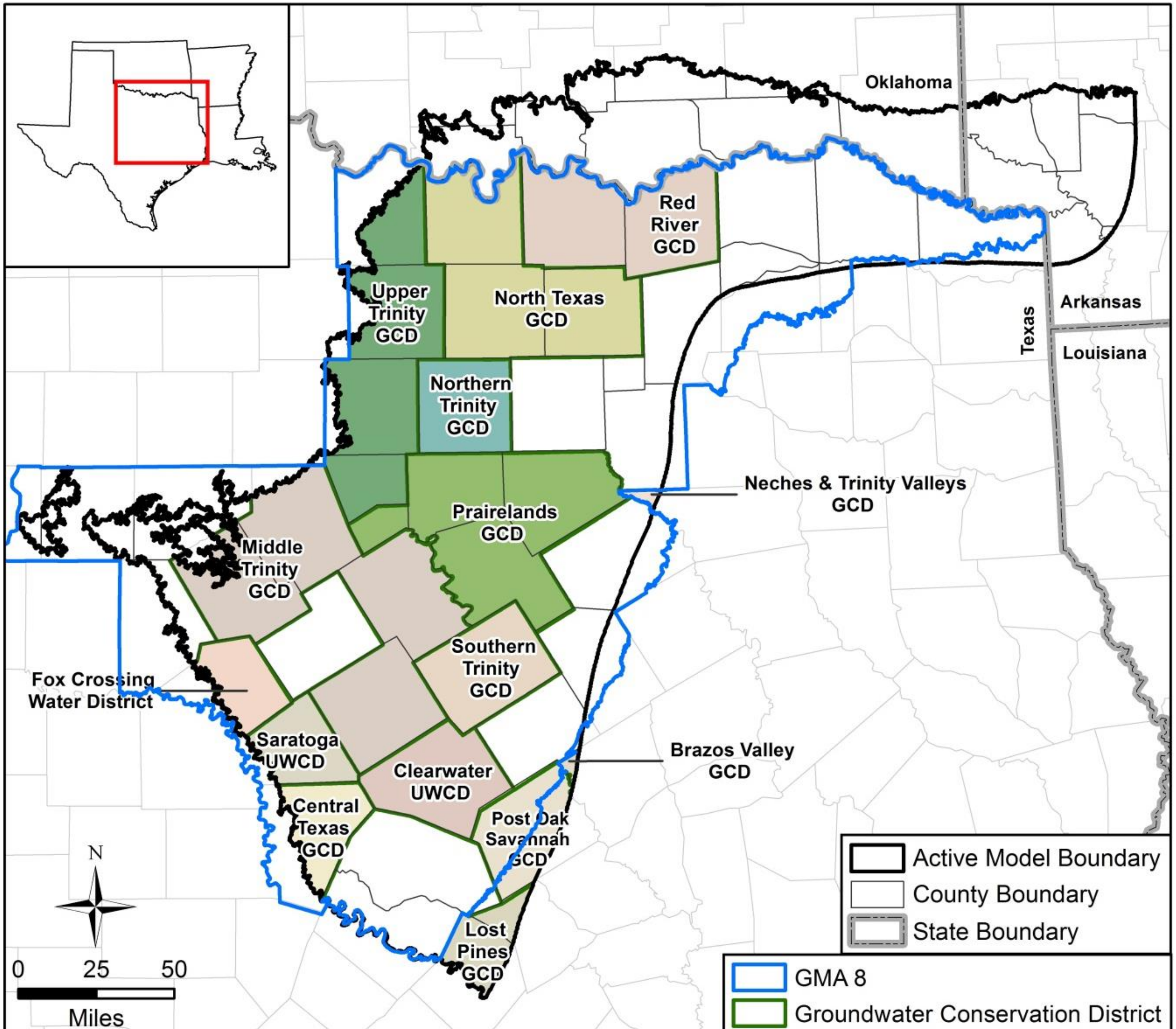
GMA 8 Consideration of TWC Section 36.108 (d)(1 – 5) Aquifer Use, Water Supply Needs, Water Management Strategies, Hydrologic Conditions, Natural Resources Issues and Subsidence

March 23, 2016

Cleburne, Texas

March 23
Agenda Item 8


Oklahoma
Red River GCD
Upper Trinity GCD
North Texas GCD
Northern Trinity GCD
Texas
Arkansas
Louisiana
Neches & Trinity Valleys GCD
Prairelands GCD
Middle Trinity GCD
Southern Trinity GCD
Fox Crossing Water District
Saratoga UWCD
Clearwater UWCD
Brazos Valley GCD
Central Texas GCD
Post Oak Savannah GCD
Lost Pines GCD
N
0 25 50
Miles
Active Model Boundary
County Boundary
State Boundary
GMA 8
Groundwater Conservation District

DFC Options Approved for Consideration

- DFCs included in **NTWGAM Run 10** by aquifer, by region, and by county, for the -
  - Trinity
  - Woodbine

DFC Options Approved for Consideration

- DFCs for the northern segment of thee Edwards Aquifer requested by Clearwater GCD included in **GAM Run 08-10**
  - Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the drought of record in Bell County.
  - Maintain at least 42 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record in Travis County.
  - Maintain at least 60 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record in Williamson County.

MapRef	Aquifer	County	RWPA	River Basin	GCD	GMA	GeoArea	Year	MAG (Acre-feet per year)
1	EBFZ_N	Bell	G	Brazos	Clearwater	8	n/a	n/a	6,469
2	EBFZ_N	Williamson	G	Brazos	None	8	n/a	n/a	3,351
3	EBFZ_N	Williamson	G	Colorado	None	8	n/a	n/a	101
4	EBFZ_N	Williamson	K	Brazos	None	8	n/a	n/a	6
5	EBFZ_N	Williamson	K	Colorado	None	8	n/a	n/a	4
6	EBFZ_N	Travis	K	Brazos	None	8	n/a	n/a	275
7	EBFZ_N	Travis	K	Colorado	None	8	n/a	n/a	4,962
									15,168

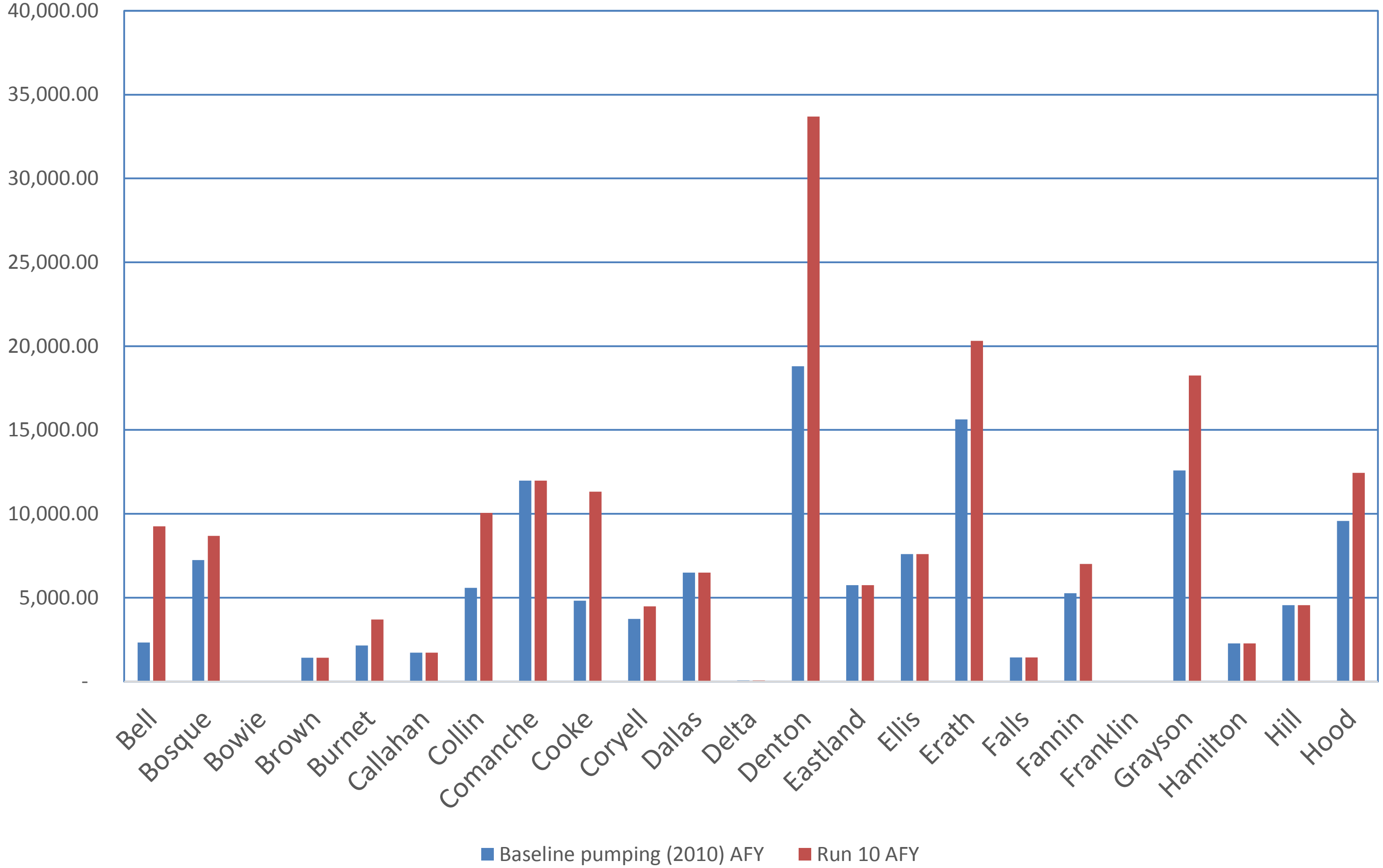
DFC Options Approved for Consideration

- DFCs for Ellenburger, San Saba, Hickory, and Marble Falls aquifers in Central Texas GCD and Saratoga GCD. MAGs will be determined by TWDB upon submission of Explanatory Report.
  - Ellenburger-San Saba Aquifer – maintain 90 percent of saturated thickness from 2010 to 2070
  - Hickory Aquifer – maintain 90 percent of saturated thickness from 2010 to 2070
  - Marble Falls Aquifer – maintain 90 percent of saturated thickness from 2010 to 2070

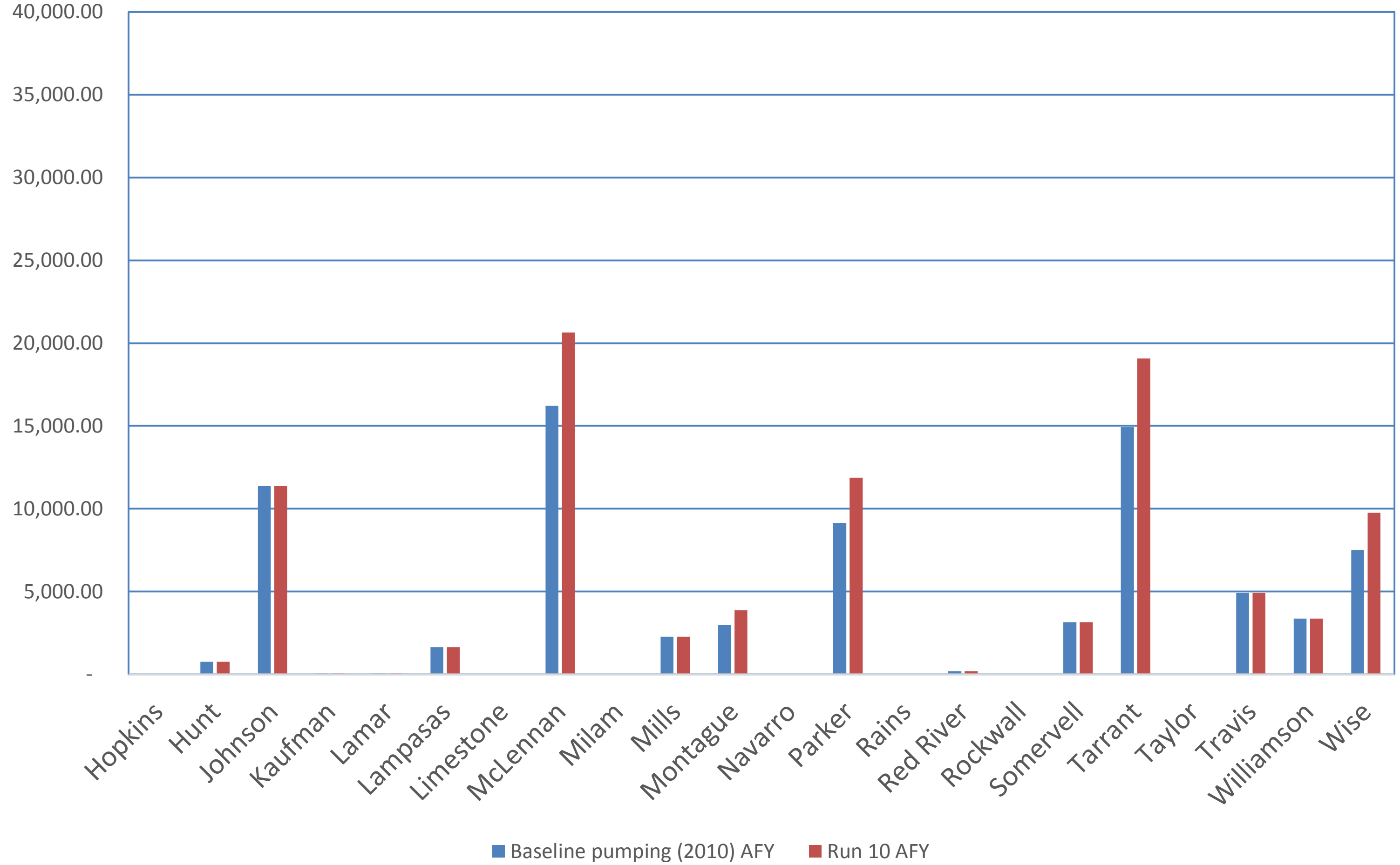
DFC Options Approved for Consideration

- GMA 8 District Representatives have designated the following aquifers in GMA 8 as non-relevant for the purposes of joint-planning, as allowed by 31 Texas Administrative Code Section 356.31
  - Blossom Aquifer
  - Brazos Valley Alluvuim
  - Nacatoch Aquifer

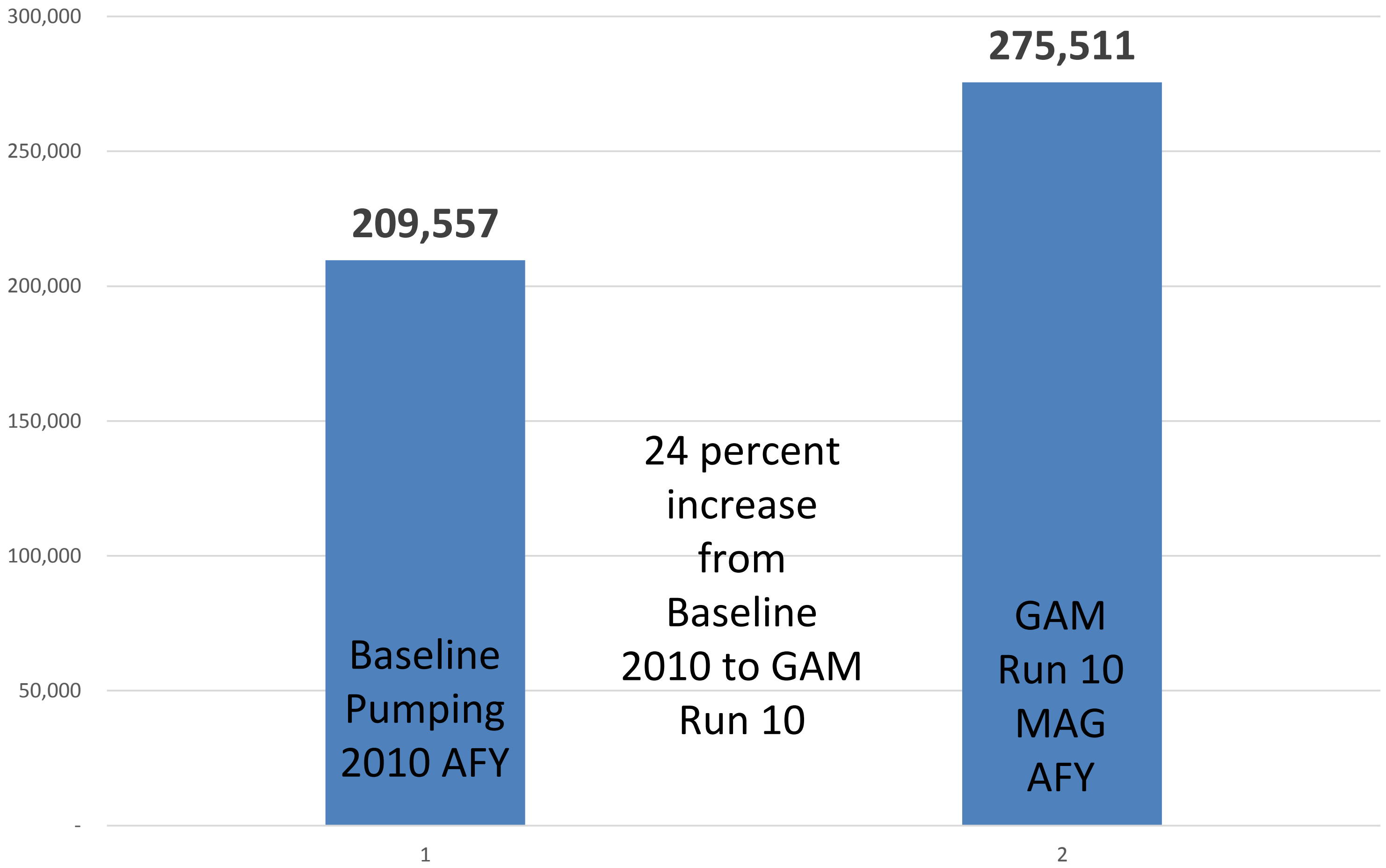
GMA 8 Baseline Pumping (2010) vs. DFC Option-GAM Run 10



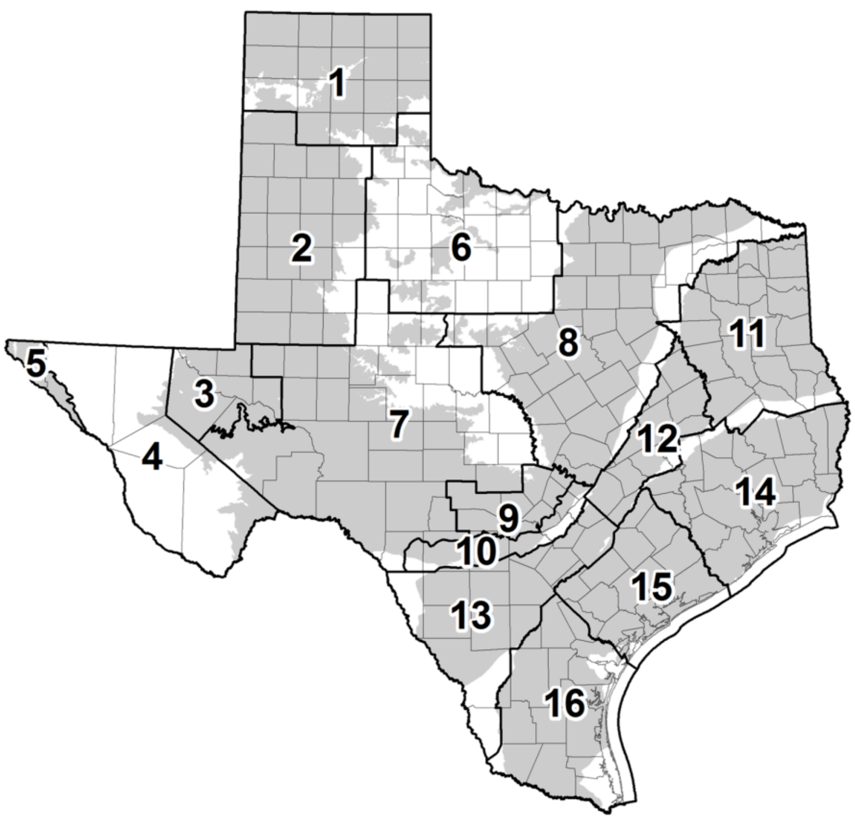
GMA 8 Baseline Pumping (2010) vs. DFC Option-GAM Run 10



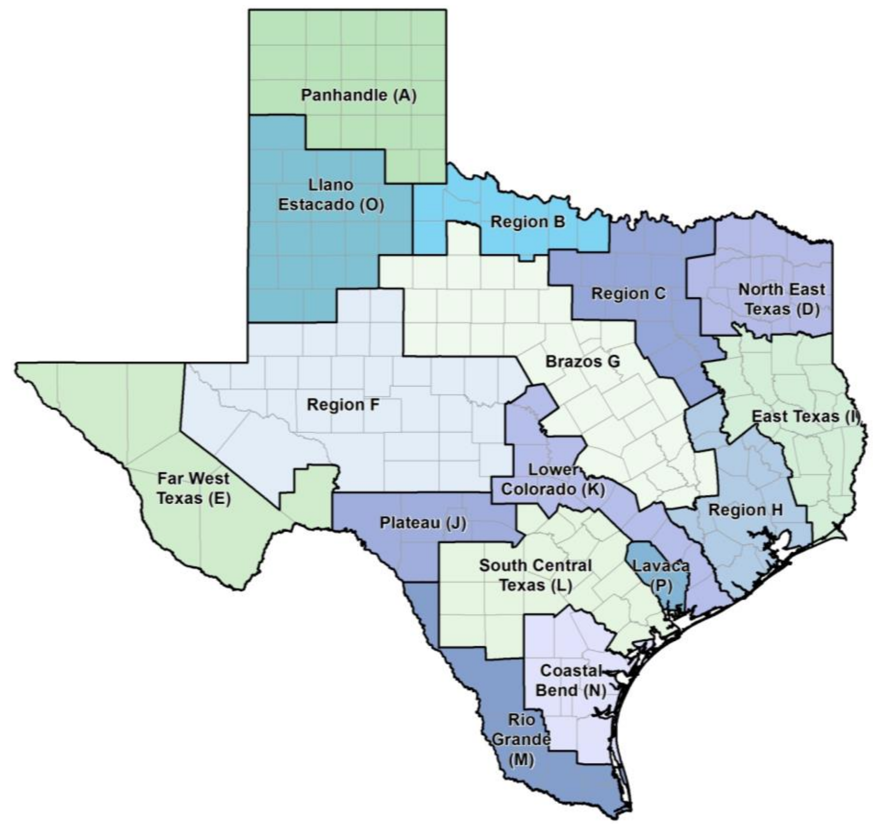
GMA 8 Baseline Pumping (2010) vs. DFC Option-GAM Run 10 - Total



Water Planning in Texas

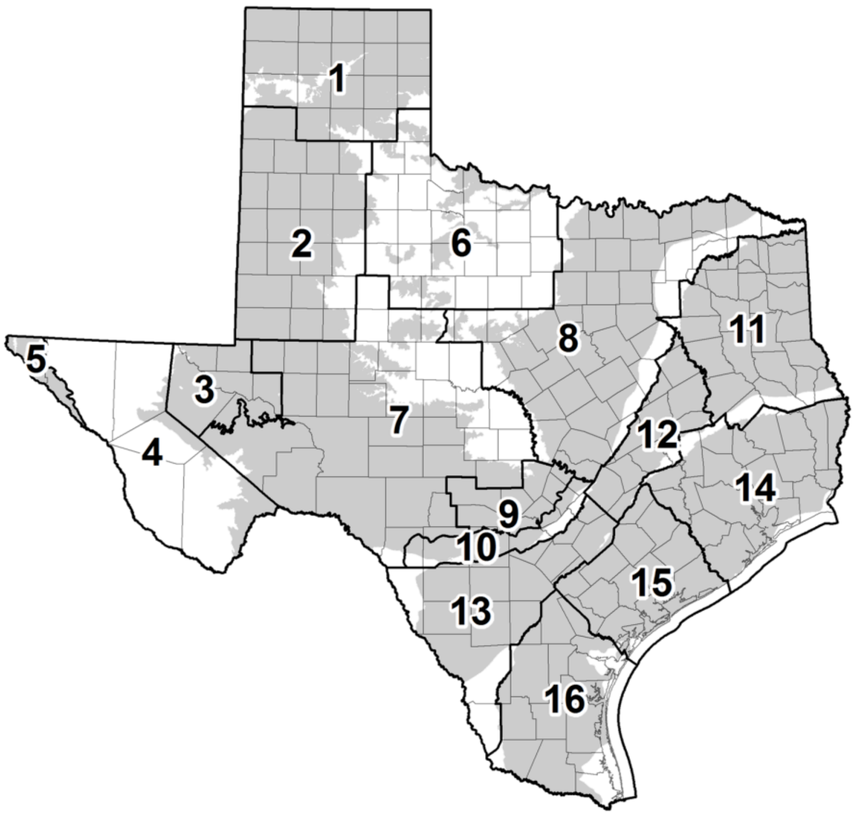


GMA Joint Planning

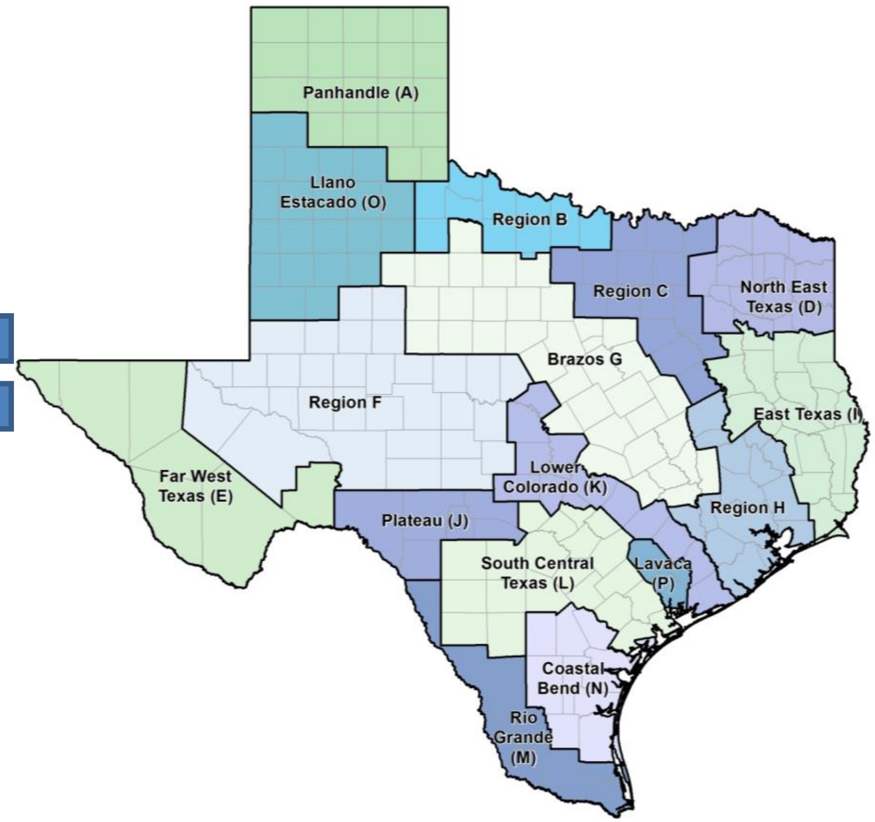


Regional Water Planning

Water Planning in Texas



GMA Joint Planning



Regional Water Planning

Aquifer Uses and Conditions TWC Section 36.108 (d)(1)

- Districts shall consider aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another. Texas Water Code 36.108 (d)(1)

Aquifer Uses and Conditions

- Aquifer uses – consideration is a function of scale of management.
  - GMA
  - GCD
  - County
  - Water use sector
  - Aquifer (or subdivision of an aquifer)

Primary Groundwater Use Data Source

- The primary source for GMA 8 for water use (including groundwater use) is the TWDB Water Use Survey (Texas Water Code 16.012 (m)) as follows:

The executive administrator may conduct surveys of entities using groundwater and surface water at intervals determined appropriate by the executive administrator to gather data to be used for long-term water supply planning. Recipients of the survey shall complete and return the survey to the executive administrator. A person who fails to timely complete and return the survey is not eligible for funding from the board for board programs and is ineligible to obtain permits, permit amendments, or permit renewals from the commission under Chapter 11. A person who fails to complete and return the survey commits an offense that is punishable as a ***Class C misdemeanor****. Surveys obtained by the board from nongovernmental entities are excepted from the requirements of Section 552.021, Government Code, unless otherwise directed in writing by the person completing the survey. This subsection does not apply to survey information regarding windmills used for domestic and livestock use.*

TWDB Water Use Survey Database

- For historical groundwater use, information is available by:
  - Reporting entity (city, MUD, SUD, WSC, non-municipal sectors)
  - County
  - Aquifer
  - Water use sector
  - Pumped vs. Used

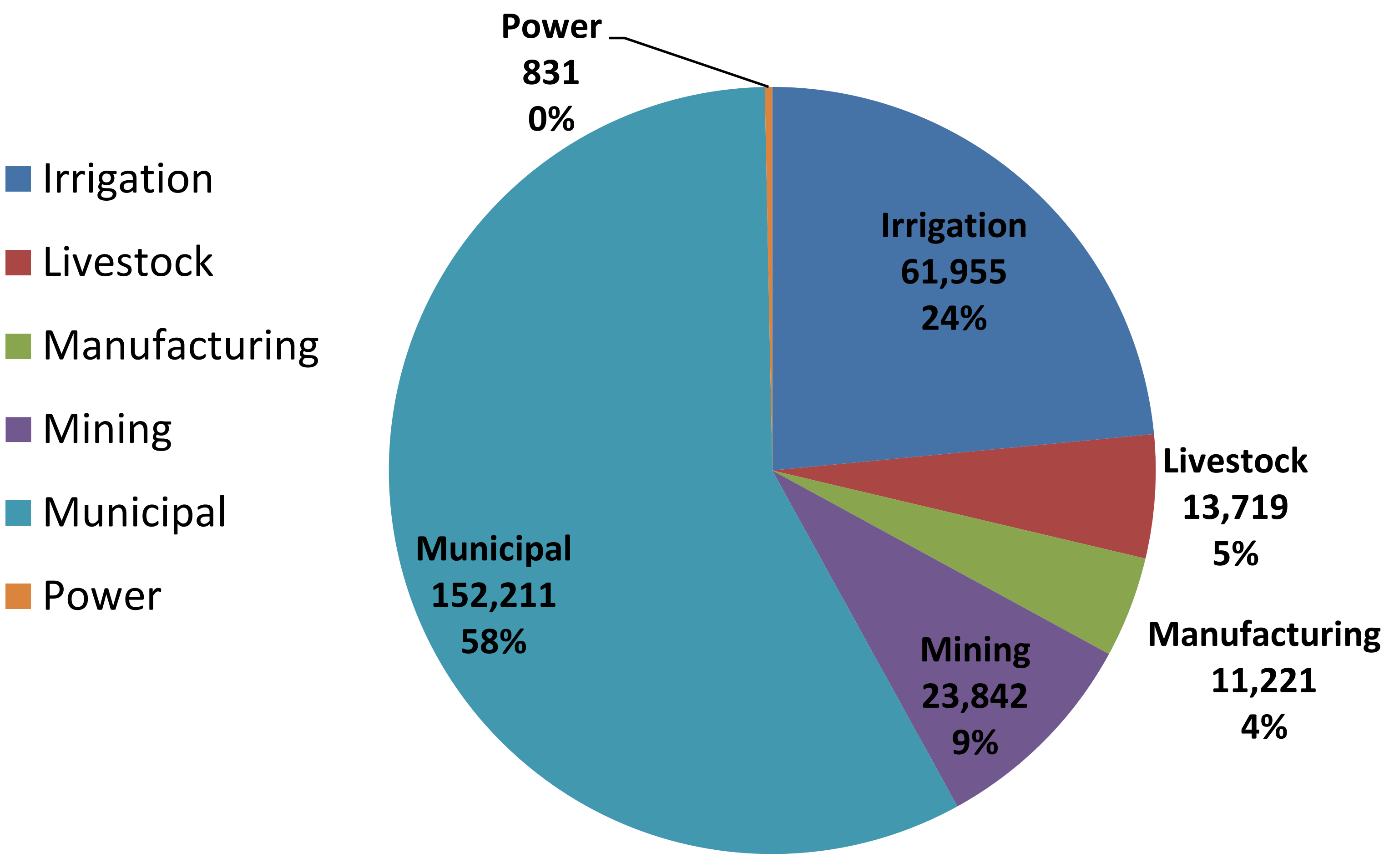
TWDB Water Use Survey Database

- All data presented in this presentation for consideration as required by TWC 36.108 (d)(1) are included in:
  - TWDBGroundwaterPumping_2007-2011_GMA8_Detail.pdf
  - TWDBGroundwaterPumping_2007-2011_GMA8_bySector.pdf

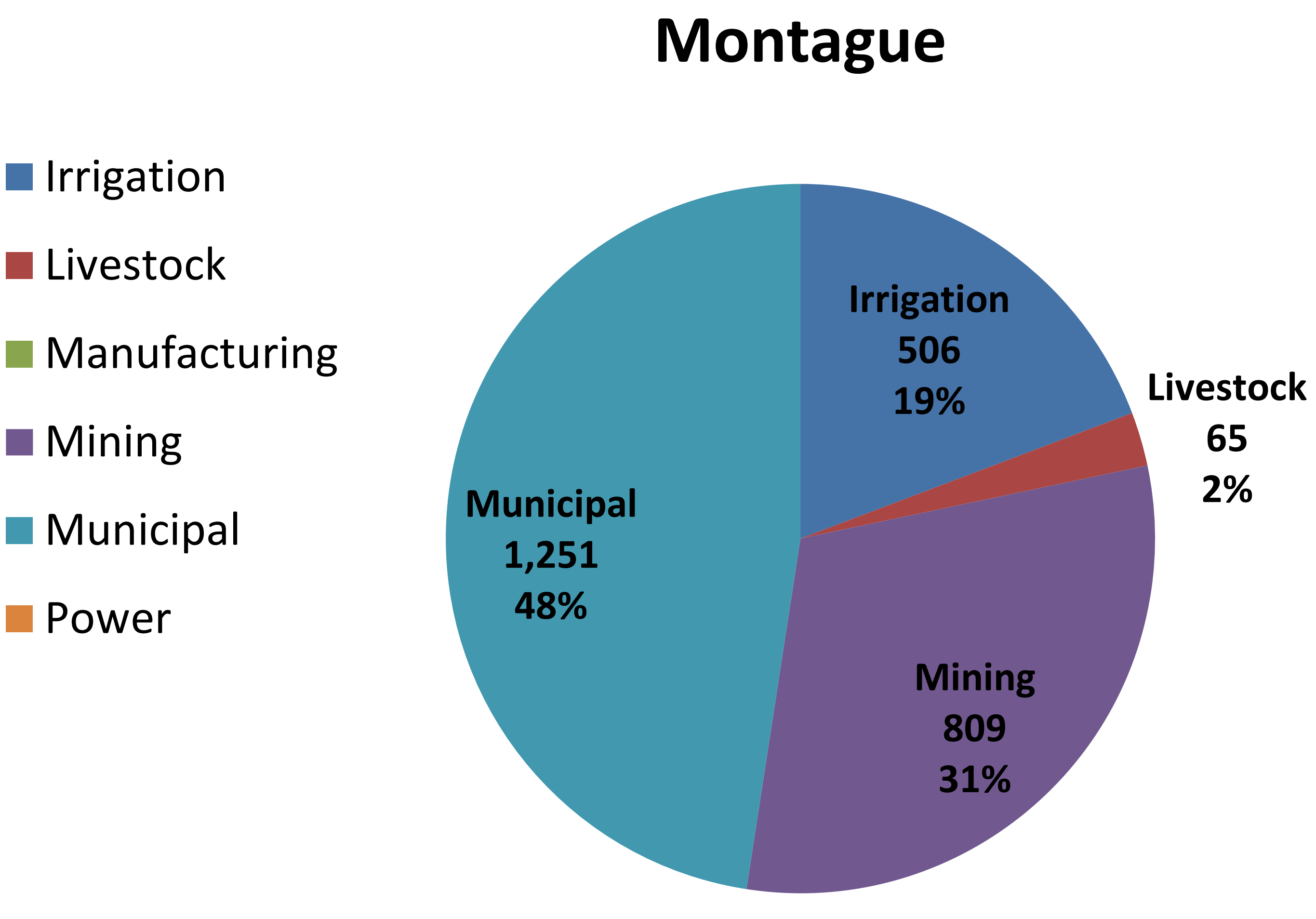
GMA 8 Water Use

- Water use information presented is the average groundwater pumping from 2007 – 2011.
- For data on individual years or other more detailed information please see tables included in Dropbox.

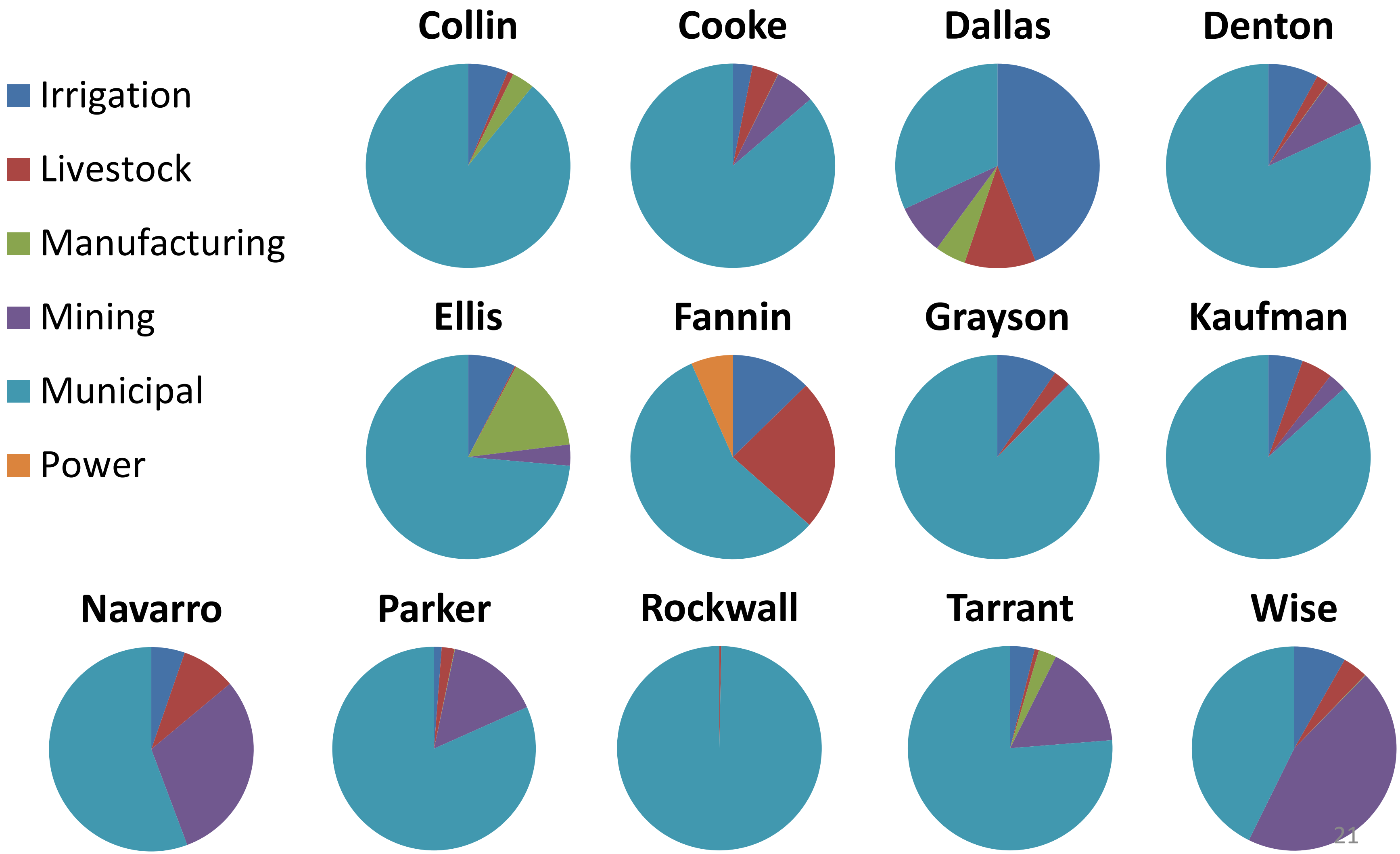
Groundwater Pumping by Type in GMA 8 - 2011



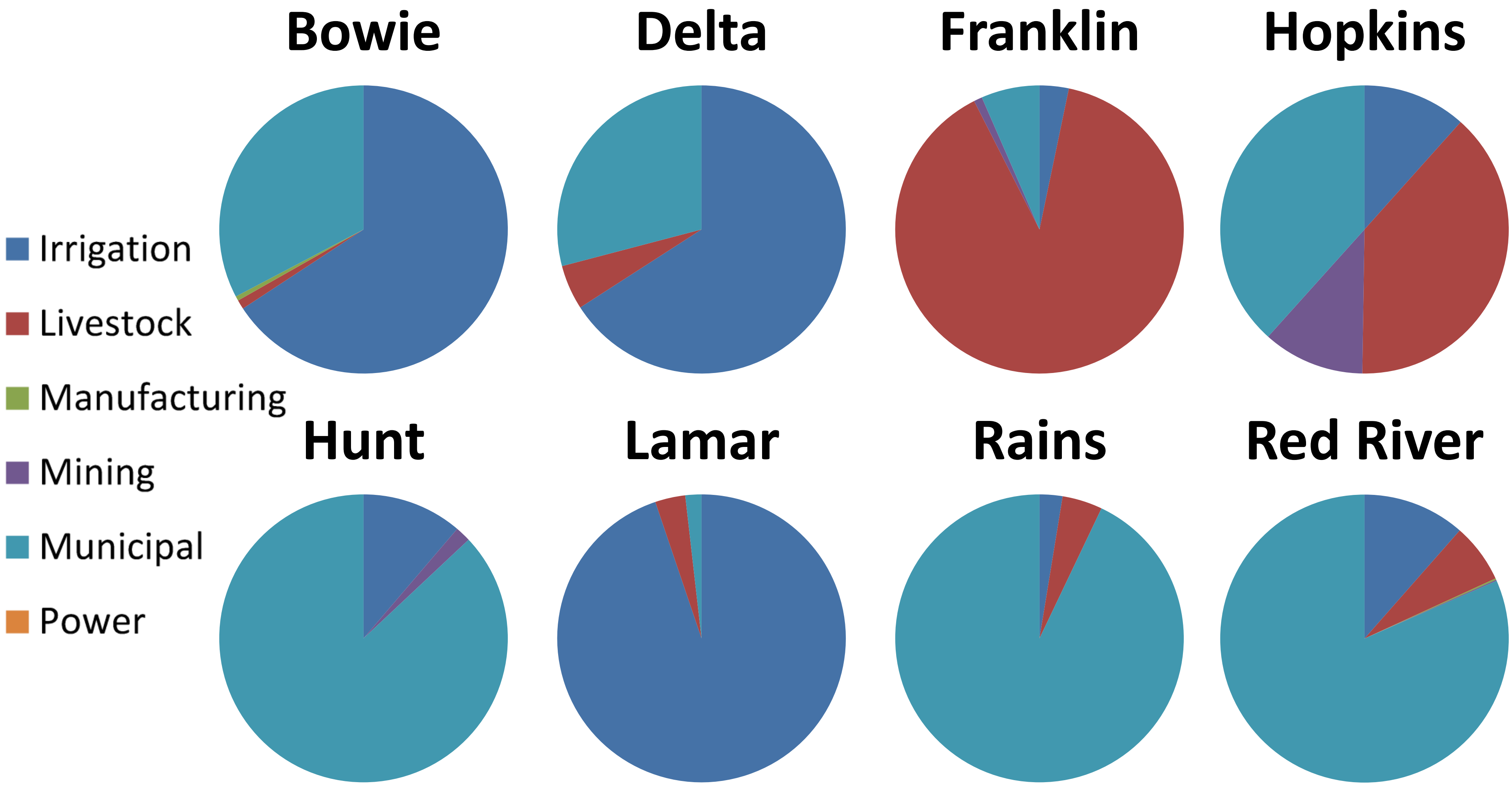
Groundwater Pumping by Type in GMA 8 – Region B



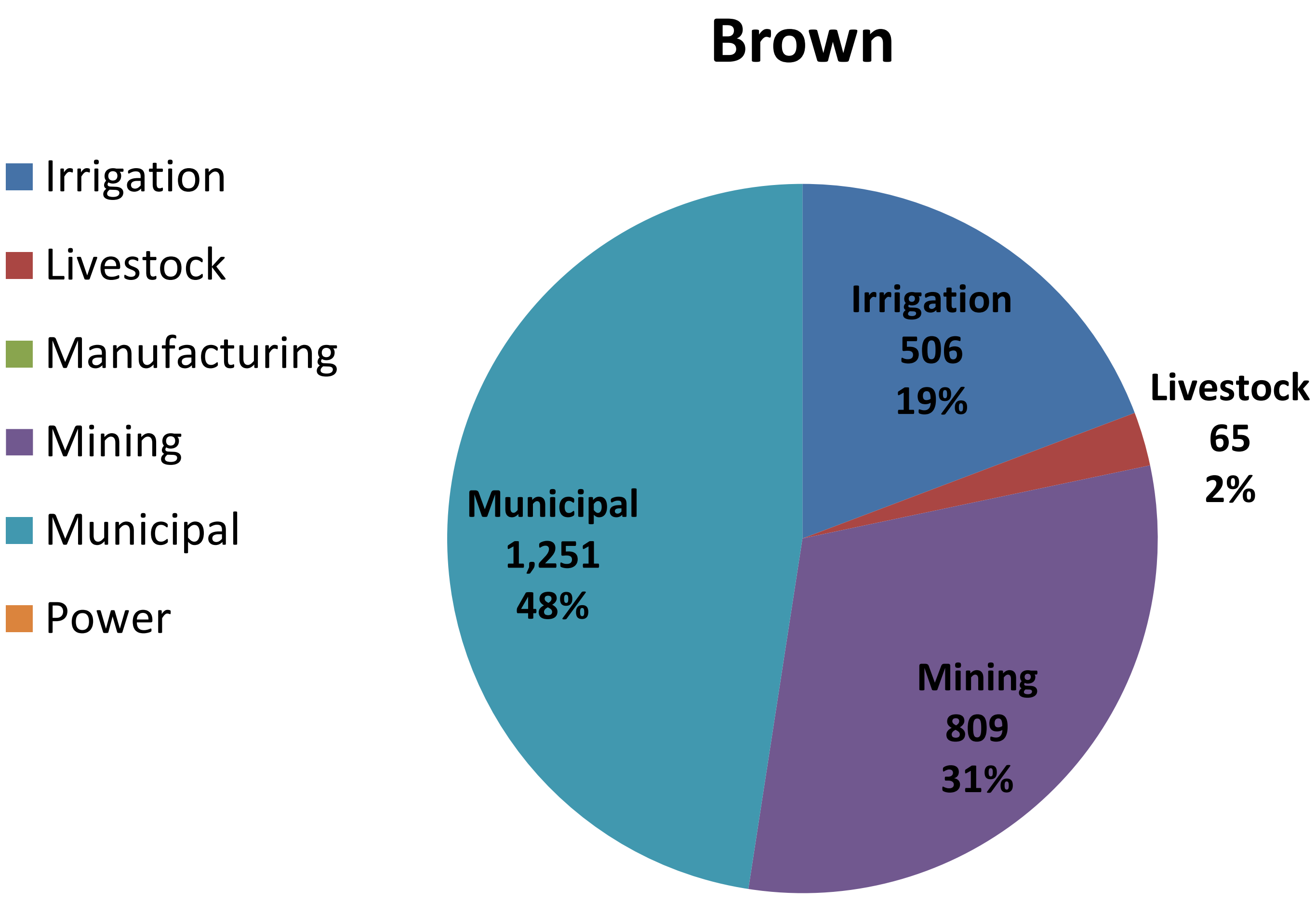
Groundwater Pumping by Type in GMA 8 – Region C



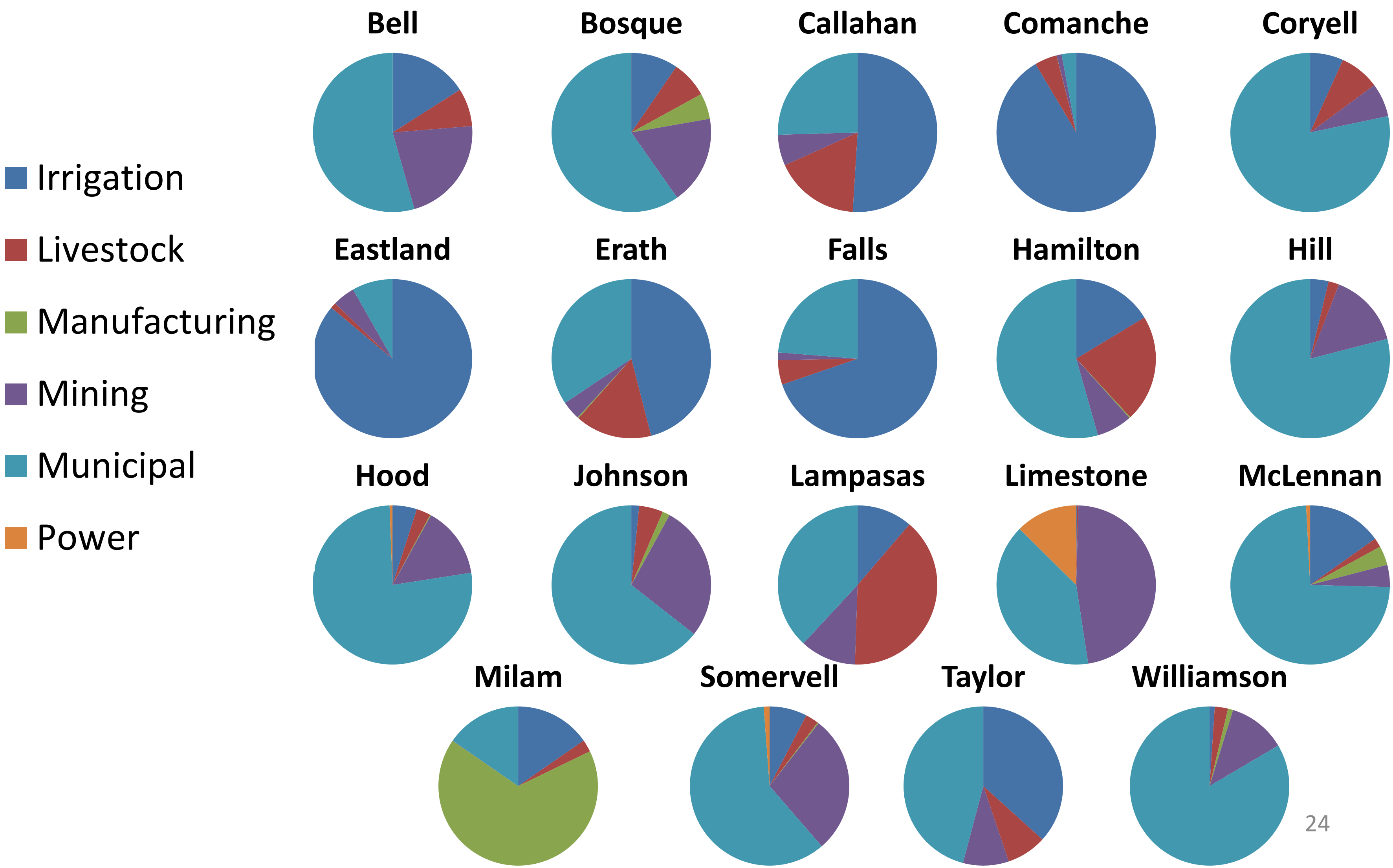
Groundwater Pumping by Type in GMA 8 – Region D



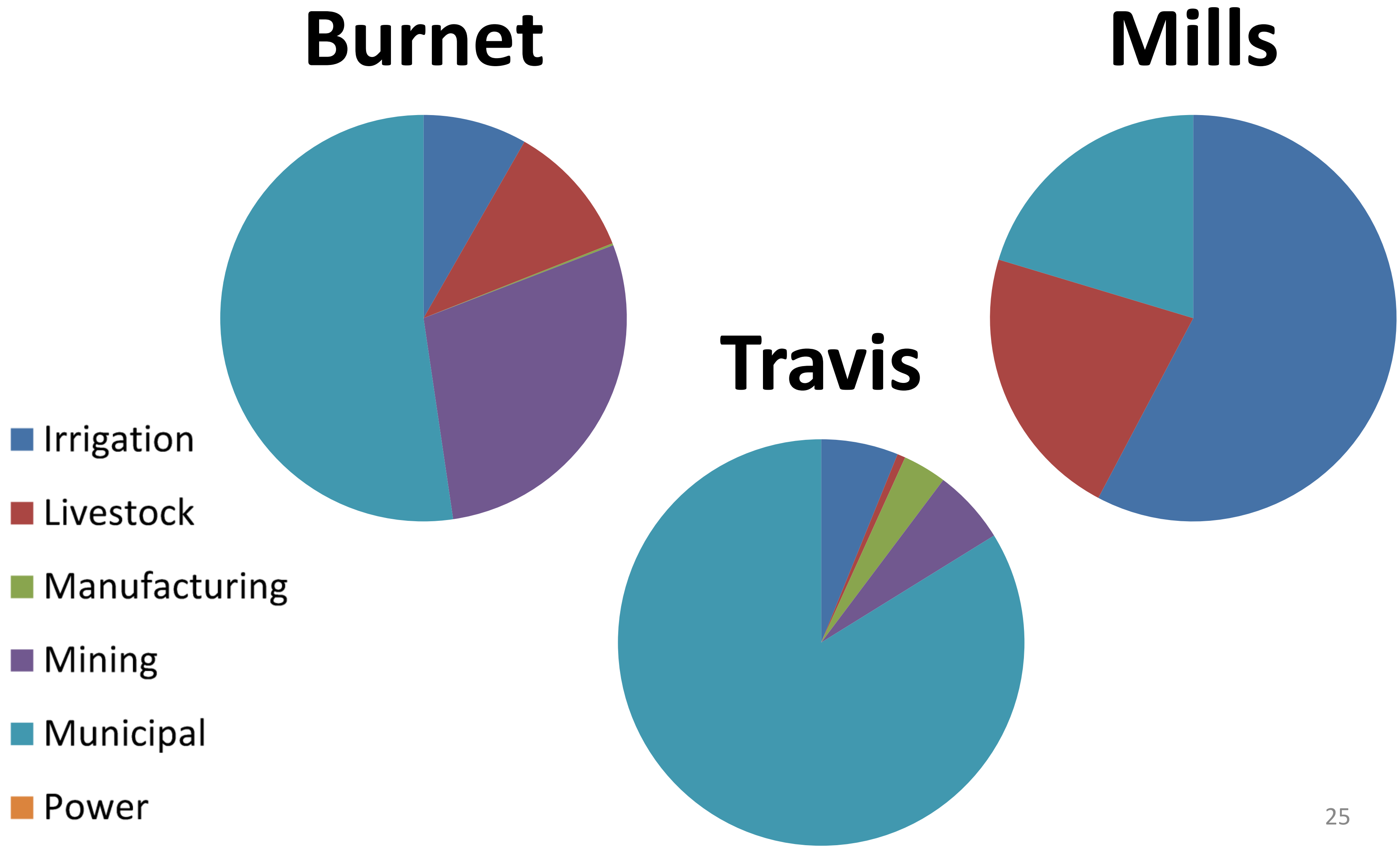
Groundwater Pumping by Type in GMA 8 – Region F



Groundwater Pumping by Type in GMA 8 – Region G



Groundwater Pumping by Type in GMA 8 – Region K

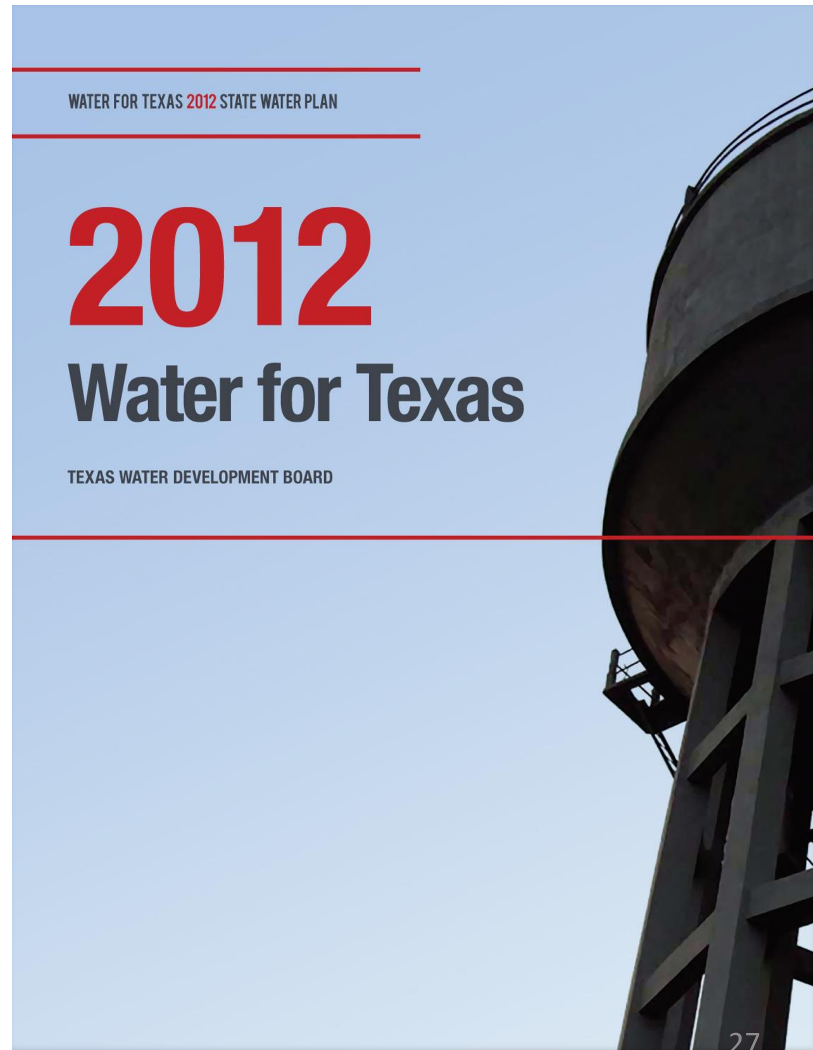


Water supply needs and water management strategies TWC Section 36.108 (d)(2)

- Districts shall consider water supply needs and water management strategies included in the state water plan.. Texas Water Code 36.108 (d)(2)

Water Supply Needs and Water Management Strategies

- For all GMAs, DFCs proposed by deadline of May 1, 2016 will be reviewed under 2012 SWP - TWDB



Water Planning Definitions (from 31 TAC 357)

- The definition of **water demand** (projections) as opposed to estimates of water use, in the planning process, is the volume of water projected to be needed during drought conditions. Water demand projections are always for the future. For the regional water planning process, they are calculated on a decadal basis. Water demand projections are not limited by any projections of supply (either surface water (WAM) or groundwater (GAM?MAG).

Water Planning Definitions

- The difference in **water demands** and currently accessible **water supplies** on a **water user group** or **wholesale water supplier** basis quantifies surpluses and ***needs***.
- **Water availability** is the maximum amount of water available from a source during the drought of record, regardless of whether the supply is physically or legally available to **water user groups**.
- Existing **water supply** is the maximum amount of water available from existing sources for use during drought of record conditions that is physically and legally available for use by a water user group

Water Planning Definitions

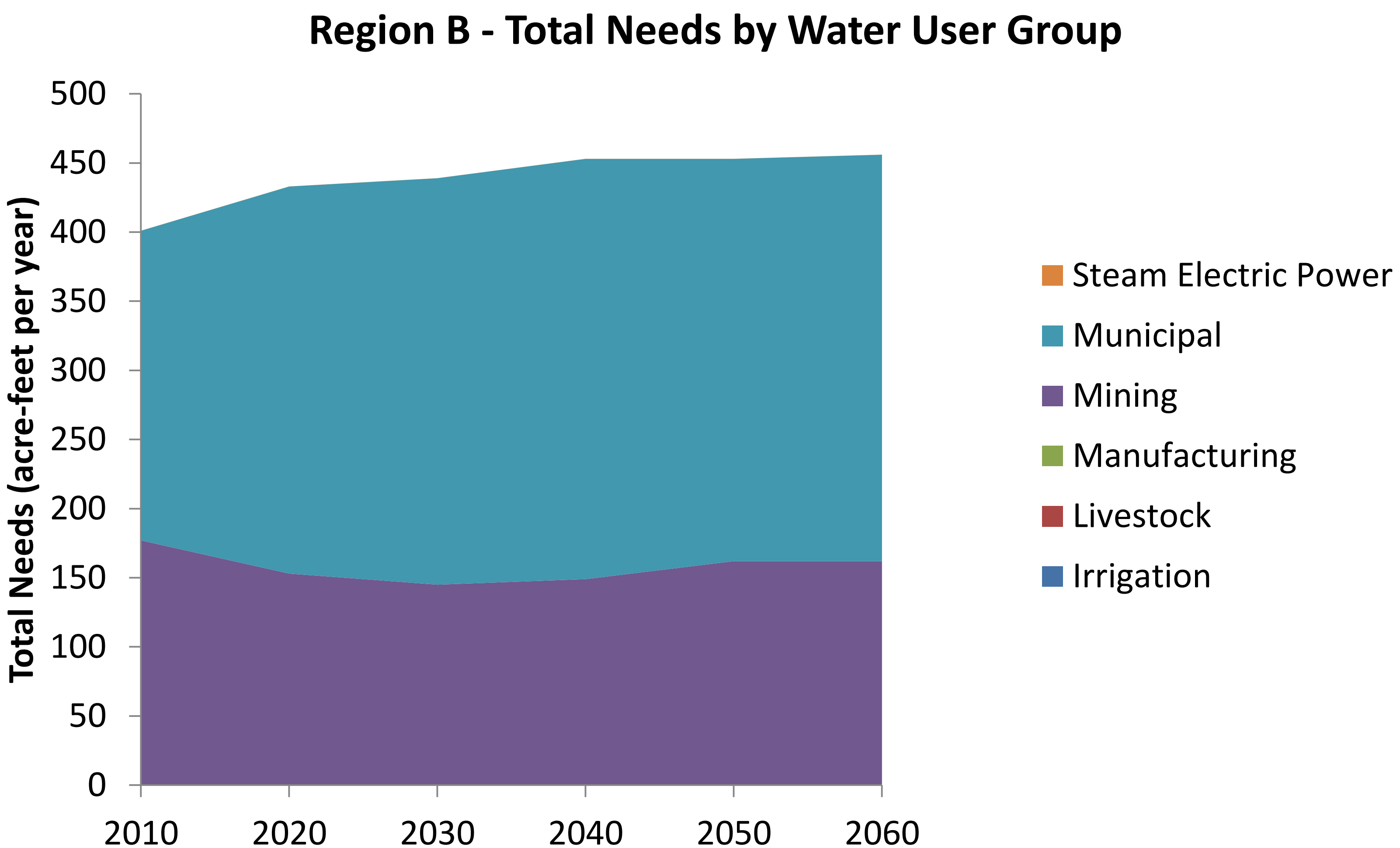
- **Water Management Strategy-**-A plan or specific project to meet a **need** for additional water by a discrete user group, which can mean increasing the total water supply or maximizing an existing supply, including through reducing demands
- **Water User Group (WUG)--**Identified user or group of users for which water demands and water supplies have been identified and analyzed and plans developed to meet water needs.

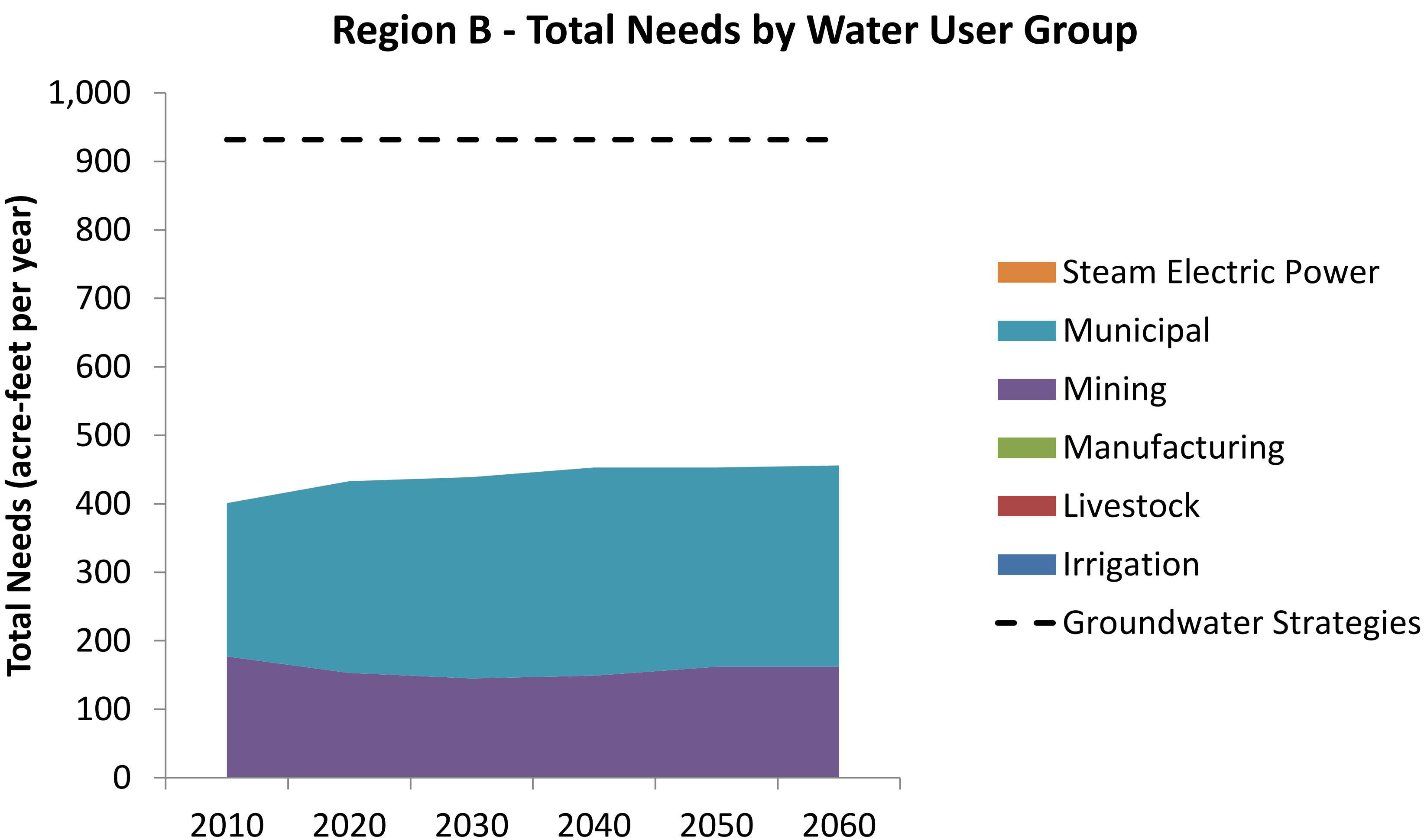
Water Planning Definitions

- **WUGs** include cities, and on a county aggregate basis rural, manufacturing, irrigation, steam electric power generation, mining, and livestock watering for each county.
- **Wholesale Water Provider (WWP)--**Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan.

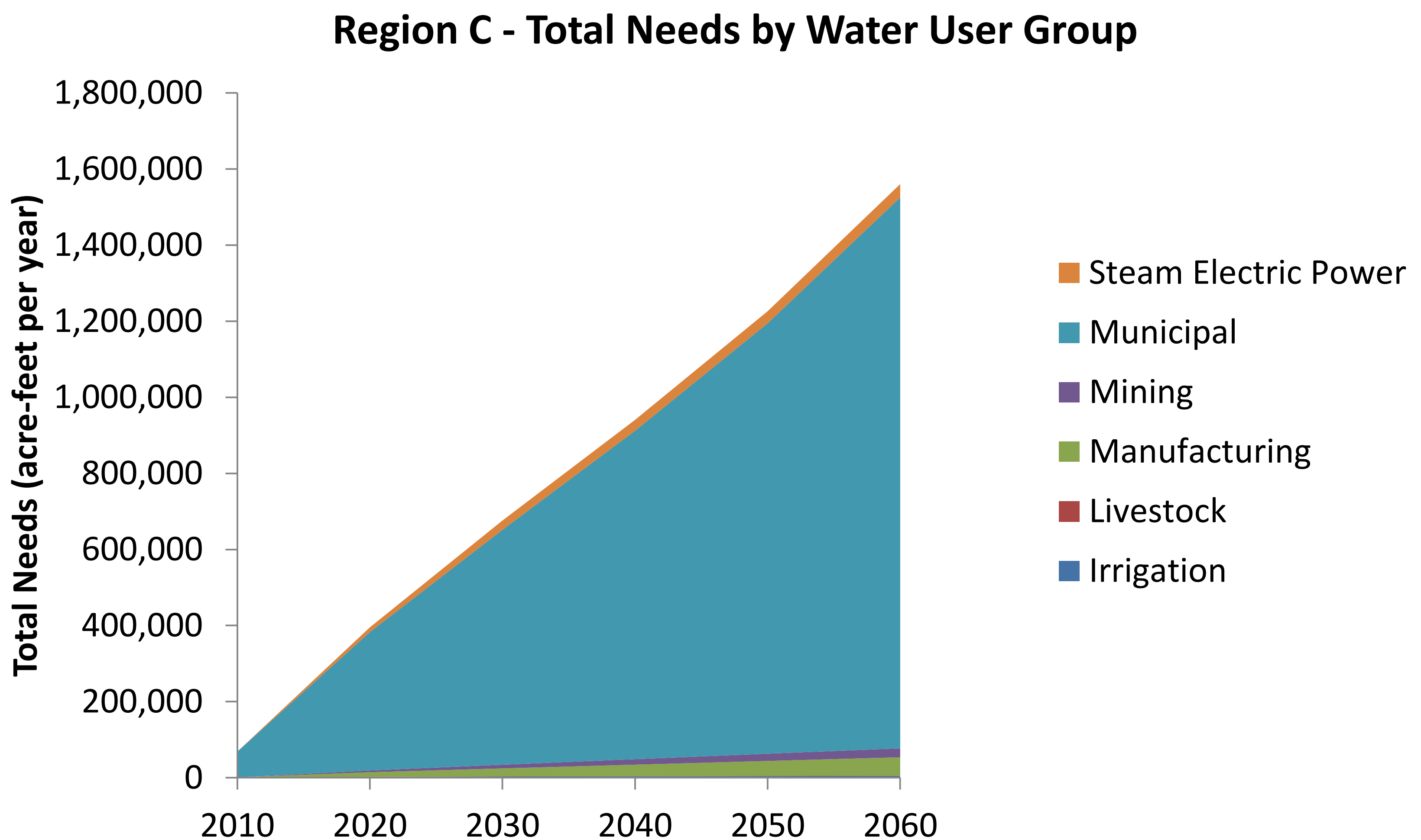
TWDB Water Planning Database

- All data presented in this presentation for consideration as required by TWC 36.108 (d)(2) are included in:
  - SWP2012_WUG_Needs_Surpluses_GMA8.pdf
  - SWP2012_WWP_Needs_Surpluses_GMA8.pdf
  - SWP2012_WUG_Strategies_GMA8_11X17.pdf
  - SWP2012_WUG_Strategies_GMA8_Letter.pdf
  - SWP2012_WUGWWP_Strategies_GMA8_11X17.pdf


Region B - Total Needs by Water User Group
Total Needs (acre-feet per year)
500
450
400
350
300
250
200
150
100
50
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation



Region B - Total Needs by Water User Group
Total Needs (acre-feet per year)
1,000
900
800
700
600
500
400
300
200
100
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation
Groundwater Strategies


Region C - Total Needs by Water User Group
Total Needs (acre-feet per year)
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2010
2020
2030
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2050
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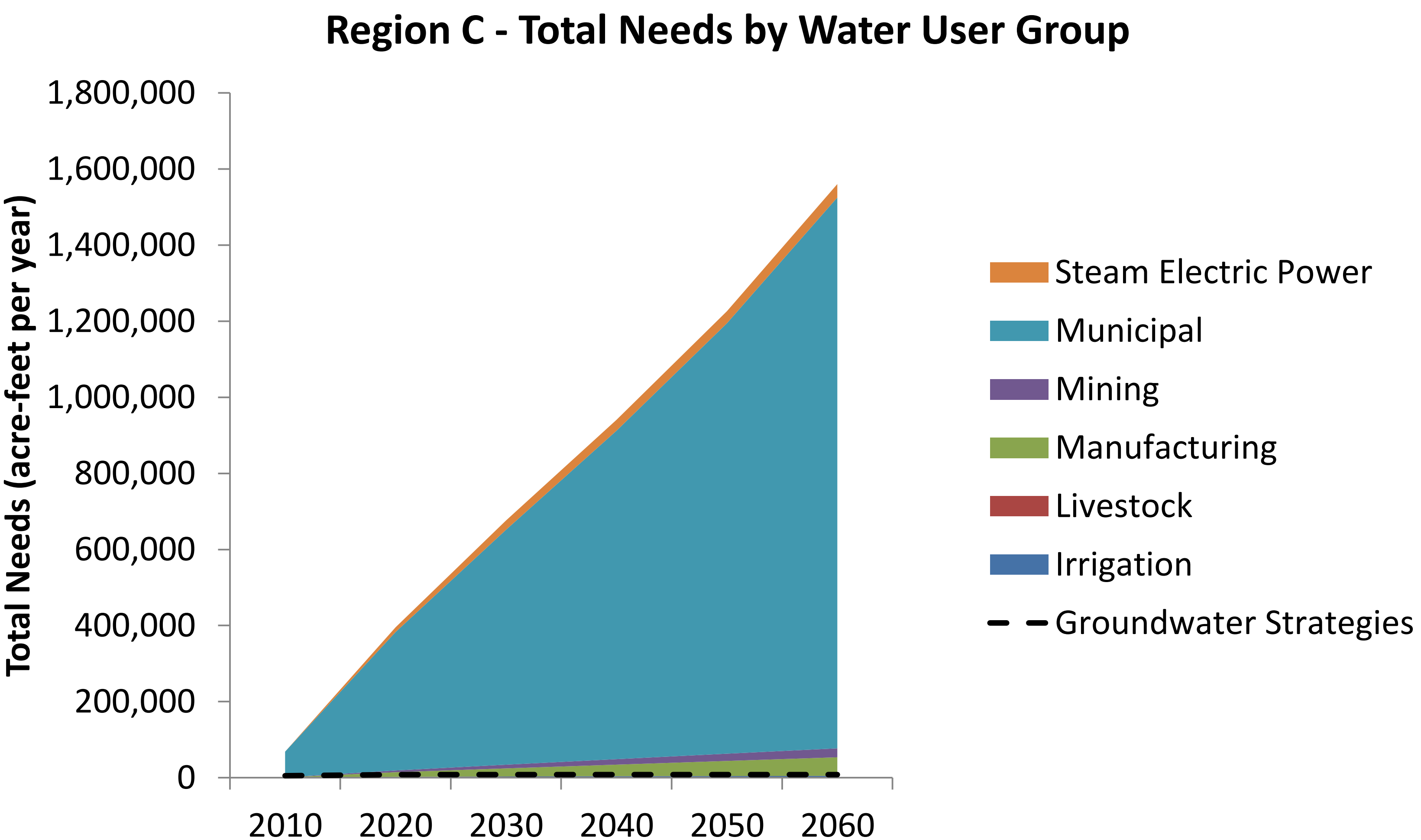
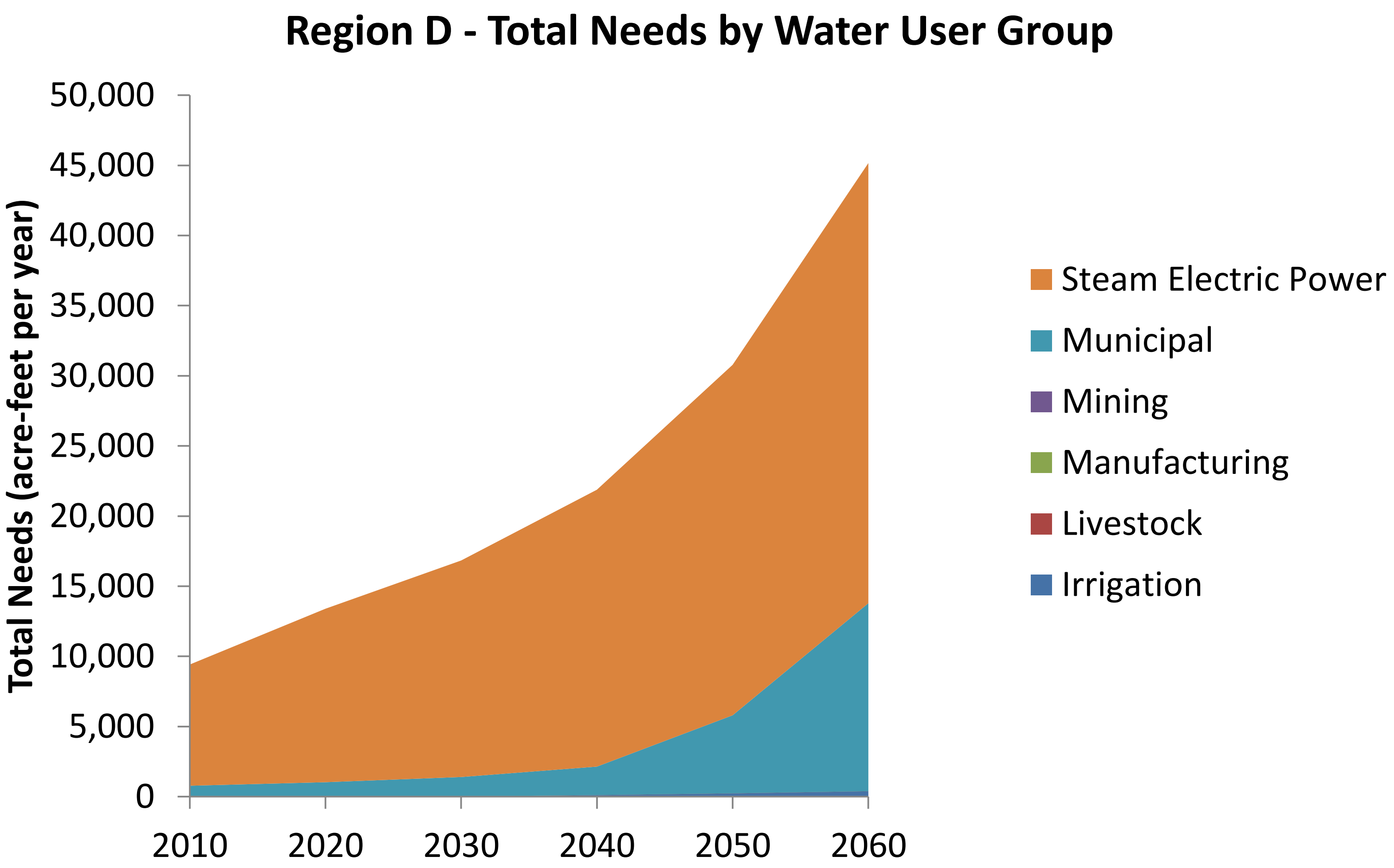
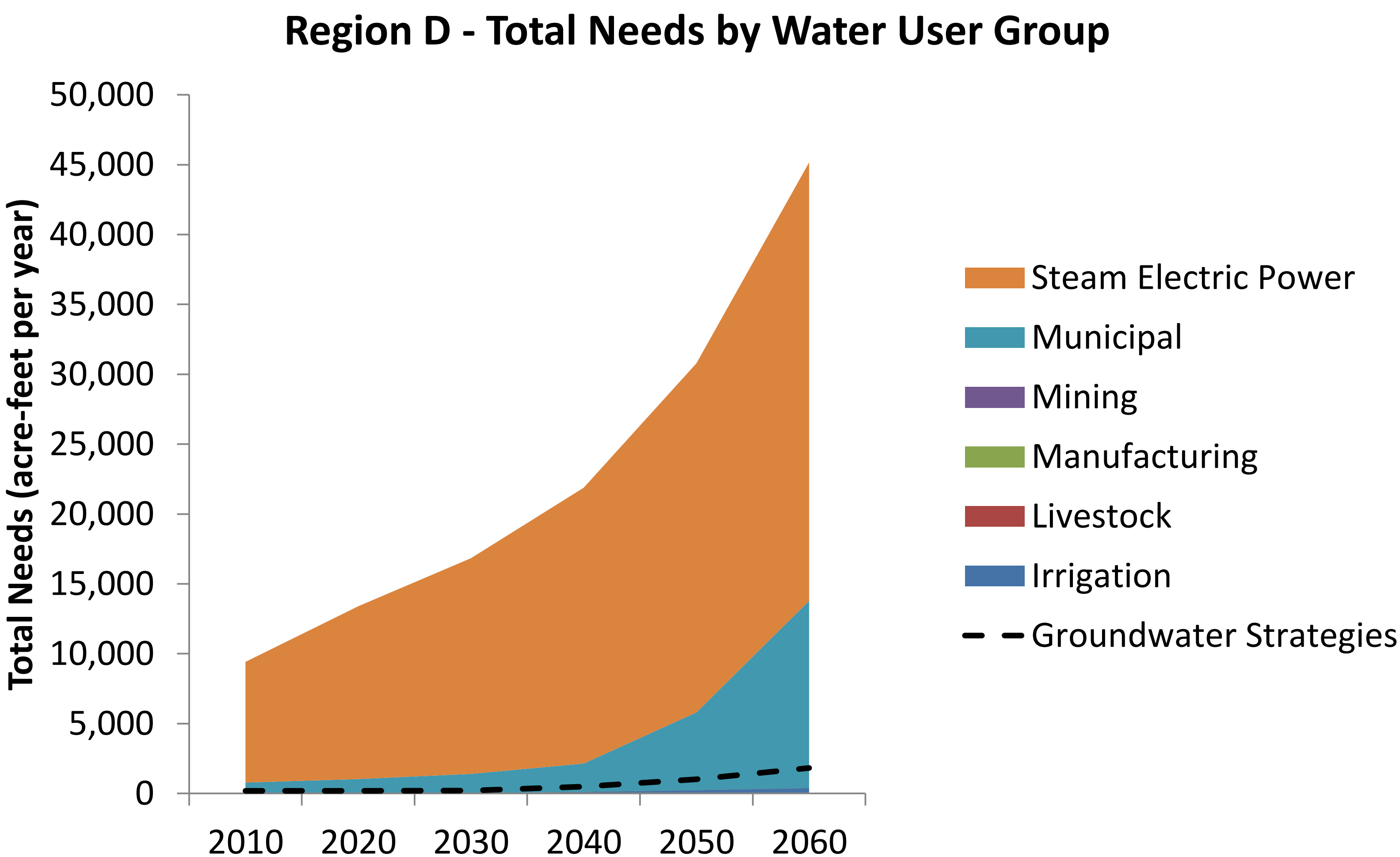
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation


Region C - Total Needs by Water User Group
Total Needs (acre-feet per year)
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation
Groundwater Strategies


Region D - Total Needs by Water User Group
Total Needs (acre-feet per year)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation


Region D - Total Needs by Water User Group
Total Needs (acre-feet per year)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2010
2020
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2050
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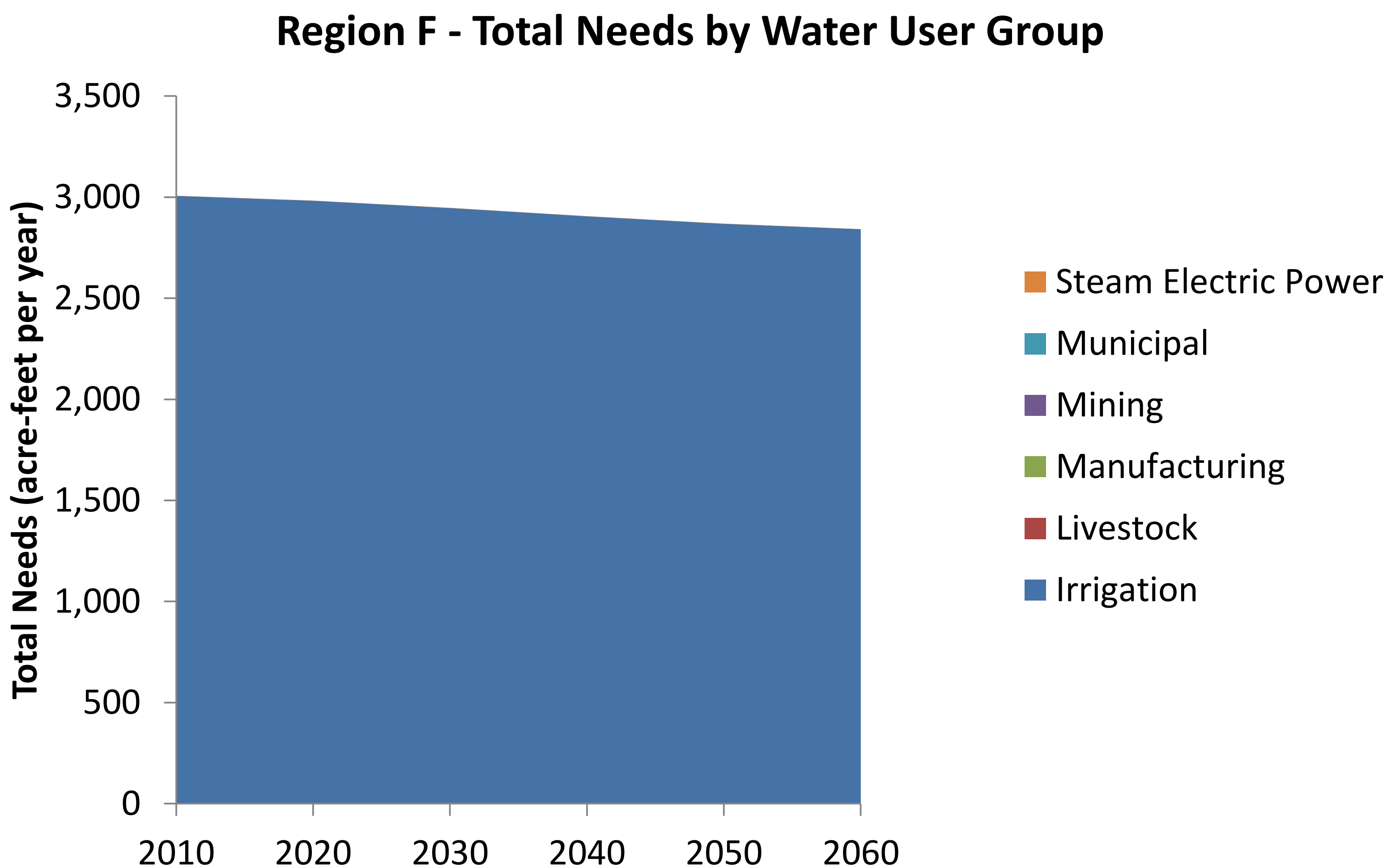
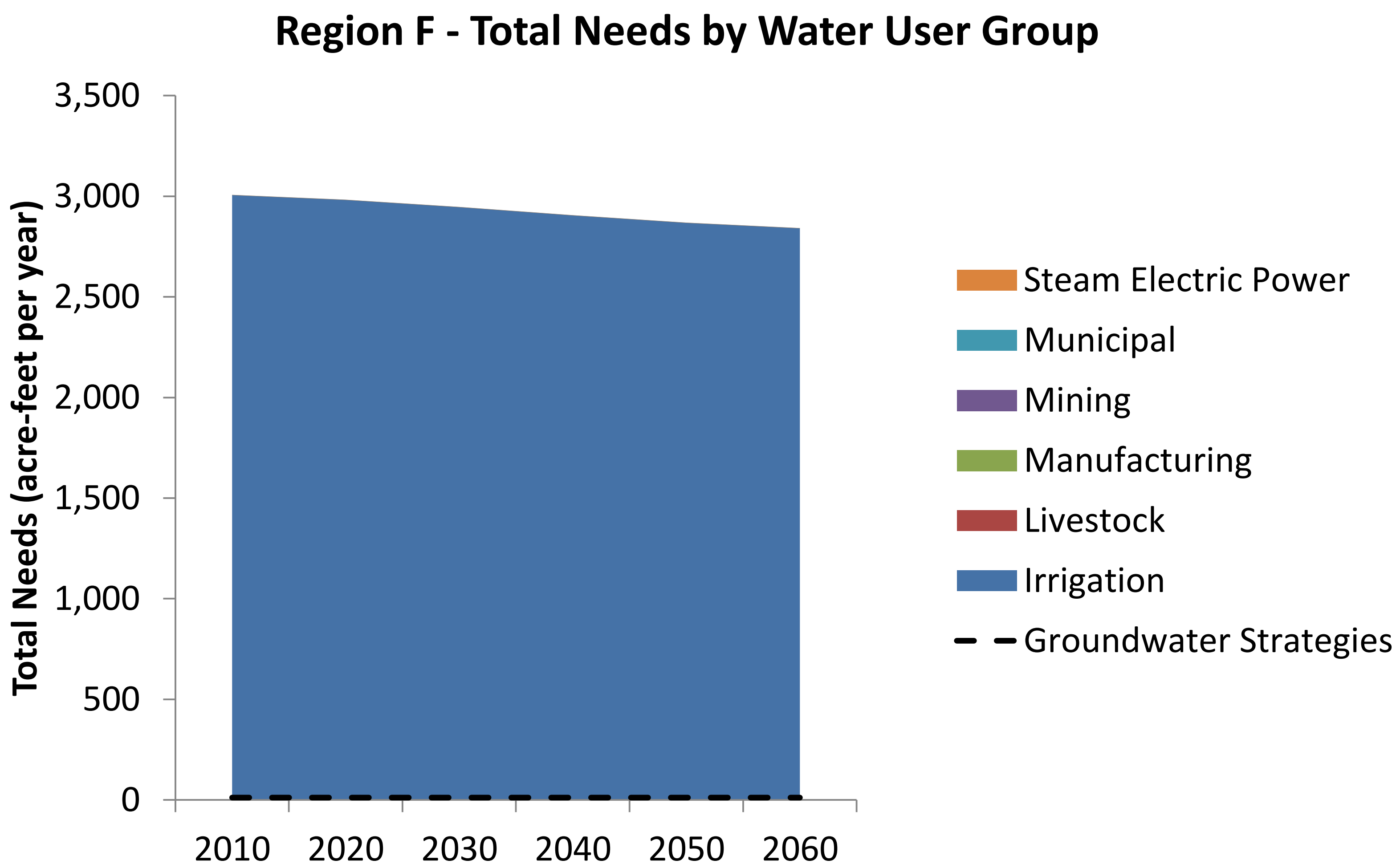
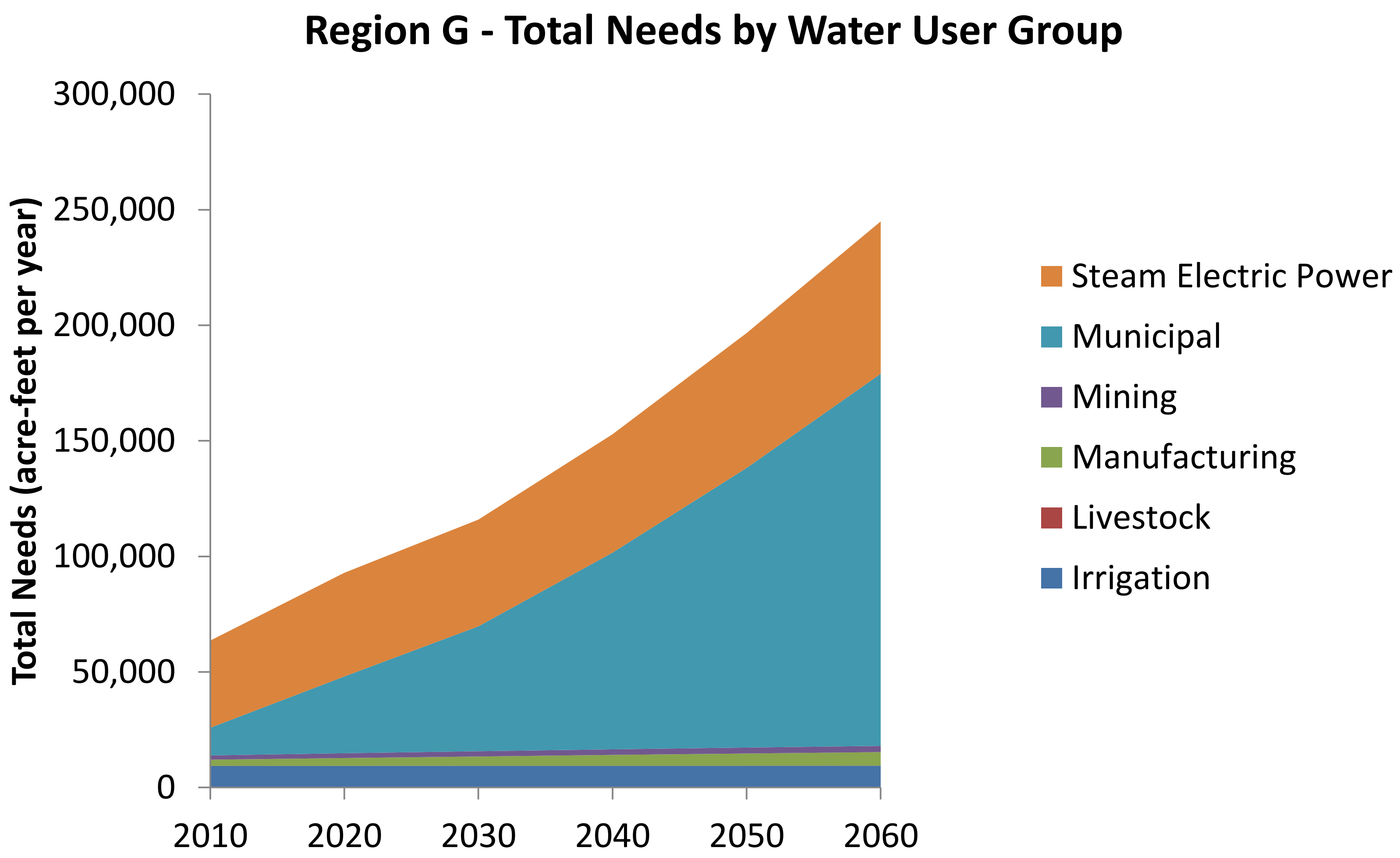
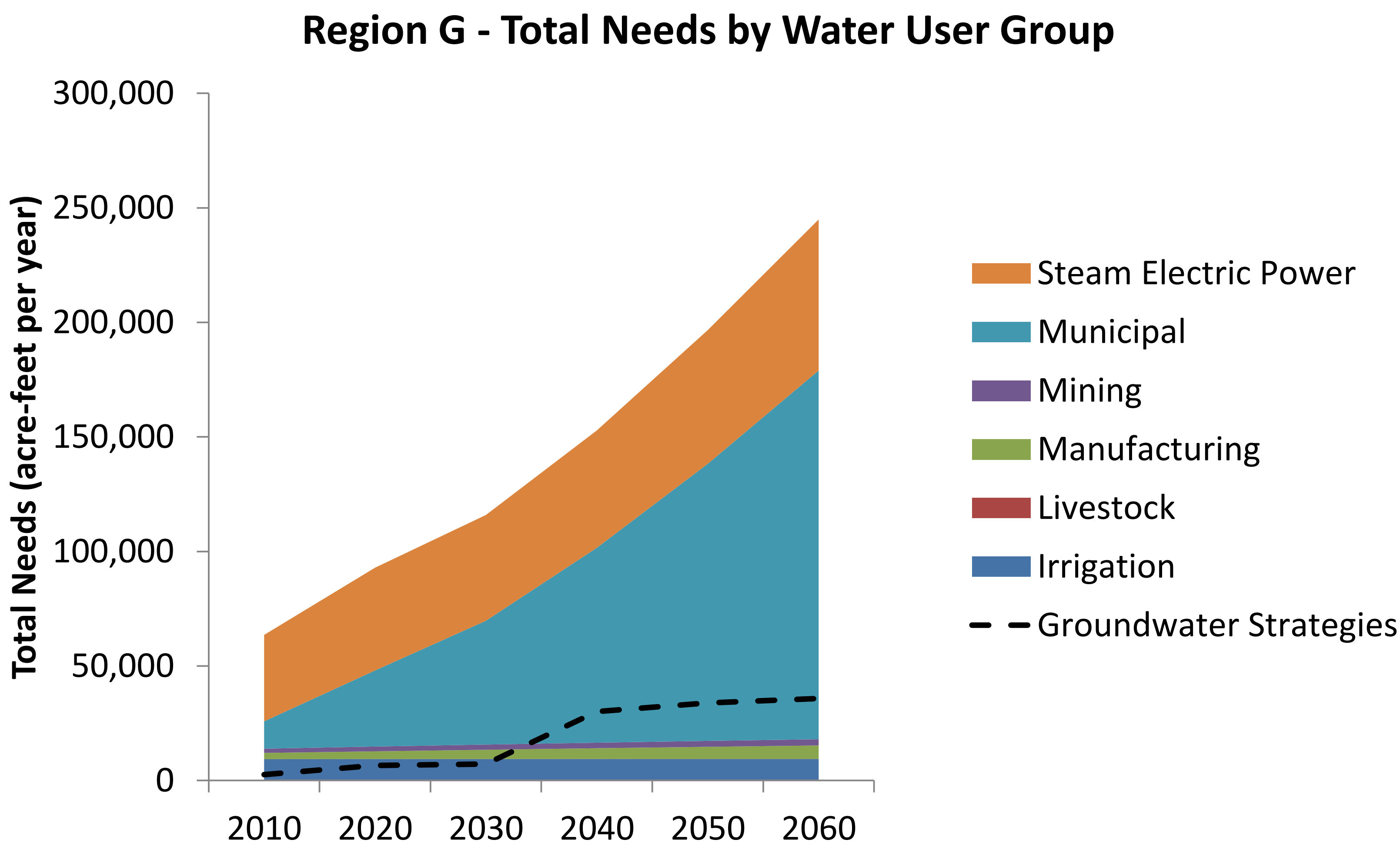
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation
Groundwater Strategies


Region F - Total Needs by Water User Group
Total Needs (acre-feet per year)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation


Region F - Total Needs by Water User Group
Total Needs (acre-feet per year)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation
Groundwater Strategies


Region G - Total Needs by Water User Group
Total Needs (acre-feet per year)
300,000
250,000
200,000
150,000
100,000
50,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation


Region G - Total Needs by Water User Group
Total Needs (acre-feet per year)
300,000
250,000
200,000
150,000
100,000
50,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
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Irrigation
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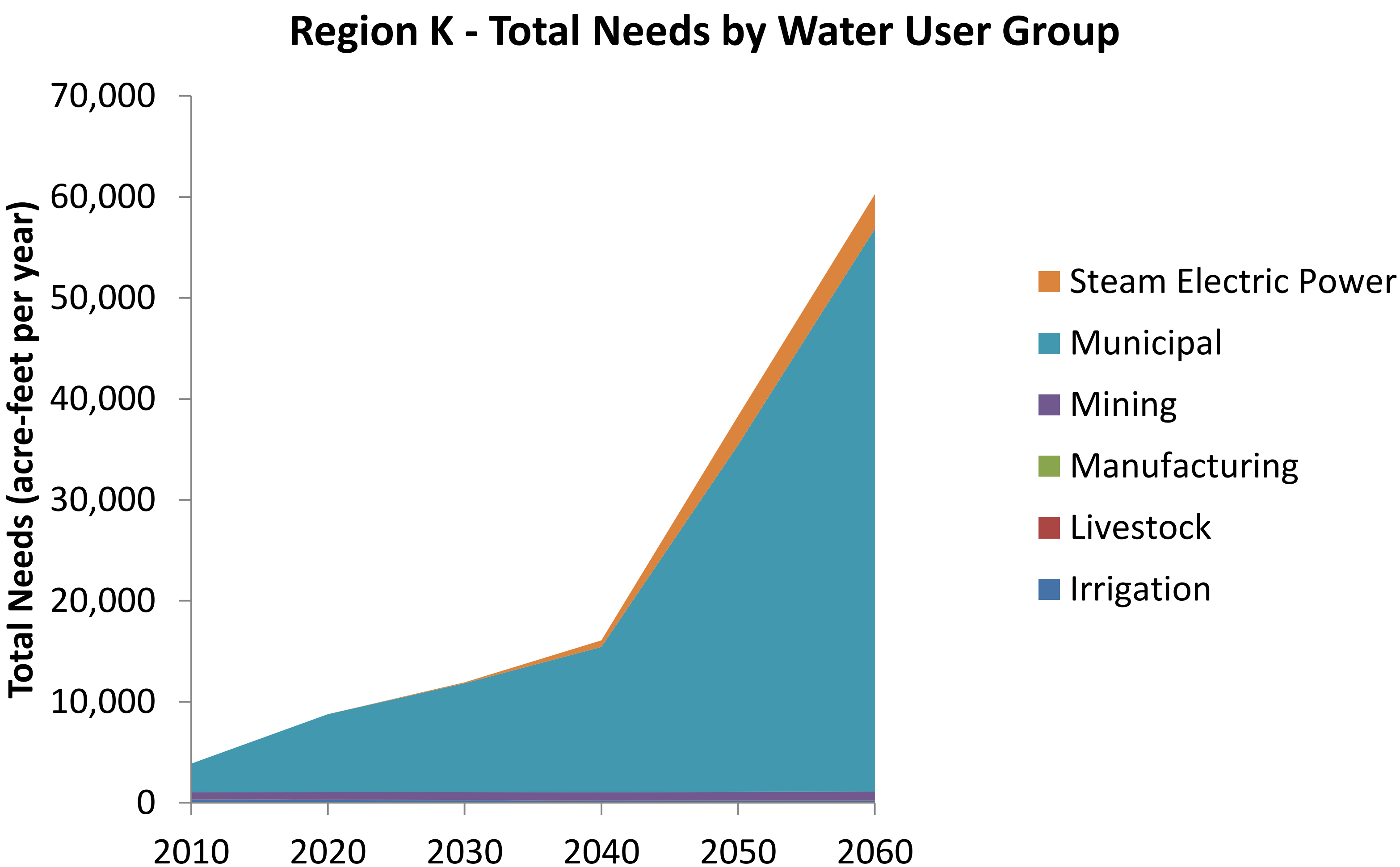

Region K - Total Needs by Water User Group
Total Needs (acre-feet per year)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
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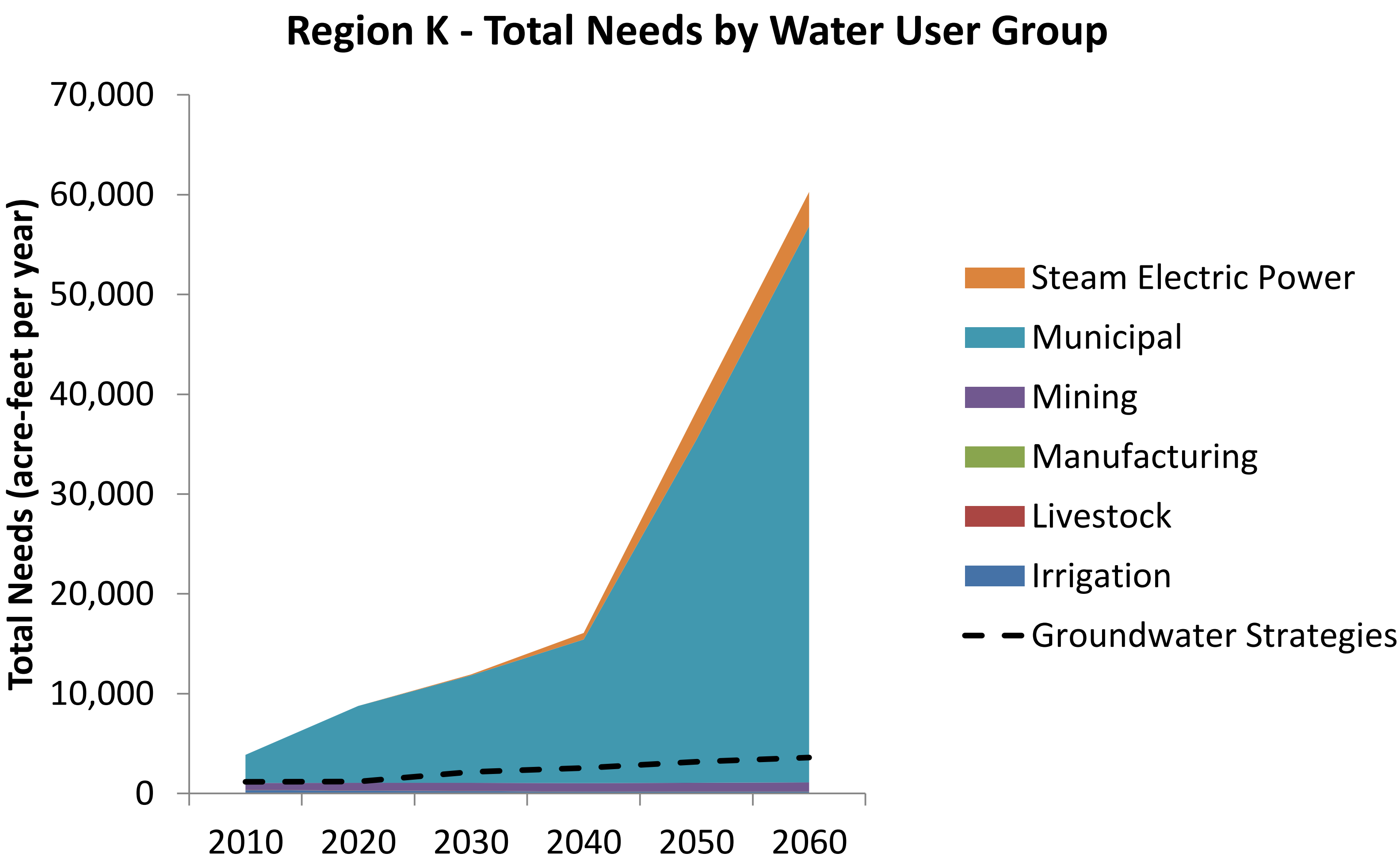
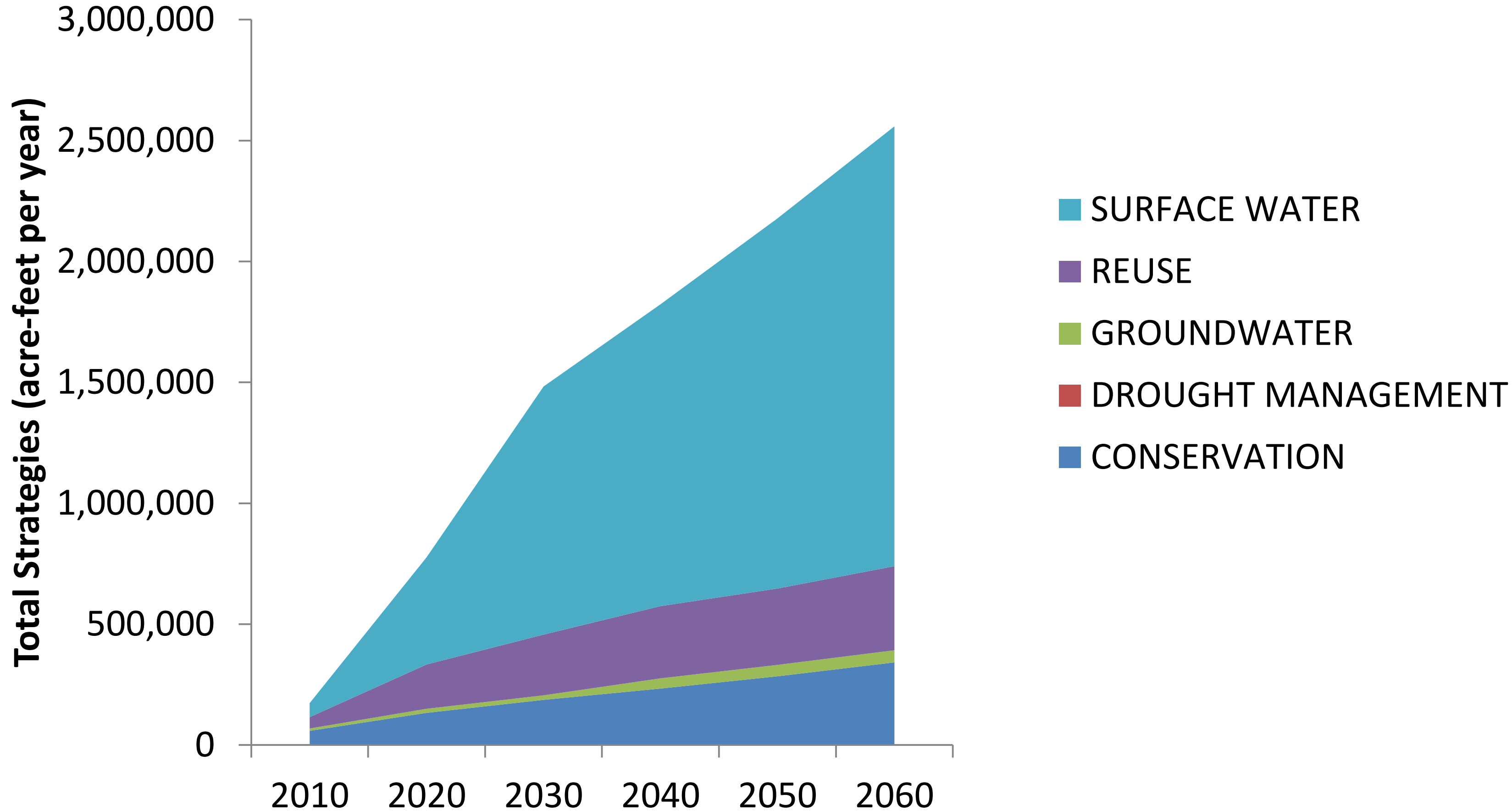
Manufacturing
Livestock
Irrigation


Region K - Total Needs by Water User Group
Total Needs (acre-feet per year)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2010
2020
2030
2040
2050
2060
Steam Electric Power
Municipal
Mining
Manufacturing
Livestock
Irrigation
Groundwater Strategies

GMA 8 Strategies by Type

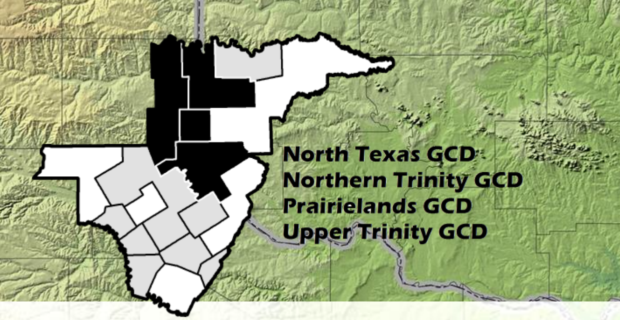


Water Supply Needs and Water Management Strategies

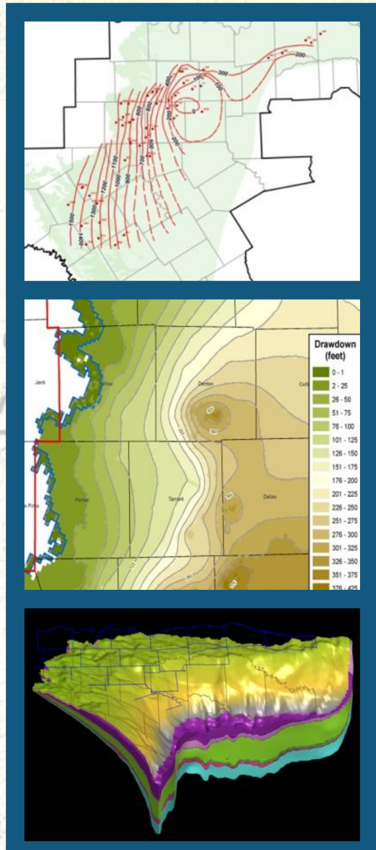
- All detail information has been provided to GMA 8 participating GCDs.
- Groundwater is a very small but locally important water management strategy to meet water supply needs, especially in the more rural counties in GMA 8.
- DFC options selected for consideration appear to be sufficient to implement adopted water management strategies in the state water plan.

Hydrologic Conditions
TWC Section 36.108 (d)(3)

- Districts shall consider hydrologic conditions, including for each aquifer in the management area, the total estimated recoverable storage as provided by the executive administrator, and the annual average recharge, inflows, and discharge. Texas Water Code 36.108 (d)(3)



Final Report on the Update of the Trinity/Woodbine Groundwater Availability Model



Presented To:

Groundwater Management Area 8

Presented By:

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

In Association With:

Bureau of Economic Geology

LBG GUYTON

November 3, 2014

Predictive Simulations 1 – 3

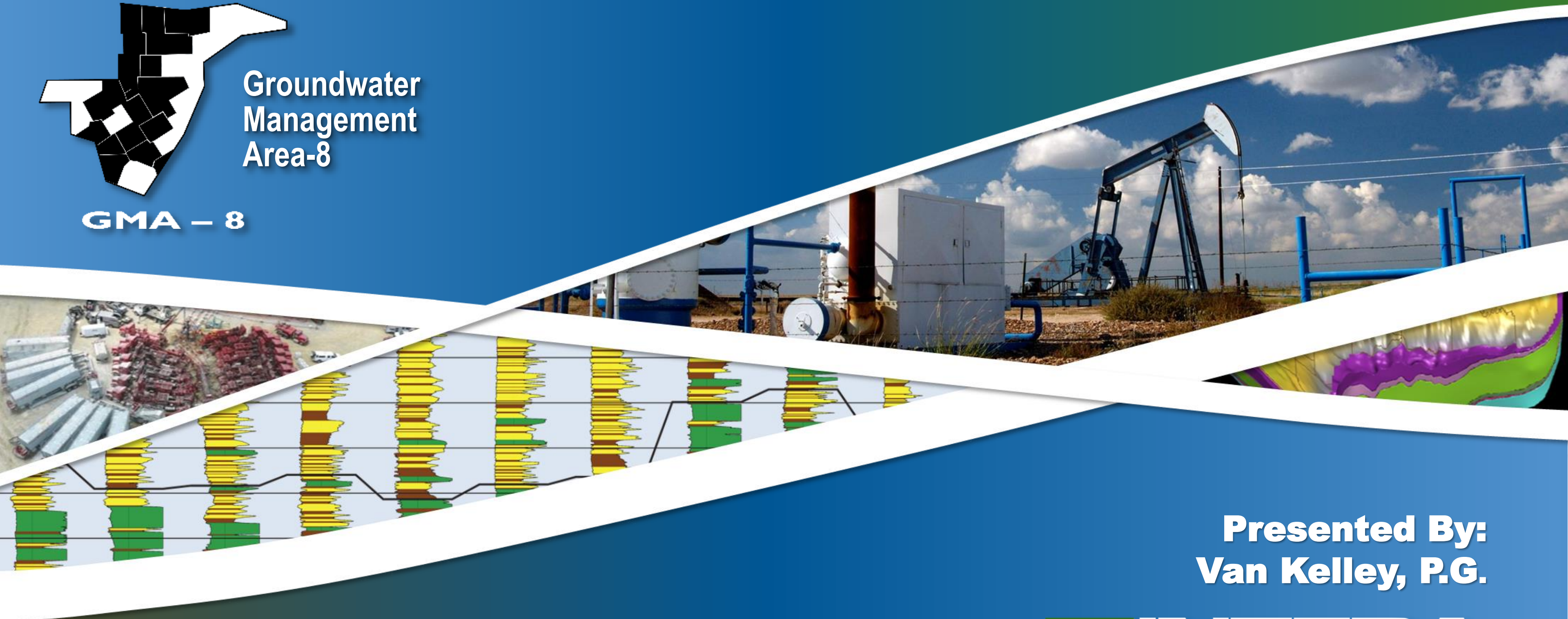
- As part of the NTWO Project 4 predictive simulations were performed:
  - *A re-simulation of the current MAG pumping*
  - A run labeled “highest practicable”
  - A run labeled “conservation”
  - A predictive run assuming current pumping
- These simulations were discussed with representatives of GMA-8 in a meeting on 6/30/14
- All simulations were run through 2070.
- Documented in a memorandum dated 9/3/14

Predictive Simulations to Support GMA-8 Runs 4 – 6

Presented to:

Groundwater Management Area-8

GMA – 8



Presented By:
Van Kelley, P.G.

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

September 2, 2015

GMA 8 Joint Planning Meeting

Discussion of Southern GMA 8 GAM Run 9 Results

November 18, 2015

GMA 8 Joint Planning Meeting

Discussion of GMA 8 GAM Run 10 Results

February 17, 2016

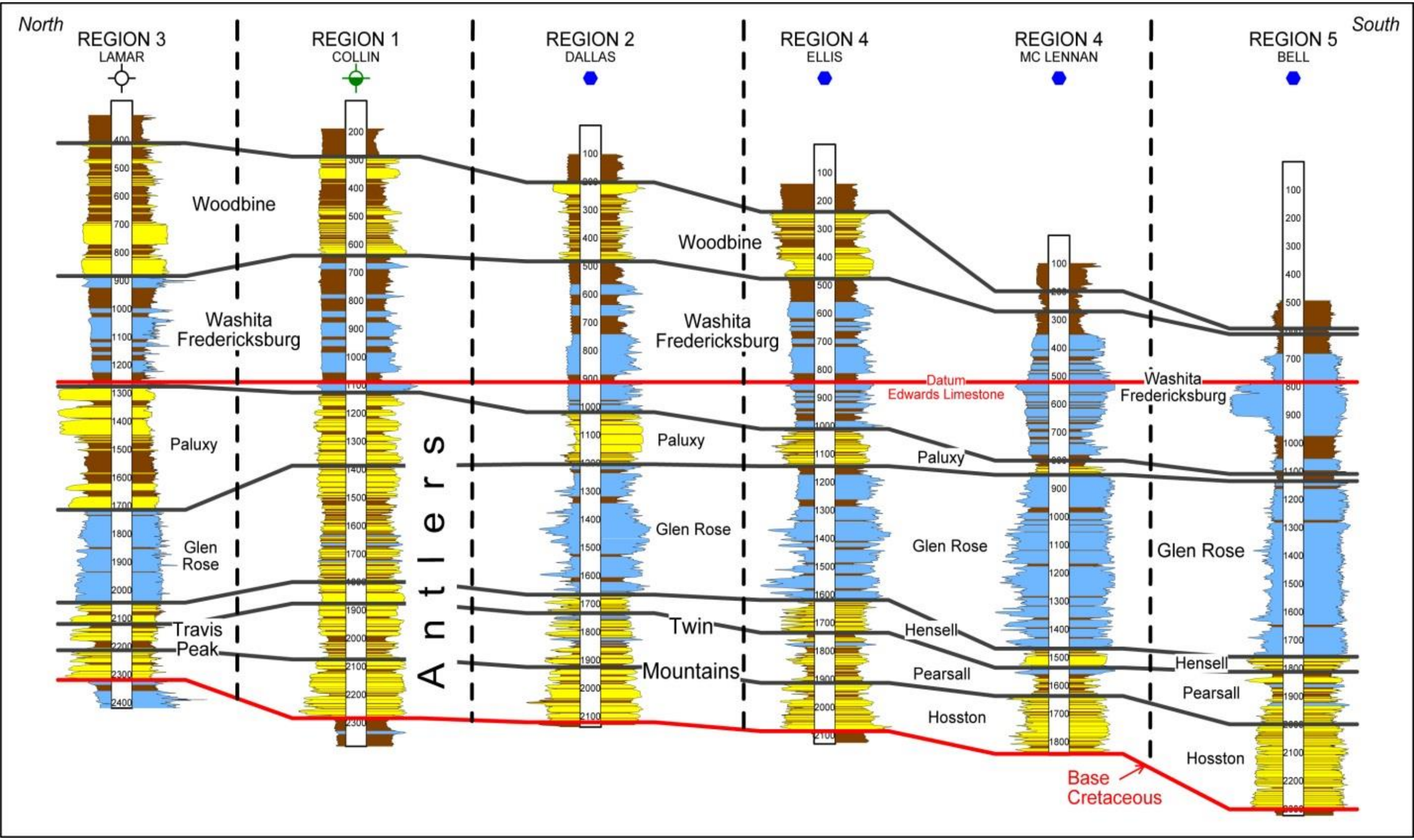
Run 10.1 Summary

Presented By:
Wade Oliver, P.G.

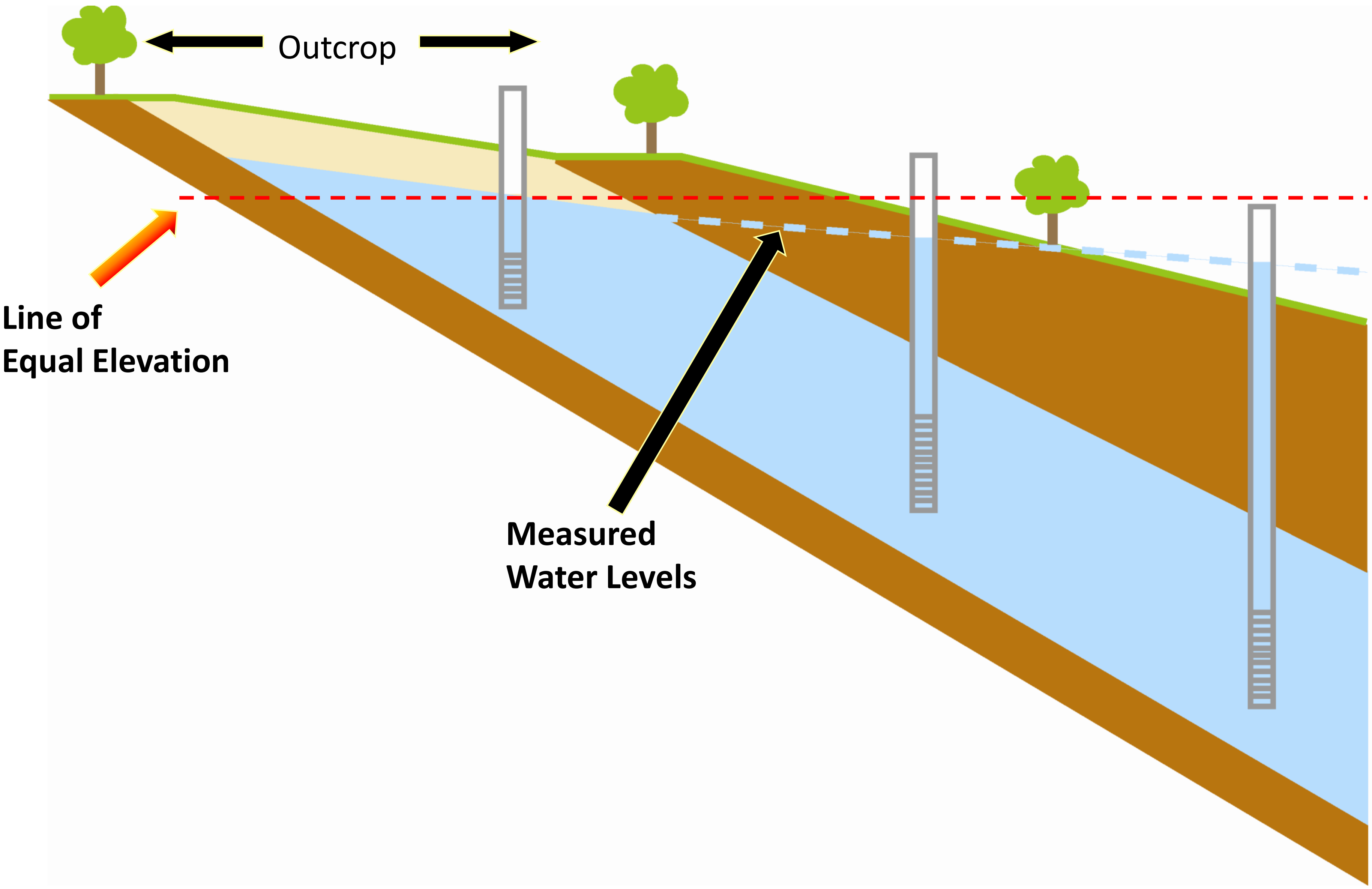
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

February 17, 2016

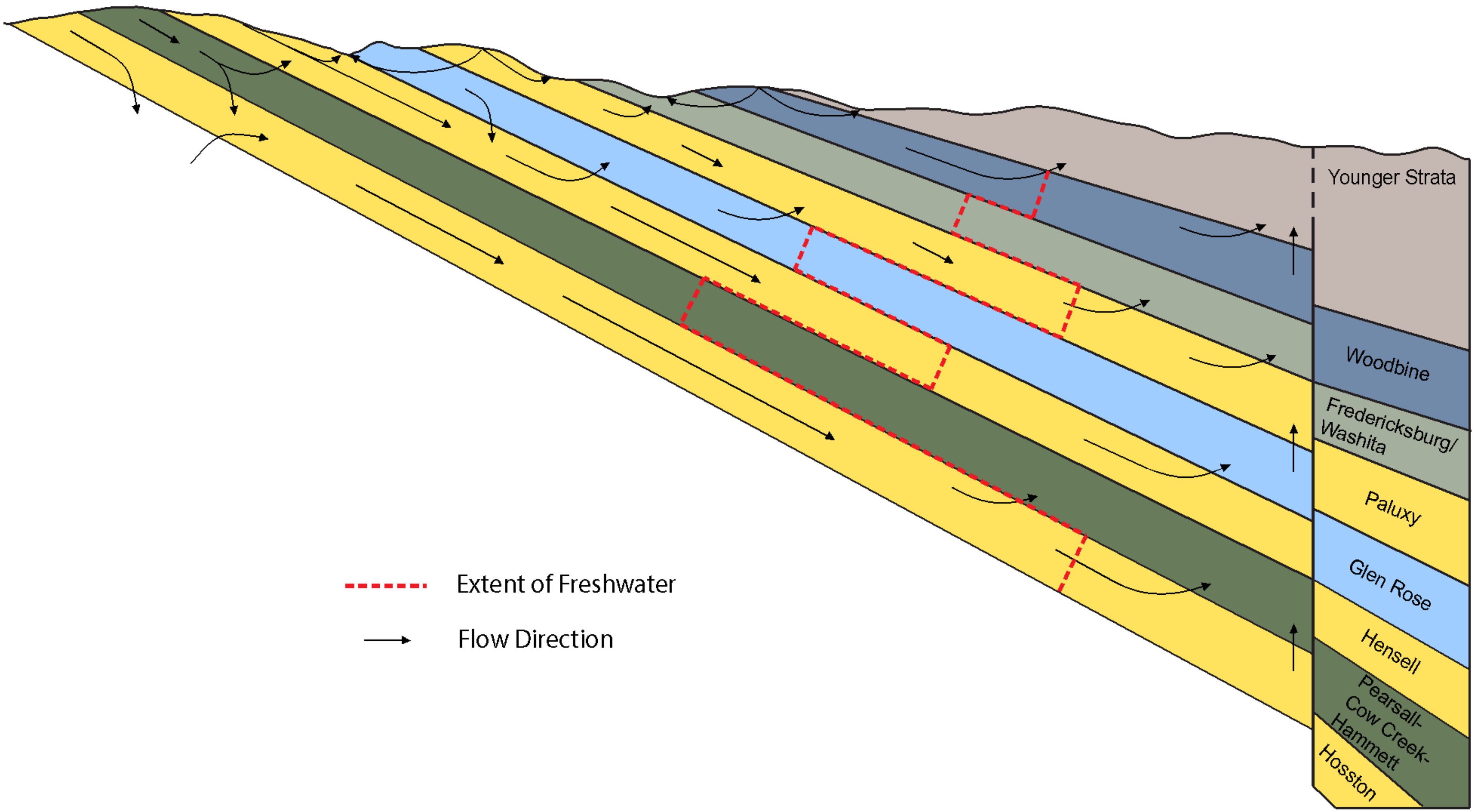
Hydrostratigraphic Framework



Predevelopment

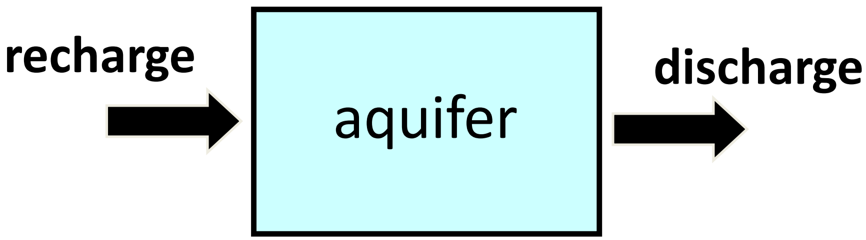


Predevelopment Schematic of Flow



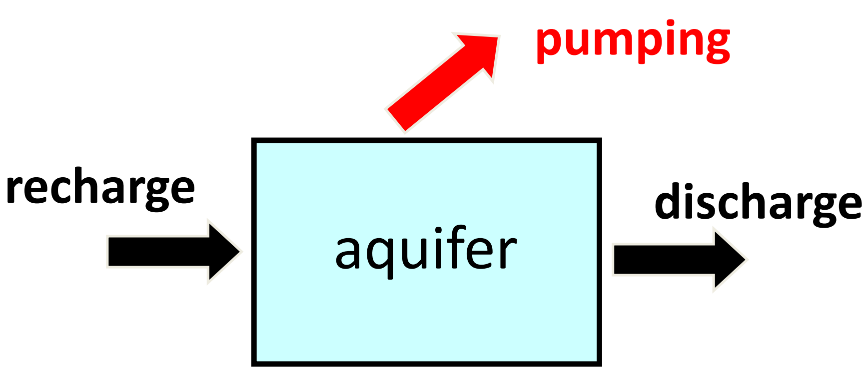
Aquifer Dynamics

Pre-development



Dynamic equilibrium:
Aquifer recharge is balanced by aquifer discharge

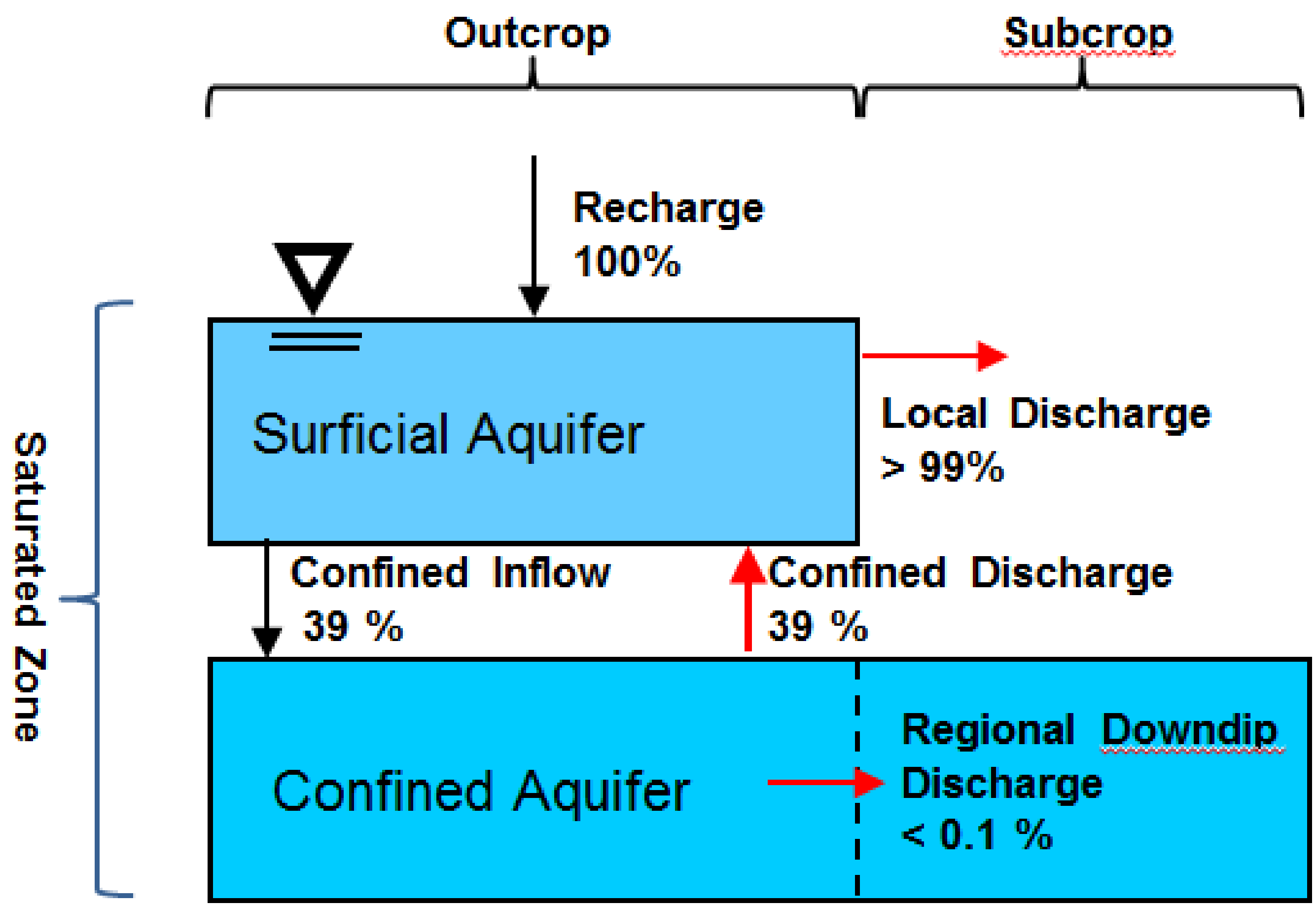
Post-development



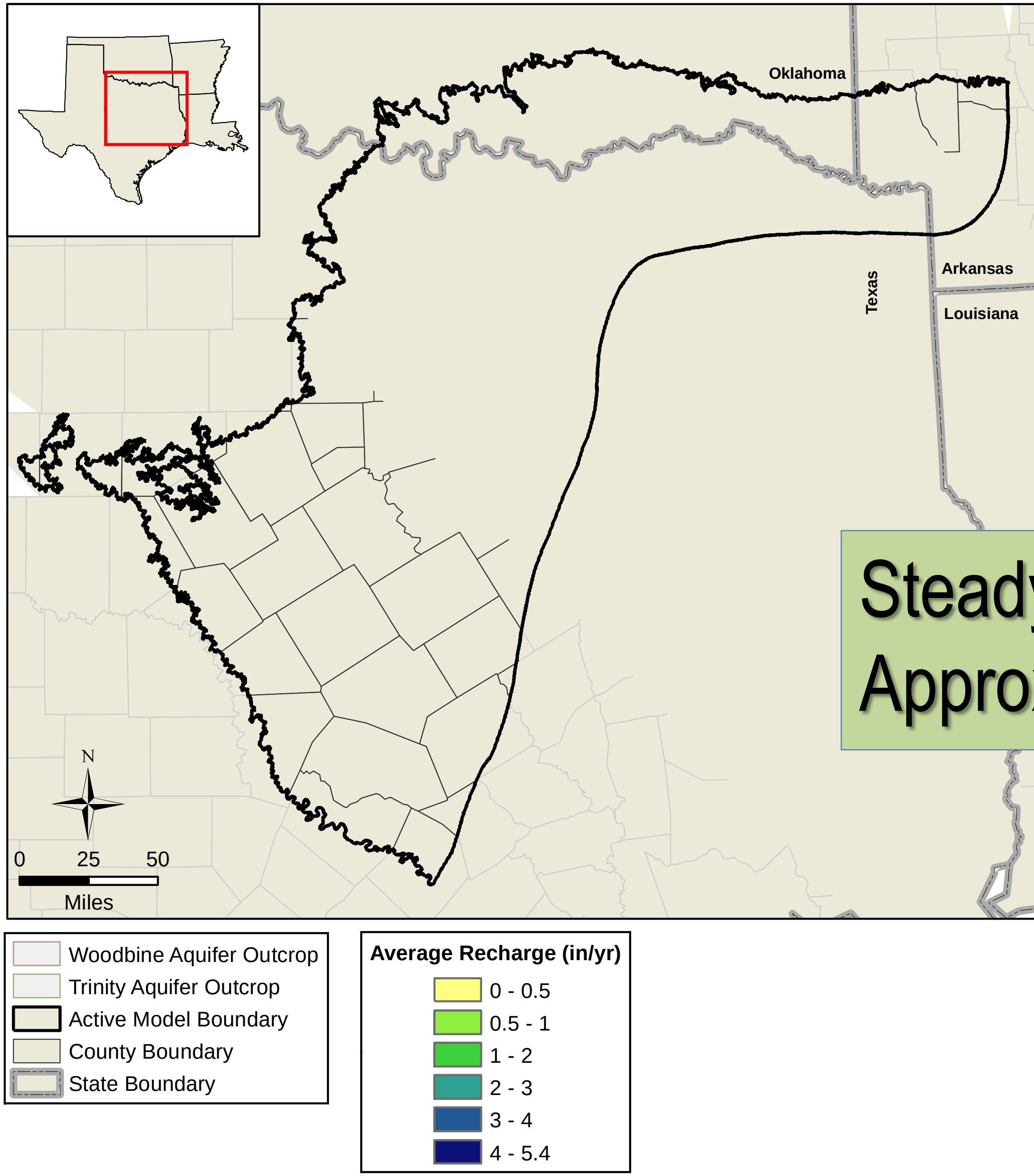
Dynamic equilibrium:
Pumping is balanced by a reduction in discharge and in some cases an increase in recharge – sometimes termed "capture"

After Alley et al, (1999) and Bredehoeft (2002)

Conceptual Groundwater Balance

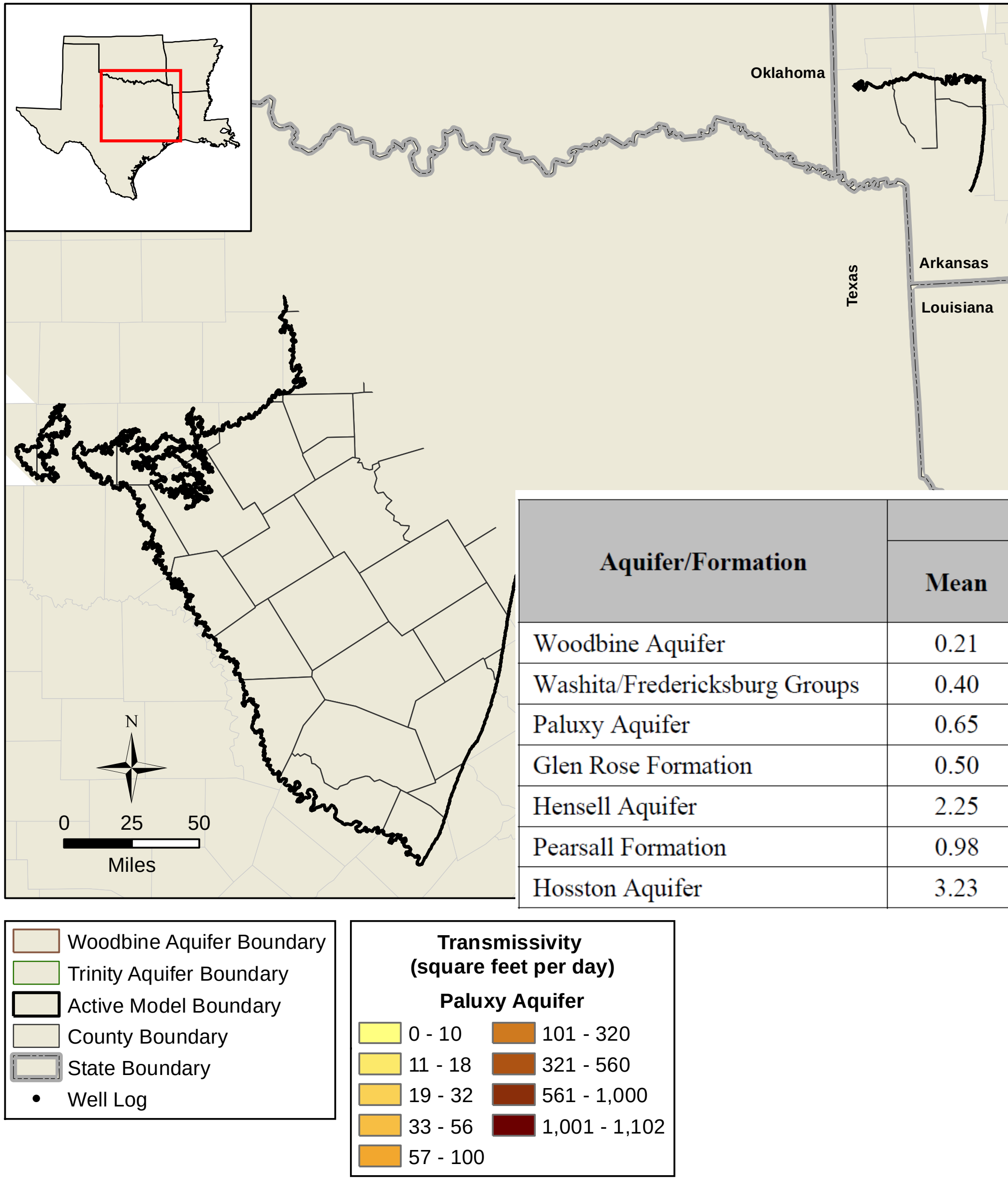


Recharge



Steady State Recharge Approximately 1.6 in/yr

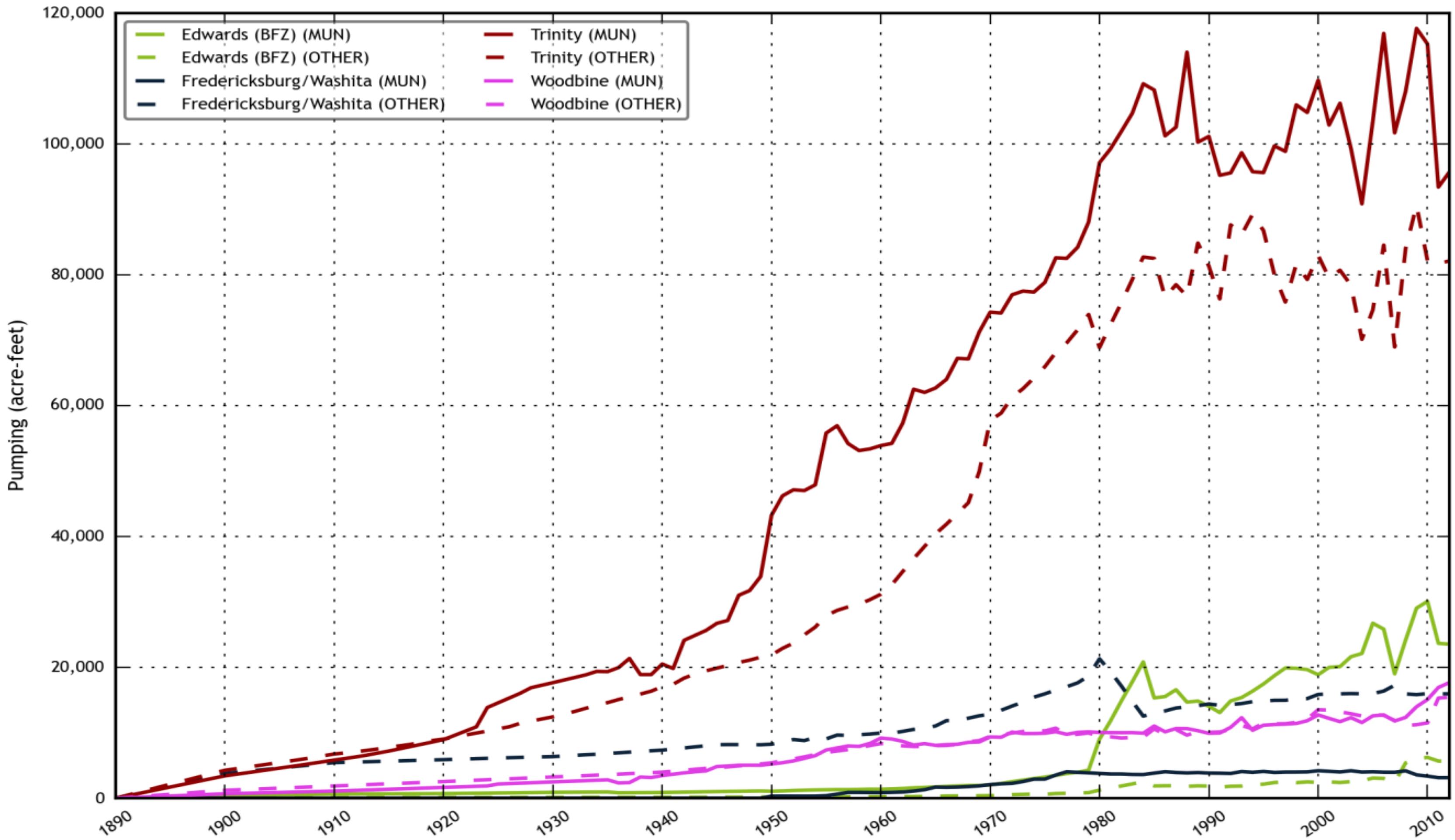
Hydraulic Properties



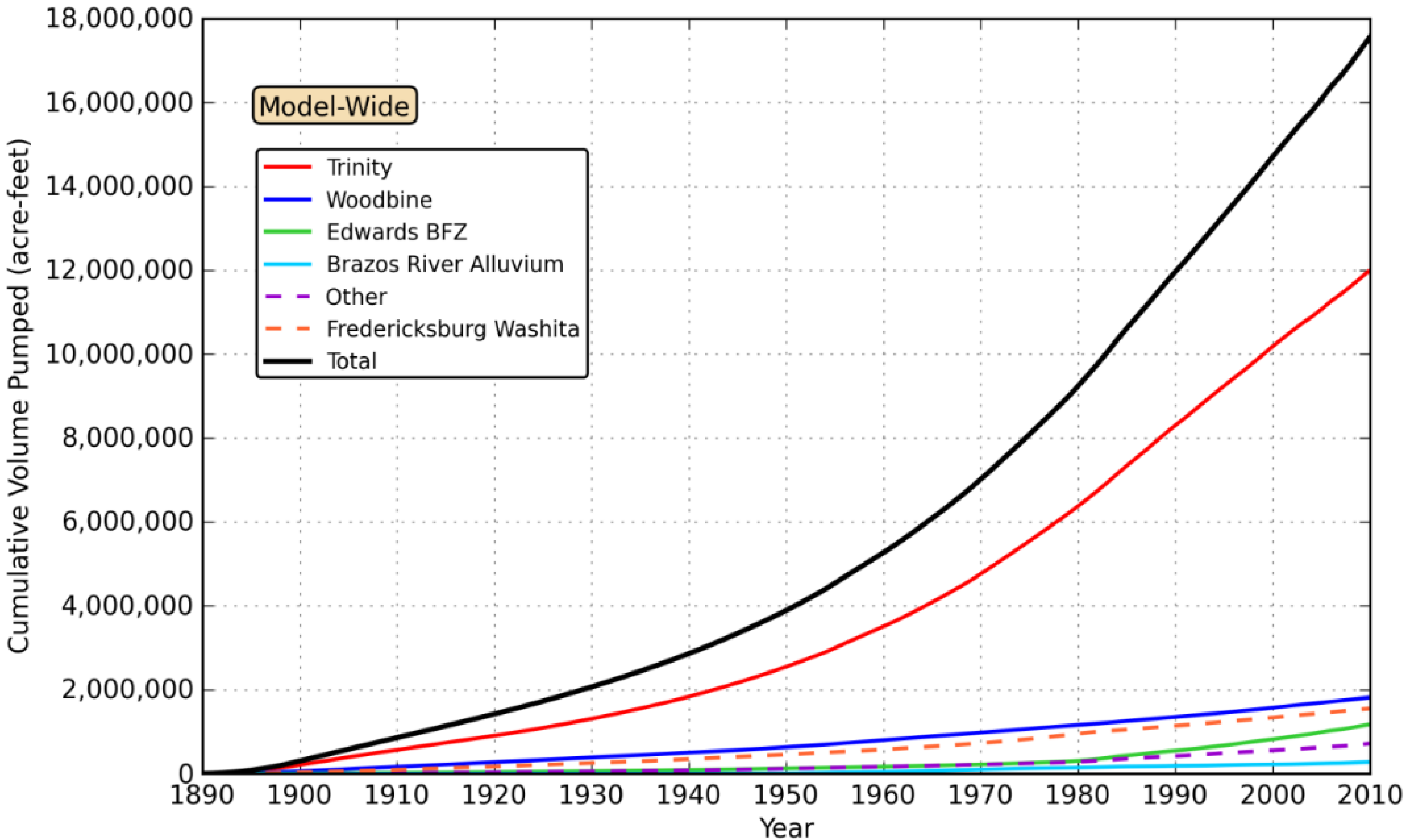
Initial Transmissivity for the Paluxy (ft2/day)

Aquifer/Formation	Horizontal Hydraulic Conductivity (feet per day)							
	Mean	Standard Deviation	Median	Percentiles				
				5	25	50	75	95
Woodbine Aquifer	0.21	0.23	0.15	0.002	0.01	0.15	0.32	0.73
Washita/Fredericksburg Groups	0.40	0.24	0.32	0.13	0.18	0.32	0.61	0.81
Paluxy Aquifer	0.65	0.52	0.47	0.01	0.26	0.47	1.06	1.61
Glen Rose Formation	0.50	0.32	0.37	0.18	0.21	0.37	0.77	1.04
Hensell Aquifer	2.25	1.88	1.67	0.09	0.70	1.67	3.66	5.79
Pearsall Formation	0.98	0.86	0.84	0.03	0.29	0.84	1.27	2.81
Hosston Aquifer	3.23	2.07	2.27	1.17	1.46	2.27	5.13	7.02

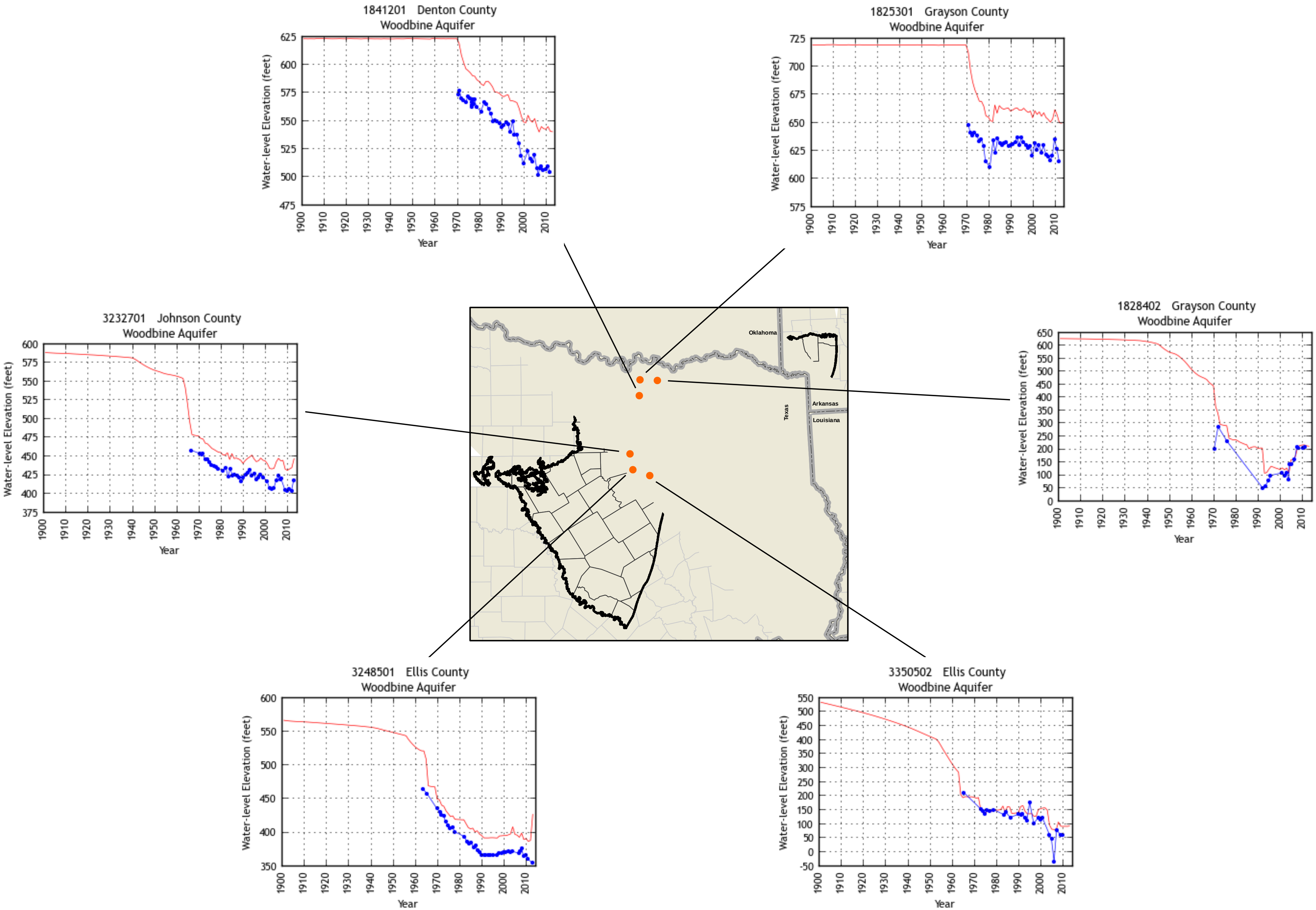
Pumping by Aquifer – 1890 to 2012



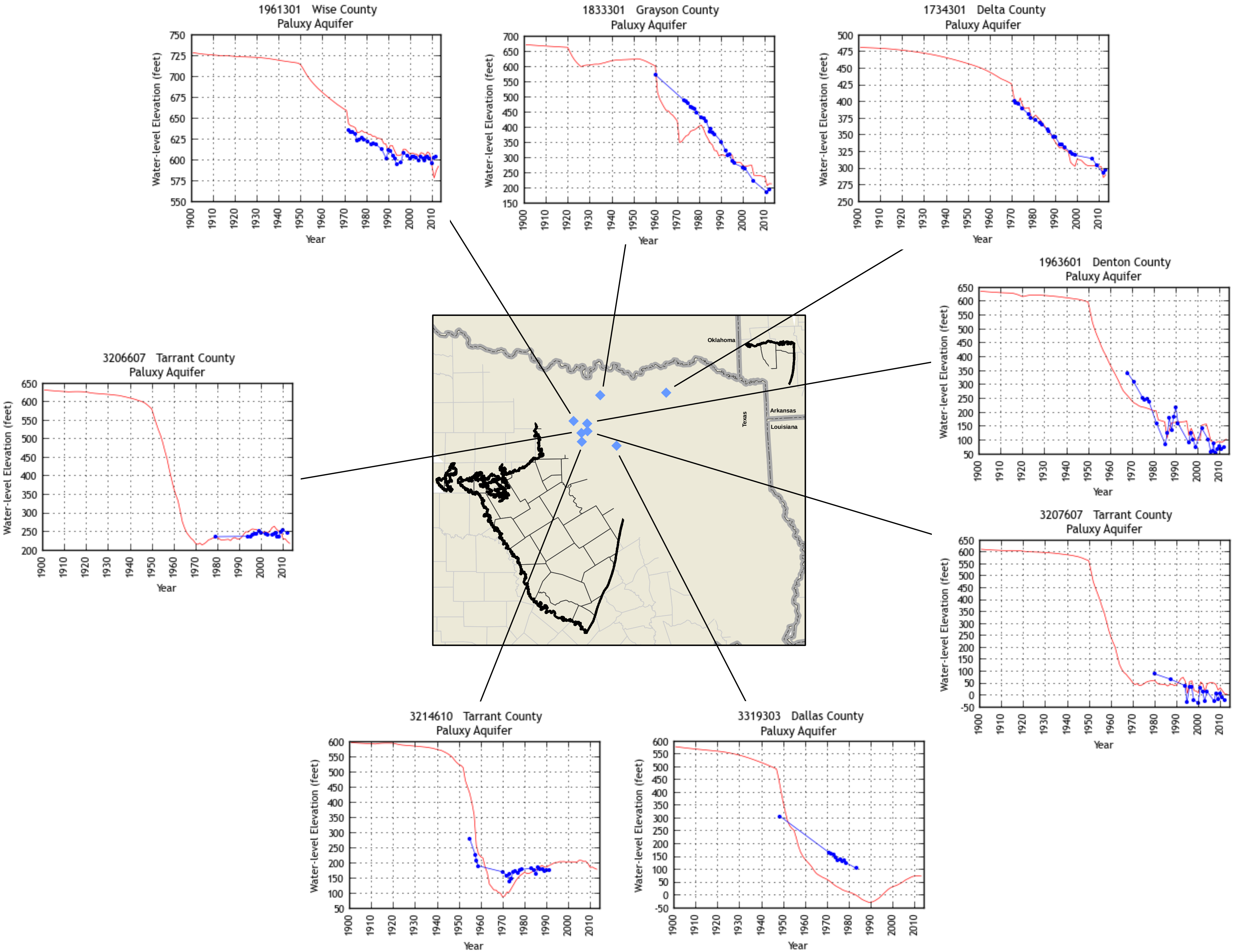
Cumulative Pumping by Aquifer



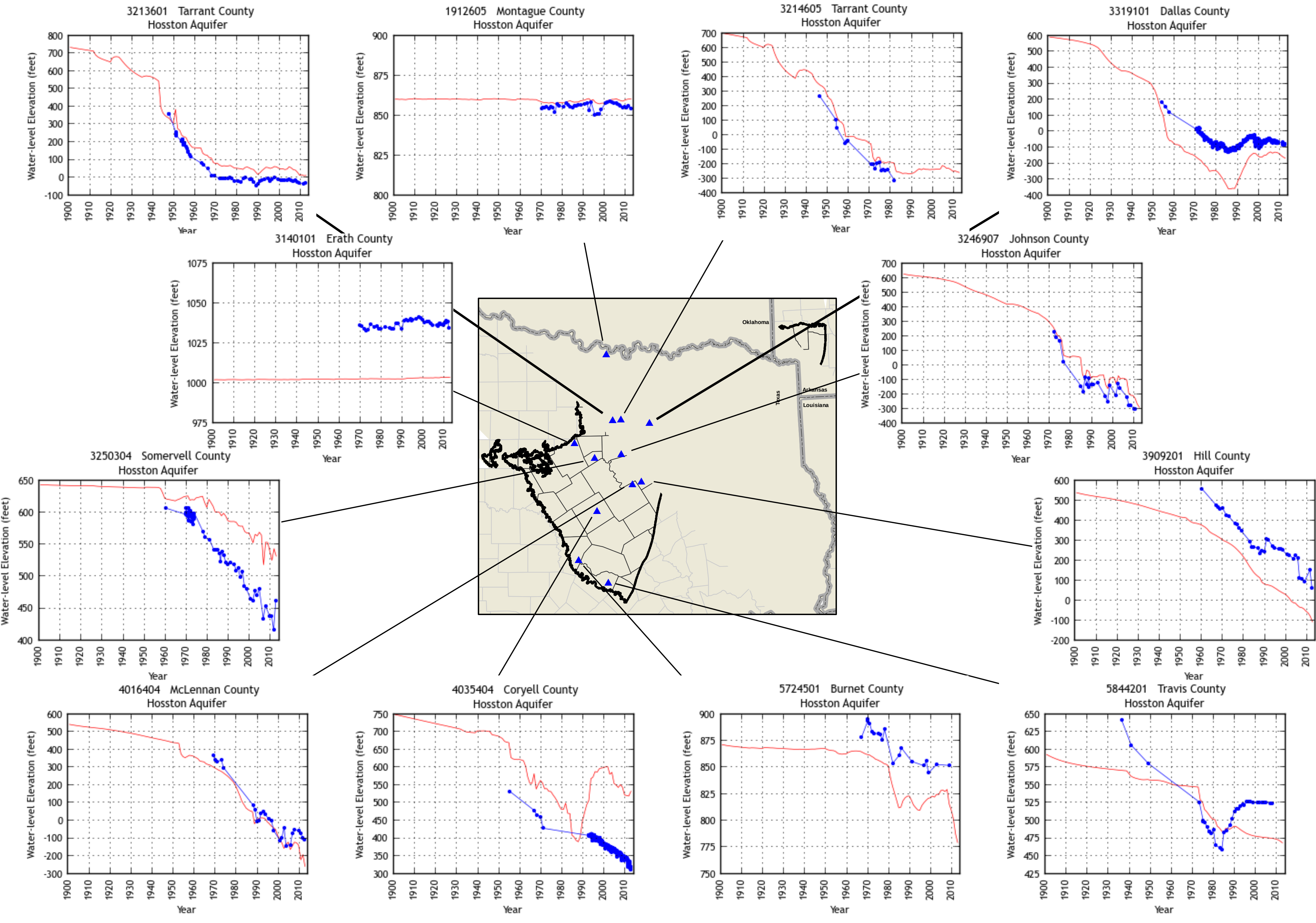
Transient Hydrographs: Woodbine



Transient Hydrographs: Paluxy



Transient Hydrographs: Hosston



Water Balance (AFY)

Year	Recharge (AFY)	Total Pumping (AFY)	Net Confined Flow[a] (AFY)	Deep Pumping[b] (AFY)	Net Downdip Confined Flow[c] (AFY)	Deep Storage[d] (AFY)
1889	1,766,549	0	503	0	2	0
1940	1,266,049	-58327.1	53,298	-31,749	23,446	8,304
1950	2,181,606	-91299.1	72,248	-48,113	30,401	17,713
1960	1,972,149	-121543	95,138	-61,981	42,364	19,617
1980	2,033,527	-227956	185,324	-104,552	75,799	28,755
1990	2,193,932	-241691	212,141	-107,284	92,347	14,937
2000	1,206,348	-266419	232,231	-117,533	100,167	17,363
2010	2,888,125	-285357	248,096	-127,078	112,140	14,937

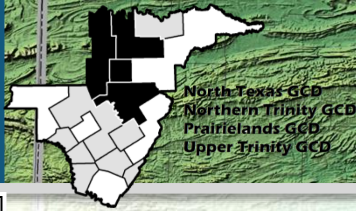
[a] net model flow in AFY from the surficial outcrop area of Layer 1 to underlying layers
[b] model pumping that occurs approximately below a depth of 300 feet below the base of the surficial outcrop area of Layer 1
[c] net model flow in AFY that occurs to aquifers at a depth of 300 feet below the base of the surficial outcrop area of Layer 1
[d] model outflow from storage in AFY occurring within aquifers at a depth of 300 feet below the base of the surficial outcrop area of Layer 1

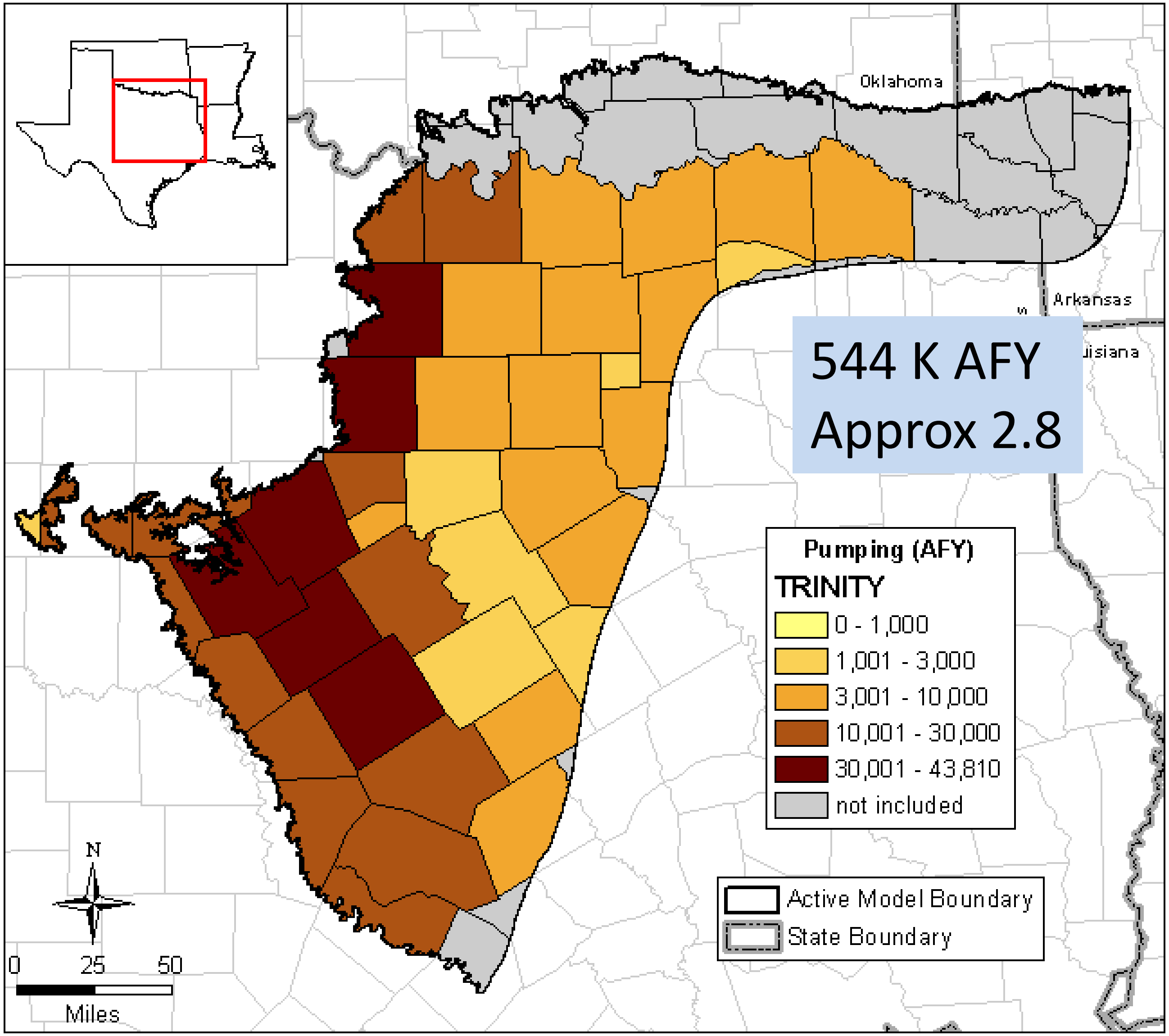
Definitions

Total Estimated Recoverable Storage—The estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume

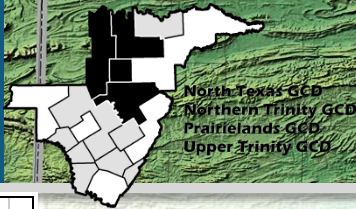
Texas Administrative Code Sec. 356.10

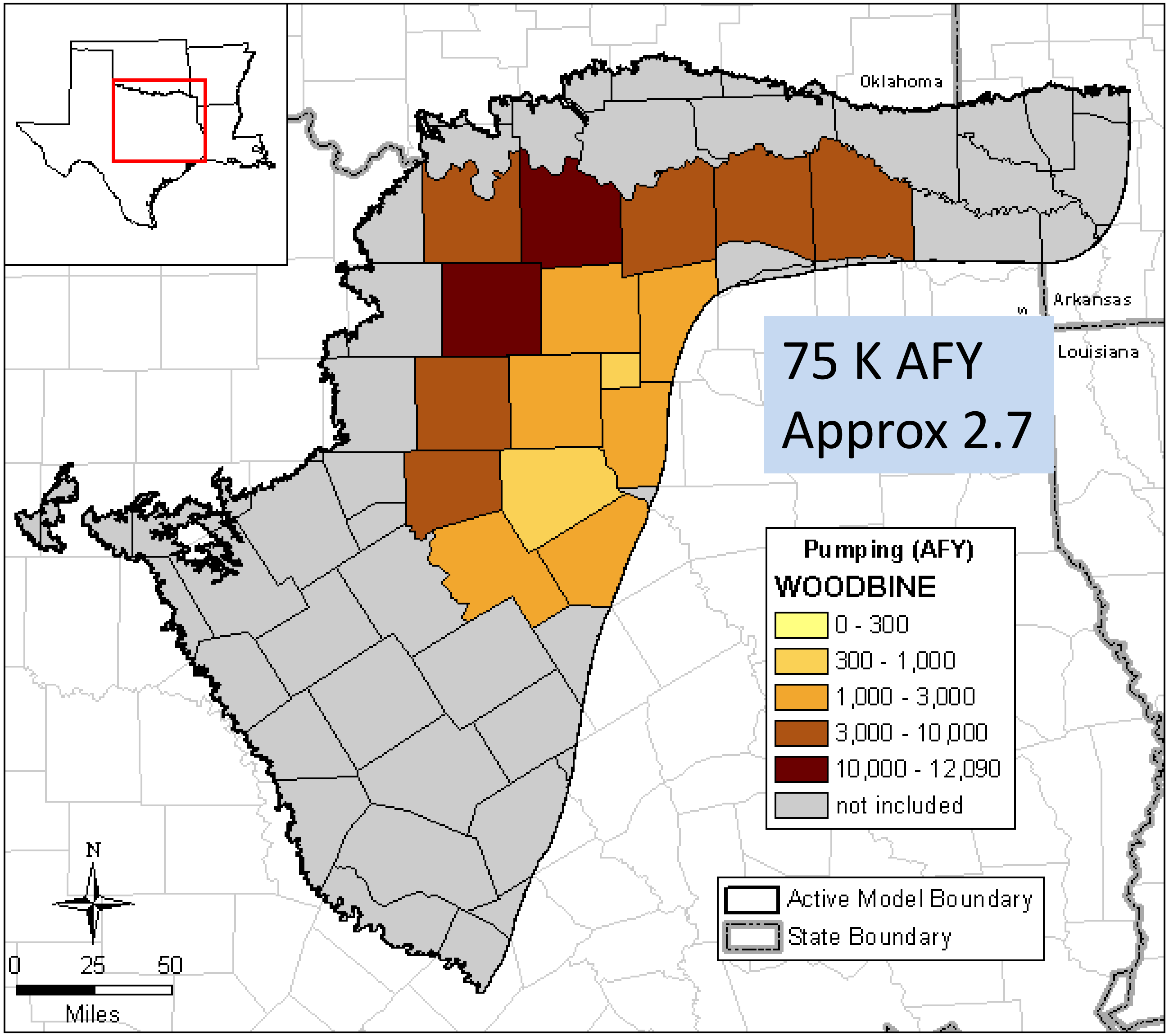
"Highest Practicable" - Trinity





“Highest Practicable” Woodbine





GAM TASK 13-031: TOTAL ESTIMATED RECOVERABLE STORAGE FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 8

by Jerry Shi, Ph.D., P.G., Robert G. Bradley, P.G., Shirley Wade, Ph.D., P.G., Ian Jones, Ph.D., P.G., Roberto Anaya, P.G., and Chelsea Seiter-Weatherford
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
Jerry Shi: (512) 463-5076
January 15, 2014

TABLE 1. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Brown	220,000	55,000	165,000
Burnet	6,600,000	1,650,000	4,950,000
Lampasas	2,800,000	700,000	2,100,000
Mills	630,000	157,500	472,500
Travis	33,000	8,250	24,750
Williamson	17,000	4,250	12,750
Total	**10,300,000**	**2,575,000**	**7,725,000**

TABLE 3. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Brown	420,000	105,000	315,000
Burnet	8,100,000	2,025,000	6,075,000
Lampasas	8,500,000	2,125,000	6,375,000
Mills	2,300,000	575,000	1,725,000
Total	**19,320,000**	**4,830,000**	**14,490,000**

TABLE 5. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE MARBLE FALLS AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Burnet	38,000	9,500	28,500
Lampasas	39,000	9,750	29,250
Total	**77,000**	**19,250**	**57,750**

TABLE 7. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bell	59,000,000	14,750,000	44,250,000
Bosque	40,000,000	10,000,000	30,000,000
Brown	2,600,000	650,000	1,950,000
Burnet	11,000,000	2,750,000	8,250,000
Callahan	1,800,000	450,000	1,350,000
Collin	88,000,000	22,000,000	66,000,000
Comanche	8,300,000	2,075,000	6,225,000
Cooke	45,000,000	11,250,000	33,750,000
Coryell	34,000,000	8,500,000	25,500,000
Dallas	77,000,000	19,250,000	57,750,000
Delta	11,000,000	2,750,000	8,250,000
Denton	64,000,000	16,000,000	48,000,000
Eastland	1,600,000	400,000	1,200,000
Ellis	78,000,000	19,500,000	58,500,000
Erath	20,000,000	5,000,000	15,000,000
Falls	36,000,000	9,000,000	27,000,000
Fannin	79,000,000	19,750,000	59,250,000
Grayson	63,000,000	15,750,000	47,250,000
Hamilton	22,000,000	5,500,000	16,500,000
Hill	52,000,000	13,000,000	39,000,000
Hood	11,000,000	2,750,000	8,250,000
Hunt	12,000,000	3,000,000	9,000,000
Johnson	35,000,000	8,750,000	26,250,000
Kaufman	9,400,000	2,350,000	7,050,000

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Lamar	77,000,000	19,250,000	57,750,000
Lampasas	12,000,000	3,000,000	9,000,000
Limestone	11,000,000	2,750,000	8,250,000
McLennan	59,000,000	14,750,000	44,250,000
Milam	22,000,000	5,500,000	16,500,000
Mills	8,500,000	2,125,000	6,375,000
Montague	7,800,000	1,950,000	5,850,000
Navarro	39,000,000	9,750,000	29,250,000
Parker	22,000,000	5,500,000	16,500,000
Red River	44,000,000	11,000,000	33,000,000
Rockwall	4,900,000	1,225,000	3,675,000
Somervell	6,000,000	1,500,000	4,500,000
Tarrant	49,000,000	12,250,000	36,750,000
Taylor	630,000	157,500	472,500
Travis	39,000,000	9,750,000	29,250,000
Williamson	77,000,000	19,250,000	57,750,000
Wise	20,000,000	5,000,000	15,000,000
Total	1,359,530,000	339,882,500	1,019,647,500

TABLE 9. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bell	11,000	2,750	8,250
Travis	5,900	1,475	4,425
Williamson	78,000	19,500	58,500
Total	**94,900**	**23,725**	**71,175**

TABLE 11. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE WOODBINE AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

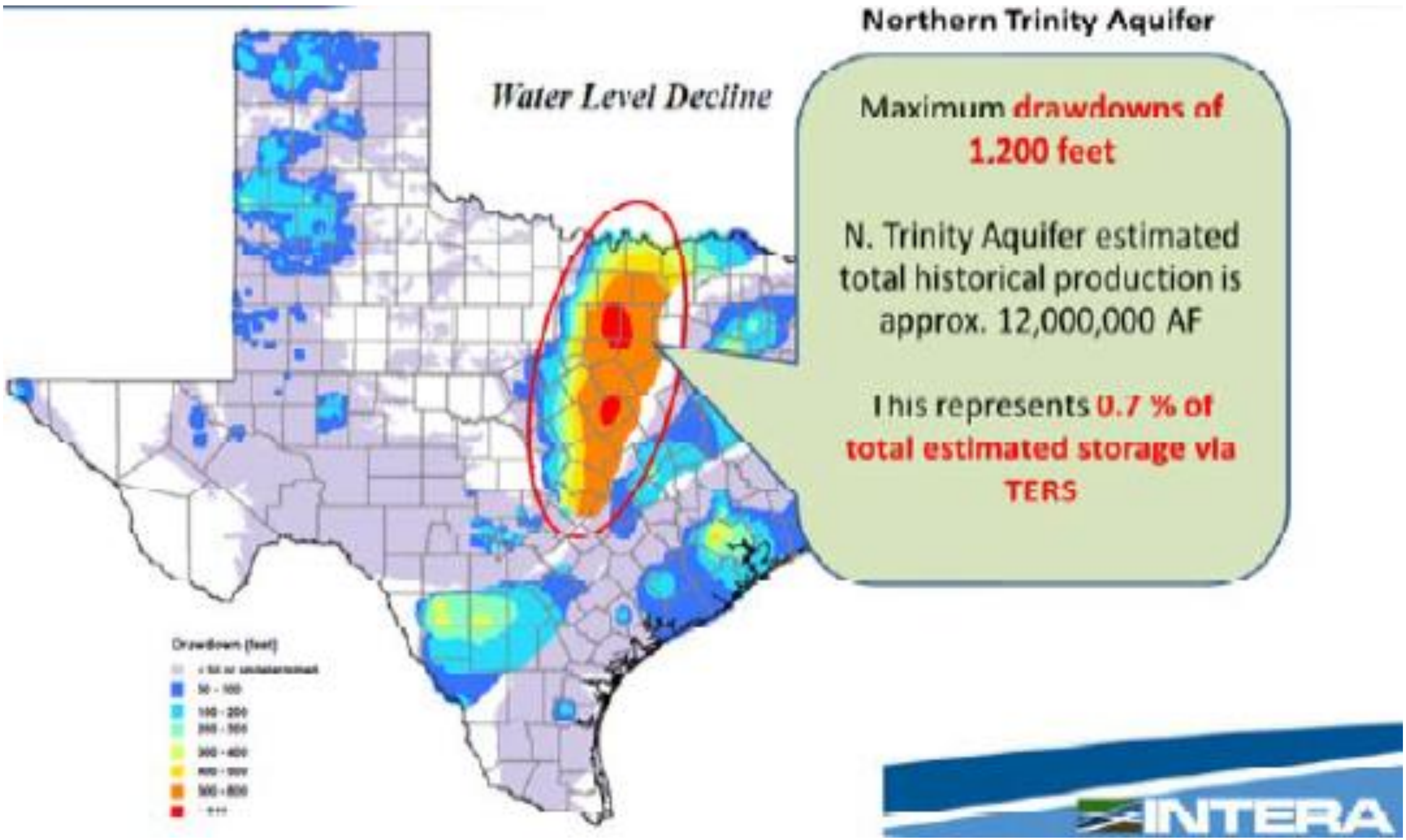
County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Collin	32,000,000	8,000,000	24,000,000
Cooke	1,200,000	300,000	900,000
Dallas	30,000,000	7,500,000	22,500,000
Denton	8,900,000	2,225,000	6,675,000
Ellis	25,000,000	6,250,000	18,750,000
Fannin	39,000,000	9,750,000	29,250,000
Grayson	32,000,000	8,000,000	24,000,000
Hill	6,700,000	1,675,000	5,025,000
Hunt	8,200,000	2,050,000	6,150,000
Johnson	4,500,000	1,125,000	3,375,000
Kaufman	4,700,000	1,175,000	3,525,000
Lamar	21,000,000	5,250,000	15,750,000
McLennan	900,000	225,000	675,000
Navarro	3,400,000	850,000	2,550,000
Red River	4,500,000	1,125,000	3,375,000
Rockwall	46,000	11,500	34,500
Tarrant	5,300,000	1,325,000	3,975,000
Total	**227,346,000**	**56,836,500**	**170,509,500**

TABLE 13. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE NACATOCH AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bowie	2,100,000	525,000	1,575,000
Delta	100,000	25,000	75,000
Ellis	66	17	50
Franklin	7,300	1,825	5,475
Hopkins	330,000	82,500	247,500
Hunt	550,000	137,500	412,500
Kaufman	120,000	30,000	90,000
Lamar	12,000	3,000	9,000
Navarro	95,000	23,750	71,250
Rains	18,000	4,500	13,500
Red River	580,000	145,000	435,000
Rockwall	280	70	210
Total	**3,912,646**	**978,162**	**2,934,485**

TABLE 15. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE BLOSSOM AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bowie	910,000	227,500	682,500
Lamar	970,000	242,500	727,500
Red River	5,200,000	1,300,000	3,900,000
Total	**7,080,000**	**1,770,000**	**5,310,000**

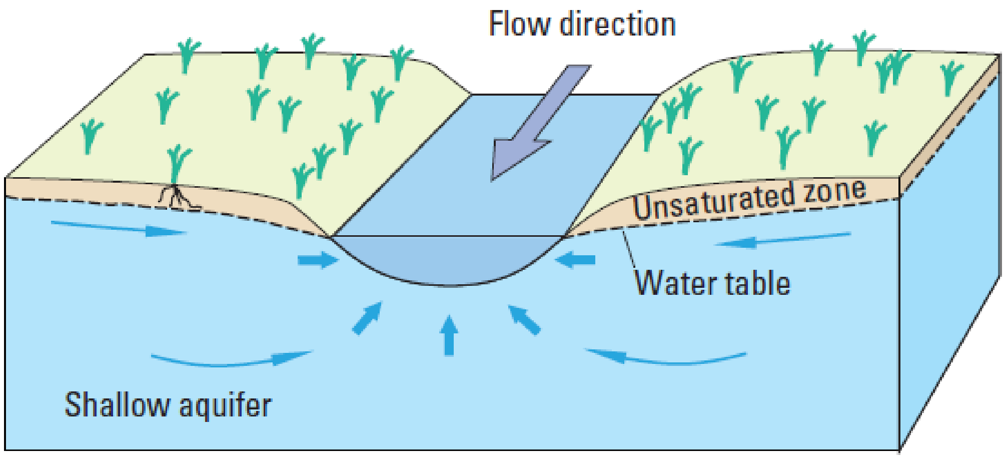

Northern Trinity Aquifer
Water Level Decline
Maximum drawdowns of 1,200 feet
N. Trinity Aquifer estimated total historical production is approx. 12,000,000 AF
This represents 0.7 % of total estimated storage via TERS
Drawdown (feet)
INTERA

Environmental Factors
TWC Section 36.108 (d)(4)

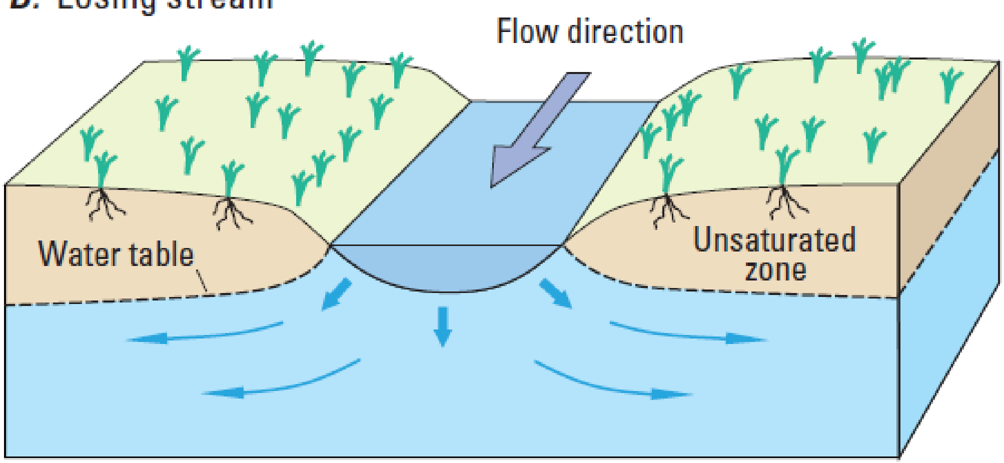
- Districts shall consider other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water. Texas Water Code 36.108 (d)(3)

Stream-Aquifer Terminology

A. Gaining stream



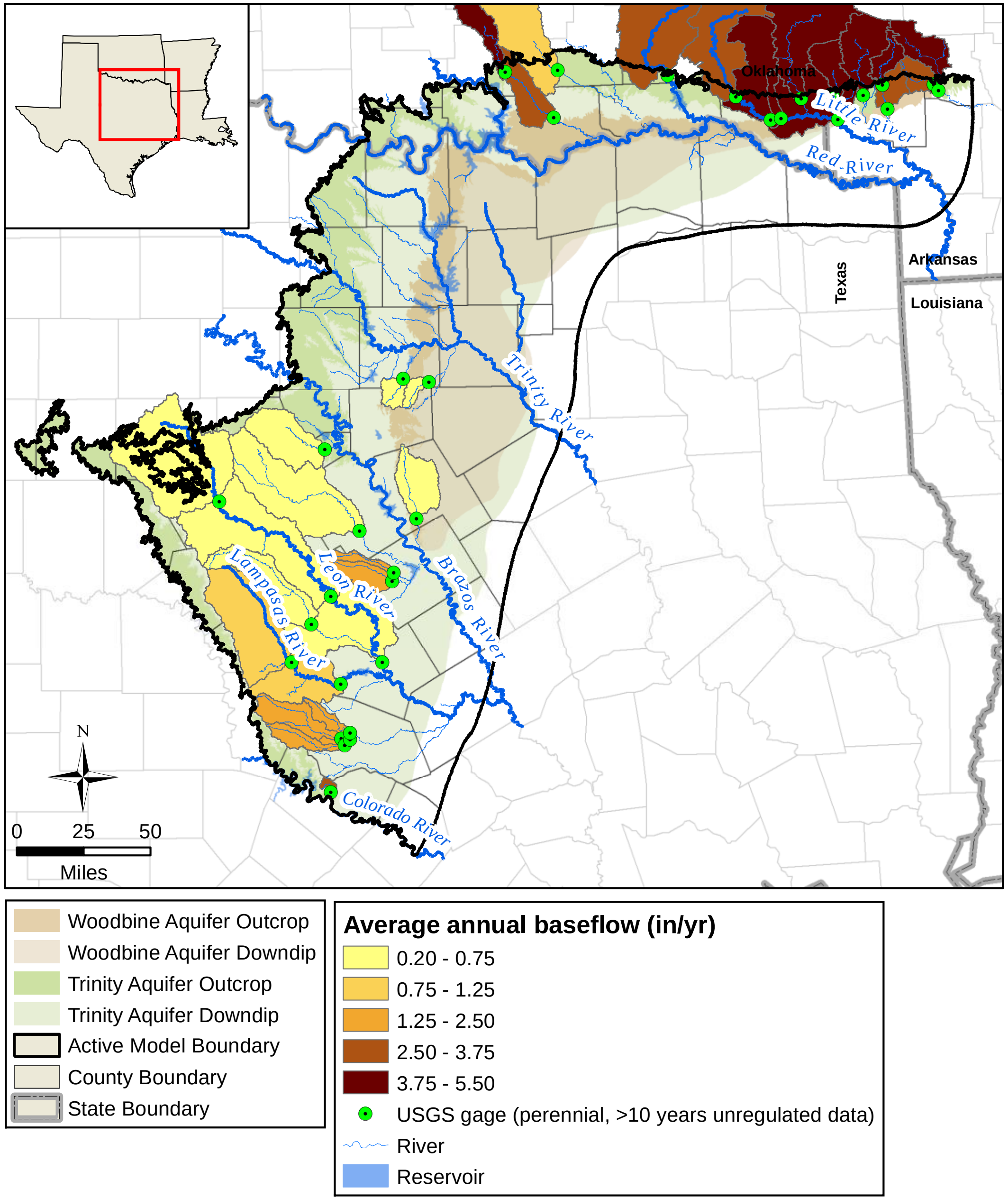
B. Losing stream

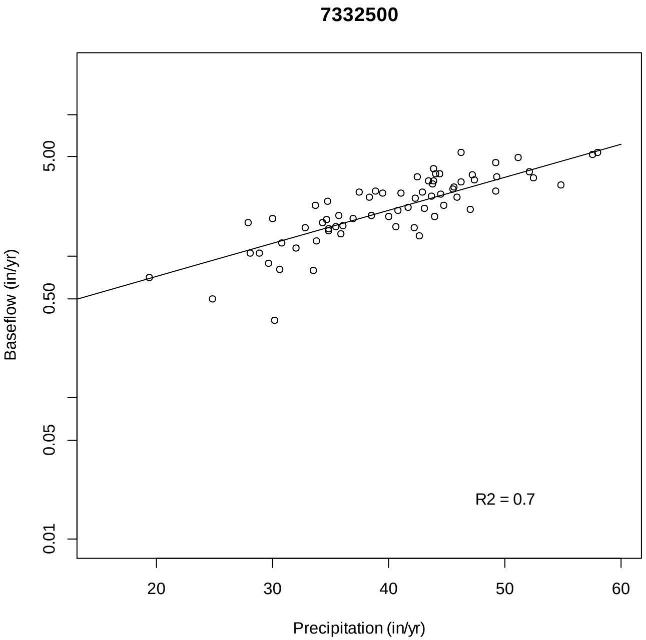


- Gaining
  - Net discharge of groundwater to surface water “ base flow”
- Losing:
  - Net discharge of surface water to groundwater “recharge”

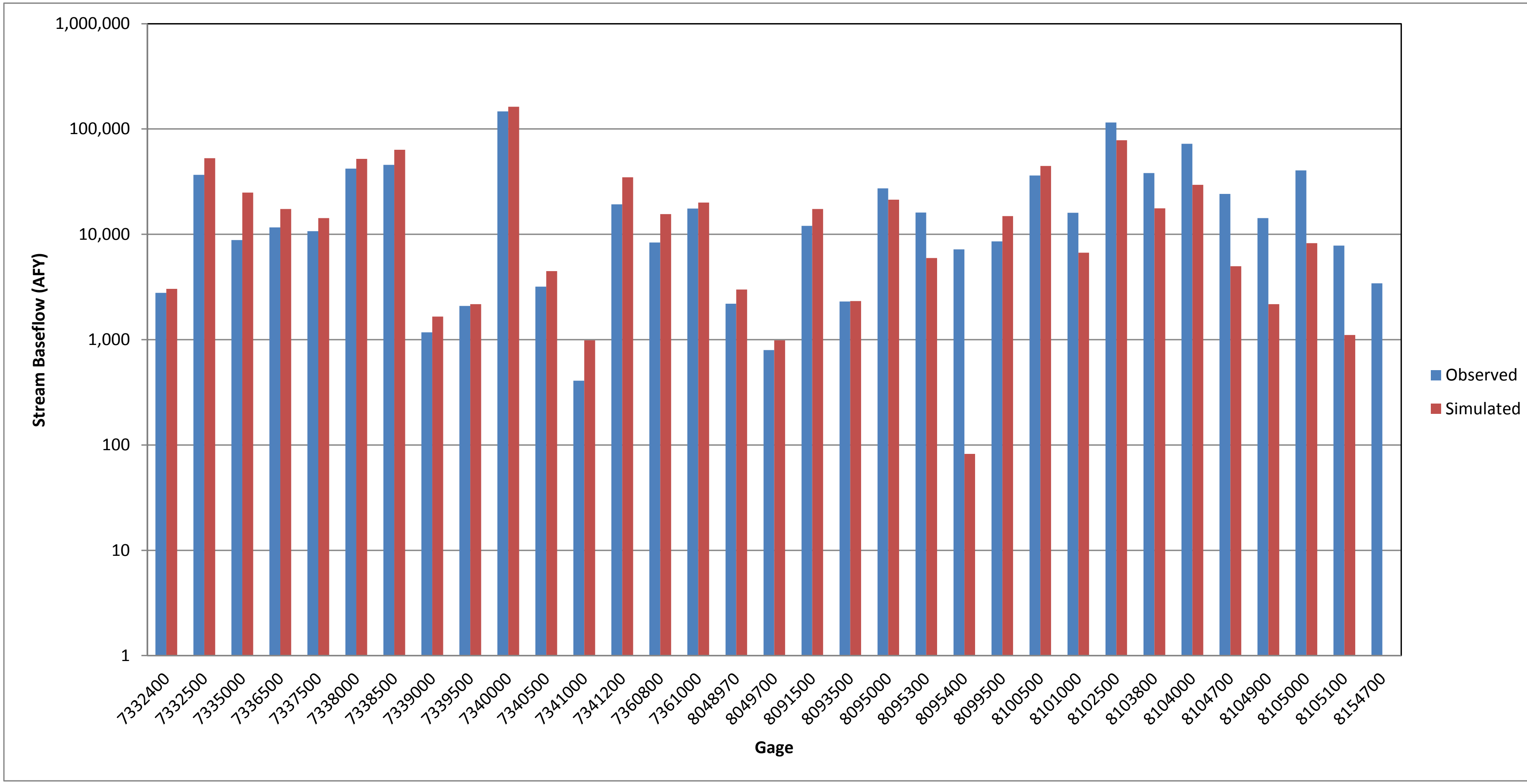
USGS Circular 1376, 2012

Stream – Aquifer Interaction





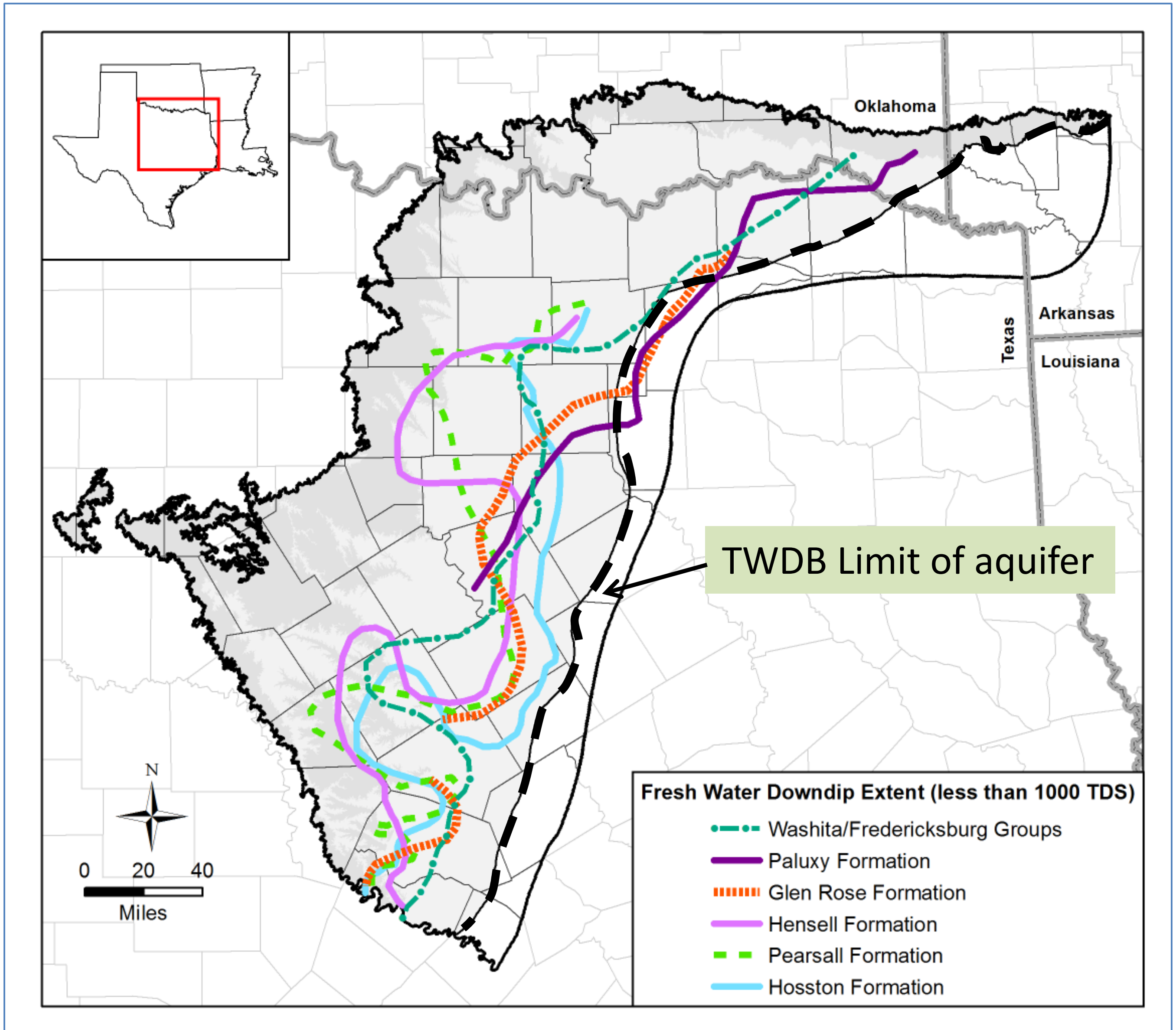
Simulated Stream Gains



Review of GMA 8 GCD Management Plan requirement for management goals addressing natural resource issues TWC Section 36.1071 (a)(5)

- A review of the 11 GMA 8 GCD management plans identified the following natural resource issues in GMA 8
  - Water quality/abandoned/deteriorated wells (Central Texas, Post Oak Savannah,),
  - Water quality monitoring (Clearwater, Middle Trinity,),
  - Injection well monitoring program (North Texas, Prairielands,)
  - Natural resources production (Saratoga, Southern Trinity)

Water Quality – 1,000 ppm TDS Limit



Subsidence
TWC Section 36.108 (d)(5)

- Districts shall consider the impacts on subsidence. Texas Water Code 36.108 (d)(3)

Review of GMA 8 GCD Management Plan requirement for management goals adopted to control and prevent subsidence TWC Section 36.1071 (a)(3)

- 11 GMA 8 GCD Management Plans were reviewed for presence of management goals related to the control and prevention of subsidence. 10 GMA GCD's Management Plans determined that this management goal was not applicable to geologic conditions in the individual GCD.
- Post Oak Savannah GCD objective to monitor drawdowns with due consideration to the potential for land subsidence. At least once every three years, Post Oak Savannah will report projected land subsidence for areas where water levels will decrease more than 300 feet (over a 50 year period from the year 2000 baseline condition) based on GAM simulations used for the joint planning process.

Water-Level Declines in the Woodbine, Paluxy, and Trinity Aquifers of North-Central Texas

Robert E. Mace, Alan R. Dutton, and **H. Seay Nance**
Bureau of Economic Geology, The University of Texas at Austin,
University Station, Box X, Austin, TX 78713-7508

Abstract

Ground-water mining of the Woodbine, Paluxy, and Trinity aquifers has led to substantial water-level declines in North-Central Texas since the turn of the century. Water-level maps constructed from R. T. Hill's 1901 well survey data show that water levels were initially above land surface before development. Numerous wells were drilled for water supply because the wells flowed at land surface. Water levels declined rapidly, and many of the wells around Fort Worth stopped flowing by 1914. Many of these wells were then abandoned, which slowed the rate of water-level decline. Since the turn of the century, water levels have declined nearly 850 ft in the Trinity aquifer in the Fort Worth area. As of 1990, water levels had declined about 400 ft in the Woodbine aquifer near Dallas and 450 ft in the Paluxy aquifer near Fort Worth. Maps drawn on the basis of water-level measurements in 1935, 1955, 1960, 1970, 1980, and 1990 show how the shape of potentiometric surfaces has evolved during the century.

This great drawdown in water levels has increased pumping costs, reversed ground-water flow directions in the Dallas–Fort Worth and Sherman areas, and may have affected water quality. Land subsidence from water-level decline has not been observed in North-Central Texas, perhaps because of the structural stability of the geologic units or a consolidation time lag. Pumping costs and water-quality problems have caused many ground-water users to switch to surface sources of water. Consequently, the rate of water-level decline has decreased in some parts of the aquifers, and in the case of the Paluxy aquifer, this may have caused recent water-level recovery.

Mace, R. E., Dutton, A. R., and Nance, H. S., 1994, Water-level declines in the Woodbine, Paluxy, and Trinity aquifers of North-Central Texas: Transactions of the Gulf Coast Association of Geological Sciences, Vol. XLIV, pp. 413-420.

Draft Technical Review Memorandum presented during 9/2/2015 GMA 8 meeting

- Conclusion - Based on the geologic and hydrogeologic characteristics in the region of GMA 8, the proposed desired future conditions will not have any impacts on subsidence.
- Final Technical Review Memorandum, along with cop of Mace and others, 1994, will be included in materials considered and in Explanatory Report.

Questions
Coming up - April 1, 2016
TWC 36.108 (d)(6 – 7)
Socioeconomic impacts and private property rights surveys