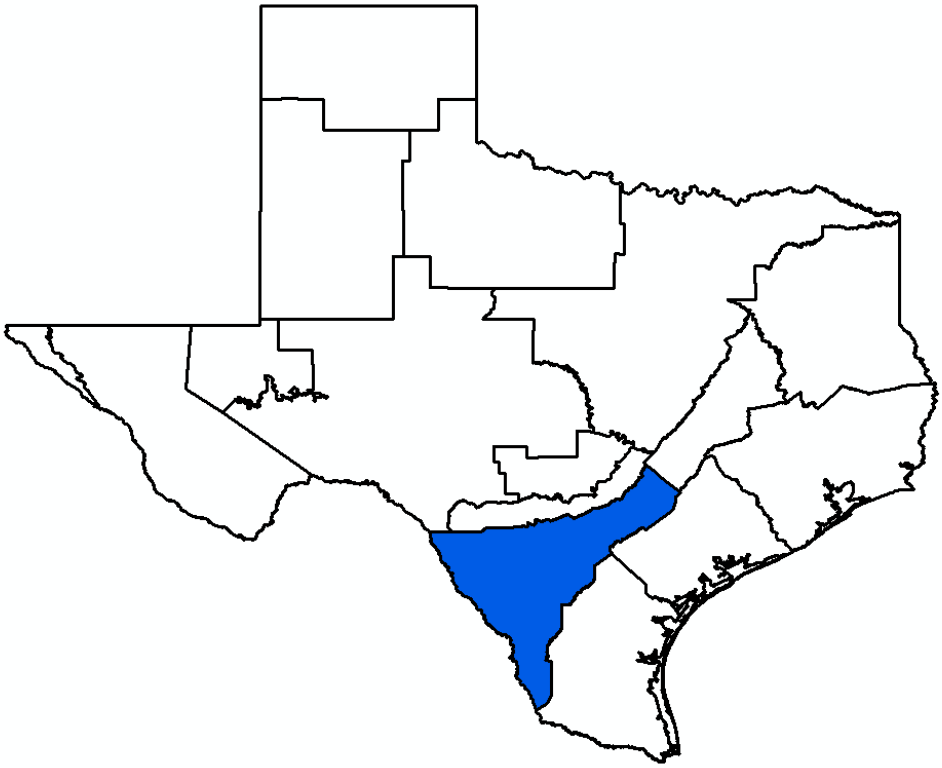
GMA 13 Technical Memorandum 16-08
Draft 1

Sparta, Queen City, and Carrizo-Wilcox Aquifers: Summary of Scenario 9 Drawdown and Outcrop Results



Prepared for:
Groundwater Management Area 13

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Table of Contents

List of Tables

List of Figures

1.0 Introduction and Objective

As a follow-up to the GMA 13 meeting of March 30, 2016, this technical memorandum summarizes the results of Scenario 9 that are covered in Technical Memoranda 16-01, 16-02, and 16-03. Technical Memorandum 16-01 included drawdown results of Scenarios 9 to 12, Technical Memorandum 16-02 covered an analysis of the outcrop area of Scenarios 9 to 12, and Technical Memorandum 16-03 covered a more detailed analysis of the outcrop areas of Scenarios 9, 13 and 14. Thus, the results of Scenario 9 are covered in three separate tech memos. Because GMA 13 is considering proposed DFCs based on Scenario 9, it seemed reasonable to summarize all the results in a single document to assist the districts during the public comment period. For more details, please refer to the original tech memos.

Scenario 9 was developed from Scenario 8, which was based on input from the groundwater conservation districts, and added all recommended and alternative water management strategies in the 2015 Region L plan.

2.0 Description of Simulations

Appendix A of Technical Memorandum 16-01 includes maps of the locations of the 12 strategies that were taken from the Region L IPP. Table 1 summarizes the pumping amounts for all strategies except the Local Carrizo strategy. Please note that nearly all require the same amount of pumping in 2020 and in 2070. Only a few require increases in pumping during the planning period.

Table 1. Summary of Pumping for Strategies

Strategy	Project	2020	2030	2040	2050	2060	2070
2	SSLGC Brackish Wilcox	5,556	5,556	5,556	5,556	5,556	5,556
3	SSLGC Expanded Carrizo Project	6,500	6,500	6,500	6,500	6,500	6,500
4	Brackish Wilcox for SS WSC	1,244	1,244	1,244	1,244	1,244	1,244
5	CVLGC Carrizo Project	10,000	10,000	10,000	10,000	10,000	10,000
6	CRWA Wells Ranch - Phase 2	10,629	10,629	10,629	10,629	10,629	10,629
7	Brackish Wilcox Groundwater for CRWA	0	16,333	16,333	16,333	16,333	16,333
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	37,334	37,334	37,334	37,334
9	SAWS Expanded Brackish Project	0	53,853	53,853	53,853	53,853	53,853
10	SAWS Expanded Local Carrizo	30,000	30,000	30,000	30,000	30,000	30,000
11	Hays/Caldwell PUA Project	10,300	15,000	15,000	35,690	35,690	35,690
12	TWA Carrizo Project	5,000	15,000	15,000	15,000	15,000	15,000

Table 2 summarizes a comparison of groundwater pumping for Region L strategies, the calibrated GAM (1999 pumping), the current MAG (GAM Run 09-34), and Scenarios 8 and 9.

Table 2. Comparison of Strategies, 1999 Pumping, Current MAG, and Scenario 8

Strategy	Project	Region L IPP		Calibrated GAM	GAM Run 09-34		Scenario 8		Scenario 9	
		2020	2070	1999	2000	2060	2012	2070	2012	2070
1	Local Carrizo		9,151	25,039	31,679	28,443	31,677	28,360	40,222	40,222
2	SSLGC Brackish Wilcox	5,556	5,556	0	235	235	235	235	6,122	6,122
3	SSLGC Expanded Carrizo Project	6,500	6,500	49	64	2,071	232	2,730	7,140	7,140
4	Brackish Wilcox for SS WSC	1,244	1,244	0	0	0	0	0	1,243	1,243
5	CVLGC Carrizo Project	10,000	10,000	37	143	174	143	160	10,960	10,960
6	CRWA Wells Ranch - Phase 2	10,629	10,629	20	3,108	5,106	3,364	6,153	11,697	11,697
7	Brackish Wilcox Groundwater for CRWA	0	16,333	35	35	35	37	117	17,954	17,954
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	87	16,989	16,989	33,601	33,601	41,067	41,067
9	SAWS Expanded Brackish Project	0	53,853	0	0	0	0	0	53,879	53,879
10	SAWS Expanded Local Carrizo	30,000	30,000	422	6,615	6,615	19,613	20,350	32,987	32,987
11	Hays/Caldwell PUA Project	10,300	35,690	101	22,646	22,646	22,647	22,647	39,262	39,262
12	TWA Carrizo Project	5,000	15,000	47	38	16,390	38	16,389	16,487	16,487
13	Other Pumping Areas	N/A	N/A	263,119	361,783	340,706	382,993	362,069	383,001	383,001

Please note that within many of the areas of these strategies, Scenario 8 included substantial pumping. These areas simply required adjustment to pumping input. Two strategy areas had no pumping in Scenario 8: Brackish Wilcox for SSWSC and SAWS Expanded Brackish Project (Strategies 4 and 9). New wells were included in these areas based on the locations as shown in Appendix A. Please note that Table 2 includes "Strategy 13" which is simply all the pumping in the model that is not within the boundaries of the 12 strategies as noted in Appendix A.

For purposes of these simulations, strategy pumping was assumed to be equal for the entire simulation period (2012 to 2070) and set based on the 2070 numbers in Table 2 (i.e. scheduled increases were not simulated to avoid problems in MAG caps in future regional planning sessions if there are changes in the timing of strategy implementation).

Scenario 9 includes all of Scenario 8 pumping plus all strategy pumping as presented in Table 2 and discussed above. A summary of the pumping in Scenario 9 is also presented in Table 2. Please note that pumping in Scenario 9 may be higher than listed by Region L to account for other pumping that had already been included in Scenario 8.

3.0 Predictive Simulation Results

3.1 Pumping and Drawdown Results

Summary tables of pumping and average drawdown for each county and model layer for Scenario 9 are presented in Tables 3 and 4, respectively.

Table 3. Scenario 9 Pumping (AF/yr)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,686	0	0	41,067	78,753
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	22,132	94,610
Guadalupe	0	0	0	0	16,851	0	8,218	22,723	47,792
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	62,434	102,417
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA13	6,415	0	14,859	0	356,554	9,777	31,036	181,039	599,702

Table 4. Scenario 9 Average Drawdown (ft) from 2011 to 2070

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	14	20	22	71	122	122	140	255	105
Bexar	0	0	0	12	141	73	64	227	155
Caldwell	0	0	9	26	134	130	56	85	82
Dimmit	-1	3	-4	-4	-3	-3	-6	-5	-4
Frio	4	4	-1	31	52	50	49	56	36
Gonzales	29	37	46	88	136	136	137	219	109
Guadalupe	0	0	-10	5	90	89	79	190	128
Karnes	28	45	57	103	145	146	185	393	138
LaSalle	8	10	13	22	29	30	9	2	15
Maverick	0	0	0	0	-7	-10	-10	-2	-6
McMullen	33	39	44	63	80	78	25	27	49
Medina	0	0	0	-1	26	27	29	31	29
Uvalde	0	0	0	0	1	4	11	26	17
Webb	-6	-4	-9	-4	-2	-1	-1	-3	-4
Wilson	10	20	23	74	135	137	210	528	172
Zavala	-6	-5	-12	-4	10	10	12	14	5
GMA13	12	16	12	33	55	54	54	102	48

3.2 Outcrop Area Saturated Thickness

Figure 1 presents the saturated thickness in 2011 of the outcrop area of the Carrizo Aquifer in 2011. Figure 2 presents the simulated saturated thickness of 2070 of the outcrop area of the Carrizo Aquifer in 2070 under Scenario.

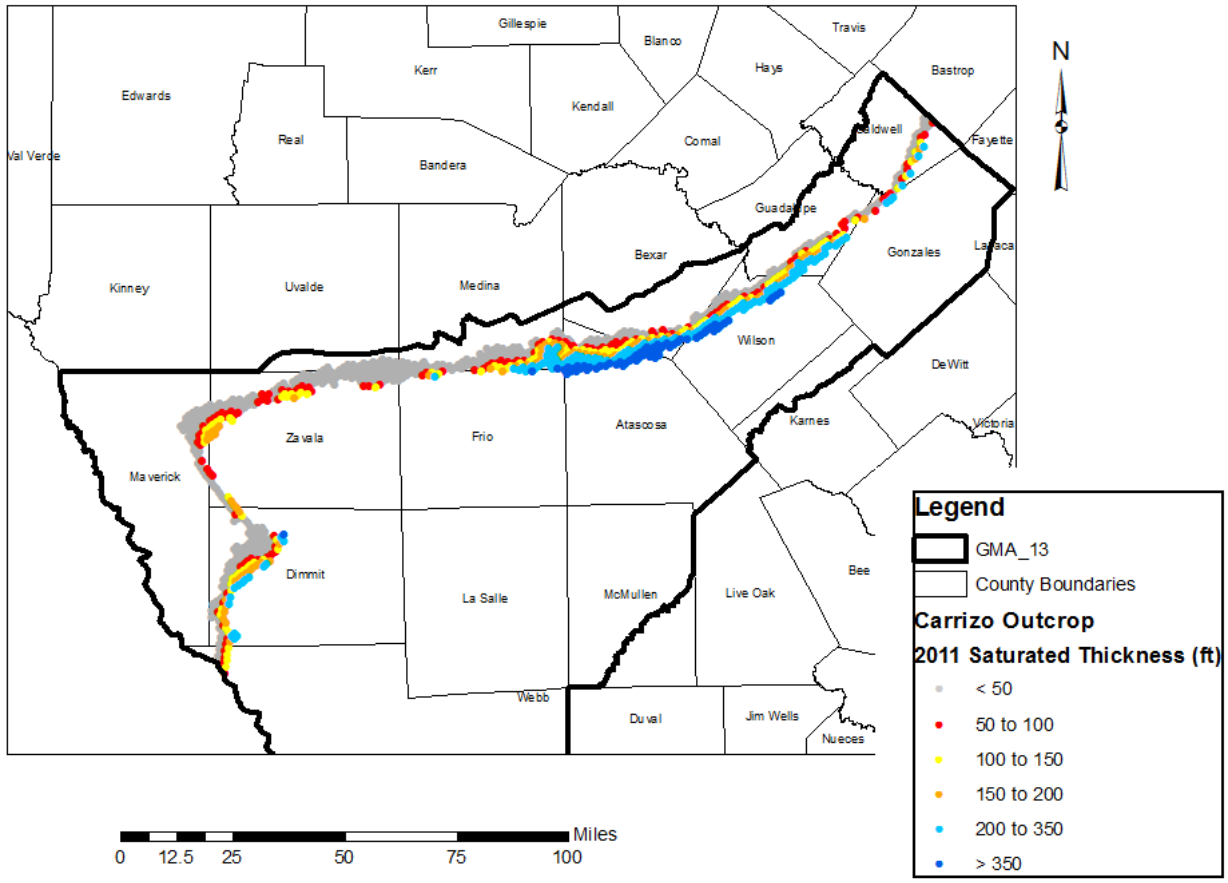

Figure 1. 2011 Saturated Thickness of the Outcrop Area of the Carrizo Aquifer

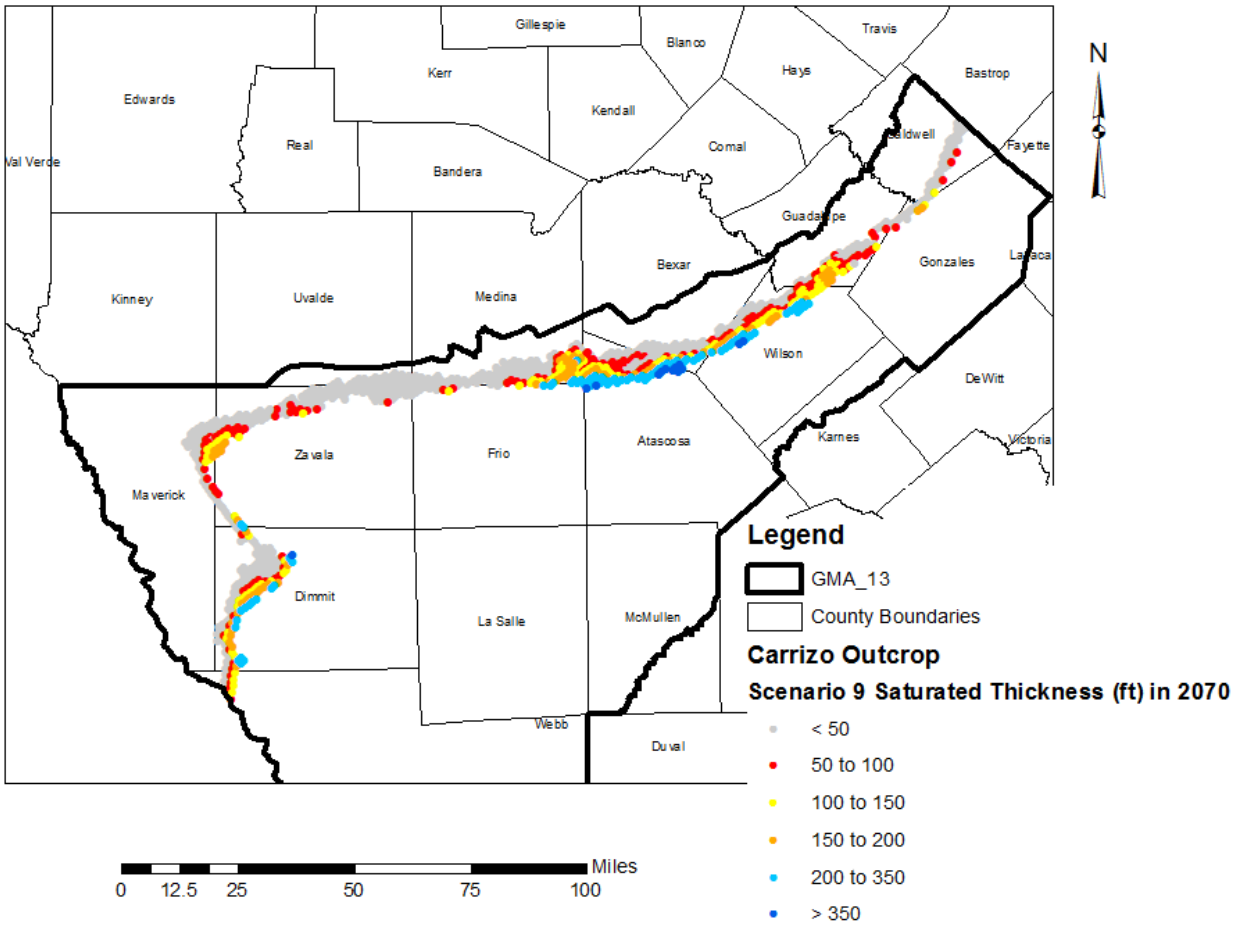

Figure 2. Simulated Saturated Thickness of the Outcrop Area of the Carrizo Aquifer in 2070 (Scenario 9)

Figure 3 presents the saturated thickness in 2011 of the outcrop area of the Wilcox Aquifer in 2011. Figure 4 presents the simulated saturated thickness of 2070 of the outcrop area of the Wilcox Aquifer in 2070 under Scenario 9.

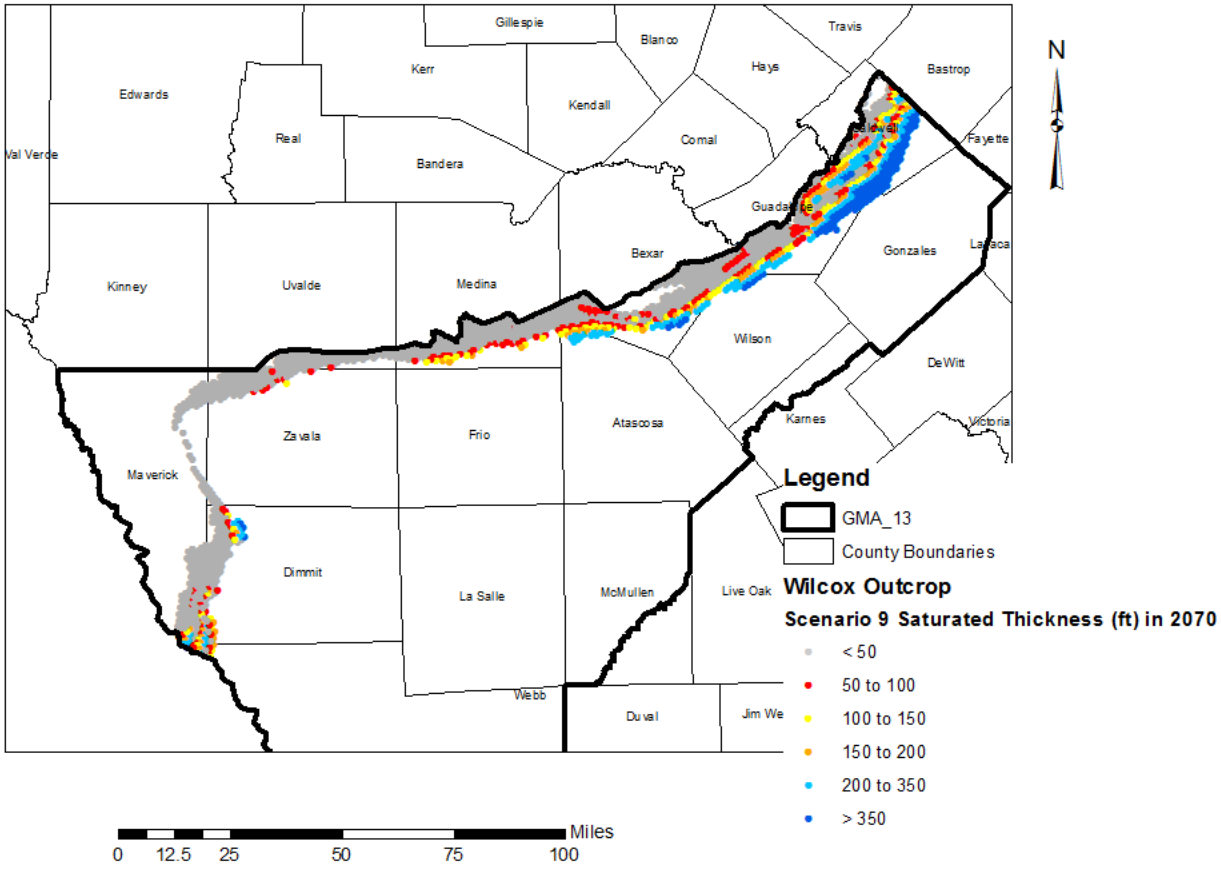

Figure 3. 2011 Saturated Thickness of the Outcrop Area of the Wilcox Aquifer

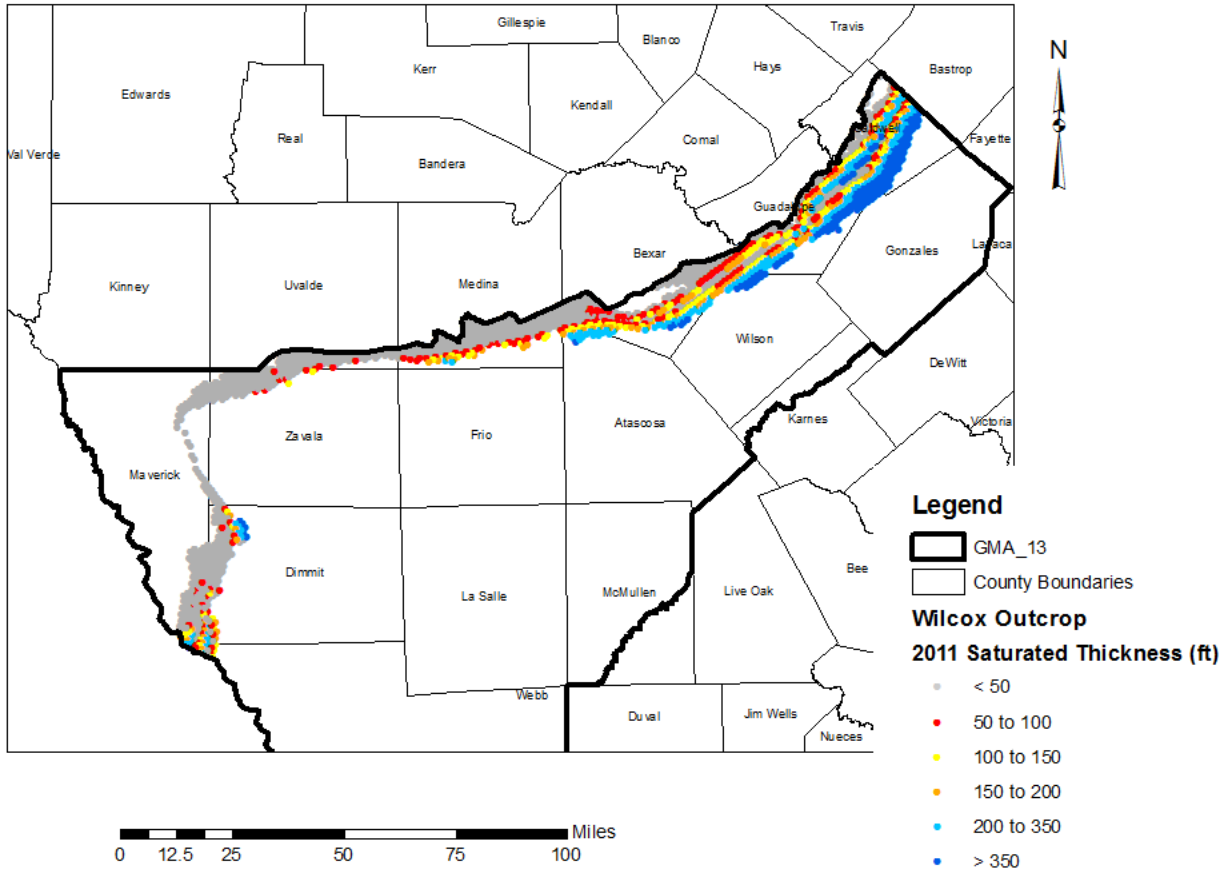

Figure 4. Simulated Saturated Thickness of the Outcrop Area of the Wilcox Aquifer in 2070 (Scenario 9)

3.3 Outcrop Area Classification

The outcrop area of the Carrizo and Wilcox aquifers was subdivided based on estimated 2011 saturated thickness. Table 5 summarizes the classification and the number of cells within each class.

Table 5. Summary of Outcrop Area Classification

Aquifer	2011 Saturated Thickness (ft)	Number of Model Cells in GMA 13
Carrizo	0 to 50	475
Carrizo	50 to 100	131
Carrizo	100 to 250	260
Carrizo	250 to 500	121
Carrizo	> 500	12
Wilcox	0 to 50	860
Wilcox	50 to 100	168
Wilcox	100 to 250	291
Wilcox	250 to 500	177
Wilcox	> 500	62

Model output was processed to calculate the saturated thickness in 2070 for each of these classes. The 2070 saturated thickness was then divided by the saturated thickness in 2011 (Table 5) and multiplied by 100 to develop an estimate of the saturated thickness remaining in 2070 as a percentage of the saturated thickness in 2011 for each class.

Table 6 presents the saturated thickness in 2070 for Scenario 9, and compares these results to Scenario 15 (a scenario where 2011 pumping is assumed from 2012 to 2070). Please note that in some western areas of GMA 13 (Dimmit, Maverick, Webb, and Zavala counties), Scenario 9 assumes pumping decreases that result in groundwater level recoveries. Thus, some of the results for saturated thickness in Scenario 9 are greater than in Scenario 15.

Table 6. Summary of Outcrop Saturated Thickness Remaining in 2070

		Scenario 9	Scenario 15
Outcrop Area of Carrizo Aquifer Saturated Thickness in 2070 (% of 2011 Saturated Thickness)	0 to 50 ft	116.59	131.76
	50 to 100 ft	72.80	80.87
	100 to 250 ft	66.03	78.92
	250 to 500 ft	61.31	77.27
	> 500 ft	65.25	84.09
Outcrop Area of Wilcox Aquifer Saturated Thickness in 2070 (% of 2011 Saturated Thickness)	0 to 50 ft	100.48	93.55
	50 to 100 ft	66.22	85.31
	100 to 250 ft	75.22	98.05
	250 to 500 ft	87.34	97.97
	> 500 ft	95.72	99.54

Please note that due to model limitations that have been documented in the Task 0 report and discussed by consultants for various stakeholders at previous GMA 13 meetings, the model

predicts drawdown in the outcrop area that is not always consistent with actual data. Note that under Scenario 15, the model predicts that saturated thickness in 2070 would drop below 80 percent even if pumping remained at 2011 rates. This is not consistent with actual monitoring data, and highlights the limitations of the model.

Therefore, a desired future condition of maintaining 75 percent of saturated thickness in the outcrop areas under Scenario 9 is considered feasible despite model predictions to the contrary. Improvements in the monitoring program in the outcrop area is needed. Also, the upcoming model update needs to focus more attention on model calibration for the outcrop area. Presumably, this update will be completed and the model will be available when the next proposed DFC is due in 2021.