Northern Trinity Brackish Groundwater Study results Stakeholder Meeting

November 1, 2017
Region G Planning Group
Waco, Texas
Presented by Mark Robinson
Innovative Water Technologies

- The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

Brackish Groundwater Production Zones

- In 2015, the 84th Texas Legislature passed House Bill 30, directing the TWDB to
  - (1) identify and designate brackish groundwater production zones in four aquifers and to report to the legislature by December 1, 2016,
  - (2) determine the volumes of groundwater that a brackish groundwater production zone can produce over 30- and 50-year periods without causing significant impact to water availability or water quality,
  - (3) work with groundwater conservation districts and stakeholders, and
  - (4) make recommendations on reasonable monitoring to observe the effects of brackish groundwater production within the zone.

- Furthermore, the TWDB shall identify and designate brackish groundwater production zones in all aquifers in the state by the legislatively mandated date of December 1, 2022.

- www.twdb.texas.gov/innovativewater/bracs/HB30.asp

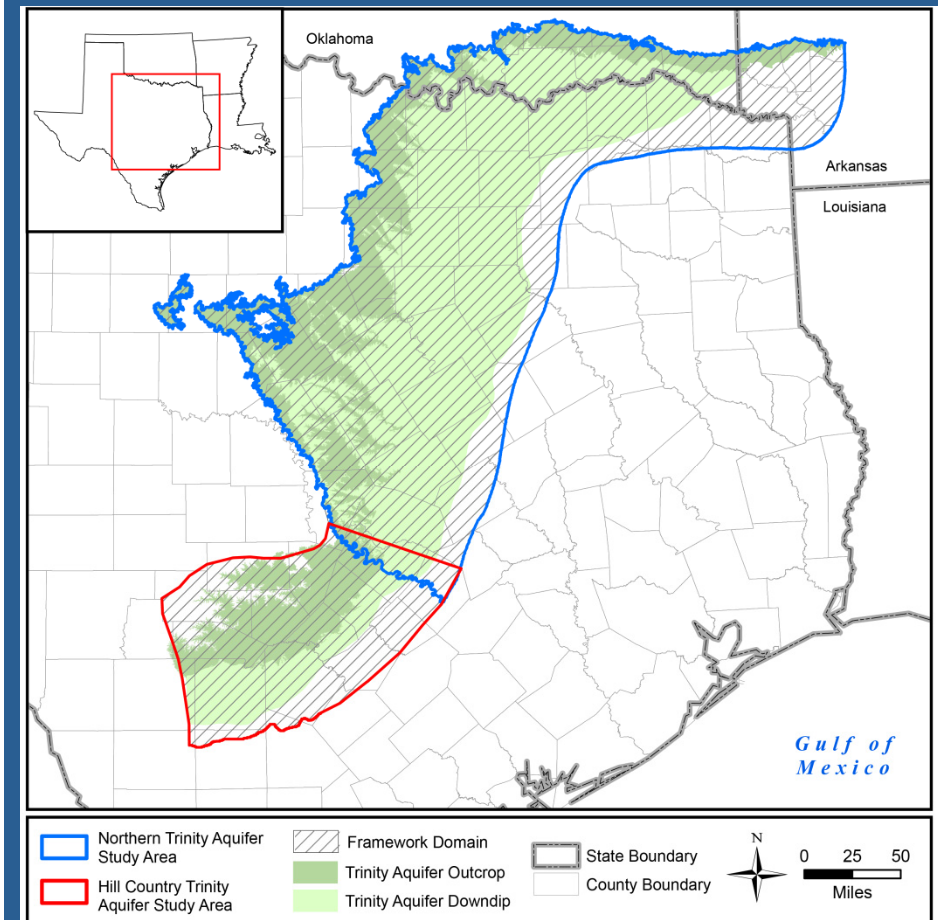
Project Team

- Leanne Stepchinski (SwRI)
  - Project management, hydrogeology
- Ronald Green (SwRI)
  - Hydrogeology
- Paul Bertetti (SwRI)
  - Geochemistry
- Ronald McGinnis (SwRI)
  - Structure and stratigraphy, log interpretation
- Nathaniel Toll (SwRI)
  - Hydrogeology, groundwater modelling
- Beth Fratesi (SwRI)
  - Hydrogeology, groundwater modelling
- Daniel Lupton (INTERA, Inc.)
  - Hydrogeology, log analysis, structure and stratigraphy, geochemistry
- Neil Deeds (INTERA, Inc.)
  - Hydrogeology, log analysis, structure and stratigraphy, geochemistry
- Jevon Harding (INTERA, Inc.)
- Rebecca Nunu, Kirk Gulliver, and Mauricio Flores (SwRI)
- Marcus Gary and Steve Johnson (EAA)
- Brian Smith and Brian Hunt (BSEACD)

Project Objectives and Accomplishments

- Objective: Evaluate the fresh, brackish, and saline groundwater resources of the Trinity Aquifer
- Accomplishments:
  - Evaluated all groundwater, water chemistry, and geophysical log data available in the study area
  - Developed a stratigraphic framework model with available structural, stratigraphic, and lithologic data
  - Developed and employed a technical approach for estimating total dissolved solids (TDS) from geophysical logs
  - Delineated fresh, brackish, and saline groundwater both horizontally and vertically in the aquifers of the project area
  - Delineated Potential Production Areas (PPAs)
  - Calculated brackish groundwater volumes in the PPAs
  - Calculated potential 30- and 50- year drawdowns in the PPAs

Geology of the Trinity Aquifer



Northern Trinity Hydrostratigraphic Units

Period	Age	Age M.Y.	Group	North Formation	Central Formation	South Formation	Hill Country Formation
Cretaceous	Cenomanian		Washita	Grayson Marl Mainstreet Pawpaw Weno Denton Duck Creek Fort Worth	Buda Del Rio Georgetown	Buda Del Rio Georgetown	Buda Del Rio Georgetown
	Albian	97.0	Fredericksburg	Kiamichi Goodland Walnut Clay	Kiamichi Edwards Comanche Peak Walnut Clay	Kiamichi Edwards Comanche Peak Walnut Clay	Edwards
	Aptian Pre-Aptian	112.0 124.5	Trinity	Antlers	Paluxy Glen Rose Twin Mountains: Hensell Pearsall Hosston	Paluxy Glen Rose Travis Peak: Hensell Pearsall Cow Creek Hammett Sligo Hosston	Paluxy Upper Glen Rose Lower Glen Rose Hensell Cow Creek Hammett Sligo Hosston
Pre-Cretaceous	Tithonian	145.0	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated

Hill Country Trinity Hydrostratigraphic Units

Northern Trinity Geologic Framework:

GAM Hydrostratigraphy Work Flow (Kelley and others, 2014)

Build Well Log Database

- BRACS, BEG, TCEQ PWS, Q-logs, commercial sources

Correlate Stratigraphic Surfaces

- Original work but built off of previous studies

Interpret Lithologies from Well Logs

- Vertical record of interbedded lithologies – 5 to 10 foot scale

Map Layer Thicknesses and Compositions

- Structure, isopach, net sandstone maps

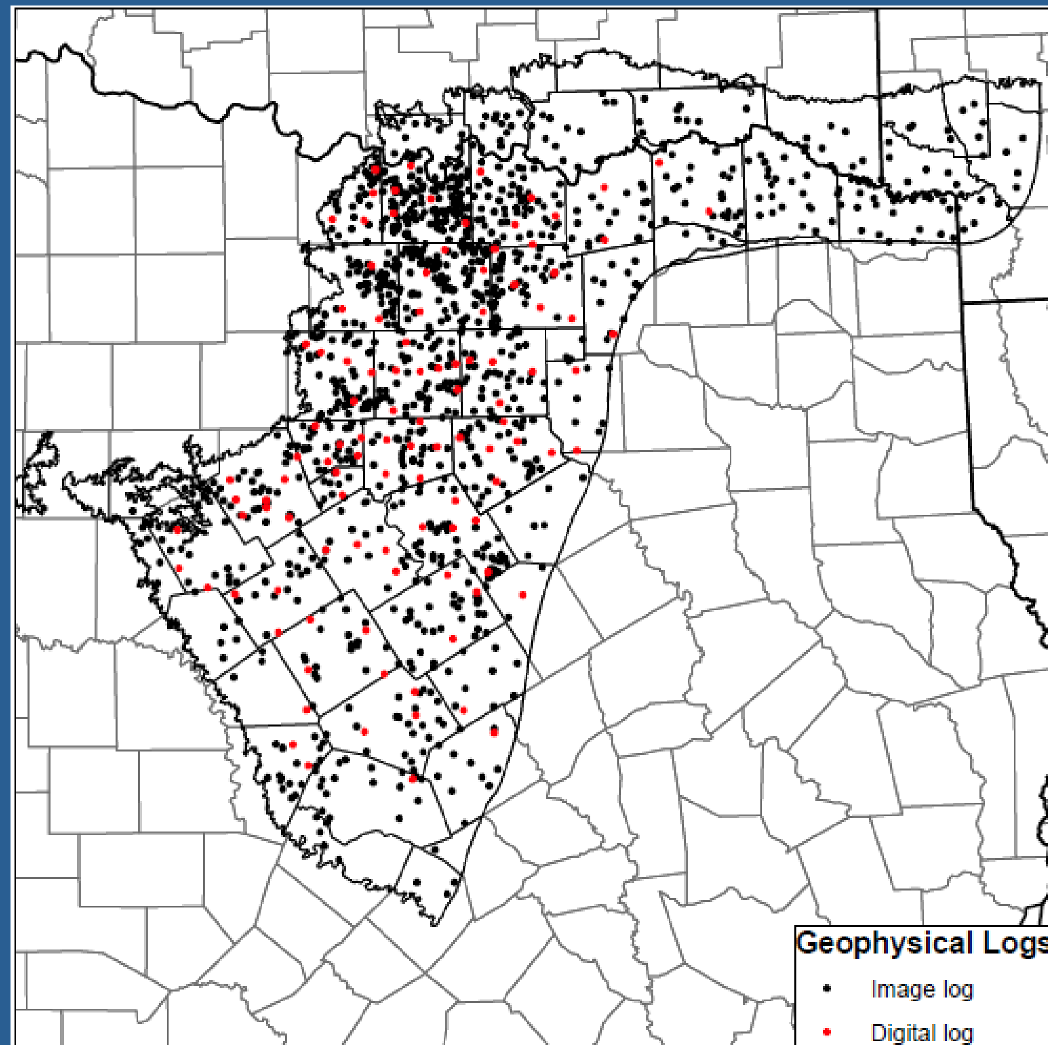
Interpret Depositional Environments

- Enhance predictability between wells – defines properties

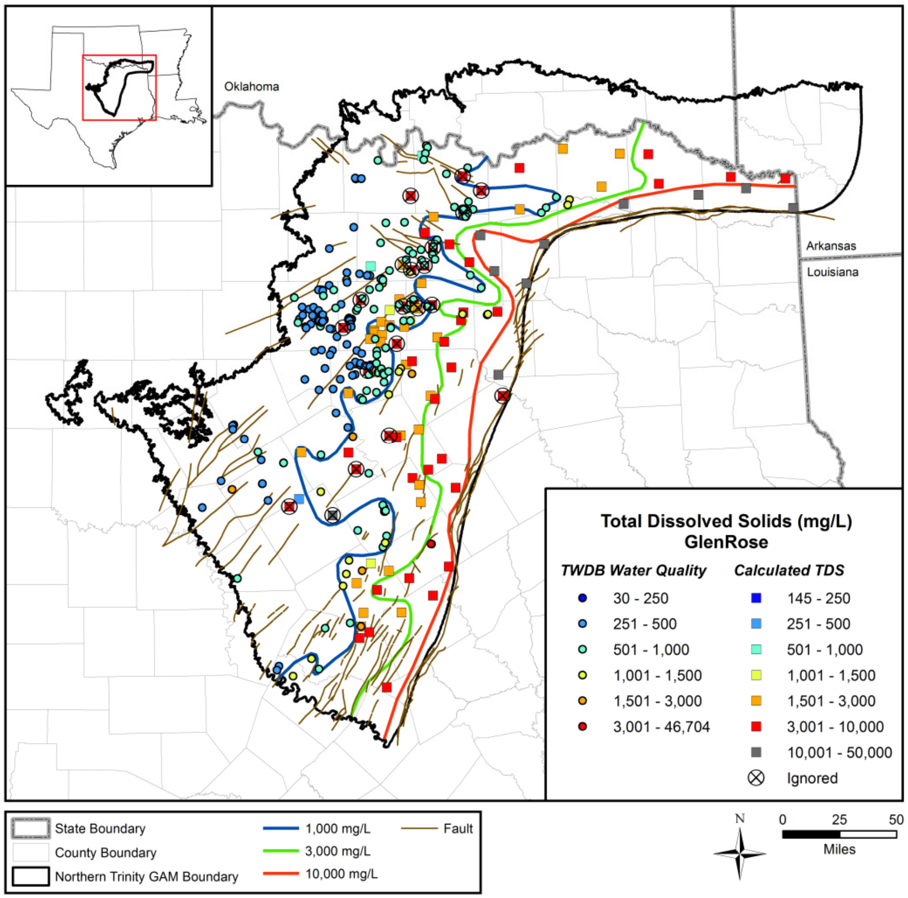
Build Well Log Database (Kelley and others, 2014)

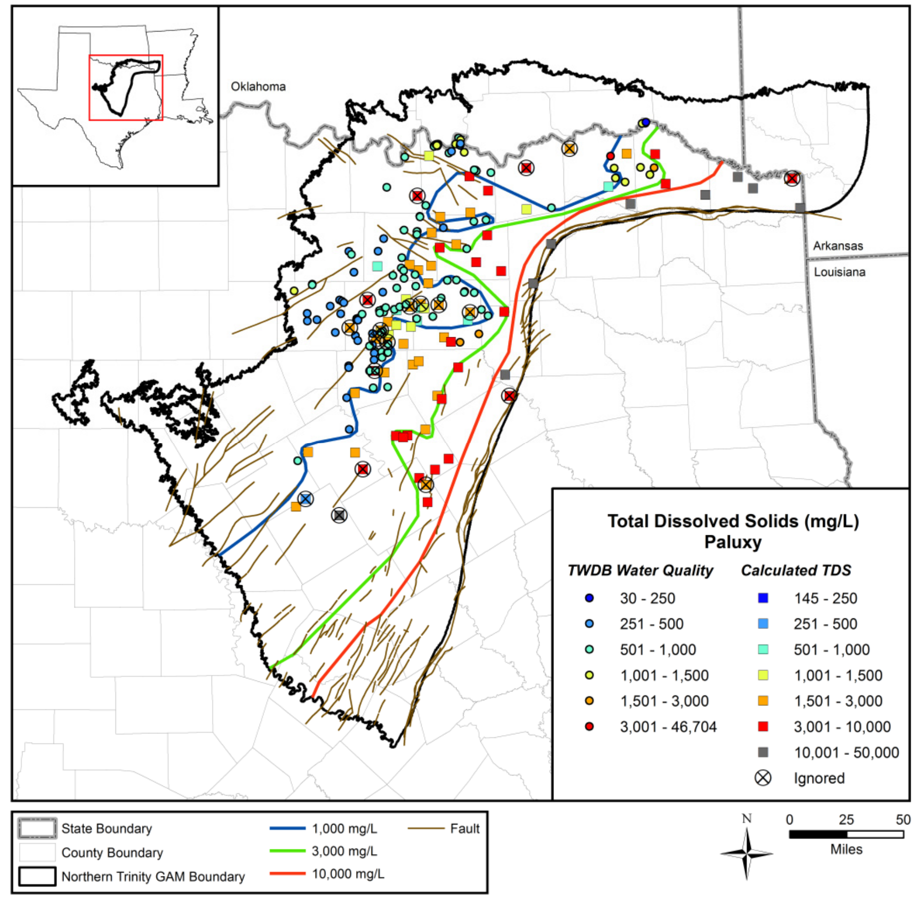
The well log database for the Northern Trinity Aquifer GAM utilized:

- 1193 wells with depth registered image logs
- 109 wells with digitized logs



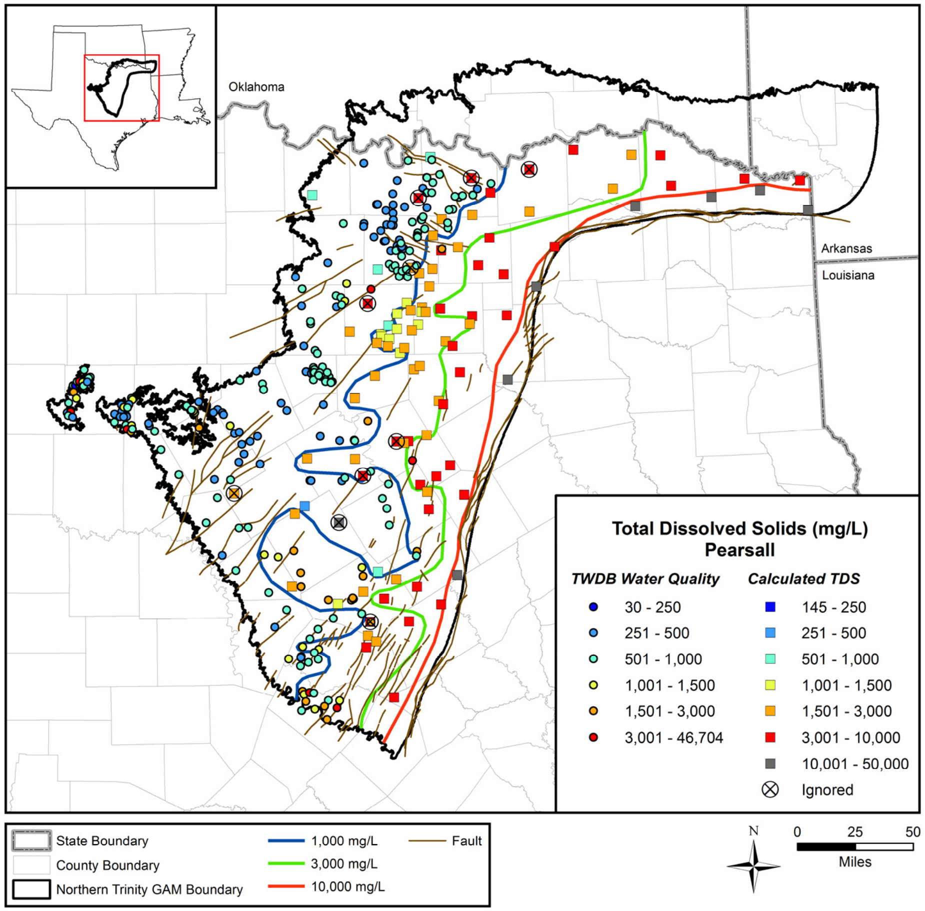
Northern Trinity Salinity Zones:
Measured and calculated water quality for Glen Rose and Paluxy formations

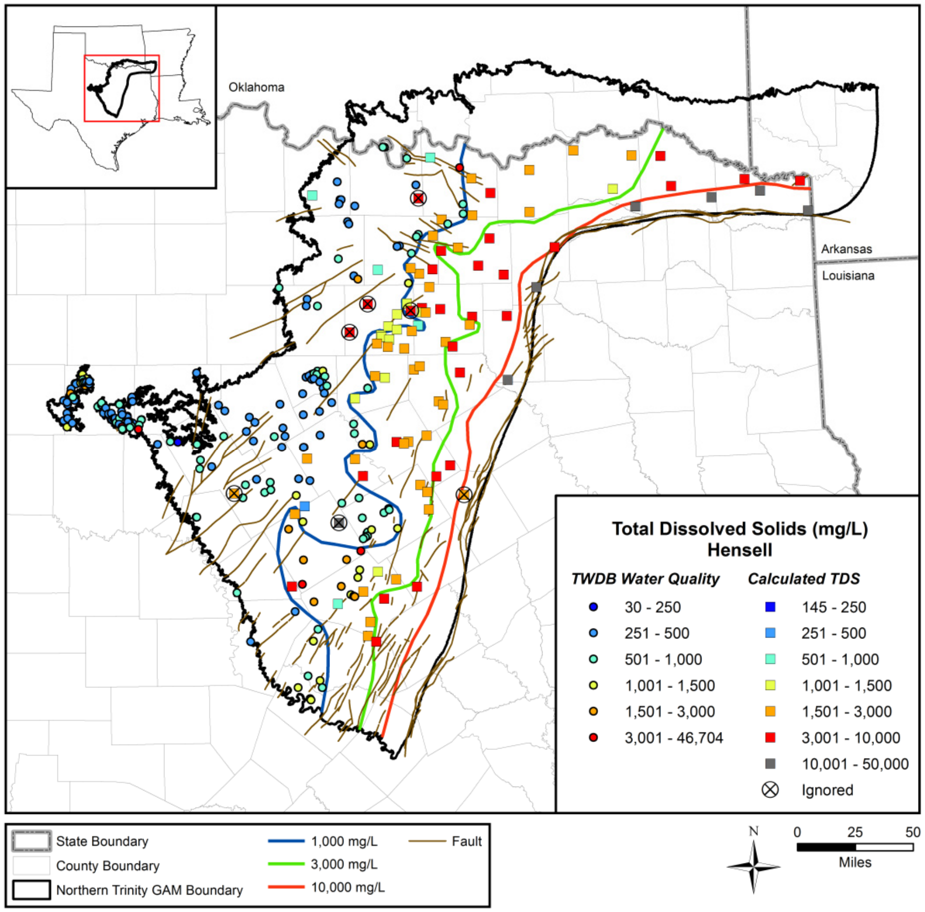




Northern Trinity Salinity Zones:

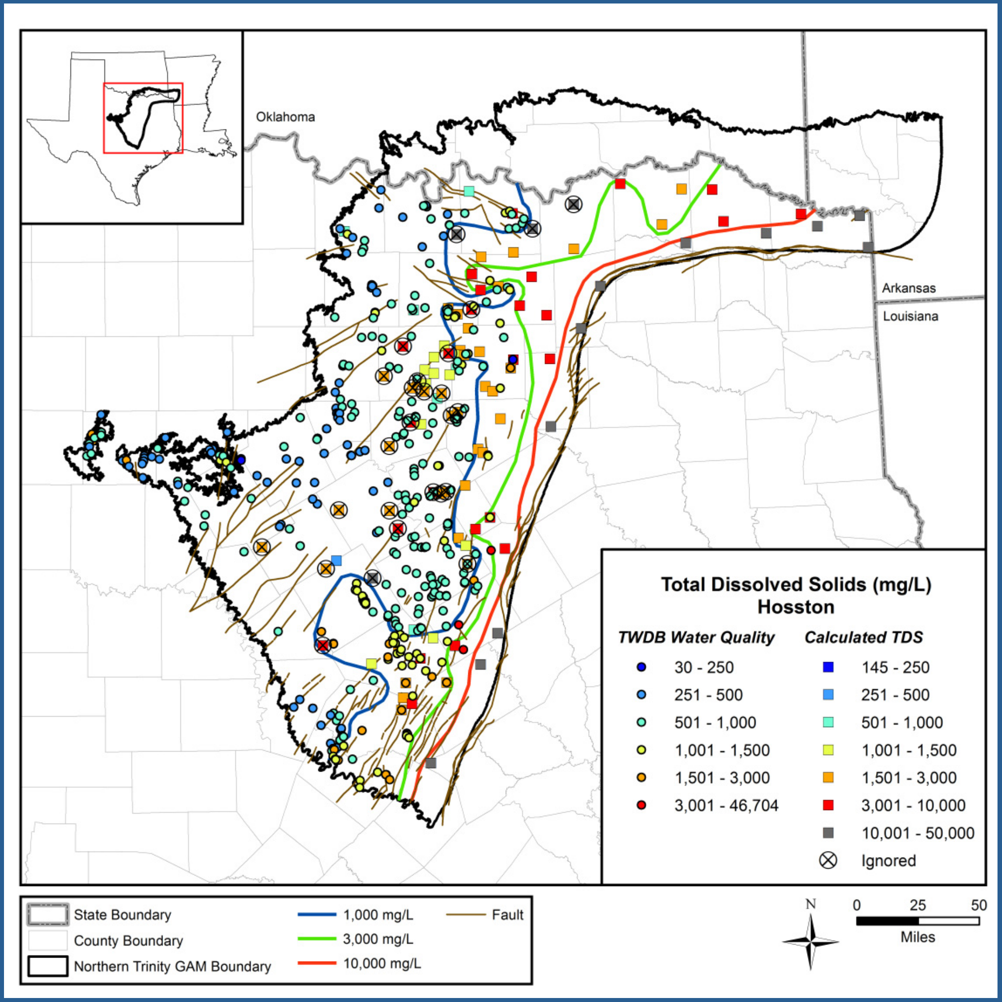
Measured and calculated water quality for Pearsall and Hensell formations





Northern Trinity Salinity Zones:

Measured and calculated water quality for Hosston Formation



Volumes- Northern Trinity

The volumes of fresh, moderately saline, slightly saline, very saline, and total groundwater volumes in the Northern Trinity Aquifer:

Aquifer Unit	Total Volume (Acre-feet)				
	Fresh	Slightly saline	Moderately saline	Very saline	Total
Paluxy	114,748,000	80,676,000	64,503,000	81,312,000	341,239,000
Glen Rose	107,622,000	137,657,000	114,292,000	79,875,000	439,446,000
Hensell	94,766,000	63,080,000	34,648,000	20,647,000	213,141,000
Pearsall	31,834,000	52,494,000	52,433,000	31,124,000	167,885,000
Hosston	171,110,000	246,770,000	232,964,000	256,357,000	907,201,000

Potential Production Areas

- House Bill 30 required the identification of potential brackish groundwater production zones.
- Potential production zones are zones that could yield significant quantities of brackish water for 30-50 years or more without impacting fresh water sources.
- The bill prescribed certain criteria the production zones must meet.

(5) identification and designation of local or regional brackish groundwater production zones in areas of the state with moderate to high availability and productivity of brackish groundwater that can be used to reduce the use of fresh groundwater and that:

Excerpt H.B. No. 30

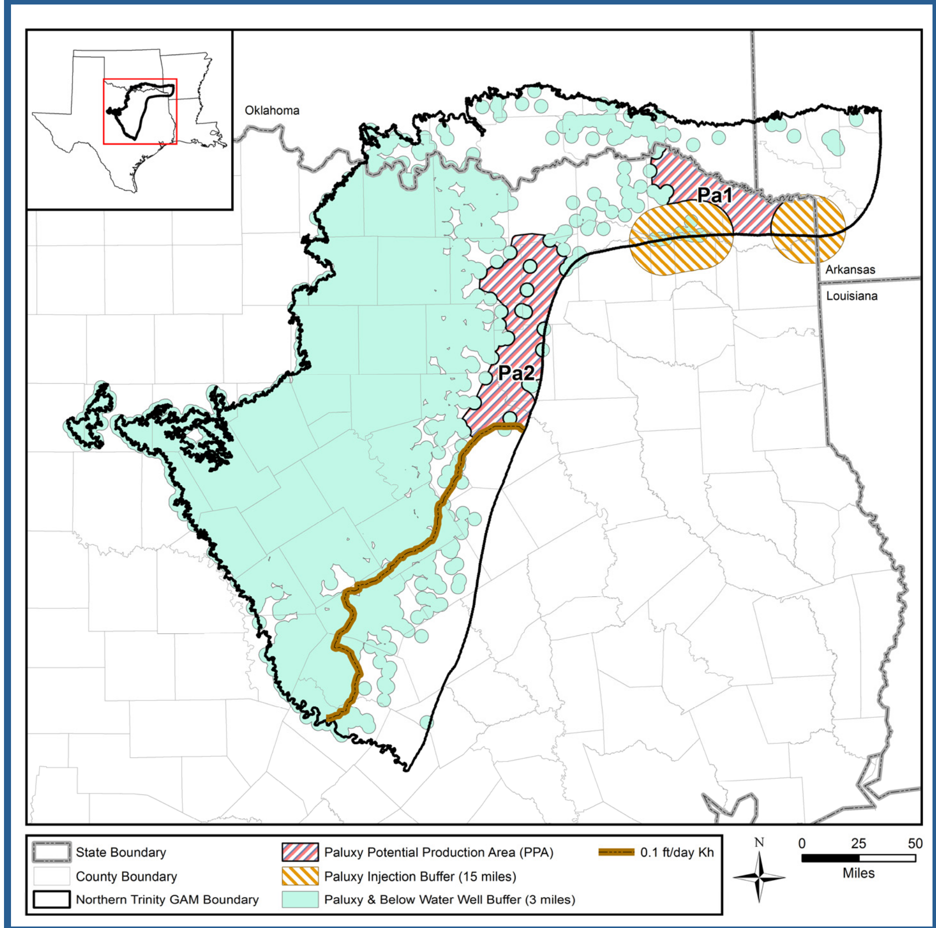
Potential Production Areas

- Exclusion criteria enumerated in H.B. No. 30
  - Separation by hydrogeologic barriers to prevent impacts on water availability and water quality in fresh groundwater sources
  - Not located in the Edwards Aquifer under the jurisdiction of the Edwards Aquifer Authority
  - Not in the boundaries of:
    - Barton Springs-Edwards Aquifer Conservation District
    - Harris-Galveston
    - Fort Bend Subsidence District
  - Not in a brackish groundwater source that is already in use by municipal, domestic, or agriculture entities
  - Not in a geologic stratum designated or used for wastewater injection through the use of injection wells

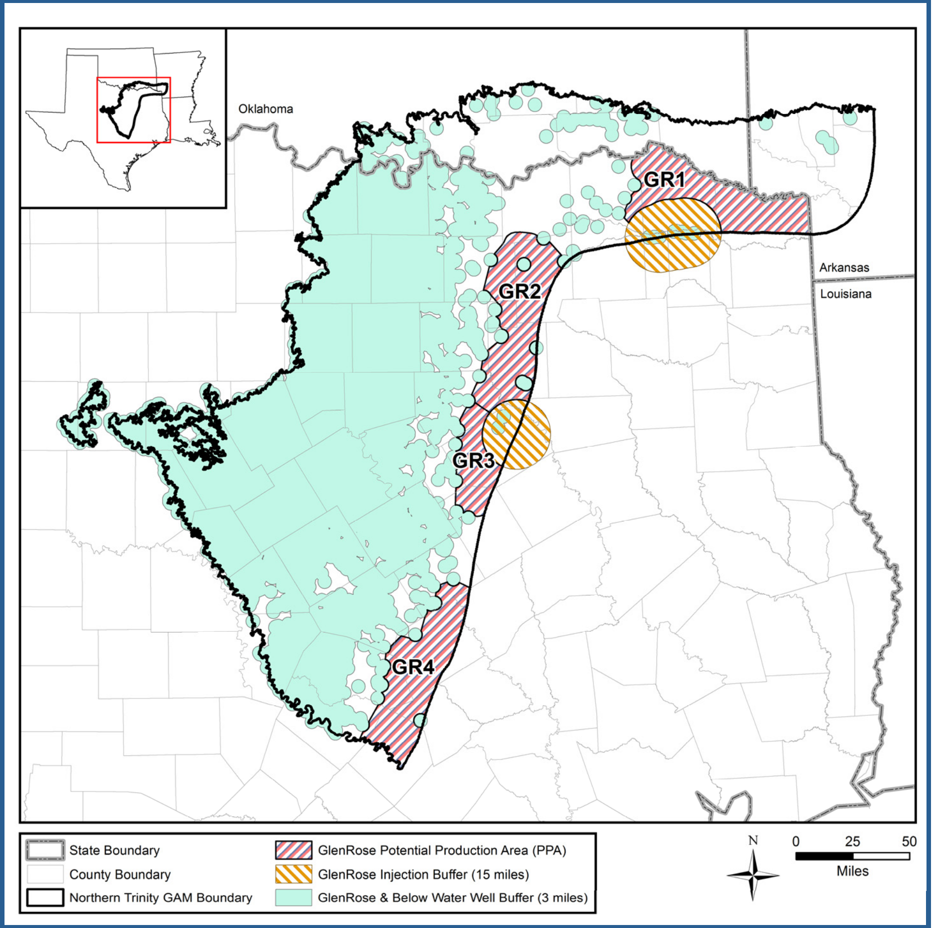
Potential Production Areas

- How exclusion criteria were applied in practice for the Trinity Aquifer
  - A 3 mile buffer is extended around wells identified from public sources with screened intervals in the Trinity Aquifer or fresh water aquifers hydraulically connected to the Trinity Aquifer
  - A 15 mile buffer extended around injection wells identified in the Texas RRC database with screened intervals in the Trinity Aquifer or fresh water aquifers hydraulically connected to the Trinity Aquifer
  - Exclude brackish portions of the Trinity Aquifer hydraulically connected to fresh water aquifers

PPAs – Northern Trinity Aquifer

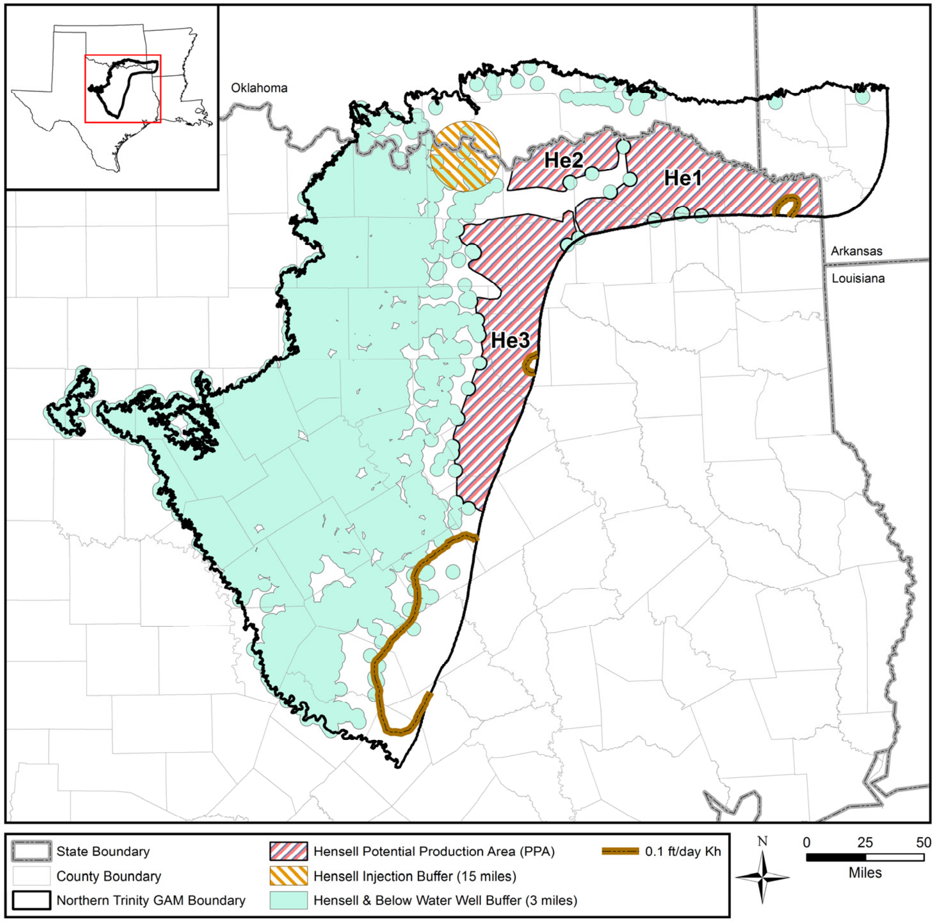


Paluxy PPAs

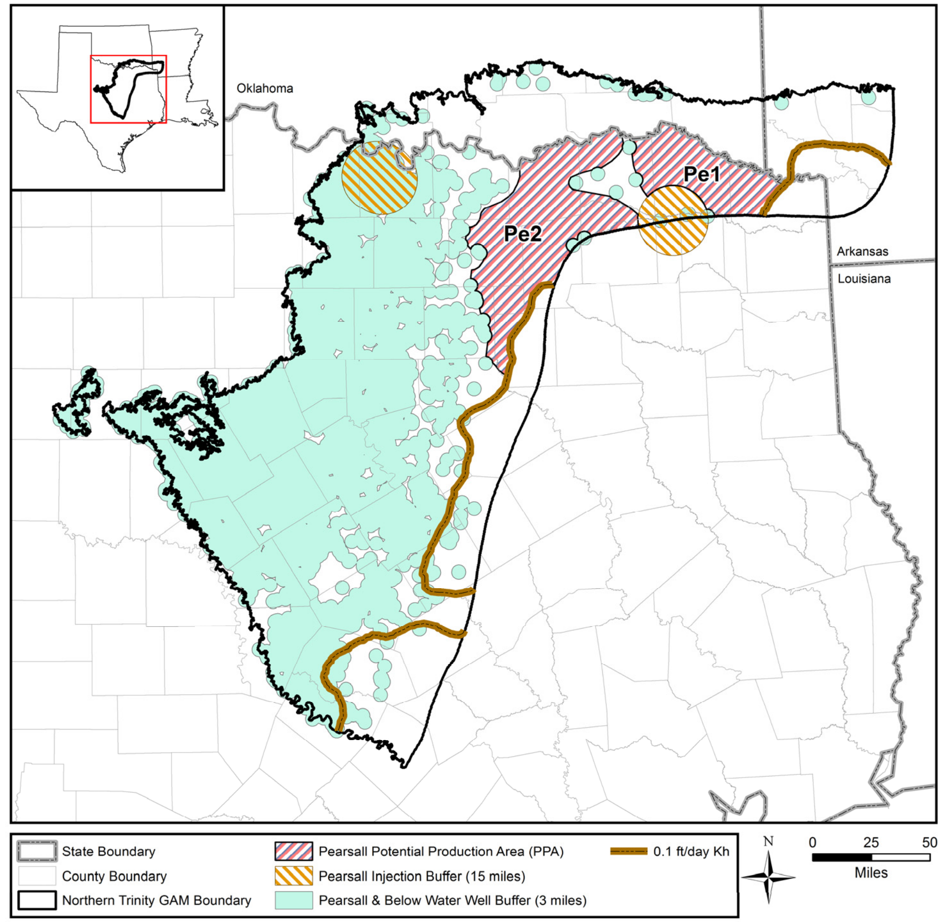


Glen Rose PPAs

PPAs – Northern Trinity Aquifer

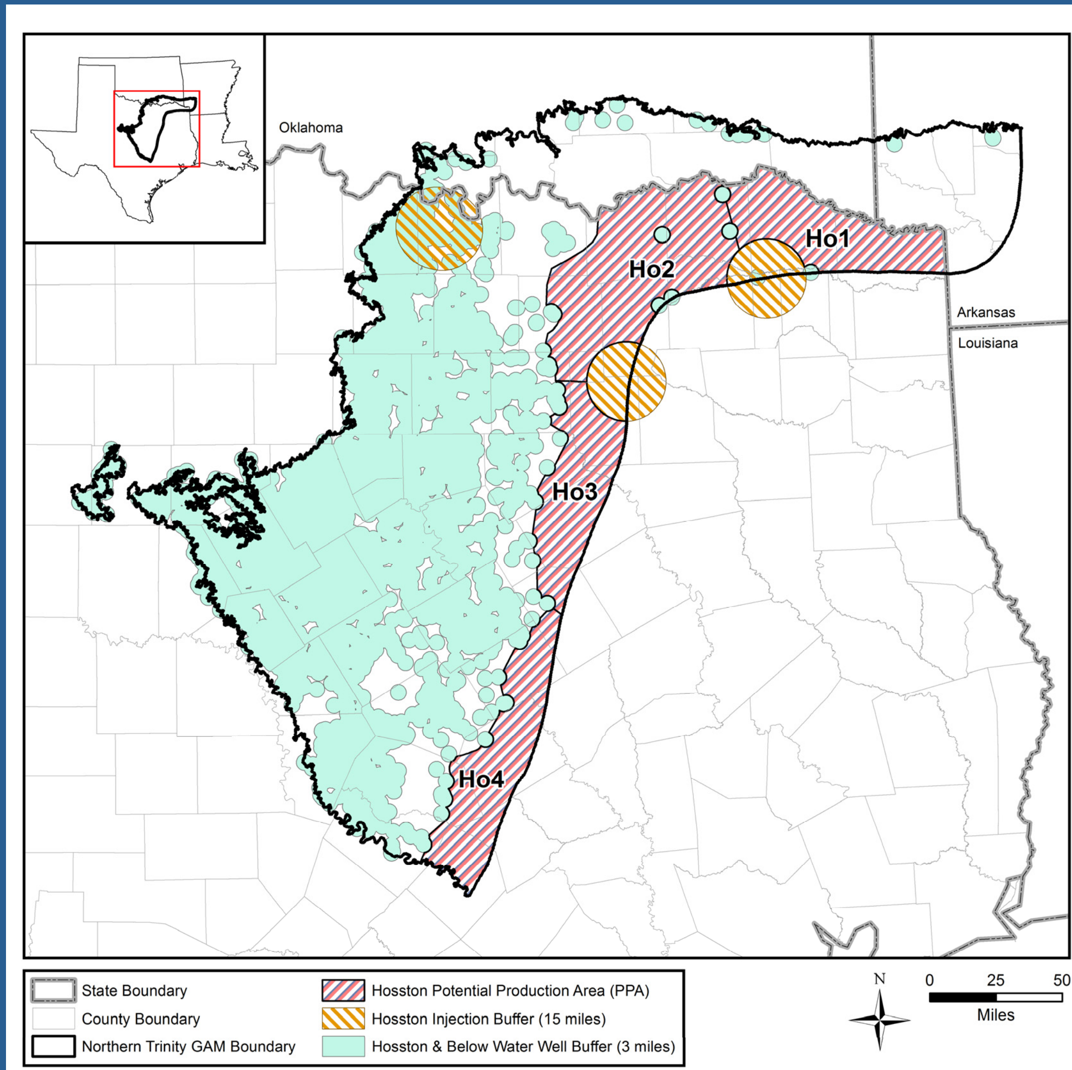


Hensell PPAs



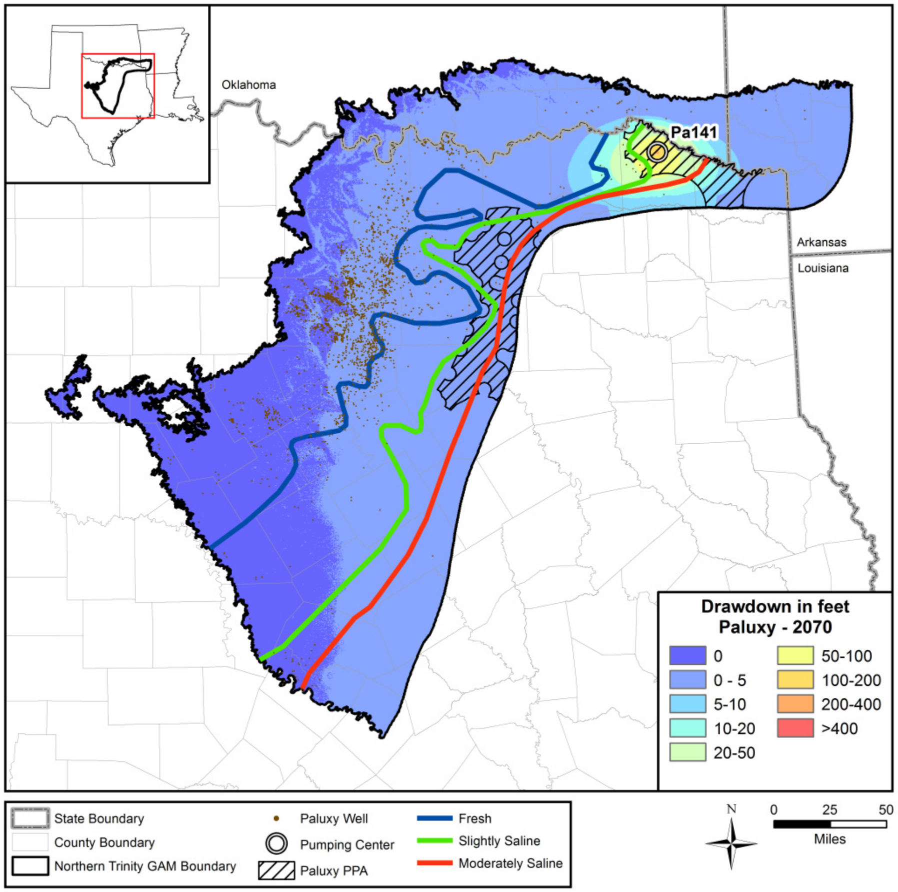
Pearsall PPAs

PPAs – Northern Trinity Aquifer

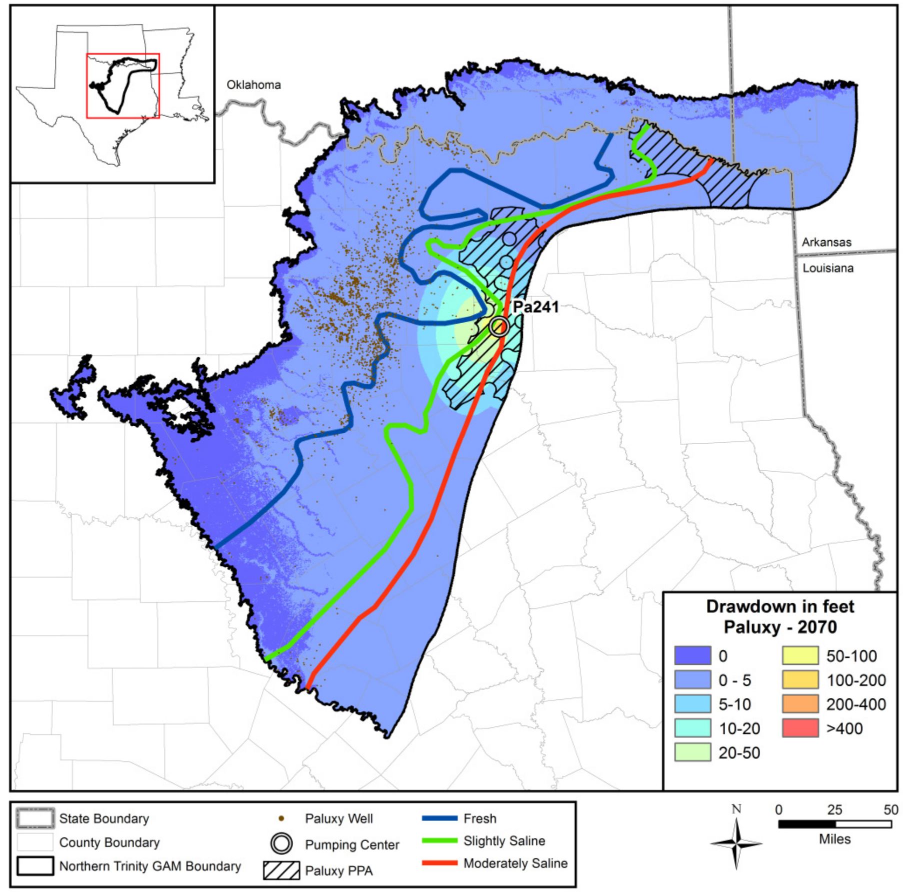


Hosston PPAs

NTA: Paluxy Drawdowns

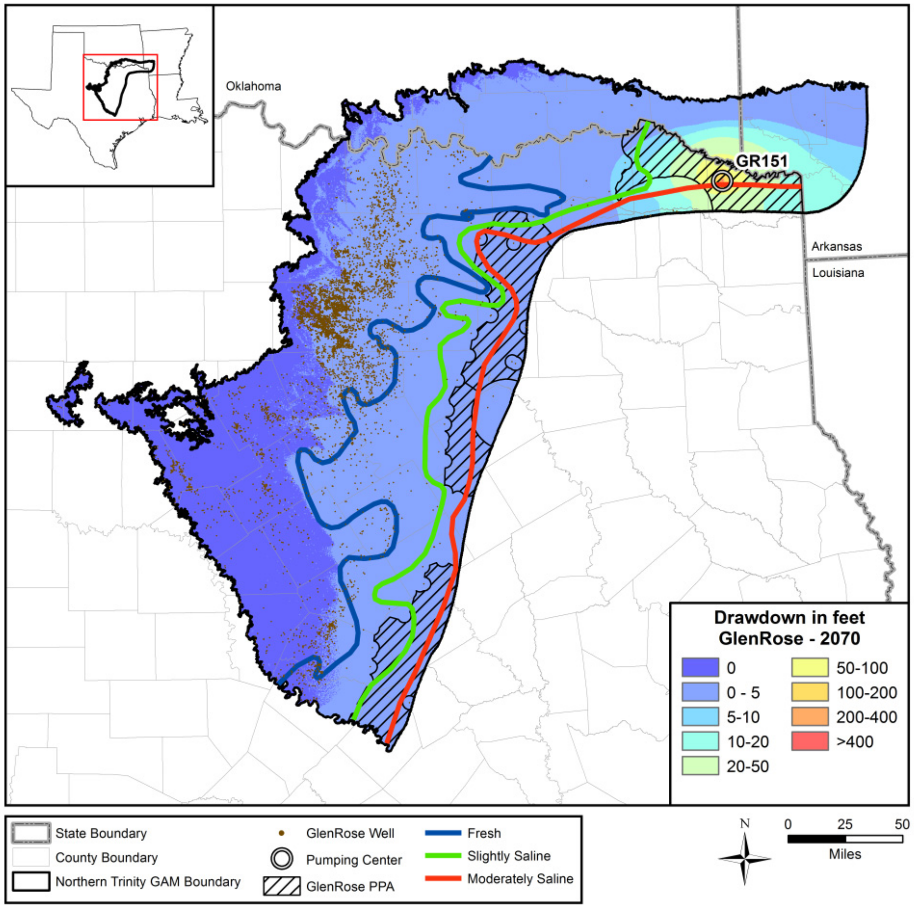


Estimated drawdown in the Paluxy Formation in the North Trinity Aquifer after 50 years of production in PPA 1, Wellfield 1.

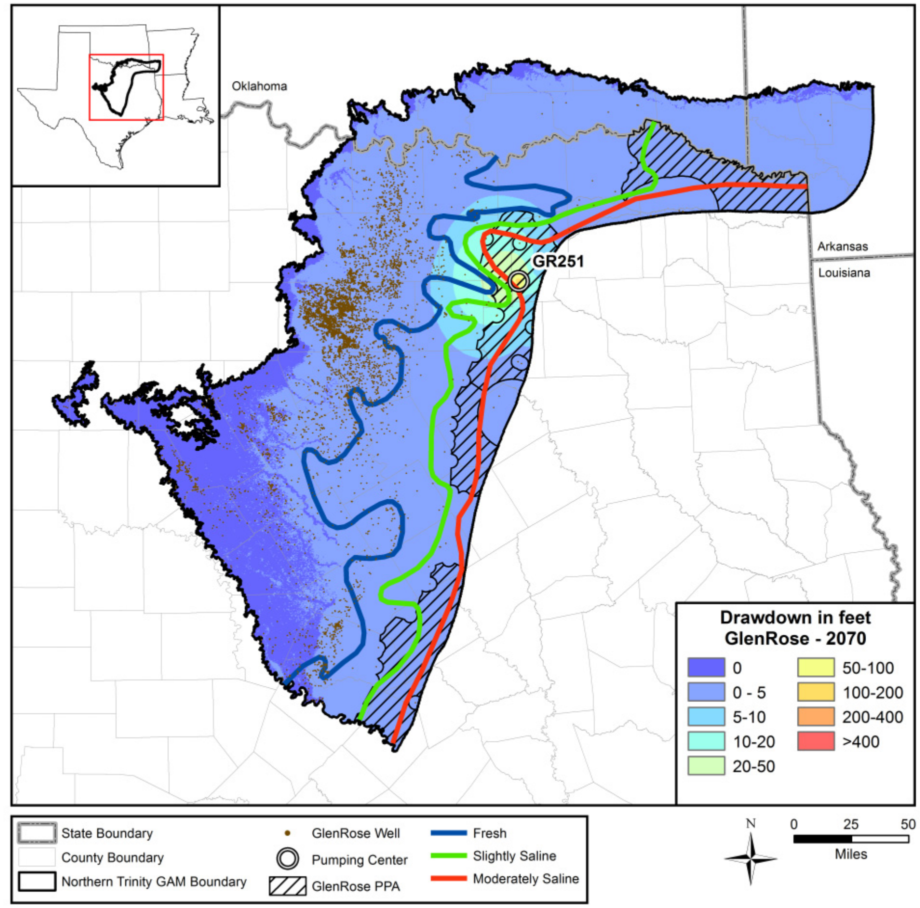


Estimated drawdown in the Paluxy Formation in the North Trinity Aquifer after 50 years of production in Paluxy PPA 2, Wellfield 1.

NTA: Glen Rose Drawdowns

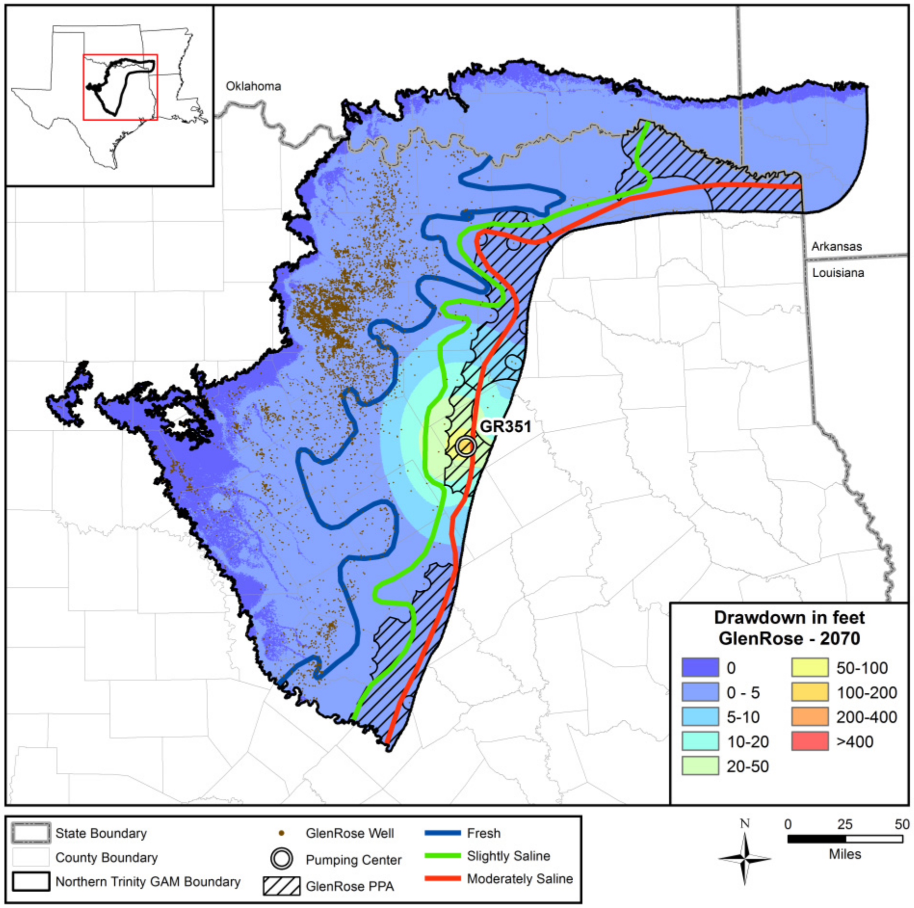


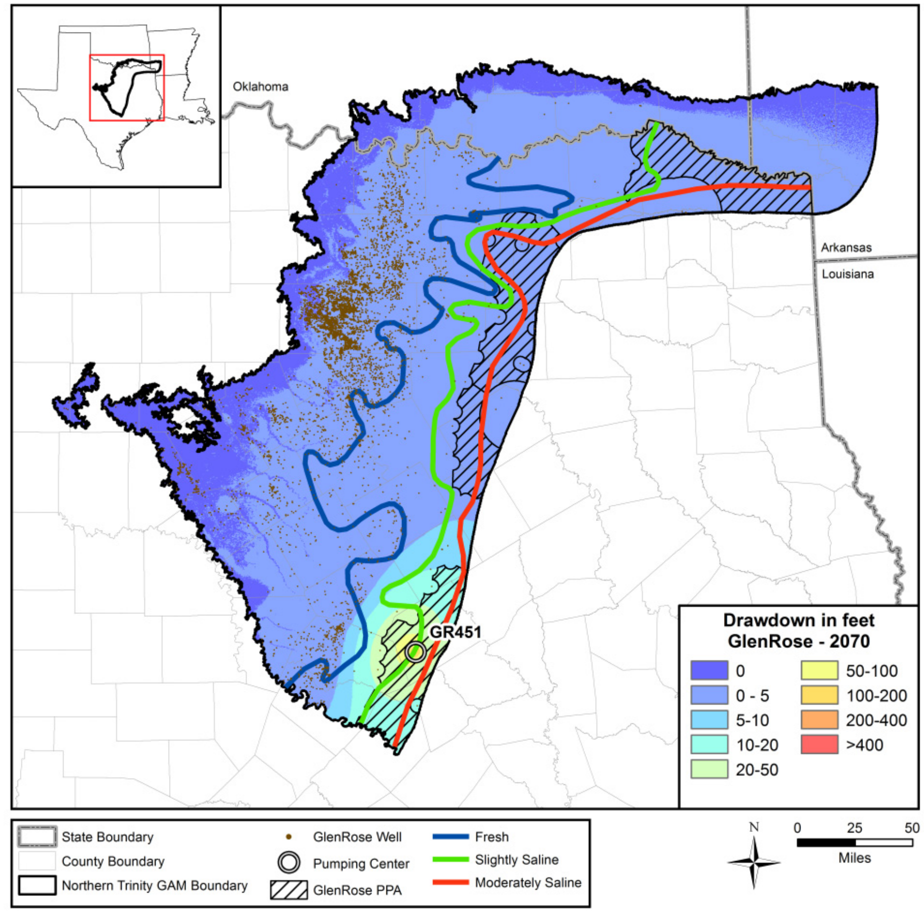
Estimated drawdown in the Glen Rose Formation in the North Trinity Aquifer after 50 years of production in Glen Rose PPA 1, Wellfield 1.



Estimated drawdown in the Glen Rose Formation in the North Trinity Aquifer after 50 years of production in Glen Rose PPA 2, Wellfield 1.

NTA: Glen Rose Drawdowns

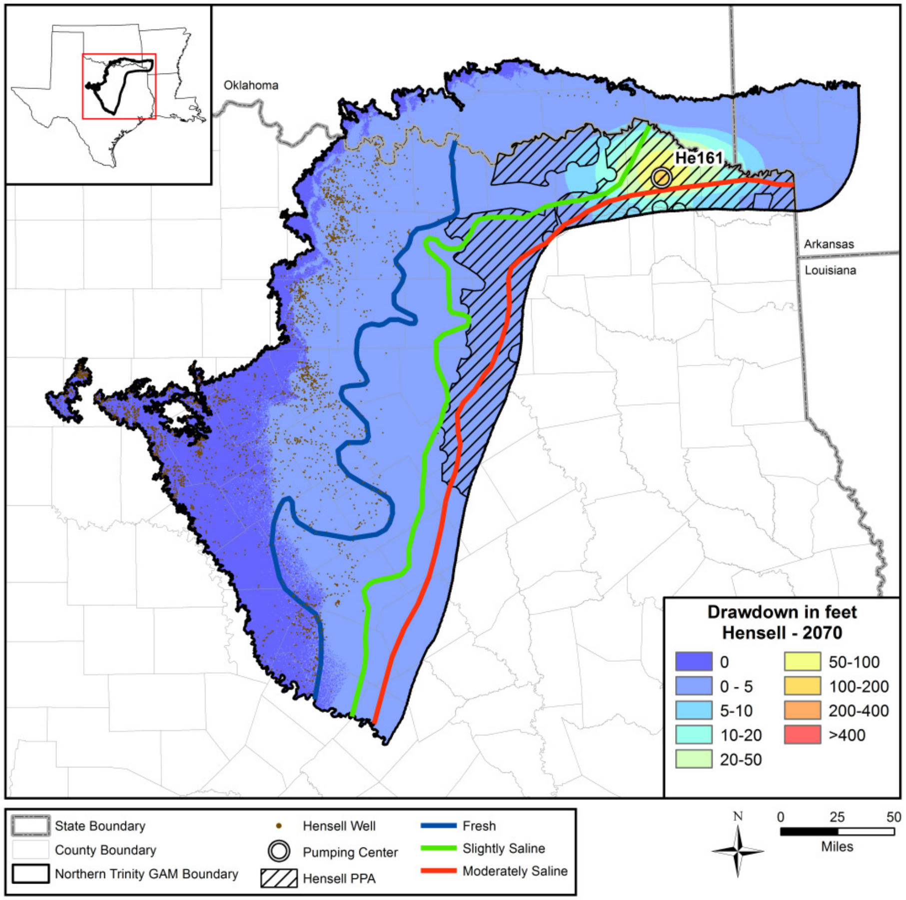




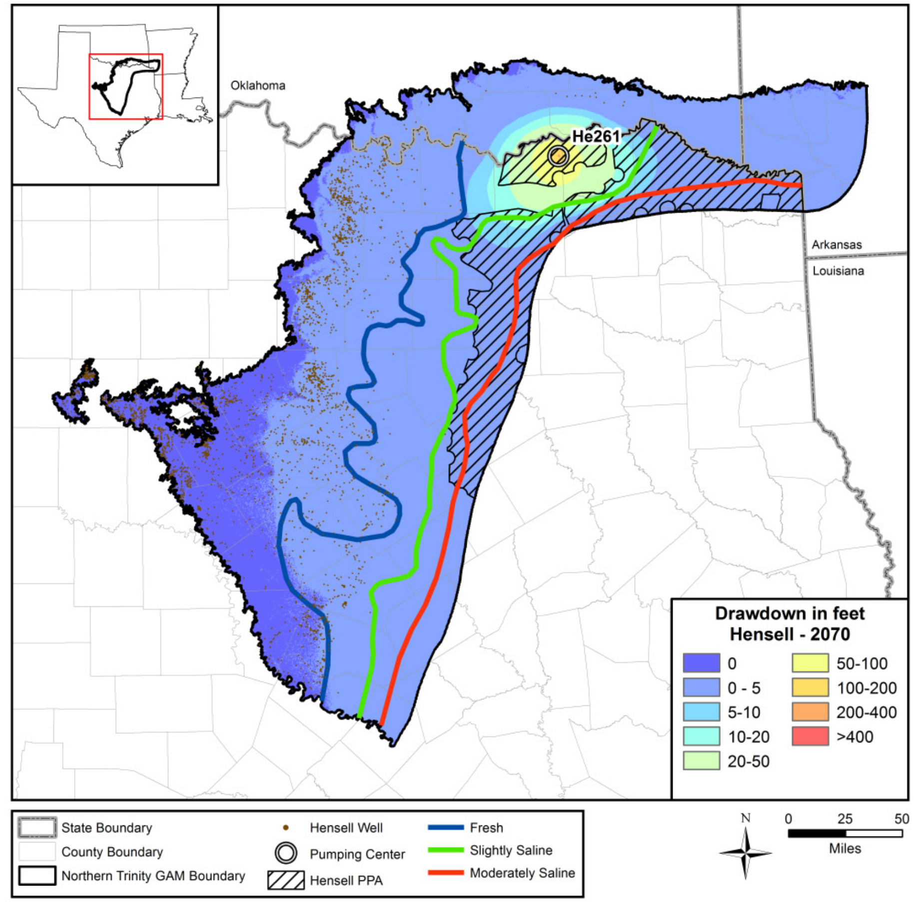
Estimated drawdown in the Glen Rose Formation in the North Trinity Aquifer after 50 years of production in Glen Rose PPA 3, Wellfield 1.

Estimated drawdown in the Glen Rose Formation in the North Trinity Aquifer after 50 years of production in Glen Rose PPA 4, Wellfield 1.

NTA: Hensell Drawdowns

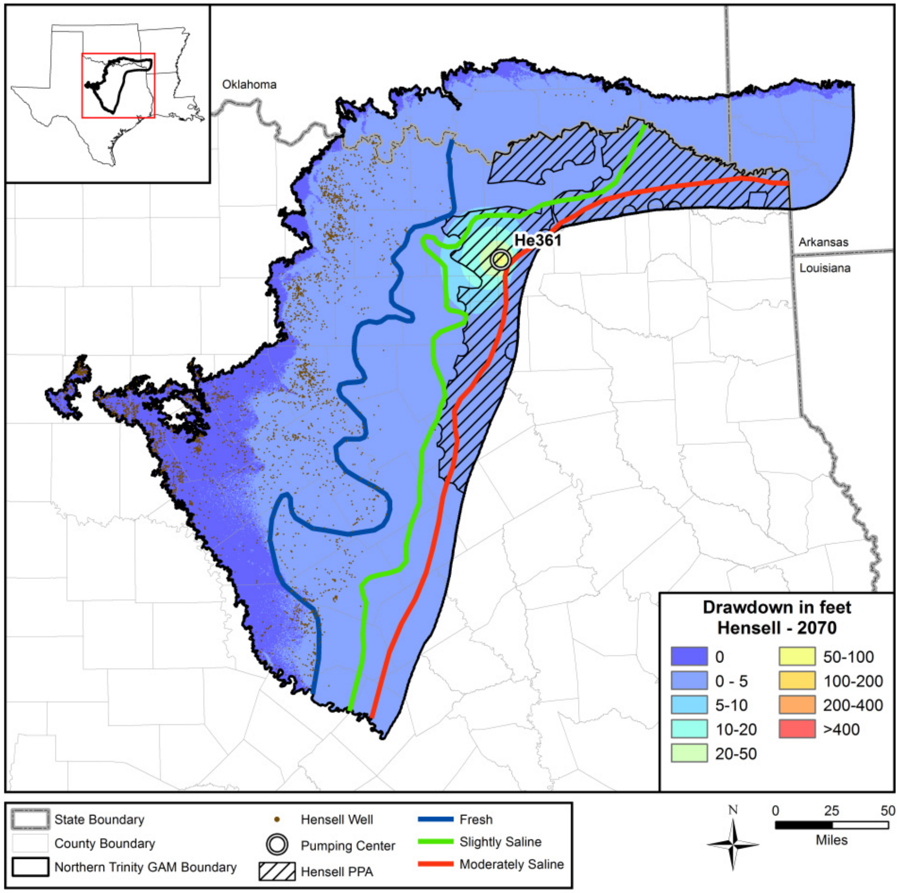


Estimated drawdown in the Hensell Formation in the North Trinity Aquifer after 50 years of production in in Hensell PPA 1, Wellfield 1.

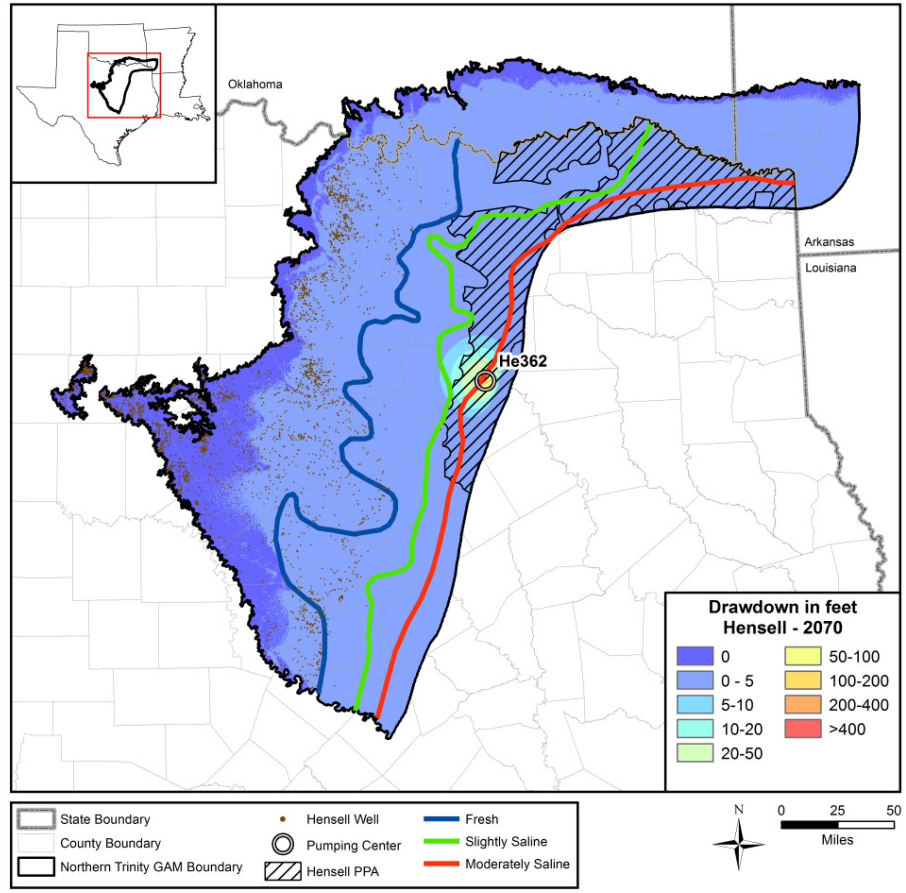


Estimated drawdown in the Hensell Formation in the North Trinity Aquifer after 50 years of production in Hensell PPA 2, Wellfield 1.

NTA: Hensell Drawdowns

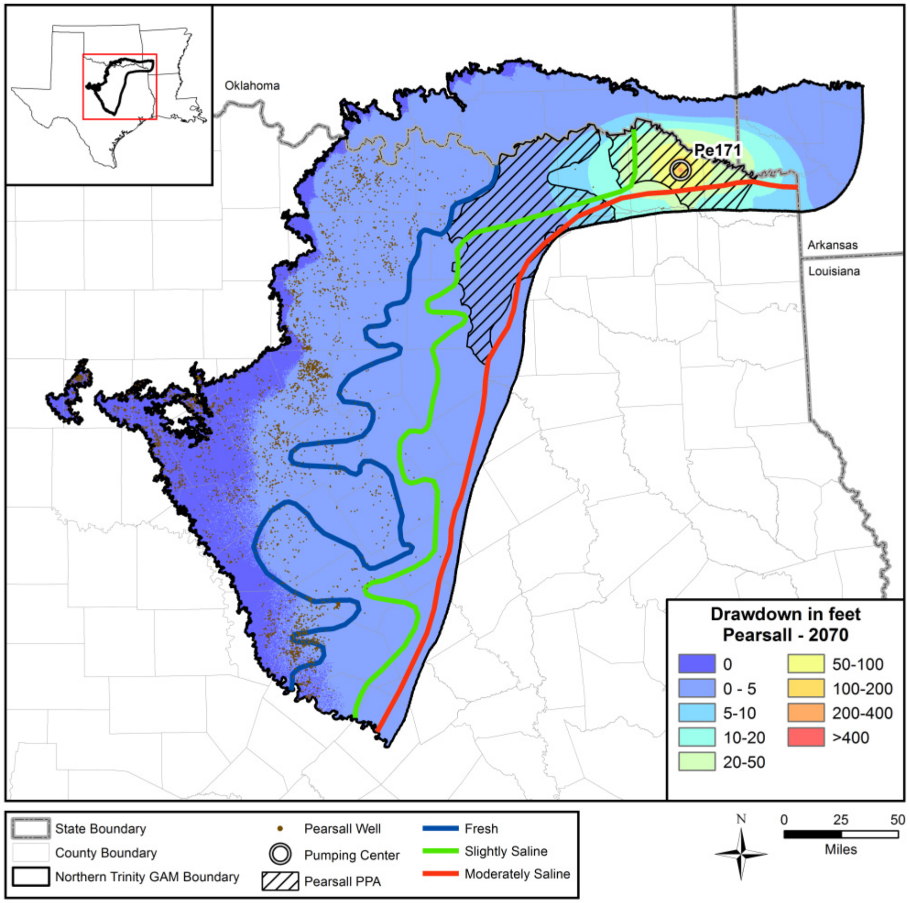


Estimated drawdown in the Hensell Formation in the North Trinity Aquifer after 50 years of production in in Hensell PPA 3, Wellfield 1.

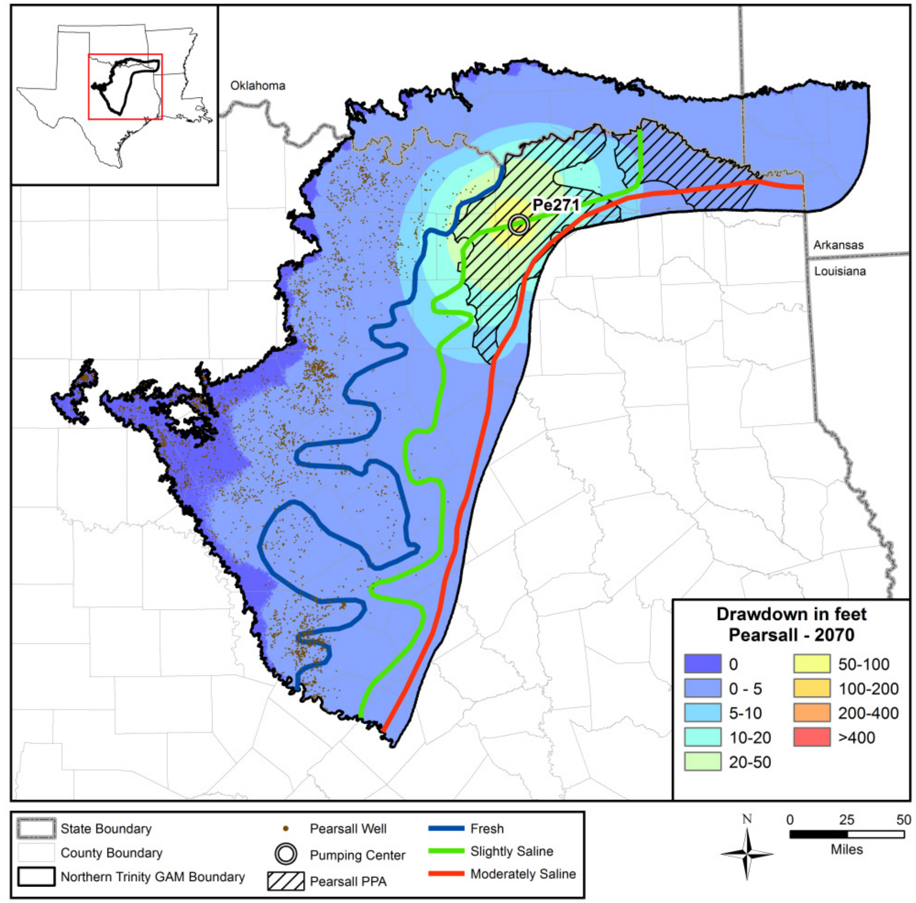


Estimated drawdown in the Hensell Formation in the North Trinity Aquifer after 50 years of production in in Hensell PPA 3, Wellfield 2.

NTA: Pearsall Drawdowns

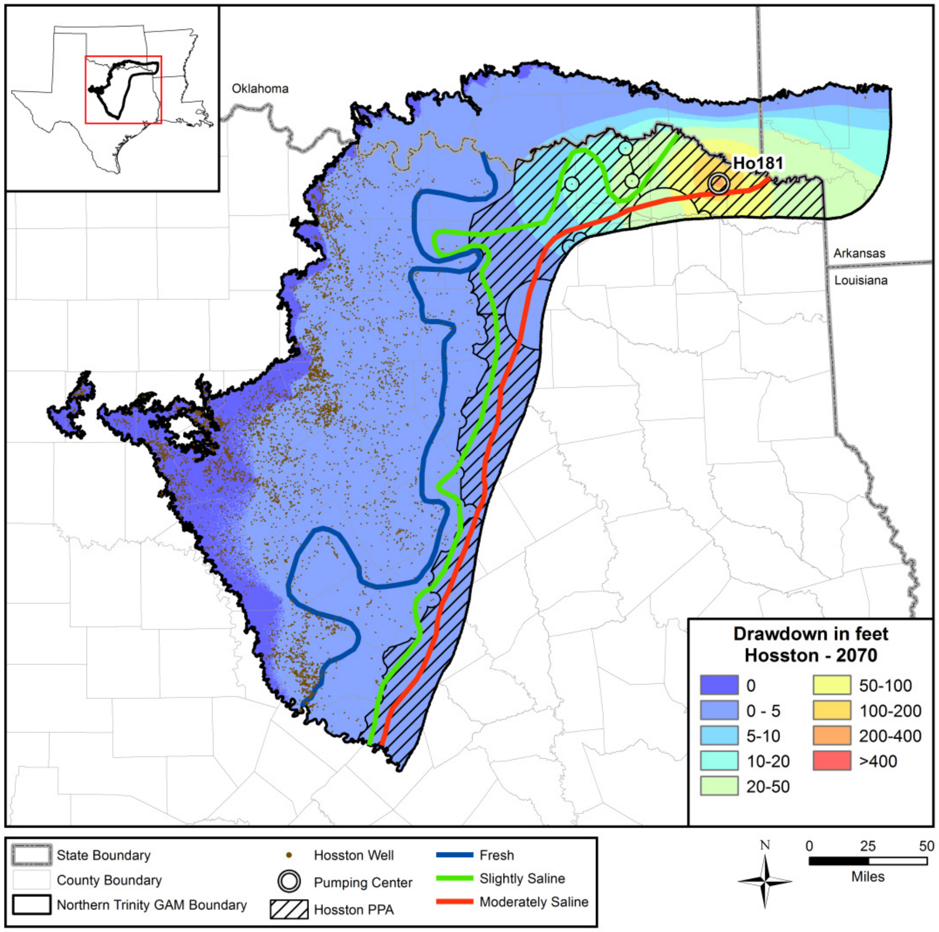


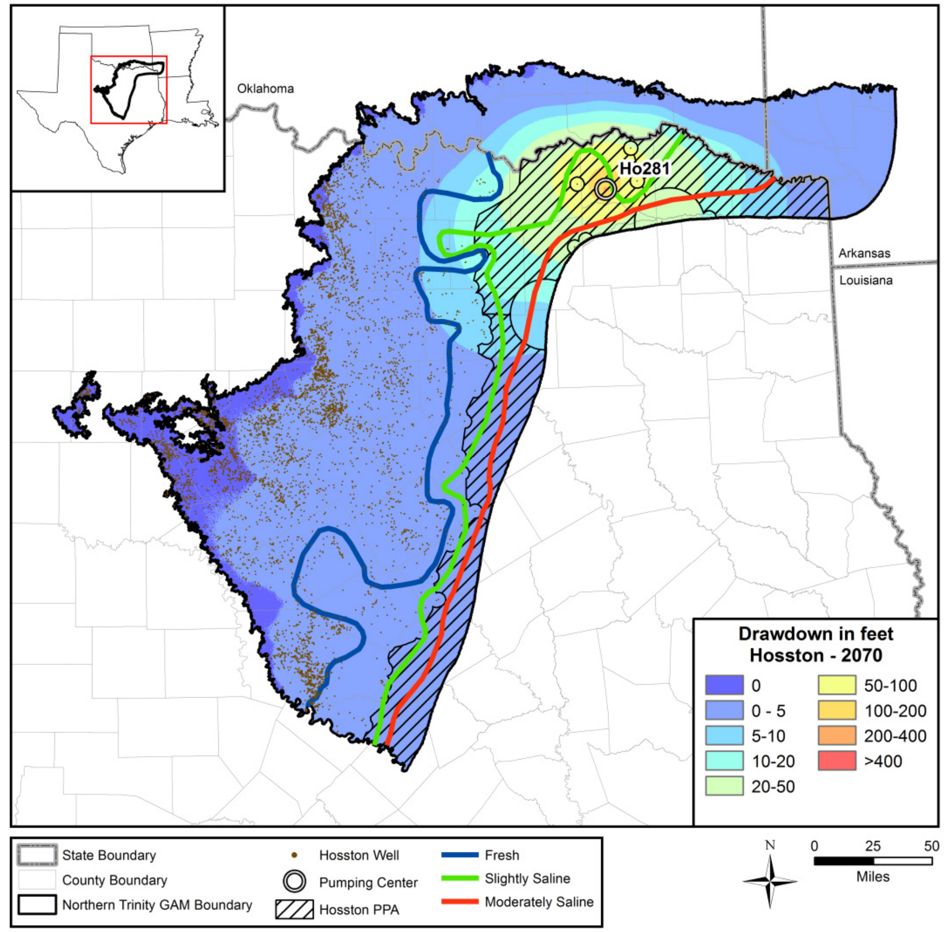
Estimated drawdown in the Pearsall Formation in the North Trinity Aquifer after 50 years of production in Pearsall PPA 1, Wellfield 1.



Estimated drawdown in the Pearsall Formation in the North Trinity Aquifer after 50 years of production in in Pearsall PPA 2, Wellfield 1.

NTA: Hosston Drawdowns

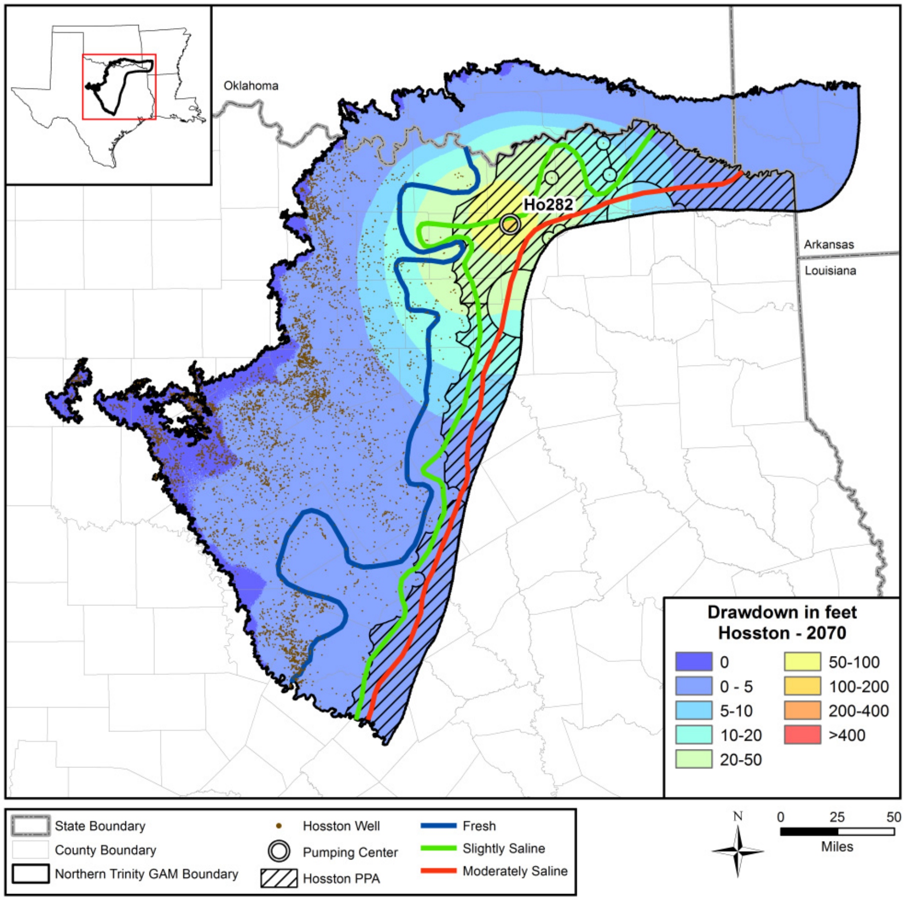




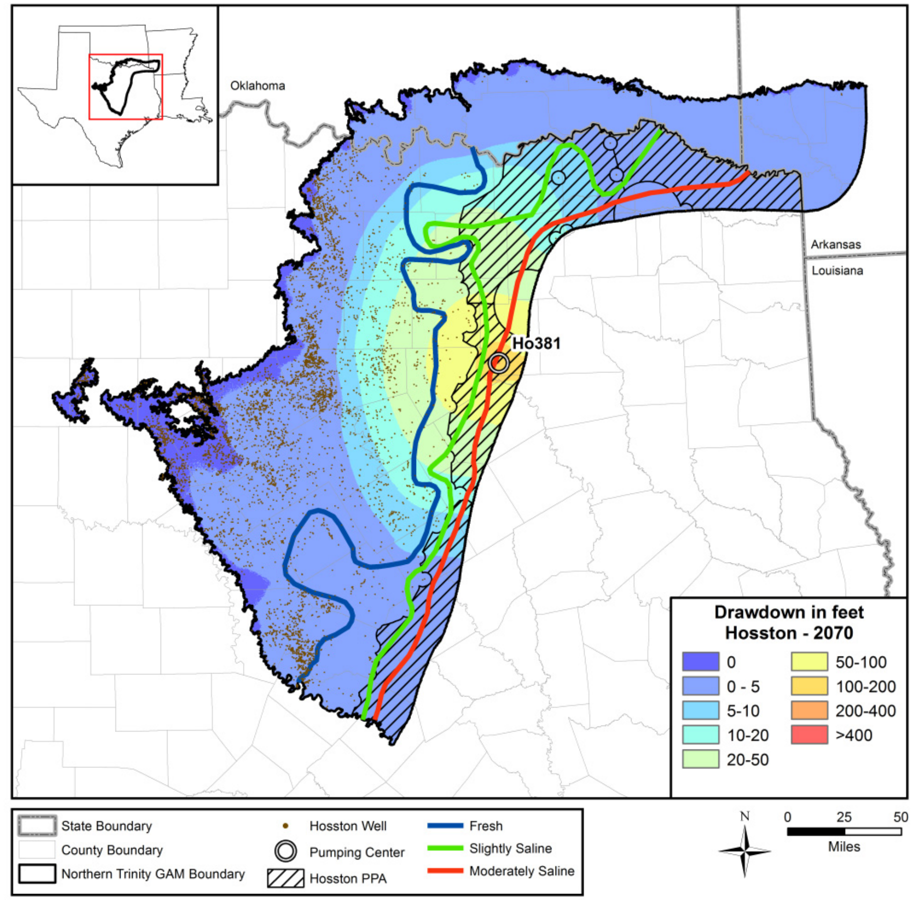
Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 1, Wellfield 1.

Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 2, Wellfield 1.

NTA: Hosston Drawdowns

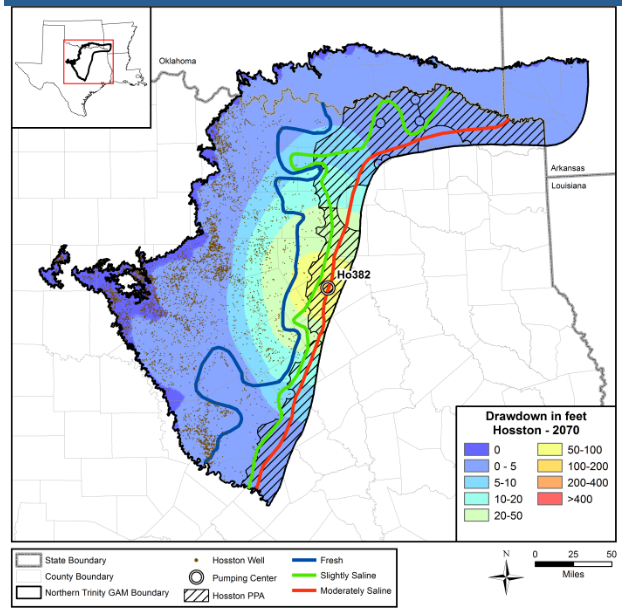


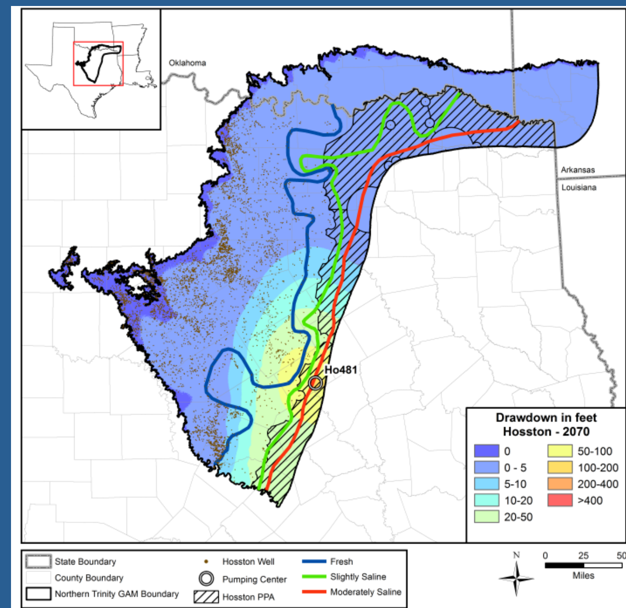
Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 2, Wellfield 2.

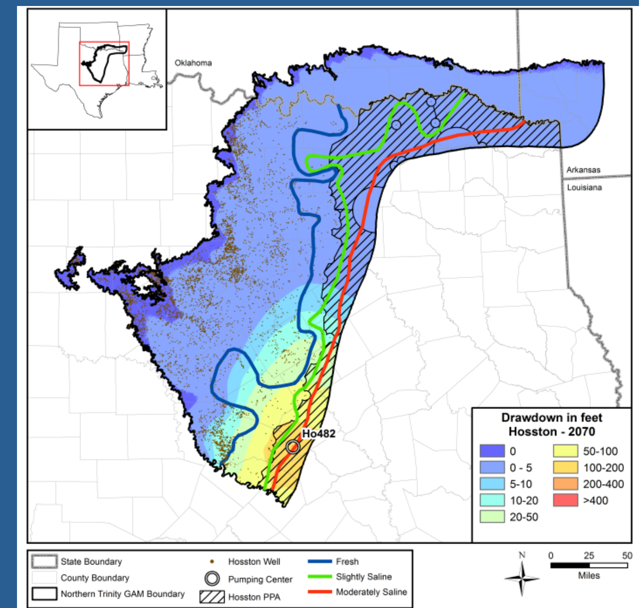


Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 3, Wellfield 1.

NTA: Hosston Drawdowns





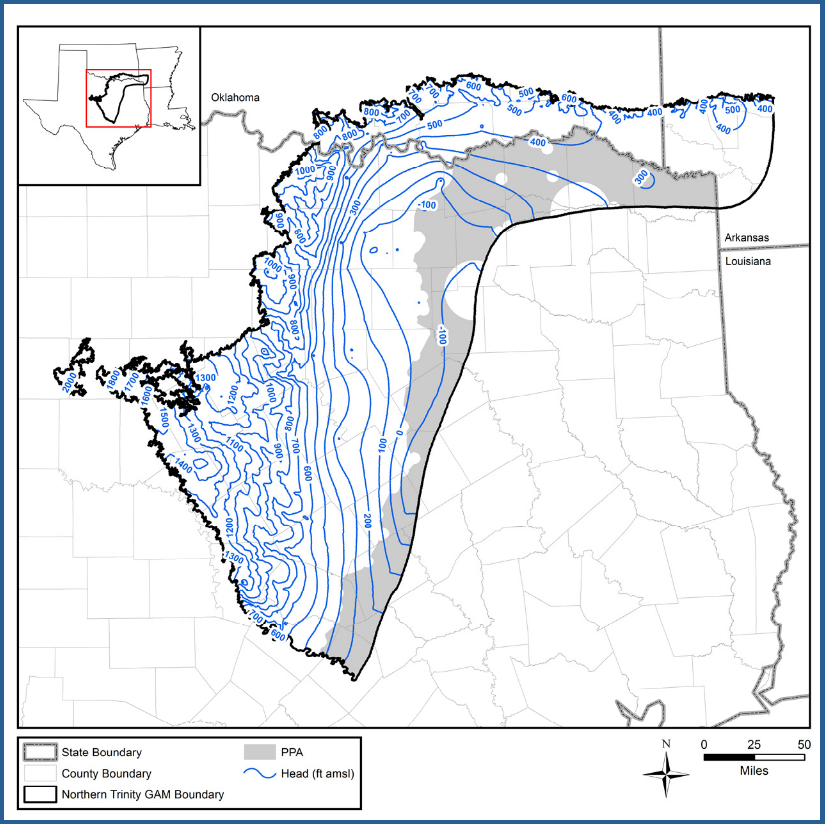


Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 3, Wellfield 2.

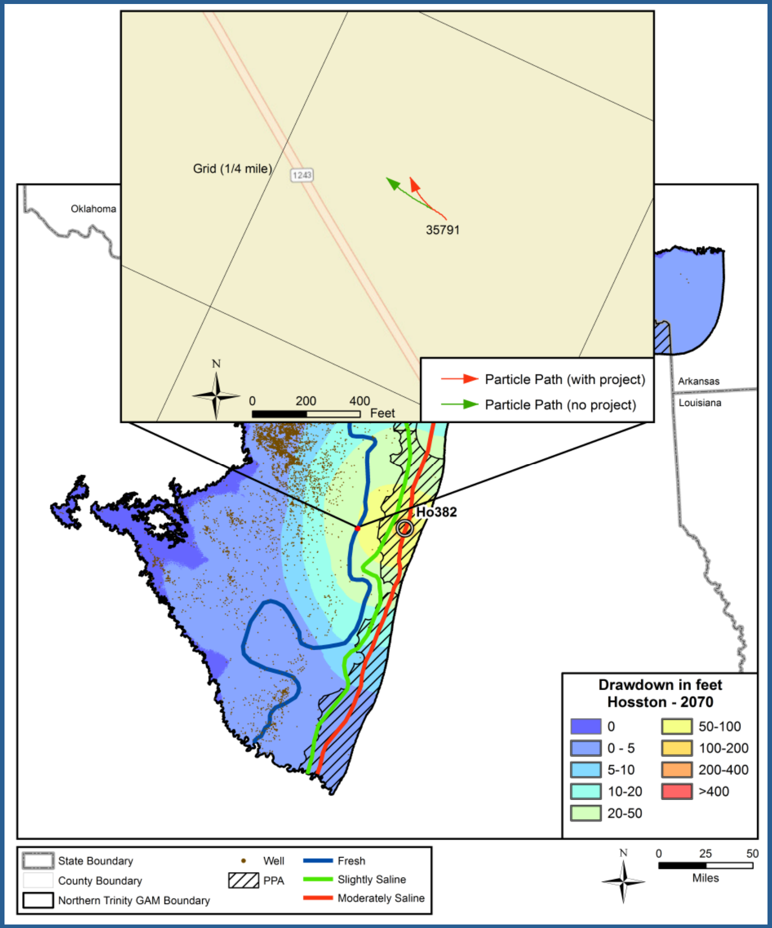
Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 4, Wellfield 1.

Estimated drawdown in the Hosston Formation in the North Trinity Aquifer after 50 years of production in Hosston PPA 4, Wellfield 2.

NTA: Drawdowns



Head contours in the Hosston Formation at the end of the basecase simulation.



Example of particle tracks after 50 years for simulation of pumping Hosston PPA #3 Wellfield #2.

What's next?

- The delineation of potential production areas presented today are draft and open to public comment
- This presentation will be publicly available at the TWDB BRACS website; Stakeholders will receive an email when it is posted
  - www.twdb.texas.gov/innovativewater/bracs/HB30.asp
- Stakeholders should send their comments to the TWDB
- The Final Report will be posted to the TWDB website
- Brackish Groundwater Production Zones will be designated by the TWDB at a public board meeting in Spring 2018
- Stakeholders will receive an email with the meeting date, time, and location

Questions, Comments, and Input from Stakeholders

- Contact Info:
  Mark Robinson
  512-463-7657
  mark.robinson@twdb.texas.gov

http://www.twdb.texas.gov/innovativewater/bracs/projects/HB30_Trinity/index.asp

PPA drawdown details

- Backup slides

Simulation of drawdown in the North Trinity Aquifer after 30 years of production

					Total Pumping Rate (afy)			Max. Drawdown at Existing Well (ft)			Max Drawdown at Fresh Water Line (ft)			Max Drawdown in Unit (ft)		
Formation	**PPA#**	**Well Field**	**Label**	**Depth to Unit Top (ft)**	**low**	**med.**	**high**	**low**	**med.**	**high**	**low**	**med.**	**high**	**low**	**med.**	**high**
Paluxy	1	1	Pa141	1,279	205	411	822	15	29	59	4	8	15	95	191	382
Paluxy	2	1	Pa241	3,873	77	155	309	9	18	36	10	19	38	73	147	294
Glen Rose	1	1	GR151	2,808	164	328	657	4	8	16	0	1	1	102	205	409
Glen Rose	2	1	GR251	4,527	65	129	258	6	12	23	7	13	27	65	130	259
Glen Rose	3	1	GR351	2,754	121	242	483	11	22	43	1	3	5	76	152	305
Glen Rose	4	1	GR451	3,024	145	290	581	7	14	29	3	7	14	75	151	301
Hensell	1	1	He161	3,387	92	184	368	4	8	16	0	0	0	100	201	401
Hensell	2	1	He261	2,180	83	166	332	16	31	62	1	2	4	84	168	335
Hensell	3	1	He361	4,497	18	36	73	2	4	7	1	2	4	42	84	168
Hensell	3	2	He362	4,165	10	19	39	3	6	13	0	0	1	77	154	308
Pearsall	1	1	Pe171	4,010	445	890	1,780	5	10	19	0	1	1	101	203	406
Pearsall	2	1	Pe271	3,634	376	752	1,504	7	13	27	9	17	34	63	126	252
Hosston	1	1	Ho181	3,913	317	633	1,267	16	32	63	1	1	2	102	203	407
Hosston	2	1	Ho281	5,099	553	1,105	2,211	19	37	74	4	8	17	85	171	341
Hosston	2	2	Ho282	4,408	465	931	1,861	9	19	37	11	21	42	53	106	213
Hosston	3	1	Ho381	4,752	479	957	1,915	21	42	83	13	26	51	71	141	282
Hosston	3	2	Ho382	4,506	699	1,398	2,796	17	34	67	13	25	51	73	146	292
Hosston	4	1	Ho481	3,098	163	327	653	18	36	72	17	34	69	46	93	186
Hosston	4	2	Ho482	3,615	154	308	616	23	46	91	10	21	42	68	135	270

Estimated drawdown for a 1,000 afy wellfield after 50 years of production – Northern Trinity Aquifer

Formation	PPA#	Well Field	Label	Depth to Unit Top (ft)	Total Pumping Rate (afy)	Max. Drawdown at Existing Well (ft)	Max Drawdown at Fresh Water Line (ft)	Max Drawdown in Unit (ft)
Paluxy	1	1	Pa141	1,279	1,000	73	20	466
Paluxy	2	1	Pa241	3,873	1,000	123	128	954
Glen Rose	1	1	GR151	2,808	1,000	26	3	625
Glen Rose	2	1	GR251	4,527	1,000	94	107	1,007
Glen Rose	3	1	GR351	2,754	1,000	91	12	633
Glen Rose	4	1	GR451	3,024	1,000	52	25	523
Hensell	1	1	He161	3,387	1,000	44	1	1,093
Hensell	2	1	He261	2,180	1,000	188	14	1,010
Hensell	3	1	He361	4,497	1,000	102	57	2,315
Hensell	3	2	He362	4,165	1,000	341	25	7,993*
Pearsall	1	1	Pe171	4,010	1,000	12	1	229
Pearsall	2	1	Pe271	3,634	1,000	19	24	169
Hosston	1	1	Ho181	3,913	1,000	53	3	325
Hosston	2	1	Ho281	5,099	1,000	35	9	156
Hosston	2	2	Ho282	4,408	1,000	22	25	117
Hosston	3	1	Ho381	4,752	1,000	48	31	152
Hosston	3	2	Ho382	4,506	1,000	26	20	107
Hosston	4	1	Ho481	3,098	1,000	118	114	293
Hosston	4	2	Ho482	3,615	1,000	174	84	463

Minimum and maximum change in simulated travel distances at 50 years – Northern Trinity Aquifer

				Maximum Difference in Distance				Minimum Difference in Distance			
Formation	**PPA#**	**Well Field**	**Label**	**Particle ID**	**Base Distance (ft)**	**Project Distance (ft)**	**Difference (ft)**	**Particle ID**	**Base Distance (ft)**	**Project Distance (ft)**	**Difference (ft)**
Paluxy	1	1	Pa141	6733	56	78	22	7060	52	41	-11
Paluxy	2	1	Pa241	6109	59	101	42	5944	35	4	-31
Glen Rose	1	1	GR151	13598	43	44	1	13640	44	42	-2
Glen Rose	2	1	GR251	13925	10	17	7	10753	102	99	-3
Glen Rose	3	1	GR351	8514	355	361	5	13755	3,117	3,111	-5
Glen Rose	4	1	GR451	16171	127	140	13	13755	3,117	2,541	-576
Hensell	1	1	He161	17106	1,814	1,815	1	19546	1,225	1,224	-1
Hensell	2	1	He261	17106	1,814	1,820	6	19950	1,373	1,363	-10
Hensell	3	1	He361	17594	1,079	1,089	10	17172	1,514	1,495	-19
Hensell	3	2	He362	20376	1,779	1,787	8	19827	567	562	-5
Pearsall	1	1	Pe171	32457	1,627	1,631	4	34056	1,413	1,409	-4
Pearsall	2	1	Pe271	32394	1,587	1,617	30	33721	575	553	-23
Hosston	1	1	Ho181	32796	1,636	1,716	80	33096	5,978	5,904	-74
Hosston	2	1	Ho281	36045	368	429	61	34935	814	725	-89
Hosston	2	2	Ho282	36046	143	226	82	35770	201	104	-97
Hosston	3	1	Ho381	35671	3,057	3,137	80	37614	1,441	1,297	-144
Hosston	3	2	Ho382	36712	2,316	2,494	177	36748	1,970	1,816	-153
Hosston	4	1	Ho481	23677	889	892	2	27515	280	278	-2
Hosston	4	2	Ho482	27467	280	307	27	26908	380	347	-33