Memorandum

To: Heather Sumpter, General Manager
Goliad County Groundwater Conservation District

From: Andrew Donnelly

Date: February 26, 2018

Subject: Task One results

1. Introduction

Goliad County Groundwater Conservation District (District) contracted with Daniel B. Stephens and Associates, Inc. (DBS&A) to conduct a preliminary assessment of water levels, recharge, desired future conditions (DFCs), and historic pumpage. The Task 1 Scope of Work items are as follows:

- Construct a baseline geographic information system (GIS) for the District.
- Evaluate all existing District monitor wells and water level data. Data will be imported and plotted. A determination or confirmation of the aquifer assigned to each monitoring well will be done. An analysis of the quality of coverage of the water level monitoring well network will be made.
- Evaluate permits, pumpage, water levels, and well information.
- Construct hydrographs for all available water level data from District files.
- Evaluate the distribution of water level declines to determine if there is consistency of trends and/or whether they are localized or widespread.
- Compare water level trends to the DFCs for Goliad County. A preliminary evaluation of the compliance of the District with their approved DFCs and recommendations on potential DFC compliance monitoring methods will be made.
- Evaluate the Central Gulf Coast Groundwater Availability Model (GAM) to determine historic recharge values used for Goliad County as well as historic pumpage amounts and distribution of this pumpage.
- Review the report for the EDYS model for any information pertinent to this evaluation.
- Gather available data on historic precipitation, and compare to recharge estimates from the GAM.

- Gather permit and pumpage data from the District and evaluate to determine pumpage trends within the District.
- Compare water level, pumpage, and precipitation data.
- Produce a report that summarizes the issues with water level trends compared to recharge/precipitation trends and groundwater production trends.

This memo report provides the results of the Task 1 scope of work, and summarizes technical concerns that the District has with the current DFCs and GAM drawdown predictions. Recommendations are provided on how the District may proceed with groundwater level monitoring and DFC compliance.

2. Available Data

The following reports were reviewed as part of this investigation:

- Texas Water Commission (TWC) Bulletin 5711 (Dale and others, 1957). This report provides a general overview of the groundwater resources of Goliad County.
- TWDB Recharge Study (Scanlon and others, 2010). This study evaluates recharge estimate methodologies and provides recharge estimates for the major aquifers in Texas, including the Gulf Coast Aquifer System.
- EDYS Model report (McLendon and others, 2016). This report documents an ecological model constructed for Goliad County.
- Intera Gulf Coast Hydrostratigraphy report (Young and others, 2010). This report evaluates the hydrostratigraphy of the Gulf Coast Aquifer System within Texas.
- TWDB Report 236- Gulf Coast Stratigraphy (Baker, 1979). This report evaluates the stratigraphy of the Gulf Coast Aquifer System for the state of Texas.
- GMA 15 Reports. Various reports done as part of the joint groundwater planning process for Groundwater Management Area (GMA) 15, which includes Goliad County.
- GAM Report (Chowdhury and others, 2004). This report documents the GAM constructed for the central portion of the Gulf Coast Aquifer System, which includes Goliad County.

These reports provided background information on the aqufiers in Goliad County, the nature of recharge to the Gulf Coast Aquifer System, and the amount of historic pumpage estimated to occur within the county.

Data available from the TWDB was also gathered and evaluated for this investigation. This data includes historic water use surveys, historic groundwater pumpage, and historic recharge and pumpage inputs used in the GAM. Precipitation data was also reviewed for comparison to recharge rates. GIS data was gathered and used to create a baseline template for the District. Specific data received from the District was also added to this template to help evaluate the data for this investigation and produce this report.

At the beginning of this investigation, DBS&A was provided the water level monitoring data that the District has been collecting since 2002. This data set contains water level monitoring data from over 100 wells within Goliad County, of which approximately 70 are currently monitored. According to the District none of the monitor wells are utilized as production wells. These monitor wells were incorporated into the GIS template developed for the District. The District also provided data on permitted wells and production under permits, which was evaluated and compared to TWDB estimates.

Data used by Groundwater Management Area (GMA) 15 was reviewed to determine how current water level declines compare to the DFCs and how the modeled available groundwater (MAG) for Goliad County compares to estimates of current groundwater pumping.

3. Results and Discussion

a. Water Levels

Water level data obtained from the District was organized and evaluated. Because many of the wells in the District's monitoring well network were installed for oil and gas supply, the well locations tend to be geographically clustered. Therefore, in order to accurately assess the water level changes across all of Goliad County, it was necessary to organize the monitor wells into groups based on the well locations to avoid potential bias due to the distribution of wells. The following steps were completed to accomplish this:

- Well locations and depths were plotted in GIS. Well locations are shown in Figure 1.
- The specific aquifer (either Chicot, Evangeline, or Jasper) that each monitoring well is completed in was determined based on well location and depth. Nearly all of the monitoring wells in the southeastern third of the county, along the Refugio County line, are Chicot wells. All of the remaining monitoring wells in the county are completed the Evangeline Aquifer, with the exception of one well that appears to be completed in the Jasper Aquifer.
- The monitoring wells were divided into 14 separate groups based on their location. Each group consists of one to twenty wells (Figure 2).
- Hydrographs were made were and then organized by group. These are provided in Appendix A. Water level changes were evaluated by group.

Each group of monitoring wells is summarized in Table 1, and water level declines for each well group are summarized in Table 2. As shown in Table 2, not all well groups (areas) indicate declines in water levels, although most do. Three well groups show overall increases in water levels, six groups indicate a small amount of decline in water levels (less than 0.5 feet/year), and three groups indicate significant declines in water levels (approximately 1 foot/year). Most of the well groups have at least one well that exhibits increasing water levels.

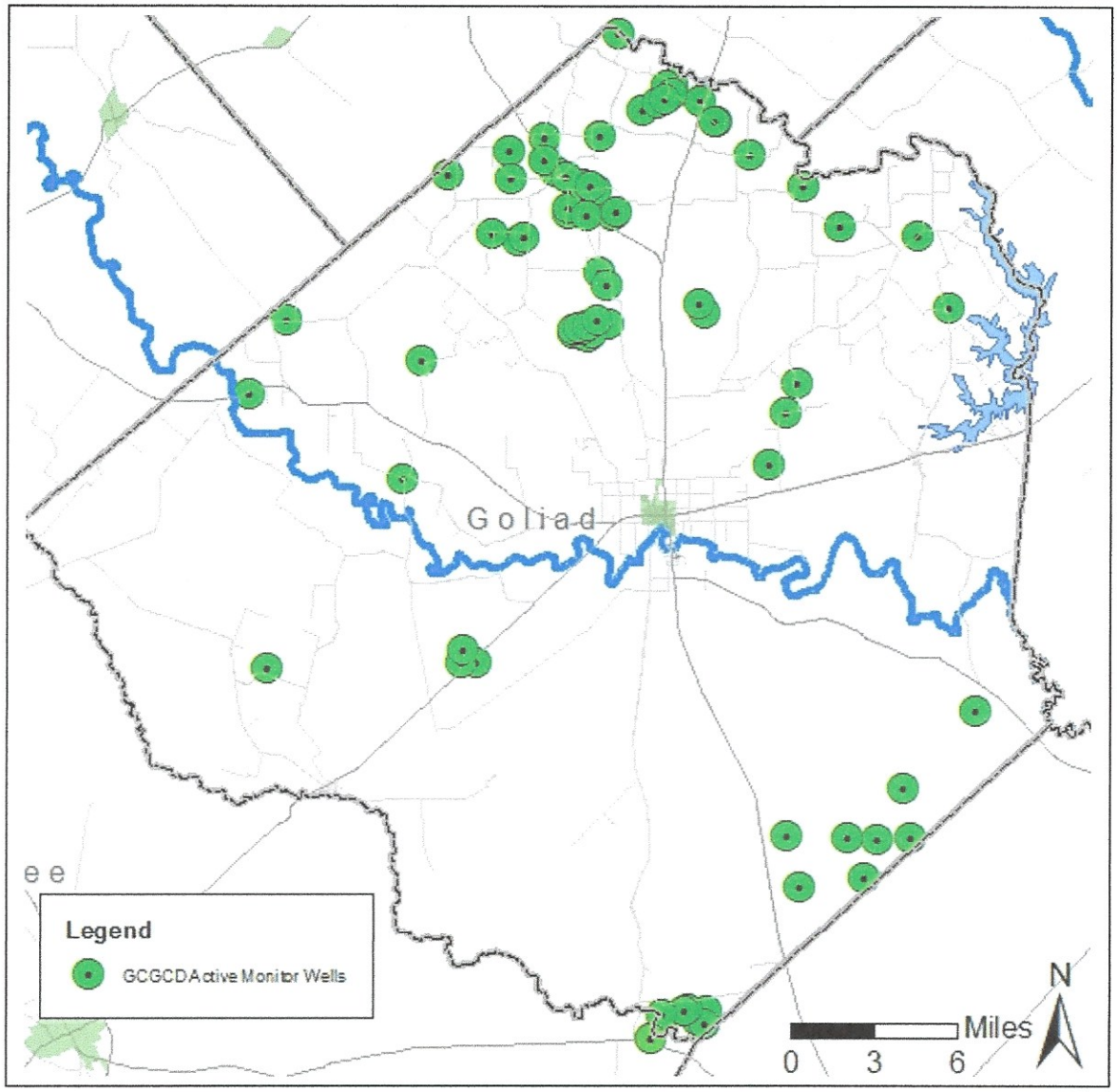

Figure 1. Locations of Goliad County GCD water level monitoring wells.

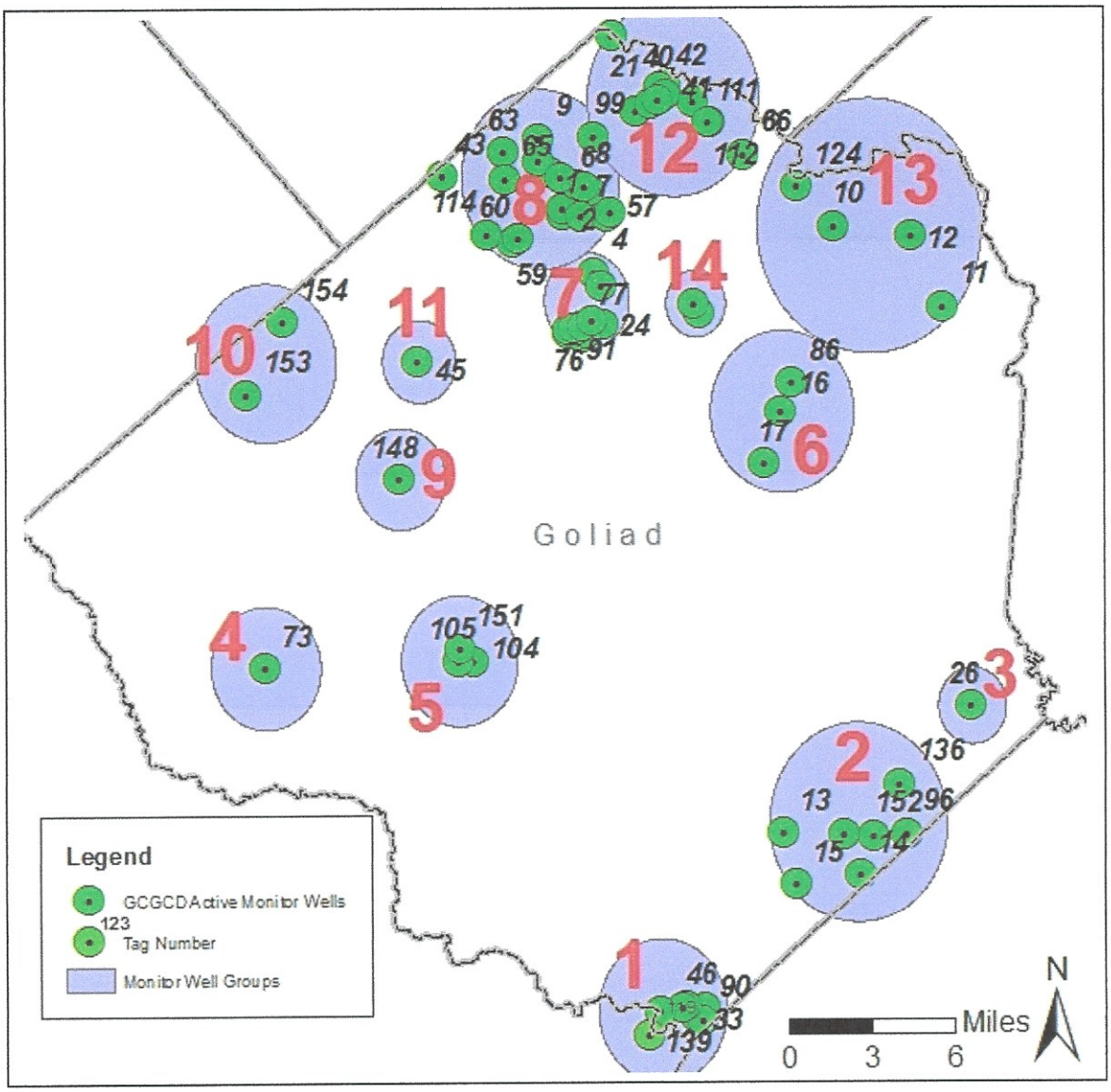

Figure 2. Locations of Goliad County GCD water level monitoring well groups.

Table 1. Summary of monitoring well groups.

Group	Aquifer	No. of Wells	Depth Range of Wells (feet)	Average Number of Years Monitoring
1	Chicot	6	96 - 325	7
2	Chicot	7	62 - 218	11
3	Chicot	1	204	14
4	Evangeline	1	280	8
5	Evangeline	3	95 - 320	11
6	Evangeline	3	160 - 263	13
7	Evangeline	13	105 - 331	9
8	Evangeline	20	25 - 324	13
9	Evangeline	1	187	15
10	Evangeline	1	290	0
11	Jasper	1	850	11
12	Evangeline	8	80 - 314	9
13	Evangeline	4	180 - 250+	13
14	Evangeline	2	300 - 320	5

Table 2. Summary of declines observed in monitoring well groups.

Group	Aquifer	No. of Wells Declining	No. of Wells Increasing	Range of Water Level Change (ft)	Average Water Level Change (ft)	Average Annual Change (ft)
1	Chicot	3	3	-2.5 to +4.2	0.4	0
2	Chicot	6	0	-0.6 to -9.5	-4.2	-0.4
3	Chicot	1	0	-2.1	-2.1	-0.15
4	Evangeline	1	0	-4.6	-4.6	-0.6
5	Evangeline	1	2	-6.9 to +8.6	1.2	0.1
6	Evangeline	2	1	-3.9 to +2.25	-1.5	-0.14
7	Evangeline	12	1	-15.7 to +10.5	-8.0	-0.9
8	Evangeline	19	1	-25 to +14.8	-10.8	-0.9
9	Evangeline	0	1	+5.5	5.5	0.4
10	Evangeline	--	--	--	--	--
11	Jasper	1	0	-11.2	-11.2	-1.0
12	Evangeline	7	1	-16.2 to +6.2	-4.6	-0.4
13	Evangeline	3	1	-4.2 to +1.6	-2.5	-0.2
14	Evangeline	1	1	-3 to +0.25	-1.4	-0.3

Note: Not all wells in the District monitoring well network have sufficient historic data to be included in this table. Group 10 has one well, but insufficient data to determine water level changes at the time of this investigation.

b. Water Level Changes Compared to DFCs

The approved DFC for the Gulf Coast Aquifer System in Goliad County is 10 feet of drawdown from January, 2000 to December, 2069 (70 years). In order for the District to have the most flexibility in monitoring water levels and managing groundwater use, we recommend that each of the individual aquifer units within the Gulf Coast Aquifer System (i.e. the Chicot, Evangeline, and Jasper Aquifers) be monitored and compared to a DFC separately. This approach will allow the District to determine which aquifer may experience compliance issues with the DFC, and groundwater usage from the individual aquifer can be managed, rather than groundwater use from all aquifers within the county.

A DFC of 10 feet over 70 years is equivalent to less than two inches of average annual decline every year over the 70-year planning horizon. This is a very small rate of decline. Based on the water level data provided by the District, Goliad County appears to be experiencing drawdown rates greater than the DFC, even when the potential bias due to monitor well locations is accounted for.

Chicot Aquifer- There are 13 monitoring wells in the Chicot Aquifer in the District monitoring well network. These wells are divided into three groups based on their location. Group 1 has an equal number of wells showing an increase in water levels and a decline in water levels; overall this group of wells indicates no change in water levels since 2008 (Table 2). Group 2 indicates declining water levels in all six wells, which have been measured for up to 14 years (Table 2). Average declines in individual wells range from 0.1 to 0.7 feet/year, and average 0.4 feet/year overall. Group 3 consists of one well with an average annual decline of 0.15 feet/year over the 14 years it has been measured. Based on these data, county-wide declines in the Chicot Aquifer appear to exceed the DFC.

Evangeline Aquifer There are 55 Evangeline Aquifer monitor wells divided into 10 groups based on location, with group sizes ranging from 1 to 20 wells. All but one group have at least one well that shows an increase in water levels since the start of water level measurement collection, but only two groups show an overall increase in water levels (Table 2). Nine of the 10 groups show an overall decline in water levels, ranging from an average decline of 0.1 feet/year to nearly 1 foot/year. Significantly, the two groups with the greatest number of wells (Groups 7 and 8) also exhibit the largest annual decline in water levels.

Jasper Aquifer There is one Jasper Aquifer monitor well (Group 11). This well shows an annual decline of approximately 1 foot/year, and a total decline of 11.2 feet over 11 years, which is more than the entire 70-year DFC of 10 feet of drawdown (Table 2). Significantly, no pumpage from the Jasper Aquifer within Goliad County was identified in the preliminary data evaluation completed for this study. The cause of the observed water level decline in this well is currently unknown.

c. Evaluation of Recharge

An important part of the current investigation is an evaluation of recharge and its potential impact on water level declines observed within the District. The GAM was evaluated to determine the recharge rates applied in Goliad County, and other studies and data were reviewed to determine if the rates used in the GAM appear to be appropriate.

Recharge rates from the GAM used in the predictive GMA 15 simulations are shown in Figure 3. Recharge rates in the northwestern two-thirds of the county, where the Evangeline Aquifer outcrops, average slightly less than 0.25 inches/year. Recharge rates in the southeastern third of the county, where the Chicot Aquifer outcrops, are higher, averaging approximately 0.9 inches/year. As indicated in Figure 3, these recharge rates are consistent across county boundaries and are not significantly different than in Bee County to the southwest or DeWitt and Victoria Counties to the north and east, respectively.

The total amount of recharge applied to Goliad County in the GAM runs was also calculated and is shown in Figure 4. This figure shows that from 1920 to 1980, prior to the model calibration time period of1980 through 1999, a total of slightly over 18,000 acre-feet/year was applied to the county, and approximately 18,500 acre-feet/year is used in the predictive model runs. During most of the calibration time period, the simulated recharge varies from approximately 11,000 acre-feet/year to nearly 30,000 acre-feet/year. However, the total recharge applied to Goliad County in 1998 and 1999 appears to be erroneous, at only 1,351 acre-feet in 1998 and 650 acre-feet in 1999. This apparent error needs to be corrected in future model runs; the effects of this error on the predictive simulations and the DFCs are currently unknown.

Precipitation data obtained from the TWDB indicates that for Quadrangle 910, which includes all of Goliad County, annual precipitation from 1940 to 2016 ranged from 12.85 to 52.97 inches, with an average of 35.21 inches. Based on these values, the average annual recharge rates used in the GAM are less than 1 percent of average annual precipitation in the part of the

county where the Evangeline Aquifer outcrops (the northern three-quarters of the county), and approximately 2.5 percent of average annual precipitation in the part of the county where the Chicot Aquifer outcrops (the southeastern quarter of the county). These average annual recharge rates are similar to those applied in the GAM for counties that adjoin Goliad County (Figure 3).

A review of a TWDB groundwater recharge study (Scanlon and others, 2010) indicates that the recharge rates used in the GAM are similar to recharge rates determined in multiple other studies for the Gulf Coast Aquifer System. Recharge rates throughout the Gulf Coast Aquifer compiled by Scanlon and others (2010) are variable, ranging from zero to several inches/year. In the Central Gulf Coast region, which includes Goliad County, recharge rates compiled by Scanlon and others (2010) range from zero to 1.3 inches/year. The recharge rates used in the historic calibration of the model and the predictive simulations using the GAM fall within this range.

An ecological model of Goliad County was constructed using the Ecological Dynamics Simulation (EDYS) model. The final report describing this model was reviewed for this investigation. The EDYS model is a mechanistic general ecosystem simulation model that simulates ecological processes on a small scale and links them in an overall large scale landscape model. This model is primarily used to evaluate various land management alternatives by assessing changes in landscape that may result. The EDYS model includes numerous components as inputs, including climatic simulators, soil type, plant type, animal type, and so on. Although groundwater is one of the model inputs, it is considered in a simplified manner. Most of the emphasis with respect to water in the subsurface appears to be within the root zones of the different plant communities; changes in groundwater levels through time due to recharge, pumpage or other factors are not assessed or considered in the EDYS model.

Although considerable effort is made to develop input parameters for many of the inputs used in this model, we were unable to determine how the EDYS model can be used to quantitatively assess the accuracy of the recharge rates used in the GAM. Major components of the groundwater budget are not incorporated into the EDYS model, and simulation of the groundwater regime is highly simplified. This approach appears to be reasonable for purposes of the EDYS model, but it is insufficient for conducting a quantitative comparison or evaluation of groundwater recharge rates used in the GAM.

The District notes that the EDYS model and report contain information indicating that the historic recharge should be significantly higher than the current recharge, and that historic recharge should also be significantly higher than the recharge used in the predictive model runs. The change in recharge is related to the change in land use that occurred in Goliad County from the 1950s to the 1980s. After the drought of the 1950s, much of the area that had been cultivated in northern Goliad County transitioned to permanent pasture, with the transition completed by about 1980. The District believes that this change in land use impacted recharge rates, and that the recharge used in the predictive model runs should be reduced by 40 to 50 percent.

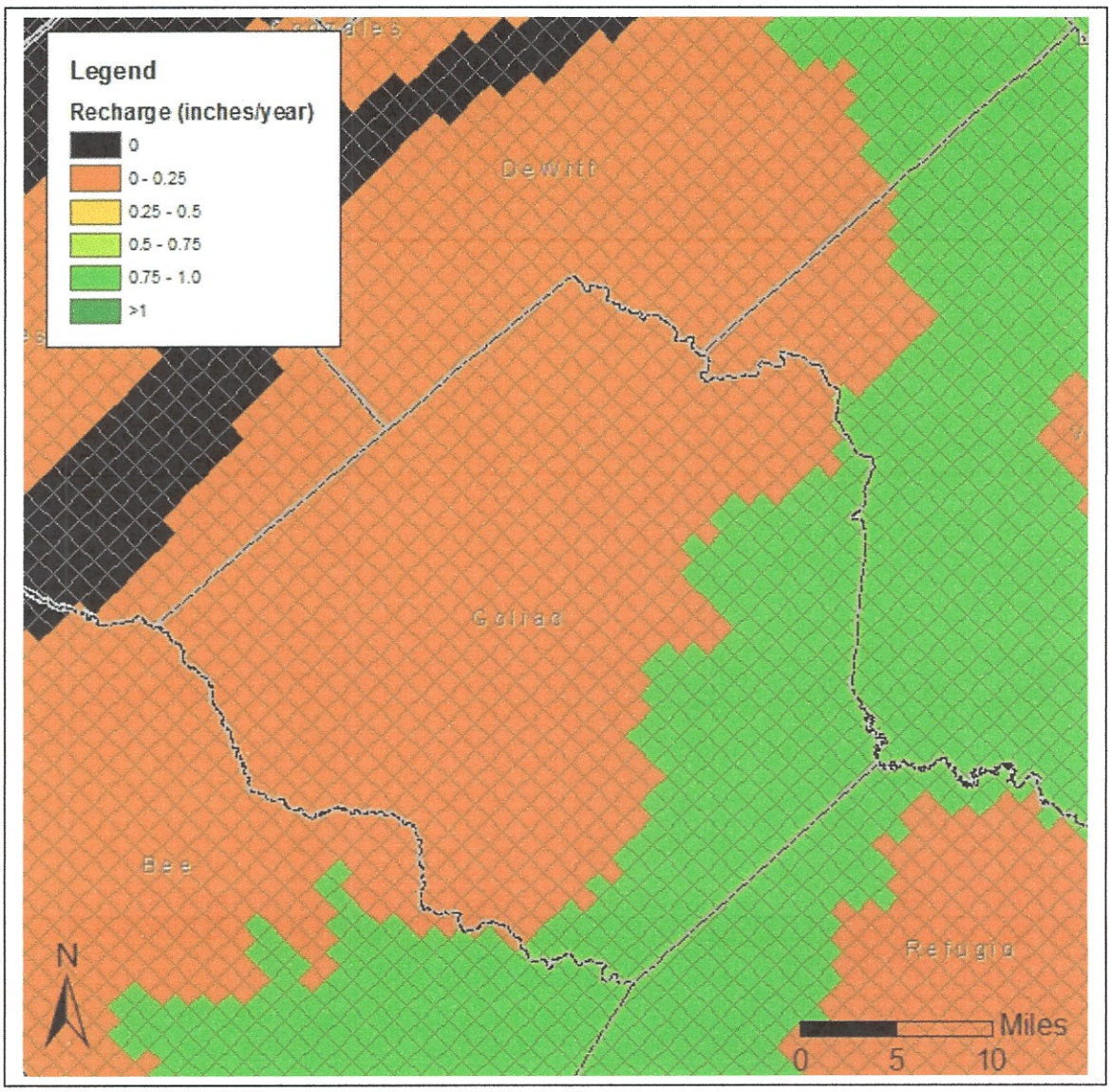

Figure 3. Recharge rates used for GMA 15 predictive simulations.

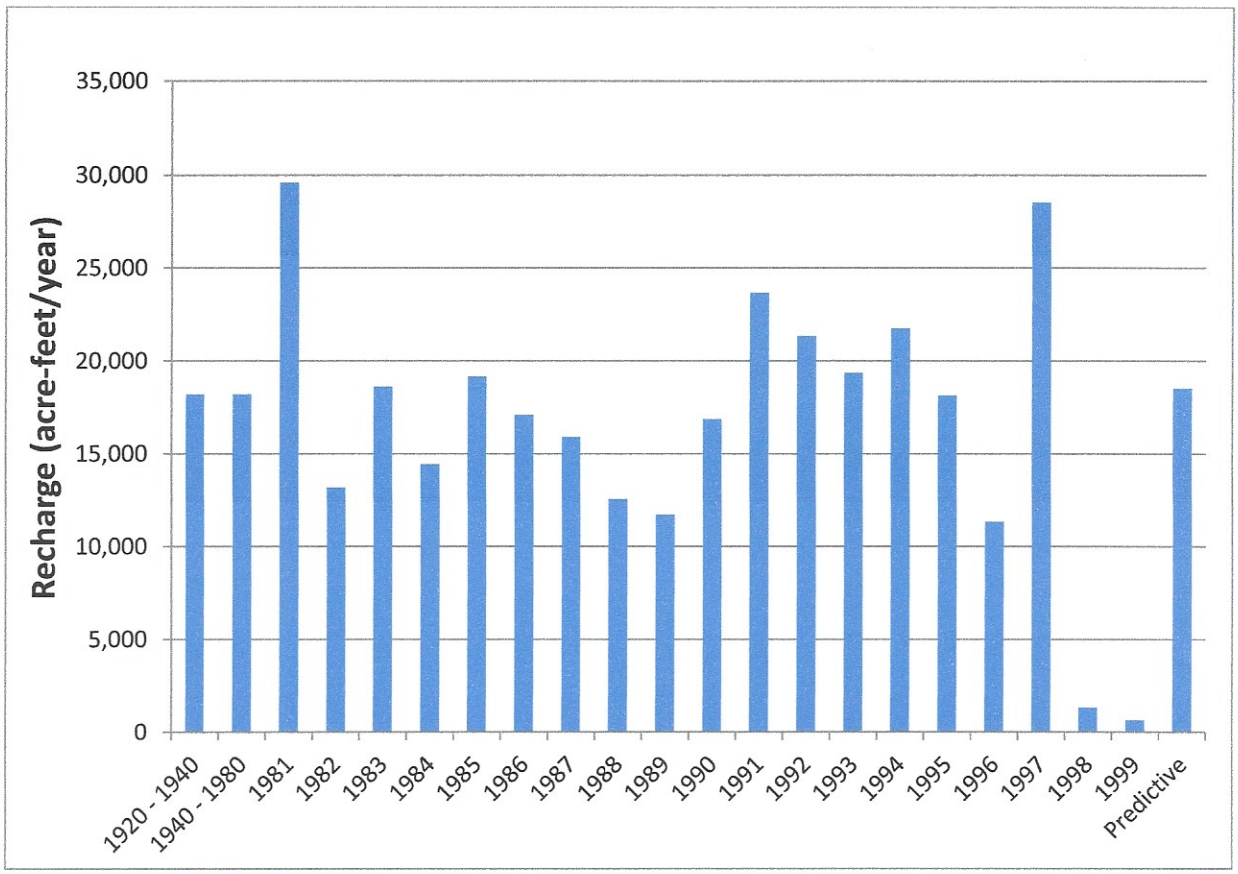

Figure 4. Total recharge applied to Goliad County in the historic and predictive GAM simulations.

d. Historic Groundwater Pumpage

Historic groundwater pumpage was reviewed for Goliad County. Data was obtained from the TWDB, the District, and GAM input files. The TWDB database provides an overview of water use and groundwater production within the county based on water use surveys conducted by the TWDB annually, but are based on the input and data received by the water use survey team at the TWDB and therefore are only as accurate as the reported values. Additional insight into the values provided by the TWDB are given by the data and input provided by the District. The pumpage estimates were also compared to the pumpage used in the GAM.

TWDB Estimates-TWDB estimates of groundwater pumpage for Goliad County from 1980 to 2015 are summarized in Table 3. This table indicates that since 1980, municipal and power pumpage within Goliad County has been fairly constant, irrigation and livestock pumpage has increased, and little to no groundwater production for industrial or mining purposes has occurred. Some of the TWDB reported data for Goliad County appears to be erroneous, as noted below:

- Municipal pumpage is fairly constant from 1980 to 2009 at reasonable values, but since 2009 the municipal water use reported by the TWDB appears to be too low.
- No groundwater production for industrial use was identified in Goliad County by the TWDB.
- Reported groundwater production for mining operations, which includes water used in support of oil and gas production, was reported to be minimal from 1980 to 2015. However, based on input from the District, oil and gas production and exploration has been conducted since the 1940s. Virtually all of the District monitor wells are capped oil and gas rig supply wells. The TWDB mining water use estimates appear to be low.
- A small but consistent amount of groundwater is reported for power production, apparently associated with the American National Power/Coleto Creek Power Plant, described below.
- TWDB groundwater production for irrigation use dramatically increased beginning in 2003. Based on input from the District, the estimates since 2003 are accurate, and estimates from 1980 to 2002 should be similar to these. The District notes that the TWDB only reports water use associated with projects that are reported under financial agriculture programs, and much of the agriculture in Goliad County is not included in these programs. The District notes that the higher numbers starting in 2003 accurately

represent use as reported by the District, and that they are aware of extensive historic use prior to 2003.

- TWDB estimates of groundwater production for livestock purposes dramatically increased since 2005. Based on input from the District, the estimates for the last 10 years are accurate, and estimates for the earlier period 1980 to 2004 should be similar to the recent values.

These pumpage estimation issues warrant additional investigation by the District.

In addition to the county-wide estimates, the TWDB also conducts water use surveys of significant water users across the state. Within Goliad County, several groundwater users have historic data available from the TWDB, including:

- *Municipal Users.* The TWDB has historic water use data from several municipal users in Goliad County, including the City of Goliad, the U.S. Naval Air Station in Goliad, and the Fannin Battle Ground State Park. Both the U.S. Naval Air Station and Fannin Battle Ground State Park have only sporadic, low volume uses reported in the 1980s and 1990s, and so they are not addressed further in this report.
- *Industrial and Power Users.* The TWDB has specific surveyed water use data from several industrial and power users, including American National Power, Coleto Creek Power LP, HNG Petrochemicals, Inc., Transcontinental Pipeline Co., and Uranium Energy Corp. However, the last three of these users reported only sporadic usage of less than 10 acre-feet/year, and so are not assessed further in this report.

Groundwater production by the City of Goliad from 1958 to 2015 is shown in Figure 5. This figure shows a slight increase in groundwater pumping during the 1970s to early 1980s, but in general it has remained fairly constant. The pumpage trend for the City of Goliad reflects the overall municipal pumpage trend for Goliad County from 1980 through 2015 noted above, and accounts for approximately 50 percent of the total municipal pumpage in the county. Groundwater production by American National Power/Coleto Creek Power LP is shown in Figure 6. This figure shows a fairly consistent amount of pumping since the 1970s.

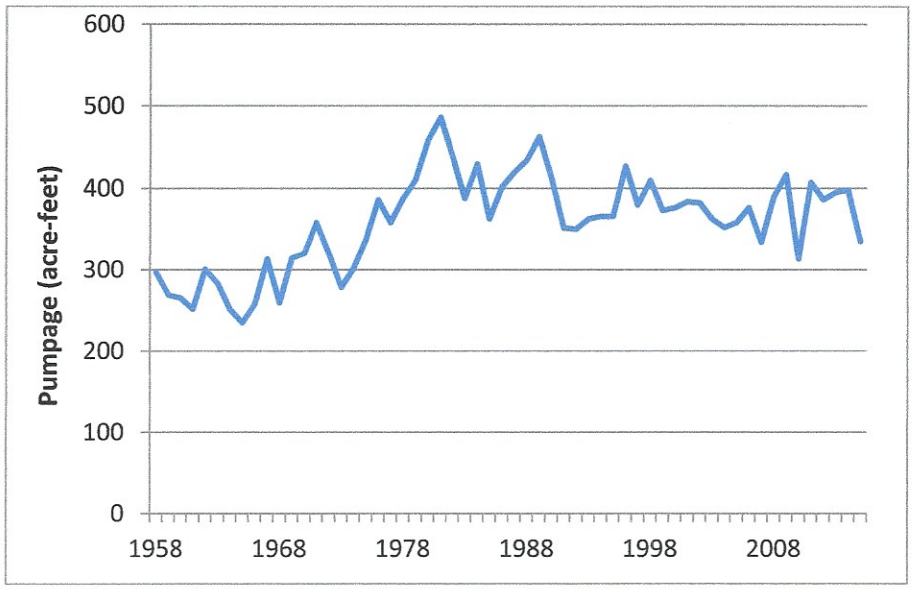

Figure 5. Estimated groundwater production from the Gulf Coast Aquifer by the City of Goliad.

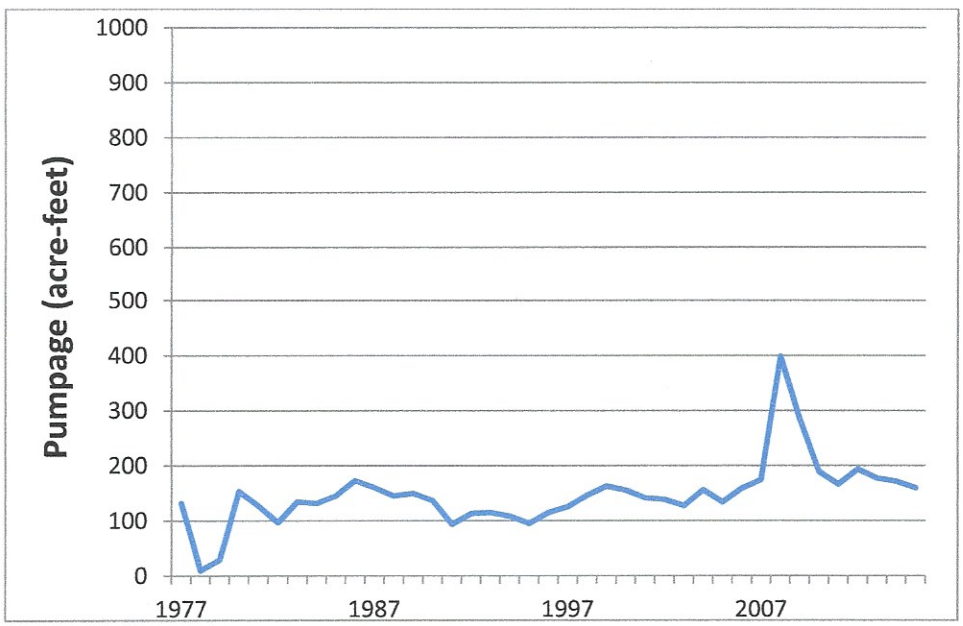

Figure 6. Estimated groundwater production from the Gulf Coast Aquifer by the American National Power/Coleto Creek Power LP.

GAM Pumpage

The GAM was evaluated to determine the historic pumpage used for calibration of the model, as well as the amount of pumpage used in the predictive simulations by GMA 15. Pumpage in Goliad County was only included in two of the four layers of the Gulf Coast Aquifer in the historic calibration inputs. These are model layer 1 (Chicot Aquifer) and model layer 2 (Evangeline Aquifer). The amount of pumpage used in the GAM calibration period of 1980 through 1999 for the Chicot and Evangeline Aquifers is shown in Figures 7 and 8, respectively, and the distribution of this pumpage within Goliad County in 1999 is shown in Figures 9 and 10, respectively.

As indicted in Figures 7 and 8, the GAM incorporates about 1,200 acre-feet/year of pumpage from 1980 through 1999, of which approximately 90 percent was from the Evangeline Aquifer. Combined, these pumping totals are similar to the TWDB estimates for total pumpage in Goliad County prior to 2000. However, this amount of pumping is significantly smaller than TWDB pumpage estimates for Goliad County since 2000. In addition, input from the District indicates that historic pumpage in the county prior to 2000 estimated by the TWDB is too low, which means that groundwater pumpage during the calibration period in the GAM is also too low.

Figure 9 shows the distribution of pumpage in the Chicot Aquifer used in the GAM. This figure indicates that the pumpage from the Chicot Aquifer is generally less than 2 acre-feet/year per model cell applied throughout the portion of the county where the Chicot Aquifer is present. Figure 10 shows the distribution of pumpage in the Evangeline Aquifer in 1999 used in the GAM. Figures 9 and 10 show that where the Chicot is present in Goliad County, the GAM generally does not have pumpage in the Evangeline Aquifer. The overall distribution of pumpage from the Evangeline Aquifer is also relatively low at less than 5 acre-feet/year per cell. There are two higher pumpage cells in the City of Goliad, presumably for the city pumping, and a single higher pumpage cell in the eastern part of the county near the town of Fannin and Coleto Creek Reservoir, which presumably represents pumpage from the American National Power /Coleto Creek Power LP.

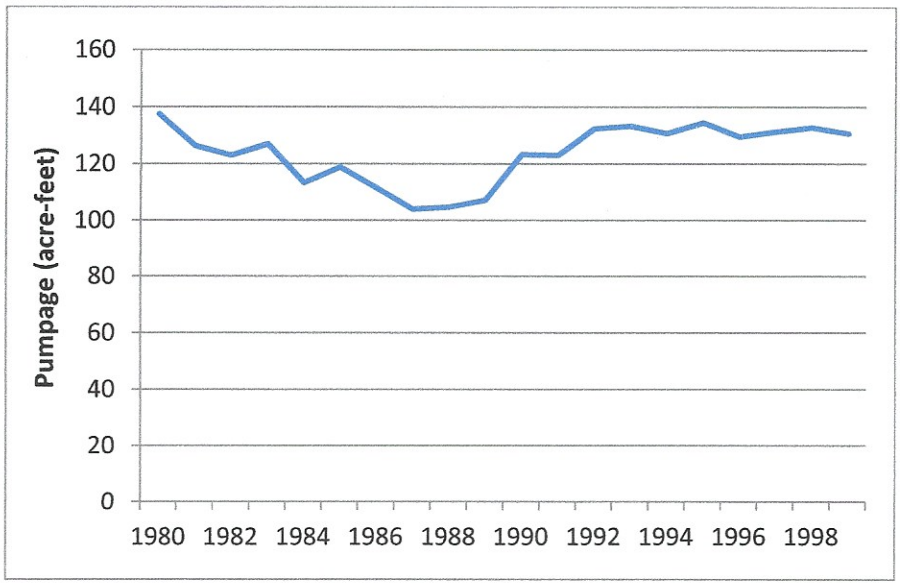

Figure 7. Historic groundwater production from the Chicot Aquifer (Layer 1) for 1980-1999 from the GAM.

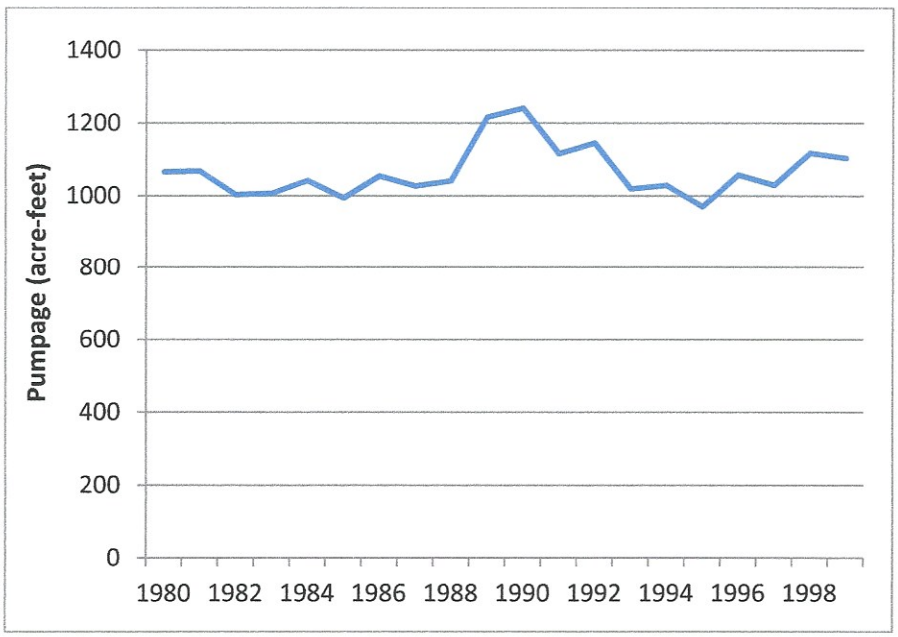

Figure 8. Historic groundwater production from the Evangeline Aquifer (Layer 2) for 1980-1999 from the GAM.

Predictive GMA 15 Pumpage

The predictive pumpage in Goliad County used by GMA 15 for joint groundwater planning was also evaluated. Figures 11 and 12 show both the historic and predictive pumpage used in the GAM for the Chicot and Evangeline aquifers, respectively. The historical calibration period is the period 1980 through 1999, and the predictive simulation period is 2000 to 2070. These figures show the significant increase in the pumpage used in the predictive portion of the simulation (after 1999) compared to the historic portion of the simulation (before 1999). Pumpage increases from approximately 100 acre-feet/year to 700 acre-feet/year in the Chicot Aquifer, and from approximately 1,000 acre-feet/year to over 10,000 acre-feet/year in the Evangeline Aquifer. As discussed above, pumpage in the historic portion of the model simulations appears to be significantly lower than the actual amount of historic pumpage based on input from the District. Pumpage used in the predictive portion of these simulations is also significantly higher than the TWDB estimated amount of pumpage that occurred in Goliad County from 2000-2015.

Goliad County GCD Permit and Production

Some permit and production data, as well as data on registered wells, was obtained from the District and reviewed. However, we were unable to determine with certainty from this data the number of active permits and registered wells in the District. The discussion below is based on our current understanding and interpretation of this dataset.

Based on the data DBS&A received, the District has 4,968.3 acre-feet/year of permitted pumpage. There are two types of permits: historic use permits and regular permitted pumpage. There are 54 historic use permits totaling 2,316.9 acre-feet/year and 62 regular permitted pumping permits totaling 2,651.4 acre-feet/year. Groundwater pumped under the historic use permits is unknown because historic use permit holders are not required to submit annual production totals. Reported production totals for the regular permitted pumpage have varied greatly, ranging from 78 to 805 acre-feet/year between 2005 and 2015.

Table 3. Estimated historic groundwater production from the Gulf Coast Aquifer in Goliad County from TWDB historic groundwater pumpage estimates.

Year	Municipal	Industrial	Mining	Power	Irrigation	Livestock	Total
1980	834	0	0	153	0	223	1,210
1984	876	0	540	132	23	110	1,681
1985	808	0	1	146	23	131	1,109
1986	836	0	1	173	26	105	1,141
1987	864	0	0	160	26	97	1,147
1988	892	0	0	145	21	85	1,143
1989	931	0	0	150	164	84	1,329
1990	915	0	0	136	205	87	1,343
1991	864	0	13	93	185	90	1,245
1992	861	0	13	113	185	121	1,293
1993	872	0	13	115	31	118	1,149
1994	858	0	13	108	59	118	1,156
1995	873	0	13	95	49	118	1,148
1996	957	0	13	115	53	87	1,225
1997	912	0	13	125	53	90	1,193
1998	936	0	13	140	53	103	1,245
1999	912	0	13	140	0	116	1,181
2000	799	0	0	156	147	92	1,194
2001	816	0	0	141	103	33	1,093
2002	819	0	0	138	251	32	1,240
2003	801	0	0	127	1,894	40	2,862
2004	768	0	0	2,154	1,585	40	4,547
2005	804	0	0	134	2,539	885	4,362
2006	854	0	0	1,197	2,176	1,045	5,272
2007	732	0	0	174	1,065	911	2,882
2008	834	0	0	399	2,257	802	4,292
2009	920	0	0	285	2,454	870	4,529
2010	563	0	0	189	1,937	774	3,463
2011	631	0	0	166	3,436	771	5,004
2012	580	0	0	193	2,884	638	4,295
2013	546	0	0	177	2,785	589	4,097
2014	516	0	0	171	2,770	587	4,044
2015	443	0	4	159	3,057	597	4,260

Source: Texas Water Development Board historic groundwater pumpage database at http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp

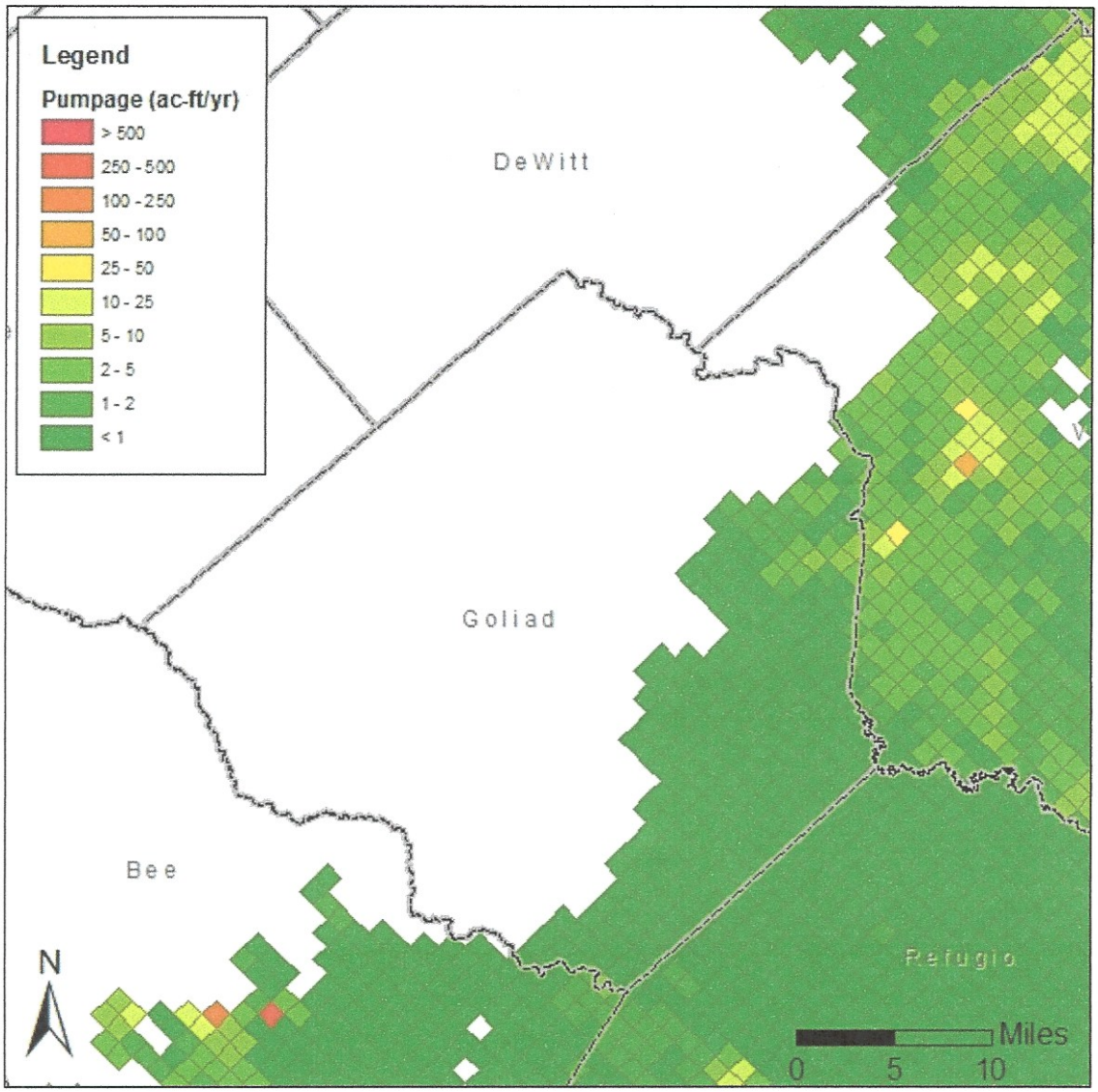

Figure 9. Distribution of historic groundwater production from the Chicot Aquifer (Layer 1) in 1999 from the GAM.

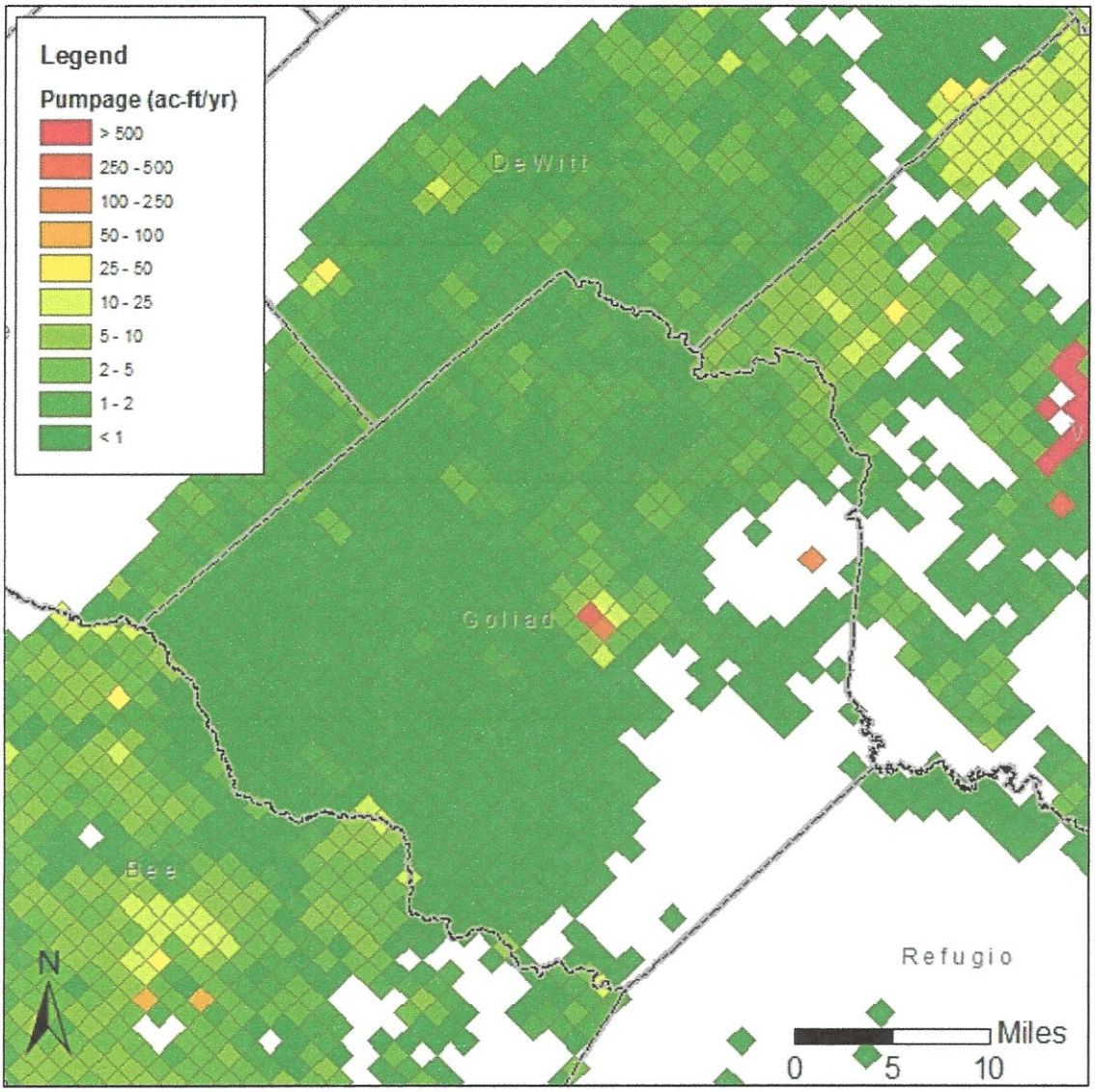

Figure 10. Distribution of historic groundwater production from the Evangeline Aquifer (Layer 2) in 1999 from the GAM.

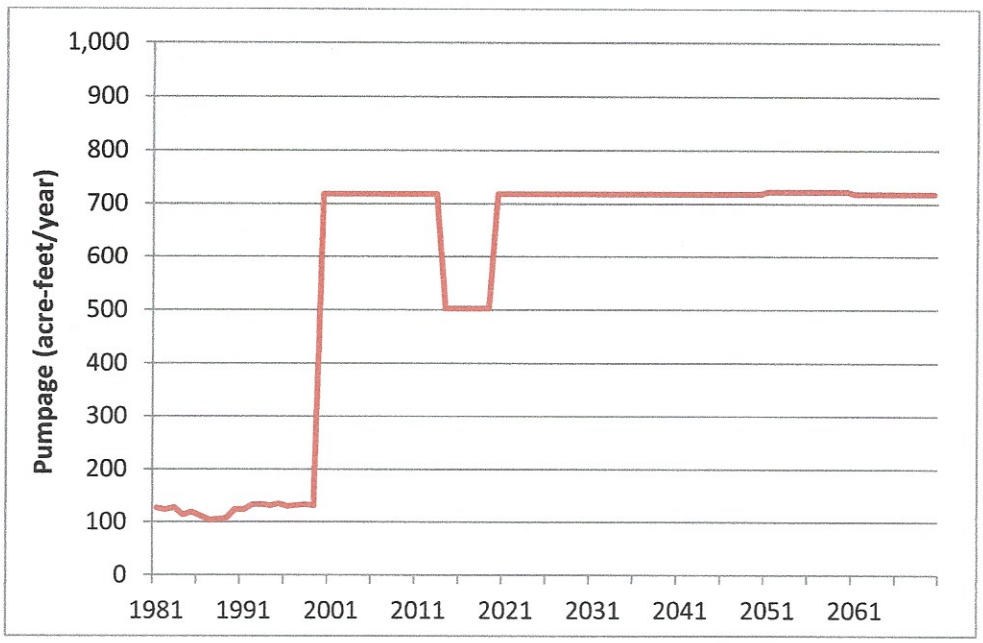

Figure 11. ***Goliad County pumpage in the historic calibration time period (1981-1999) and predictive time period (2000-70) for the Chicot Aquifer.***

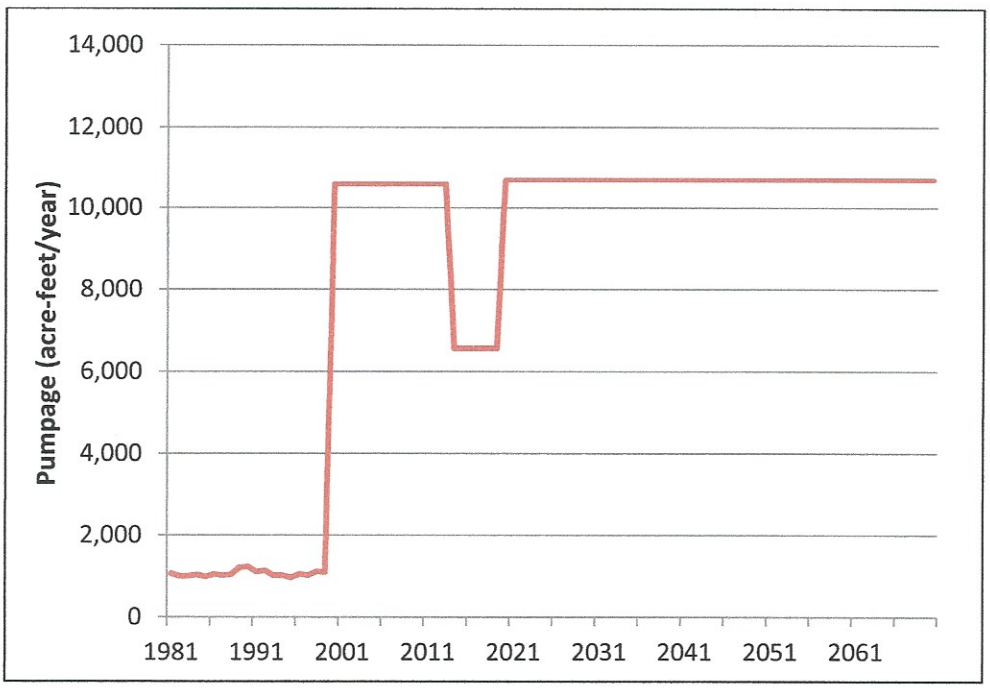

Figure 12. ***Goliad County pumpage in the historic calibration time period (1981-1999) and predictive time period (2000-70) for the Evangeline Aquifer.***

4. Summary and Conclusions

The District contracted DBS&A to conduct an initial evaluation of water levels, DFCs, recharge, and pumpage within Goliad County. The District has a water level monitoring network of 97 wells and has been collecting water level measurements since 2002-2003. Wells in the monitor well network were divided into groups to determine the nature and extent of the water-level changes in different parts of Goliad County. The observed rate of decline was determined to be different in different areas of the county, and ranged from 0.1 to 1.0 feet/year. In some areas the water levels have increased since the water level monitoring began. In addition, most areas within Goliad County that have multiple monitoring wells have at least one well that shows an increase in water levels, although most wells in the same area show a decline.

Water level declines in Goliad County may the due to the combination of pumpage and a decrease in recharge over time. The amount of decline observed in some wells, and the variable rates of declines observed in the wells (including some wells that exhibit increasing water levels) implies that pumpage is a significant factor in water levels changes that are observed in the monitoring well network.

The DFC for Goliad County is 10 feet of drawdown in the Gulf Coast Aquifer System from 2000 to 2069; the DFC does not refer to specific aquifer units. To provide for flexibility in monitoring and managing groundwater production, we suggest that the District evaluate each of the aquifer units within the Gulf Coast Aquifer System (the Chicot, Evangeline, and Jasper Aquifers) separately. Following this approach, the DFC for each of the individual aquifers would also be 10 feet of drawdown from 2000 to 2069.

Although the methodology for the assessment of DFC compliance has not been developed yet for the District, the drawdowns that have been observed in the Chicot, Evangeline, and Jasper Aquifers appear to be greater than the DFC, regardless of the DFC compliance methodology that may be chosen by the District. The exceedance of the DFCs is a concern due to the potential this may have in limiting future permits issued by the District.

Recommendations for expanding the monitoring well network are provided in Section 5. We believe that expansion of the monitoring well network is important to cover areas of the county where few or no monitoring wells currently exist. Options for assessing DFC compliance for the District depend on the potential expansion of the monitoring well network. We recommend that the District assess DFC compliance using the following approach:

1. Evaluate the Chicot and Evangeline aquifers separately, which requires sufficient monitor wells in each aquifer unit
2. Group monitor wells based on location to remove location bias where multiple wells are monitored in relatively localized regions.

Groundwater recharge values used in the GAM in Goliad County are similar to or the same as that used in adjacent counties and in other portions of the GAM, and the magnitude of recharge is consistent with values estimated in prior studies. Recharge rates used in the predictive simulations to approximate average recharge conditions are approximately 0.25 inches/year in the Evangeline Aquifer outcrop area, and 0.9 inches/year in the Chicot Aquifer outcrop area. Based on an average annual rainfall of 35 inches/year the recharge rates used in the GAM are 1 percent of average annual precipitation in the Evangeline Aquifer outcrop area and 2.5 percent of average annual precipitation in the Chicot Aquifer outcrop area.

An error was discovered in the recharge package used for the historical calibration period of the GAM that may impact calculated water level declines in predictive model runs. Recharge at the end of the calibration time period in the southern part of the model, including Goliad County, is much lower than it should be. This error may cause water levels at the end of the calibration simulation (which are used as starting water levels for predictive simulations) to be lower than they should be, which in turn may lower the calculated drawdowns at the end of each predictive simulation. This issue should be further evaluated by the District and corrected in future models and model runs.

An ecological model developed for Goliad County was assessed for insight into the recharge rates used in the GAM. However, we were unable to use information from this model to help quantifiably assess whether the recharge rates in the GAM are appropriate.

Historic pumpage for Goliad County from the TWDB, the District, and the GAM was reviewed. County-wide estimates from the TWDB prior to 2000 were approximately 1,000 to 1,500 acre-feet/year, most of which was for municipal use, with lesser amounts for mining, power, irrigation, and livestock uses. Based on input from the District these estimates of historic pumpage appear to be too low, and pumpage prior to 2000 should be similar to pumpage after 2000.

Pumpage used in the GAM calibration reflected the historic groundwater pumpage estimates in the TWDB database. Of this pumpage, 90 percent was from the Evangeline Aquifer and 10 percent from the Chicot Aquifer. Most of the pumpage from the Evangeline Aquifer and all of

the pumpage from the Chicot Aquifer in the historic pumpage dataset is evenly distributed at low rates across the part of the county where each aquifer is present, except for several model cells believed to represent City of Goliad and Coleto Creek Power LP.

In addition to county-wide estimates, the TWDB has data available from annual water use surveys that have been conducted. These data provide some additional information about groundwater production from the Gulf Coast Aquifer System in Goliad County, specifically that approximately half of the municipal pumpage is from the City of Goliad, which is the only significant municipal water supply source in the county, and that the only other current water user group of any significant size is Coleto Creek Power LP.

5. Recommendations

Our recommendations based on the results of this investigation are as follows:

- The DFC compliance methodology should monitor and evaluate the Chicot, Evangeline, and Jasper Aquifers separately. This will provide the District with flexibility in managing groundwater use within Goliad County.
- Because the official DFC is 10 feet of drawdown over 70 years for the entire Gulf Coast Aquifer System, we recommend assuming this means 10 feet of drawdown for each of the three aquifer units in the Gulf Coast Aquifer System.
- The assessment of DFC compliance should not be done using each well in the monitoring well network equally. Because of the spatial distribution of the wells, some of the wells should be grouped prior to calculating DFC compliance. This will eliminate bias that could be introduced into the calculations due to the locations of the wells.
- The monitoring well network should be expanded, attempting to identify and begin measuring wells in areas not already monitored. Although the DFC is an average water level decline over the entire District, water levels are currently monitored in only about half of the county. It would benefit the District to incorporate monitor wells away from the areas where large numbers of monitoring wells are already located, if possible, into the monitoring program.
- The District should organize and fully evaluate the permitted pumpage and production under both historic use and regular permits.
- The District should contact the TWDB about updating the estimates of historic pumpage based on the District's understanding of pumpage history and patterns within Goliad County. This includes the county-wide estimates of irrigation and livestock pumpage since 1980. . Historic pumpage estimates should also include reviewing pumpage for oil and gas supply within Goliad County.
- The District should review and compile all permits, both regular and historic use, issued by the District into a single dataset. Wells associated with permits should be identified, and as much information as possible should be gathered for each permitted well. The aquifer that each well/permit applies to should also be identified.

- The District should review and compile the information on all known wells in the District into a single dataset that includes well location, depth, aquifer the well is completed in, type of use and other factors.
- The District should review and compile all water quality sampling data that has been done by the District in the last 15 years. The information provided by the District indicates that hundreds of wells have been sampled, and this data should be compiled into a county-wide summary of groundwater quality conditions. Similar studies have been, or are being, conducted by other GCDs in the region, including Fayette County GCD and Pecan Valley GCD.
- The District should finalize a methodology for DFC compliance assessment. Completion of this task is dependent on the results and implementation of the above recommendations, especially the expansion of the water level monitoring network.
- The District should request that GMA 15 evaluate the impact of the erroneous recharge data used for Goliad County and surrounding areas in the model calibration. The District should also ensure that the erroneous recharge data used in the previous GAM calibration is corrected in the current revision of the GAM being conducted by the TWDB.

6. References

Baker, E.T., 1979- Stratigraphic and hydrogeologic framework of part of the coastal plain of Texas: Texas Water Development Board Report 236; July, 1979; 18 pp.

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Dale, O.C., E.A. Moulder, and T. Arnow, 1957- Ground-water resources of Goliad County, Texas; Texas Board of Water Engineers Bulletin 5711; September, 1957; 102 pp.

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Scanlon, B.R., A. Dutton, and M. Sophocleous, 2010- Groundwater recharge in Texas; special report prepared for the Texas Water Development Board; 2010; 84 pp.

Young, S.C., T. Budge, P.R. Knox, E. Baker, S. Hamlin, B. Galloway, and N. Deeds, 2010- Hydrostratigraphy of the Gulf Coast Aquifer from the Brazos River to the Rio Grande; report prepared fo rthe Texas Water Development Board; February, 2010; 213 pp.

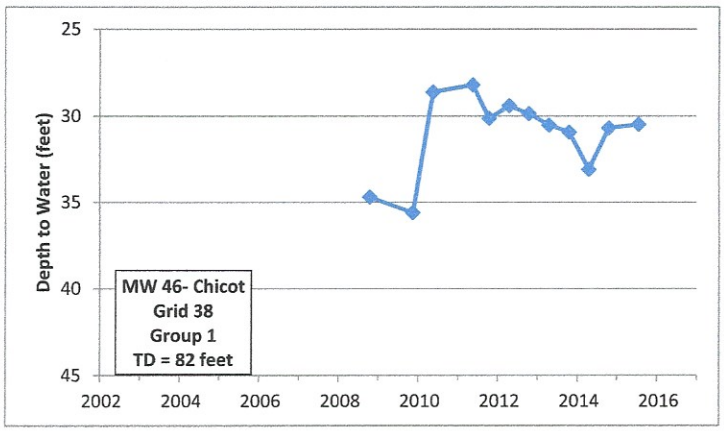
Young, S.C., 2016- Desired future conditions Explanatory Report for Groundwater Management Area 15; Consultant report prepared for Groundwater Management Area 15; June 14, 2016; 818 pp.

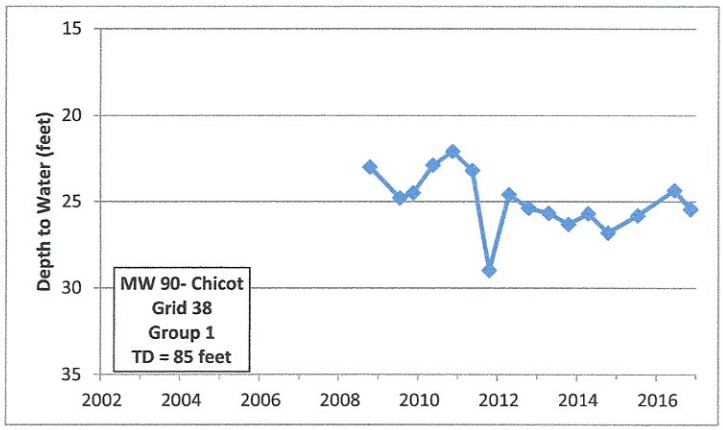
GMA 15 Reports- Various reports done as part of the joint groundwater planning process for Groundwater Management Area (GMA) 15, which includes Goliad County.

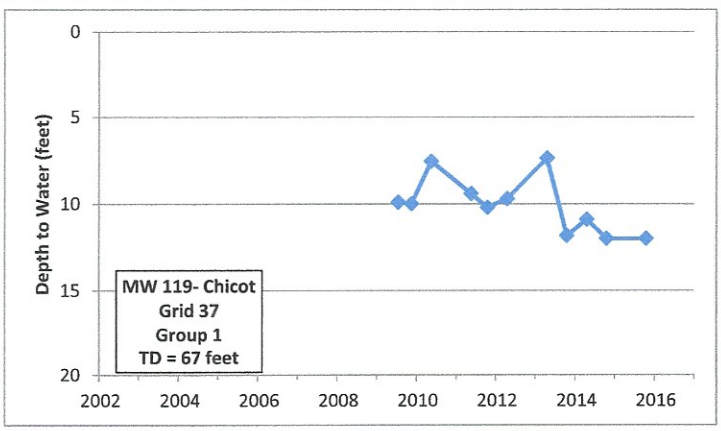
Appendix A

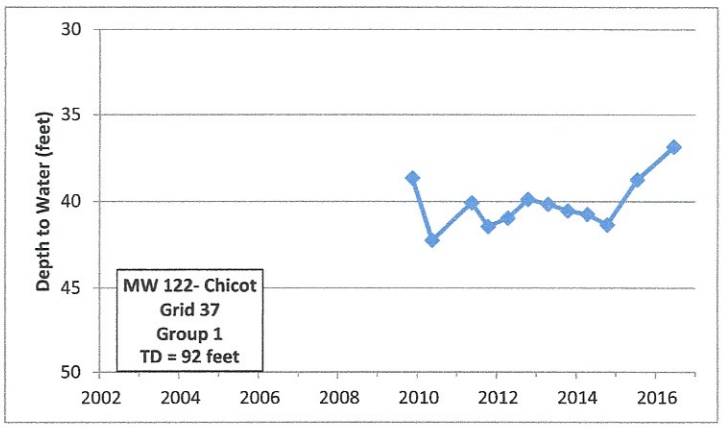
Hydrographs

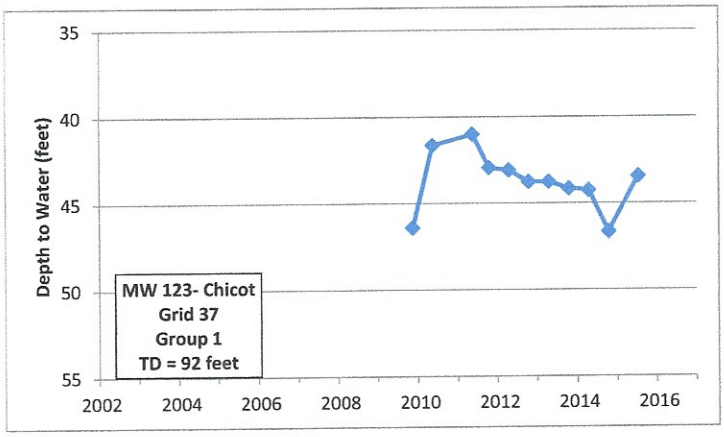
Group 1 Hydrographs

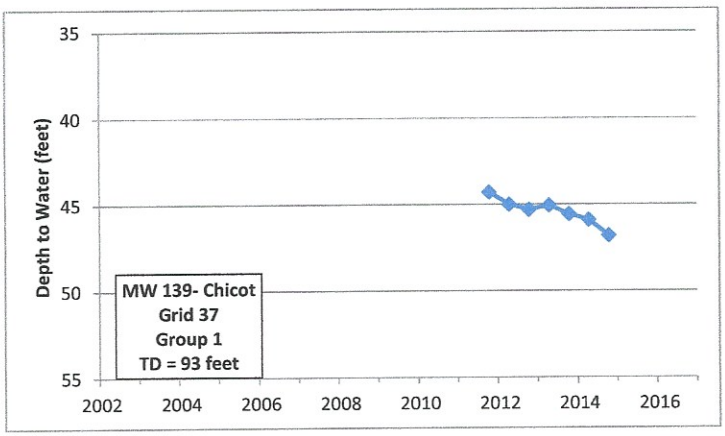

Depth to Water (feet)
25
30
35
40
45
2002
2004
2006
2008
2010
2012
2014
2016
MW 46- Chicot
Grid 38
Group 1
TD = 82 feet


Depth to Water (feet)
15
20
25
30
35
2002
2004
2006
2008
2010
2012
2014
2016
MW 90- Chicot
Grid 38
Group 1
TD = 85 feet

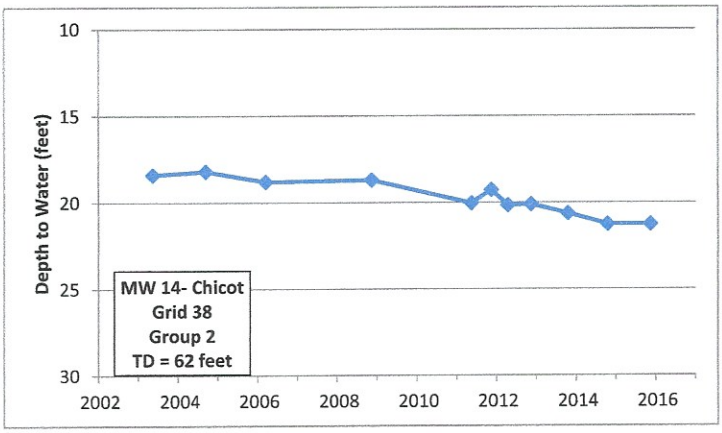

Depth to Water (feet)
0
5
10
15
20
2002
2004
2006
2008
2010
2012
2014
2016
MW 119- Chicot
Grid 37
Group 1
TD = 67 feet

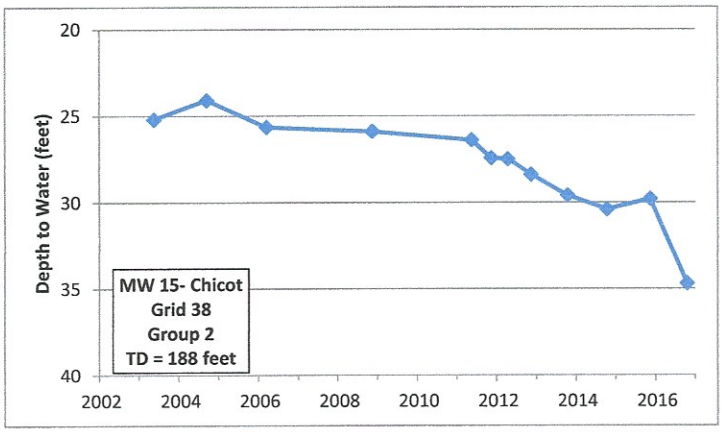

Depth to Water (feet)
30
35
40
45
50
2002
2004
2006
2008
2010
2012
2014
2016
MW 122- Chicot
Grid 37
Group 1
TD = 92 feet

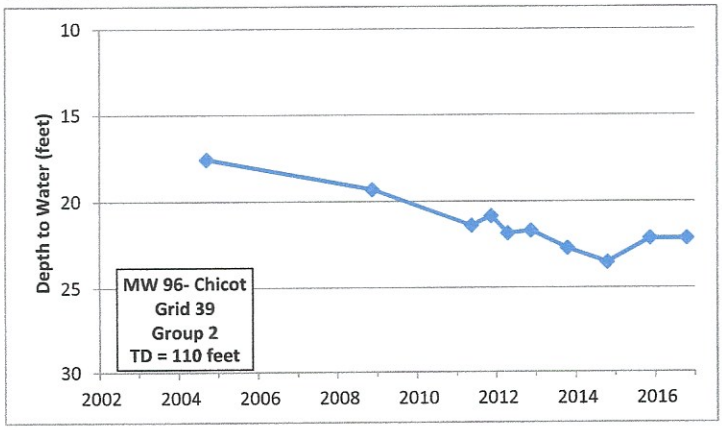

35
40
45
50
55
Depth to Water (feet)
2002
2004
2006
2008
2010
2012
2014
2016
MW 123- Chicot
Grid 37
Group 1
TD = 92 feet

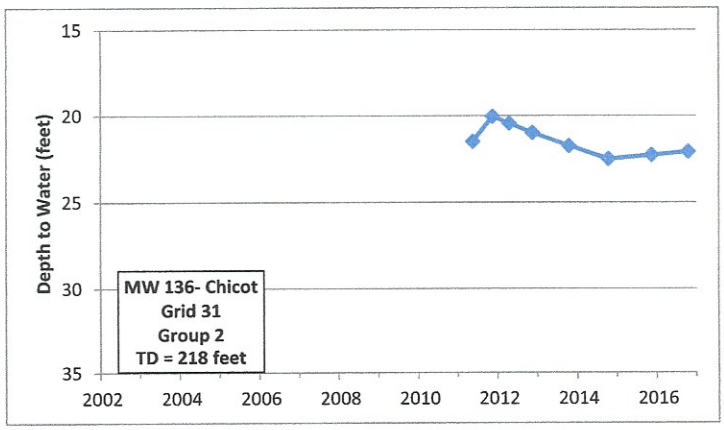

35
40
45
50
55
Depth to Water (feet)
2002
2004
2006
2008
2010
2012
2014
2016
MW 139- Chicot
Grid 37
Group 1
TD = 93 feet

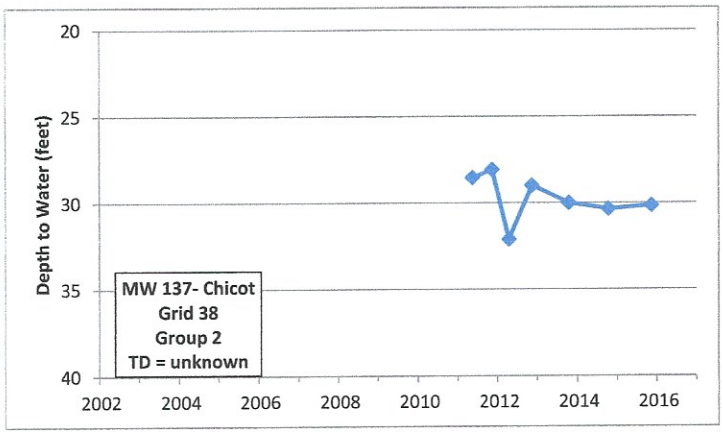
Group 2 Hydrographs

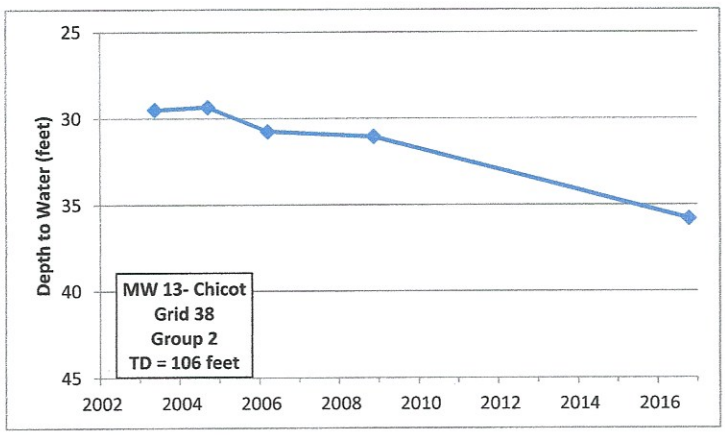

Depth to Water (feet)
10
15
20
25
30
2002
2004
2006
2008
2010
2012
2014
2016
MW 14- Chicot
Grid 38
Group 2
TD = 62 feet


Depth to Water (feet)
20
25
30
35
40
2002
2004
2006
2008
2010
2012
2014
2016
MW 15- Chicot
Grid 38
Group 2
TD = 188 feet

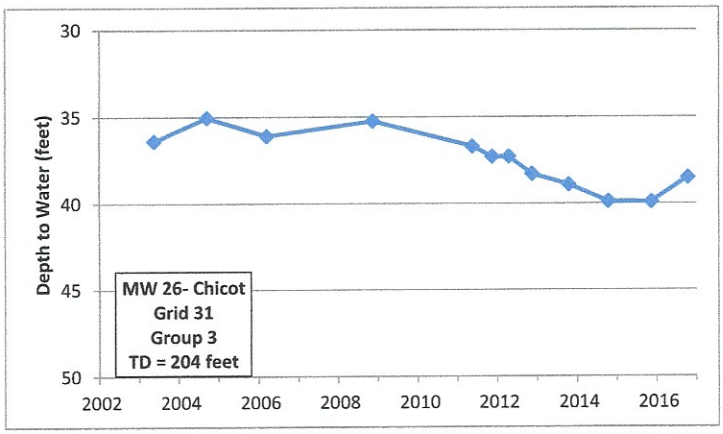

Depth to Water (feet)
10
15
20
25
30
2002
2004
2006
2008
2010
2012
2014
2016
MW 96- Chicot
Grid 39
Group 2
TD = 110 feet

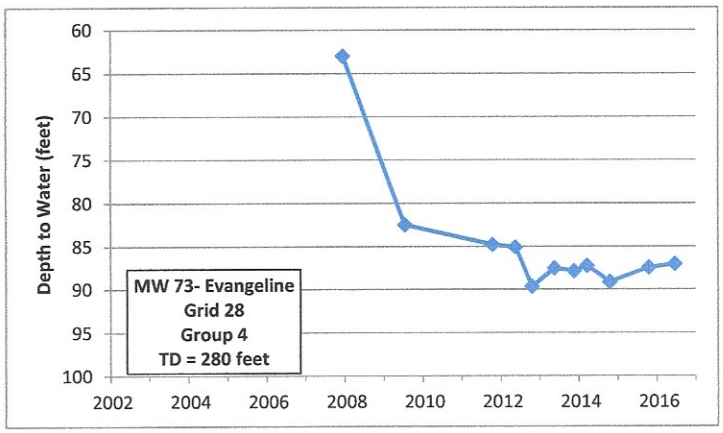

Depth to Water (feet)
15
20
25
30
35
2002
2004
2006
2008
2010
2012
2014
2016
MW 136- Chicot
Grid 31
Group 2
TD = 218 feet


Depth to Water (feet)
20
25
30
35
40
2002
2004
2006
2008
2010
2012
2014
2016
MW 137- Chicot
Grid 38
Group 2
TD = unknown

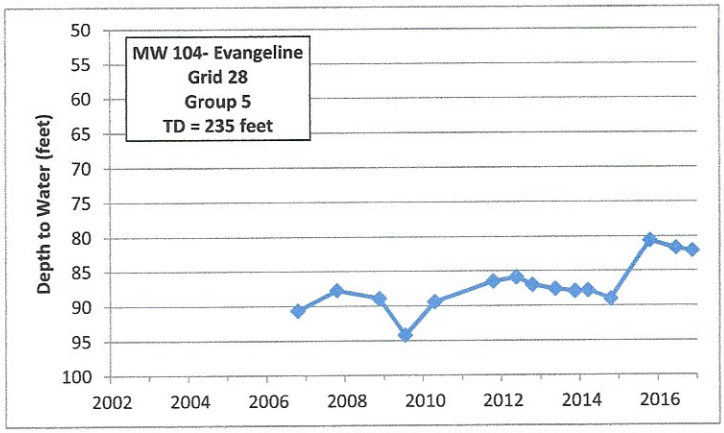

Depth to Water (feet)
25
30
35
40
45
2002
2004
2006
2008
2010
2012
2014
2016
MW 13- Chicot
Grid 38
Group 2
TD = 106 feet

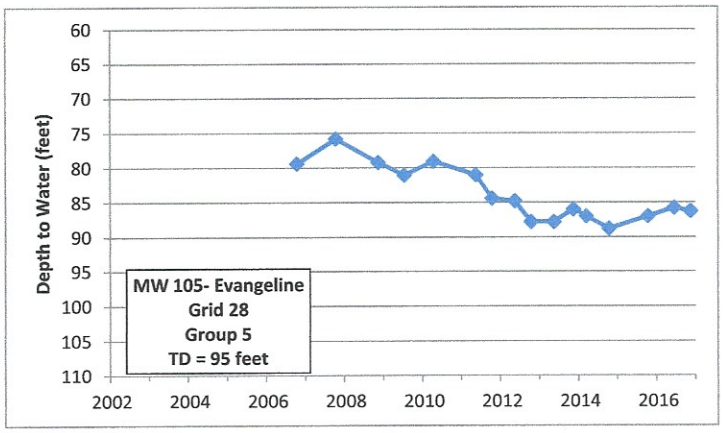
Groups 3 and 4 Hydrographs

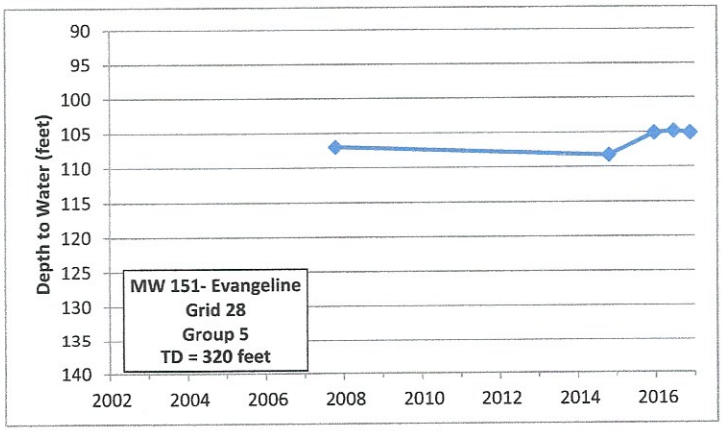

30
35
40
45
50
Depth to Water (feet)
2002
2004
2006
2008
2010
2012
2014
2016
MW 26- Chicot
Grid 31
Group 3
TD = 204 feet


60
65
70
75
80
85
90
95
100
Depth to Water (feet)
2002
2004
2006
2008
2010
2012
2014
2016
MW 73- Evangeline
Grid 28
Group 4
TD = 280 feet

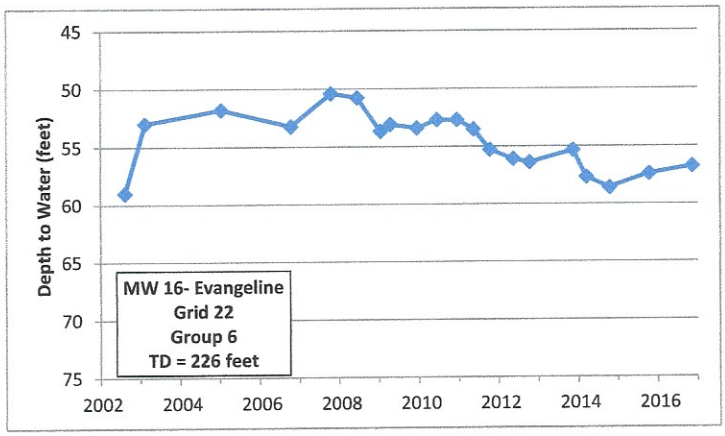
Group 5 Hydrographs

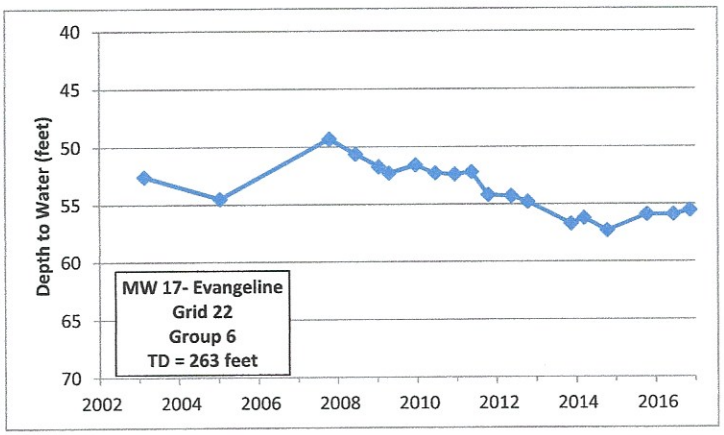

MW 104- Evangeline
Grid 28
Group 5
TD = 235 feet
Depth to Water (feet)
50
55
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016

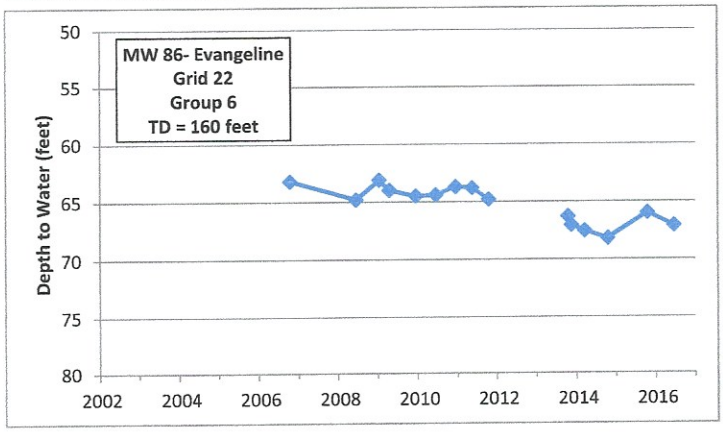

MW 105- Evangeline
Grid 28
Group 5
TD = 95 feet
Depth to Water (feet)
60
65
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016


MW 151- Evangeline
Grid 28
Group 5
TD = 320 feet
Depth to Water (feet)
90
95
100
105
110
115
120
125
130
135
140
2002
2004
2006
2008
2010
2012
2014
2016

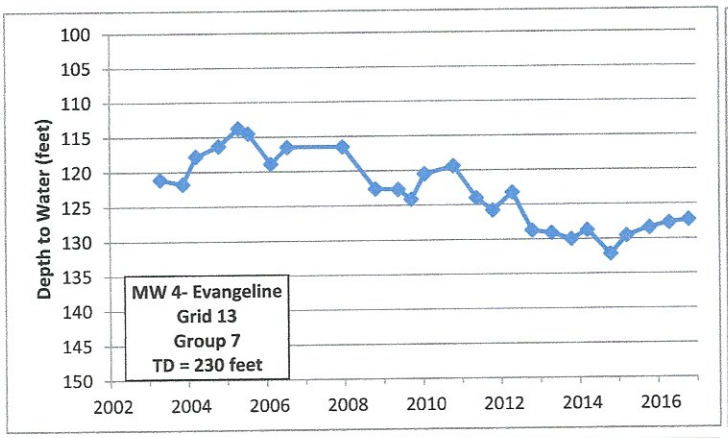
Group 6 Hydrographs

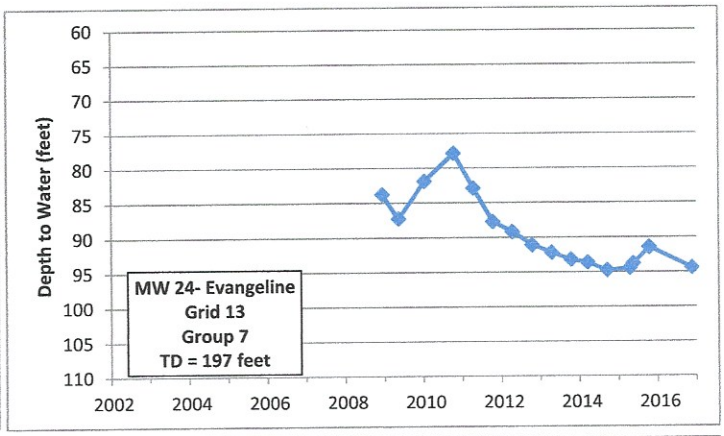

Depth to Water (feet)
45
50
55
60
65
70
75
2002
2004
2006
2008
2010
2012
2014
2016
MW 16- Evangeline
Grid 22
Group 6
TD = 226 feet

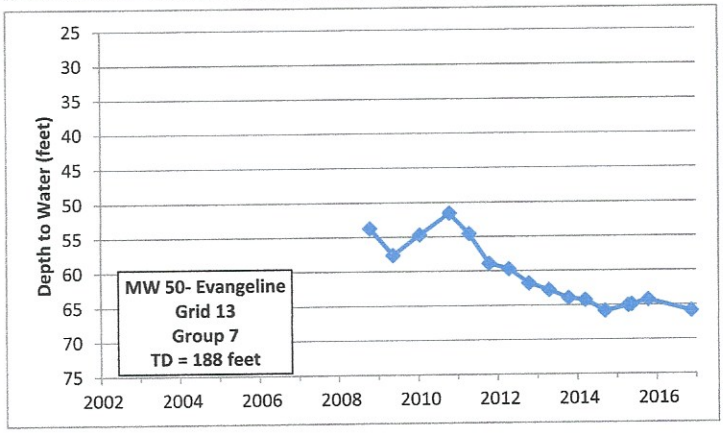

Depth to Water (feet)
40
45
50
55
60
65
70
2002
2004
2006
2008
2010
2012
2014
2016
MW 17- Evangeline
Grid 22
Group 6
TD = 263 feet

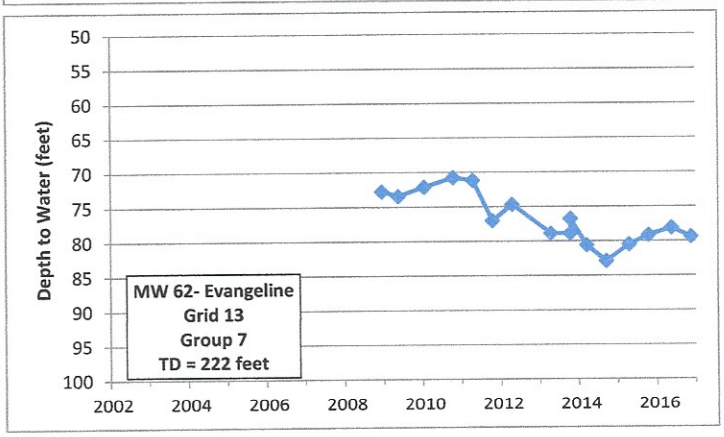

Depth to Water (feet)
50
55
60
65
70
75
80
2002
2004
2006
2008
2010
2012
2014
2016
MW 86- Evangeline
Grid 22
Group 6
TD = 160 feet

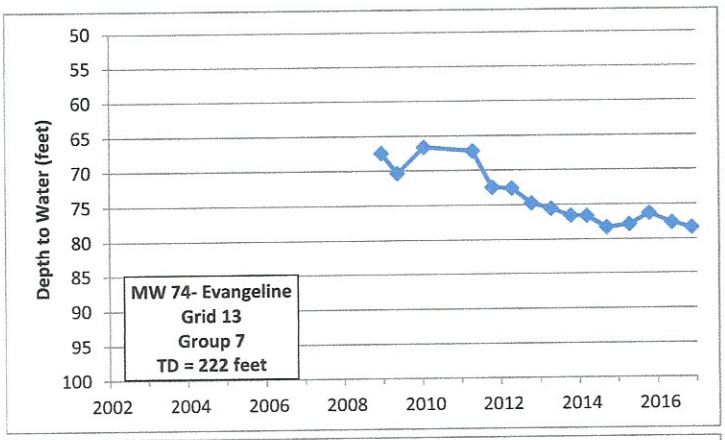
Group 7 Hydrographs

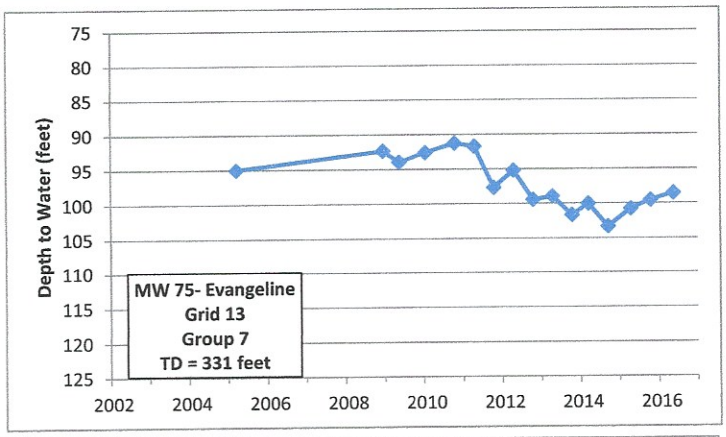

Depth to Water (feet)
100
105
110
115
120
125
130
135
140
145
150
2002
2004
2006
2008
2010
2012
2014
2016
MW 4- Evangeline
Grid 13
Group 7
TD = 230 feet

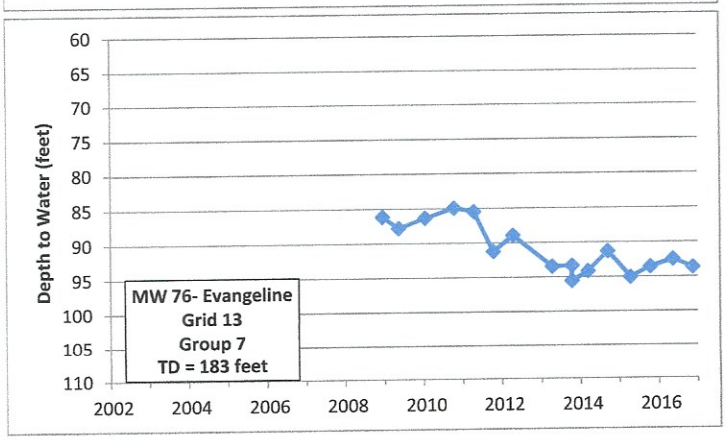

Depth to Water (feet)
60
65
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016
MW 24- Evangeline
Grid 13
Group 7
TD = 197 feet

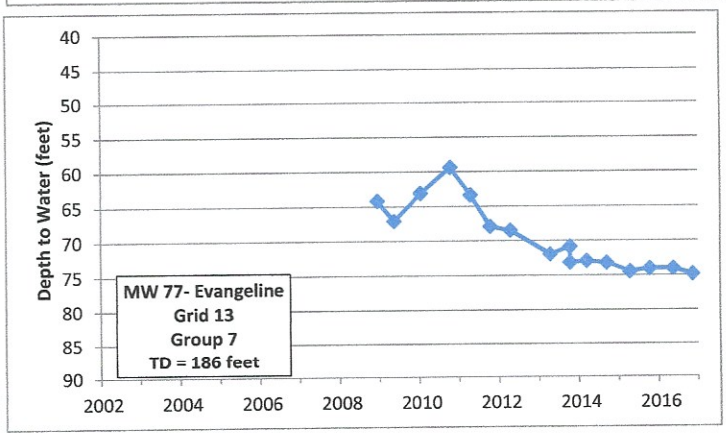

Depth to Water (feet)
25
30
35
40
45
50
55
60
65
70
75
2002
2004
2006
2008
2010
2012
2014
2016
MW 50- Evangeline
Grid 13
Group 7
TD = 188 feet

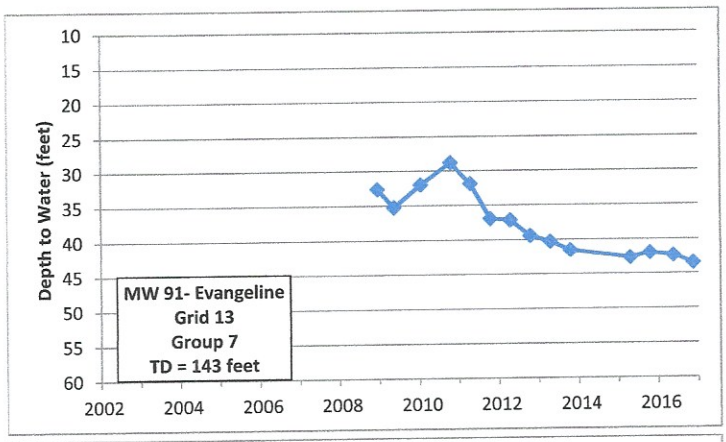

Depth to Water (feet)
50
55
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 62- Evangeline
Grid 13
Group 7
TD = 222 feet

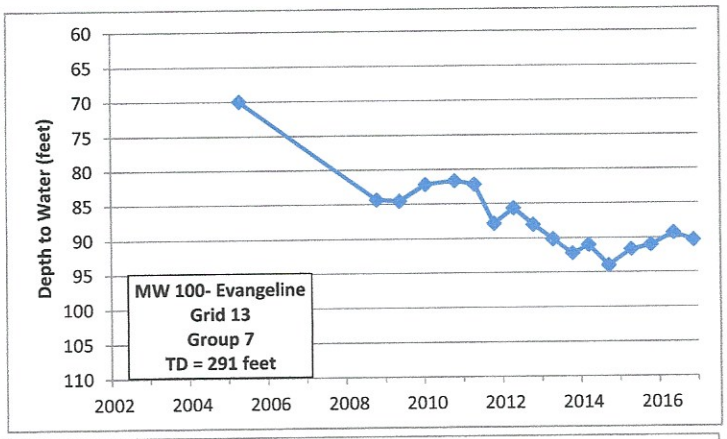

Depth to Water (feet)
50
55
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 74- Evangeline
Grid 13
Group 7
TD = 222 feet

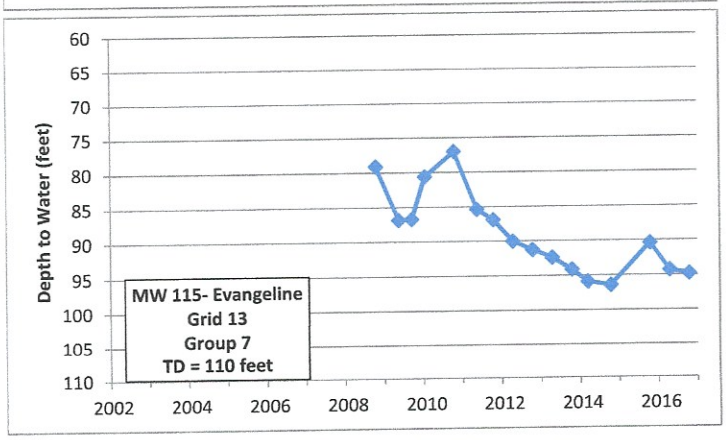

Depth to Water (feet)
75
80
85
90
95
100
105
110
115
120
125
2002
2004
2006
2008
2010
2012
2014
2016
MW 75- Evangeline
Grid 13
Group 7
TD = 331 feet

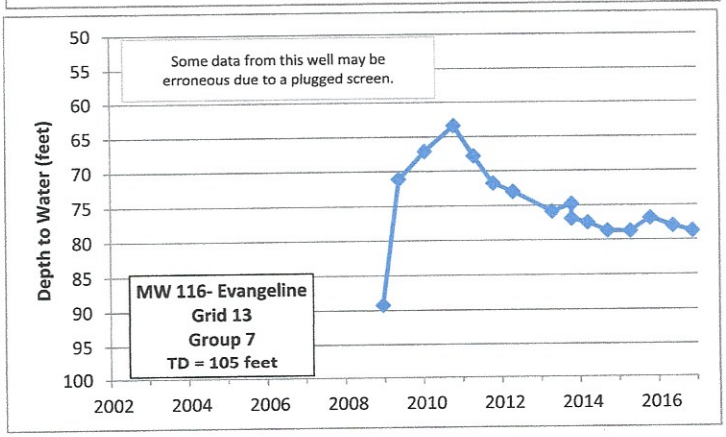

Depth to Water (feet)
60
65
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016
MW 76- Evangeline
Grid 13
Group 7
TD = 183 feet

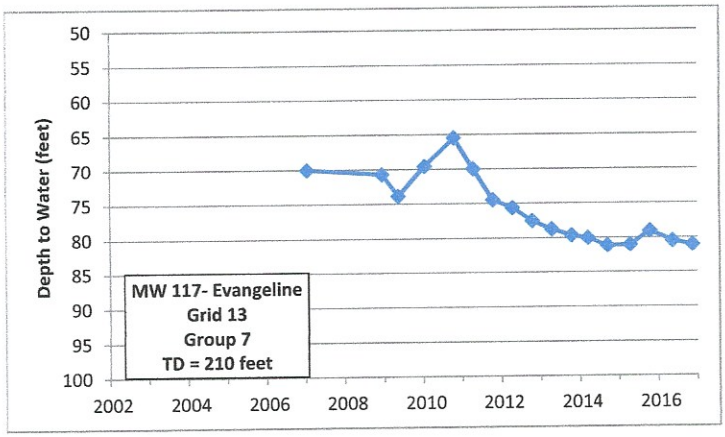

Depth to Water (feet)
40
45
50
55
60
65
70
75
80
85
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 77- Evangeline
Grid 13
Group 7
TD = 186 feet


Depth to Water (feet)
10
15
20
25
30
35
40
45
50
55
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 91- Evangeline
Grid 13
Group 7
TD = 143 feet

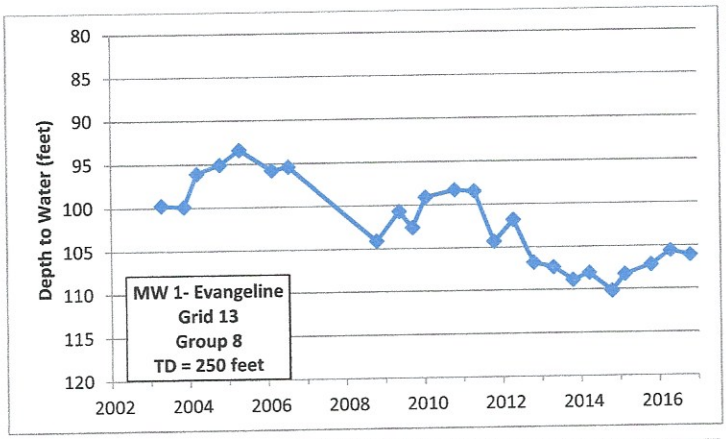

Depth to Water (feet)
60
65
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016
MW 100- Evangeline
Grid 13
Group 7
TD = 291 feet

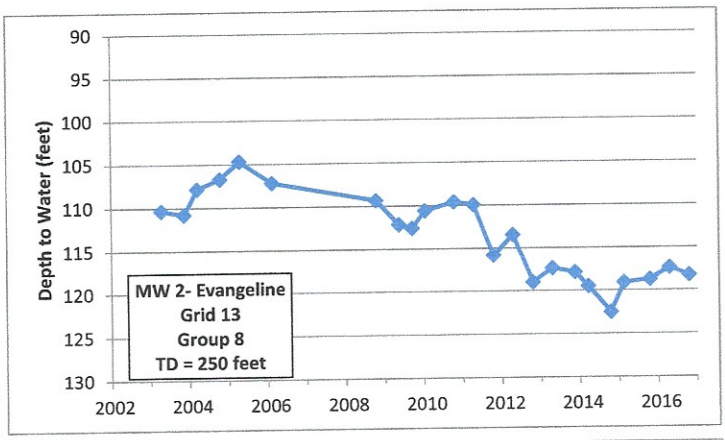

Depth to Water (feet)
60
65
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016
MW 115- Evangeline
Grid 13
Group 7
TD = 110 feet

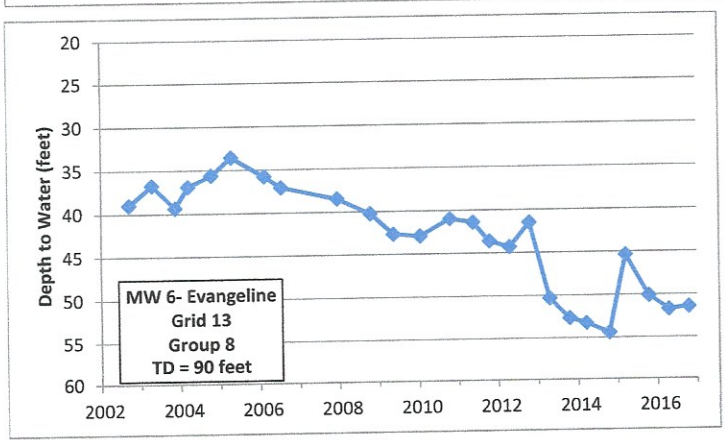

Some data from this well may be erroneous due to a plugged screen.
Depth to Water (feet)
50
55
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 116- Evangeline
Grid 13
Group 7
TD = 105 feet

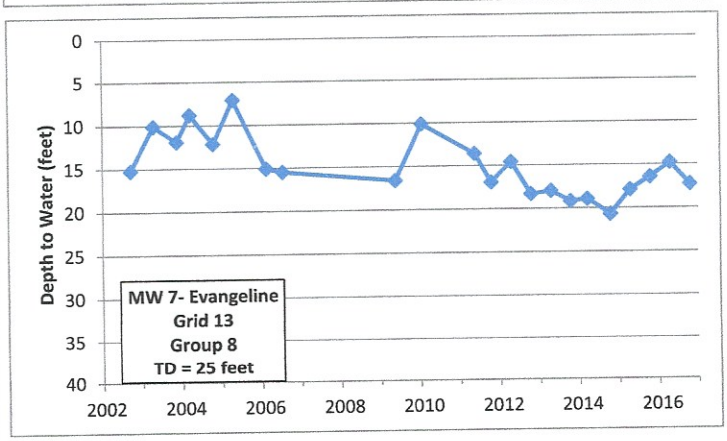

Depth to Water (feet)
50
55
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 117- Evangeline
Grid 13
Group 7
TD = 210 feet

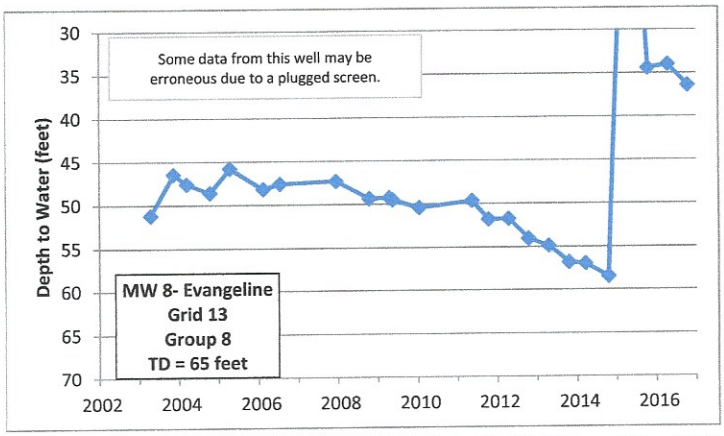
Group 8 Hydrographs

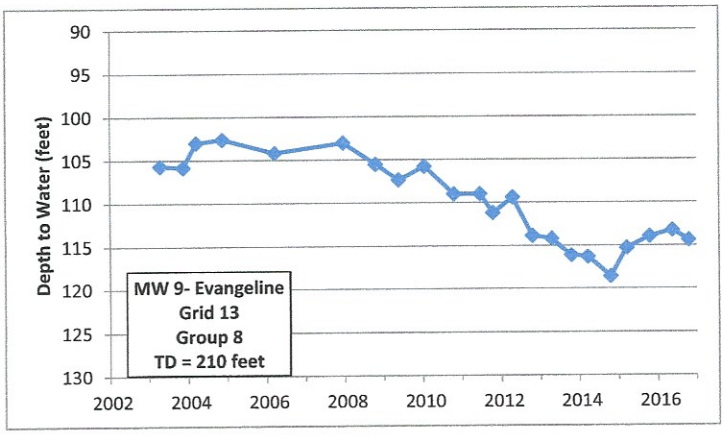

Depth to Water (feet)
80
85
90
95
100
105
110
115
120
2002
2004
2006
2008
2010
2012
2014
2016
MW 1- Evangeline
Grid 13
Group 8
TD = 250 feet

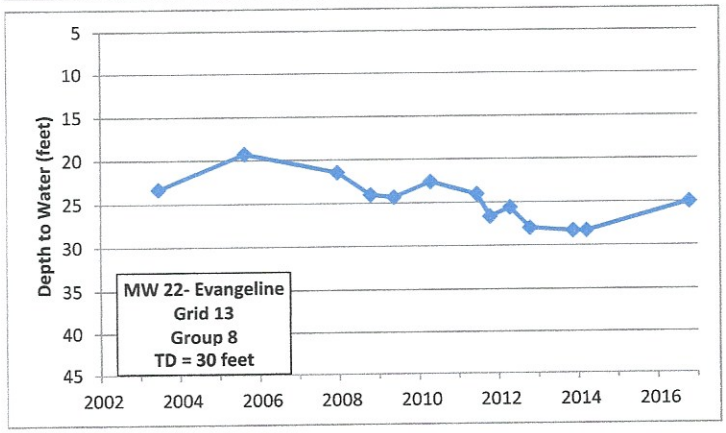

Depth to Water (feet)
90
95
100
105
110
115
120
125
130
2002
2004
2006
2008
2010
2012
2014
2016
MW 2- Evangeline
Grid 13
Group 8
TD = 250 feet

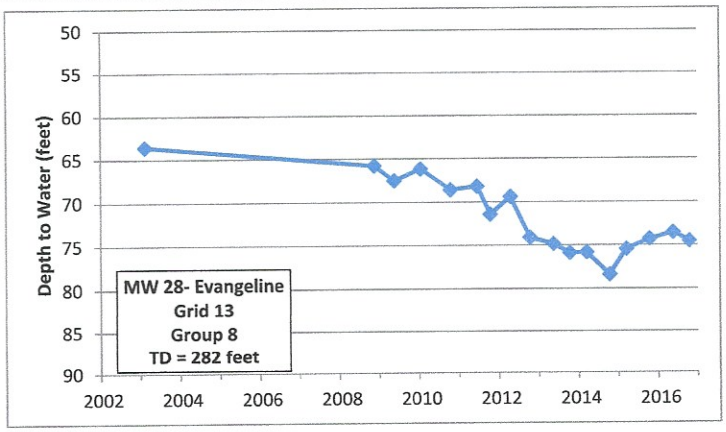

Depth to Water (feet)
20
25
30
35
40
45
50
55
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 6- Evangeline
Grid 13
Group 8
TD = 90 feet

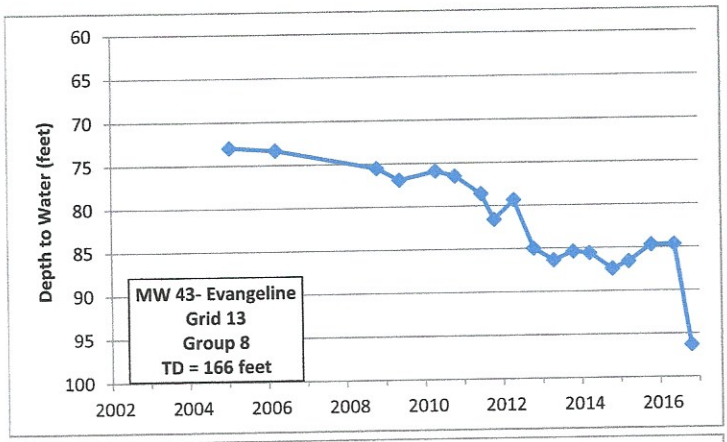

Depth to Water (feet)
0
5
10
15
20
25
30
35
40
2002
2004
2006
2008
2010
2012
2014
2016
MW 7- Evangeline
Grid 13
Group 8
TD = 25 feet

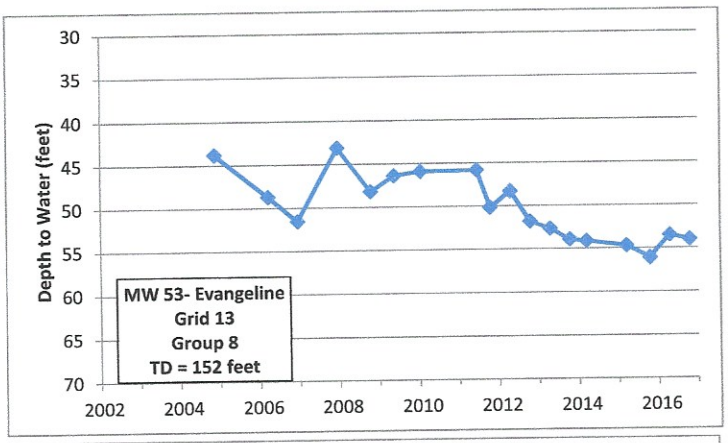

Some data from this well may be erroneous due to a plugged screen.
MW 8- Evangeline
Grid 13
Group 8
TD = 65 feet
Depth to Water (feet)
30
35
40
45
50
55
60
65
70
2002
2004
2006
2008
2010
2012
2014
2016

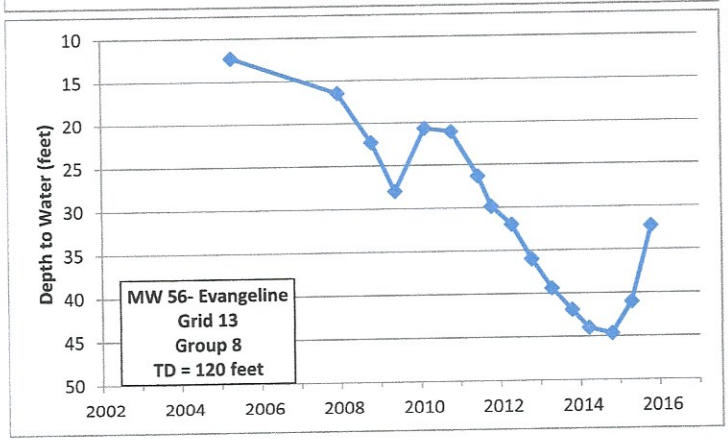

MW 9- Evangeline
Grid 13
Group 8
TD = 210 feet
Depth to Water (feet)
90
95
100
105
110
115
120
125
130
2002
2004
2006
2008
2010
2012
2014
2016

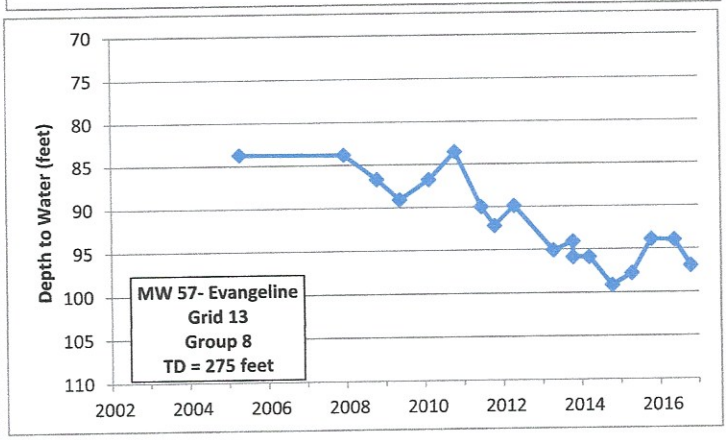

MW 22- Evangeline
Grid 13
Group 8
TD = 30 feet
Depth to Water (feet)
5
10
15
20
25
30
35
40
45
2002
2004
2006
2008
2010
2012
2014
2016

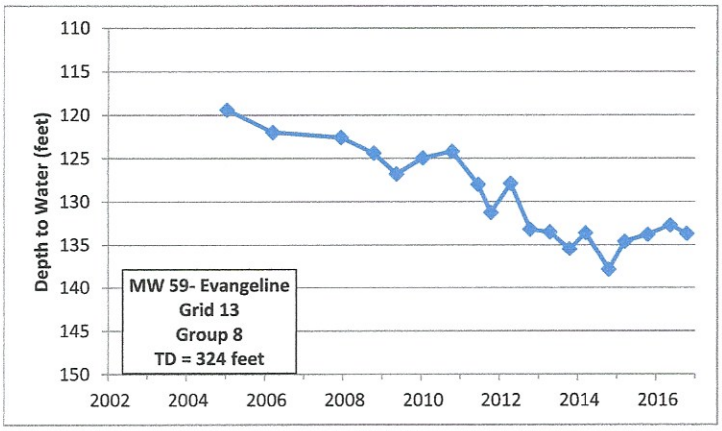

MW 28- Evangeline
Grid 13
Group 8
TD = 282 feet
Depth to Water (feet)
50
55
60
65
70
75
80
85
90
2002
2004
2006
2008
2010
2012
2014
2016

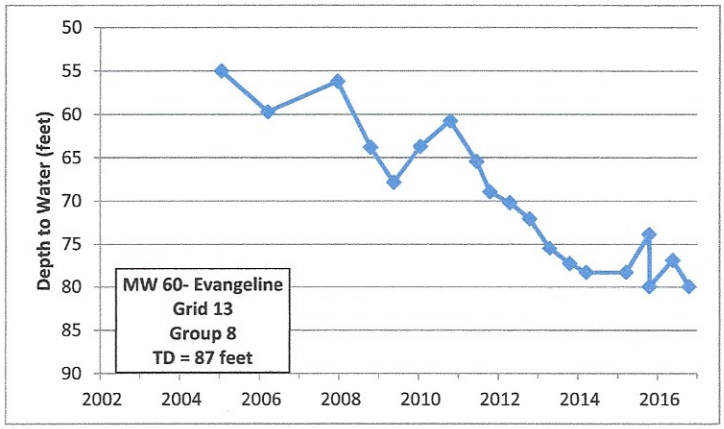

Depth to Water (feet)
60
65
70
75
80
85
90
95
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 43- Evangeline
Grid 13
Group 8
TD = 166 feet

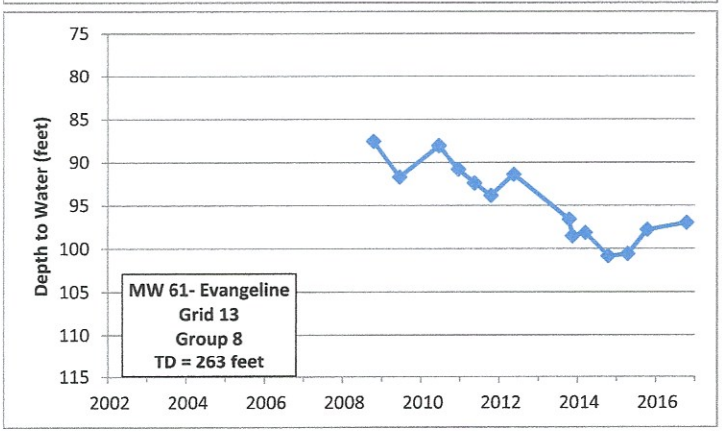

Depth to Water (feet)
30
35
40
45
50
55
60
65
70
2002
2004
2006
2008
2010
2012
2014
2016
MW 53- Evangeline
Grid 13
Group 8
TD = 152 feet

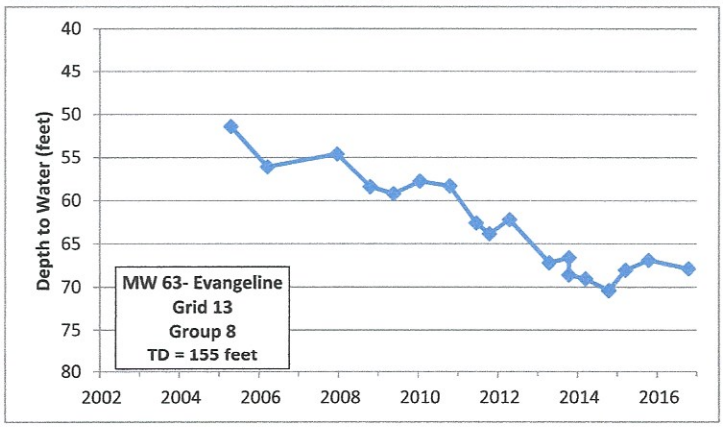

Depth to Water (feet)
10
15
20
25
30
35
40
45
50
2002
2004
2006
2008
2010
2012
2014
2016
MW 56- Evangeline
Grid 13
Group 8
TD = 120 feet

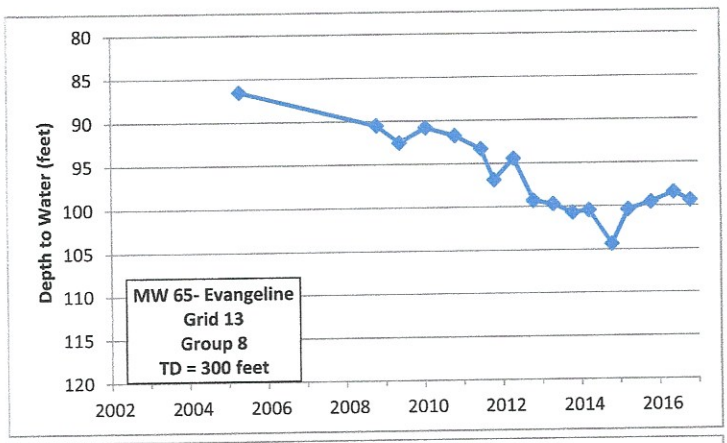

Depth to Water (feet)
70
75
80
85
90
95
100
105
110
2002
2004
2006
2008
2010
2012
2014
2016
MW 57- Evangeline
Grid 13
Group 8
TD = 275 feet

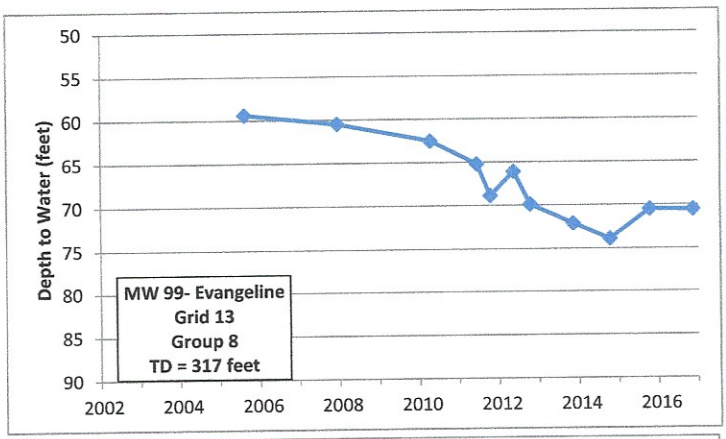

Depth to Water (feet)
110
115
120
125
130
135
140
145
150
2002
2004
2006
2008
2010
2012
2014
2016
MW 59- Evangeline
Grid 13
Group 8
TD = 324 feet

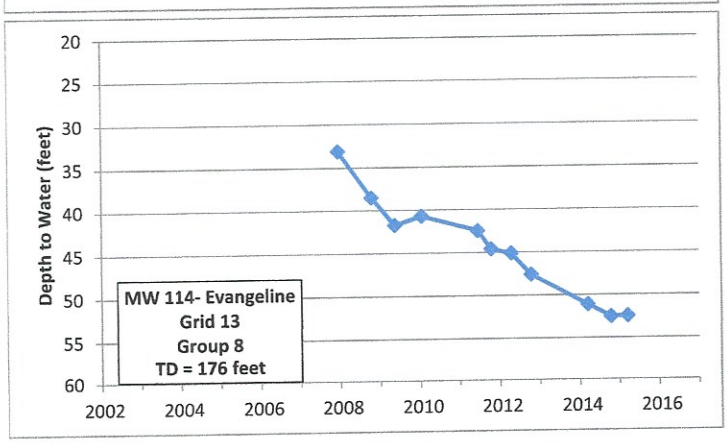

Depth to Water (feet)
50
55
60
65
70
75
80
85
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 60- Evangeline
Grid 13
Group 8
TD = 87 feet

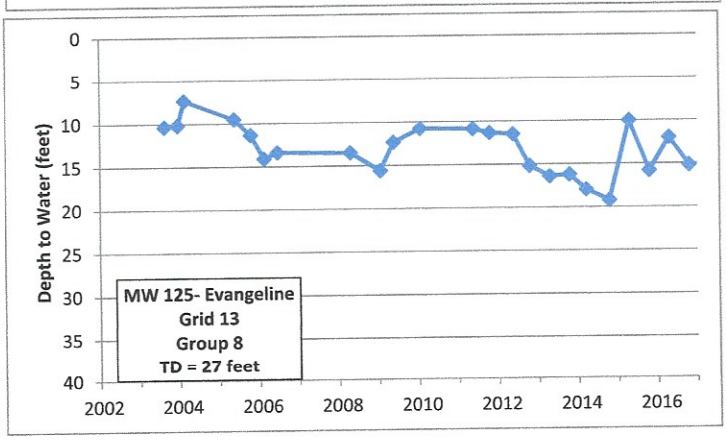

Depth to Water (feet)
75
80
85
90
95
100
105
110
115
2002
2004
2006
2008
2010
2012
2014
2016
MW 61- Evangeline
Grid 13
Group 8
TD = 263 feet


Depth to Water (feet)
40
45
50
55
60
65
70
75
80
2002
2004
2006
2008
2010
2012
2014
2016
MW 63- Evangeline
Grid 13
Group 8
TD = 155 feet

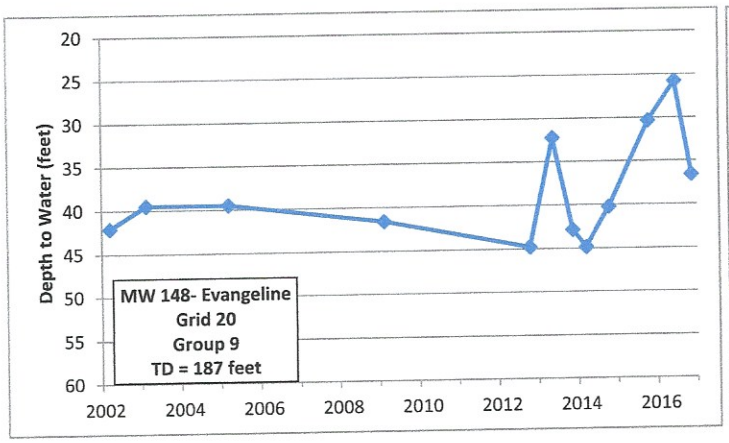

Depth to Water (feet)
80
85
90
95
100
105
110
115
120
2002
2004
2006
2008
2010
2012
2014
2016
MW 65- Evangeline
Grid 13
Group 8
TD = 300 feet

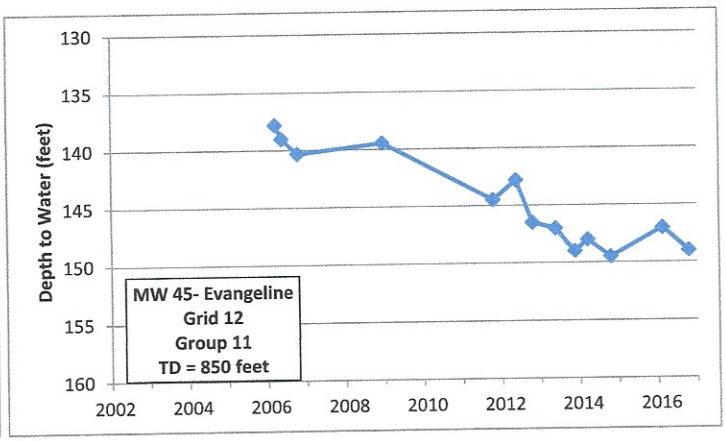

Depth to Water (feet)
50
55
60
65
70
75
80
85
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 99- Evangeline
Grid 13
Group 8
TD = 317 feet


Depth to Water (feet)
20
25
30
35
40
45
50
55
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 114- Evangeline
Grid 13
Group 8
TD = 176 feet

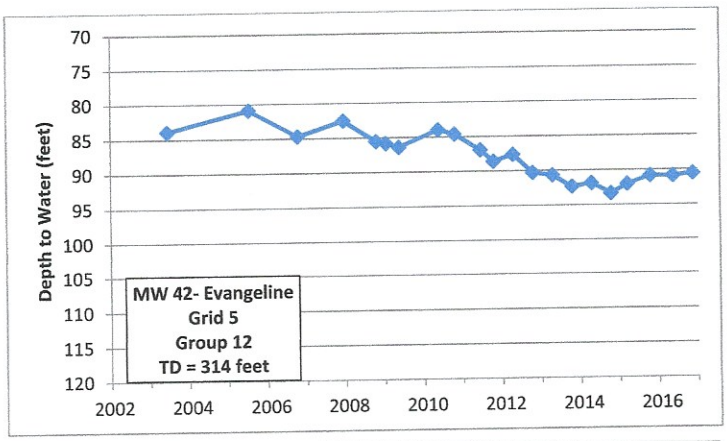

Depth to Water (feet)
0
5
10
15
20
25
30
35
40
2002
2004
2006
2008
2010
2012
2014
2016
MW 125- Evangeline
Grid 13
Group 8
TD = 27 feet

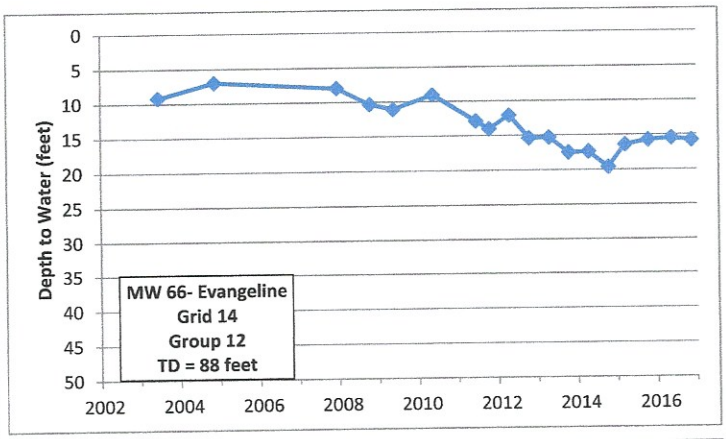
Groups 9 and 11 Hydrographs

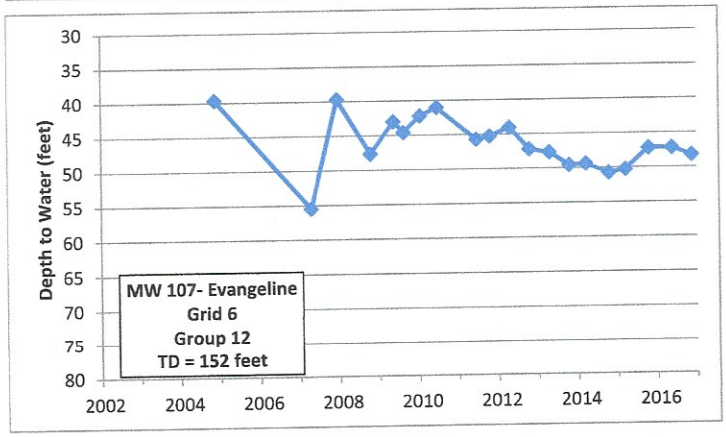

Depth to Water (feet)
20
25
30
35
40
45
50
55
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 148- Evangeline
Grid 20
Group 9
TD = 187 feet

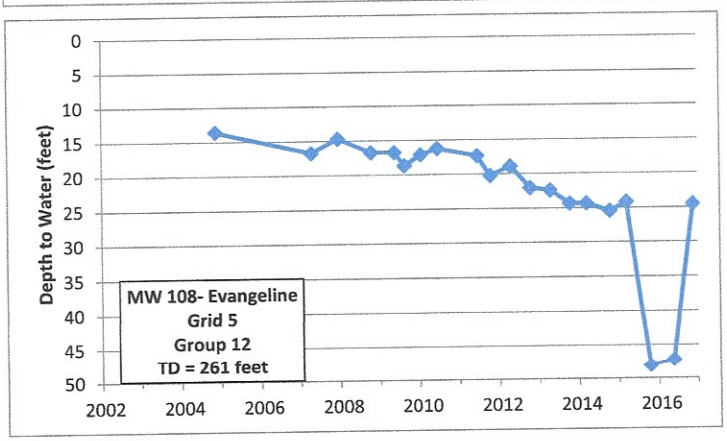

Depth to Water (feet)
130
135
140
145
150
155
160
2002
2004
2006
2008
2010
2012
2014
2016
MW 45- Evangeline
Grid 12
Group 11
TD = 850 feet

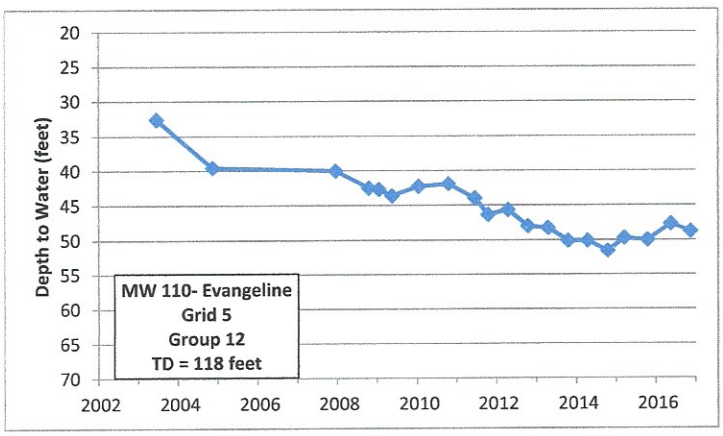
Group 12 Hydrographs

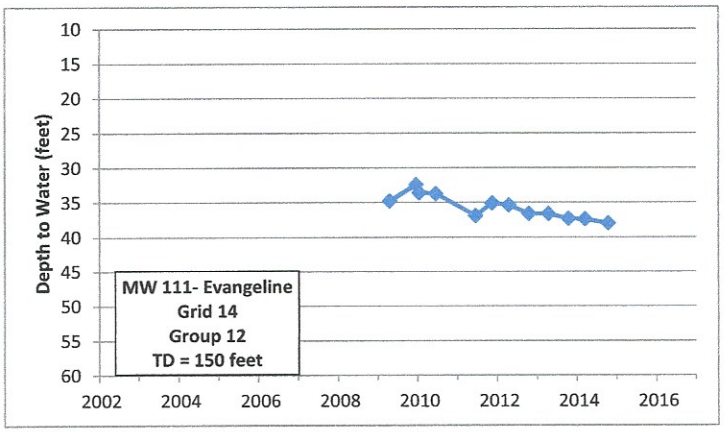

Depth to Water (feet)
70
75
80
85
90
95
100
105
110
115
120
2002
2004
2006
2008
2010
2012
2014
2016
MW 42- Evangeline
Grid 5
Group 12
TD = 314 feet

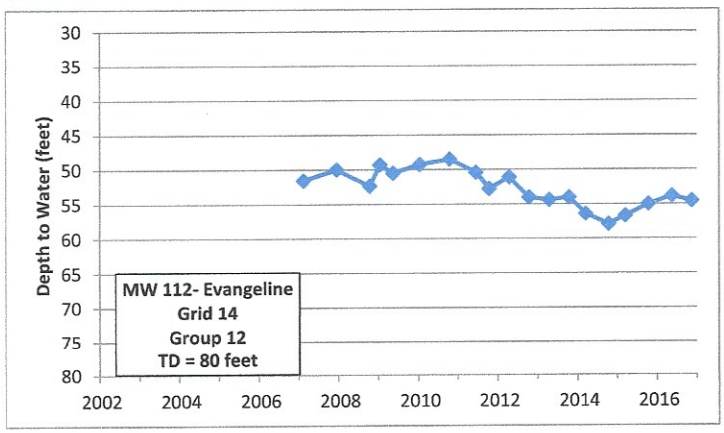

Depth to Water (feet)
0
5
10
15
20
25
30
35
40
45
50
2002
2004
2006
2008
2010
2012
2014
2016
MW 66- Evangeline
Grid 14
Group 12
TD = 88 feet

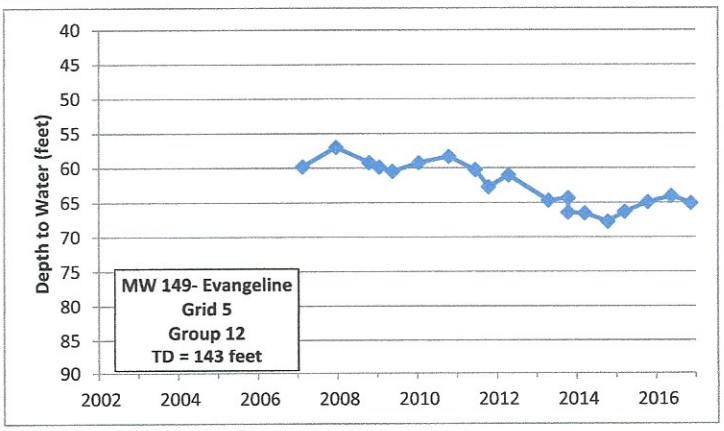

Depth to Water (feet)
30
35
40
45
50
55
60
65
70
75
80
2002
2004
2006
2008
2010
2012
2014
2016
MW 107- Evangeline
Grid 6
Group 12
TD = 152 feet


Depth to Water (feet)
0
5
10
15
20
25
30
35
40
45
50
2002
2004
2006
2008
2010
2012
2014
2016
MW 108- Evangeline
Grid 5
Group 12
TD = 261 feet

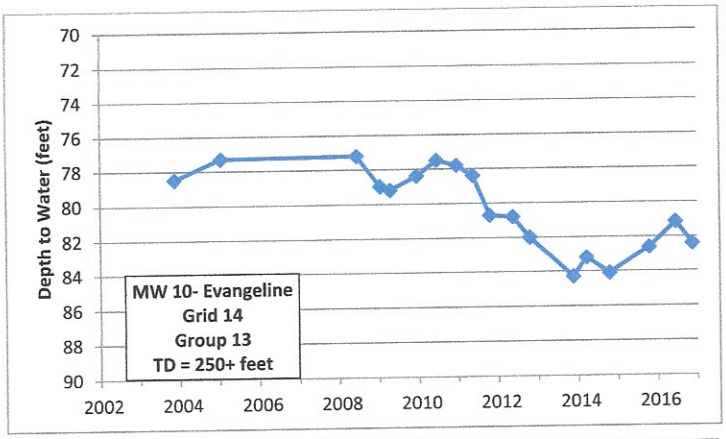

Depth to Water (feet)
20
25
30
35
40
45
50
55
60
65
70
2002
2004
2006
2008
2010
2012
2014
2016
MW 110- Evangeline
Grid 5
Group 12
TD = 118 feet

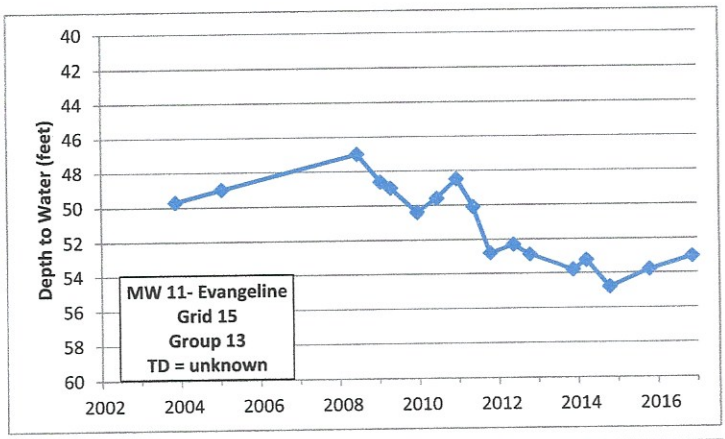

Depth to Water (feet)
10
15
20
25
30
35
40
45
50
55
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 111- Evangeline
Grid 14
Group 12
TD = 150 feet

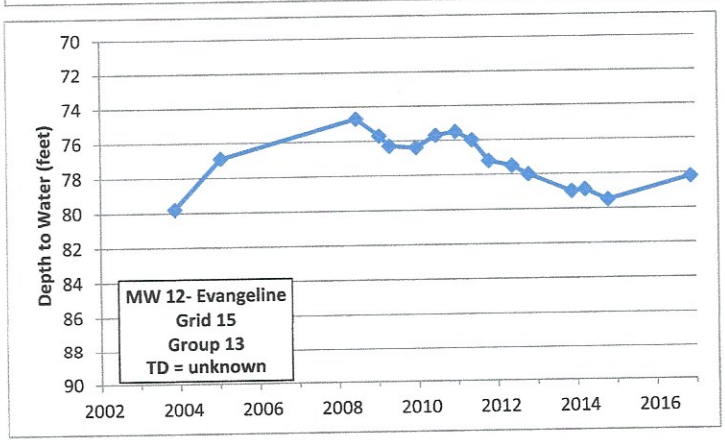

Depth to Water (feet)
30
35
40
45
50
55
60
65
70
75
80
2002
2004
2006
2008
2010
2012
2014
2016
MW 112- Evangeline
Grid 14
Group 12
TD = 80 feet

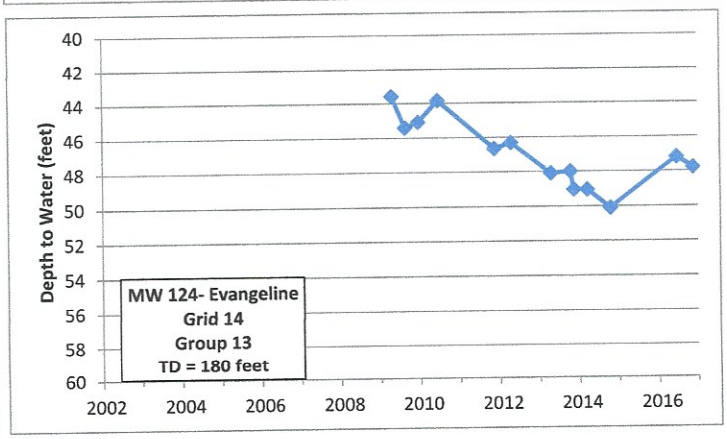

Depth to Water (feet)
40
45
50
55
60
65
70
75
80
85
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 149- Evangeline
Grid 5
Group 12
TD = 143 feet

Group 13 Hydrographs

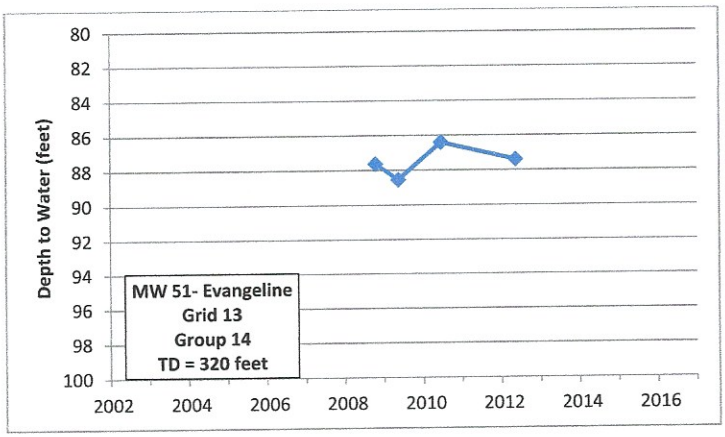

Depth to Water (feet)
70
72
74
76
78
80
82
84
86
88
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 10- Evangeline
Grid 14
Group 13
TD = 250+ feet

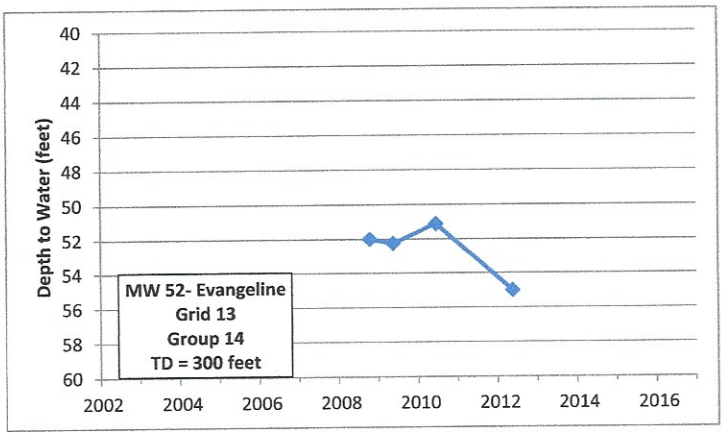

Depth to Water (feet)
40
42
44
46
48
50
52
54
56
58
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 11- Evangeline
Grid 15
Group 13
TD = unknown


Depth to Water (feet)
70
72
74
76
78
80
82
84
86
88
90
2002
2004
2006
2008
2010
2012
2014
2016
MW 12- Evangeline
Grid 15
Group 13
TD = unknown


Depth to Water (feet)
40
42
44
46
48
50
52
54
56
58
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 124- Evangeline
Grid 14
Group 13
TD = 180 feet

Group 14 Hydrographs


Depth to Water (feet)
80
82
84
86
88
90
92
94
96
98
100
2002
2004
2006
2008
2010
2012
2014
2016
MW 51- Evangeline
Grid 13
Group 14
TD = 320 feet


Depth to Water (feet)
40
42
44
46
48
50
52
54
56
58
60
2002
2004
2006
2008
2010
2012
2014
2016
MW 52- Evangeline
Grid 13
Group 14
TD = 300 feet