LRE WATER
CONNECTING WATER TO LIFE

1/14/2022
TBPE Firm 14368

Technical Memorandum

To:	Groundwater Management Area 13
From:	Jordan Furnans, PhD, PE, PG
Date:	January 14, 2022
Project:	2021 Joint Planning
Subject:	Groundwater Availability Modeling Technical Elements

---

The purpose of this memo is to meet the requirements of "Desired Future Condition Submission Packet Checklist - Groundwater Availability Modeling Technical Elements (part 4)" checklist. All modeling was conducted at the direction of Groundwater Management Area (GMA) 13 members.

Description of Desired Future Condition (DFC) - Carrizo-Wilcox, Queen City, and Sparta Aquifers

As described in Section 2 of the Explanatory Report, for the Carrizo-Wilcox, Queen City, and Sparta Aquifers two desired future conditions were proposed. The primary desired future condition is that 75 percent of the saturated thickness in the outcrop at the end of 2012 remains at the end of 2080. The secondary desired future condition is that the average drawdown of 49 feet (+/- 5 feet) be achieved for all of Groundwater Management Area 13, as calculated for the entire period from 2012 through 2080.

Modeling Approach

GAM version: The Southern Portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers as represented in Kelley and others (2004).

Stress periods: 81 stress periods of 365.25 days each. The first stress period begins on January 1, 2000 and the last stress period (81) ends on December 31, 2080. The first stress period corresponds to the end of the calibration period.

Recharge: Average recharge applied throughout the predictive period

Predictive pumping: Details on the modifications to the predictive pumping are documented in the technical memorandums in Appendix 4 of the Explanatory Report.

Version of TWDB "model grid" file: "qcsp_s_grid05132019.csv" available at http://www.twdb.texas.gov/groundwater/models/gam/gam_grids/qcsp_s.zip as of the date of this technical memorandum.

Evaluation method: To extract data from the model and calculate average drawdown we used a script written using the Julia programming language available at https://julialang.org/. The script is named “Calc_avg_dd_GMA13_2019_001.jl” and is included with the modeling files. We calculated average drawdown for GMA 13 as a whole with the following assumptions:

- Calculations only occur within the active aquifer footprint as defined in the “model grid” file (AQ_Active[#] == 1; where [#] is the layer number)
- Drawdown = starting head – head for the stress period of interest
    - For the DFCs, the stress period of interest = 81
    - Starting head = simulated head at the end of the calibration period (12/31/1999)
    - If a cell goes dry, drawdown = starting head – bottom of the aquifer
- Average drawdown = sum of drawdown in each model cell within area of interest divided by the number of model cells within the area of interest

Results: Summarized below. Also, see Appendix 4.5 in Explanatory Report.

Table 1. Abbreviated summary of the pumping input values for portions of counties located within GMA 13.

Current Draft Pumping Input (i.e.,Well File), Acre-Feet per Year							
GCD/County	**Layer**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Evergreen UWCD	Sparta	2,739	2,183	2,071	1,974	1,888	1,814
	Queen City	13,614	10,797	10,455	10,134	9,724	9,358
	Carrizo	201,458	173,264	173,397	174,659	175,888	177,356
	Upper Wilcox	374	374	374	374	374	374
	Middle Wilcox	374	374	374	374	374	374
	Lower Wilcox	3,071	6,571	10,421	34,081	69,931	87,931
	Total	221,630	193,563	197,092	221,596	258,179	277,207
Gonzales County UWCD	Sparta	3,554	3,554	3,554	3,554	3,554	3,554
	Queen City	10,183	10,183	10,183	10,183	10,183	10,183
	Carrizo	47,486	61,408	71,481	81,382	86,337	87,298
	Upper Wilcox	15	15	15	15	15	15
	Middle Wilcox	11,216	15,716	20,216	24,716	24,716	24,716
	Lower Wilcox	2,200	8,800	15,400	22,000	22,000	22,000
	Total	74,654	99,675	120,848	141,850	146,805	147,765
Guadalupe County GCD	Sparta	0	0	0	0	0	0
	Queen City	0	0	0	0	0	0
	Carrizo	28,883	25,411	26,053	26,395	26,685	27,084
	Upper Wilcox	0	0	0	0	0	0
	Middle Wilcox	6,690	7,090	9,200	11,268	11,268	11,268
	Lower Wilcox	21,215	21,215	22,188	23,164	23,164	23,164
	Total	56,788	53,716	57,441	60,826	61,117	61,516
McMullen GCD	Sparta	0	0	0	0	0	0
	Queen City	3	3	3	3	3	3
	Carrizo	7,773	7,773	4,857	4,857	4,857	4,857
	Upper Wilcox	1,280	1,280	1,280	1,280	1,280	1,280
	Middle Wilcox	88	88	88	88	88	88
	Lower Wilcox	0	0	0	0	0	0
	Total	9,144	9,144	6,228	6,228	6,228	6,228
Medina County GCD	Sparta	0	0	0	0	0	0
	Queen City	0	0	0	0	0	0
	Carrizo	515	515	515	515	515	515
	Upper Wilcox	0	0	0	0	0	0
	Middle Wilcox	1,250	1,250	1,250	1,250	1,250	1,250
	Lower Wilcox	1,250	1,250	1,250	1,250	1,250	1,250
	Total	3,015	3,015	3,015	3,015	3,015	3,015
Plum Creek CD	Sparta	0	0	0	0	0	0
	Queen City	0	0	0	0	0	0
	Carrizo	0	1,991	5,037	5,712	6,050	10,000
	Upper Wilcox	0	0	0	0	0	0
	Middle Wilcox	5,702	5,702	5,702	5,702	5,702	5,702
	Lower Wilcox	11,916	11,916	11,916	11,916	11,916	11,916
	Total	17,617	19,609	22,655	23,330	23,667	27,617
Uvalde County UWCD	Sparta	0	0	0	0	0	0
	Queen City	0	0	0	0	0	0
	Carrizo	0	1,991	5,037	5,712	6,050	10,000
	Upper Wilcox	0	0	0	0	0	0
	Middle Wilcox	5,702	5,702	5,702	5,702	5,702	5,702
	Lower Wilcox	11,916	11,916	11,916	11,916	11,916	11,916
	Total	17,617	19,609	22,655	23,330	23,667	27,617
Wintergarden GCD	Sparta	987	987	987	987	987	987
	Queen City	11	11	11	11	11	11
	Carrizo	35,724	35,724	35,724	35,724	35,724	35,724
	Upper Wilcox	9,417	9,417	9,417	9,417	9,417	9,417
	Middle Wilcox	3,818	3,818	3,818	3,818	3,818	3,818
	Lower Wilcox	415	415	415	415	415	415
	Total	50,372	50,372	50,372	50,372	50,372	50,372

Table 2. Calculated simulated average drawdown from January 1, 2000 through December 31, 2080.

Current Draft Average Drawdown from 12/31/2012, Feet							
	Layer	2020	2030	2040	2050	2060	2070
Districts in GMA 13	Sparta	3	6	8	11	13	15
	Queen City	3	7	11	15	18	22
	Carrizo	13	27	39	51	61	72
	Upper Wilcox	12	27	38	50	60	71
	Middle Wilcox	3	11	21	32	43	55
	Lower Wilcox	3	12	22	36	50	73
	Total	7	18	28	39	50	63
All of GMA 13	Sparta	3	6	8	11	13	15
	Queen City	3	7	11	15	18	22
	Carrizo	11	22	32	41	50	59
	Upper Wilcox	10	22	31	41	50	58
	Middle Wilcox	2	9	17	27	36	46
	Lower Wilcox	3	11	19	31	43	62
	Total	6	15	23	33	42	53

Description of Desired Future Condition (DFC) - Carrizo-Wilcox, Queen City, and Sparta Aquifers

As described in Section 2 of the Explanatory Report, for the Yegua-Jackson Aquifer, relevancy was established only for Gonzales and Karnes Counties. The desired future conditions determined for the Yegua-Jackson Aquifer are:

- Gonzales County: Average drawdown from the end of 2010 through 2080 is 3 feet (+/- 1 foot).
- Karnes County: Average drawdown from the end of 2010 through 2080 is 1 foot (+/- 1 foot).

Modeling Approach

GAM version: The Yegua-Jackson Aquifer as represented in Deeds and others (2010).

Stress periods: 81 stress periods of 365.25 days each. The first stress period begins on January 1, 2000 and the last stress period (81) ends on December 31, 2080. The first stress period corresponds to the end of the calibration period.

Recharge: Average recharge applied throughout the predictive period

Predictive pumping: Details on the modifications to the predictive pumping are documented in the technical memorandums in Appendix 4 of the Explanatory Report.

Version of TWDB "model grid" file: "ygjk_grid_poly070920.csv" available at http://www.twdb.texas.gov/groundwater/models/gam/gam_grids/ygjk.zip as of the date of this technical memorandum.

Evaluation method: To extract data from the model and calculate average drawdown we used a script written using the Julia programming language available at https://julialang.org/. The script is named "Calc_avg_dd_GMA13_YJ_2020_001.jl" and is included with the modeling files. We calculated average drawdown for Gonzales County and Karnes County within GMA-13 with the following assumptions:

- Calculations only occur within the active aquifer footprint as defined in the "model grid" file (AQ_Active[#] == 1; where [#] is the layer number)
- Drawdown = starting head – head for the stress period of interest
    - For the DFCs, the stress period of interest = 81
    - Starting head = simulated head at the end of the calibration period (12/31/1999)
    - If a cell goes dry, drawdown = starting head – bottom of the aquifer
- Average drawdown = sum of drawdown in each model cell within area of interest divided by the number of model cells within the area of interest

Modeling Contact Information

Jordan Furnans, PhD, PE, P.G.
LRE Water, LLC
(512) 736-6485
Jordan.Furnans@LREWater.com

**Modeling was performed by Mike Keester prior to his resignation on 12/30/2021. As of 1/14/2022, Mr. Keester may be contacted at:

Mike Keester, PG
RW Harden & Associates, Inc.
(512) 962-7660
mike.keester@rwharden.com