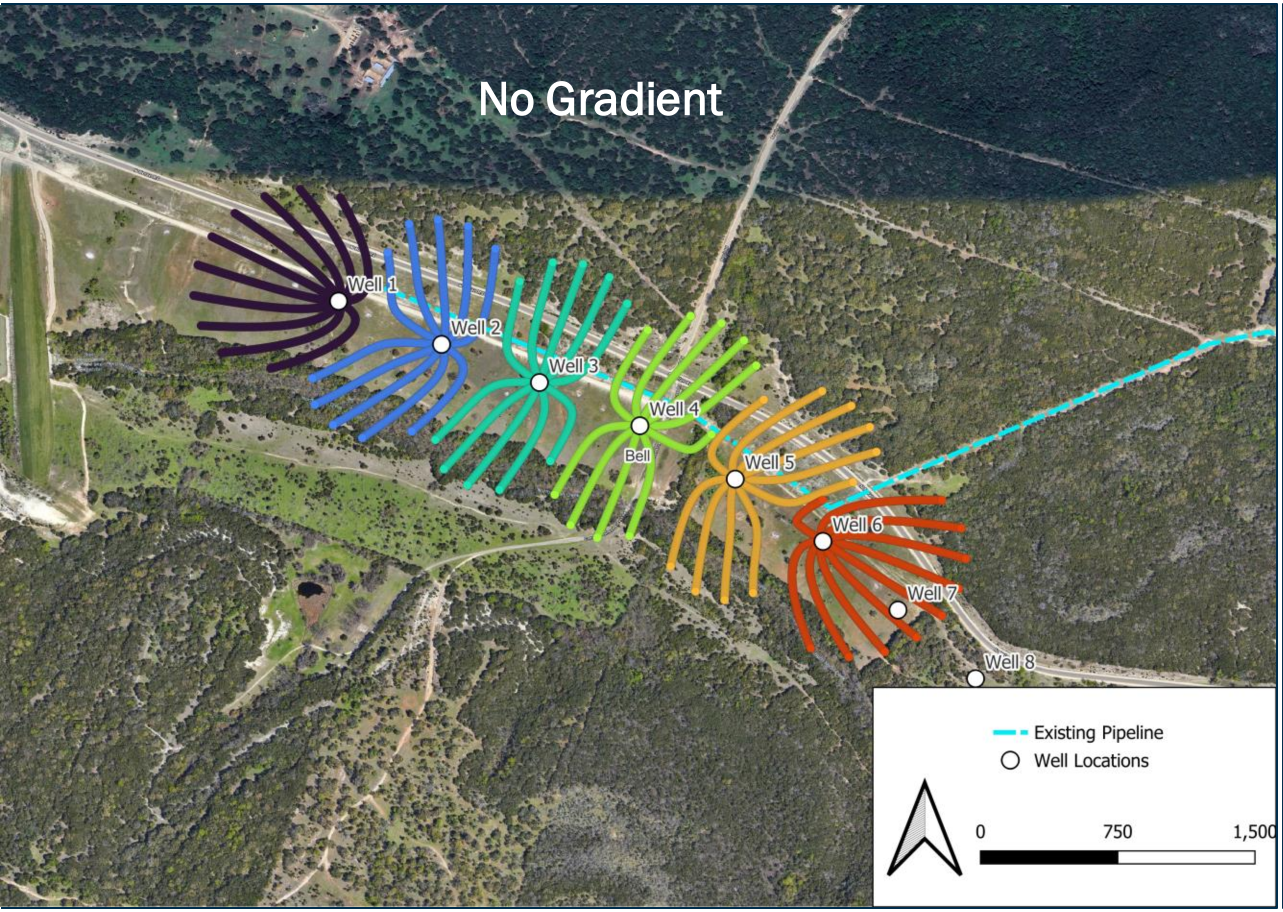
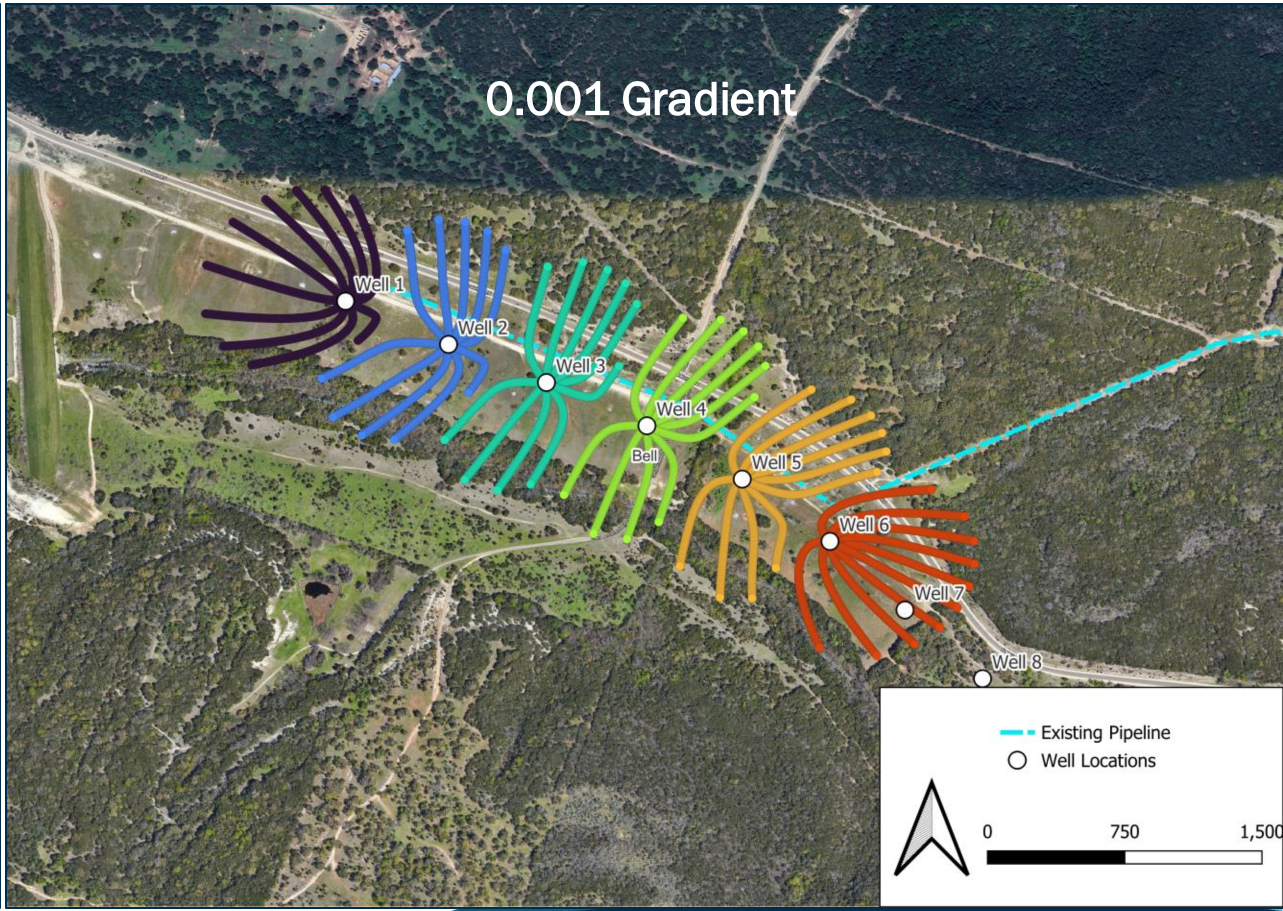
Draft Final Configuration, 9 wells, 600 ft spacing





Bubble Extent – 10 months continuous recharge at 2MGD (ASR Wells 1-6)





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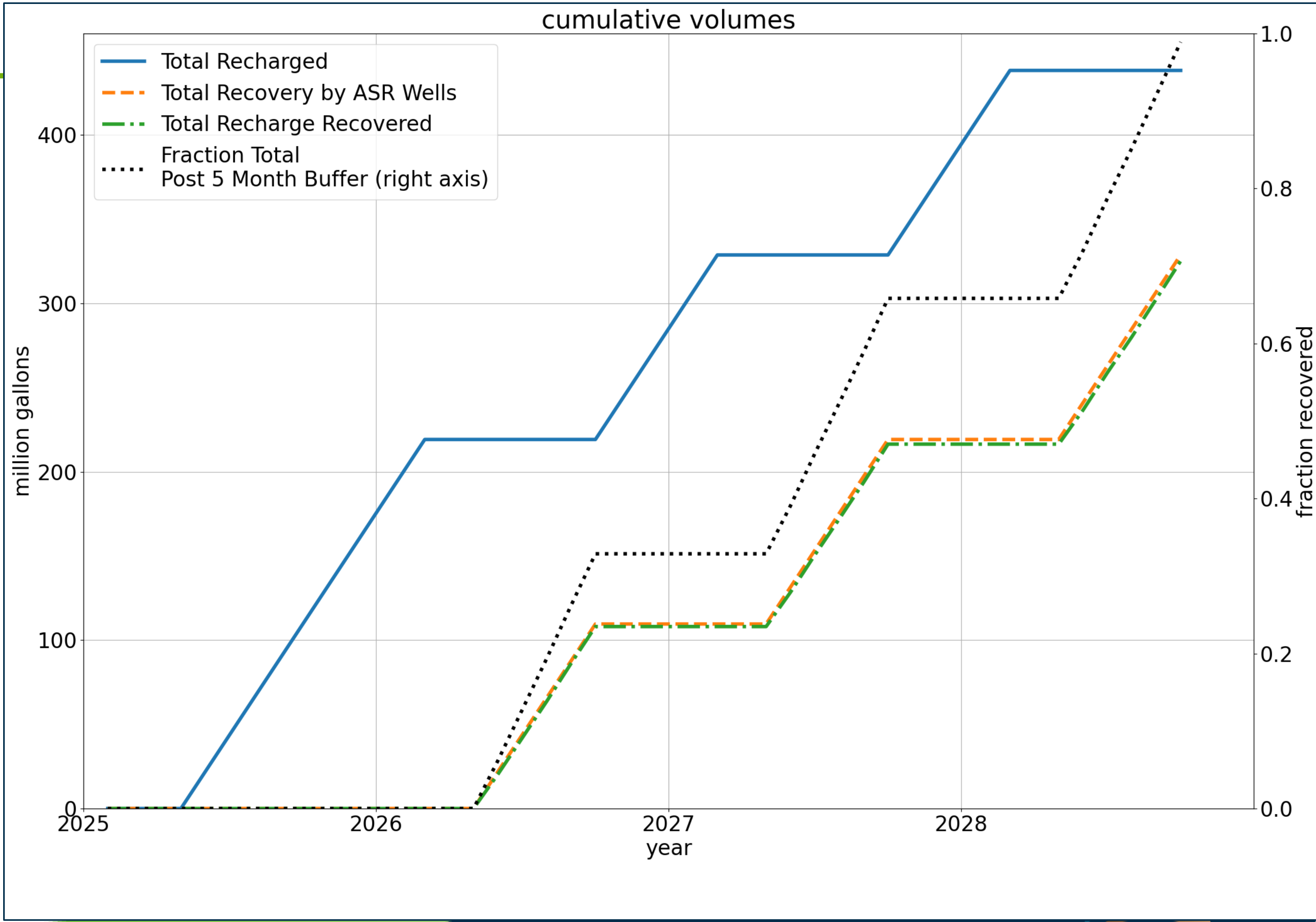
Recoverability

- Percent of recharge water that can be recovered during normal operation
- TCEQ permit requires and estimate of recoverability
- IMPORTANT: You cannot “over recover” past your permitted amount without an additional production permit from the groundwater conservation district



Next Steps

- TCEQ Permit Package in Review at Agency
- Demonstration well construction
- Cycle testing program
- Full wellfield buildout

City of Temple

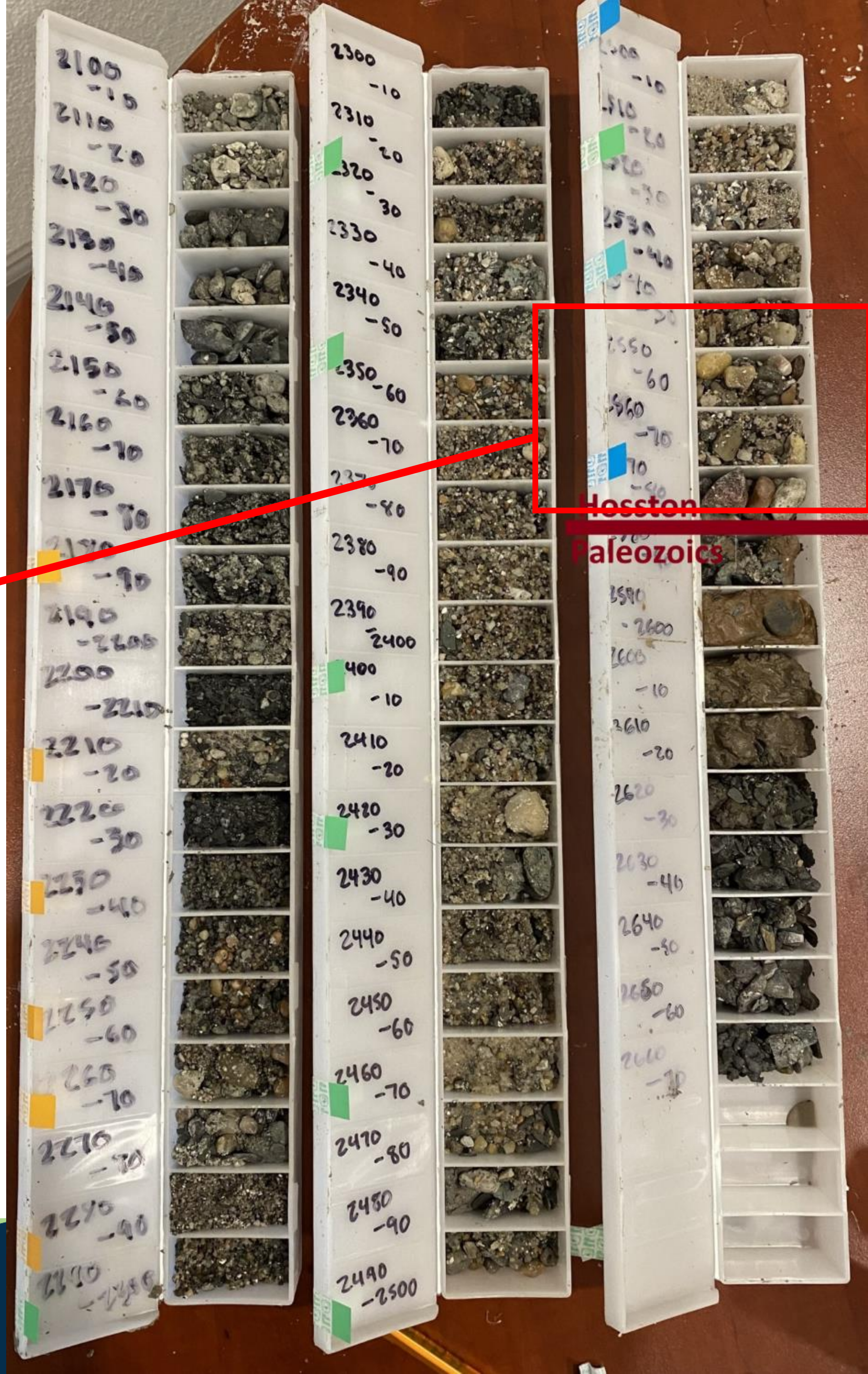
City of Temple Well

- Construct a Lower Trinity well to provide a water supply to an industrial partner (data center) southeast of town
- Construct well to meet UIC requirements for ASR (e.g. HSLA steel casing)
- Perform ASR feasibility study in parallel with well construction
- Potentially convert well to ASR in the future, with recycled water as a source

Pilot Hole Findings

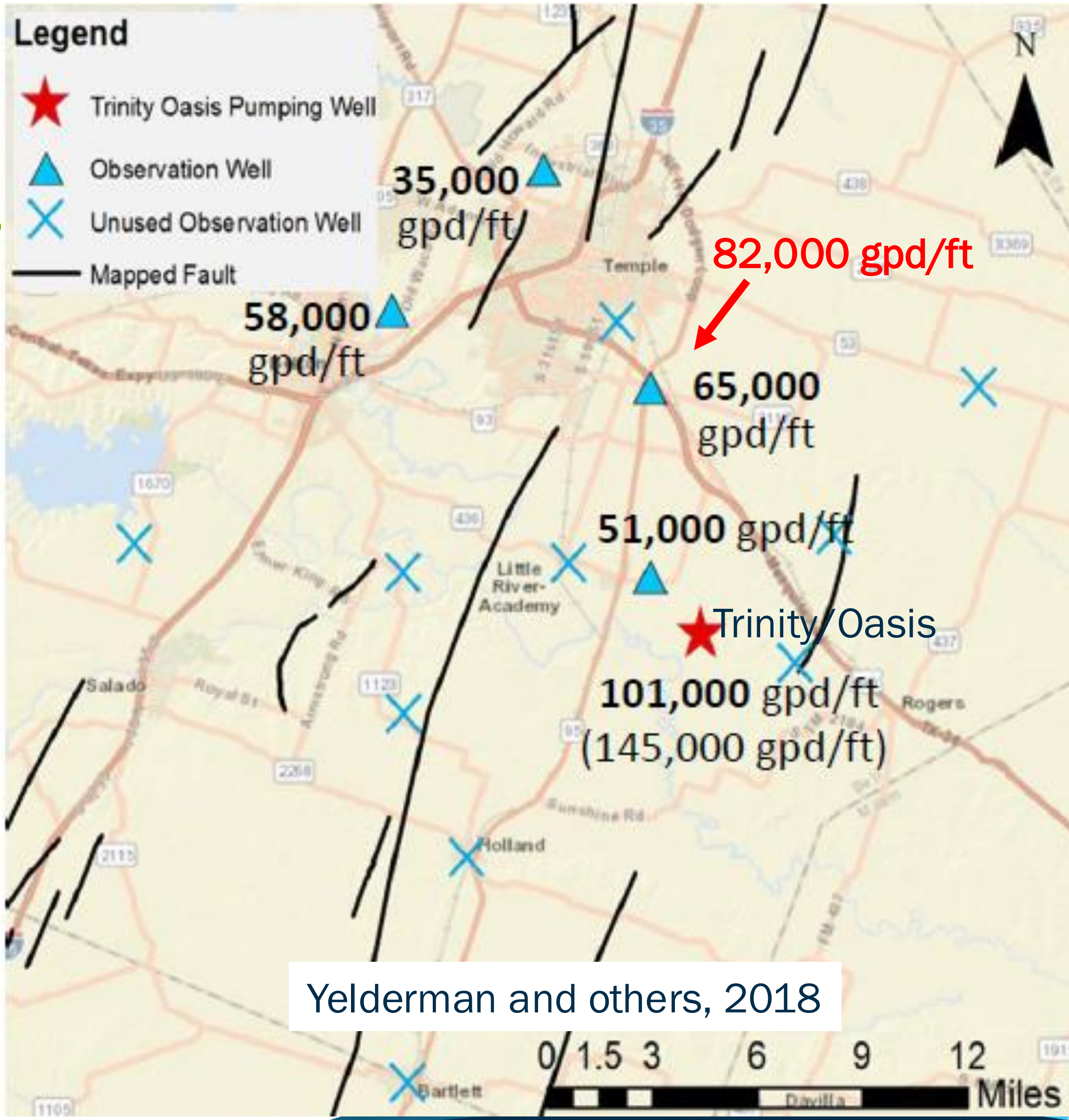
Thanks to Vince Clause for providing chip tray photos

Gravel!



Well Performance

- Well was tested at 2,000+ gpm
- Transmissivity estimated at 11,000 ft^2/d (82,000 gpd/ft)
- Temple will take over well, considering next steps for potential ASR



Yelderman and others, 2018

Phased ASR Implementation

- Obtain ASR Authorization for Pilot Testing of Well 1 (ASR-1)
  - Full scale recharge and recovery cycles to confirm well hydraulics and any water quality changes
- Identify potential ASR well sites for an expanded system
  - Groundwater model tools
  - Infrastructure requirements

ASR Model Scenarios

Objectives

- Confirm workable ASR well locations to meet desired recharge and recovery objectives
- Compare available draw-up and drawdowns with model results
- Identify likely extent of ASR bubbles relative to property boundaries, whether the bubbles coalesce and any potential bubble migration that may impact recovered water quality

Approach

- Agree recharge and recovery rates and schedule
- Predict water level changes
- Complete particle tracking simulations
- Assess multiple layout scenarios starting with agreed potential well locations

Scenario	Description
1	Two ASR Wells (2,000 ft spacing
1B	Two ASR Wells (1,000 ft spacing)
2	Four ASR Wells (2,000 to 3,000 feet apart)
2B	Four ASR Wells (3 wells approx. 1,000 feet apart)
2C	Four ASR Wells, revised location for ASR-2

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Scenario 2 – Four ASR Wells

- Two ASR wells did not stress the aquifer!
- Three scenarios completed:
  - Scenario 2: using locations for ASR-1 (existing well), ASR-2, ASR-3 and ASR-4, approximate spacing 2,000 - 3,000 feet
  - Scenario 2B: revised with ASR-3 relocated between ASR-2 and ASR-4 to check increased hydraulic interference and potentially changed bubble geometry
  - Scenario 2C: revised with ASR-2 relocated 1,000 ft south of ASR-4 to accommodate land development
- Recharge and Recovery Rates and Volumes

Recharge / Recovery Rates per Well (GPM)	Combined Recharge Rate (MGD)	Annual Total Recharge /Recovery Volume (MG)	Combined Recovery Rate (MGD)
1,500/2,625	8.640	1814.4	15.120

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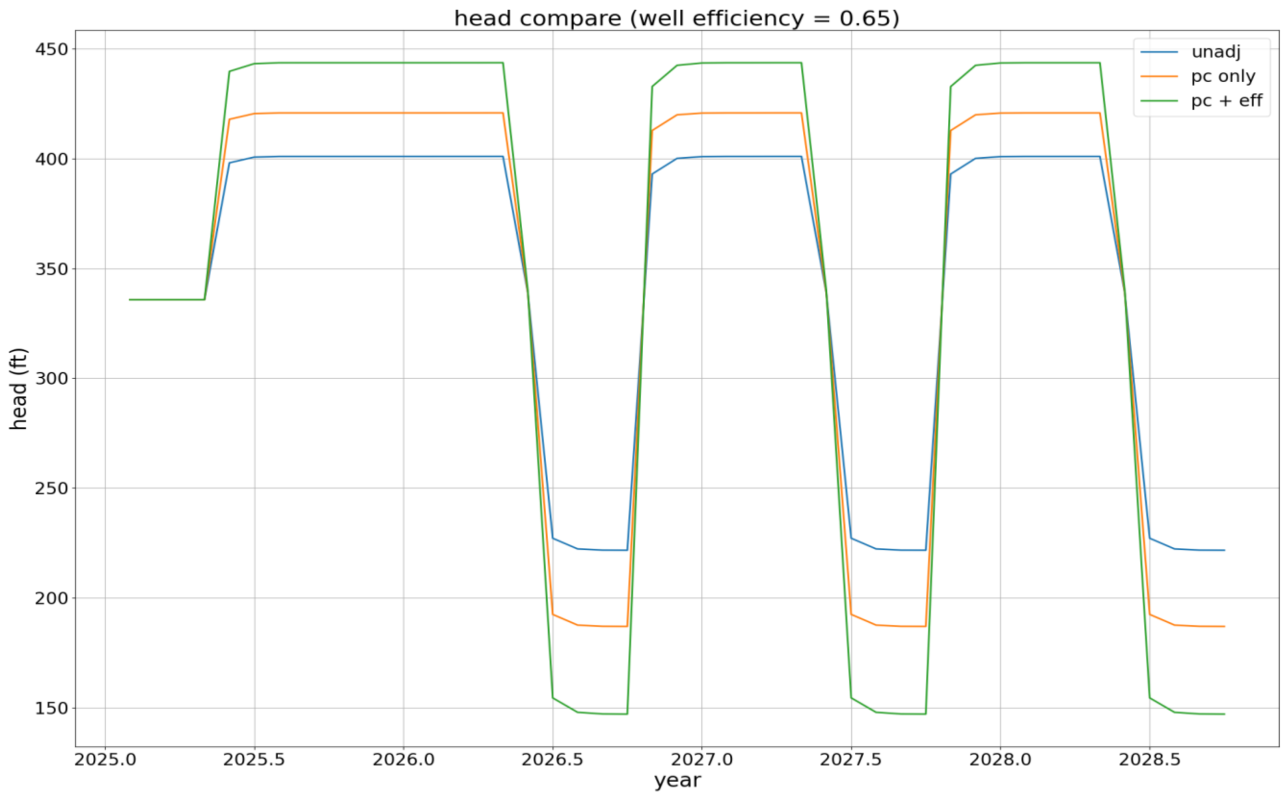
Scenario 2: Predicted Groundwater Heads



Scenario 2: Four Active Wells

Max: 444 ft amsl (108 ft drawup)

Min: 147 ft amsl (189 ft drawdown)

NOTE: Lowest Land Elevation is 564 ft amsl at Well #1 (Wells are generally between 565 to 590 ft amsl)
Water Level: 328 ft. below land surface on 2024-06-22

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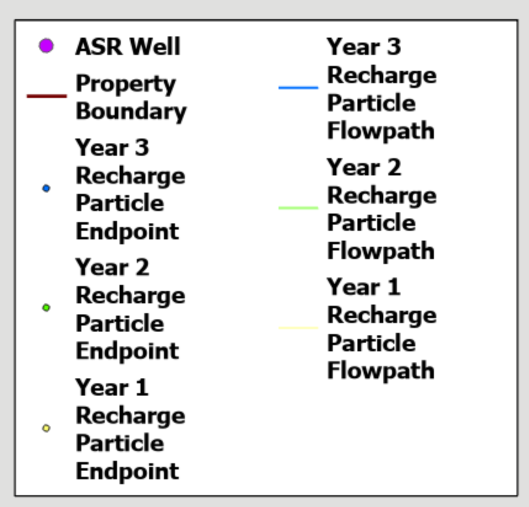
Scenario 2: Four Active Wells ASR-1,2,3,4 (2,000 to 3,000 ft apart)

Key Observations:

- Similar results to Scenario 1 with twice the capacity (storage and rates)
- Slightly smaller buffer zone margin for ASR-4 (southwestern well)
- If recovered water quality is important additional recharge may be needed during later years



Predicted ASR Bubble Geometry

For thick aquifer sequences large volumes can be stored, but the lateral extent of the recharged water may also be limited.

Issues to consider:

- Recovered water quality may be impacted, especially if native groundwater is brackish
- Aquifers are not vertically homogenous, i.e. the edges of the stored water will be irregular meaning buffer zone development likely more important
- Any potential water quality changes from recharge likely to occur within a limited distance
- Improved opportunity for control of the recharged water within property boundaries

Summary

- Hosston characteristics are different at the two locations, but both are viable for ASR
  - Up to 4 MGD recovery at Fort Hood site
  - Up to 15 MGD recovery at Temple site
- Hosston/Lower Trinity is a valuable aquifer for storing water
- Aquifer recharge is one solution for offsetting regional declines from production

Thank you!

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