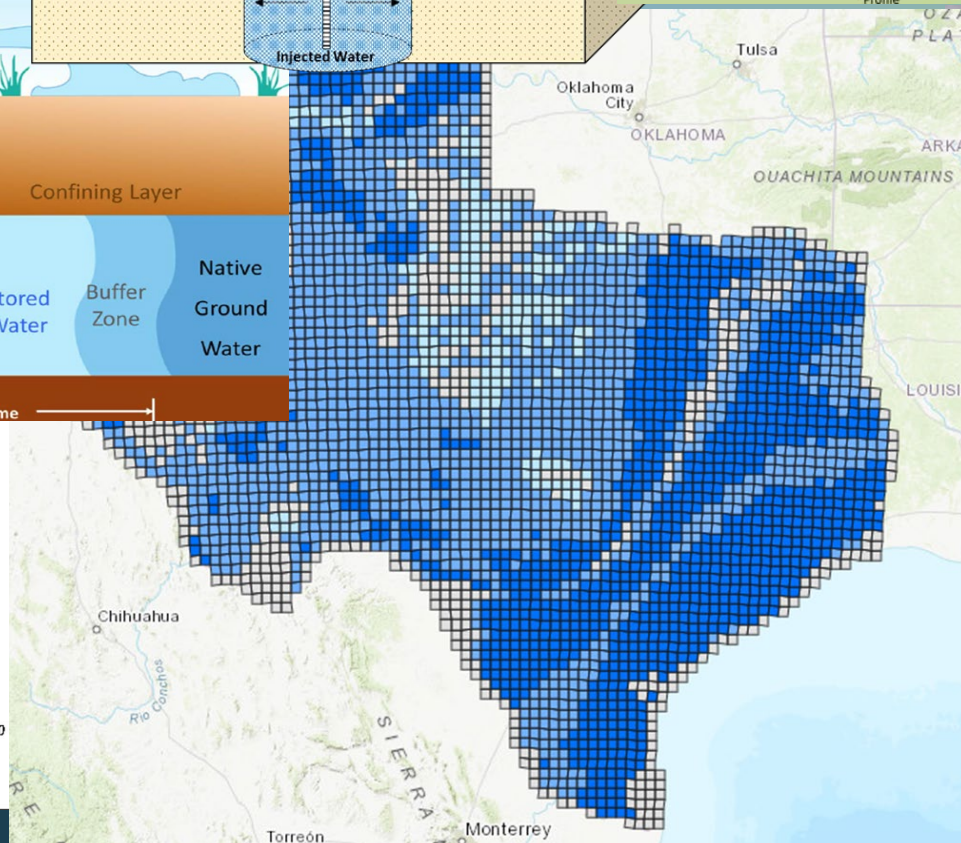
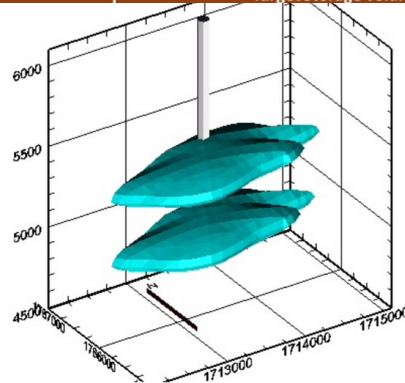
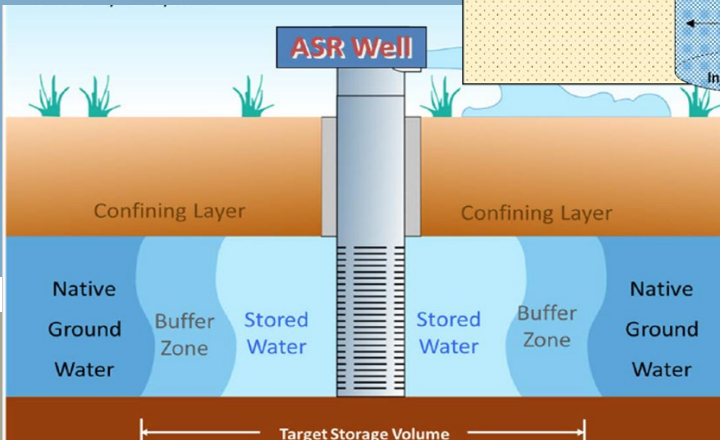
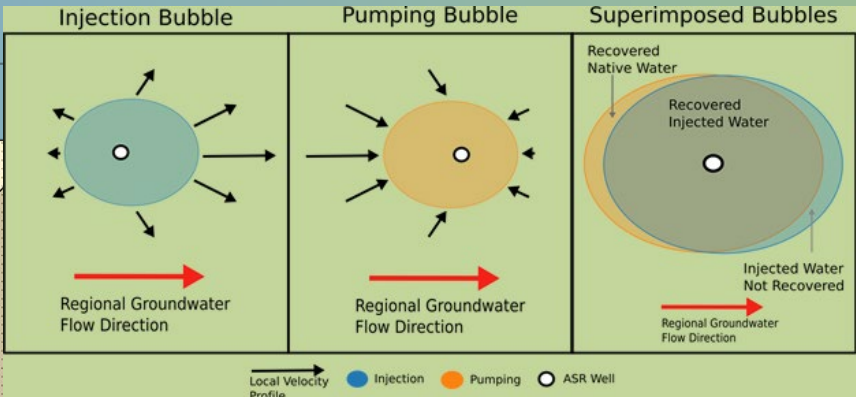
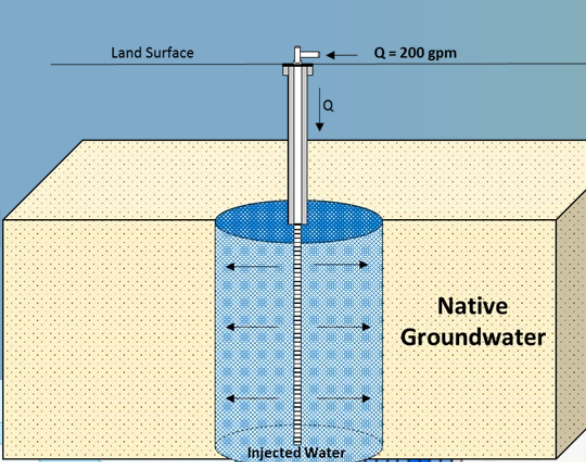


ASR, Is It a Viable Strategy In Bell County?

Presented To:
Bell County Annual
Water Symposium



Presented By:
Neil Deeds
Steve Young



November 17, 2021



Outline

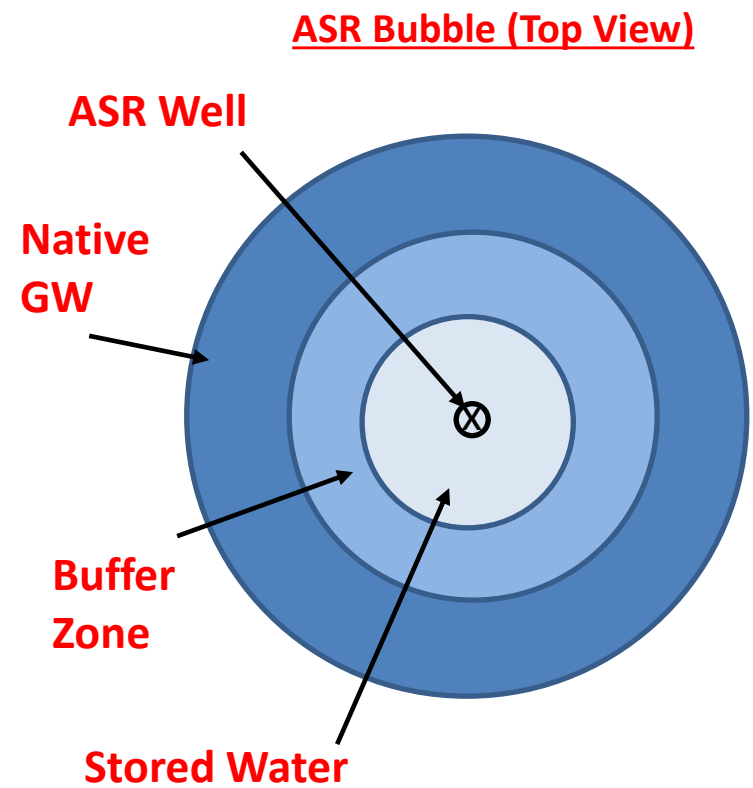
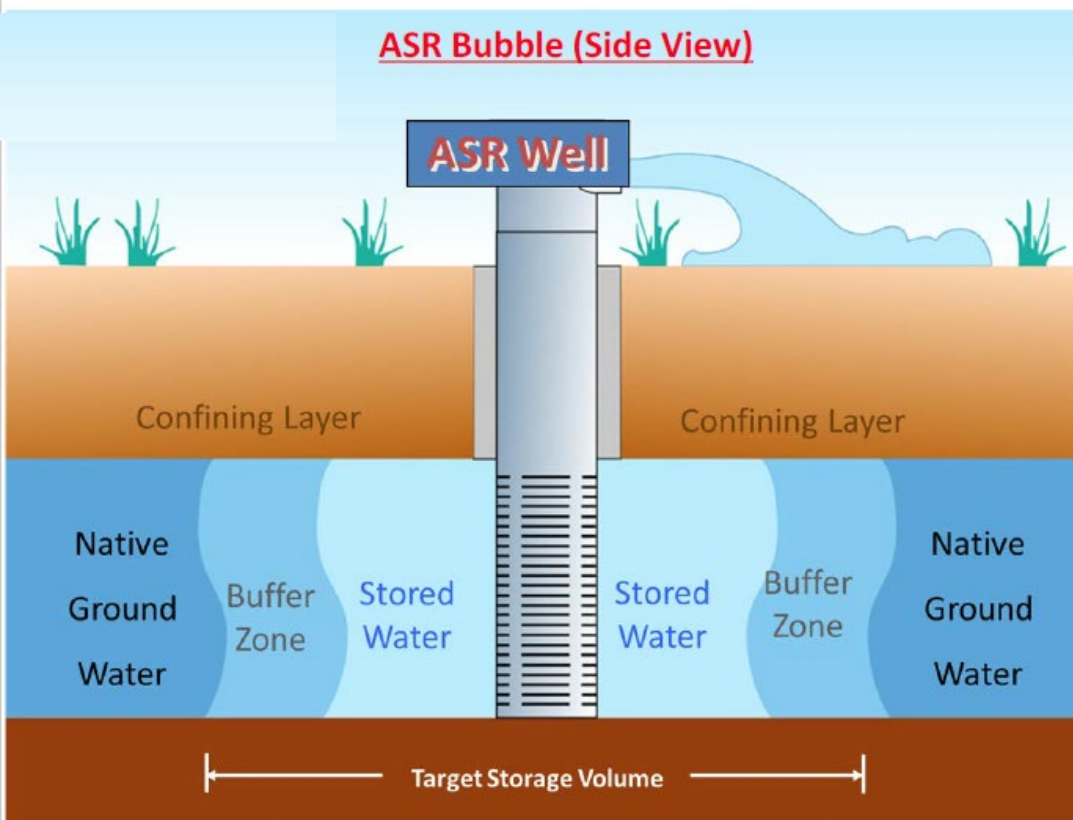
- Introduction to Aquifer Storage and Recovery (ASR)
- General Discussion of ASR in Texas and Bell County
- ASR as a Water Strategy
- Bell County ASR Coalition
- Assessment of ASR Candidate Sites

INTRODUCTION TO AQUIFER STORAGE AND RECOVERY

Idealized Diagram of Stored ASR Water

ASR: 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.*

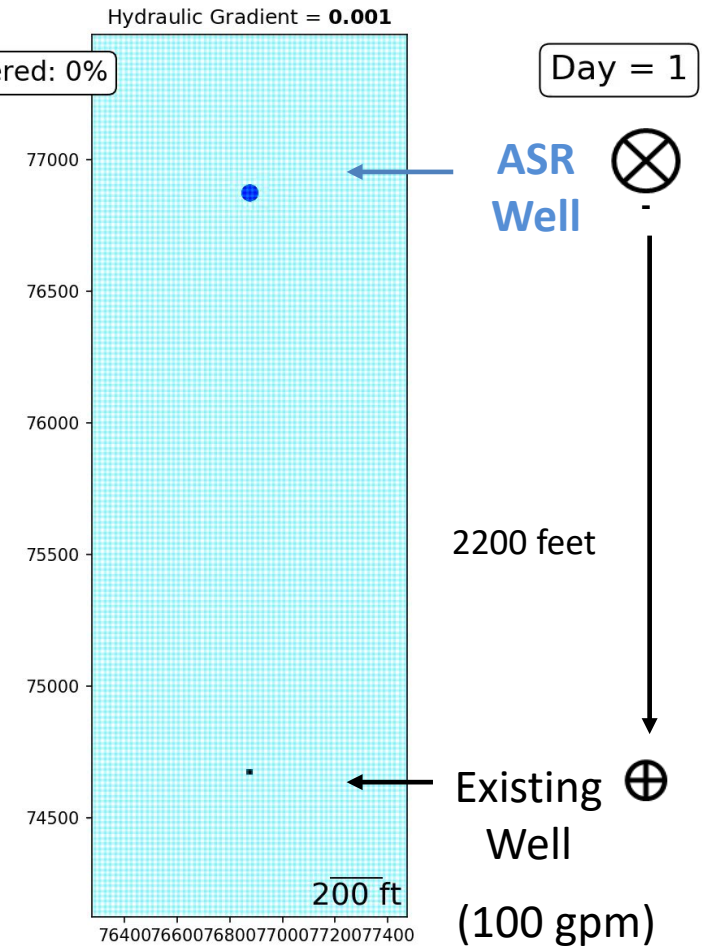
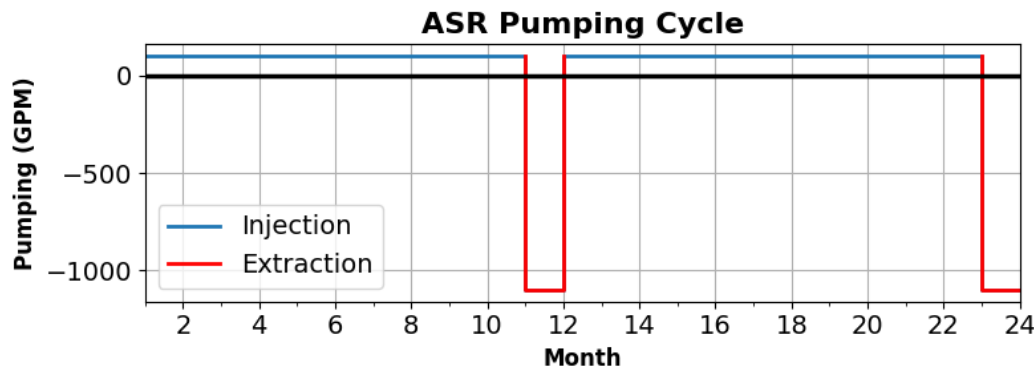
- TCEQ: 30TAC 331.2(8)



ASR Operation: Injection and Pumping

- Operations
 - Inject water at 100 gpm for 11 months (48 million gallons)
 - Extract water at 1100 gpm for 1 month (48 million gallons)

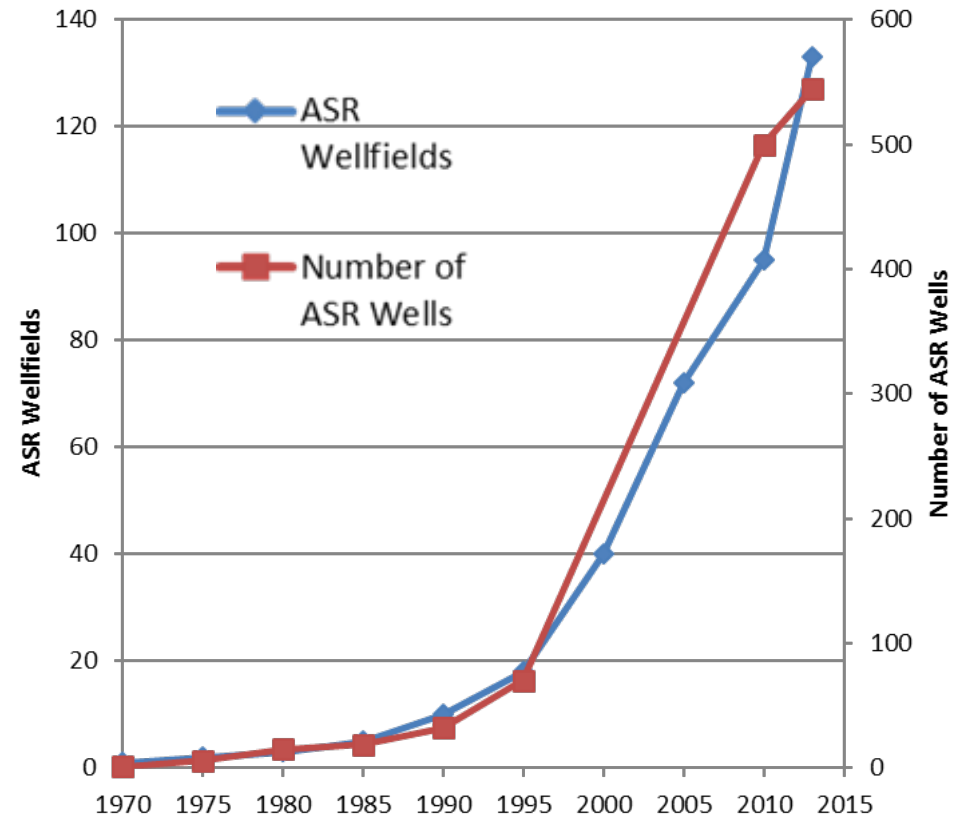
- Aquifer Properties
 - 50 feet thick
 - Hydraulic conductivity = 10 ft/day



Factors Contributing to ASR Implementation

- Economics
 - Typically lower capital cost of alternative water supplies
 - Phased implementation
- Environmental and Water Quality Benefits
 - Small storage footprint compared to surface reservoirs
 - No evaporative losses or sedimentation losses from surface reservoirs
- Adaptability to Different Situations
 - Fresh, brackish or saline aquifers
 - Drinking water, reclaimed water, stormwater or groundwater storage

Increase in ASR Facilities Development



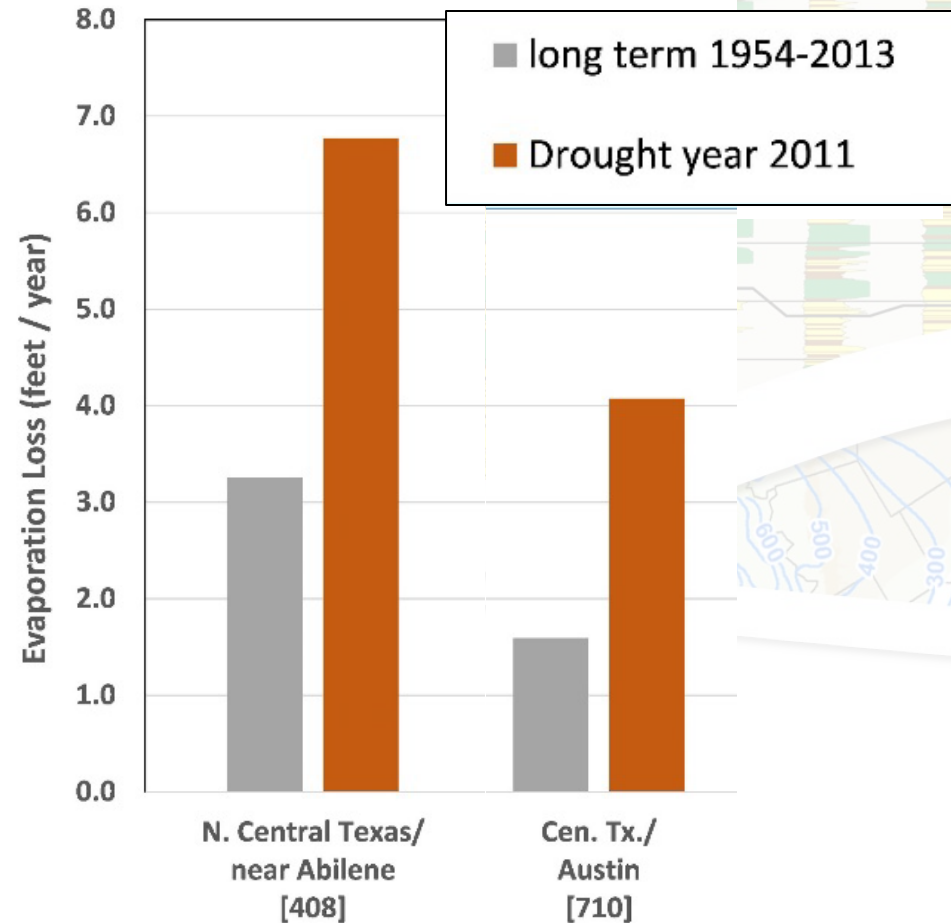
Potential Advantages of ASR over Surface Storage

- No evaporation
- No surface inundation
- No sedimentation

In 2011, the Highland Lakes System lost an estimated 192,000 AF evaporation.

The same year, City of Austin used 168,000 AF from the system.

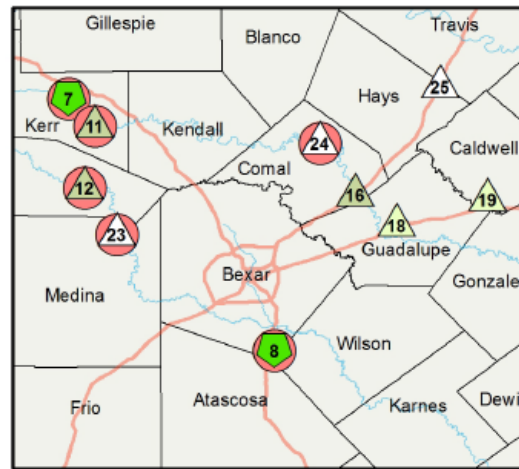
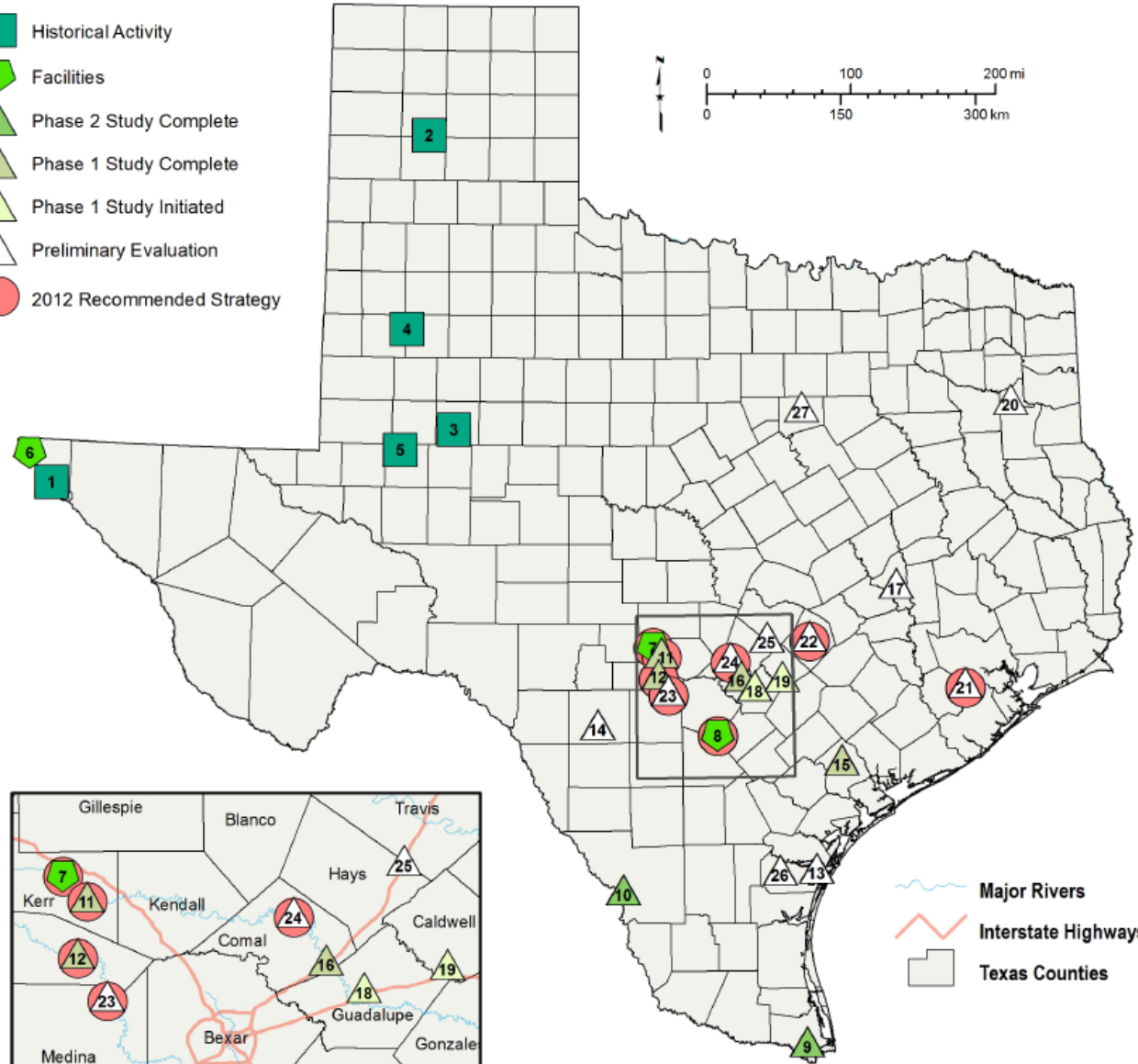
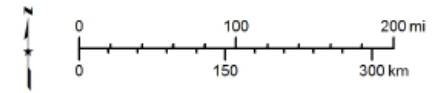
The 2007 State Water plan indicates a loss of 90,000 AF annually to sedimentation in TX reservoirs



GENERAL DISCUSSION OF ASR IN TEXAS AND BELL COUNTY

Where is ASR being used?

- Historical Activity
- ◆ Facilities
- ▲ Phase 2 Study Complete
- ▲ Phase 1 Study Complete
- ▲ Phase 1 Study Initiated
- △ Preliminary Evaluation
- 2012 Recommended Strategy



- ~ Major Rivers
- Interstate Highways
- Texas Counties

TWDB, 2015

Historical: El Paso, Amarillo, CRMWD, High Plains, Midland

Today: San Antonio, Kerrville, El Paso, Ruby Ranch

Demonstration Wells: New Braunfels Utility, City of Victoria, City of Byran, City of Buda

Studying/studied: Many

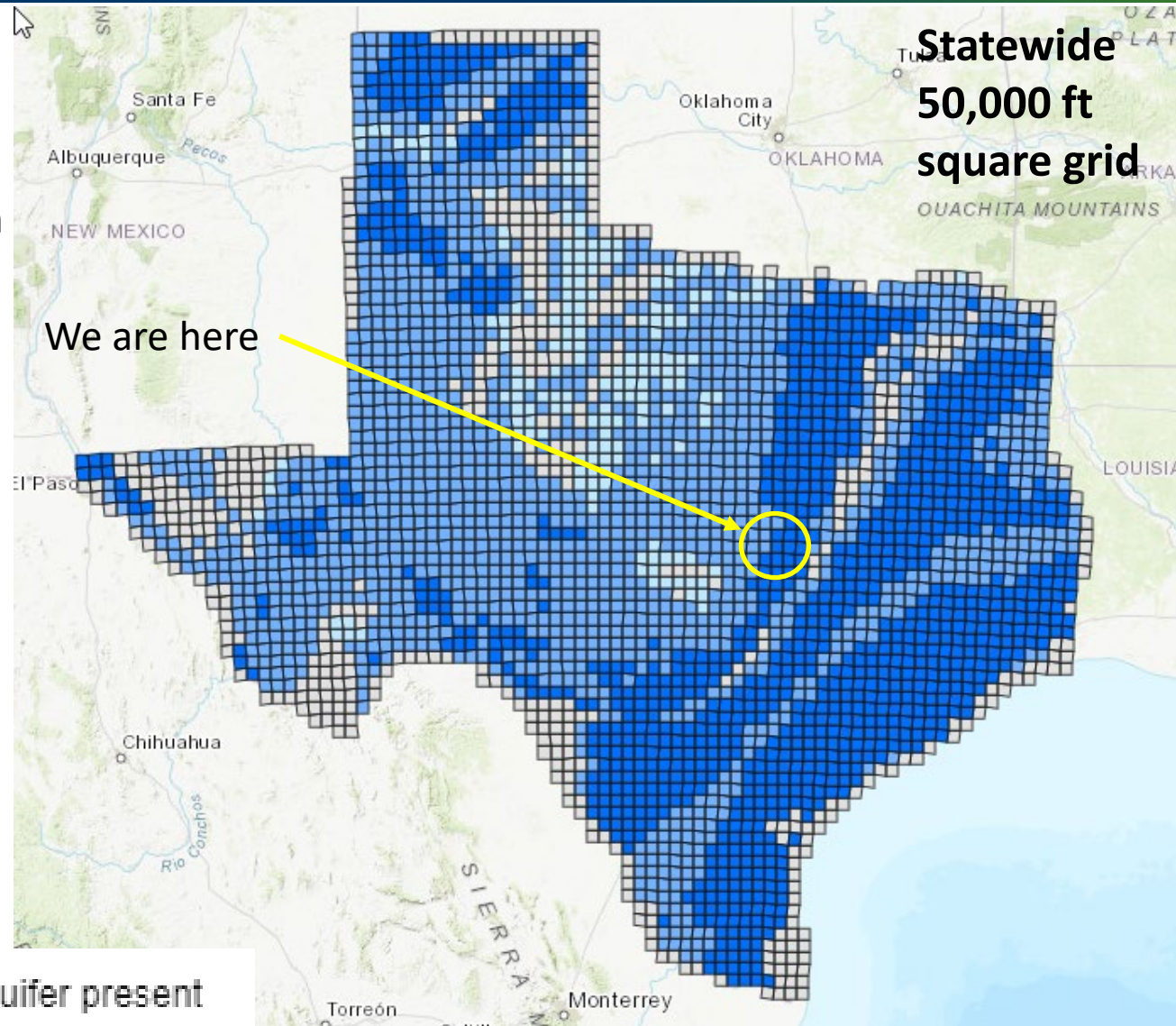
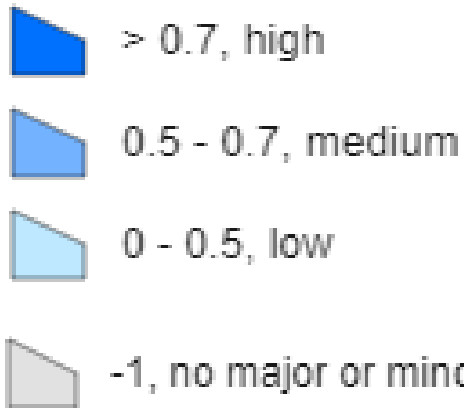
Overview TWBD Study

- 86th legislature passed HB 721, directed TWDB to conduct a statewide survey to evaluate suitability of 31 major/minor aquifers for ASR
- Primary factors:
 - Hydrogeologic suitability
 - Excess water availability
 - Water supply needs

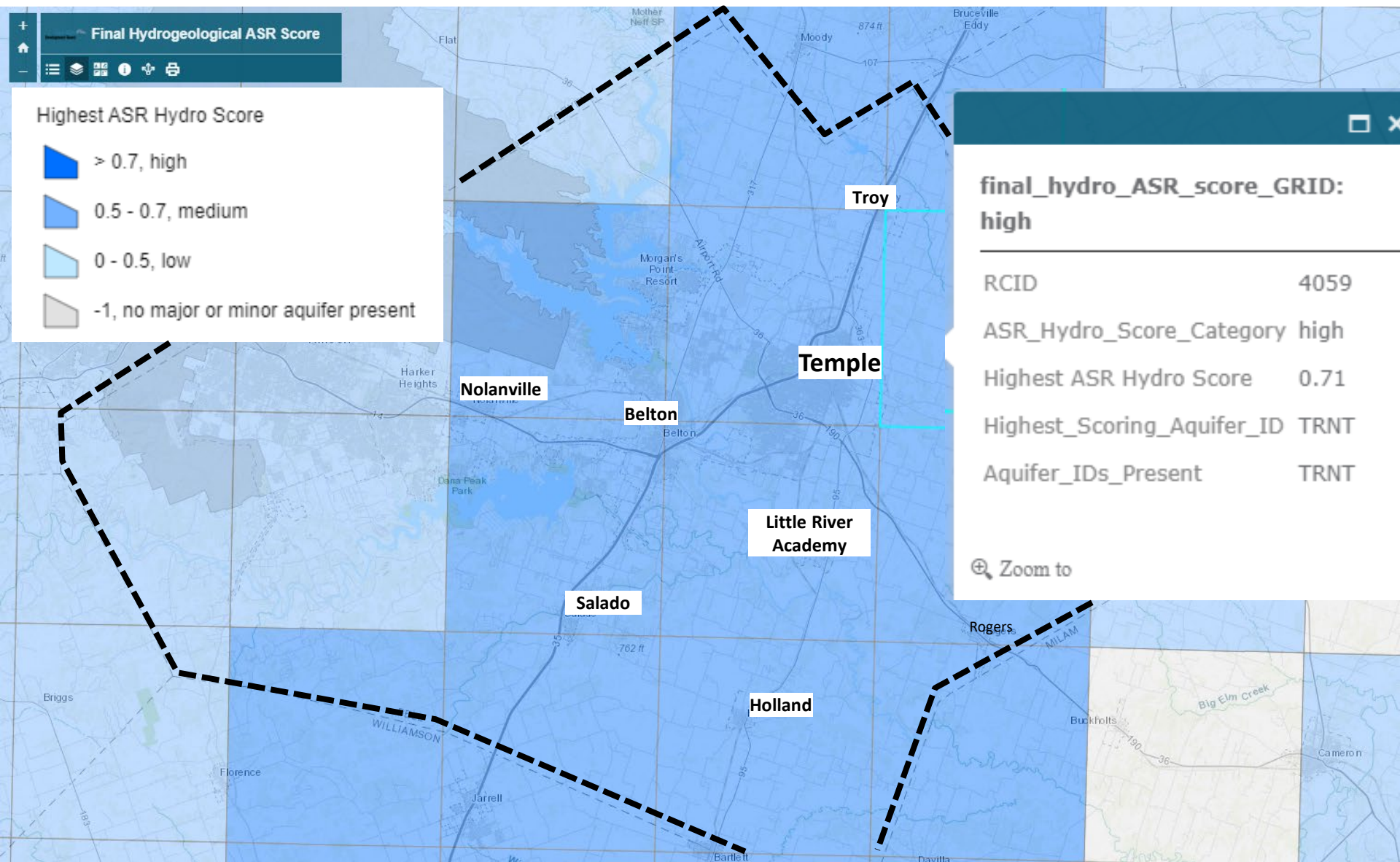
Hydrogeologic Suitability

- Aquifer Factors
 - Hydraulic Properties
 - Storage Properties
 - Available Drawdown
 - Confinement
- Groundwater Factors
 - Drift Velocity
 - Water Quality

Highest ASR Hydro Score










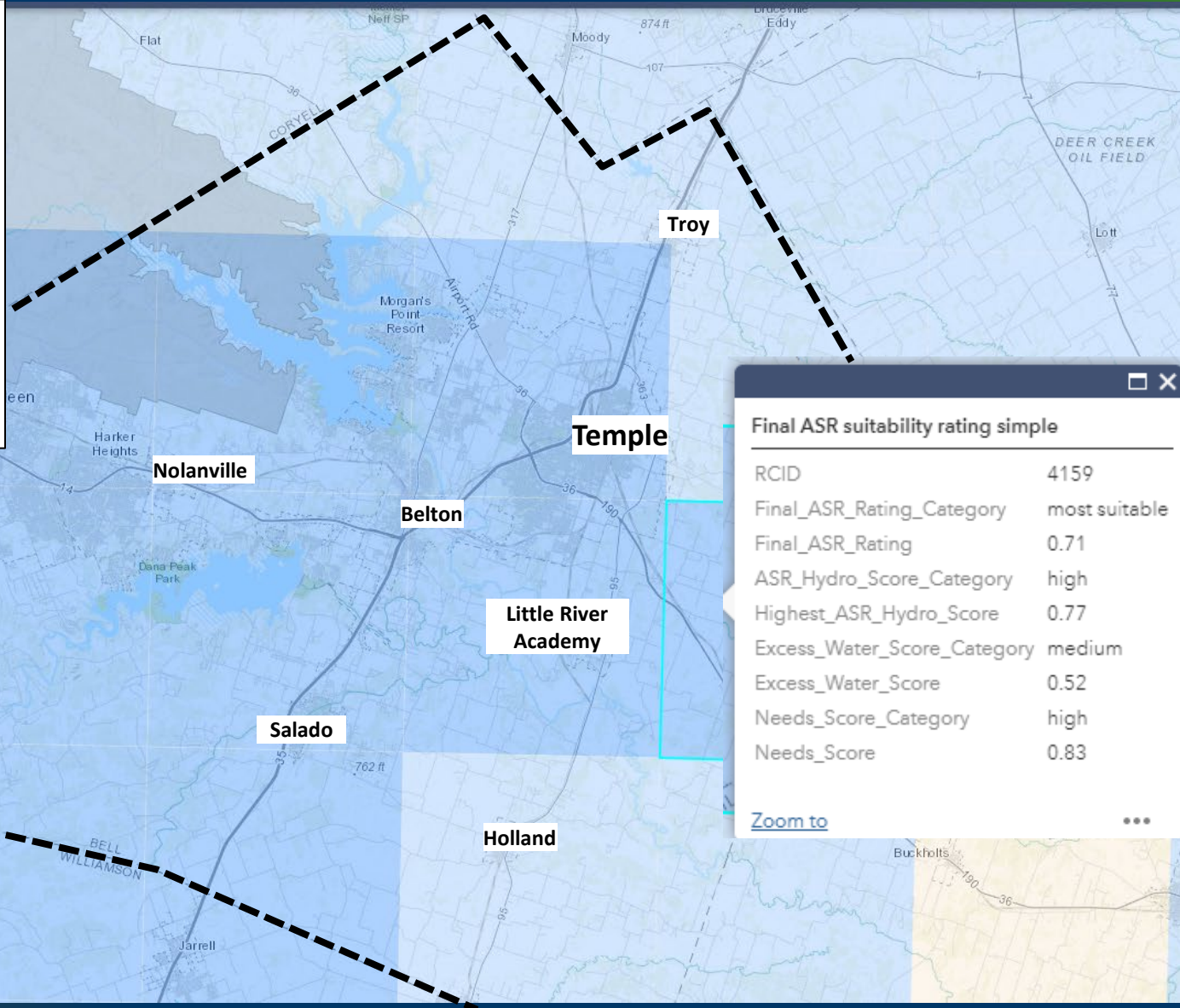
Hydrogeologic Suitability



Overall Suitability

Final_ASR_Rating

-  most suitable
-  moderately suitable
-  less suitable
-  no excess water identified
-  no need identified
-  neither excess water nor need
-  no major/minor aquifer

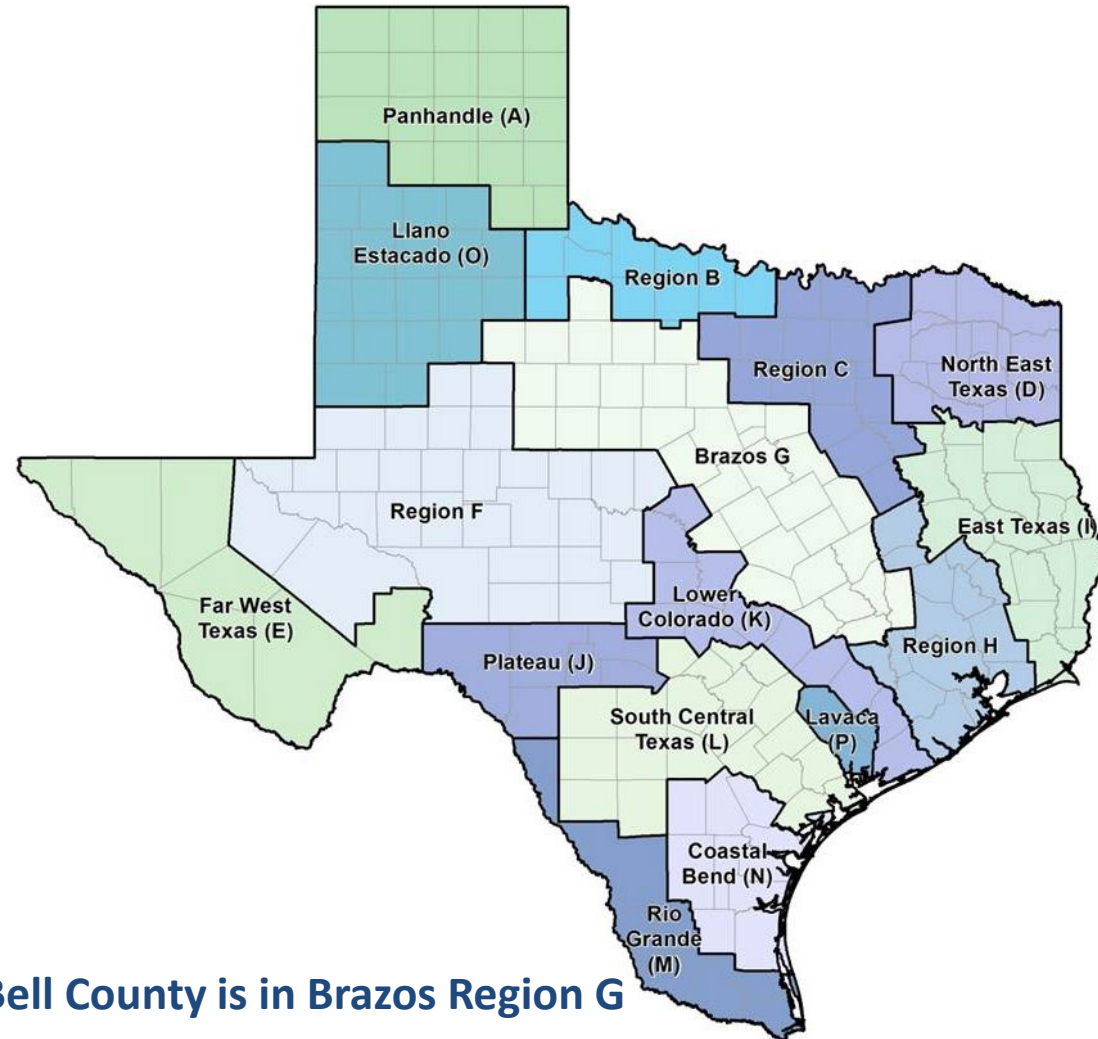


ASR AS A WATER STRATEGY

Regional Water Planning: Water Strategies

- State Water Plan Beg with Water Supply Reports from 16 Planning Groups
- Each Group Determines
 - water supply
 - water demand
 - water needs
 - water strategies

16 Regional Planning Groups



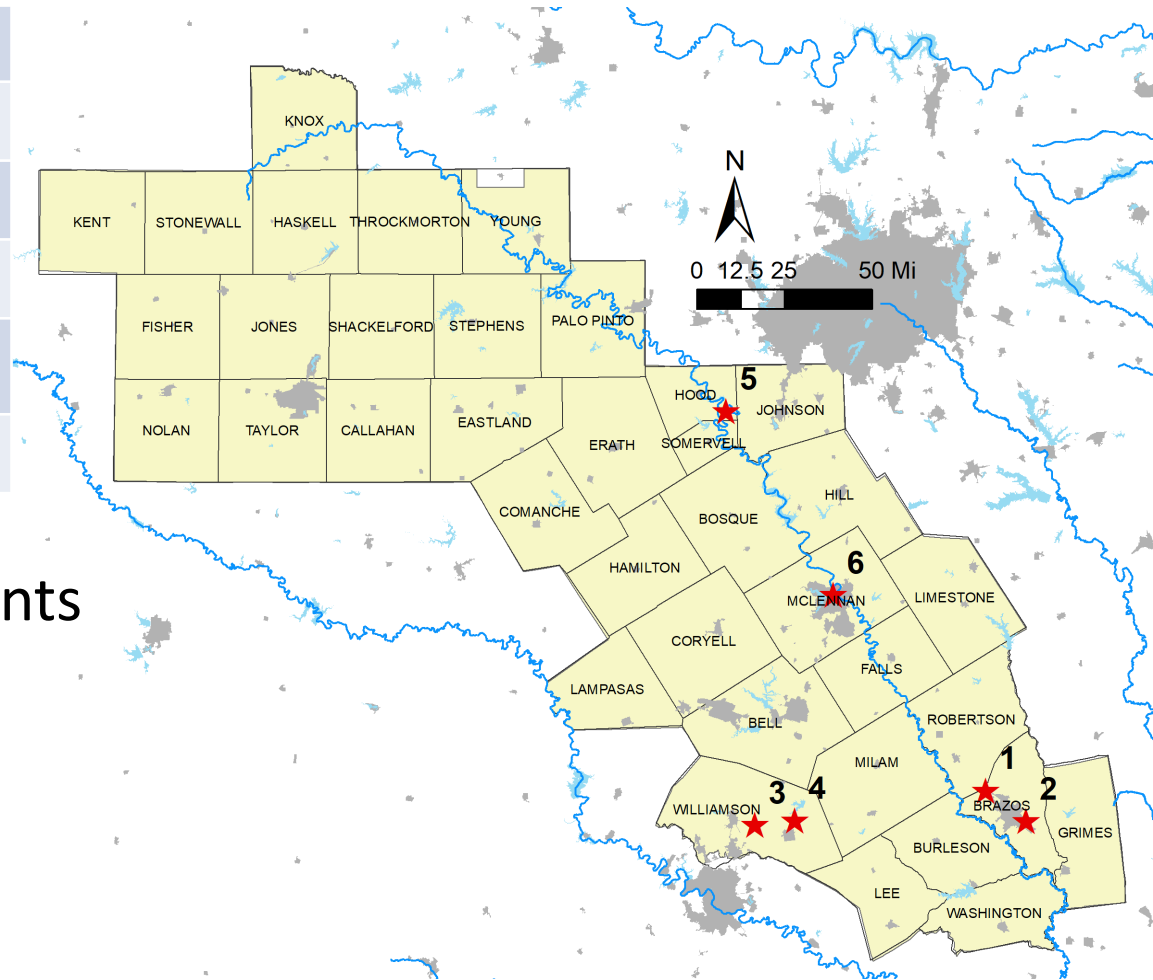
Bell County is in Brazos Region G

Water Management Strategies in Regional Plans

- Meet identified needs
- Be designed to:
 - Reduce water consumption, reduce water loss, improve efficiency in water use, OR
 - Develop, deliver or treat additional water to WUGs or WWPs in at least 1 decade
- Be “feasible”
- Have available water according to WAM or MAG
- Have a sponsor

2021 Brazos G Regional Water Plan: ASR Water Strategies

| ID | Description |
|----|--------------------------------------|
| 1 | City of Bryan |
| 2 | City of College Station |
| 3 | Lake Georgetown ASR |
| 4 | Lake Granger ASR |
| 5 | Johnson County SUD and Acton MUD ASR |
| 6 | Trinity ASR in McLennan County |



Water Strategy Components

- Description
- Available Yield
- Environmental Issues
- Engineering & Costing
- Implementation

BELL COUNTY ASR COALITION & ASSESSMENT OF ASR CANDIDATE SITES

ASR Coalition

- Creation
 - When: December 2019
 - Why: perform study to provide more locale results than the TWDB study and to “kick start” assessment for Region G
 - How: Interlocal Agreement penned by Honorable Judge Blackburn
- Coalition Members
 - Brazos River Authority
 - Fort Hood
 - Bell County Water Control Improvement District #1
 - City of Temple
 - Central Texas Water Supply Corporation
 - City of Rogers
 - Clearwater Underground WCD
 - Bell County

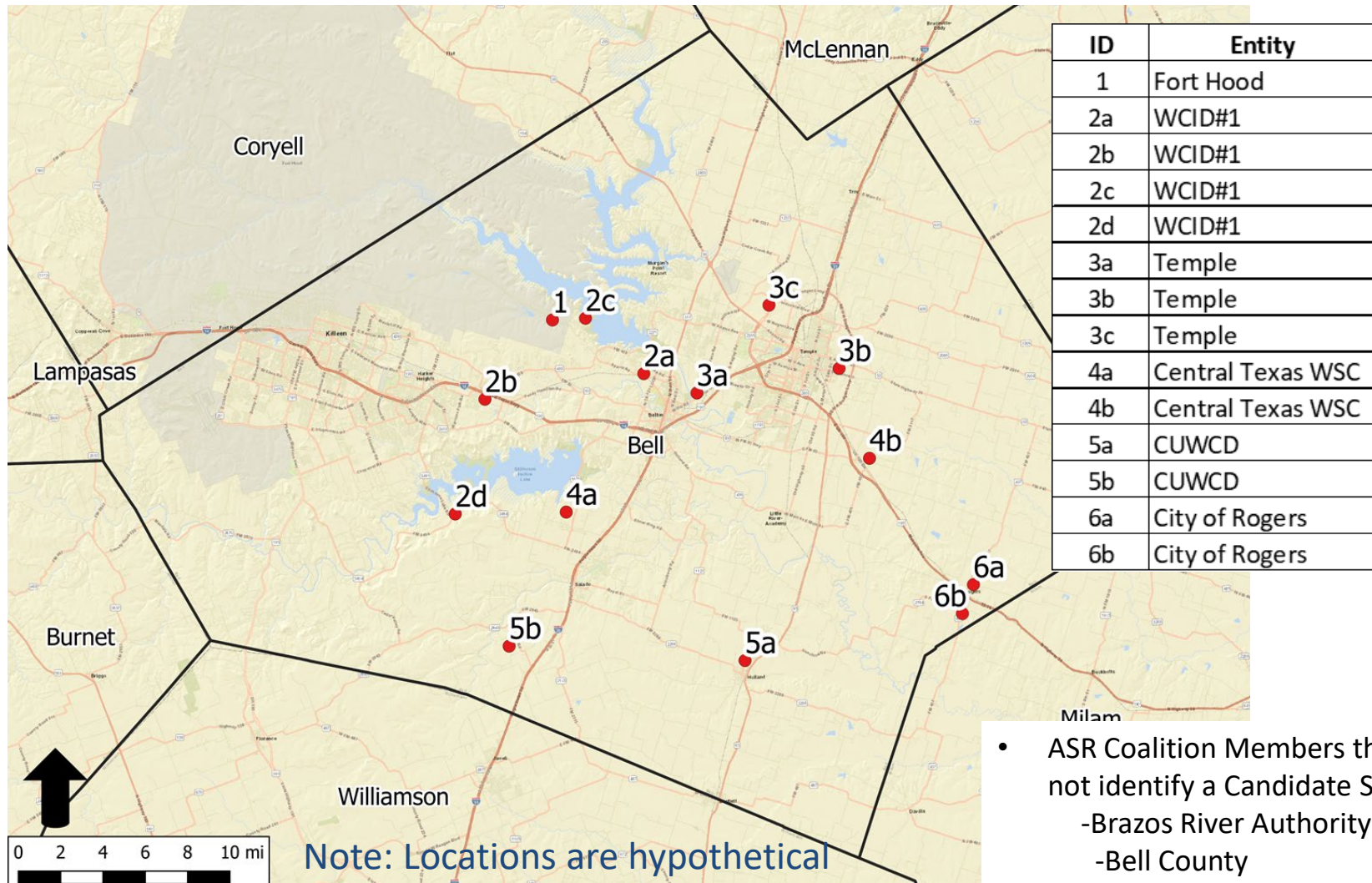
Bell County ASR Project

- Preliminary Evaluation of Bell County Aquifers for ASR
- Identify Potential ASR Projects for Coalition Members
- Perform Groundwater Modeling to Evaluate Feasibility of ASR
 - Aquifer capacity to recharge, storage, and product water
 - Assessment of well field
 - Recoverability of injected water
- Field Implementation and Costs ¹
- Permitting²

¹CDM assistance (David Smith)

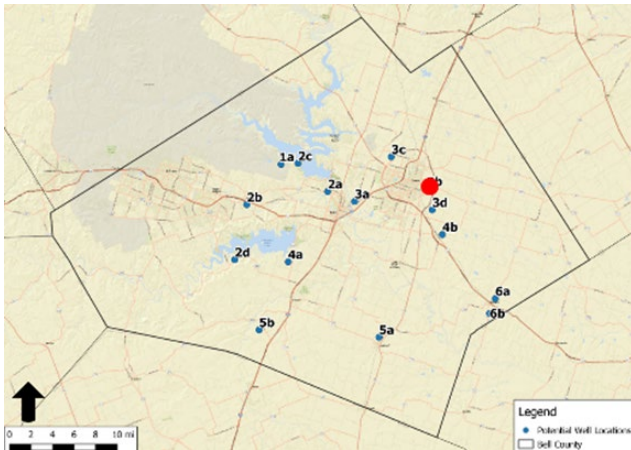
²TCEQ assistance (Lorrie Council)

Fourteen Candidate ASR Sites Identified

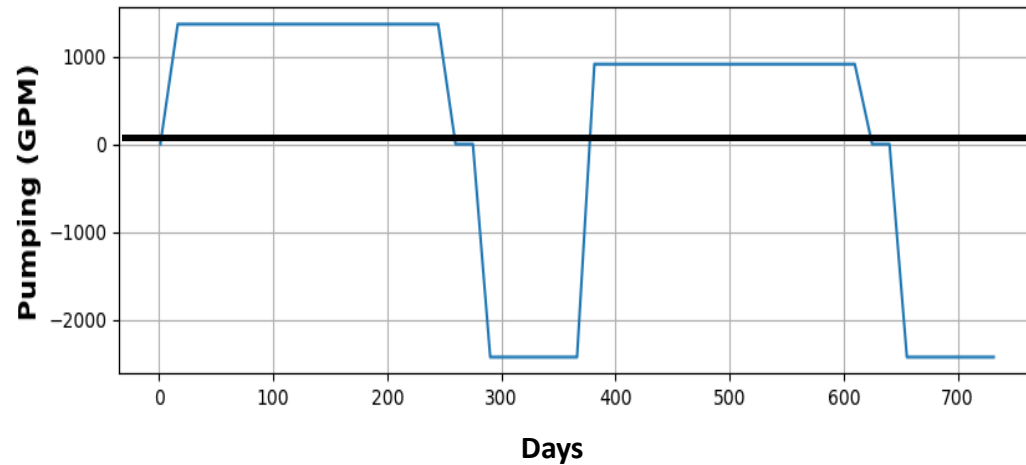


Groundwater Modeling

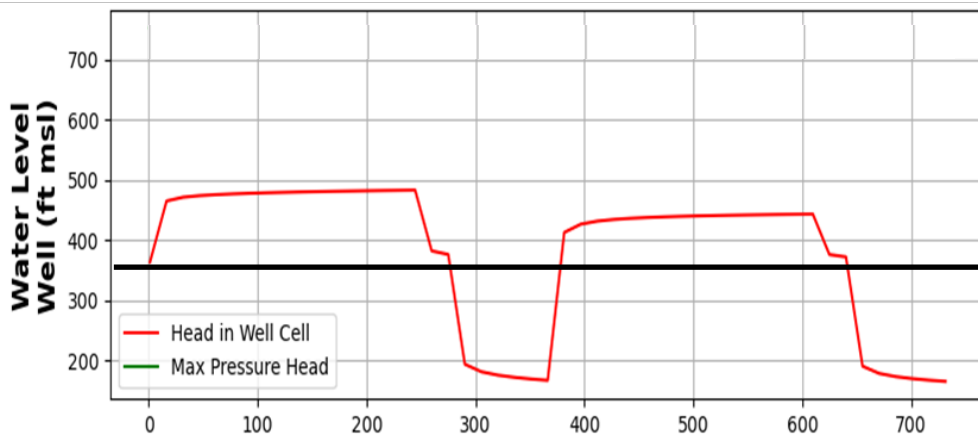
INPUT: Aquifer properties



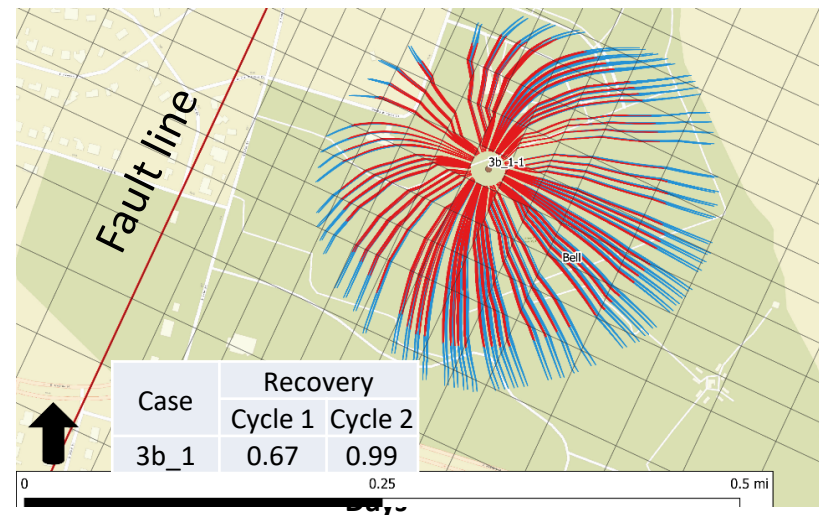
Injection and Pumping Schedule



OUTPUT: Drawup and Drawdown



Recoverability and Plume Migration



Summary of Viable ASR Locations and Applications

ASR Applications

- 9 = load leveling
- 3 = drought supply
- 2 = emergency supply

| ID | Entity | ASR Mode | Recharge and Storage | | | Well Field Operations | |
|------|----------------|----------|----------------------|-------------|----------|-----------------------|-------------------|
| | | | Rate (MGD) | Span (mths) | TSV (MG) | # Wells | Well Spacing (ft) |
| 1a_1 | Fort Hood | ES | 4 | 0.5 | 92 | 3 | 500 |
| 1a_2 | | DS | 2 | 5 | 458 | 2 | 250 |
| 3b_1 | City of Temple | LL | 3.5 | 3 | 480 | 1 | na |
| 3c_1 | | LL | 3.5 | 3 | 480 | 3 | 250 |
| 3d_1 | | LL | 3.5 | 3 | 480 | 1 | na |
| 3d_2 | | ES | 6.5 | 6 | 1,784 | 2 | 1,000 |
| 4a_1 | Central | LL | 0.6 | 3 | 82 | 1 | na |
| 4b_1 | Texas WSC | LL | 0.6 | 3 | 82 | 1 | na |
| 5a | CUWCD | LL | 1 | 3 | 137 | 1 | na |
| 5b | | LL | 1 | 3 | 137 | 1 | na |
| 6a | City of Rogers | LL | 4 | 3 | 549 | 1 | na |
| 6a | | DS | 4 | 12 | 2,196 | 1 | na |
| 6b | | LL | 4 | 3 | 549 | 1 | na |
| 6b | | DS | 4 | 12 | 2,196 | 1 | na |

Note: LL = Load Leveling; ES = Emergency Supply; DS = Drought Supply

TS = Targeted Storage Volume

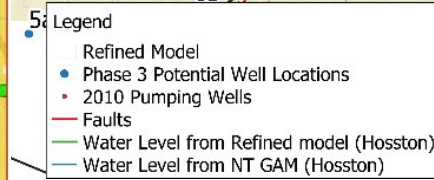
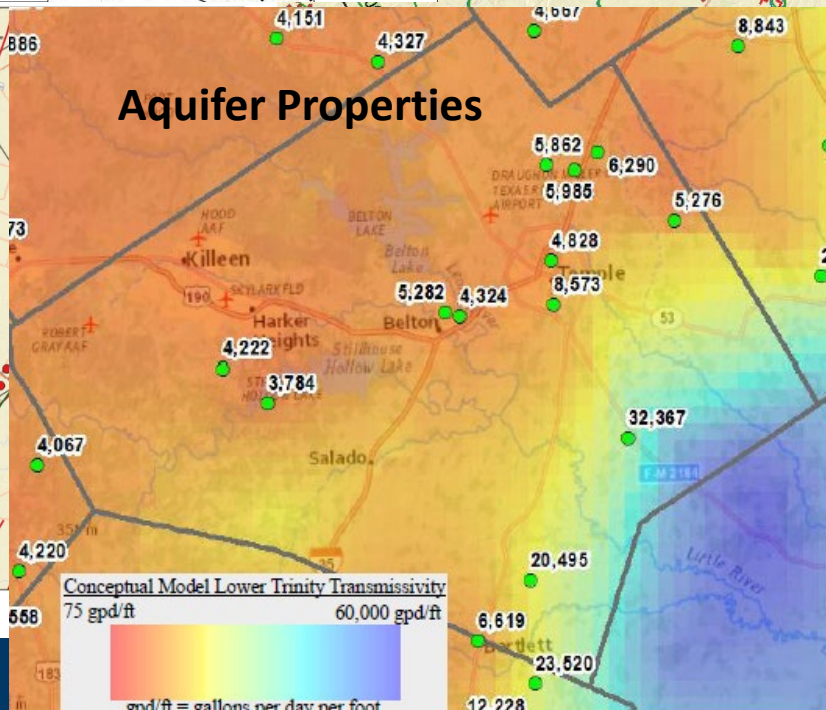
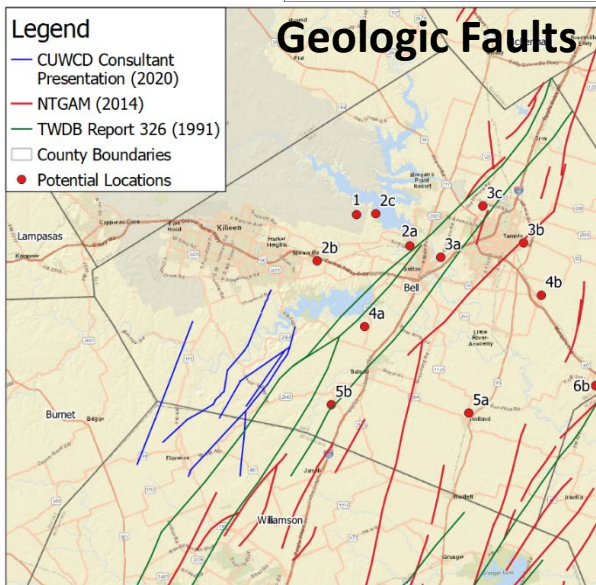
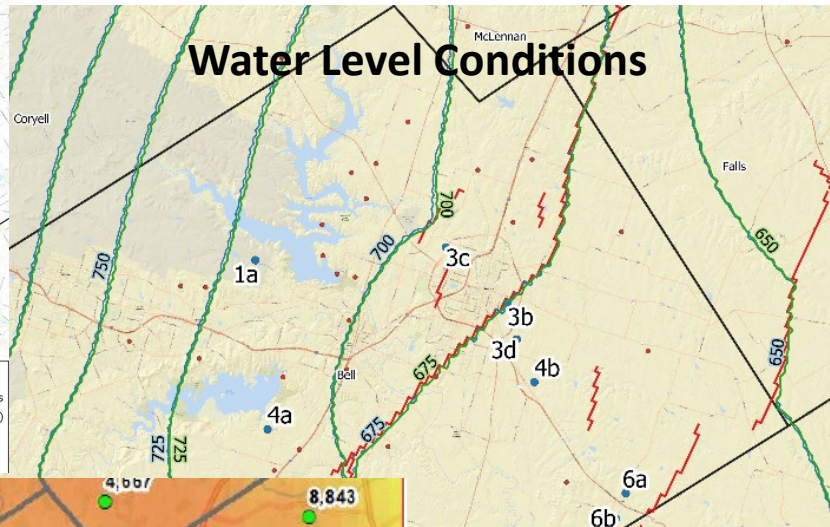
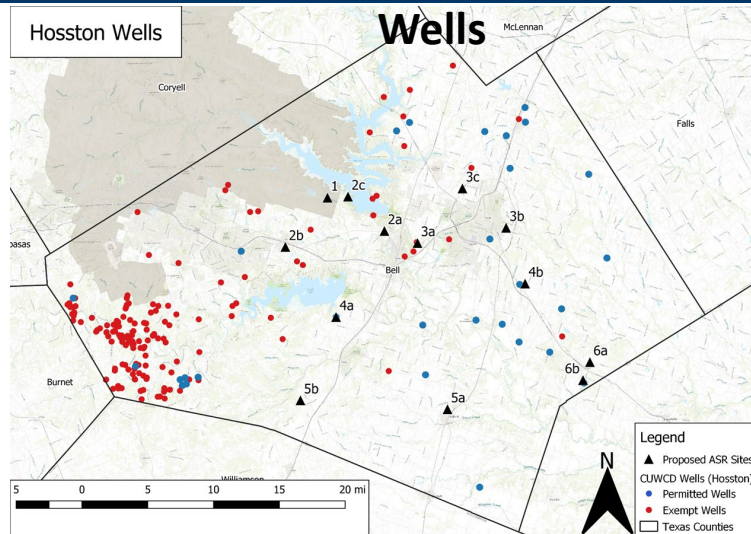
FAQ: ASR Application

- What is the role of GCDs in permitting ASR projects?
- How can we ensure that the recharge water does not have a deleterious effect on the aquifer?
- What amount of monitoring is required for an ASR project?
- How can I learn more about Bell County ASR Project?



Questions ?

Groundwater Modeling of ASR Performance



ASR Operation: Recoverability and Plume Migration

- Operations
 - Inject water at 100 gpm for 11 months (48 million gallons)
 - Extract water at 1100 gpm for 1 month (48 million gallons)

- Aquifer Properties
 - 50 feet thick
 - Hydraulic conductivity = 10 ft/day

