Red River GCD Vision Workshop

LBG-Guyton Associates

November 20, 2015

Session Outline

- Review Pumping: 2011 through June 2015
- State Water Plan Strategies For Red River GCD
- Review Water Demands
- Water Level Changes and DFCs
- Assessment Of Available Drawdown In 2070 For Public Water Supply Wells

Pumping by County Graphs

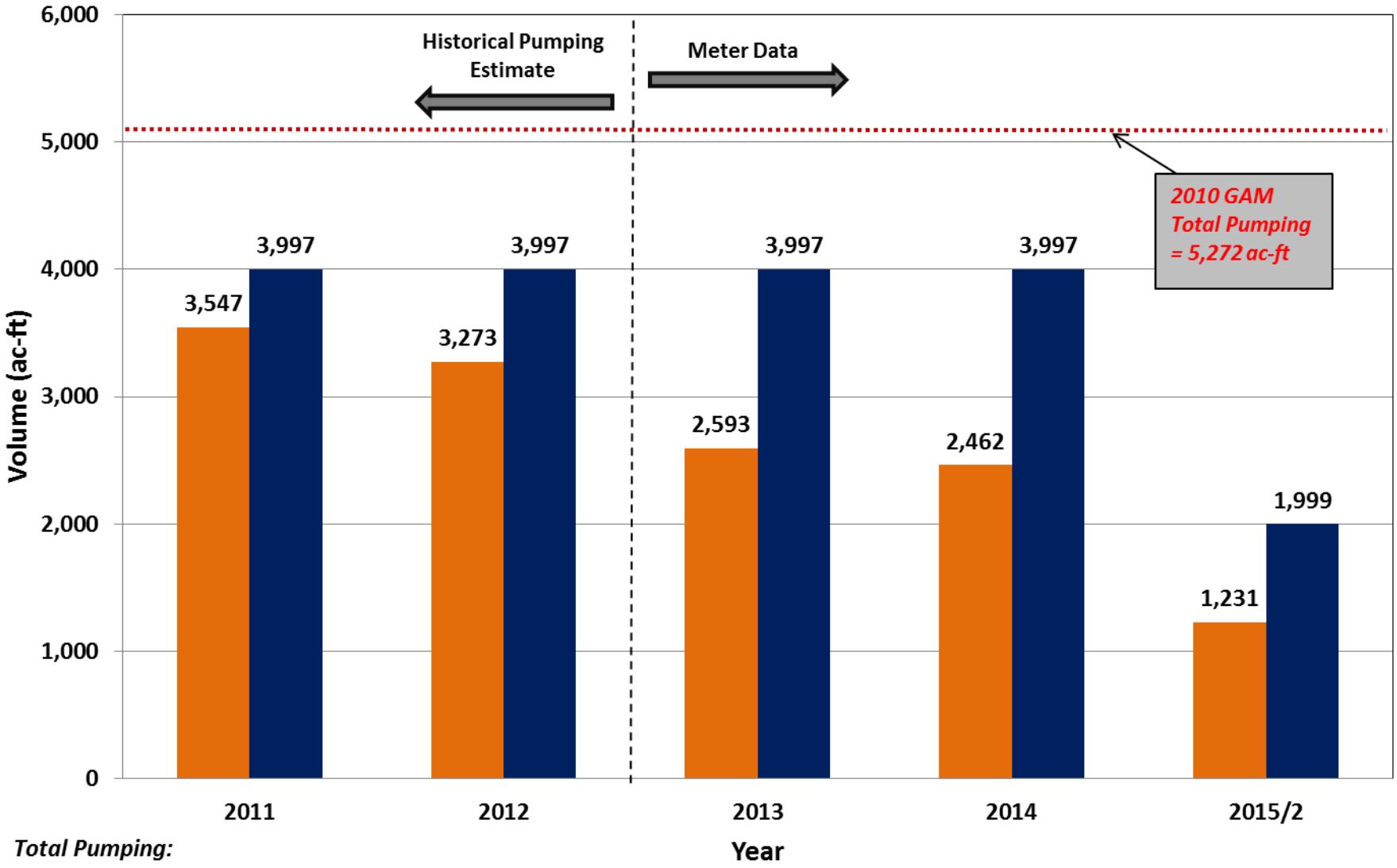
- Total Metered Pumping Compared to Total MAGs
- Total Metered plus Exempt Pumping Compared to MAGs
- Total Metered Pumping by Aquifer Compared to MAG
- Total Metered plus Exempt Pumping by Aquifer

Notes on Pumping Estimates

- TWDB Historical Groundwater Pumping Estimates Used for Years 2011 and 2012
- Exempt Pumping Volumes from North Trinity GAM Tables
- Meter Data Used for Years 2013, 2014, and January through June of 2015
- For Year 2015, MAG and Exempt Pumping Volumes were divided by 2

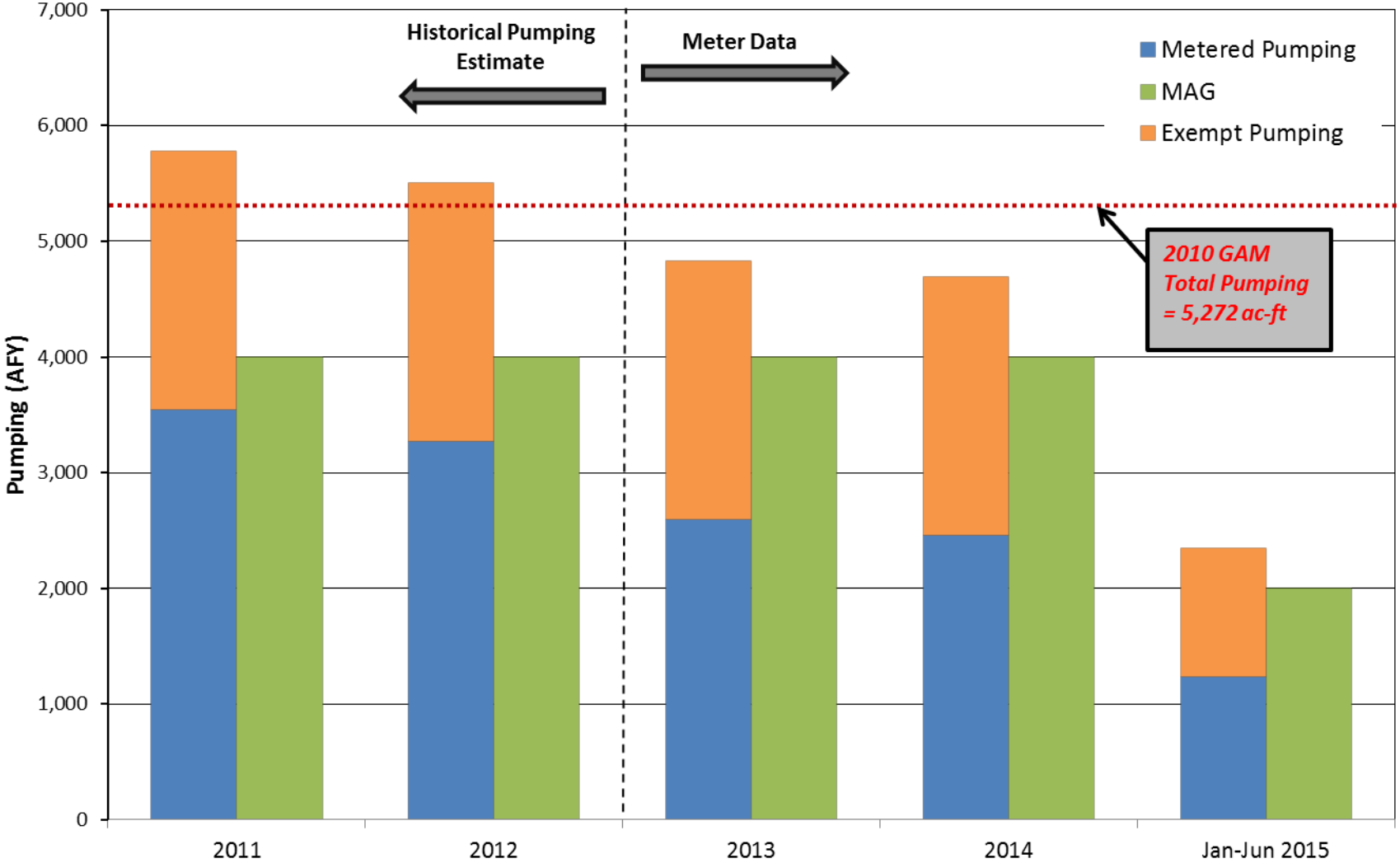
Grayson County

Fannin County Total Metered Pumping



Total Pumping:
2011 and 2012 source: TWDB historical pumping estimates.
2013, 2014 and first half of 2015 source: RRGCD meter data.

Fannin County Total Pumping Comparisons



TWDB Historical estimates used for Year 2011 and 2012 pumping.
Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.
MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.

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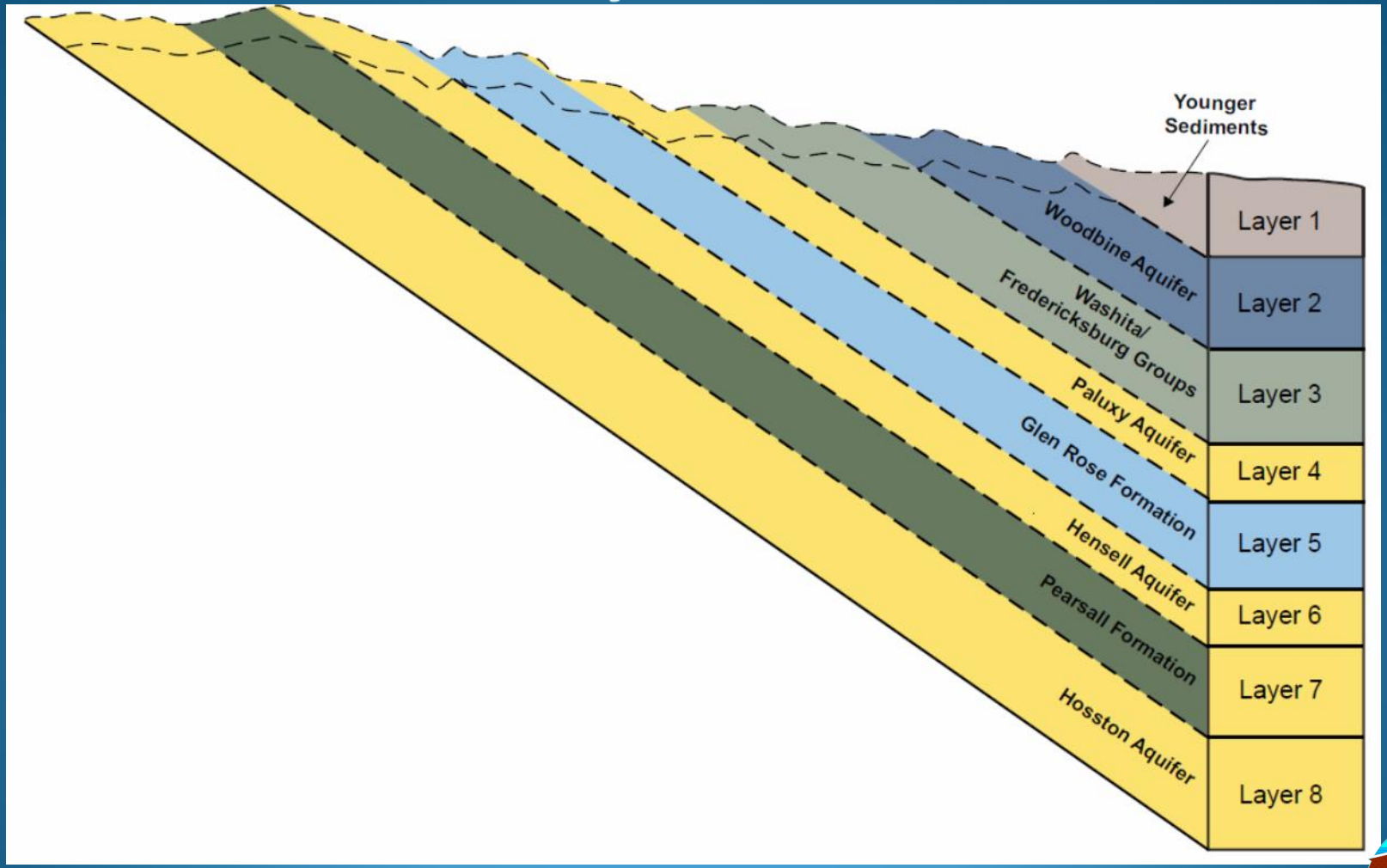
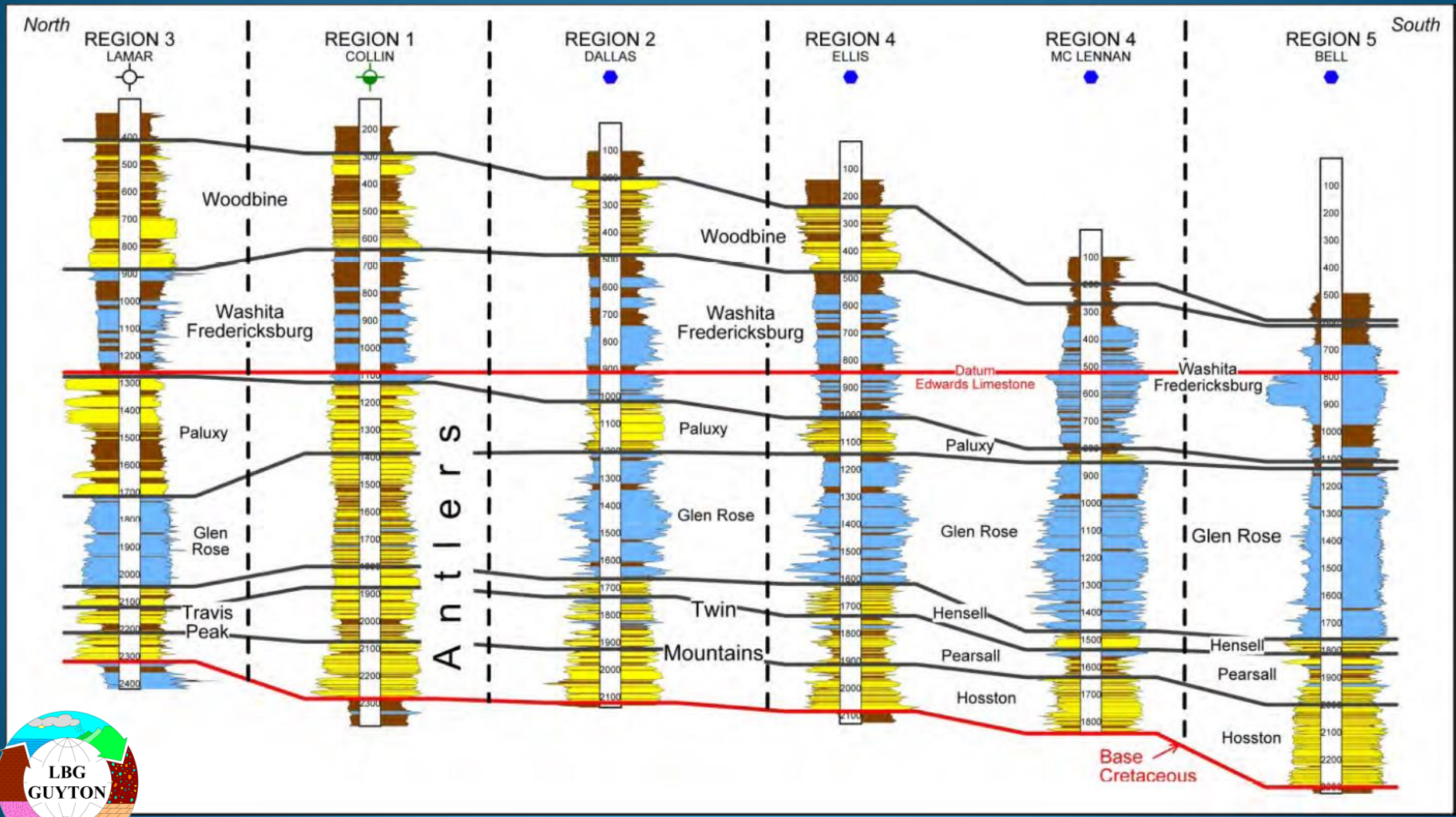
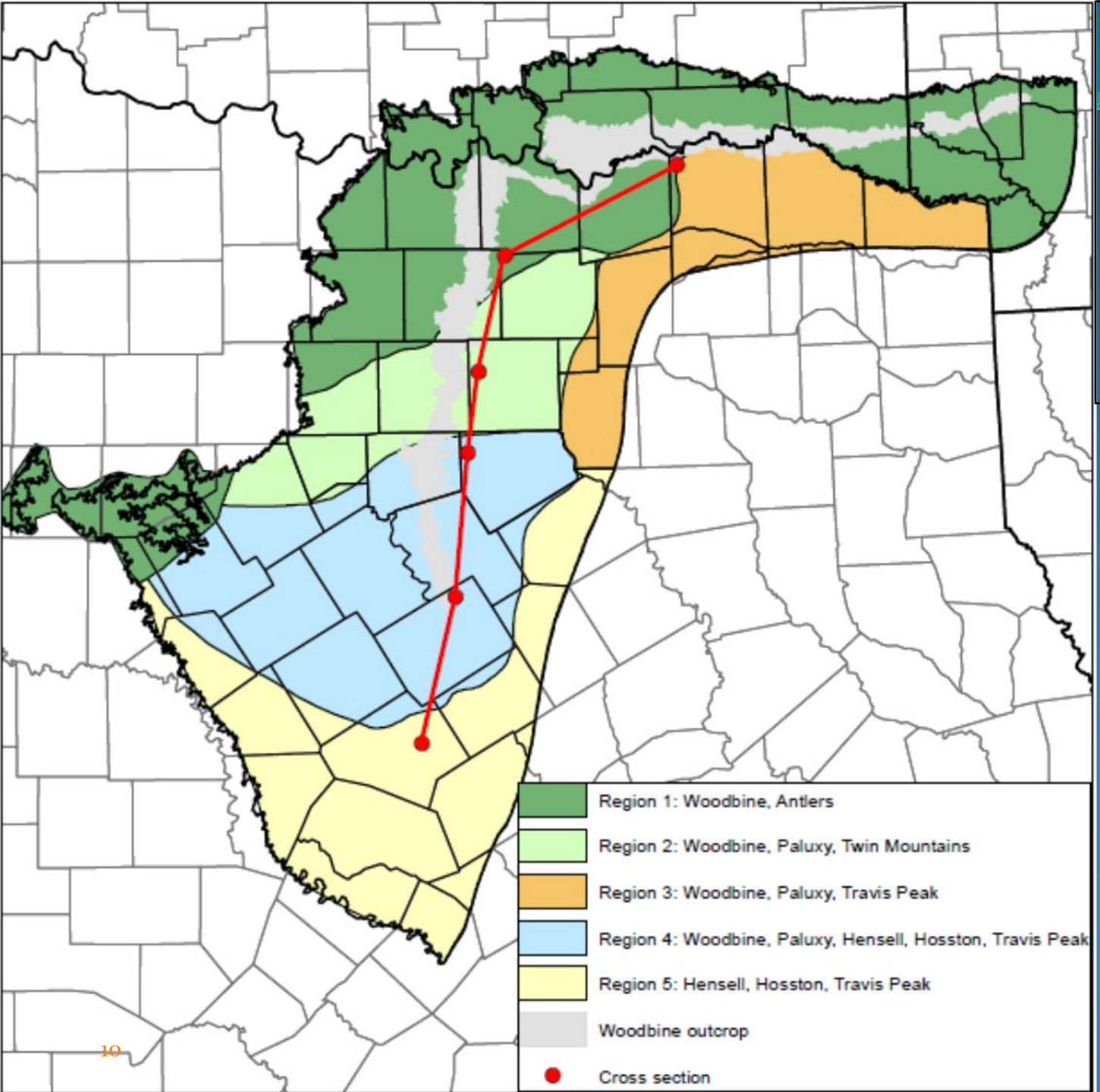
NTWGAM Layers



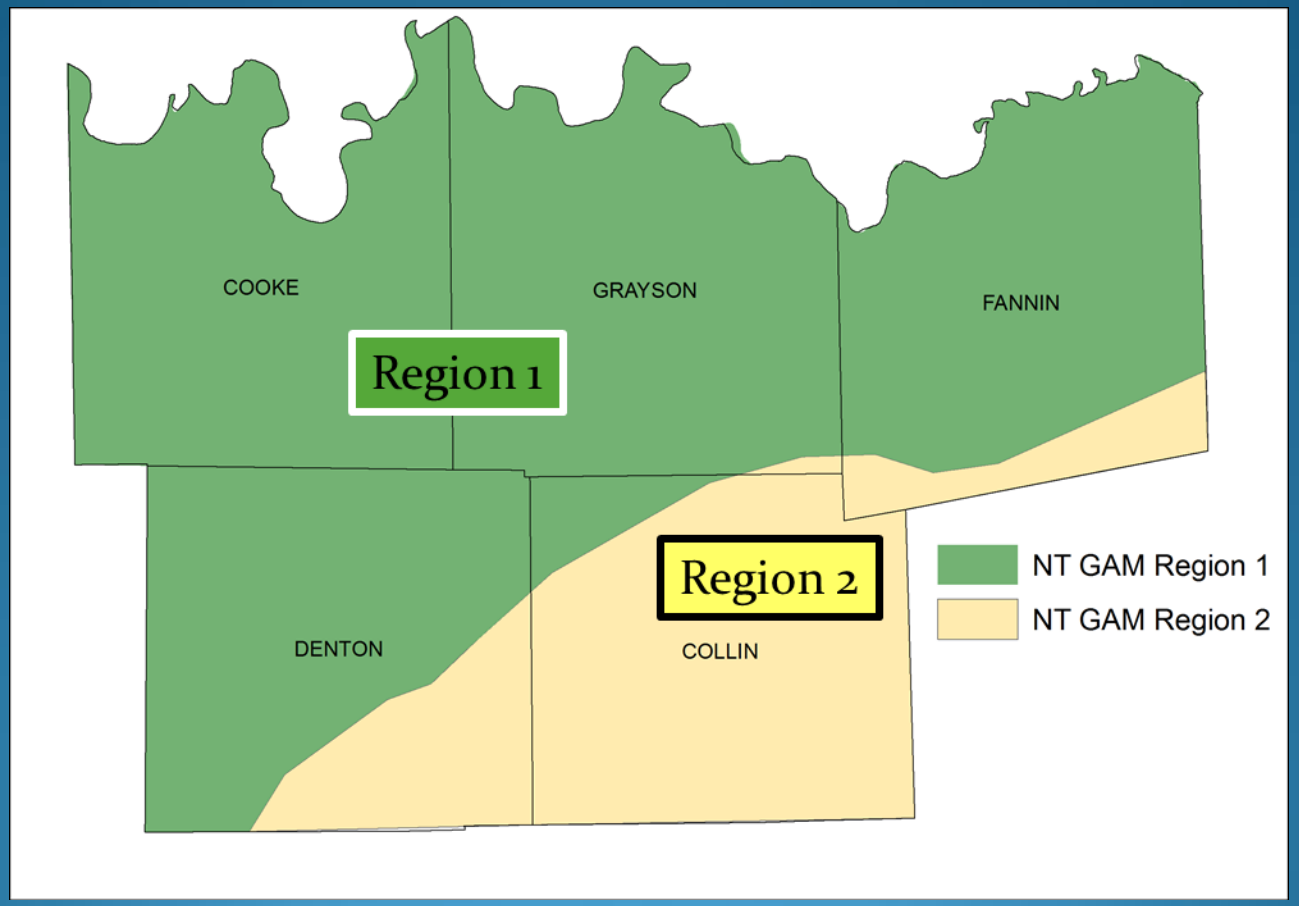
Northern Trinity Aquifer



Northern Trinity and Woodbine Aquifers



North Trinity GAM Stratigraphic Regions



Region 1: Woodbine, Antlers
Region 2: Woodbine, Paluxy, Twin Mountains

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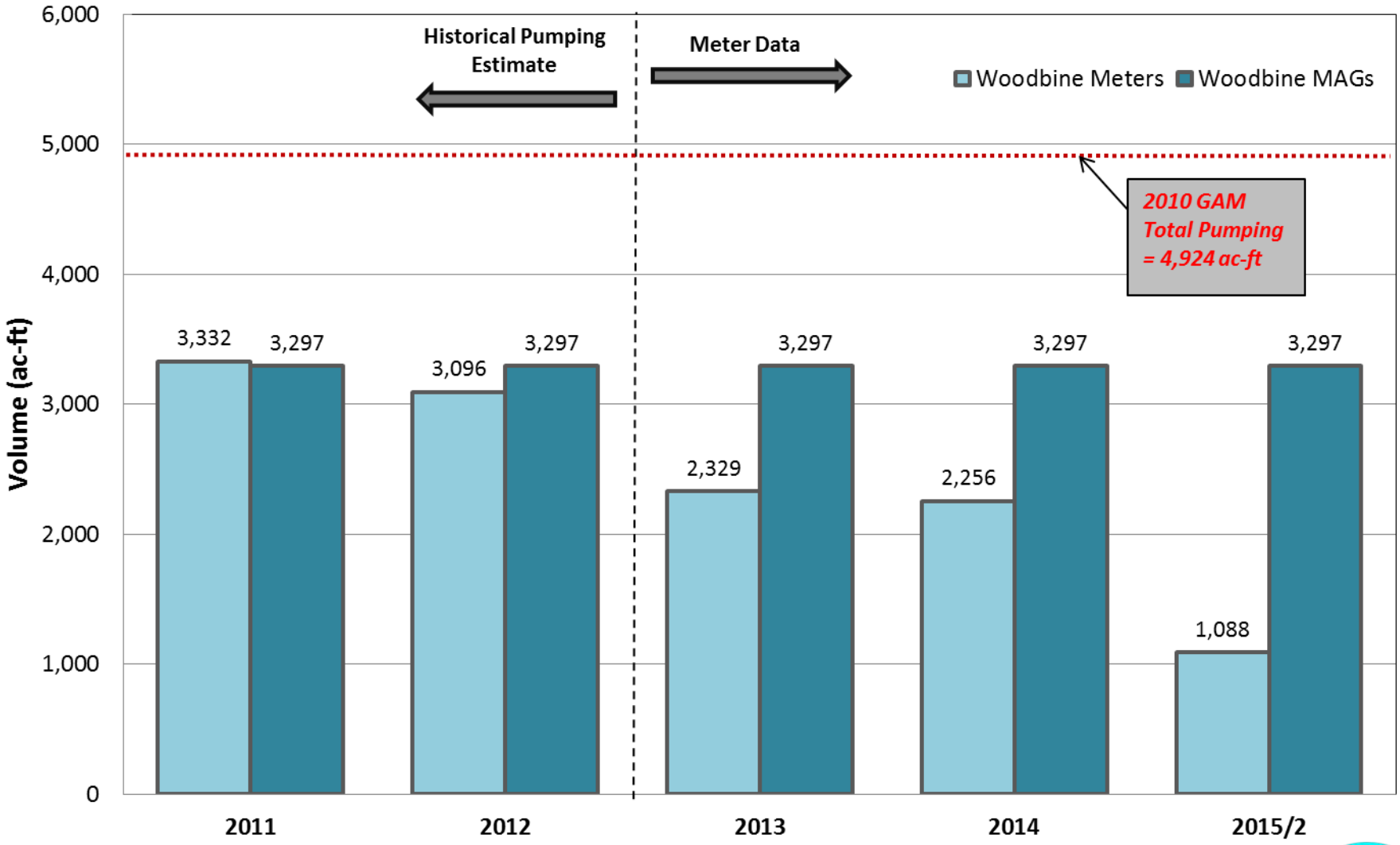
Model Terminology	Region 1	Region 2	Region 3	Region 4	Region 5
Woodbine Aquifer	Woodbine	Woodbine	Woodbine	Woodbine	Woodbine (no sand)
Washita/ Fredericksburg Groups	Washita/ Fredericksbur	Washita/ Fredericksbur	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg
Paluxy Aquifer	Antlers	Paluxy	Paluxy	Paluxy	Paluxy (no sand)
Glen Rose Formation	Antlers	Glen Rose	Glen Rose	Glen Rose	Glen Rose
Hensell Aquifer	Antlers	Twin Mountains	Travis Peak	Hensell/ Travis Peak	Hensell/ Travis Peak
Pearsall Formation	Antlers	Twin Mountains	Travis Peak	Pearsall/ Sligo	Pearsall/ Sligo
Hosston Aquifer	Antlers	Twin Mountains	Travis Peak	Hosston/ Travis Peak	Hosston/ Travis Peak

yellow = sandstone aquifers

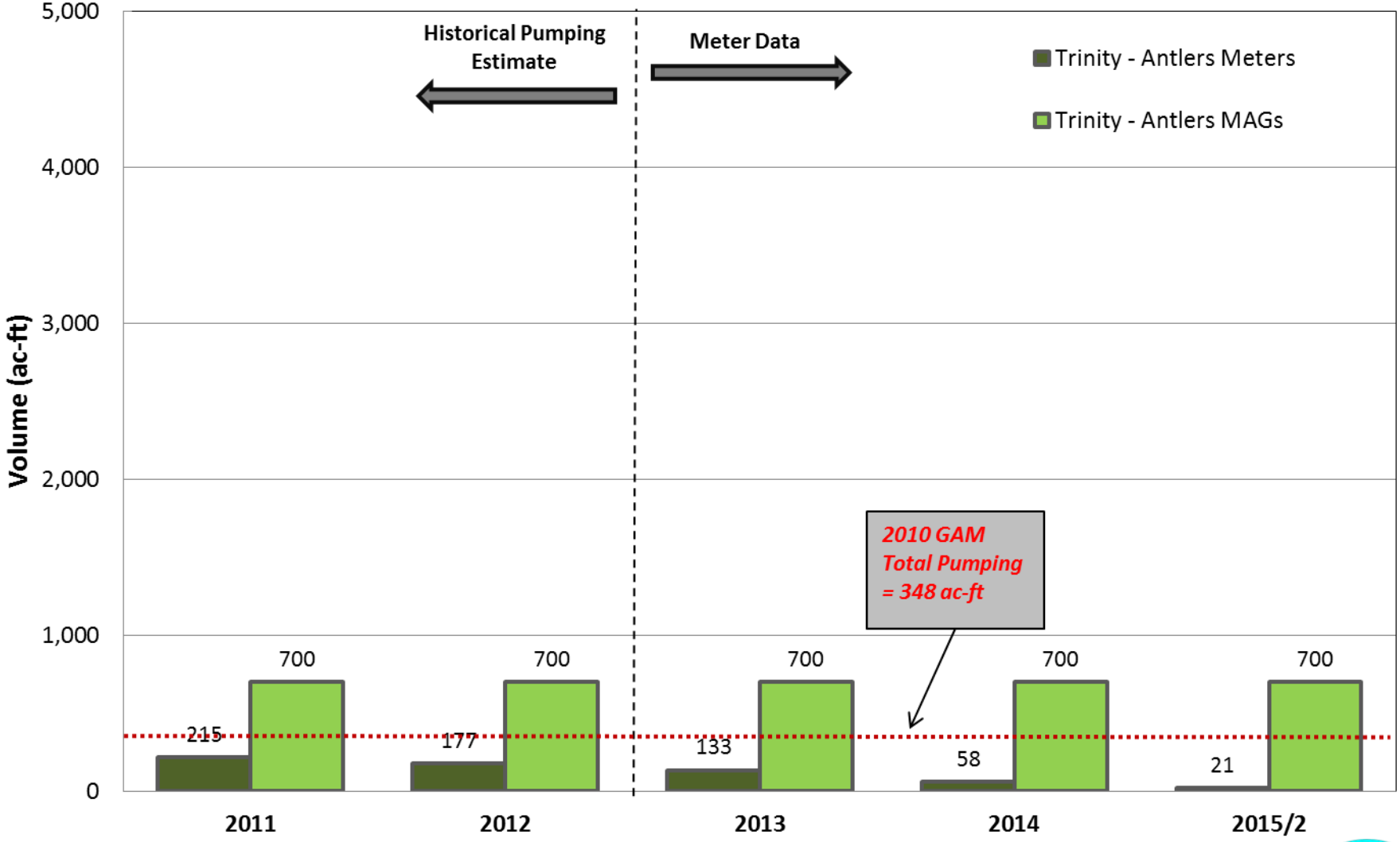
Figure 4.1.6 **Chart showing model terminology and corresponding formation names and aquifer names common to each region.**

Fannin County (Region 1)
Metered Pumping and MAG



Total Pumping:
2011 and 2012 source: TWDB historical pumping estimates.
2013, 2014 and first half of 2015 source: RRGCD meter data.

Fannin County (Region 1)
Metered Pumping and MAG



Total Pumping:
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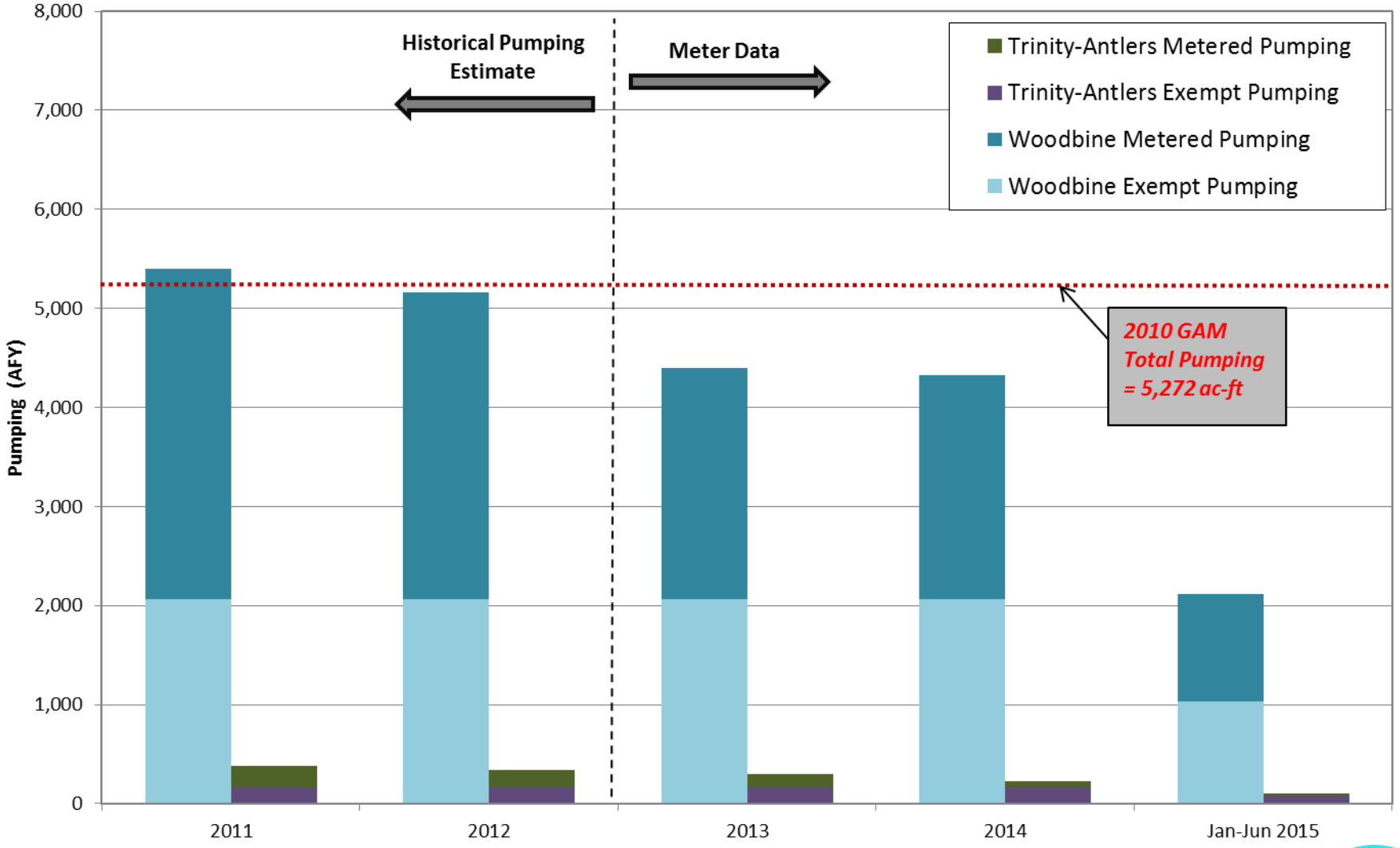
2013, 2014 and first half of 2015 source: RRGCD meter data.

Fannin County Pumping by Year and Aquifer



TWDB Historical estimates used for Year 2011 and 2012 pumping.
Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.
MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.

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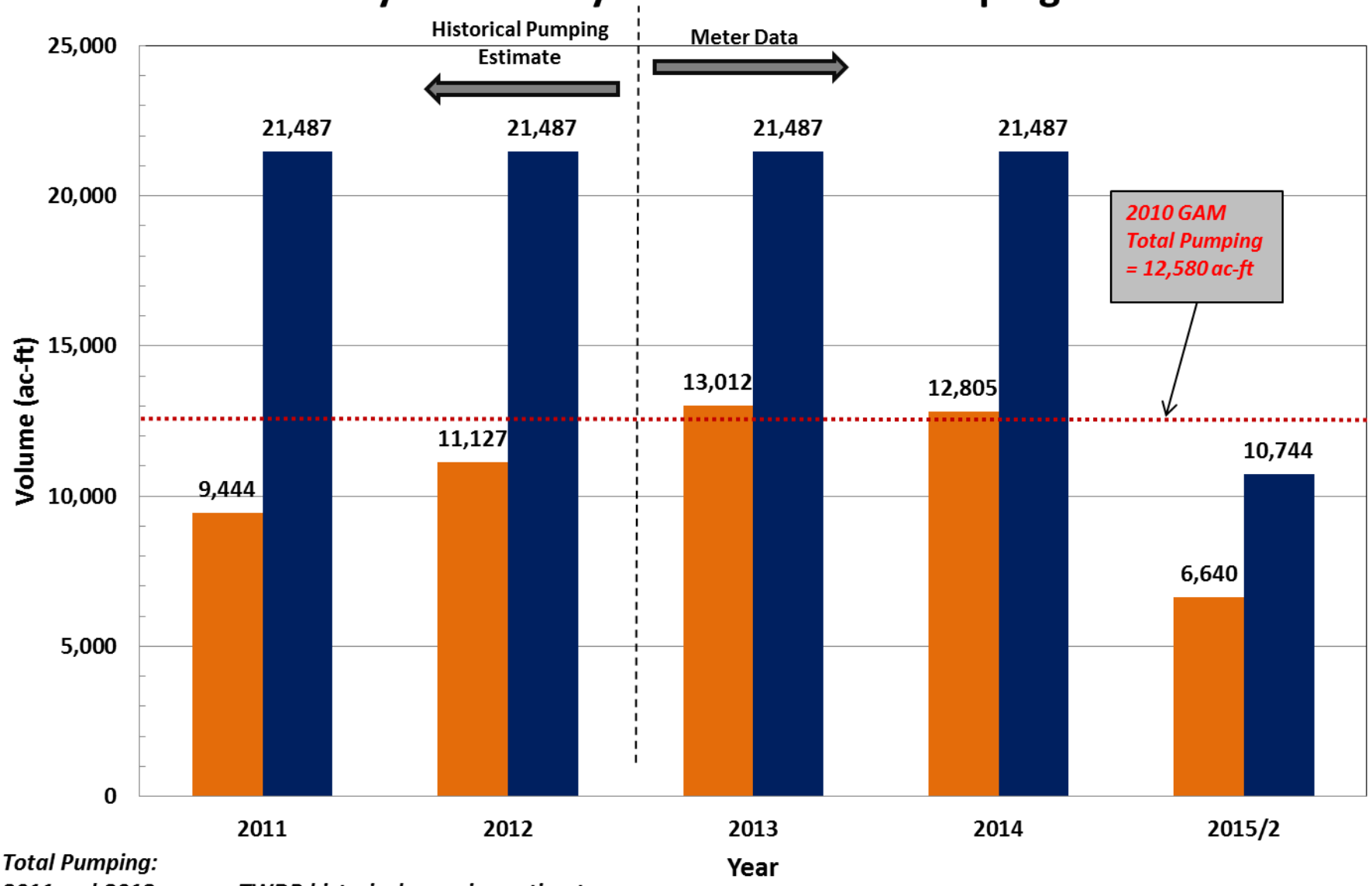
Big Picture Comparison Fannin County

- Meter data generally shows combined metered and exempt pumping slightly exceed MAGs in Fannin County but that total pumping had gradually decreased over the last 4.5 years

Grayson County

Grayson County Total Metered Pumping



Total Pumping:
2011 and 2012 source: TWDB historical pumping estimates.
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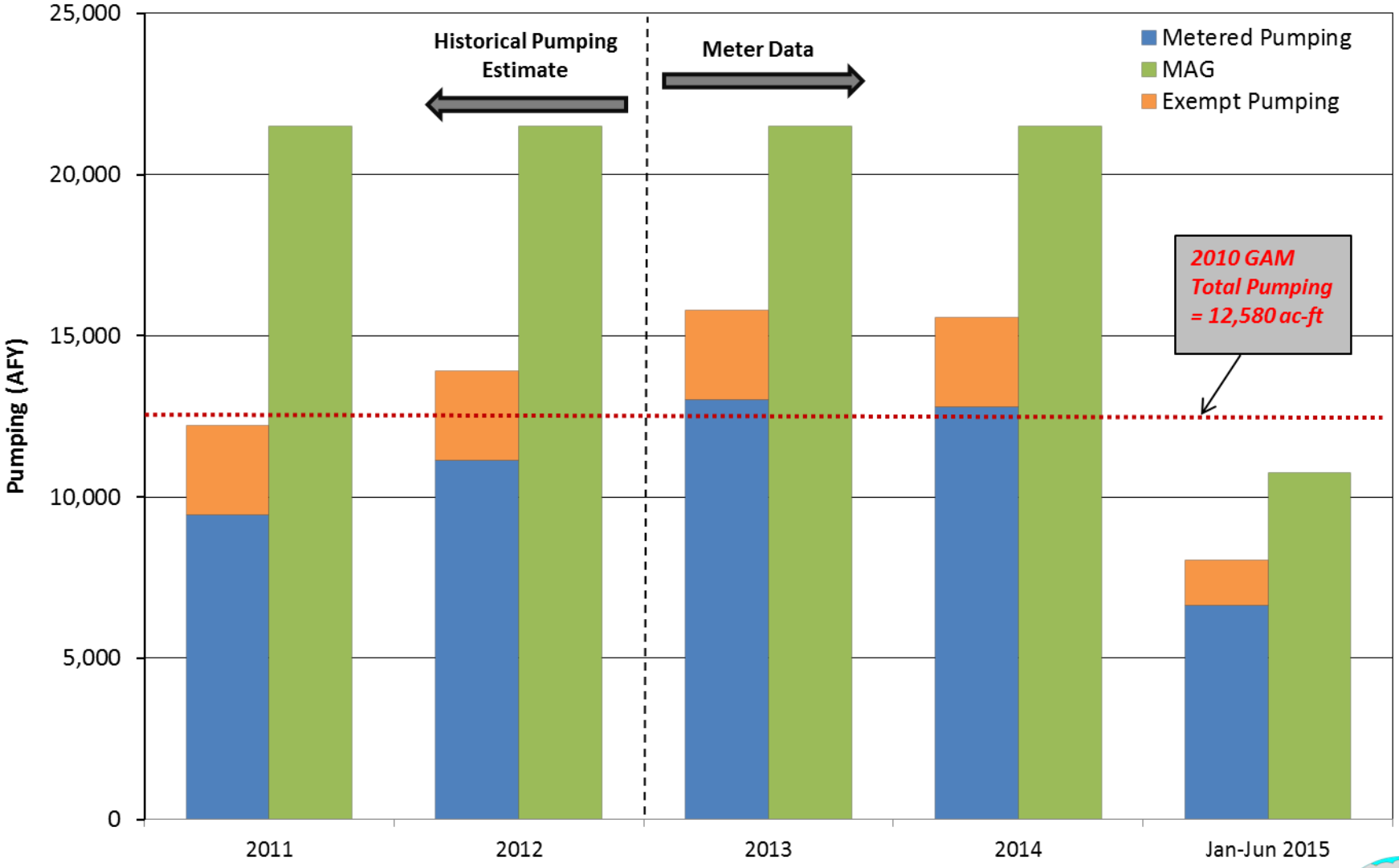
Grayson County Total Pumping Comparisons



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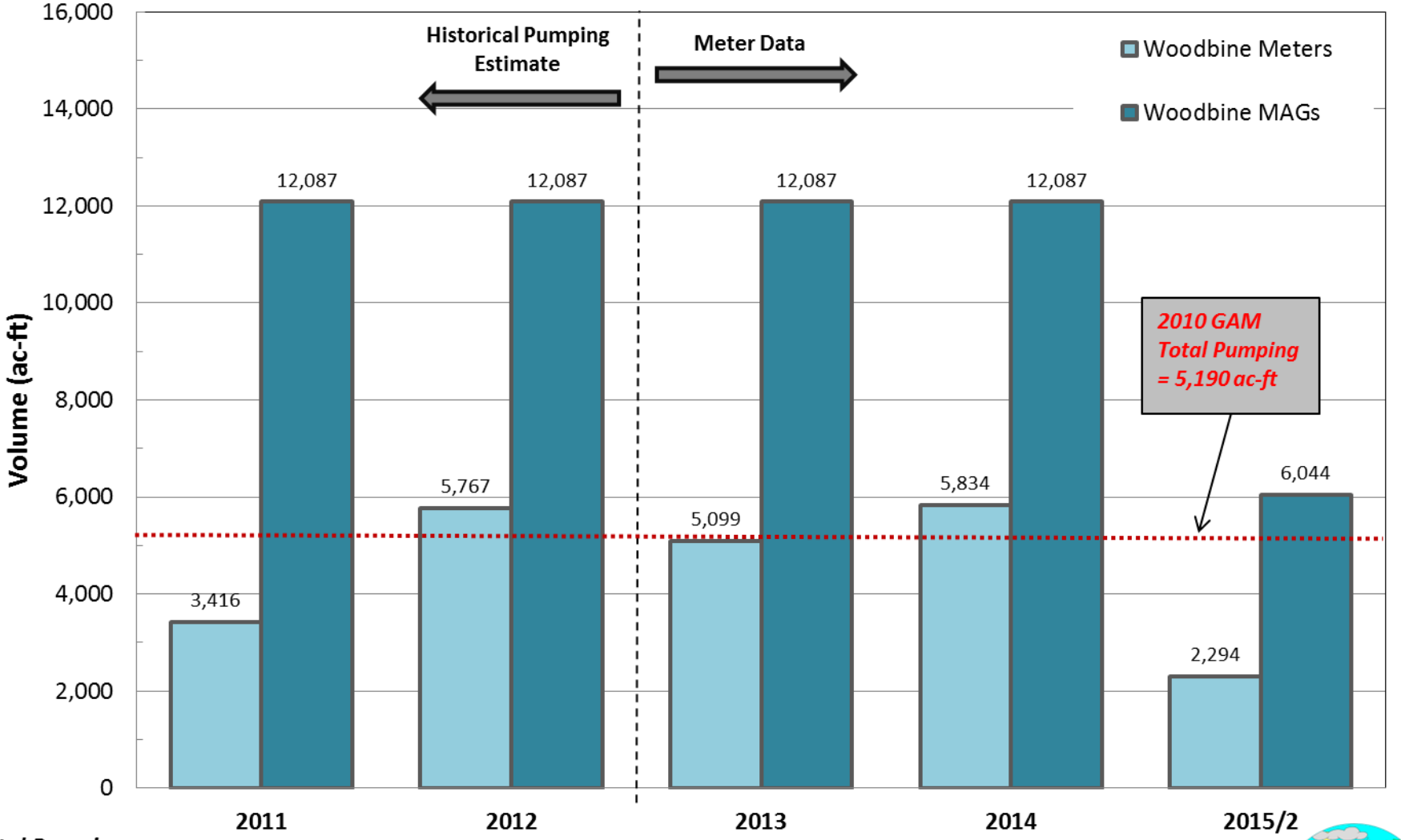
Grayson County (Region 1)
Metered Pumping and MAG



Total Pumping:
2011 and 2012 source: TWDB historical pumping estimates.
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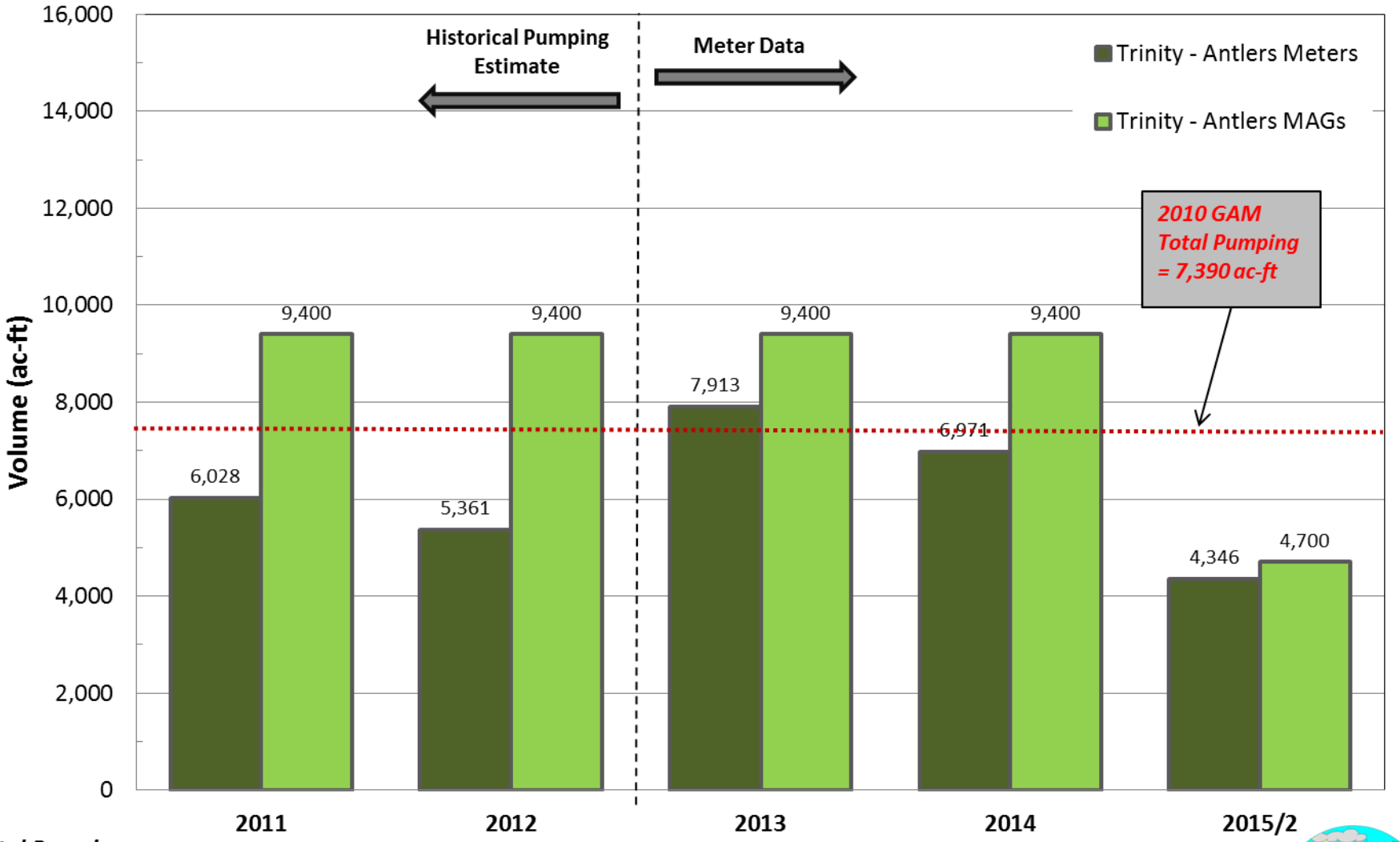
Grayson County (Region 1)
Metered Pumping and MAG



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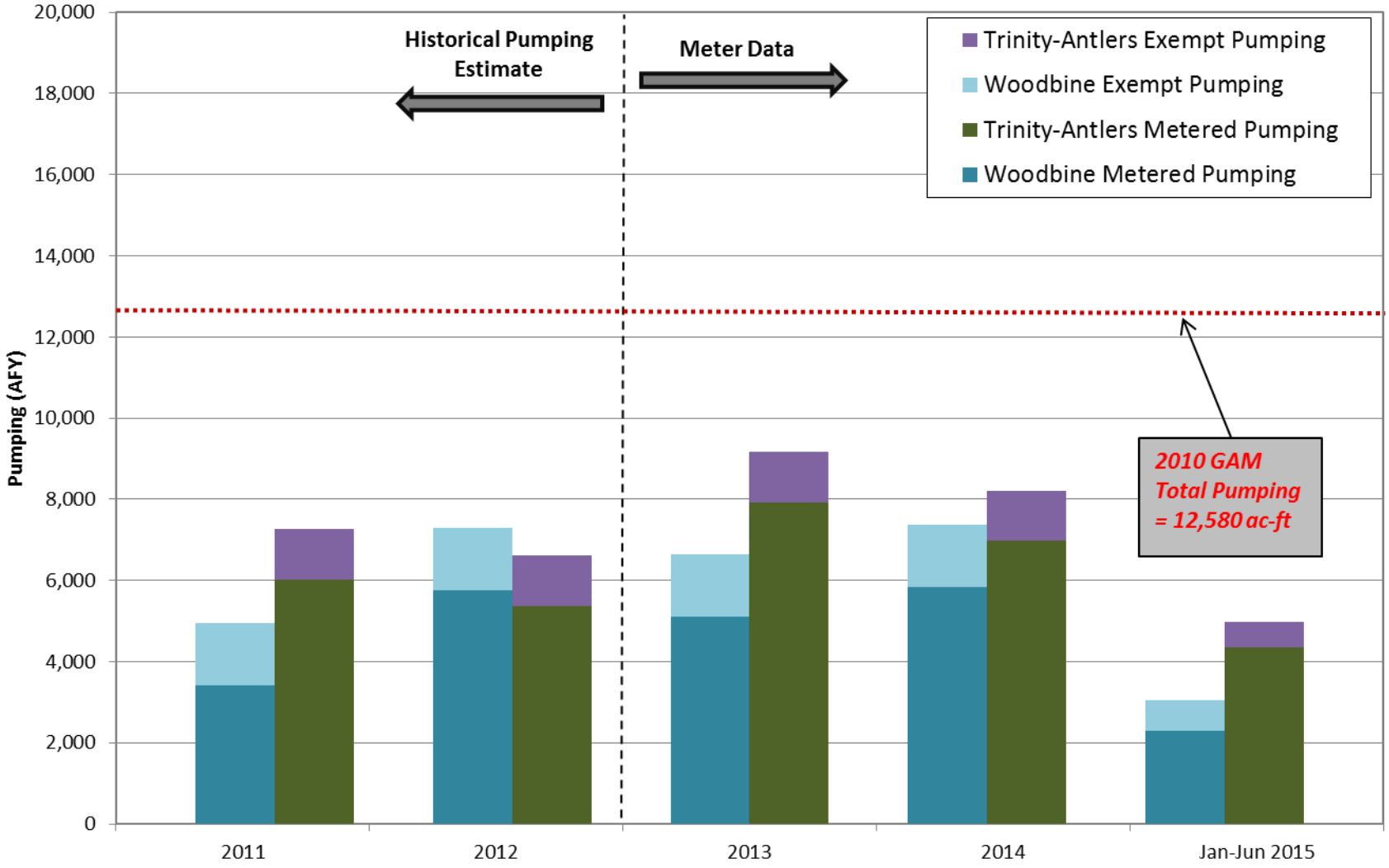
Grayson County Pumping by Year and Aquifer



TWDB Historical estimates used for Year 2011 and 2012 pumping.
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MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.

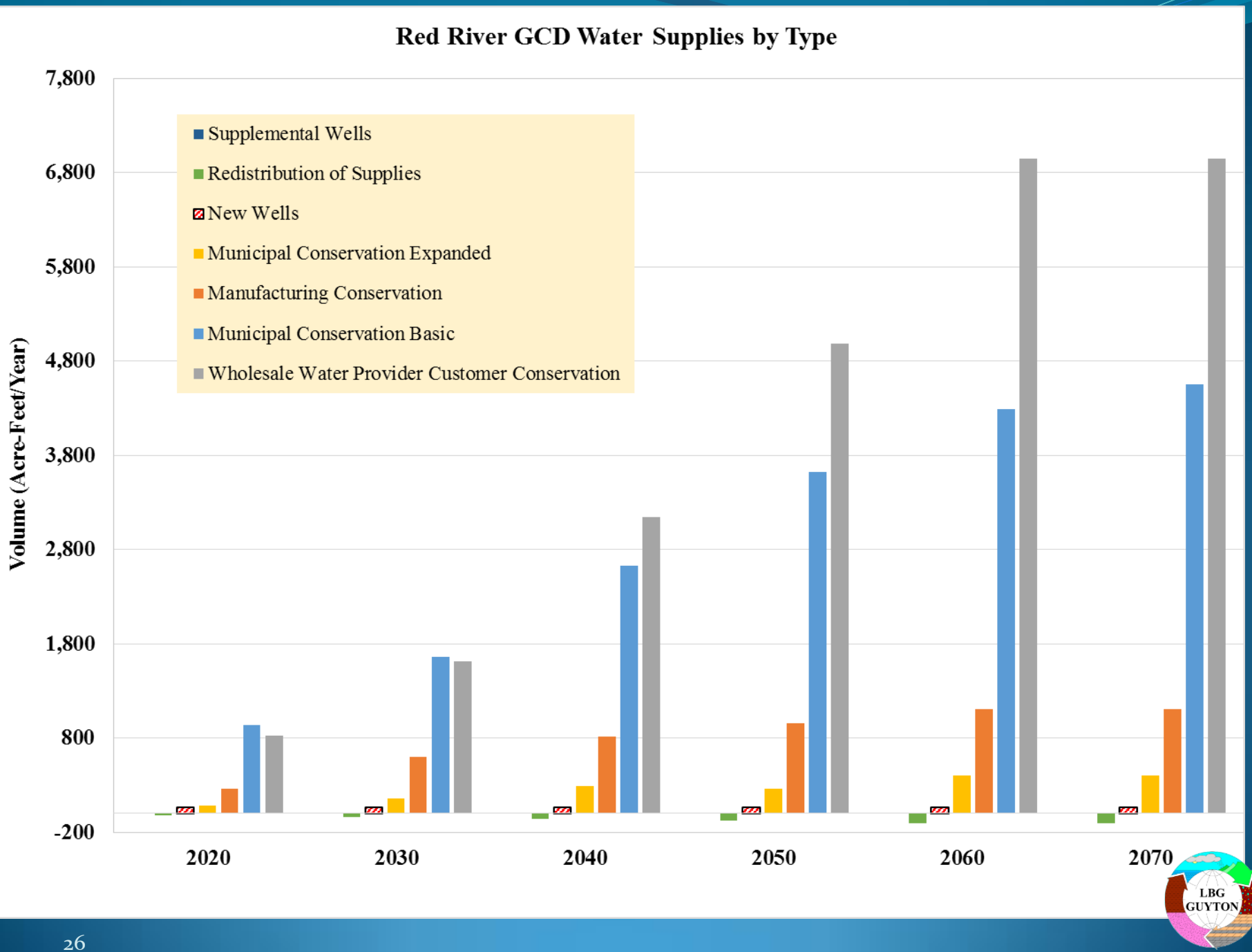
Big Picture Comparison Grayson County

- Grayson: Meter data shows that pumping is relatively steady and total pumping does not currently exceed MAG volumes

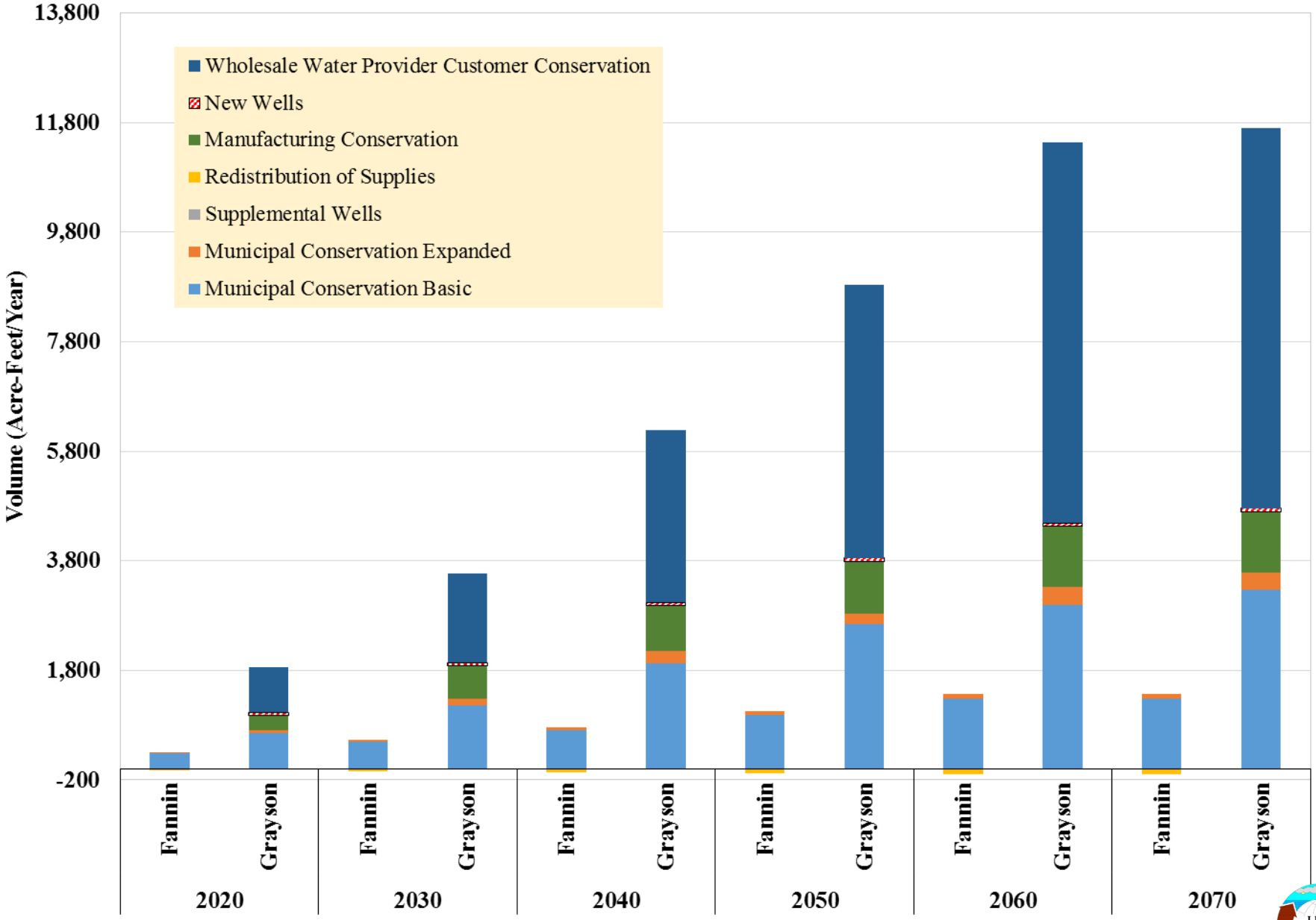
Review of Water Supply Strategies for Red River GCD

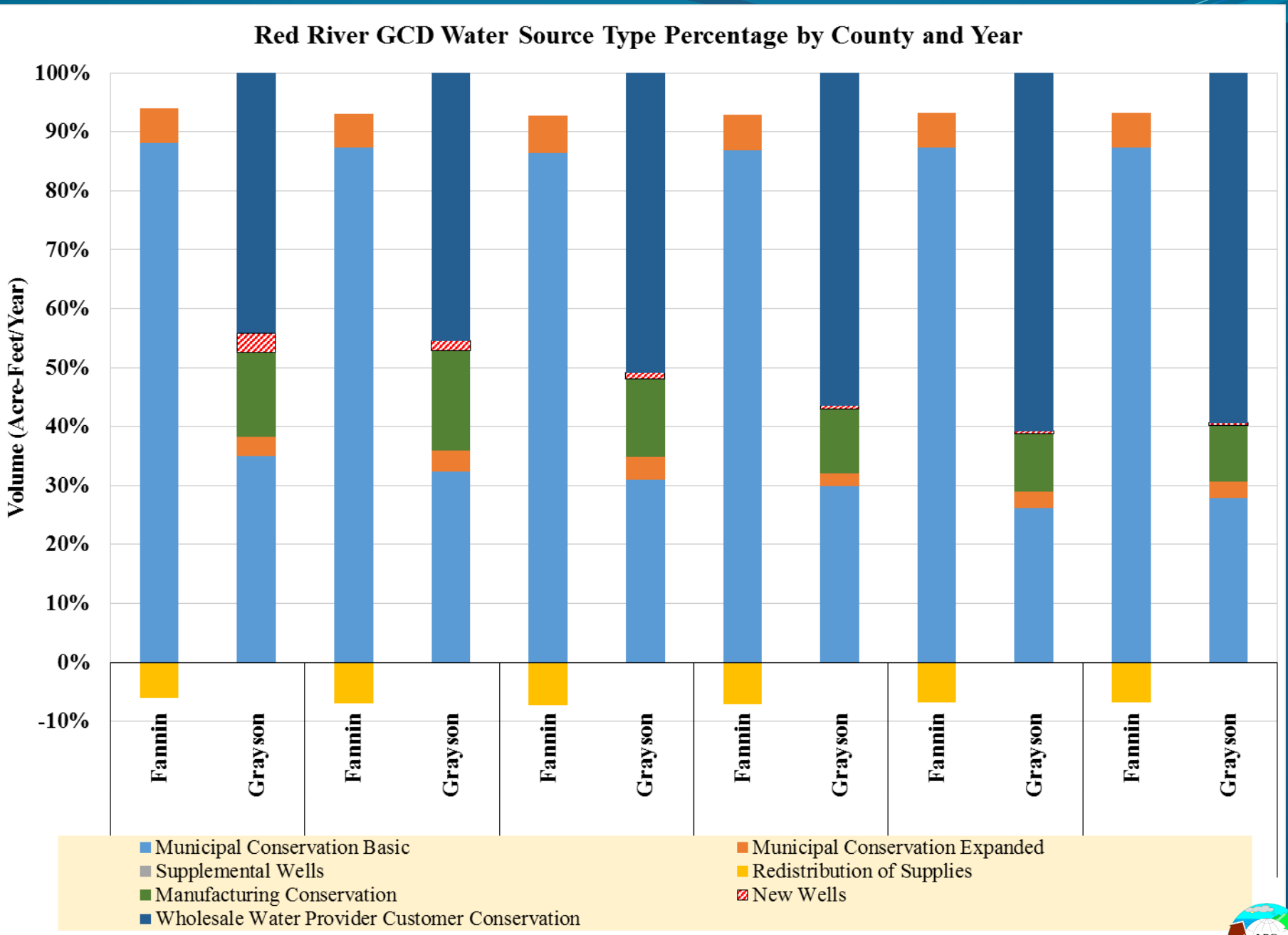
Water Management Strategy Graphs

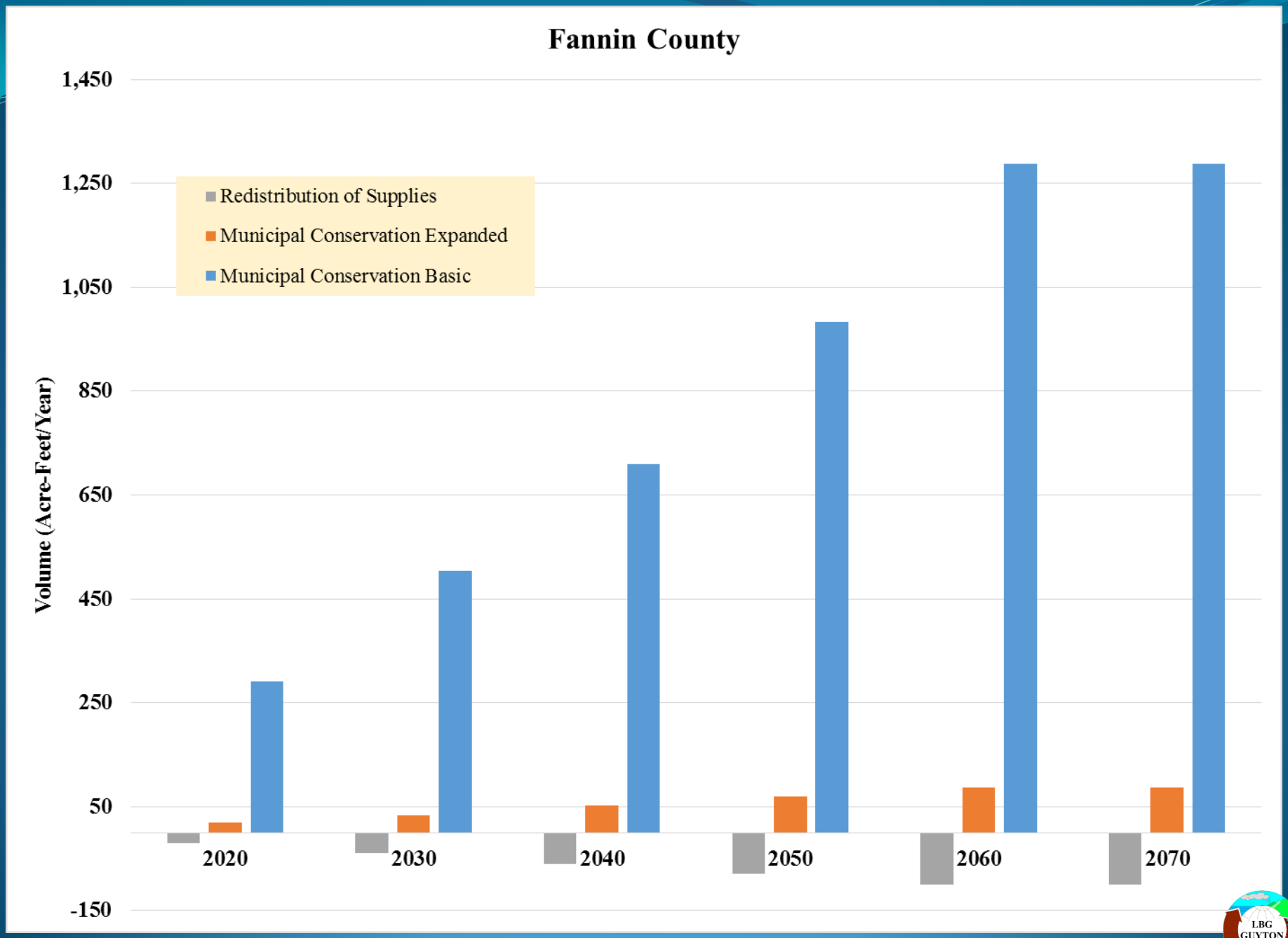
- Water Supplies by Type
- Water Supplies by Type: By County and Year
- Water Source Type: Percentage by County and Year
- Total Strategy Volumes by County

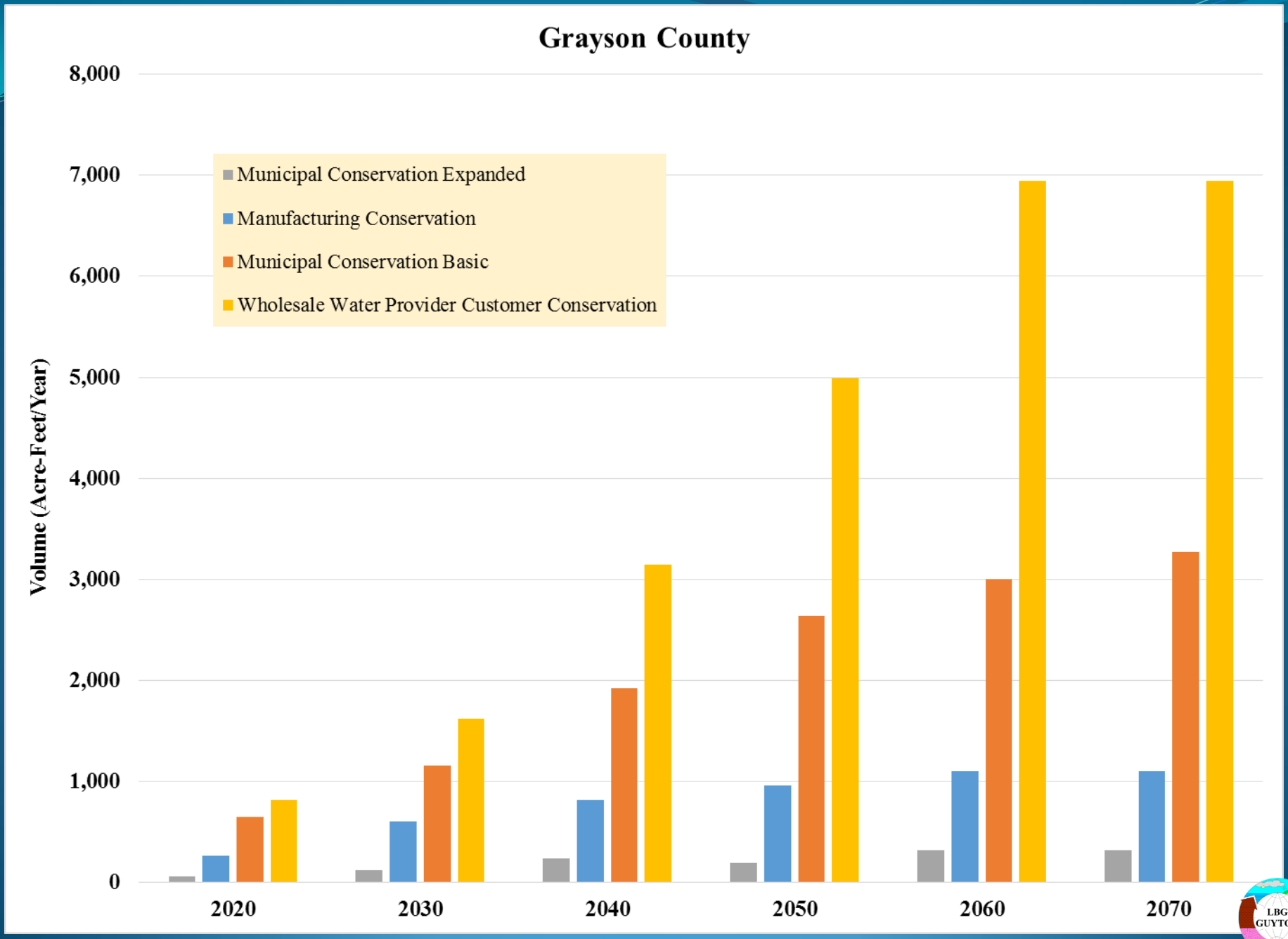

Red River GCD Water Supplies by Type
Volume (Acre-Feet/Year)
7,800
6,800
5,800
4,800
3,800
2,800
1,800
800
-200
Supplemental Wells
Redistribution of Supplies
New Wells
Municipal Conservation Expanded
Manufacturing Conservation
Municipal Conservation Basic
Wholesale Water Provider Customer Conservation
2020
2030
2040
2050
2060
2070

Red River GCD Water Supplies by Type, County, and Year




Red River GCD Water Source Type Percentage by County and Year
Volume (Acre-Feet/Year)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
Fannin
Grayson
Municipal Conservation Basic
Municipal Conservation Expanded
Supplemental Wells
Redistribution of Supplies
Manufacturing Conservation
New Wells
Wholesale Water Provider Customer Conservation


Fannin County
1,450
1,250
1,050
850
650
450
250
50
-150
Volume (Acre-Feet/Year)
Redistribution of Supplies
Municipal Conservation Expanded
Municipal Conservation Basic
2020
2030
2040
2050
2060
2070

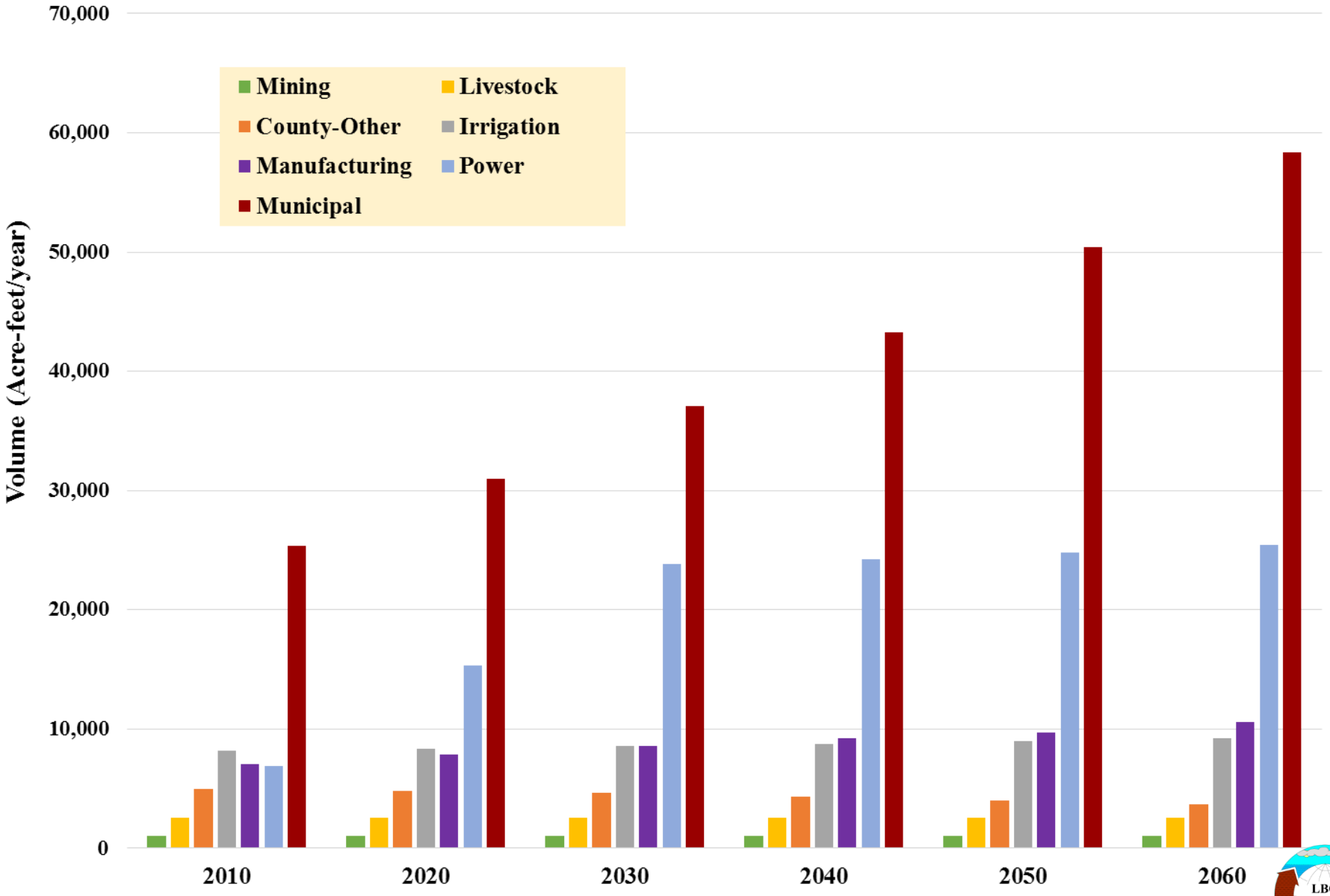

Grayson County
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Volume (Acre-Feet/Year)
Municipal Conservation Expanded
Manufacturing Conservation
Municipal Conservation Basic
Wholesale Water Provider Customer Conservation
2020
2030
2040
2050
2060
2070

Summary of Strategies

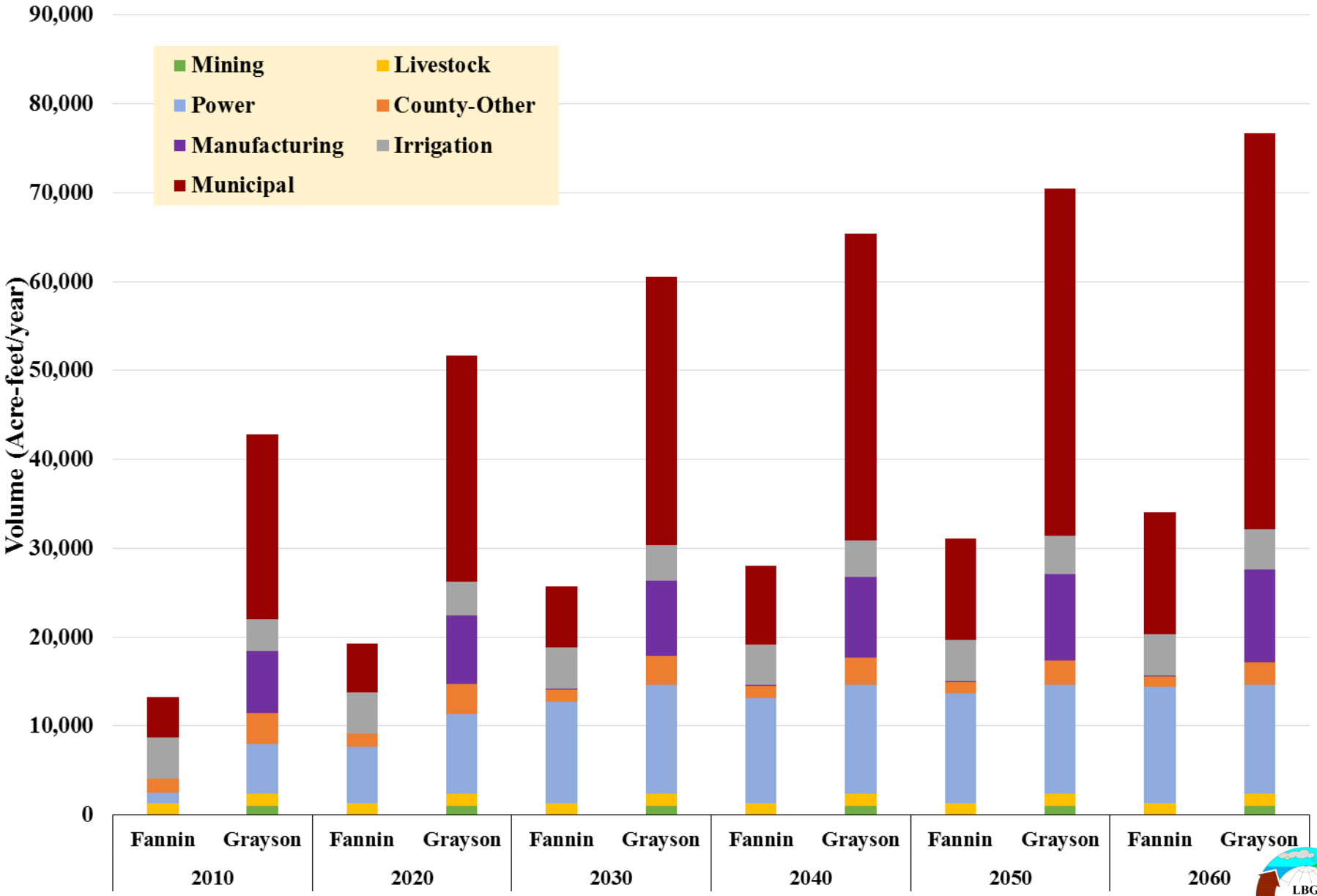
- Conservation, Conservation, Conservation – Is this a realistic expectation?
- Additional strategies need to be considered in the event that conservation ultimately is not as strategically successful as initially planned
- New wells are a very small component of future strategies, although the meter vs. MAG calculations suggest that more new wells could be a viable option

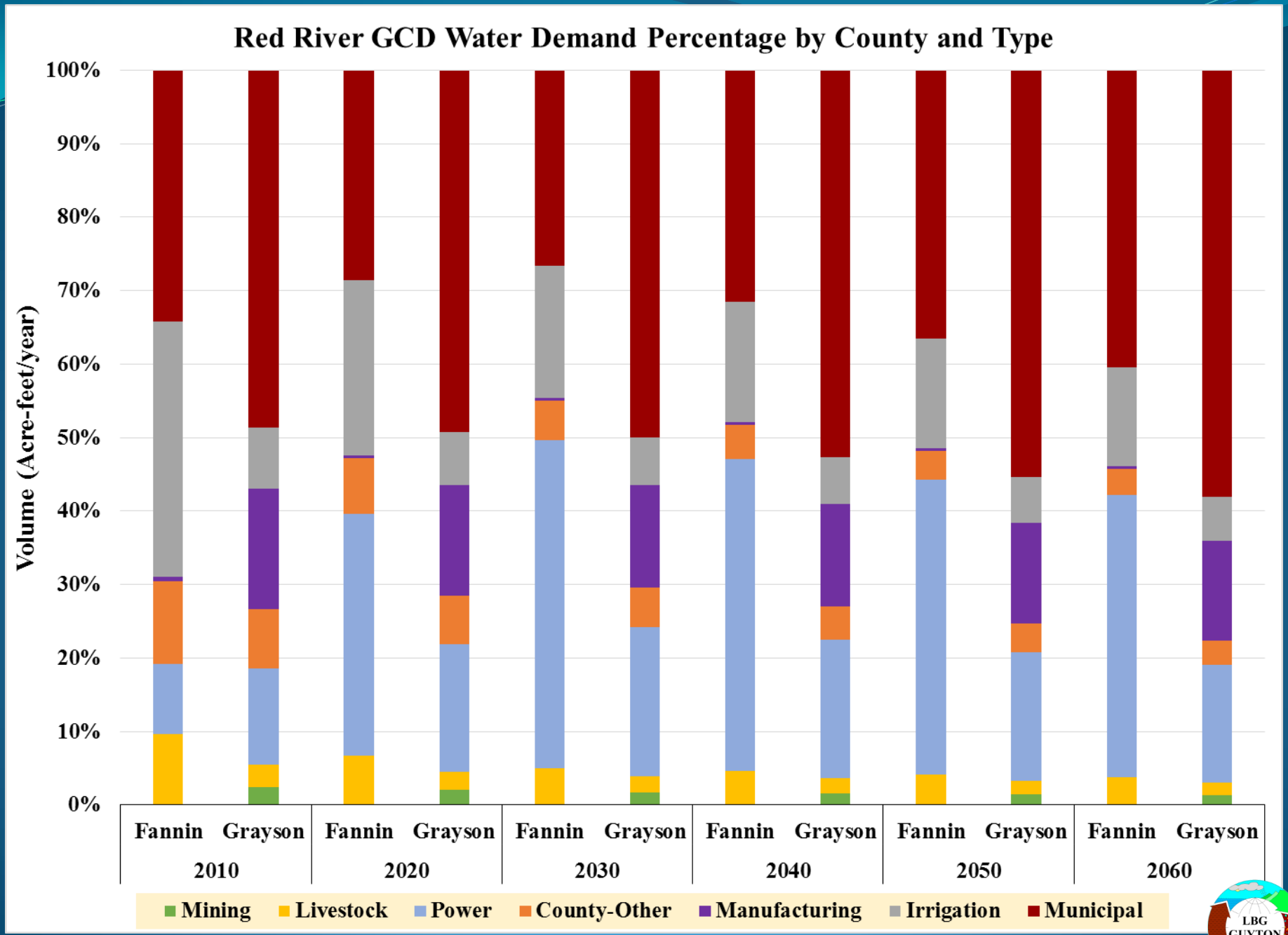
Review of Water Demand

Red River GCD Water Demand by Type



Red River GCD Water Demand by County, Type, and Year



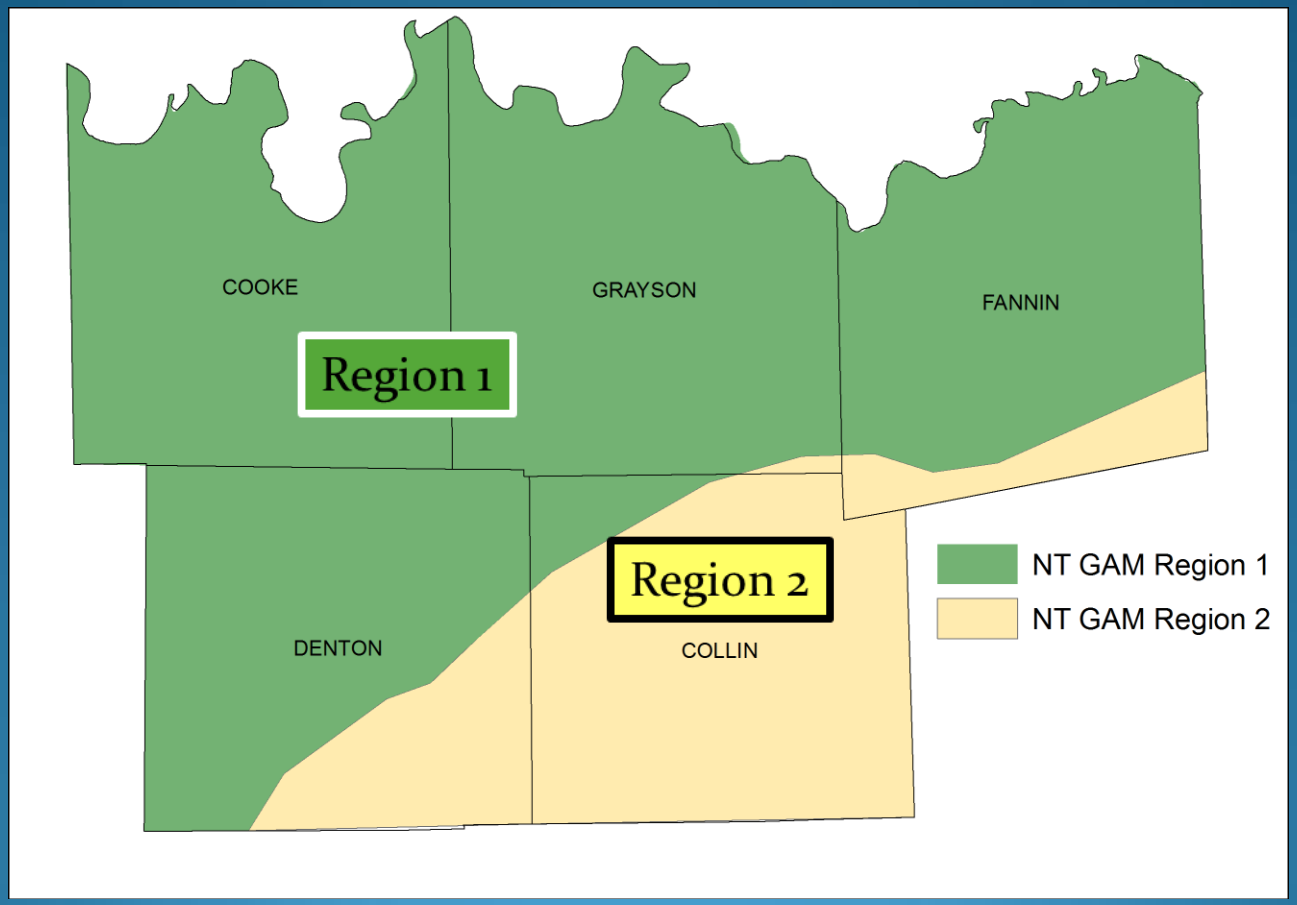

Red River GCD Water Demand Percentage by County and Type
Volume (Acre-feet/year)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Fannin Grayson
2010
Fannin Grayson
2020
Fannin Grayson
2030
Fannin Grayson
2040
Fannin Grayson
2050
Fannin Grayson
2060
Mining
Livestock
Power
County-Other
Manufacturing
Irrigation
Municipal

Demand Summary

- Non-Municipal demand: ~30,000 ac-ft in 2010 to over 50,000 ac-ft in 2060
- Municipal: ~25,000 ac-ft in 2010 to nearly 60,000 ac-ft in 2060

Review of DFCs and Water Level Changes

North Trinity GAM Stratigraphic Regions



Region 1: Woodbine, Antlers
Region 2: Woodbine, Paluxy, Twin Mountains

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Model Terminology	Region 1	Region 2	Region 3	Region 4	Region 5
Woodbine Aquifer	Woodbine	Woodbine	Woodbine	Woodbine	Woodbine (no sand)
Washita/ Fredericksburg Groups	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg
Paluxy Aquifer	Antlers	Paluxy	Paluxy	Paluxy	Paluxy (no sand)
Glen Rose Formation	Antlers	Glen Rose	Glen Rose	Glen Rose	Glen Rose
Hensell Aquifer	Antlers	Twin Mountains	Travis Peak	Hensell/ Travis Peak	Hensell/ Travis Peak
Pearsall Formation	Antlers	Twin Mountains	Travis Peak	Pearsall/ Sligo	Pearsall/ Sligo
Hosston Aquifer	Antlers	Twin Mountains	Travis Peak	Hosston/ Travis Peak	Hosston/ Travis Peak

yellow = sandstone aquifers

Figure 4.1.6 **Chart showing model terminology and corresponding formation names and aquifer names common to each region.**

Converting Trinity DFCs

Region 1

Region 2

Red River GCD Desired Future Conditions (50-year DFC)

	Woodbine	Antlers	Paluxy	Glen Rose	Hensell	Hosston	Twin Mountains
Fannin	186	193	212	196	182	181	182
Grayson	28	165	175	161	160	165	163

All values are in feet of drawdown over a 50-year period.

Red River GCD Desired Future Conditions (One-year DFC)

	Woodbine	Antlers	Paluxy	Glen Rose	Hensell	Hosston	Twin Mountains
Fannin	3.7	4	4.2	3.9	3.6	3.6	4
Grayson	0.6	3	3.5	3.2	3.2	3.3	3

All values are in feet of drawdown over a one-year period.

= calculated DFC

To derive DFCs for Region 1 Trinity - Antlers, the DFCs for the Paluxy, Glen Rose, Hensell and Hosston were averaged.

For Region 2 Trinity – Twin Mountains, the DFCs for the Hensell and Hosston were averaged.

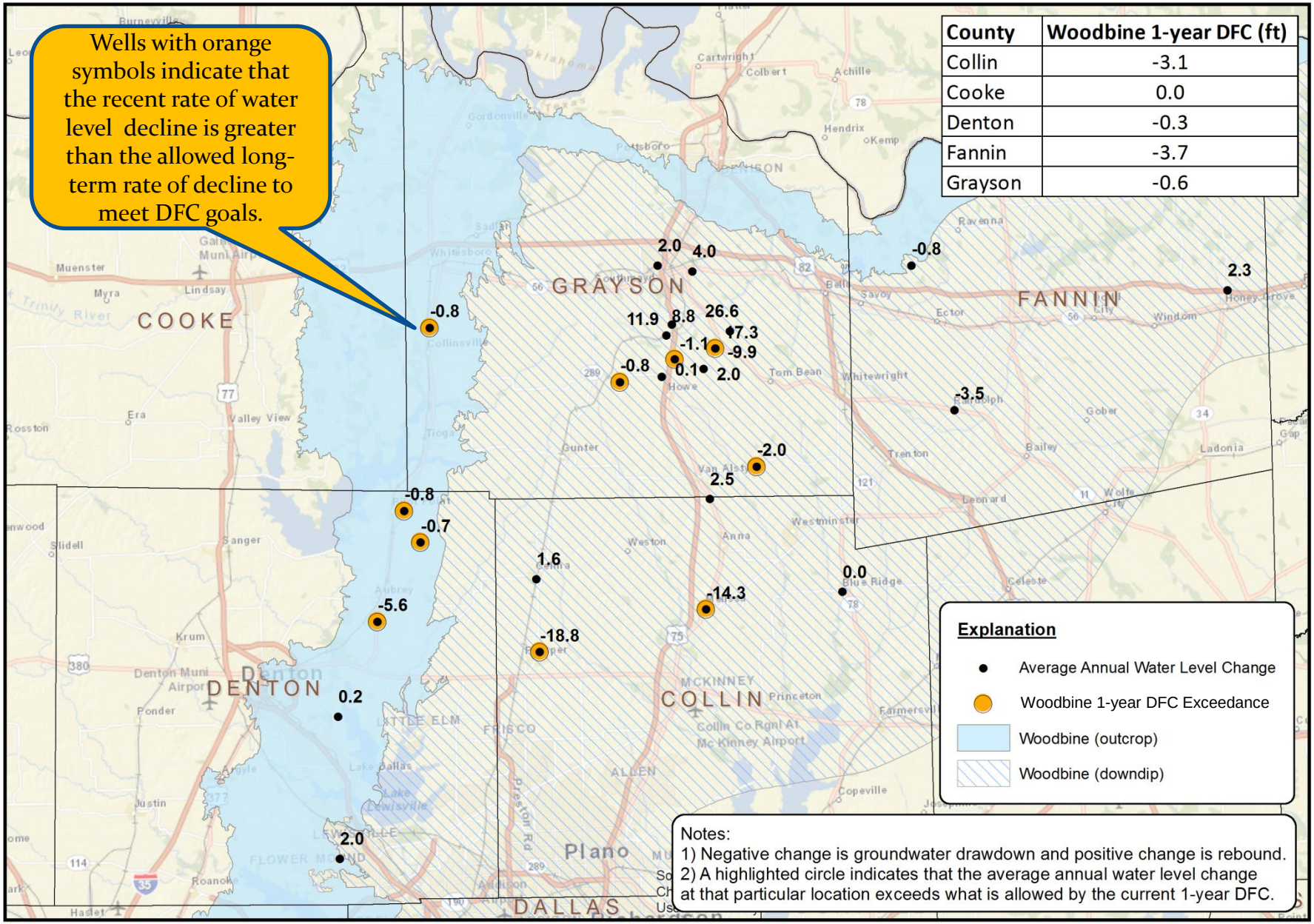
Calculation of Water Level Change

- Used TWDB water level data for wells with at least five measurements between January 2000 and June 2015
- Calculated the water level change from the first measurement to the last
- Divided by the number of years between first and last measurements to get an average annual water level change
- Mapped along with North Texas data to add continuity to the data set
- Negative change is drawdown (water level decline) and positive change is a rebound (increase in water level elevation)

Calculation of Water Level Change

SWN	County	LBG Aquifer	Strat Region	WL Change (ft)	Total Years	Average Change (ft)	+/-	1-yr DFC	status
1733501	Fannin	Paluxy	2	5.0	14	-0.4	decline	-4.2	Less than DFC
1725302	Fannin	Woodbine	1	-32.0	14	2.3	rebound	-3.7	Less than DFC
1822801	Fannin	Woodbine	1	10.7	14	-0.8	decline	-3.7	Less than DFC
1838302	Fannin	Woodbine	1	42.0	12	-3.5	decline	-3.7	Less than DFC
1817908	Grayson	Antlers	1	62.0	14	-4.4	decline	-3.3	Exceeds DFC
1820703	Grayson	Antlers	1	-7.0	10	0.7	rebound	-3.3	Less than DFC
1820802	Grayson	Antlers	1	-210.0	12	16.8	rebound	-3.3	Less than DFC
1820803	Grayson	Antlers	1	-25.0	7	3.4	rebound	-3.3	Less than DFC
1825604	Grayson	Antlers	1	77.0	10	-8.0	decline	-3.3	Exceeds DFC
1827802	Grayson	Antlers	1	285.0	11	-25.1	decline	-3.3	Exceeds DFC
1827901	Grayson	Antlers	1	141.0	12	-11.3	decline	-3.3	Exceeds DFC
1828101	Grayson	Antlers	1	130.0	9	-13.8	decline	-3.3	Exceeds DFC
1828102	Grayson	Antlers	1	14.0	11	-1.2	decline	-3.3	Less than DFC
1828404	Grayson	Antlers	1	55.0	10	-5.3	decline	-3.3	Exceeds DFC
1828606	Grayson	Antlers	1	35.0	12	-2.8	decline	-3.3	Less than DFC
1828803	Grayson	Antlers	1	-90.0	12	7.2	rebound	-3.3	Less than DFC
1833301	Grayson	Antlers	1	152.5	14	-10.9	decline	-3.3	Exceeds DFC
1820707	Grayson	Woodbine	1	-25.0	12	2.0	rebound	-0.6	Less than DFC
1820801	Grayson	Woodbine	1	-50.0	12	4.0	rebound	-0.6	Less than DFC
1825301	Grayson	Woodbine	1	11.0	14	-0.8	decline	-0.6	Exceeds DFC
1827804	Grayson	Woodbine	1	4.0	5	-0.8	decline	-0.6	Exceeds DFC
1828103	Grayson	Woodbine	1	-135.0	11	11.9	rebound	-0.6	Less than DFC
1828402	Grayson	Woodbine	1	-110.0	12	8.8	rebound	-0.6	Less than DFC
1828403	Grayson	Woodbine	1	11.0	10	-1.1	decline	-0.6	Exceeds DFC
1828504	Grayson	Woodbine	1	-180.0	10	17.3	rebound	-0.6	Less than DFC
1828505	Grayson	Woodbine	1	103.0	10	-9.9	decline	-0.6	Exceeds DFC
1828605	Grayson	Woodbine	1	-195.0	7	26.6	rebound	-0.6	Less than DFC
1828705	Grayson	Woodbine	1	-1.0	14	0.1	rebound	-0.6	Less than DFC
1828802	Grayson	Woodbine	1	-23.0	11	2.0	rebound	-0.6	Less than DFC
1836602	Grayson	Woodbine	1	28.0	14	-2.0	decline	-0.6	Exceeds DFC

These calculation compare a 1-year average using multiple years of measurements to assess recent status of DFCs based on recent rate of decline or rebound.



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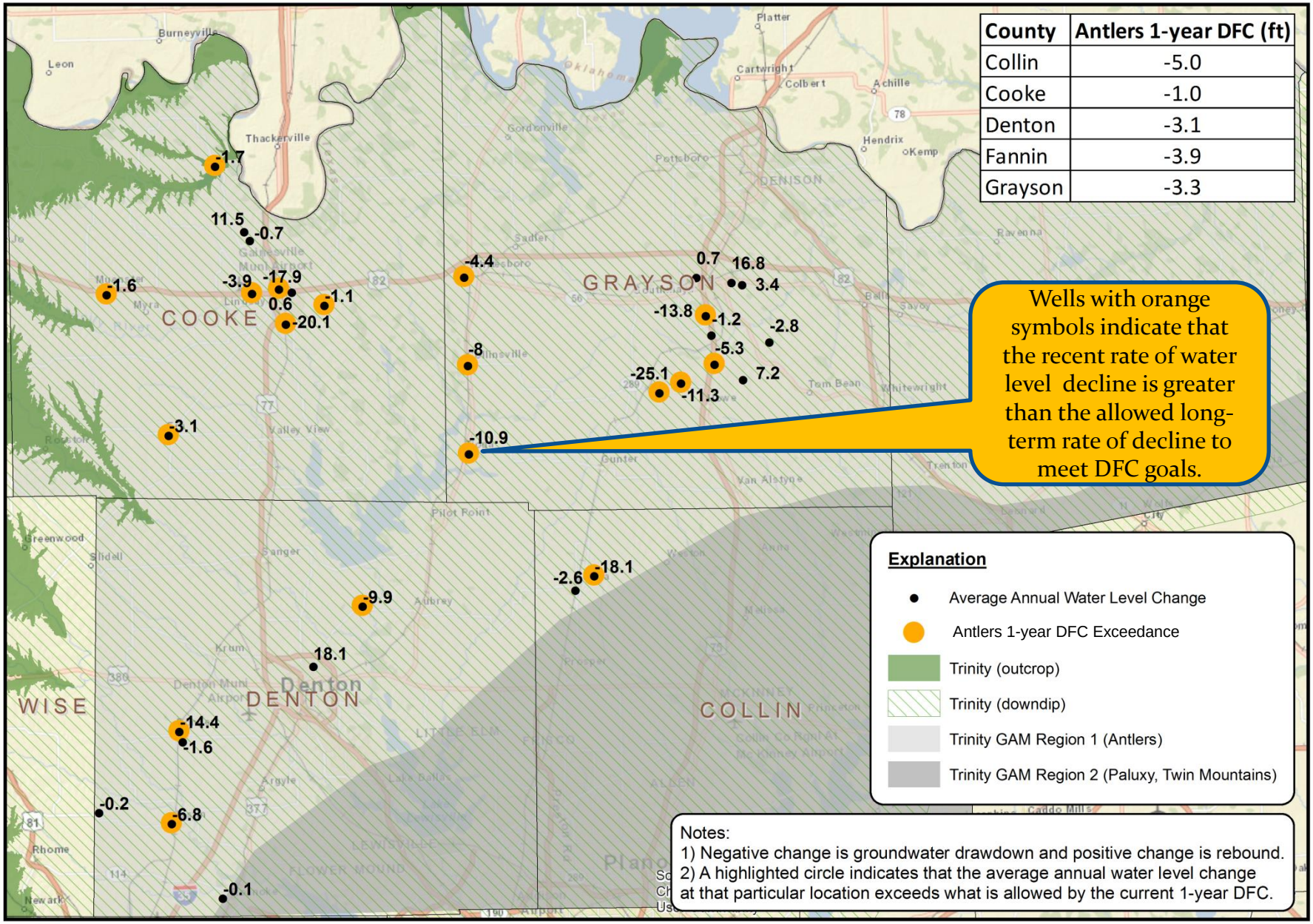
WOODBINE AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015



County	Antlers 1-year DFC (ft)
Collin	-5.0
Cooke	-1.0
Denton	-3.1
Fannin	-3.9
Grayson	-3.3

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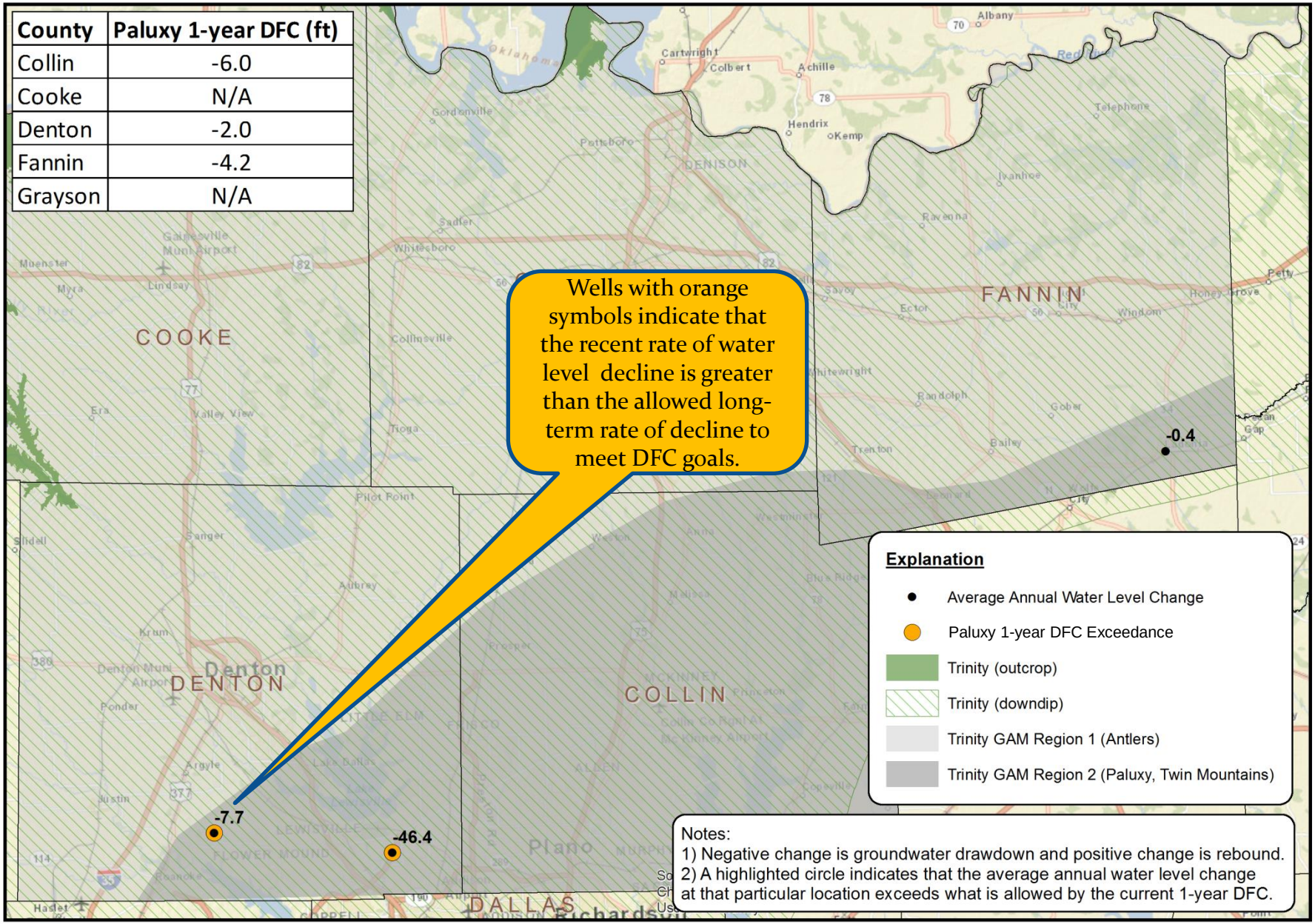
TRINITY ANTLERS AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015

County	Paluxy 1-year DFC (ft)
Collin	-6.0
Cooke	N/A
Denton	-2.0
Fannin	-4.2
Grayson	N/A



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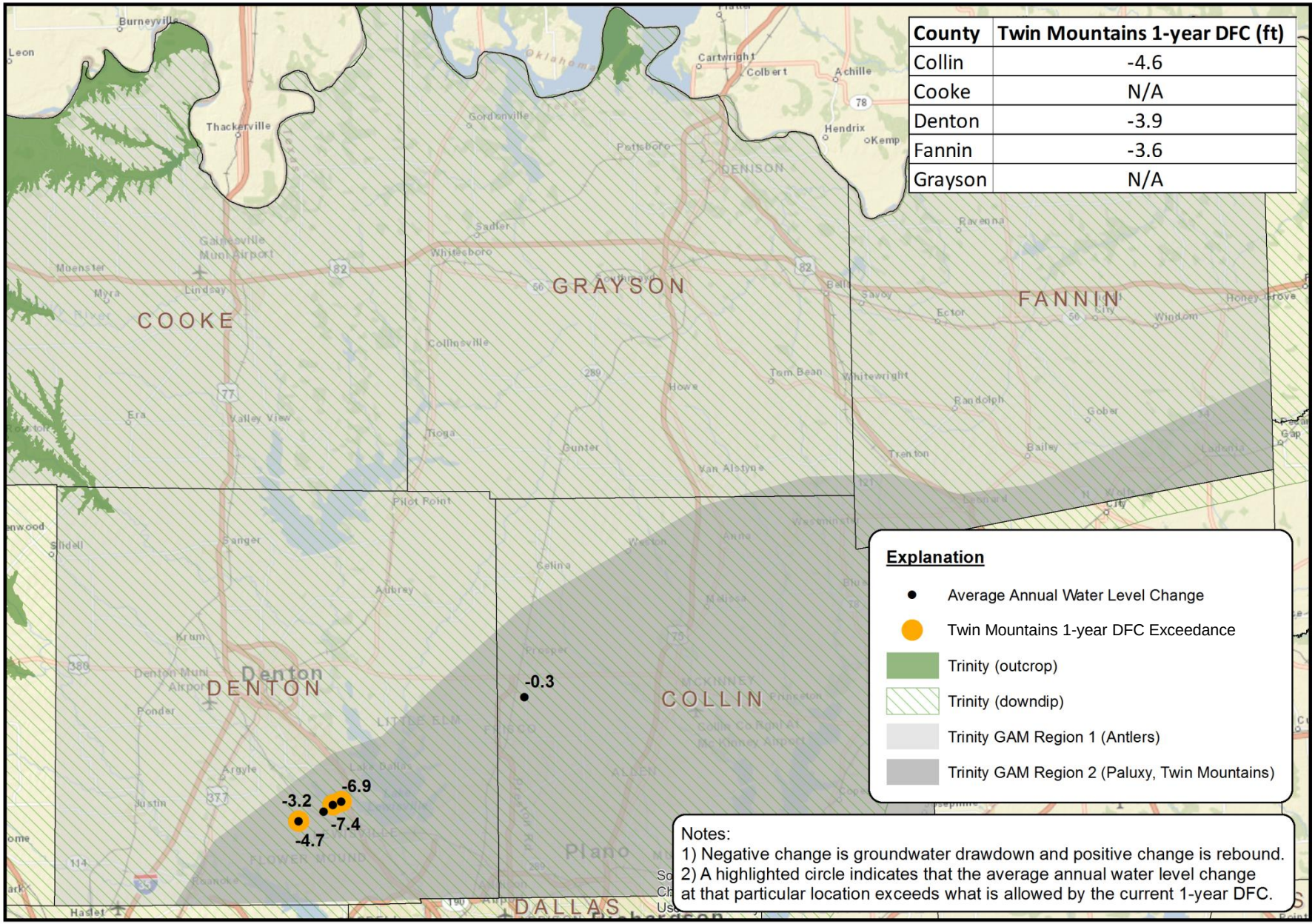
TRINITY PALUXY AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015



County	Twin Mountains 1-year DFC (ft)
Collin	-4.6
Cooke	N/A
Denton	-3.9
Fannin	-3.6
Grayson	N/A

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Miles

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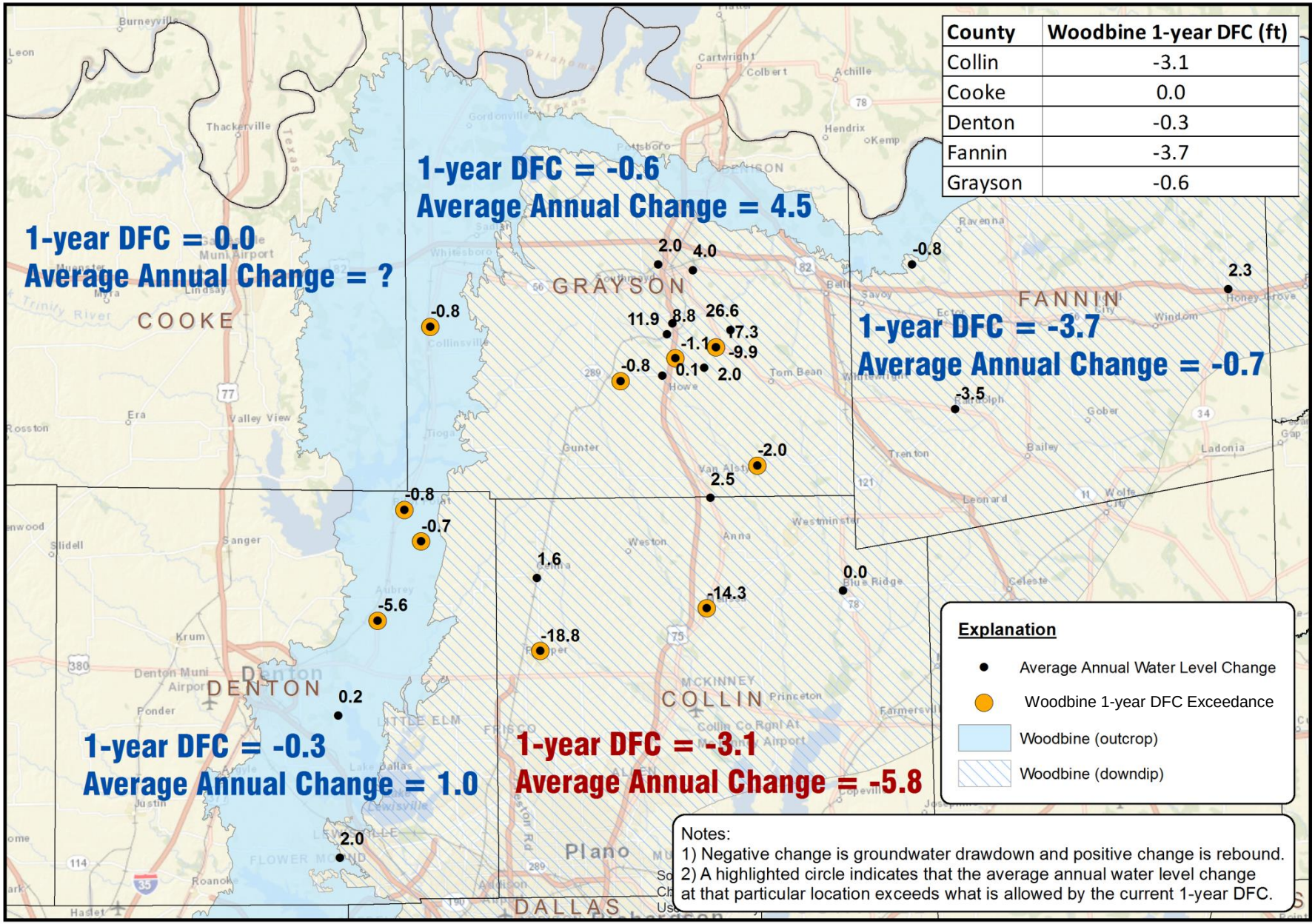
TRINITY TWIN MOUNTAINS AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015



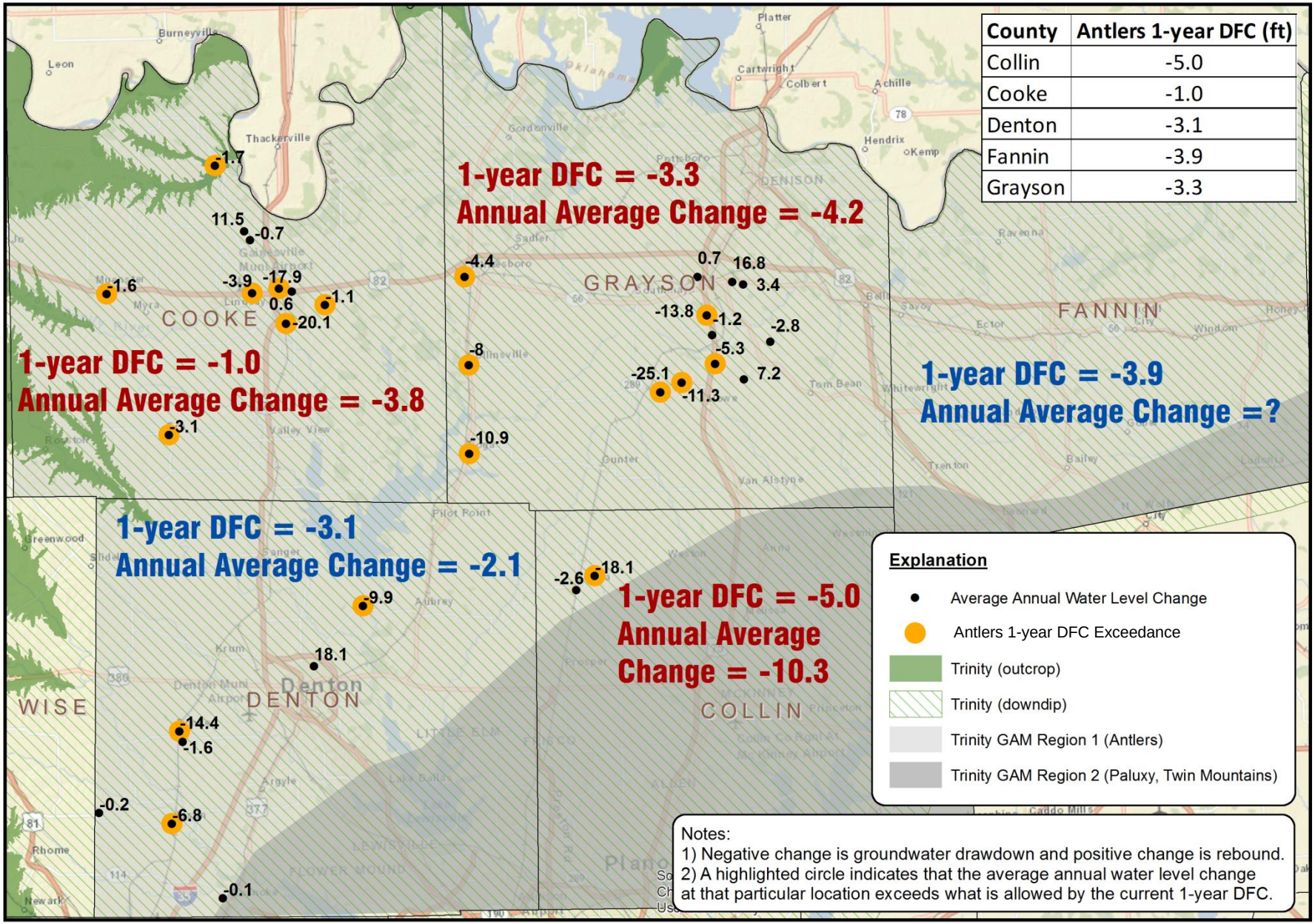
County	Woodbine 1-year DFC (ft)
Collin	-3.1
Cooke	0.0
Denton	-0.3
Fannin	-3.7
Grayson	-0.6

LBG-GUYTON ASSOCIATES

0 5 10
Miles

N

WOODBINE AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015



County	Antlers 1-year DFC (ft)
Collin	-5.0
Cooke	-1.0
Denton	-3.1
Fannin	-3.9
Grayson	-3.3

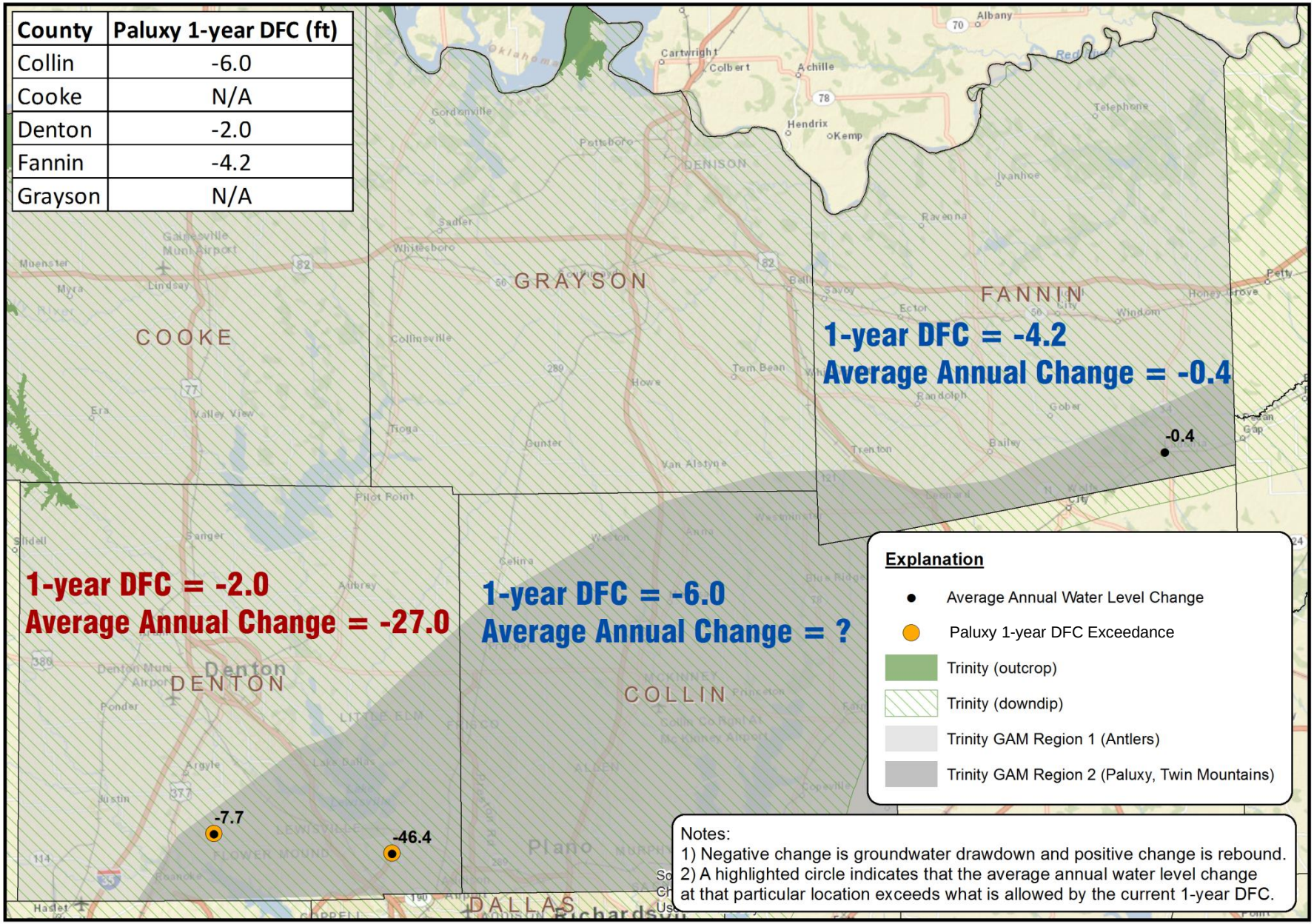
LBG-GUYTON ASSOCIATES

0 5 10
Miles

N

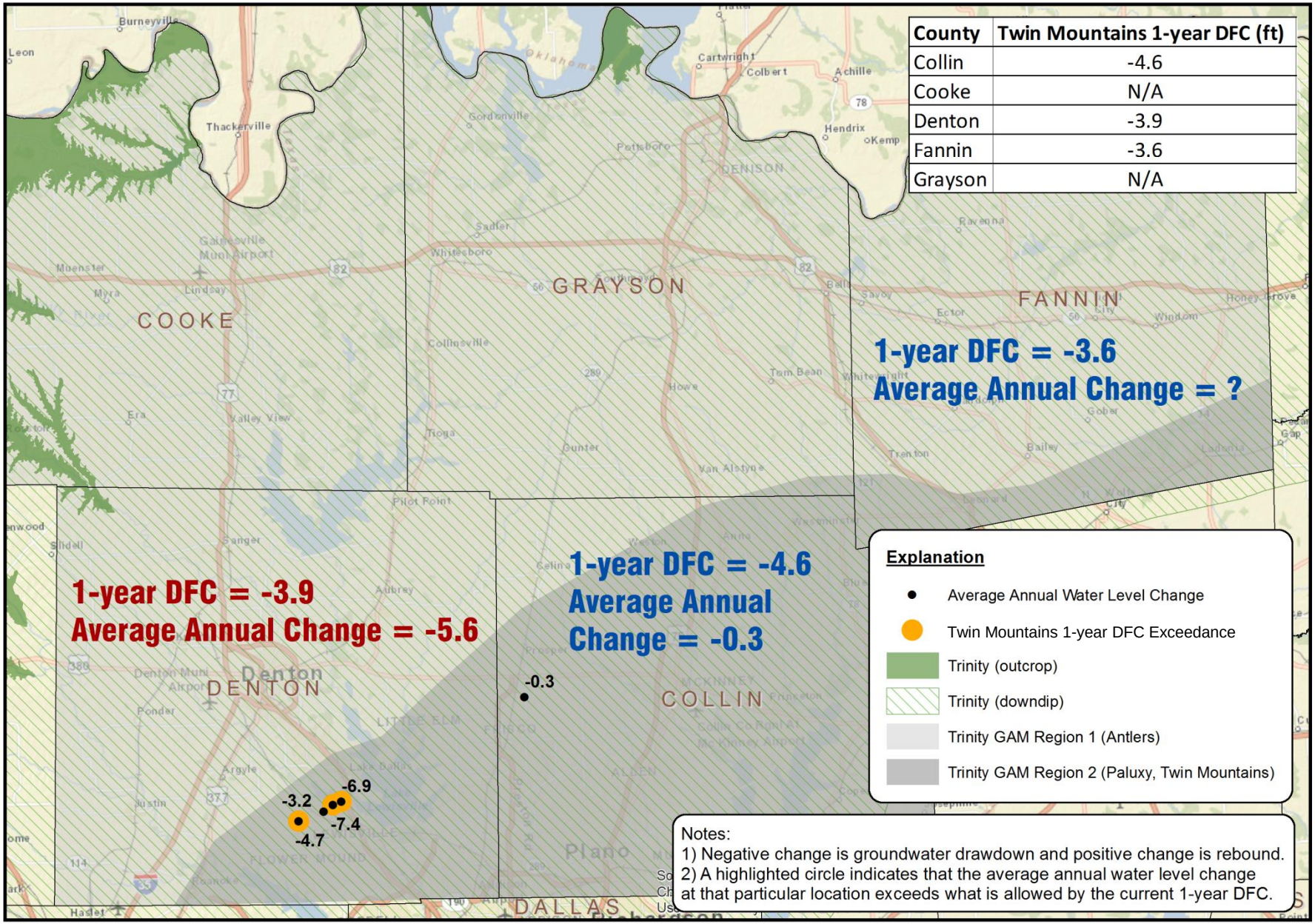
TRINITY ANTLERS AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015

County	Paluxy 1-year DFC (ft)
Collin	-6.0
Cooke	N/A
Denton	-2.0
Fannin	-4.2
Grayson	N/A



LBG-GUYTON ASSOCIATES

TRINITY PALUXY AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015



County	Twin Mountains 1-year DFC (ft)
Collin	-4.6
Cooke	N/A
Denton	-3.9
Fannin	-3.6
Grayson	N/A

LBG-GUYTON ASSOCIATES

0 5 10
Miles

N

TRINITY TWIN MOUNTAINS AQUIFER
AVERAGE ANNUAL WATER LEVEL CHANGE
2000-2015

Summary of Water Levels /DFCs

	Woodbine	Antlers	Paluxy	Twin Mountains
Fannin	Less than DFC	No Data	Less than DFC	No Data
Grayson	Less than DFC	Less than DFC	N/A	N/A

FINE PRINT

- Preliminary data and analysis
- Based on arithmetic averages of wells by county
- Evaluation not meant to imply any regulatory response

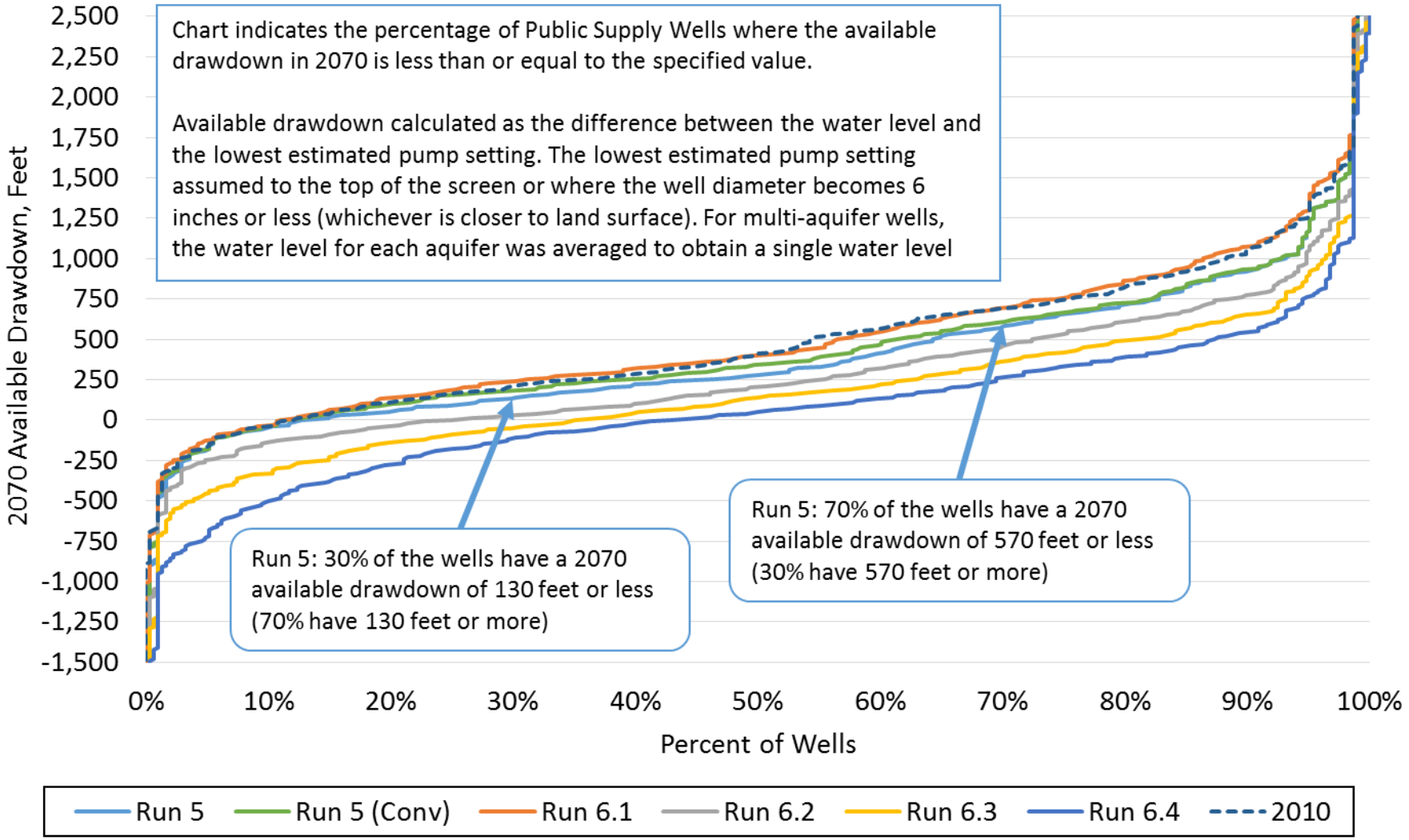
Summary of Water Levels/ DFCs

- Woodbine: Good monitoring well coverage, could use a couple more in Fannin County, no county average busts the DFC
- Antlers: No water level data in Fannin County, Grayson County average water level change busts DFC
- Paluxy: Another monitoring well in Fannin County would be helpful, no county average busts the DFC
- Twin Mountains: N/A?

Available Drawdown in 2070

- Public Water Supply wells
- 2070 available drawdown calculated above the "lowest" possible pump setting
  - Top of the screen
  - 6" casing or screen
- Water levels were averaged across multiple layers as appropriate in Hydrogeologic Regions 1 and 2
- Simulated water levels represent regional condition – therefore, 24-hour drawdown in each well needs to be accounted for when assessing well impacts – these impacts are not included in this analysis

Red River Groundwater Conservation District
Aquifer Desired Future Conditions Evaluations
Northern Trinity / Woodbine GAM Run Results
Available Drawdown in Public Water Supply Wells

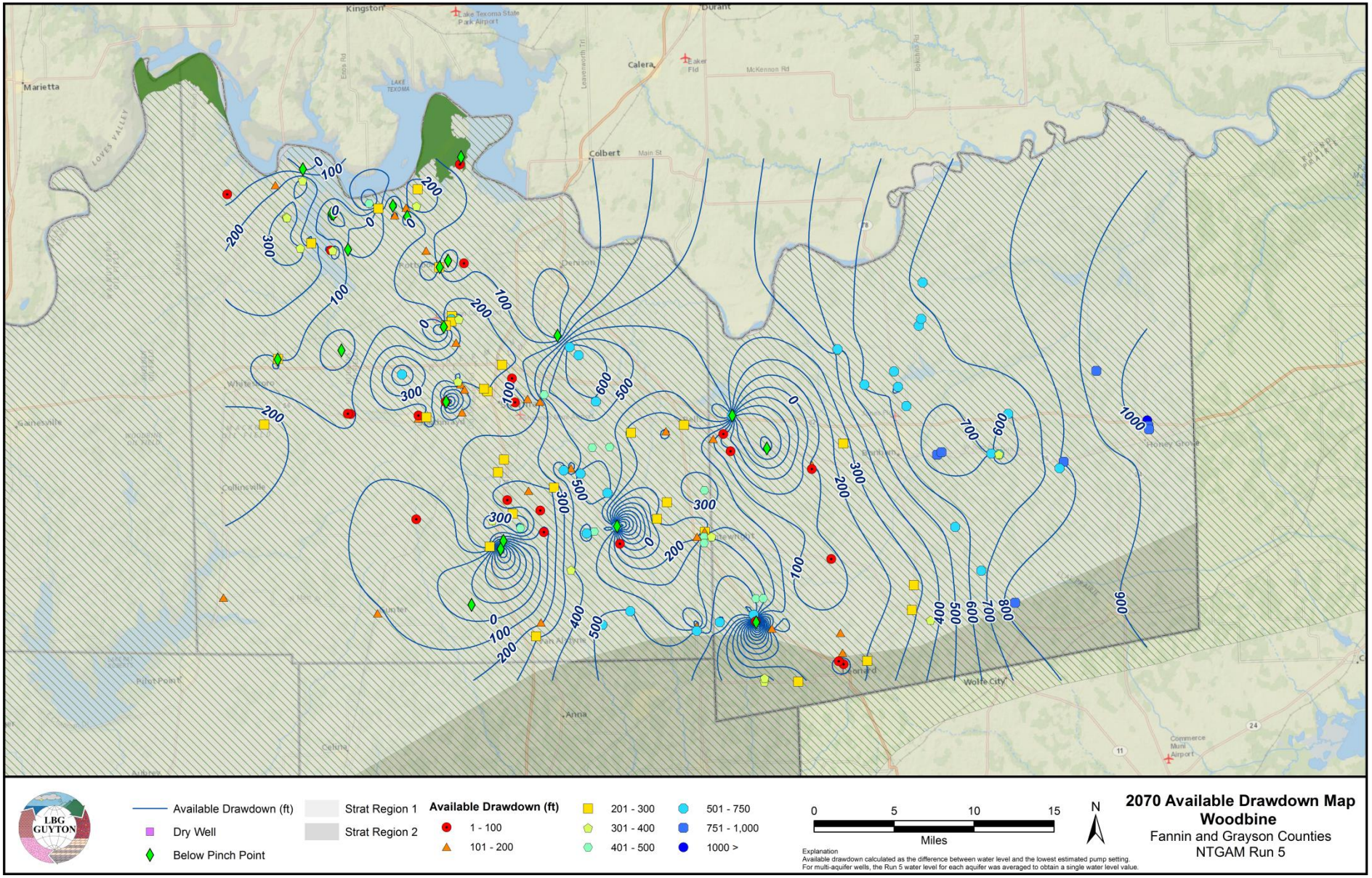


Runs 5 and 6

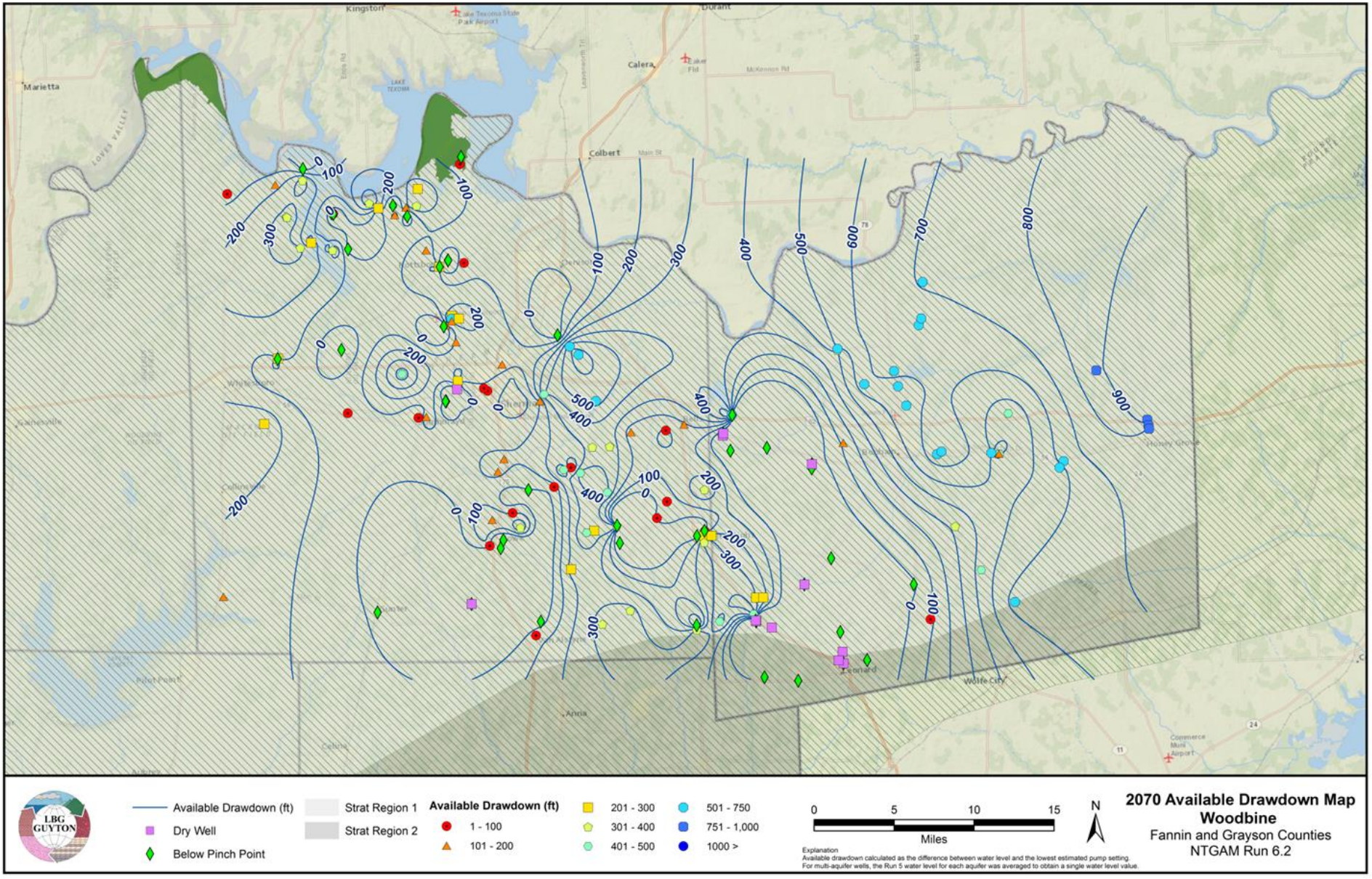
- **RUN 5** - "Status quo" pumping run, Baseline for comparing other GAM runs

- **RUN 6** - Modify pumping rates from Run 5
  - 6.2 = 130% of 2010 pumping
  - 6.4 = 190% of 2010 pumping

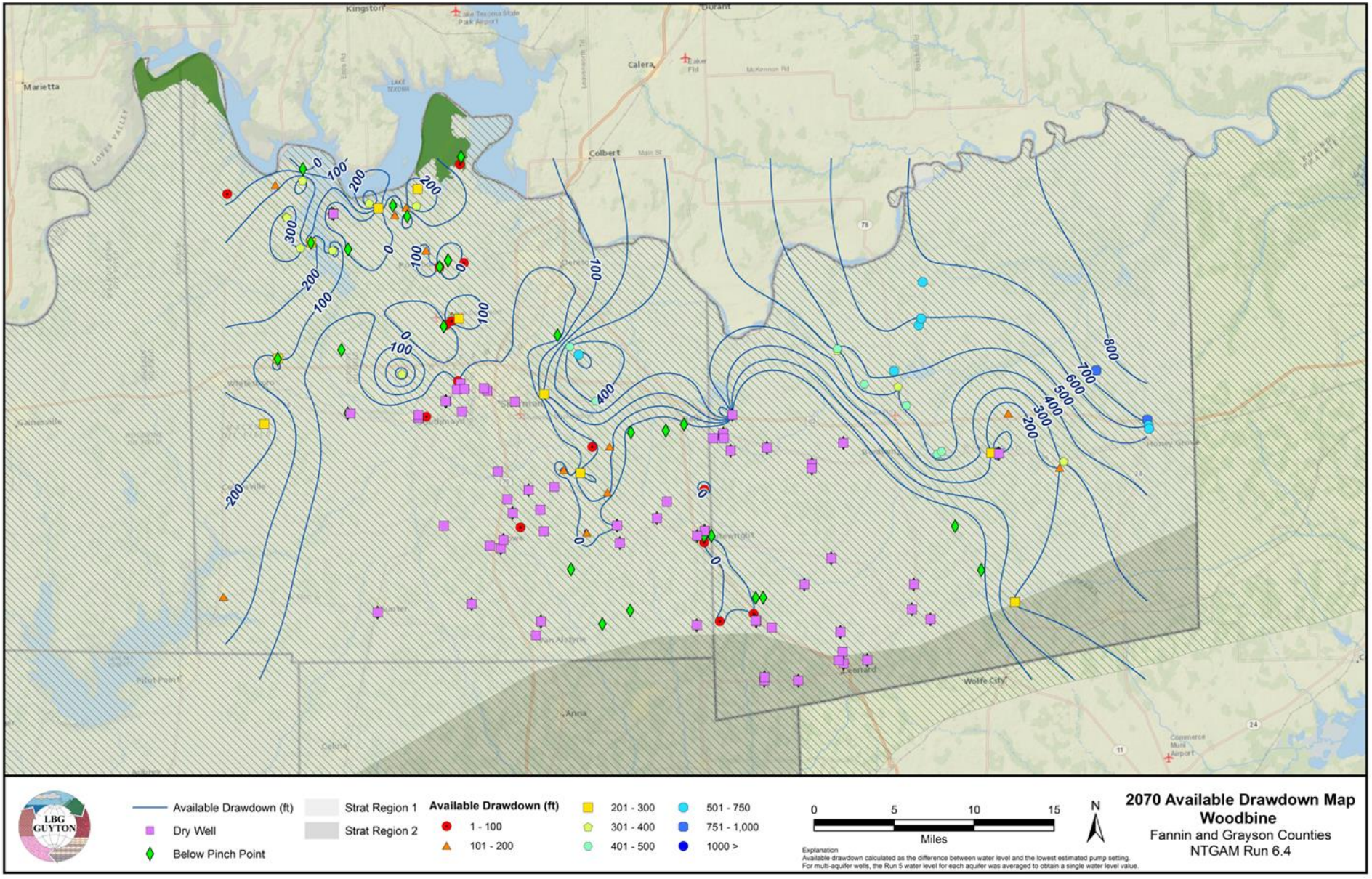
Woodbine – Run 5 (2010 Constant Pumping thru 2070)
Status of Public Water Supply Wells in 2070



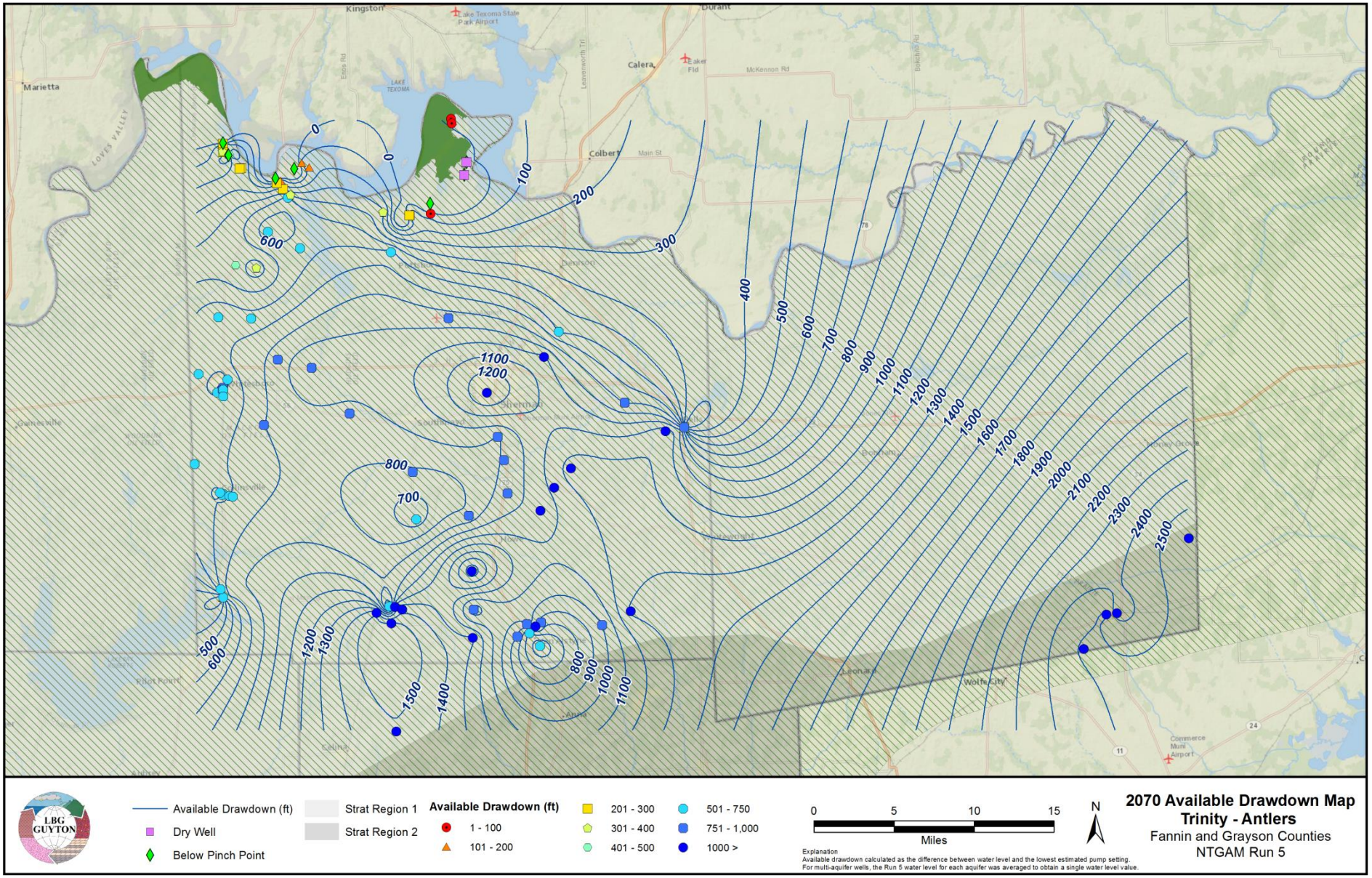
Woodbine – Run 6.2 (1.3x 2010 pumping)
Status of Public Water Supply Wells in 2070



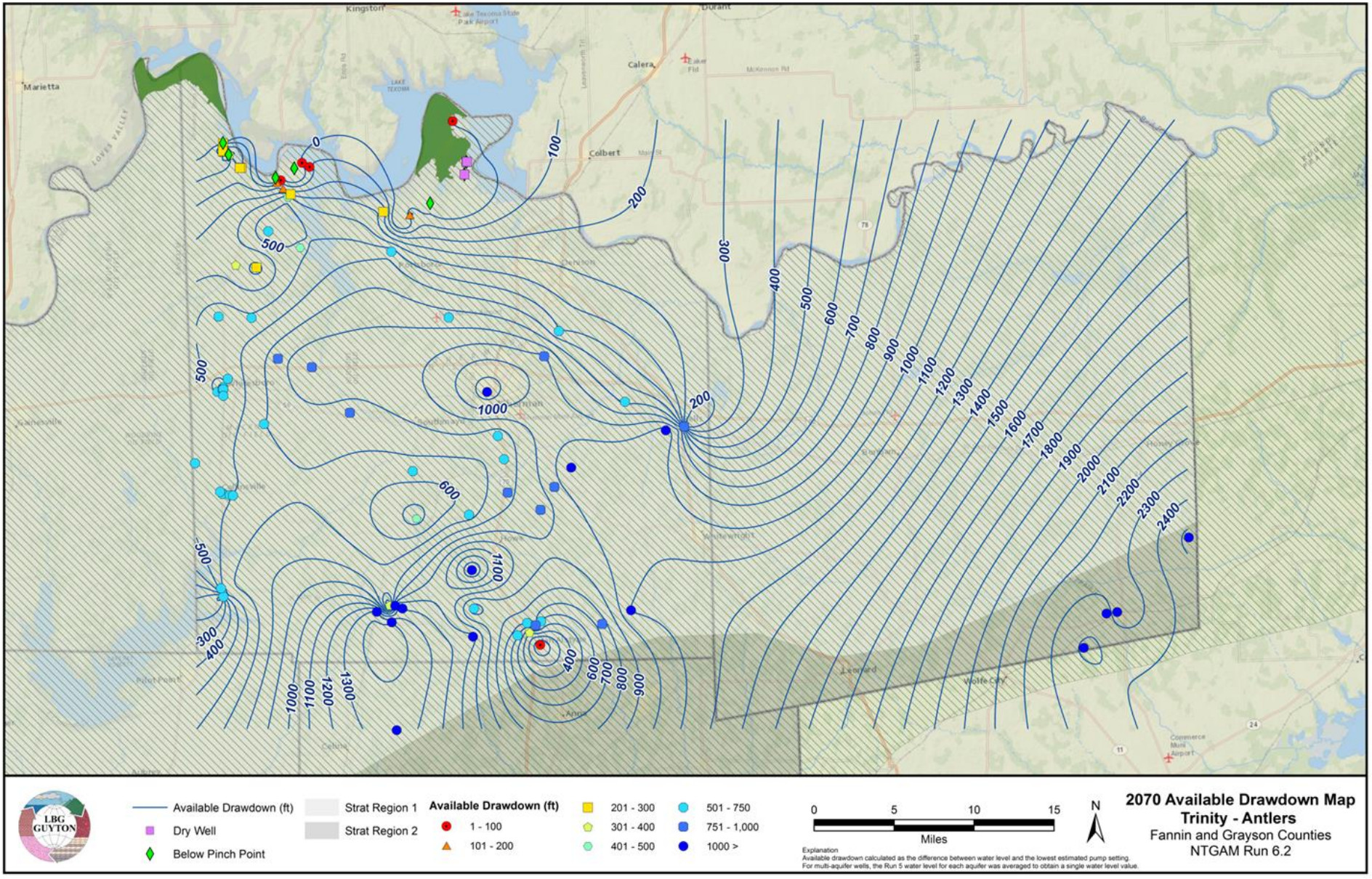
Woodbine – Run 6.4 (1.9 x 2010 pumping)
Status of Public Water Supply Wells in 2070



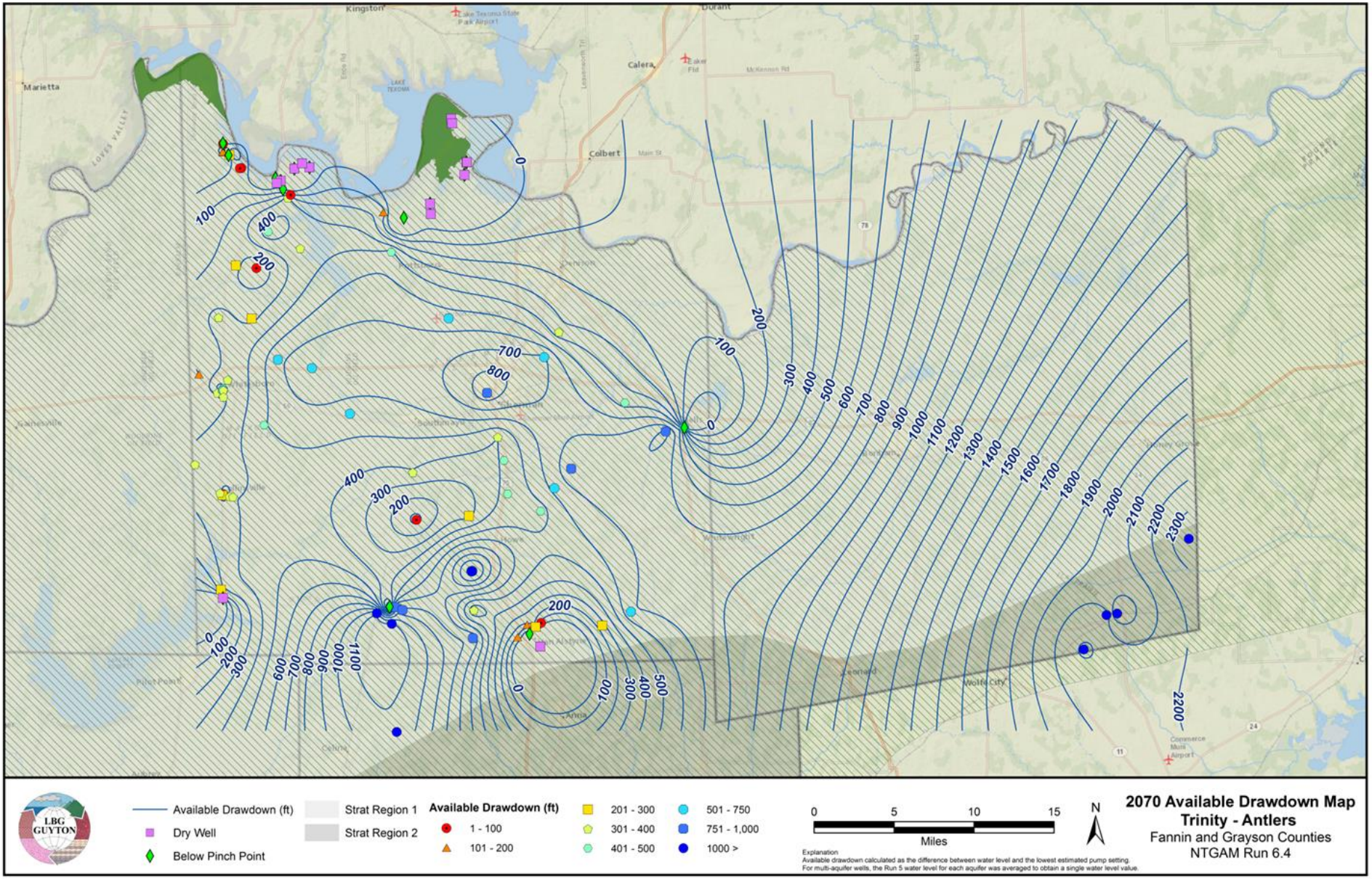
Trinity Antlers – Run 5 (2010 Constant Pumping thru 2070)
Status of Public Water Supply Wells in 2070



Trinity Antlers – Run 6.2 (1.3x 2010 pumping)
Status of Public Water Supply Wells in 2070



Trinity Antlers – Run 6.4 (1.9x 2010 pumping)
Status of Public Water Supply Wells in 2070



Issues…..

- How to state DFCs ?
  - Drawdown in 2070
  - Available drawdown in 2070
  - With the modeling approach and results - Each of these is possible
- Scale of DFC ?
  - GMA wide
  - County and aquifer
  - Downdip (confined) and Outcrop (unconfined)
  - Impact on Monitoring, Implementation, Petitions, Rules, Management Plans

What's next?

- Most districts are currently assessing the modeling results
- GMA-8 meeting on January 22
- Next Step: Based on everything you have learned
  - Discuss facts and develop a direction for GMA-8
  - Consider percent remaining available drawdown in 2070 as a DFC
  - Additional runs based on input from GCDs