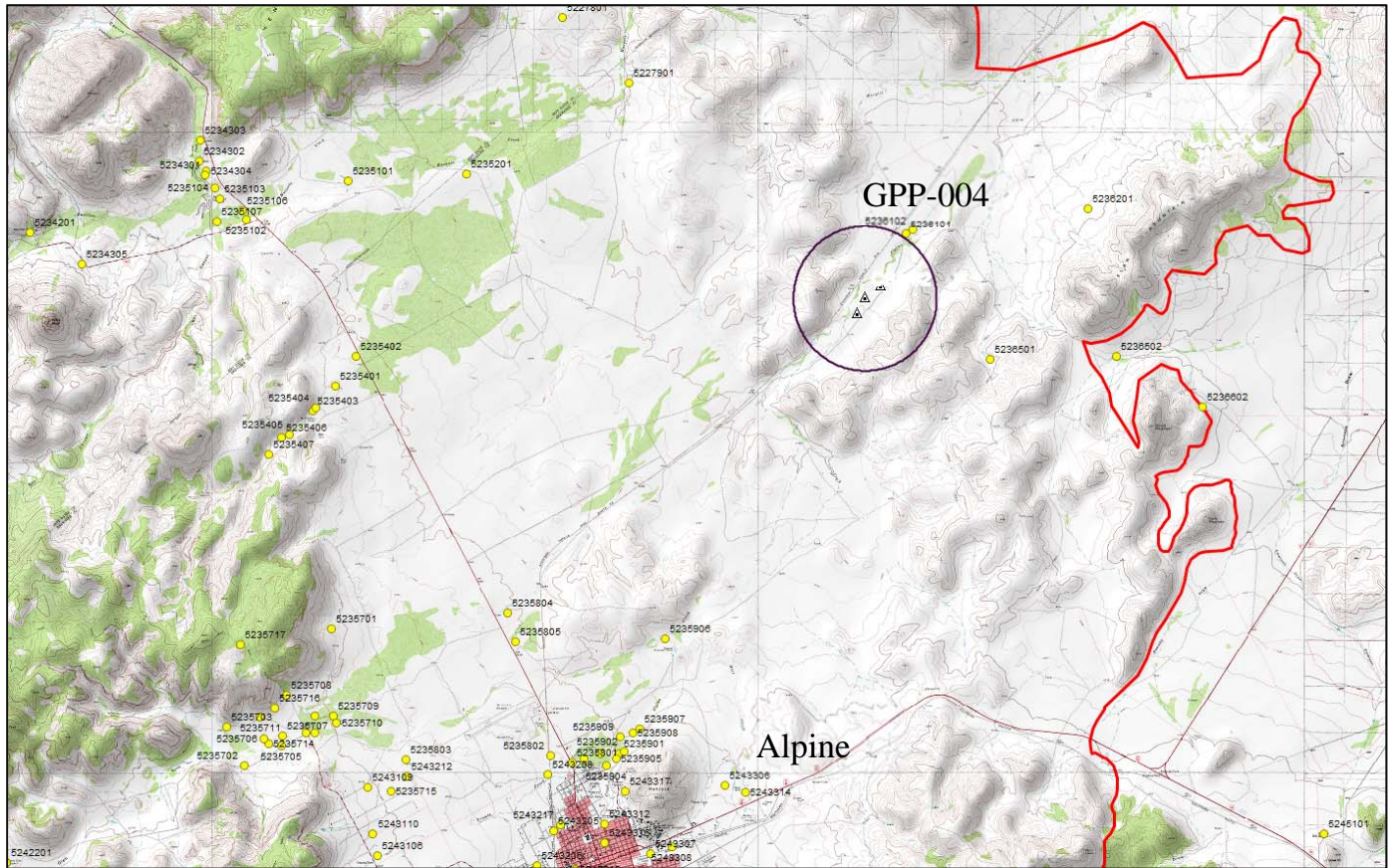


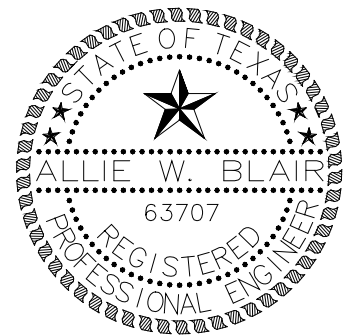
Technical Review of Application to Brewster County Groundwater Conservation District for a Groundwater Production Permit GPP-004 in the Northeastern Area of Alpine Plain, Brewster County, Texas



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Revised July 24, 2018

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Firm Registration F-1709



1. Overview

The report was requested by the General Manager of the Brewster County Groundwater Conservation District (District) and was prepared in accordance with generally recognized engineering principles, practice, and methods. This report is based on the review of technical literature, the records of the District, and the information provided in the application for permit GPP-004.

2. Well Locations and Literature Review

The maximum annual groundwater production requested in Application GPP-004 is for 230 acre-feet from the Igneous Aquifer using three wells as shown in Figure 1 (the wells are located in Block 9, Section 200 of GH & SA Railroad Co. Survey). One of the three wells (CSA #1) has been completed and tested, and detailed information regarding the well was included in application. There is limited technical information regarding the groundwater in the vicinity of the three wells. The 1957 TWDB Bulletin No. 5712 by Littleton and Audsley (Littleton) studied groundwater in the Alpine area, including wells located in the Alpine Plain area (see Figure 1).

Figure 2 shows the generalized water table elevations in 1955 for the Alpine Plain area (Littleton). The arrows were added to the figure showing the direction that water elevation decreases. The GPP-004 wells are located within the section of land that is shaded blue. The rate of decrease in the water table elevations (from west to east) in the Alpine Plain area is steep at approximately 90 feet per mile. This suggests that the horizontal transmissivity of the aquifer in this area is small and restricts groundwater from moving from higher to lower elevations.

A recently measured static water elevation for GPP-004 CSA #1 well (see Figure 5) was approximately 3822 ft (MSL). The water table elevations contours in Figure 2 stop approximately 5 miles to the west of CSA #1 well. If the water table gradient (a rate of decrease in the water table elevation of 90 feet per mile) is extrapolated from the 4250 ft contour to the location of the CSA #1 well, the predicted water table elevation is 3800 ft (MSL). Assuming that the extrapolation is valid, then the water table elevation for the CSA #1 well has remained relatively unchanged since 1955, over 60 years, and perhaps much longer. This suggests that there is very little movement of water from the west portion (higher land elevation) of the Alpine Plain towards the east (lower land elevation).

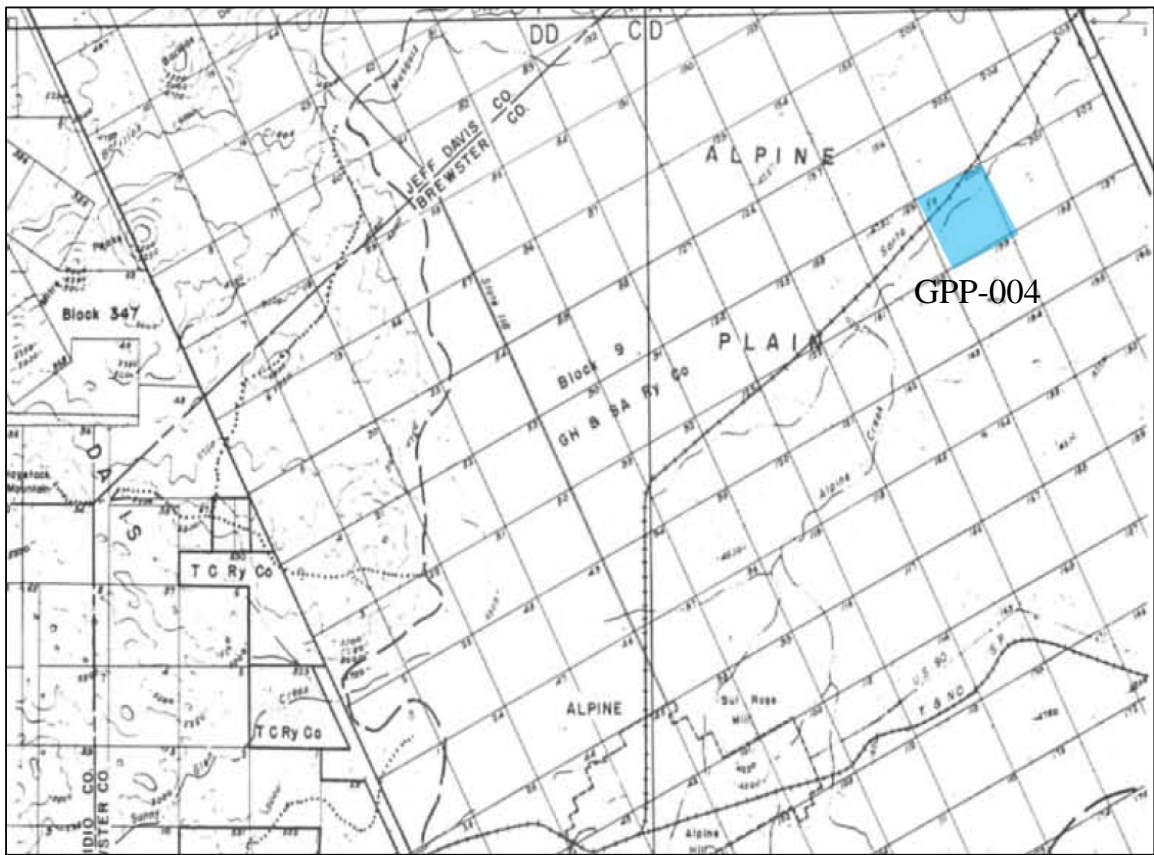


Figure 1 – TWDB Bulletin 5712 by Littleton and Audsley - 1957 Map of Alpine Plain Area

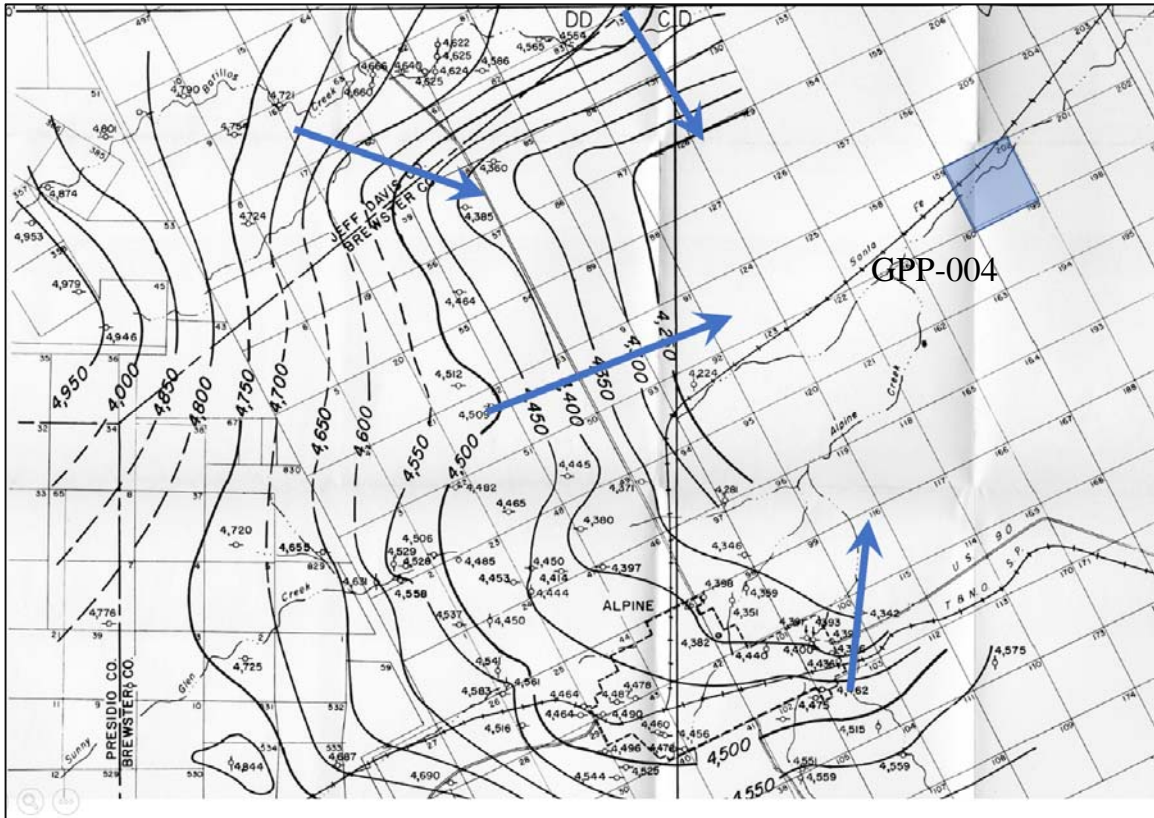


Figure 2 – TWDB Bulletin 5712 - 1955 Map of Water Table Elevations (arrows added)

Figure 3 and 4 shows the surface geology rock units in the Northeastern portion of the Alpine Plain area. The primary rock units are Tpct (Crossen Trachyte) and Qal (alluvium). Figure 4 shows that a fault exists approximately 2600 feet north and east of the CSA #1 well.

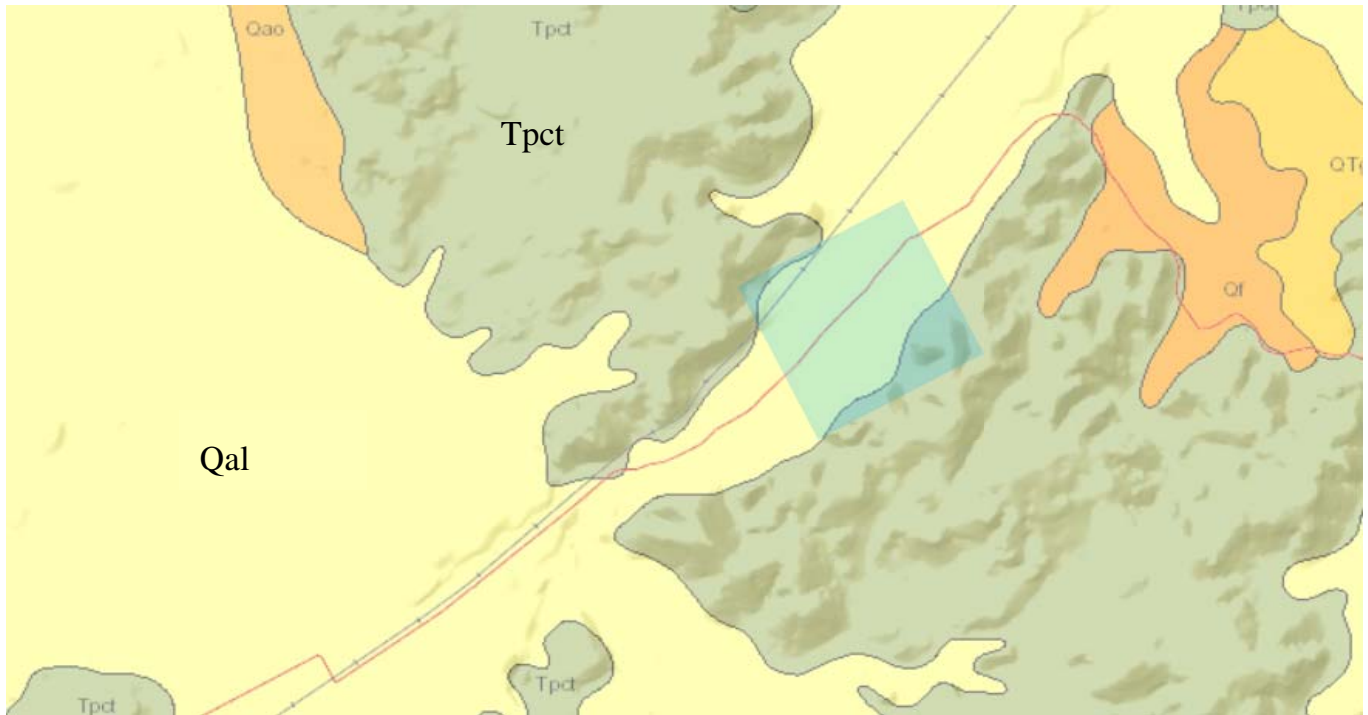


Figure 3 – Texas BEG Rock Unit Geology in the Alpine Plains Area

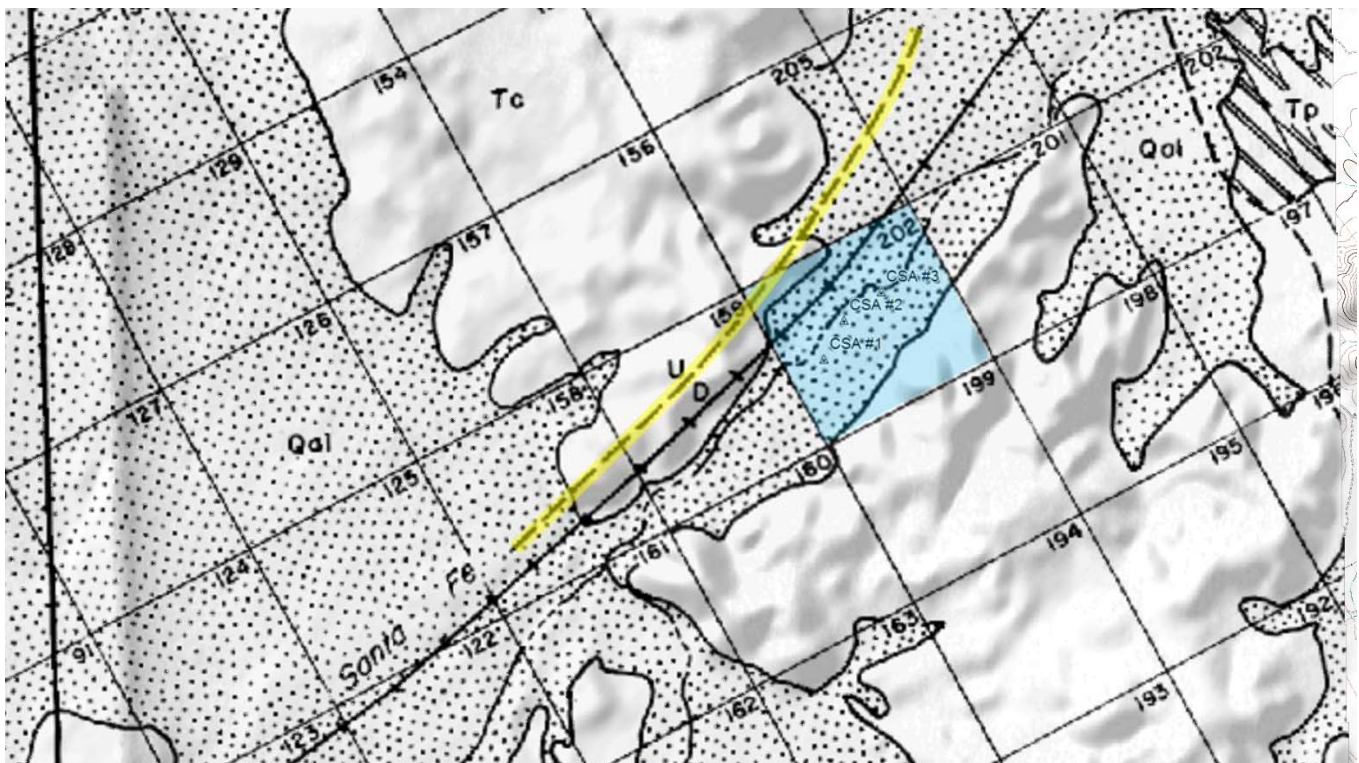


Figure 4 – Fault Line (yellow) from McAnulty (1950) as Modified by Littleton (1955)

Figure 5 is from the 2004 TWDB report Title “Groundwater Availability Model for the Igneous and parts of the West Texas Bolsons Aquifers” (2004 GAM Report) showing the predicted 2020 water elevations and the assumed saturated thickness for the Igneous Aquifer.

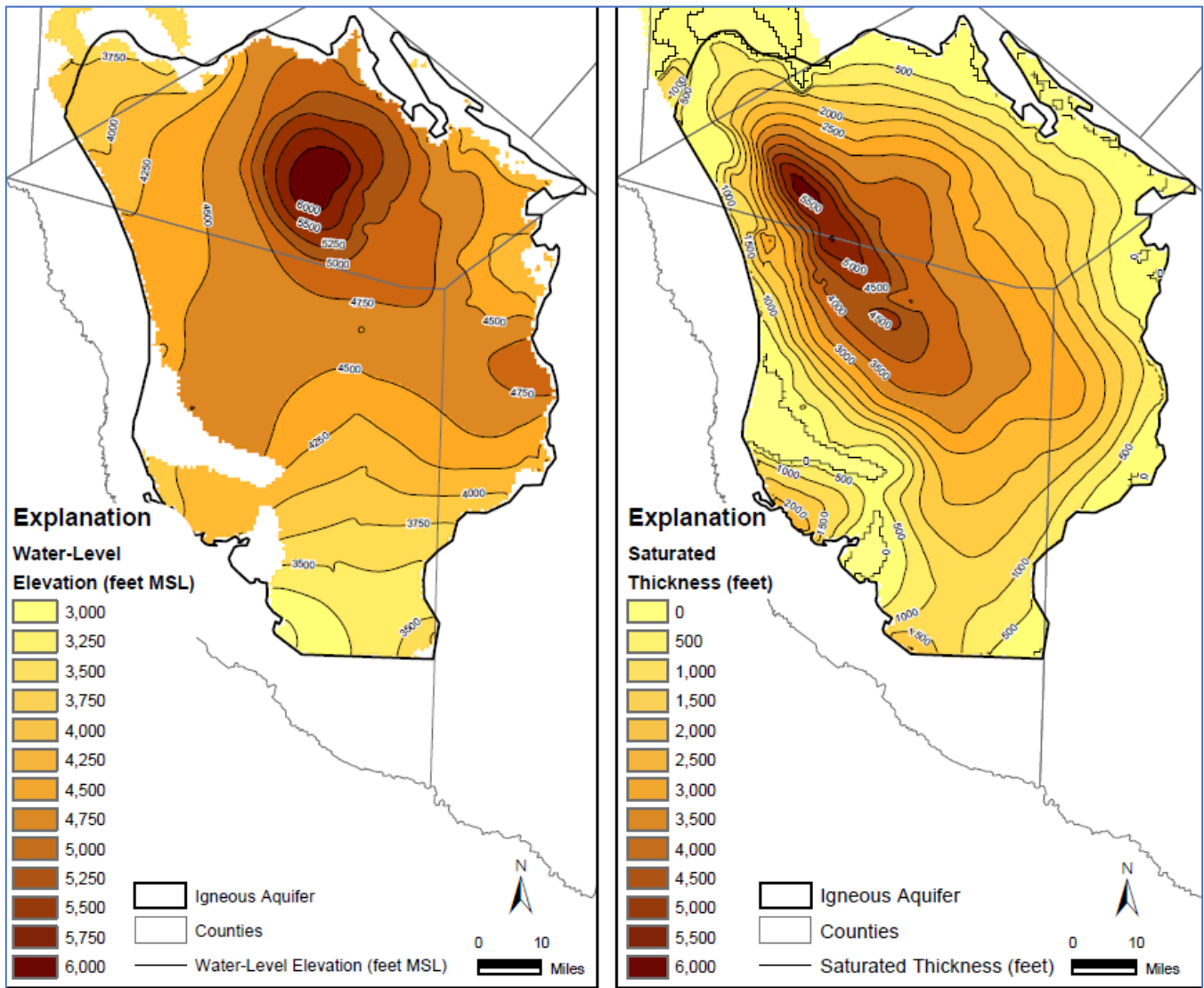
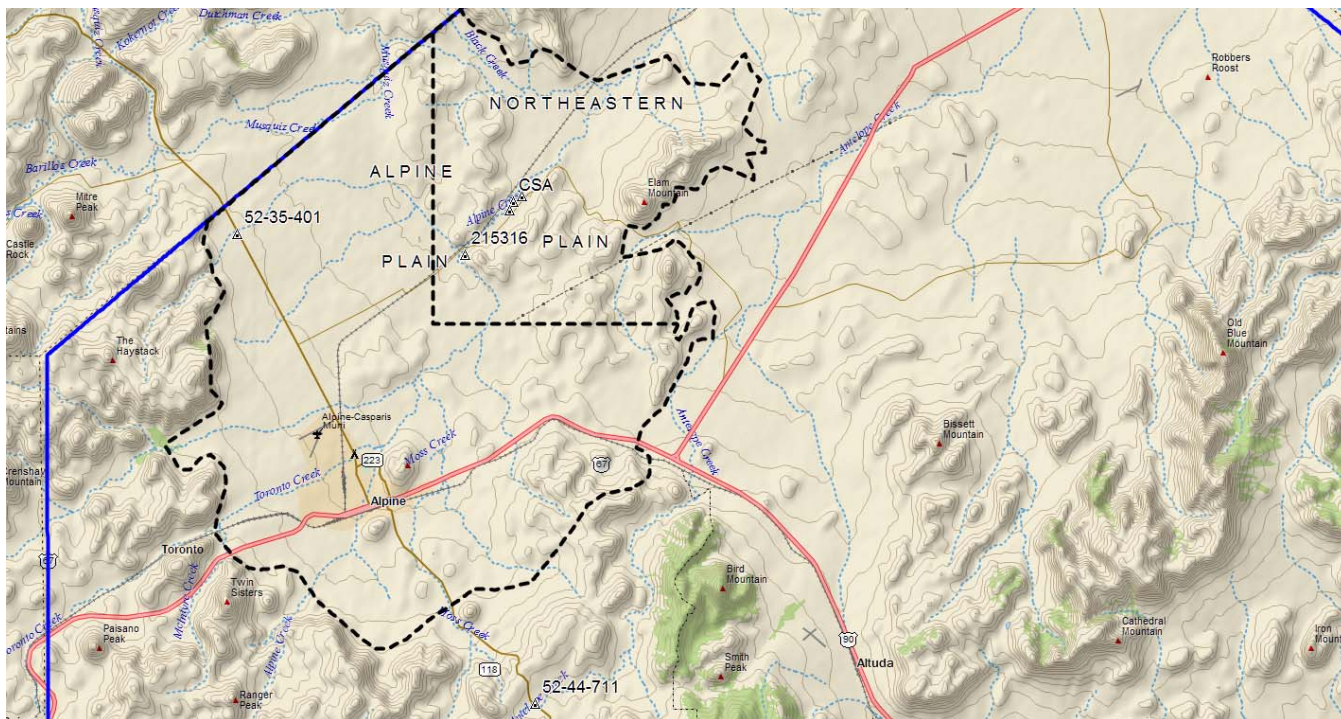


Figure 5 – TWDB Igneous Aquifer GAM Report – 2020 Water Levels and Saturated Thickness

3. Location of Wells of Interest and Well Depths

Figure 6 shows the location of the three CSA wells and three other wells of interest: Beard Stock well, City of Alpine, Meriwether No. 1 well, and Double Diamond Subdivision, Meriwether well. The closest existing well near the CSA #1 well is the Beard Stock well which does not have a state well number but does have a well tracking number of 215316. This well is approximately 1.55 miles west of the CSA #1 well. The City of Alpine’s closest well to the CSA #1 well is Meriwether No. 1 (52-35-401) which is approximately 6.9 miles west of the CSA#1 well. Double Diamond Subdivision’s closest well is the Meriwether well (52-44-711) and is approximately 12.2

miles south of CSA#1 well. TWDB well records show the City of Alpine’s Meriwether No. 1 well as being “unused”. The table below summarizes the information regarding each well.



Well Name	Number	Latitude	Longitude	Distance	Distance	Gnd Elev USGS ft MSL	Gnd Elev Well Report ft MSL
				miles	ft		
CSA #1	462133	30° 27' 53" N	103° 36' 10" W	0	-	4,121	NR
Beard	215316	30° 26' 55" N	103° 37' 17" W	1.55	8,184	4,173	4,147
Alpine	52-35-401	30° 27' 02" N	103° 43' 20" W	6.89	36,379	4,436	4,488
Double Diamond	52-44-711	30° 17' 09" N	103° 35' 31" W	12.33	65,102	5,118	5,130
Well Name	Number	Depth to Bottom ft	Depth to Water Date	Depth to Water ft	GW Elevation ft MSL	Difference in GW Elevation	GW Water Level Slope ft/ft
CSA #1	462133	502	10/5/2017	299	3,822	NA	NA
Beard	215316	280	5/7/2010	221	3,952	130	0.0159
Alpine	52-35-401	372	8/16/1999	91	4,345	523	0.0144
Double Diamond	52-44-711	230	3/25/2003	22	5,096	1274	0.0196

Figure 6 – Location of CSA Wells and Wells of Interest

The 2007 report by LBG Guyton titled “Well Field Evaluation, City of Alpine, Texas, Phase II Report” provides estimates of the City of Alpine water production and measured groundwater levels in most of the City’s wells. The report evaluated “Twenty-three wells of the City’s inventory

of 26 active [wells]...are grouped into three hydrologically separate areas or well fields; Sunny Glen, Musquiz, and Inner City...” Figure 7 shows the location of the City of Alpines wells. The report identified the Meriwether No. 1 well but did not discuss or analyze the well.

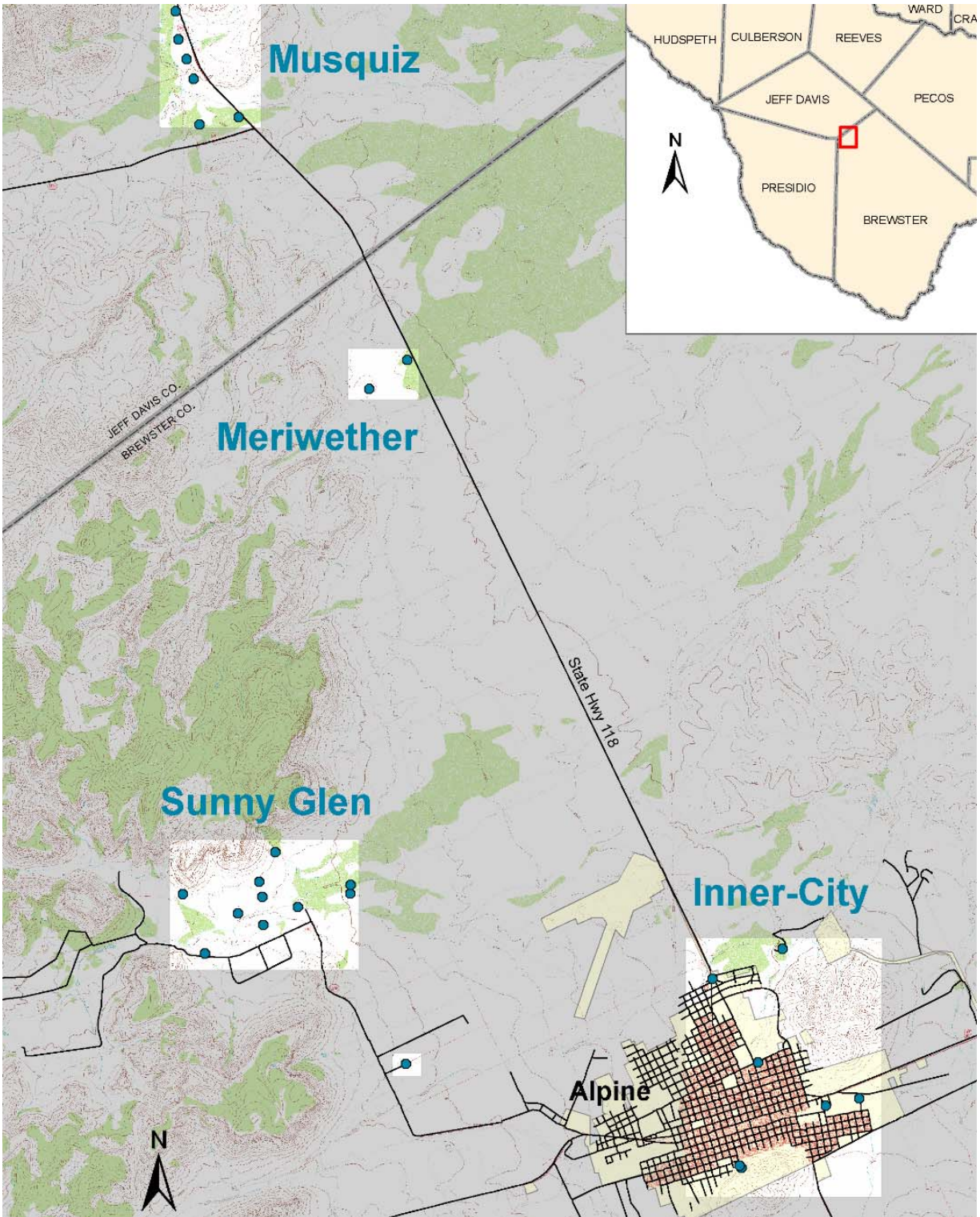


Figure 7 – Location of City of Alpine Wells (from 2007, LBG Guyton Report)

The report concluded that “*Aquifer simulations using a numerical groundwater flow model show continued decline in the Sunny Glen and Inner City well fields but at levels that are probably sustainable. However, current water-level declines in the Musquiz well field and simulated future declines indicate that the City should plan to reduce production from that well field in the future.*”. The Musquiz well field is located approximately 2.3 miles north of the Meriwether No. 1 well and is outside of the District’s boundaries.

4. Deeded and Qualified Land (District Rules Section 5.205) for Application GPP-004

Figure 8 shows the outline of the 8,193 acres of deeded land owned by the applicant and the location of the existing (CSA #1) and proposed wells (CSA #2 and CSA #3).

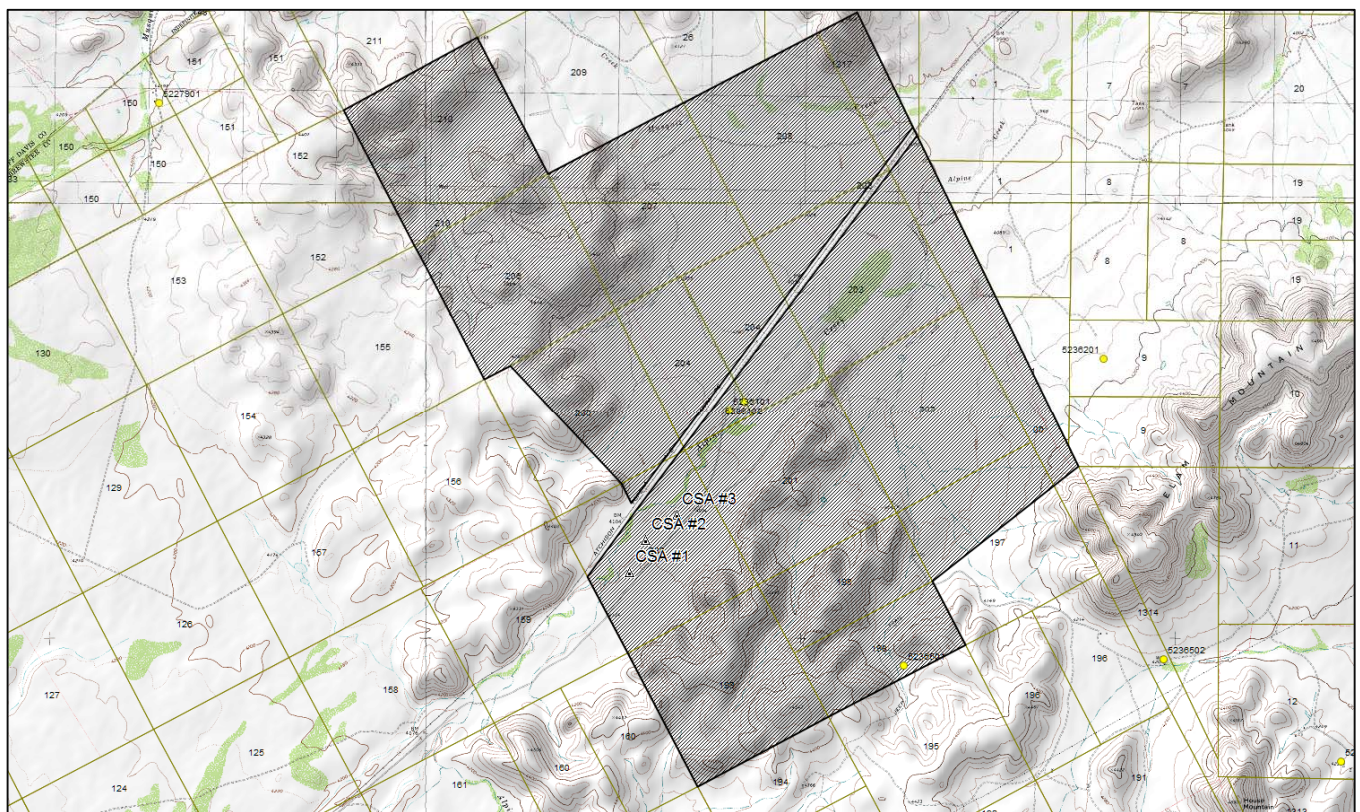


Figure 8 – Outline of Deeded Lands and Location of Wells Under Application GPP-004

The entire 8,193 acres is located within the TWDB boundaries for the Igneous Aquifer (see Figure 9). There is limited information regarding the saturated thickness of the Igneous Aquifer within this land. Figure 5 suggests the aquifer thickness ranges from near 0 feet to 500 feet. The 2020 water elevation predicted by the GAM shows that land immediately east of the 8,193 acres as being dry (see Figure 5). Figure 9 shows the extent of the Igneous Aquifer within the Brewster County.

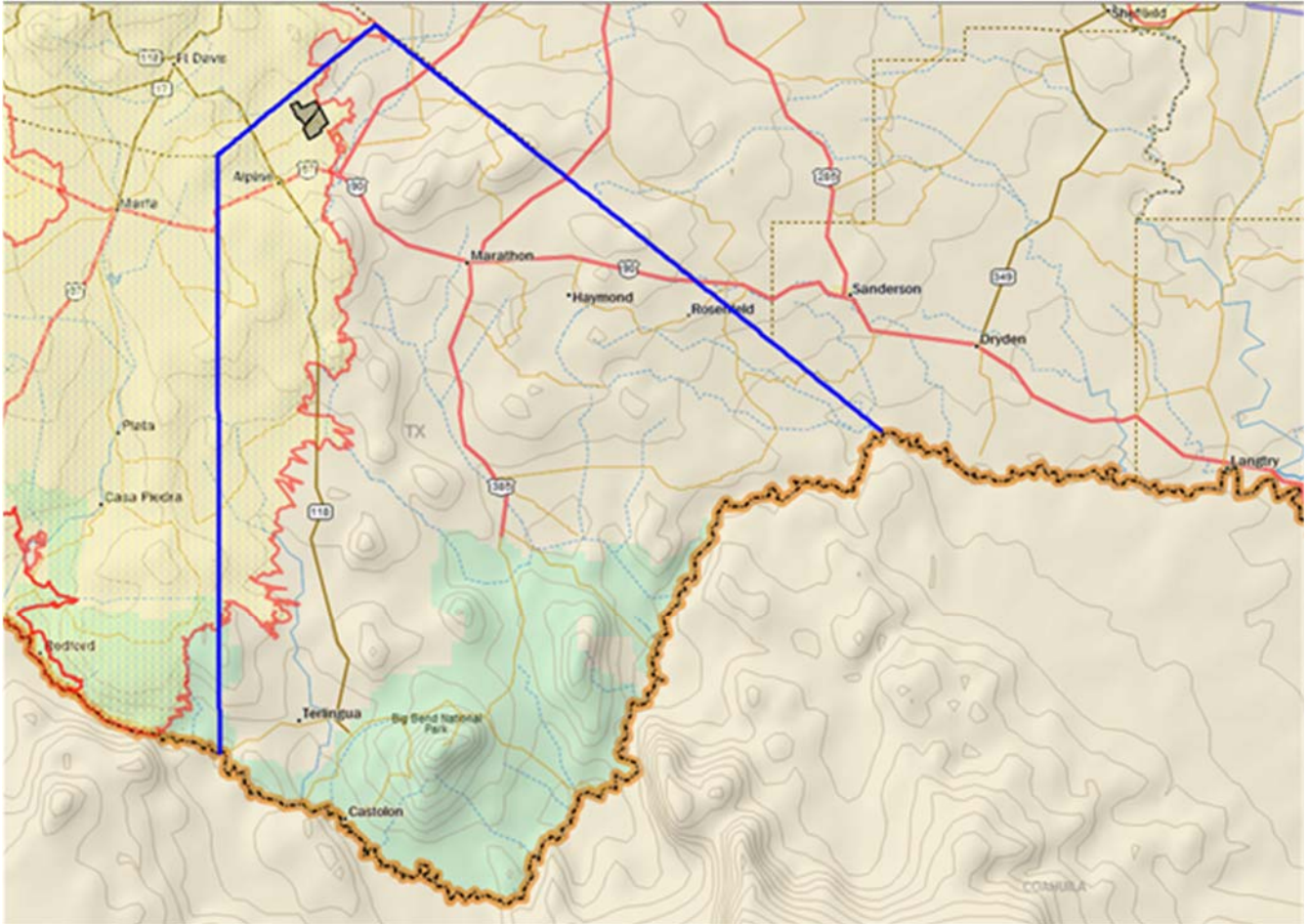


Figure 9 – Boundary of Igneous Aquifer in Brewster County

5. Desired Future Conditions (DFC) and Modeled Available Groundwater (MAG)

The TWDB GR 16-030 MAG report shows the MAG as 2,586 acres feet per year for the portion of the Igneous Aquifer in Brewster County. TWDB report GMA4 DFC GMA4 shows the associated Desired Future Condition (DFC) of an aquifer wide decline in groundwater elevation in the Igneous Aquifer of 10 feet between 2010 and 2060 (50 years) or 0.2 feet per year. On page 4-47 of the 2004 GAM Report the authors state: *“The Igneous aquifer is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication.”* The total surface area of the Igneous aquifer (TWDB Minor Aquifer Boundaries) is 3.90 million acres. The portion of the aquifer within Brewster County is approximately 0.59 million acres or 15% of the total surface area.

The table on the next page shows an estimate of the amount of water pumped from the Igneous Aquifer in Brewster County in 2017. The majority of this water is pumped from the City of Alpine wells located in the Sunny Glen and Inter City areas (the Musquiz area is outside of the

District’s/County’s boundaries). The acre-foot value used for the City of Alpine was based on the City’s capacity to pump and not the actual pumping. The 2007 LBG Guyton Report (Section 5.1.1) estimated that approximately 812 acre-feet per year would be the total annual pumping for the Sunny Glen and Inter City wells in 2020.

Estimate of 2017 Igneous Aquifer Groundwater Production in Brewster County	
Description of Source and Use	af/yr
2016 MAG (TWDB Report GR15-030 MAG)	2,586
Estimate of Permit Use (2017)	110
City of Alpine GW Use Igneous Brewster*	1,428
Estimate of Domestic and Livestock (Exempt)**	128
Estimate of Unpermitted Non-Exempt Use	400
Estimate of Total Use in 2017	2,066
Difference (MAG - 2017 Use)	520
*Farwest Texas 2016 Water Plan Sec. 11.2.4. This amount is equal to the amount of water available (capacity) and not the actual production in 2017	
** TWDB 2015 Report Projected Exempt Groundwater Use Estimates	

The difference between the estimated amount of water pumped for all uses and the MAG is 520 acre-feet. One of the major limitations of the requirements of Chapter 36 of the Texas Water Code in regard to management of groundwater using the MAG/DFC process is the spatial averaging of the decline in groundwater levels over a 50-year time period. This simple averaging does not take into consideration the “*complex water-bearing formations that are in varying degrees of hydrologic communication.*”

6. Water Conservation and Beneficial Use

Application GPP-004 proposes to use a maximum of 230 acre-feet per year for production (mining) of specialized aggregate for construction. As a comparison of the amount of production, an exempt well (domestic and livestock) is allocated 28 acre-feet per year by statute and rule. The 230 acre-feet per year is equal to approximately the amount of water allocated 8 exempt wells.

The application (Exhibit 2.3 of Application GPP-004) shows a complex water reuse system that captures and reuses the majority of the groundwater pumped several times prior to the water being consumed. All of the water uses proposed in the application are beneficial. The maximum water use requested was 230 ac-ft per year (75 million gallons per year) or an average of 0.205 million gallons per day. For comparison purposes, the City of Alpine water well and treatment facilities capacity is rated at 3.9 million gallons per day (City of Alpine Ordinances, Chapter 66). The application states that approximately 1.5 million tons of aggregate will be produced per year. Approximately 50 gallons of water will be consumed for each ton of aggregate produced.

7. References

- 1957, Texas Board Of Water Engineers, Bulletin 5712, R.T. Littleton and G.L. Audsley, Groundwater Geology Of The Alpine Area, Brewster, Jeff Davis, And Presidio Counties, Texas,
- 2004, Texas Water Development Board GAM Report, Beach, J. A., Ashworth, J. B., Finch, Jr., S. T., Chastain-Howley, A., Calhoun, K., Urbanczyk, K. M., Sharp, J. M., and Olson, J., 2004, Groundwater availability model for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat)
- 2007, LBG Guyton, Well Field Evaluation, City of Alpine, Texas, Phase II Report
- 2015, Texas Water Development Board, Projected Exempt Groundwater Use Estimates Groundwater Management Area 4 - TWDB Final Estimates
- 2016, Texas Water Development Board, Far West Texas Water Plan.
- 2017, City of Alpine, Code Of Ordinances Chapter 66 Natural Resources.
- 2018, Texas Water Development Board, GAM Run 16-030 MAG: Modeled Available Groundwater For The Aquifers In Groundwater Management Area 4.
- 2018, Application GPP-004 by J.P. Stubbs to Brewster County Groundwater Conservation District No. 1.