WELLBORNSUD

Proposed Lightsey Property Simsboro Well

TECHNICAL MEMORANDUM

Hydrogeologic Evaluation for Proposed Lightsey Property Simsboro Well

FINAL / August 2023

carollo®
TBPELS No. F-882

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Contents

Tables

Figures

Abbreviations

bgs	Below ground surface
BVGCD	Brazos Valley Groundwater Conservation District
BVGCD DB	BVGCD Groundwater Database
Carollo	Carollo Engineers, Inc.
DFC	Desired Future Condition
GAM	Groundwater Availability Model
SUD	Special Utility District
TWDB	Texas Water Development Board
SDR: DB	TWDB Submitted Driller's Reports Database
WTP	water treatment plant

SECTION 1 Hydrogeologic Evaluation for Proposed Lightsey Property Simsboro Well

1.1 Background

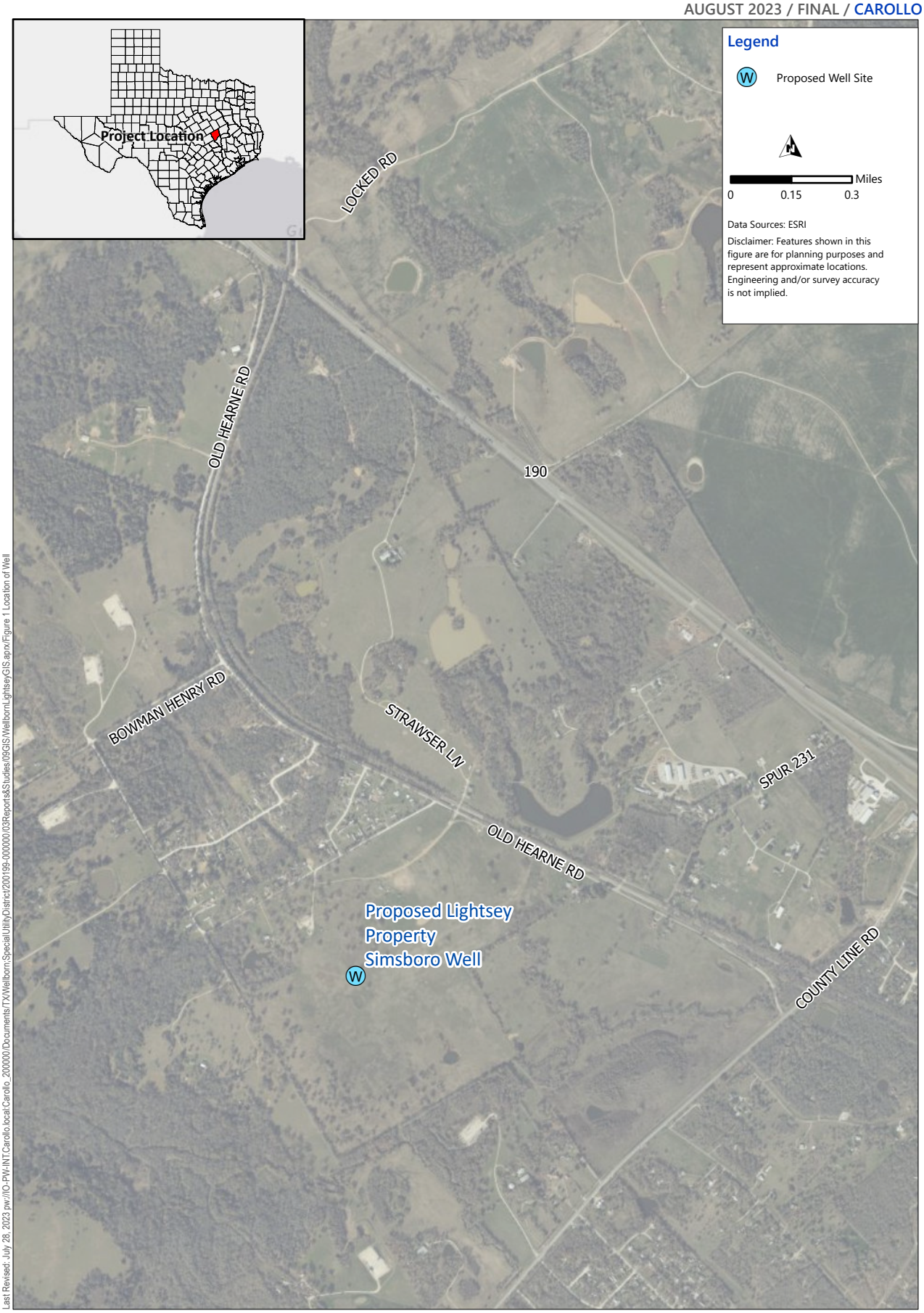
Wellborn Special Utility District (SUD) is developing a project to construct a public water supply well in the Simsboro Formation at a 180-acre site east of Old Hearne Road in Robertson County, Texas. The proposed well has an anticipated yield of 2,000 gpm with an annual production limit of 1,972 acre-feet/year. Carollo Engineers, Inc. (Carollo) has completed a hydrogeologic evaluation of the projected effect of the proposed withdrawal for the Lightsey Property Well (well) in the Simsboro Formation in accordance with the rules of the Brazos Valley Groundwater Conservation District (BVGCD). This report provides a description of the hydrogeologic conditions in proximity to the proposed well, a table of nearby registered and permitted wells, and an estimate of the water-level drawdown caused by the proposed well. The location of the proposed well is shown in Figure 1.

The approximate coordinates of the well site are latitude 30° 44′ 28.97″ N, longitude 96° 28′ 38.12″ W. The proposed well design includes a 24-inch surface casing to a depth of 650 ft followed by an 18 inch steel casing to the top of the targeted water-bearing interval in the Simsboro Formation at an estimated depth of 2,234 feet below ground surface (bgs). The total thickness of the Simsboro Formation is approximately 500 feet at this location. The production zone of the well comprises approximately 500 feet of 24 inch under-reamed, gravel-packed borehole with a 12-3/4-inch stainless steel screen. Preliminary well design information is based on historical research of similar Simsboro wells in the area.

BVGCD District Rule 8.4(b)(7)(B) specifies three items that must be addressed in the evaluation report.

1. A description of the hydrogeologic conditions in proximity to the well(s) that includes: the surface geology, the depth interval of the proposed water bearing zone, the anticipated thickness of the water bearing zone, a statement of whether the water bearing zone is anticipated to be in unconfined or confined condition, and a description of any hydrologic features or geologic features located within one mile of the proposed well(s) site(s).
2. A table giving data on each registered or permitted well located within one mile of the well(s) and screening the same aquifer. The well table shall include the name of the well owner, well registration or permit number, casing and screen diameters and depth settings, total well depth, and aquifer screened. A map shall be provided showing the location of the well(s) at a scale no greater than one-inch equals 1,000 feet.
3. An estimate of the drawdown that can be caused by pumping the well(s) at the permitted rate for one year and ten years at a distance of up to five miles from the well(s). Water-level drawdown contours shall be shown at ten-foot contour intervals. The estimate can be developed using the Theis equation and aquifer transmissivity and storage coefficients in the most recent or Texas Water Development Board (TWDB)approved version of the Queen City Sparta GAM or TWDB Yegua-Jackson GAM, as applicable. Aquifer hydraulic data available from other sources and in proximity to the well(s) also can be considered in estimating the water-level drawdown effects of pumping. The evaluation must include an estimate of the drawdown at the locations of existing registered and permitted wells contained in the BVGCD database that screen the same aquifer as the well(s) and are located within one mile of the well(s). This estimate shall be developed using an analytical tool approved by the District and the best available science concerning local aquifer properties such as transmissivity and storativity.

The following sections provide the information for the required items.



Last Revised: July 28, 2023 pw://IO-PW-INT.Carollo.local:Carollo_200000/Documents/TX/Wellborn,SpecialUtilityDistrict/200199-000000/03Reports&Studies/09GIS/WellbornLightseyGIS.aprx/Figure 1 Location of Well

Figure 1 Location of Well
WELLBORN SUD
PROPOSED LIGHTSEY PROPERTY SIMSBORO WELL

1.2 Description of Hydrogeologic Conditions

The sediments that form the hydrogeologic units in the Robertson County area are part of a Gulf-ward thickening wedge of Cenozoic sediments deposited in the Houston Embayment of the northwest Gulf Coast Basin (Young et al., 2018). The depositional environments reflect sea level oscillations and changes in amount and source of sediments. Growth faults greatly increased the thickness of some stratigraphic units in short distances (Baker, 1979).

The primary depositional sequences in ascending stratigraphic order are the Midway Group; the Wilcox Group, including the Simsboro Formation; the Claiborne Group; and the Jackson Group (Table 1). Each of these depositional sequences is bounded by marine shales and finer-grained sediments representing transgressions, as exemplified in the Reklaw and Weches formations of the Claiborne Group. These sequences overlay the thick marine clays of the Midway Group.

Table 1 Stratigraphy and Aquifers in the Robertson County Area (after Young et al, 2018)

Series	Group	Formation	Aquifer
Eocene	Jackson		Yegua-Jackson
	Claiborne	Yegua	
		Cook Mountain	
		Sparta	Sparta
		Weches	
		Queen City	Queen City
		Reklaw	
		Carrizo	Carrizo-Wilcox
	Wilcox	Calvert Bluff	
		Simsboro	
Paleocene		Hooper	
	Midway		

1.3 Surface Geology

The Tertiary Cook Mountain Formation is exposed at the surface of the well site. The Cook Mountain Formation in this area is a marine deposit consisting of up to 300 feet of carbonaceous clay and a small amount of sand, sandstone, limestone, glauconite, gypsum, and fossilized wood (Follett, 1974; USGS, 2023).

1.4 Depth Interval of the Proposed Water Bearing Zone

The Lightsey Property Simsboro Well is targeting the Simsboro Formation within the Carrizo-Wilcox Aquifer at a depth of 2,334 feet to 2,854 feet bgs.

1.5 Anticipated Thickness of the Water Bearing Zone

The targeted water-bearing thickness of the Simsboro Formation is 500 feet at the proposed well site based on the information in the Groundwater Availability Model (GAM) for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Young et al, 2018) and previous evaluations for Wellborn SUD Wells A and B.

1.6 Statement of Whether the Water Bearing Zone is Anticipated to be in Unconfined or Confined Condition

The conceptual model of groundwater flow for the "Groundwater Availability Model for the Central Portion of the Carrizo-Wilcox, Queen City, and Sparta Aquifers" (Young et al, 2018) states that groundwater flow within the aquifers is controlled by topography, structure, and permeability variations within the different layers. The Wilcox Aquifer, including the target Simsboro Formation, is under confined conditions in Robertson County. Through historical research of similar Simsboro wells in the area and information available from the BVGCD groundwater database, it is estimated that the top of the Simsboro aquifer is approximately 2,334 feet below ground surface (bgs) in the proposed well field. Additionally, it is estimated the static water level will be around 248 feet bgs.

1.7 Description of any Hydrologic Features or Geologic Features Located Within One Mile of the Proposed Well Site

The units in the well site dip to the southeast toward the Gulf. Most of the water produced from the Carrizo-Wilcox Aquifer in the BVGCD area is from the Simsboro Formation with municipalities such as Bryan and College Station along with Texas A&M University obtaining most of their water from this unit (Thorkildsen and Price, 1991; Follett, 1974).

The Simsboro Formation is an identifiable unit only in central Texas, comprising one of the three formational divisions of the Wilcox Group within this region. It is composed primarily of fine- to coarse-grained, light gray sand with relatively small amounts of clay, mudstone, and mudstone conglomerate (Thorkildsen and Price, 1991). The Simsboro Formation was deposited in a fluvial environment and formed a complex distribution of sands with diverse sand body geometries. Simsboro sands are discontinuous river channel deposits with interchannel deposits composed of finer-grained sands and muds.

1.8 Existing Wells

The BVGCD rules require a table giving data on each registered or permitted well located within one mile of the proposed well and screening the same aquifer. Based on data compiled from the BVGCD groundwater database and the TWDB Groundwater Database, two other wells completed in the Simsboro Formation are located within one mile of the proposed well. The wells are identified by well numbers BVDO-0285 and BVDO-0003. Well BVDO-0285 is proposed Wellborn SUD Well #7 that is currently permitted but has not yet been drilled. Well #7 is located 3,805 feet north of the proposed well. Well BVDO-0003is a City of Bryan public supply well drilled to a depth of 2,770 feet, 5,262 feet south of the proposed well. Table 2 provides information for all wells located within 1-mile of the proposed well site. Locations of the wells are shown in Figure 2.

Table 2 Existing Wells Within 1-Mile of Proposed Lightsey Property Simsboro Well

Well/Owner Name	Primary Permit Number	Well Tracking/State Well Number	Casing and Screen Diameter and Depth		Total Well Depth (feet)	Aquifer Screened	Source
			Blank	Screen			
City of Bryan Well #18	BVDO-0003	71146	10" steel 2122-2770	10" 0.025 pipe base 2328-2750	2770	Simsboro	BVGCD DB
Wellborn SUD Well #7	BVDO-0285	20-00-285	12.75" Steel Liner 2234-2334	12.75" SS 2334-2834	2854	Simsboro	BVGCD DB
Lakewood #1	BVHU-0982	10-00-982	6" PVC 0-380	4" 378-438	338	Queen City	BVGCD DB
Victor Harris	BVR-0155	59-21-104	--	--	--	Queen City	BVGCD DB
--	BVR-0169	70-00-169	--	--	--	Unknown	BVGCD DB
Well #1	BVR-0429	70-00-429	--	--	--	Queen City	BVGCD DB
--	BVR-0430	70-00-430	--	--	--	Queen City	BVGCD DB
Well #3	BVR-0431	70-00-431	--	--	--	Queen City	BVGCD DB
Well #2	BVR-0619	70-00-619	--	--	--	Queen City	BVGCD DB
--	BVR-1569	70-01-569	--	--	--	Queen City	BVGCD DB
Mike Flemming	BVR-2454	70-02-454	4" Plastic 0-280	4" Slotted 280-310	310	Sparta	BVGCD DB
Jim Franklin	BVR-2784	70-02-784	4" PVC 0-345	2.5" SS 345	345	Queen City	BVGCD DB
Leroy Cauvel	BVR-2799	70-02-799	4" PVC 0-282	2.5" PVC 312-322	322	Sparta	BVGCD DB
Leroy Cauvel	BVR-2807	70-02-807	4" PVC 0-282	2.5" PVC 312-322	322	Queen City	BVGCD DB
--	BVR-2811	70-02-811	--	--	--	Sparta	BVGCD DB
Union Pacific Resources	BVR-2812	70-02-812	4" 0-340	4" Slotted 340-400	400	Queen City	BVGCD DB
Well #1 (Holtom)	BVR-2815	70-02-815	4" PVC 0-280	280-380	380	Queen City	BVGCD DB
Halton	BVR-2819	70-02-819	4" Plastic 0-303	4" Plastic 303-318	318	Queen City	BVGCD DB
Paul Garner	BVR-2820	70-02-820	4" PVC 0-195	2.5" Slotted	195	Sparta	BVGCD DB
--	BVR-2821	70-02-821	--	--	--	Queen City	BVGCD DB
--	BVR-2824	70-02-824	--	--	--	Queen City	BVGCD DB
Justin (Ronnie) Holder	BVR-2825	70-02-825	4" Plastic 0-377	2" Screen 377-427	427	Queen City	BVGCD DB
--	BVR-2829	70-02-829	--	--	--	Queen City	BVGCD DB

Well/Owner Name	Primary Permit Number	Well Tracking/State Well Number	Casing and Screen Diameter and Depth		Total Well Depth (feet)	Aquifer Screened	Source
			Blank	Screen			
Well #2	BVR-2830	70-02-830	4" PVC 1-380, 2" Galv 368-410, 2" PVC 430-440	2.5" Slotted PVC 410-430	440	Queen City	BVGCD DB
Louis Urbanovisky	BVR-3232	70-03-232	4" Steel 0-248	2" SS 248-369	369	Sparta	BVGCD DB
--	BVR-3505	70-03-505	--	--	--	Queen City	BVGCD DB
--	BVR-3508	70-03-508	--	--	--	Queen City	BVGCD DB
Halton	BVR-3510	70-03-510	4" Steel 0-355	4" SS 344-390	390	Queen City	BVGCD DB
--	BVR-3511	70-03-511	--	--	--	Queen City	BVGCD DB
Well #3	BVR-3512	70-03-512	4" Plastic 0-290	2" Plastic 290-402	402	Queen City	BVGCD DB
--	BVR-3513	70-03-513	--	--	--	Queen City	BVGCD DB
--	BVR-4516	70-04-516	--	--	--	Sparta	BVGCD DB
--	BVR-4629	70-04-629	--	--	--	Unknown	BVGCD DB
Frank M. Johnson	BVR-4930	70-04-630	--	--	--	Unknown	BVGCD DB
Suzzie Bradley	BV-11517	59-21-102	--	--	90	Sparta	BVGCD DB
Bailey	BV-11518	59-21-103	4" Steel	--	50	Alluvium, Brazos River	BVGCD DB
Willie Shulz	BV-11521	59-21-106	--	--	800	Carrizo	BVGCD DB
Bill Parks	NA	192172	4" PVC 0-470, 4" PVC Blank 500-525	4" PVC 470-500	525	Queen City	SDR DB
Kenneth Melesky	NA	140298	--	--	295	Sparta	SDR DB

Note:
(1) Well report unavailable or does not provide the requested information.
Abbreviations: BVGCD DB: BVGCD Groundwater Database; SDR DB: TWDB Submitted Driller's Reports Database

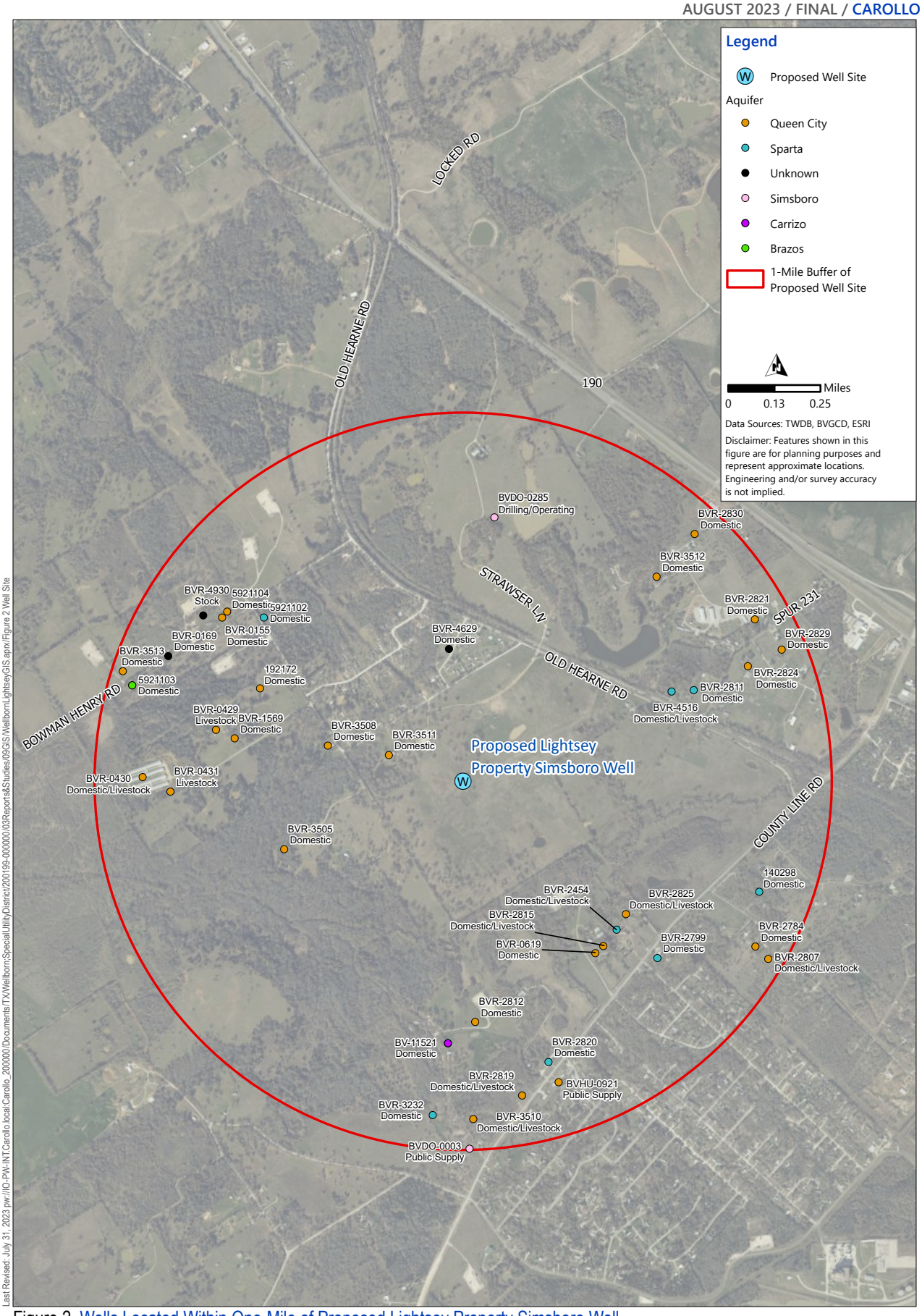


Figure 2 Wells Located Within One-Mile of Proposed Lightsey Property Simsboro Well
WELLBORN SUD
PROPOSED LIGHTSEY PROPERTY SIMSBORO WELL

1.9 Estimate of the Water-Level Drawdown

BVGCD requires an estimate of the water-level drawdown that can be caused by pumping the proposed well at the permitted rate for one year and ten years at five miles from the well. This estimate must be developed using the most recent TWDB-approved version of the GAM for the Queen City, Sparta, and Carrizo-Wilcox aquifers.

For this analysis, Carollo obtained version 3.02 of the GAM for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. The GAM is a three-dimensional groundwater flow model of the Carrizo-Wilcox, Queen City and Sparta Aquifers which includes 10 layers of formations, including the Simsboro Formation. The model can simulate the aquifer's response to pumping from the proposed well in a regional context and provides a useful tool for assessing the impacts of the proposed withdrawal. For detailed documentation of the model, please refer to Final Report: Groundwater Availability Model for the Central Portion of the Sparta, Queen City, and Carrizo-Wilcox Aquifers (Young et al., 2018).

1.9.1 Description of Central Carrizo-Wilcox, Queen City, and Sparta GAM

The Carrizo–Wilcox aquifer, one of nine major aquifers in Texas, extends across the state parallel to the Gulf Coast from the Rio Grande northeastward into Arkansas and Louisiana and supplies water to approximately 60 counties. Groundwater production is predominantly for municipal public-water supply, manufacturing, and rural domestic use. The largest areas of municipal use from the Carrizo–Wilcox aquifer are in the Bryan-College Station, Lufkin-Nacogdoches, and Tyler areas (Dutton et al., 2003). The active model area for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers GAM, as well as the location of groundwater conservation districts in the model area, is shown in Figure 3. The active model boundary extends from the up-dip limit of the Carrizo-Wilcox Aquifer outcrop to the northwest; the up-dip limit of the Wilcox growth fault zone, which is located past the extent of fresh water in the Carrizo-Wilcox, Queen City, and Sparta aquifers, to the southeast; approximately the San Antonio River to the southwest; and Cherokee and Nacogdoches counties to the northeast. The model area includes all or part of 46 counties, of which 14 are in Groundwater Management Area 12. Model files were obtained from the Texas Water Development Board.

An Unstructured Grid Version of the USGS MODFLOW model, MODFLOW-USG, was used to simulate ground-water flow. MODFLOW-USG is a three-dimensional control volume finite difference groundwater flow code that is supported by boundary condition packages to handle recharge, evapotranspiration, streams, springs and reservoirs. The model consists of ten layers representing the Sparta Aquifer, the Weches Formation, the Queen City Aquifer, the Reklaw Formation, the Carrizo Aquifer, the Calvert Bluff Formation, the Simsboro Formation, and the Hooper Formation along with the alluvium of the Brazos and Colorado rivers and outcrop area of the other hydrogeologic units. The model incorporates available information on structure, hydrostratigraphy, hydraulic properties, stream flow, and recharge estimates. MODFLOW-USG supports an unstructured grid, which allows the grid to be refined locally without adjusting the grid size away from the area of interest. This option was used along select rivers and streams in the model. Grid cells range in size from 0.25- mi2 near major streams to 1-mi2 in refined areas. More information about the hydrogeology of the aquifer system, model design and input datasets, calibration procedure, and simulation results are in Young et al. (2018).

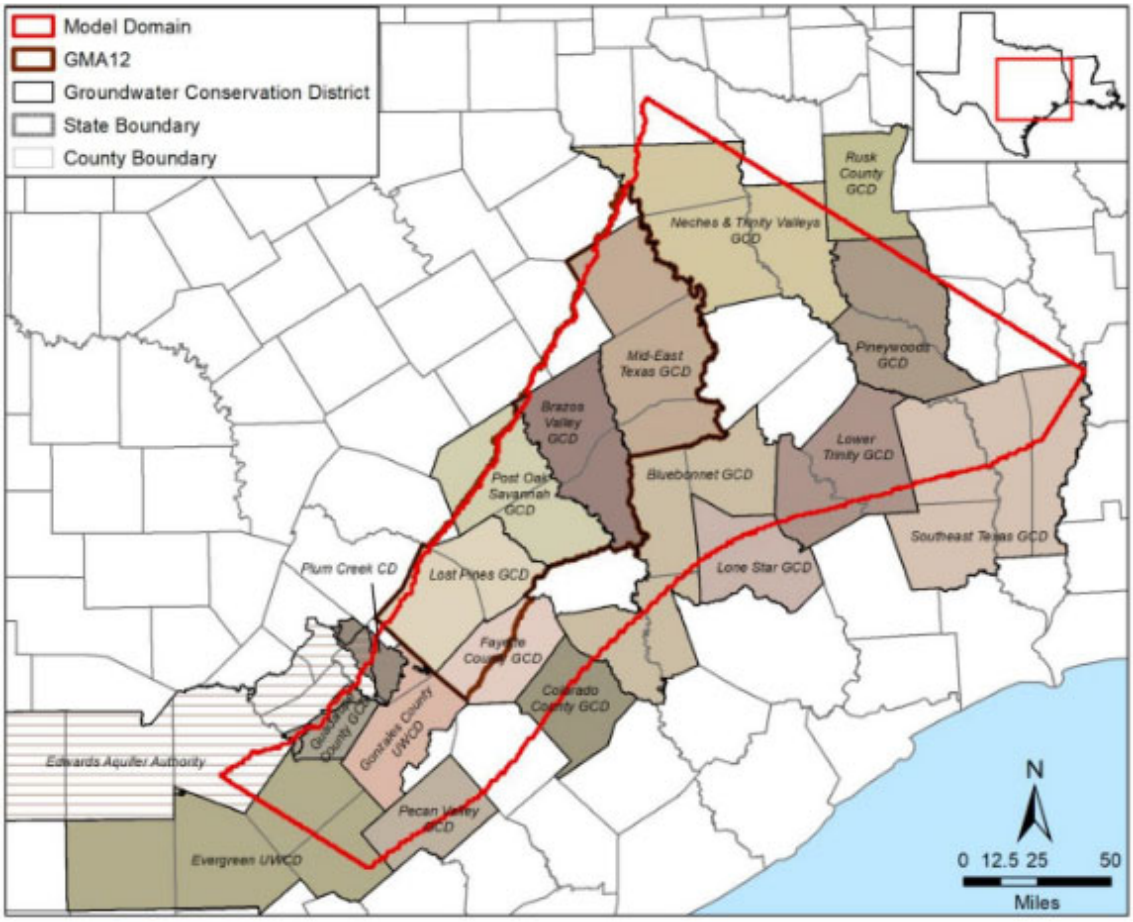


Figure 3 Location of Central Carrizo-Wilcox, Queen City, and Sparta GAM (Young et al., 2018)

In 2020, the GAM was updated better to predict drawdown caused by pumping by the Vista Ridge production wells screened in the Simsboro Aquifer based on pumping test data from nine Vista Ridge wells located in Burleson County. Hydraulic conductivity values of the Simsboro Aquifer in the vicinity of the Vista Ridge well field were adjusted using parameter optimization software to improve the capability of the GAM to better match observed drawdown and transmissivity from the aquifer pumping tests. The primary modification of the GAM consisted of changing the hydraulic conductivity of the Simsboro Aquifer by an average ratio of 1.5 within a radial distance of about 15 miles of the Vista Ridge well field which improved the performance of the GAM to reproduce the transmissivity values of the aquifer tests (Young, et al., 2020).

1.9.2 GAM Pumping Scenario

The withdrawal scenario prepared with the GAM comprises historical withdrawals from the aquifer system for 1930–2010. The only predictive pumping scenario currently available for this model is the scenario for determination of modeled available groundwater based on the Desired Future Condition (DFC) (Donnelly, 2018). This scenario is not a realistic depiction of projected future water demands from the aquifer, but rather is used to determine the maximum amounts of groundwater available. Results of DFC modeling using the Carrizo-Wilcox GAM showed that upwards of 38,000 acre-feet/year is available for withdrawal from the Simsboro Formation in Robertson County in 2020 with that number increasing to nearly 83,000 acre-feet/year by 2070 (Shi and Harding, 2022).

Therefore, the historical scenario has been used as a baseline for comparison of the effects of the proposed withdrawal. The proposed well was added to the model at the time period representing 2001 to allow for ten years of withdrawal to be simulated. The impacts of the proposed well can be evaluated by examining the differences in simulated water levels between the historical baseline scenario and the scenario with the proposed well added.

Pumping wells in the model are represented by specified-flow boundaries. The GAM-specified pumping rates at the proposed well location were adjusted by adding the proposed pumping to the model grid corresponding to the location of the proposed well. Because the GAM uses annual stress periods, an annual production rate of 1,972 acre-feet was used to represent pumping in the model. A constant pumping rate of -235,343 feet^3/day was added in model cell (50,152) in layer 9. The pumping rate began in model stress period 73 which corresponds to the year 2001. This pumping continued through the end of the simulation at stress period 82 for a total simulation of ten years of withdrawal at the proposed well.

1.9.3 GAM Results

Figure 4 shows the additional drawdown from the proposed well in the Simsboro Formation after 1-year of withdrawal. Additional drawdown of more than 10 feet occurs within about a one-mile radius of the pumping well. Figure 5 shows the additional drawdown from the proposed well in the Simsboro Formation after 10 years of withdrawal. Additional drawdown of more than 10 feet occurs within a radius of about 2.75 miles of the pumping well. Drawdown in the Simsboro Formation within about 1-mile of the pumping wells is expected to exceed 14 feet after 10 years of withdrawal. Simulated additional drawdown after 1 and 10 years of pumping along a 20-mile cross-section of the formation, shown in Figure 6a, is illustrated in Figure 6b.

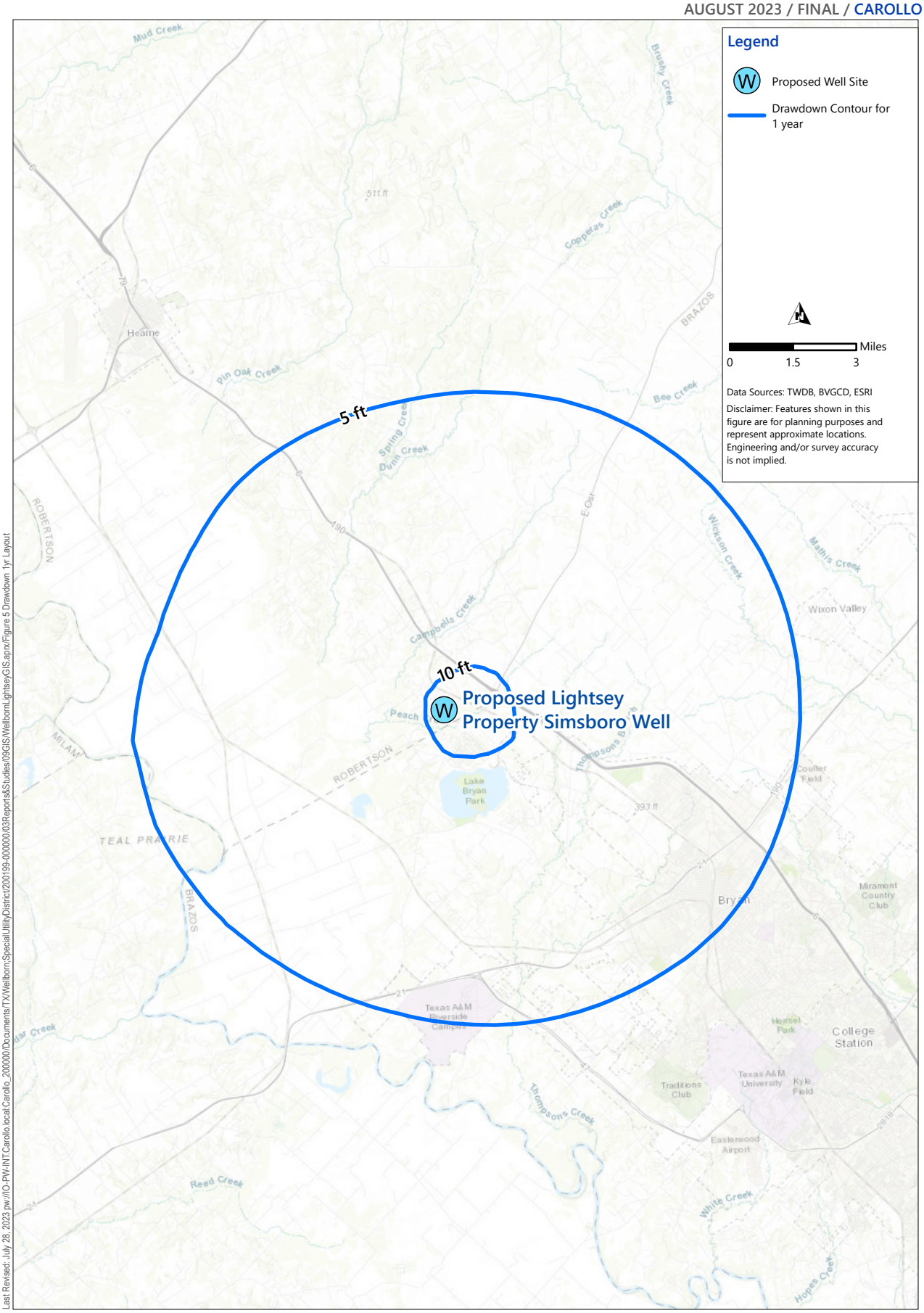
The adopted DFC for the Simsboro Formation within the BVGCD is an average aquifer drawdown of 262 feet as measured from January 2000 through December 2070 (GMA 12, 2021). This DFC results in an annual estimated available groundwater of 38,219 acre-feet/year in 2020 increasing to 82,824 acre-feet/year by 2070 (Shi and Harding, 2022). After 10 years of withdrawal, the proposed well is predicted to cause an average drawdown of 4.1 feet in the Simsboro Formation over the area of the BVGCD, or about 3.3 percent of the DFC of 262 feet of average drawdown. Similarly, the expected annual withdrawal of 1,972 acre-feet is 5.2 percent of the modeled available groundwater total of 38,219 acre-feet/year for the Simsboro Formation in Robertson County in 2020 (Shi and Harding, 2022).

The simulated maximum drawdown at the pumping well is about 14.5 feet. It is recognized that localized drawdown near the proposed well is underestimated by the GAM because of the regional nature of the model. However, because the observed piezometric head in the Simsboro Formation (~2,382 feet) is much greater than the expected drawdown, the effect of pumping the wells on the Simsboro Formation is small. No land subsidence or depletion are expected to occur as a result of withdrawal at the proposed well.

As shown in Table 2, two currently permitted Simsboro wells are located within one mile of the proposed project. The simulated additional drawdown at these wells after 1 year and 10 years of pumping is provided in Table 3. Again, because the piezometric head in the Simsboro Formation in this area is much greater than the expected drawdown, the expected impacts to these wells from the proposed project are small.

Table 3 Estimated Drawdown at Existing Wells Within 1-Mile of Proposed Lightsey Property Simsboro Well

Name of Well Owner	BVGCD Well Number	Expected Drawdown after 1 Year (ft)	Expected Drawdown after 10 Years (ft)
City of Bryan	BVDO-0003	9.6	11.7
Wellborn SUD	BVDO-0285	10.3	12.3



Last Revised: July 28, 2023 pw://IO-PW-INT.Carollo.local:Carollo_200000/Documents/TX/Wellborn;SpecialUtilityDistrict/200199-000000/03Report&Studies/09GIS/WellbornLightseyGIS.aprx/Figure 5 Drawdown 1yr Layout

Figure 4 Simulated Additional Drawdown in the Simsboro Formation after 1 Year
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PROPOSED LIGHTSEY PROPERTY SIMSBORO WELL

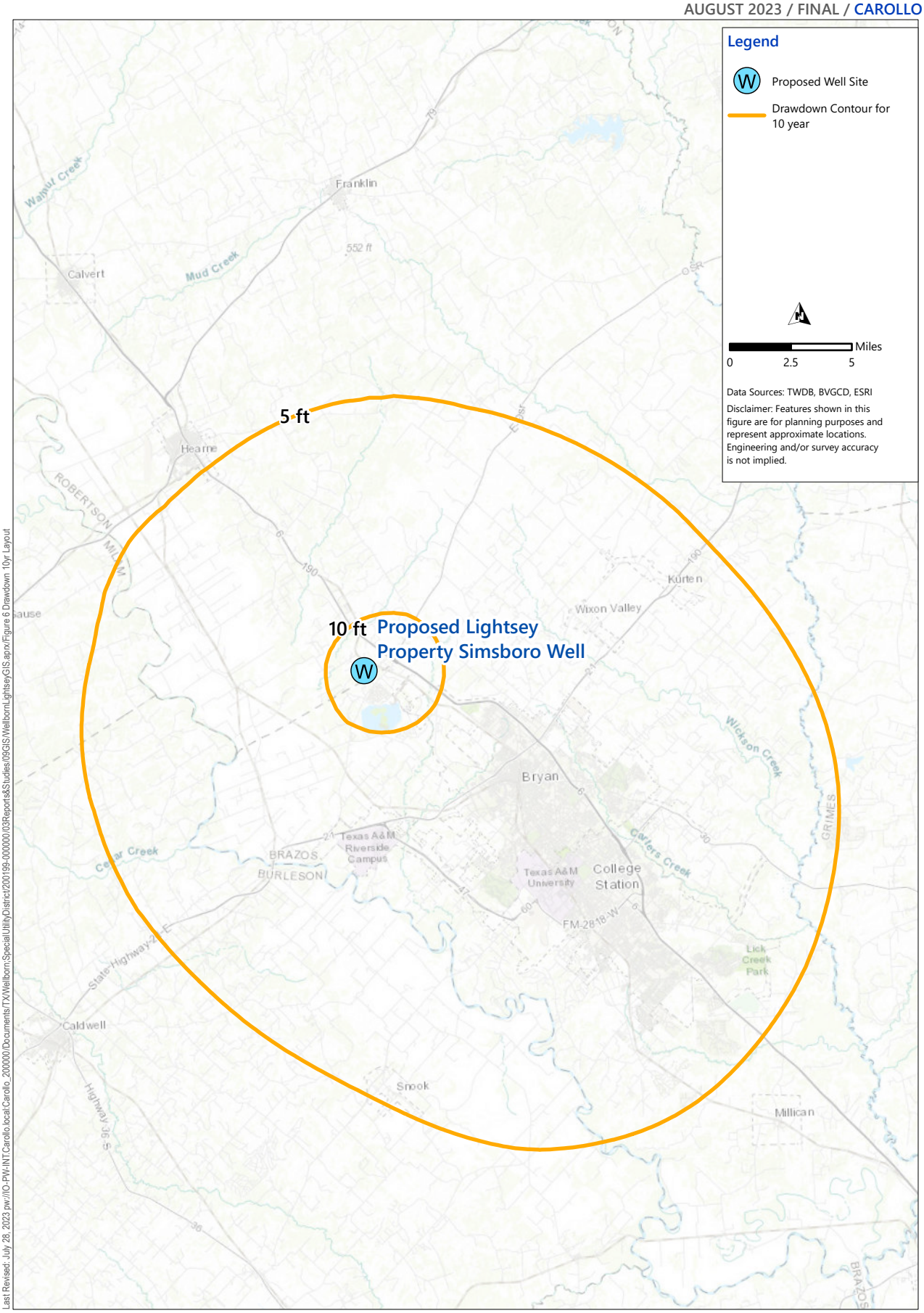

Figure 5 Simulated Additional Drawdown in the Simsboro Formation after 10 Years
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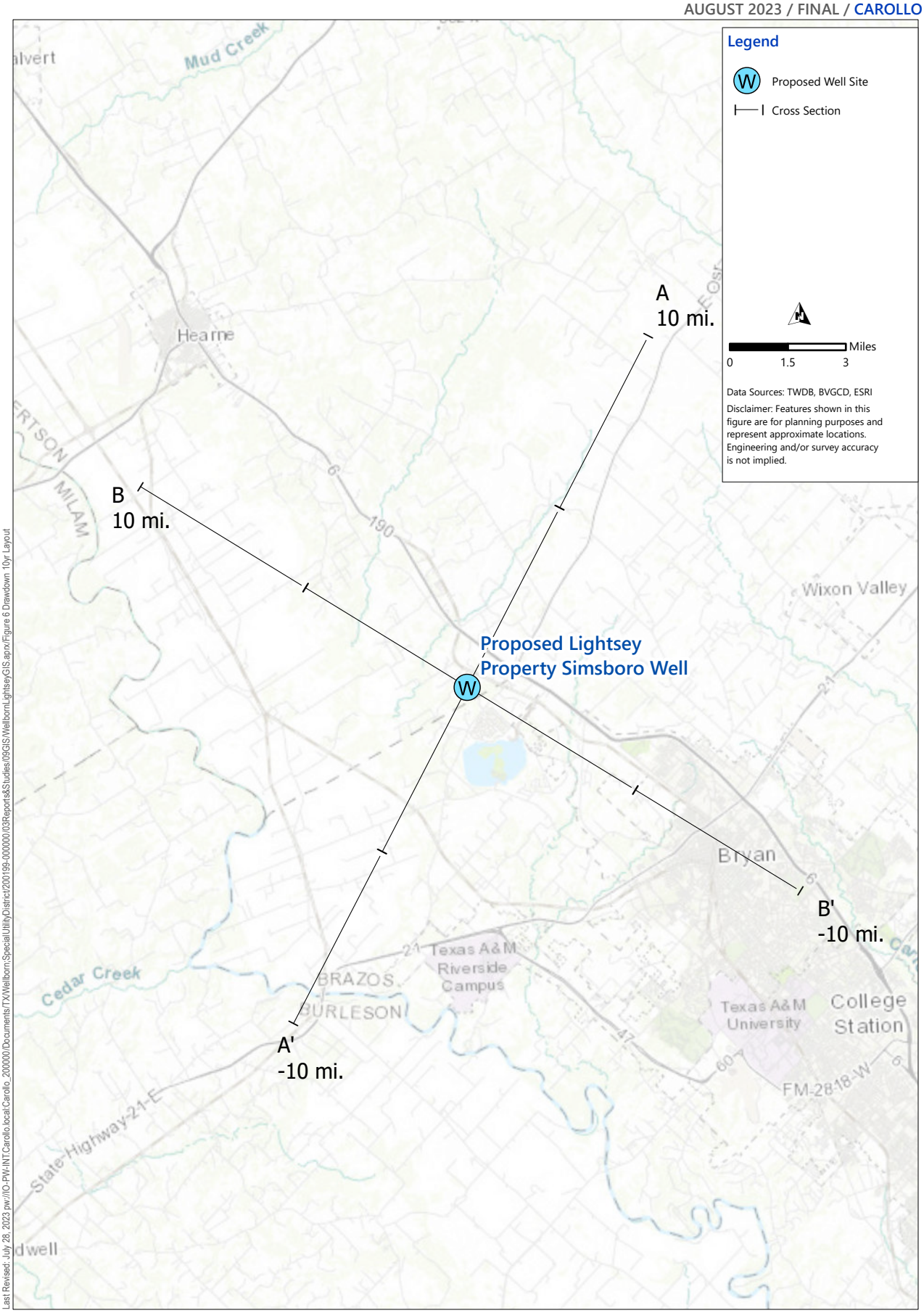
PROPOSED LIGHTSEY PROPERTY SIMSBORO WELL



Last Revised: July 28, 2023 pw://IO-PW-INT.Carollo.local:Carollo_200000/Documents/TX/Wellborn;SpecialUtilityDistrict/200199-000000/03Reports&Studies/09GIS/WellbornLightseyGIS.aprx/Figure 6 Drawdown 10yr Layout

Figure 6a Drawdown Cross Section Lines
WELLBORN SUD
PROPOSED LIGHTSEY PROPERTY SIMSBORO WELL

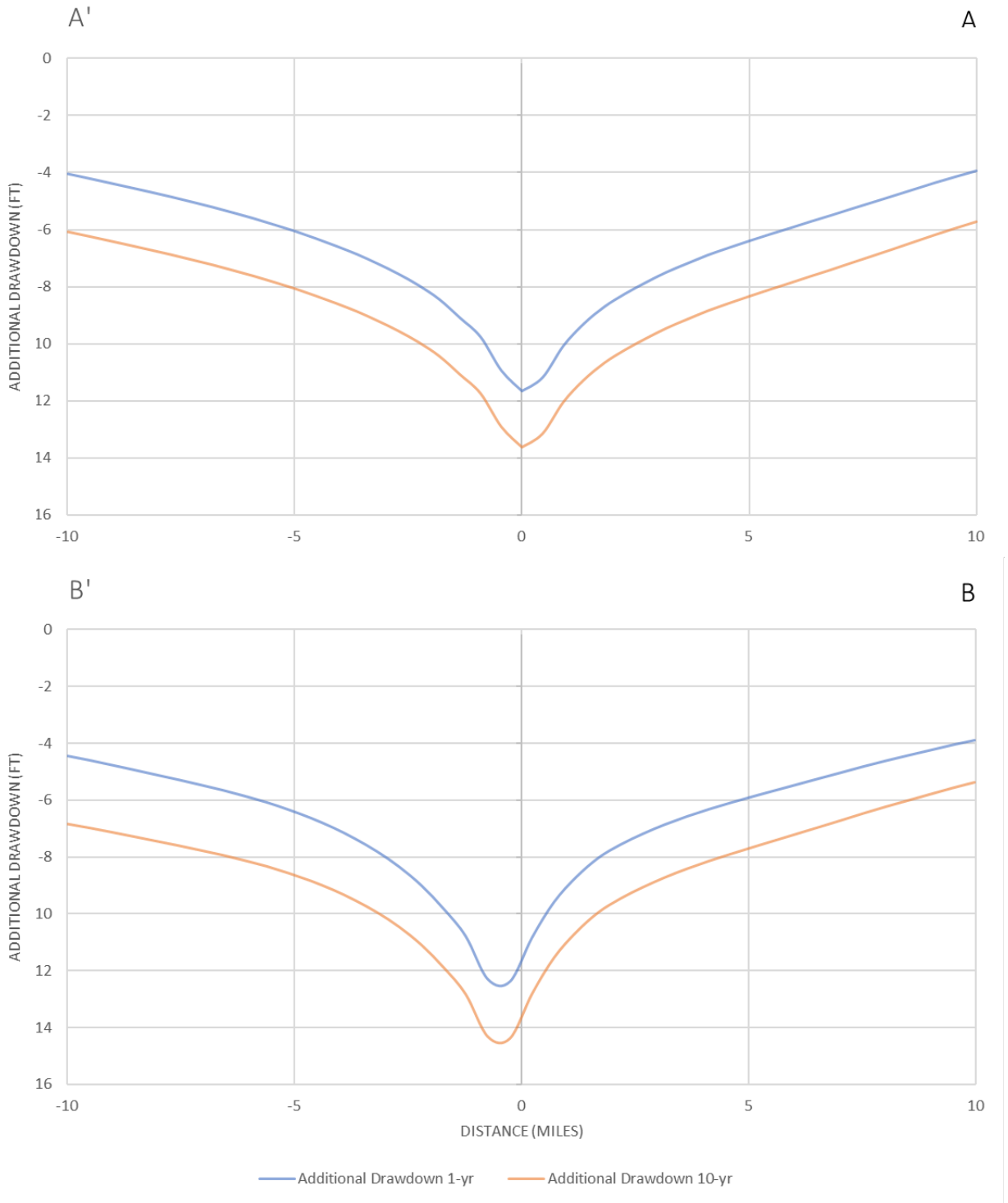


Figure 6b Simulated Additional Drawdown from Withdrawals by Lightsey Property Simsboro Well

SECTION 2 CONCLUSIONS AND RECOMMENDATIONS

Carollo has completed an evaluation of the projected effect of the proposed withdrawal for the Lightsey Property Well on the Simsboro Formation in accordance with the rules of the Brazos Valley Groundwater Conservation District. The predicted additional drawdown is less than 7 feet at a radius of 10 miles after 10 years of pumping. This additional drawdown is not expected to substantially affect existing water users because the piezometric head in the Simsboro Formation in this area is much greater than the simulated additional drawdown. There are two currently permitted wells within a 1-mile radius of the proposed project in the Simsboro Formation. Additionally, the expected annual withdrawal of 1,972 acre-feet is 5.2 percent of the modeled available groundwater total of 38,219 acre-feet/year for the Simsboro Formation in Robertson County in 2020.

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