North Texas GCD Board Meeting

October 8, 2019

Discussion of DFCs and MAGs numbers for submission to GMA8

wsp

Agenda Item 9

- Update and possible action regarding the process for the development of Desired Future Conditions (DFCs).
  - *Presentation, discussion and possible action on development of Desired Future Conditions and Modeled Available Groundwater numbers for submission to Groundwater Management Area 8 for the current joint planning cycle*

GMA 8 - WSP Team Approach to Presenting Information on Nine Factors
(Texas Water Code Subsections 36.108(d)(1-9))

- Factor presentations – Three GMA 8 Meetings (November 2019, February 2020, and May 2020)
- Focused discussion on factors during each meeting
- Factor presentation content to be reflective of explanatory report content
- Re-visit factor discussions as needed when various GAM runs, or DFC statements considered

GMA 8 Schedule to Discuss Nine Factors

November 2019		
Environmental Impacts	Subsidence Impacts	Hydrological Conditions
February 2020		
Aquifer Uses or Conditions	Supply Needs & Management Strategies	Private Property Rights
May 2020		
Socioeconomic Impacts	DFC Feasibility	Other Relevant Information

MAGs, Pumping, and DFCs

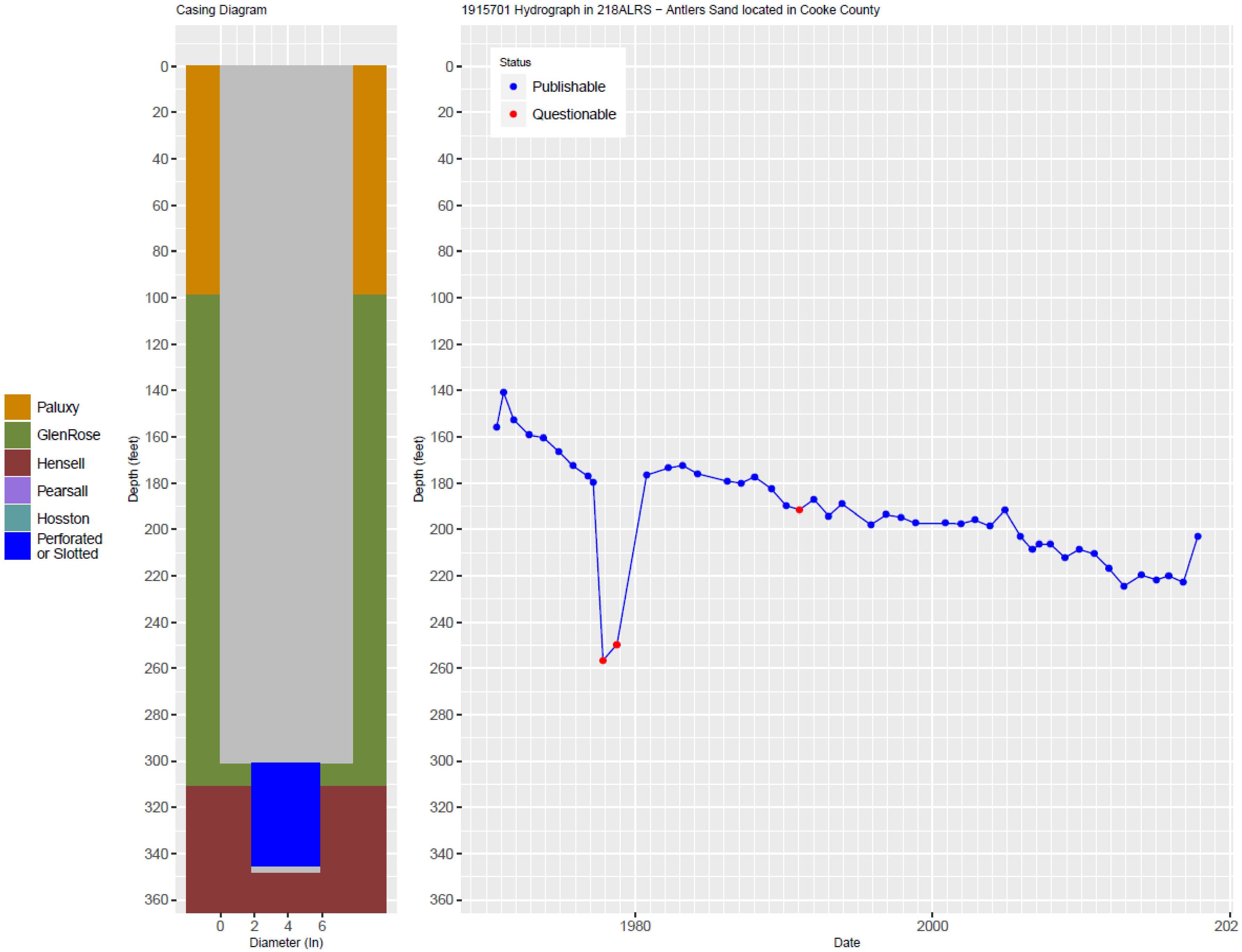
Three primary factors for consideration:

1. Hydrological Conditions
2. Subsidence
3. Environmental Impacts

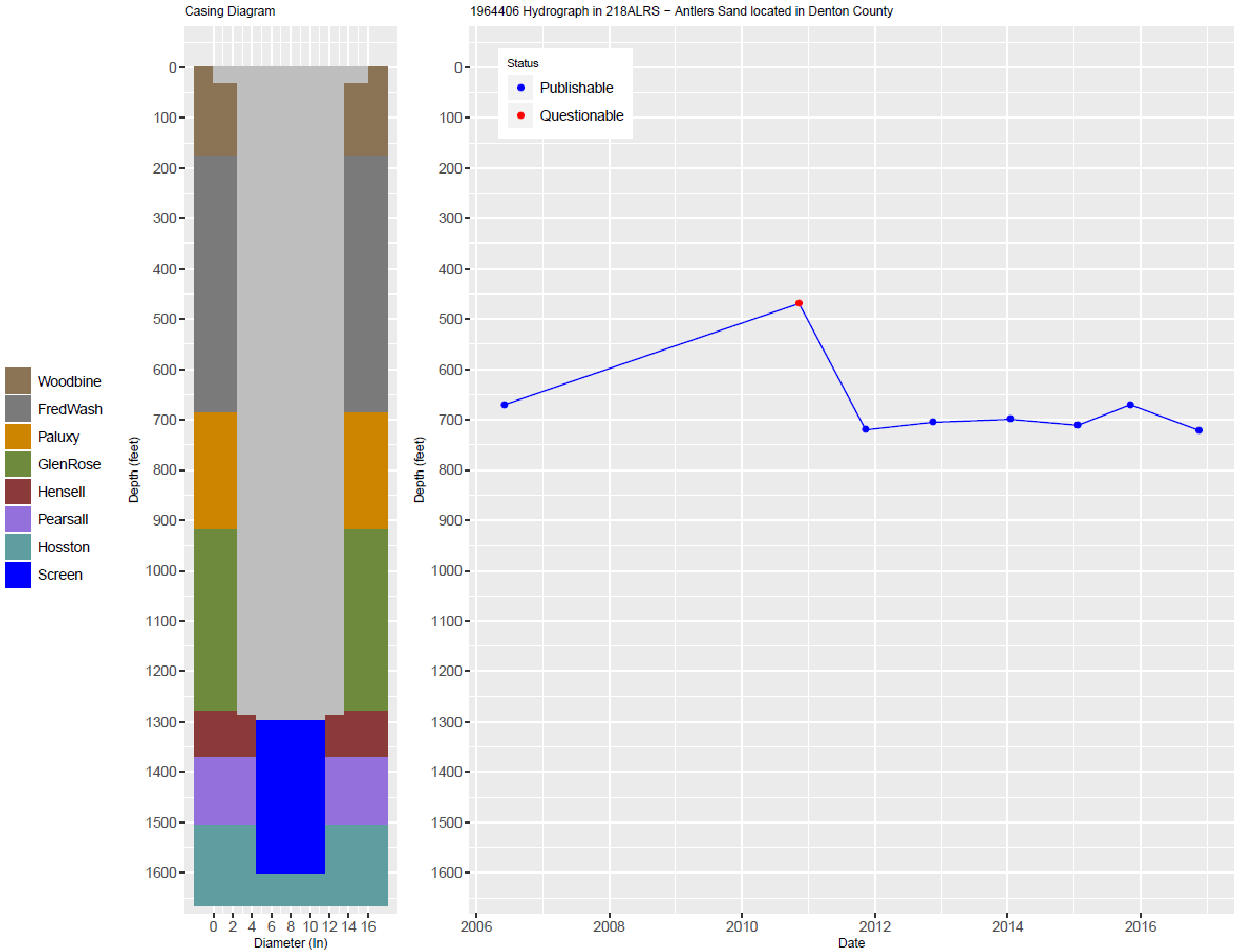
Hydrological Conditions Summary: Water Level Data

- TWDB GWDB water level data
- Define relevant aquifer codes
- Count measurements and throw out null values.
  - *Wells with less than 3 measurements; and*
  - *Wells that do not have a measurement since 2000*
- Selection criteria reduced well locations with water levels from 8,461 to 627 wells used for mapping/hydrographs

ANTLERS AQUIFER HYDROGRAPH



The Aquifer layers shown in the casing diagram were developed using the NTWGAM. In certain cases, assumptions used to develop the NTWGAM can cause well casing and screen intervals to not align well with modeled aquifer layers.



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TWDB Subsidence Tool- What Is It?

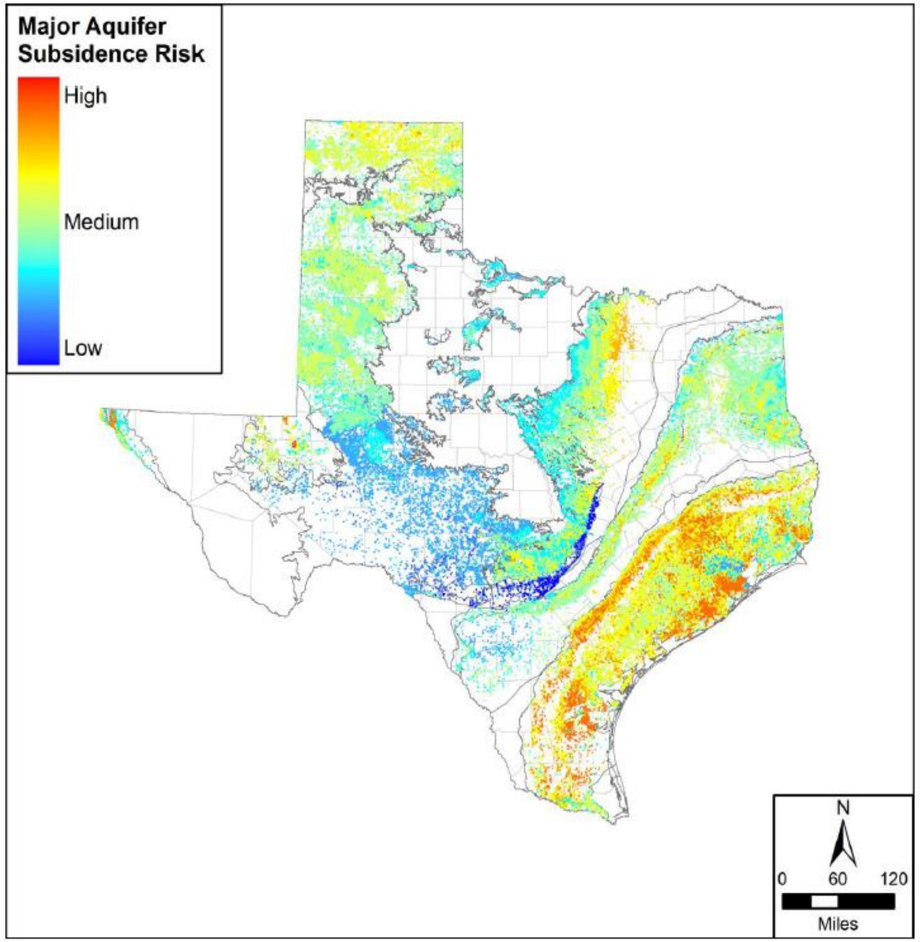
- Developed in 2017
- Helps GCDs identify risk subsidence due to groundwater pumping
- Capable in identifying risk subsidence in all major/minor aquifers in Texas

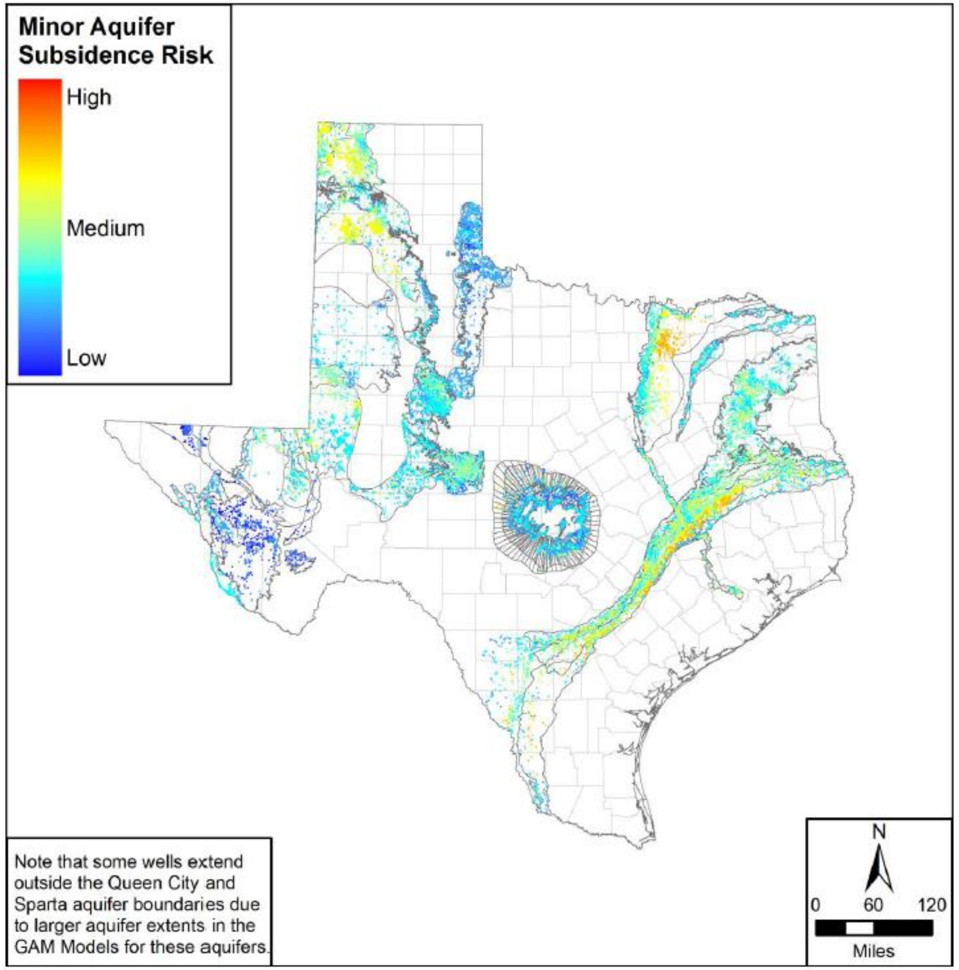
Subsidence

- How Is Subsidence Estimated?
  - *Saturated thickness and extent of clay*
  - *Clay compressibility*
  - *Aquifer lithology*
  - *Pre-consolidation characterization*
  - *Predicted DFC water level decline*

Visualizing the Subsidence Risk

- 340,000 wells statewide
- "High Risk" include Yegua Jackson and Gulf Coast
- "Low Risk" include igneous and Edwards aquifers
- *The only common characteristic shared by all "High Risk" aquifers is that they all have unconsolidated clastic aquifers*

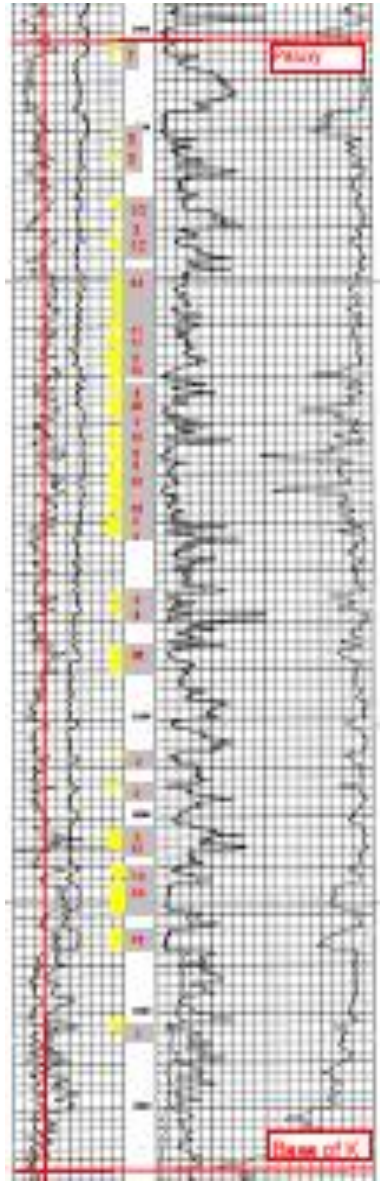




The Localized Evaluation Process

1. Identify the downdip area
2. Find 2-3 TWBD or GCD wells that meet available data criteria
3. Analyze logs to determine aquifer thickness and clay thickness
4. Calculate the risk using the tool

City of Celina 18-42-604
Clay thickness = 354 feet



Subsidence Calculations

Aquifer	**Trinity**
Report Generated by	A. Feigenbaum
Report Date	9/5/2019
Well Name	Celina 18-42-604
Water Levels to Use for Predictions	Base and Future

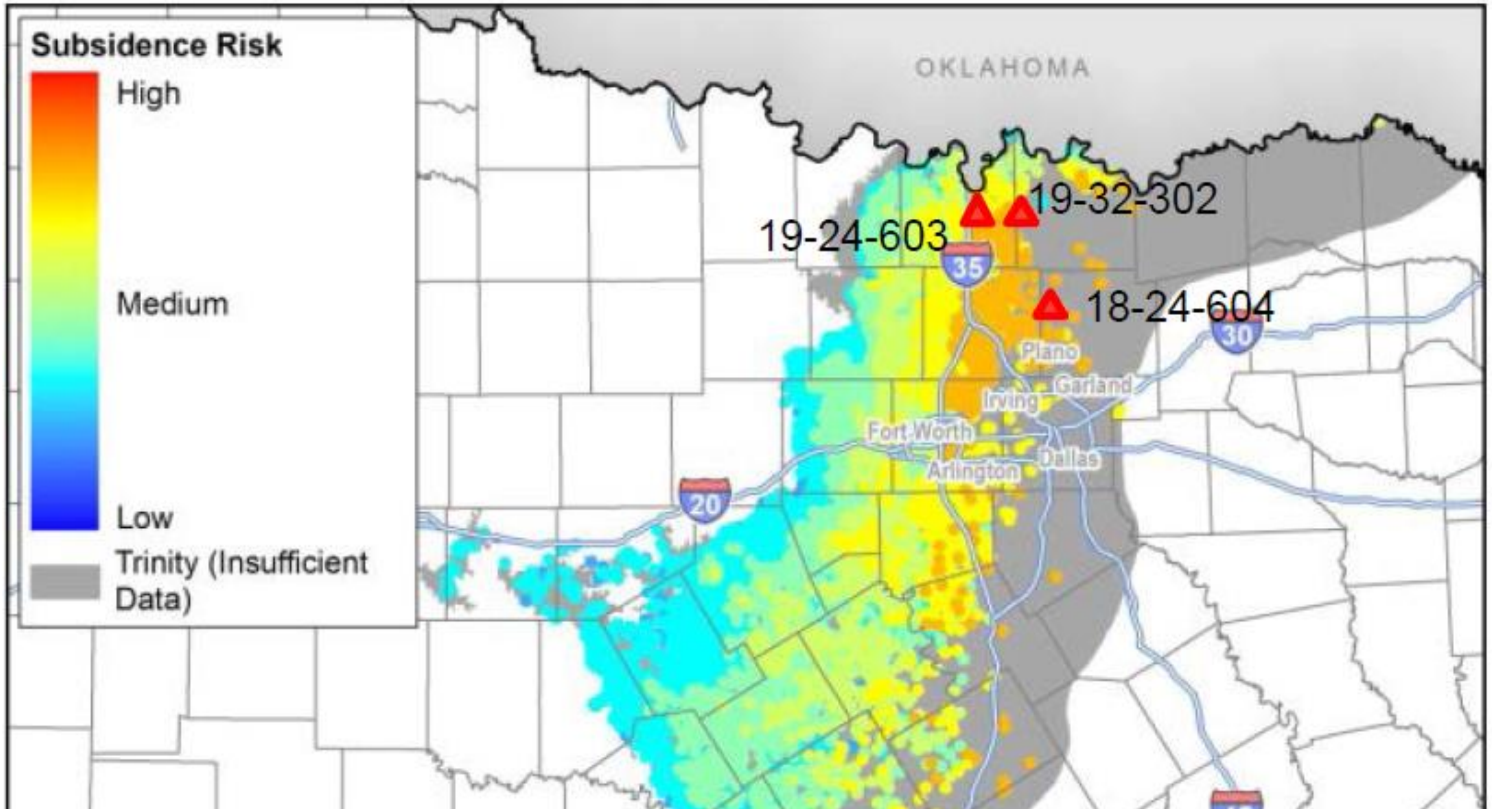
Location and Water Level Based User Input	User Input Values	Units
Land Surface (feet MSL)	691	feet
Aquifer Top (feet MSL)	-720	feet
Aquifer Thickness	1,150	feet
Clay Thickness within Aquifer	354	feet
Groundwater Temperature	34	Degrees Celsius
Groundwater Total Dissolved Solids (TDS)	591	mg/l
Predevelopment Water Level (feet MSL)	401	feet
Current Water Level (feet MSL)	-10	feet
Unsaturated Thickness	701	feet
Preconsolidation (deepest) Water Level (feet MSL)	-17	feet
Base Water Level (feet MSL)	45	feet
Future Water Level (feet MSL)	-206	feet
Beginning Year for Subsidence Evaluation	2010	year
Ending Year for Subsidence Evaluation	2070	year

Subsidence Risk Results

Aquifer Subsidence Calculations based on overall aquifer information and user supplied input values		Units
Water Level Trend	-9.50	ft/year; negative for decline
Predominant Aquifer Lithology	Consolidated Clastic	Description
Aquifer Storage Coefficient	0.0001	Dimensionless
Aquifer Porosity	25	Percent
Predominant Aquifer Clay Type	Hard Clay	Type
Aquifer Clay Porosity	50	Percent
Minimum Aquifer Compressibility	8.96E-05	psi^{-1}
Maximum Aquifer Compressibility	1.38E-04	psi^{-1}
Minimum Clay Compressibility	4.76E-04	psi^{-1}
Maximum Clay Compressibility	8.96E-04	psi^{-1}
Minimum Elastic Specific Storage (S_{ske})	2.37E-07	ft^{-1}
Maximum Elastic Specific Storage (S_{ske})	4.22E-07	ft^{-1}
Minimum Inelastic Specific Storage (S_{skv})	2.37E-05	ft^{-1}
Maximum Inelastic Specific Storage (S_{skv})	4.22E-05	ft^{-1}
Total Weighted Risk for Well 0 (low risk) to 10 (high risk)	**7.81**	

Evaluation: North Texas GCD

Well Owner	State Well ID	Aquifer Thickness (feet)	Clay Thickness (feet)	**Subsidence Risk Score**	Minimum Subsidence (feet)	Maximum Subsidence (feet)
Kiowa SUD	19-32-302	1,250	547	**7.03**	0.56	1.02
City of Celina	18-24-604	1,150	354	**7.81**	0.53	0.94
Camp Sweeney	19-24-603	800	267	**7.19**	1.01	1.95

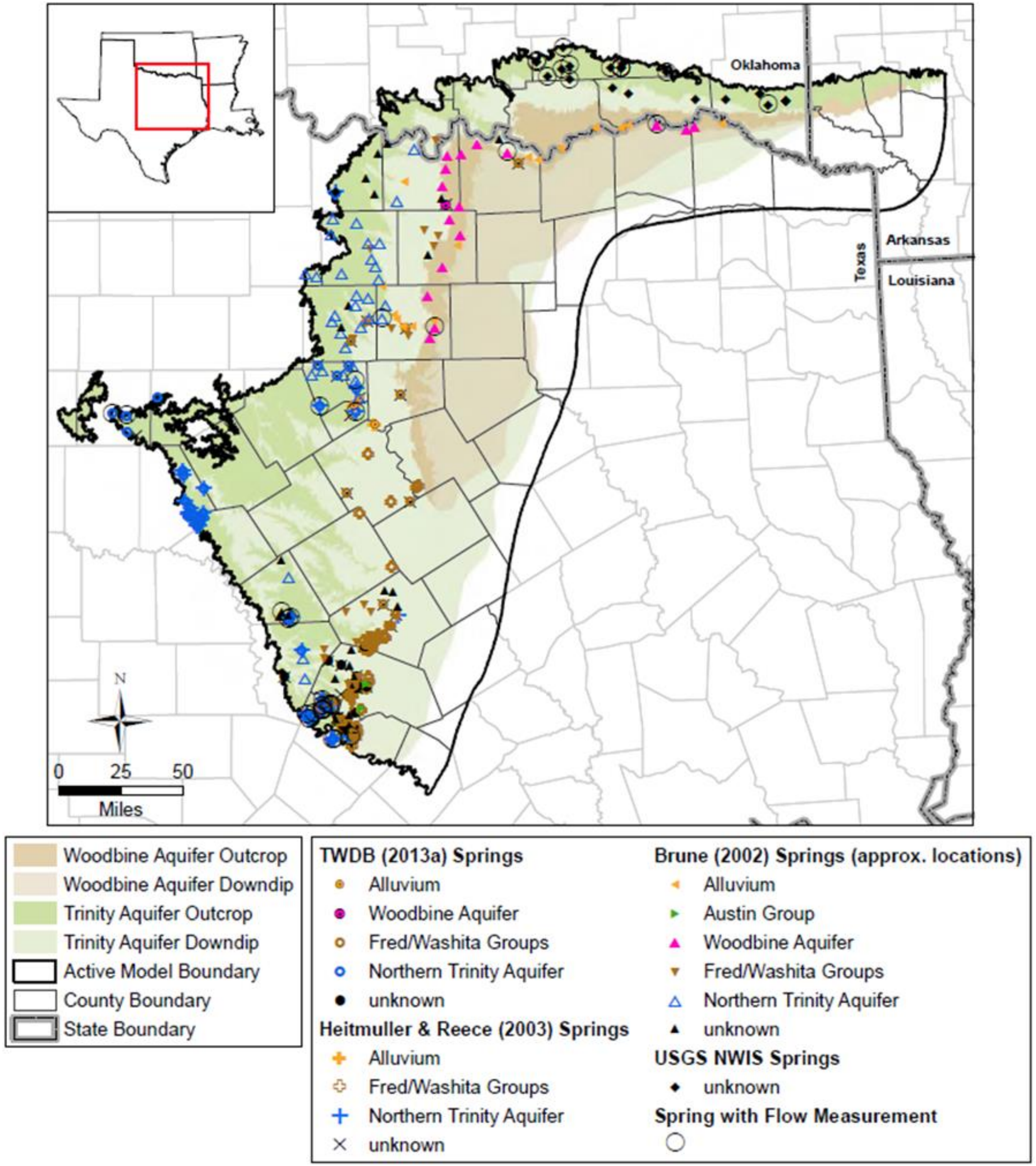


Evaluation: North Texas GCD Results

- Trinity Aquifer has a subsidence risk score of 4.5
- The 3 wells used in our study have risk scores from 7.03 to 7.81
  - *These are downdip wells characteristic of worst case scenario*
- Clay thicknesses range from 267-547 feet
- Aquifer thicknesses range from 800-1,250 feet

Conclusion: The calculated risk values are indicative of a moderate subsidence risk.

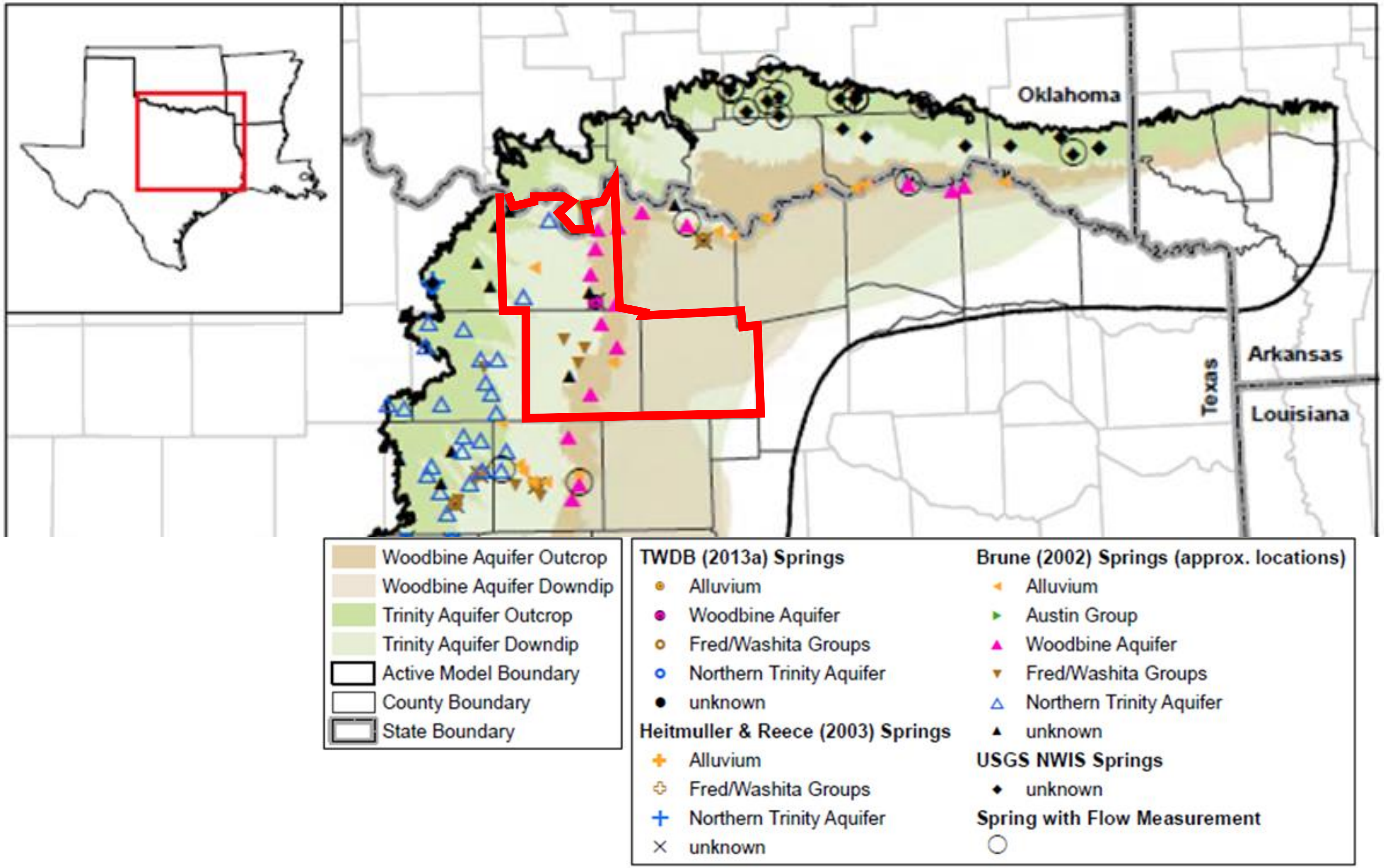
Environmental Impacts: Spring Locations



Environmental Impacts: Spring Discharge and Streamflow

- Southern portion of GMA 8 has the greatest density of springs.
- Most are in the Washita/Fredericksburg, which includes Edwards BFZ.
- Many located in far western extent of GMA 8.
- Also found in the northern Trinity in Hood, Montague, Parker, and Wise counties.
- Springs flow when the water level elevation of the aquifer is higher than the spring elevation.
- Water level declines reduce spring flow.

Environmental Impacts: Spring Locations



Environmental Impacts Summary

- Includes impacts to spring flow and to surface water-groundwater interaction.
- Water budgets from Run 10 in existing ER indicate reduced spring flows and baseflows where DFCs include drawdowns in aquifer outcrop areas.
- Examples of water budgets include:
  - *Denton Woodbine because the water budget has ephemeral flows, perennial flows, and springs; and*
  - *Cooke Woodbine because the water budget has ephemeral flows.*

Environmental Impacts:
ER Run 10 Water Budget Examples

NTGCD Run 10 - Cooke County - Woodbine Aquifer							
Component	2010	2020	2030	2040	2050	2060	2070
Lateral Flow	-1,193	-1,154	-1,124	-1,101	-1,082	-1,055	-1,047
Leakage (Above)	0	0	0	0	0	0	0
Leakage (Below)	-1,042	-1,022	-1,038	-1,053	-1,063	-1,069	-1,078
Recharge	12,596	12,596	12,596	12,596	12,596	8,521	12,596
Perennial	0	0	0	0	0	0	0
Ephemeral	-10,536	-10,196	-9,941	-9,741	-9,583	-8,932	-9,167
Evapotransipration	0	0	0	0	0	0	0
Springs	-8	-7	-7	-7	-6	-5	-6
Reservoir	-1,210	-1,169	-1,136	-1,109	-1,087	-1,060	-1,045
Wells	-800	-800	-800	-800	-800	-800	-800
Flowing	0	0	0	0	0	0	0
Storage	2,198	1,757	1,456	1,219	1,031	4,406	552
Total	6	6	5	5	5	5	5

NTGCD Run 10 - Denton County - Woodbine Aquifer							
Component	2010	2020	2030	2040	2050	2060	2070
Lateral Flow	-1,809	-2,102	-2,331	-2,486	-2,595	-2,645	-2,727
Leakage (Above)	26	77	125	164	195	223	243
Leakage (Below)	-3,005	-3,008	-3,089	-3,147	-3,187	-3,187	-3,214
Recharge	18,915	18,915	18,915	18,915	18,915	10,699	18,915
Perennial	-210	-202	-199	-197	-196	-174	-191
Ephemeral	-11,924	-11,180	-10,649	-10,226	-9,878	-8,927	-9,084
Evapotransipration	0	0	0	0	0	0	0
Springs	-37	-36	-34	-33	-32	-30	-30
Reservoir	-1,952	-1,939	-1,927	-1,916	-1,904	-1,874	-1,864
Wells	-3,609	-3,609	-3,609	-3,609	-3,609	-3,609	-3,609
Flowing	0	0	0	0	0	0	0
Storage	3,607	3,086	2,801	2,536	2,292	9,524	1,562
Total	0	0	0	0	0	0	0

Thank you!

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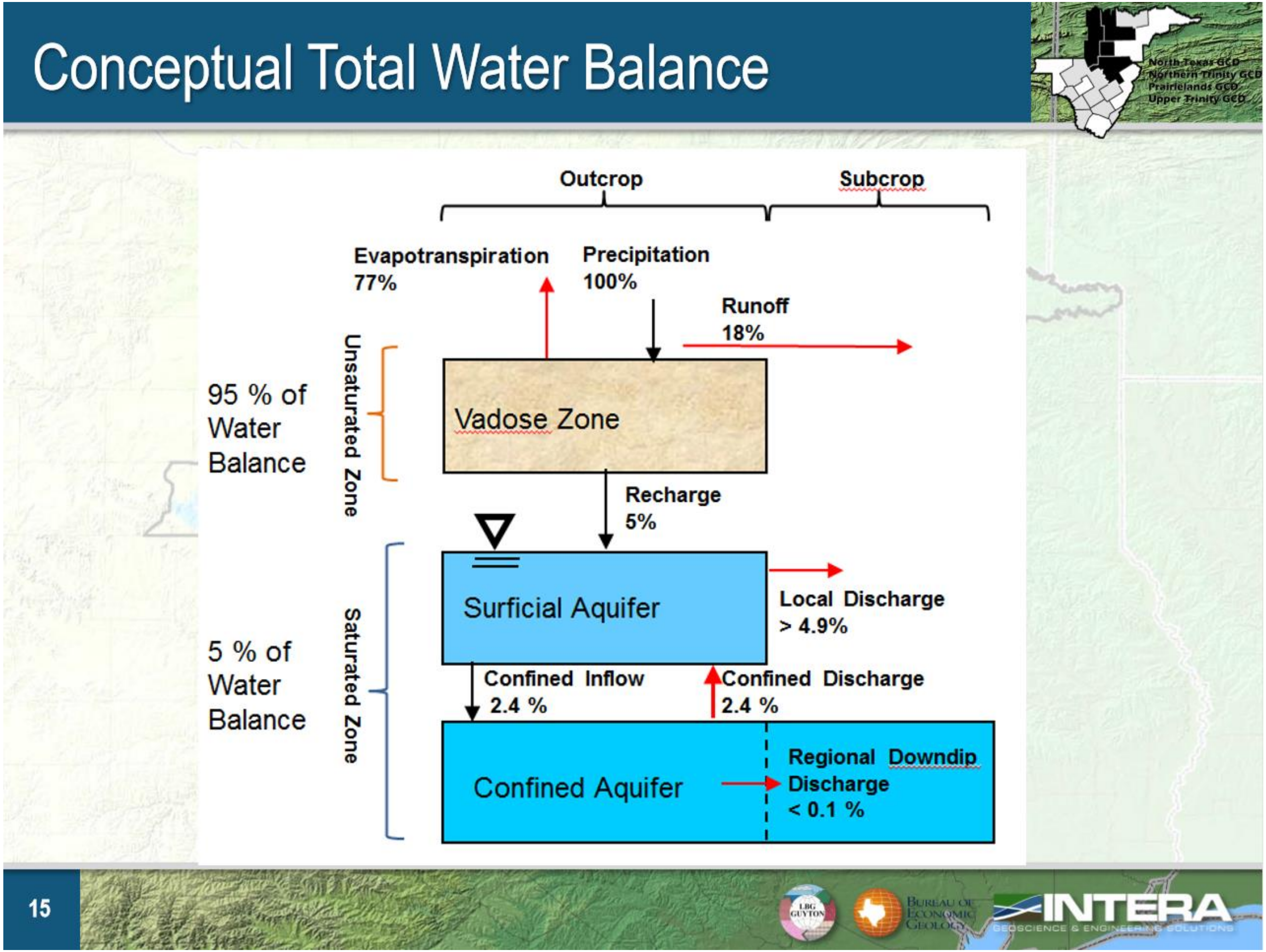
Conceptual Total Water Balance
North Texas GCD
Northern Trinity GCD
Prairielands GCD
Upper Trinity GCD
Outcrop
Subcrop
Evapotranspiration
77%
Precipitation
100%
Runoff
18%
95 % of
Water
Balance
Unsaturated Zone
Vadose Zone
Recharge
5%
Surficial Aquifer
Local Discharge
> 4.9%
5 % of
Water
Balance
Saturated Zone
Confined Inflow
2.4 %
Confined Discharge
2.4 %
Confined Aquifer
Regional Downdip
Discharge
< 0.1 %
15
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Subsidence: Using the Tool

- Tool requires a geophysical log, adequate water level data, water quality data, and the DFC
- The log is used to determine aquifer top, bottom, thickness, and clay thickness in the *aquifer*, not in the portion of the aquifer, and not from surface to TD
- Ideally, a predevelopment water level, a 2010 water level, and a current water level is available
- Current GCD or TWDB observation wells are the best candidates.

WSP Team Approach to Preparing the Explanatory Report
(Texas Water Code Section 36.108(d-3))

- Use GMA 8 second round of DFC joint planning ER as starting point
- Update ER discussion and appendices as needed
- WSP Team presents and reviews 1st ER draft – August 2020
- GMA 8 considers ER approval – November 2020

Key Factors Impacting Subsidence

1. Clay layer distribution, thickness, & compressibility
2. Amount and timing of water level changes
3. Lowest historical water level