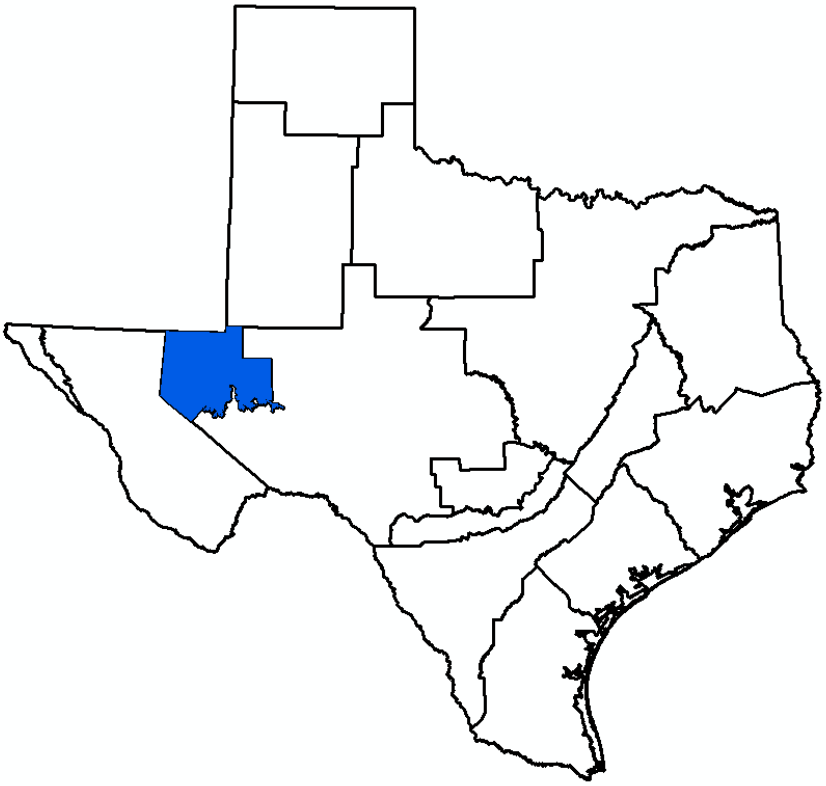
GMA 3 Technical Memorandum 17-01
Final

Edwards-Trinity (Plateau) and Pecos Valley Aquifers: Update of Average Drawdown Calculations



Prepared for:
Groundwater Management Area 3

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Update of Average Drawdown Calculations

Geoscientist and Engineering Seal

This report documents the work and supervision of work of the following licensed Texas Professional Geoscientist and licensed Texas Professional Engineers:

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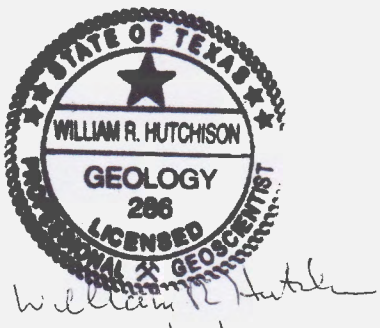

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1.0 Introduction

The desired future conditions for the Pecos Valley and Edwards-Trinity (Plateau) Aquifer in GMA 3 were adopted on October 20, 2016. The basis for the desired future conditions was Scenario 11 as described in GMA 3 Technical Memorandum 16-01. During review of the materials for administrative completeness, the Texas Water Development Board could not reproduce the average drawdowns that were used as the desired future conditions with the model files that were submitted. After several meetings and emails, the differences seem to be centered on the use of different "grid files". The grid file contains data and information on the geographic location of each cell of the model, including:

- Geographic coordinates (x- and y-coordinates)
- County
- Groundwater Management Area
- Groundwater Conservation District (if applicable)
- River Basin
- Regional Planning Area
- Active or inactive cell in the model
- Inside or outside the official aquifer boundary (as defined by TWDB)

The groundwater model simulations that were completed in 2010 during the initial round of desired future conditions used a version of the grid file that was developed in 2009. Since then, a 2011 version, a 2014 version, and a 2015 version were developed.

Due to an oversight, the groundwater model simulation that was the basis for the adopted desired future conditions used the outdated grid file from 2009 to calculate average drawdowns in each of the counties that comprise GMA 3 instead of the most recent grid file developed by TWDB in 2015.

This Technical Memorandum documents the updated average drawdown for each county within GMA 3 using the updated 2015 grid file. It is important to emphasize that the model run has not been changed, only the basis for calculating average drawdown. It is also important to note that the drawdown in individual cells has not changed, only the overall average in two counties.

In Pecos County, work has been completed recently to compare actual data, and model output from individual cells from the output of Scenario 11 to develop proposed alternative regulatory thresholds. That work is not affected by these updated average drawdowns contained in this report since the underlying model run has not been changed, and drawdown in individual cells has not changed.

2.0 Grid File and Drawdown Comparison

2.1 Grid File Comparison

The average drawdown is calculated as the sum of all drawdowns within an area divided by the number of cells in the area. In this case, the area is defined by active model cells within a county. The calculation that was completed in 2010 and which was done in Technical Memorandum 16-01 was based on the 2009 grid file. The updated averages are based on the 2015 grid file. Table 1 summarizes the cell counts for each county in GMA 3 for the 2009 grid file and the 2015 grid file. The differences are minor in Pecos and Reeves counties, and appear to be more significant in the other counties.

Table 1. Number of Active Cells Used in Average Drawdown Calculation

County	2009 Grid	2015 Grid
Crane	548	441
Loving	554	385
Pecos	996	993
Reeves	2,490	2,373
Ward	761	666
Winkler	785	560

2.2 Average Drawdown Comparison

Table 2 summarizes the average drawdown reported in the GMA 3 resolution that adopted the desired future conditions and the average drawdown reported in GMA 3 Technical Memorandum 16-01. These average drawdown calculations were based on the 2009 grid file. Table 2 also shows the average drawdown calculated by TWDB using the 2015 grid file.

Table 2. Summary of Average Drawdown (2010 to 2070) from 2009 and 2015 Grid Files

County	Average Drawdown in Resolution (ft) (Based on 2009 Grid File)	Average Drawdown in GMA 3 Technical Memorandum 16-01 (ft) (Based on 2009 Grid File)	TWDB Reported Drawdown (ft) (Based on 2015 Grid File)
Crane	46	46	58
Loving	4	4	5
Pecos	14	14	14
Reeves	7	7	8
Ward	55	55	63
Winkler	115	115	161

Of note in this comparison is that the average drawdown in Crane, Ward, and Winkler counties is substantially higher using the 2015 grid file than the 2009 grid file. In this case and without further action by GMA 3, TWDB would have calculated Modeled Available Groundwater (MAG) numbers that were lower than those presented in Technical Memorandum 16-01.

If GMA 3 prefers to maintain the pumping that was assumed in Scenario 11 of Technical Memorandum 16-01, GMA 3 must adopt a new set of desired future conditions (i.e. set the desired future conditions based on the average drawdown that is based on the 2015 grid file).

If GMA 3 prefers to maintain the average drawdowns that are listed in the resolution, the MAGs will be different, and significantly reduced in some counties.

2.3 Maximum Drawdown Comparison

One way to test the assertion that the differences in average drawdown are not important for the application to cell by cell analyses of the model output from Scenario 11 is to compare the maximum drawdown in each county that is calculated from each of the grid files (i.e. 2009 and 2015). Table 3 presents the maximum drawdown for each county based on the two grid files.

Table 3. Maximum Drawdown from 2010 to 2070 (ft) in Each County

County	2009 Grid	2015 Grid
Crane	97.46	97.46
Loving	11.23	11.23
Pecos	44.85	44.85
Reeves	38.73	38.73
Ward	221.29	221.29
Winkler	312.28	312.28

Please note that the maximum drawdown in each county is the same for each grid file. This suggests, along with the general similarities of average drawdowns in each county, that the differences in the grid files are in areas where the drawdown is in areas with relatively small drawdowns. Based on this, it would be incorrect to conclude, for example, that changing the desired future condition in Winkler County from 115 ft to 161 ft is a significant change, especially if future compliance relied on cell-by-cell comparisons with actual data.

3.0 Modeled Available Groundwater Comparison

Modeled Available Groundwater is defined as the pumping that will achieve the desired future condition. Pumping is one of the inputs to the model. The pumping that was assumed for Scenario 11 is documented in GMA 3 Technical Memorandum 16-01. The output from Scenario 11 includes the drawdown in each cell of the model. As described above, the average drawdown was reviewed by TWDB as part of its review for administrative completeness. Based on the 2015 grid file, the average drawdown was different than that calculated using the 2009 grid file. Consequently, the pumping that would achieve the average drawdowns associated with the 2015 grid files would be different than the pumping originally assumed in GMA 3 Technical Memorandum 16-01.

Table 4 summarizes the pumping reported in the GMA 3 Technical Memorandum 16-01 for Scenario 11 that would achieve the average drawdown based on the 2009 grid file. Table 4 also presents the pumping that was recalculated by TWDB that would achieve the average drawdown based on the 2015 grid file.

Table 4. Comparison of Pumping to Achieve Average Drawdowns (2009 Grid File and 2015 Grid File)

County	GMA 3 Technical Memorandum Pumping (AF/yr) Based on 2009 Grid File	TWDB Calculated Pumping (AF/yr) Based on 2015 Grid File
Crane	5,000	4,991
Loving	3,000	2,684
Pecos (GMA 3 Portion Only)	122,734	122,899
Reeves	190,000	184,050
Ward	50,000	47,477
Winkler	50,000	29,370

Absent additional action by GMA 3 to update the desired future conditions, there would a Modeled Available Groundwater that would be significantly lower in Winkler County than had been contemplated in Technical Memorandum 16-01. Other counties would have Modeled Available Groundwater values slightly lower than had been contemplated in Technical Memorandum 16-01.

5.0 Recalculated Average Drawdown and "Proposed" MAGs

The model files that were submitted to TWDB were used to run the model again to verify the correct pumping file had been submitted. The post-processor that reads the model output file and the grid file was revised to read the 2015 version of the grid file. The post-processor was also expanded to include reading the cell-by-cell output file and reporting the pumping by decade and by county.

Table 5 summarizes the average drawdown calculations. Please note that the two columns of average drawdown from 2010 to 2070 are presented: one based on the "ib" entry of the grid file (the active model cells within the county), and one based on the "aq" entry of the grid file (the active model cells within the county that are within the official boundary of the aquifer as defined by TWDB). In this case, the ib-based and aq-based drawdowns are the same.

Table 5. Average Drawdowns from 2010 to 2070 Calculated with 2015 Grid File

County	Average Drawdown (ft) Based on "IB"	Average Drawdown (ft) Based on "AQ"
Crane	58	58
Loving	5	5
Pecos	14	14
Reeves	8	8
Ward	63	63
Winkler	161	161

If GMA 3 opts to readopt the desired future conditions based on Scenario 11, the values in Table 5 would be the correct drawdown values that are based on the 2015 grid file that TWDB uses for the MAG calculation.

Table 6 summarizes the pumping that will achieve the drawdowns in Table 5 organized by county and decade. Please note that these values were obtained from the cell-by-cell output file from Scenario 11.

Table 6. Pumping to Achieve the Drawdown (Proposed MAGs)

County	Pumping (AF/yr) by Decade						
	2010	2020	2030	2040	2050	2060	2070
Crane	4,991	4,991	4,991	4,991	4,991	4,991	4,991
Loving	2,982	2,982	2,982	2,982	2,982	2,982	2,982
Pecos	122,899	122,899	122,899	122,899	122,899	122,899	122,899
Reeves	189,744	189,744	189,744	189,744	189,744	189,744	189,744
Ward	49,976	49,976	49,976	49,976	49,976	49,976	49,976
Winkler	49,949	49,949	49,949	49,949	49,949	49,949	49,949