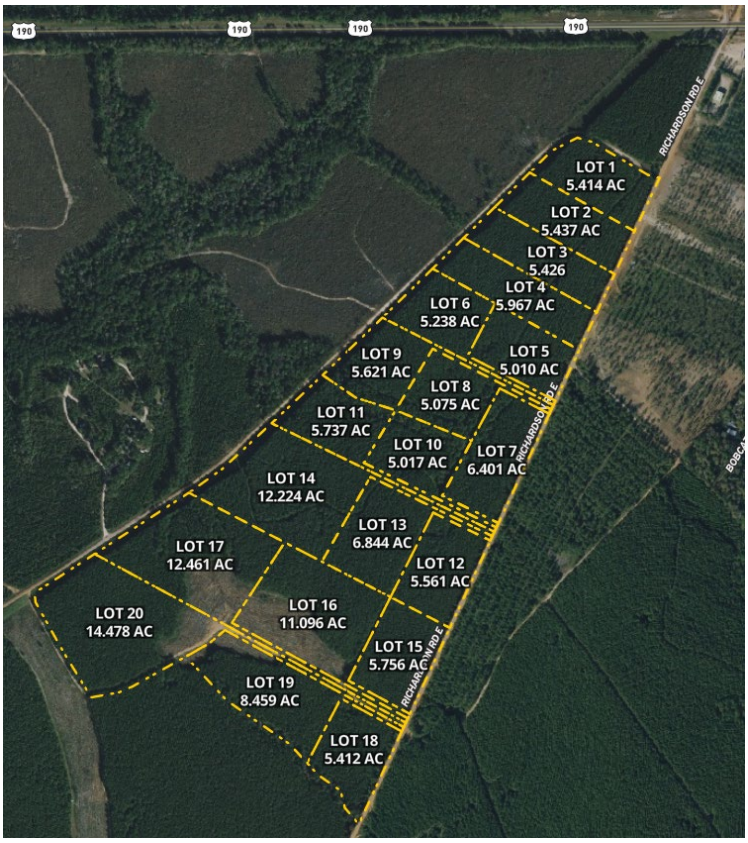
Report

Summary of Existing Groundwater Data in the Vicinity of Falcone Forest Section IV Property, Polk County, Texas



Prepared for:
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March 4, 2022

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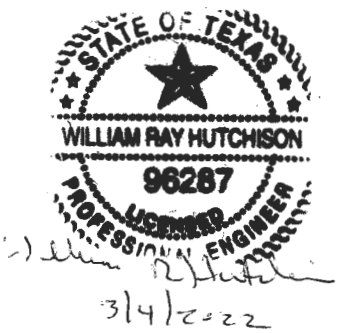

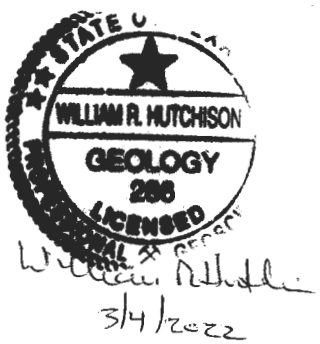

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1.0 Introduction and Summary of Results

1.1 Introduction

On February 14, 2022, Mr. Jacob McLaughlin requested a groundwater data summary for a 142-acre property in Polk County for Tanglewood Landholdings TX, LLC. On the preliminary plat map of the property dated January 10, 2022 provided by Mr. McLaughlin, the property is described as Falcone Forest Section IV (142.634 acres out of the Juan Falcone Survey, Abstract No. 32 & Maria Lindsey Survey Abstract 397). Mr. McLaughlin also provided a link to a digital map using mapright.com that was used to identify coordinates at various locations on the property.

The data for this effort were obtained from the Texas Water Development Board at the following webpage: ***http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp***

The data were downloaded for Polk County on February 20, 2022 from the following categories:

- Record of Wells
- Water Levels
- Water Quality

The data were processed to identify wells, groundwater levels, and groundwater quality data within a few miles of the subject property. In addition, the Groundwater Availability Model of the area (maintained by the Texas Water Development Board) was used to generally identify aquifer designations and depths.

1.2 Summary of Results

Based on a review of the available data, domestic wells in the area are most likely completed in the Burkeville Formation of the Gulf Coast Aquifer. In the vicinity of the property, the Burkeville Formation occurs from the ground surface to about 575 to 600 feet below ground surface.

Existing domestic wells within two miles of the property in the area range in depth from about 50 feet to about 250 feet. Wells deeper than 150 feet are likely more appropriate in this area. Well yield data are limited to public supply wells completed at depths greater than expected for domestic wells, but production rates over 50 gallons per minute would be expected with sufficient pumping capacity.

Groundwater level data trends in the area show no long-term declines. However, the particular depth to water expected in wells with a depth in the 150 to 250 ft range in the area are limited to a few wells with data from the 1960s and 1970s. These depth to water readings ranged from about 50 feet to about 130 feet.

Groundwater quality data demonstrates that total dissolved solids are 400 gm/l or less (drinking water standard is 1,000 mg/l), and chloride concentrations are also low (less than 50 mg/l with a drinking water standard of 300 mg/l).

2.0 Aquifer Designation and Depths

The property is underlain by the Gulf Coast Aquifer described by George and others (2011) as:

> ***The Gulf Coast Aquifer*** *is a major aquifer paralleling the Gulf of Mexico coastline from the Louisiana border to the border of Mexico. It consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The maximum total sand thickness of the Gulf Coast Aquifer ranges from 700 feet in the south to 1,300 feet in the north. Freshwater saturated thickness averages about 1,000 feet. Water quality varies with depth and locality: it is generally good in the central and northeastern parts of the aquifer, where the water contains less than 500 milligrams per liter of total dissolved solids, but declines to the south, where it typically contains 1,000 to more than 10,000 milligrams per liter of total dissolved solids and where the productivity of the aquifer decreases. High levels of radionuclides, thought mainly to be naturally occurring, are found in some wells in Harris County in the outcrop and in South Texas. The aquifer is used for municipal, industrial, and irrigation purposes. In Harris, Galveston, Fort Bend, Jasper, and Wharton counties, water level declines of as much as 350 feet have led to land subsidence. The regional water planning groups, in their 2006 Regional Water Plans, recommended several water management strategies that use the Gulf Coast Aquifer, including drilling more wells, pumping more water from existing wells, temporary overdrafting, constructing new or expanded treatment plants, desalinating brackish groundwater, developing conjunctive use projects, and reallocating supplies.*

The Groundwater Availability Model of the northern portion of the Gulf Coast Aquifer (also known as the Houston Area Groundwater Model, or HAGM) simulated groundwater flow in the Gulf Coast Aquifer by discretizing (or subdividing) the aquifer into cells that are one square mile in area. The model grid consists of 137 rows and 245 columns. The individual aquifer units that comprise the Gulf Coast Aquifer (Chicot, Evangeline, Burkeville, and Jasper) are represented as distinct model layers. Not all units are present everywhere in the model domain (Figure 1).

Using the model grid, at a specific location, it is possible to generally understand which aquifer units are present and estimate the depths and thicknesses of those units. The northern and western parts of the property are covered by model row 41, column 167. The middle and southern parts of the property are covered by model row 42, column 167.

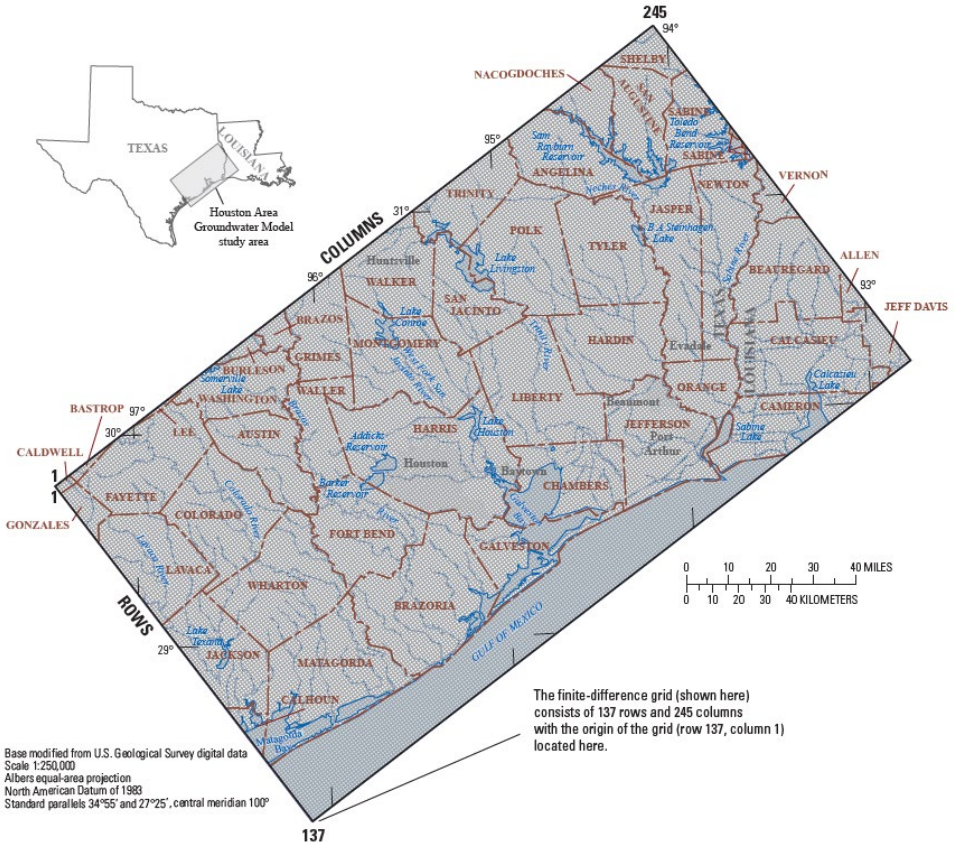

Figure 1. Houston Area Groundwater Model Domain and Grid (from Kasmarek, 2012)

Based on the estimates in the regional groundwater model (HAGM), the Evangeline Aquifer is thin (less than 50 feet) to nonexistent. The Burkeville Formation is generally at the surface and between 575 and 597 feet thick, and the Jasper Aquifer is about 900 feet thick, and occurs below the Burkeville Formation.

Within the Burkeville Formation, HAGM data also show about 67 to 77 feet of clay (about 12 percent of the total thickness). Within the Jasper Aquifer, HAGM data show about 553 to 562 feet of clay (about 62 percent of the total thickness).

Based on this information wells less than 600 feet will generally be completed in more favorable aquifer conditions (more sand, less clay) than wells deeper than 600 feet deep. This is a generalized conclusion based on regional data, and actual local conditions are likely to vary considerably as compared to the idealized regional data.

3.0 Well Data

Data obtained from the Texas Water Development Board from Polk County include data from 16 wells within two miles of the center of the subject property (defined as Lot 10). These wells are between 30 and 1,180 feet deep. Only four of the wells have information on well casing diameter, and all four are listed as 10-inch wells. Well production data are included for three wells. Indian Spring Estate Well #4 has a reported yield of 320 gallons per minute, Indian Springs Well No. 2 has a yield of 150 gallons per minute. Another well has a listed measured discharge of 20 gallons per minute in August 1966. Pertinent well data are summarized in Table 1.

Table 1. Pertinent Well Data within Two Miles of Property

Well Number	Distance to Middle of Lot 10 (miles)	Latitude (decimal degrees)	Longitude (decimal degrees)	Well Depth (ft)	Casing Diameter (in)	Pump Type	Well Use	Remarks
6119416	1.17	30.693611	-94.747222	255	10	Submersible	Public Supply	Owner Well Number: Old Don or #1C. TCEQ Source ID: G1870040B. Well originally drilled for Pine Springs Utilities.
6118305	1.21	30.708334	-94.764723	247		Jet	Domestic	
6119418	1.21	30.6930556	-94.7463889	1180	10	Submersible	Public Supply	Well Report Tracking Number: 243248. Owner Well Number: Indian Springs Eastate well #4. TCEQ Source ID: G1870040E. Pump set at 399 ft. Reported yield 320 GPM with 56 feet drawdown after pumping 36 hours in 2007. Specific capacity 5.71 GPM/ft. Pumping level 266 feet.
6119417	1.22	30.6929417	-94.7462667	665	10	None	Unused	Indian Springs well No. 2. Yield 150 GPM with 300 ft. drawdown when drilled. Specific capacity 0.5 GPM/ft. D-log to 665 feet.
6119404	1.34	30.701945	-94.748056	30		Jet	Domestic	Dug well.
6118602	1.38	30.701112	-94.786667	385	10	Submersible	Public Supply	Owners well #3. Cemented from 0 to 360 feet.
6118601	1.44	30.6875	-94.790556	174		Jet	Domestic	Screen from 108 feet to bottom.
6118303	1.51	30.712778	-94.764723	156		Piston	Unused	Unused. Cased to bottom. Screen from 150 feet to bottom.
6119403	1.55	30.701112	-94.743334	33		None	Unused	Historical observation well.
6119419	1.61	30.679444	-94.743056	285		Unknown	Public Supply	TCEQ Source ID: G1870040C. Owners Indian Springs Estates well #2. PWS ID #1870040C. Well originally drilled for Pine Springs Utilities.
6119401	1.65	30.703056	-94.742778	200		Piston	Plugged or Destroyed	Destroyed.
6119402	1.65	30.703056	-94.742778	152		Jet	Domestic	Screen from 137 feet to bottom. Reported very hard rock from 45 feet to 120 feet.
6119406	1.75	30.682222	-94.738889	320		Turbine	Public Supply	Screen from 280 to 300 feet. Measured discharge 20 gpm, Aug. 1966. Temp. 70 degrees F.
6119415	1.90	30.704167	-94.738611	52		Bucket	Domestic	
6118901	1.95	30.662778	-94.764167	245		Jet	Domestic	
6119410	1.97	30.693334	-94.733611	330			Public Supply	

4.0 Groundwater Levels

Groundwater level data obtained from the Texas Water Development Board show 14 wells within two miles of the middle of the subject property (defined by Lot 10) that have at least one groundwater level data point. Two wells have multiple data points sufficient to summarize the data in hydrographs (Figures 2 and 3). The other 12 wells have a single data point, and the data from these wells are summarized in Table 2.

Figure 2 shows the data for Well 61-19-417 (well depth 665 ft, 1.2 miles from Lot 10). The data includes a single point in 1999 after completion, and several data points after 2013 when a water level recorder was installed. The most recent data is from early 2022. Please note that from 1999

to the first recorder data show a slight (about a 1 ft) decline in depth to water. The recorder data shows a seasonal fluctuation of about a foot, and a long-term general recovery of groundwater levels from 2013 to early 2022. This general recovery is consistent with regional data that exhibit a recovery after the drought of 2011 and 2012.

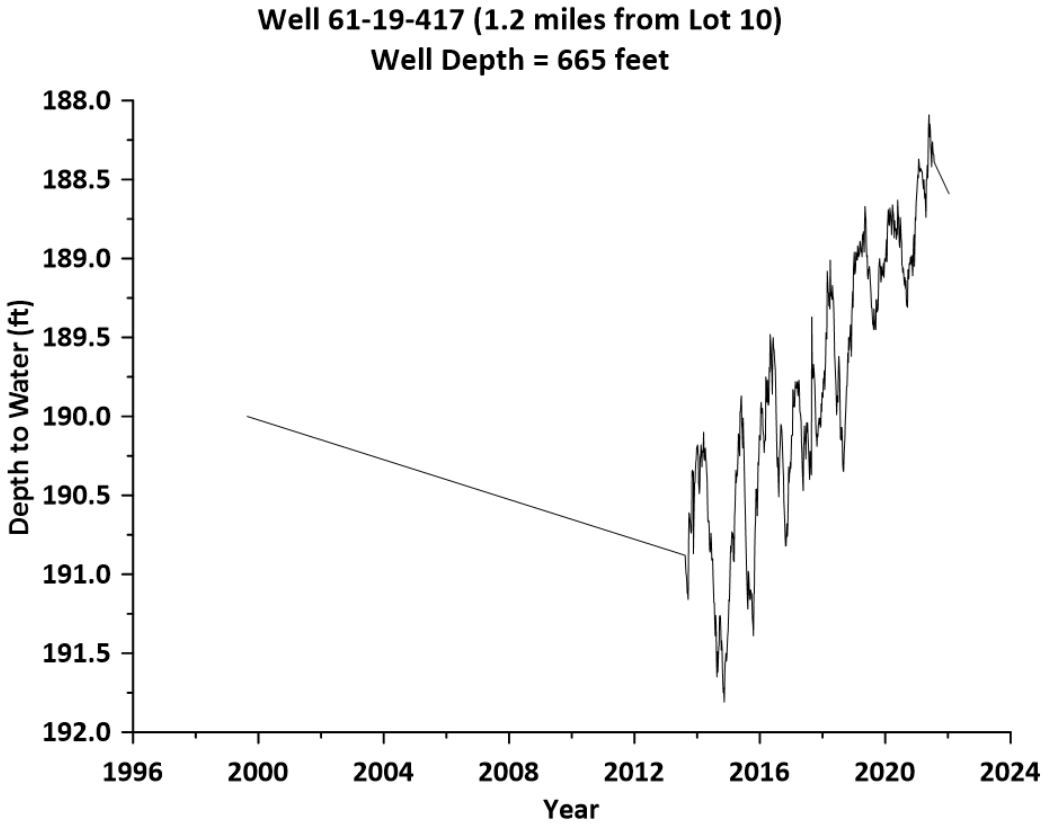

Figure 2. Hydrograph of Depth to Water - Well 61-19-417

Figure 3 shows the data for Well 41-19-403 (well depth 33 ft, 1.6 miles from Lot 10). The data period is 1966 to 1993. The shallow depth of the well (33 feet) and the lack of recent data (none since 1993) limits the usefulness of the data for any meaningful analysis related to future domestic wells on the property.

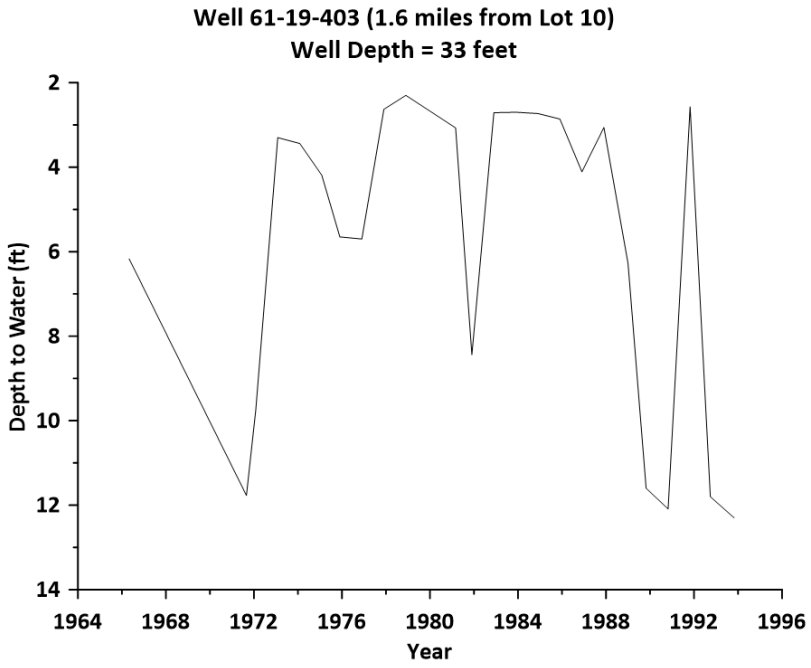

Figure 3. Hydrograph of Depth to Water - Well 61-19-403

Table 2 summarizes the depth to water data for 12 wells within two miles of the property that have a single measurement in the database. These data provide nothing meaningful in terms of trends since there is only one measurement per well but are provided for a general understanding of depth to water expected in the vicinity of the property for wells less than 600 feet deep (i.e. Burkeville Formation wells).

Table 2. Summary of Wells within Two Miles with a Single Groundwater Level Measurement

Well Number	Distance to Middle of Lot 10 (miles)	Well Depth (ft)	Latitude (decimal degrees)	Longitude (decimal degrees)	Date	Depth to Water (ft)
6119416	1.17	255	30.693611	-94.747222	8/6/1976	140
6118305	1.21	247	30.708334	-94.764723	1964	80
6119418	1.21	1180	30.6930556	-94.7463889	2007	210
6119404	1.34	30	30.701945	-94.748056	5/11/1966	14.6
6118602	1.38	385	30.701112	-94.786667	5/22/1984	50
6118601	1.44	174	30.6875	-94.790556	1965	70
6118303	1.51	156	30.712778	-94.764723	1946	60
6119401	1.65	200	30.703056	-94.742778	1947	150
6119402	1.65	152	30.703056	-94.742778	5/10/1966	130.3
6119406	1.75	320	30.682222	-94.738889	8/15/1966	135.2
6119415	1.90	52	30.704167	-94.738611	5/11/1966	33
6119410	1.97	330	30.693334	-94.733611	6/3/1966	67.3

5.0 Groundwater Quality

Groundwater quality data obtained from the Texas Water Development Board show three wells within two miles of the middle of the subject property (defined by Lot 10) that have groundwater quality data. Two wells have a single sampling date, and one well has three sampling dates as shown in Table 3.

Table 3. Summary of Wells within Two Miles with a Groundwater Quality Data

Well Number	Distance to Middle of Lot 10 (miles)	Well Depth (ft)	Date	Latitude (decimal degrees)	Longitude (decimal degrees)	Calcium (mg/l)	Chloride (mg/l)	Hardness (mg/l)	Sodium (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)
6119416	1.17	255	5/21/2009	30.693611	-94.74722	73.8	43.7	213	39.6	9.62	339
6119418	1.21	1180	8/7/2013	30.693056	-94.74639	8.16	27.8	22	140	5.67	405
6119418	1.21	1180	4/6/2017	30.693056	-94.74639	9.68	27.4	26.051	147	5.99	403
6119418	1.21	1180	6/24/2021	30.693056	-94.74639	9.63	28.6	25.75	150	5.77	423
6119417	1.22	665	5/19/2005	30.692942	-94.74627	58.9	46.5	167	61.5	8.51	375

Please note that one well is 255 feet deep and is apparently completed in the Burkeville Formation. The other two wells are 665 and 1,180 feet deep and are apparently completed in the Jasper Aquifer. The single well completed in the Burkeville Formation was sampled in 2009. The wells completed in the Jasper Aquifer were sampled between 2005 and 2021. All results appear to be similar given the relatively narrow range in concentrations for each constituent.

Although it is expected that the target of domestic wells for the property would be the Burkeville Formation, and there is only a single data point for this formation from 2009, the similarity between the water quality of all the wells listed in Table 3 and the consistency over time (2005 to 2021) suggest that the results of the single Burkeville well are reasonably reliable.

6.0 References

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Kasmarek, M.C., 2012, Hydrogeology and Simulation of Groundwater Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas, 1891-2009: United States Geological Survey Scientific Investigations Report 2012-5154, 55 p.

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April 8, 2022

Mr. Jacob McLaughlin
Tanglewood Landholdings TX, LLC
1412 Collier St., Ste. A
Austin, TX 78704

RE: Estimated Water Use and Availability: Falcone Forest Section IV Property, Polk County, Texas

Dear Mr. McLaughlin:

In response to Polk County comments on my March 4, 2022 report that provided a review of groundwater data in the vicinity of the subject property, this letter summarizes an analysis of estimated water use for full build-out of the property and compares that use to groundwater availability in the Jasper Aquifer in Polk County.

Estimated Water Use

Water use estimates for this analysis were derived from a report prepared by the Texas Water Development Board in 2021 for the Texas Legislature that includes estimates of daily water use for municipal water systems. Estimates of residential water use for municipal systems are applicable for this development. The report can be accessed here:

https://www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/Water-Use-of-Texas-Water-Utilities-87th-Legislative.pdf

Residential per capita water use for medium, medium-large, and large municipal utilities was estimated to be 82 gallons per person per day. Large metropolitan residential per capita water use was 68 gallons per person per day, which is not considered a reasonable estimate for this analysis due to the differences between expected water uses for rural home sites and large metropolitan residences.

The estimate of 82 gallons per person per day is likely on the low end of what would be expected but provides a reasonable starting point. The estimated per capita use for the subject property could be as high as 142 gallons per person per day, which is consistent with the high-end estimates in the Texas Water Development Board report of total system per capita use for large municipal utilities.

The Texas Water Development Board report also provides estimates of residential water use on a per connection basis. For the medium, medium-large, and large utilities, these estimates ranged from 228 to 240 gallons per connection per day. Thus, dividing the per connection estimate by the per capita estimate, an estimate of people per household can be obtained. The number of people per residence ranged from 2.78 to 2.91. The number of people per residence is rounded to 3 for purposes of this analysis, and the estimated water use is presented below:

Estimated Range of Water Use for Development
Assumes 3 people per residence

Per Capita Water Use	Residences Per Lot	Gallons Per Day	AF/yr
82	1	4,920	5.51
82	2	9,840	11.02
142	1	8,520	9.54
142	2	17,040	19.09

Please note that the range of estimated water use is between 5.5 and 19 acre-feet per year. The higher-end estimates assume that two residences will be constructed on each lot.

Groundwater Availability

Groundwater availability in Texas is established through the joint planning process as specified in Section 108 of Chapter 36 of the Texas Water Code. Polk County lies within Groundwater Management Area 14. Groundwater Conservation Districts within Groundwater Management Area 14 adopt Desired Future Conditions (DFC) every five years, which is an expression of aquifer conditions in the future.

The groundwater pumping that will achieve the DFC is termed the Modeled Available Groundwater (MAG). The MAG is calculated by the Texas Water Development Board based on the DFC adopted by Groundwater Conservation Districts in Groundwater Management Area 14 and is based on groundwater model simulations.

The current Modeled Available Groundwater for the Jasper Aquifer in Polk County was developed based on Desired Future Conditions adopted on April 29, 2016, details of which are available here:

http://www.twdb.texas.gov/groundwater/management_areas/gma14.asp

Based on the model used to calculate Modeled Available Groundwater, groundwater pumping from the Jasper Aquifer in Polk County in 2009 was 3,334 AF/yr. This model was developed by the US Geological Survey in 2013, and 2009 is the last year of the calibration period. For comparative purposes, the groundwater pumping from the Jasper Aquifer in Polk County in 1989 was 2,850 AF/yr. Thus, groundwater pumping increased

about 484 AF/yr over the most recent 21-year period of the current groundwater model. Even if the rate of growth was doubled from 2010 to 2021, current pumping is likely less than 4,000 AF/yr.

Based on the Desired Future Condition that was adopted in 2016, the Modeled Available Groundwater for the Jasper Aquifer in Polk County for 2020 to 2070 is 27,662 AF/yr, an increase of over 23,000 AF/yr over current estimated uses.

On January 5, 2022, the Groundwater Conservation Districts in Groundwater Management Area 14 adopted new Desired Future Conditions. Although not yet formally calculated by the Texas Water Development Board, the new Modeled Available Groundwater for the Jasper Aquifer in Polk County is expected to be 30,411 AF/yr for 2030 to 2080.

Summary

- The estimated water use of the development are expected to be within the range of 5.5 to 19 AF/yr.
- Current groundwater pumping in the Jasper Aquifer in Polk County is less than 4,000 AF/yr
- Groundwater availability in Texas is calculated every five years in accordance with the joint planning process defined by the Texas Water Code. The most recent official groundwater availability for the Jasper Aquifer in Polk County is 27,662 AF/yr. The updated availability calculated are in process, and is expected to yield an availability value of 30,411 AF/yr.
- Based on the difference between availability and current use, an additional 23,000 to 26,000 AF/yr of groundwater in the Jasper Aquifer in Polk County is available for development through 2080.
- The estimated residential use associated with this development represents a small incremental increase as compared with the amount of available groundwater defined by the joint planning process.

I appreciate the opportunity to assist you with this effort. If you have any questions or wish to discuss this proposal, please call me at 512-745-0599 or email me at billhutch@texasgw.com.

Sincerely,

William R Hutchison

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April 21, 2022

Mr. Jacob McLaughlin
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1412 Collier St., Ste. A
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RE: Summary Conclusions Relative to Rule 364.32(b) of Texas Administrative Code: Falcone Forest Section IV Property, Polk County, Texas

Dear Mr. McLaughlin:

Background

On February 14, 2022, Mr. Jacob McLaughlin requested a groundwater data summary for a 142-acre property in Polk County for Tanglewood Landholdings TX, LLC. A report covering this summary was delivered on March 4, 2022. In response to Polk County comments, a second letter, dated April 8, 2022, was delivered that covered the estimated water use for full build-out of the property and compares that use to groundwater availability in the Jasper Aquifer in Polk County.

In response to comments received during a telephone conference call with Polk County representatives on April 19, 2022, this letter provides two summary statements regarding the findings of my March 4, 2022 report and April 8, 2022 letter. These summary statements are intended to "certify" that the requirements of Rule 364.32(b) have been met.

Water Quality Component of Rule 364.32(b)

Please note that the water quality requirements of Rule 364.32(b) were written to cover "community water systems":

> ***The water quality of the water produced from the test well must meet the standards of water quality required for community water systems as set forth in 30 TAC §§290.104, 290.106, 290.108 and 290.109, either:***
> ***(1) without any treatment to the water; or***
> ***(2) with treatment by an identified and commercially available water treatment system.***

A copy of Chapter 290, which covers "Public Drinking Water" standards is attached to the email that transmits this letter for reference. Please note that §290.102 of these standards is titled "General Applicability", and notes that these standards apply to "all public water systems". As discussed in the March 4, 2022 report and April 8, 2022 letter, lots in the proposed subdivision will be supplied with individual wells, not a community water system.

Aside from the fact that the document itself states that the standards apply to community water systems, many of these standards are not designed to be applied to individual wells supplying individual homes. For example:

- §290.104 includes standards for disinfection by-products that are characteristic of a community water distribution system, not individual wells on individual lots.
- §290.109 includes standards on microbial contaminants, and in §290.104(a) are noted as being applicable to public water systems.

Certification

The previously submitted report and letter (March 4, 2022 and April 8, 2022, respectively) contain sufficient information, data, and analyses to "certify" the following:

- Individual wells on each lot can provide "long term (30 years)" supplies of water sufficient to the "ultimate needs of the subdivision".
- The data reviewed from wells in the area demonstrate that calcium, chloride, hardness, sodium, sulfate, and total dissolved solids are within the standards listed in Chapter 290, and the data further show that there is no trend of water quality degradation from 2005 to 2021. Thus, "the water quality of the water produced" from each well is expected to meet the standards of water quality "without any treatment to the water".

I appreciate the opportunity to assist you with this effort. If you have any questions or wish to discuss this proposal, please call me at 512-745-0599 or email me at billhutch@texasgw.com.

Sincerely,

William R Hutchison

William R. Hutchison, Ph.D., P.E., P.G.