Hydrogeology of the Edwards and Trinity Aquifers in the Vicinity of the Proposed Vulcan Quarry, Comal County, Texas

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Introduction

Vulcan Construction Materials, LLC, has proposed a major limestone aggregate quarry in central Comal County (Pape-Dawson Engineers, 2024) southwest of the intersection of highways SH-46 and FM 3009 (Texas Commission on Environmental Quality (TCEQ) Edwards Aquifer Permit#: 13001906) (Figure 1). The site encompasses 1,515 acres of which about 956 acres will be quarried. The site is entirely within the Edwards Aquifer Recharge Zone (TCEQ Recharge Zone Map).

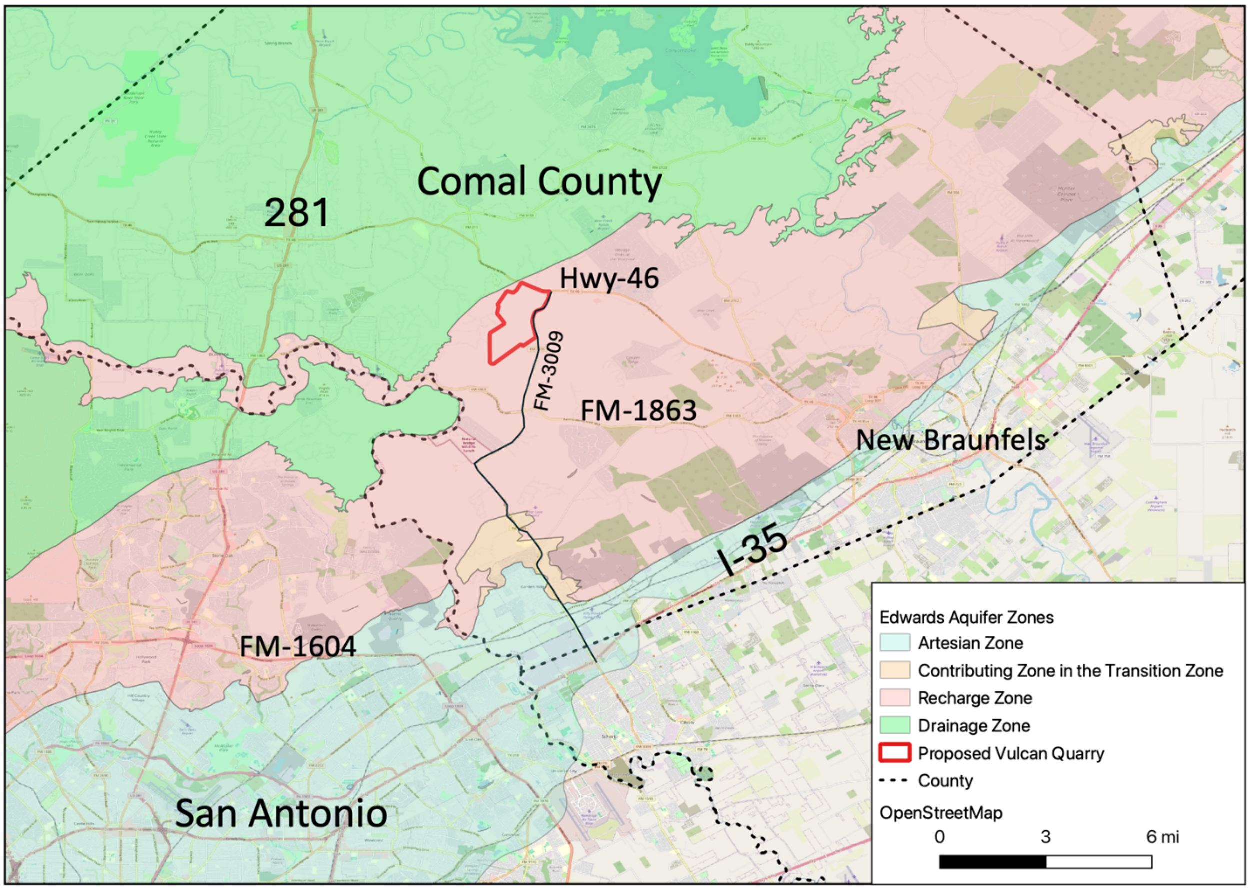


Figure 1. Location map of proposed quarry showing hydrogeologic zones (Source: J. Finneran).

Vulcan plans to extract rock from the Kainer (Edwards Group) and Upper Member of the Glen Rose (Trinity Group) Formations (Figure 2). These formations consist largely of limestone and are karstic in nature. A karst setting is characterized by voids in the rock such as caves, sinkholes, losing streams, and conduits through which water can infiltrate rapidly from the surface and flow through the rock and underlying aquifer. Eventually, much of this water will reach downgradient water-supply wells and springs. Thirty-seven sensitive karst features have been documented on the proposed property (Pape-Dawson, 2024). Numerous sensitive features on surrounding properties have previously been documented. The presence of these features in high numbers indicates that water at the surface can easily enter these features, pass through a system of voids in the rock, then provide recharge to the water table of the underlying aquifer. Contaminants from the quarrying operation will be carried by this recharging water into the subsurface and the underlying aquifer to reach downgradient receptors such as water-supply wells and biota that live in and downstream of the springs.

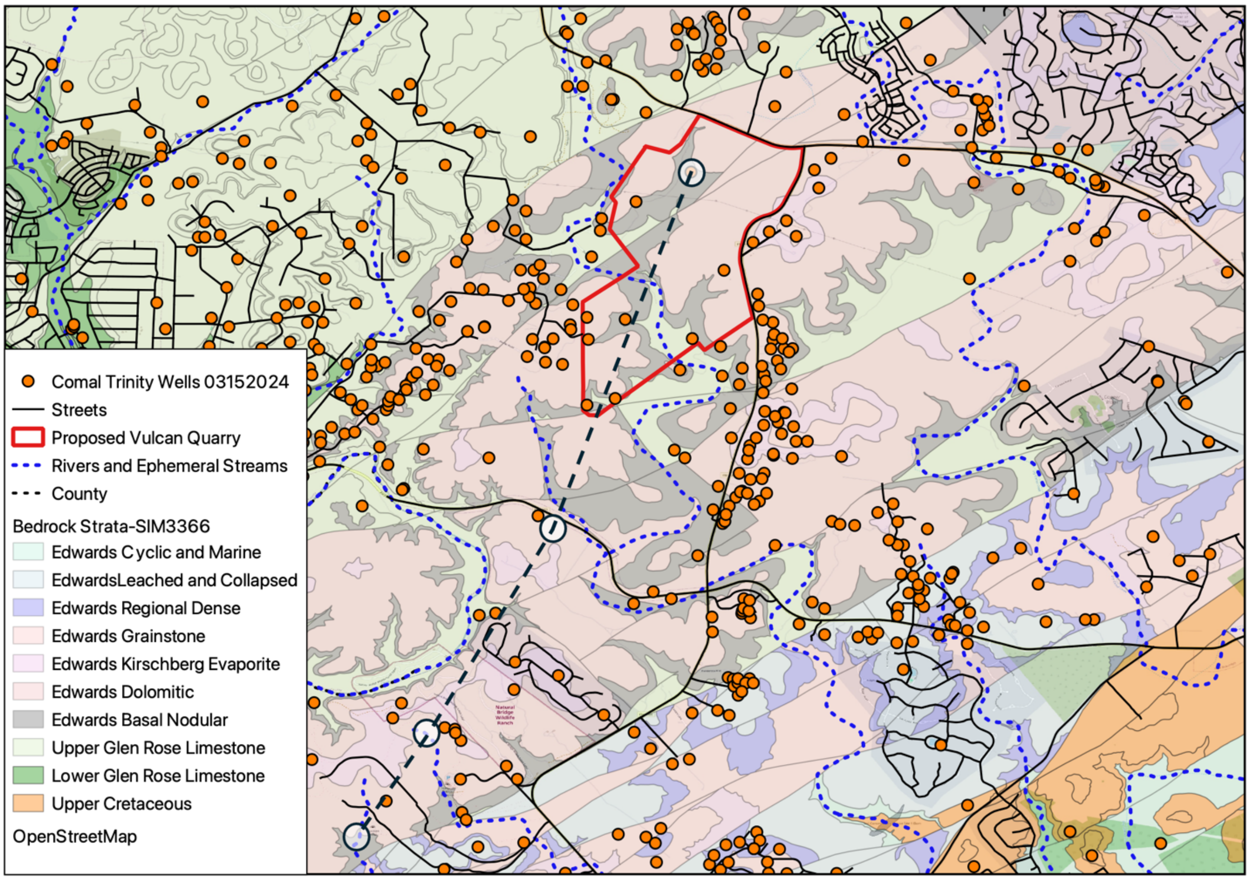


Figure 2. Geologic map of central Comal County showing water-supply wells (Source: J. Finneran).

<u>Hydrogeology</u>

The hydrogeology at the proposed quarry site is similar to the hydrogeology along strike to the northeast and southwest in Hays and Bexar counties, respectively. Significantly more studies have been conducted in these areas and the findings from these studies are applicable to the proposed quarry site. Some of these studies can be found in Clark et al. (2023a and 2023b), Hunt and Smith (2019), Gary et al. (2011), Johnson and Schindel (2006), Green et al. (2019), and Ferrill et al. (2003).

Figure 3 is a schematic cross section from Hays County showing the relationship between the various Edwards and Trinity hydrostratigraphic units (Hunt et al., 2017). Because of the similarity of the geology along strike, this figure provides a good representation of the hydrogeology beneath the proposed quarry site. Figure 4 is a hydrostratigraphic column for Hays and Travis Counties showing how the various geologic units relate to each other hydraulically. This column is similar to one by Clark et al. (2023) (Figure 5) which is representative of Comal and northern Bexar Counties. Even though some of the nomenclature is different many of the same hydraulic relationships are the same. One of the key concepts shown in these figures is that the lowermost Kainer/Basal Nodular-Walnut (lower Edwards) is hydraulically connected to the uppermost Upper Glen Rose (Upper Trinity) (Wong et al. 2014; Smith et al., 2018; Smith and Hunt, 2019). These studies have identified the potential for groundwater to move vertically between the Kainer and the uppermost Upper Glen Rose. Studies conducted by the Edwards Aquifer Authority have identified flow of groundwater laterally and across faults from the Upper Glen Rose into the Kainer then into the Person Formation (upper Edwards) (Figure 6) in northern Bexar County (Johnson et al., 2010).

Both hydrostratigraphic columns indicate that there are evaporite units in the lower section of the Upper Glen Rose. This is significant for groundwater flow because these units are generally very low in porosity and therefore limit vertical flow of groundwater. This generally sets a lower level for the overlying aquifer that consists of the Edwards and uppermost Upper Glen Rose. However, there is some potential for vertical flow along faults and fractures. Studies have generally shown that the amount of vertical flow between the Edwards/uppermost Upper Glen Rose and the Cow Creek (Middle Trinity) along these faults is minimal (Wong et al., 2014; Smith and Hunt, 2019). One exception to this is a Middle Trinity well (State Well Number 68-14-701) that demonstrates some hydraulic connectivity to Cibolo Creek (G. Veni, personal communication, April 5, 2024).

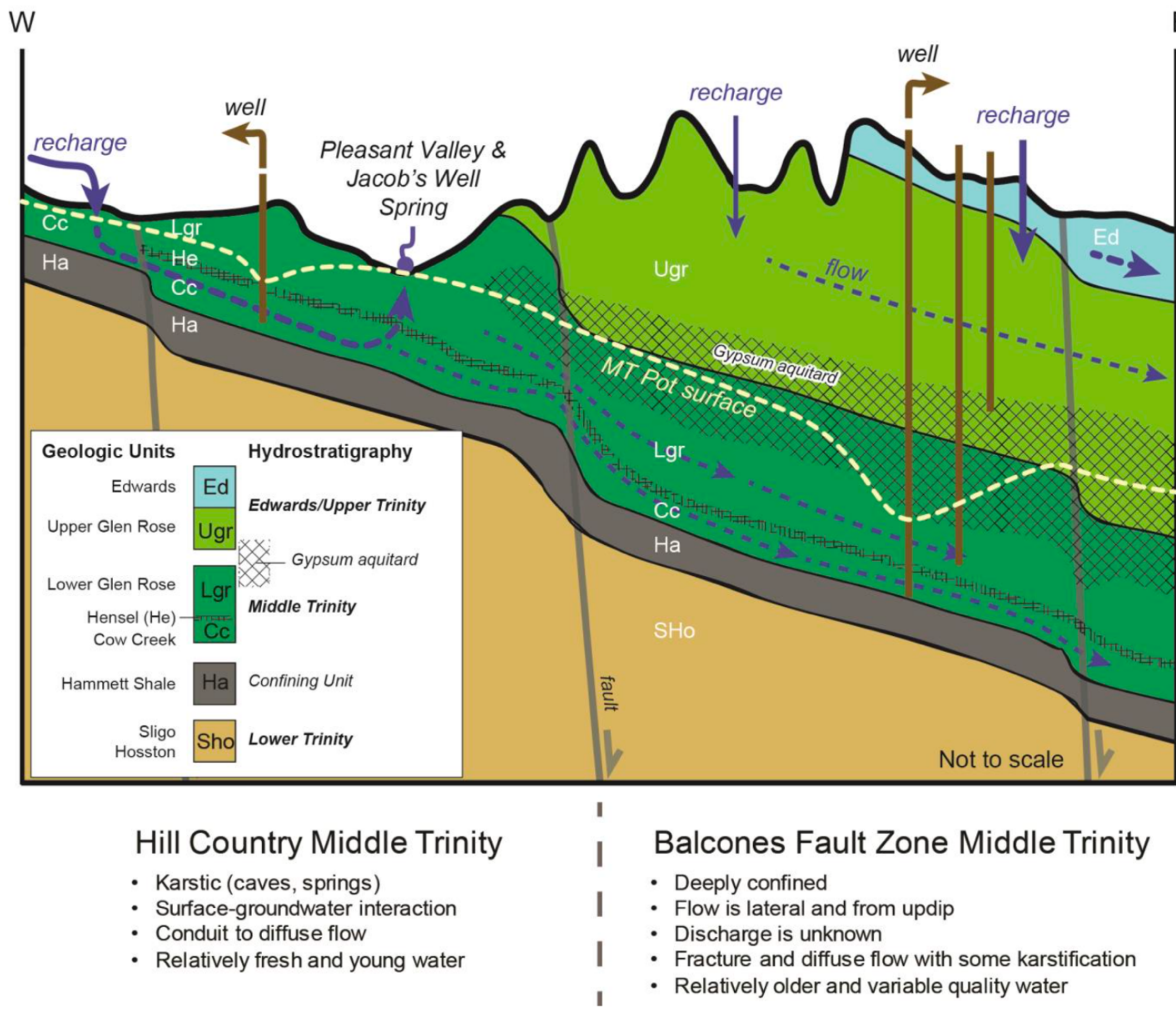


Figure 3. Schematic cross section of the Edwards and Trinity Aquifers. Cross section is based on field and well data from Hays County (Hunt et al., 2017). The portion of the cross section to the right, where the Edwards and Upper Glen Rose are exposed at the surface is representative of the proposed Vulcan quarry site.

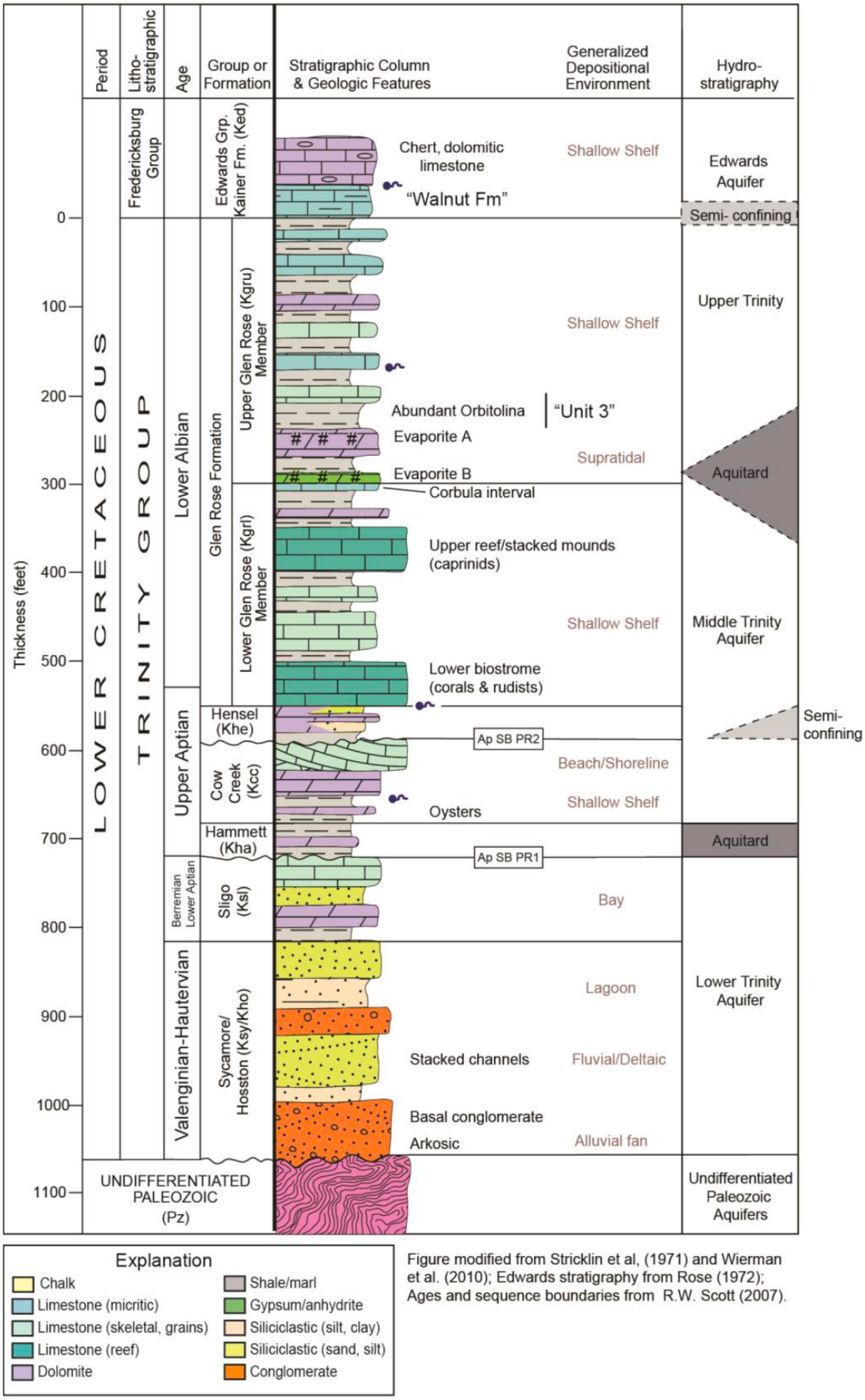


Figure 4. Stratigraphic and hydrostratigraphic column (Hunt et al., 2017).

Group or formation[1]	Member (formal and informal)		Hydrologic unit or informal hydrostratigraphic unit
Taylor Group (Pecan Gap Chalk)	**	Kpg	Upper confining unit (UCU)
Austin Group	**	Ka	
Eagle Ford Group	**	Kef	
Buda Limestone	**	Kb	
Del Rio Clay	**	Kdr	
Georgetown Formation	**	Kg	I
Person Formation	Cyclic and marine, undivided[2]	Kpcm	II
	Leached and collapsed[2]	Kplc	III
	Regional dense member[2]	Kprd	IV
Kainer Formation	Grainstone[2]	Kkg	V
	Kirschberg Evaporite[1]	Kkke	VI
	Dolomitic[2]	Kkd	VII
	Burrowed[2]	Kkb	Seco Pass***
	Basal nodular[2]	Kkbn	VIII
Glen Rose Limestone	Upper Glen Rose Limestone[2]	Kgrc	Cavernous
		Kgrcb	Camp
		Kgrue	Upper evaporite
		Kgrf: Kgruf	Fossiliferous: Upper
		Kgrf: Kgrlf	Fossiliferous: Lower
		Kgrle	Lower evaporite
	Lower Glen Rose Limestone[2]	Kgrb	Bulverde
		Kgrhf: Kgrlb	Herff Falls***: Litle Blanco
		Kgrhf: Kgrts	Herff Falls***: Twin Sisters
		Kgrhf: Kgrd	Herff Falls***: Doeppenschmidt
		Kgrr	Rust
		Kgrhc	Honey Creek
Pearsall Formation	Hensell Sand[1]	Kheh	Hensell
	Cow Creek Limestone[1]	Kcccc	Cow Creek
	Hammett Shale[1]	Khah	Hammett

[1]Formal.

[2]Informal.

**No further subdivision.

***Informal hydrostratigraphic unit name that has not been published previously.

Figure 5. Explanation of hydrostratigraphic units (Clark, 2023).

Figure 2. Cross section showing stratigraphy and estimated dye trace paths.

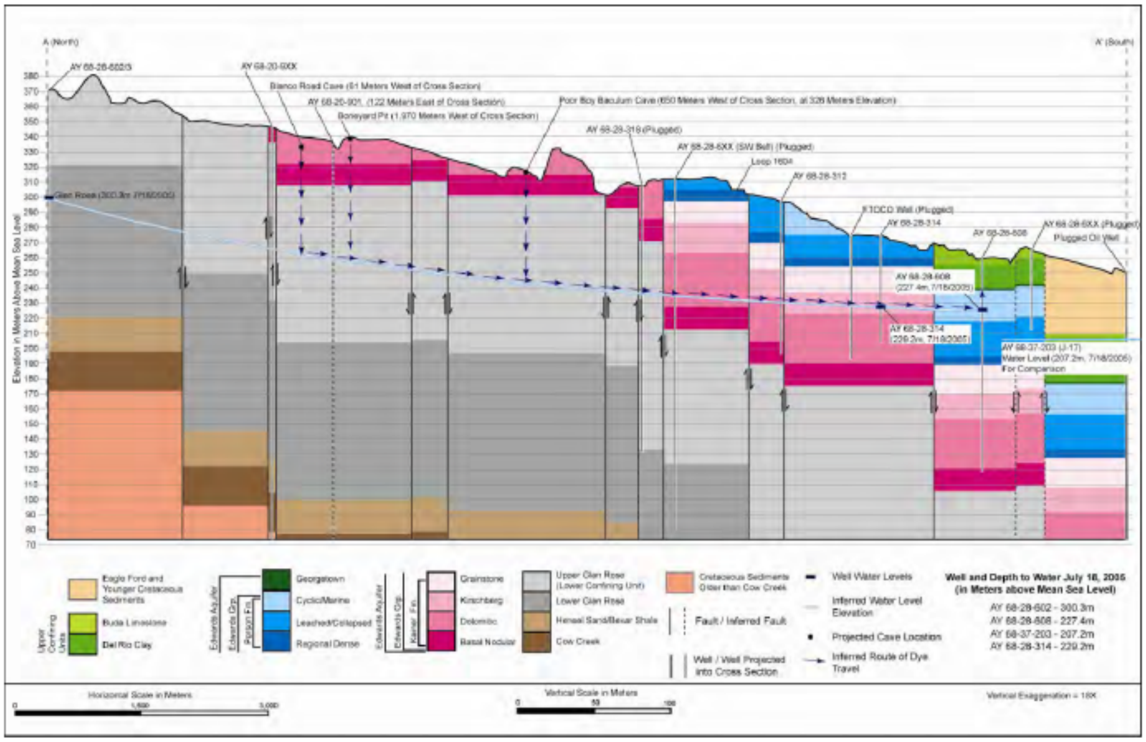


Figure 6. Flow of groundwater laterally and across faults from the Upper Glen Rose (Upper Trinity) into the Kainer (lower Edwards) then into the Person Formation (upper Edwards) in northern Bexar County (Johnson et al., 2010).

<u>Surface Water Recharge</u>

The Vulcan WPAP for the proposed quarry states that 37 sensitive (recharge) features were found during the field investigation for the Geologic Assessment (Pape-Dawson Engineers, 2024). Seven of the features, including three caves, require protection according to the TCEQ (2012) rating system. This number of sensitive features appears anomalously low when compared to the surrounding area.

Recharge features, unless very large, are likely to be covered or filled with soil and vegetation, yet water can easily infiltrate this cover and soil. The 158-acre Bigbee tract immediately north of the proposed quarry site and across Hwy 46, 38 sensitive features were found, and this site has 1/10 the acreage of the proposed quarry site (Frost GeoSciences, 2021). Another site immediately southwest of the proposed quarry site was investigated for inclusion in a conservation easement program based on its significant potential for recharge through numerous recharge features (G. Schindel, personal communication, April 12, 2024; Schindel, 2021). As mentioned above, the hydrogeology of the proposed quarry site is similar to that along strike to the northeast and southwest.

Water recharging the subsurface will pass through a series of voids that have been formed by dissolution of the limestone, dolomite, and evaporite lithologies. These solution voids are more concentrated along faults and fractures, but interconnected voids can also develop in the absence of faults and fractures. The hydrostratigraphic column in Figure 5 shows that the uppermost hydrostratigraphic unit is called the Cavernous unit because of the large number of caves and smaller voids found in this region (Clark et al., 2023). Plans for the proposed quarrying operation indicate that the Cavernous unit will be significantly mined. A zone of high permeability was encountered in the Vulcan's Blue Pine Holdings #1 well between a depth of 63 and 143 ft. Circulation of drilling fluids and groundwater was lost into the formation over this interval (TWDB Submitted Drilling Reports). This zone of high permeability is correlative to the Cavernous zone and to major caves to the south such as Natural Bridge Caverns (Woodruff et al., 2017). It should be expected that as the quarry advances downward more voids (recharge features) will be encountered. With removal of surface material and the underlying bedrock, it is likely that the area will become more prone to infiltration of surface water and this infiltrating water will be heading directly toward the underlying aquifer. The proposed depth on the mining pits will put them in or near this permeable zone shown by the stratigraphic cross-section below (Figure 7) (J. M. Olivier, personal communication, April 4, 2024).

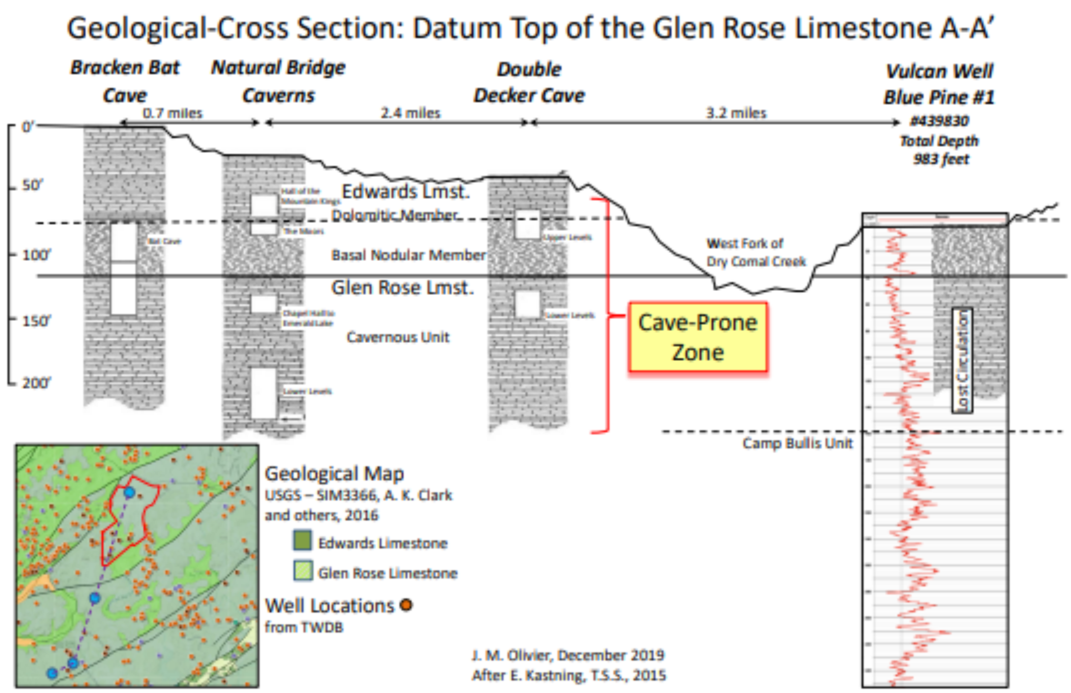


Figure 7. Geologic cross section showing the correlation between the well on the Vulcan site and caves in the same geologic units (Source: J. M. Olivier).

Groundwater Flowpaths

Once this infiltrating water reaches the water table of the aquifer, it will follow the hydraulic gradient. Some of this groundwater will be extracted by water-supply wells, much of it will discharge at the surface from springs, and some will remain in the aquifer following a flowpath into a deeper system many miles from where it first became recharge (Smith and Hunt, 2018).

Figure 8 is a potentiometric surface map of the Edwards Aquifer with water-level data from 2003 (Johnson et al., 2006). Even though no data were collected close to the proposed quarry site, the map suggests that flow from the site would move generally southeast then shift to the east then northeast toward Hueco and Comal Springs. A study following a 2,000-gallon diesel fuel spill in January 2000 at the DynoNobel explosives plant near the CEMEX Balcones Quarry in New Braunfels, Texas, shows flowpaths of the diesel fuel to both Hueco and Comal Springs (G. Schindel, personal communication, April 12, 2024). The proposed Vulcan quarry site is located seven miles NW from the plant. Groundwater flowing from the site would flow generally southeast until it reaches these flowpaths and would ultimately discharge to Hueco and Comal Springs. Some lesser components of the flow would bypass the springs and flow further downgradient towards San Marcos Springs.

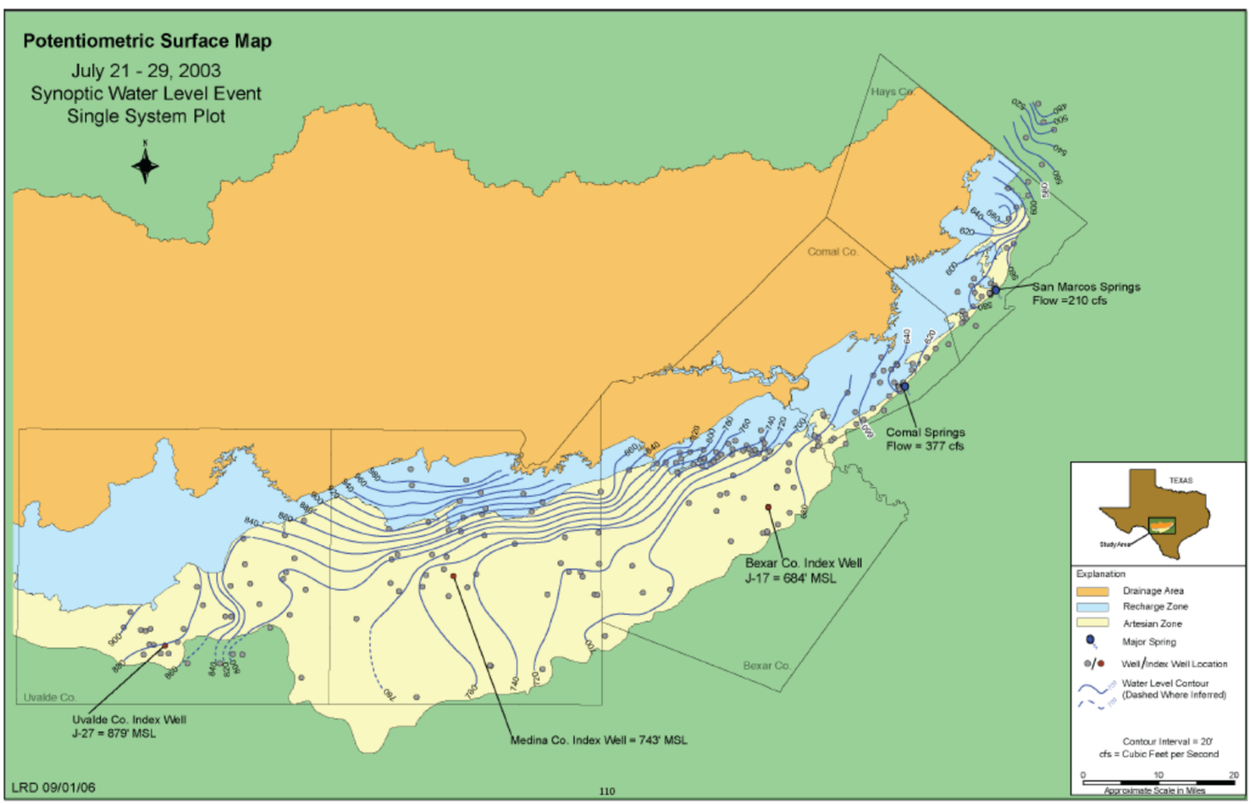


Figure 8. Potentiometric surface map showing approximate Edwards groundwater flow direction in south-central Comal County to be to the southeast (Johnson et al., 2006).

Water Quality

Because of the very porous nature of the lithologies beneath the proposed quarry site, any contamination generated by the quarrying operation would have a very direct and rapid impact on the underlying aquifer. Various studies have shown the potential for contamination of aquifers from the use of ammonium nitrate/fuel oil (ANFO) as an explosive. Contamination with nitrate can occur from poor handling of ANFO prior to an explosion and from incomplete combustion of the ANFO. Studies have shown that the amount of ANFO that does not combust during an explosion could be as high as 28% (BME, 2016 and Brochu, 2010). This leaves a considerable amount of nitrate available to be dissolved by water passing through the area of the blast. Once dissolved in the water, the nitrate is unlikely to break down into less hazardous components and will travel downgradient along the groundwater flowpaths.

Assuming the proposed quarry becomes active, there will be a significant likelihood for groundwater to become contaminated with nitrate and other hazardous substances from the site. Nearby wells could experience nitrate levels above the EPA's maximum concentration limit safe for human consumption of 10 mg/L (N). Wells and springs further downgradient of the quarry would likely see increases in nitrate concentrations but less so than wells immediately downgradient of the quarry. Some of this water with elevated nitrate could make its way to Hueco and Comal Springs. Several protected, aquatic, endangered species live in Comal Springs.

Water Levels

TCEQ requires that quarrying operations limit the downward expansion of a quarry to a level that is 25 ft above the highest expected water level (TCEQ, 2012). This level would either be set for water levels in December 2007, if available, or during a period equivalent to 90% of high rainfall. Because of limited water-level data on and near the site, it is difficult to determine what that level would be in the aquifer beneath different parts of the quarry site under varying rainfall conditions. To adequately evaluate water levels in the aquifer, the applicant should be required to do a thorough evaluation of data that are available and to collect data from onsite and nearby wells. A listing of wells and limited water-level data are included in Appendix A of this report (J. Doyle, personal communication, April 10, 2024). Because a water table is rarely a flat surface, a number of wells need to be measured within a short time period. These data then need to be compared to data collected during different wet and dry periods to determine appropriate water levels on all sides of the property. Water-level data from Hays (Hunt and Smith, 2019) and Bexar Counties (Johnson and Schindel, 2006), indicate that in the portions of the Edwards Aquifer at some distances from the major springs, hydraulic gradients can be as much as 100 ft per mile. Such a high gradient could be present beneath the quarry site, but it should be anticipated that there could be at least a 50-ft difference in water levels from one side of the site to the other. This difference in water levels would significantly impact the depth to which the quarry could be mined.

The WPAP (Pape-Dawson Engineers, 2024) for the site states that the mining areas will not be mined below an elevation of 1040 ft msl. According to the WPAP, this level of the quarry bottom will provide a 25-ft buffer above the high water level of the aquifer. A review of available water-level data indicates that at times, the bottom of the quarry will be flooded by the underlying aquifer (Figure 9). Water-level data from five wells close to the perimeter of the quarry boundary were evaluated to estimate expected water levels beneath the quarry and proposed depths of the excavations (Appendix B) (J. Finneran, personal communication, April 16, 2024). The White #4 well (#520690) had a water level of 1022 ft-msl on 12/5/07. At this water level plus the 25-ft buffer, the bottom of the quarry would be out of compliance. Another well (Tucker, EAA #Wxxx-137) had a water level of 1048 ft on 12/14/98. At this water level, the bottom of the quarry would be 8 ft below the water level in the aquifer.

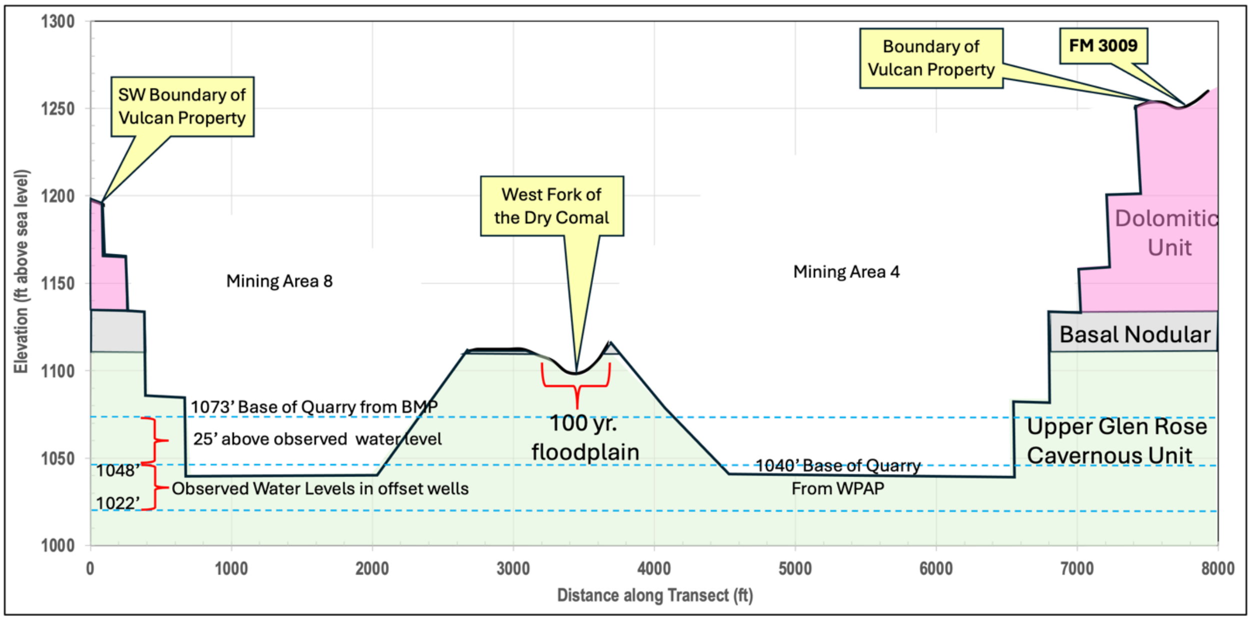


Figure 9. Schematic cross section with estimated topography after mining and water levels based on available data (J. Finneran, personal communication, April 16, 2024).

<u>Groundwater Availability</u>

Recent studies (Watson and Smith, 2023) have shown that intense growth in central Texas, particularly the Hill Country, has brought about significantly increased pumping from the Edwards and Trinity Aquifers. This increased pumping combined with the severe droughts that the region experiences frequently is causing numerous wells to go dry. Many springs either cease flowing during these periods, or the amount of flow is significantly reduced. Reduced spring flow leads to reduced flow in streams on which many people depend on. And these reduced flows also have negative impact on the ecology immediately in the spring area and downstream stretches. And, decreased groundwater availability increases the potential for contamination from various sources.

An analysis of the proposed quarries needs for water based on water use per ton of quarried material shows that approximately 383 acre-ft (125,000,000 gallons) of groundwater per year would be needed (M. Poffenberger, personal communication, April 13, 2024). Groundwater availability studies from the Edwards and Trinity Aquifers in Hays County have estimated that pumping 383 acre-ft of groundwater per year could cause sufficient water-level declines in adjacent wells such that during periods of drought those wells could cease to yield water.

<u>Conclusions</u>

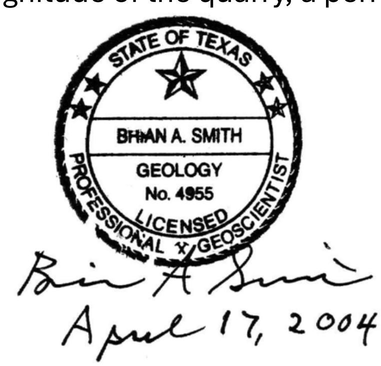
A permit for the quarry should not be considered until the following issues are addressed:

- Elevations of the aquifer should be determined prior to any excavation. The elevation of 1040 ft-msl for the bottom of the quarry, as stated in the WPAP, is likely to be out of compliance with the required buffer of 25 ft. And it is also likely that water levels in the aquifer will be above the elevation of 1040 ft-msl during periods of high water levels.

- The Geologic Assessment shows that 37 sensitive features were found. This number is anomalously low for the geology in this area. Further evaluation of recharge features is needed to determine areas that will require protective buffers. In addition, a dye-trace study should be conducted to determine flowpaths of groundwater from the site and to determine which downgradient wells might be impacted by contaminants coming from the quarry.

- The operation of a quarry will contribute contamination to the underlying aquifer. To determine background water-quality conditions, water-supply wells immediately downgradient of the quarry should be sampled and analyzed for nitrates and total petroleum hydrocarbons prior to issuing a permit for the quarry.

A thorough evaluation of existing data and data collected by the studies stated above will show that the aquifer beneath this site is highly sensitive to contamination. Because of the sensitivity of the site and the magnitude of the quarry, a permit should not be granted.



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Appendix A. Well Data

Well_Number	Latitude	Longitude	Location	Date Drilled	Use	TD	Elevation	Hole Size	Casing Size	Comp_Type	Top	Bot	Yield	Aquifer	Surface Geol	Water Level	Water Elev.	Database
17890	29.753195	-98.303472	Elizabeth James 30838 FM3009, New Braunfels, 78132	3/10/03	D	595.00	1161.00	8.75	4.50	P	255.00	595.00	12.00	Upper Trinity	Kkd	260.00	901.00	SDR
42322	29.781111	-98.325833	Doug Harrison Off Hwy 46, New Braunfels, 78130	8/11/03	D	940.00	1182.00	8.00	5.00	OH	400.00	940.00	10.00	Middle Trinity	Kgrcb	420.00	762.00	SDR
47428	29.755278	-98.328611	Torry L. Hurt 31341 Beck Rd., Bulverde, 78163	10/18/04	D	650.00	1141.00	9.50	4.50	P	150.00	650.00	10.00	Upper Trinity	Kgrc	335.00	806.00	SDR
62403	29.750805	-98.327444	Nathan and Kira Olson 245 Saur Road, Bulverde, 78163	6/28/05	D	740.00	1160.00	9.50	5.00	P	540.00	740.00	8.00	U & M Trinity	Kkd	401.00	759.00	SDR
83030	29.762778	-98.323611	Richard Hehs 2520 Shearer Rd, Bulverde, 78163	4/11/06	D	860.00	1112.00	8.75	5.00	P	660.00	860.00	12.00	Middle Trinity	Kkbn	425.00	687.00	SDR
91867	29.759445	-98.324722	Steve Southwell 435 Third Fork, Bulverde, 78163	7/26/06	D	840.00	1113.00	5.50	0.00	OH	540.00	840.00	8.00	Middle Trinity	Kgrc	420.00	693.00	SDR
148952	29.779444	-98.321944	Doug Harrison Highway 46 Diamond H Ranch, New Braunfels	1/20/06	D	920.00	1262.00	8.00	5.00	OH	560.00	920.00	30.00	Middle Trinity	Kkbn	369.00	893.00	SDR
148953	29.779444	-98.322222	Doug Harrison Highway 46 Diamond H Ranch, New Braunfels	1/13/06	D	700.00	1271.00	8.00	5.00	P	665.00	700.00	10.00	Middle Trinity	Kkbn	370.00	901.00	SDR
165144	29.781111	-98.327778	Doug Harrison 700 Harrison Road, New Braunfels, 78132	12/10/08	D	800.00	1205.00	8.00	4.50	P	640.00	780.00	20.00	Middle Trinity	Kgruf	420.00	785.00	SDR
184564	29.783334	-98.308889	Ron Bigbee 10900 Hwy 46 West, New Braunfels, 78132	9/13/06	D	860.00	1266.00	8.00	5.00	P	680.00	860.00	10.00	Middle Trinity	Kkbn	430.00	836.00	SDR
189338	29.745777	-98.328416	Michael Olsen 414 Saur Rd., Bulverde, 78163	7/24/09	D	1000.00	1205.00	9.00	4.50	S	800.00	1000.00	15.00	Middle Trinity	Kkd	520.00	685.00	SDR
197965	29.784167	-98.325278	Doug Harrison 1650 INDEPENDENCE DRIVE, NEW BRAUNFELS, 78132	9/13/09	D	860.00	1204.00	12.25	8.63	P	660.00	860.00	0.00	Middle Trinity	Kgrc	456.00	748.00	SDR
197966	29.784167	-98.325278	Doug Harrison 1650 INDEPENDENCE DRIVE, NEW BRAUNFELS, 78132	9/13/09	D	660.00	1204.00	12.25	8.63	P	660.00	860.00	0.00	Middle Trinity	Kgrc	456.00	748.00	SDR
390602	29.754723	-98.303612	Milann Guckian 30739 FM3009, New Braunfels, 78132	1/27/15	D	980.00	1193.00	8.00	4.50	OH	800.00	980.00	8.00	Middle Trinity	Kkd	472.00	721.00	SDR
402605	29.7825	-98.313889	Lee Page 219 DOEHNE OAKS, NEW BRAUNFELS, 78132	8/6/15	D	410.00	1247.00	6.00	6.00	OH	292.00	410.00	10.00	Upper Trinity	Kgrc	180.00	1067.00	SDR
417876	29.785278	-98.308611	LOT 4 DOEHNE OAKS, NEW BRAUNFELS, 78132	3/8/16	D	460.00	1296.00	6.00	6.00	OH	342.00	460.00	5.00	Upper Trinity	Kkd	330.00	966.00	SDR
420134	29.786389	-98.313889	LOT 3 DOEHNE OAKS, NEW BRAUNFELS, 78132	2/1/16	D	440.00	1299.00	6.00	6.00	OH	321.00	440.00	7.00	Upper Trinity	Kkbn	274.00	1025.00	SDR
439830	29.770222	-98.312083	Blue Pine Holding 10901 TX 46 HWY 3009/ TX 46	1/2/17	IRR	983.00	1143.00	9.88	6.00	OH	632.00	943.00	150.00	Middle Trinity	Kkbn	121.00	1022.00	SDR
454726	29.771971	-98.294277	Carlos Banuelos 9801 Hwy 46 (east of FM3009) W111-780	6/21/17	D	683.00	1225.00	9.00	4.50	P	380.00	660.00	10.00	Upper Trinity	Kkd	255.00	970.00	SDR
475959	29.789889	-98.309222	Kyle Sargisson 1148 Imhoff lane, New Braunfels, 78132	3/20/18	D	455.00	1302.00	9.00	4.50	S	398.00	418.00	5.00	Upper Trinity	Kkd	347.00	955.00	SDR
481756	29.783056	-98.310556	Castele Avalon 10900 W ST HWY 46, New Braunfels, 78132	5/11/18	D	702.00	1237.00	8.00	4.50	P	500.00	702.00	15.00	Middle Trinity	Kgrc	315.00	922.00	SDR
493397	29.764306	-98.323444	Mike McCrary 2580 Shearer Road, Bulverde, 78163	10/1/18	D	920.00	1182.00	8.00	4.50	S	840.00	900.00	3.00	Middle Trinity	Kkbn	515.00	667.00	SDR
502269	29.783861	-98.311139	1108 Imhoff, New Braunfels, 78132	1/31/19	D	860.00	1220.00	9.00	4.50	S	558.00	818.00	10.00	Middle Trinity	Kgrc	197.00	1023.00	SDR
520687	29.740666	-98.325277	Eric W. White 11301 HWY 46 W, New Braunfels, #1 Loc from SDR	10/25/07	IRR	962.00	1135.00	8.75	6.00	OH	40.00	963.00	15.00	U & M Trinity	Kkd	355.00	780.00	SDR
520688	29.748944	-98.325138	Eric W. White 11301 HWY 46 W, New Braunfels, #2 Loc from SDR	11/6/07	IRR	970.00	1170.00	8.75	6.00	OH	40.00	970.00	20.00	U & M Trinity	Kkd	402.00	768.00	SDR
520689	29.7515	-98.320444	Eric W. White 11301 HWY 46 W, New Braunfels, #3 Loc from SDR	11/12/07	IRR	976.00	1124.00	8.75	6.00	OH	40.00	976.00	20.00	U & M Trinity	Kkbn	315.00	809.00	SDR
520690	29.75175	-98.325305	Eric W. White 11301 HWY 46 W, New Braunfels, #4 Loc from SDR	12/5/07	IRR	1054.00	1158.00	8.75	6.00	OH	38.00	1054.00	80.00	U & M Trinity	Kgrc	136.00	1022.00	SDR
520691	29.749027	-98.311917	Eric W. White 11301 HWY 46 W, New Braunfels, #5 Loc from SDR	10/16/07	IRR	931.00	1120.00	8.75	6.00	OH	40.00	931.00	60.00	U & M Trinity	Kkbn	155.00	965.00	SDR
520692	29.741444	-98.321721	Eric W. White 11301 HWY 46 W, New Braunfels, #6 Loc fro SDR	11/19/07	IRR	968.00	1098.00	8.75	6.00	OH	40.00	968.00	25.00	U & M Trinity	Kgrc	297.00	801.00	SDR
533817	29.784586	-98.310181	Ashei Duffy 1114 Imhoff, New Braunfels, 78132	12/26/19	D	360.00	1250.00	9.00	5.00	S	100.00	320.00	30.00	Upper Trinity	Kkbn	90.00	1160.00	SDR
6814902	29.774102	-98.290252	H. Conrad Hwy 46 near Meyer Ranch windmill	1/29/40	IRR	208.00	1174.00					208.00		Upper Trinity	Kkd	139.11	1034.89	GWDB
6822203	29.745294	-98.305563	Chris Hopmann 30323 FM3009 New Braunfels	8/1/19	D	700.00	1123.00	9.88	6.00	OH	500.00	700.00	10.00	Middle Trinity	Kkbn	329.70	793.30	GWDB
6822204	29.748042	-98.308322	Chris Hopmann 30323 FM3009 New Braunfels	8/1/19	D	240.00	1151.00		6.00	OH		240.00		Upper Trinity	Kkbn	113.90	1037.10	GWDB
W102-615	29.764028	-98.299944	Karl Fuchs 31600 FM3009	5/15/01	D	490.00	1301.00	8.00	5.00	P	180.00	490.00	22.00	Upper Trinity	Kkg	180.00	1121.00	EAA
W103-427	29.743222	-98.305944	Windell and Camille Cannon 30045 FM3009	8/11/04	D	400.00	1100.00	8.00	5.00	OH	160.00	400.00	10.00	Upper Trinity	Kkbn	350.00	750.00	EAA
W104-737	29.761278	-98.304194	Stephen and Jane Johnson 31400 FM3009	2/1/06	D	550.00	1241.00	6.50	5.00	S	500.00	560.00	5.00	Upper Trinity	Kkd	400.00	841.00	EAA
W106-830	29.762625	-98.302128	Craig Johnson 31450 FM3009	1/23/01	D	555.00	1272.00	8.00	5.00	OH	220.00	555.00	10.00	Upper Trinity	Kkke	230.00	1042.00	EAA
W109-777	29.744305	-98.308111	Windell Cannon 30045 FM 3009	3/21/00	D	720.00	1090.00	9.88	6.00	P	520.00	720.00	8.00	Middle Trinity	Kgrc	438.00	652.00	EAA
W109-793	29.770499	-98.296389	Larry Lowak 31320 FM3009	6/28/00	D	540.00	1242.00	8.00	5.00	OH	420.00	540.00	10.00	Upper Trinity	Kkd	260.00	982.00	EAA
W110-297	29.753661	-98.304942	Eric White 30715 FM-3009		D	920.00	1190.00						10.00					
W111-669	29.749039	-98.329616	Major W. T. Bump Lot 17 Beck Rd	11/16/84	D	700.00	1214.00	6.00	6.63	OH	130.00	700.00	9.00	Upper Trinity	Kkd	300.00	914.00	EAA
W111-706	29.768194	-98.295833	James Olson 32190 FM3009	12/20/96	D	600.00	1265.00	6.75	4.50	P	400.00	600.00	10.00	Upper Trinity	Kkke	400.00	865.00	EAA
W112-709	29.757739	-98.30788	Windmill well on east side of White Ranch															EAA
W112-710	29.766453	-98.319072	Windmill well on west side of White Ranch															EAA
W202-083	29.753353	-98.327105	R. L. Musgrove 31401 Beck Rd	7/31/86	D	900.00	1160.00	6.00	6.00	OH	325.00	900.00	4.00	U & M Trinity	Kkd	423.00	737.00	EAA
W202-087	29.751428	-98.302958	Alan Hammack 30700 FM3009	3/13/97	D	545.00	1192.00	6.75	4.50	S	270.00	545.00	12.00	Upper Trinity	Kkd	240.00	952.00	EAA
W202-101	29.740164	-98.30708	Glen Mueltlstien 29691 FM3009	2/11/99	D	500.00	1081.00	6.00	5.00	OH	300.00	500.00	100.00	Upper Trinity	Kkbn	260.00	821.00	EAA
W202-104	29.745064	-98.313486	C. Bruce Lee (Heartland Masada Ranch) 30715 FM 3009	2/22/02	D	920.00	1166.00	8.00	4.50	P	720.00	920.00	10.00	Middle Trinity	Kkd	600.00	566.00	EAA
Wxxx-132	29.78293	-98.29999	Tillman Thomas 800 Heritage Oaks	5/29/00	D	543.00	1236.00	6.00	6.00	OH	258.00	543.00	7.00	Upper Trinity	Kgrc	215.00	1021.00	TCEQ
Wxxx-133	29.777538	-98.292613	Bob Satterwhite 10000 Hwy-46 New Braunfels	12/11/93	D	540.00	1192.00	6.75	4.50	OH	340.00	540.00	5.00	Upper Trinity	Kkd	200.00	992.00	TCEQ
Wxxx-134	29.778554	-98.301422	Ken Higby 292 Heritage Oaks Spring Branch TX	5/29/02	D	1062.00	1281.00	10.00	5.00	OH	698.00	1062.00	100.00	Middle Trinity	Kkd	458.00	823.00	TCEQ
Wxxx-137	29.750203	-98.327365	Butch Tucker 333 Saur Rd	12/10/98	D	800.00	1198.00	7.88	4.50	P	540.00	800.00	24.00	Middle Trinity	Kkd	150.00	1048.00	TCEQ
	29.745845	-98.312141	Bruce Lee Permanent Pond				1063.20							Upper Trinity	Kgrc	0.00	1063.20	
WR-1	29.770979	-98.302511	Location from WPAP												Kek			WPAP
WR-2	29.768473	-98.307756	Location from WPAP												Kek			WPAP
WR-3	29.751478	-98.32036	Location from WPAP												Kek			WPAP
WR-4	29.747936	-98.31689	Location from WPAP												Kgr			WPAP
WR-5	29.749045	-98.311958	Location from WPAP												Kgr			WPAP
WR-6	29.741425	-98.321705	Location from WPAP												Kgr			WPAP
S-1	29.770019	-98.312197	Blue Pine Holding Location from WPAP												Kek			WPAP
S-2	29.772232	-98.303037	Cased borehole on White Ranch Location from WPAP												Kek			WPAP
S-3	29.766466	-98.319097	Cased borehole on White Ranch Location from WPAP												Kek			WPAP
S-4	29.75774	-98.307887	Cased borehole on White Ranch Location from WPAP												Kek			WPAP
S-5	29.752889	-98.31672	Cased borehole on White Ranch Location from WPAP												Kgr			WPAP
S-36	29.766218	-98.322403	Uncased borehole on White Ranch Location from WPAP															WPAP
			6822204 EAA monitor well Upper Glen Rose. Donated to CTGCD															
			6822203 EAA monitor well Lower Glen Rose. Donated to CTGCD															
			6814902 Old monitor well. Not active?															
			Log on Green highlighted wells															

Source: J. Doyle

SDR: TWDB Submitted Drillers Reports

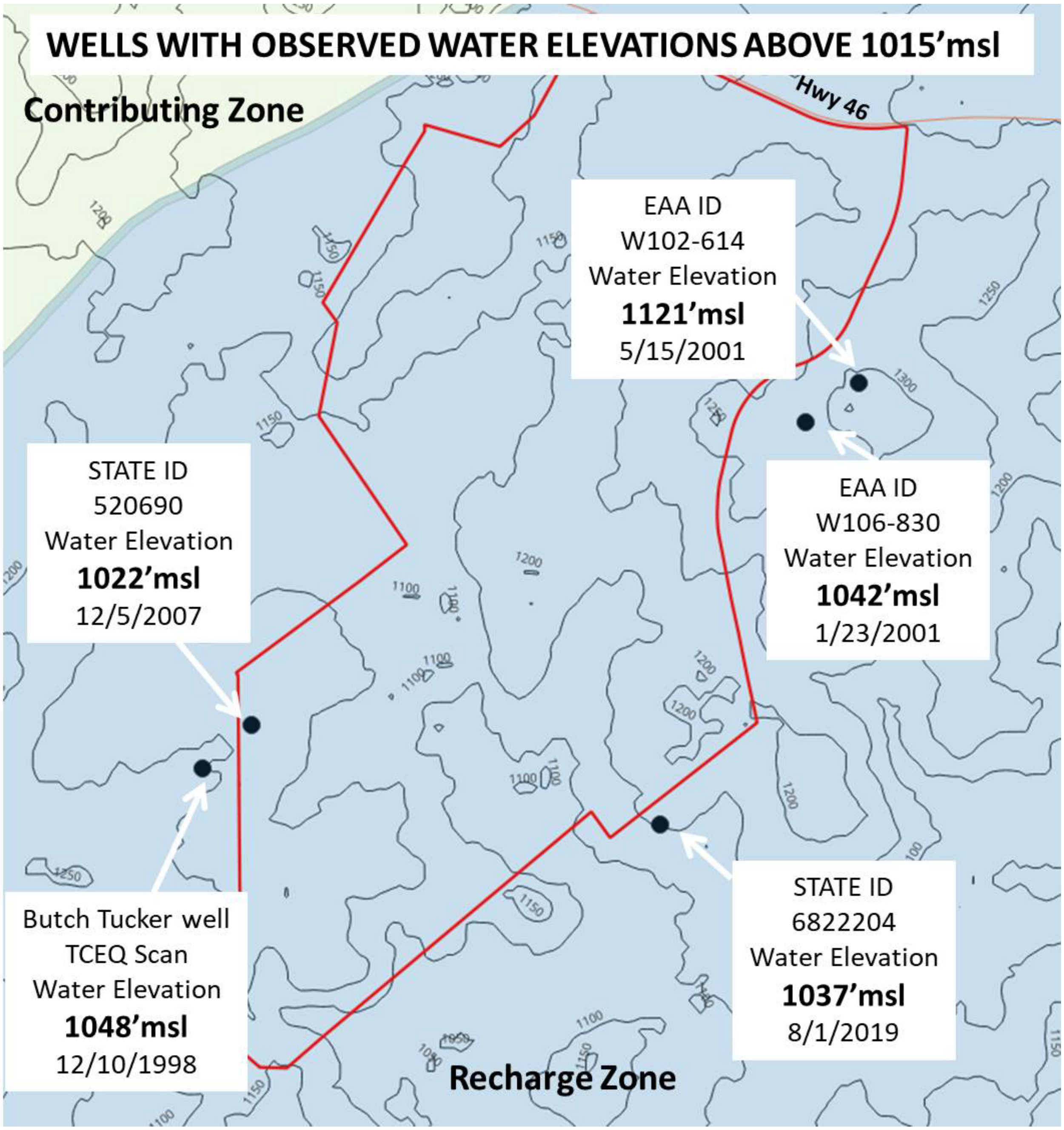
GWDB: TWDB Groundwater Database

EAA: Edwards Aquifer Authority

TCEQ: Texas Commission on Environmental Quality

WPAP: Pape-Dawson, 2024, Water Pollution Abatement Plan

Appendix B. Location Map and Well Records



Source: J. Doyle

EAA well W102-615

Latitude 29.764028 Longitude -98.299944

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

[redacted]as Department of License and Regula[redacted]
Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
KARL FUCHS	127 PENNSYLVANIA	NEW BRAUNFELS	TX.	78130

2) WELL LOCATION

County	Physical Address	City	State	Zip
COMAL	31600 FM 3009	NEW BRAUNFELS	TX	78130

3) Type of Work ☑ New Well ☐ Deepening ☐ Reconditioning

Lat. | Long. | Grid # 68-14-8

4) Proposed Use (check) ☐ Monitor ☐ Environmental Soil Boring ☑ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) NT

6) Drilling Date
Started 4 / 30 / 01
Completed 5 / 15 / 01

Diameter of Hole

Dia. (in)	From (ft)	To (ft)
8"	0	490

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☑ Cable Tool ☐ Jetted ☐ Other

0 - 10	CALICHE
10 - 130	WHITE LIMESTONE
130 - 150	ORANGE "
150 - 180	WHITE "
180 - 275	YELLOW " (WATER)
275 - 490	BLUE

SEQ # | EMPT | DESC CO | JUL 11 2001 | COMMENT | AG

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion ☑ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other
If Gravel Packed give the interval from ____ ft. to ____ ft.

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr.. if commercial	Setting (ft) From	To	Gage Casing Screen
5"	N	PVC SCH 40	280	0	
		PERFORATED	280	180	

9) Cementing Data
Cementing from 170 ft. to 160 ft. # of sacks used 2
20 ft. to 0 ft. # of sacks used 4
Method Used MIXER
Cementing By S. L. VOGES
Distance to septic system field or other concentrated contamination NA ft.
Method of verification of above distance

13) Plugged ☐ Well plugged within 48 hours
Casing left in well: Cement/Bentonite placed in well:

From (ft)	To (ft)	From (ft)	To (ft)	Sacks used

10) Surface Completion
☐ Specified Surface Slab Installed
☑ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump
☐ Turbine ☐ Jet ☑ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet etc., 460 ft.

11) Water Level
Static level 180 ft. below Date 5 / 15 / 01
Artesian Flow ____ gpm. Date __ / __ / __

15) Water Test
Type test ☐ Pump ☑ Bailer ☐ Jetted ☐ Estimated
Yield: 20 gpm with 0 ft. drawdown after 8 hrs.

12) Packers

	Type	Depth
2	SCREEN	175 + 170

16) Water Quality
Did you knowingly penetrate any strata which contain undesirable constituents.
☐ YES ☑ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water GOOD Depth of Strata EDWARDS
Was a chemical analysis made ☐ Yes ☑ No

Company or individual's Name (type or print) S. L. VOGES CONST.

Address 128 VOGES City NEW BRAUNFELS State TX Zip 78132

Signature CHARLES KUTSCHER 7 / 8 / 01 Signature [signature] 5 / 22 / 01
Licensed Driller/Pump Installer Date Apprentice Date

TDLR FORM 001WWD White - TDLR Yellow - Owner Pink - Driller/Pump Installer

[signature] WPRL 1861 STATON L. VOGES WWDAPP 799

Butch Tucker 333 Saur Rd
Latitude 29.750203 Longitude -98.327365

Send original copy by certified return receipt request mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087 1200

ATTENTION OWNER: Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Butch Tucker (Name) ADDRESS 12415 La Albada SanAntonio 78233 (Street or RFD) (City) (State) (Zip)

2) ADDRESS OF WELL: County Comal Beck Rd/Saver (Street, RFD or other) (City) (State) (Zip) GRID # 68148

3) TYPE OF WORK (Check): [X] New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring [X] Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

6) WELL LOG:
Date Drilling:
Started 11/30 19 98
Completed 12/10 19 98

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7 7/8	Surface	800

7) DRILLING METHOD (Check): ☐ Driven [X] Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	3	Black dirt
3	18	Lt grey limestone
18	100	Cream limestone
100		Void, lost return

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [X] Open Hole ☐ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other
If Gravel Packed give interval ... from ____ ft. to ____ ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	To	Gage Casting Screen
4.5	N	Sdr17 250psiPVC (260' perf)	0	800	Sdr17
5	N	200psiPVC stubout	0	2	Sdr21

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 80 ft. No. of sacks used 6
0 ft. to 10 ft. No. of sacks used 4
Method used poured in top
Cemented by Mike
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

13) TYPE PUMP:
☐ Turbine ☐ Jet [X] Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., 661 ft.

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted [X] Estimated
Yield: 24 gpm with 20 ft. drawdown after 1 hrs.

11) WATER LEVEL:
Static level 150 ft. below land surface Date 12/14/98
Artesian flow ____ gpm. Date ____

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes [X] No

12) PACKERS:

Type		Depth
6 mil cones	plastic	80'

SEQ # FILE ID EMP # JAN 08 1999 TEMP COMMENT

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME BoMax Industries Inc (Type or print) WELL DRILLER'S LICENSE NO. 2016PW

ADDRESS 1901 Pedernales Drive Spicewood Tx 78669 (City) (State) (Zip)

(Signed) [signature] (Licensed Well Driller) Michael E. Stempelmann (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) *White - TNRCC Yellow - DRILLER Pink - WELL OWNER*

Texas Water Development Board

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 68-22-204

groundwater division

GWDB Reports and Downloads

Well Basic Details

Scanned Documents

State Well Number	6822204
County	Comal
River Basin	Guadalupe
Groundwater Management Area	9
Regional Water Planning Area	L - South Central Texas
Groundwater Conservation District	Comal Trinity GCD
Latitude (decimal degrees)	29.7480417
Latitude (degrees minutes seconds)	29° 44' 52.95" N
Longitude (decimal degrees)	-98.3083222
Longitude (degrees minutes seconds)	098° 18' 29.96" W
Coordinate Source	Global Positioning System - GPS
Aquifer Code	
Aquifer	Trinity
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	1151
Land Surface Elevation Method	Global Positioning System-GPS
Well Depth (feet below land surface)	240
Well Depth Source	Person Other than Owner
Drilling Start Date	
Drilling End Date	
Drilling Method	
Borehole Completion	

Well Type	
Well Use	
Water Level Observation	GCD Current Site Visit
Water Quality Available	No
Pump	
Pump Depth (feet below land surface)	
Power Type	
Annular Seal Method	
Surface Completion	
Owner	Chris Hopmann
Driller	
Other Data Available	
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	Hopman Shallow
Previous State Well Number	
Reporting Agency	Groundwater Conservation District
Created Date	11/6/2020
Last Update Date	11/6/2020

Remarks	Reported and monitored by Edwards Aquifer Authority.

Casing - No Data

Well Tests - No Data

Lithology - No Data

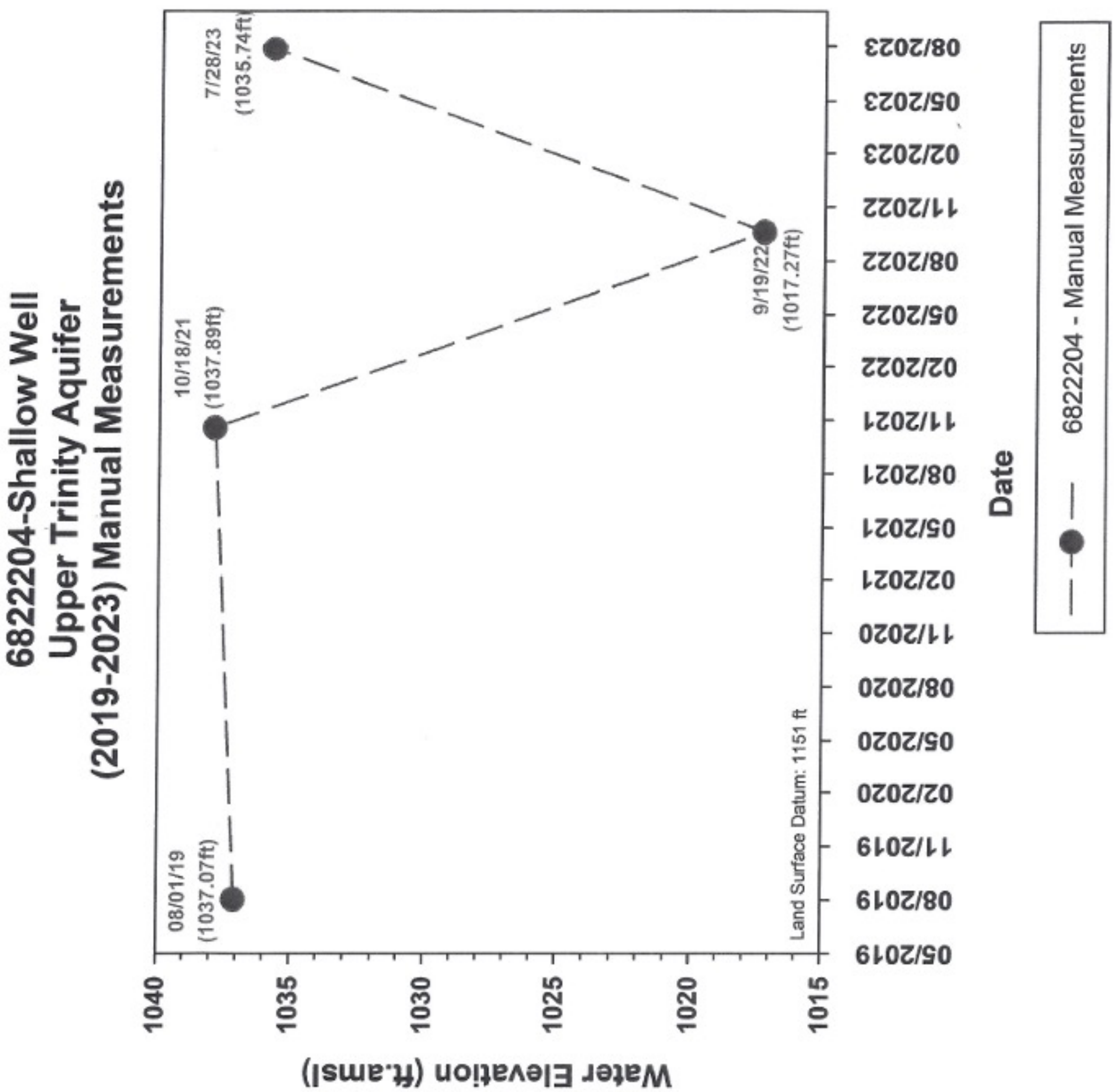
Annular Seal Range - No Data

Borehole - No Data

Plugged Back - No Data

Filter Pack - No Data

Packers - No Data


6822204-Shallow Well
Upper Trinity Aquifer
(2019-2023) Manual Measurements
Water Elevation (ft.amsl)
1040
1035
1030
1025
1020
1015
Date
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
08/2021
11/2021
02/2022
05/2022
08/2022
11/2022
02/2023
05/2023
08/2023
08/01/19
(1037.07ft)
10/18/21
(1037.89ft)
9/19/22
(1017.27ft)
7/28/23
(1035.74ft)
Land Surface Datum: 1151 ft
6822204 - Manual Measurements

STATE OF TEXAS WELL REPORT for Tracking #520690

Owner:	**Eric W White**	Owner Well #:	**4**
Address:	**11301 HWY 46 W** **New Braunfels, TX 78132**	Grid #:	**68-14-8**
Well Location:	**11301 HWY 46 W** **New Braunfels, TX 78132**	Latitude:	**29° 45' 06.3" N**
		Longitude:	**098° 19' 31.1" W**
Well County:	**Comal**	Elevation:	**1158 ft. above sea level**
Number of Wells Drilled:	**6**		

Type of Work: **New Well** Proposed Use: **Irrigation**

Drilling Start Date: **12/3/2007** Drilling End Date: **12/5/2007**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.75**	**0**	**1054**

Drilling Method: **Air Rotary**

Borehole Completion: **Pilot HOle**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**38**	**Benseal 4 Bags/Sacks**

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **136 ft.** below land surface on **2007-12-05**

Packers: **Rubber at 38 ft.**

Type of Pump: **No Data**

Well Tests: **Jetted** **Yield: 80 GPM with ? ft. drawdown after 2 hours**

EAA well W106-830
Latitude 29.762625 Longitude -98.302128

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of License and Regulation
Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512)463-7880 FAX (512)463-8616
Toll free (800)803-9202
Email address: water.well@license.state.tx.us

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

WELL REPORT

A. WELL IDENTIFICATION AND LOCATION DATA

1) OWNER

Name	Address	City	State	Zip
CRAIG JOHNSON	4710 CRESTED GROVE	SAN ANTONIO	TX	78217

2) WELL LOCATION

County	Physical Address	City	State	Zip
COMAL	31450 FM 3009	NEW BRAUNFELS	TX.	78130

3) Type of Work ☑ New Well ☐ Deepening ☐ Reconditioning

Lat. | Long. | Grid # 68-14-8

4) Proposed Use (check) ☐ Monitor ☐ Environmental Soil Boring ☑ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) N↑

6) Drilling Date
Started 12/28/00
Completed 1/23/01

Diameter of Hole

Dia.(in)	From (ft)	To (ft)
8"	0	

7) Drilling Method (check) ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☑ Cable Tool ☐ Jetted ☐ Other

Formation Description

0-25	ORANGE, FRACTURE ROCK
25-135	LIMESTONE, WHITE
135-240	YELLOW
240-555	BLUE (WATER)

(Use reverse side of Well Owner's copy, If necessary)

8) Borehole Completion ☑ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☐ Other
If Gravel Packed give the interval from ft. to ft.

Casing, Blank Pipe, and Well Screen Data

Dia. (in.)	New Or Used	Steel, Plastic, etc. Perf., Slotted, etc Screen Mfr., if commercial	Setting (ft) From	To	Gage Casing Screen
5"	N	PVC SCH#40	0		

9) Cementing Data
Cementing from 220 ft. to 0 ft. # of sacks used 21
ft. to ft. # of sacks used
Method Used MIXER, ELECTRIC & PUMP
Cementing By S.L. VOGES
Distance to septic system field or other concentrated contamination ft.
Method of verification of above distance

13) Plugged ☐ Well plugged within 48 hours

Casing left in well: From (ft)	To (ft)	Cement/Bentonite placed in well: From (ft)	To (ft)	Sacks used

10) Surface Completion
☐ Specified Surface Slab Installed
☑ Specified Surface Sleeve Installed
☐ Pitless Adapter Used
☐ Approved Alternative Procedure Used

14) Type Pump ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other N/A
Depth to pump bowls, cylinder, jet etc., ft.

11) Water Level
Static level 230 ft. below Date 1/23/01
Artesian Flow gpm. Date / /

15) Water Test
Type test ☐ Pump ☑ Bailer ☐ Jetted ☐ Estimated
Yield: 10 gpm with 325 ft. drawdown after 1/2 hrs.

12) Packers

	Type	Depth
2	SCREEN	220 + 215

16) Water Quality
Did you knowingly penetrate any strata which contain undesirable constituents.
☐ YES ☑ NO If yes, did you submit a REPORT OF UNDESIRABLE WATER
Type of water GOOD Depth of Strata GLEN ROSE
Was a chemical analysis made ☐ Yes ☑ No

Company or individual's Name (type or print) S. L. VOGES CONST.
Address 128 VOGES City NEW BRAUNFELS State TX Zip 78132
Signature [signature] 2-20-01 Licensed Driller/Pump Installer Date | Signature [signature] 1/10/01 Apprentice Date

TDLR FORM a001WWD White - TDLR Yellow - Owner Pink - Driller/Pump Installer

CHARLES R. KUTSCHER FEB 26 2001 STATON L. VOGES
WPKL 1861 WWDAPP 799