AGS
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: Review of Burnside Investments, Inc. 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 Burnside Investments, Inc. (Burnside) for five proposed new wells to be completed in the Simsboro Aquifer with a withdrawal amount of 9,189 acre-feet per year (ac-ft/yr). The proposed wells are located on a tract of land located about 5 miles southwest 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 Burnside 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 Burnside Investments, Inc. Wells

The five proposed Burnside wells have maximum production rates that range from 800 to 1,800 gallons per minute (gpm) and an annual permit allocation of 9,189 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 Burnside wells.

Well	Maximum Production Rate (gpm)	Annual Permit Allocation (acre-feet)
1	1,800	2,323
2	1,800	2,323
3	1,300	1,678
4	1,400	1,807
5	820	1,058

Table 1. Proposed Burnside Investments, Inc. Well Maximum Production Rate and Annual Permit Allocation

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

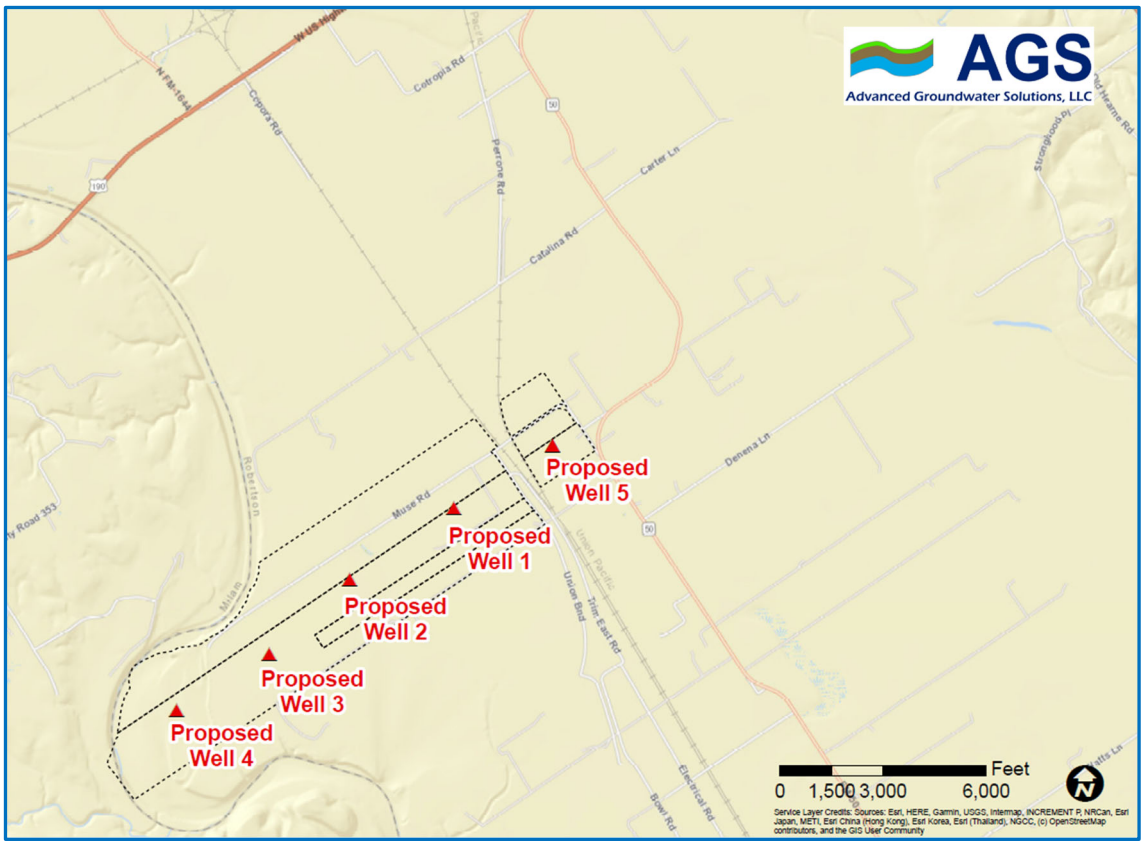


Figure 1. Proposed Burnside Investments, Inc. Well Location Map

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 1,300 and 1,400 feet below ground level (bgl) and the base of the Simsboro Aquifer to occur at depths between 1,700 and 1,900 feet bgl in the vicinity of the proposed Burnside wells based on the GAM datasets and Bureau of Economic Geology (BEG) mapping.

AGS estimates the top of the Simsboro Aquifer to occur at an approximate depth of about 1,415 feet bgl and the base of the Simsboro Aquifer to occur at an approximate depth of about 1,925 feet bgl in the vicinity of the proposed Burnside 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 Burnside wells.

Simsboro Aquifer Wells Within 1-mile of the Proposed Burnside Investments, Inc. Wells

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

The TGI AER did not identify any BVGCD permitted or registered wells within 1-mile of the proposed Burnside wells. AGS reviewed permitted and registered well data available from BVGCD and did not find any BVGCD permitted or registered wells within 1-mile of the proposed 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 Burnside wells at a

combined rate of 9,189 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. Table 2 in the TGI AER shows GAM simulated 1-year and 10-year drawdown estimates at BVGCD permitted and registered Simsboro wells within a 5-mile radius of the proposed Burnside 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 9,189 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 with 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 9,189 ac-ft/yr show about 17 to 25 feet of drawdown at 5 miles and about 35 to 40 feet of drawdown at 1 mile after 1-year of pumping and about 22 to 32 feet of drawdown at 5-miles and about 40 to 48 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.

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 121,607 gallons per day per foot (gpd/ft) and a storage value of 0.000137 were used in the AGS analytical simulations with each proposed Burnside 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 Burnside well locations.

AGS was able to generally recreate the 1-year and 10-year simulation results of the TGI analytical modeling. Table 2 below provides a summary of the AGS simulated drawdown estimates at 1-foot from each of the proposed Burnside wells after pumping 9,189 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	67	79
2	68	81
3	62	74
4	60	72
5	52	64

Table 2. AGS Theis Analytical Simulated Drawdown at the Proposed Burnside Investments, Inc. Wells After 1-Year and 10-Years of Pumping 9,189 ac-ft/yr

Estimated Long-term impacts at the Proposed Burnside Investments, Inc. Wells based on the GMA 12 2021 DFC Run

As a way of evaluating potential long-term estimated water level decline at the proposed Burnside 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 2 through 6. 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 Burnside 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 Burnside wells.

Water levels available from the City of Hearne Well 5 (BVGCD Permit BVHU-0014) are shown on Figure 2. 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 5 miles north-northeast of the proposed Burnside Well 5.

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 Burnside 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 Burnside 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 9,189 ac-ft/yr for 1-year and 10-years from the proposed Burnside wells.

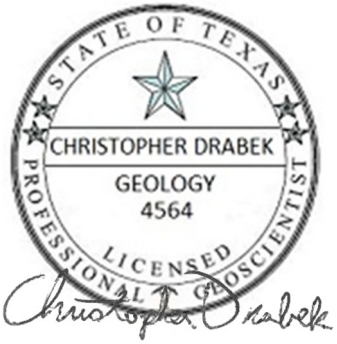
References

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)

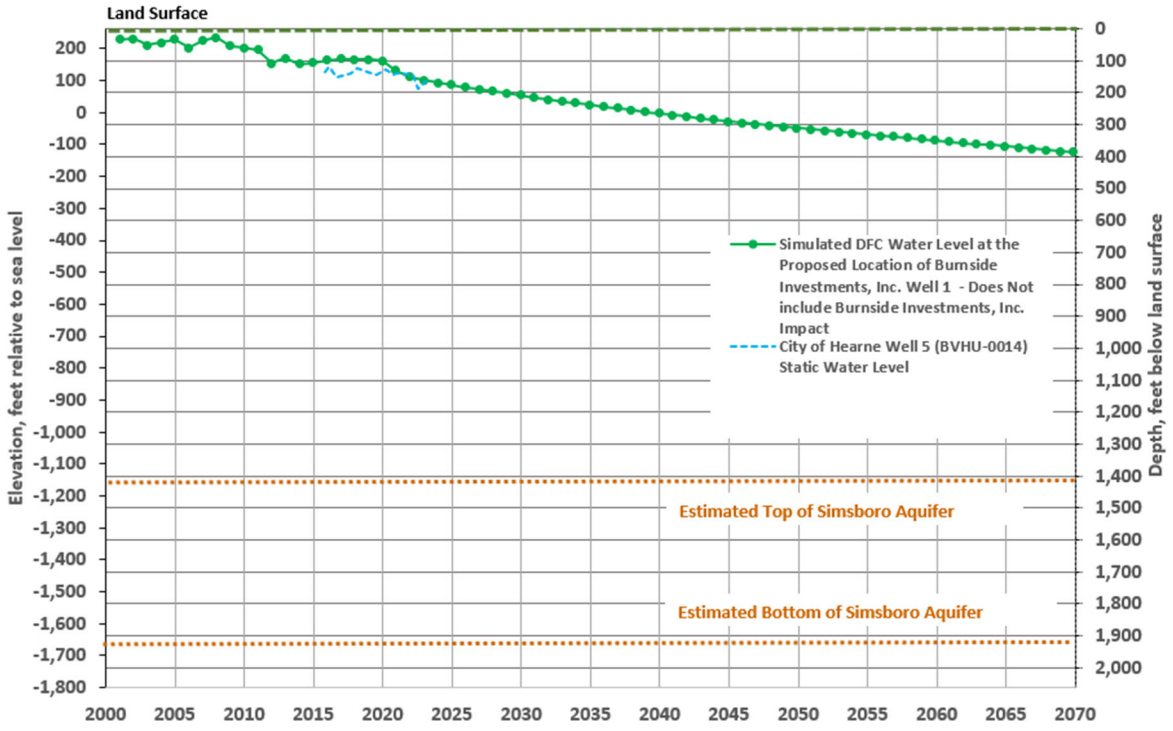


Figure 2. Projected DFC Water Level Change at Proposed Burnside Investments, Inc. Well 1

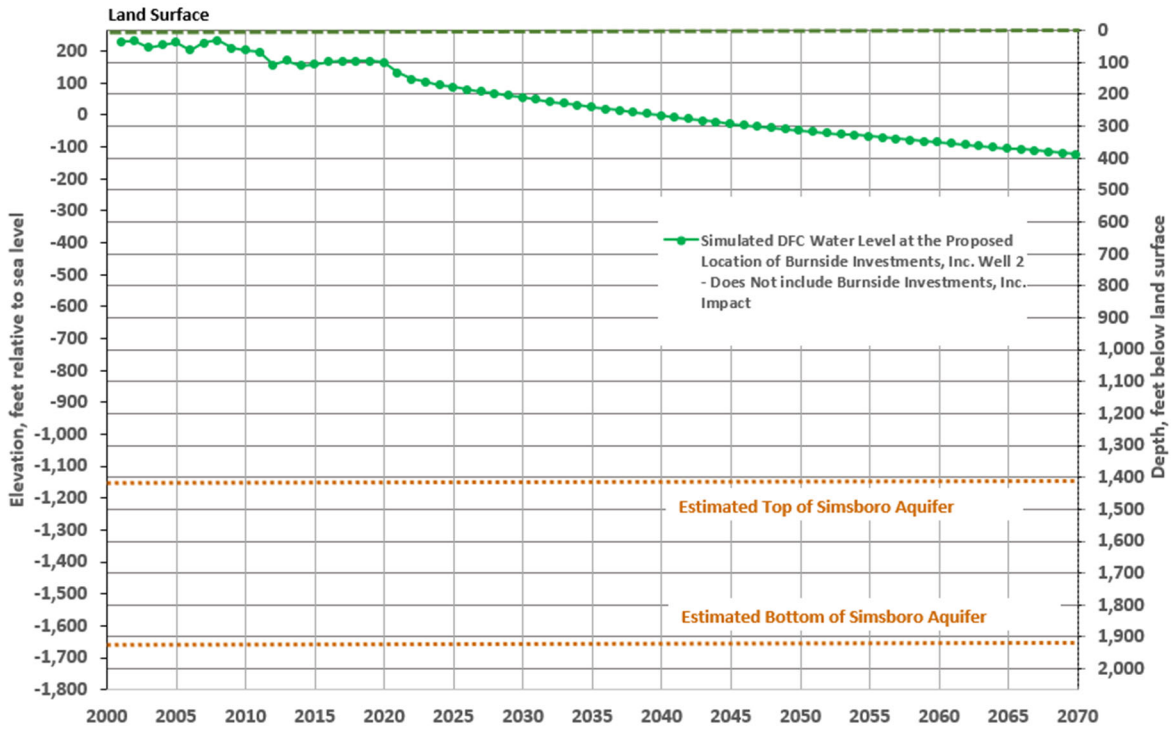


Figure 3. Projected DFC Water Level Change at Proposed Burnside Investments, Inc. Well 2

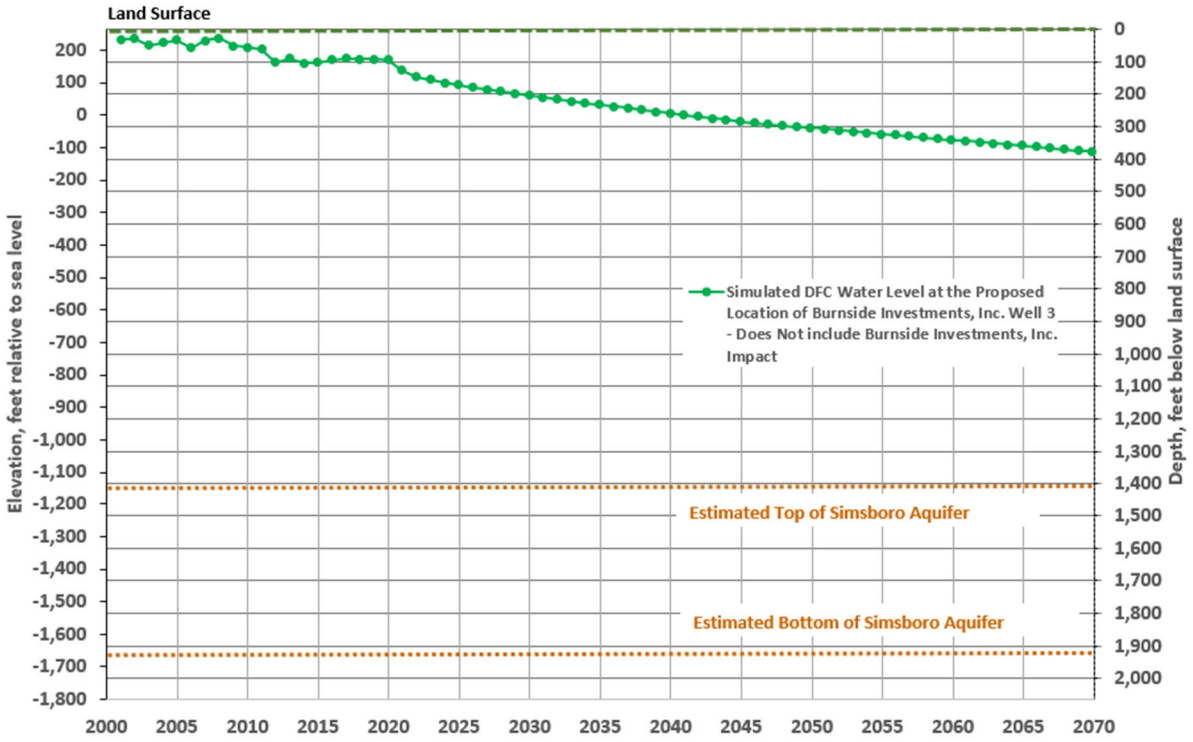


Figure 4. Projected DFC Water Level Change at Proposed Burnside Investments, Inc. Well 3

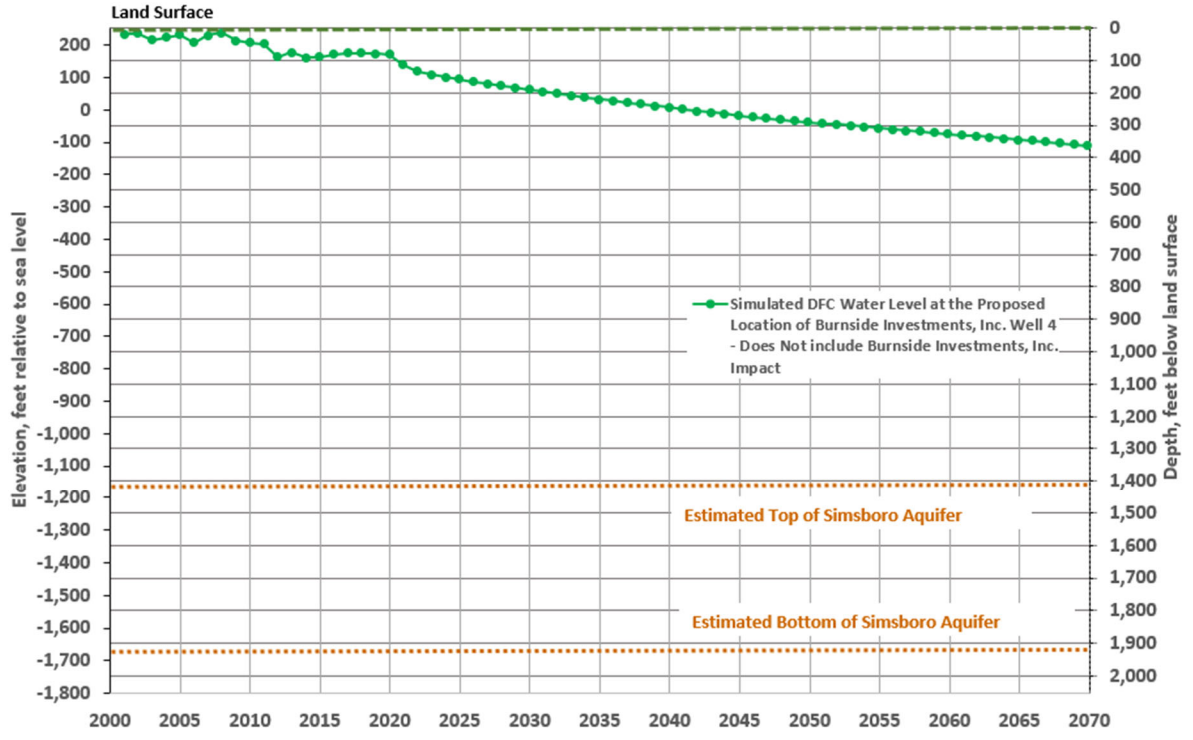


Figure 5. Projected DFC Water Level Change at Proposed Burnside Investments, Inc. Well 4

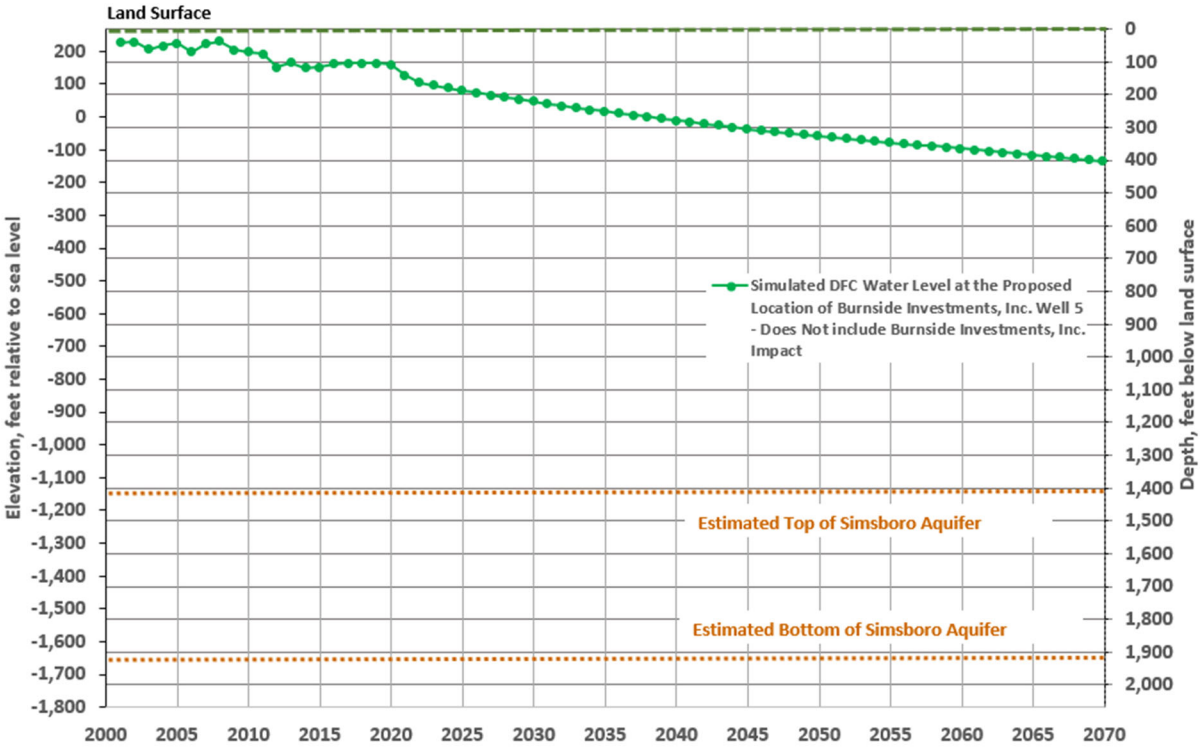
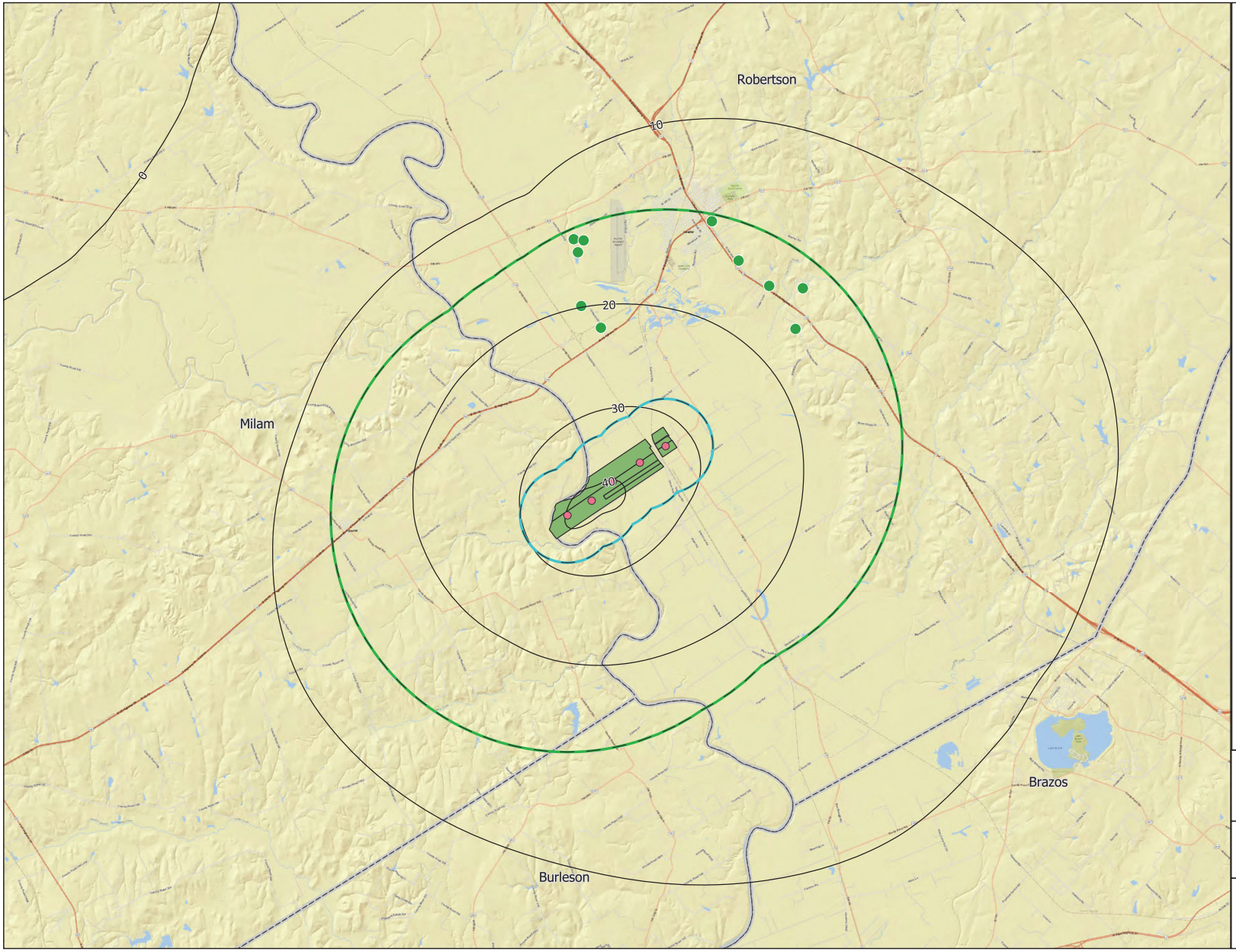


Figure 6. Projected DFC Water Level Change at Proposed Burnside Investments, Inc. Well 5



Explanation

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

BVGCD Reported Wells w/in 5 Miles

- Simsboro

0 2 4 mi

Burnside Investments, Inc.

Figure 8: 1-Year GAM Drawdown Contours

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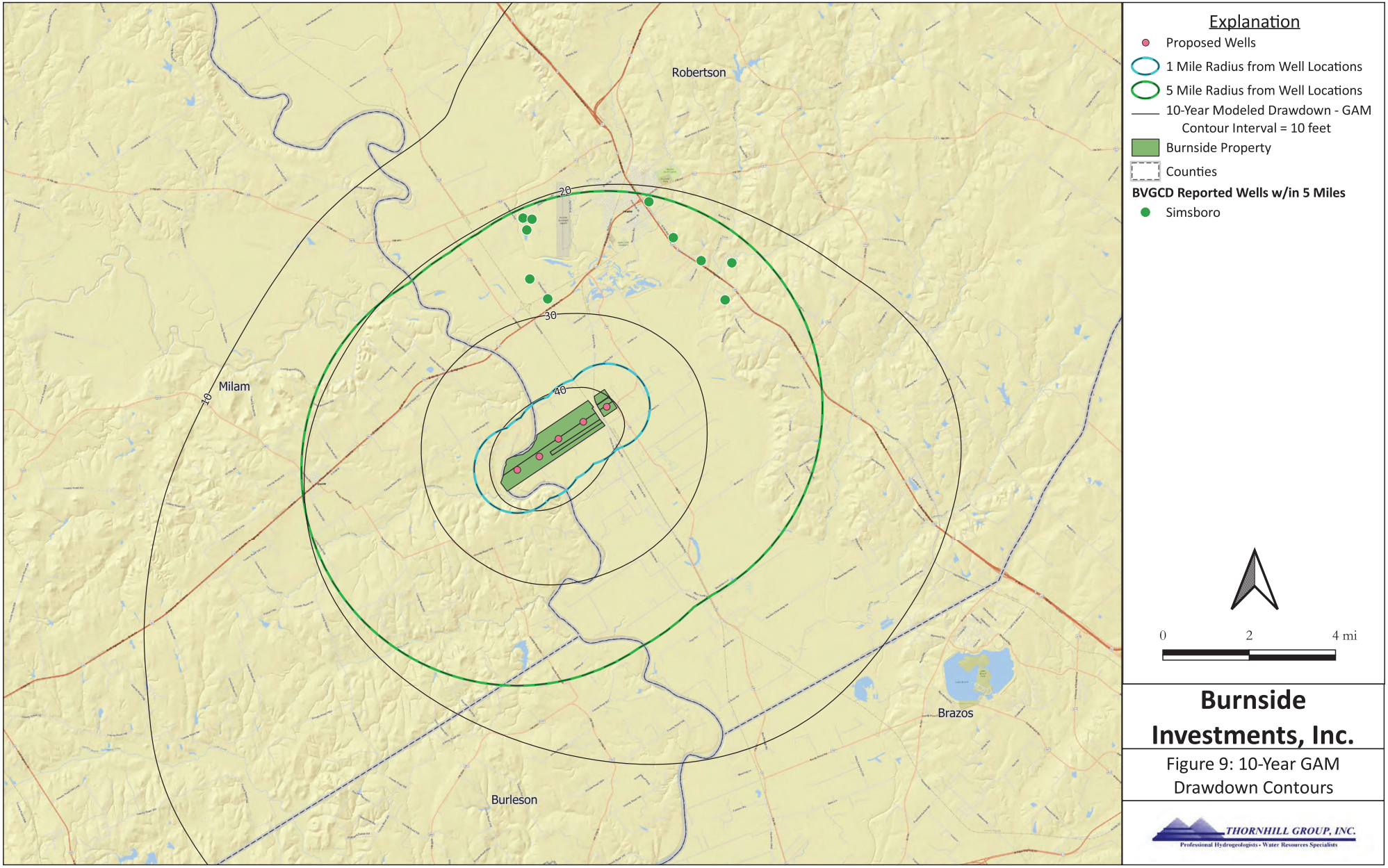
Robertson
Milam
Burleson
Brazos
10
20
30
40
Explanation
Proposed Wells
1 Mile Radius from Well Locations
5 Mile Radius from Well Locations
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Contour Interval = 10 feet
Burnside Property
Counties
BVGCD Reported Wells w/in 5 Miles
Simsboro
0
2
4 mi
Burnside Investments, Inc.
Figure 9: 10-Year GAM Drawdown Contours
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