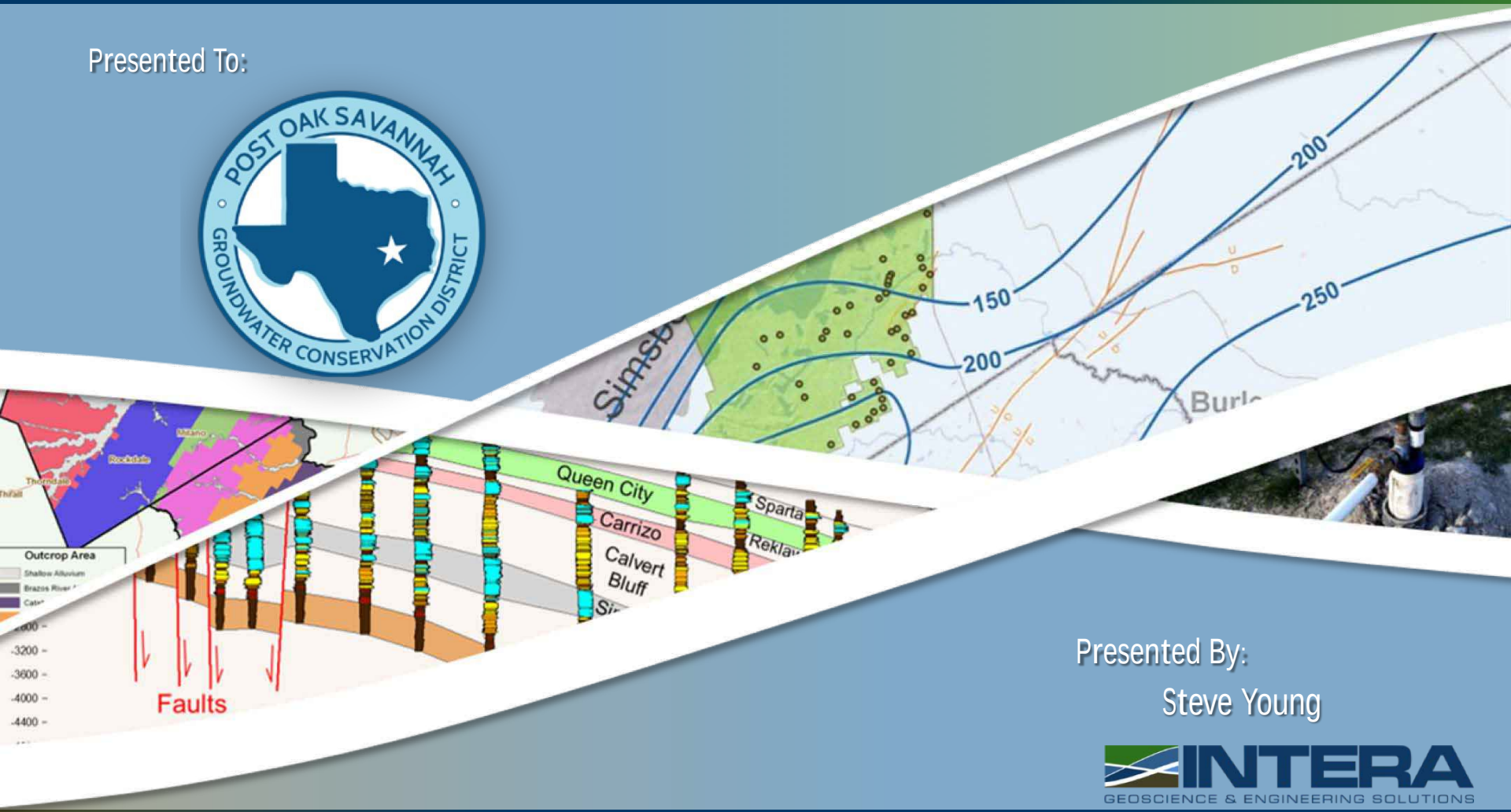
DFC Committee Meeting Update

Presented To:



Presented By:

Steve Young

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

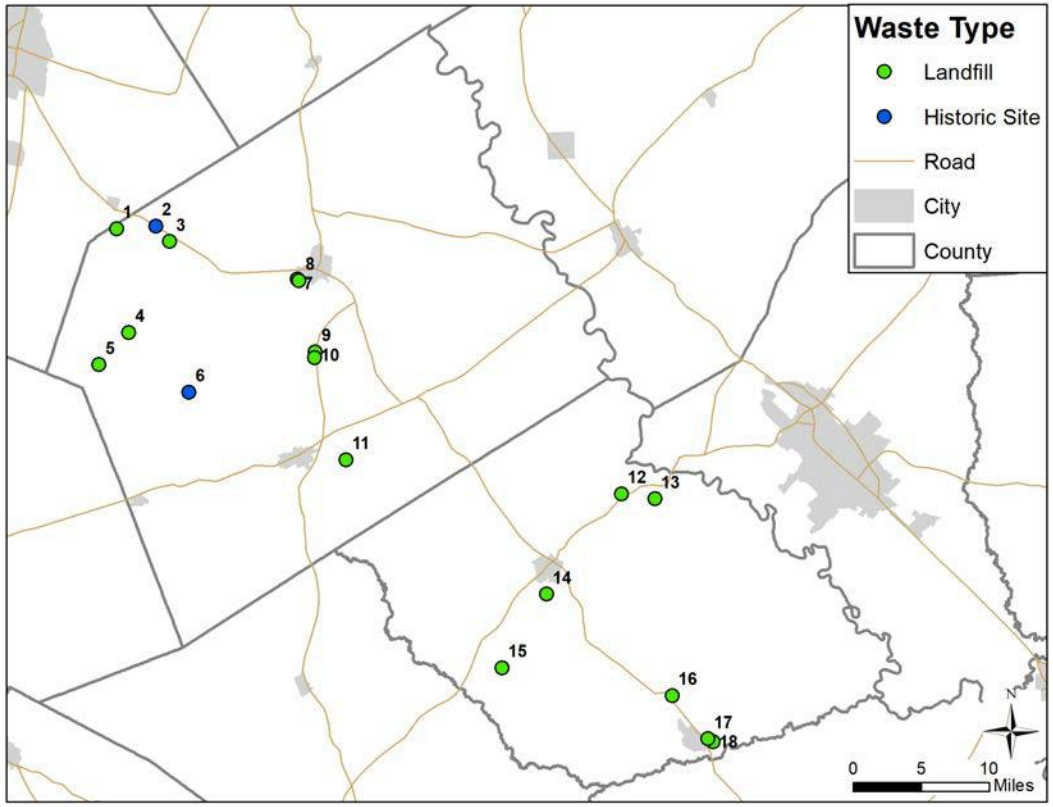
March 6, 2018

Topics

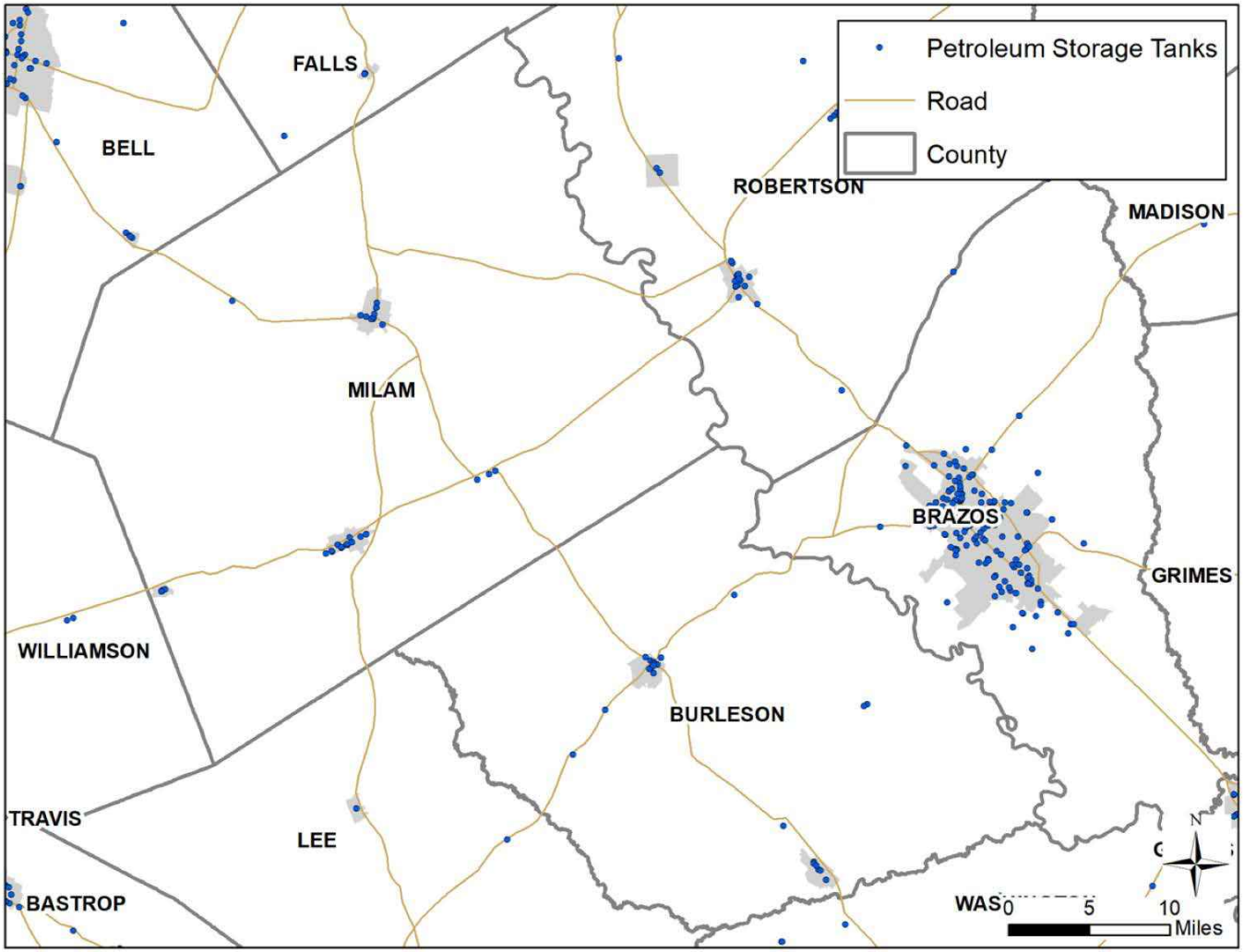
- Groundwater Quality Issues Including Brackish Water
- Aquifer Storage Recovery Project Including Demonstrated Recoverability
- POSGCD Guidance Document for Evaluating Compliance with DFCs and Protective Drawdown Limits
- Update on Central Sparta, Queen City, and Carrizo-Wilcox Update

Municipal and Industrial Waste Sites

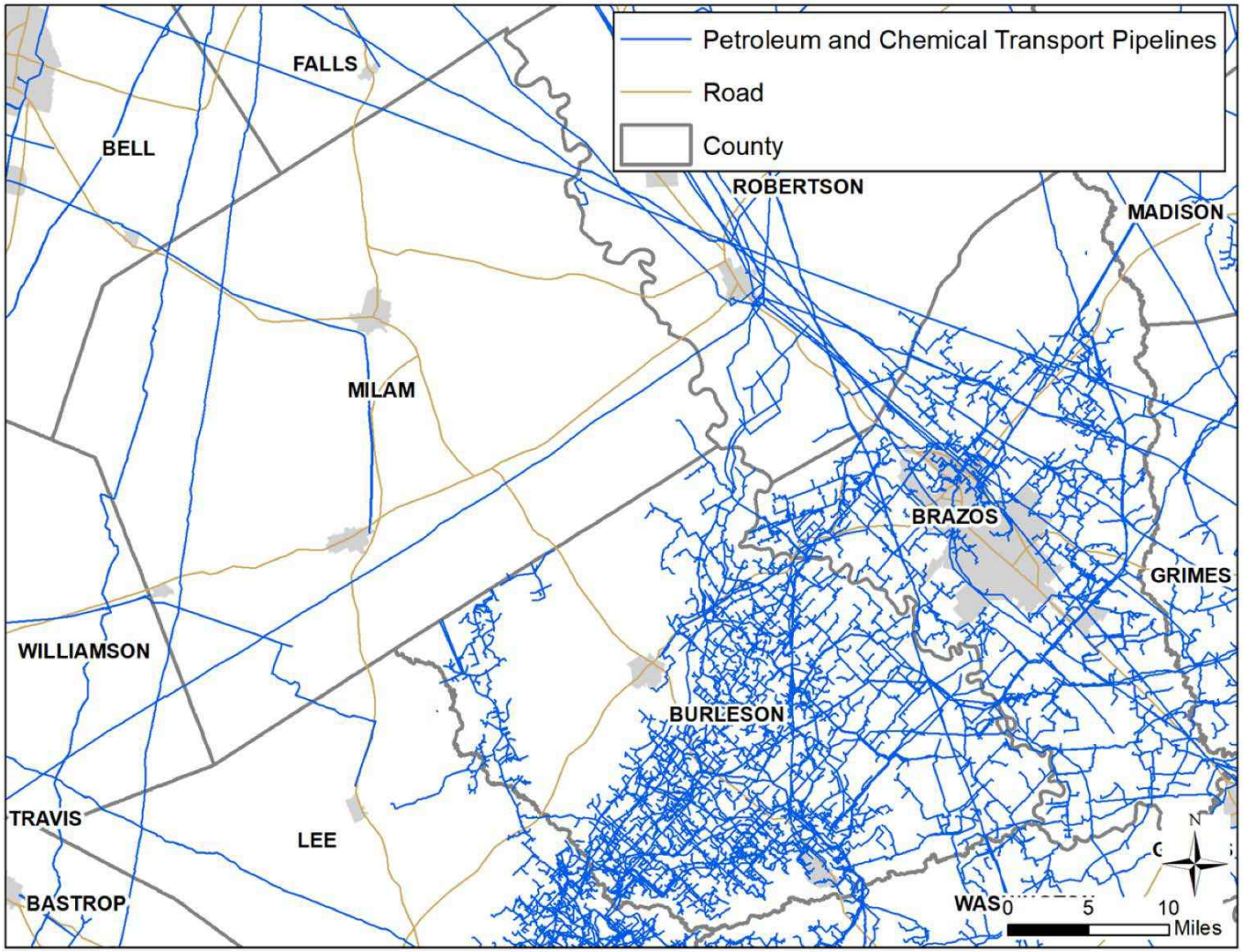
Num	Type	Name
1	Landfill	CITY OF ROGERS LANDFILL
2	Historic Site	MICRODIRT INC
3	Landfill	MILAM COUNTY LANDFILL
4	Landfill	FRIENDSHIP COMMUNITY LANDFILL
5	Landfill	MILAM COUNTY PRECINCT 1 LANDFILL
6	Historic Site	DOONER ORGANICS COMPOSTING FACILITY
7	Landfill	CITY OF CAMERON LANDFILL
8	Landfill	CITY OF CAMERON LANDFILL
9	Landfill	MILAM COUNTY LANDFILL
10	Landfill	CITY OF HENRIETTA LANDFILL
11	Landfill	CITY OF ROCKDALE LANDFILL
12	Landfill	BURLESON COUNTY PRECINCT 2 LANDFILL
13	Landfill	BURLESON COUNTY PRECINCT 2 LANDFILL
14	Landfill	CITY OF CALDWELL LANDFILL
15	Landfill	BURLESON COUNTY LANDFILL
16	Landfill	BURLESON COUNTY LANDFILL
17	Landfill	CITY OF SOMMERVILLE
18	Landfill	CITY OF SOMERVILLE LANDFILL



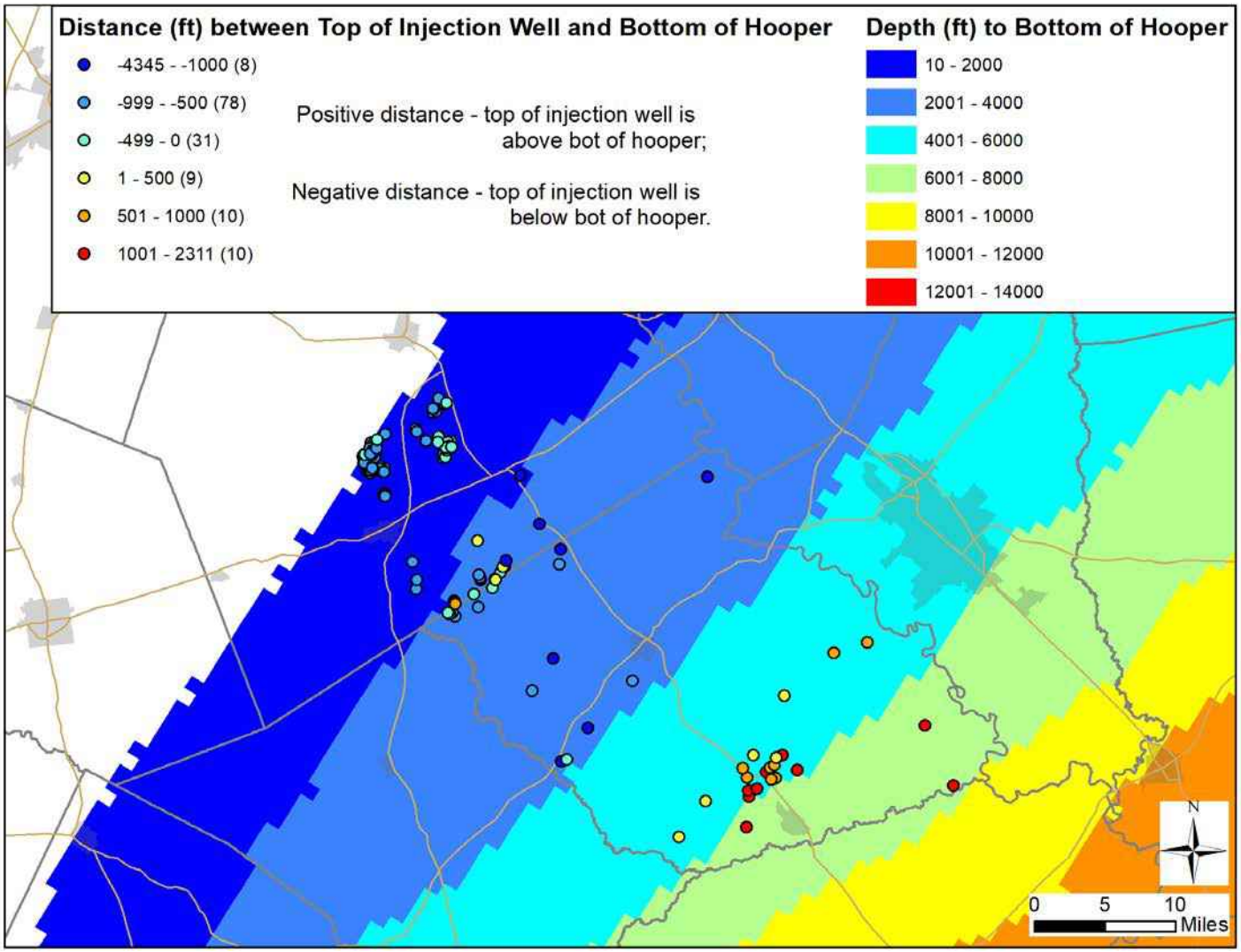
Petroleum Storage Tank Sites



Petroleum and Chemical Pipelines



Underground Injection Control Wells



Characterize Groundwater Water Quality

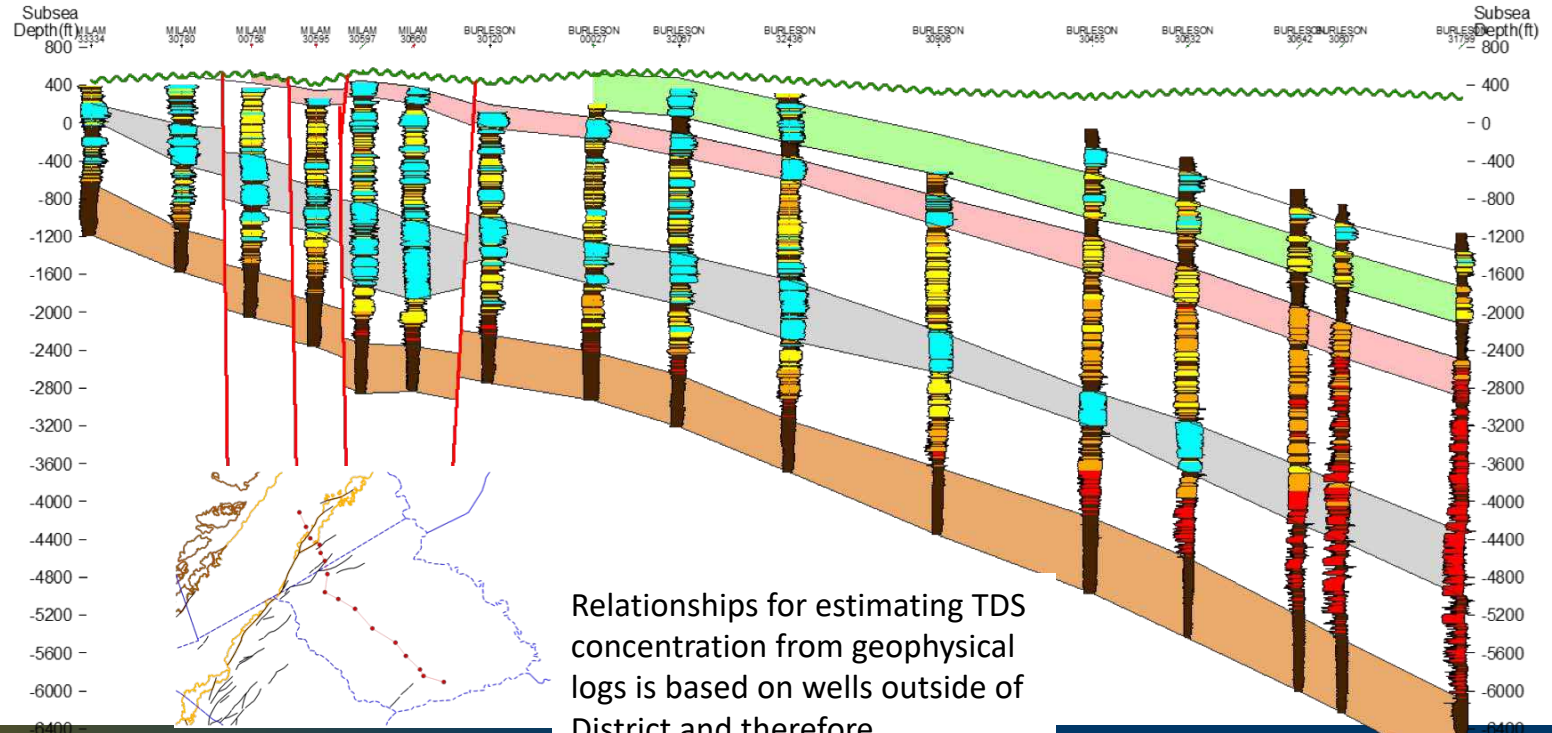
Groundwater Salinity Classification	Total Dissolved Solids Concentration (units: milligrams per liter)
Fresh	0 to 1,000
Slightly Saline	1,000 to 3,000
Moderately Saline	3,000 to 10,000
Very Saline	10,000 to 35,000
Brine	Greater than 35,000

Brackish Water (1,000 mg/L to 10,000 mg/L)

- EPA Secondary Drinking Water Limit (500 mg/l)
- TCEQ Secondary Drinking Water Limit (1,000mg/l)
- Major/Minor (Texas) Mapped Limit (3,000 mg/l)
  In Gulf Coast, Texas Railroad Commission Defines Useable water at (3,000 mg/l) for Groundwater Protection
- EPA Underground Source of Drinking Water (USDW) is defined as having a less than 10,000 mg/L
- Seawater

Example Mapping of Salinity Zones in POSGCD

- Develop relationship between a resistivity measurement on a geophysical log and TDS concentration (dependent on formation)
- Assemble geophysical logs and develop a continuous profile of formation types, sand beds, and TDS concentration with depth
- Interpret geophysical logs in three-dimensions – see example below



Relationships for estimating TDS concentration from geophysical logs is based on wells outside of District and therefore approximate

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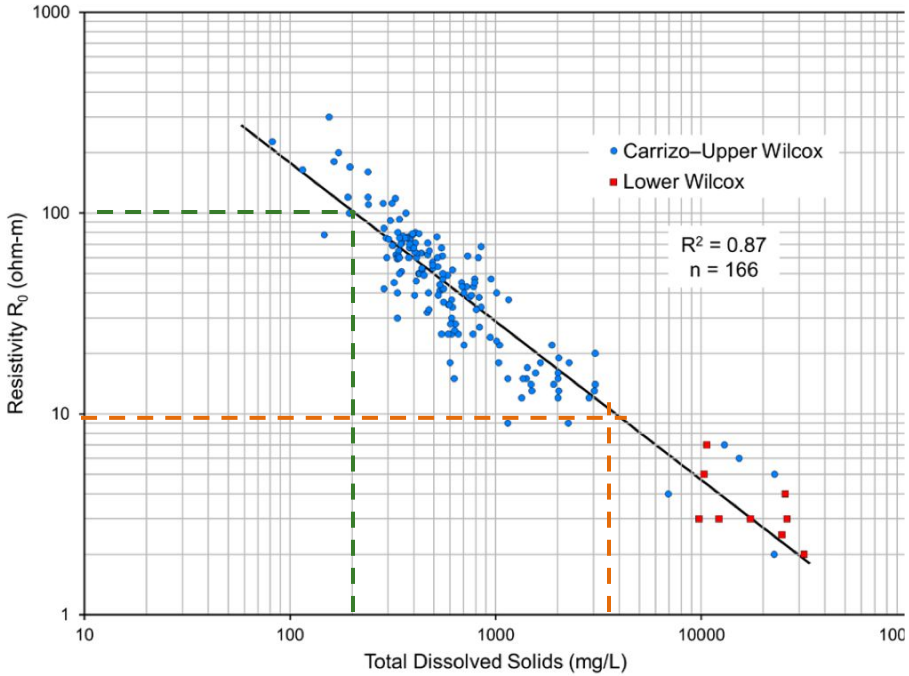
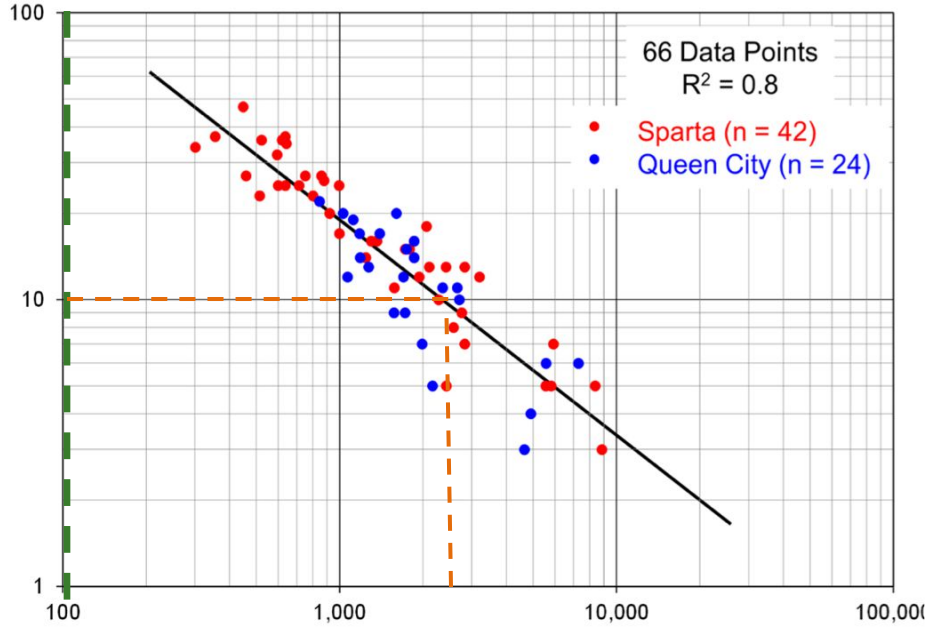
Study to Improve Characterization of Fresh and Brackish Groundwater Resources

- Build on relationship developed for GMA13 to estimate TDS from Geophysical Logs
  - Estimate base of fresh water and volume of fresh water (TDS < 1,000 mg/L)
  - Estimate base of brackish water (TDS < 10,000 mg/L)
    - Establish basis for challenging vertical location of future injections wells
    - Establish baseline data to investigate benefits of possible brackish management zone





From Hamlin and others (2018) GMA 13 TWDB BRACS Study

TCEQ Application for Class V Underground and Injection Control (UIC) Well for ASR

Aquifer Storage and Recovery

Any permit or authorization issued by the TCEQ for an ASR project must be for aquifer storage and recovery in accordance with the following definitions in Title 30 of the Texas Administrative Code (30 TAC), Chapter 331:

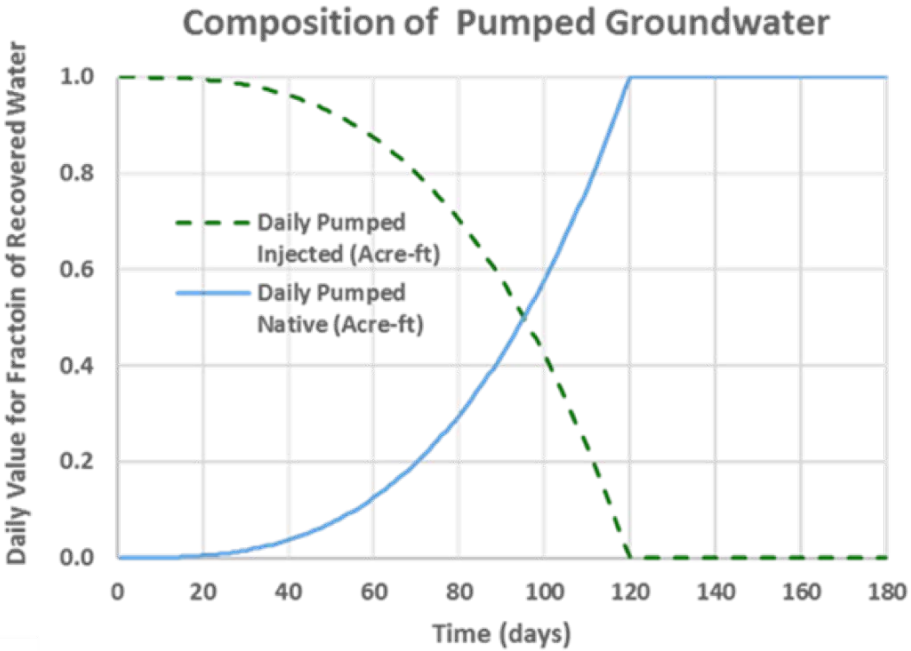
> Aquifer Storage and Recovery [30 TAC §331.2(8)]: "The injection of water into a geologic formation, group of formations, or part of a formation that is capable of underground storage of water for later retrieval and beneficial use."
>
> Aquifer Storage and Recovery Project [30 TAC §331.2(11)]: A project involving the injection of water into a geologic formation for the purpose of subsequent recovery and beneficial use by the operator.

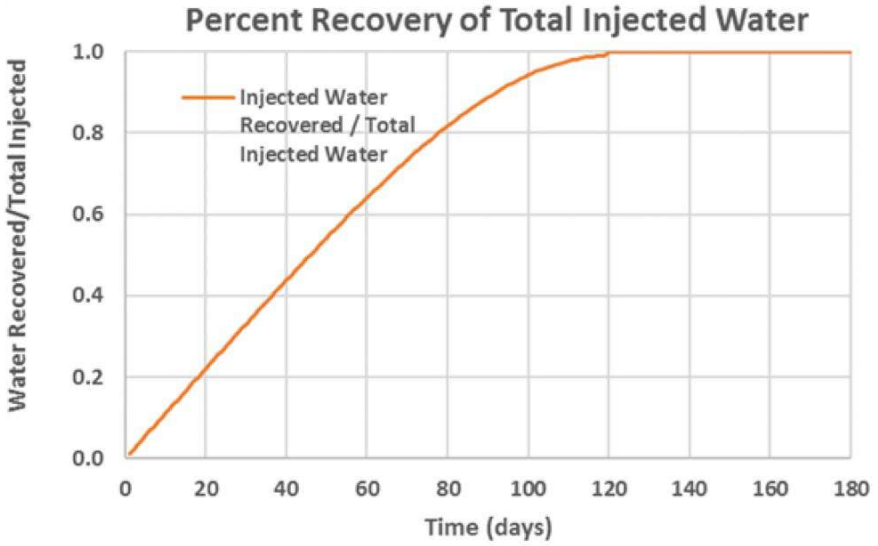
Section VIII. Demonstration of Recoverability

In order for the commission to make a determination as to whether injection of water into a geologic formation will result in a loss of injected water or native groundwater, as required under TWC, §27.154(b), please provide an analysis of the volume of injected water that will be recovered. This analysis should consider the geologic, hydrogeologic, and hydrochemistry of the injection zone, the quality of the injected water, and the operational conditions proposed for the project. The commission anticipates that this analysis will require groundwater modeling. Please provide a detailed discussion of how the applicant estimated the percentage of injected water that will be recovered. If this estimated percentage of the injected water volume that is estimated is based on groundwater modeling, please describe the modeling performed, with justification for all assumptions and input parameter values.

Hypothetical Example of ASR Recoverability

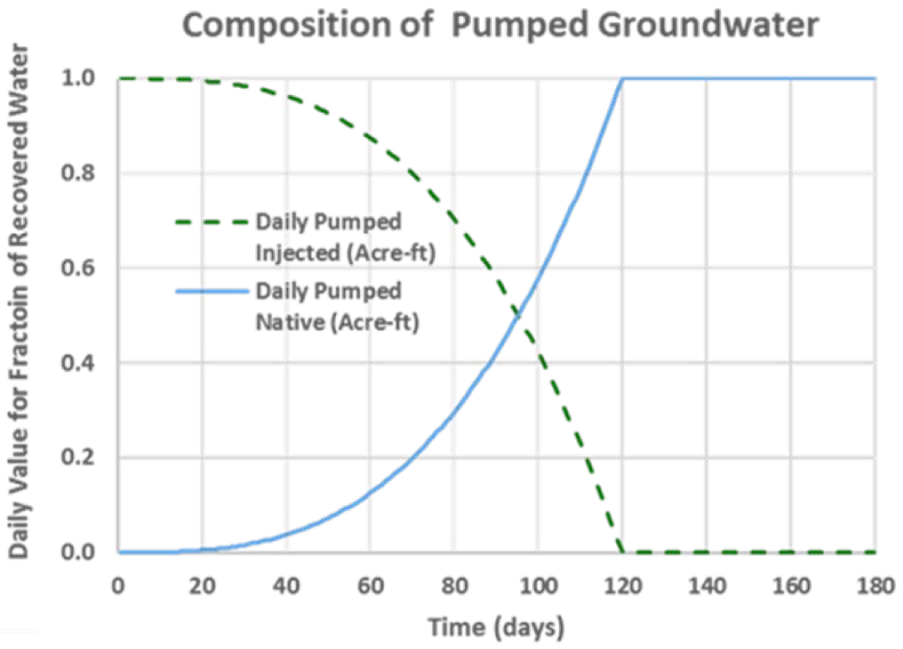
- Injected 200 acre-feet
- Withdraw water at 500 gpm for 180 days
- Water withdrawn is a mixture of injected water and native groundwater
- Takes 120 days (or 265 acre-feet) to withdrawal all of the injected groundwater

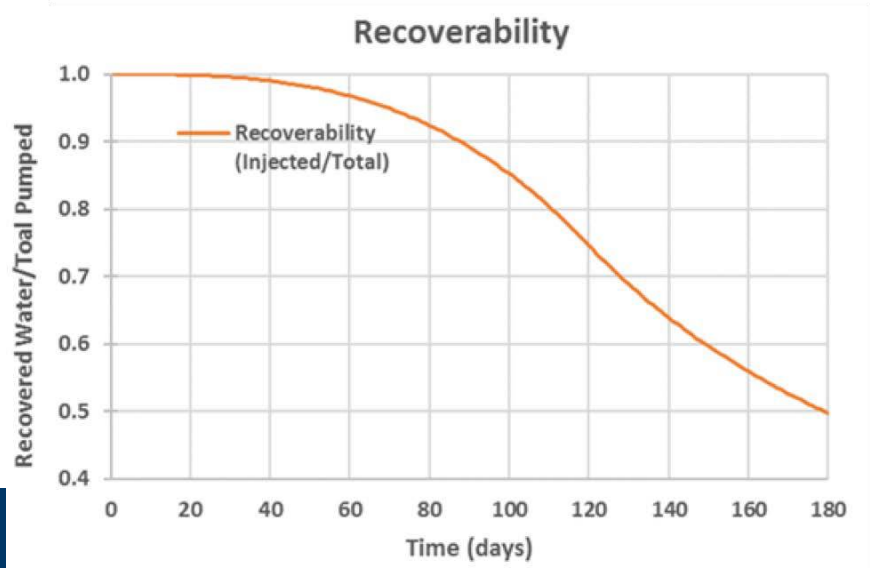




Hypothetical Example of ASR Recoverability

- Fraction of recovered water that was injected decreases with volume pumped
- Recoverability is fraction of recovered water that is injected water
- Recoverability is 1.0. 0.9, and 0.5 at 20, 90, and 120 days





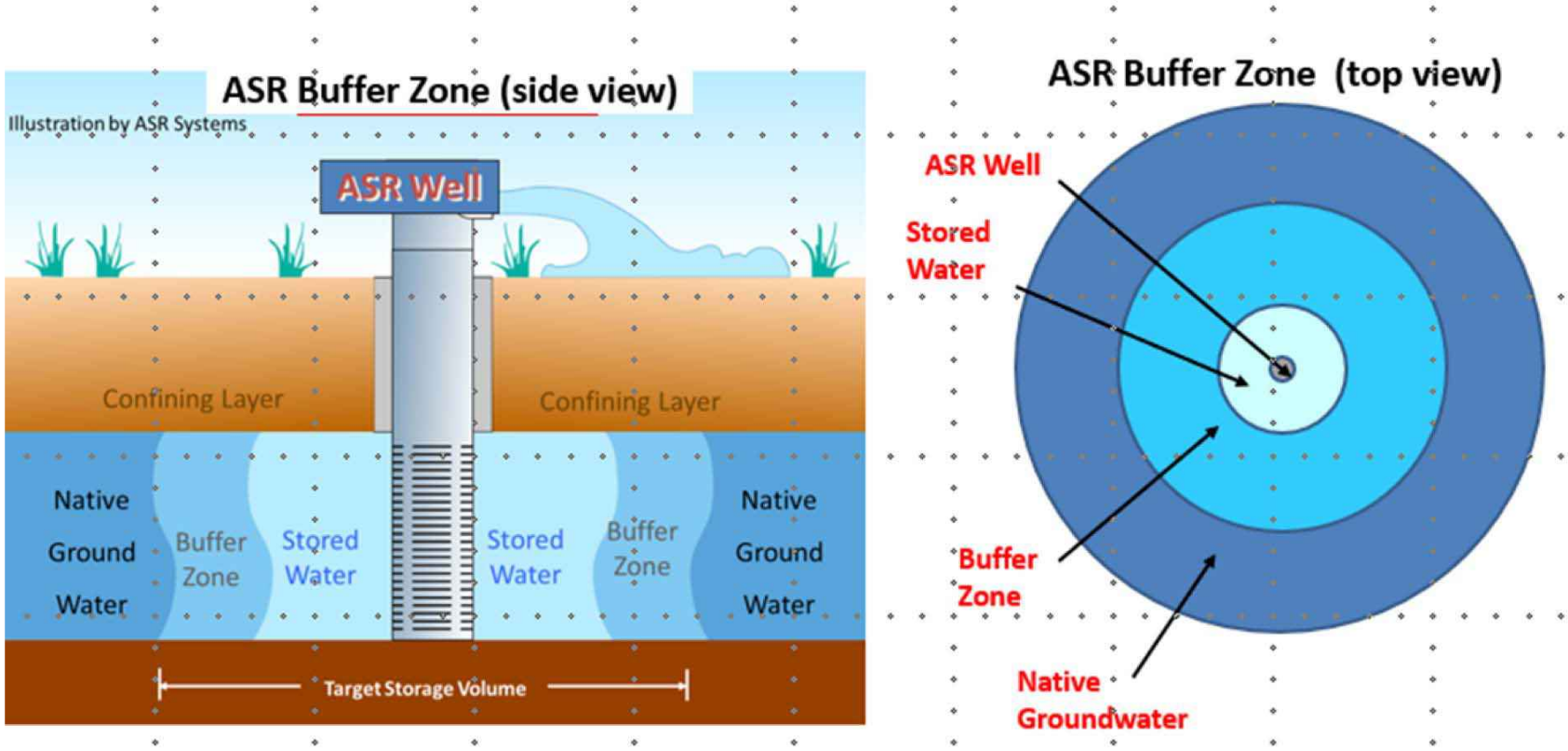
Factors Affecting Recoverability

Operational Factors	
ASR Application	**Duration**
Seasonal Supply	short
	long
Establish Firm Yeild	short
	long
Drought of Record	short
	long

Hydraulic Conditions: Aquifer Hydraulic Properties	
ASR Zone	**Hydraulic Properties**
Inject and recover from one aquifer zone	Uniform
	Moderate heterogeneity
	Large heterogeneity
Inject and recover from two aquifer zones	Uniform
	Moderate heterogeneity
	Large heterogeneity

Hydraulic Conditions: Aquifer Flow Conditions	
Factor	**Condition**
Hydraulic Gradient (regional GW flow)	none
	small
	large
Nearby Pumping	none
	small amount
	large amount

Modeling Operational Factors will Include of Buffer Zone



Project Tasks

- Investigation appropriate methods and approaches for modeling and monitoring ASR
- Coordinating and working with University of Texas to provide information to TCEQ for a guidance manual
- Identify and evaluation options for modeling and monitoring recoverability to demonstrate recoverability
- Perform realistic evaluation of ASR in District
- Workshop for GMA 12 to discuss rules for monitoring ASR
- Submitted presentation topic to TAGD summit in August 2018

POSGCD Guidance Document for Evaluating Compliance with DFC

- Received comments from POSGCD
- Modify document and sent out for review by other GMA 12 districts by mid March
- Anticipate GMA 12 review complete by end of April 2018
- Present results at next GMA 12 meeting

Update on Central Sparta, Queen City, and Carrizo-Wilcox Update

- Updated faults locations and properties
- Revise approach for simulating recharge as a function of precipitation
- Revise approach for simulating surface water-groundwater for Colorado and Brazos River
- Revised storage and transmissive properties of aquifers based on results from sand maps and aquifer pumping tests

Questions ?