GMA 8 Joint Groundwater Planning

November 22, 2019

Blanton & Associates, Inc.
Environmental Consulting • Planning • Project Management

Agenda Item 6
Discussion and possible action of upcoming model run inputs.

- Run 11 – Update of NTWGAM DFC/MAG Run
- GMA 8 representatives met with TWDB
- WSP has received Pumping Updates from:
  - *Upper Trinity GCD*
  - *Southern Trinity GCD (still working)*
- Path forward
  - *Complete updated run and present results at February meeting*

Summary of August 8, 2019 meeting with TWDB

- MAGs from this round of planning will be used in 2027 State Water Plan (2030-2080)
  - New run will begin in 2010 (no change)
  - WSP will extend DFC Model run to 2080
  - 2070 input will be used for 2071-2080
  - "Leap year" causes confusion in MAGs (WSP will make each year 365.25 days)
  - WSP will update pumping as provided by GCDs
  - WSP will provide files to TWDB as early as possible
- Subsidence vulnerability report should be used when considering the subsidence factor in setting DFCs in this round of joint planning
- For non-relevant aquifers, RWPGs provide groundwater availability estimates (reviewed by TWDB staff)

Agenda Item 6
Discussion and possible action of upcoming model run inputs.

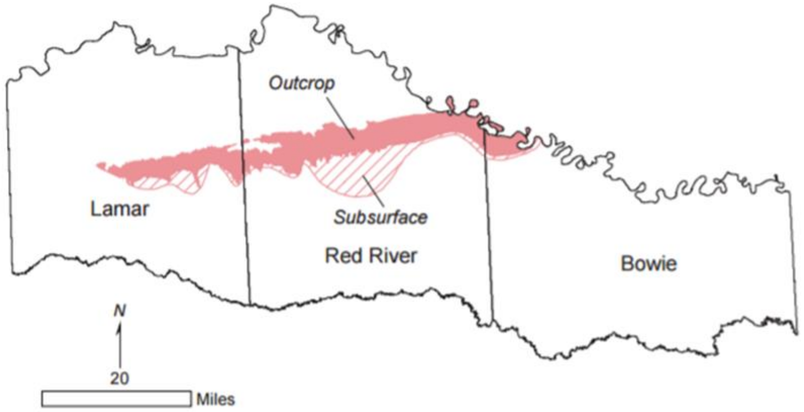
- Upper Trinity GCD updated pumping

Aquifer	O/D*	County	acft
Glen Rose	Outcrop	Hood	792
Glen Rose	Downdip	Hood	125
Paluxy	Outcrop	Hood	159
Twin Mountains	Outcrop	Hood	5,025
Twin Mountains	Downdip	Hood	10,768
Antlers	Outcrop	Montague	6,114
Antlers	Downdip	Montague	
Antlers	Outcrop	Parker	2,905
Antlers	Downdip	Parker	
Glen Rose	Outcrop	Parker	3,684
Glen Rose	Downdip	Parker	1,406
Paluxy	Outcrop	Parker	2,614
Paluxy	Downdip	Parker	50
Twin Mountains	Outcrop	Parker	1,294
Twin Mountains	Downdip	Parker	2,527
Antlers	Outcrop	Wise	9,106
Antlers	Downdip	Wise	2,439
TOTAL			**49,009**

*O/D refers to the "outcrop" or "downdip" portion of each aquifer

Review of NON-RELEVANT Aquifers

- The Nacatoch, Blossom and Brazos River Alluvium aquifers were classified as non-relevant for the purposes of joint planning
- DFCs were not adopted for these aquifers



Questions ?

Agenda Item 7

- Presentations and discussions regarding Environmental Impacts, Subsidence Impacts, and Hydrological Conditions factors as they relate to Desired Future Conditions pursuant to Texas Water Code Section 36.108(d).

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

Hydrological Conditions

Hydrological Conditions Summary: Water Level Data

— TWDB GWDB water level data

— Define relevant **TWDB** aquifer codes

— Count measurements and throw out null values.

  — *Wells with less than 3 measurements; and*

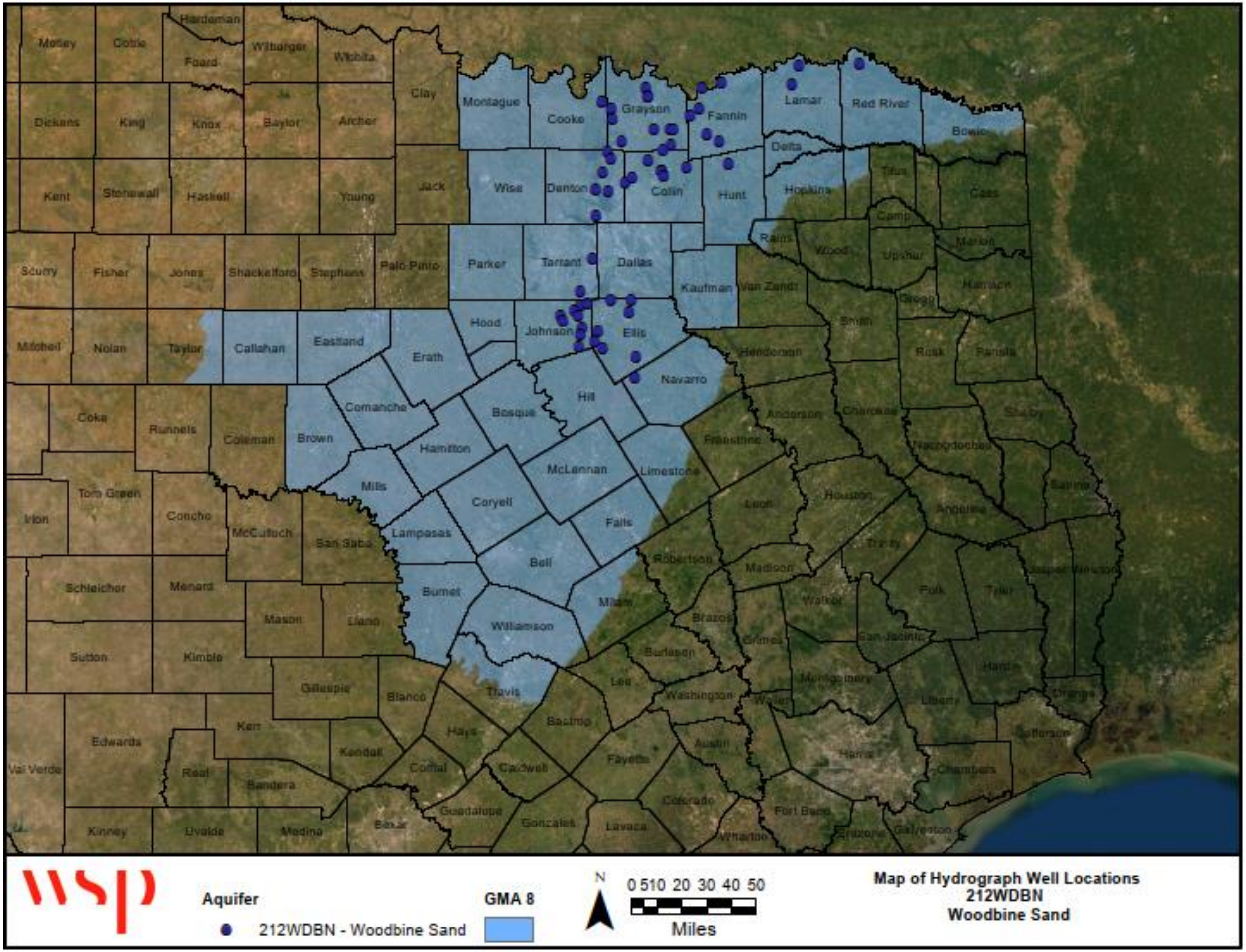
  — *Wells that do not have a measurement since 2000*

— Selection criteria reduced well locations with water levels from 8,461 to 677 wells used for mapping/hydrographs

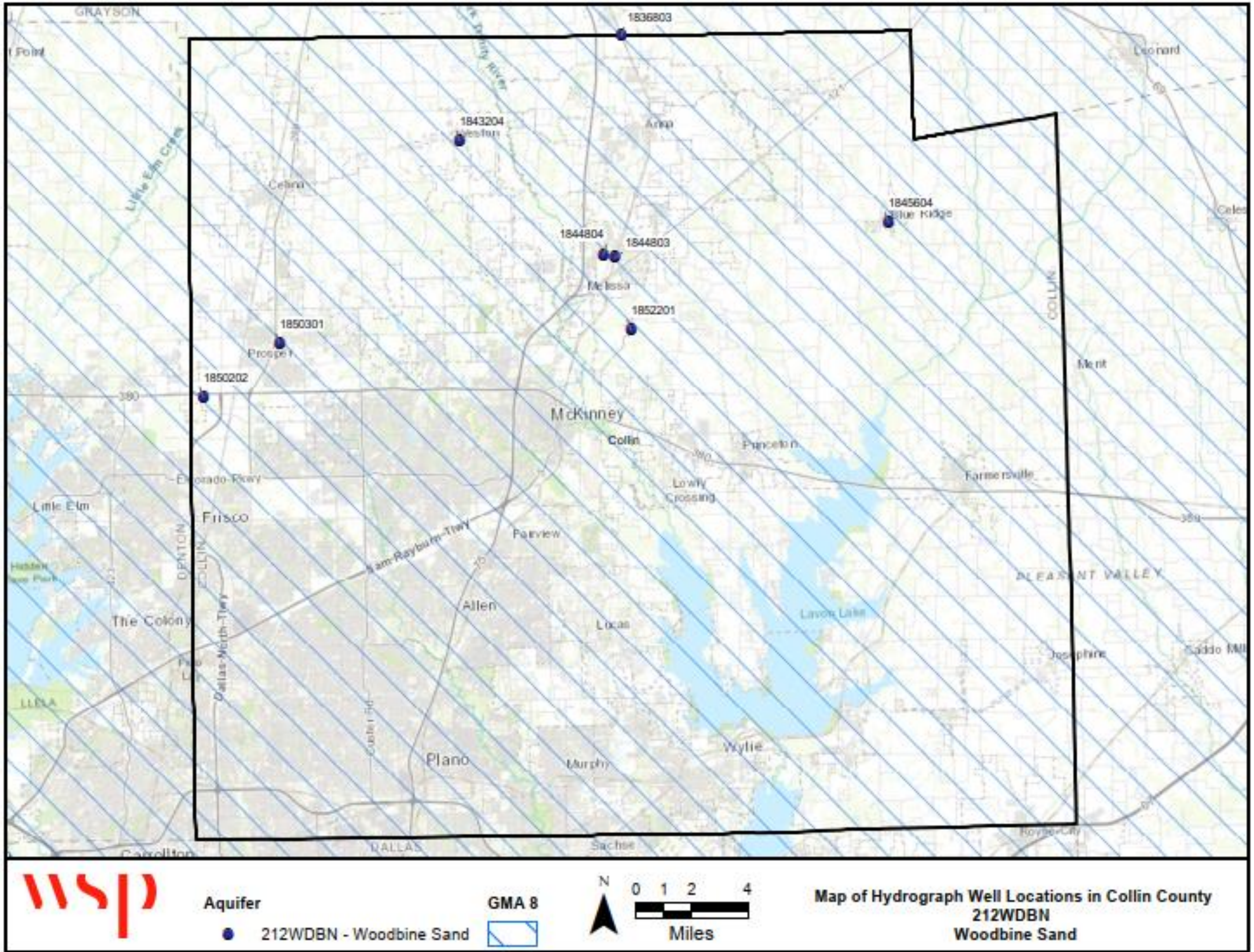
— WSP will provide PDFs for GMA 8 posting and review

Graph of the Number of Wells per GCD and Aquifer

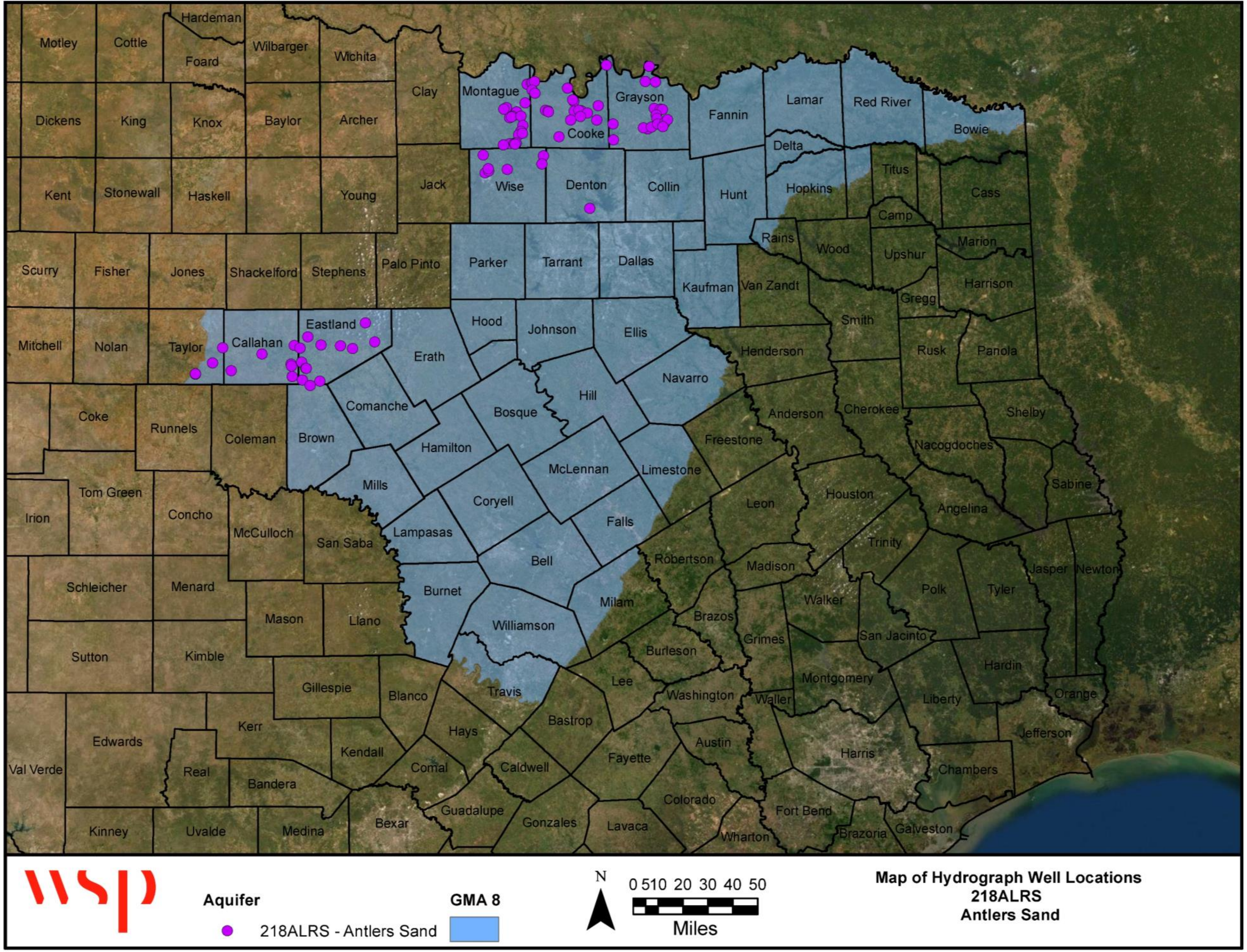
WOODBINE AQUIFER WELLS WITH HYDROGRAPHS



WOODBINE AQUIFER WELLS WITH HYDROGRAPHS IN COLLIN COUNTY



ANTLERS AQUIFER WELLS WITH HYDROGRAPHS



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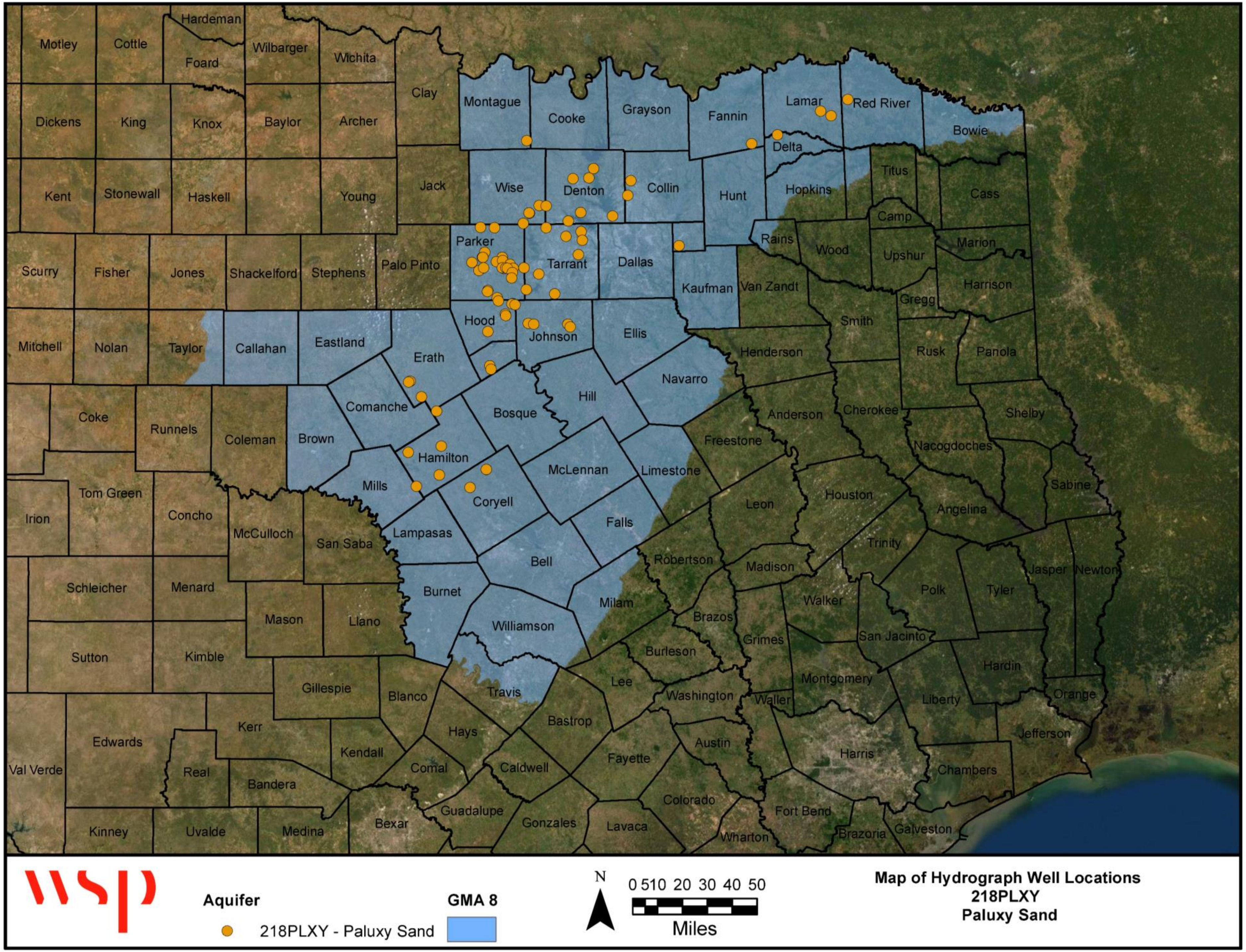
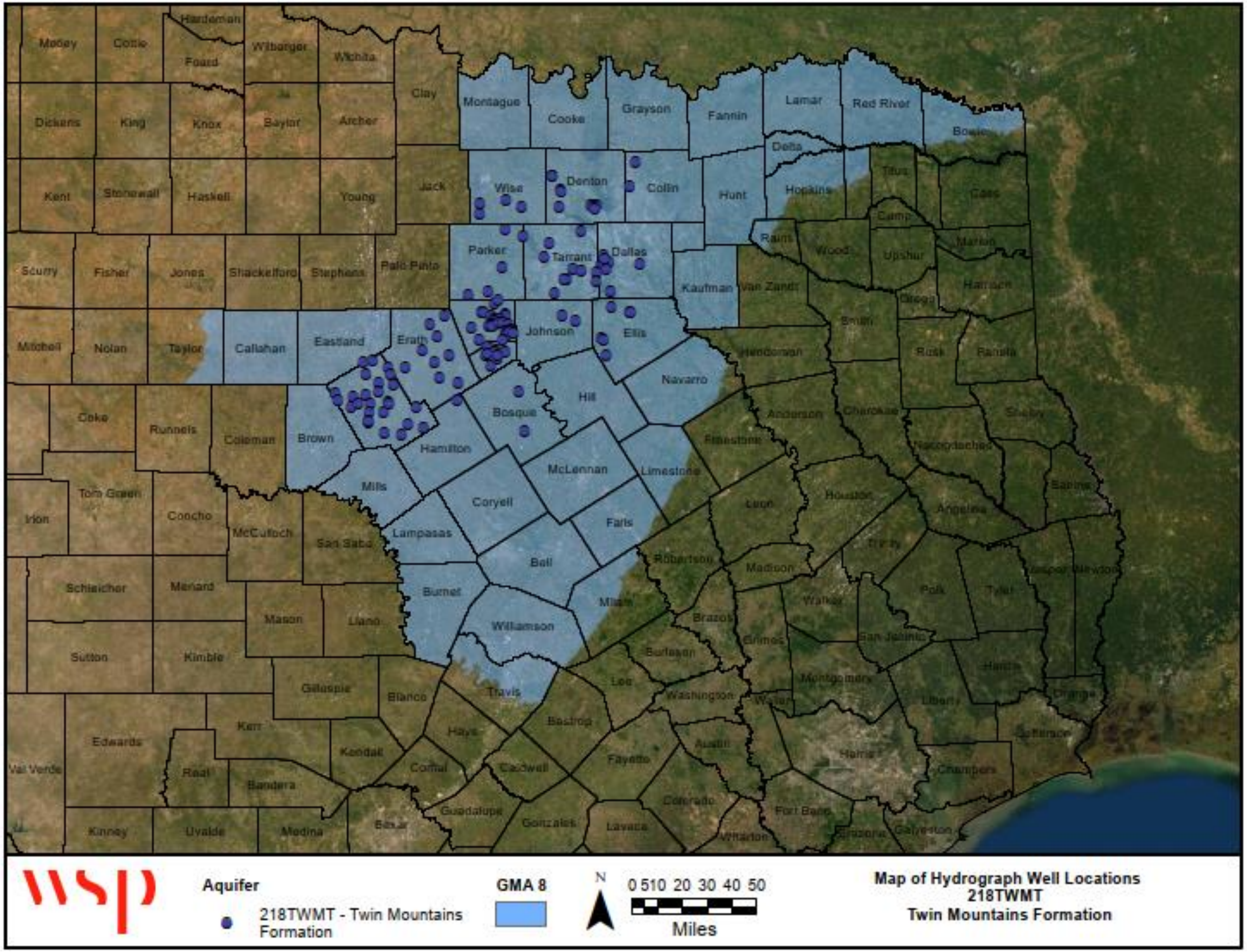
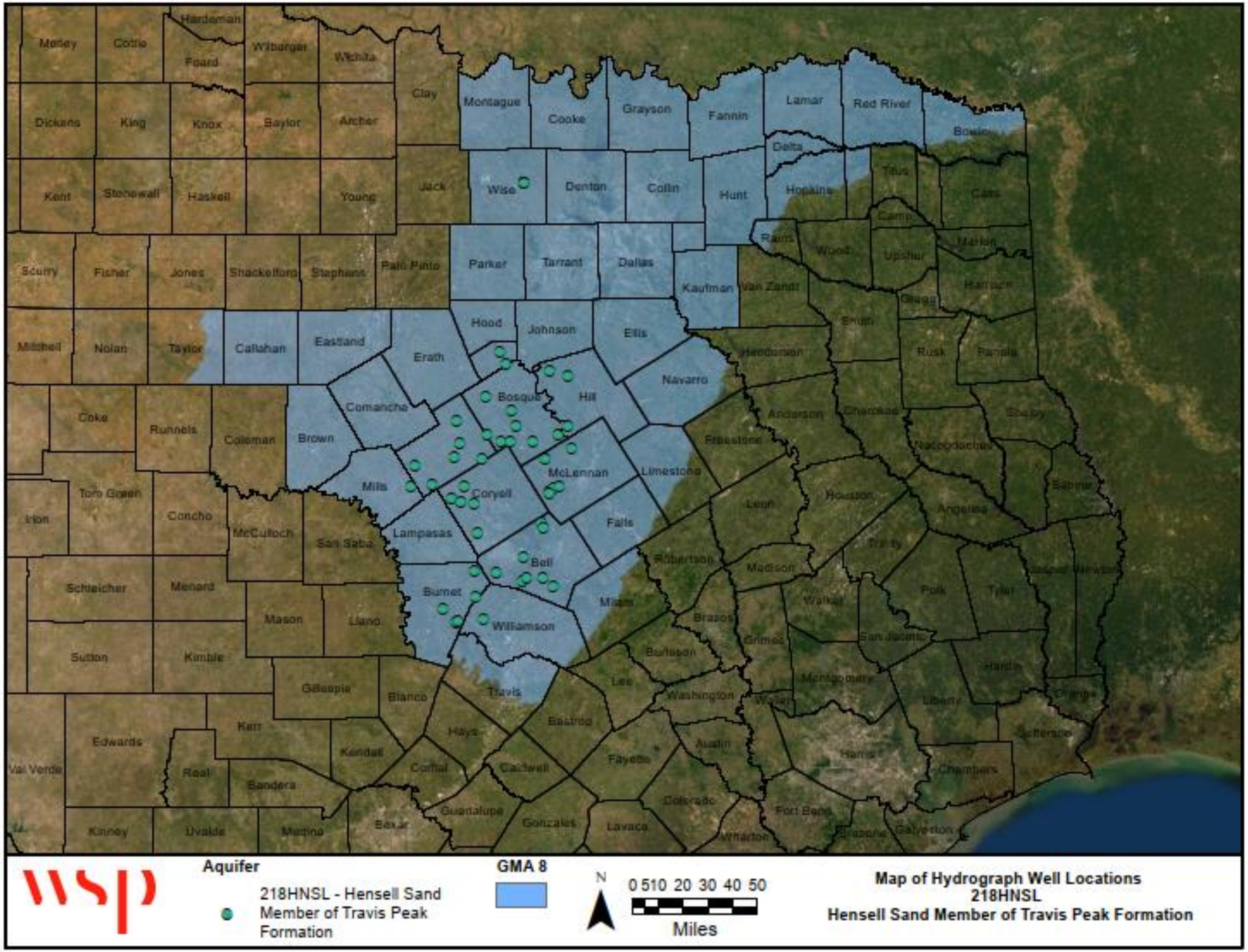
PALUXY AQUIFER WELLS WITH HYDROGRAPHS



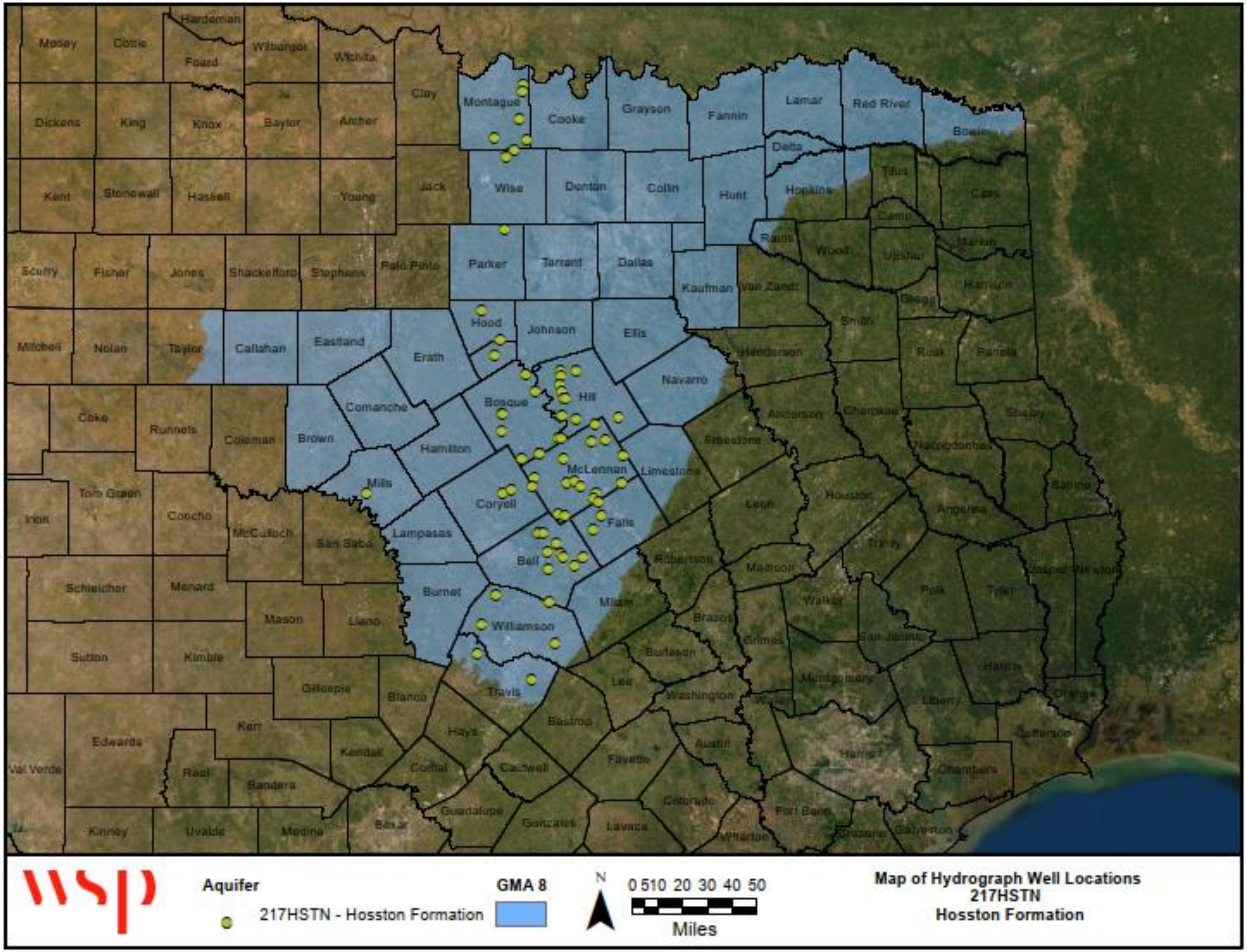
TWIN MOUNTAIN AQUIFER WELLS WITH HYDROGRAPHS



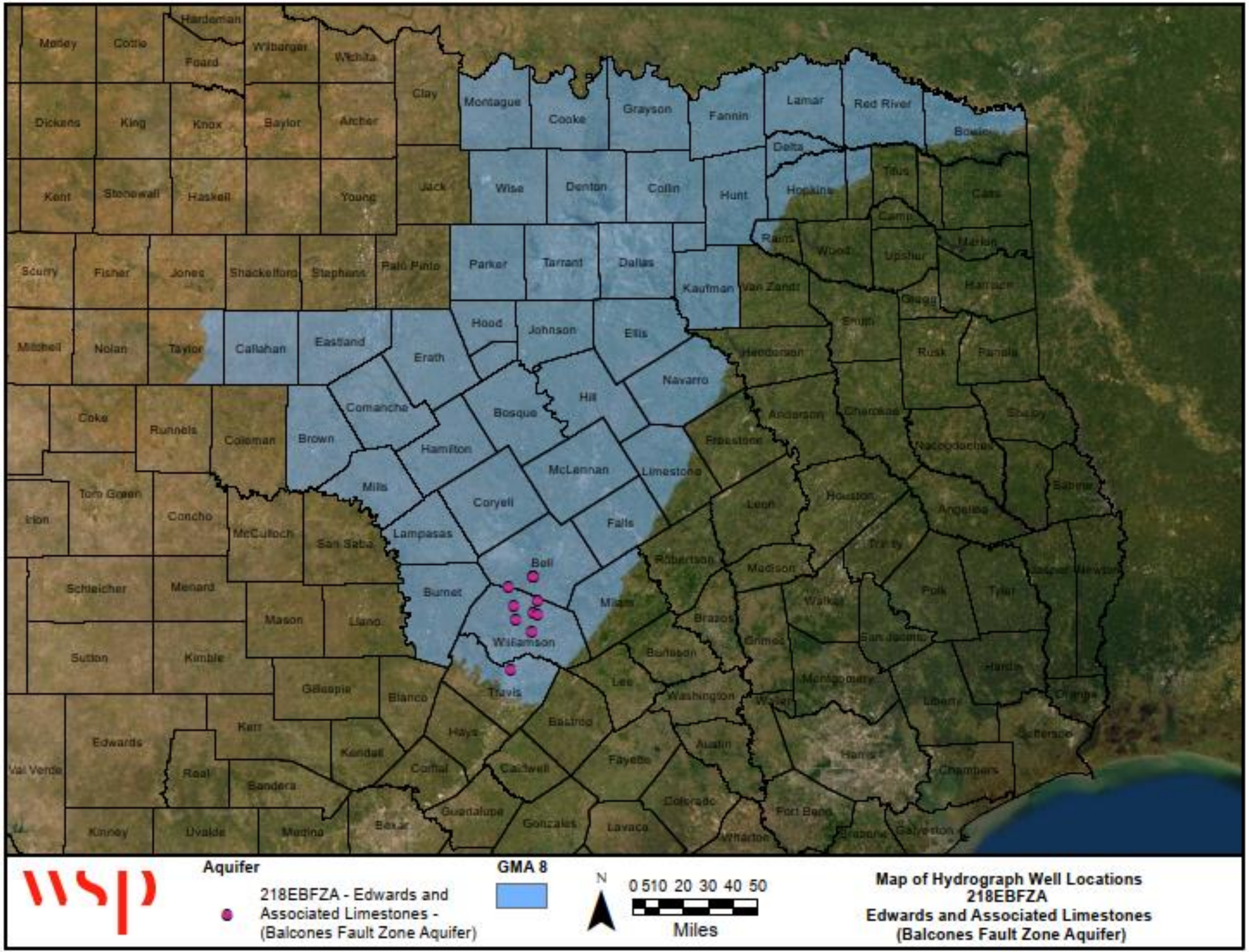
HENSELL AQUIFER WELLS WITH HYDROGRAPHS



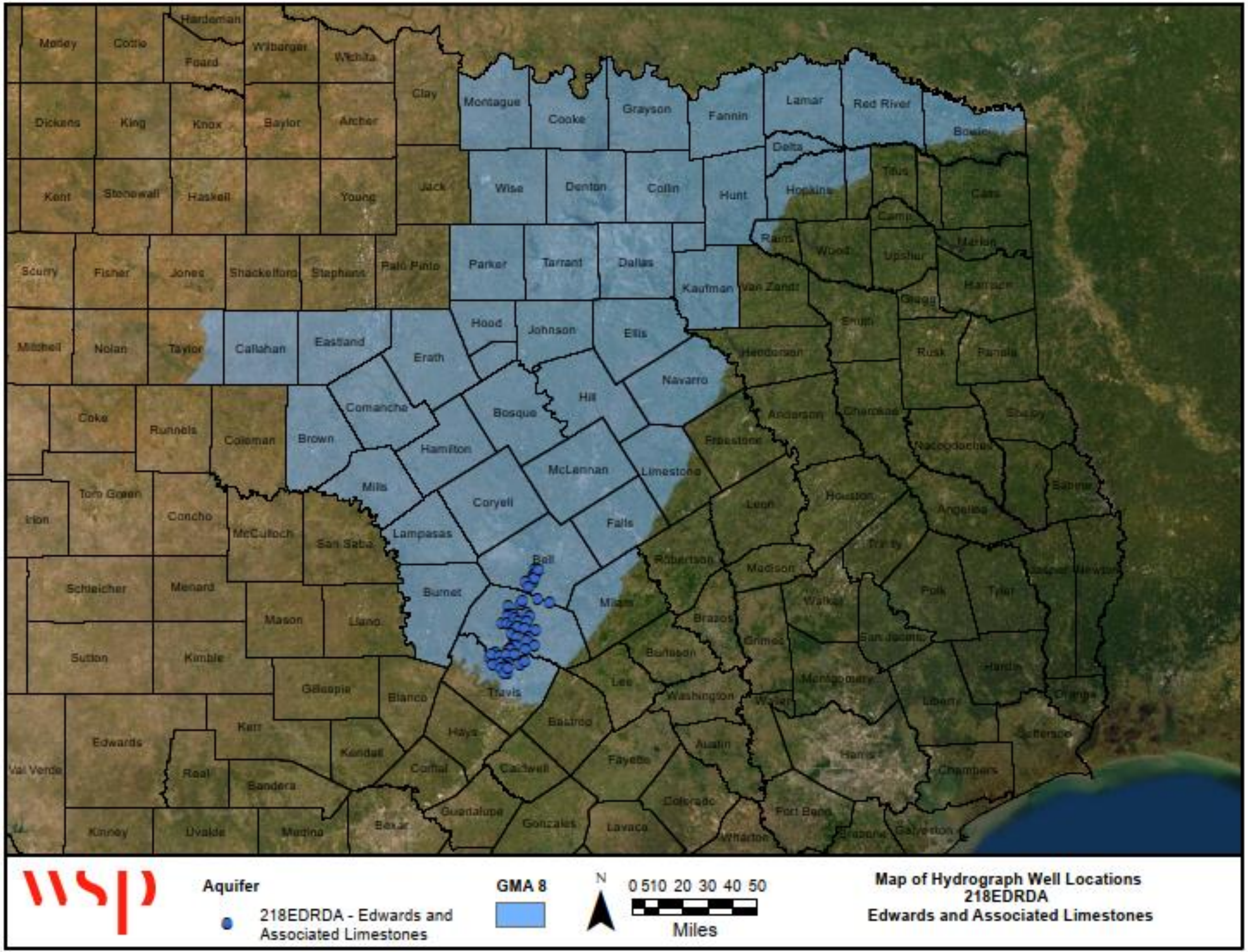
HOSSTON AQUIFER WELLS WITH HYDROGRAPHS

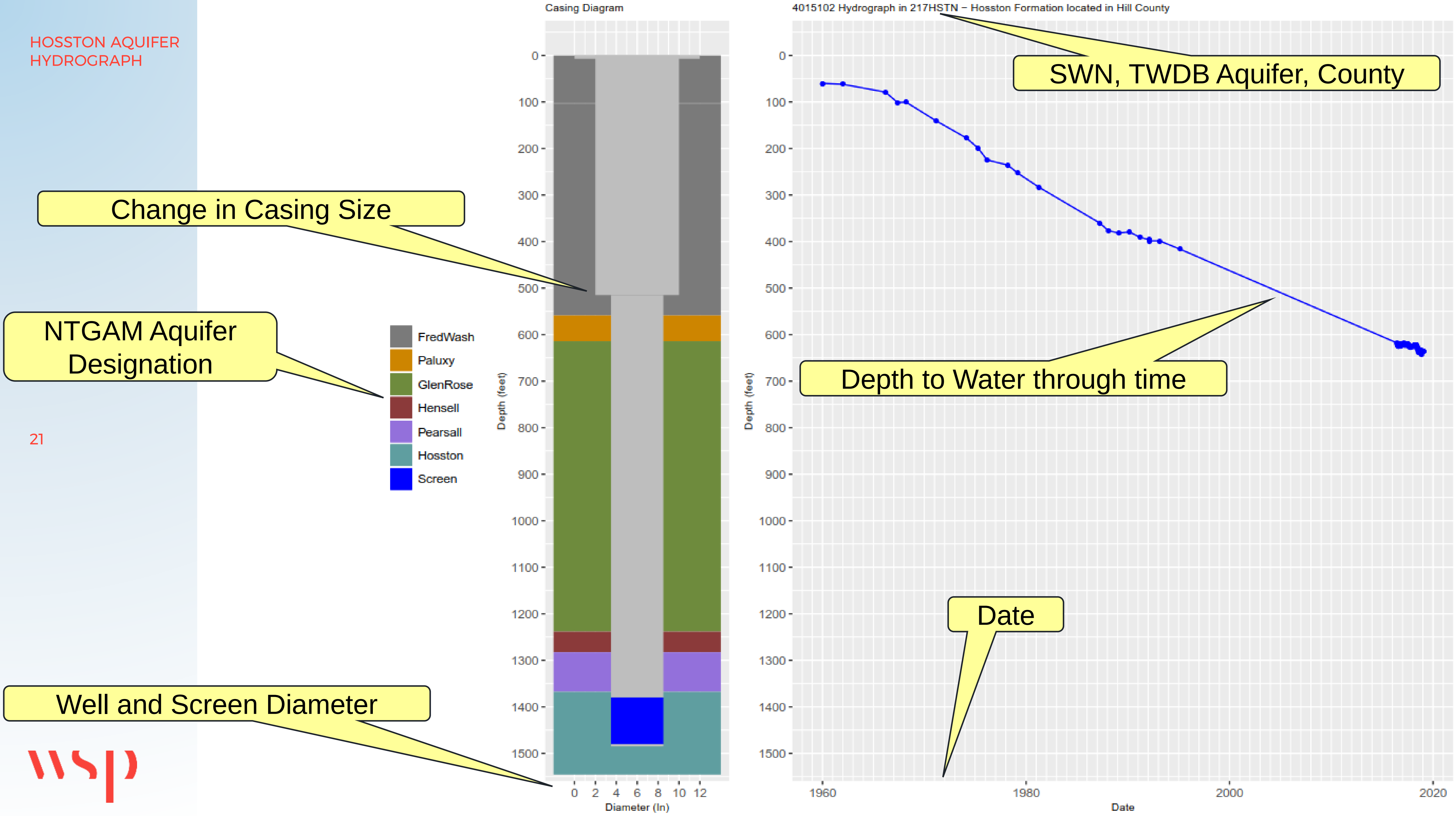


EDWARDS BFZ AQUIFER WELLS WITH HYDROGRAPHS



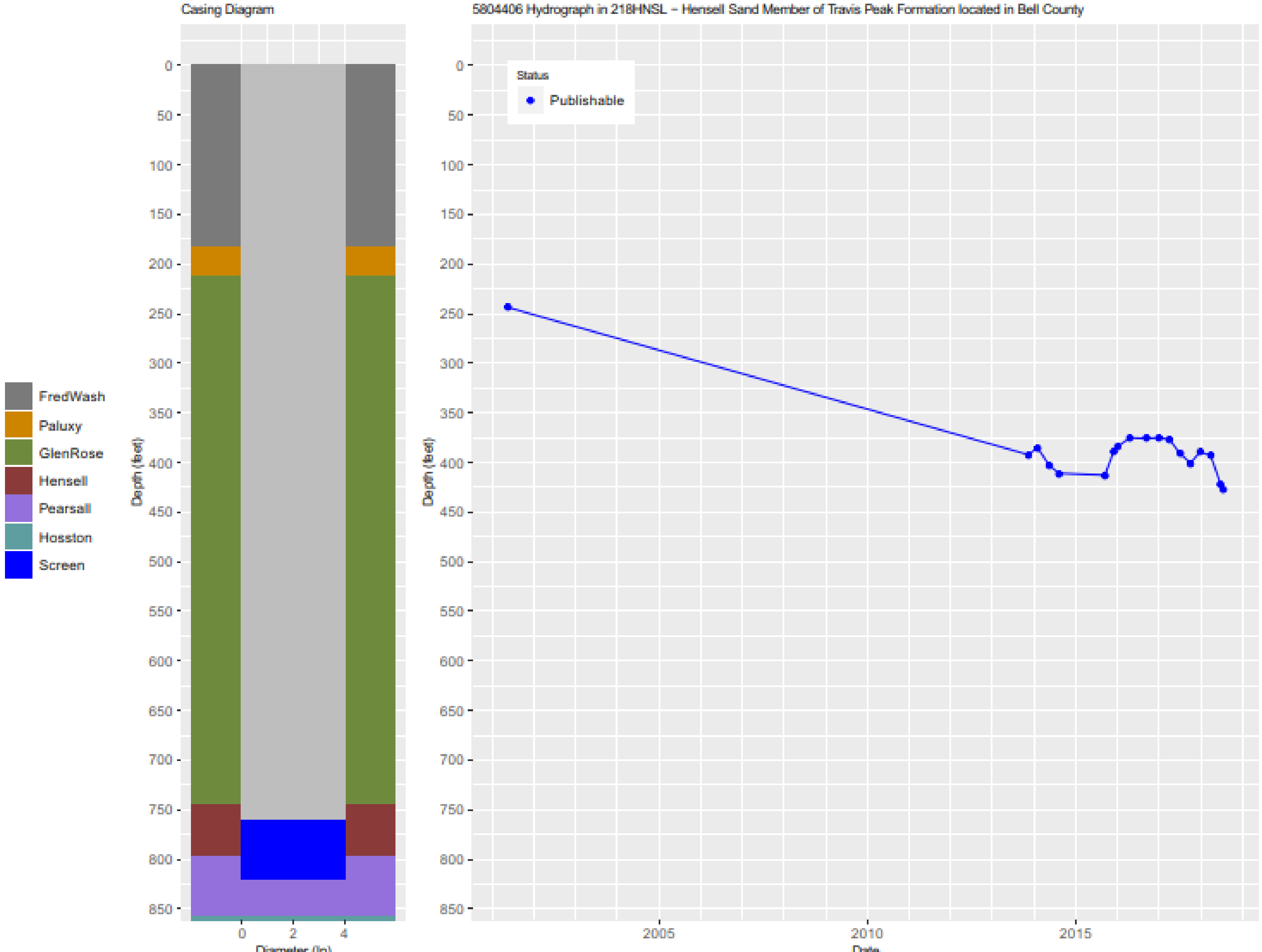
EDWARDS AND ASSOCIATED LIMESTONES AQUIFER WELLS WITH HYDROGRAPHS





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.

HENSELL
AQUIFER
HYDROGRAPH
IN
BELL COUNTY



Subsidence Impacts

Key Factors Impacting Subsidence

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

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: 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*

— 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.

Subsidence

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

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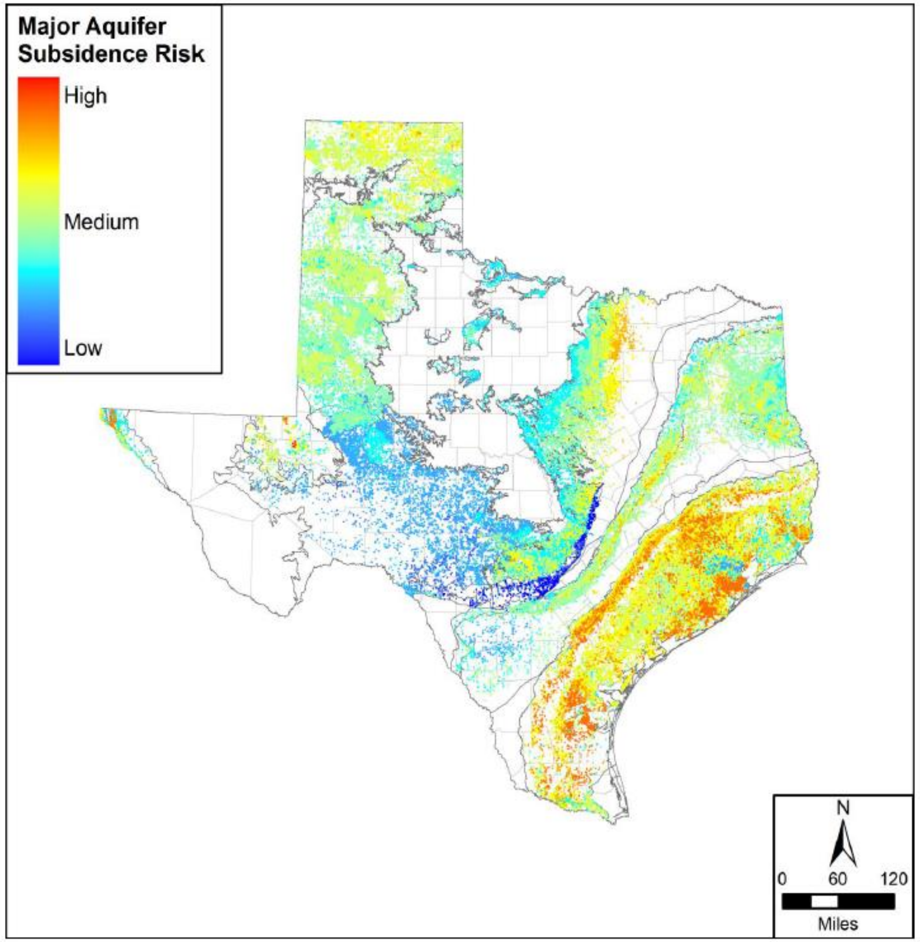
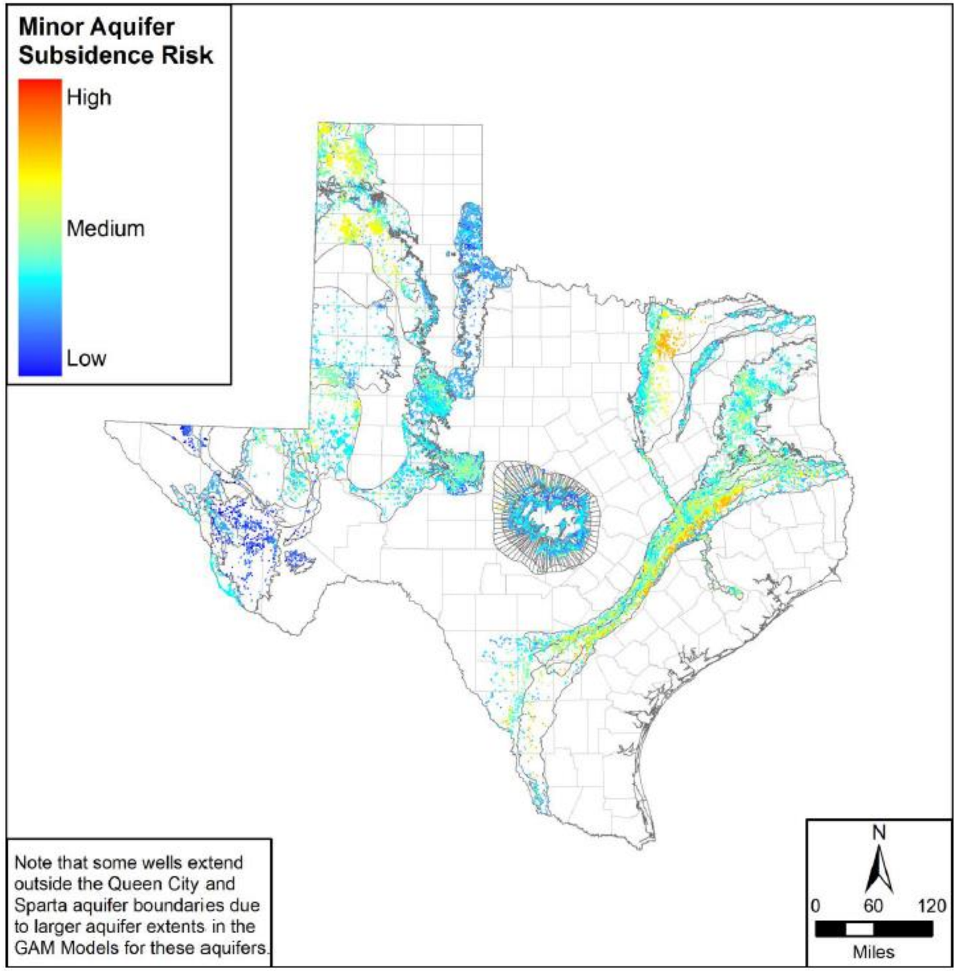
Visualizing the Subsidence Risk

- 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*

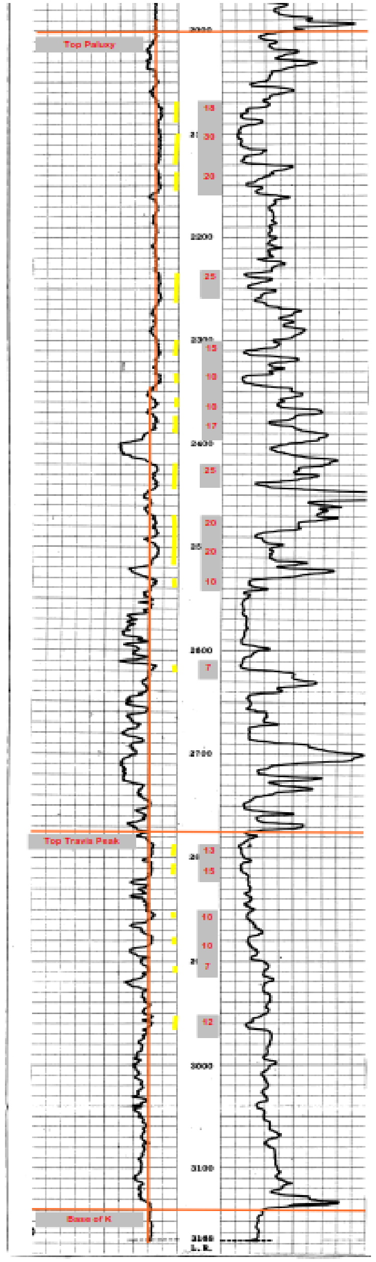




The Localized Evaluation Process

1. Identify the downdip area
2. Find 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

Rockett SUD 33-26-902
Clay thickness = 294 feet



Subsidence Calculations

Aquifer	**Trinity**
Report Generated by	K. Laughlin
Report Date	3/13/2019
Well Name	33-26-902 Rockett SUD
Water Levels to Use for Predictions	Base and Future

Location and Water Level Based User Input	**User Input Values**	**Units**
Land Surface (feet MSL)	592	feet
Aquifer Top (feet MSL)	-1,408	feet
Aquifer Thickness	1,140	feet
Clay Thickness within Aquifer	294	feet
Groundwater Temperature	44	Degrees Celsius
Groundwater Total Dissolved Solids (TDS)	1,295	mg/l
Predevelopment Water Level (feet MSL)	32	feet
Current Water Level (feet MSL)	-709	feet
Unsaturated Thickness	1,301	feet
Preconsolidation (deepest) Water Level (feet MSL)	-603	feet
Base Water Level (feet MSL)	-579	feet
Future Water Level (feet MSL)	-880	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	-5.01	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	Stiff 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	8.96E-04	psi^{-1}
Maximum Clay Compressibility	1.79E-03	psi^{-1}
Minimum Elastic Specific Storage (S_{ske})	2.41E-07	ft^{-1}
Maximum Elastic Specific Storage (S_{ske})	4.57E-07	ft^{-1}
Minimum Inelastic Specific Storage (S_{skv})	2.41E-05	ft^{-1}
Maximum Inelastic Specific Storage (S_{skv})	4.57E-05	ft^{-1}
Total Weighted Risk for Well 0 (low risk) to 10 (high risk)	**7.66**	

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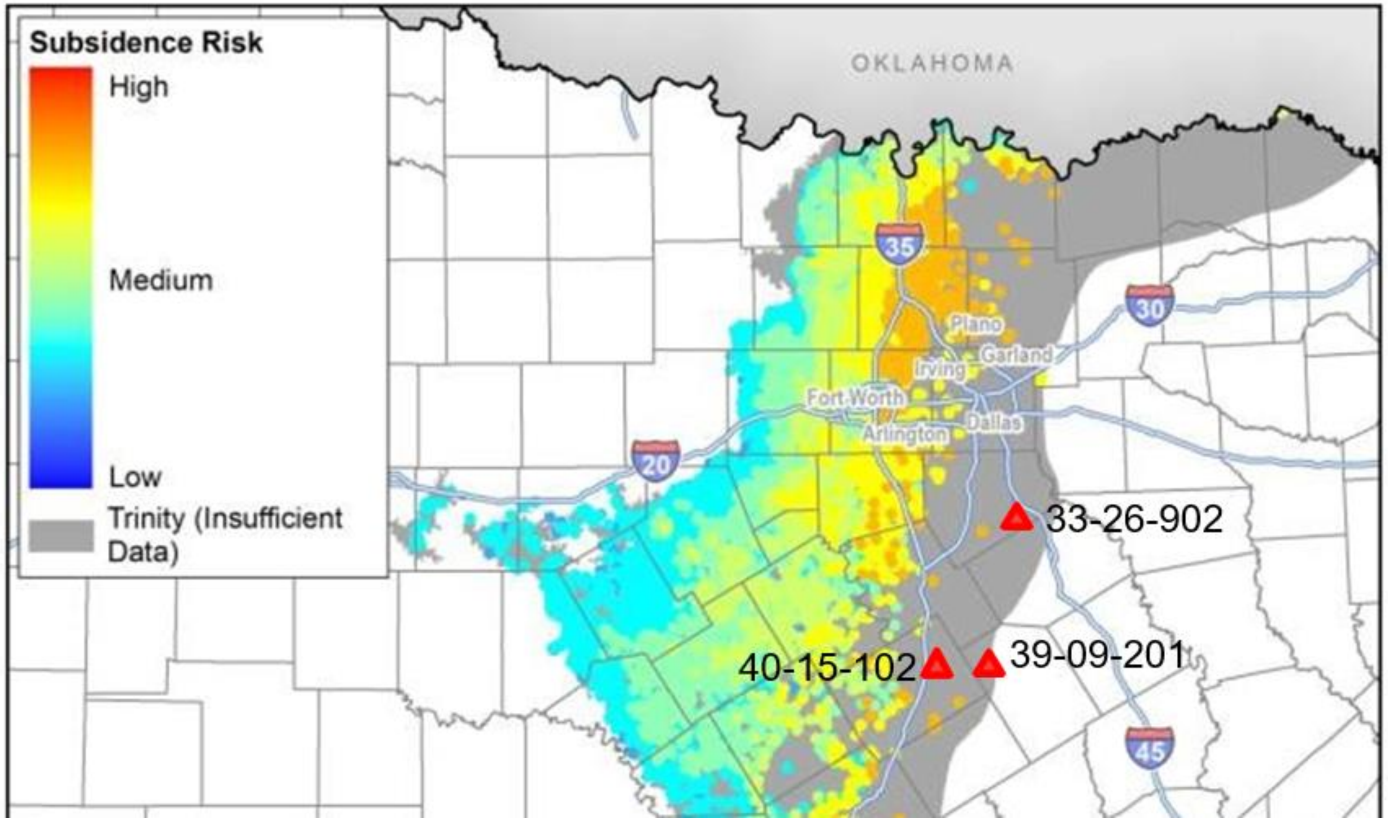
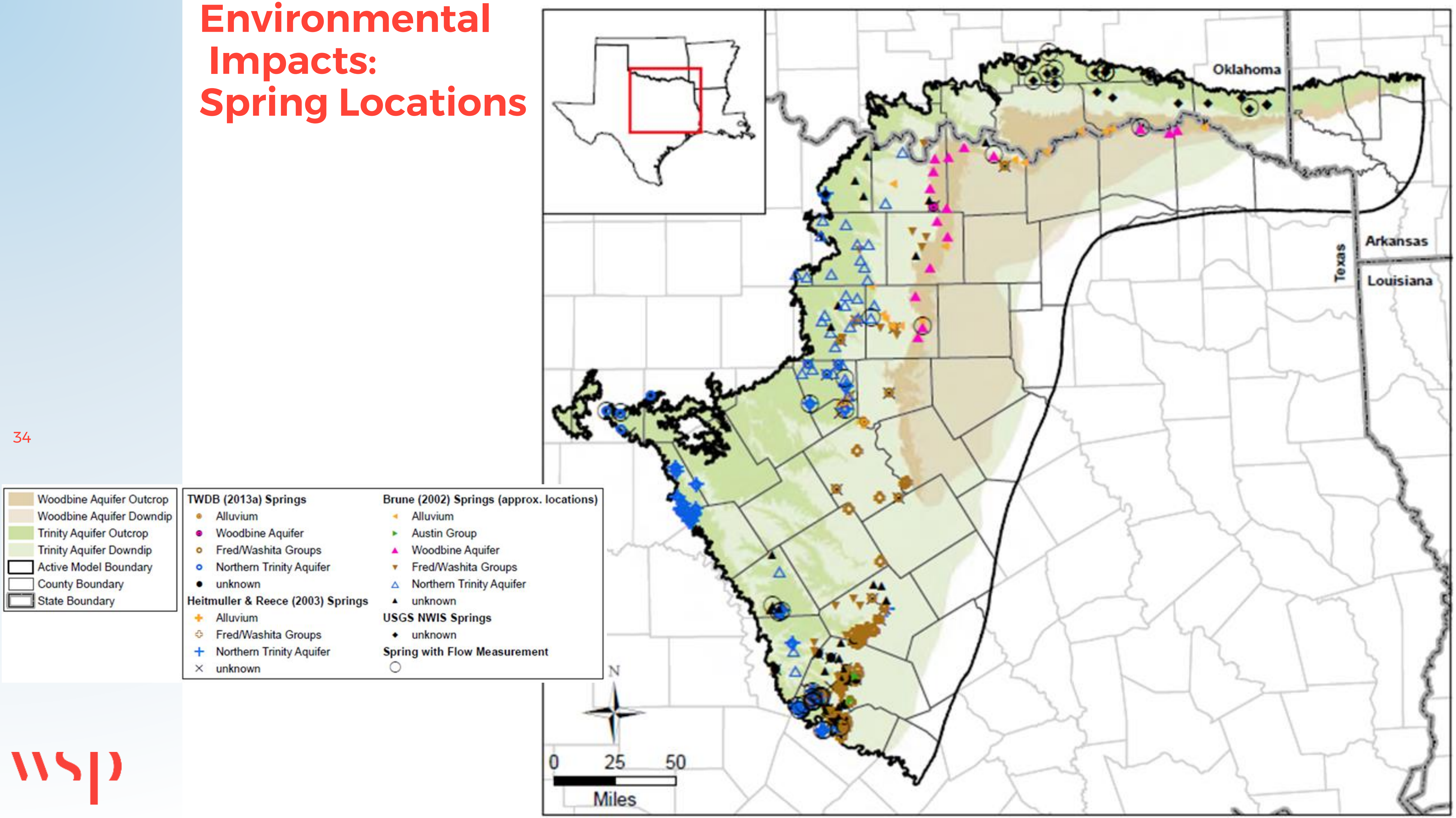
Prairielands GCD (and nearby)

Well Owner	State Well ID	Aquifer Thickness (feet)	Clay Thickness (feet)	**Subsidence Risk Score**	Minimum Subsidence (feet)	Maximum Subsidence (feet)
Rockett SUD	33-26-902	1,140	668	**7.66**	0.6	1.2
Penelope WSC	39-09-201	1,440	299	**8.59**	3.0	6.0
Aquilla	40-15-102	835	294	**7.66**	2.5	4.5



Environmental Impacts

Environmental Impacts: Spring Locations



Environmental Impacts: Spring Discharge and Streamflow

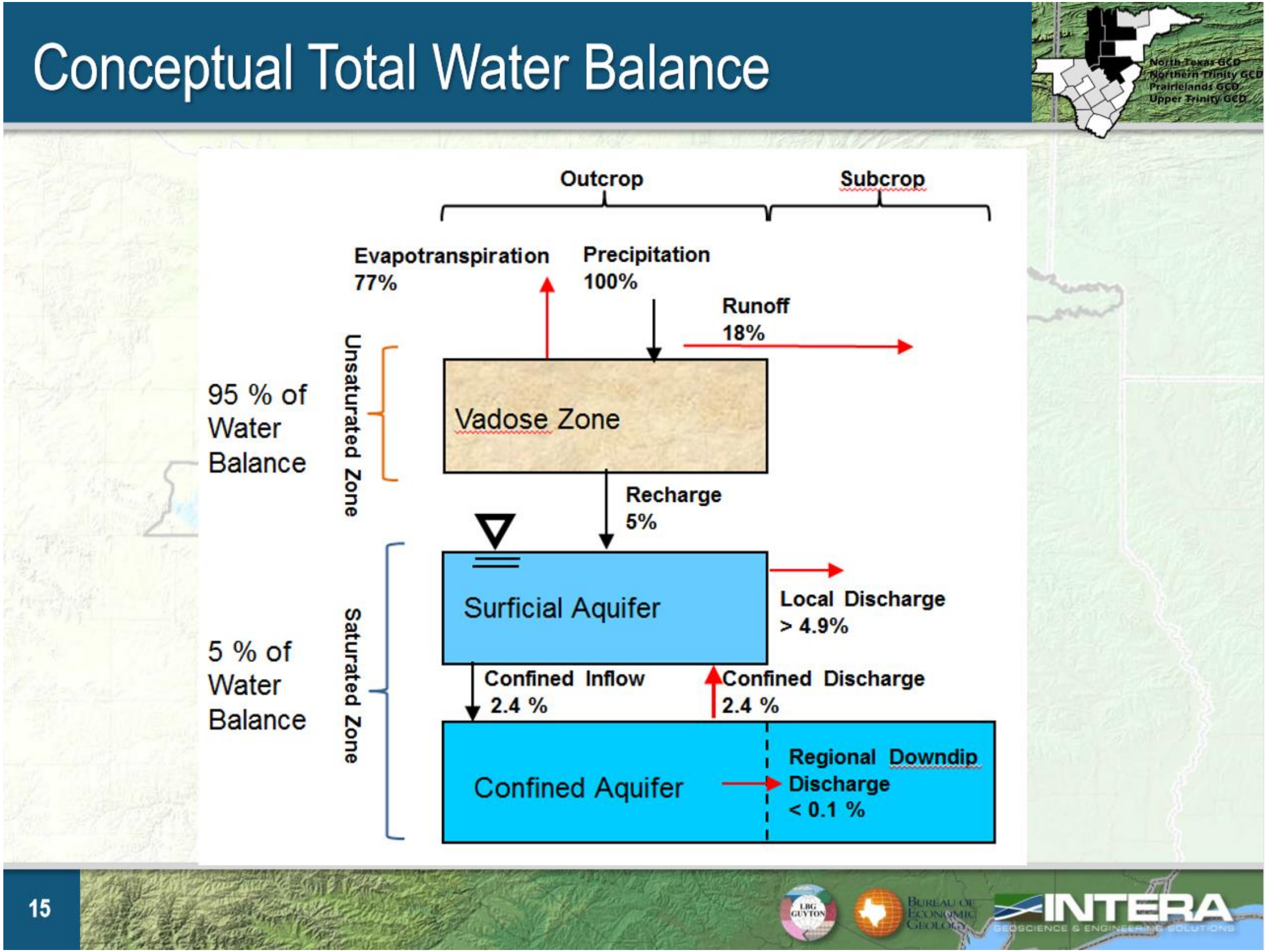
- Southern portion of GMA 8 has the greatest density of springs.
- Most are in the Washita/Fredericksburg, which includes Edwards BFZ.
- Many located in far western extent of GMA 8.
- Springs flow when the water level elevation of the aquifer is higher than the spring elevation.
- Water level declines reduce spring flow in the model

Environmental Impacts Summary

— NTGAM includes boundary conditions to represent :

  — *Springs*
  — *Ephemeral streams*
  — *Perennial streams*

— Water budgets from Run 10 in existing ER indicate reduced spring flows and baseflows where DFCs include water level decline in aquifer outcrop areas.


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%
5 % of Water Balance
Saturated Zone
Surficial Aquifer
Local Discharge > 4.9%
Confined Inflow 2.4 %
Confined Discharge 2.4 %
Confined Aquifer
Regional Downdip Discharge < 0.1 %
15
INTERA

Environmental Impacts:
ER Run 10 Water Budget Examples

NTGCD Run 10 - Johnson County - Wash/Fred Aquifer							
Component	2010	2020	2030	2040	2050	2060	2070
Lateral Flow	-2,882	-2,920	-2,927	-2,944	-2,960	-2,969	-2,977
Leakage (Above)	1,105	1,022	1,039	1,068	1,096	1,122	1,140
Leakage (Below)	-4,767	-4,214	-4,234	-4,279	-4,313	-4,336	-4,354
Recharge	17,488	17,488	17,488	17,488	17,488	9,023	17,488
Perennial	-145	-125	-122	-120	-119	-104	-117
Ephemeral	-15,345	-14,345	-13,842	-13,474	-13,168	-12,558	-12,499
Evapotransipration	0	0	0	0	0	0	0
Springs	-22	-20	-20	-19	-19	-18	-18
Reservoir	122	124	125	127	128	129	130
Wells	-2,554	-2,554	-2,554	-2,554	-2,554	-2,554	-2,554
Flowing	0	0	0	0	0	0	0
Storage	7,093	5,636	5,140	4,800	4,514	12,356	3,854
Total	92	92	92	92	93	92	93

18% decline

NTGCD Run 10 - Somervell County - Hensell Aquifer							
Component	2010	2020	2030	2040	2050	2060	2070
Lateral Flow	2,051	1,909	1,834	1,791	1,761	1,740	1,722
Leakage (Above)	1,984	2,335	2,480	2,557	2,602	2,624	2,646
Leakage (Below)	-720	-1,035	-1,139	-1,194	-1,227	-1,249	-1,266
Recharge	308	308	308	308	308	164	308
Perennial	-1,935	-1,681	-1,564	-1,488	-1,435	-1,343	-1,353
Ephemeral	0	0	0	0	0	0	0
Evapotransipration	0	0	0	0	0	0	0
Springs	0	0	0	0	0	0	0
Reservoir	0	0	0	0	0	0	0
Wells	-2,127	-2,127	-2,127	-2,127	-2,127	-2,127	-2,127
Flowing	0	0	0	0	0	0	0
Storage	440	292	208	154	118	191	70
Total	0	0	0	0	0	0	0

30% decline

Summary of Impacts to Springs and Perennial/Ephemeral Streams

GCD or County	Percent Difference from 2010 to 2070 **Perennial**	Percent Difference from 2010 to 2070 **Ephemeral**	Percent Difference from 2010 to 2070 **Springs**
Clearwater UWCD	18	34	79
Middle Trinity GCD	19	16	100
ND Brown	0	9	11
Central Texas GCD	35	14	0
ND Callahan	0	8	0
North Texas GCD	11	14	18
ND Dallas	31	0	0
ND Eastland	0	14	0
Prairielands GCD	29	19	20
Red River GCD	7	11	0
ND Hamilton	16	21	0
Upper Trinity GCD	36	21	24
ND Jack	0	38	0
ND Lamar	2	5	16
Saratoga UWCD	7	7	3
Southern Trinity GCD	17	26	0
ND Mills	-3	7	0
ND Palo Pinto	0	12	0
ND Red River	4	5	0
Northern Trinity GCD	15	19	28
ND Taylor	0	2	0
ND Travis	NA	22	0
ND Williamson	NA	31	0

*Positive values indicate decline, and negative values indicate increase

Agenda Item 10

- Discussion of possible agenda items and dates for next GMA 8 meeting

GMA 8 Schedule to Discuss Nine Factors

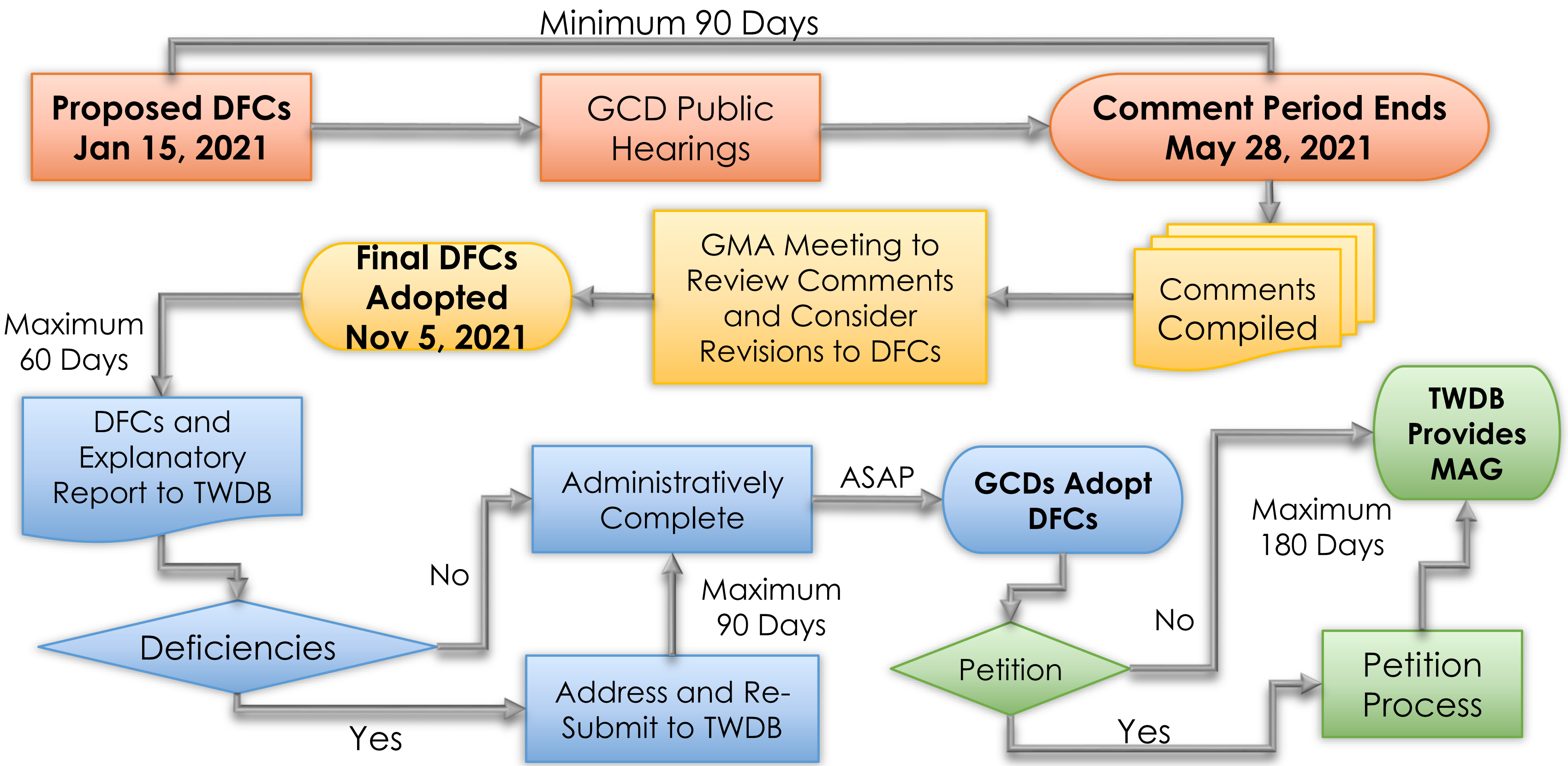
November 2019		
Environmental Impacts	Subsidence Impacts	Hydrological Conditions
February 2020		
Aquifer Uses or Conditions	Supply Needs & Management Strategies	Private Property Rights
May 2020		
Socioeconomic Impacts	DFC Feasibility	Other Relevant Information

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

Anticipated Timeline for GMA 8 DFC Process



Thank you!

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