Advanced Groundwater Solutions, LLC
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Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Hydrogeologic Review of Transport Permit Applications for Mr. James Brien, Cula d'Brazos LLC, Ely Family Partnership LP, Fazzino Investments LP, RH2O LLC, Mr. Clifford A. Skiles III, and L. Wiese Moore LLC

DATE: May 24, 2024

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the hydrogeological information provided in Attachment C (Supplemental information for Section IV – Plans) of the March 2024 Transport Permit Applications prepared by Thornhill Group, Inc. (TGI) in support of the transport of groundwater from BVGCD wells permitted in the Simsboro Aquifer. Seven collective landowners hold operating permits with a combined total maximum production of 57,718 acre-feet per year (ac-ft/yr) from the Simsboro Aquifer. The seven landowners have entered option agreements with Upwell Well Brazos Valley Farm LLC (UWBVF) and UWBVF intends to transport the groundwater outside of the District.

UWBVF holds an existing BVGCD transport permit (BVTP-001) and related production permits in the amount of 49,999 ac-ft/yr from its Goodland Farms property. The seven current transport permit applications are part of the UWBVF project and have a combined maximum total production of 57,718 ac-ft/yr. The aggregated total groundwater authorized for transport out of BVGCD shall be limited to 100,000 ac-ft/yr from all BVGCD authorized wells. Attachment C from the March 2024 Transport Permit Applications prepared by TGI indicates that it is anticipated that the transported groundwater will likely be primarily to the City of Georgetown in Williamson County.

The seven transport permit applications prepared by TGI include an identical discussion of all items related to BVGCD Rule 10.3 in Attachment C, with the exception of BVGCD Rule 10.3(b). The applications focused on the Rule 10.3(b) discussion on each of the individual transport permit applicant's permitted Simsboro wells.

AGS has evaluated the technical aspects discussed in Attachment C of each of the submitted transport permit applications and also performed groundwater flow model simulations to assess the cumulative pumping effects of the aggregate transport pumping using the Texas Water Development Board (TWDB) Central Carrizo-Wilcox Groundwater Availability Model (GAM).

March 2024 Transport Permit Applications

The seven applicants with permitted wells in transport permit applications include the following well permit holders: Mr. James Brien, Cula d'Brazos LLC, Ely Family Partnership LP, Fazzino Investments LP, RH2O LLC, Mr. Clifford A. Skiles III and L. Wiese Moore LLC. Figure 1 shows the location of the UWBVF wells that are a part of the existing transport permit (BVTP-001) and the permitted wells in the transport permit applications.

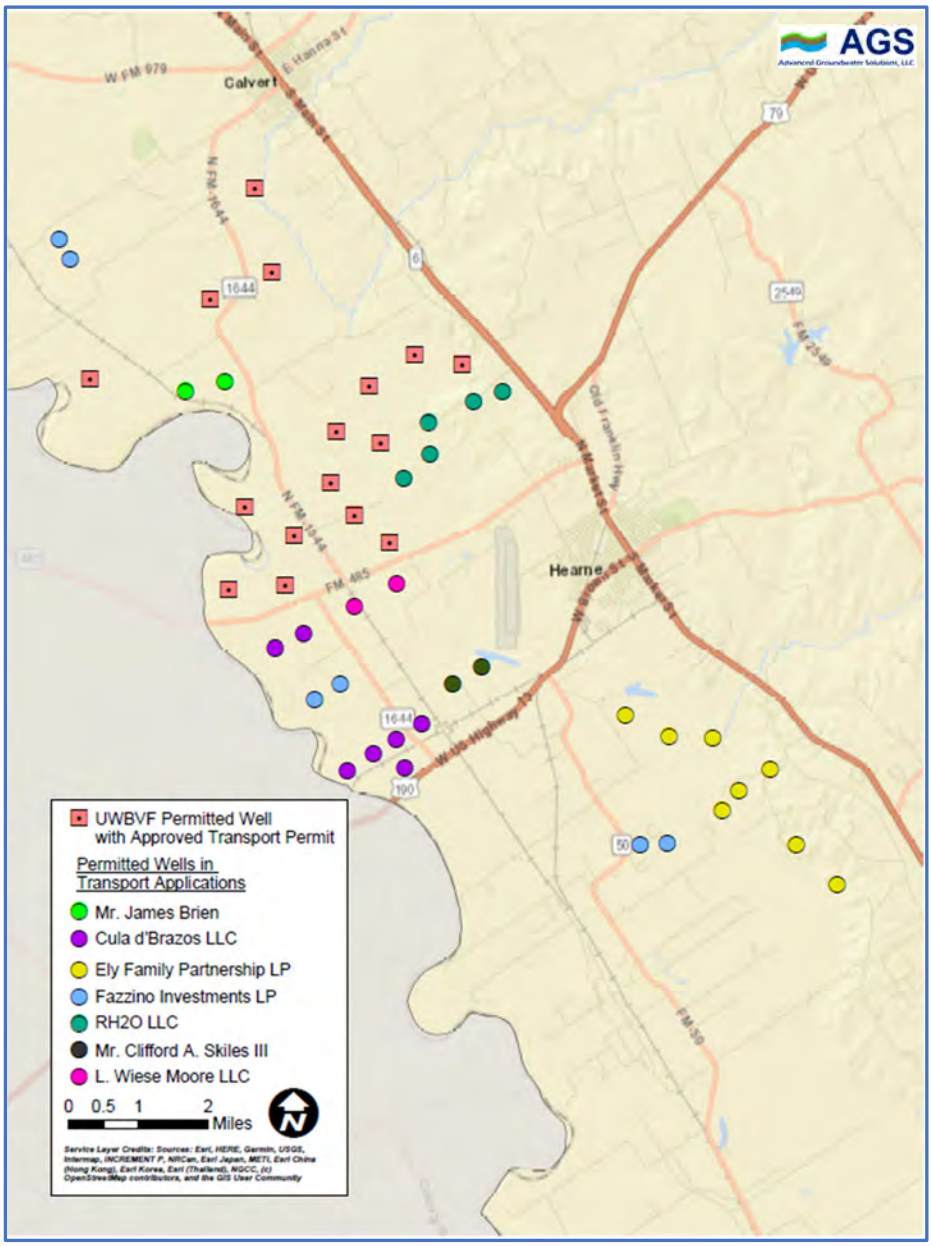


Figure 1. Location map of BVGCD permitted wells in the existing transport permit (BVTP-001) and the BVGCD permitted wells that are in the transport application.

Most of the permitted Simsboro wells that are in the transport permit applications were approved by BVGCD in 2023. Table 1 provides the BVGCD permit holder, well number, BVGCD permit number and the maximum annual production for each permitted well that is in the transport applications.

Table 1. BVGCD permitted wells that are in the transport applications.

BVGCD Permit Holder	Well Number	BVGCD Permit Number	Maximum Annual Production (ac-ft/yr)
Mr. James Brien	Well 2	BVDO-0315	2,186
Mr. James Brien	Well 3	BVDO-0316	1,929
Cula d'Brazos LLC	Well 1	BVDO-0408	2,839
Cula d'Brazos LLC	Well 2	BVDO-0409	2,968
Cula d'Brazos LLC	Well 3	BVDO-0410	1,290
Cula d'Brazos LLC	Well 4	BVDO-0411	1,226
Cula d'Brazos LLC	Well 5	BVDO-0412	1,161
Cula d'Brazos LLC	Well 6	BVDO-0413	1,161
Cula d'Brazos LLC	Well 7	BVDO-0414	1,355
Ely Family Partnership LP	Well 1	BVDO-0377	1,484
Ely Family Partnership LP	Well 2	BVDO-0378	2,581
Ely Family Partnership LP	Well 3	BVDO-0379	1,097
Ely Family Partnership LP	Well 4	BVDO-0380	2,065
Ely Family Partnership LP	Well 5	BVDO-0381	1,419
Ely Family Partnership LP	Well 6	BVDO-0382	2,065
Ely Family Partnership LP	Well 7	BVDO-0383	1,807
Ely Family Partnership LP	Well 8	BVDO-0384	1,355
Fazzino Investments LP	Well 1	BVDO-0394	1,290
Fazzino Investments LP	Well 2	BVDO-0395	1,290
Fazzino Investments LP	Well 3	BVDO-0396	2,710
Fazzino Investments LP	Well 4	BVDO-0397	2,710
Fazzino Investments LP	Well 5	BVDO-0398	1,187
Fazzino Investments LP	Well 6	BVDO-0399	1,161
RH2O LLC	Well 1	BVDO-0385	1,678
RH2O LLC	Well 2	BVDO-0386	2,194
RH2O LLC	Well 3	BVDO-0387	1,742
RH2O LLC	Well 4	BVDO-0388	1,484
RH2O LLC	Well 5	BVDO-0389	1,032
Mr. Clifford A. Skiles III	Well 1	BVDO-0108	2,700
Mr. Clifford A. Skiles III	Well 2	BVDO-0317	2,100
L. Wiese Moore LLC	Well 1	BVDO-0401	2,000
L. Wiese Moore LLC	Well 2	BVDO-0402	2,452

Availability of Water in the Brazos Valley Groundwater Conservation District and Proposed Receiving Area

Rule 10.3(a)(1-3)

The transport permit applications provide a discussion of the BVGCD management plan and Brazos G regional water plan related to groundwater availability in Robertson County. AGS reviewed the discussion of groundwater availability in Robertson County in the application based on the BVGCD management plan and Brazos G regional water plan and found no errors in the values discussed.

The applications do not discuss the groundwater availability in Brazos County. Robertson and Brazos Counties are included in the same groundwater conservation district and pumping of groundwater in each county directly affects groundwater conditions of the other county. BVGCD's current adopted desired future condition (DFC) for the Simsboro Aquifer is 262 feet of drawdown from 2000 to 2070 and the BVGCD DFCs are based on aquifer drawdown in Brazos and Robertson Counties.

Rule 10.3(a)(1): location of the proposed receiving area for the water to be transported.

Attachment C of the transport permit application describes the City of Georgetown's reservation agreement with EPCOR to negotiate a water supply agreement for Georgetown to import between 39,399 and 70,000 ac-ft/yr from Robertson County. UWBVF has entered into an agreement with EPCOR.

According to the transport permit applications, there is potential for other municipalities, public water suppliers or other end users Williamson County, Bell County, Milam County, and Travis County to participate in this regional project. The applications note that advanced stage negotiations with a second municipality in Williamson County are ongoing.

Attachment C Appendix A of the transport permit application includes a map showing the producing area, which includes the locations of the wells that are part of the existing UWBVF transport permit and the permitted wells that are in the transport applications. Milam, Williamson, Travis and Bell counties are identified as counties of interest on this figure. Attachment C Appendix C of the transport permit application includes a map showing the producing area including well locations as described above, the counties of interest, and also highlights the City of Georgetown CCN.

Rule 10.3(a)(2): information describing alternate sources of supply that might be utilized by the applicant and the groundwater user, and the feasibility and practicability of utilizing such supplies.

As noted in Attachment C of the transport permit application no alternative source of water is available to each applicant that would allow participation in UWBVF's groundwater project.

The City of Georgetown's Integrated Water Resource Plan (IWRP) indicates that Georgetown will continue its conjunctive use of local groundwater and surface water available from the Brazos

River Authority (BRA) and that other water supply strategies including conservation and water reclamation will be implemented.

The transport permit application indicates that current planning documents demonstrate water needs so substantial that the likely end users of transported Robertson County groundwater have explored multiple alternative water source strategies.

The transport permit applications describe groundwater alternatives for Williamson County and the City of Georgetown that include: 1) the Brazos River Alluvium in Milam and Robertson counties; 2) Simsboro groundwater from an adjacent county. No additional alternative sources of supply for likely potential end users were discussed.

Rule 10.3(a)(3): description of the amount and purpose of use in the proposed receiving area for which water is needed.

Based on the City of Georgetown IWRP, the City of Georgetown will have a gap of up to 99,000 acre-feet/year by 2070 between its existing available supply and future water demands.

The application includes a discussion on projected water shortages in Williamson, Bell and Travis counties due to population growth and water demand based on the Brazos G and Region K regional water plan. The application also references water demand increases in Milam County.

The application states in Attachment C: *'the end users in the receiving area will use the water for beneficial uses which will primarily include municipal or public water supply but uses could also include any other beneficial use as defined by Chapter 36 of the Texas Water Code including industrial/manufacturing, irrigation, recreational uses, and others.'*

Projected Effect of the Proposed Groundwater Transport on Aquifer Conditions

BVGCD Rule 10.3(b): the projected effect of the proposed groundwater transport on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District, including the Rule 8.4 information and studies and any proposed plan of the applicant to mitigate adverse hydrogeological impacts of the proposed transport of water from the District.

The application focused the groundwater modeling simulations and discussion on each of the individual transport permit applicant's permitted Simsboro Aquifer wells. At the request of BVGCD, the application discussed two simulations that included pumping based on S-19 plus 75,941 ac-ft/yr and S-19 plus 99,924 ac-ft/yr in the DFC discussions.

AGS reviewed the GAM and analytical modeling simulations presented in each transport permit application. Our discussion of the review of the TGI modeling simulations are included in Appendix A.

AGS Groundwater Modeling Simulations

In order to assess "the projected effect of the proposed groundwater transport on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District", the District asked AGS to use the TWDB GAM to assess the impacts of the volumes requested by the transport permit application. The District also requested that the GAM be updated to incorporate a more refined understanding of the location of a fault north of Calvert. In addition, the DFC pumping file (S-19) was updated to reflect the most recent future demand projections for municipal entities in the District. These two changes are described in more detail below.

Calvert Area Fault Update

Using available geophysical logs and water level data, Ground Water Consultants LLC and AGS have been refining the location of a fault that is located north of the City of Calvert. There is a slight offset between the fault as shown in version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM and the fault mapped using geophysical logs. The fault has been shifted slightly to the northwest by one or two model cells based on the geophysical log data. Figure 2 shows the GAM Version 3.02 fault location (red line) and the updated fault location (blue dashed line). A part of the fault that is located immediately to the north and west of Calvert from about Highway 6 back towards the southwest was not adjusted. This is shown by the overlapping red and blue dash lines on Figure 2. AGS updated the location of these faults in Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020).

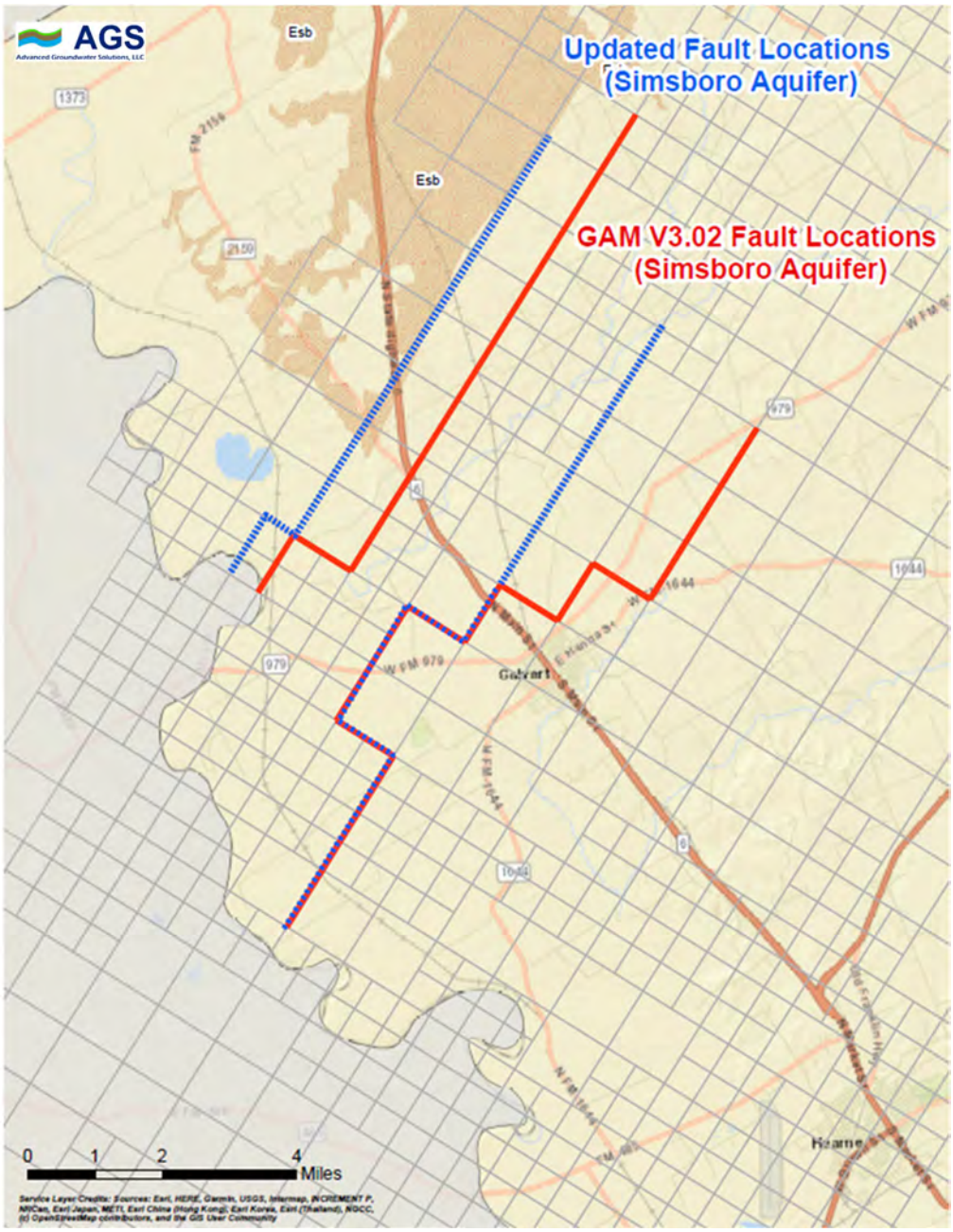


Figure 2. Original and modified location of the modeled faults in Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM.

S-19 Well File Modification / S-19G3 Well File Development

The District requested that AGS update the S-19 well file to incorporate the best available science and data. This scenario is referred to as S-19G3. These modifications included three updates, including 1) updated historic pumping based on metered volumes, 2) updated municipal demands in the District based on the 2022 State Water Plan, and 3) changes to pumping assumptions in the Vista Ridge project located in Post Oak Savannah GCD.

The District has been collecting pumping information from installed meters on permitted wells for several years. This data was used to adjust historic and future pumping for irrigation near the UWBVF project area. The development of the S-19 well file predates UWBVF and S-19 includes an anticipated ramp up to the maximum permitted production from 2020 to 2070. The S-19G3 pumping modifications include distributing a total of 5,000 ac-ft/yr between the 12 existing UWBVF agricultural wells starting in 2011. This pumping is held constant through 2070, with the exception of 2023. The basis for this adjustment is 2022 and 2023 metered water production from the 12 UWBVF agricultural wells. All other UWBVF permitted production from the Simsboro Aquifer is set to 0 through 2070. This effectively removes additional UWBVF pumping from S-19 and establishes a base run for the UWBVF production associated with the transport pumping.

The 2070 municipal water demands for Brazos and Robertson Counties included in the 2022 State Water Plan were reviewed and compared to the current maximum permitted groundwater production of each municipality. The current permitted groundwater production represents the maximum permitted groundwater available for each municipality. If the current permits held by each municipality are equal to or greater than the 2070 water demand from the 2022 State Water Plan, the production in S-19G3 ramps up to the total permitted production from 2029 to 2070. If the current permits held by each municipality are less than the 2070 water demand from the 2022 State Water Plan, the production in S-19G3 ramps up to the total permitted production from 2029 to 2060 and is held constant through 2070. Simsboro Aquifer permits held by municipalities that were issued after the development of S-19 are included in S-19G3 with pumping starting in 2029.

Pumping adjustments to S-19 were made to the Carrizo and Simsboro Aquifers for the Vista Ridge Project to reflect the current operation of the wellfield. Pumping was added to the Simsboro Aquifer to bring the total combined Vista Ridge production to 50,000 ac-ft/yr from 2022 to 2070. Additional pumping adjustments were made to the Carrizo and Simsboro Aquifers starting in 2024 to reflect the current pumping conditions in the Vista Ridge wellfield, with Carrizo pumping reduced from 15,000 ac-ft/yr to 9,100 ac-ft/yr and the Simsboro pumping increased from 35,000 ac-ft/yr to 41,000 ac-ft/yr.

Transport Application Scenarios completed by AGS

Based on guidance from District staff, AGS developed three pumping scenarios to assess the transport permit application. S-19G3 served as the base run for each of the three scenarios.

S-19G3 + 50k

The S-19G3 + 50,000 ac-ft/yr (50k) scenario adds an additional 50,000 ac-ft/yr to the Simsboro Aquifer in S-19G3 that is distributed evenly between the UWBVF wells that are a part of an existing transport permit (BVTP-001). The additional 50,000 ac-ft/yr of pumping is added in 2029 and is held constant through 2070. Locations of the UWBVF wells that are a part of the existing transport permit are shown on Figure 1 and Table 2 provides the UWBVF well number, BVGCD permit number and maximum annual production for each of these wells.

Table 2. UWBVF wells that are part of an existing transport permit (BVTP-001).

BVGCD Permit Holder	Well Number	BVGCD Permit Number	Maximum Annual Production (ac-ft/yr)
UW Brazos Valley Farm, LLC	CS1	BVDO-0254	4,839
UW Brazos Valley Farm, LLC	CS2	BVDO-0255	5,322
UW Brazos Valley Farm, LLC	CS3	BVDO-0256	5,322
UW Brazos Valley Farm, LLC	Well B	BVDO-0292	4,068
UW Brazos Valley Farm, LLC	Well C	BVDO-0293	2,001
UW Brazos Valley Farm, LLC	Well G	BVDO-0294	2,776
UW Brazos Valley Farm, LLC	PS1	BVDO-0295	3,164
UW Brazos Valley Farm, LLC	PS2	BVDO-0296	1,937
UW Brazos Valley Farm, LLC	PS3	BVDO-0297	3,099
UW Brazos Valley Farm, LLC	PS4	BVDO-0298	2,905
UW Brazos Valley Farm, LLC	PS5	BVDO-0299	1,937
UW Brazos Valley Farm, LLC	PS6	BVDO-0300	2,195
UW Brazos Valley Farm, LLC	PS8	BVDO-0301	2,260
UW Brazos Valley Farm, LLC	PS9	BVDO-0302	3,680
UW Brazos Valley Farm, LLC	PS10	BVDO-0303	1,937
UW Brazos Valley Farm, LLC	PS11	BVDO-0304	2,557

S-19 + 75k

The S-19G3 + 75,000 ac-ft/yr (75k) simulation adds an additional 75,000 ac-ft/yr to the Simsboro Aquifer in S-19G3 that is distributed evenly between the UWBVF wells that are a part of the existing transport permit (BVTP-001) and the permitted wells in the transport permit applications. The additional 75,000 ac-ft/yr of pumping is added to S-19G3 in 2029 and is held constant through 2070. The locations of the UWBVF wells that are a part of the existing transport permit and the permitted wells in the transport permit applications are shown on Figure 1. Tables 1 and 2 provide the permit holder, permit holder's well number well number, BVGCD permit number and maximum annual production for each permitted well.

S-19 + 100k

The S-19G3 + 100,000 ac-ft/yr (100k) simulation adds an additional 100,000 ac-ft/yr to the Simsboro Aquifer in S-19G3 that is distributed evenly between the UWBVF wells that are a part of the existing transport permit and the permitted wells in the transport permit applications. The additional 100,000 ac-ft/yr of pumping is added to S-19G3 in 2029 and is held constant through 2070. The locations of the UWBVF wells that are a part of the existing transport permit and the permitted wells in the transport permit applications are shown on Figure 1. Tables 1 and 2 provide the permit holder, permit holder's well number well number, BVGCD permit number and maximum annual production for each permitted well.

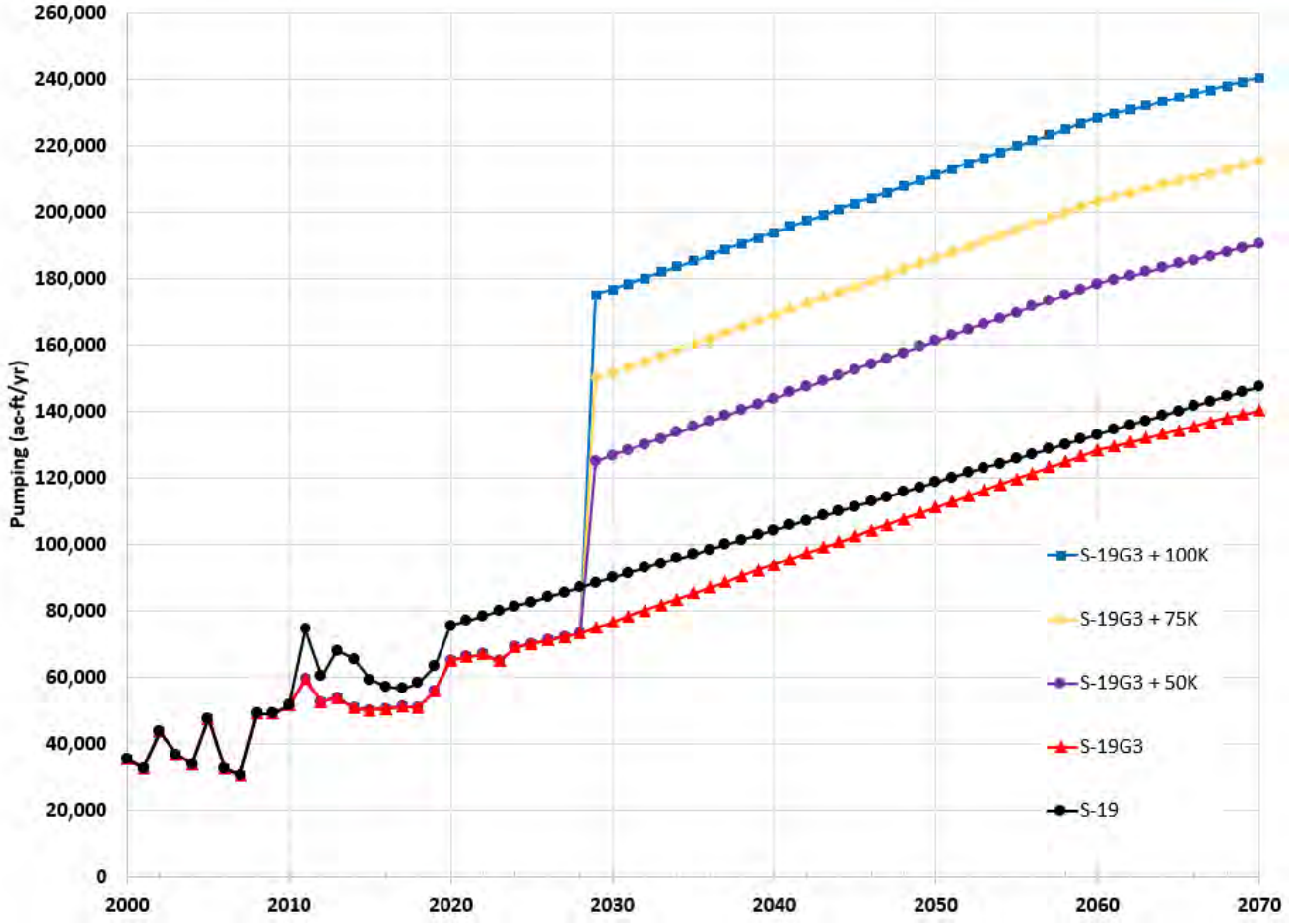


Figure 3. Comparison of the Simsboro Aquifer pumping through time for the transport pumping simulations completed by AGS.

Figure 3 shows a plot of the Simsboro Aquifer pumping from S-19, S-19G3 and the three transport runs, S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k. The first difference in S-19 and S-19G3 pumping occurs in 2011 and then another change in S-19G3 occurs in 2029 with the additional pumping for the transport runs being added to S-19G3 starting in 2029.

Modeling Results of Transport Application Scenarios – Isolated Pumping Effects

AGS isolated the pumping effects in the Simsboro Aquifer for each of the three transport scenarios described above. For each of the isolation runs, two GAM simulations were completed with the first simulation (the baseline run) using the S-19G3 well file for the run and with the second simulation (the modified 'S-19G3 plus' run) being identical to the baseline except that the estimated transport pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the S-19G3 baseline run from the modified 'S-19G3 plus' run. The simulations performed to isolate the transport pumping effects consider a 30-year pumping period (2029-2059), which

approximates a 30-year permit term. Figures 4, 5 and 6 show the AGS simulated 30-year isolated effects of pumping 50,000 ac-ft/yr, 75,000 ac-ft/yr and 100,000 ac-ft/yr, respectively.

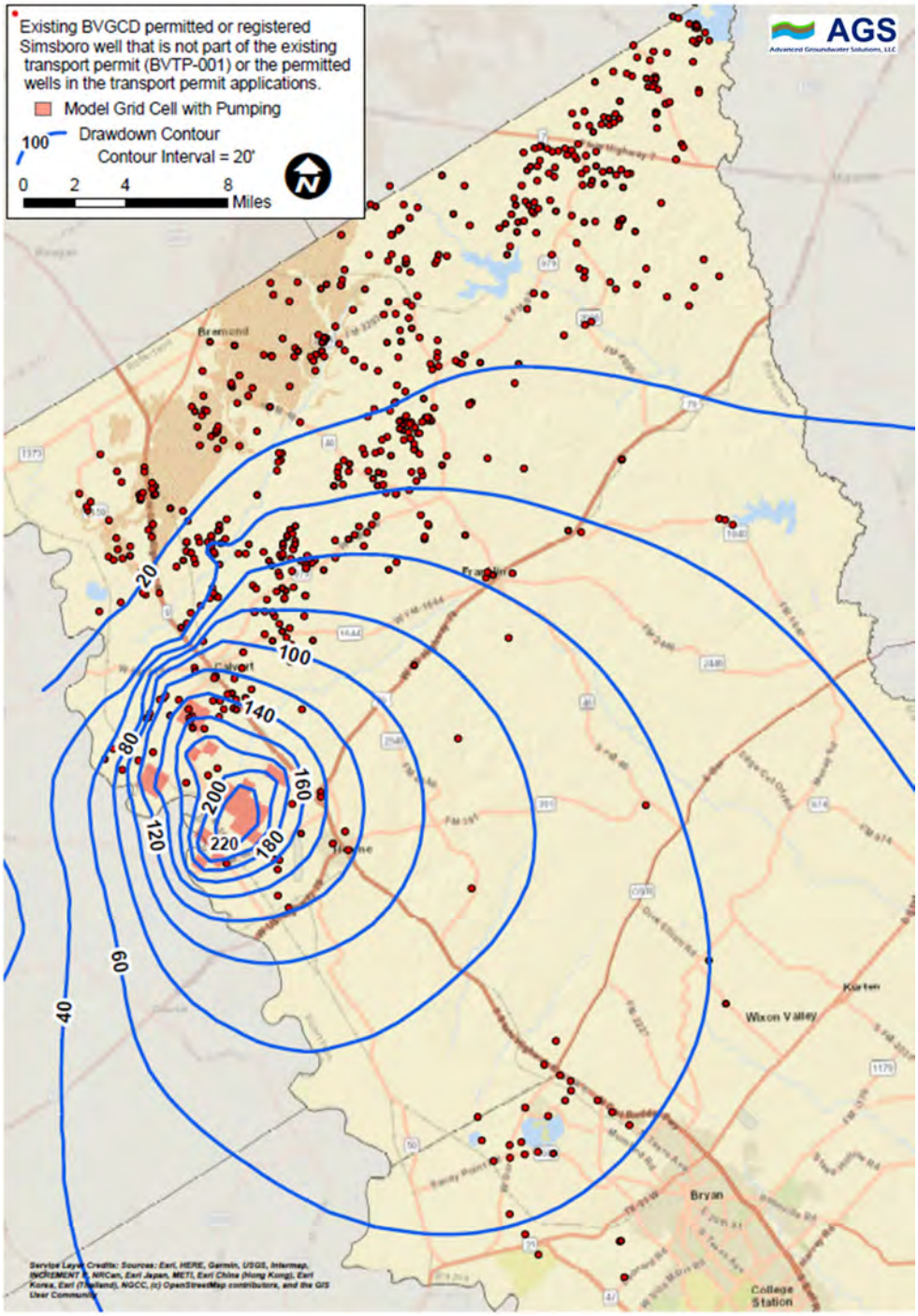


Figure 4. AGS simulated Simsboro drawdown in 2059 from 50,000 ac-ft/yr scenario by UWBVF wells under existing transport permit (BVTP-001).

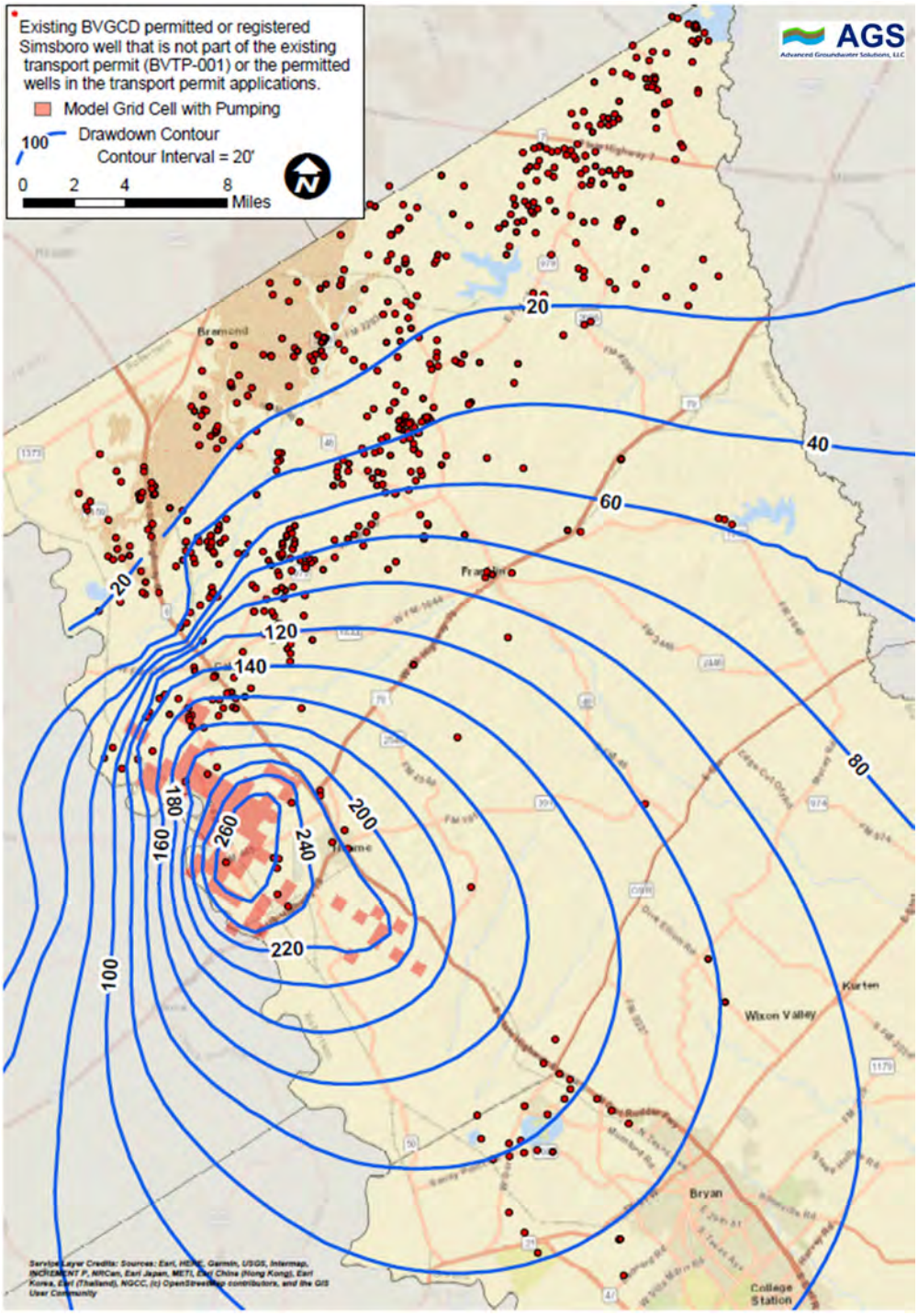


Figure 5. AGS simulated Simsboro drawdown in 2059 from 75,000 ac-ft/yr scenario by UWBVF wells under existing transport permit (BVTP-001) and the permitted wells in the transport permit applications.

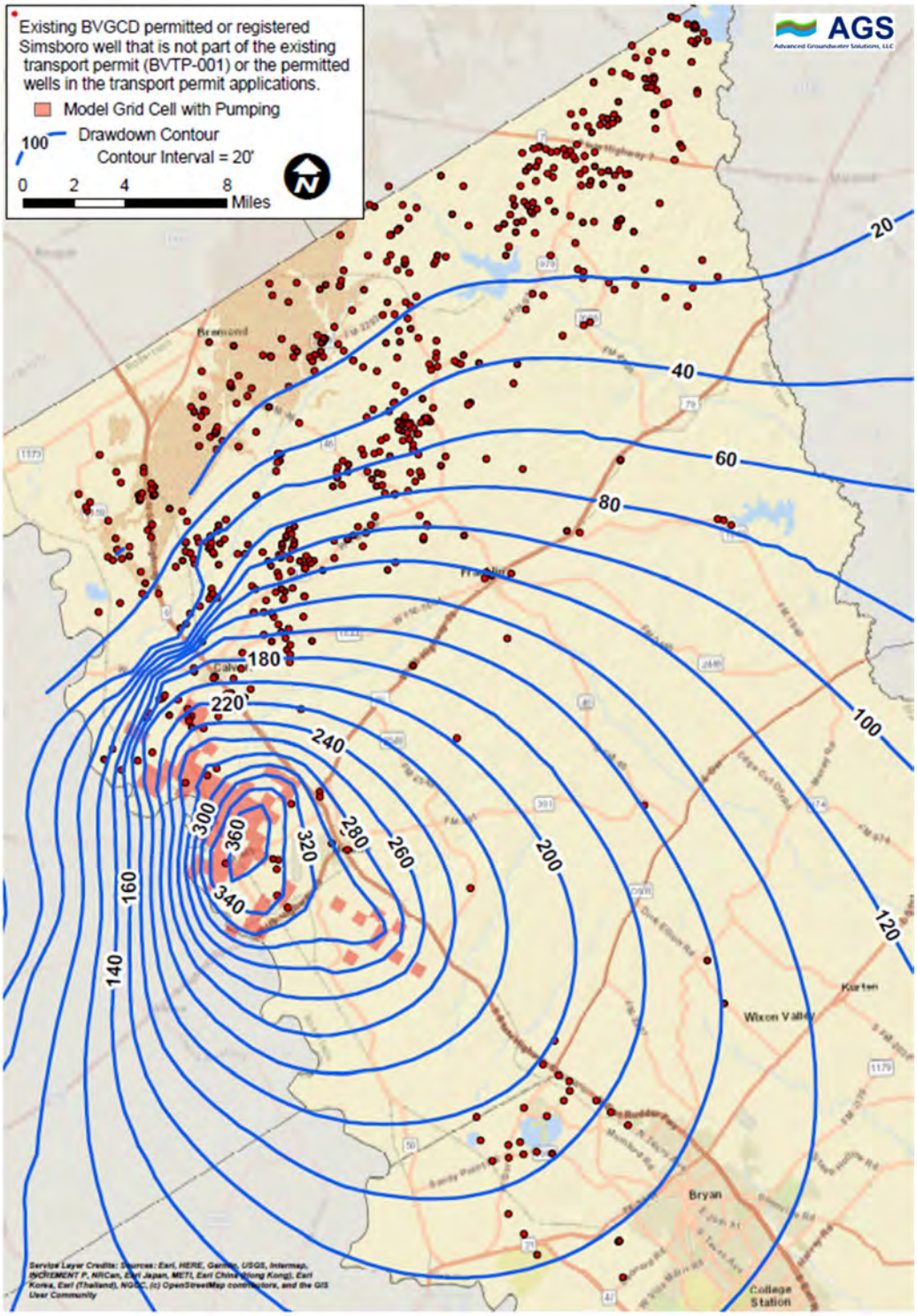


Figure 6. AGS simulated Simsboro drawdown in 2059 from 100,000 ac-ft/yr scenario by UWBVF wells under existing transport permit (BVTP-001) and the permitted wells in the transport permit applications.

The isolated pumping effects in the Simsboro Aquifer shown in Figures 4, 5 and 6 after pumping an additional 50,000 ac-ft/yr, 75,000 ac-ft/yr and 100,000 ac-ft/yr for 30-years, respectively, show increased drawdown near the UWBVF well locations and the locations of the permitted wells in the transport permit applications. The pumping effects radiate outward from the UWBVF area and decrease with distance from the UWBVF. The effects of the fault discussed early in this memorandum can be observed in the area to the north-northwest of Calvert as the drawdown difference contours appear to bunch together at south of the fault.

The points shown on Figures 4, 5 and 6 are existing BVGCD permitted and registered Simsboro wells that are not part of the existing transport permit or the permitted wells in the transport permit applications. There are approximately 612 BVGCD permitted and registered Simsboro wells that are included in this category. These wells will be discussed later in this memorandum.

AGS Transport Scenarios – Simulated Remaining Available Drawdown above the top of the Simsboro Aquifer

For each of the transport scenarios, AGS used the simulated water levels in the Simsboro Aquifer at 2059 to calculate the remaining available drawdown above the top of the Simsboro Aquifer at 2059. The year 2059 represents the end of the 30-year term for the transport permit applications. The available drawdown contours shown on Figures 7, 8 and 9 were estimated by subtracting water level elevation at 2059 estimated from the S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k simulations, respectively, from the top of the Simsboro Aquifer elevation as included in Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM.

The model simulations show that the simulated remaining available drawdown remains above the top of the Simsboro Aquifer in the three transport scenarios.

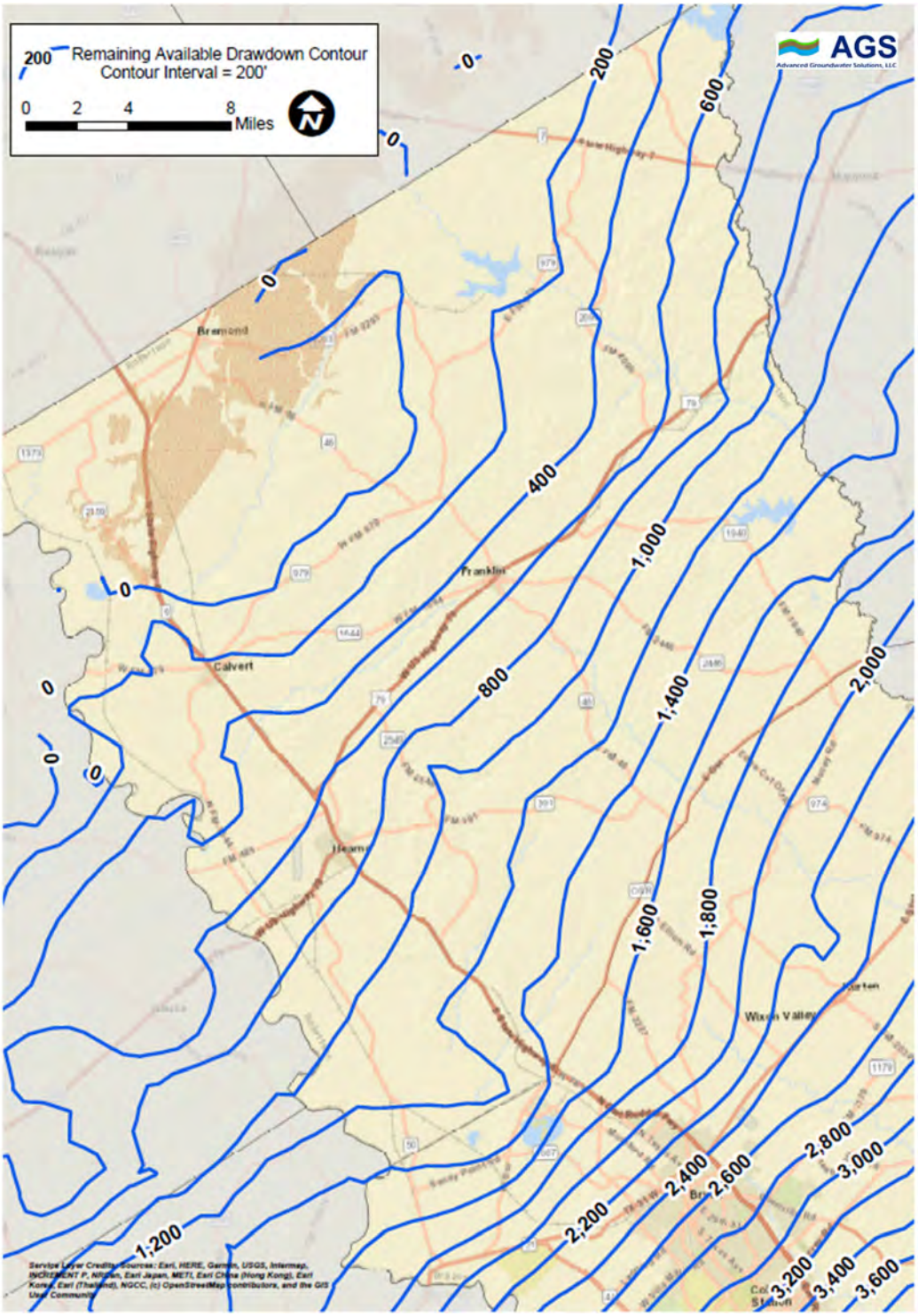


Figure 7. AGS simulated remaining available drawdown above the top of the Simsboro Aquifer in 2059 that results from the S-19G3 + 50,000 ac-ft/yr pumping scenario.

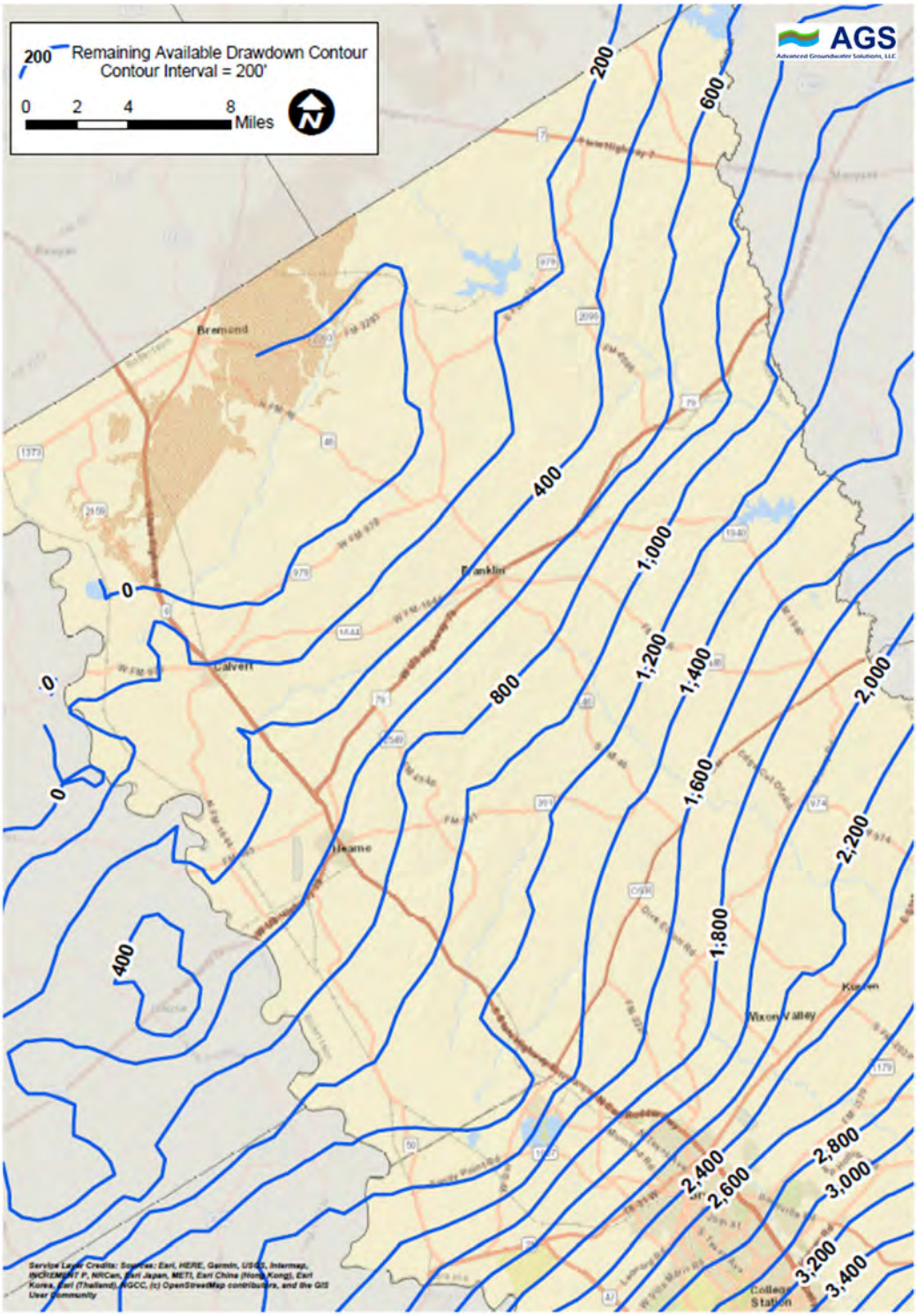


Figure 8. AGS simulated remaining available drawdown above the top of the Simsboro Aquifer in 2059 that results from the S-19G3 + 75,000 ac-ft/yr pumping scenario.

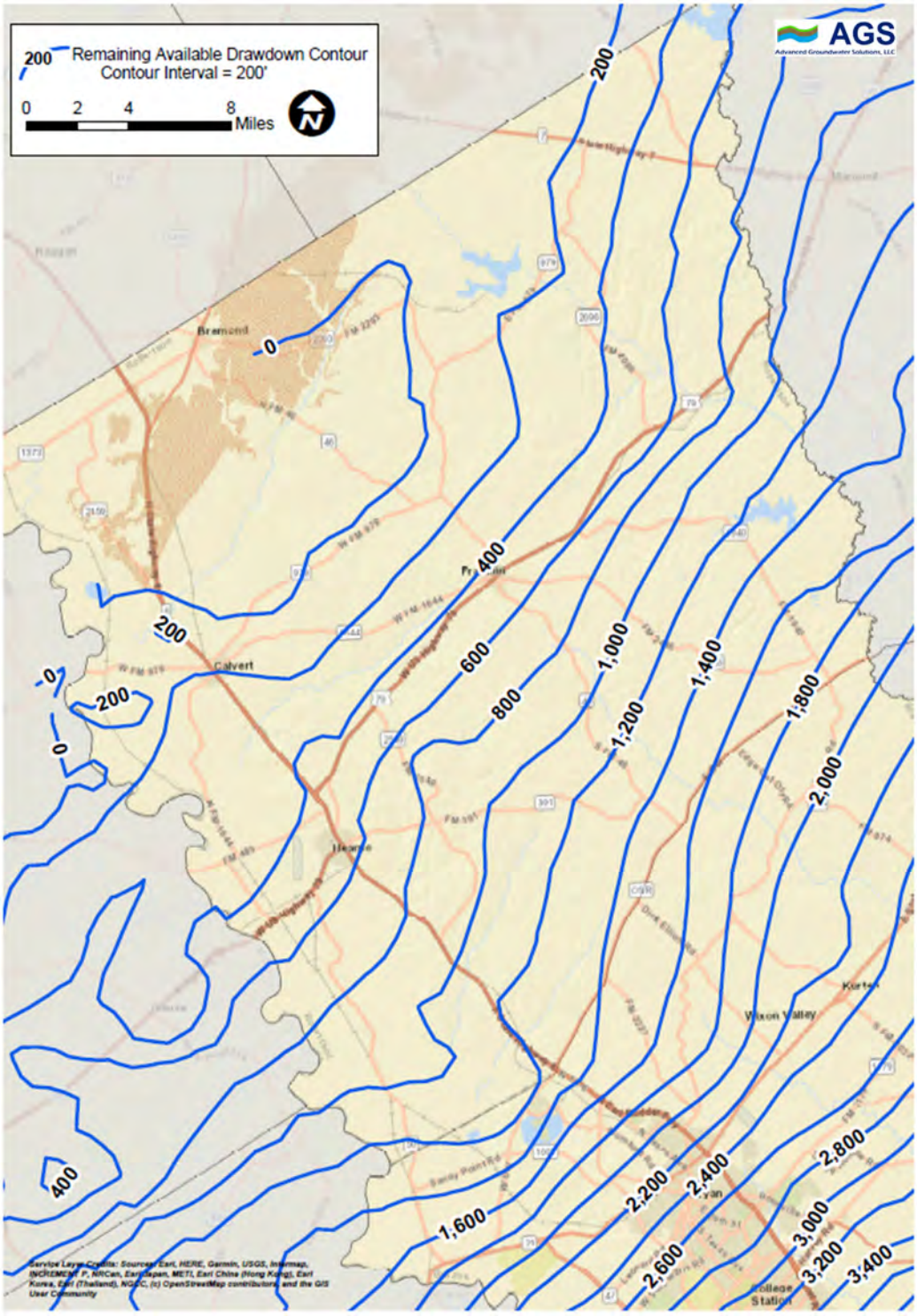


Figure 9. AGS simulated remaining available drawdown above the top of the Simsboro Aquifer in 2059 that results from the S-19G3 + 100,000 ac-ft/yr pumping scenario.

Effects of the Transport Pumping on Desired Future Conditions Adopted by Brazos Valley Groundwater Conservation District

AGS calculated estimates of the DFC drawdown from 2000 to 2070 that results from S-19, S-19G3, S-19G3 + 50,000 ac-ft/yr, S-19G3 + 75,000 ac-ft/yr and S-19G3 + 100,000 ac-ft/yr pumping scenarios. Figure 10 shows plots of the AGS simulated Simsboro Aquifer DFC drawdown (from 2000 to 2070) for each of the pumping scenarios outlined above. As pumping in the Simsboro increases in BVGCD, the drawdown at 2070 increases and the date at which the drawdown reaches the current Simsboro DFC of 262 feet occurs sooner. The S-19G3 + 50k scenario results in an estimated drawdown of about 332 feet in 2070 and reaches a drawdown value of 262 feet in 2050. The S-19G3 + 75k scenario results in an estimated drawdown of about 375 feet in 2070 and reaches a drawdown value of 262 feet in 2041. The S-19G3 + 100k scenario results in an estimated drawdown of about 408 feet in 2070 and reaches a drawdown value of 262 feet in 2036.

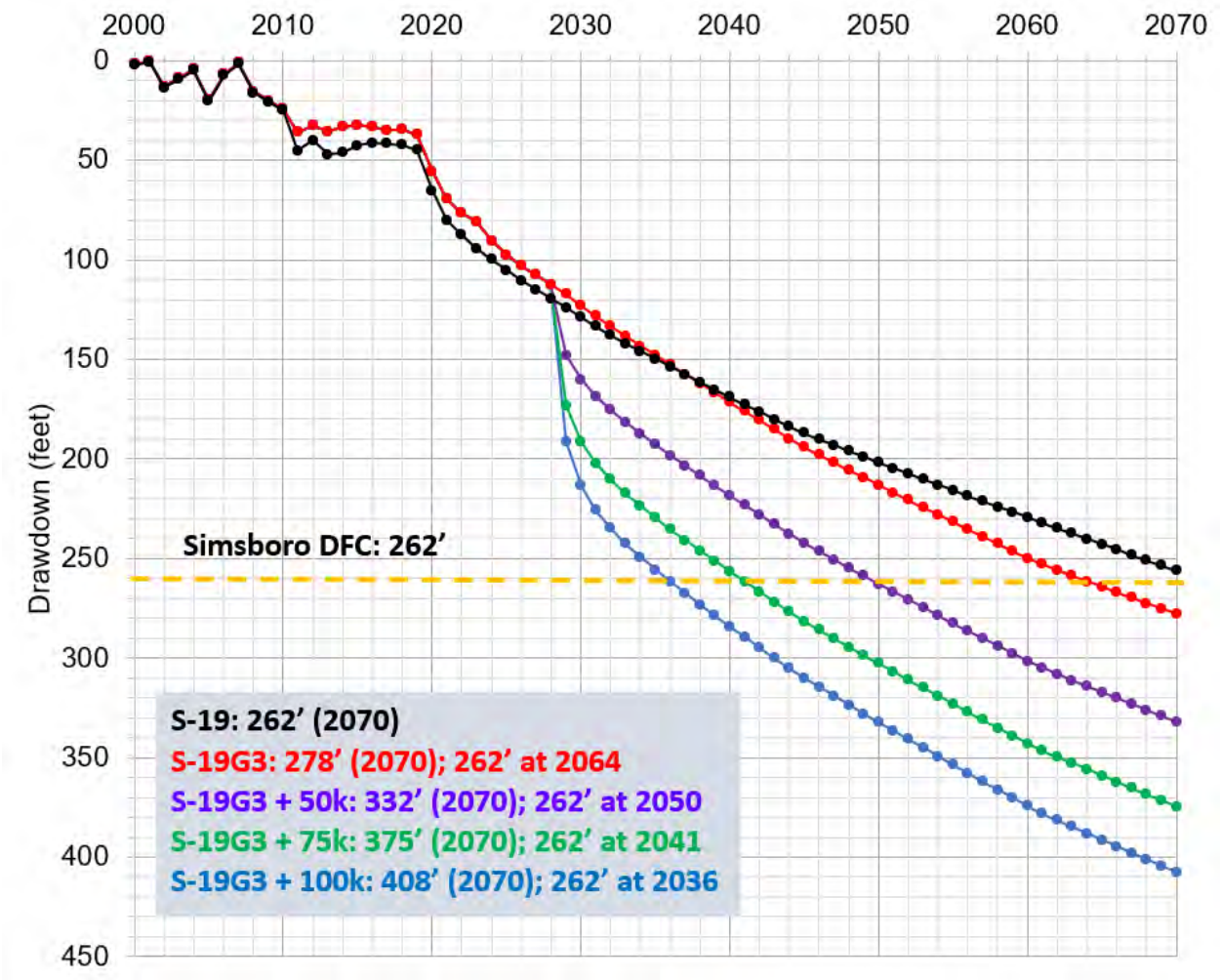


Figure 10. AGS simulated Simsboro Aquifer DFC drawdown (2000 – 2070).

Effects due to increases in the Simsboro Aquifer pumping can be observed in the BVGCD DFC drawdown (2000 to 2070) estimates in the Carrizo Aquifer, Calvert Bluff Formation and Hooper Formation as shown in Figures 11, 12 and 13, respectively. S-19G3 includes a slight decrease in the Carrizo pumping in the vicinity of the Vista Ridge project. However, most of the differences in the BVGCD DFC estimates in the Carrizo, Calvert Bluff and Hooper can be attributed to the increases in simulated Simboro Aquifer pumping. Simulated drawdown at 2070 increases and the date which the drawdown reaches the currently adopted aquifer DFC occurs sooner. Figures 11, 12 and 13 include text to indicate the simulated drawdowns at 2070 and the year at which the drawdown reaches the current DFC for each aquifer. Although not included herein, our review of the volumetric model budget indicates that increased leakage occurs from aquifers above and below the Simboro with increased pumping in the Simsboro.

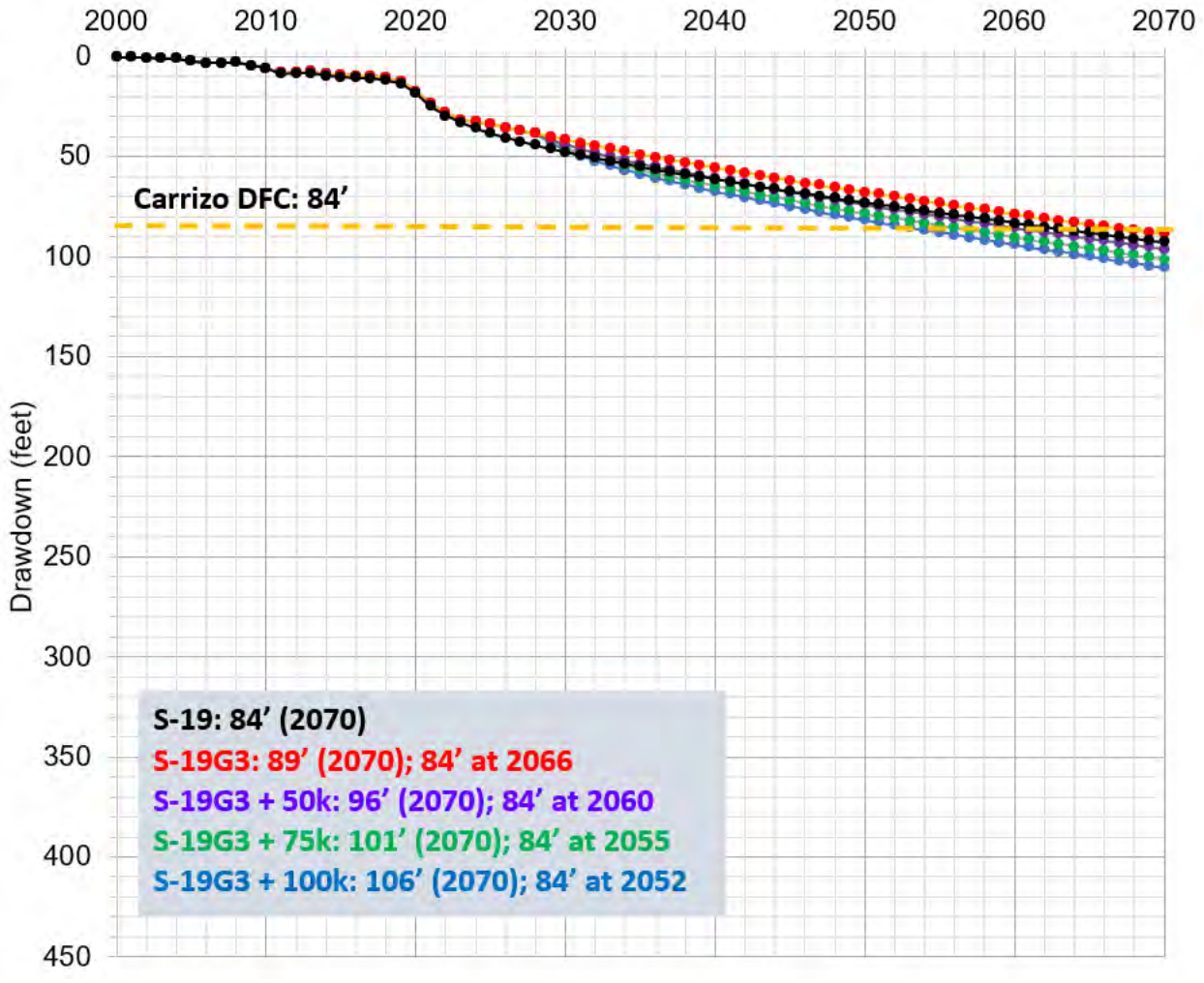


Figure 11. AGS simulated Carrizo Aquifer DFC drawdown (2000 – 2070).

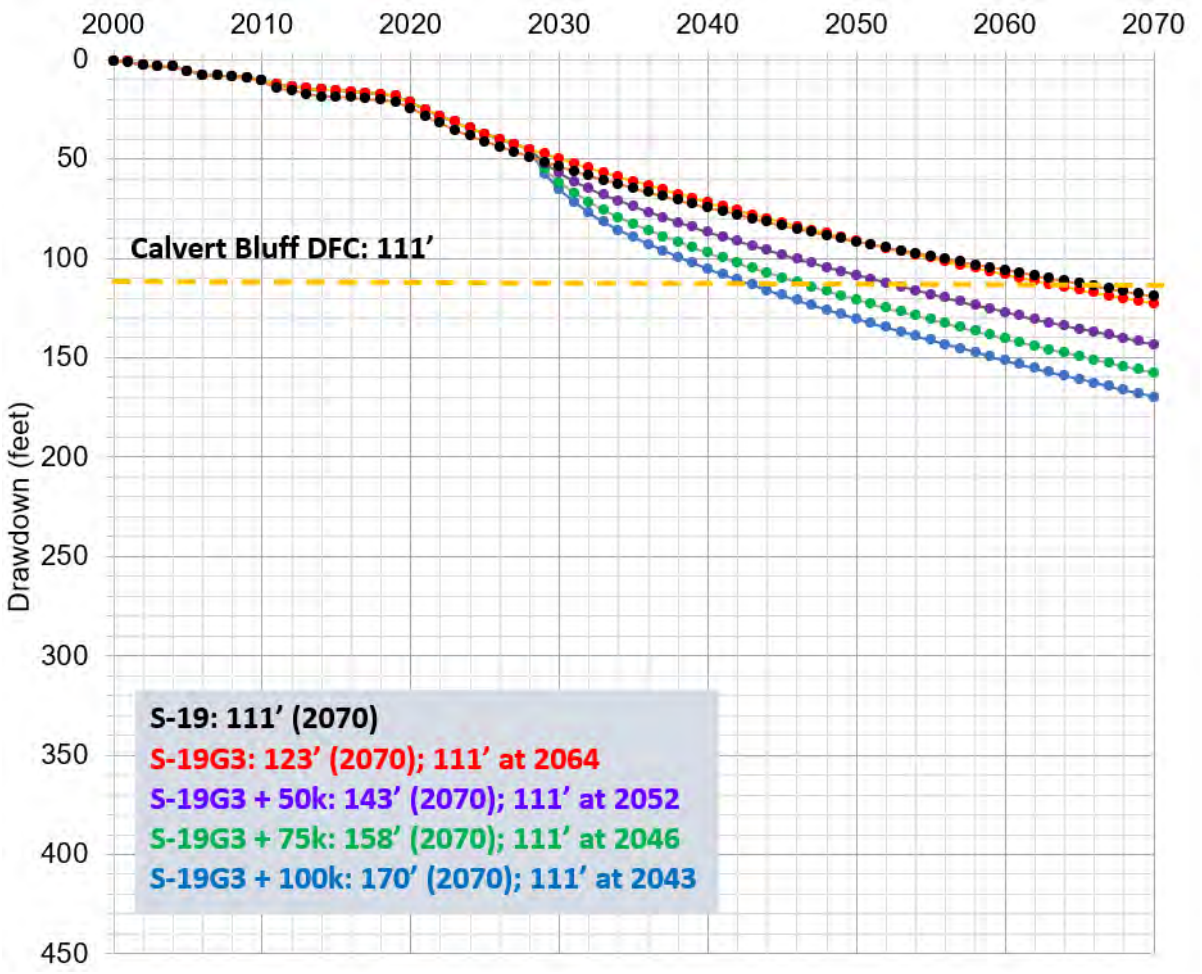


Figure 12. AGS simulated Calvert Bluff DFC drawdown (2000 – 2070).

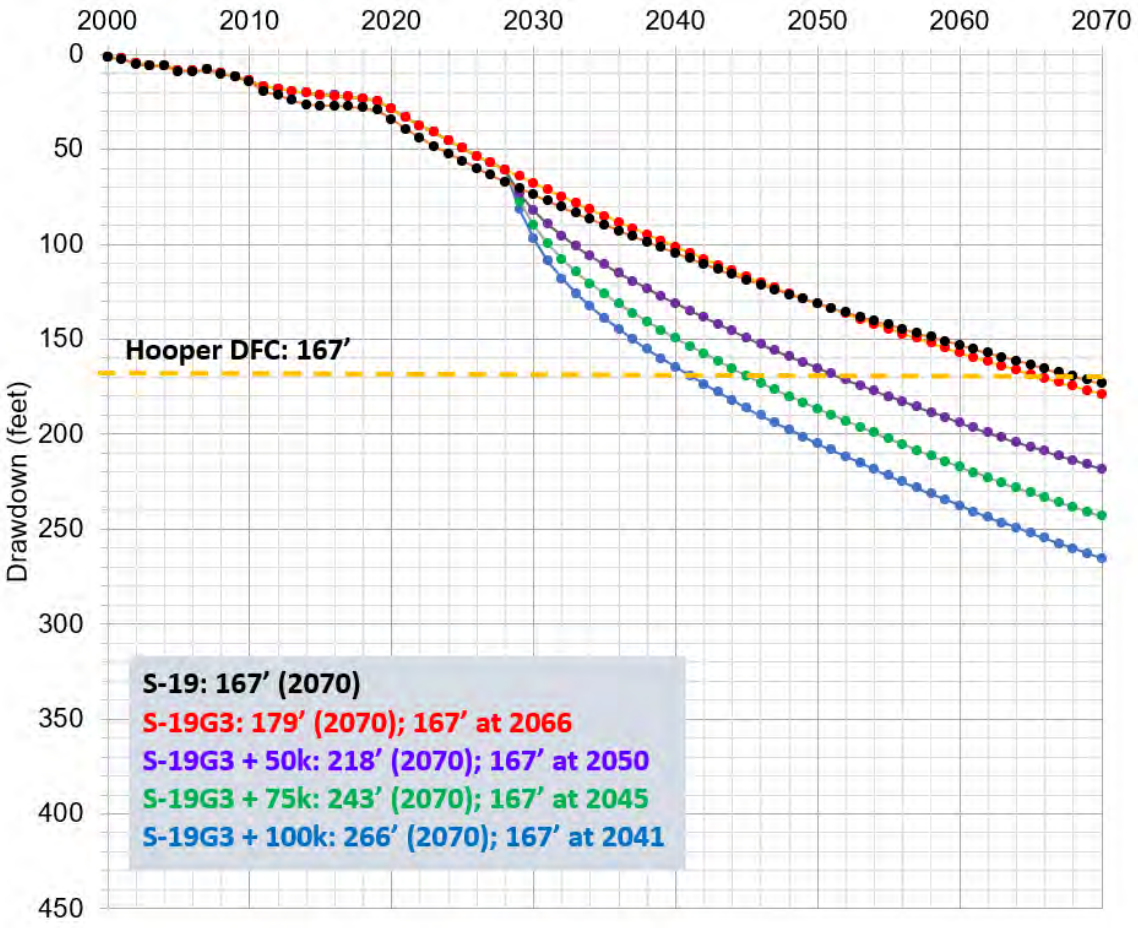


Figure 13. AGS simulated Hooper DFC drawdown (2000 – 2070).

Desired Future Conditions Analysis Contained in the Application

TGI conducted model simulations to compare pumping impacts to the currently established DFC of the Simsboro Aquifer within the boundaries of BVGCD. The application presented a table showing the average Simsboro drawdown in BVGCD between 2000 to 2070 based on the following pumping scenarios: S-19 (the most recent DFC Run approved by GMA 12); S-19 plus applicant's permitted pumping (example: L. Wiese Moore at 4,452 acre-ft/yr); S-19 plus 75,941 ac-ft/yr; S-19 plus 99,924 ac-ft/yr; and S-19 plus all permits.

The application estimates about 373 feet of drawdown in the Simsboro Aquifer in 2070 due to pumping from the S-19 plus 75,941 ac-ft/yr scenario and about 399 feet of drawdown in the Simsboro Aquifer in 2070 from the S-19 plus 99,924 ac-ft/yr scenario. As shown on Figure 10, AGS estimated about 375 feet of drawdown in the Simsboro Aquifer in 2070 from the S-19G3 + 75,000 ac-ft/yr scenario and about 408 feet of drawdown in the Simsboro Aquifer at 2070 from the S-19G3 + 100,00 ac-ft/yr scenario. Both values are reasonably close to the 2070 Simsboro drawdown estimates included in the application.

AGS found no significant issues with the average simulated water level decline estimates contained in the application.

Pumping Effects of Simulated Pumping on BVGCD Permitted and Registered Simsboro Wells

AGS reviewed the effects on the BVGCD permitted and registered Simsboro wells that can be attributed to the S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k pumping scenarios.

Figures 14, 15 and 16 show the simulated 2028 to 2059 drawdown in the Simsboro Aquifer for the S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k pumping simulations, respectively. The drawdown was estimated by subtracting the simulated 2028 water levels from the simulated 2059 water levels for each pumping scenario.

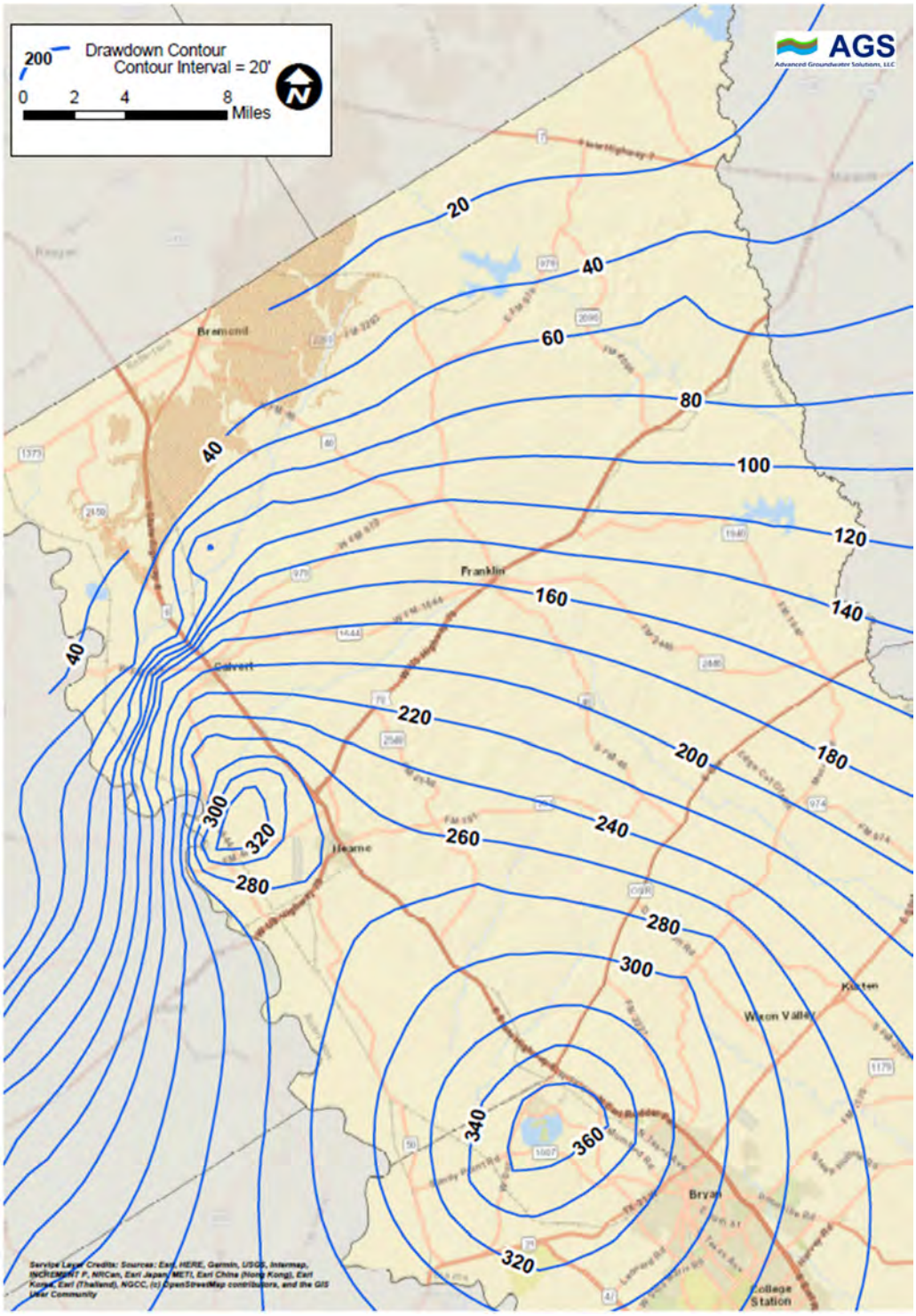


Figure 14. AGS simulated Simsboro drawdown (2028-2059) from the S-19G3 + 50,000 ac-ft/yr pumping scenario.

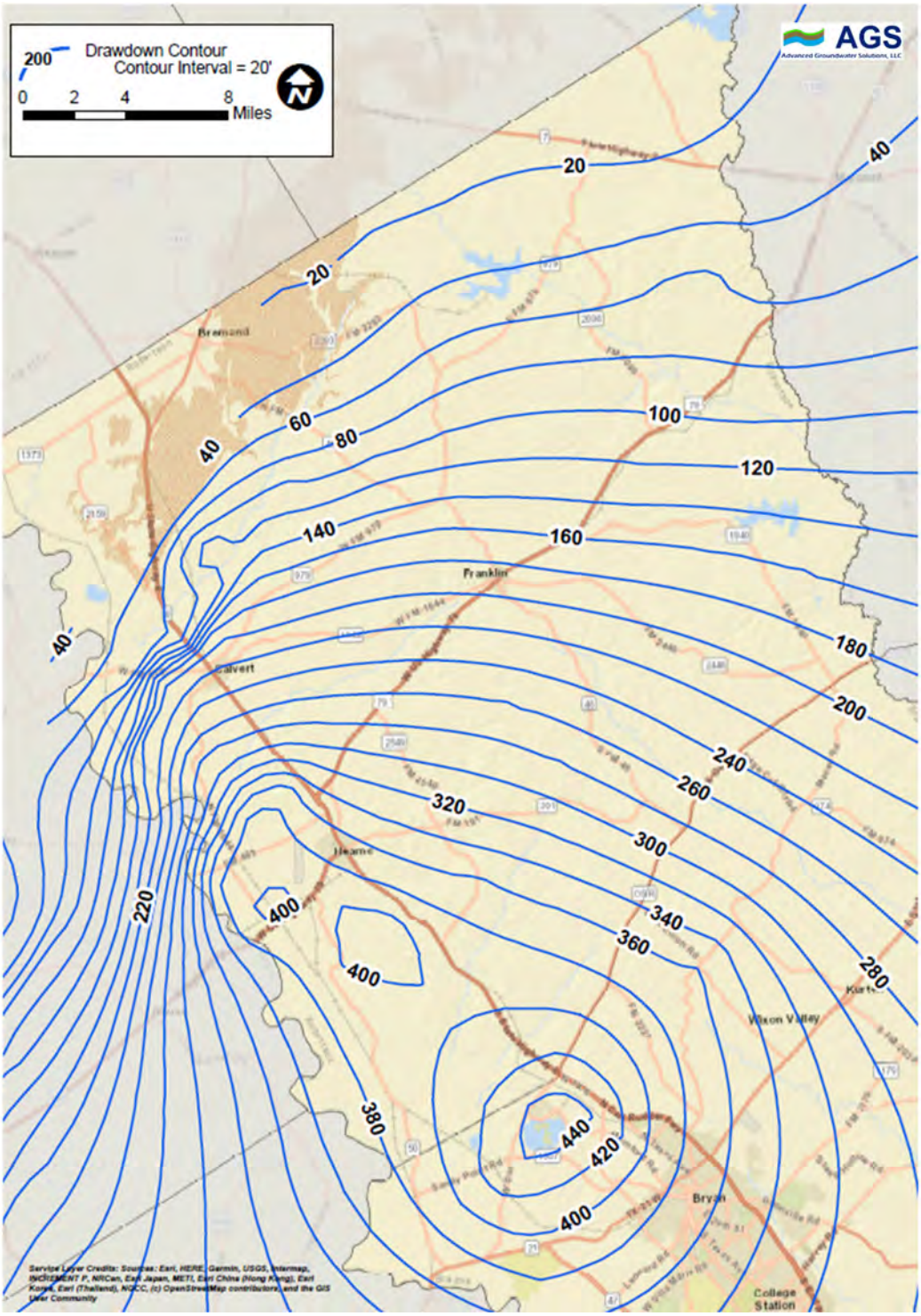


Figure 15. AGS simulated Simsboro drawdown (2028-2059) from the S-19G3 + 75,000 ac-ft/yr pumping scenario.

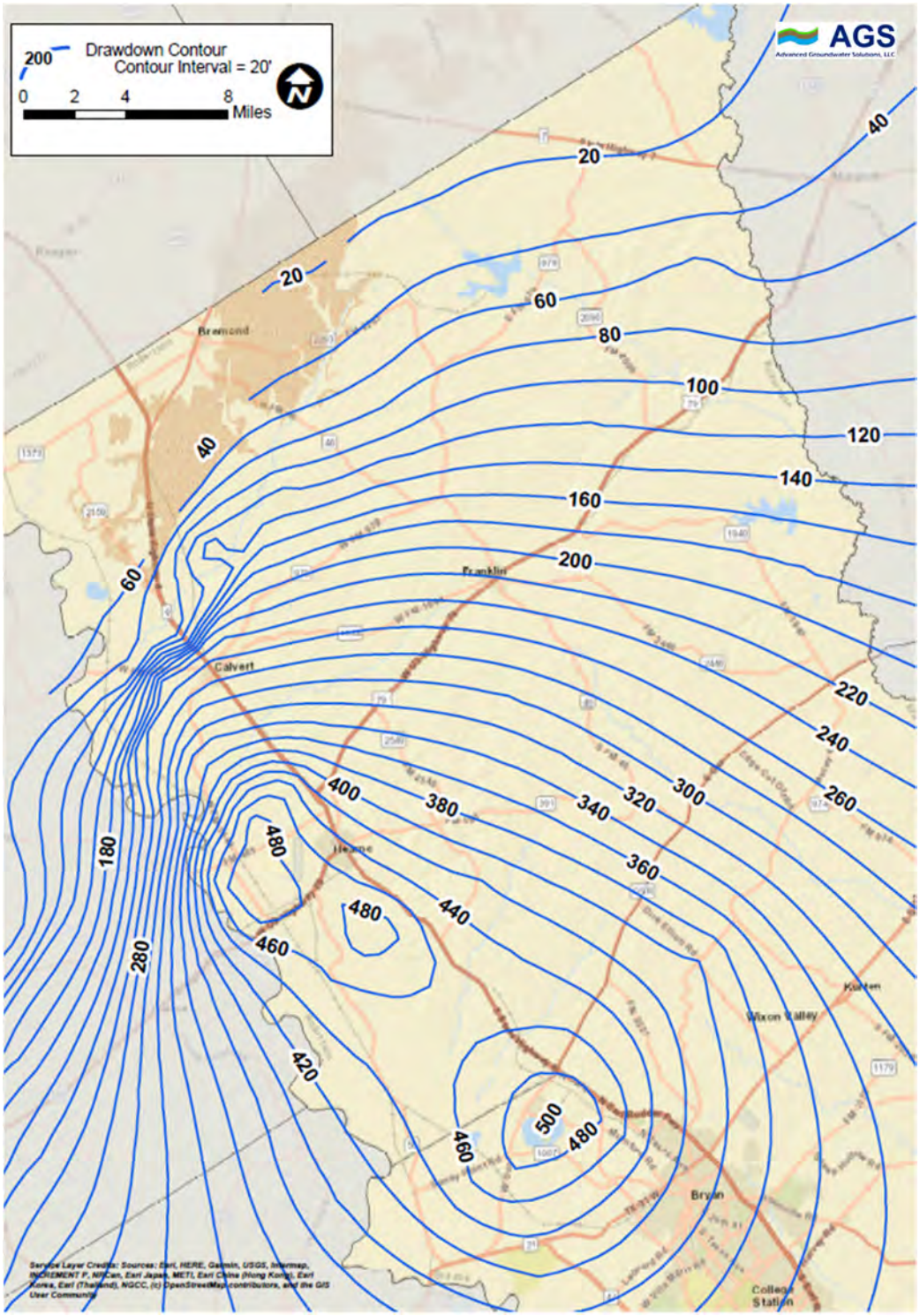


Figure 16. AGS simulated Simsboro drawdown (2028-2059) from the S-19G3 + 100,000 ac-ft/yr pumping scenario.

This analysis considers 612 BVGCD permitted and registered Simsboro wells. These are existing BVGCD permitted and registered Simsboro wells that are not associated with the existing transport permit or in the transport permit applications.

- This assessment does not allocate responsibility for impacts among all the groundwater producers in the Simsboro Aquifer.
- Timing and magnitude of pumping have potential impacts on allocation of responsibility and on when and if wells may require mitigation.
- This analysis compares the simulated water level elevation in 2059 to well construction and pump data (as available or estimated) and estimates whether a pump will need to be lowered or whether a well will need to be redrilled based on that single estimate of water level elevation.
- This analysis does not include age of wells, depreciation of wells and pumps, or standard maintenance and pump replacements.
- The analysis is preliminary and limited.

Well construction details including information on the liner, screen and total depth of the well were considered as well redrill criteria. Estimated water levels were considered as part of the pump lowering criteria, with evaluation of the needs for a pump rebuild / additional pump stages and changes to the pump column assembly.

Redrill criteria include:

- If liner information is known - redrill if 2059 water level elevation is below liner elevation - required head above pump estimate.
- Otherwise, if screen information is known: 2059 water level below middle of screened interval.
- Otherwise, if only total depth is available or estimated: 2059 water level below total depth + required head above pump estimate.

Pump lowering criteria include:

- If water level is 50 feet below base case of 2028 water levels in S-19G3, assume both pump lowering and pump and motor rebuild.
- If water level is 20-49 feet below base case of 2028 water levels in S-19G3, assume additional column only.
- If water level is less than 20 feet below base case of 2028 water levels in S-19G3, no pump lowering is required.

There are approximately 27 BVGCD permitted and registered Simsboro wells that are located outside of the GAM model grid and do not have a 2059 water level estimate. These wells are located in the northwest part of Robertson County.

There are potentially up to 33 wells included in the redrill category with anomalous data. These may have a different well total depth, aquifer designation, and/or water level than what is used in the AGS estimate development.

Figure 17 shows the estimated number of BVGCD permitted and registered Simsboro wells that will need to be redrilled or have the pump lowered based on the S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k pumping scenarios. Figures 18, 19 and 20 show the locations of BVGCD permitted or registered Simsboro wells that need to be redrilled, have the pump lowered or require no additional work based on the S-19G3 + 50k, S-19G3 + 75k and S-19G3 + 100k pumping scenarios, respectively.

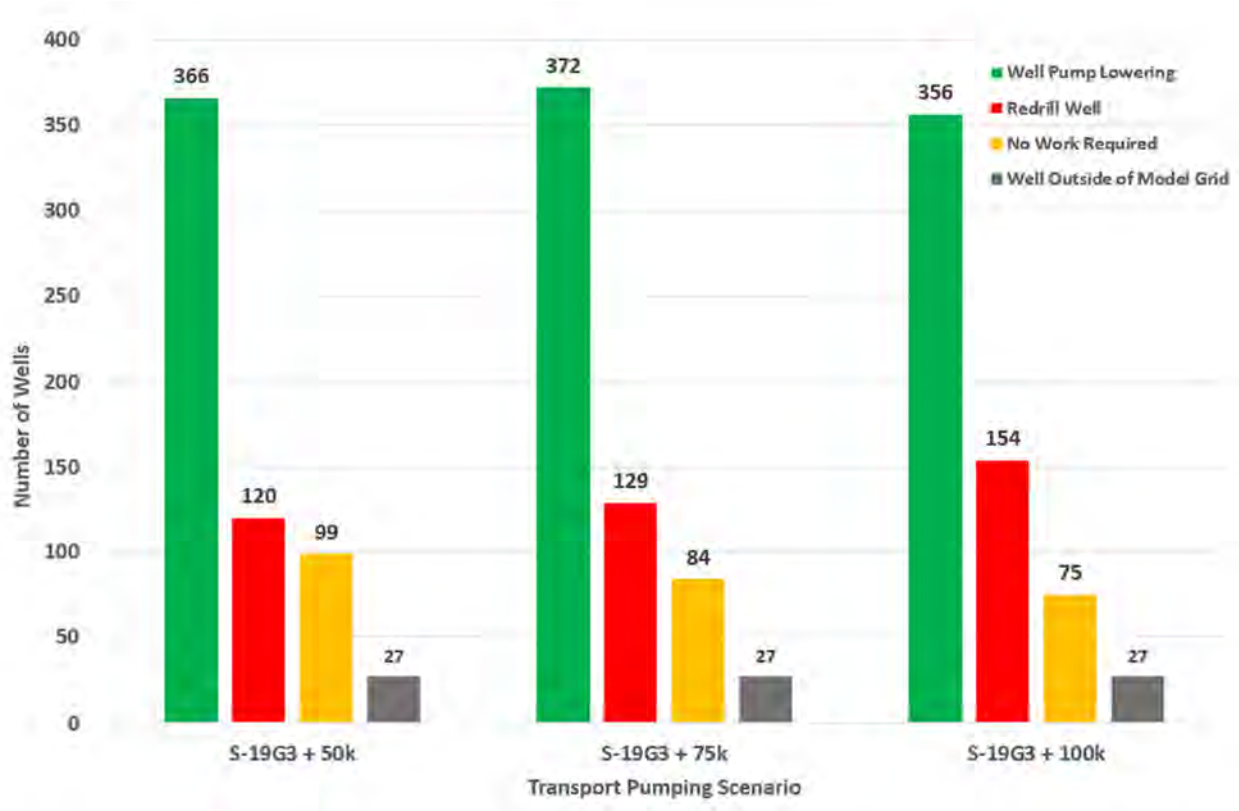


Figure 17. AGS estimate of the number of BVGCD permitted or registered Simsboro wells that will need to be redrilled or have the pump lowered based on the S-19G3 + 50,000 ac-ft/yr, S-19G3 + 75,000 ac-ft/yr and S-19G3 + 100,000 ac-ft/yr pumping scenarios.

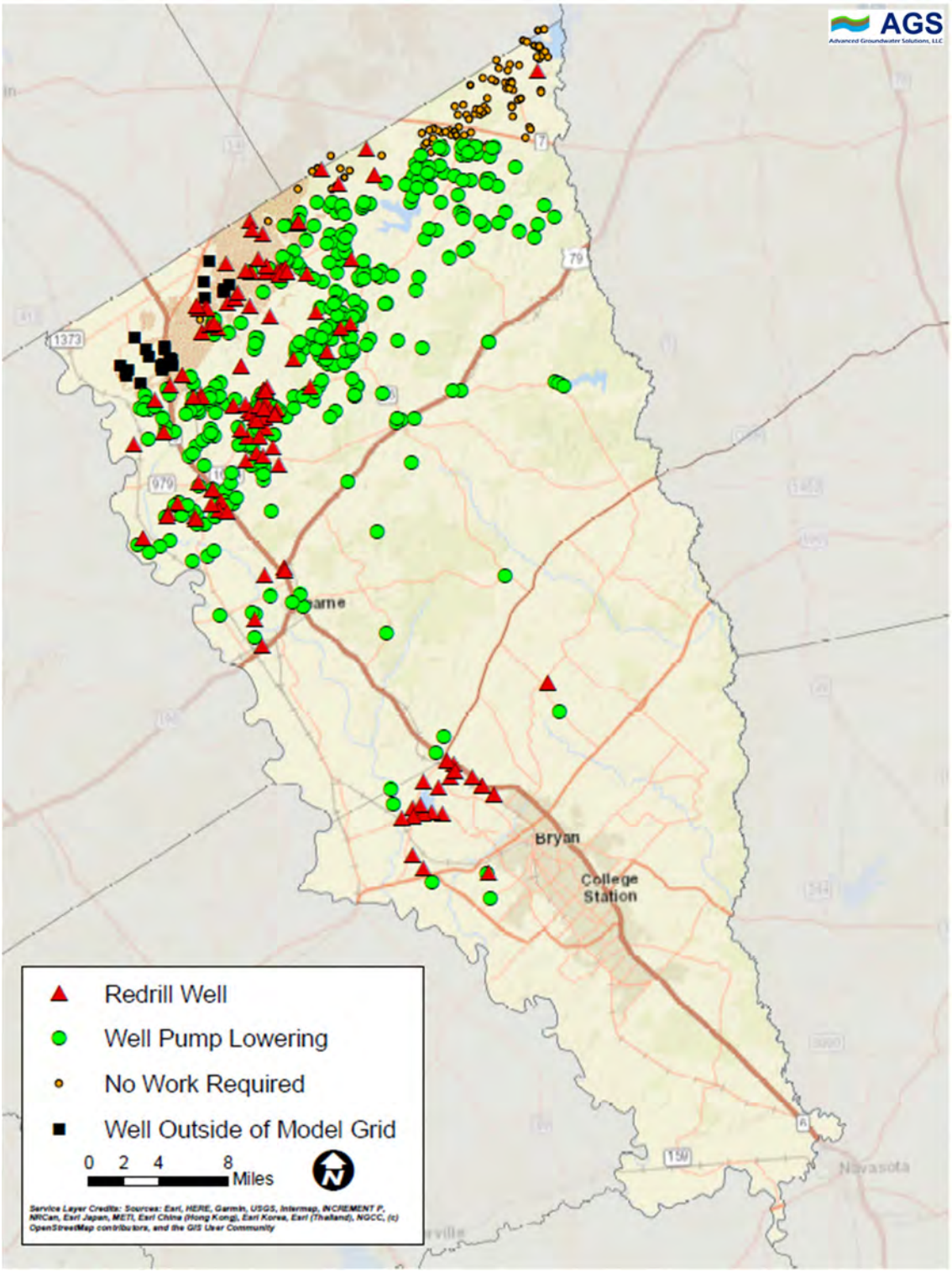


Figure 18. AGS developed locations of BVGCD permitted or registered Simsboro wells that are estimated to be redrilled or have the pump lowered based on simulated 2059 water level from the S-19G3 + 50,000 ac-ft/yr pumping scenario.

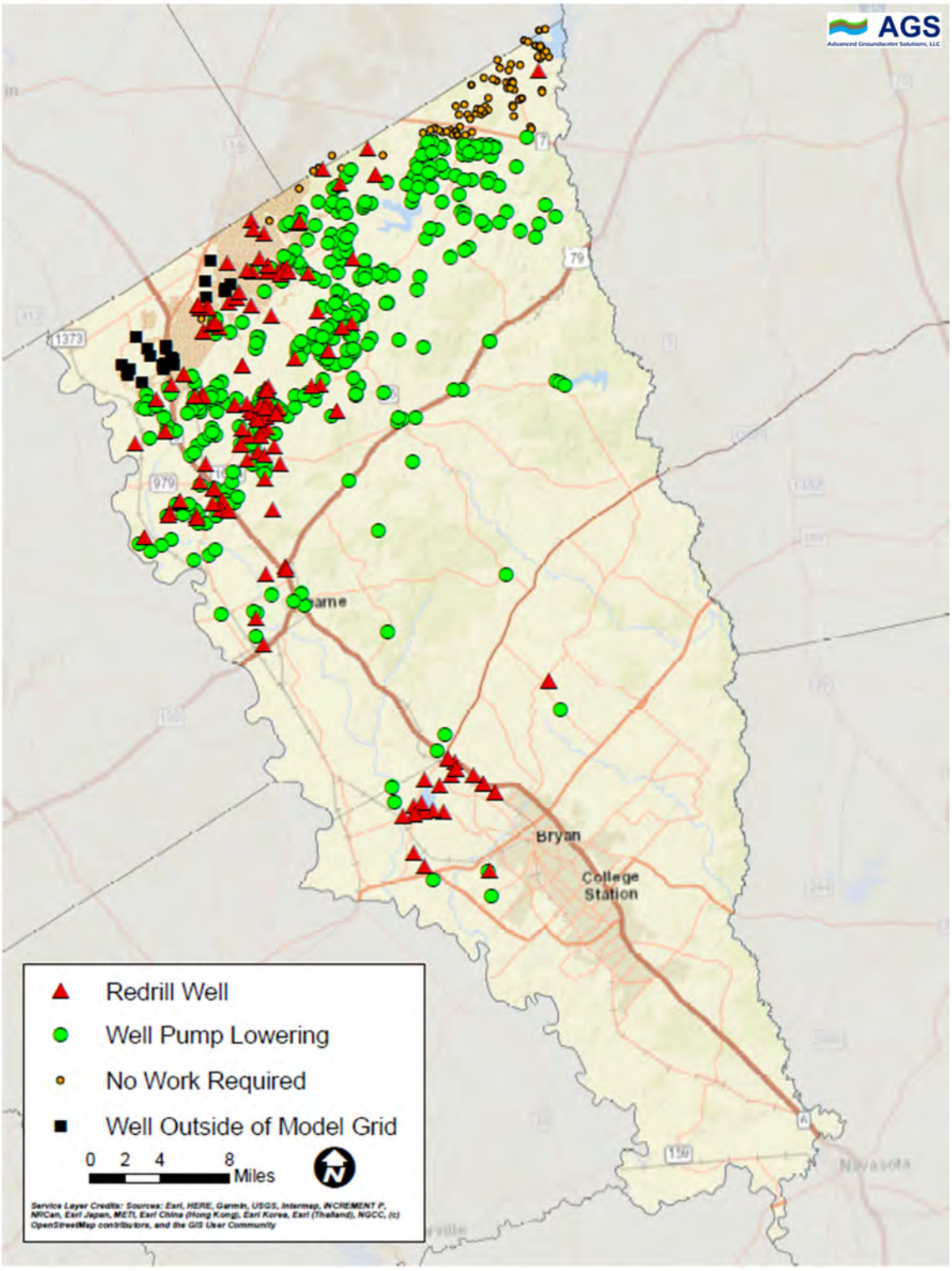


Figure 19. AGS developed locations of BVGCD permitted or registered Simsboro wells that are estimated to be redrilled or have the pump lowered based on simulated 2059 water level from the S-19G3 + 75,000 ac-ft/yr pumping scenario.

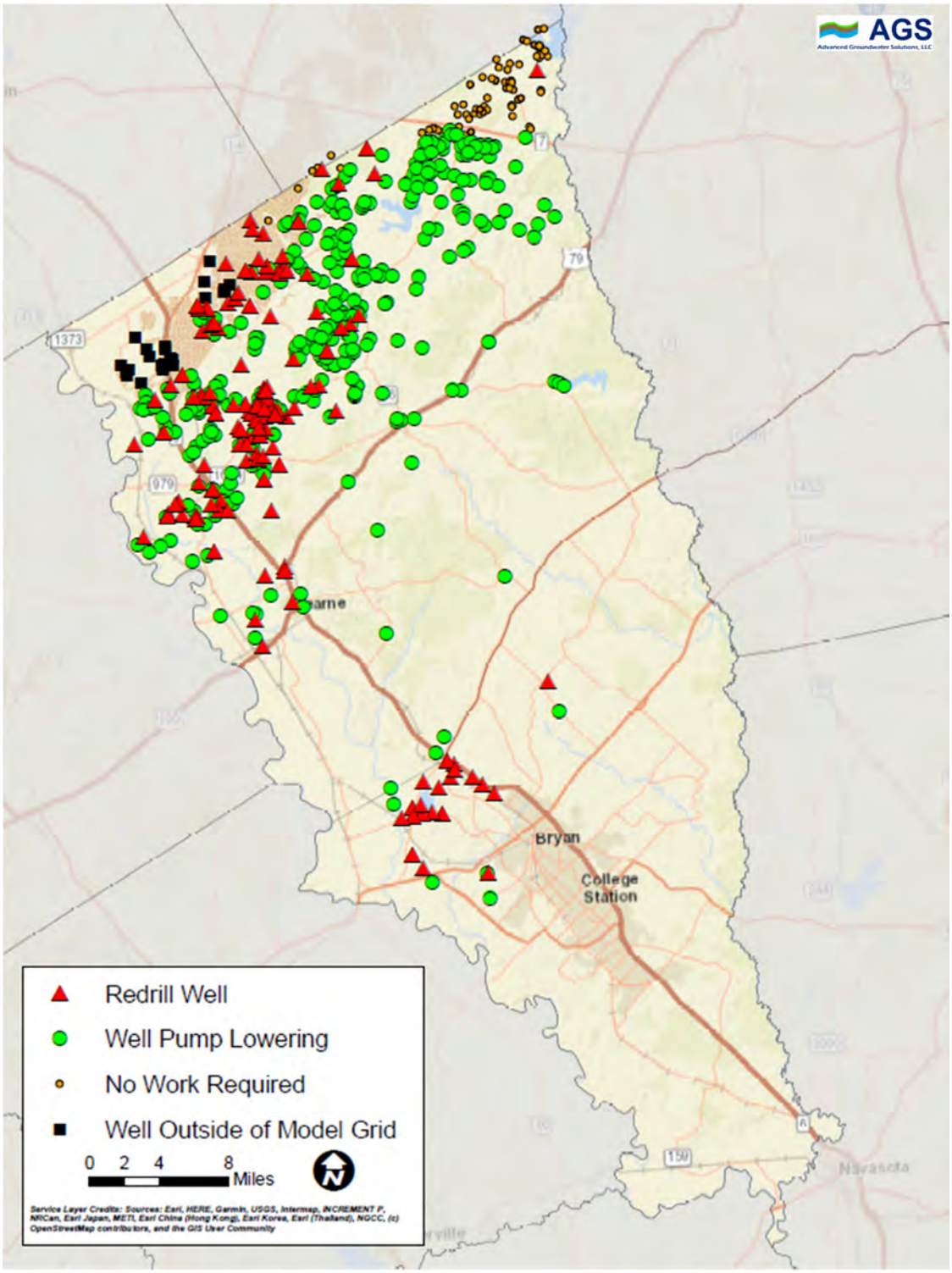


Figure 20. AGS developed locations of BVGCD permitted or registered Simsboro wells that are estimated to be redrilled or have the pump lowered based on simulated 2059 water level from the S-19G3 + 100,000 ac-ft/yr pumping scenario.

Inclusion of Proposed Transport in Region G Regional Water Plan and Certified District Management Plan

Rule 10.3(c1): the approved Regional Water Plan and certified District Management Plan, including a description of how the proposed transport is addressed in any approved regional water plan(s) including the Region G Regional Water Plan and, the certified District Management Plan.

The export/import of groundwater from the Simsboro Aquifer from Robertson County is not currently included in the Brazos G regional water plan or the State water plan.

The export of groundwater from Robertson County is not included in the November 2023 BVGCD Groundwater Management Plan.

The application states in Attachment C: '*While the proposed EPCOR/UWBVF project does not require funding from the State of Texas, the project entities may proceed with ensuring the project is included in the next round of regional water planning.*'

Technical Description of Facilities to be used for Transportation of water and Construction Time Schedule

Rule 10.3(c2): a technical description of the facilities to be used for transportation of water and a time schedule for any construction thereof, that will be used to establish the term of the transport permit, under Section 36.122 (i) of the Texas Water Code.

The application indicates that each applicants' wells will be completed per State and BVGCD regulations at the permitted locations and are anticipated to be connected with collection pipelines to the main transmission line that will extend from Roberson County to the receiving areas. The pipeline route and collection line size have not been finalized.

The application stated that additional details can be provided when the water is firmly contracted. TGI states that all water wells, storage tanks, collection lines, valving, transmission lines and other appurtenances will be designed, constructed and operated in accordance with applicable rules, requirements and guidelines of the TCEQ described in Title 30 Texas Administrative Code (30 TAC).

According to the application, the City of Georgetown outlined a project schedule for the development, construction and operation of the proposed project to import between 39,399 to 70,000 acre-feet of groundwater from Robertson County. The project schedule showed preliminary engineering, securing easements and obtaining construction permits starting in mid-2025, construction starting in 2027 with delivery of water in late 2029.

Anticipated Duration for the Proposed Transport of Groundwater

Rule 10.3(d): state the presently anticipated duration for the proposed transport of groundwater.

The transport permit application states that the duration of transport is expected to be at least 30 to 60 years and is anticipated to begin transporting water in 2029. Based on the application, it is assumed that the transport permits would most likely be renewed and the project extended for longer than 60 years.

The City of Georgetown schedule included in the application shows incremental increases in the amount of groundwater produced from Robertson County for 2029 to about 2044. The application does not include discussion regarding the estimated amount and timing of the use of groundwater exported from Robertson County in areas of ongoing negotiations.

Applicant's Water Conservation Goals

Rule 10.3(e): provide information showing what water conservation measures the applicant has adopted, what water conservation goals the applicant has established, and what measures and time frames are necessary to achieve the applicant's established water conservation goals.

The application states that UWBVF and the transport permit applicants will comply with BVGCD's management plan, drought contingency plan and well plugging guidelines and that the water will be transported by pipeline in accordance with sound engineering practices. The application also states that the project will involve a program of leak detection, repair and water loss accounting for the water transmission, delivery and distribution system.

AGS did not find detailed information for each of the items discussed above in the transport permit applications.

The application states that the City of Georgetown and other likely users would implement conservation and drought contingency plans per standard procedures of their water department or in accordance with applicable regulations. The application provided a link to the City of Georgetown water conservation plan. The Georgetown IWRP would apply conservation as one of the water supply strategies and target a 10 percent reduction in annual demand through conservation measures.

Additional Information Related to Sale of Water

Rule 10.3(f): if and when the water is to be resold to others, provide a description of the applicant's service area, metering, leak detection and repair program for its water storage, delivery and distribution system, drought or emergency water management plan, and information on each subsequent customer's water demands, including population and customer data, water use data, water supply system data, alternative water supply, water conservation measures and goals, conjunctive use, and the means for implementation and enforcement of all applicable rules, plans, and goals.

The application states that UWBVF and the transport permit applicants will comply with BVGCD's management plan, drought contingency plan and well plugging guidelines. The application also states that the seven applicants will install flowmeters to meet BVGCD's technical requirements and will report the permitted production according to BVGCD rules.

The project receiving area is shown to be in Williamson, Bell, Travis and Milam Counties and water produced under the transport permits would be provided to end users who will distribute the water to their service areas. The application states that one or more end users would likely have certified service areas and that end users in the receiving area would employ metering, leak detection and repair programs for their water storage, delivery and distribution systems. The application states that drought and emergency water management plans will be considered in the context of final designs based on ultimate end users when contracts for sale of waster are in place.

The application provided regional and state water planning links related to the potential counties for population projections, county water level water supply planning and water conservation.

Summary

AGS has reviewed the hydrogeological information provided in Attachment C of the seven transport permit applications prepared by TGI in support of the transport permit application.

At the time of the submission of the seven transport permit applications, the City of Georgetown in Williamson County appears to be the only entity with an agreement for the Simsboro water transported from Robertson County. The City of Georgetown has a reservation agreement with EPCOR to negotiate a water supply agreement for Georgetown to import between 39,399 and 70,000 ac-ft/yr from Robertson County. UWBVF has entered into an agreement with EPCOR. It is possible that other municipalities, public water suppliers or other end users could participate in that or another reginal project.

In each of the seven transport well applications, TGI focuses the groundwater modeling simulations and discussion on each of the individual transport permit applicant's permitted Simsboro wells. AGS discusses the TGI model simulations included with the seven transport permit applications in Appendix A of this memorandum.

At the request of BVGCD staff, AGS completed an update to a fault in Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM, updated the S-19 well file

and performed series of model scenarios that simulates the pumping effects of an additional 50,000 ac-ft/yr, 75,000 ac-ft/yr and 100,000 ac-ft/yr of transport pumping over the 30-year term of the permit.

- AGS has updated the location of the fault that is positioned to the north of Calvert in Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020).
- AGS updated the GMA 12 S-19 well file to include adjustments to historic pumping based on metered volumes, municipal demands in the District based on the 2022 State Water Plan, and pumping assumptions in the Vista Ridge project located in Post Oak Savannah GCD.
- The updated S-19G3 well file serves as a basis for model scenarios that simulate 50,000 ac-ft/yr, 75,000 ac-ft/yr and 100,000 ac-ft/yr of transport pumping over the 30-year term of the permit.
- The isolated pumping effects associated with transport pumping radiate outward from the UWBVF area and decrease with distance from the UWBVF.
- AGS simulated the remaining available drawdown above the top of the Simsboro Aquifer in 2059 for each of the three transport pumping scenarios. The model simulations show that the simulated remaining available drawdown is above the top of the Simsboro Aquifer in the three pumping scenario simulations.
- AGS developed estimates of the DFC drawdown from 2000 to 2070 that results from S-19, S-19G3, S-19G3 + 50,000 ac-ft/yr, S-19G3 + 75,000 ac-ft/yr and S-19G3 + 100,000 ac-ft/yr pumping scenarios. As pumping in the Simsboro increases in BVGCD, the drawdown at 2070 increases and the year at which the drawdown reaches the current Simsboro DFC of 262 feet occurs sooner.
- The S-19G3 + 50k scenario results in an estimated drawdown of about 332 feet at 2070 and reaches a drawdown value of 262 feet in 2050. The S-19G3 + 75k scenario results in an estimated drawdown of about 375 feet at 2070 and reaches a drawdown value of 262 feet in 2041. The S-19G3 + 100k scenario results in an estimated drawdown of about 408 feet at 2070 and reaches a drawdown value of 262 feet in 2036.
- Pumping effects due to increases in the Simsboro Aquifer pumping can be observed in the BVGCD 2000 to 2070 DFC drawdown estimates in the Carrizo Aquifer, Calvert Bluff Formation and Hooper Formation. S-19G3 includes a slight decrease in the Carrizo pumping in the vicinity of the Vista Ridge project. However, most of the differences in the 2000 to 2070 BVGCD DFC estimates in the Carrizo, Calvert Bluff and Hooper can be attributed to the increases in simulated Simboro Aquifer pumping. Simulated drawdown at 2070 increases and the year at which the drawdown reaches the current aquifer / formation DFC occurs sooner.
- AGS calculated and mapped total drawdown in the Simsboro Aquifer in 2059 based on the three transport pumping scenarios.

- AGS evaluated the pumping effects of the simulated pumping on the BVGCD permitted and registered Simsboro wells. The analysis is preliminary and limited. The analysis does not allocate responsibility for impacts. Timing and magnitude of pumping have potential impacts on allocation of responsibility. It is estimated that 366 wells would need to have pumping lowered and that 120 wells would need to be redrilled in the S-19G3 + 50k scenario, 372 wells would need to have pumping lowered and that 129 wells would need to be redrilled in the S-19G3 + 75k scenario and 356 wells would need to have pumping lowered and that 154 well would need to be redrilled in the S-19G3 + 100k scenario.

References

Brazos Valley Groundwater Conservation District, 2023, Groundwater Management Plan (amended 11/16/2023), 121 pages.

Brazos Valley Groundwater Conservation District, 2023, Rules of the Brazos Valley Groundwater Conservation District (amended 9/14/2023), 81 pages.

City of Georgetown Integrated Water Resources Plan; CDM Smith (2023),

https://gus.georgetown.org/wp-content/uploads/sites/47/2023/08/Georgetown-IWRP_Executive-Summary_FINAL-2.pdf

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

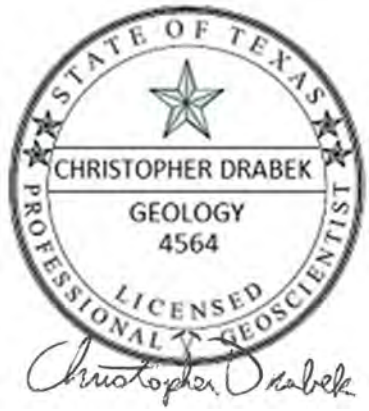
Texas Water Development Board, Region G Planning Group,

https://www.twdb.texas.gov/waterplanning/rwp/regions/g/index.asp

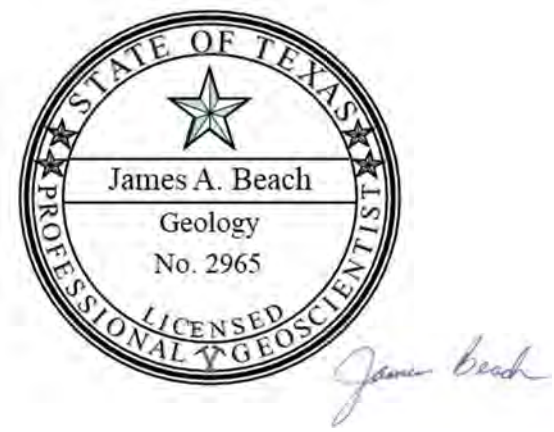
Texas Water Development Board, 2022 Texas State Water Plan,

https://2022.texasstatewaterplan.org/statewide

Geoscientist's Seal:



The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on May 24, 2024.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)



The seal appearing on this document was authorized by James A. Beach, P.G. 2965 on May 24, 2024
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)

APPENDIX A

Projected Effect of the Proposed Groundwater Transport on Aquifer Conditions Discussion

Projected Effect of the Proposed Groundwater Transport on Aquifer Conditions

BVGCD Rule 10.3(b) requires the projected effect of the proposed groundwater transport on aquifer conditions, depletion, subsidence and effects on existing permit holders or other groundwater users within the District. Rule 8.4 information and studies and any proposed plan of the applicant to mitigate adverse hydrogeological impacts of the proposed transport of water from the District should also be included. The permit applications provide updates and discussion on the permitted wells associated with each transport permit application.

TGI references the individual Simsboro Aquifer Evaluation report completed in support of obtaining the Simsboro well permits for each of the applicants in Attachment C of the transport permit application and includes a copy of the previously submitted Aquifer Evaluation Report with each transport permit application. AGS has previously reviewed the submitted TGI Aquifer Evaluation Reports as part of the well permitting process and a copy of the AGS technical review is included in Appendix B.

BVGCD Permitted or Registered Wells within 1-mile, 5-miles and 10-miles of the BVGCD Permitted Simsboro Wells Under Consideration for a Transport Permit

BVGCD Rule 8.4(b)(7)(B)(2) requires a well table providing data on BVGCD permitted and registered wells within 1-mile of the proposed well(s) that are completed in the same aquifer. The permit applications identified most of the wells within a 1-mile of the permitted wells. The only additional well identified in the AGS review was BVR-0239, which is located within 1-mile of the permitted L. Wiese Moore wells.

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of the water-level or artesian head drawdown that can be caused by pumping the well(s) at the permitted rate for one year, ten years and twenty years at a distance of five miles from the well(s) producing 3,000 or less acre feet per year and ten miles for well(s) producing more than 3,000 acre feet per year. TGI provided simulated drawdown estimates at most BVGCD permitted and registered wells within the radii as described above for each permitted well. AGS identified four BVGCD permitted and registered Simsboro wells that were not included in the permit application maps and tables. Table 1 below provides a list of the BVGCD permitted and registered Simsboro Aquifer wells that are not included in the permit applications.

Table 1. BVGCD permitted and registered Simboro wells not included in the transport permit modeling simulations.

Transport Permit Applicant:	Mr. James Brien	Cula d'Brazos LLC	Ely Family Partnership LP	Fazzino Investments LP	RH2O LLC	Mr. Clifford A. Skiles III	L. Wiese Moore LLC
BVGCD permitted or registered Simsboro well not Included in well radius search (Applicable Radius from Well)	BVR-0239 (5-mile radius) BVR-2985 (10-mile radius) BVHU-0045 (10-mile radius)	BVR-0239 (5-mile radius)	BVR-0239 (5-mile radius)	BVR-0239 (5-mile radius) BVR-2964 (10-mile radius)	BVR-0239 (5-mile radius)	BVR-0239 (5-mile radius)	BVR-0239 (1-mile radius)

The simulated drawdown values at each of these wells should be similar to wells in the general vicinity and the addition of these wells to the dataset reviewed would not change the results of the model simulations.

Transport Permit Application Model Simulations

The transport permit application included maps illustrating drawdown contours based on modeling of each of the applicants permitted groundwater production (example: L. Wiese Moore 4,452 acre-ft/yr) for durations of one (1), 10, and 20 years. Appendix B found in each of the transport applications provides tabulations of simulated drawdown at BVGCD registered and permitted Simsboro wells within 1, 5 and 10 miles of each of the permitted wells.

Groundwater Availability Model Simulations

AGS reviewed the groundwater availability model (GAM) pumping simulations, maps and tables provided in each of the seven transport permit applications and was generally able to recreate the simulated results presented in Attachment C of each of the transport applications using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020).

There can be some minor differences in the simulated drawdown between drawdown estimates, but most of the differences in estimated drawdown values are generally within about 10 +/- feet. The AGS Aquifer Evaluation Reviews completed as part of the original well permitting process for each of the seven transport permit applicants discuss the detailed differences in the 1-year and 10-year GAM simulated results.

The GAM estimated drawdown contours appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped recently by Ground Water Consultants, LLC and AGS.

Analytical Model Simulations

AGS reviewed the analytical modeling pumping simulations and related maps and tables provided in each of the transport permit applications. AGS was generally able to recreate the simulated results presented in Attachment C for most of the transport applications using a Theis based analytical model and simulation parameters provided by TGI on February 12, 2024.

AGS and TGI simulated slightly different drawdown values at the pumping wells in each simulation. AGS uses a drawdown estimate at a distance of 1-foot from each pumping well and TGI historically has averaged the drawdown of the pumping well over the model grid cell. The TGI method underestimates the drawdown at each pumping when compared to the AGS method.

Table 2 below provides a comparison of the TGI and AGS analytical model results at each pumping well for five of the seven transport permit analytical model simulations. The AGS analytical verification simulation results are very similar to the TGI results at the surrounding non-pumping wells located at distance from the pumping wells.

Table 2. Comparison of TGI and AGS analytical simulation drawdown estimates at the permitted pumping wells.

BVGCD Permit Holder	Well Number	BVGCD Permit Number	TGI Simulated 1 year Drawdown at Well (feet)	AGS Simulated 1 year Drawdown at Well (feet)	TGI Simulated 10 year Drawdown at Well (feet)	AGS Simulated 10 year Drawdown at Well (feet)	TGI Simulated 20 year Drawdown at Well (feet)	AGS Simulated 20 year Drawdown at Well (feet)
Cula d'Brazos LLC	Well 1	BVDO-0408	112	133	121	148	129	156
Cula d'Brazos LLC	Well 2	BVDO-0409	104	142	113	150	121	157
Cula d'Brazos LLC	Well 3	BVDO-0410	95	109	104	117	112	125
Cula d'Brazos LLC	Well 4	BVDO-0411	99	113	108	120	116	128
Cula d'Brazos LLC	Well 5	BVDO-0412	99	111	107	119	115	127
Cula d'Brazos LLC	Well 6	BVDO-0413	97	107	105	115	114	123
Cula d'Brazos LLC	Well 7	BVDO-0414	98	108	106	119	114	127
Ely Family Partnership LP	Well 1	BVDO-0377	90	103	98	111	106	119
Ely Family Partnership LP	Well 2	BVDO-0378	94	125	102	133	114	141
Ely Family Partnership LP	Well 3	BVDO-0379	96	106	104	114	113	122
Ely Family Partnership LP	Well 4	BVDO-0380	100	124	109	132	118	140
Ely Family Partnership LP	Well 5	BVDO-0381	97	113	105	122	113	130
Ely Family Partnership LP	Well 6	BVDO-0382	99	120	107	128	116	137
Ely Family Partnership LP	Well 7	BVDO-0382	92	116	100	124	108	132
Ely Family Partnership LP	Well 8	BVDO-0384	84	101	92	109	99	117
RH2O LLC	Well 1	BVDO-0385	76	74	82	110	88	116
RH2O LLC	Well 2	BVDO-0386	88	115	94	121	100	127
RH2O LLC	Well 3	BVDO-0387	77	100	83	106	89	112
RH2O LLC	Well 4	BVDO-0388	82	102	88	108	94	114
RH2O LLC	Well 5	BVDO-0389	78	95	84	98	90	104
Mr. Clifford A. Skiles III	Well 1	BVDO-0108	42	83	51	93	73	97
Mr. Clifford A. Skiles III	Well 2	BVDO-0317	43	71	53	82	66	85
L. Wiese Moore LLC	Well 1	BVDO-0401	54	78	58	81	61	84
L. Wiese Moore LLC	Well 2	BVDO-0402	52	93	55	97	58	100

Analytical Model Simulation Differences

AGS identified slight differences with the analytical model simulations submitted in support of the transport permit applications for Mr. James Brien and Fazzino Investments LP. The differences are minor and do not generally affect the overall outcome of the simulations.

Mr. James Brien

The transport permit application includes a simulation that uses well pumping rates base on annual allocations of 2,742 ac-ft/yr and 2,420 ac-ft/yr, which equals pumping rates of 1,700 gpm and

1,500 gpm, respectively. AGS was able to verify the analytical simulations performed using these values. However, the BVGCD approve annual allocation from the Simsboro Aquifer is 2,186 ac-ft/yr for Well BVDO-0315 and 1,929 ac-ft/yr for Well BVDO-0316, which is equal to average annual pumping rates of 1,355 gpm and 1,196 gpm, respectively.

Since the actual maximum permitted production rates of the Mr. James Brien wells (BVDO-0315 and BVDO-0316) are less than what was used in the analytical modeling simulations, the simulations results would be less than what is shown in the tables included in the Mr. James Brien transport permit application. AGS confirmed this by performing an analytical model simulation using the average annual pumping rate based on the annual permitted production values and estimated drawdown values at each well are slightly less than those shown in the permit application tables.

Fazzino Investments LP

The transport permit application includes a simulation that uses well pumping rates based on annual allocations of 1,097 ac-ft/yr for Fazzino Investments LP Wells BVDO-0377 and BVDO-0378, which equal a pumping rate of 680 gpm for each well. However, the BVGCD approved annual allocation from the Simsboro Aquifer is 1,290 ac-ft/yr each for Wells BVDO-0377 and BVDO-0378, which is equal to an annual average pumping rate of 800 gpm for each well. All additional Fazzino Investments LP permitted wells included the correct annual allocations and associated average well production rates. AGS was able to recreate the simulations performed in the transport permit application using the values provided in the February 12, 2024 aquifer property table.

Since the average annual production rates of the two Fazzino Investments LP wells (BVDO-0377 and BVDO-0378) are slightly higher than what was used in the analytical modeling simulations, the analytical model simulations results would be slightly higher than what is shown in the tables included in the transport permit application. AGS confirmed this by performing an analytical model simulation using the average annual pumping rate based on the annual permitted production values and estimated drawdown values at each well are slightly higher than the values shown in the tables, which are typically within about 5 to 10 feet of the non-pumping wells.

Summary

AGS has reviewed the GAM and analytical modeling presented in the transport permit applications and was able to generally recreate the estimated results. There are minor differences between the TGI and AGS approach to the analytical model simulations. AGS is documenting the differences but does not consider them to be major for the purposes of this review.

APPENDIX B

AGS Technical Memorandums Regarding the Review of the Simsboro Aquifer Evaluation Reports Submitted in Support of the Permit Applications for the Permitted Wells Associated with the Seven Transport Permit Applications

Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of James Brien Simsboro Aquifer Evaluation Report

DATE: February 6, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report prepared by Thornhill Group, Inc. (TGI) in support of a permit application from Mr. James Brien for two wells with a combined withdrawal amount of 4,115 acre-feet per year (ac-ft/yr) from the Simsboro Aquifer. Ground Water Consultants, LLC (GWC) supported the review of the report. The first submitted Aquifer Evaluation Report is dated January 10, 2023. After preliminary review, AGS, GWC and BVGCD provided comments to TGI and requested some modifications to the report on January 25, 2023. A revised report was submitted to BVGCD on January 27, 2023. The Aquifer Evaluation Report was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the proposed two wells screening the Simsboro Aquifer in the west part of Robertson County.

The Aquifer Evaluation Report identifies Brien Well 1 with a maximum pumping rate of 1,700 gallons per minute (gpm) and an annual permit allocation of 2,186 acre-feet and Brien Well 2 with a maximum pumping rate of 1,500 gpm and an annual permit allocation of 1,929 acre-feet. The combined maximum pumping rate of Brien Wells 1 and 2 is 3,200 gpm with a total annual permit allocation of 4,115 acre-feet. The proposed locations of the wells are shown on Figure 1 with the wells located just west of FM 1644 and north of the Brazos River.

AGS and GWC have evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted Aquifer Evaluation Reports. Discussion of the Aquifer Evaluation Report in this memorandum refers to the revised version of the report dated January 27, 2023.

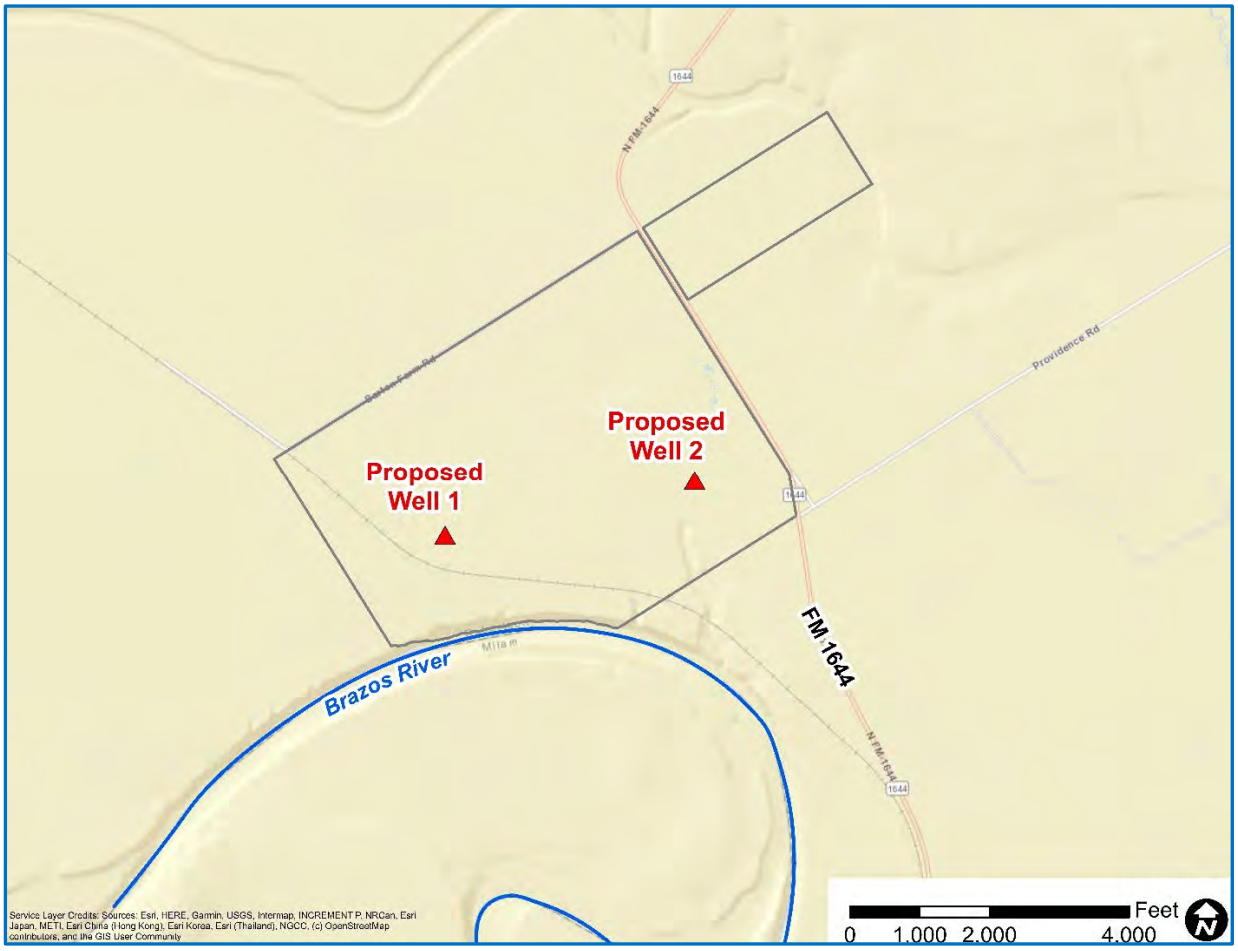


Figure 1. Proposed Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the Aquifer Evaluation Report and generally agrees with the information presented in this section. Our comments regarding the hydrogeologic conditions at the subject property are included below.

Paragraph one of the Surface Geologic Setting on Page 3 of the TGI report states 'Geologically updip and present to the southeast of the property is the Queen City Aquifer…' and while the Queen City Aquifer can be found to the southeast of the Brien property, the Queen City is located downdip, not updip, of the formations present below the Brien property.

The Aquifer Evaluation Report identifies the top of the Simsboro Aquifer in the range of about -375 to -500 feet relative to sea level (rsl) or about 650 to 780 feet below land surface at the subject property. Review of local electric logs and the Brien irrigation well drillers log (State of Texas Well Report Tracking Number 313037) indicates that the top of the Simsboro in the vicinity of the Brien property could about -275 to -350 feet rsl or about 555 to 630 feet below land surface. The

Aquifer Evaluation Report did not discuss the base of the Simsboro Aquifer. We estimate the base of the of the Simsboro in the vicinity of the Brien property is about -675 to -760 feet rsl or about 955 to 1,040 feet below land surface. TGI estimated the sand thickness of the Simsboro Aquifer to be in the range of 450 to 500 feet. Site specific information will be available once the test hole is drilled and logged for the first of the two proposed wells. The proposed well screen interval was not discussed for either of the proposed wells in the Aquifer Evaluation Report.

There is about a 100- to 150-foot difference in opinion of the estimated depth to the top of the Simsboro Aquifer across the Brien property. TGI estimates that the Simsboro water levels would rise between 475 and 650 feet above the top of the Simsboro. The difference in the estimated top of the Simsboro Aquifer could result in a difference of about 100 feet in the estimate of the amount of artesian head available above the top of the Simsboro Aquifer. AGS considers these differences to be worth mentioning but not overly consequential for the purposes of this report.

Simsboro Aquifer Wells Within 1-mile of the Proposed Wells

Rule 8.4(b)(7)(B)(2)

Six (6) BVGCD permitted or registered wells were identified in Table 2 of the Aquifer Evaluation Report. Table 2 includes data on each registered or permitted well screening the Simsboro Aquifer located within one mile of the proposed wells and generally includes most of the required information for the wells. Ideally, the top and bottom of the screen interval would be shown in the Screen Depth column, if available. Based on the information provided in Table 2, the well listed with a NULL registration or permit number could potentially be BVR-1503. BVR-1503 is discussed later in this section.

A map showing the location of the proposed wells and the BVGCD registered or permitted wells within one mile of the proposed wells is included as Figure 2 in the Aquifer Evaluation Report. We would recommend labeling each well with the permit or registration number. AGS has included a map with the wells labeled as Figure 2 below.

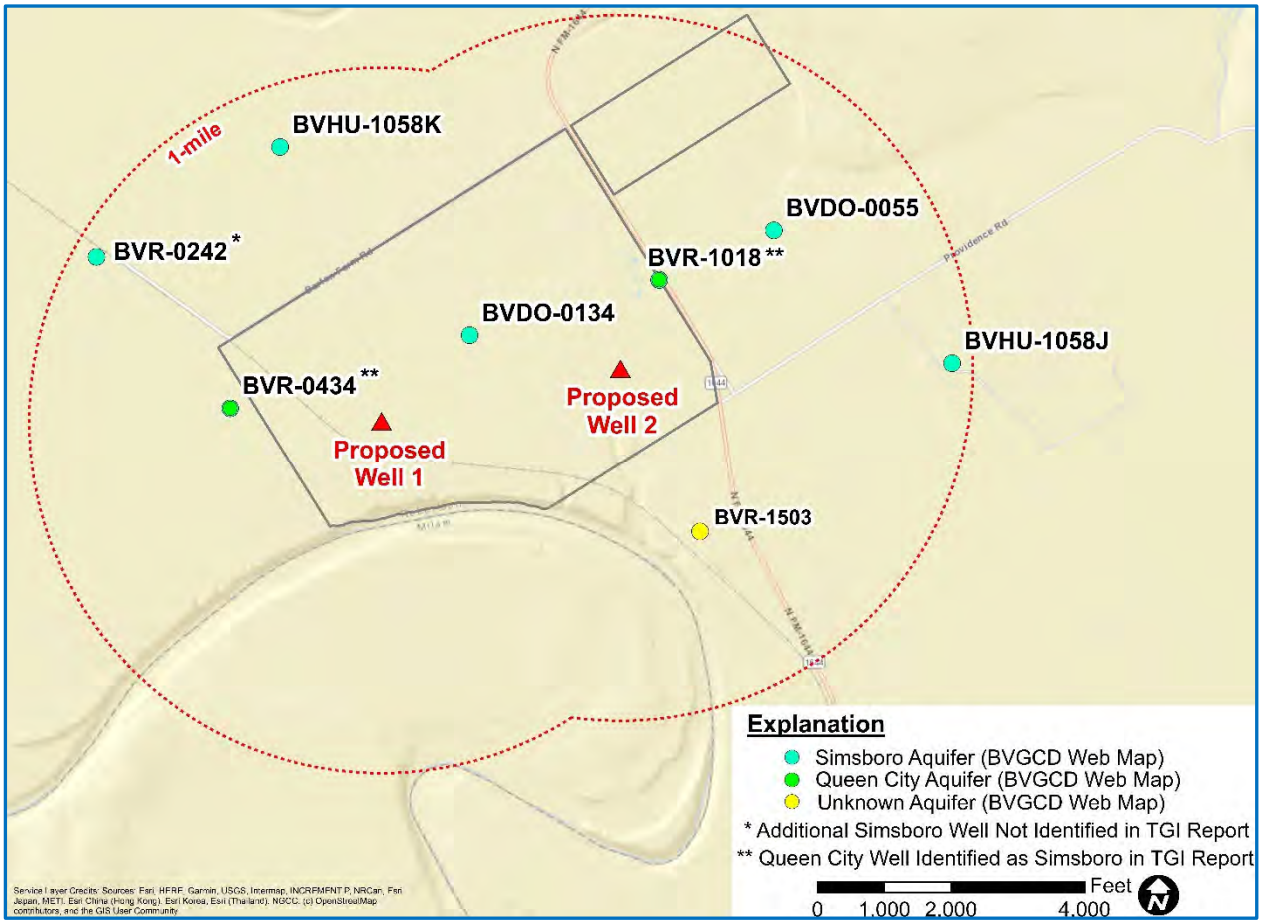


Figure 2. Map of Wells Near the Proposed Wells

The six (6) permitted or registered wells identified within one mile of the proposed wells were compared to wells shown on the BVGCD Groundwater Management Application Public Web Map (https://brazosvalleygcd.halff.com/default.aspx). Table 2 from the TGI report includes two wells listed as Simsboro that are identified as Calvert Bluff on the BVGCD Web Map (BVR-0434, and BVR-1018).

BVR-0242 is identified as a Simsboro well on the BVGCD Web Map and is located within one mile of the proposed Brien 1 well location. BVR-0242 is not included in Table 2 of the TGI report or shown on Figure 2 in the Aquifer Evaluation Report. The BVR-0242 State of Texas Well Report (Tracking Number 495742) shows the well screened interval as 587 to 607 feet below ground level (-302 to -322 feet rsl), which would indicate that the well is completed in the Simsboro. BVR-0242 is subsequently not included in the model simulation discussion or results.

BVR-1503 is shown as a well with an unknown aquifer on the BVGCD Web Map. The depth of the well would fit with the Simsboro Aquifer in the area; however, water level data collected this past summer does not correlate with other Simsboro wells in the area.

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

Groundwater Availability Model Simulation

TGI used the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from pumping the two proposed wells continuously at a combined rate of 4,115 ac-ft/yr for one year and 10 years. The GAM simulations focus on isolating the effects of the proposed permitted pumping and do not include the impacts from other Simsboro pumping in BVGCD or regional impacts from pumping in areas surrounding BVGCD.

Figures 6 and 7 of the Aquifer Evaluation Report show simulated effects after one year and 10-years of pumping, respectively. The TGI 10-year GAM simulated interference drawdown is estimated to be about 20 to 50+ feet within one mile from the proposed wells and about less than five feet to 13 feet at a distance of five miles from the proposed wells, depending on the direction from the proposed wells. A copy of the TGI 10-year GAM simulated interference drawdown illustration from the Aquifer Evaluation Report (Figure 7) is attached to this memorandum. The GAM estimated drawdown contours to the northwest appear to be influenced by a fault included in the GAM, which is in the same general area as a fault that has been mapped recently by GWC and AGS.

Table 1 from the Aquifer Evaluation Report shows GAM simulated one year and 10-year drawdown estimates at BVGCD permitted and registered Simsboro wells within a five-mile radius of the proposed wells. The GAM simulated drawdown values shown in TGI Table 1 were spot checked against the drawdown contours shown on TGI Figures 6 and 7 of the Aquifer Evaluation Report.

The TGI report did not discuss the GAM simulation methodology, including how much pumping was placed at each model node. To check the results, AGS performed a GAM simulation using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020) with each of the proposed wells pumping the requested annual permit allocation (Brien Well 1: 2,186 ac-ft/yr at Node 159438; Brien Well 2: 1,929 ac-ft/yr at Node 159940). The AGS GAM simulation results after one year and 10 years of pumping 4,115 ac-ft/yr show that drawdown estimates are about 5 to 10 feet less than what is reported in the TGI simulation. AGS reserves the right to perform additional model simulations in the future and review the results.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. A transmissivity value of 65,000 gallons per day per foot (gpd/ft) and storativity value of 0.0001 were used at both well locations to simulate drawdown after one year and 10 years of pumping. Table 1 provided in the Aquifer Evaluation Report shows simulated one year and 10-year drawdown estimates at BVGCD

permitted and registered Simsboro wells within a five mile radius of the proposed wells based on the analytical modeling. AGS verified TGI calculations using a Theis based tool.

Estimated Long-term impacts at wells based on GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the two proposed wells, AGS plotted the simulated water level decline at the proposed well locations based on results from the 2021 Groundwater Management Area (GMA) 12 Desired Future Conditions (DFC) water level projections for the Simsboro Aquifer. The water level projections shown on the graphs in Figure 3 below are from the TWDB approved DFC run (GMA 12 "S-19") but do not include the local impacts from the proposed wells included in the Aquifer Evaluation Report nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the Modeled Available Groundwater (MAG). The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

Figure 3. Projected DFC Water Level Decline at the two proposed wells.

The graph illustrates the relationship between the land surface, estimated static water level through time, and the estimated top and bottom of the Simsboro Aquifer at the location of the two proposed wells. Available drawdown in wells in the Simsboro will decline over time based on the DFC simulation. Pumping water levels in wells in areas of concentrated pumping could be one hundred or more feet deeper than the estimated static water levels shown on Figure 3. Although not discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer.

TGI's report makes note of the testing observed by BVGCD representatives on March 18, 2009. For clarification, BVGCD representatives (LBG-Guyton Associates John Seifert) observed short term pumping (15-20 minutes) of the irrigation wells with flow meter readings of about 3,000 gpm on March 18, 2009.

Conclusions

The submitted Aquifer Evaluation Report generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year. As required by the rules, the evaluation focuses on the proposed Brien wells pumping of 4,115 ac-ft/yr from the Simsboro Aquifer and does not include what could be the overall effects of all the pumping that could occur in the area.

Geoscientist's Seal:

The seal appearing on this document was authorized
by Christopher Drabek, P.G. 4564 on 2/6/2023.
Advanced Groundwater Solutions, LLC
TBPG Firm Registration No. 50639

References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

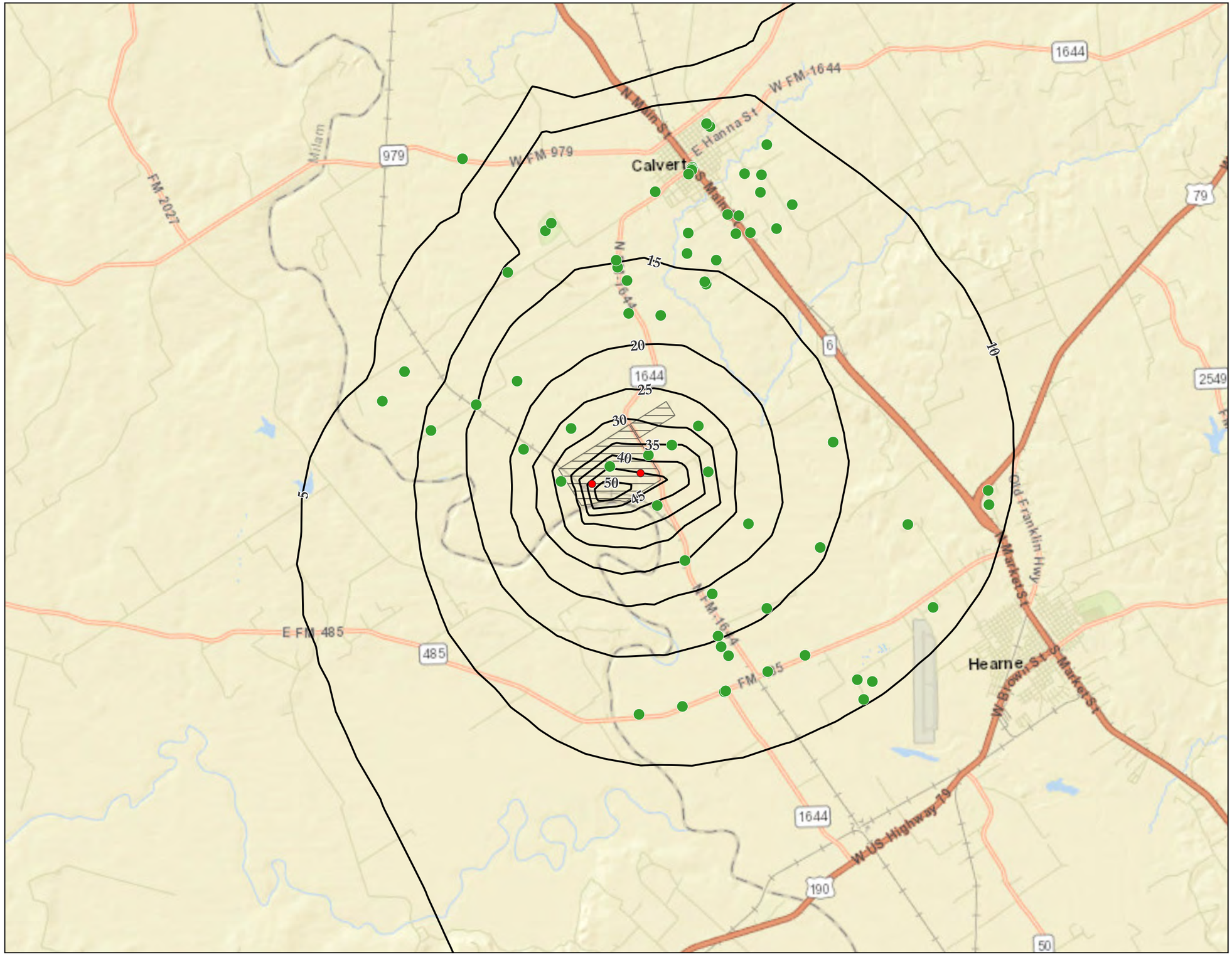


Figure 7:
10-Year QCSP GAM
Drawdown Contours

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Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of Cula d'Brazos LLC Simsboro Aquifer Evaluation Report

DATE: September 1, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application for Cula d'Brazos LLC (Cula d'Brazos) for seven proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 12,000 acre-feet per year (ac-ft/yr). The proposed wells are located on two properties with Property 1 located about 4.2 miles to the west-southwest of the City of Hearne and Property 2 is located about 3 miles southwest of the City of Hearne. The locations of the wells are shown on Figure 1. The AER dated July 28, 2023 was submitted to BVGCD on July 31, 2023. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new wells in the west part of Robertson County.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed Cula d'Brazos wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation report.

Proposed Cula d'Brazos LLC Wells

The seven proposed Cula d'Brazos wells have maximum production rates that range from 900 to 2,300 gallons per minute (gpm) and an annual permit allocation of 12,000 acre-feet. Table 1 below provides a summary of the maximum production rate in gpm and the annual permitted allocation in acre-feet for each of the proposed Cula d'Brazos wells.

Well	Maximum Production Rate (gpm)	Annual Permit Allocation (acre-feet)
1	2,200	2,839
2	2,300	2,968
3	1,000	1,290
4	950	1,226
5	900	1,161
6	900	1,161
7	1,050	1,355

Table 1. Proposed Cula d'Brazos LLC Well Maximum Production Rate and Annual Permit Allocation

The locations of the seven proposed Cula d'Brazos wells are shown below on Figure 1.

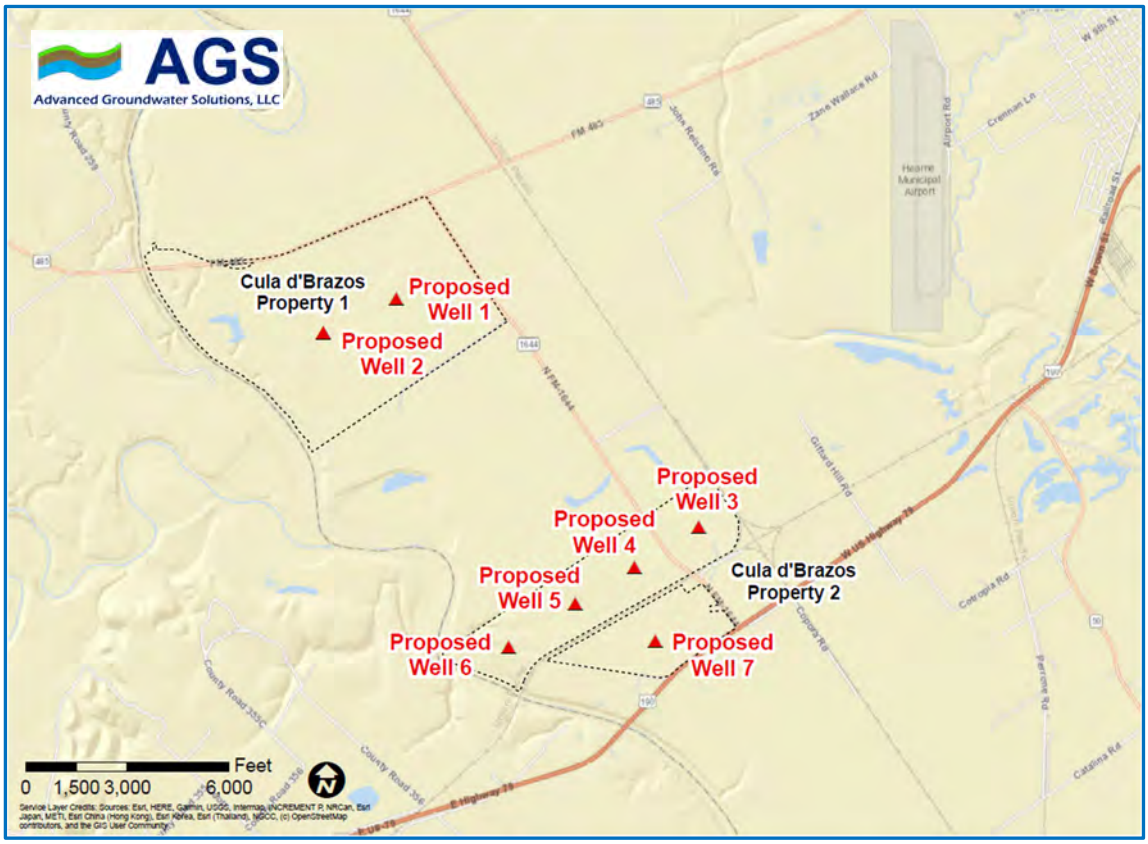


Figure 1. Proposed Cula d'Brazos LLC Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER estimates the top of the Simsboro Aquifer to occur at depths between 900 and 920 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 1,360 and 1,400 feet bgl in the vicinity of the proposed Cula d'Brazos wells at Property 1. TGI estimates the Simsboro Aquifer to occur in the approximate depth intervals of about 1,050 to 1,650 feet bgl at Cula d'Brazos Property 2.

AGS reviewed available electric log data in the vicinity of the proposed Cula d'Brazos wells and estimates that the top of the Simsboro Aquifer to occur at depth of about 910 feet bgl and the base of the Simsboro Aquifer to occur a depth of about 1,280 feet near the Cula d'Brazos Property 1. AGS estimates the top of the Simsboro Aquifer to occur at depths between about 1,045 and 1,080 feet bgl and the base of the Simsboro Aquifer to occur at depths between about 1,430 and 1,490 feet bgl in the vicinity of Cula d'Brazos Property 2.

Site specific information will be available once the test holes are drilled and logged for each of the proposed Cula d'Brazos wells.

Simsboro Aquifer Wells Within 1-mile of the Proposed Cula d'Brazos Wells

Rule 8.4(b)(7)(B)(2)

Table 1 in the TGI AER provides information on the BVGCD permitted or registered Simsboro wells within one mile of the proposed Cula d'Brazos wells and locations of the permitted or registered wells are shown on Figures 6, 6a, 6b, 6c and 6d in the TGI AER. The table does not include information on the well screened interval.

AGS reviewed permitted and registered well data available from BVGCD and identified three additional BVGCD permitted wells that are located within 1-mile of the proposed Cula d'Brazos wells that were not included in Table 1 of the TGI AER. Table 2 below provides a summary of the additional permitted wells identified by AGS.

Permit	Permit Holder	Well
BVDO-0301	UW Brazos Valley Farm, LLC	PS8
BVDO-0350	Corpora Farms	10
BVDO-0351	Corpora Farms	11

Table 2. Addition BVGCD Permitted Wells Identified Within 1-mile of the Proposed Cula d'Brazos LLC Wells

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of up to five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed Cula d'Brazos wells at a combined rate of 12,000 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 8 and 9) are attached to this memorandum. Tables 1 and 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at most BVGCD permitted and registered Simsboro wells within a 1-mile and 5-mile radius of the proposed Cula d'Brazos wells. The TGI report did not discuss the GAM simulation methodology, but the TGI GAM model results appear to be reasonable based on AGS simulation verification runs.

In the AGS verification runs, two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 "S-19" Desired Future Condition (DFC) run and with the second simulation (the modified run) being identical to the baseline except that the requested 12,000 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year.

Table 3 below provides a summary of the AGS GAM simulated drawdown estimates at 1-Mile and 5-Miles from each pair of the proposed Cula d'Brazos wells after pumping 12,000 ac-ft/yr for 1-year and 10 years.

Cula d'Brazos Property	AGS GAM Simulated Drawdown After 1-Year of Pumping at 1-mile (feet)	AGS GAM Simulated Drawdown After 1-Year of Pumping at 5-miles (feet)	AGS GAM Simulated Drawdown After 10-Years of Pumping at 1-mile (feet)	AGS GAM Simulated Drawdown After 10-Years of Pumping at 5-miles (feet)
1	45-60	>10-33	50-65	12-39
2	44-60	18-26	50-65	23-32

Table 3. AGS GAM Simulated Drawdown After Proposed Cula d'Brazos Pumping of 12,000 ac-ft/yr for 1-Year and 10-Years

The AGS GAM simulations show slightly higher simulated drawdown than the TGI simulations, however the drawdown estimates in each simulation are generally within about 10 feet or less. AGS is showing higher estimated drawdown related to Cula d'Brazos Properties 1 and 2 in Table 3 above than what is shown in the TGI table on Page 7 of the AER. AGS has reviewed the combined effects of the proposed Fazzino pumping at distances of 1- and 5-miles from each pair of wells on the individual Cula d'Brazos properties.

The GAM estimated drawdown contours appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped by GWC and AGS using local geophysical logs and other hydrogeologic data.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. The TGI AER did not discuss the input parameters used in the analytical modeling.

AGS simulated the drawdown at the pumping wells using the Theis analytical model and estimated the drawdown at one foot from the well. A transmissivity of 71,807 gallons per day per foot (gpd/ft) and a storage value of 0.000149 were used in the AGS analytical simulations with each proposed Cula d'Brazos well pumping its average annual production rate. The transmissivity and storage values used in the AGS analytical simulations represent an average of the Simsboro Aquifer parameters in the GAM at the proposed Cula d'Brazos well locations.

AGS was able to generally recreate the 1-year simulation results of the TGI analytical modeling. The TGI 10-year analytical simulation appears to underestimate the drawdown compared to simulations performed by AGS using the aquifer parameters as described above. Simulated drawdown could be less if TGI used a larger storage value in the 10-year simulation. Figure 2 below shows the estimated AGS analytical modeling drawdown contours that result from pumping 12,000 ac-ft/yr for 10-years.

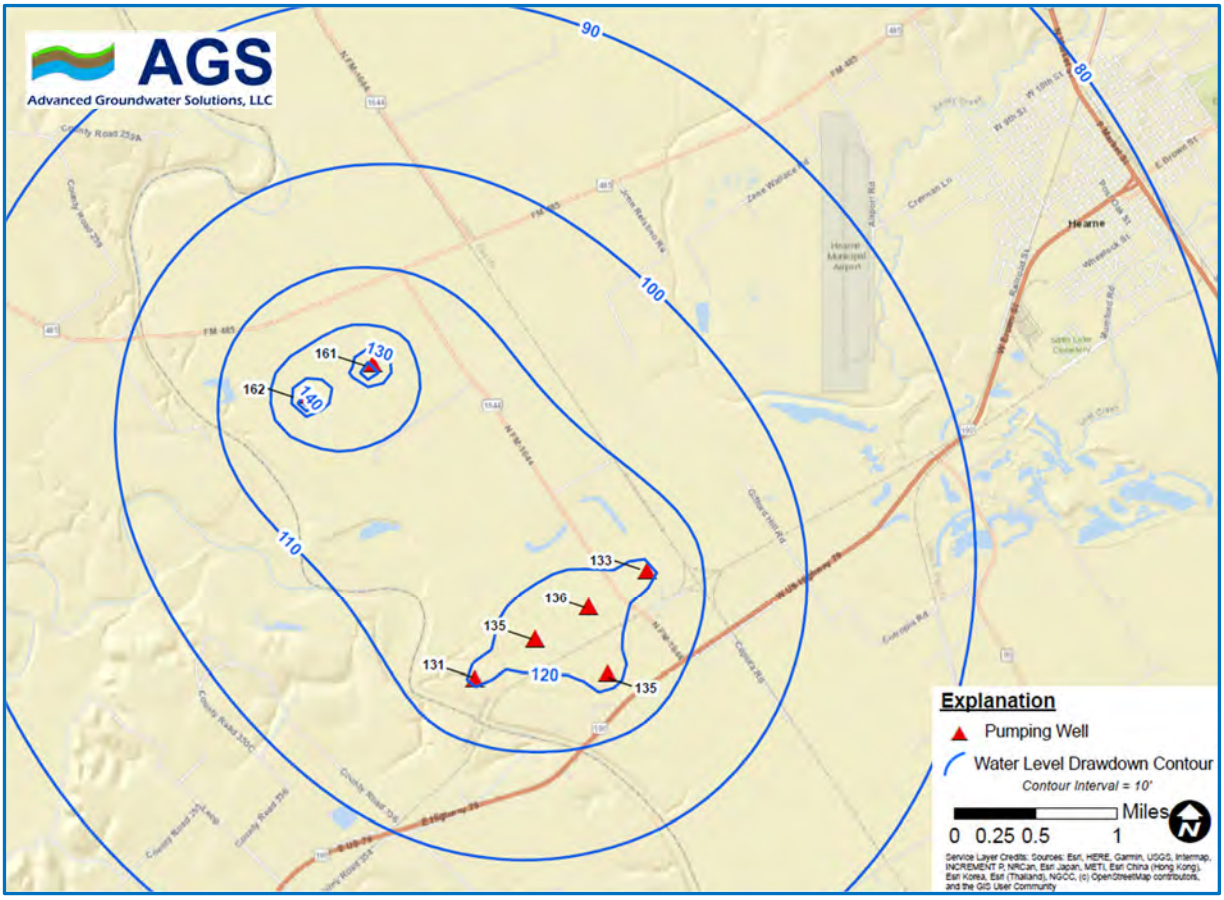


Figure 2. AGS Theis Analytical Simulated Drawdown After Proposed Cula d'Brazos LLC Pumping of 12,000 ac-ft/yr for 10-Years

Table 3 below provides a summary of the AGS simulated drawdown estimates at 1-foot from each of the proposed Cula d'Brazos wells after pumping 12,000 ac-ft/yr for 1-year and 10 years.

Well	AGS Simulated Drawdown After 1-Year of Pumping (feet)	AGS Simulated Drawdown After 10-Years of Pumping (feet)
1	133	161
2	135	162
3	105	133
4	109	136
5	108	135
6	103	131
7	107	135

Table 3. AGS Theis Analytical Simulated Drawdown at the Proposed Cula d'Brazos LLC Wells After 1-Year and 10-Years of Pumping 12,000 ac-ft/yr

Estimated Long-term impacts at the Proposed Cula d'Brazos LLC Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Cula d'Brazos wells, AGS plotted the simulated water level decline at each well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown on the attached Figures 3 through 9. The water level projections shown in the attached figures are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed Cula d'Brazos wells included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

The graphs illustrate the relationship between the land surface, estimated static water level through time and the estimated base of the Simsboro Aquifer based on review of available local electric logs near the locations of the proposed Cula d'Brazos wells.

Water levels available from a private domestic well (BVGCD BVR-1506) are shown on Figure 3. The well screen sands of the Simsboro Aquifer and the total depth of the well is 1,250 feet bls. BVR-1506 is located about 0.6 miles north-northeast of proposed Cula d'Brazos Well 1. Water levels available from the City of Hearne Well 5 (BVGCD BVHU-0014) are shown on Figure 5. The well screen sands of the Simsboro Aquifer in the depth interval of about 1,128 to 1,275 feet below land surface. BVHU-0014 is located about 3.7 miles northeast of proposed Cula d'Brazos Well 3.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. In other words, the line with green dots does not include the impact of the proposed Cula d'Brazos wells. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed wells will have some of the same type effects on the aquifer.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The TGI GAM simulations look reasonable and AGS was able to recreate the TGI simulation results. There are minor differences in the simulated drawdown estimated by TGI and AGS near the proposed Cula d'Brazos well locations, but these can most likely be attributed to differences in the approach to the GAM simulation(s).

AGS was able to generally recreate the TGI analytical simulation results of pumping the requested permitted amount of 12,000 ac-ft/yr for 1-year from the proposed Cula d'Brazos wells. The 10-year analytical simulation results in the TGI AER appear to underestimate the drawdown compared to simulations performed by AGS using the same aquifer parameters used in the 1-year simulations. The TGI simulated drawdown could be less if a larger storage value was used in the 10-year simulation.

AGS is documenting the differences but does not consider them to be major for the purposes of this report.

References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

Geoscientist's Seal:

The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on 9/1/2023.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)

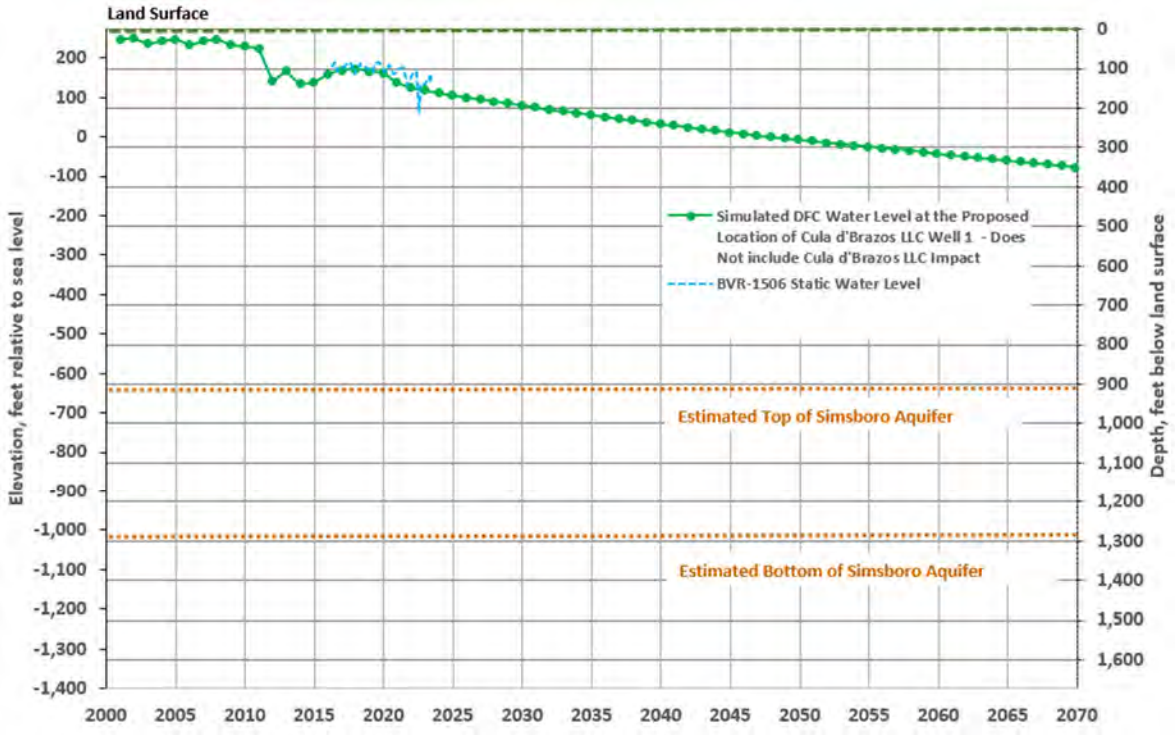


Figure 3. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 1

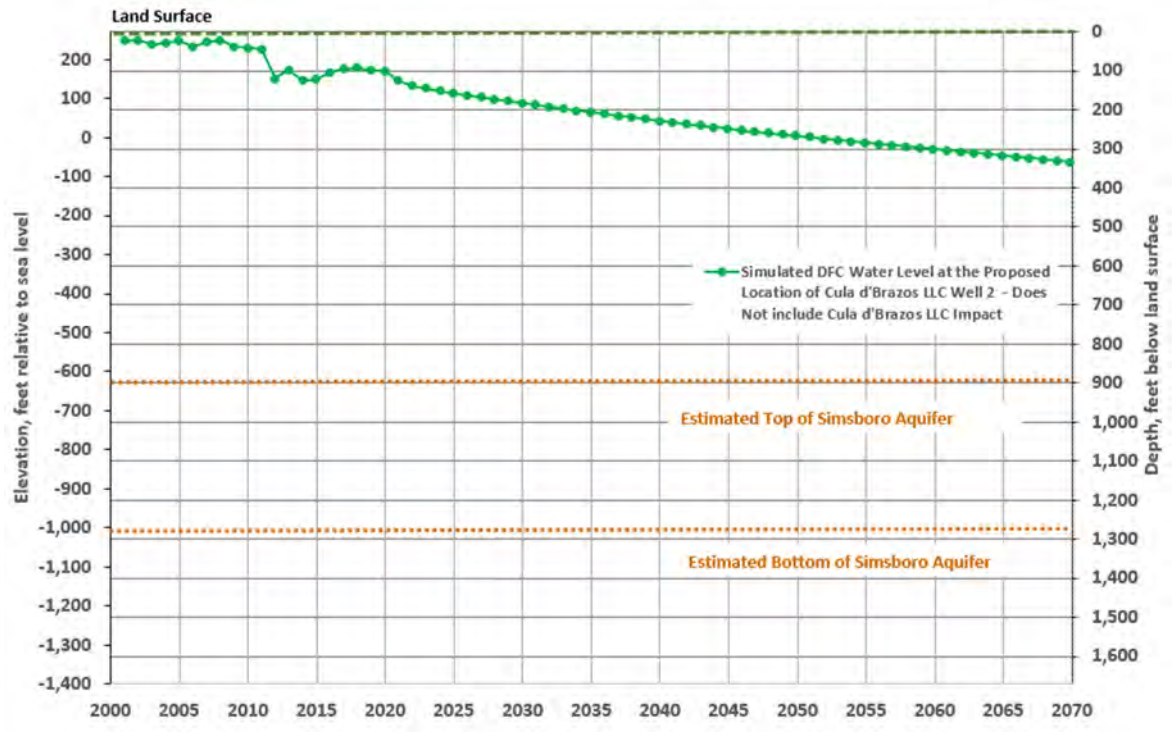


Figure 4. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 2

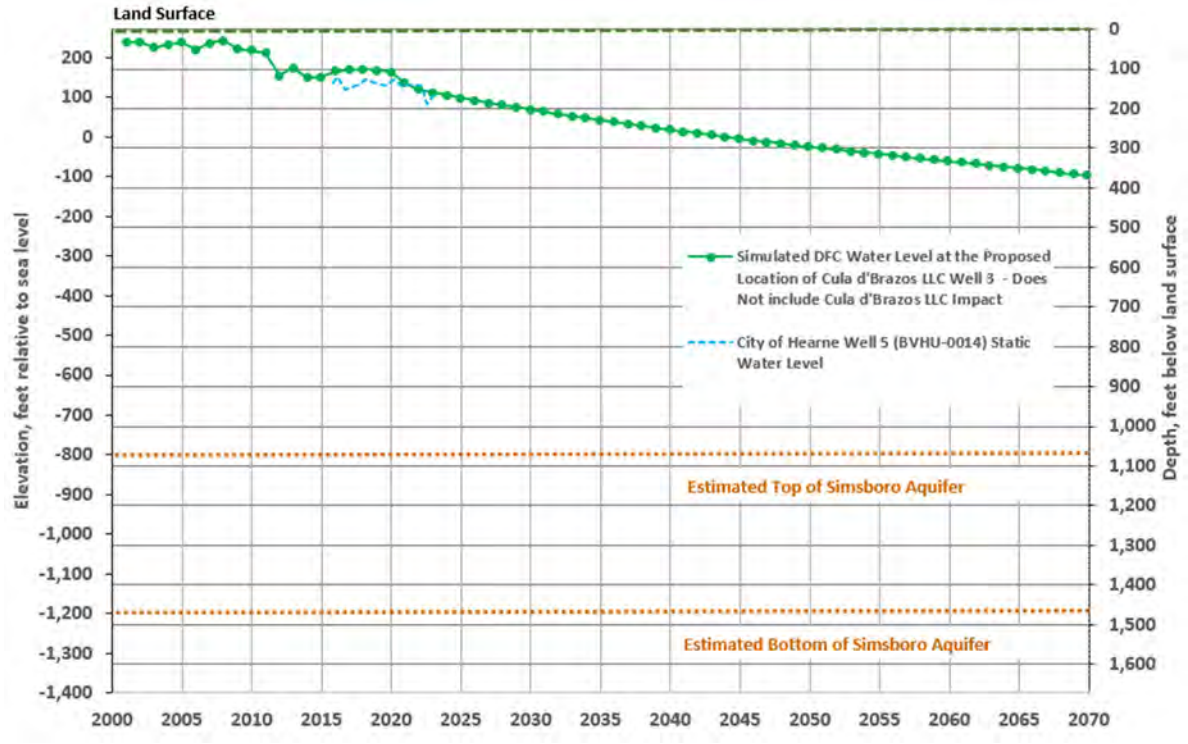


Figure 5. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 3

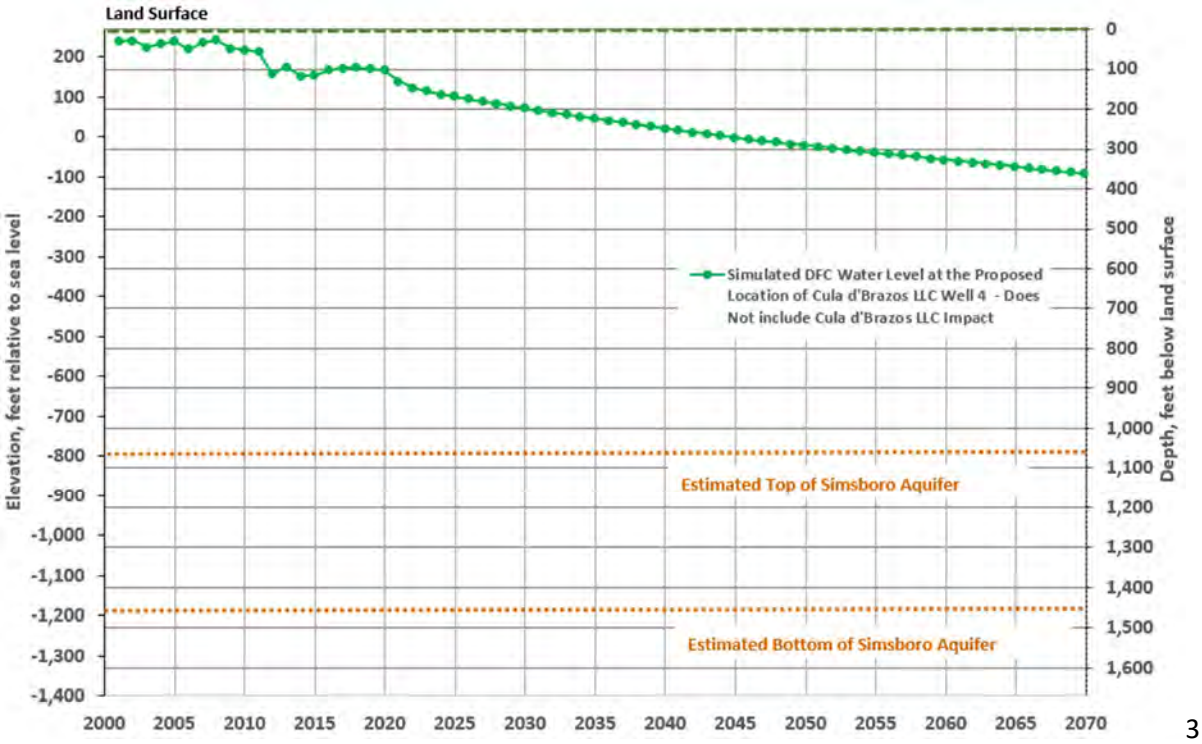


Figure 6. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 4

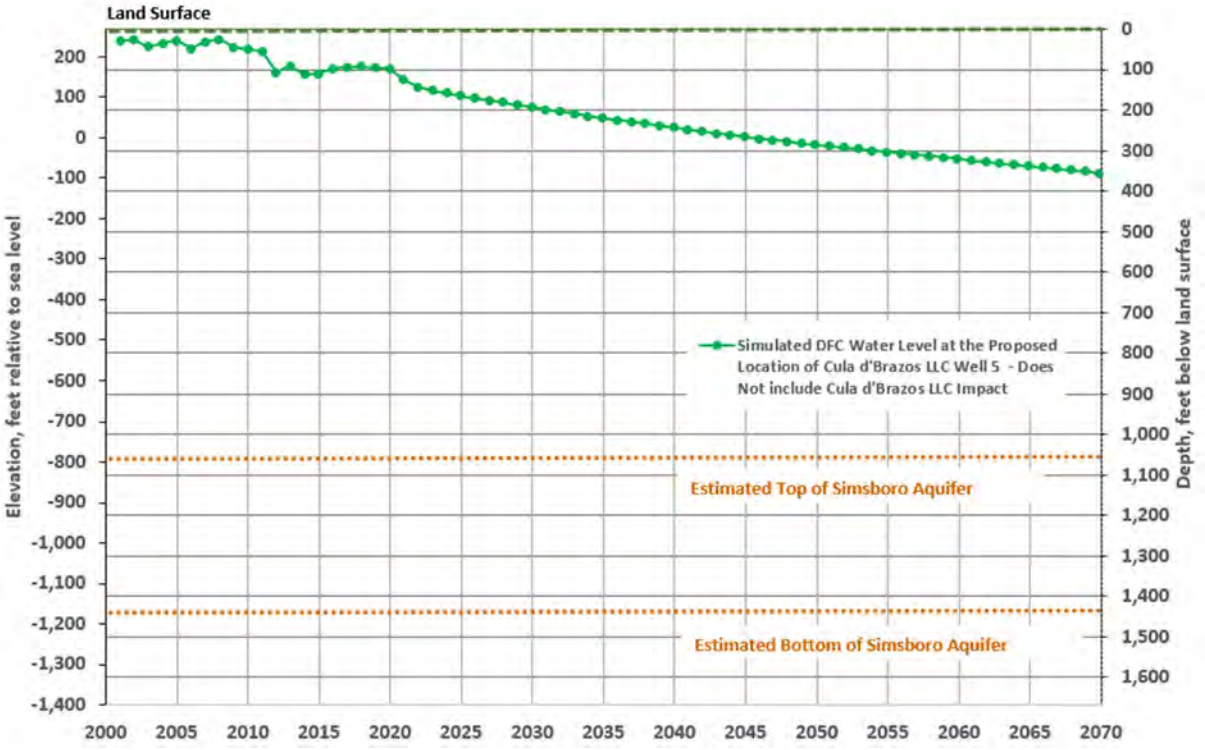


Figure 7. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 5

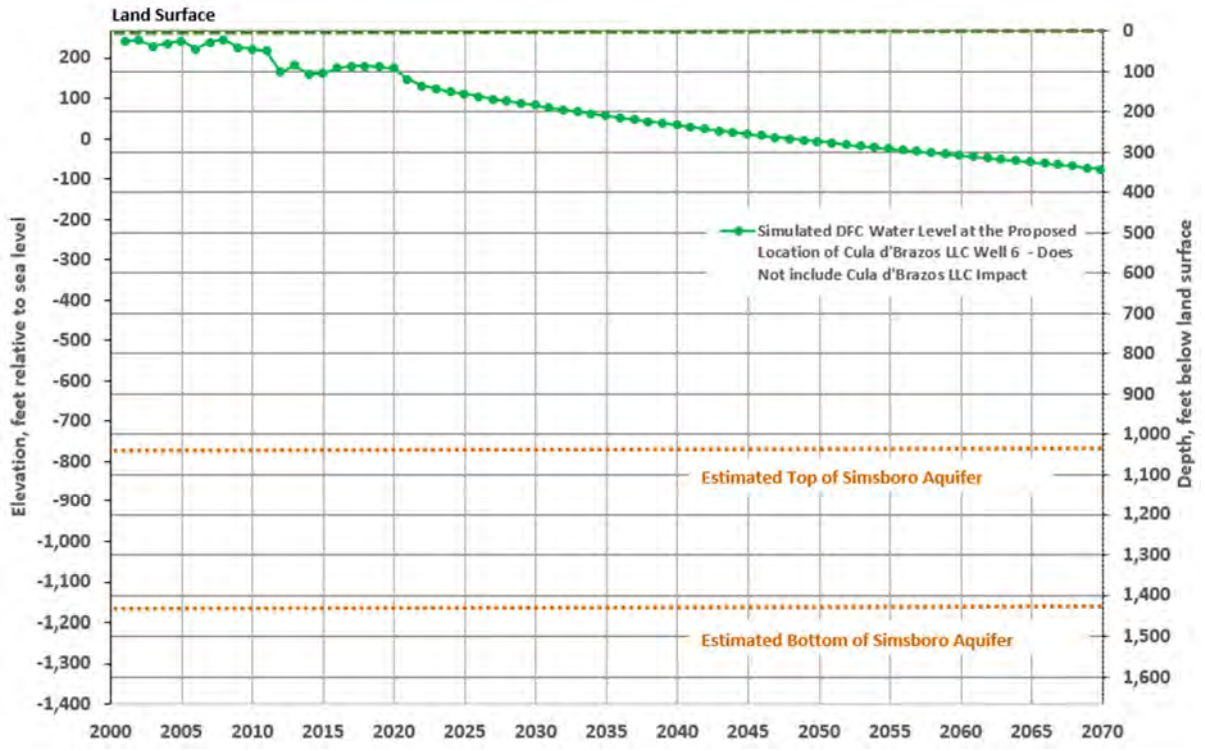


Figure 8. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 6

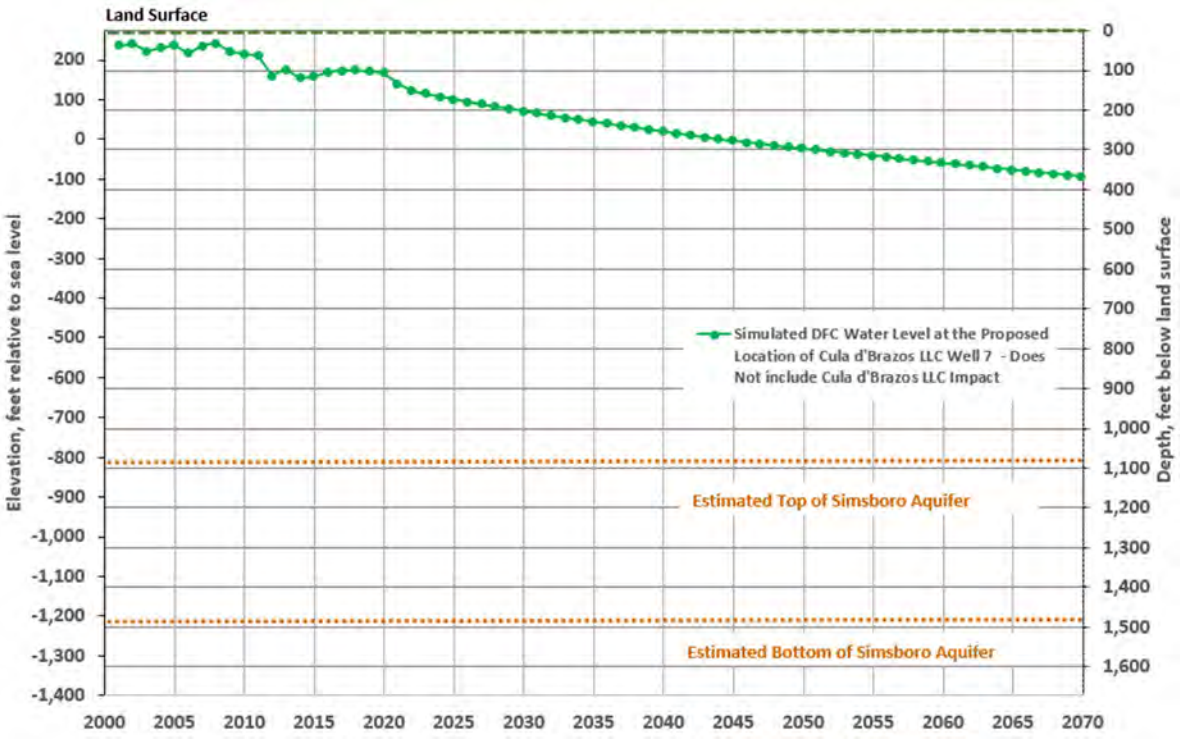
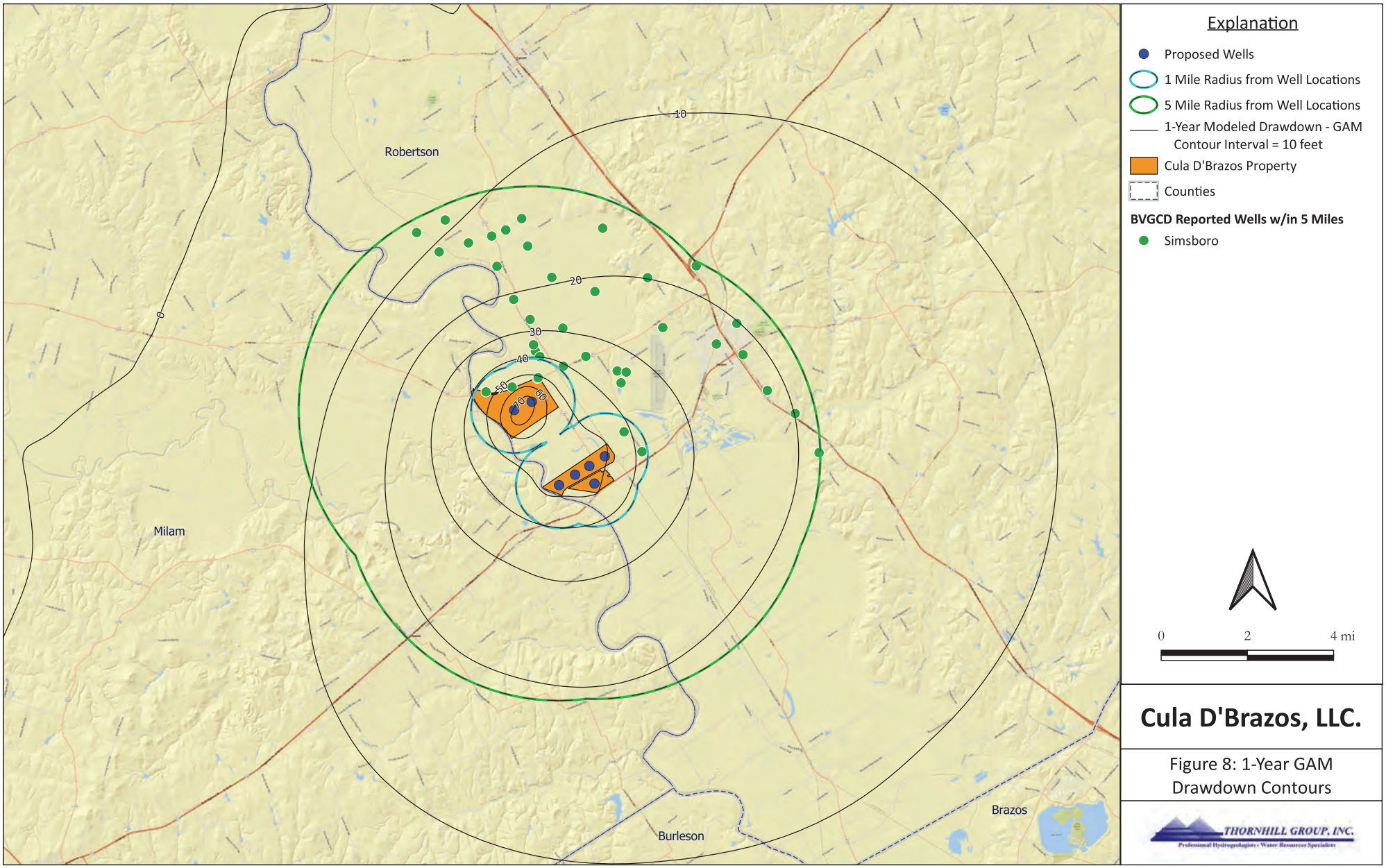


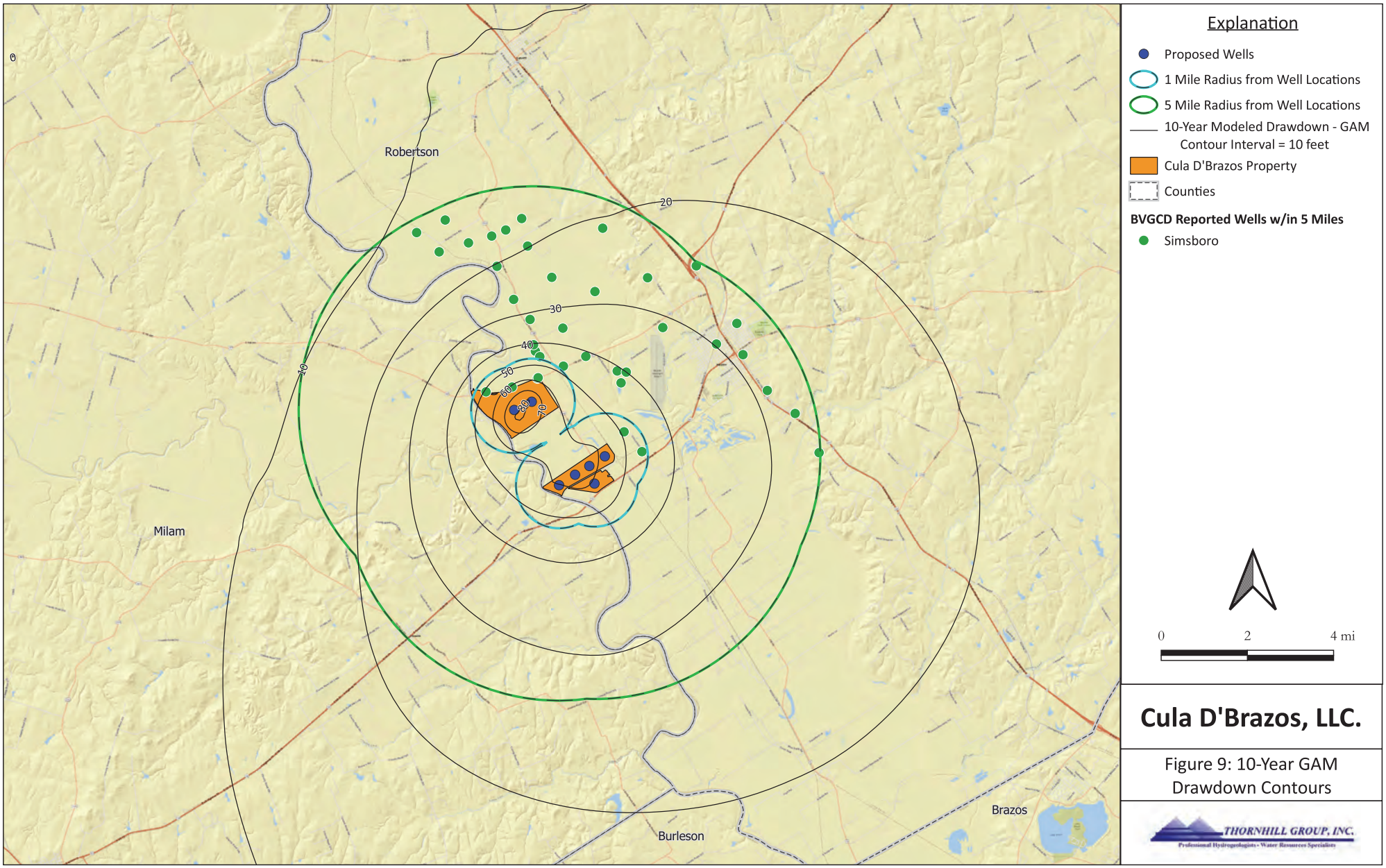
Figure 9. Projected DFC Water Level Change at Proposed Cula d'Brazos LLC Well 7



Cula D'Brazos, LLC.

Figure 8: 1-Year GAM Drawdown Contours

THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists


0
Robertson
Milam
Burleson
Brazos
10
20
30
40
50
60
80
70
Explanation
Proposed Wells
1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
10-Year Modeled Drawdown - GAM
Contour Interval = 10 feet
Cula D'Brazos Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
0
2
4 mi
Cula D'Brazos, LLC.
Figure 9: 10-Year GAM Drawdown Contours
THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists

Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of the Ely Family Partnership Simsboro Aquifer Evaluation Report

DATE: September 1, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application for the Ely Family Partnership (Ely) for eight proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 13,873 acre-feet per year (ac-ft/yr). There is a minor difference in the requested annual permit allocation described in the TGI AER, which is 13,872 ac-ft/yr. The proposed wells are located on multiple tracts of land with the farthest north proposed well located about 2.3 miles south of the City of Hearne and the farthest south proposed well located about 5.5 miles southeast of the City of Hearne. The locations of the wells are shown on Figure 1. The AER dated July 20, 2023 was submitted to BVGCD on July 21, 2023. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new wells in the west part of Robertson County.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed Ely wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation report.

Proposed Ely Family Partnership Wells

The eight proposed Ely wells have maximum production rates that range from 850 to 2,000 gallons per minute (gpm) and an annual permit allocation of 13,873 acre-feet. Table 1 below provides a summary of the maximum production rate in gpm and the annual permitted allocation in acre-feet for each of the proposed Ely wells.

Well	Maximum Production Rate (gpm)	Annual Permit Allocation (acre-feet)
1	1,150	1,484
2	2,000	2,581
3	850	1,097
4	1,600	2,065
5	1,100	1,419
6	1,600	2,065
7	1,400	1,807
8	1,050	1,355

Table 1. Proposed Ely Family Partnership Well
Maximum Production Rate and Annual Permit Allocation

The locations of the eight proposed Ely wells are shown below on Figure 1.

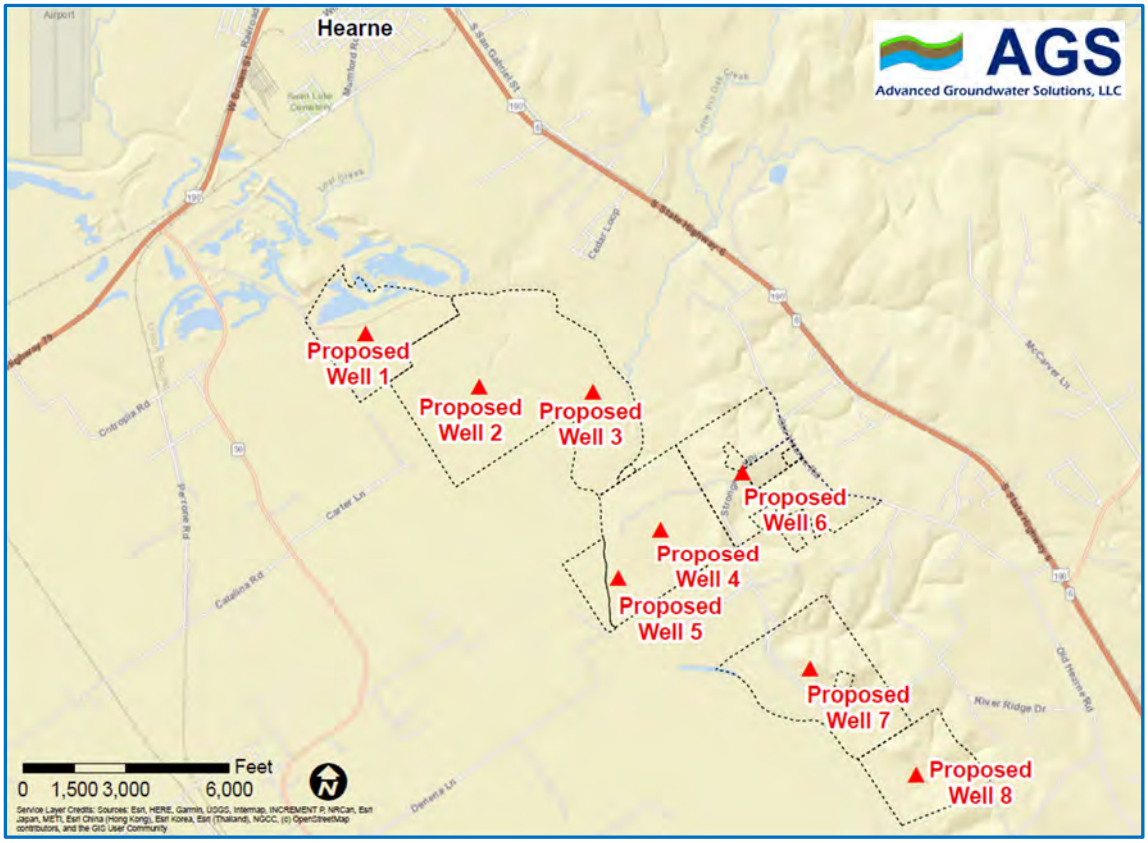


Figure 1. Proposed Ely Family Partnership Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER estimates the top of the Simsboro Aquifer to occur at depths between 1,270 and 1,700 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 1,800 and 2,300 feet bgl in the vicinity of the proposed Ely wells based on the GAM and Bureau of Economic Geology (BEG) mapping.

AGS estimates the top of the Simsboro Aquifer to occur at depths between about 1,340 and 1,650 feet bgl and the base of the Simsboro Aquifer to occur at depths between about 1,890 and 2,275 feet bgl in the vicinity of the proposed Ely wells based on the review of available local geophysical logs.

Site specific information will be available once the test holes are drilled and logged for each of the proposed Ely wells.

Simsboro Aquifer Wells Within 1-mile of the Proposed Ely Family Partnership Wells

Rule 8.4(b)(7)(B)(2)

Table 1 in the TGI AER provides information on the BVGCD permitted or registered Simsboro wells within one mile of the proposed Ely wells and locations of the permitted or registered wells are shown on Figures 6, 6a, 6b and 6c in the TGI AER. TGI Table 1 does not include information on the well screened interval.

AGS reviewed permitted and registered well data available from BVGCD and noted that the one BVGCD registered well (BVR-0390) identified in the TGI AER within 1-mile of the proposed Ely wells is listed as a Calvert Bluff well in the BVGCD database. AGS did not identify any additional BVGCD permitted or registered well(s) within 1-mile of the proposed Ely wells.

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of up to five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed Ely wells at a combined rate of 13,872 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 8 and 9) are attached to this memorandum. Tables 1 and 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at most BVGCD permitted and registered Simsboro wells within a 1-mile and 5-mile radius of the proposed Ely wells. As previously discussed, well BVR-0390 shown in the TGI AER Table 1 is currently listed as a Calvert Bluff well in the BVGCD database. Also, the latitude and longitude for the John Nigliazzo well (BVR-0571) is incorrect in TGI Table 2 and should be 30.85419698 / -96.55696673. BVR-0571 is also currently listed as a Calvert Bluff well in the BVGCD database.

The TGI report did not discuss the GAM simulation methodology, but the TGI GAM model results appear to be reasonable based on AGS simulation verification runs.

In the AGS verification runs, two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 “S-19” Desired Future Condition (DFC) run and with the second simulation (the modified run) being identical to the baseline except that the requested 13,873 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 “S-19” includes additional regional pumping, which gradually increases through time. GMA 12 “S-19” was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year.

The AGS GAM simulation results after 1 and 10 years of pumping 13,873 ac-ft/yr show about 22 to 35 feet of drawdown at 5 miles and about 48 to 58 feet of drawdown at 1 mile after 1-year of pumping and about 28 to 45 feet of drawdown at 5 miles and about 58 to 68 feet of drawdown at 1 mile after 10-years of pumping. The AGS GAM simulations show slightly higher simulated drawdown than the TGI simulations, however the drawdown estimates in each simulation are within about 10 feet or less.

The GAM estimated drawdown contours at distance appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped by GWC and AGS using local geophysical logs and other hydrogeologic data.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. The TGI AER did not discuss the input parameters used in the analytical modeling.

AGS simulated the drawdown at the pumping wells using the Theis analytical model and estimated the drawdown at one foot from the well. A transmissivity of 80,145 gallons per day per foot (gpd/ft) and a storage value of 0.000145 were used in the AGS analytical simulations with each proposed Ely well pumping its average annual production rate. The transmissivity and storage values used in the AGS analytical simulations represent an average of the Simsboro Aquifer parameters in the GAM at the proposed Ely well locations.

AGS was able to generally recreate the 1-year simulation results of the TGI analytical modeling. The TGI 10-year analytical simulation appears to underestimate the drawdown compared to simulations performed by AGS using the aquifer parameters as described above. Simulated drawdown could be less if TGI used a larger storage value in the 10-year simulation. Figure 2 below shows the estimated AGS analytical modeling drawdown contours that result from pumping 13,873 ac-ft/yr for 10-years.

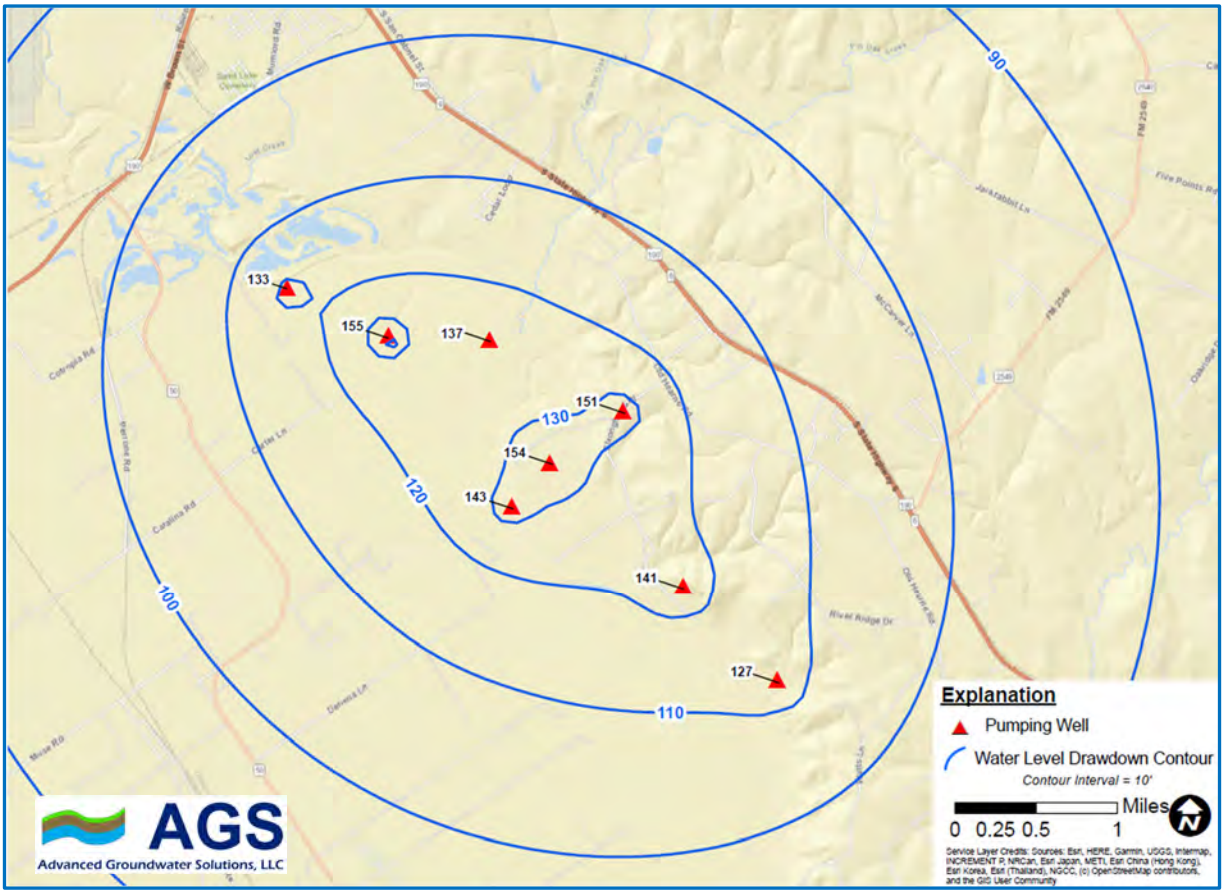


Figure 2. AGS Theis Analytical Simulated Drawdown After Proposed Ely Family Partnership Pumping of 13,873 ac-ft/yr for 10-Years

Table 2 below provides a summary of the AGS simulated drawdown estimates at 1-foot from each of the proposed Ely wells after pumping 13,873 ac-ft/yr for 1-year and 10 years.

Well	AGS Simulated Drawdown After 1-Year of Pumping (feet)	AGS Simulated Drawdown After 10-Years of Pumping (feet)
1	104	133
2	127	155
3	109	137
4	126	154
5	115	143
6	122	151
7	113	141
8	98	127

Table 2. AGS Theis Analytical Simulated Drawdown at the Proposed Ely Family Partnership Wells After 1-Year and 10-Years of Pumping 13,873 ac-ft/yr

Estimated Long-term impacts at the Proposed Ely Family Partnership Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Ely wells, AGS plotted the simulated water level decline at each proposed well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown on the attached Figures 3 through 10. The water level projections shown in the attached figures are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed Ely wells included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

The graphs illustrate the relationship between the land surface, estimated static water level through time and the estimated base of the Simsboro Aquifer based on review of available local electric logs near the locations of the proposed Ely wells.

Water levels available from the City of Hearne Well 5 (BVGCD Permit BVHU-0014) are shown on Figure 3. The well screen sands of the Simsboro Aquifer in the depth interval of about 1,128 to 1,275 feet below land surface. BVHU-0014 is located about 2.5 miles north-northwest of proposed Ely Well 1.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. In other words, the line with green dots does not include the impact of the proposed Ely wells. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed wells will have some of the same type effects on the aquifer.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The TGI GAM simulations look reasonable and AGS was able to recreate the TGI simulation results. There are minor differences in the simulated drawdown estimated by TGI and AGS near the proposed Ely well locations, but these can most likely be attributed to differences in the approach to the GAM simulation(s).

AGS was able to generally recreate the TGI analytical simulation results of pumping the requested permitted amount of 13,873 ac-ft/yr for 1-year from the proposed Ely wells. The 10-year analytical simulation results in the TGI AER appear to underestimate the drawdown compared to simulations performed by AGS using the same aquifer parameters used in the 1-year simulations. The TGI simulated drawdown could be less if a larger storage value was used in the 10-year simulation.

AGS is documenting the differences but does not consider them to be major for the purposes of this report.

References

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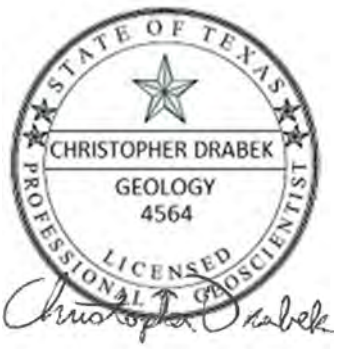


The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on 9/1/2023.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)

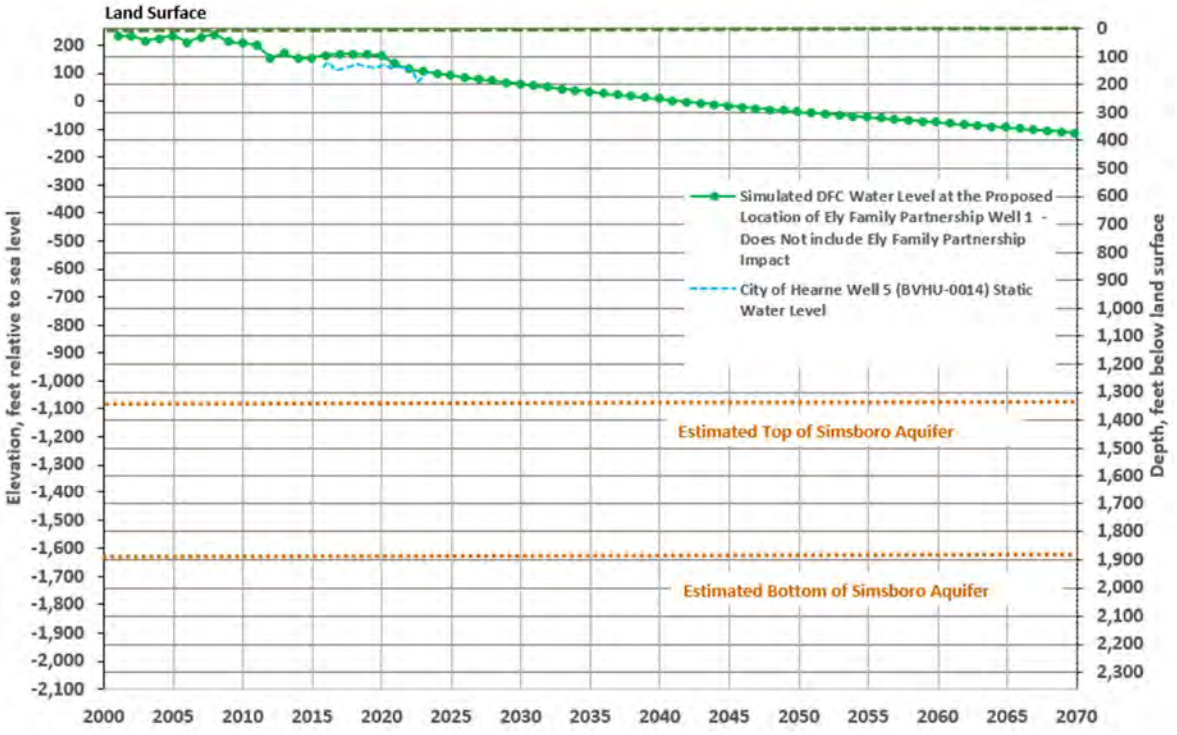


Figure 3. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 1

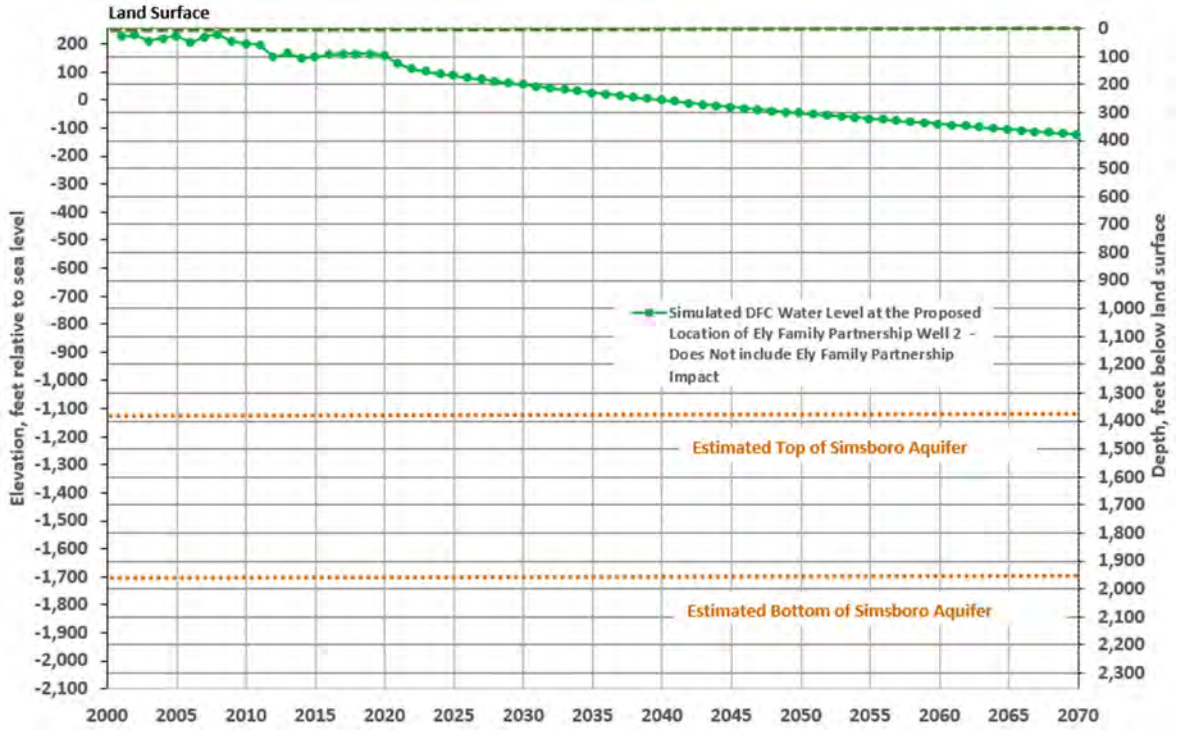


Figure 4. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 2

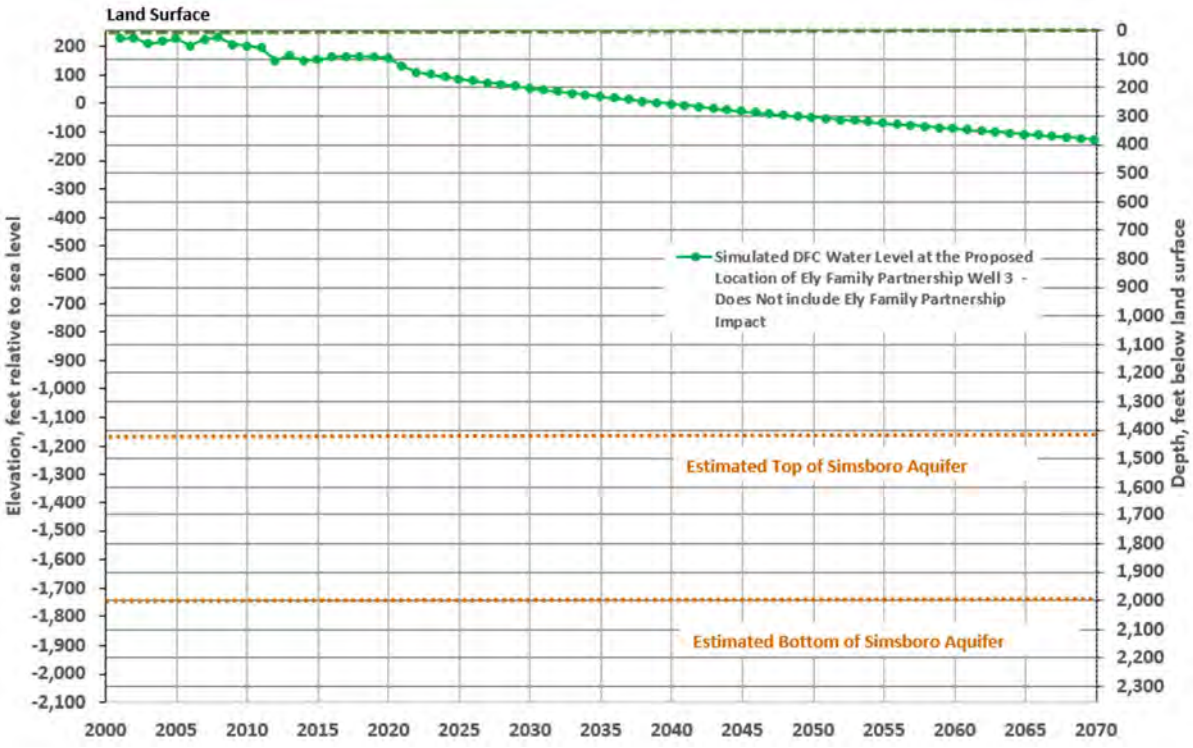


Figure 5. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 3

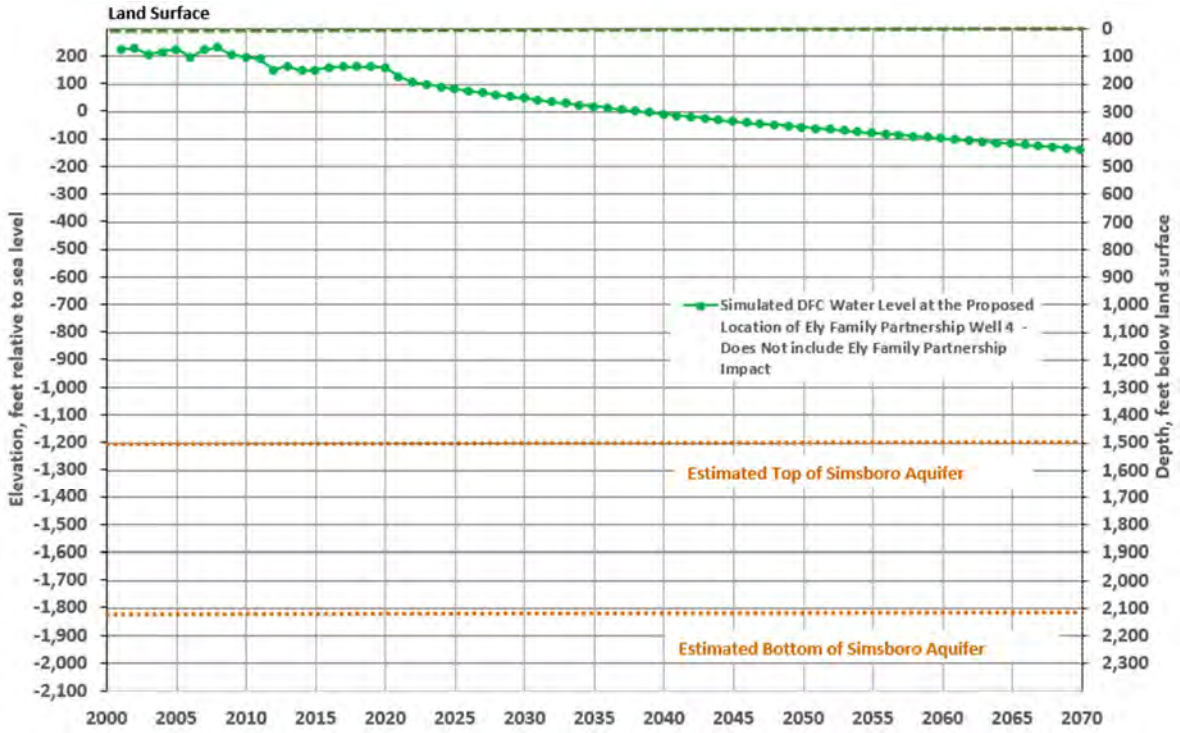


Figure 6. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 4

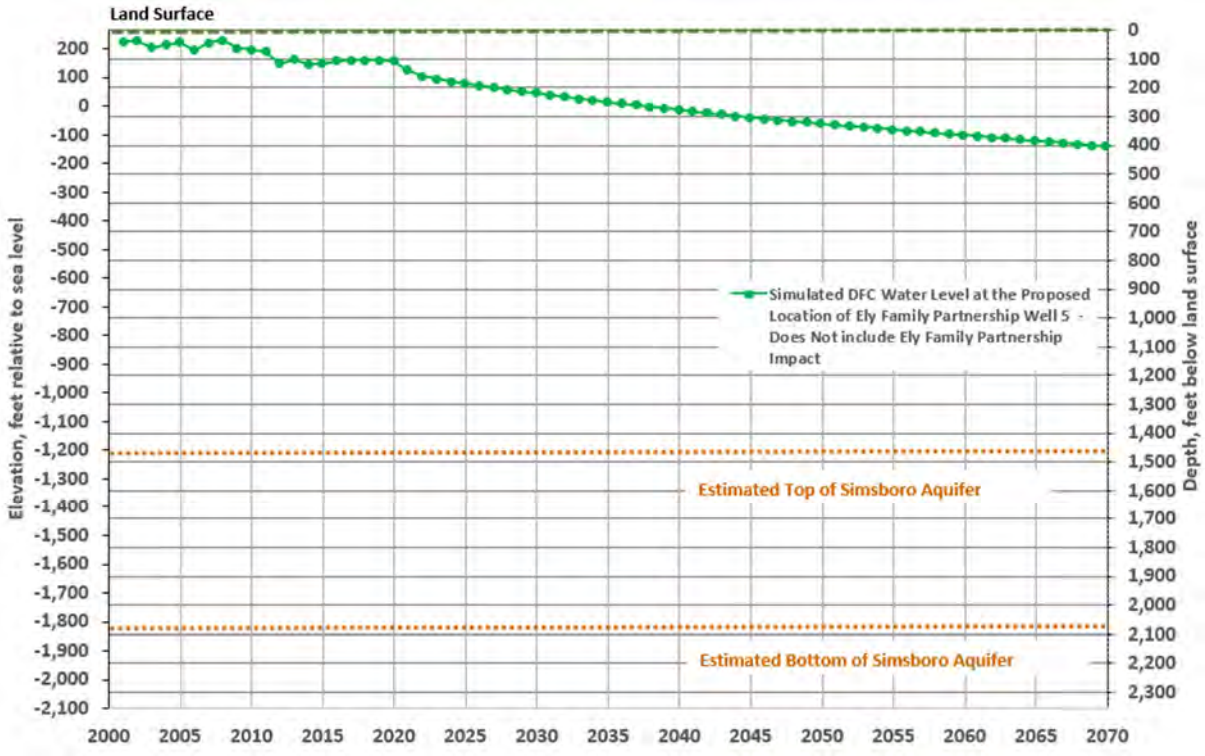


Figure 7. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 5

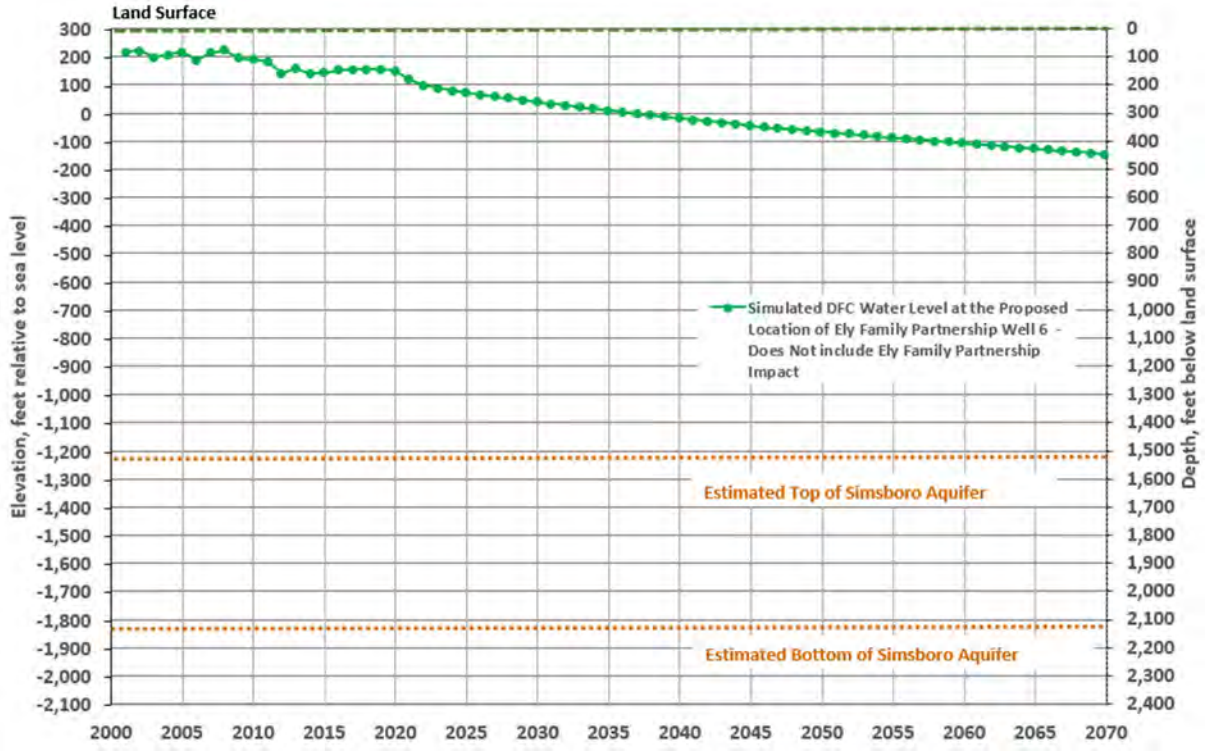


Figure 8. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 6

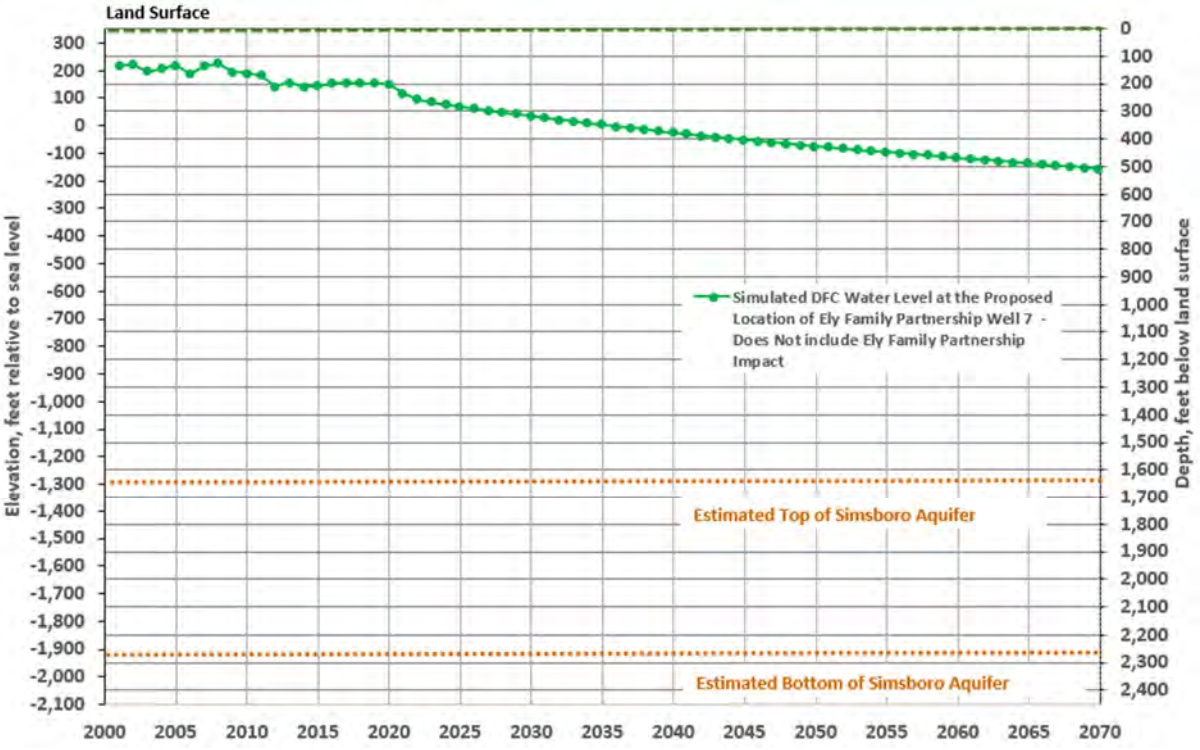


Figure 9. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 7

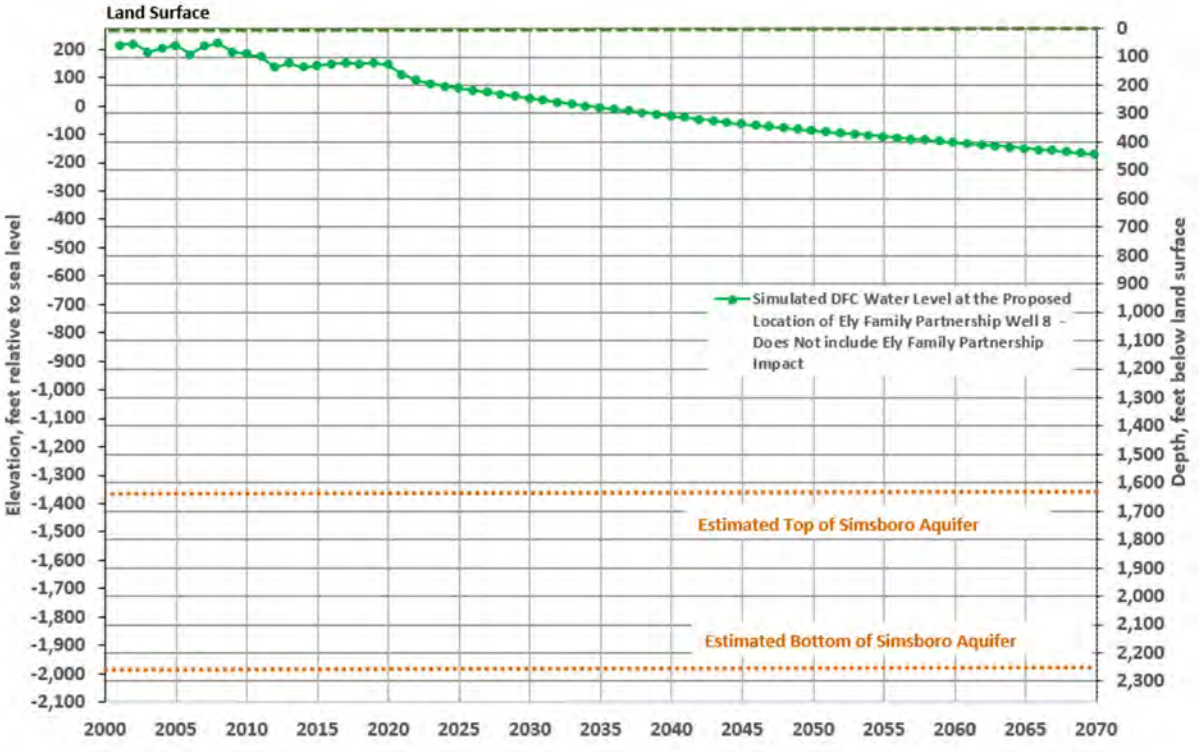
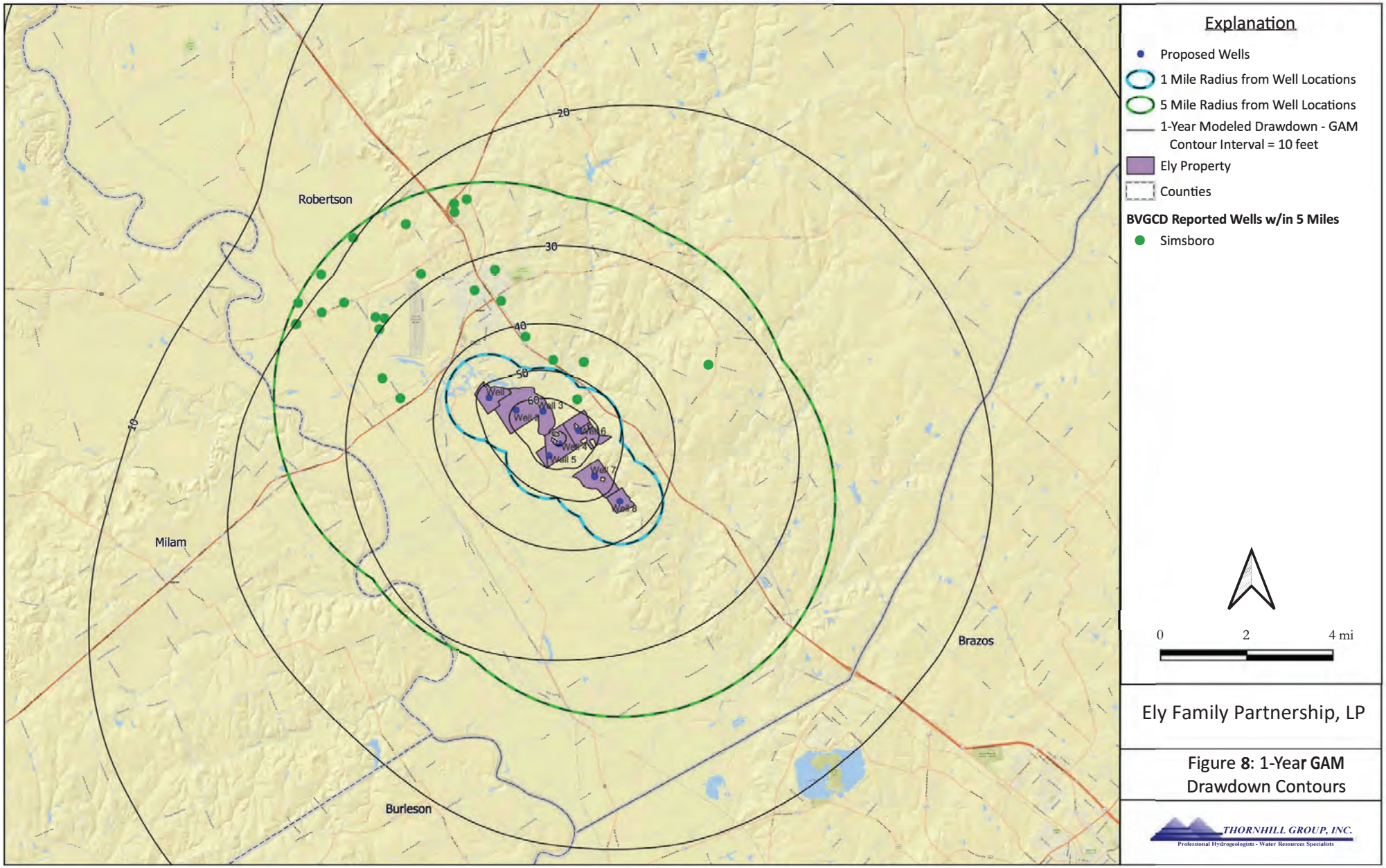


Figure 10. Projected DFC Water Level Change at Proposed Ely Family Partnership Well 8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1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
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Contour Interval = 10 feet
Ely Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
20
30
40
50
60
10
Robertson
Milam
Burleson
Brazos
Well 1
Well 2
Well 3
Well 4
Well 5
Well 6
Well 7
Well 8
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Ely Family Partnership, LP
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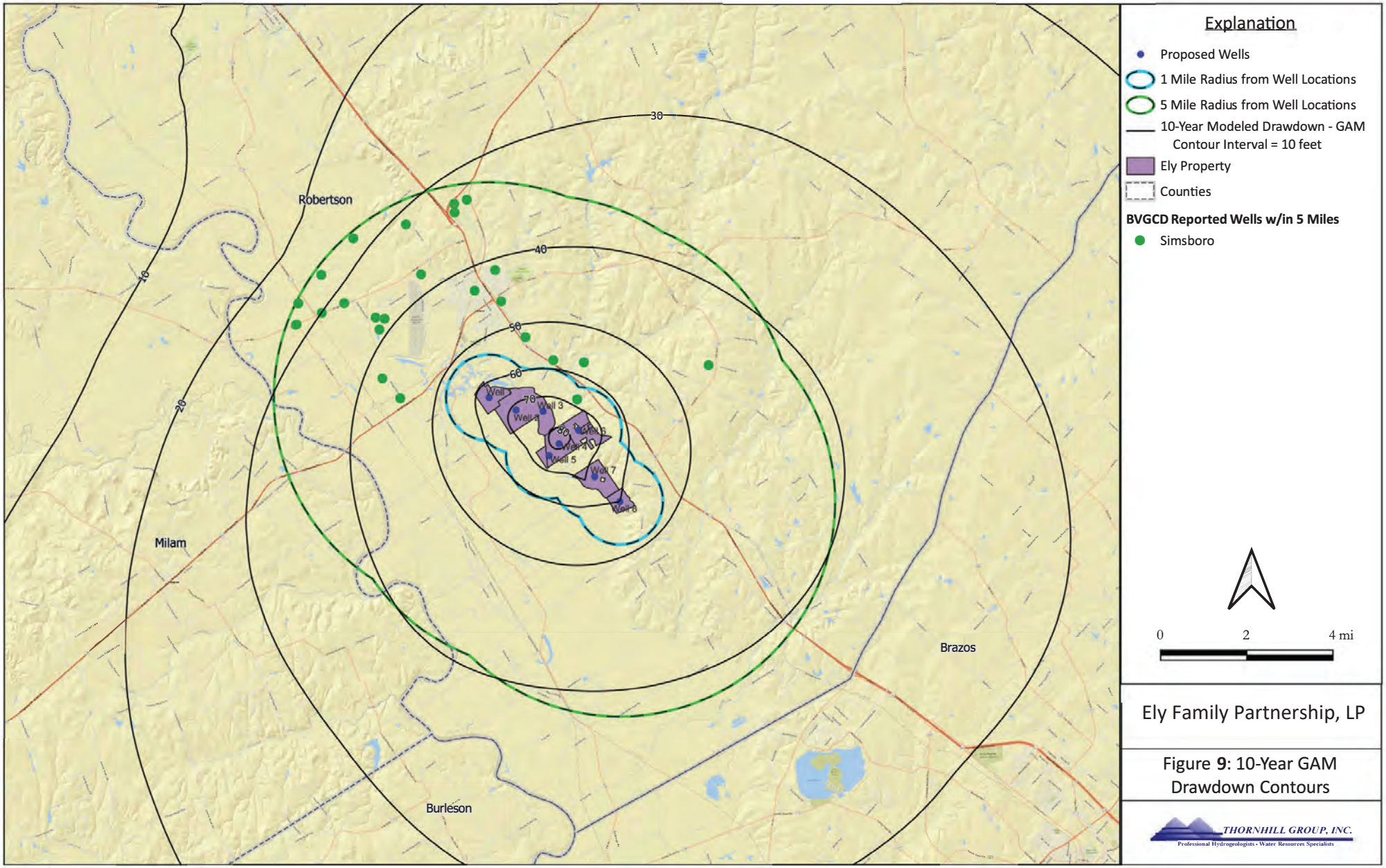
THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists



Ely Family Partnership, LP

Figure 9: 10-Year GAM Drawdown Contours

THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists

Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of the Fazzino Investments LP Simsboro Aquifer Evaluation Report

DATE: September 1, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application for Fazzino Investments LP (Fazzino) for six proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 10,348 acre-feet per year (ac-ft/yr). The proposed wells are located on three tracts of property with Property 1 located about 8.8 miles to the northwest of the City of Hearne, Property 2 located about 4 miles to the west of the City of Hearne and Property 3 located about 4 miles to the south of the City of Hearne. The locations of the three Fazzino properties and the proposed Fazzino wells are shown on Figure 1. The AER dated July 25, 2023 was submitted to BVGCD on July 26, 2023. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new wells in the west part of Robertson County.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed Fazzino wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation report.

Proposed Fazzino Investments LP Wells

The six proposed Fazzino wells have maximum production rates that range from 900 to 2,100 gallons per minute (gpm) and an annual permit allocation of 10,348 acre-feet. Table 1 below provides a summary of the maximum production rate in gpm and the annual permitted allocation in acre-feet for each of the proposed Fazzino wells.

Well	Maximum Production Rate (gpm)	Annual Permit Allocation (acre-feet)
1	1,000	1,290
2	1,000	1,290
3	2,100	2,710
4	2,100	2,710
5	920	1,187
6	900	1,161

Table 1. Proposed Fazzino Investments LP Well
Maximum Production Rate and Annual Permit Allocation

The locations of the six proposed Fazzino wells are shown below on Figure 1.

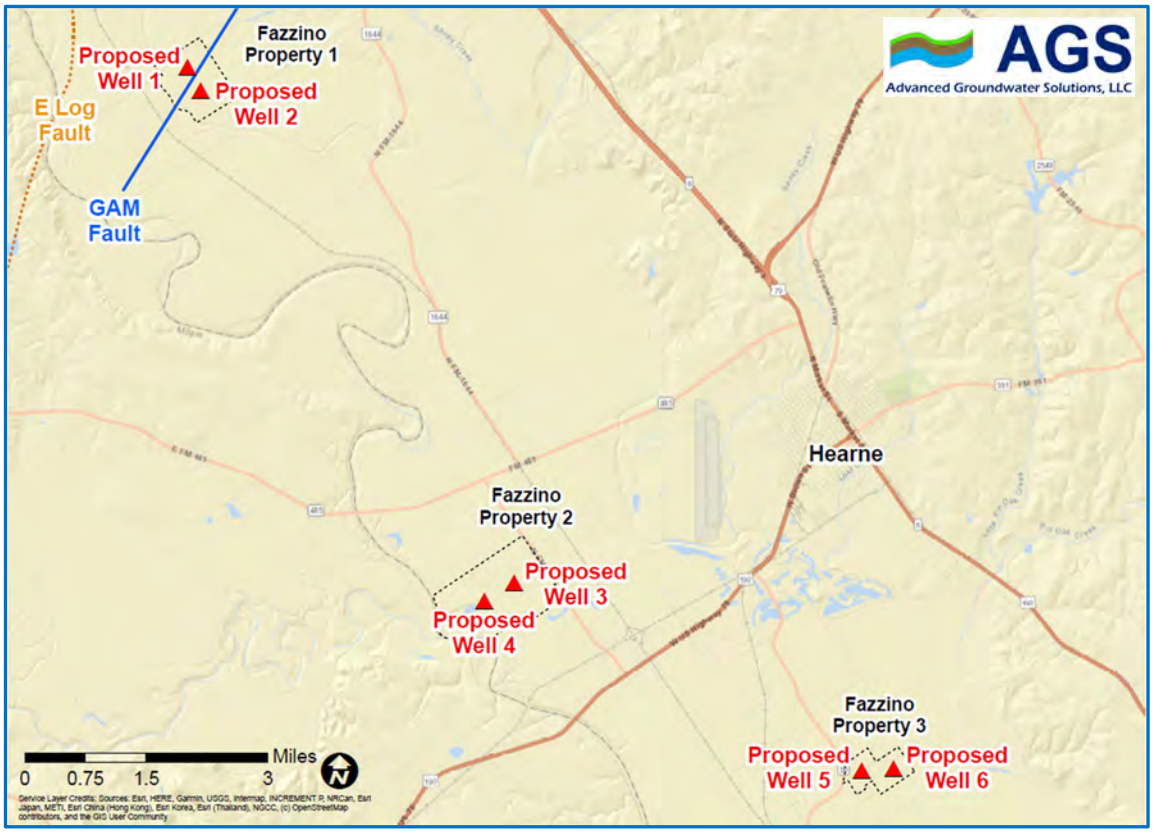


Figure 1. Proposed Fazzino Investments LP Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER estimates the top of the Simsboro Aquifer to occur at depths between 360 and 390 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 820 and 840 feet bgl in the vicinity of the proposed Fazzino wells. TGI estimates the Simsboro Aquifer to occur in the approximate depth intervals of about 970 to 1,480 feet bgl and about 1,355 to 1,965 feet bgl at Fazzino Properties 2 and 3, respectively.

AGS reviewed available electric log data in the vicinity of the proposed Fazzino wells and estimates that the top of the Simsboro Aquifer to occur at depth of about 300 feet bgl and the base of the Simsboro Aquifer to occur a depth of about 785 feet near the Fazzino Property 1. AGS estimates the Simsboro Aquifer to occur in the approximate depth intervals of about 975 to 1,560 feet bgl and about 1,440 to 2,020 feet bgl at Fazzino Properties 2 and 3, respectively.

Site specific information will be available once the test holes are drilled and logged for each of the proposed Fazzino wells.

TGI mentions faulting that has been inferred by TWDB/BEG mapping about 5 to 7 miles north of Fazzino Property 1 and that if present could trend closer to Property 1. The TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM includes a fault that is position between proposed Fazzino Wells 1 and 2. There are limited electric logs in the immediate vicinity of proposed Wells 1 and 2, but a better understanding of the faulting will be gained as additional wells are drilled in logged in this area. AGS and Ground Water Consultants have mapped a fault using electric logs that is to the west of Proposed Wells 1 and 2. The location of these faults is shown on Figure 1 of this memorandum.

Simsboro Aquifer Wells Within 1-mile of the Proposed Fazzino Investments LP Wells

Rule 8.4(b)(7)(B)(2)

Table 1 in the TGI AER provides information on the BVGCD permitted or registered Simsboro wells within one mile of the proposed Fazzino wells and locations of the permitted or registered wells are shown on Figure 6 and Figures 6a through 6f in the TGI AER. The table does not include information on the well screened interval.

AGS reviewed permitted and registered well data available from BVGCD and identified four additional BVGCD permitted wells that are located within 1-mile of the proposed Fazzino wells that were not included in Table 1 of the Fazzino AER. Table 2 below provides a summary of the additional permitted wells identified by AGS.

Permit	Permit Holder	Well
BVDO-0343	Corpora Farms	3
BVR-4236	Private	Domestic
BVR-4363	Private	Domestic 2
BVR-1861	Privarte	Stock

Table 2. Addition BVGCD Permitted Wells Identified by AGS Within 1-mile of the Proposed Fazzino Investments LP Wells

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of up to five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed Fazzino wells at a combined rate of 10,348 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 8 and 9) are attached to this memorandum. Tables 1 and 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at most BVGCD permitted and registered Simsboro wells within a 1-mile and 5-mile radius of the proposed Fazzino wells. The TGI report did not discuss the GAM simulation methodology, but the TGI GAM model results appear to be reasonable based on AGS simulation verification runs.

In the AGS verification runs, two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 “S-19” Desired Future Condition (DFC) run and with the second simulation (the modified run) being identical to the baseline except that the requested 10,348 ac-ft/yr of pumping was included in the MODFLOW

WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year.

Table 3 below provides a summary of the AGS GAM simulated drawdown estimates at 1-Mile and 5-Miles from each pair of the proposed Fazzino wells after pumping 10,348 ac-ft/yr for 1-year and 10 years.

Fazzino Property	AGS GAM Simulated Drawdown After 1-Year of Pumping at 1-mile (feet)	AGS GAM Simulated Drawdown After 1-Year of Pumping at 5-miles (feet)	AGS GAM Simulated Drawdown After 10-Years of Pumping at 1-mile (feet)	AGS GAM Simulated Drawdown After 10-Years of Pumping at 5-miles (feet)
1	12-18	<10-15	16-24	<10-22
2	32-35	<10-26	36-40	12-33
3	21-26	17-38	29-34	20-42

Table 3. AGS GAM Simulated Drawdown After Proposed Fazzino Investments LP Pumping of 10,348 ac-ft/yr for 1-Year and 10-Years

The AGS GAM simulations show slightly higher simulated drawdown than the TGI simulations, however the drawdown estimates in each simulation are generally within about 10 feet or less. AGS is showing higher drawdown estimates related to Fazzino Properties 2 and 3 in Table 3 above than what are shown in the TGI table on Page 7 of the AER. AGS has reviewed the combined effects of the proposed Fazzino pumping at distances of 1- and 5-miles from each pair of wells on the individual Fazzino properties.

The GAM estimated drawdown contours appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped by GWC and AGS using local geophysical logs and other hydrogeologic data. The influence of the GAM faults is more noticeable near Fazzino Property 1.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. The TGI AER did not discuss the input parameters used in the analytical modeling.

AGS simulated the drawdown at the pumping wells using the Theis analytical model and estimated the drawdown at one foot from the well. A transmissivity of 65,320 gallons per day per foot (gpd/ft) and a storage value of 0.000171 were used in the AGS analytical simulations with each proposed Fazzino well pumping its average annual production rate. The transmissivity and storage values used in the AGS analytical simulations represent an average of the Simsboro Aquifer parameters in the GAM at the proposed Fazzino well locations.

AGS was able to generally recreate the 1-year simulation results of the TGI analytical modeling. The TGI 10-year analytical simulation appears to underestimate the drawdown compared to simulations performed by AGS using the aquifer parameters as described above. Simulated drawdown could be less if TGI used a larger storage value in the 10-year simulation. Figure 2 below shows the estimated AGS analytical modeling drawdown contours that result from pumping 10,348 ac-ft/yr for 10-years.

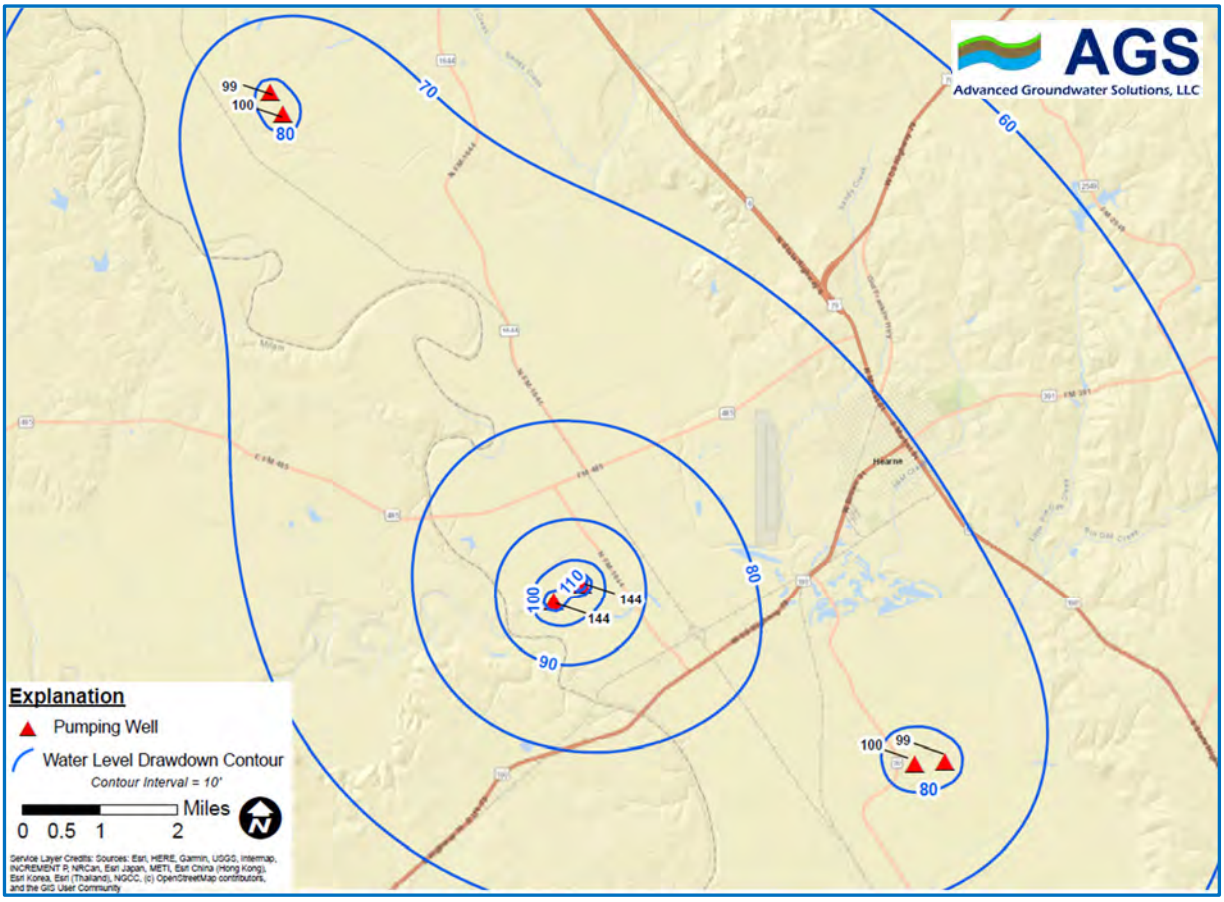


Figure 2. AGS Theis Analytical Simulated Drawdown After Proposed Fazzino Investments LP Pumping of 10,348 ac-ft/yr for 10-Years

Table 4 below provides a summary of the AGS simulated drawdown estimates at 1-foot from each of the proposed Fazzino wells after pumping 10,348 ac-ft/yr for 1-year and 10 years.

Well	AGS Simulated Drawdown After 1-Year of Pumping (feet)	AGS Simulated Drawdown After 10-Years of Pumping (feet)
1	73	99
2	74	100
3	118	144
4	118	144
5	74	100
6	73	99

Table 4. AGS Theis Analytical Simulated Drawdown at the Proposed Fazzino Investments LP Wells After 1-Year and 10-Years of Pumping 10,348 ac-ft/yr

Estimated Long-term impacts at the Proposed Fazzino Investments LP Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Fazzino wells, AGS plotted the simulated water level decline at each well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown on the attached Figures 3 through 8. The water level projections shown in the attached figures are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed Fazzino wells included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

The graphs illustrate the relationship between the land surface, estimated static water level through time and the estimated base of the Simsboro Aquifer based on review of available local electric logs near the locations of the proposed Fazzino wells.

Water levels available for a domestic well (BVGCD BVR-1283) are shown on Figure 3. The well screen sands of the Simsboro Aquifer in the depth interval of about 450 to 460 feet below land

surface. BVR-1283 is located about 1 mile southwest of proposed Fazzino Well 1. Water levels available from a private domestic well (BVGCD BVR-1506) are shown on Figure 5. The well screen sands of the Simsboro Aquifer and the total depth of the well is 1,250 feet bls. BVR-1506 is located about 1.3 miles north-northwest of proposed Fazzino Well 3.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. In other words, the line with green dots does not include the impact of the proposed Fazzino wells. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed wells will have some of the same type effects on the aquifer.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The TGI GAM simulations look reasonable and AGS was able to recreate the TGI simulation results. There are minor differences in the simulated drawdown estimated by TGI and AGS near the proposed Fazzino well locations, but these can most likely be attributed to differences in the approach to the GAM simulation(s).

AGS was able to generally recreate the TGI analytical simulation results of pumping the requested permitted amount of 10,348 ac-ft/yr for 1-year from the proposed Fazzino wells. The 10-year analytical simulation results in the TGI AER appear to underestimate the drawdown compared to simulations performed by AGS using the same aquifer parameters used in the 1-year simulations. The TGI simulated drawdown could be less if a larger storage value was used in the 10-year simulation.

AGS is documenting the differences but does not consider them to be major for the purposes of this report.

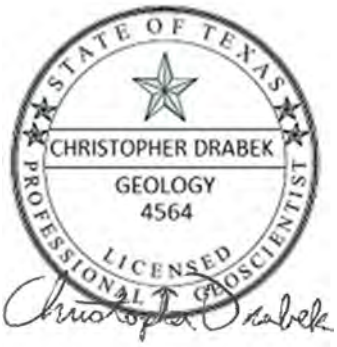
References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

Geoscientist's Seal:



The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on 9/1/2023.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)

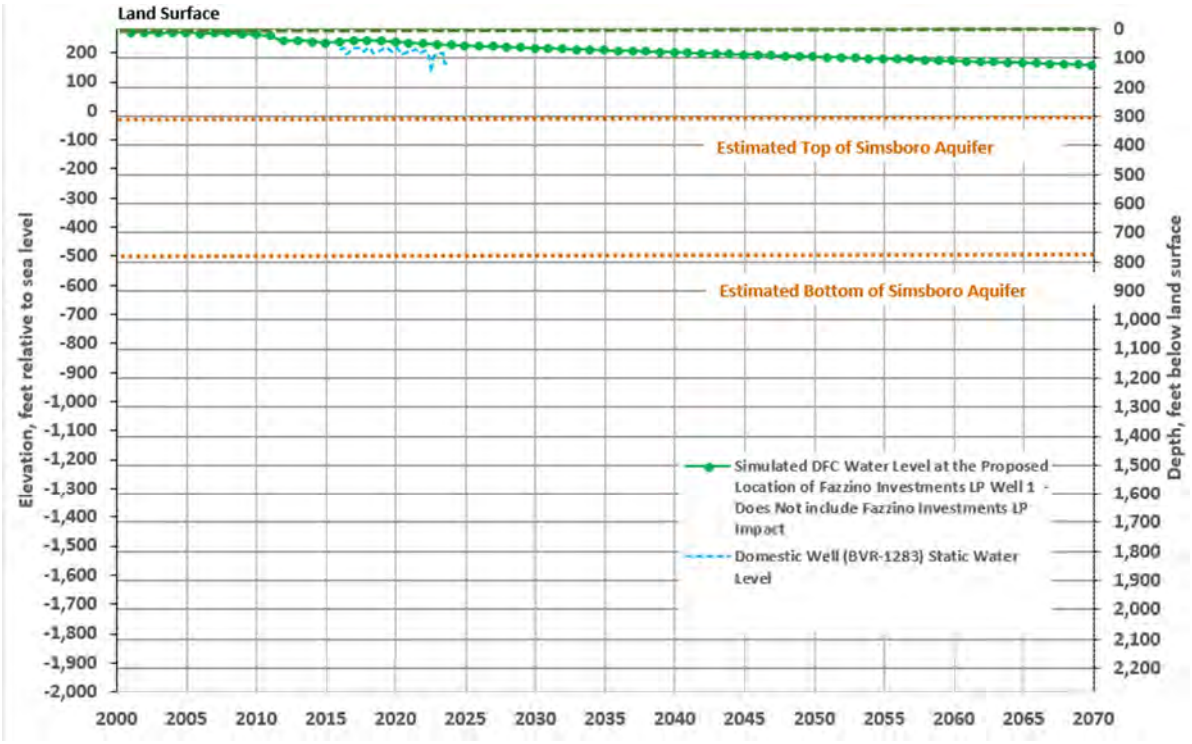


Figure 3. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 1

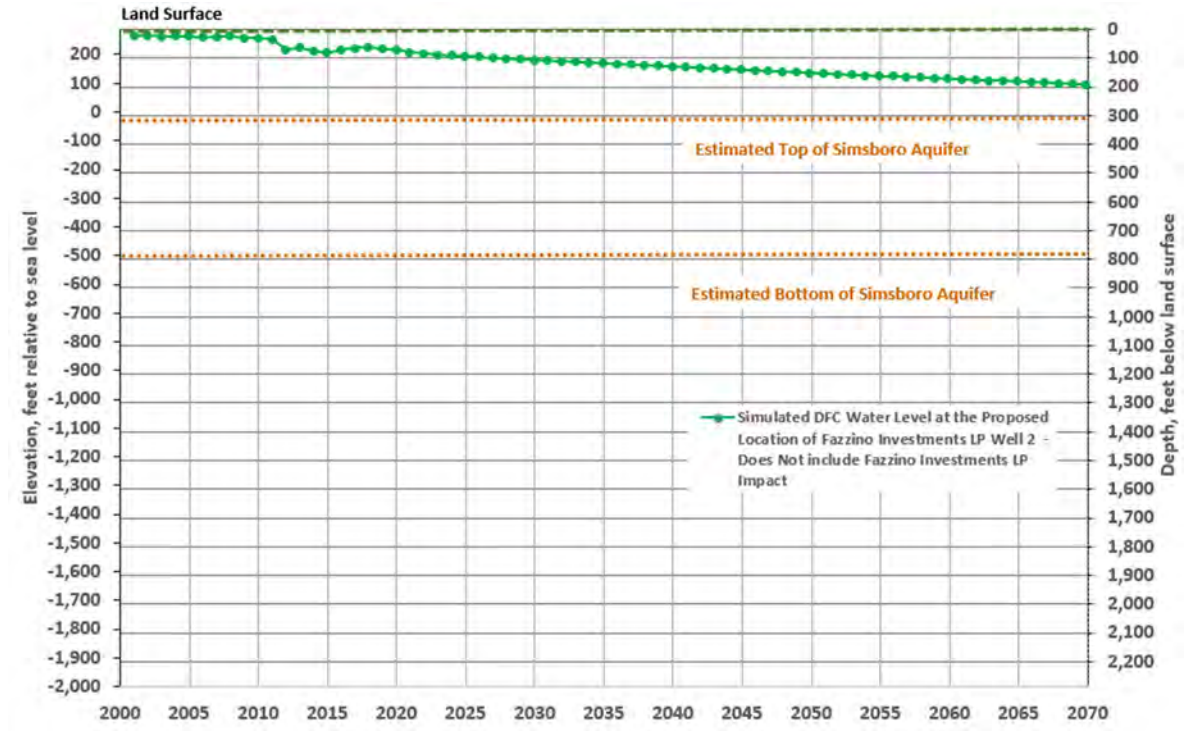


Figure 4. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 2

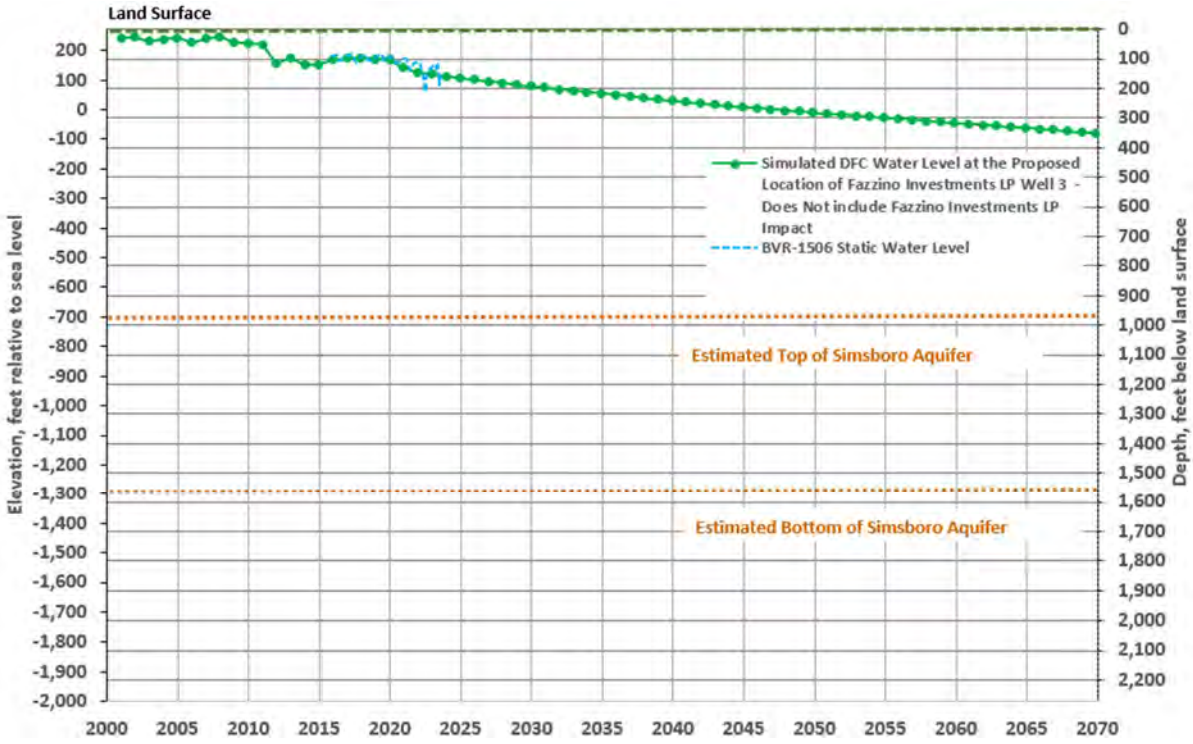


Figure 5. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 3

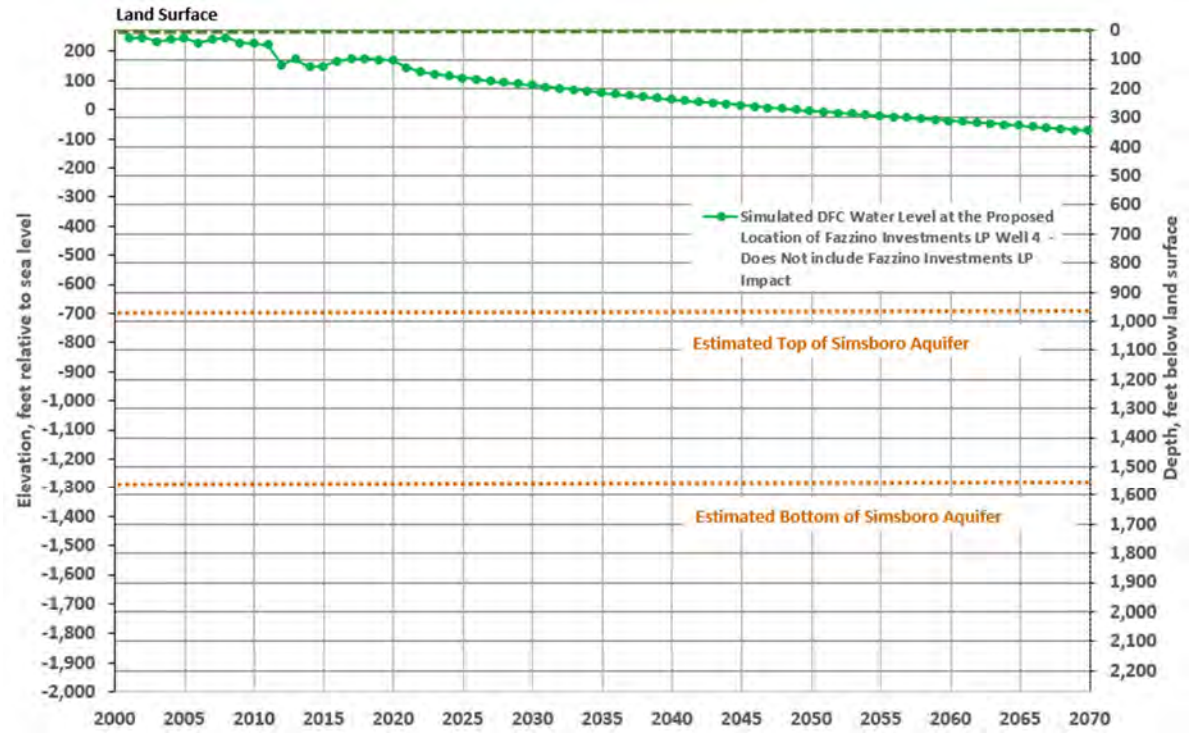


Figure 6. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 4

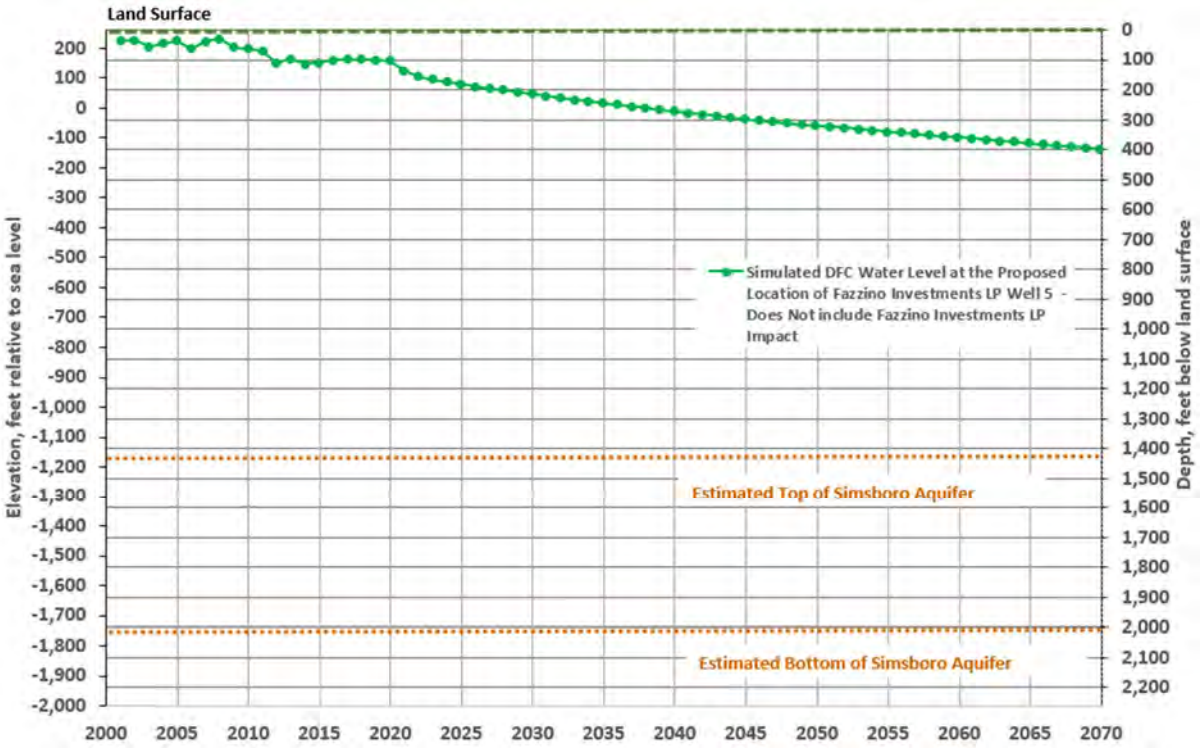


Figure 7. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 5

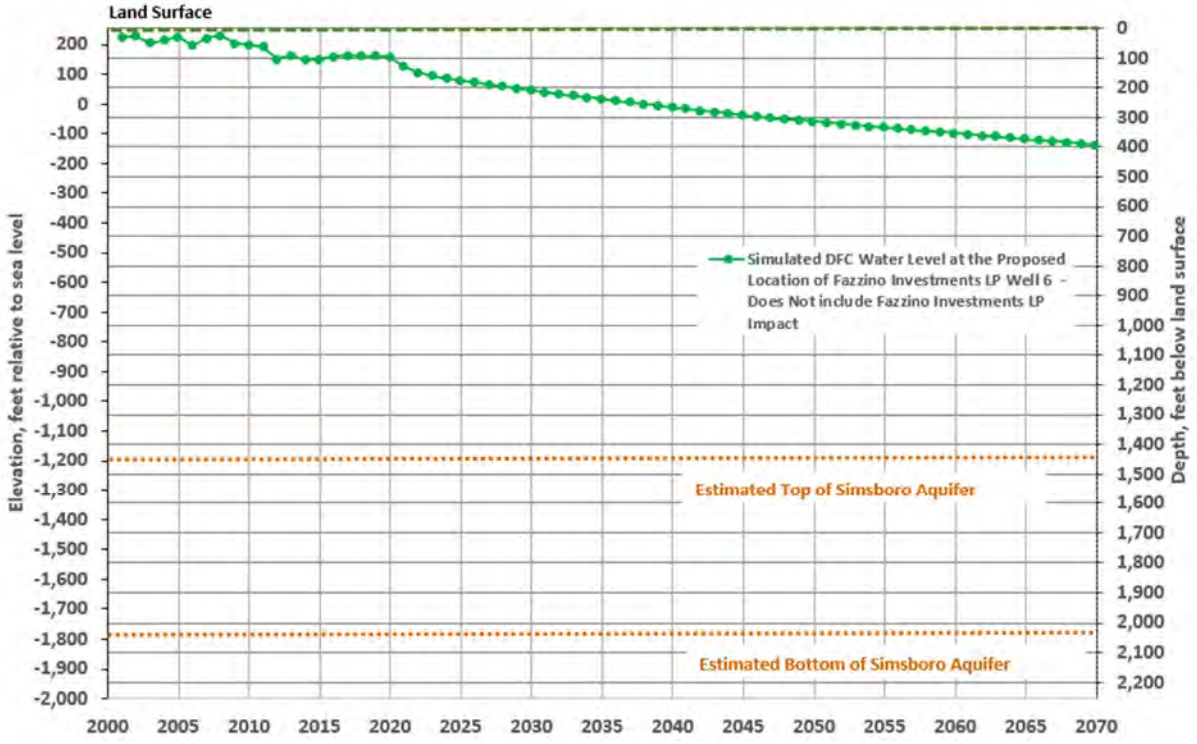
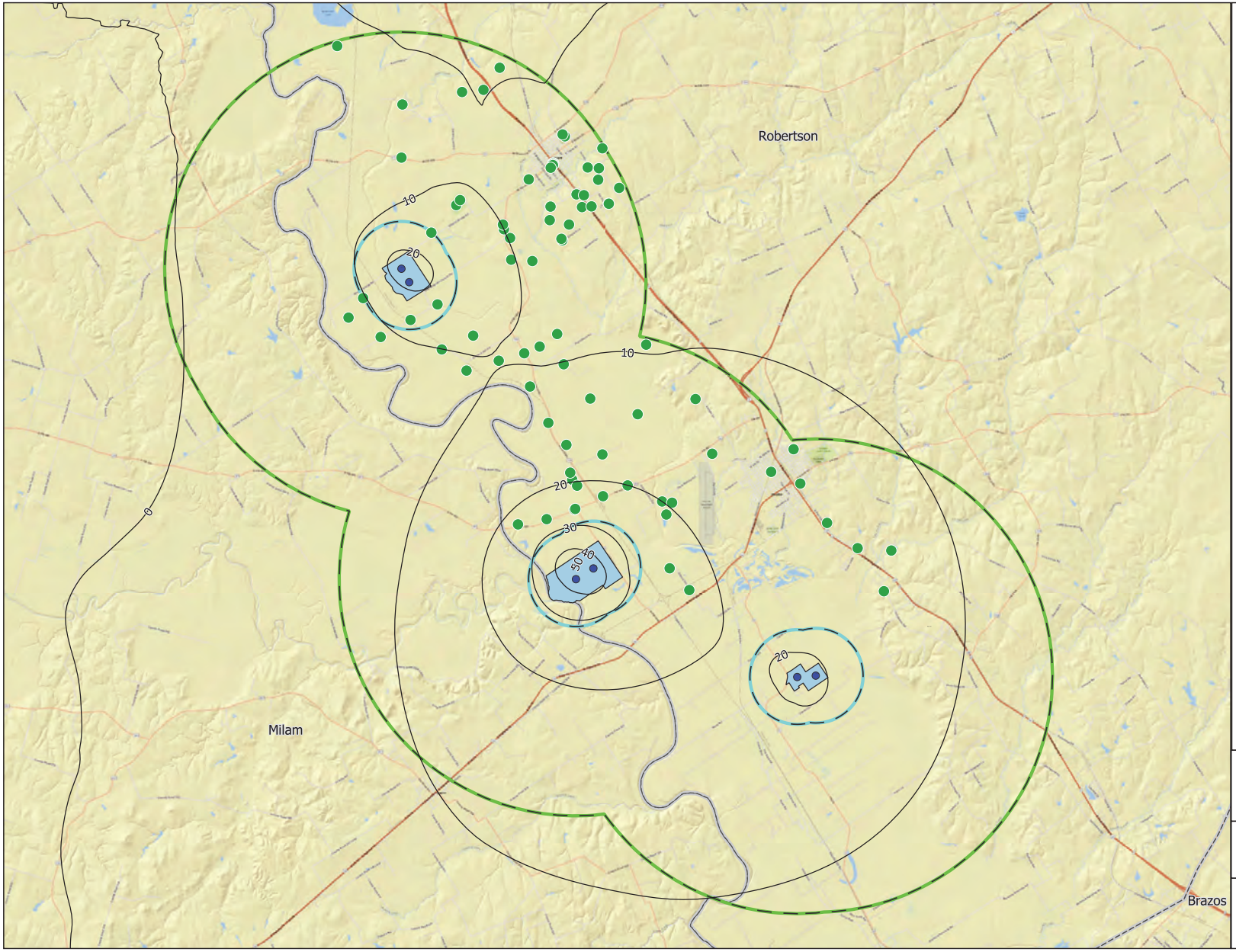


Figure 8. Projected DFC Water Level Change at Proposed Fazzino Investments LP Well 6



Explanation

- Proposed Wells
- 1 Mile Radius from Well Locations
- 5 Mile Radius from Well Locations
- 1-Year Modeled Drawdown - GAM
  Contour Interval = 10 feet
- Fazzino Property
- Counties

BVGCD Reported Wells w/in 5 Miles

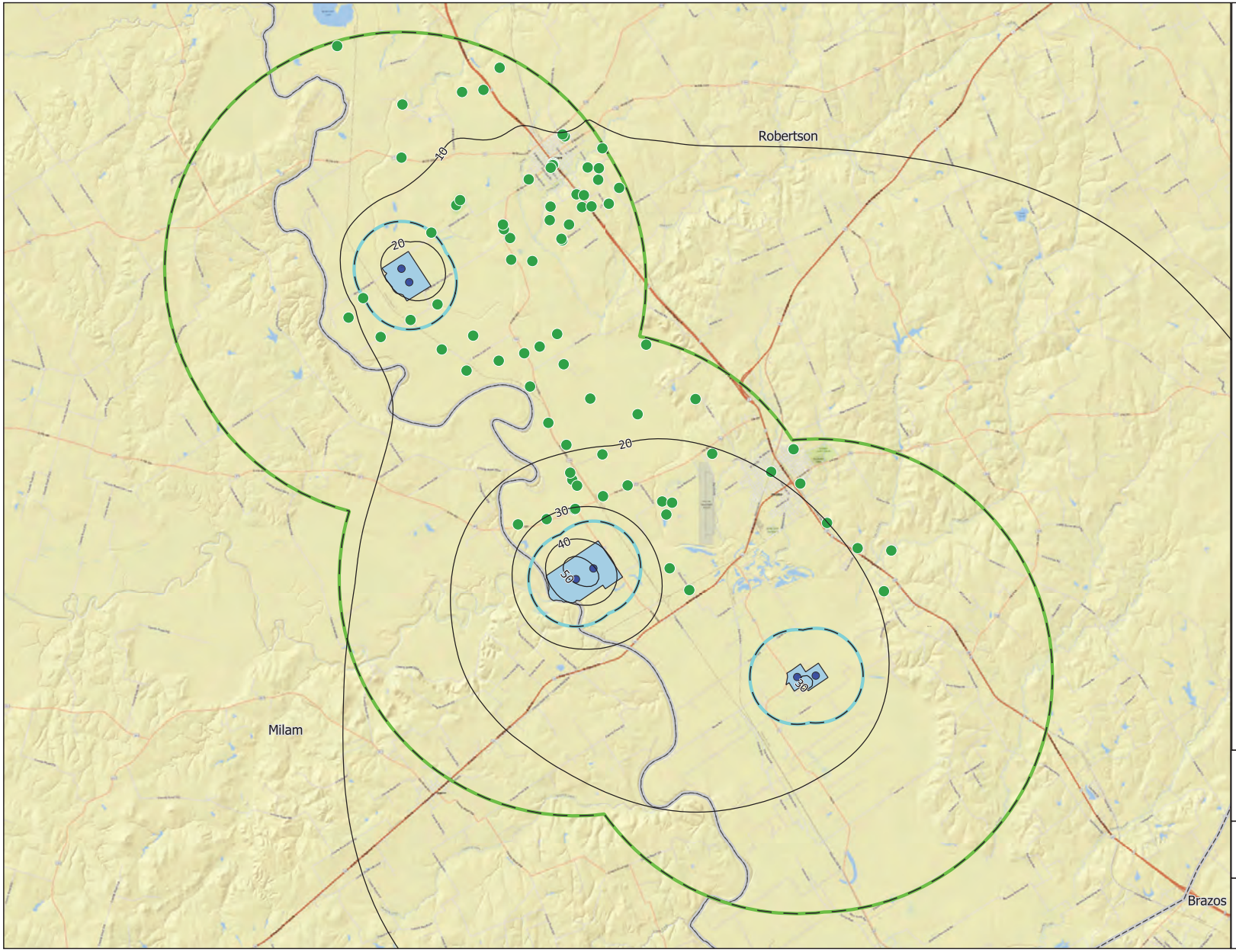
- Simsboro

0 2 4 mi

Fazzino Investments, LP

Figure 8: 1-Year GAM Drawdown Contours

THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists



Explanation

- Proposed Wells
- 1 Mile Radius from Well Locations
- 5 Mile Radius from Well Locations
- 10-Year Modeled Drawdown - GAM
  Contour Interval = 10 feet
- Fazzino Property
- Counties

BVGCD Reported Wells w/in 5 Miles

- Simsboro

0 2 4 mi

Fazzino Investments, LP

Figure 9: 10-Year GAM Drawdown Contours

THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists

Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of RH2O LLC Simsboro Aquifer Evaluation Report

DATE: September 1, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application for RH2O LLC (RH2O) for five proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 8,130 acre-feet per year (ac-ft/yr). The TGI AER refers to the proposed RH2O wells as proposed Red Hill Farms (RHF) wells. The proposed wells are located on a tract of land located about 3 miles northwest of the City of Hearne. The locations of the wells are shown on Figure 1. The AER dated July 21, 2023 was submitted to BVGCD on that date. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new wells in the west part of Robertson County.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed RH2O wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation report.

Proposed RH2O LLC Wells

The five proposed RH2O wells have maximum production rates that range from 800 to 1,700 gallons per minute (gpm) and an annual permit allocation of 8,130 acre-feet. Table 1 below provides a summary of the maximum production rate in gpm and the annual permitted allocation in acre-feet for each of the proposed RH2O wells.

Well	Maximum Production Rate (gpm)	Annual Permit Allocation (acre-feet)
1	1,300	1,678
2	1,700	2,194
3	1,350	1,742
4	1,150	1,484
5	800	1,032

Table 1. Proposed RH2O LLC Well Maximum Production Rate and Annual Permit Allocation

The locations of the five proposed RH2O wells are shown below on Figure 1.

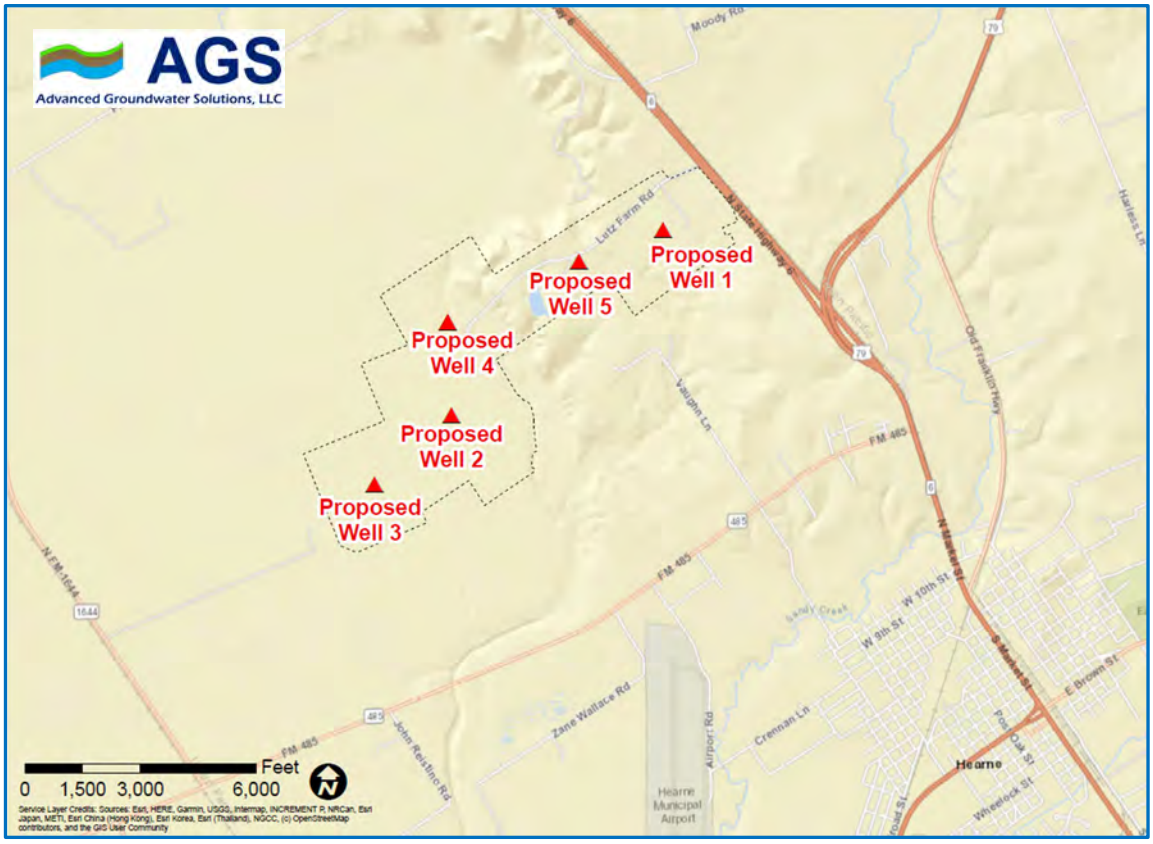


Figure 1. Proposed RH2O LLC Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER estimates the top of the Simsboro Aquifer to occur at depths between 870 and 1,050 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 1,340

and 1,550 feet bgl in the vicinity of the proposed RH2O wells based on the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM and Bureau of Economic Geology (BEG) mapping.

AGS estimates the top of the Simsboro Aquifer to occur at depths between about 885 and 990 feet bgl and the base of the Simsboro Aquifer to occur at depths between about 1,260 and 1,415 feet bgl in the vicinity of the proposed RH2O wells based on the review of available local geophysical logs.

Site specific information will be available once the test holes are drilled and logged for each of the proposed RH2O wells.

Simsboro Aquifer Wells Within 1-mile of the Proposed RH2O Wells

Rule 8.4(b)(7)(B)(2)

Table 1 in the TGI AER provides information on the BVGCD permitted or registered Simsboro wells within 1-mile of the proposed RH2O wells and locations of the permitted or registered wells are shown on Figures 6, 6a and 6b in the TGI AER. The table does not include information on the well screened interval.

AGS reviewed permitted and registered well data available from BVGCD and identified four additional BVGCD permitted wells that are located within 1-mile of the proposed RH2O wells that were not included in Table 1 of the AER. Table 2 below provides a summary of the additional permitted wells identified by AGS.

Permit	Permit Holder	Well
BVDO-0298	UW Brazos Valley Farm, LLC	PS4
BVDO-0302	UW Brazos Valley Farm, LLC	PS9
BVDO-0304	UW Brazos Valley Farm, LLC	PS11
BVDO-0300	UW Brazos Valley Farm, LLC	PS6

Table 2. Addition BVGCD Permitted Wells Identified Within 1-mile of the Proposed RH2O LLC Wells

AGS also noted that UW Brazos Valley Farm, LLC Well CS3 (BVDO-0256) is located at or just slightly beyond a distance of 1-mile from the proposed RH2O wells.

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of up to five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at

locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed RH2O wells at a combined rate of 8,130 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 9 and 10) are attached to this memorandum. Tables 1 and 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at most BVGCD permitted and registered Simsboro wells within a 1-mile and 5-mile radius of the proposed RH2O wells. The TGI report did not discuss the GAM simulation methodology, but the TGI GAM model results appear to be reasonable based on AGS simulation verification runs.

In the AGS verification runs, two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 "S-19" Desired Future Condition (DFC) run and with the second simulation (the modified run) being identical to the baseline except that the requested 8,130 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year.

The AGS GAM simulation results after 1 and 10 years of pumping 8,130 ac-ft/yr show about 8 to 18 feet of drawdown at 5 miles and about 30 to 38 feet of drawdown at 1 mile after 1-year of pumping and about 10 to 20 feet of drawdown at 5 miles and about 35 to 40 feet of drawdown at 1 mile after 10-years of pumping.

The GAM estimated drawdown contours near proposed RH2O wells appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped by GWC and AGS using local geophysical logs and other hydrogeologic data.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. The TGI AER did not discuss the input parameters used in the analytical modeling.

AGS simulated the drawdown at the pumping wells using the Theis analytical model and estimated the drawdown at one foot from the well. A transmissivity of 55,117 gallons per day per foot (gpd/ft) and a storage value of 0.000151 were used in the AGS analytical simulations with each proposed RH2O well pumping its average annual production rate. The transmissivity and storage values used in the AGS analytical simulations represent an average of the Simsboro Aquifer parameters in the GAM at the proposed RH2O well locations.

AGS was able to generally recreate the 1-year simulation results of the TGI analytical modeling. The TGI 10-year analytical simulation appears to underestimate the drawdown compared to simulations performed by AGS using the aquifer parameters as described above. Simulated drawdown could be less if TGI used a larger storage value in the 10-year simulation. Figure 2 below shows the estimated AGS analytical modeling drawdown contours that result from pumping 8,130 ac-ft/yr for 10-years.

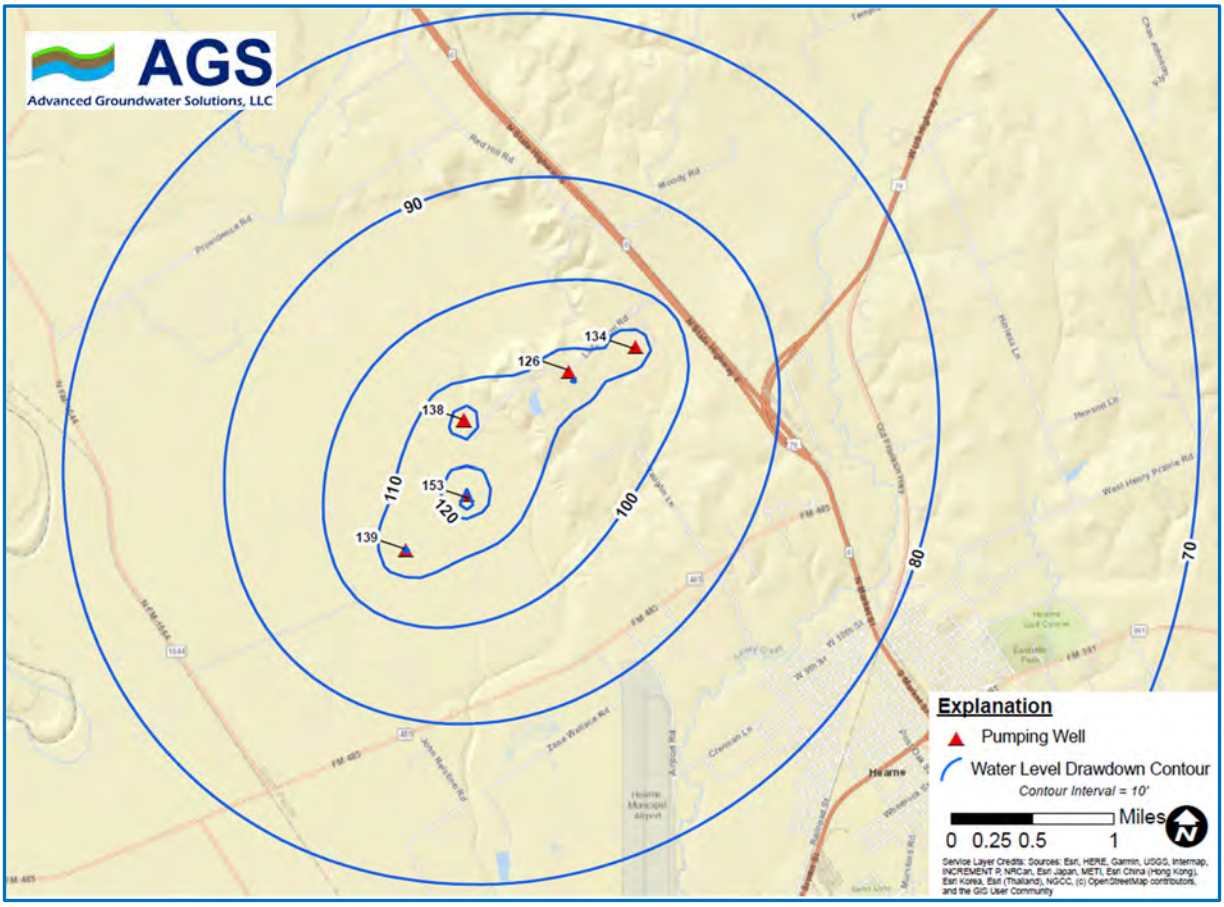


Figure 2. AGS Theis Analytical Simulated Drawdown After Proposed RH2O Pumping of 8,130 ac-ft/yr for 10-Years

Table 3 below provides a summary of the AGS simulated drawdown estimates at 1-foot from each of the proposed RH2O wells after pumping 8,130 ac-ft/yr for 1-year and 10 years.

Well	AGS Simulated Drawdown After 1-Year of Pumping (feet)	AGS Simulated Drawdown After 10-Years of Pumping (feet)
1	110	134
2	129	153
3	115	139
4	114	138
5	102	126

Table 3. AGS Theis Analytical Simulated Drawdown at the Proposed RH2O Wells After 1-Year and 10-Years of Pumping 8,130 ac-ft/yr

Estimated Long-term impacts at the Proposed RH2O LLC Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed RH2O wells, AGS plotted the simulated water level decline at each well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown on the attached Figures 3 through 7. The water level projections shown in the attached figures are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed RH2O wells included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

The graphs illustrate the relationship between the land surface, estimated static water level through time and the estimated top and bottom of the Simsboro Aquifer based on review of available local electric logs near the locations of the proposed RH2O wells.

Water levels available from the City of Hearne Well 4 (POW) (BVGCD Permit BVHU-0013) are shown on Figure 3. The well screen sands of the Simsboro Aquifer in the depth interval of about 1,221 to 1,425 feet below land surface. BVHU-0013 is located about 1.7 miles south of proposed RH2O Well 1.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. In other words, the line with green dots does not include the impact of the proposed RH2O wells. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed wells will have some of the same type effects on the aquifer.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The TGI GAM simulations look reasonable and AGS was able to recreate the TGI simulation results. There are minor differences in the simulated drawdown estimated by TGI and AGS near the proposed RH2O well locations, but these can most likely be attributed to differences in the approach to the GAM simulation(s).

AGS was able to generally recreate the TGI analytical simulation results of pumping the requested permitted amount of 8,130 ac-ft/yr for 1-year from the proposed RH2O wells. The 10-year analytical simulation results in the TGI AER appear to underestimate the drawdown compared to simulations performed by AGS using the same aquifer parameters used in the 1-year simulations. The TGI simulated drawdown could be less if a larger storage value was used in the 10-year simulation.

AGS is documenting the differences but does not consider them to be major for the purposes of this report.

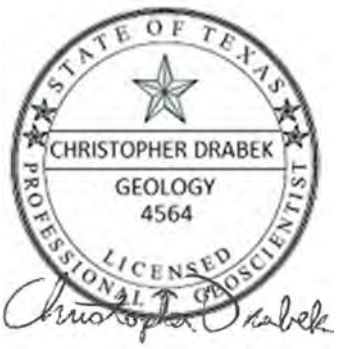
References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

Geoscientist's Seal:



The seal appearing on this document was authorized by Christopher Drabek, P.G. 4564 on 9/1/2023.
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)

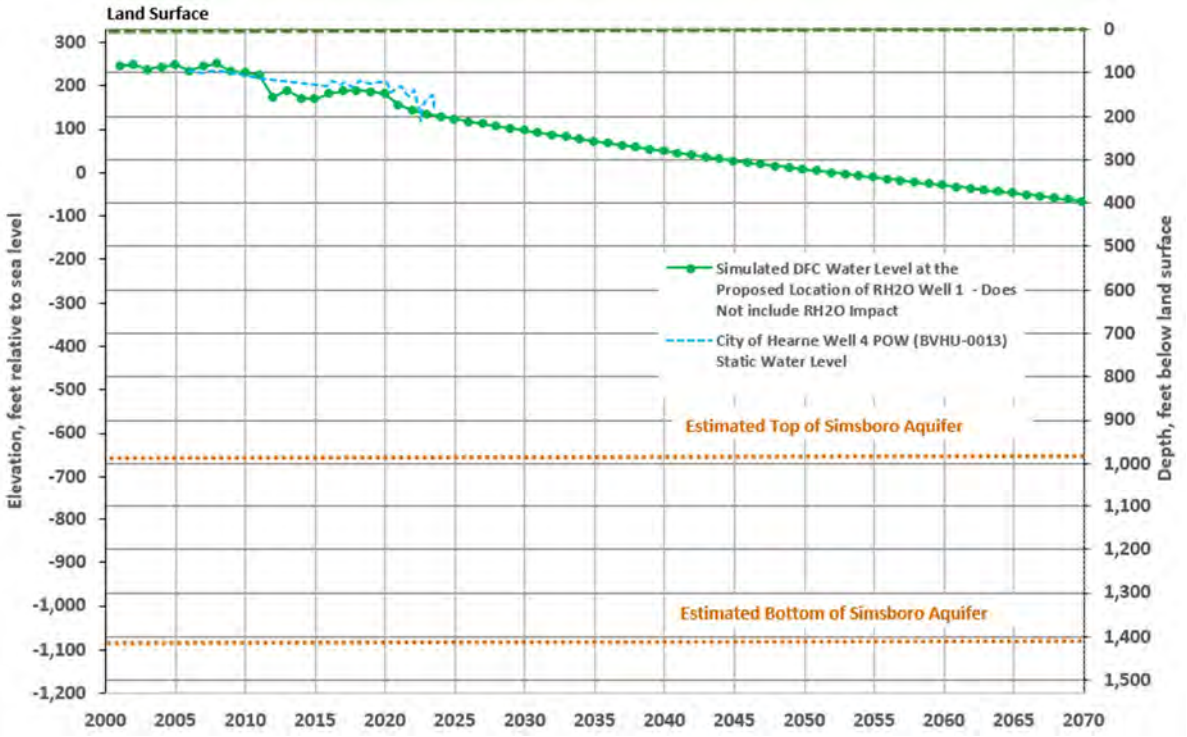


Figure 3. Projected DFC Water Level Change at Proposed RH2O Well 1

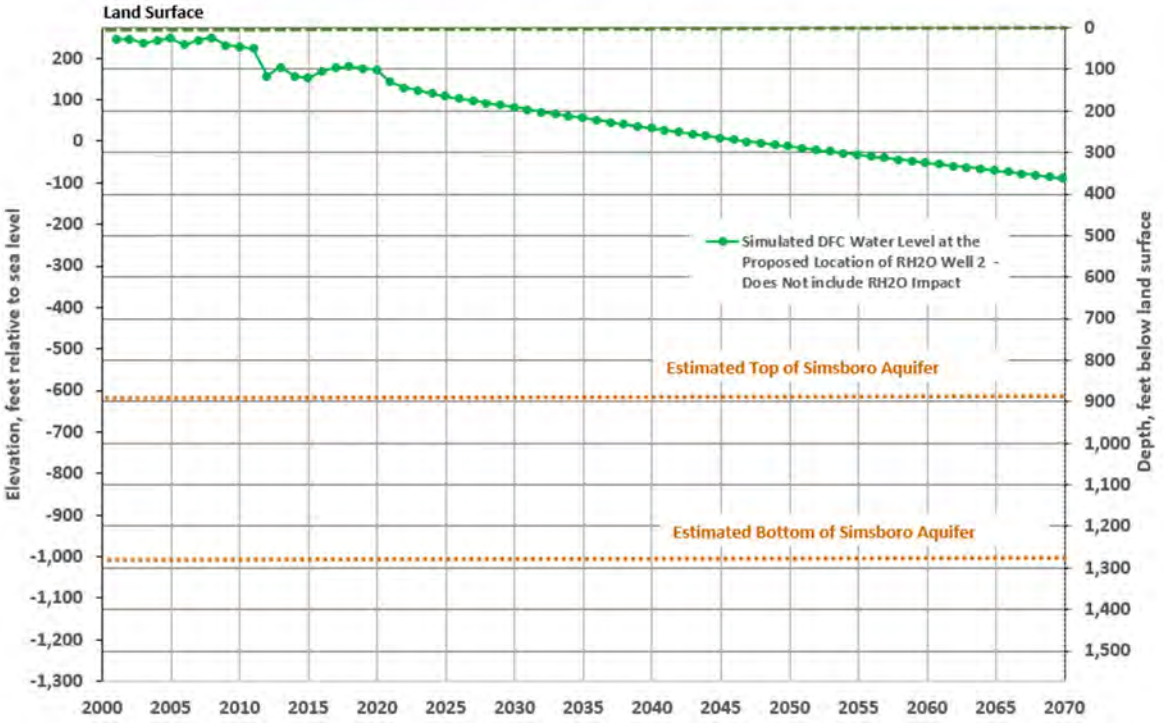


Figure 4. Projected DFC Water Level Change at Proposed RH2O Well 2

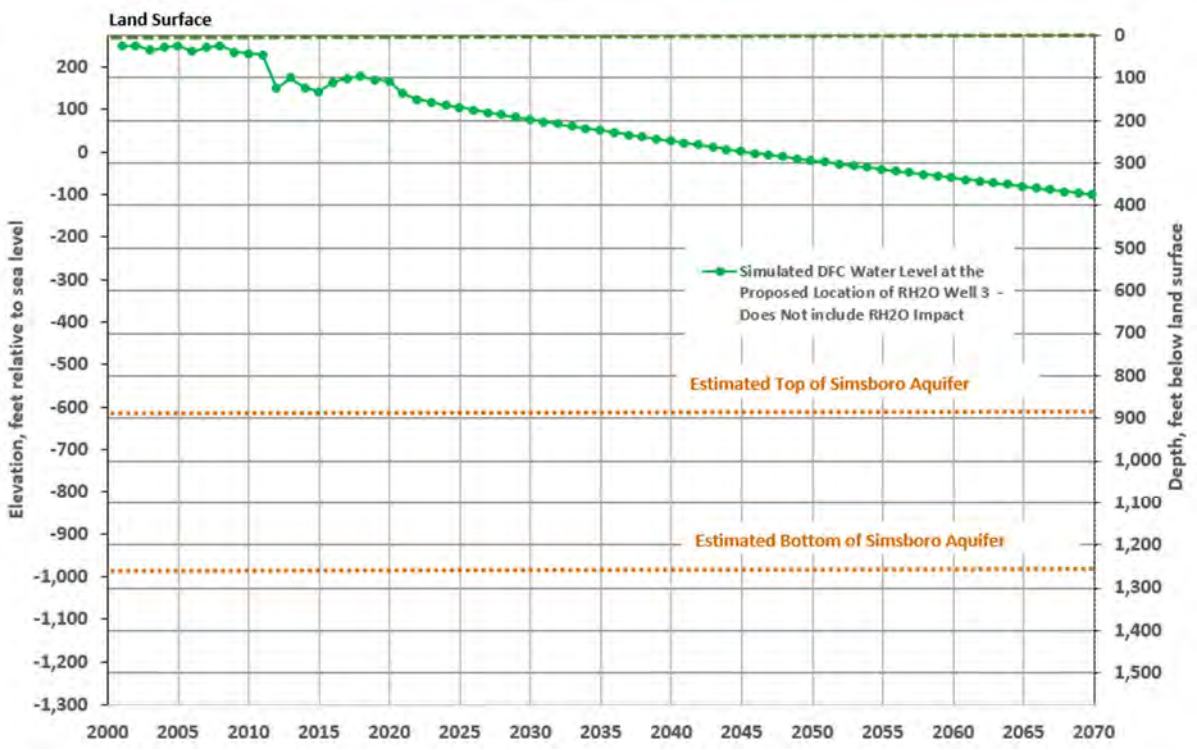


Figure 5. Projected DFC Water Level Change at Proposed RH2O Well 3

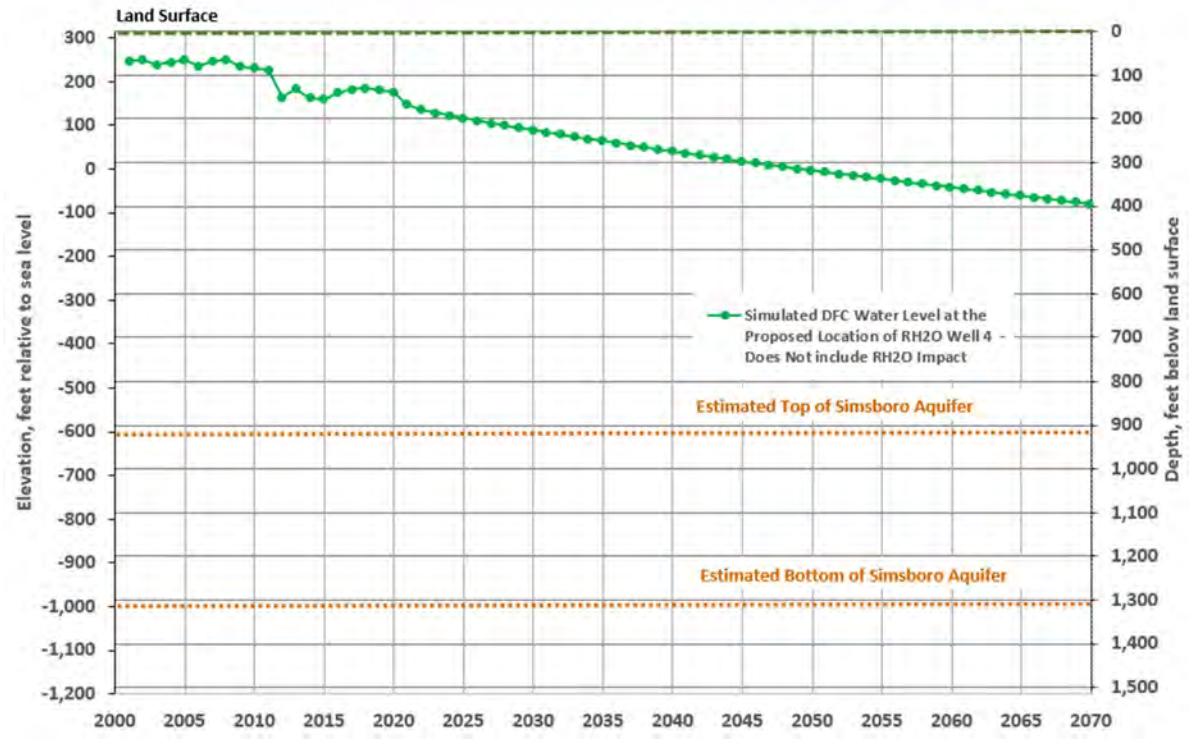


Figure 6. Projected DFC Water Level Change at Proposed RH2O Well 4

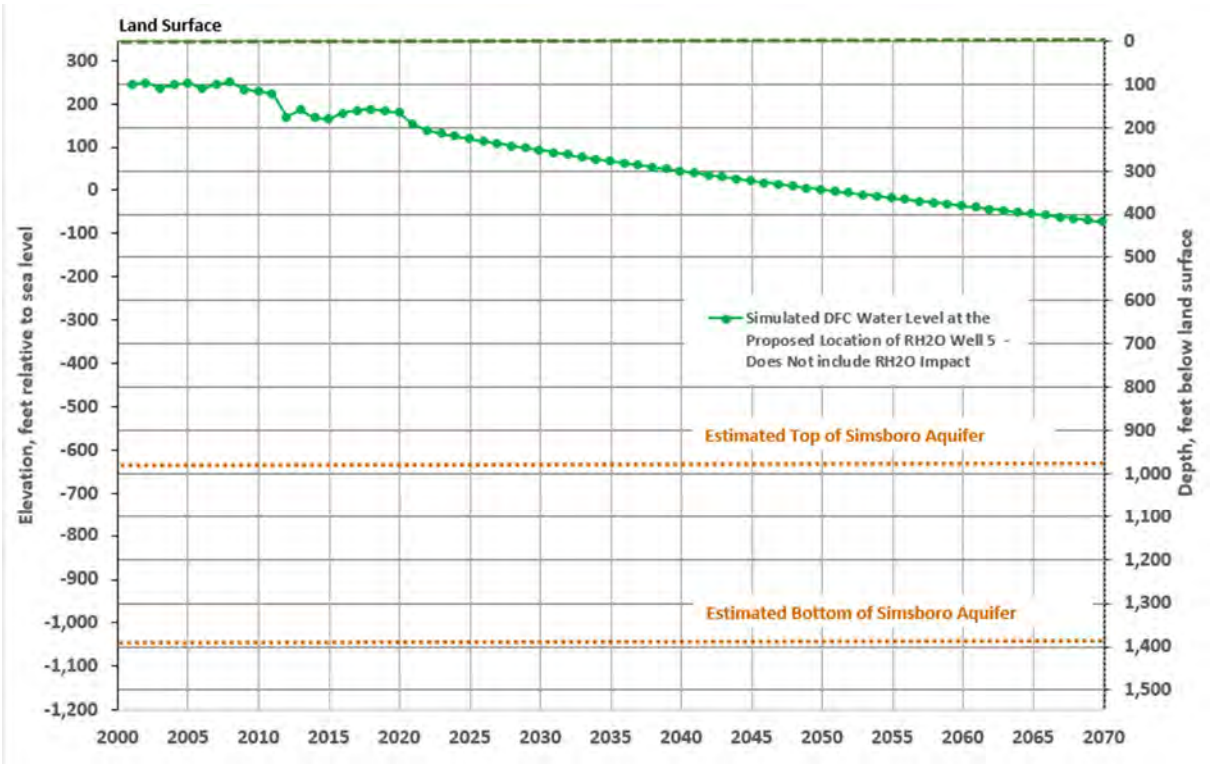
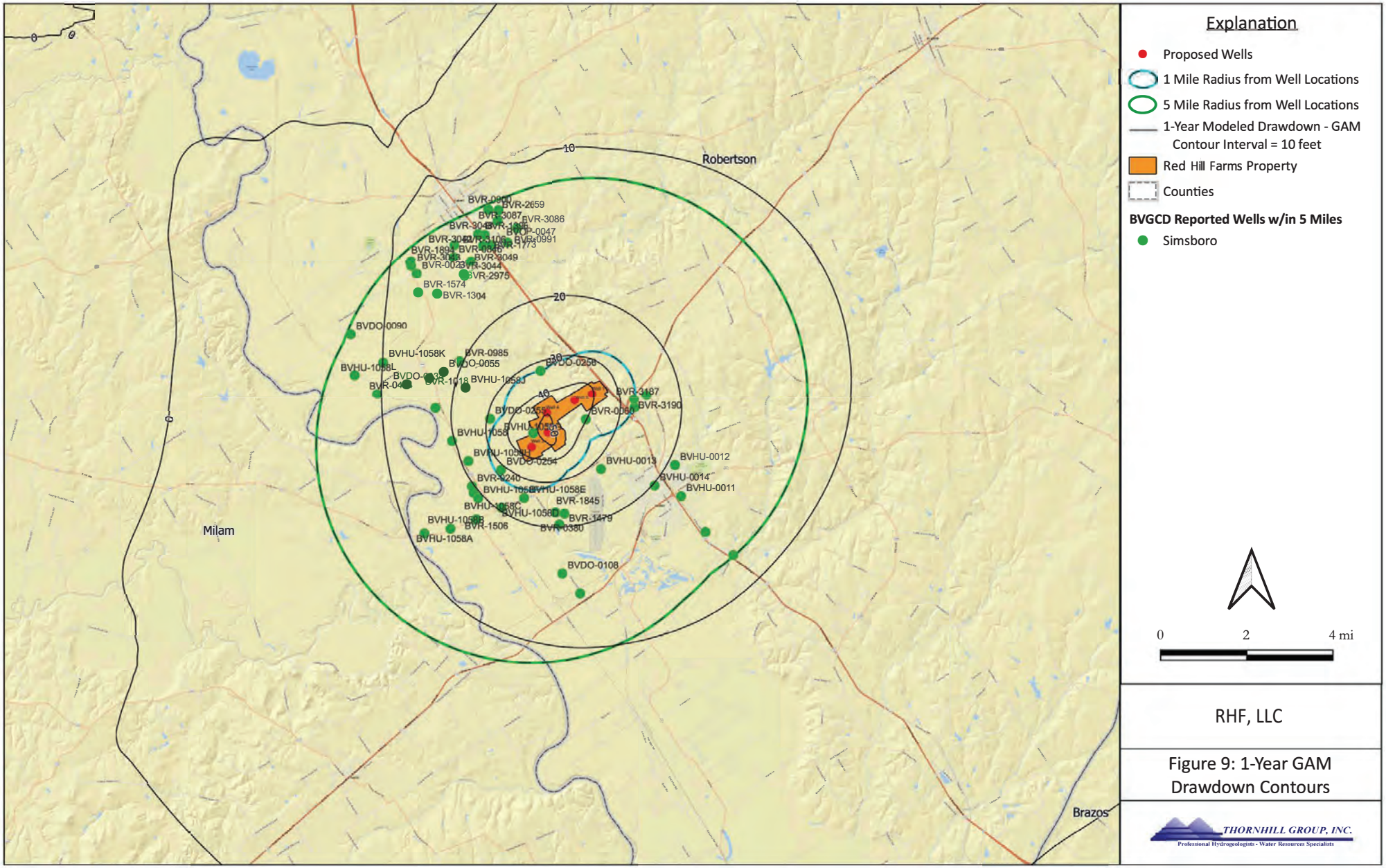
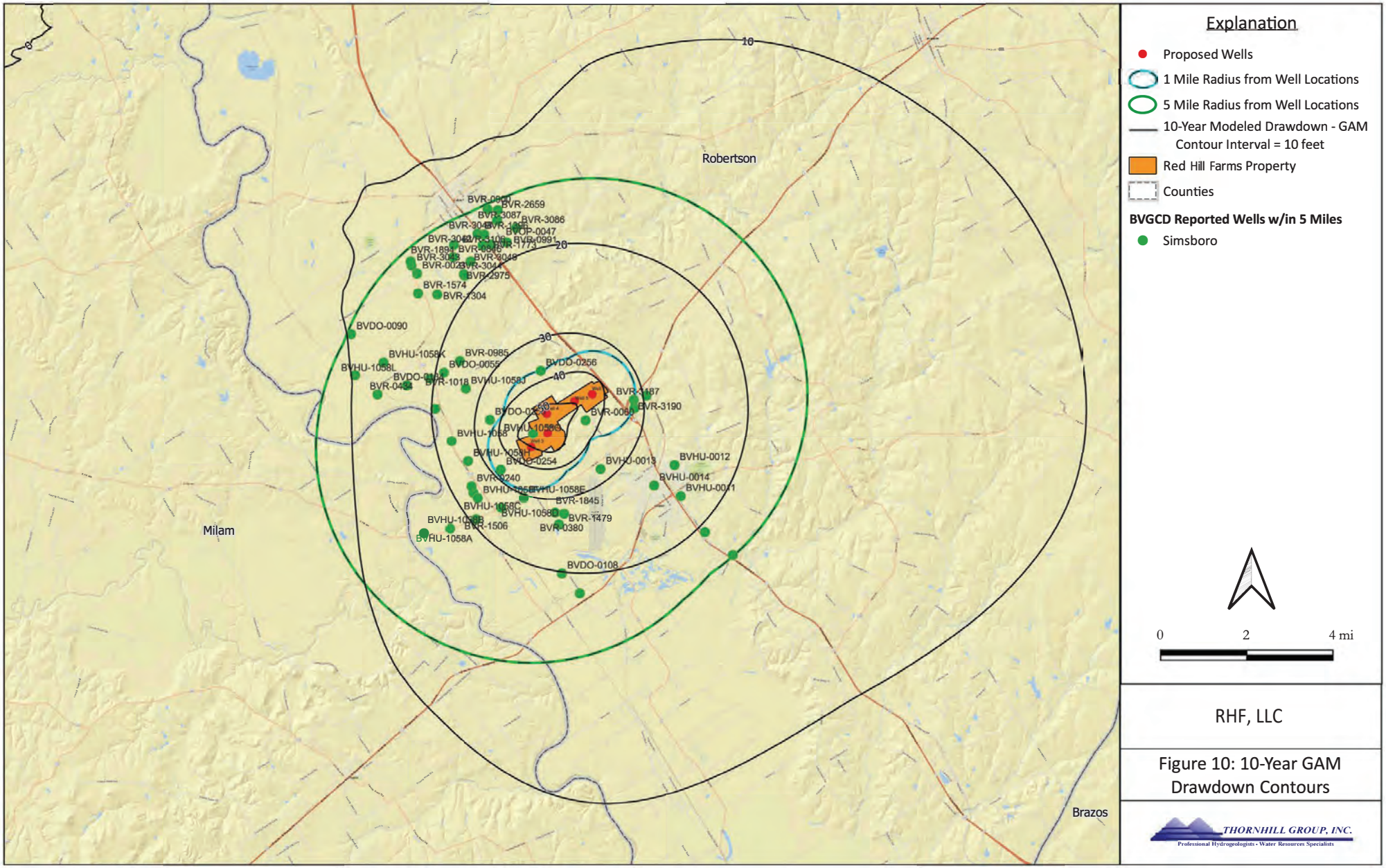


Figure 7. Projected DFC Water Level Change at Proposed RH2O Well 5


Explanation
Proposed Wells
1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
1-Year Modeled Drawdown - GAM
Contour Interval = 10 feet
Red Hill Farms Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
0
2
4 mi
Robertson
Milam
Brazos
10
20
30
40
BVR-0990
BVR-2659
BVR-3087
BVR-3086
BVR-3045
BVR-3046
BVOP-0047
BVR-0991
BVR-3047
BVR-3106
BVR-1773
BVR-1894
BVR-0946
BVR-3048
BVR-9049
BVR-0023
BVR-3044
BVR-2975
BVR-1574
BVR-1304
BVDO-0090
BVHU-1058K
BVR-0985
BVDO-0055
BVHU-1058L
BVDO-0258
BVR-1018
BVHU-1058J
BVR-3187
BVR-3190
BVDO-0255
BVR-0986
BVHU-1058
BVHU-1058H
BVDO-0254
BVHU-0013
BVHU-0012
BVHU-0014
BVHU-0011
BVR-0240
BVHU-1058G
BVHU-1058E
BVR-1845
BVHU-1058C
BVHU-1058D
BVR-1479
BVHU-1058B
BVR-1506
BVR-0380
BVHU-1058A
BVDO-0108
RHF, LLC
Figure 9: 1-Year GAM Drawdown Contours
THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists


Explanation
Proposed Wells
1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
10-Year Modeled Drawdown - GAM
Contour Interval = 10 feet
Red Hill Farms Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
10
20
30
40
Robertson
Milam
Brazos
BVR-0959
BVR-2659
BVR-3087
BVR-3086
BVOP-0047
BVR-0991
BVR-1773
BVR-1894
BVR-0846
BVR-3048
BVR-3049
BVR-0023
BVR-3047
BVR-2975
BVR-1574
BVR-1304
BVDO-0090
BVHU-1058K
BVR-0985
BVHU-1058L
BVDO-0055
BVDO-0256
BVDO-0253
BVR-1018
BVHU-1058J
BVR-0434
BVR-3187
BVR-3190
BVDO-0250
BVR-0088
BVHU-1058G
BVHU-1058
BVHU-1058H
BVDO-0254
BVHU-0013
BVHU-0012
BVR-3240
BVHU-0014
BVHU-0011
BVHU-1058F
BVHU-1058E
BVR-1845
BVHU-1058C
BVHU-1058D
BVR-1479
BVHU-1058B
BVR-1506
BVR-0380
BVHU-1058A
BVDO-0108
0
2
4 mi
RHF, LLC
Figure 10: 10-Year GAM Drawdown Contours
THORNHILL GROUP, INC.
Professional Hydrogeologists - Water Resources Specialists

Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of Trey Skiles Simsboro Aquifer Evaluation Report

DATE: March 6, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application from Mr. Trey Skiles for a proposed new well completed in the Simsboro Aquifer with a withdrawal amount of 2,100 acre-feet per year (ac-ft/yr) and an increase in permitted production from the Simsboro Aquifer for existing well BVDO-0108 from 1,400 ac-ft/yr to 2,700 ac-ft/yr. Pumping from both wells will be aggregated for a total production of 4,800 ac-ft/yr from the Simsboro Aquifer. The first submitted AER is dated February 8, 2023. After preliminary review, AGS and BVGCD provided comments to TGI and requested some modifications to the report on February 20, 2023. A revised report was submitted to BVGCD on February 24, 2023. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new well and requested increase in permitted production from well BVDO-0108 in the west part of Robertson County.

The AER identifies Trey Skiles Well 1 with a maximum pumping rate of 1,600 gallons per minute (gpm) and an annual permit allocation of 2,100 acre-feet and BVDO-0108 with a maximum pumping rate of 2,000 gpm and an annual permit allocation of 2,700 acre-feet. The combined maximum pumping rate of both wells is 3,600 gpm with a total annual permit allocation of 4,800 acre-feet. The proposed locations of the wells are shown on Figure 1 below with the wells located north-northeast of the intersection of Highway 79 and FM 1644.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed and existing Trey Skiles wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation reports. Discussion of the AER in this memorandum refers to the revised version of the report dated February 24, 2023.

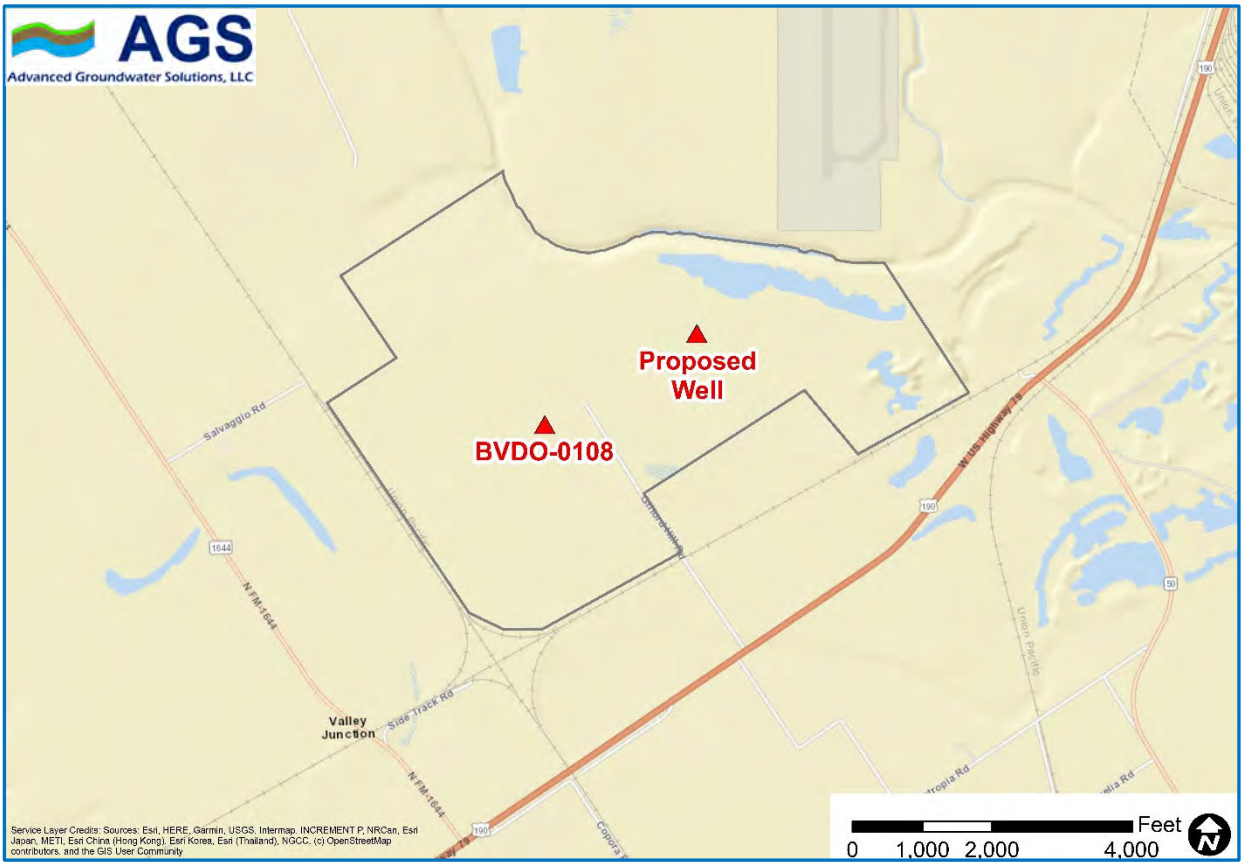


Figure 1. Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER identifies the top of the Simsboro Aquifer in the range of about -776 to -876 feet relative to sea level (rsl) or about 1,050 to 1,150 feet below land surface and the base of the Simsboro Aquifer in the range of about -1,146 to -1,376 feet rsl or about 1,420 to 1,650 feet below land surface at the Trey Skiles property. TGI estimated the sand thickness of the Simsboro Aquifer to be in the range of 370 to 500+ feet. Review of local electric logs and the BVDO-0108 lithology log (State of Texas Well Report Tracking Number 311188) indicates that the TGI top and bottom of the Simsboro Aquifer estimates in the vicinity of the Trey Skiles property are reasonable. The proposed well screen interval was not discussed in the AER.

Simsboro Aquifer Wells Within 1-mile of the Proposed Wells

Rule 8.4(b)(7)(B)(2)

AGS has confirmed that the two BVGCD wells that were identified in Table 2 of the AER are the only permitted or registered Simsboro wells within one mile of the existing and proposed Trey Skiles wells. Table 2 of the Aquifer Evaluation Report includes data on each registered or permitted well screening the Simsboro Aquifer located within one mile of the proposed and existing wells and generally includes most of the required information for the wells. Ideally, the top and bottom of the screen interval would be shown in the Screen Depth column, if available.

A map showing the location of the proposed and existing Trey Skiles wells and the BVGCD registered or permitted wells within one mile of the Skiles wells is included as Figure 2 in the AER. The two BVGCD permitted or registered wells identified within one mile of the proposed and existing Trey Skiles wells are in agreement with the wells shown on the BVGCD Groundwater Management Application Public Web Map (https://brazosvalleygcd.halff.com/default.aspx).

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI GAM Simulations

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed and existing Trey Skiles wells at a combined rate of 4,800 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 6 and 7) are attached to this memorandum. Table 1 from the AER shows GAM simulated 1-year and 10-year drawdown estimates at BVGCD permitted and registered Simsboro wells within a five-mile radius of the proposed wells.

The TGI report did not discuss the GAM simulation methodology, but it is our general understanding that TGI used the TWDB approved 2021 Groundwater Management Area (GMA) 12 Desired Future Conditions (DFC) run (GMA 12 "S-19") to evaluate water level (head) changes at various stress periods within the DFC run to estimate pumping effects. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year. Based on our understanding of the TGI methodology, it does not provide an isolated estimate of the water-level drawdown that can be caused by pumping the requested 4,800 ac-ft/yr from the Trey Skiles wells as required by BVGCD Rule 8.4(b)(7)(B)(3) due to the additional pumping in the GMA 12 "S-19" run.

To isolate the total impact of the proposed pumping, AGS completed two GAM simulations. The first simulation (the baseline run) is the unmodified GMA 12 "S-19" DFC run and the second simulation (the modified run) is identical to the baseline except that the requested 4,800 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water levels of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping.

AGS GAM Simulations

The AGS methodology described above and used in the GAM simulations focuses on the pumping effects of the proposed pumping and does not include the impacts from other Simsboro pumping in BVGCD or regional impacts from pumping in areas surrounding BVGCD.

AGS simulated the requested annual permit allocation by assigning the proposed Trey Skiles well 2,100 ac-ft/yr of pumping at Node 162516 and BVDO-0108 2,700 ac-ft/yr of pumping at Node 162515. The AGS GAM simulation results after 1 and 10 years of pumping 4,800 ac-ft/yr show drawdown estimates that are generally about 5 feet or more greater than what is shown in the TGI simulation results. The AGS drawdown contours show that the estimated drawdown is spread over a larger geographical area than what is shown in the TGI report.

Figure 2 shows the AGS estimated effects that result from simulation of the requested 4,800 ac-ft of pumping from the Simsboro Aquifer after one year. AGS GAM simulated one year drawdown is estimated to range from about 22 to over 30 feet within one mile from the simulated Skiles wells and about 6 to 13 feet at a distance of five miles from the Skiles wells, depending on the direction from the proposed wells.

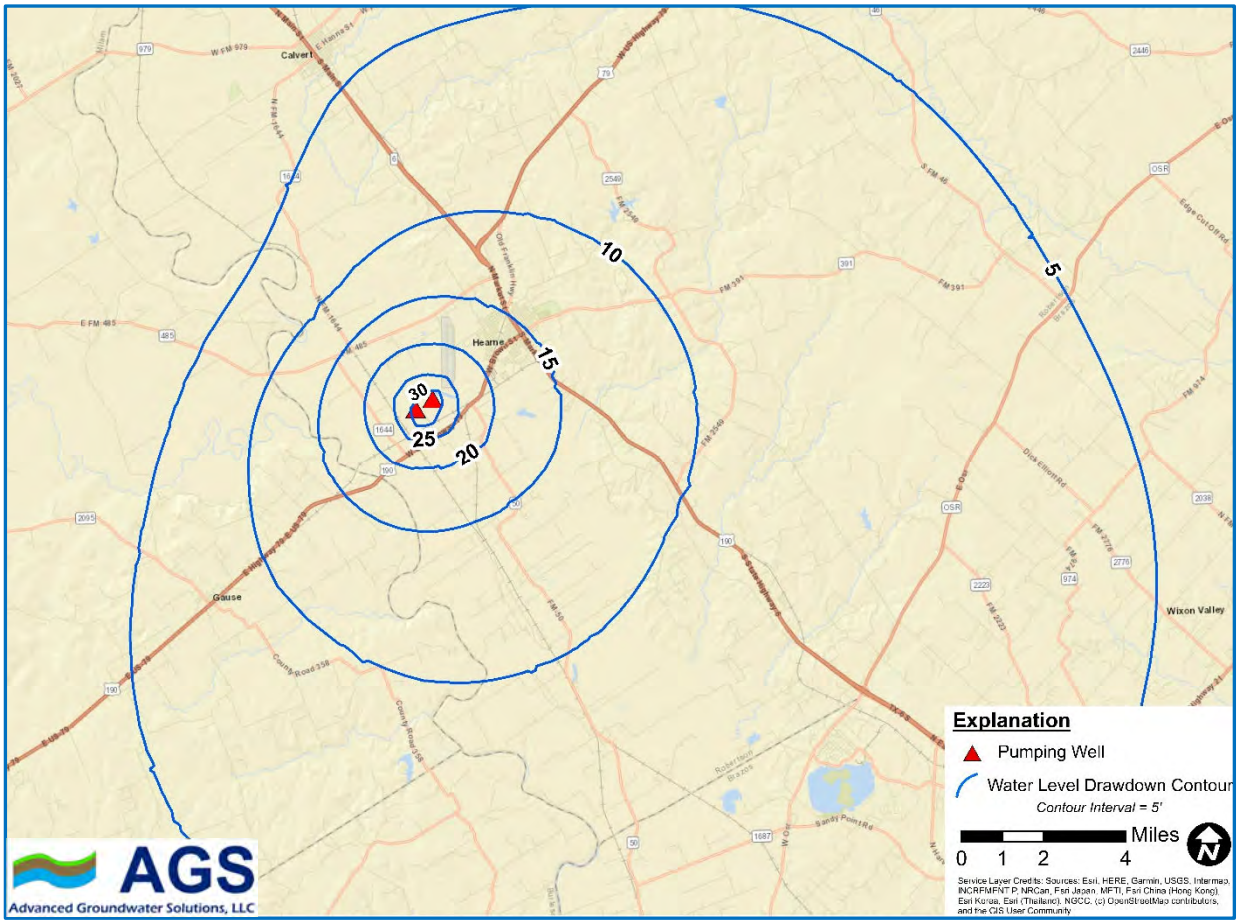


Figure 2. GAM Simulated Drawdown Effects in Simsboro Aquifer After Proposed Skiles Pumping of 4,800 ac-ft/yr for 1-Year

Figure 3 shows the AGS estimated effects that result from simulation of the requested 4,800 ac-ft of pumping from the Simsboro Aquifer after 10 years. AGS GAM simulated 10-year drawdown is estimated to be about 24 to over 35 feet within one mile from the simulated Trey Skiles wells and about 8 to 14 feet at a distance of five miles from the proposed and existing Trey Skiles wells, depending on the direction from the proposed wells.

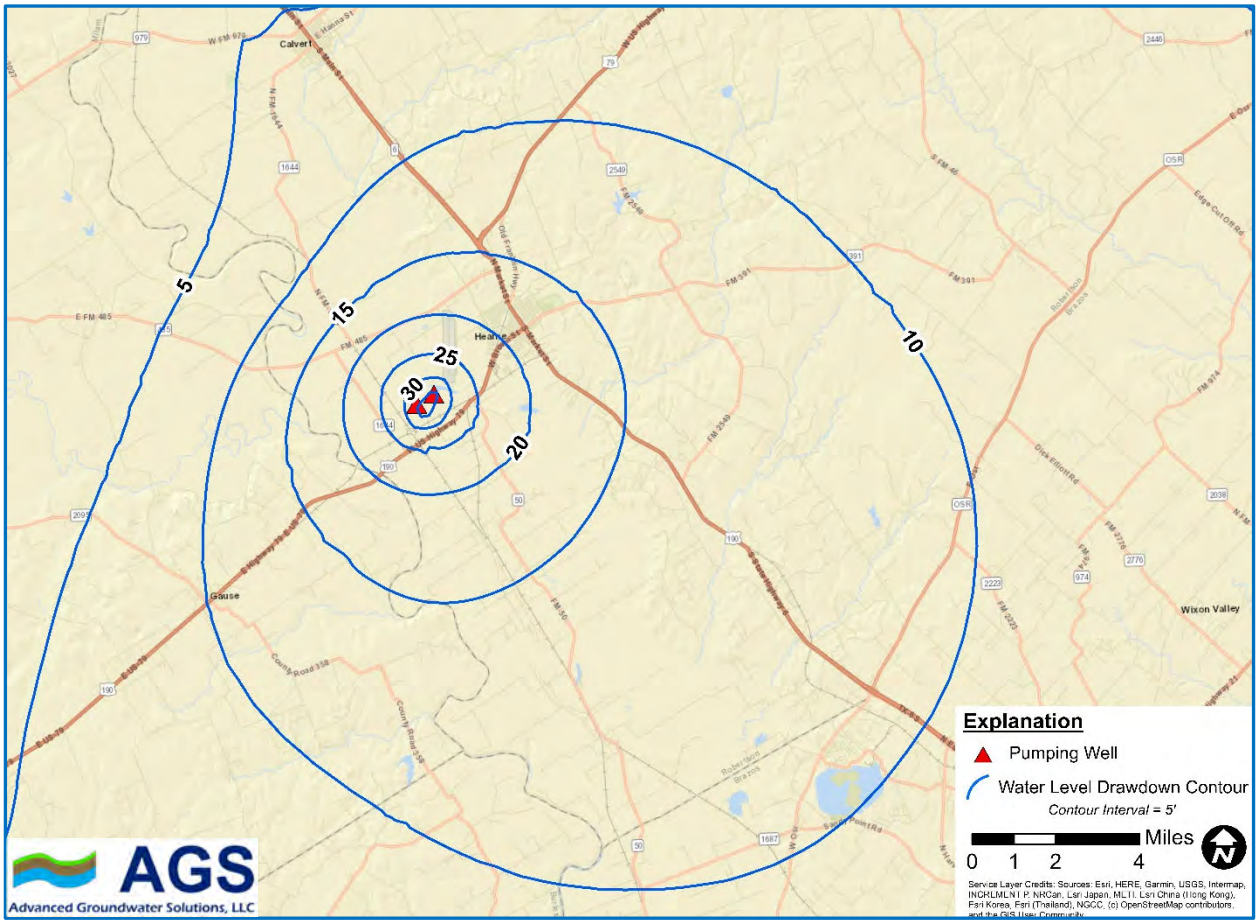


Figure 3. GAM Simulated Drawdown Effects in Simsboro Aquifer After Proposed Skiles Pumping of 4,800 ac-ft/yr for 10-Years

The AGS GAM estimated 5-foot drawdown contours to the northwest appear to be influenced by a fault included in the GAM, which is in the same general area as a fault that has been mapped recently by Groundwater Consultants, LLC and AGS using local geophysical logs and other hydrogeologic data.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. A transmissivity value of 75,000 gallons per day per foot (gpd/ft) and storativity value of 0.0001 were used at each well location to simulate drawdown after 1 and 10 years of pumping. A copy of the TGI 1-year and 10-year analytical simulated interference drawdown illustrations from the AER (TGI Figures 8 and 9) are attached to this memorandum. Table 1 provided in the AER shows simulated 1-year

and 10-year drawdown estimates at BVGCD permitted and registered Simsboro wells within a five-mile radius of the proposed wells based on the analytical modeling. Discussions with TGI personnel indicate that the estimated analytical drawdown values at the proposed Trey Skiles well and existing well BVDO-0108 locations shown in Table 1 were derived from averaging the estimated drawdown at the well over a grid cell within the analytical tool.

AGS estimated the drawdown at the pumping wells using the Theis analytical model and calculating the drawdown at one foot from the well. Using this approach, AGS simulated an additional 22 feet of drawdown at the proposed well location (1-year drawdown: 52 feet (TGI) versus 74 feet (AGS); 10-year drawdown: 62 feet (TGI) versus 84 feet (AGS)) and an additional 24 feet of drawdown at the existing BVDO-0108 location (1-year drawdown: 59 feet (TGI) versus 83 feet (AGS); 10-year drawdown: 70 feet (TGI) versus 94 feet (AGS)). AGS was able to verify the TGI analytical estimated drawdown at all other locations shown in Table 1 of the TGI report.

With this approach, there is an increased density of contours near the proposed Trey Skiles well and existing well BVDO-0108 and we think these are more appropriate estimates of "near well" drawdown. However, there are many factors that will determine the actual drawdown near the well during pumping, and therefore, these differences are assumed to be minor for the purposes of the AER. Figures 4 and 5 show the estimated AGS analytical modeling drawdown contours that result from pumping 4,800 ac-ft/yr for 1-year and 10-years, respectively. Simulated drawdown contours at distance are similar for both methodologies.

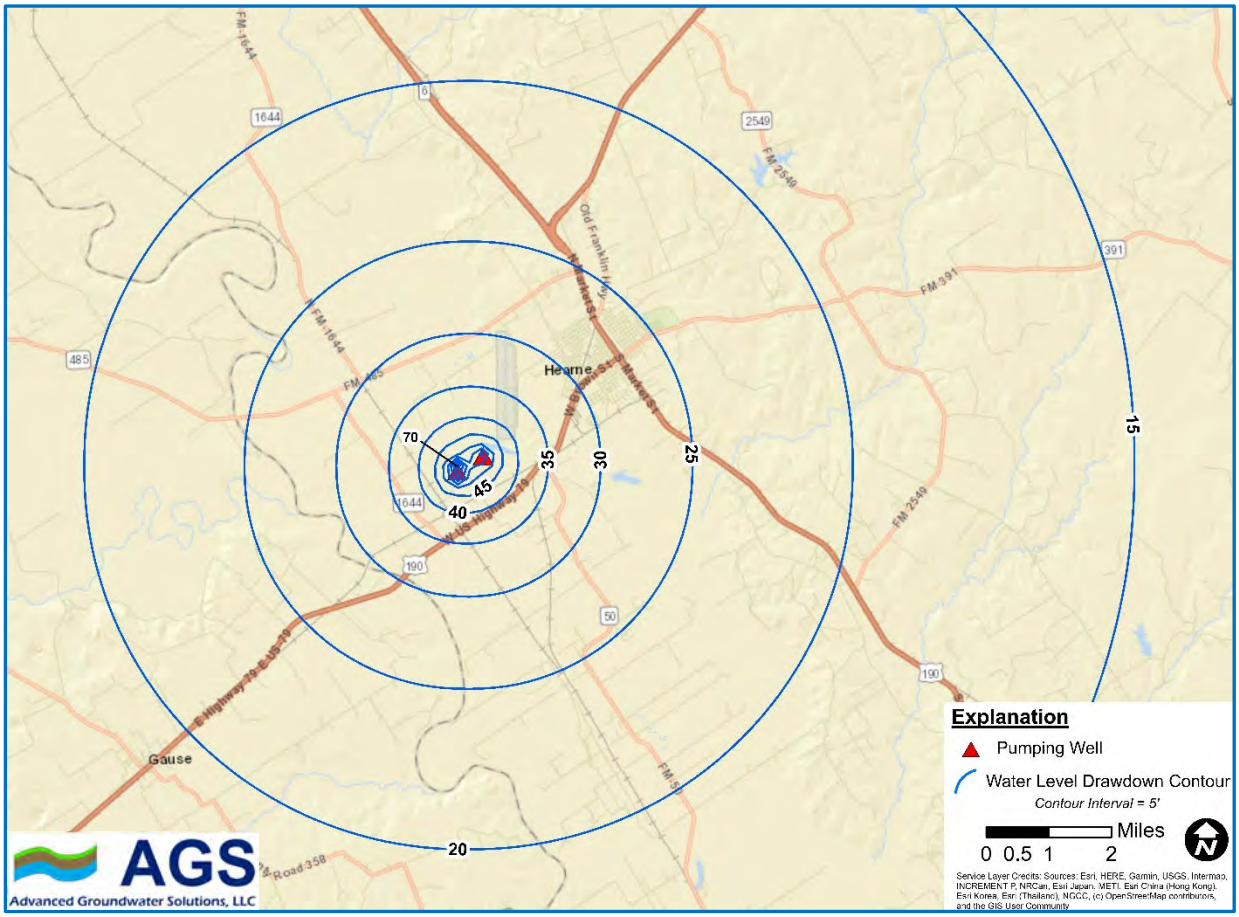


Figure 4. Analytical Simulated Drawdown Effects After Proposed Skiles Pumping of 4,800 ac-ft/yr for 1-Year

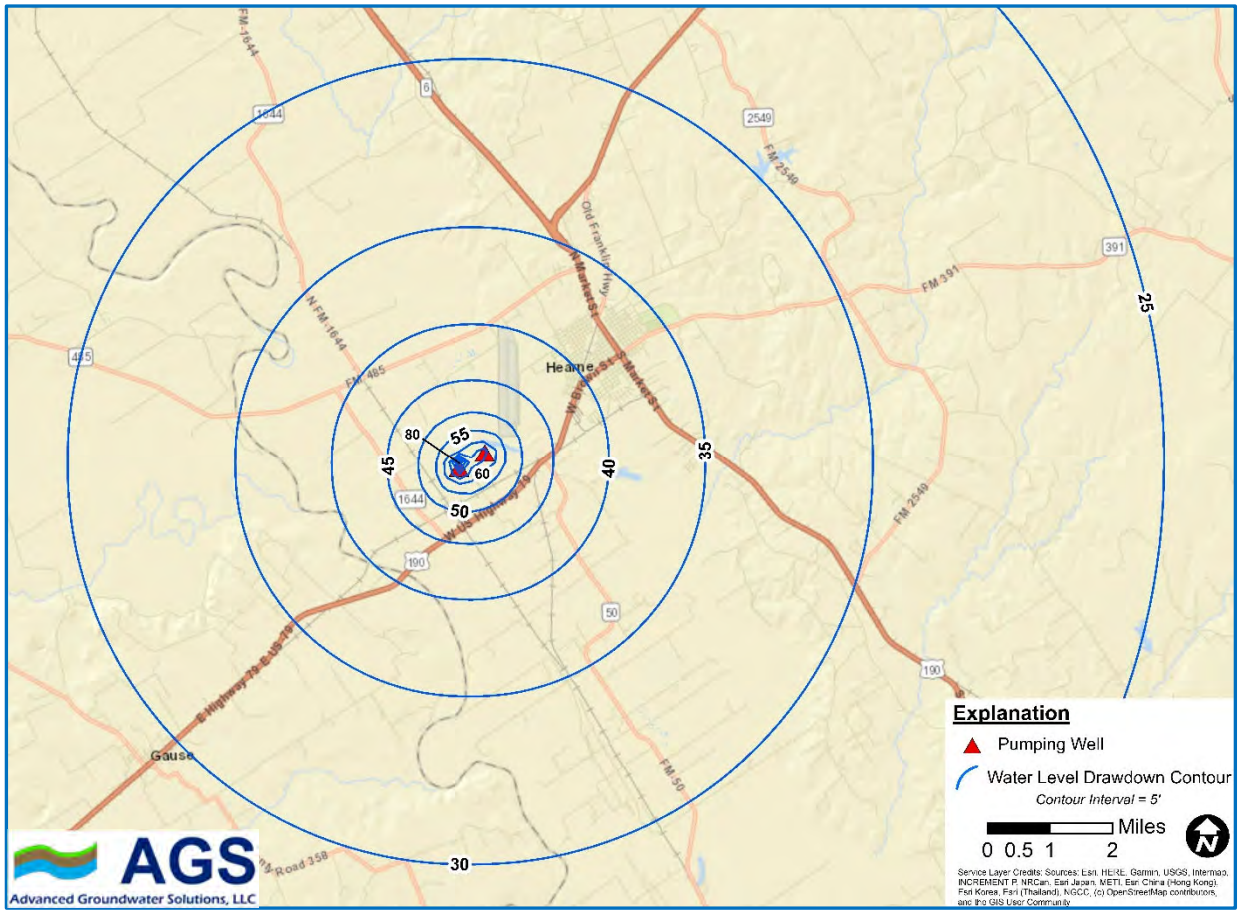


Figure 5. Analytical Simulated Drawdown Effects After Proposed Skiles Pumping of 4,800 ac-ft/yr for 10-Years

Estimated Long-term impacts at wells based on GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Trey Skiles well and existing well BVDO-0108, AGS plotted the simulated water level decline at each well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown in Figure 6 below. The water level projections shown in Figure 6 are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed Trey Skiles well and the requested well BVDO-0108 permitted production increase included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

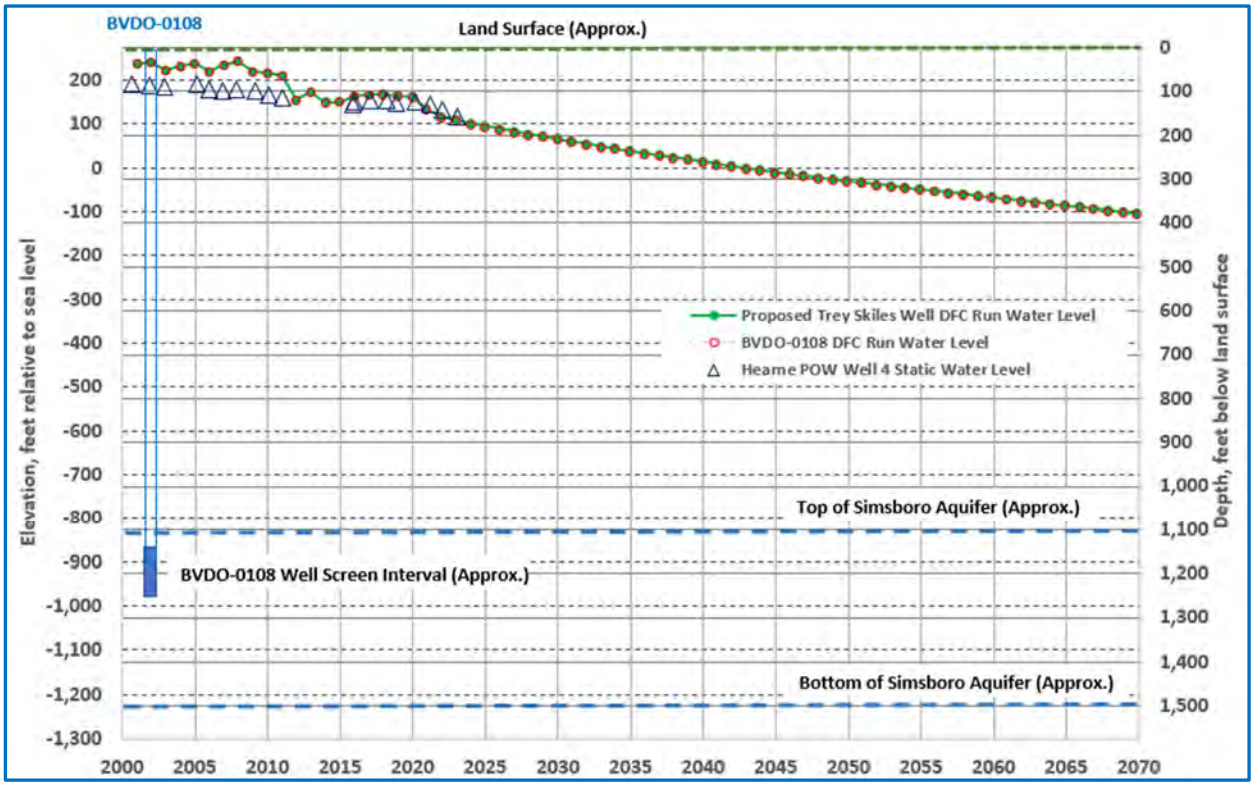


Figure 6. Projected GMA 12 2021 Planning Cycle DFC Water Level Decline at the Proposed Trey Skiles Well and Existing Well BVDO-0108

The graph illustrates the relationship between the land surface, estimated static water level through time, and the estimated top and bottom of the Simsboro Aquifer at the location of the proposed Trey Skiles well and BVDO-0108. Select historical static water level measurements are also shown on Figure 6 for the City of Hearne POW Well 4 (BVGCD Permit BVHU-0013), which is located about 2.1 miles to the north-northeast of the proposed Trey Skiles well and screen sands of the Simsboro Aquifer in the depth interval of about 1,221 to 1,426 feet below land surface or approximately -920 to -1,133 feet rsl).

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. Pumping water levels in wells in areas of concentrated pumping could be one hundred or more feet deeper than the estimated regional static water levels shown on Figure 6. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer.

TGI's report makes note of the testing observed by BVGCD representatives on March 18, 2009. For clarification, BVGCD representatives (LBG-Guyton Associates John Seifert) observed short term pumping (15-20 minutes) of the irrigation wells with flow meter readings of about 3,000 gpm on March 18, 2009.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The GAM simulations performed by TGI did not completely isolate the effects of pumping the total requested permitted amount of 4,800 ac-ft/yr from the proposed Trey Skiles well and existing well BVDO-0108. AGS performed GAM simulations that isolated the proposed Trey Skiles well and existing BVDO-0108 effects of pumping 4,800 ac-ft/yr. The AGS evaluation focused on the requested Trey Skiles permitted pumping of 4,800 ac-ft/yr from the Simsboro Aquifer and does not include what could be the overall effects of all the pumping that could occur in the area. AGS concluded that the TGI GAM simulations underestimated the amount of potential drawdown by about 5 or more feet and underestimated the areal extent of the drawdown.

The TGI analytical modeling simulations underestimate the pumping effects of the requested permitted pumping (4,800 ac-ft/yr) by about 22 to 24 feet very near the proposed Trey Skiles well and existing well BVDO-0108 but provide reasonable estimates of drawdown at distance.

AGS considers these differences to be worth mentioning but not overly consequential for the purposes of this report. AGS recommends that future AER simulations be completed using methods that isolate the pumping effects of the proposed permitted pumping.

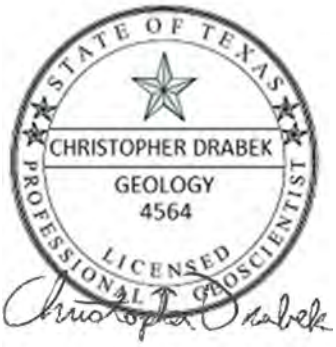
References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

Shi, J. and Harding, J., 2022, GAM RUN 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12, 36 p.

Geoscientist's Seal:



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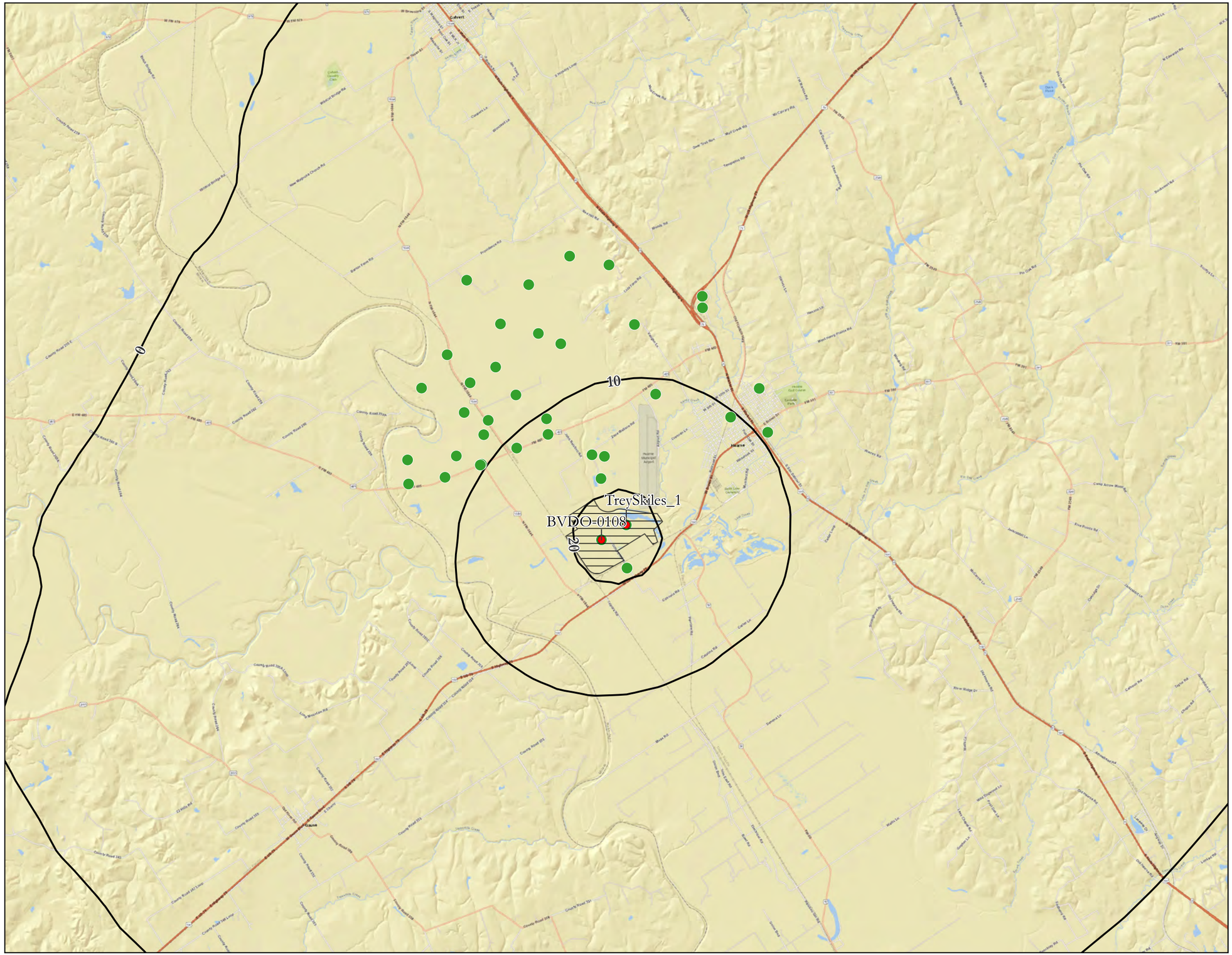

Trey Skiles Proposed Well Location

BVGCD Registered Simsboro Well

1-Year Drawdown (feet)

Trey Skiles Property Boundary

N

0 1 2 3 4 mi

Scale 1:100,000

Figure 6: 1-Year QCSP GAM Drawdown Contours

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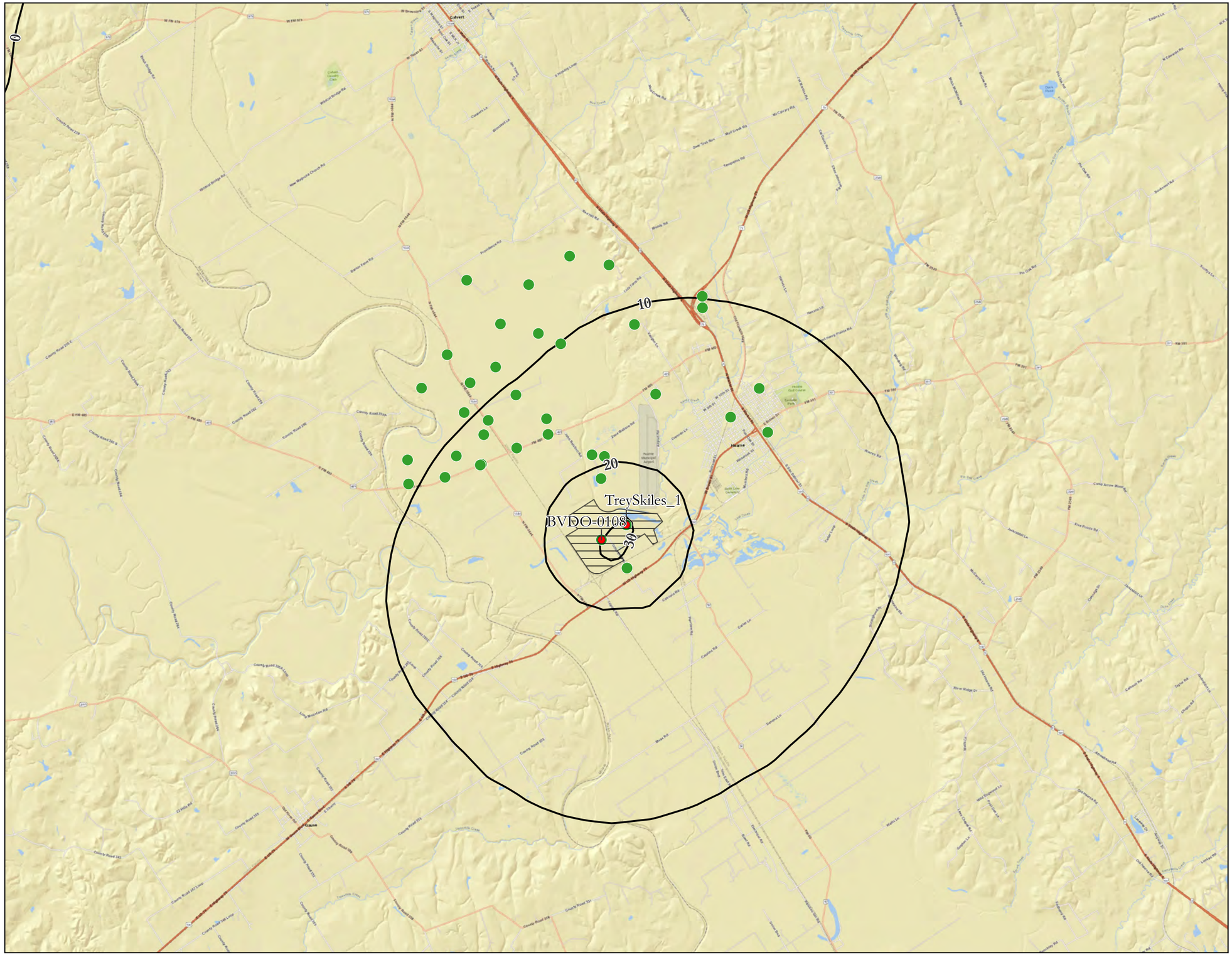

Trey Skiles Proposed Well Location

BVGCD Registered Simsboro Well

10-Year Drawdown (feet)

Trey Skiles Property Boundary

N

0 1 2 3 4 mi

Scale 1:100,000

Figure 7: 10-Year QCSP GAM Drawdown Contours

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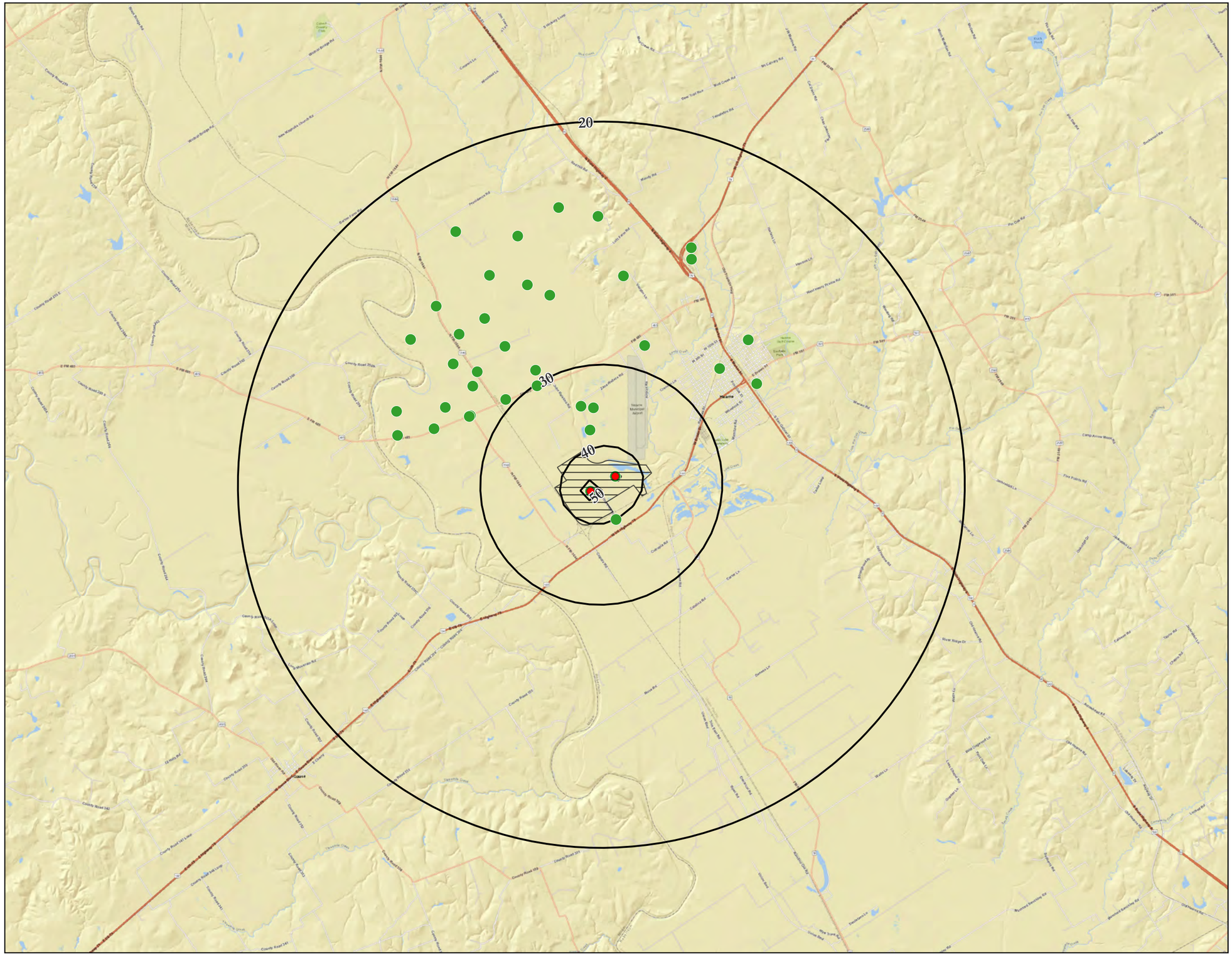

- Trey Skiles Proposed Well Locations
- BVGCD Registered Simsboro Well
- 1-Year Drawdown (feet)
- Trey Skiles Property Boundary

N

0 1 2 3 4 mi

Scale 1:100,000

Figure 8: 1-Year Analytical Drawdown Contours

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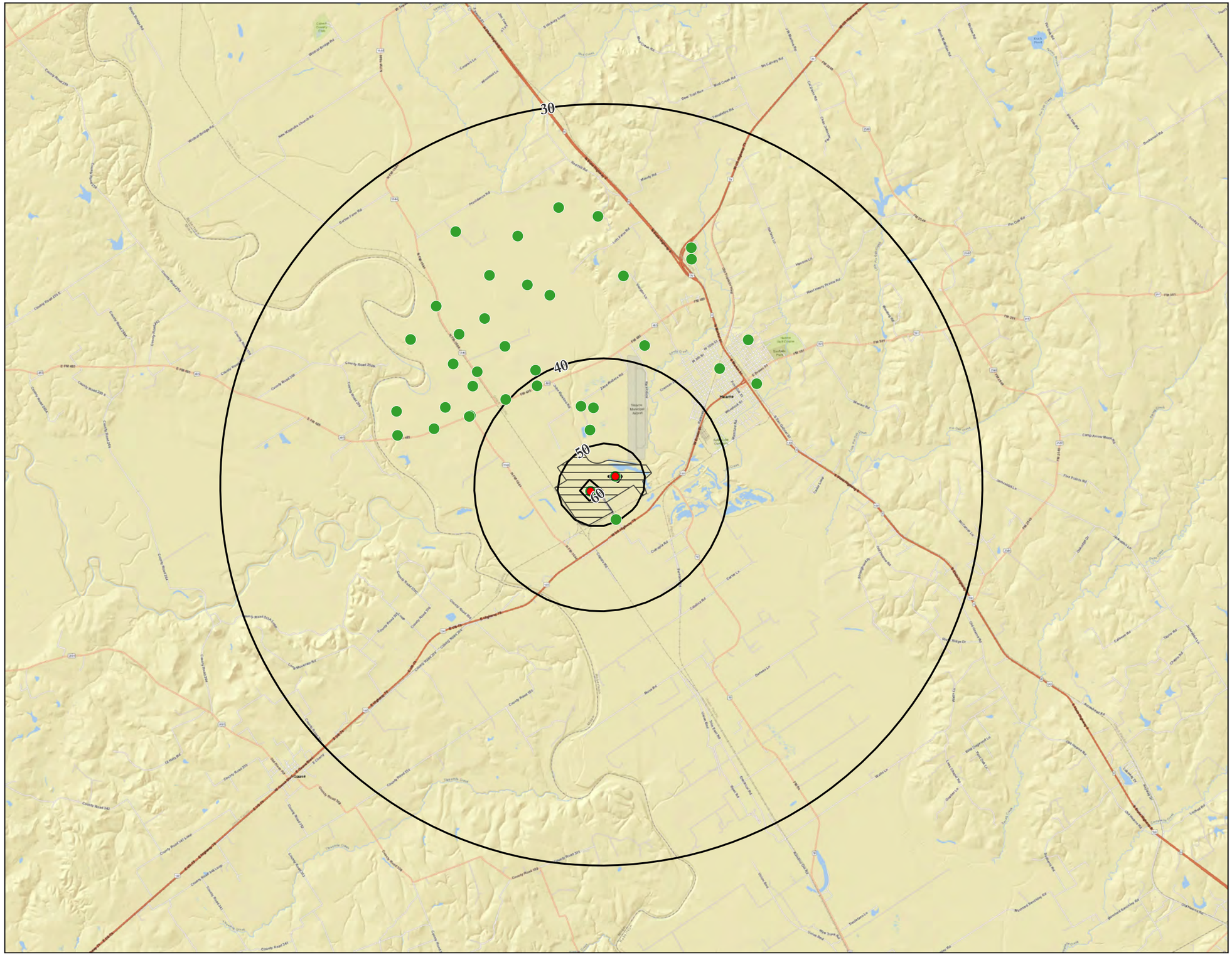

Trey Skiles Proposed Well Location

BVGCD Registered Simsboro Well

10-Year Drawdown (feet)

Trey Skiles Property Boundary

N

0 1 2 3 4 mi

Scale 1:100,000

Figure 9: 10-Year Analytical Drawdown Contours

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Advanced Groundwater Solutions, LLC
www.advancedgw.com

Technical Memorandum

TO: Mr. Alan Day, General Manager
Brazos Valley Groundwater Conservation District

FROM: Christopher Drabek, P.G., and James Beach, P.G.

SUBJECT: Review of L. Wiese Moore LLC Simsboro Aquifer Evaluation Report

DATE: September 1, 2023

Introduction

On behalf of the Brazos Valley Groundwater Conservation District (BVGCD, District), Advanced Groundwater Solutions, LLC (AGS) has reviewed the Aquifer Evaluation Report (AER) prepared by Thornhill Group, Inc. (TGI) in support of a permit application for L. Wiese Moore LLC (Wiese Moore) for two proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 4,452 acre-feet per year (ac-ft/yr). The proposed wells are located on a tract of land located about 3 miles west of the City of Hearne. The locations of the wells are shown on Figure 1. The AER dated July 26, 2023 was submitted to BVGCD on July 27, 2023. The AER was submitted to address BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year and discusses the potential impacts of groundwater production from the Simsboro Aquifer of the proposed new wells in the west part of Robertson County.

AGS has evaluated the hydrogeological conditions, mapping of BVGCD permitted and registered Simsboro wells within one mile of the proposed Wiese Moore wells and the water level drawdown estimates developed using the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) and analytical tools presented in the submitted aquifer evaluation report.

Proposed L. Wiese Moore LLC Wells

Proposed Wiese Moore Well 1 has a maximum production rate of 1,550 gallons per minute (gpm) and an annual permit allocation of 2,000 ac-ft/yr. Proposed Wiese Moore Well 2 has a maximum production rate of 1,900 gpm and an annual permit allocation of 2,452 ac-ft/yr. The locations of the two proposed Wiese Moore wells are shown below on Figure 1.

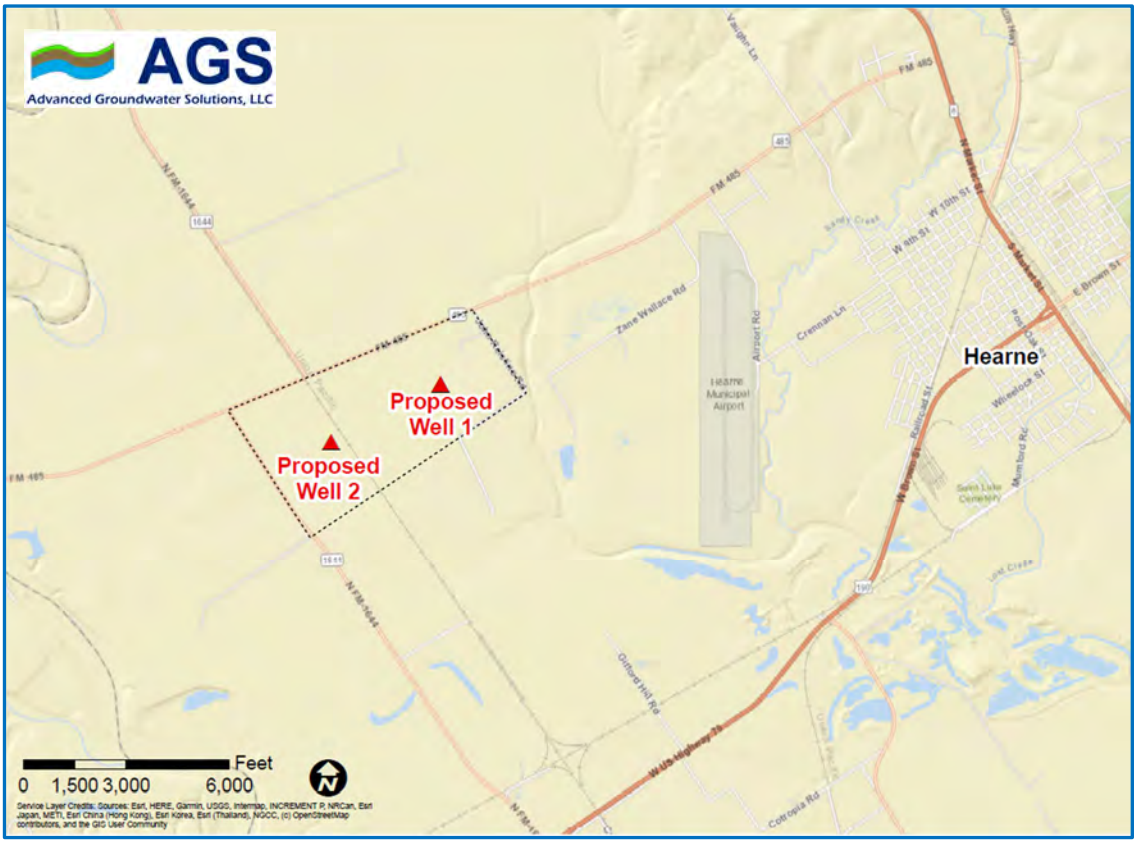

Figure 1. Proposed L. Wiese Moore LLC Well Location Map

Hydrogeologic Conditions

Rule 8.4(b)(7)(B)(1)

AGS has evaluated the hydrogeological conditions presented in the AER and generally agrees with the information presented in this section.

The AER estimates the top of the Simsboro Aquifer to occur at depths between 950 and 1,050 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 1,400 and 1,550 feet bgl in the vicinity of the proposed Wiese Moore wells based on the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM and Bureau of Economic Geology (BEG) mapping.

AGS estimates the top of the Simsboro Aquifer to occur at depths between about 930 and 980 feet bgl and the base of the Simsboro Aquifer to occur at depths between about 1,300 and 1,350 feet bgl in the vicinity of the proposed Wiese Moore wells based on the review of available local geophysical logs.

Site specific information will be available once the test holes are drilled and logged for each of the proposed Wiese Moore wells.

Simsboro Aquifer Wells Within 1-mile of the Proposed L. Wiese Moore LLC Wells

Rule 8.4(b)(7)(B)(2)

Table 1 in the TGI AER provides information on the BVGCD permitted or registered Simsboro wells within one mile of the proposed Wiese Moore wells and locations of the permitted or registered wells are shown on Figures 6, 6a and 6b in the TGI AER. The table does not include information on the well screened interval.

AGS reviewed permitted and registered well data available from BVGCD and identified three additional BVGCD permitted wells that are located within 1-mile of the proposed Wiese Moore wells that were not included in Table 1 of the Wiese Moore AER. Table 1 below provides a summary of the additional permitted wells identified by AGS.

Permit	Permit Holder	Well
BVDO-0300	UW Brazos Valley Farm, LLC	PS6
BVDO-0348	Corpora Farms	8
BVDO-0349	Corpora Farms	9

Table 1. Addition BVGCD Permitted Wells Identified Within 1-mile of the Proposed L. Wiese Moore LLC Wells

Interference Drawdown Estimates

Rule 8.4(b)(7)(B)(3)

BVGCD Rule 8.4(b)(7)(B)(3) requires an estimate of water level drawdown caused by the well(s) pumping at the permitted rate for 1 year and 10 years at a distance of up to five miles from the well(s) using Version 3.02 of the Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifers GAM (INTERA Incorporated and others, 2020). An estimate of the drawdown at locations of existing registered and permitted wells in the BVGCD database that are located within one mile and screen the same aquifer as the well(s) is required to be developed using an analytical tool.

Appropriate analytical models are generally used to provide estimates of pumping effects at or near the well(s) over shorter time horizons. Regional numerical models like the TWDB GAMs are generally used to account for regional variability in the aquifer such as changes in transmissivity and faulting as well as recharge, leakage between aquifers, stream-aquifer interaction, other pumping, and other factors impacting water levels. Appropriate numerical models can provide more reliable estimates of pumping effects on a more regional scale and over longer time horizons.

Groundwater Availability Model Simulation

TGI used the TWDB Central Portion of the Sparta, Queen City and Carrizo-Wilcox Aquifer GAM to estimate drawdown that results from continuously pumping the proposed Wiese Moore wells at a combined rate of 4,452 ac-ft/yr for 1 year and 10 years. A copy of the TGI 1-year and 10-year GAM simulated interference drawdown illustrations from the AER (TGI Figures 8 and 9) are attached to this memorandum. Tables 1 and 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at most BVGCD permitted and registered Simsboro wells within a 1-mile and 5-mile radius of the proposed Wiese Moore wells. The TGI report did not discuss the GAM simulation methodology, but the TGI GAM model results appear to be reasonable based on AGS simulation verification runs.

In the AGS verification runs, two GAM simulations were completed with the first simulation (the baseline run) using the unmodified Groundwater Management Area (GMA) 12 "S-19" Desired Future Condition (DFC) run and with the second simulation (the modified run) being identical to the baseline except that the requested 4,452 ac-ft/yr of pumping was included in the MODFLOW WEL file. The simulated water levels from each simulation were compared by subtracting the simulated water level elevations of the baseline run from the modified run. This comparison isolates the pumping effects of the requested pumping. GMA 12 "S-19" includes additional regional pumping, which gradually increases through time. GMA 12 "S-19" was approved in 2021 and does not include all of the pumping from the Simsboro Aquifer that has been permitted by BVGCD in the area in the past year.

The AGS GAM simulation results after 1 and 10 years of pumping 4,452 ac-ft/yr show about 10 feet or less of drawdown at 5 miles and about 20 to 23 feet of drawdown at 1 mile after 1-year of pumping and about 5 to 15 feet of drawdown at 5 miles and about 23 to 25 feet of drawdown at 1 mile after 10-years of pumping. The AGS GAM simulations show slightly higher simulated drawdown than the TGI simulations, however the estimated drawdown in each simulation are within about 10 feet.

The GAM estimated drawdown contours near proposed Wiese Moore wells appear to be influenced by faults included in the GAM, which are in the same general area as faults that have been mapped by GWC and AGS using local geophysical logs and other hydrogeologic data.

AGS has reviewed this AER based on the hydrogeologic information available today, the information provided by the applicant, and the models and tools available at this time. New scientific or hydrogeologic information or updated models may change the findings of this review.

Analytical Model Simulation

TGI used an analytical model based on the Theis non-equilibrium equation to estimate theoretical potentiometric head declines at and surrounding the proposed wells. The TGI AER did not discuss the input parameters used in the analytical modeling.

AGS simulated the drawdown at the pumping wells using the Theis analytical model and estimated the drawdown at one foot from the well. A transmissivity of 54,297 gallons per day per foot

(gpd/ft) and a storage value of 0.000151 were used in the AGS analytical simulations with each proposed Wiese Moore well pumping its average annual production rate. The transmissivity and storage values used in the AGS analytical simulations represent an average of the Simsboro Aquifer parameters in the GAM at the proposed Wiese Moore well locations.

AGS was able to generally recreate the 1-year simulation results of the TGI analytical modeling. The TGI 10-year analytical simulation appears to underestimate the drawdown compared to simulations performed by AGS using the aquifer parameters as described above. Simulated drawdown could be less if TGI used a larger storage value in the 10-year simulation. Figure 2 below shows the estimated AGS analytical modeling drawdown contours that result from pumping 4,452 ac-ft/yr for 10-years.

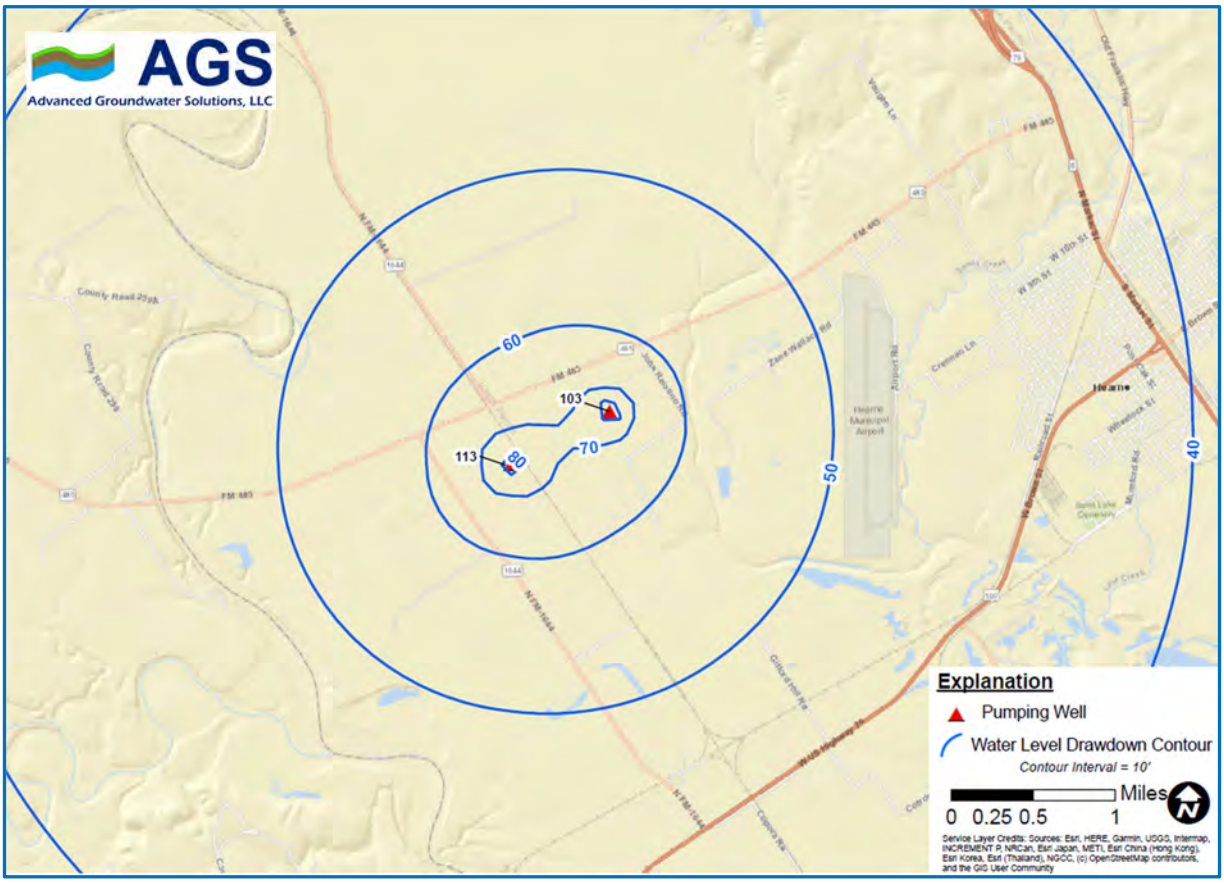

Figure 2. AGS Theis Analytical Simulated Drawdown After Proposed L. Wiese Moore LLC Pumping of 4,452 ac-ft/yr for 10-Years

AGS analytical simulated drawdown at 1-foot from proposed Wiese Moore Wells 1 and 2 is about 90 and 99 feet, respectively after 1-year of pumping and about 103 and 113 feet after 10 years of pumping.

Estimated Long-term impacts at the Proposed L. Wiese Moore LLC Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Wiese Moore wells, AGS plotted the simulated water level decline at each well location based on the 2021 GMA 12 DFC/Modeled Available Groundwater (MAG) projections for the Simsboro Aquifer as shown on Figure 3 below. The water level projections shown in the attached figures are from the TWDB approved DFC/MAG run known as GMA 12 "S-19", but do not include the local impacts from the proposed Wiese Moore wells included in the AER, nor do they include all of the pumping from the Simsboro Aquifer that has been permitted in the area in the past year. The DFC run includes pumping estimates from the Groundwater Conservation Districts in GMA 12 as of about December 2021 that yield DFCs so that the TWDB can estimate the MAG. The detailed assumptions for the DFC simulation can be found in the GMA 12 Explanatory Report (Daniel B. Stephens & Associates and others, 2022) and documentation of the TWDB MAG run can be found in GAM Run 21-017 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 12 (Shi and Harding, 2022).

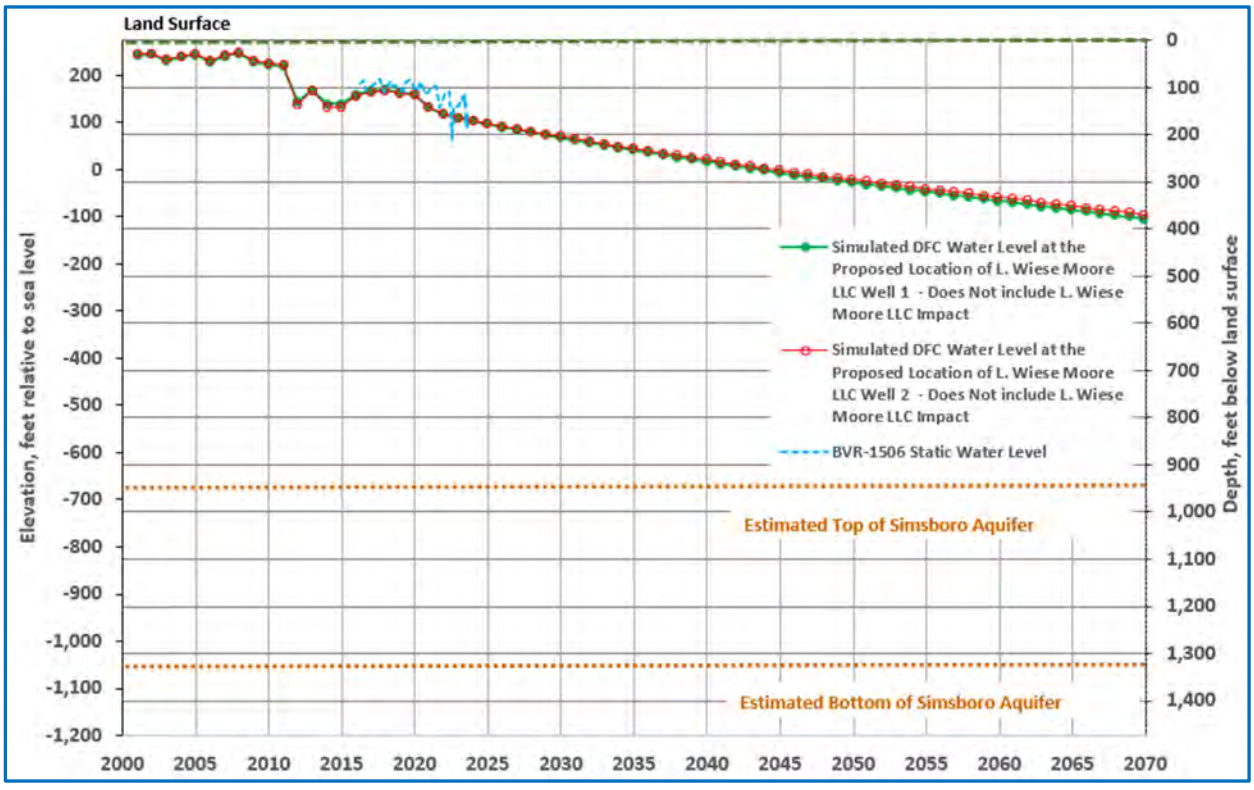

Figure 3. Projected GMA 12 2021 Planning Cycle DFC Water Level Decline at the Proposed L. Wiese Moore LLC Wells.

The graph illustrates the relationship between the land surface, estimated static water level through time and the estimated top and bottom of the Simsboro Aquifer based on review of available local electric logs near the locations of the proposed Wiese Moore wells.

Water levels available from a private domestic well (BVGCD BVR-1506) are shown on Figure 3. The well screen sands of the Simsboro Aquifer and the total depth of the well is 1,250 feet bls. BVR-1506 is located about 0.6 miles west-northwest of proposed Wiese Moore Well 2.

Available drawdown in wells in the Simsboro Aquifer will decline over time based on the DFC simulation. In other words, the lines with green dots and red dots do not include the impact of the proposed Wiese Moore wells. Although not evaluated or discussed in detail herein, these levels of water level decline in wells and artesian head decline in the aquifer will have some impact on vertical leakage, intercepted discharge, reduction in confined and unconfined storage, and potential flow directions in the aquifer. Pumping by the proposed wells will have some of the same type effects on the aquifer.

Conclusions

The submitted AER generally addresses the requirements defined by BVGCD Rule 8.4(b)(7)(B) for wells capable of producing 800 or more acre-feet per year.

The TGI GAM simulations look reasonable and AGS was able to recreate the TGI simulation results. There are minor differences in the simulated drawdown estimated by TGI and AGS near the proposed well locations, but these can most likely be attributed to differences in the approach to the GAM simulation(s).

AGS was able to generally recreate the TGI analytical simulation results of pumping the requested permitted amount of 4,452 ac-ft/yr for 1-year from the proposed Wiese Moore wells. The 10-year analytical simulation results in the TGI AER appear to underestimate the drawdown compared to simulations performed by AGS using the same aquifer parameters used in the 1-year simulations. The TGI simulated drawdown could be less if a larger storage value was used in the 10-year simulation.

AGS is documenting the differences but does not consider them to be major for the purposes of this report.

References

Daniel B. Stephens & Associates, INTERA Incorporated, and Ground Water Consultants, LLC, 2022, Desired Future Condition Explanatory Report for Groundwater Management Area 12, 859 p.

INTERA Incorporated, D.B. Stephens & Associates, and Ground Water Consultants, LLC, 2020, GMA 12 Update to the Groundwater Availability Model for the Central Portion of the Sparta, Queen City, Carrizo-Wilcox Aquifers: Update to Improve Representation of the Transmissive Properties of the Simsboro Aquifer in the Vicinity of the Vista Ridge Well Field, 30 p.

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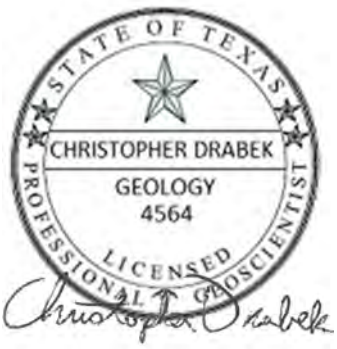

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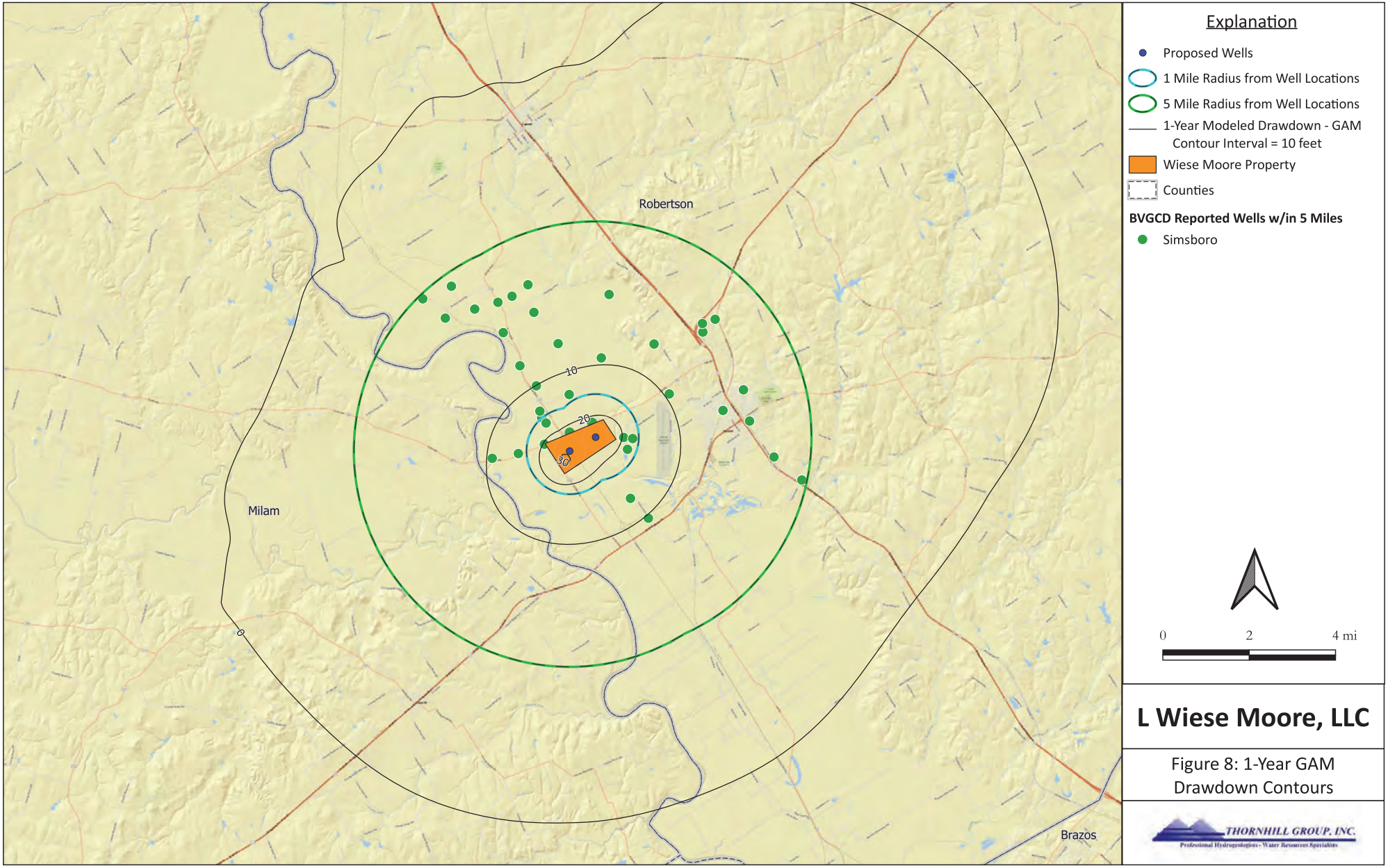
Explanation
Proposed Wells
1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
1-Year Modeled Drawdown - GAM
Contour Interval = 10 feet
Wiese Moore Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
Robertson
Milam
Brazos
10
20
30
0
0
2
4 mi
L Wiese Moore, LLC
Figure 8: 1-Year GAM
Drawdown Contours
THORNHILL GROUP, INC.
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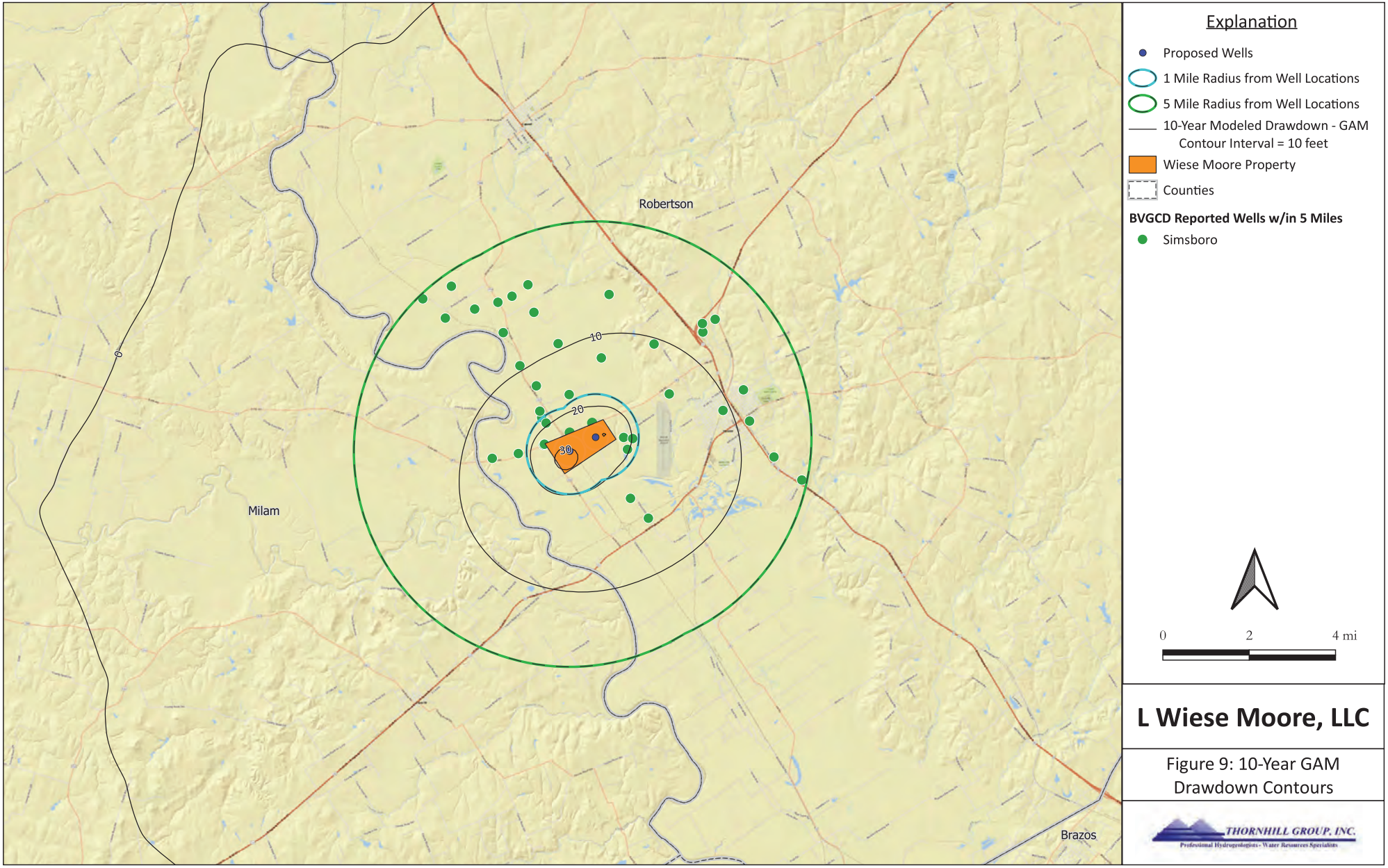
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2
4 mi
L Wiese Moore, LLC
Figure 9: 10-Year GAM Drawdown Contours
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