

# Assessment of Potential for Comingling of Brackish Water

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*Presented for the Texas Groundwater Protection Committee  
Virtual Meeting*

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# Objectives

- Document a scientific assessment of brackish groundwater comingling issues statewide and with a focus on select aquifer/regions
- Inform future policy development regarding the concept of comingling.

Task Number	Task Description
Task 1	Project Management
Task 2	Stakeholder Outreach
Task 3	Review of Statutes and Terminology
Task 4	Statewide Assessment of Comingling Issues
Task 5	Assessment of Select Aquifers/Regions
Task 6	Review of Findings
Task 7	Recommendations and Need for Future Study
Task 8	Reporting

# TDLR Water Well Drillers Advisory Council Summit

August 17th, 2018

- Study was initiated based on concerns brought up by the workgroup
- Five questions were asked:
  - Define (groundwater) degradation.
  - Identify the amount of time and what conditions must be met for a test well to stay open.
  - What is the minimum well construction standards to produce brackish water?
  - Would mixing 20,000 mg/L with 30,000 mg/L brackish water be considered comingling?
  - Define aquifers and zones.

# Stakeholder Outreach

Two stakeholder meetings were conducted

- February 5, 2020
  - Public webinar and request for input
    - *Is comingling an issue in your district?*
    - *Does the definition of comingling require modification?*
    - *If so, how? How would you define degradation?*
    - *Do you have physical data to support the presence of comingling in your aquifers?*
    - *Do you have documented well completion practices in your district causing comingling?*
- February 2, 2021
  - Meeting with representatives from TDLR

# Review of Statutes and Definitions

Administrative Code Title	Part	Chapter / Subchapter
TAC Title 16 - Economic Regulation	Part 1 – Railroad Commission	Chapter 3 - Oil and Gas Division
	Part 4 – Texas Department of Regulation and Licensing	Chapter 76 – Water Well Drillers and Pump Installers Rules
TAC - Title 30 - Environmental Quality	Part 1 – Texas Commission on Environmental Quality	Chapter 3 - Definitions
		Chapter 293 C – Requirements for Groundwater Conservation Districts
		Chapter 290 D - Rules and Regs Public Water Supply Systems
		Chapter 290 F - DW Standards and Reporting for Public Water Systems
TAC - Title 31 - Natural Resources	Part 10 – Texas Water Development Board Part 18 - Texas Groundwater Protection Committee	Chapter 331 - Underground Injection Control
		Chapter 356 - Groundwater Management
		Chapter 601 - Groundwater Contamination Report

Statute Title	Chapter	Subject
Occupations Code	Subtitle A, Chapters 1901 and 1902	Water Well Drillers and Pump Installers
Texas Water Code	Chapter 26	Water Quality Control
Texas Water Code	Chapter 36	Groundwater Conservation Districts

# Review of Statutes and Definitions

**Comingling defined in 16 TAC 76.10(16)** – the mixing, mingling, blending or combining through the borehole casing or annulus or the filter pack of water *that differ in chemical quality*, which *causes quality degradation* of any *aquifer or zone*

- Two conditions must be met for comingling to occur:
  1. Mixing occurs between waters of different chemical quality
  2. Mixing causes degradation to an aquifer or a zone
- Comingling does not occur:
  1. When waters of the same chemical quality mix in a borehole
  2. When two different quality waters mix within a borehole, but that mixing does not cause degradation

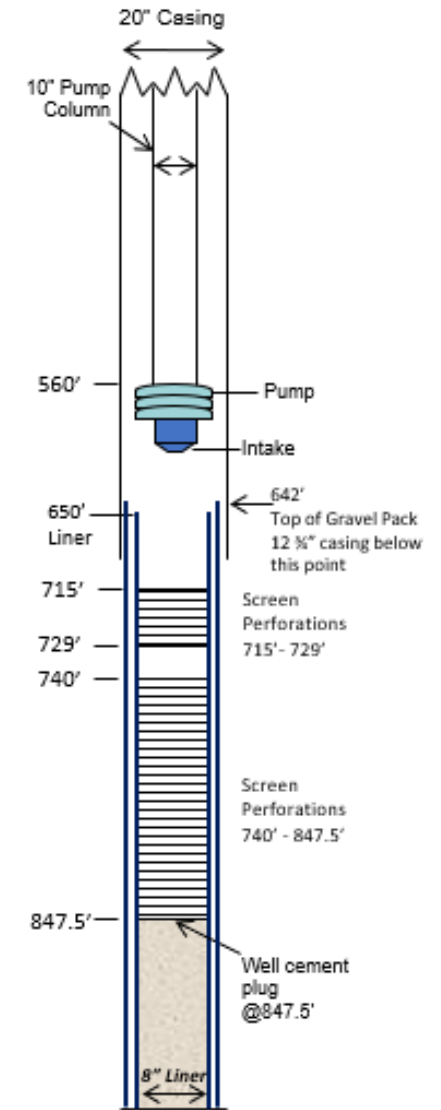
# Review of Statutes and Definitions

**Pollution defined in 16 TAC 76.10 (42)** - The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water that renders the water harmful, detrimental, or injurious to humans, animals, vegetation, or property, or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any or reasonable purpose. (same as 30 TAC 331.10(86) )

- 16 TAC 76 is intended to prevent contamination of useable water with a human or environmental health risk.
- Mixing of groundwaters that maintains use may not be considered degradation and therefore comingling

# What Could Cause Comingling?

- Well Drilling
  - Different water quality zones
  - Different zones of hydraulic pressures (heads)
  - Creation of conduits between aquifer/zones
- Well Completion
  - Selection vertical intervals for screening
  - Selection of intervals for casing
- Well Operations
  - Pumping Schedule (on/off pumping)
  - Monitoring of flow and quality





# Physical Framework for Comingling

- Stratification of Water Quality

- Regional flow processes
- Specific deposits

- Vertical Hydraulic Gradients

- Naturally Occurring (artesian conditions)
- Pumping Induced (depressurized zones)

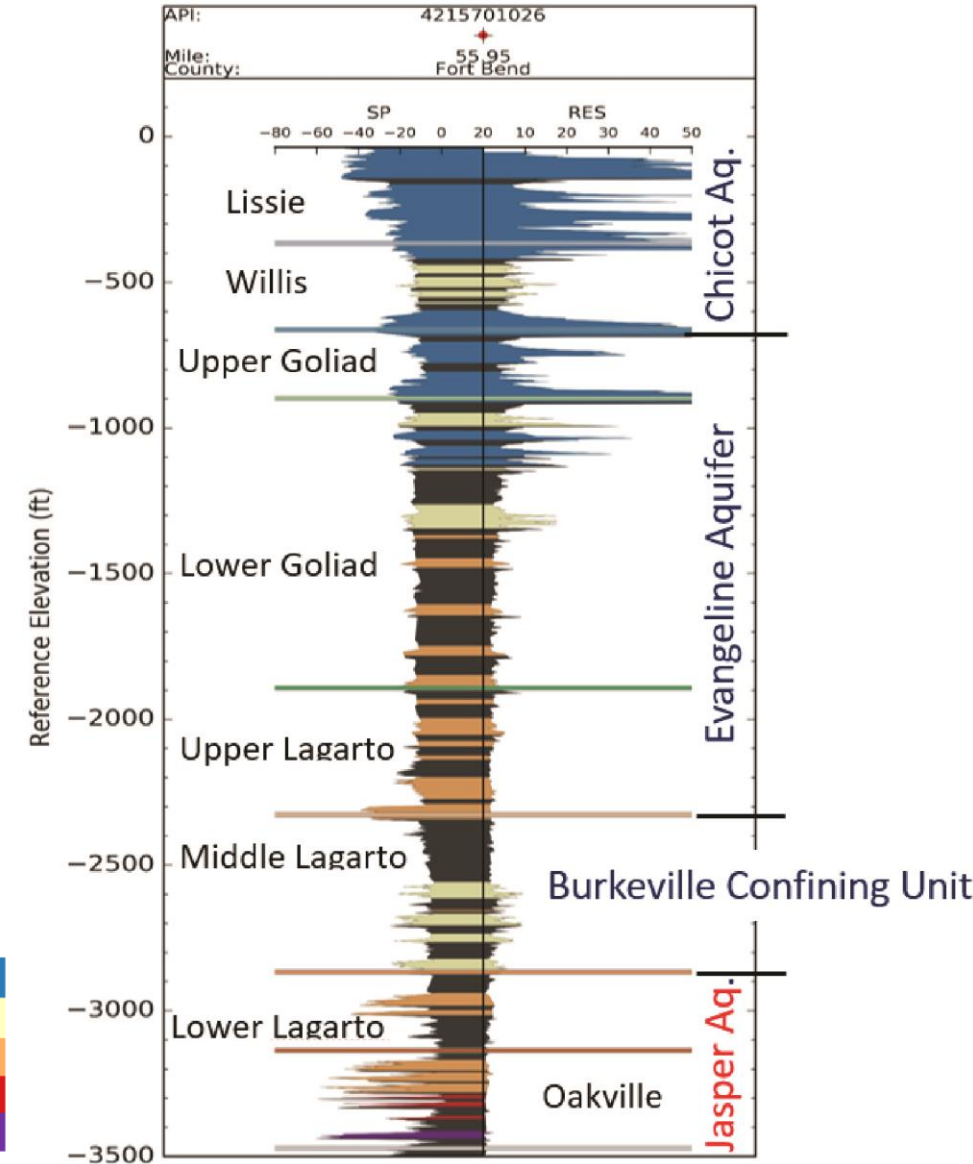
- Well Completion

- Screens intersecting undesirable (injurious) water

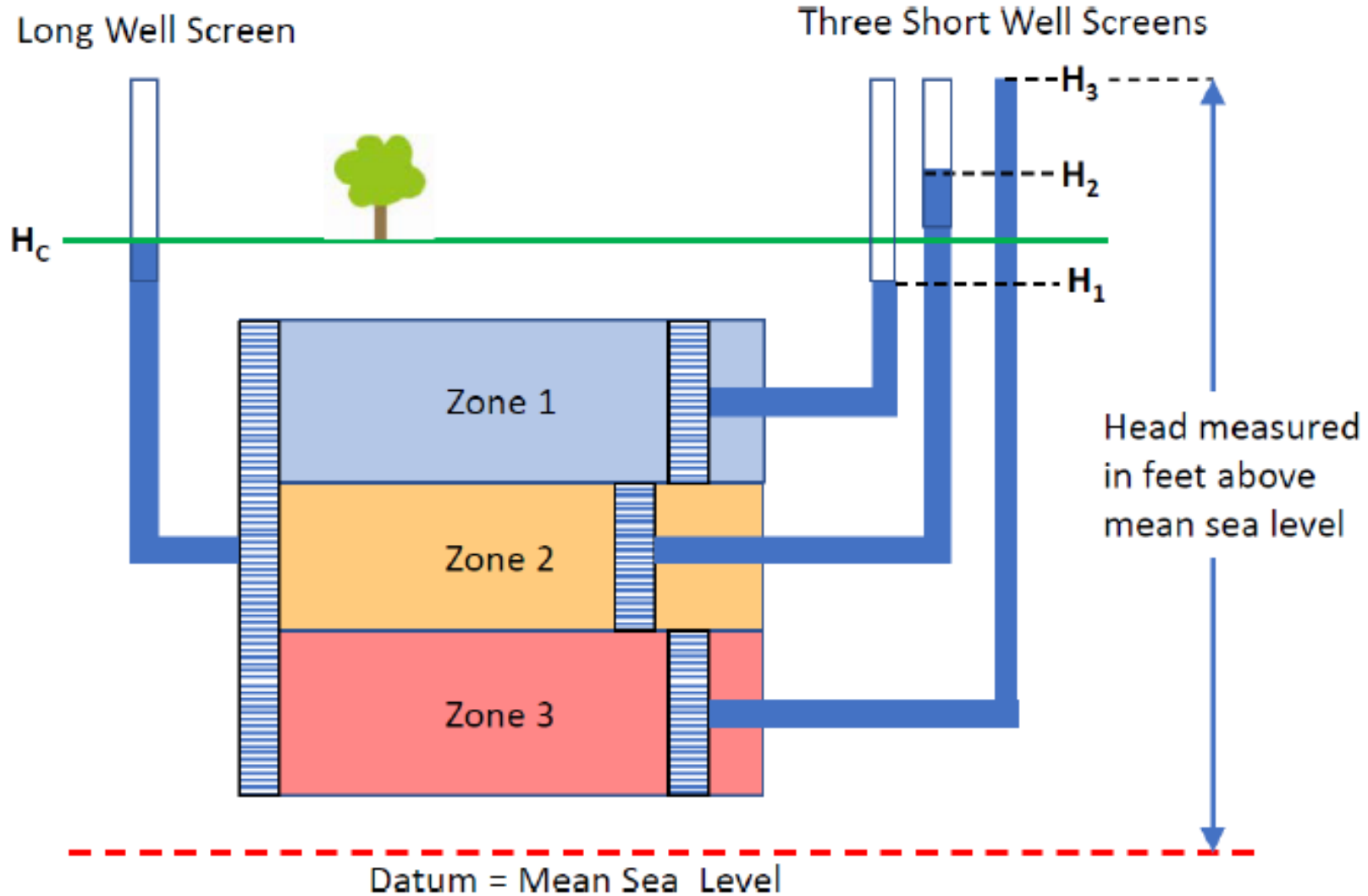
- Drilling and Well Operations

- Well (period of non pumping)
- Borehole (time left open)

Quality	TDS (mg/L)
Fresh	< 1,000
Slightly Saline	1,000 - 3,000
Moderately Saline	3,000 - 10,000
Very Saline	10,000 - 35,000
Brine	> 35,000

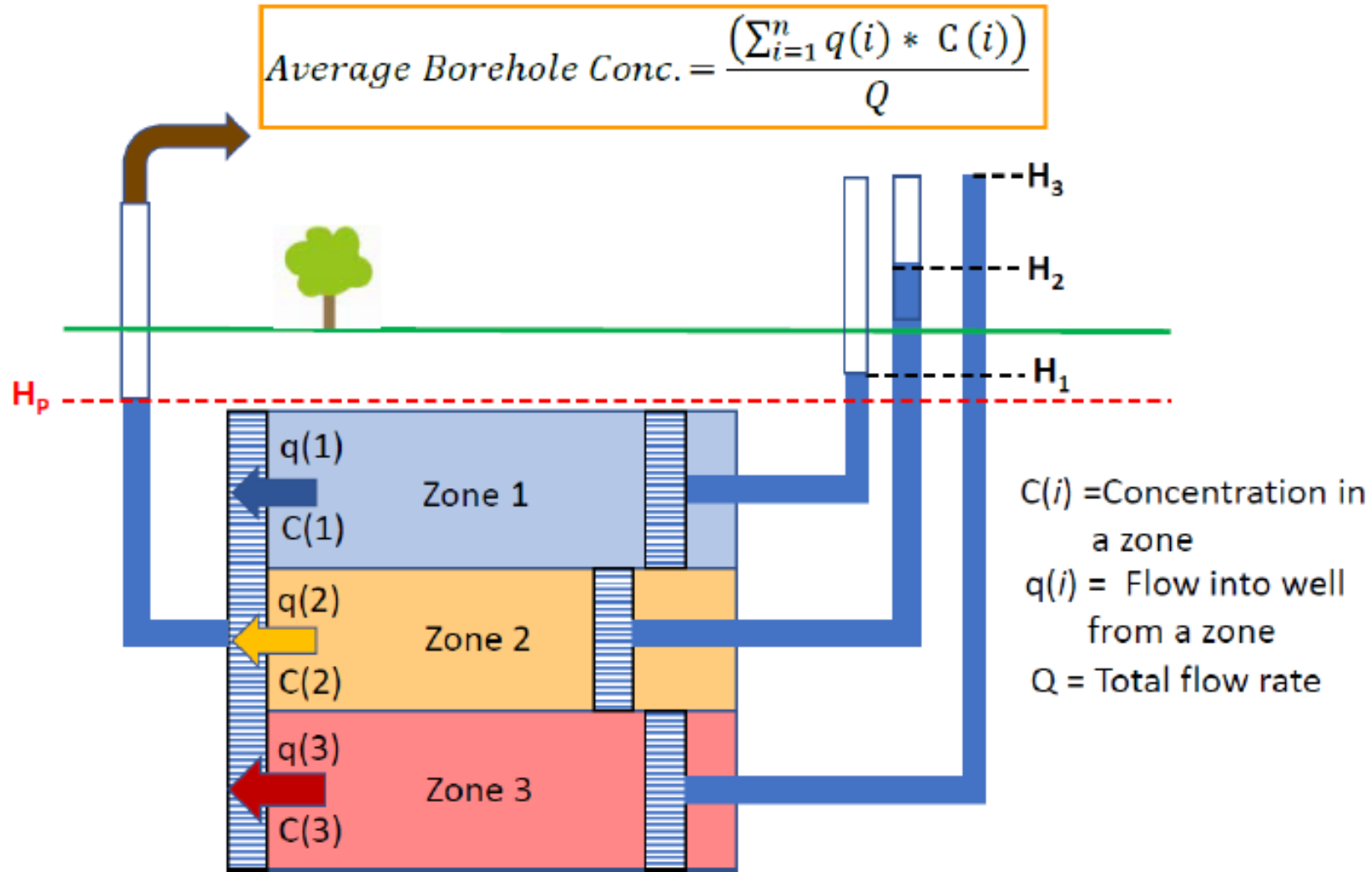


# Physical Framework for Comingling



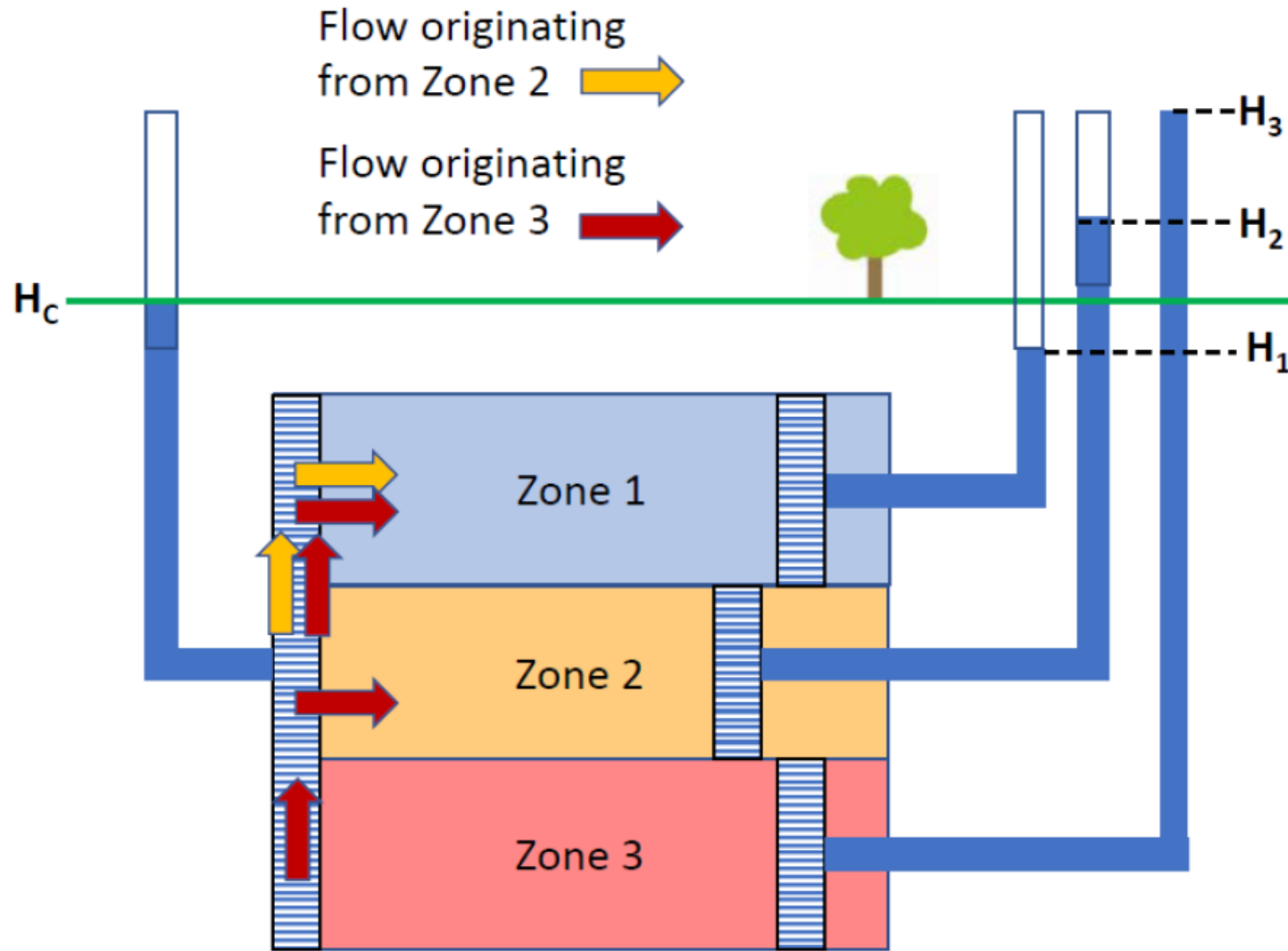
Note:  $H_1$  = Zone 1 Head,  $H_2$  = Zone 2 Head,  $H_3$  = Zone 3 Head,  $H_c$  = composite head

# Physical Framework for Comingling



Note:  $H_1$  = Zone 1 Head,  $H_2$  = Zone 2 Head,  $H_3$  = Zone 3 Head,  $H_p$  = Head during pumping

# Physical Framework for Comingling



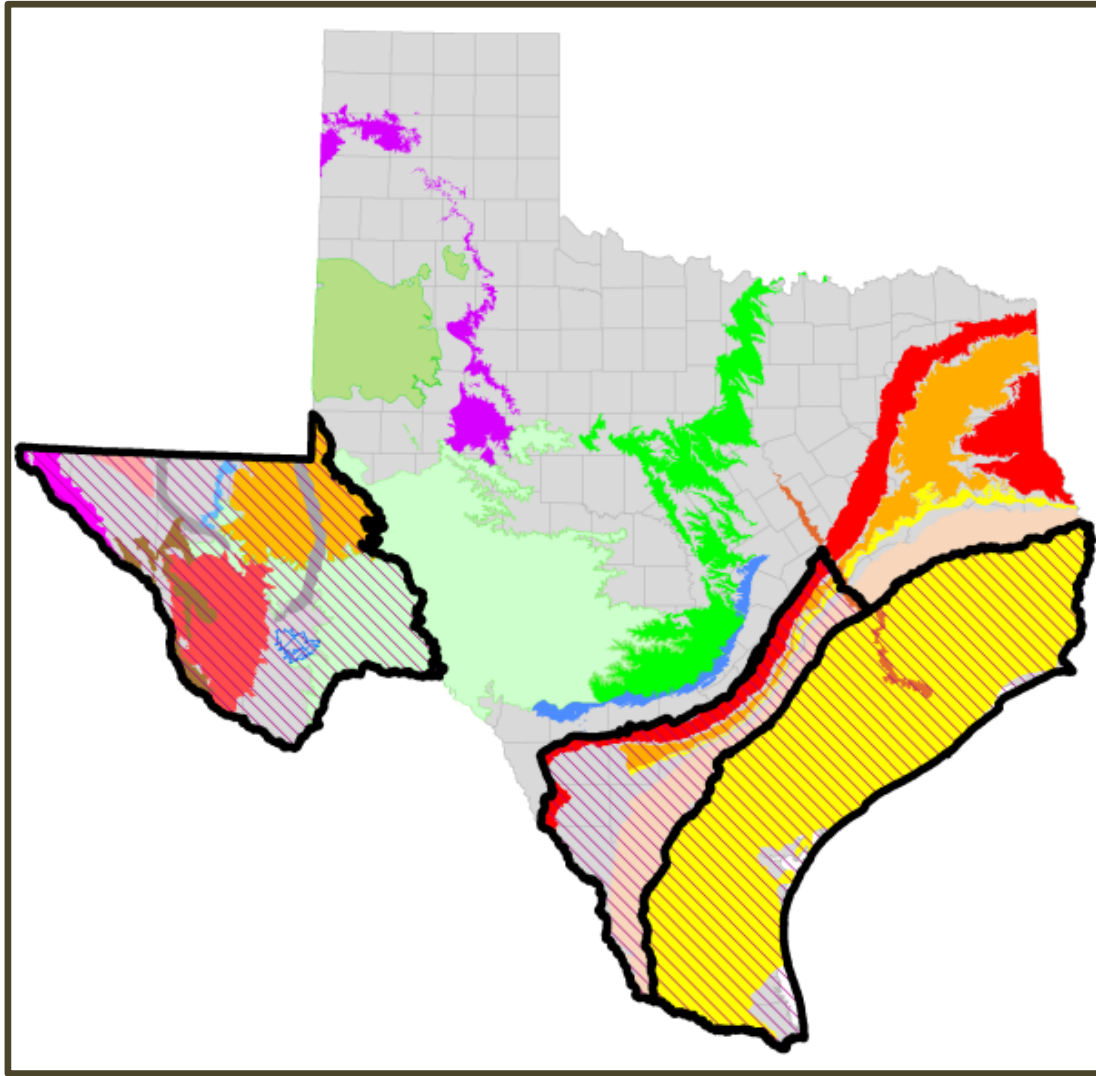
Note:  $H_1$  = Zone 1 Head,  $H_2$  = Zone 2 Head,  $H_3$  = Zone 3 Head,  $H_c$  = composite head

# Physical Framework for Comingling

- Comingling is mixing of groundwater within a well between zones such that one zone degrades another aquifer or zones
  - It does not apply to the mixing that occurs at the well head from pumping.
- Comingling could occur under non-pumping and pumping conditions. However, the potential is far greater under non-pumping conditions
- The data required to delineate the potential for comingling is rarely collected
  - Zonal water quality as well as zonal flow rates under non-pumping well conditions



# Analysis of Select Aquifers and Regions



Three specific areas to assess specified by TDLR :

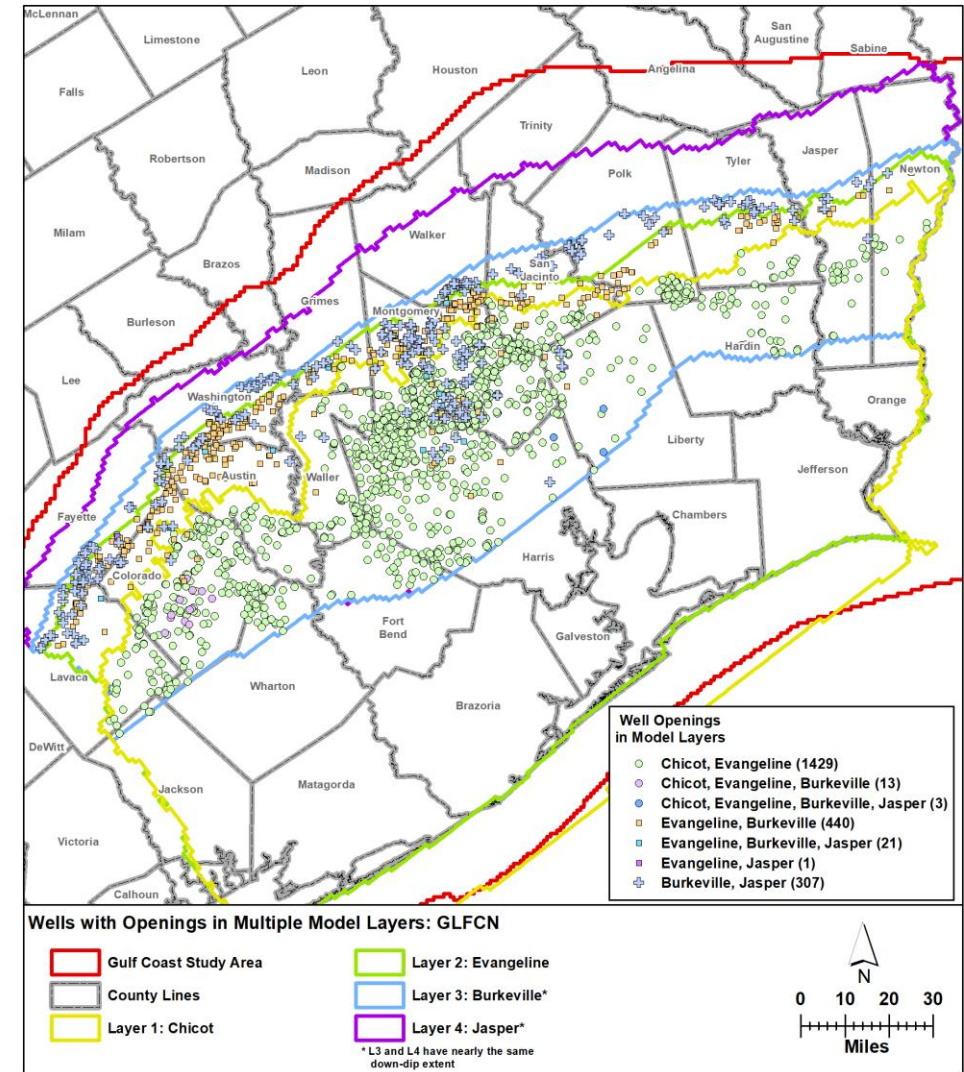
- The Gulf Coast Aquifer System
- The Eagle Ford Region
- Trans-Pecos Region

Objective was to characterize the potential for comingling both within and between aquifers in each region

# Analysis of Select Aquifers and Regions

Approach focused on developing a database with necessary data:

- Well completions with an emphasis on identifying multi-aquifer completions
- Maximum head differences between aquifers at the location of multi-completed wells
- Water quality within the aquifers including amount and location of brackish water



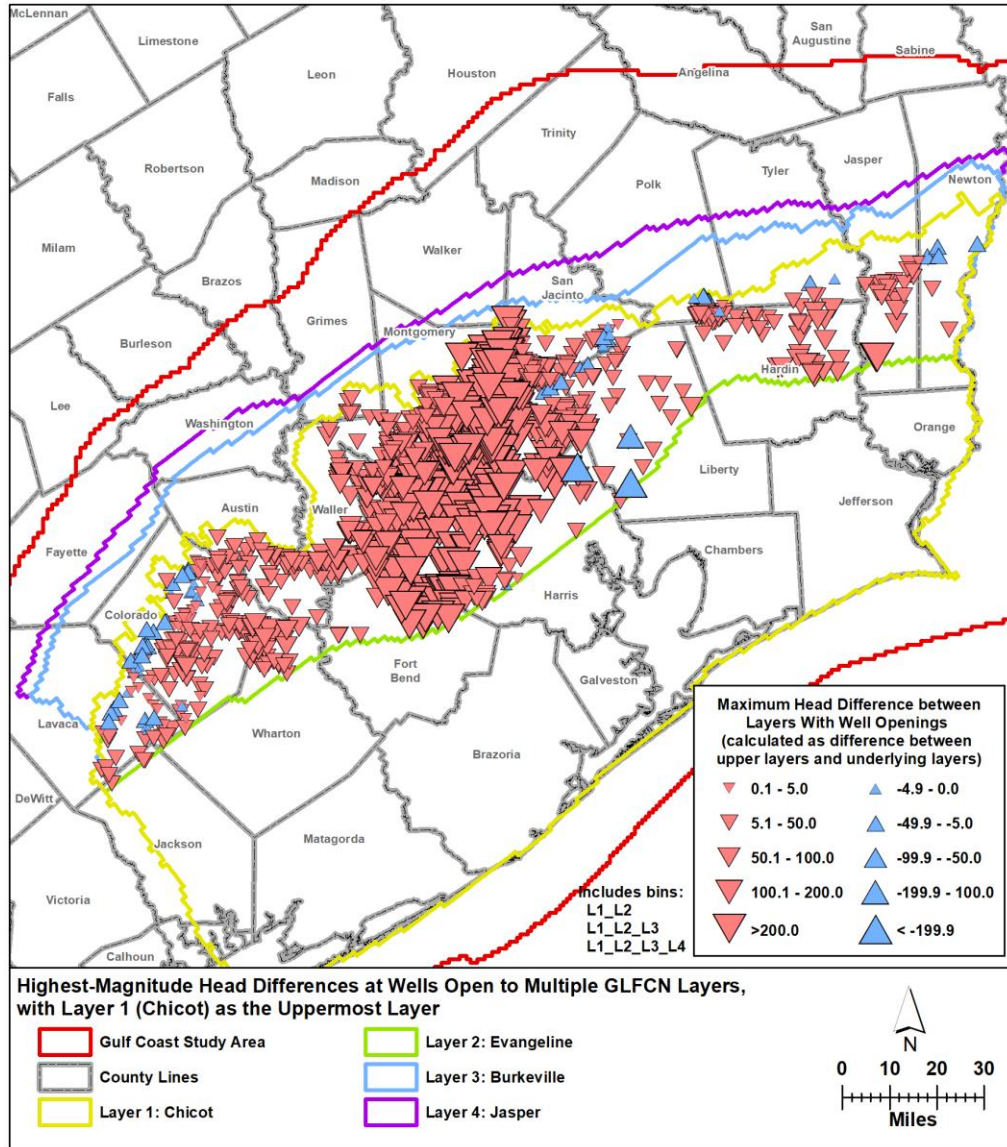
# Analysis of Select Aquifers and Regions

Database included wells with screen information:

- Gulf Coast - 102,699
- Eagle Ford - 35,580
- Trans-Pecos - 5,815

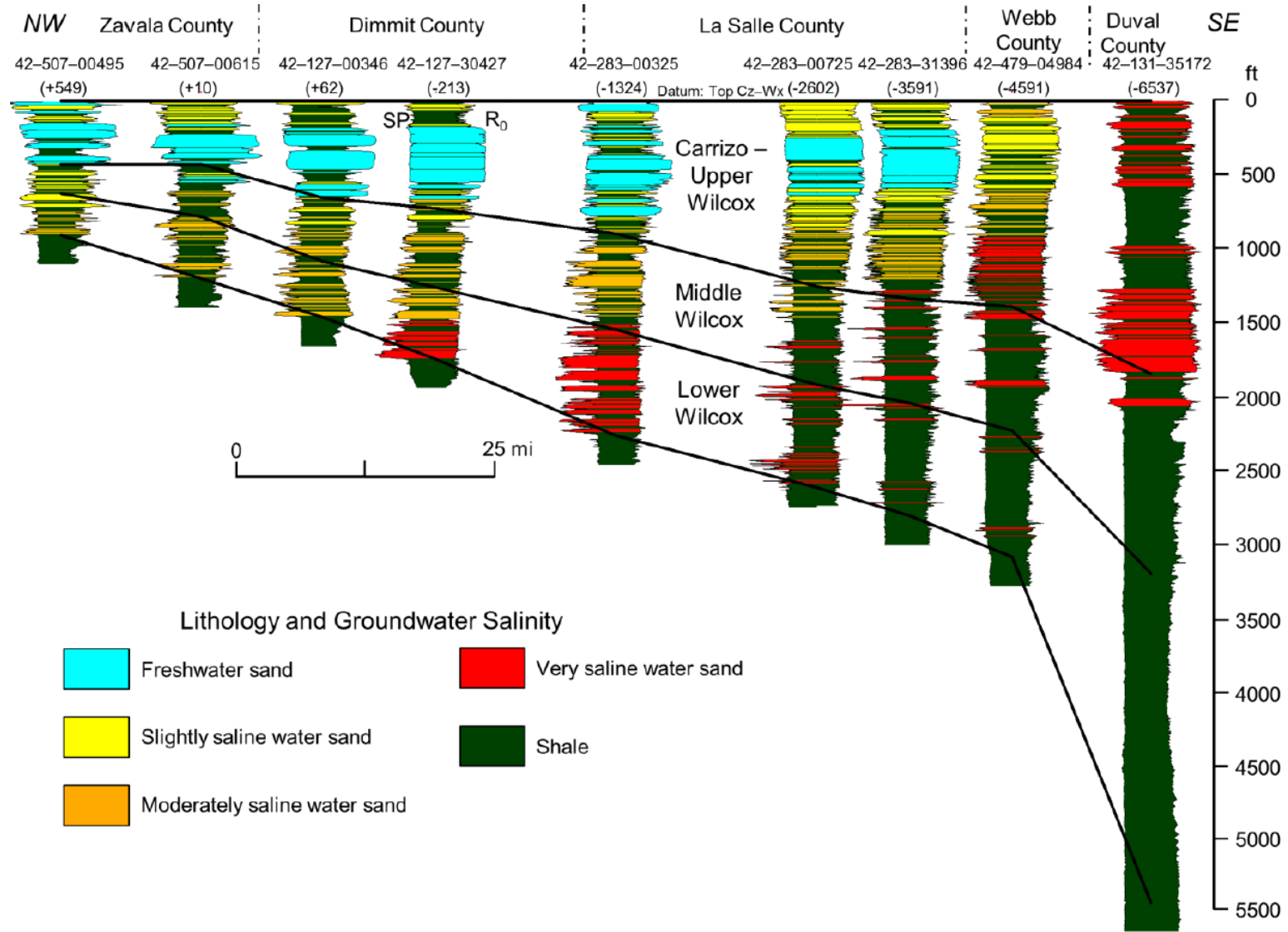
Aquifer Structure and hydraulic heads from TWDB Groundwater Availability Models

Water quality data from TWDB Brackish Resources Aquifer Characterization System and the Groundwater databases

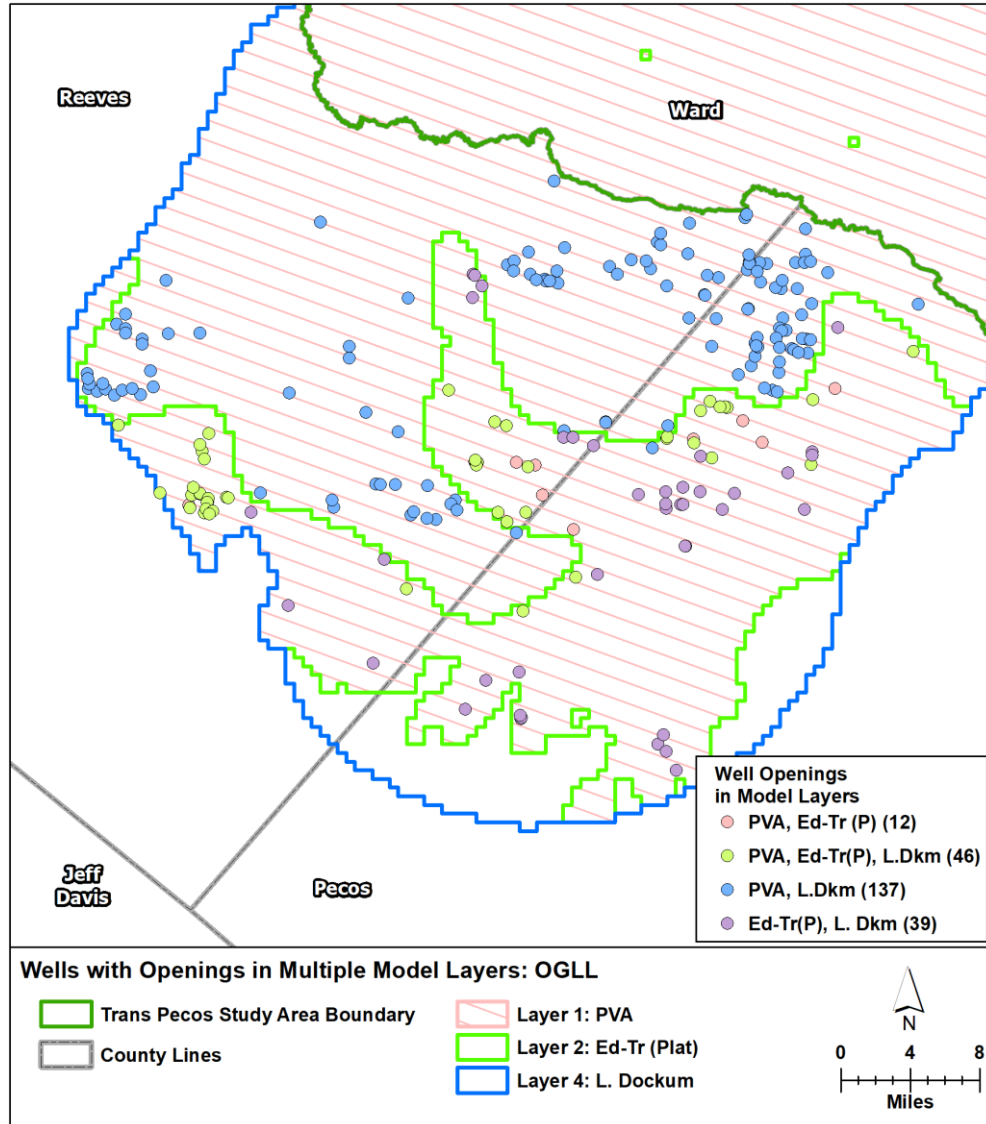




# Analysis of Select Aquifers and Regions



# Analysis of Select Aquifers and Regions



- All three aquifer/regions have potential for comingling to occur
- The Gulf Coast Aquifer and the Eagle Ford Regions have the highest potential for comingling of the three areas
- Case studies are presented for each region
  - Provide well-specific evidence of potential comingling and the mechanisms that may cause comingling
  - Provide insight into the types of detailed characterization data that requires collection to evaluate comingling

# Statewide Ranking of Comingling Potential

- Desktop study of statewide ranking of each aquifer for potential for comingling
- Aquifers given a normalized score
- Criteria:
  - Brackish groundwater availability
  - Brackish groundwater productivity
  - Range of salinity classes
  - Aquifer layering (stratification)
  - Historical vertical head differences
  - Cross-aquifer completions

Aquifer	Score	Category
Gulf Coast	0.95	High
Dockum	0.85	High
Edwards-Trinity (Plateau)	0.80	High
Carrizo-Wilcox	0.76	High
Edwards (BFZ)	0.72	High
Queen City & Sparta	0.71	High
Pecos Valley Alluvium	0.71	High
Northern Trinity	0.69	High
Yegua Jackson	0.69	High
Edwards-Trinity (High Plains)	0.68	High

# Conclusions and Future Considerations

- Two specific conditions must be met for comingling to occur:
  - Mixing occurs between waters of different chemical quality
  - Mixing causes degradation to an aquifer or a zone
- Groundwater flow can occur in a borehole under non-pumping conditions if the hydraulic head within aquifers or zones co-completed by the well have different hydraulic heads
- Stratification of water quality commonly occurs in aquifers
- Conditions that could lead to comingling are common in Texas aquifers, and future aquifer characterization may need to characterize it
- Additional data collection, such as zonal hydraulic head data, may aid in the characterization of comingling potential

# Report Information

Available for download on TWDB's website:

<https://www.twdb.texas.gov/groundwater/bracs/projects/Comingling/index.asp>

Recording of the TDLR Water Well Drillers Advisory Council Summit

<https://www.youtube.com/watch?v=GHxWjjLjbwA>

# Contact Information

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# Questions?