Barton Springs Edwards Aquifer
CONSERVATION DISTRICT

October 11, 2017

Via certified mail and email

Wet Rock Groundwater Services, LLC
317 Ranch Rd 620 South, Suite 203
Austin, TX 78734

RE: Administrative Completeness Review of a Production Permit Application submitted by Electro Purification LLC, for authorization to produce groundwater from the Middle Trinity Aquifer.

Dear Mr. Kaveh Khorzad:

This letter is to inform you that as of **October 11, 2017**, the first 90-day period for the administrative completeness review of the above-referenced application received on July 13, 2017 expired with the application remaining administratively incomplete. In accordance with District Rule 3-1.6(B), this letter serves to notify Electro Purification, LLC of the deficient information and documentation (specified below) and that the applicant is granted a 90-day extension to allow further time for submittal of the deficient information and for processing and administrative completeness review. **With the extension, the application will not be due to expire until January 9, 2018.**

District staff has reviewed the Production Permit application submitted by Electro Purification LLC. On the basis of this review, the District has determined that the following items have not been satisfied:

- ☐ **3-1.4(A)(8)(c) – Pumpage Volume. Provide a detailed statement describing:**
  (i). The estimated pumping rate at which water will be withdrawn from each well.
  The applicant has submitted information relating to the proposed pumping rate at which water will be withdrawn from each well. The submitted information in Table 2, page 9 of the descriptive statement reflects three (3) existing wells and two (2) non-existent wells. The proposed two (2) non-existent wells are nearly 1-mile outside of the tested well transect and area of influence and therefore, the estimated yields assigned to those wells are speculative. Furthermore, those two wells have not yet been constructed nor tested thus the potential impacts of any future pumping wells located outside of the tested well transect and area of influence are speculative. To address this application requirement, please modify Table 2 of the descriptive statement to <u>only</u> reflect the estimated pumping rates for the three (3) constructed and tested wells.

- ☐ **3-1.4(A)(8)(c) – Pumpage Volume. Provide a detailed statement describing:**
  (i). The requested permit pumpage volume; a description of how the requested pumpage volume was determined. The applicant shall provide pumpage volume

calculations based on the type of use, anticipated pumping capabilities, pumping times, pumping frequency, and other pertinent data to substantiate approximate groundwater production. The requested pumpage volume should demonstrate reasonable nonspeculative demand.

The applicant has submitted information relating to the pumping rate at which water will be withdrawn from each well, as well as information related to the customer contract with Goforth SUD. However, the applicant has not provided adequate information to support the volume request nor is there any information relating to the reasonable and nonspeculative demonstration for that demand.

To address the application requirement for demonstrating a beneficial use, based on a fair and reasonable assessment of actual demand, the applicant shall provide additional details and data demonstrating the projected demands of contracted individual customers Submitted information may include data from contracted individual customers such as reported deliveries, reported groundwater pumping, and projected demands from the 2016 regional water plan. Other examples of relevant data and information include:

- Customer's use (per capita consumption)and projected needs;
- Potential curtailments of source supplies;
- Available firm yield and interruptible supplies;
- Growth and demand projections reflected in TWDB Regional Water Plan;
- Population projections;
- Additional water sources (current and projected).

☐ **3-1.4(A)(8)(d) – Demand Trends. Provide a detailed statement describing: a detailed statement describing:**

(i). A projected annual volume breakdown by type of use (e.g. PWS, commercial, irrigation, industrial).

(ii). A projected quarterly timeline detailing the anticipated pumpage volumes for the first three to five years of pumping.

(iii). An explanation of future demands and long term system growth.

(iv). For public water suppliers, provide an estimated or calculated per capita and/or household consumption.

The applicant has not submitted any information or descriptive statements relating to demand trends. Please provide a complete and descriptive statement for the above four sections.

☐ **3-1.4(A)(8)(l)(i) – A notice list of registered well owners within a half mile radius.**

District staff is currently reviewing the data you submitted and the data that you were previously provided. Staff wants to assure that all known well registrations have been captured in the application materials. Staff will provide the applicant with any updated well registration to allow for preparation of certified mailings.

☐ **3-1.4(D)(2) - The Aquifer Test and Hydrogeologic Report must be prepared by a Texas licensed professional geoscientist or engineer pursuant to the District's guidance document, *Guidelines for Hydrogeologic Reports and Aquifer Testing (Guidelines).***

3-1.4(D)(4) - Hydrogeological Report. The report must include hydrogeologic information as specified in the Guidelines and shall provide findings and conclusions addressing the response of an aquifer to pumping over time and the potential for causing unreasonable impacts.

District staff has completed an initial review of the submitted Hydrogeological Report and has determined that the report is incomplete as it does not completely satisfy report requirements referenced by rule and described in the District's Guideline. Enclosure - 1 of this correspondence letter, describes the deficiencies and unmet standards as set forth in the Guidelines. The District requests that the applicant submit an amended Hydrogeological Report with additional supporting information that addresses all four (4) sections of deficiencies and needed responses outlined in Enclosure-1.

Please provide the above requested information within **30 days** of the date of this letter. If you have any further questions or need clarification regarding the requested information, please feel free to contact my office by phone at 512/282-8441.

Sincerely,

John T. Dupnik, P.G.
General Manager

Enclosure: "Enclosure-1"

cc:

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ENCLOSURE -1

Review of Hydrogeologic Report of the Electro Purification, LLC Cow Creek Well Field: Hays County, Texas
with
Attachment A –Technical Memo 2017-1010

Barton Springs
Edwards Aquifer
CONSERVATION DISTRICT

Review of Hydrogeologic Report of the Electro Purification, LLC Cow Creek Well Field: Hays County, Texas

BSEACD Aquifer Science
October 11, 2017

Overview

District rules (3-1.4) require that a hydrogeologic report be prepared as part of the application process for production of greater than 2 million gallons per year (BSEACD, 2016a). Specifically rule 3-1.4.D.4 relating to Hydrogeologic Reports and Aquifer Tests states:

> *"The report must include hydrogeologic information as specified in the Guidelines and shall provide findings and conclusions addressing the response of an aquifer to pumping over time and the potential for causing unreasonable impacts."*

The BSEACD Aquifer Science (AS) team has reviewed the hydrogeologic report (dated July 11, 2017) submitted on behalf of Electro Purification (EP) in support of an application for pumping 2.5 million gallons per day (MGD) from a well field near the Rolling Oaks Subdivision of Hays County. The report was authored by Wet Rock Groundwater Services, LLC (WRGS, 2017). The intent of this review is to determine if the submitted hydrogeologic report satisfies the purpose, report requirements, and standards described in the District's rules and the District guidance document, *Guidelines for Aquifer Tests and Hydrogeologic Reports* (BSEACD, 2016b). Pursuant to District Rule (3-1.4.D.7), applications may be deemed administratively incomplete due to reports that do not meet the District's minimum standards or significantly deviate from the guideline.

For large or potentially impactful permit requests review of the applicant's hydrogeologic report involves an assessment of the aquifer test data and hydrogeologic setting, aquifer parameters, and potential for unreasonable impacts from the proposed pumping. AS staff have provided an evaluation the aquifer test data and hydrogeology setting in Technical Memo 2017-1010 (Attachment A). This letter summarizes an initial review of the WRGS hydrogeologic report for determination of administrative completeness.

Based upon the review of the aquifer test data summarized in Technical Memo 2017-1010 (Attachment A) we find that the WRGS hydrogeologic report (July 11, 2017) in support of the 2.5 MGD is administratively incomplete. The report does not meet the minimum standards outlined in the District's hydrogeologic guidelines (BSEACD, 2016b). Specifically, the report (1) does not present an adequate conceptual aquifer model based on the test data (BSEACD, 2016b; page 7, III-C), (2) does not adequately evaluate observation well data and examine the potential for unreasonable impacts of the proposed pumping project (BSEACD, 2016b; page 9, Section F), (3) includes non-existent production wells in the evaluation, and (4) includes a variety of data omissions. A revised hydrogeologic report that specifically addresses the deficiencies outlined below is required for further consideration of the permit application.

Deficiencies

1) ***Rule 3-1.4.D.2, Guidelines Section III-C, Hydrogeology and Conceptual Model.*** *The submitted report describes a conceptual model that is not supported by data relating to source water to the EP wells.*

   A conceptual model provides the context for evaluations of aquifer test results and the potential for unreasonable impacts. The data from the EP aquifer test indicate a compartmentalized aquifer system within the Cow Creek (Technical Memo 2017-1010). Accordingly, most of the water pumped from the EP wells will be derived from storage in the Cow Creek formation. However, the WRGS report suggests a source of water to the EP wells as occurring from capture (inducing recharge, or reducing springflows) in a relatively short period of time, such that impacts from drawdown during pumping would be minimal. At the same time WRGS describes an aquifer that is isolated by faults from its recharge zone and therefore to have "likely no effect" to springs such as Jacob's Well Spring (JWS) or Pleasant Valley Springs (PVS). It is not possible to have an aquifer system isolated by faults from the springs yet have a strong connection to the recharge zone.

   Previous studies indicate a regional hydrologic connection from the recharge zone into portions of the deeply confined zone of the Middle Trinity. For example, overall responses in water levels (pressure pulses) to rain events generally correlate from the JWS area to deeply confined wells near Buda. Furthermore, potentiometric surfaces and freshwater (low TDS values) indicate groundwater flow from the west associated with relay ramps across fault zones (Hunt et al., 2015). In contrast, data from the aquifer test provide direct evidence of at least partial barriers to flow in the EP project area that are likely associated with faults (e.g. the lack of recovery in Odell 2, Lowe, Ochoa, Woods wells; Technical Memo 2017-1010). Furthermore isotopes of hydrogen (^{3}H, tritium) and carbon (^{14}C) suggest very old water in the EP area. While a hydrogeologic connection exists from the deeply confined Middle Trinity Aquifer to its recharge zone west of JWS, the data indicate slow groundwater velocities and relatively low permeabilities. Thus, it could be many years before pumping at EP would capture groundwater that would otherwise discharge from JWS or PVS.

   The WRGS report describes the Cow Creek (target production zone) as being hydrologically isolated ("no connection") from overlying hydrogeologic units by citing the response in Odell #1 as supporting evidence. AS staff evaluation of the data reveal a hydrologic connection to the overlying units that was not evaluated by the WRGS report. While the majority of water is derived from the Cow Creek, there is in fact a hydrologic response in wells close to the pumping center that are completed in the Upper and Lower Glen Rose (Technical Memo 2017-1010).

   In summary, data from the aquifer test evaluated in Technical Memo 2017-1010 is interpreted by AS staff as a leaky compartmentalized aquifer system. The data suggests that the majority of water for the EP wells will be derived from storage in the Cow Creek, with a lesser amount from the overlying formations, over the short term (years), with the effects of capture of recharge and springflow discharge occurring over much longer periods of time. Thus, the aquifer test data does not support the conceptual model described by WRGS.

To satisfy this application requirement and address the apparent contradiction, please provide a response to the following items:

a) Please address the source of water for the proposed EP wells over both short-term (years) and long-term (decadal) time frames and provide citations and data to support your response.

b) Please address the apparent contradiction in the WRGS conceptual model of the aquifer system as compared to the AS staff's above-described interpretation of the aquifer system including citations and supporting data from the aquifer test.

2) ***Rule 3-1.4.D1&4, Guidelines Section III-F.*** *This requires that the hydrogeologic report provide findings and conclusions addressing the response of the target aquifer to pumping over time and the potential to cause unreasonable impacts. The submitted report, however, does not adequately evaluate potential unreasonable impacts.*

The BSEACD Aquifer Test Guidelines (BSEACD 2016b; page 8, Section III-D) require a discussion of the aquifer test results including annotated hydrographs for all of the data for each well. The WRGS report omits hydrographs and discussion of much of the observation well data. The evaluation of the omitted observation well data are critical to the evaluation of the aquifer test and any potential unreasonable impacts. The guidelines also require discussion of drawdown, lack of recovery (boundary effects), and the compounding effects of drought and well interference (BSEACD, 2016b; page 9, Section III-F). The WRG report, however, only provides qualitative statements attempting to address the potential for unreasonable impacts. Some of those qualitative statements from the WRGS Report are included as quotes below followed by the District's response:

a. *WRGS Report: "...some drawdown will be seen in neighboring wells completed within the Cow Creek Limestone."*

District Response: Cumulative drawdown in Cow Creek observation wells from the test is on the order of 200 ft.

b. *WRGS Report: "There was no connection observed between the pumping wells and observation wells completed in the Upper Glen Rose formation"*

District Response: There is a hydrologic response in water levels in wells close to the pumping center that are completed in the in Upper and Lower Glen Rose.

c. *WRGS Report: "...no significant recharge or discharge boundaries experienced."*

District Response: The very slow recovery of Odell 2, Ochoa, and Lowe Cow Creek observation wells indicate a no-flow boundary.

d. *WRGS Report: "The heterogeneity, anisotropy, and non-perfect elasticity characteristics of the Middle Trinity Aquifer explain the delayed recovery rates post pumping phase of the aquifer test."*

District Response: No discussion is given as to how heterogeneity and anisotropy explain the slow or delayed recovery. In addition no definition or discussion is devoted to "non-perfect elasticity." A no-flow boundary is a more logical reason for the slow recovery.

e. *WRGS Report: "Based upon EP's anticipated phased-in pumping schedule for delivery to the Goforth SUD, actual impacts on the aquifer and neighboring wells will be able to be observed based upon actual pumping and appropriate measures taken, if needed, in a timely manner without the threat of unreasonable impacts occurring."*

   District Response: The potential for unreasonable impacts has not been adequately evaluated in a quantitative manner in this report to support this conclusion.

An adequate quantitative evaluation of potential unreasonable impact will involve the assessment of measured drawdown and modeled projected drawdown among other data. Prior to any modeling projections, an assessment of the sum of the measured drawdown from the three pumping wells on the observation wells and further adjusted for known drought fluctuations may provide an initial indicator of the potential for unreasonable impacts. This type of analysis, however, was not performed or described in the WRGS report.

To satisfy this application requirement, please provide a response to the following items:

a) Provide quantitative data and evidence in support for the WRGS report statements (a-e). When invoking concepts such as listed in statement (d), please provide discussion and citations as to how those concepts explain the observation.

b) Starting with the observation wells, provide a systematic, quantitative evaluation of the potential for unreasonable impacts from the proposed pumping that considers the conceptual model, observed cumulative drawdown, modeled drawdown, well construction (including pump setting), drought, and other factors.

3) ***Rule 3-1.4.D4** – This requires that the hydrogeologic report provide findings and conclusions addressing the response of the target aquifer to pumping over time and the potential to cause unreasonable impacts. The submitted report includes two non-existent wells outside the tested well transect (called Bridges No. 5 and 6).*

The two non-existent wells that are about 1 mile south of the tested well field transect. The aquifer parameters, yields, and drawdown assigned to the wells are speculative and, therefore, may not be representative or adequately serve as the basis of an evaluation of unreasonable impacts that may be attributed to these non-existent wells located at the southern boundary of the Bridges property.

To satisfy this application requirement, please remove all reference and any evaluation considering these two non-existent wells outside the tested well field transect.

4) ***Rule 3-1.4.D4** – This requires that the hydrogeologic report provides findings and conclusions addressing the response of the target aquifer to pumping over time and the potential to cause*

unreasonable impacts. The report includes secondary deficiencies that need to be addressed to adequately evaluate the potential for unreasonable impacts.

To satisfy this requirement, please provide a response to following items that should be corrected or addressed in any future hydrogeologic report.

a) Lack of manual measurements by WRGS for EP observation wells. These are important to verify the performance of the transducer. The appendix should have an abbreviated table of water-level data, or electronic copies submitted.

b) Lack of non-EP observation well hydrographs. Evaluation of the all the observation data is needed in the report. This is especially true to substantiate claims of no response to Upper and Lower Glen Rose wells. AS staff review of the data reveal response within Upper and Lower Glen Rose wells. Observation well data were provided via email to WRGS on 2/21/2017.

c) Appendix B does not contain the available well completion data from surrounding monitor wells. The lack of well completion for non-EP observation wells (which was provided to WRGS on 2/7/2017) is important to the evaluation of potential unreasonable impacts.

d) Figure 13 is not an accurate geologic base map. The best map is the Collins 2002. https://repositories.lib.utexas.edu/handle/2152/30310. This has implications for the location of faults affecting drawdown and recovery.

e) Figures 15 and 41 have the wrong sense of motion on the fault.

f) Some hydrographs in Figure 17 are not directly comparable to the study area. The DSWSC well is within the recharge zone of the Middle Trinity aquifer (recharge occurs along portions of adjacent Onion Creek).

g) Although the transducer was installed in the Escondita observation after the Bridges #1 test had started pumping, the recovery data at the Escondita well from the Bridges No 1 test was a minimum of 85 ft.

h) The rate of change of drawdown from the pumping wells was not zero as Figures 27, 30, and 33 suggest. An AS staff calculation indicates that the Bridges #1 continued to decline at a rate of about 0.15 ft/hr over the last half day of pumping.

i) Estimates of aquifer parameters for all observation wells need to be included in the evaluation, or provide justification why parameters were not provided for a given well. For example data from the Bowman well was not analyzed yet there are sufficient data for inclusion in the analyses. This is also true of the Escondito well for the Bridges #1 test.

j) The methods and parameters selected to model future drawdown appear to underestimate actual drawdown, thus calling into question the accuracy of the parameters selected.

    - Provide discussion of the parameters selected for the distance-drawdown estimates (Figures 35, 36, and 39) and how the drawdown curves compare to the measured data. Some of the observed drawdown should plot near the 1-week curves, indicating the accuracy of the selected parameters.

- Discuss the estimated 7-year drawdown map (Figure 42) in relation to the cumulative measured drawdown in the observation wells from the three tests. Cumulative measured drawdown in the Woods 01 well is about 200 ft, while Figure 42 estimates drawdown at Woods 01 well at 239 ft after 7 years.

Conclusions

The aquifer-test data collected by WRGS, BSEACD, and EAA are of high quality. A lot was learned about the aquifers from this aquifer test. AS staff assessment of the aquifer test data and hydrogeologic setting is described in Technical Memo 2017-1010. This type of evaluation is the foundation for any subsequent estimation of aquifer parameters and potential for unreasonable impacts. This is the type of evaluation of the data required from a hydrogeologic report and described in the District's guidelines (BSEACD, 2016b).

The evaluation of the aquifer test data in the WRGS report is insufficient per District aquifer test guidelines and rules (BSEACD, 2016a and 2016b). The report omits key observation data and makes unsubstantiated qualitative statements about the potential for unreasonable impacts. A revised hydrogeologic report that addresses the deficiencies outlined in this letter must be submitted in the next 30 days.

References

BSEACD, 2016a, Rules and Bylaws, Barton Springs Edwards Aquifer Conservation District, 159 p., Effective date: April 28, 2016. < http://bseacd.org/uploads/081816FINAL-BSEACD-Rule_MASTER.pdf>

BSEACD, 2016b, Guidelines for Hydrogeologic Reports and Aquifer Testing, Barton Springs Edwards Aquifer Conservation District, adopted May 12, 2016, 16 p.

Hunt, B.B., B.A. Smith, A. Andrews, D.A. Wierman, A.S. Broun, and M.O. Gary, 2015, Relay ramp structures and their influence on groundwater flow in the Edwards and Trinity Aquifers, Hays and Travis Counties, Central Texas, Sinkhole Conference, October 5-10, 2015, Rochester, Minnesota

Wet Rock Geological Serivces (WRGS), 2017, Hydrogeologic Report of the Electro Purification, LLC Cow Creek Well Field: Hays County, Texas. Report of Findings WRGS 17-001, 80 p + appendices

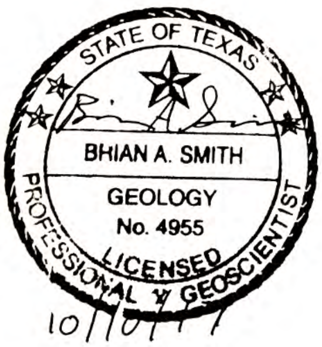
Attachment A

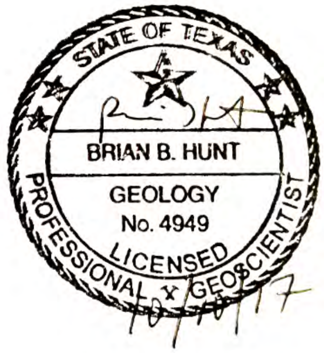
BSEACD Technical Memo 2017-1010

Barton Springs Edwards Aquifer CONSERVATION DISTRICT

Technical Memo 2017-1010
October 2017

Hydrogeologic Setting and Data Evaluation: 2016 Electro Purification Aquifer Test, Cow Creek Well Field: Hays County, Texas





BSEACD Aquifer Science

Introduction

An application for a production permit to authorize production of 2.5 million gallons per day (MGD) of groundwater from the Middle Trinity Aquifer was submitted by Electro Purification (EP) on July 13, 2017. In accordance with District Rules, such large-scale production permit applications must include a hydrogeological report that provides findings and conclusions addressing the response of an aquifer to pumping over time and the potential for "unreasonable impacts" as defined by District rules. A hydrogeologic report prepared by Wet Rock Geological Services (WRGS) was submitted in support of the application. A significant portion of the report documents an aquifer test also conducted by WRGS on behalf of Electro Purification. Aquifer testing and data collection occurred from the period of October 2016 through February 2017. The aquifer test results are critical to the evaluation for the potential for unreasonable impacts for the permit request.

For large or potentially impactful permit requests, AS staff have a three-part review process of the aquifer test data and information provided in the hydrogeologic report. Each evaluation is the foundation for the subsequent evaluation. The review process includes: evaluation of the aquifer test data and hydrogeologic setting, estimation of aquifer parameters, and assessment of the potential for unreasonable impact from the proposed pumping.

The purpose of this technical memo is to thoroughly evaluate the aquifer test data and hydrogeologic setting and will be used to review the completeness of the applicant's hydrogeologic report. The purpose is also to identify any trends, hydrologic boundaries, or other factors that are needed for future evaluations including analytical modeling and the potential for the proposed production to cause unreasonable impacts to wells, springs and other water resources.

Study Area

The study area is generally in **Figure 1** that contains a map of the key wells mentioned in this memo. **Table 1** is a summary of the observation wells and pumping wells involved in the aquifer test. **Appendix A** contains well completion diagrams for most of the wells.

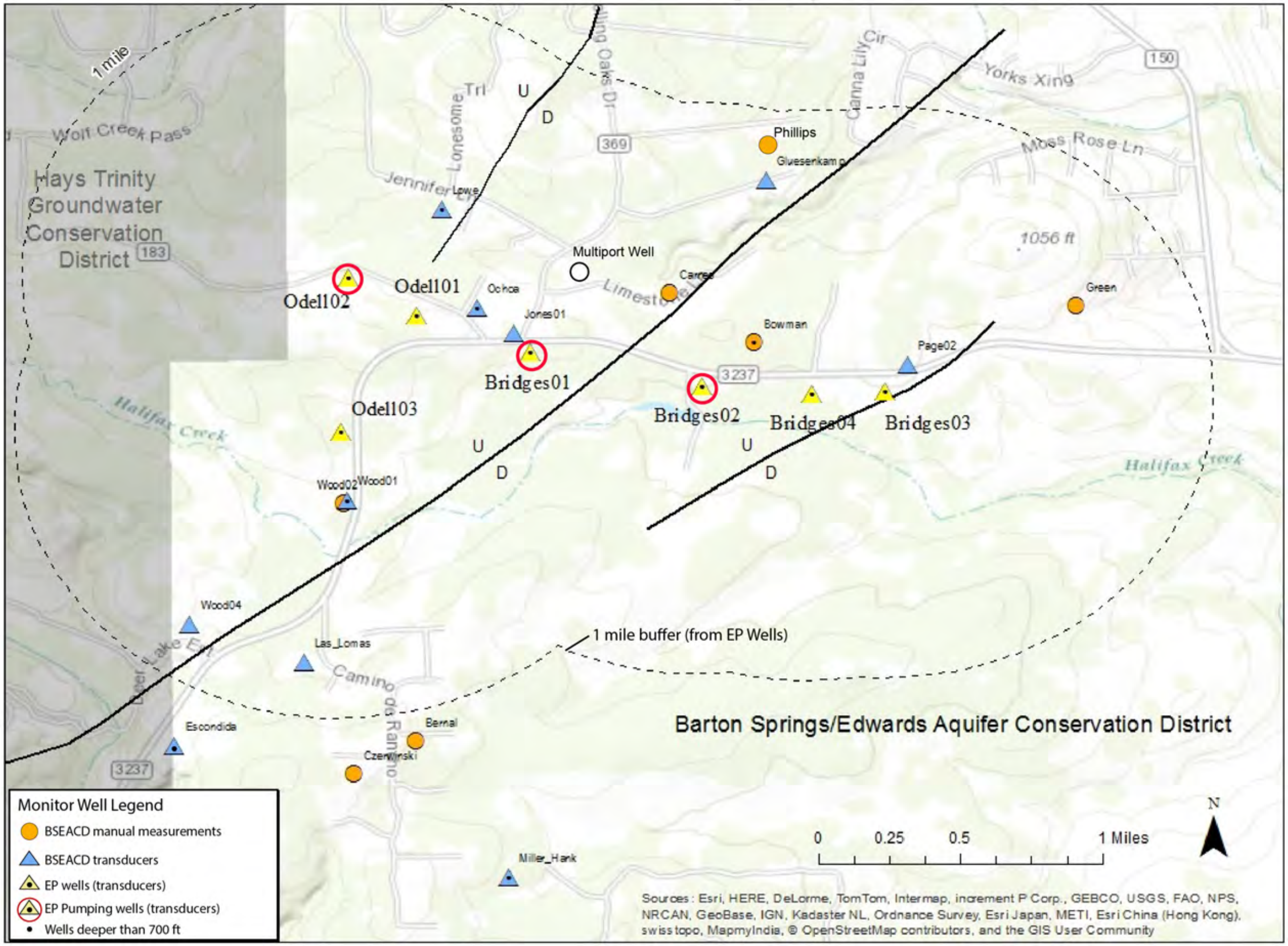


Figure 1 Study Area. *Map of pumping (red circles) and observation wells. Dark lines are faults mapped from Collins, 2002.*

Table 1. Summary Well Information

Well Name	*Type*	*Primary Aquifer*	*Easting*	*Northing*	*LSD (ft-msl)*	*Depth (ft)*	*TWDB ID*	*TDLR*	*Pump Depth (ft)*
*Odell #2**	Test	Cow Creek	-98.033266	30.051297	1097	850		388364	
*Bridges #1**	Test	Cow Creek	-98.023799	30.047528	1045	930		364899	
*Bridges #2**	Test	Cow Creek	-98.015065	30.045915	1005	905		36490	
Bridges #3	Test	Middle Trinity (Cow Creek)	-98.005508	30.045698	1004	940		353110	
Bridges #4	Test	Middle Trinity (Cow Creek)	-98.009159	30.045586	990	905		388352	
Odell #3	Test	Middle Trinity (Cow Creek)	-98.033288	30.043467	1068	845		388365	
Multiport	Monitor	Middle and Upper Trinity	-98.022097	30.050799	1041	857	5764613		n/a
Lowe	Domestic	Middle Trinity (Cow Creek)	-98.028147	30.054813	1070	860	5764607	394760	760
Ochoa	Domestic	Middle Trinity (Cow Creek)	-98.026624	30.049818	1073	810	5764605		660
Bowman	Domestic	Middle Trinity (Cow Creek)	-98.012465	30.048084	1035	850	5764604	353577	
Wood01	Domestic	Middle Trinity (Cow Creek)	-98.033235	30.039939	1067	790	5764907	233129	500
Escondida 1	Domestic	Middle Trinity (Cow Creek)	-98.040862	30.028895	1104	930		435981	
Bernal	Domestic	Middle Trinity (Cow Creek)	-98.029591	30.027753	1118	915		198272	700
Miller_Hank	Domestic	Middle Trinity (Cow Creek)	-98.024938	30.020883	1066	900	5764908	153626	
Carnes	Domestic	Middle Trinity	-98.016605	30.050539	1028	520			
Green	Domestic	Middle Trinity	-97.995917	30.04993653	1000	483			460
Odell #1	Test	Middle Trinity (Lower Glen Rose)	-98.029498	30.049374	1096	745		388355	
Wood04 (Deer Barn)	Domestic	Middle Trinity	-98.041058	30.033718	1081	630	5764818	77215	500
Czerwienski	Domestic	Middle Trinity	-98.032688	30.026099	1134	700			660
Philllips	Domestic	Upper Trinity	-98.011297	30.057077	1010	250e			
Gluesenkamp	Domestic	Upper Trinity	-98.011238	30.055873	1007	195	5764606		
Las_Lomas	Irrigation	Upper Trinity	-98.03517192	30.0317832	1070	225			
Page	Stock	Upper Trinity	-98.004464	30.046928	1007	430			
Jones01	Unused	Upper Trinity	-98.024335	30.048287	1049	350			n/a
Wood02	Unused	Upper Trinity	-98.0331812	30.039906	1065	98e			n/a

e=estimate; *Wells pumped for aquifer test.

Background data and trends

Springflow, water level, and weather data were reviewed to evaluate background trends during the aquifer testing. One weather station is located immediately east of the study area (Halifax Ranch), and another weather station is located west in the recharge zone of the Middle Trinity aquifer along the Blanco River (DiLeo Ranch). The data were obtained from the Edwards Aquifer Authority (**Table 2 and Figure 2**; EAA, 2017). Blanco River stream flows and Jacob's Well springflow data were obtained from the USGS (**Table 1 and Figure 2**; USGS, 2017a and USGS, 2017b).

Background hydrologic conditions during the aquifer testing were relatively high. Rainfall totals for the 6-month period, which include the period of aquifer testing, were wetter-than-normal. **Figures 2a and 2b** illustrates the rainfall and corresponding stream and springflows responses. A Middle Trinity well (57-67-705; WSC #1) located near Wimberley and not in the study area of the aquifer testing provides background trend data (**Figures 2a and 2b;** TWDB, 2017). Water levels in this well represent aquifer and recharge conditions for the updip region of the aquifer being tested. Water levels in this well were generally rising over the 6-month period at a rate of about 0.12 ft/d. Depth to water ranged from 132 to 105 ft with an average depth of 116 ft during this period, which represents levels higher (elevation) than the median values for this site since 2005. In addition, **Figure 2a** contains the hydrograph from the Woods 01 (Cow Creek) observation well that is within the study area. Pre-aquifer test data in **Figure 2a** indicate water levels as relatively constant. **Figure 2c** is the period of record hydrograph for the Woods 01 observation well. The transducer was installed January 28, 2015 during the EP well testing of the Odell wells that occurred late January to early February 2015. The Woods well shows drawdown and recovery associated with that testing. There is about 50 ft of natural variability in water levels from mid-2015 to mid-2016 prior to the aquifer testing in late 2016. The Ochoa and Lowe observation wells also have a long period of record and show nearly identical trends as the Woods 01 over this time period.

In summary, most of the water-level trends were either rising during the Bridges #2 and Odell #2 testing, or relatively static during the Bridges #1 testing (**Figure 2**). Given these conditions, no background corrections are deemed critical to the evaluation of the aquifer test data. Where sustained drawdown occurs in the observation well data that can be correlated to the aquifer test, the cause is most likely drawdown due to EP pumping wells, unless otherwise noted. The hydrologic conditions make the effects of drawdown potentially more subdued, but also easier to identify aquifer test pumping responses with a high degree of confidence.

Barometric fluctuations can influence water-levels changes under certain conditions. During testing, water-level fluctuation due to barometric responses averaged about +/-0.2 ft per day (**Figures 2a and 2b**) and were very minor compared to the response to pumping. Thus, barometric effects were not a factor in the evaluation of the test data.

Table 2. *Summary of monthly weather and flow data. Aquifer testing occurred from October 2016 into January 2017.*

MONTH	RAINFALL TOTAL (IN) HALIFAX RANCH	MEAN FLOW BLANCO AT HALIFAX (CFS)[B]	MEAN FLOW JWS (CFS)[C]
AUG-16[A]	12.98	259	22.4
SEP-16	4.28	169	15.3
OCT-16	0.05	117	14.0
NOV-16	1.88	82	12.3
DEC-16	4.35	130	20.1
JAN-17	3.81	171	34.5
FEB-17[A]	0.03	160	28.1
TOTAL/AVG	***23.4***	***155.4***	***21.0***

A-partial month (two week period)
B-long-term average flow in the Blanco at Wimberley (USGS 08171000) is about 143 cfs
C-long-term average flow at JWS is about 13 cfs
D- normal rainfall totals for this period are 16.6 inches.

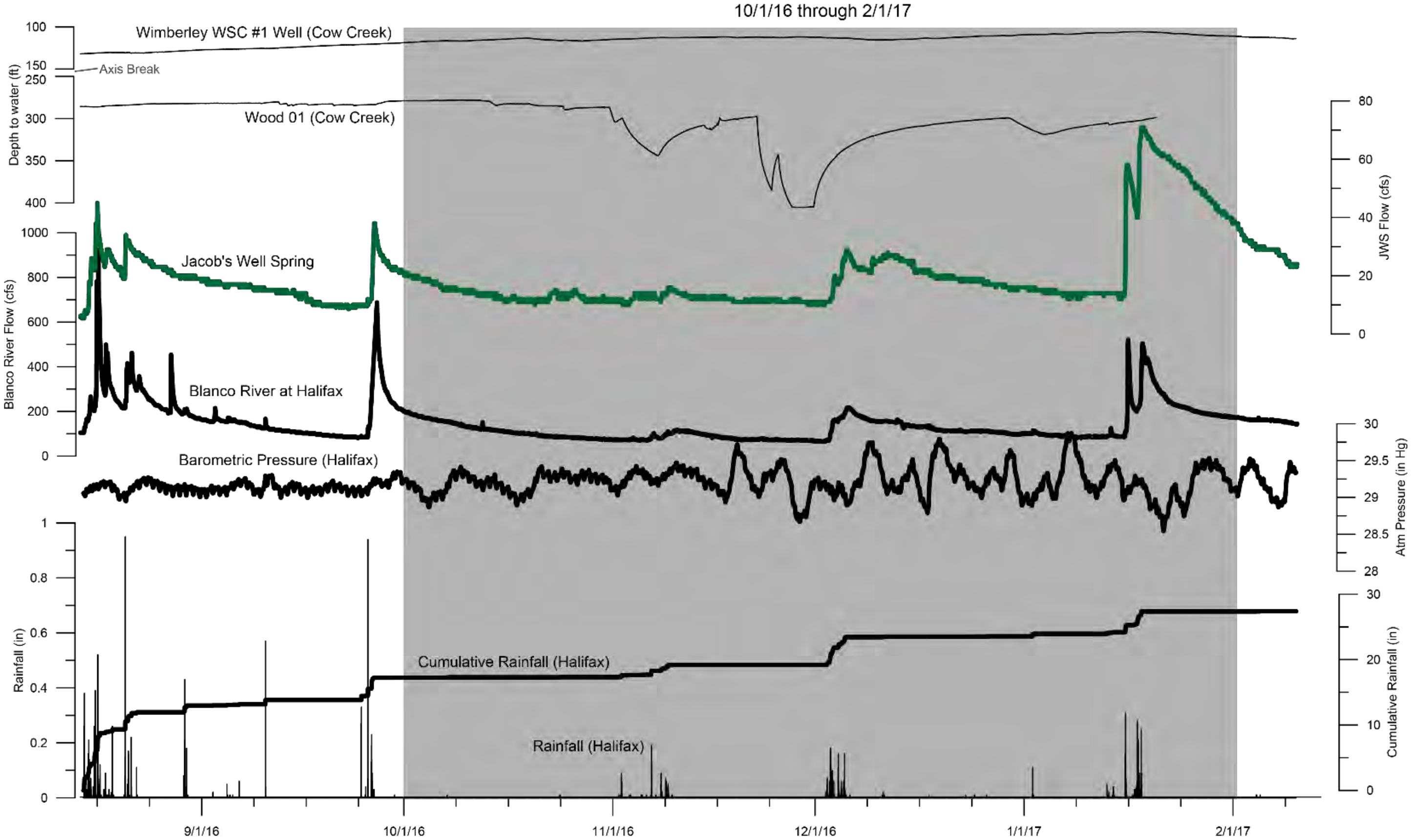


Figure 2a. Background Hydrologic Conditions August 2016 through February 2017. *Hydrograph showing rainfall, groundwater, surface water, springflow, and barometric trends during the aquifer test period.*

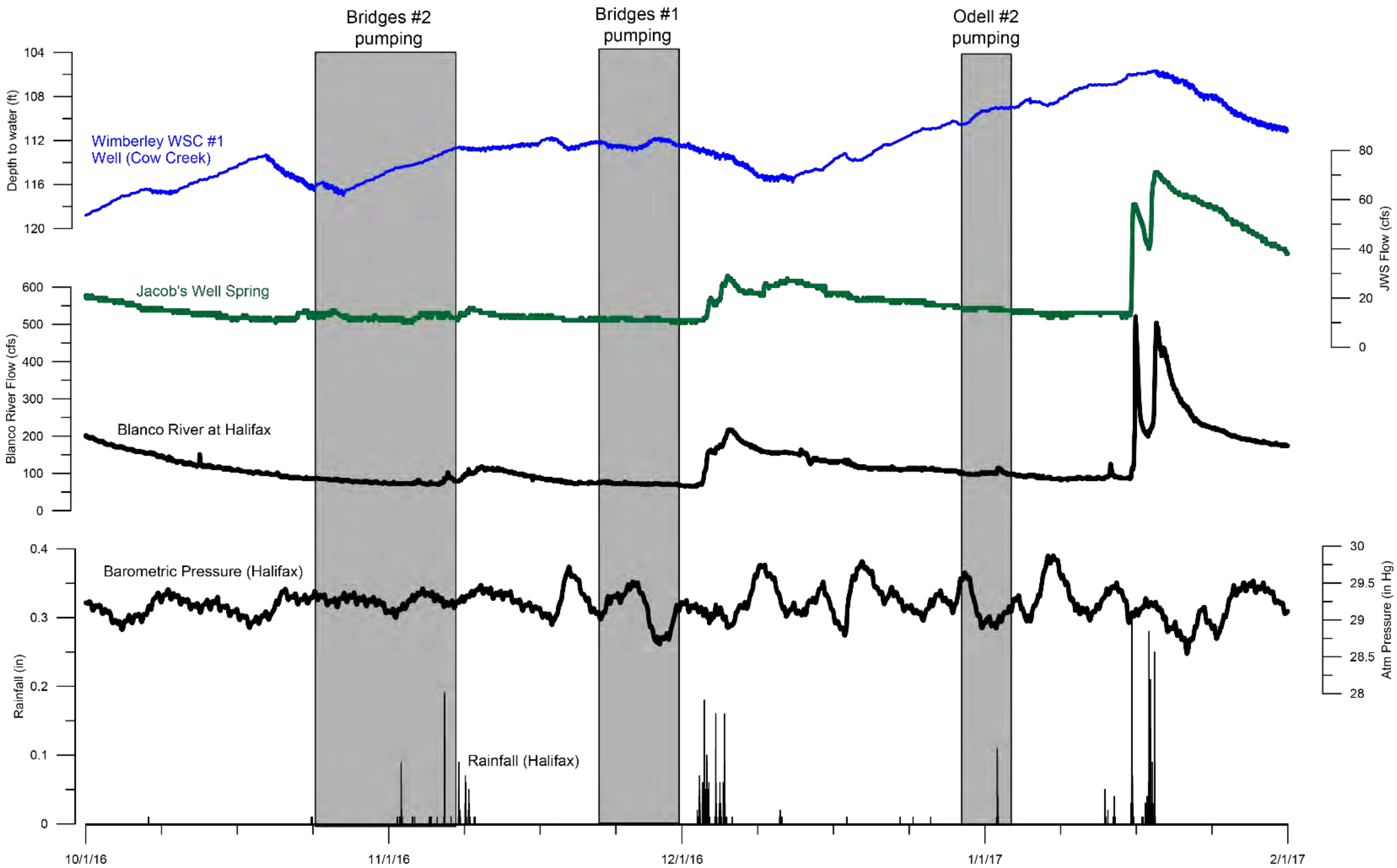


Figure 2b. Background Hydrologic Conditions. *Hydrograph showing rainfall, groundwater, surface water, springflow, and barometric trends during the aquifer test period.*

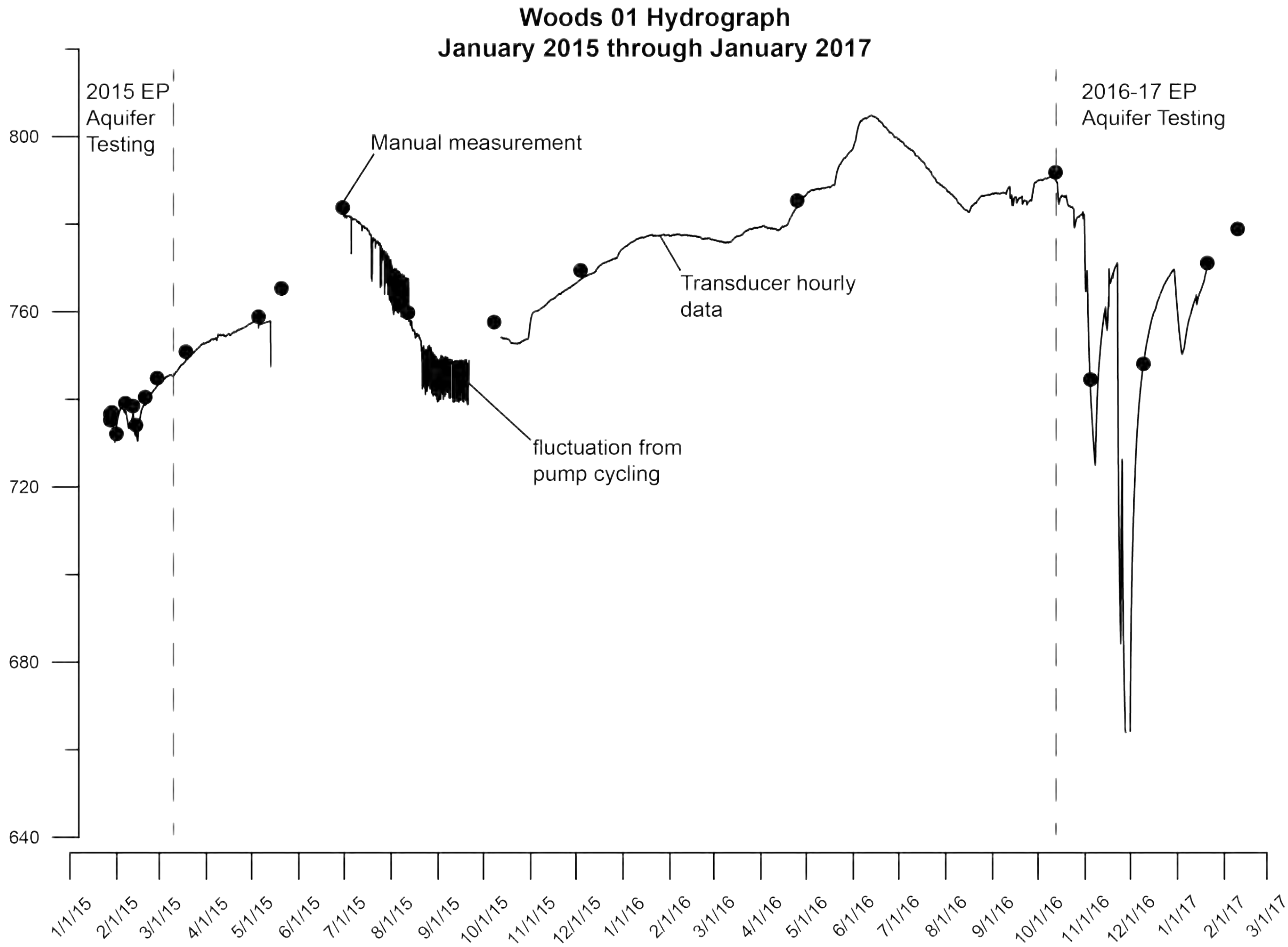


Figure 2c. Background Hydrograph from the Woods 01 (Cow Creek) Well. *Hydrograph showing the period of record for the Woods 01 well, which is the longest continuous period of record available in the vicinity of EP. The graph has periodic manual measurements in addition to the hourly transducer data. The Lowe and Ochoa wells have very similar data over this same period. All the monitor wells contain similar manual measurements to verify the accuracy of the transducer data.*

Aquifer Test Design and EP Pumping Wells

WRGS conducted an aquifer test in support of an application for a production permit equivalent to 2.5 million gallons per day (MGD) or 1,736 gallons per minute (gpm). In accordance with the District's rules and guidance document, *Guidelines for Hydrogeologic Reports and Aquifer Testing* (BSEACD, 2016), aquifer tests are designed to stress the aquifer system and require a pumping rate that is either three times the daily demand over 24 hours, or a maximum daily pumping rate for three days. Because the yield of the wells was unknown, and based on initial yields of the test wells in 2015, the aquifer test was designed to pump for 5 days. **Appendix B** contains the Work Plan for this aquifer test.

Pumping well activities for the three wells are summarized in **Table 3** and the pumping is shown in **Figure 3**. The shaded water levels will be used throughout this memo in the evaluation of water-level responses in the observation wells in subsequent figures.

During the aquifer tests, the pumping wells were equipped with a packer to isolate the Cow Creek from the overlying (Glen Rose) units. Transducers were placed above and below the packer, with the pump below the packer. Accordingly, two sets of water-level data are available from the three pumping wells (Bridges 1 & 2, Odell 2). Each pumping well have water-level data above ("upper zone") and below ("lower zone") the temporary inflatable packer. For example the Bridges #2 lower zone represents data collected below the packer in the Cow Creek formation (target production zone). The Bridges #2 upper zone represents water levels above the packer and Cow Creek and within in the Lower Glen Rose and Upper Glen Rose formations. After the pump test and recovery period were complete, the packer and transducers were moved to the next test well.

Water-level data labeled simply as Bridges #2 (no upper or lower modifier) was collected with no packer in the borehole and when other EP wells were pumping. All EP pumping and observation well data were collected by WRGS with pressure transducers rented from In-Situ instruments. Surface elevations were determined by WRGS using Google Earth.

Acidization

Prior to aquifer testing, WRGS acidized the pumping wells to increase the well yield. This was done on each of the three wells prior to inserting the packer and testing of the well. Cow Creek observation wells record changes in water levels from the effects of the brief pumping to fill frac tanks prior to acidication, and the subsequent injection of acid and water. The clearest example of the water-level response to the pumping and injection is shown in the hydrographs from the Lowe and Odell #3 wells (**Figure 4)**.

As expected, the acidization increased the total dissolved solids (TDS) in the water produced from the borehole of the pumping wells for a short period of time. Acidization increased the yield (more than doubling the specific capacity) on Bridges #1 and Odell #2 and had generally no clear effect on Bridges #2. A comparison of the specific capacity data of the three wells in 2015 and 2016 are shown in **Figure 5**.

Water samples were collected prior, during, and after the aquifer test period on some observation wells by the Edwards Aquifer Authority (EAA) and the District. Water chemistry results are presented in **Appendix C**. While changes in the chemistry were noted in the surrounding observation wells, it is not clearly associated with the acidization, but appears more directly influenced by pumping-induced flows (see section on water chemistry).

Aquifer Test

Table 3 summarizes the EP pumping activities. The pumping wells had several mechanical and electrical issues that caused the tests to be stopped and then restarted (**Table 3**). The pumping wells did not fully recover before restarting the test. Each test reached a consistent pumping rate and drawdown rate. Each of the pumping wells reached a linear drawdown trend, but did not reach equilibrium. Using the drawdown for the last 6 hours of each test, the drawdown rates were 0.04 ft/hr, 0.15 ft/hr, and 0.32 ft/hr, for Bridges #2, Bridges #1 and Odell #2, respectively (**Figure 6**).

Table 3. Summary of EP pumping well activities.

	Date Start	*Stop*	*Duration (hrs)*	*Average GPM*	*Max GPM*	*ref level (ft-msl)*	*Drawdown (ft)*	*% Recovery*	*Comment*
Bridges 2									

Table 3. Summary of EP pumping well activities.

	Date Start	Stop	Duration (hrs)	Average GPM	Max GPM	ref level (ft-msl)	Drawdown (ft)	% Recovery	Comment
Acid	10/20/2016								
Set Packer	10/21/2016								
Bridges 2-A	10/24/16 12:23	10/24/16 15:27	3.1	507	750	775	419		pump failure
Bridges 2-recovery	10/24/16 15:27	10/31/16 9:44	162.3			768		98%	
Bridges 2-B	10/31/16 9:44	11/1/16 3:23	17.6	395	600	775	401		generator failure
Bridges 2-B recovery	11/1/16 3:23	11/2/16 7:59	28.6			754		95%	
Bridges 2-C	11/2/16 7:59	11/7/16 15:01	127.0	304.74	620	775	409		reference initial level
Bridges 2 recovery	11/7/16 15:01	11/15/16 0:00	177.0			751		94%	recovery from initial level
Bridges 1									
Acid	11/16/2016								
Set Packer	11/17/2016								
Bridges 1-A	11/22/2016 9:02	11/24/2016 13:19	52.3	738	810	768	184		battery failure
Bridges 1-A recovery	11/24/2016 13:19	11/25/2016 13:11	23.9					75%	
Bridges 1-B	11/25/2016 13:11	11/30/2016 13:17	120.1	655	710	721	218		drawdown relative to initial reference level
Bridges 1 recovery	11/30/2016 13:17	12/8/2016 10:06	188.8			743		89%	recovery from initial level
Odell 2									
Acid	12/17/2016 12:00								
Set Packer	unknown								
Odell 2	12/29/2016 13:34	1/3/2017 14:48	121.2	565	620	787	157		some short duration power failures with pumping ceasing
Odell 2 recovery	1/3/2017 14:48					774		92%	

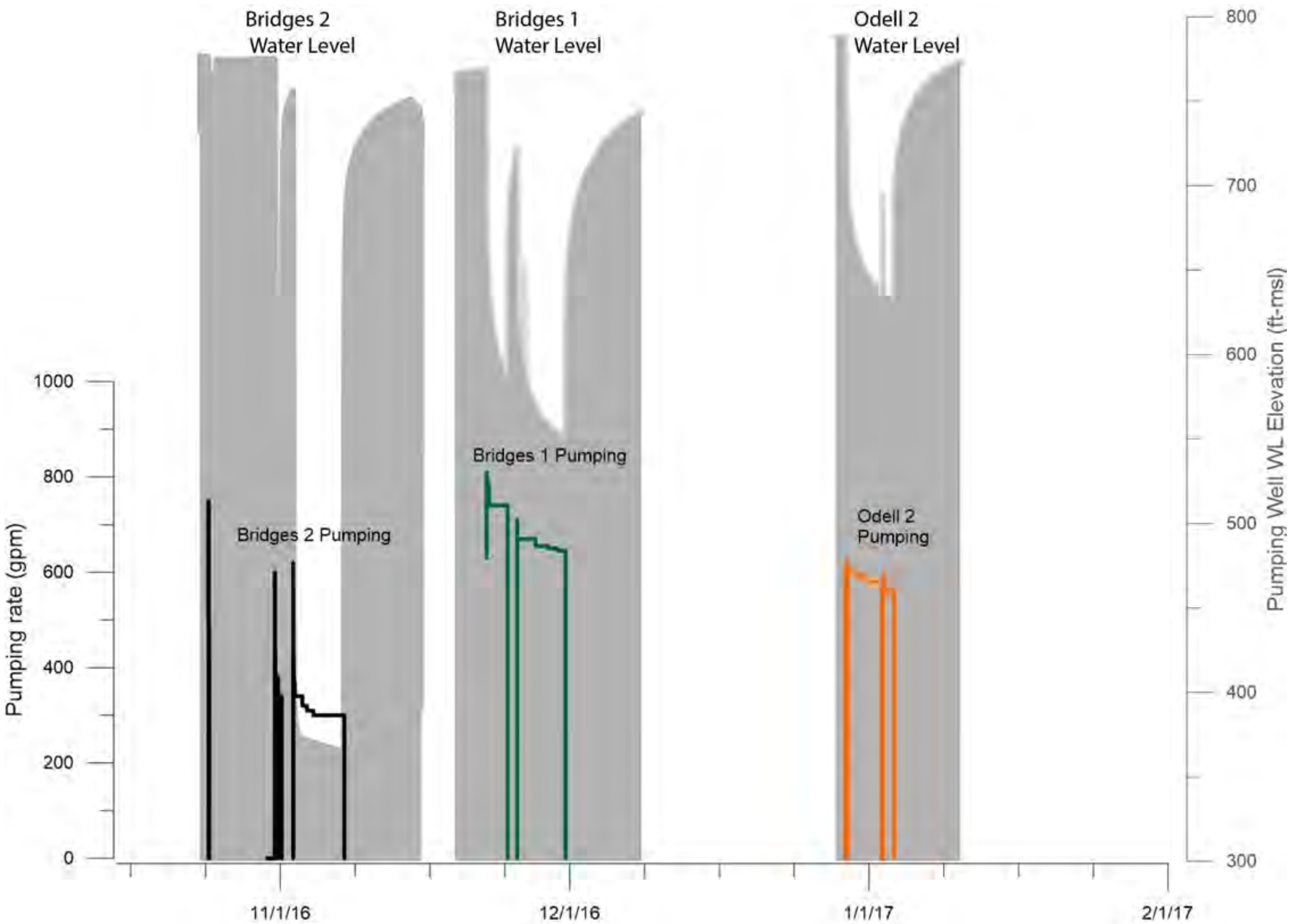


Figure 3. Pumping Well Summary. *Summary of pumping (gpm) and water-level response to pumping in the three pumping wells (Bridges 2, Bridges 1, and Odell 2).*

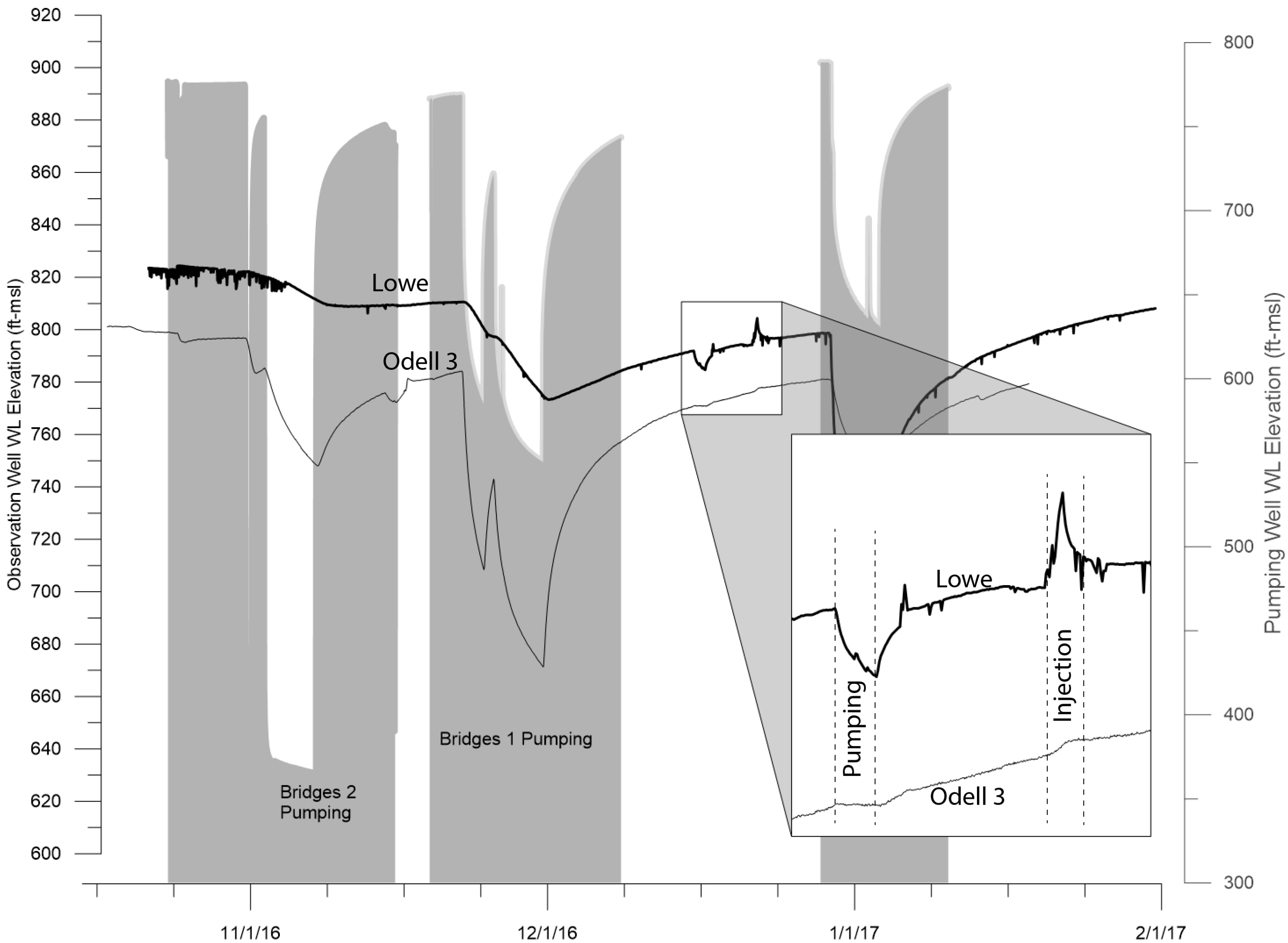


Figure 4. Response to Acidization. *Hydrograph with inset graph highlighting the response to pumping to fill frac tanks and then subsequent injection of acid in the Lowe (upper elevation line) and Odell #3 (lower elevation levels) wells. The Lowe well responded very quickly, while the Odell #3 was more subdued. This occurred prior to the pumping test.*

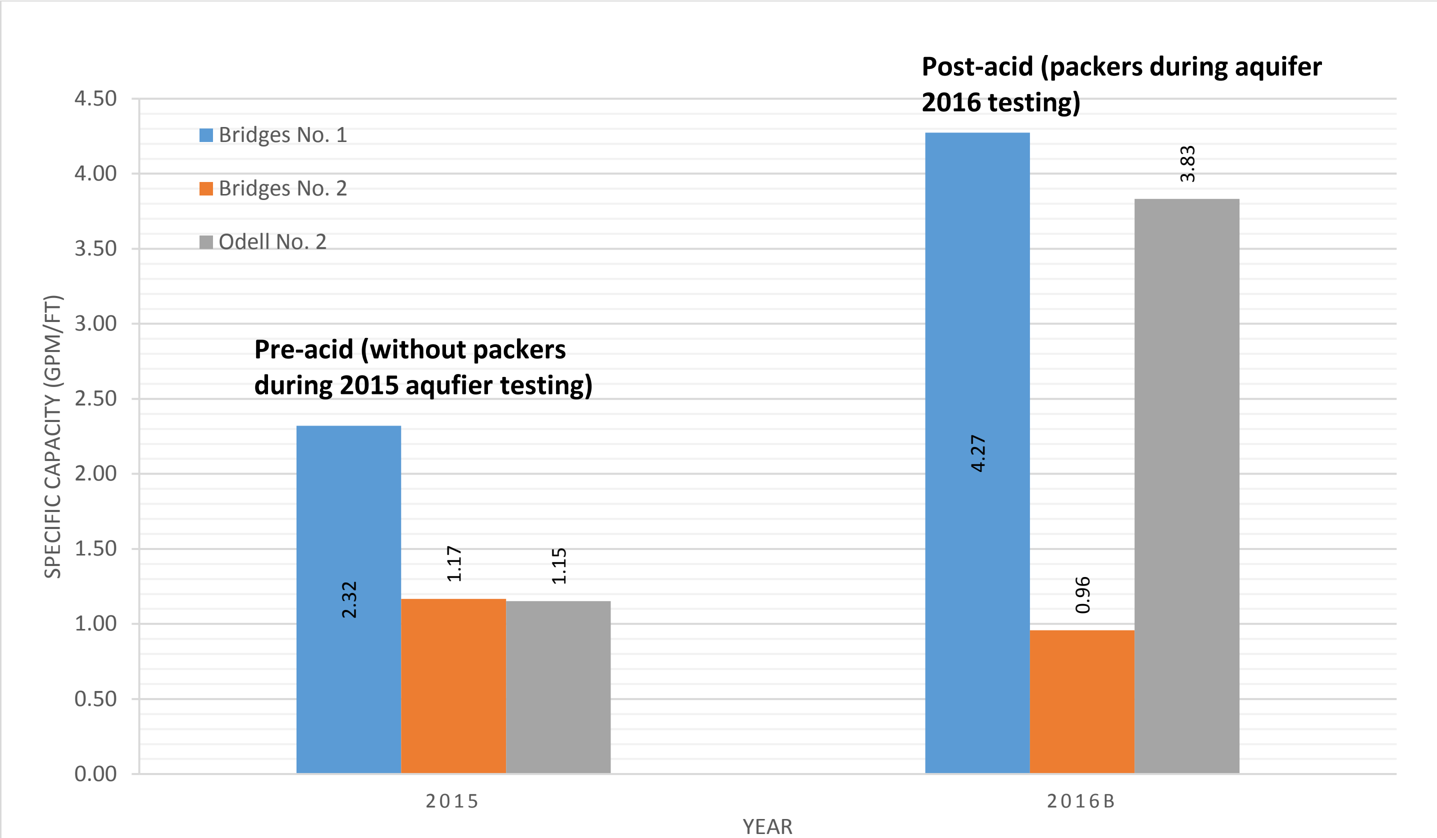


Figure 5. Effect of Acidization on Pumping Wells. *Comparison of specific capacities for three wells and the effectiveness of acidization. In order to compare to the 2015 data, the yield and drawdown for the 2016 test was taken at 47 hours after pumping.*

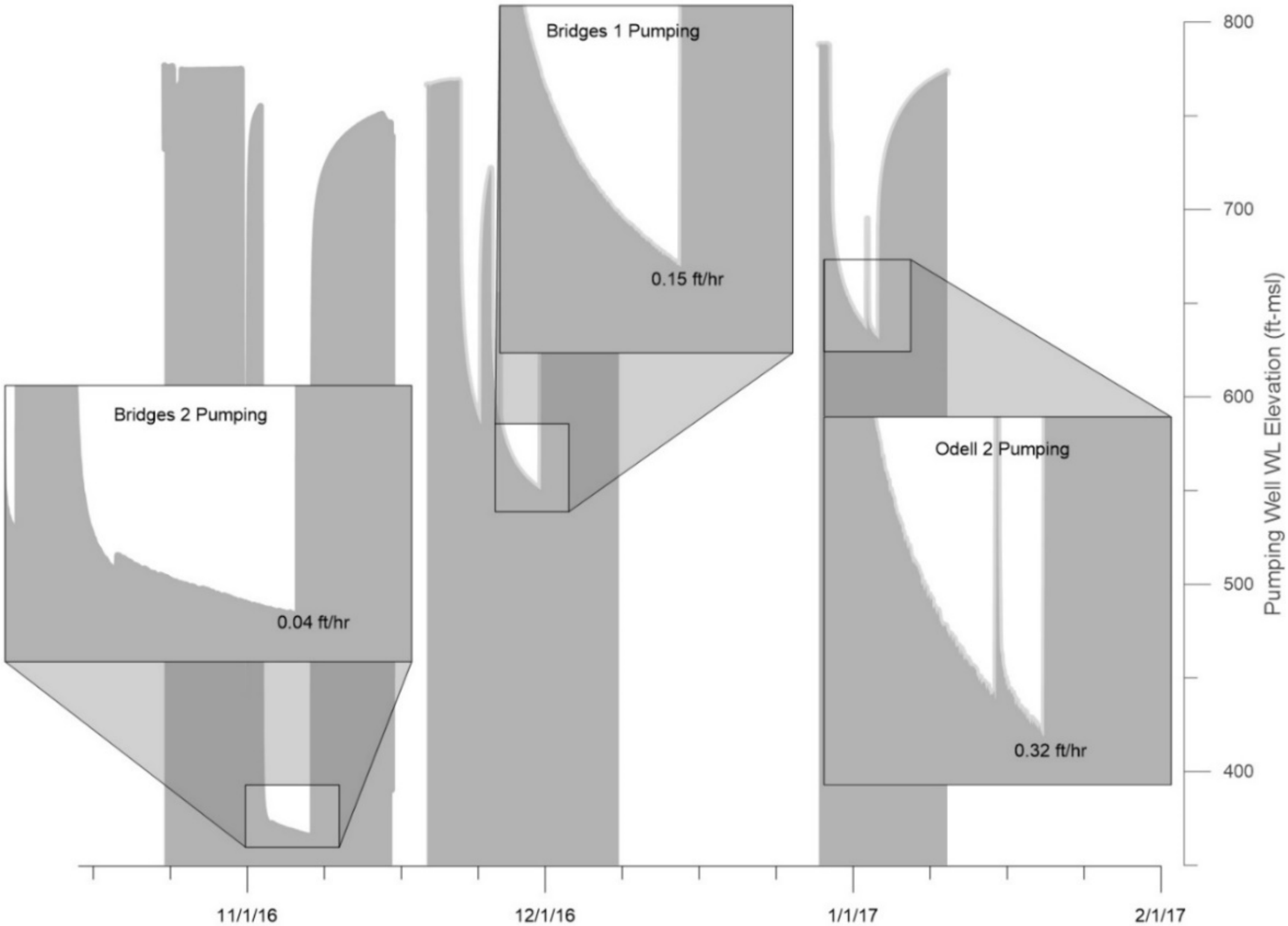


Figure 6. Rate of Drawdown in EP Wells. *Hydrograph showing rate of drawdown (ft/hr) for the last 6 hours of the test for each pumping well. Bridges #2 showed the least rate of change and the Odell #2 had the highest rate of change.*

Observation Wells

All observation and pumping well data are provided in **Appendix D**. BSEACD monitored 17 wells during the aquifer test. All non-EP well data were collected by BSEACD staff except for the Carnes well, which were mostly collected by the owner with a BSEACD-owned electronic tape (eline). For all sites, manual measurements were periodically collected with eline and/or a sonic meter (Ravensgate). The sonic meter data were verified with an eline. BSEACD transducer data were collected at hourly intervals with In-Situ pressure transducers. Frequent manual measurements throughout test provides verifiable data quality.

WRGS monitored the seven EP wells (three with dual completion) during the aquifer test. EP pumping and observation wells have only sporadic manual eline data (n=15). Accordingly, the accuracy of water levels in the EP observation wells from transducers is not verifiable, but appears to be good. BSEACD performed some edits/modifications to the original data sent by Wetrock, including:

- Correcting a 20 ft shift on 12/26/16 in Bridges 2;
- Deleted data from Bridges 1 Upper after 12/4/16 due to a reported bovine interference;
- Reduced data from 1-minute to 30-minute intervals (with no loss in detailed response).

A summary of the water-level responses in the observation wells during the aquifer test is provided in **Figure 4**. **Figure 7** is a map labeling the maximum drawdown for each observation well that corresponds to each EP pumping test. **Figure 8** is a contour map of the total measured drawdown observed in the Cow Creek wells for each of the three tests. **Figure 9** is a contour map of the total drawdown summed from the three pumping wells. The superposition of drawdown represents what would occur if all three had pumped simultaneously. Contours were hand drawn and provide an estimate of the magnitude and shape of the cone of depression.

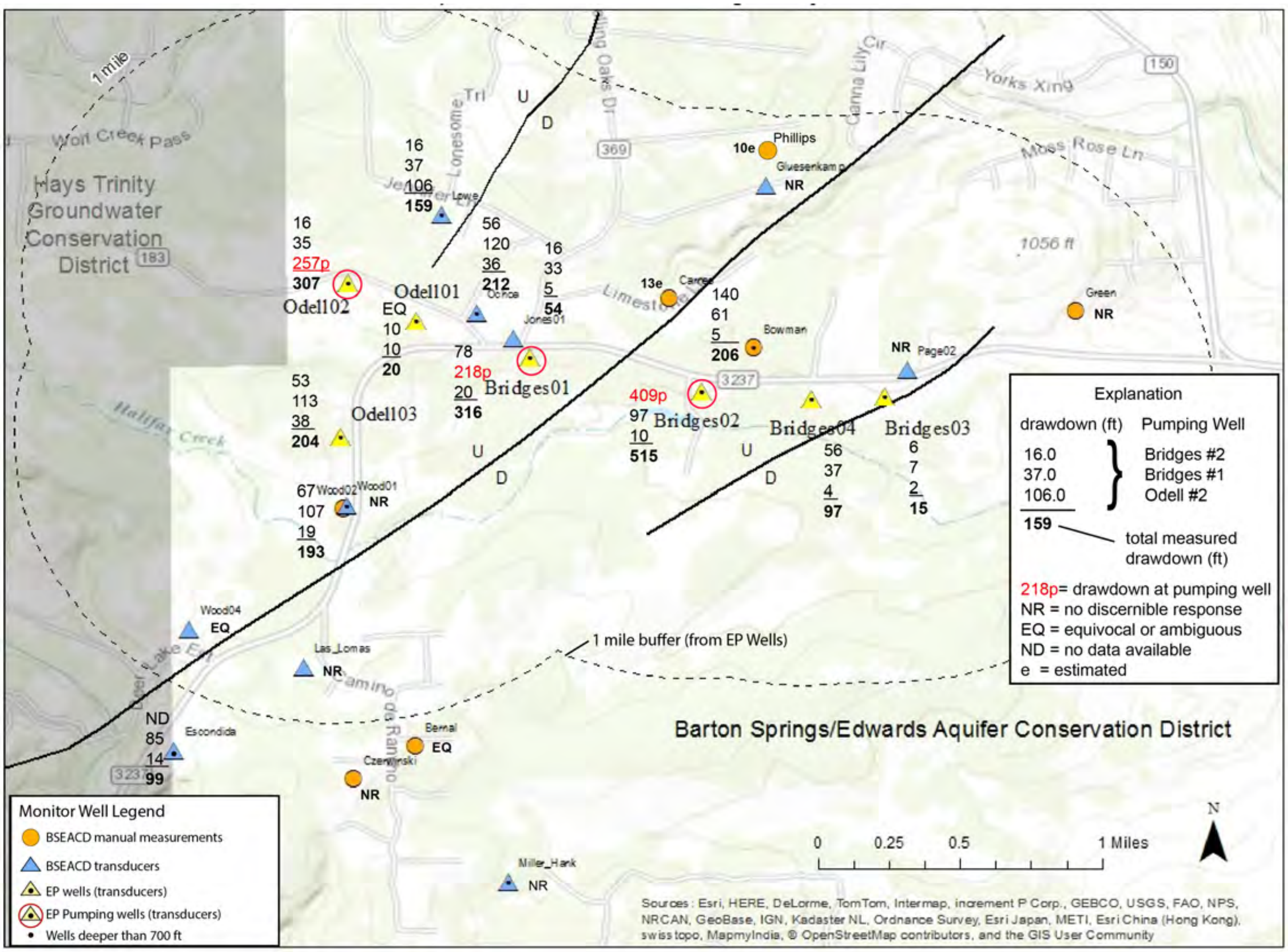
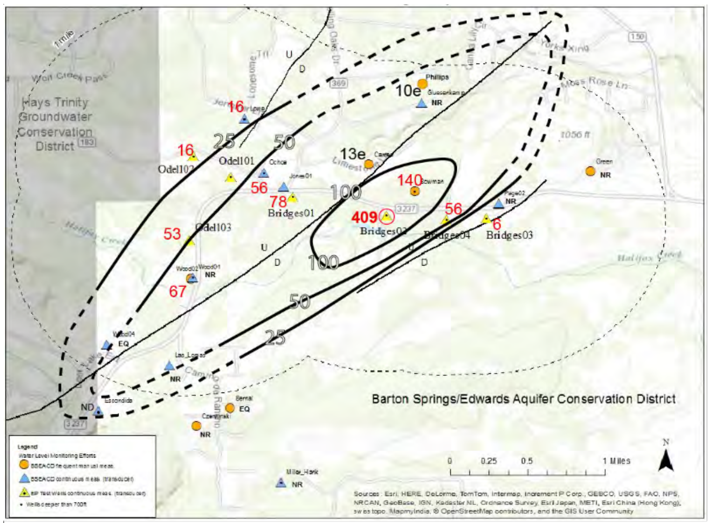


Figure 7. Drawdown Map. *Map of the observed response and maximum drawdown from each of the pumping wells (red circles). The total drawdown from all three pumping wells is indicated in bold.*

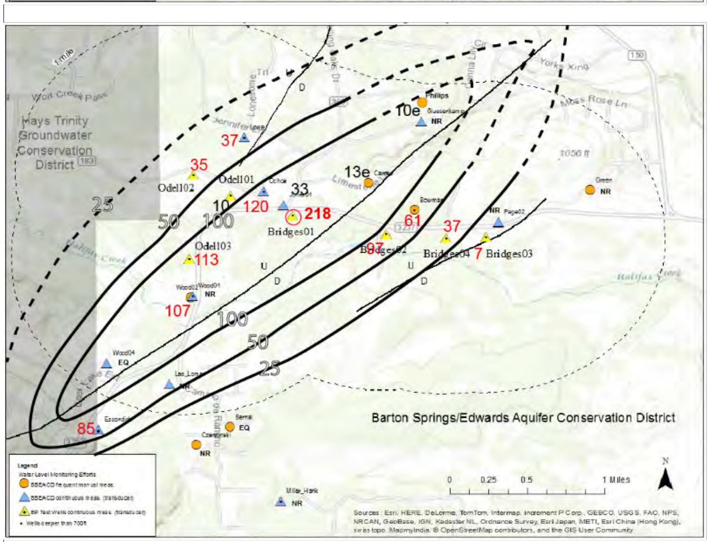
Table 4. Summary of the response in observation wells to the pumping wells during the aquifer test.

WELL NAME	DATA	TYPE	PRIMARY AQUIFER	BRIDGES #2	BRIDGES #1	ODELL 2	COMBINED DRAWDOWN (FT)	COMMENT
BERNAL	Periodic	Domestic	Middle Trinity (Cow Creek)	EQ	EQ	EQ	EQ	
BOWMAN	Periodic	Domestic	Middle Trinity (Cow Creek)	139.6	60.5	4.6 (m)	204.7	
BRIDGES #1*	Continuous	Test	Middle Trinity	77.6	217.9**	20.2 (m)	315.7	Pumping well (lower zone)
BRIDGES #1—UPPER*	Continuous	Test	Lower Glen Rose and Upper Trinity	ND	8.7	ND		Pumping well (upper zone); not shown on drawdown map
BRIDGES #2*	Continuous	Test	Middle Trinity	408.8**	96.8	9.7	515.3	Pumping well (lower zone)
BRIDGES #2—UPPER*	Continuous	Test	Lower Glen Rose and Upper Trinity	7.9	ND	ND		Pumping well (upper zone); not shown on drawdown map
BRIDGES #3*	Continuous	Test	Middle Trinity (Cow Creek)	6.4	6.5	1.7	14.6	
BRIDGES #4*	Continuous	Test	Middle Trinity (Cow Creek)	56.0	37.3	3.9	97.2	
CARNES	Periodic	Domestic	Middle Trinity	EQ	EQ	EQ	13e	Delayed and slow drawdown over period of aquifer testing; slow recovery after completed.
CZERWIENSKI	Periodic	Domestic	Middle Trinity	NR	NR	NR	NR	
ESCONDIDA 1	Continuous	Domestic	Middle Trinity (Cow Creek)	ND	85(r)	13.5	98.5(m)	
GLUESENKAMP	Continuous	Domestic	Upper Trinity	NR	NR	NR	NR	Shallow, perched aquifer karst system
GREEN	Periodic	Domestic	Middle Trinity	NR	NR	NR	NR	
JONES01	Continuous	Unused	Upper Trinity	15.7	32.8	5.4	53.9	Delayed response
LAS_LOMAS	Continuous	Irrigation	Upper Trinity	NR	NR	NR	NR	
LOWE	Continuous	Domestic	Cow Creek	16.2	36.6	106.4	159.2	Poor recovery
MILLER_HANK	Continuous	Domestic	Middle Trinity (Cow Creek)	NR	NR	NR	NR	
OCHOA	Continuous	Domestic	Middle Trinity (Cow Creek)	55.7	120.1	35.7	211.5	Poor recovery
ODELL #1*	Continuous	Test	Middle Trinity (Lower Glen Rose)	EQ	10e	10e	20e	Delayed response
ODELL #2*	Continuous	Test	Middle Trinity	15.6	34.5	257**	307	Pumping well (lower zone); poor recovery overall
ODELL #2—UPPER*	Continuous	Test	Lower Glen Rose and Upper Trinity	ND	ND	6e		Pumping well (upper zone); not shown on drawdown map
ODELL #3*	Continuous	Test	Middle Trinity (Cow Creek)	53	112.8	37.7	203.5	Slow recovery
PAGE	Periodic	Stock	Upper Trinity	NR	NR	NR	NR	
PHILLIPS	Periodic	Domestic	Upper Trinity	EQ	EQ	EQ	10e	Similar to Carnes
WOOD01	Continuous	Domestic	Middle Trinity (Cow Creek)	66.7	106.8 (m)	18.9	192.4	Woods 1 out of water 11/30/16 23:00 to 11/30/16 18:00
WOOD02	Periodic	Unused	Upper Trinity	NR	NR	NR	NR	Windmill
WOOD04 (DEER BARN)	Continuous	Domestic	Middle Trinity	NR	EQ	EQ	EQ	

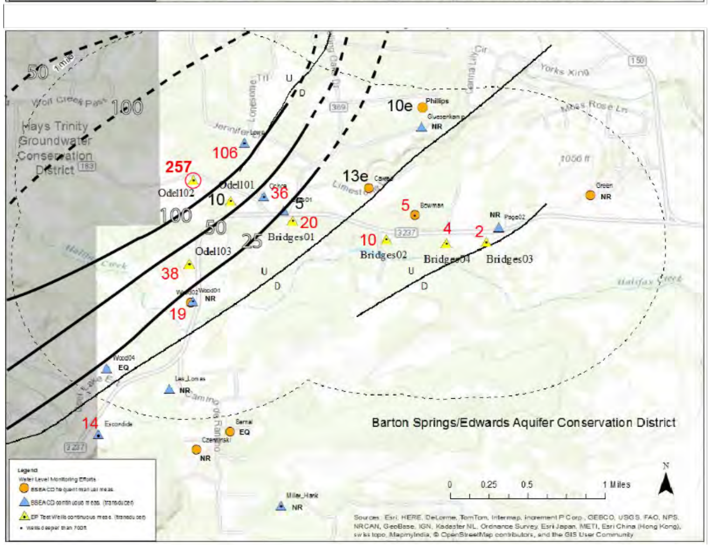
* EP data; e= estimated; (m)= minimum; (r)= recovery data only; ND= no data available; EQ = equivocal or ambiguous; NR = no discernible response



Bridges #2 Drawdown contours
November 2-7, 2016
305 gpm average



Bridges #1 Drawdown contours
November 25-30, 2016
655 gpm average



Odell #2 Drawdown contours
December 29, 2016-January 3, 2017
565 gpm average

Explanation

140 = max drawdown (ft) in Cow Creek well

133= max drawdown (ft) in Upper and Lower Glen Rose (e indicates estimate)

50 Drawdown contour (ft), dashed where estimated

Figure 8. *Drawdown contours in the Cow Creek for each pumping well. Contours are hand-drawn estimates.*

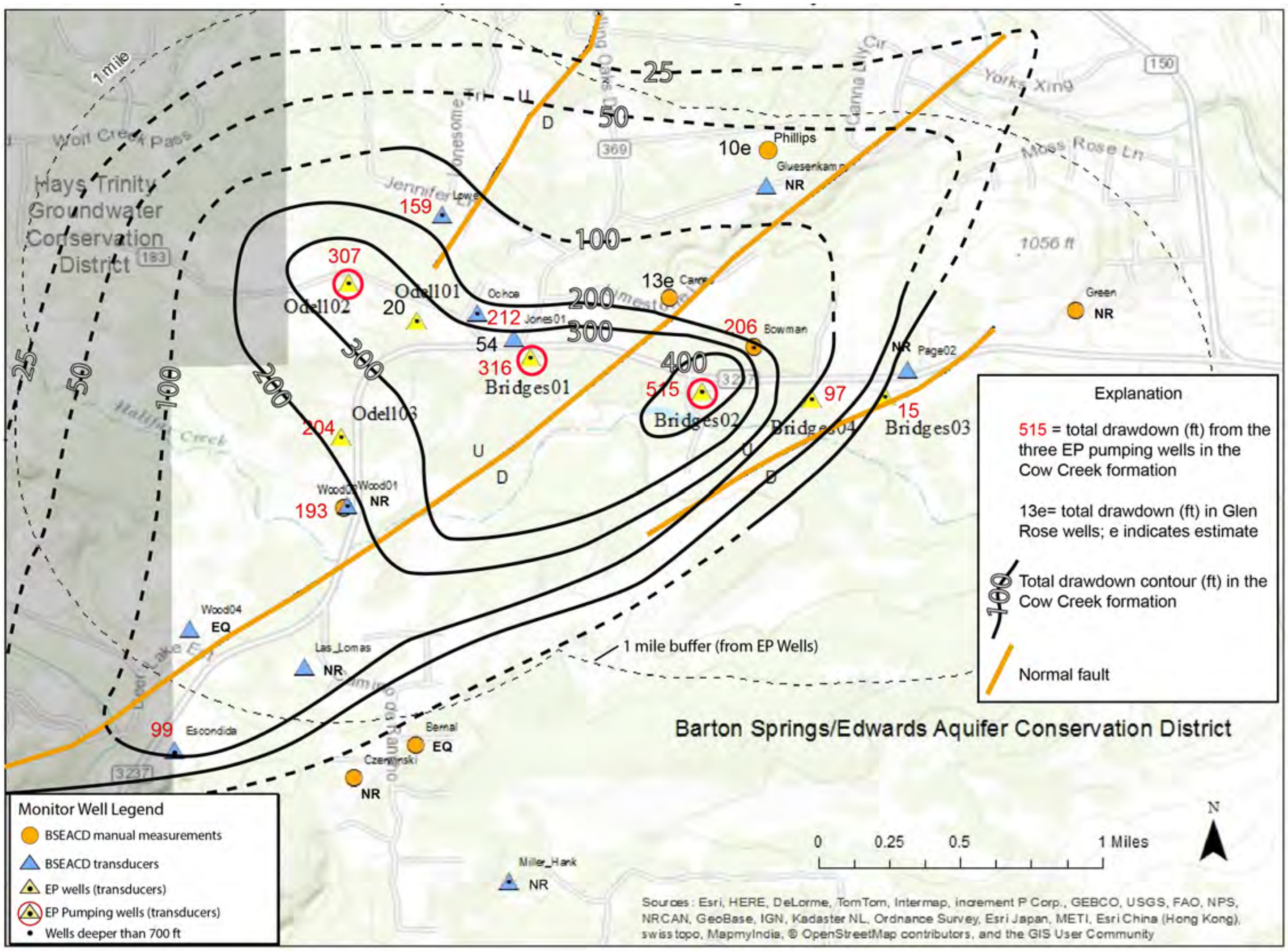


Figure 9. Total Drawdown Map. *Map showing the total (or cumulative) drawdown and contours from the three pumping wells during the aquifer test. Contours are hand-drawn estimates.*

Observation Well Response to Pumping

The following section reviews the observation well response during the aquifer test. The review is organized by the observation well production zone.

Cow Creek Wells

A temporary packer was used to isolate the Cow Creek formation from the overlying units in each pumping well. Previous data suggested that most of the production would come from the Cow Creek formation. Indeed, 11 observation wells completed in the Cow Creek (and some including portions of the Lower Glen Rose) responded to pumping of the Cow Creek during the aquifer test **(Figure 10)**. Drawdown in the Cow Creek wells was variable, but ranged from 14 to 211 ft in observation wells. **Figures 11-14** are detailed hydrographs of the response to pumping. Most of the Cow Creek observation wells had very slow recovery following pumping. An example is the Lowe well that had a drawdown of about 15 ft in response to the Bridges #2 pumping, yet the water levels had minimal recovery (less than 1 ft) after two weeks of no pumping. Odell #2 had a similar response to the Bridges #2 pumping as the Lowe well.

However, not all observation wells completed in the Cow Creek responded to pumping. **Figure 15** is a hydrograph of two observation wells completed in the Cow Creek that either had no discernible response (Miller), or the data was equivocal and ambiguous (Bernal). These two wells were generally more than a mile to the south of the EP well field.

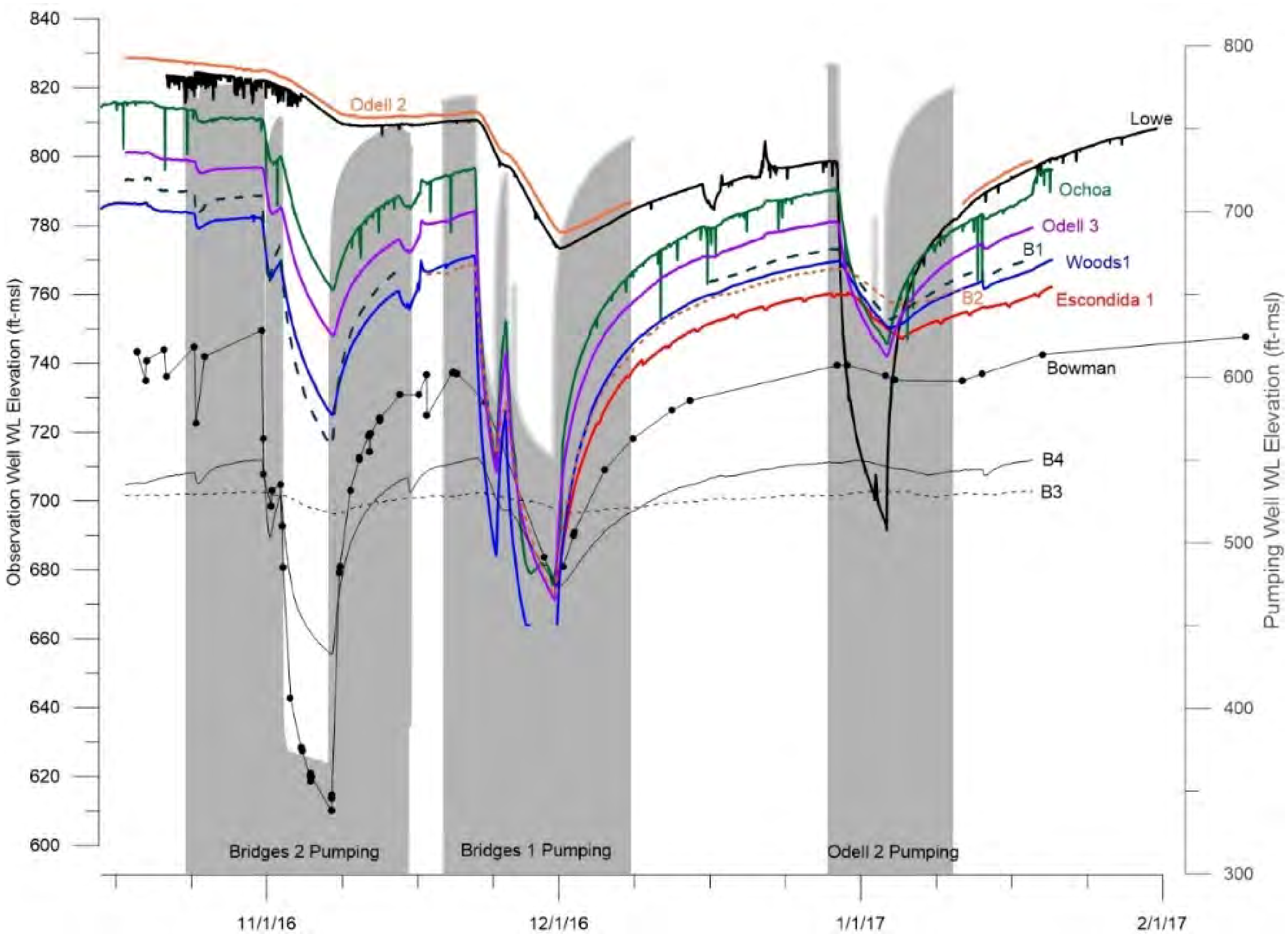


Figure 10. Hydrograph of Cow Creek Wells. *Hydrograph of 11 wells completed in the Cow Creek (and some portions of the Lower Glen Rose) that responded to the pumping of the Cow Creek. The shaded water levels are from the pumped wells isolated to the Cow Creek.*

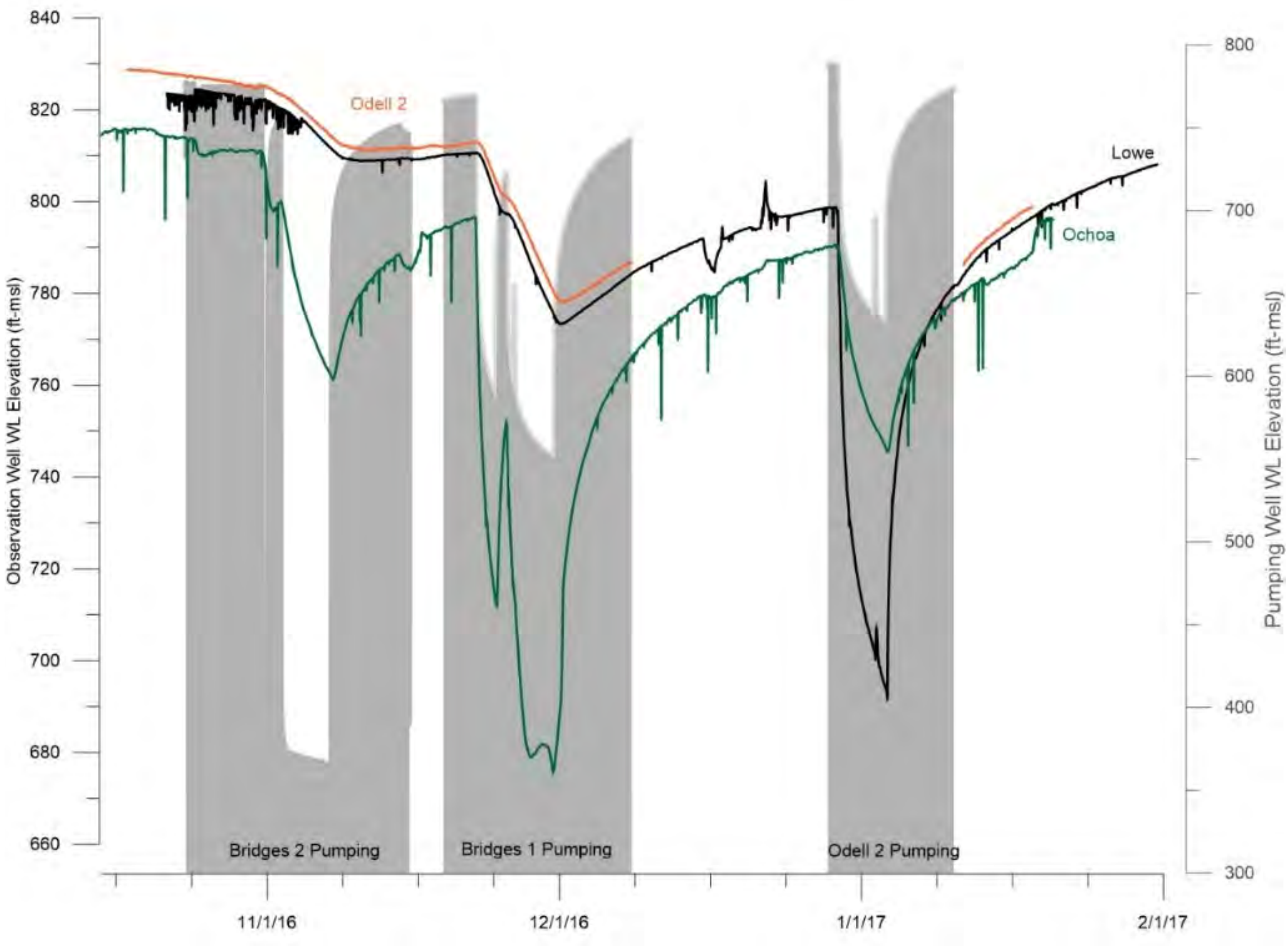


Figure 11. Hydrograph of the Odell 2, Lowe, and Ochoa observation wells.

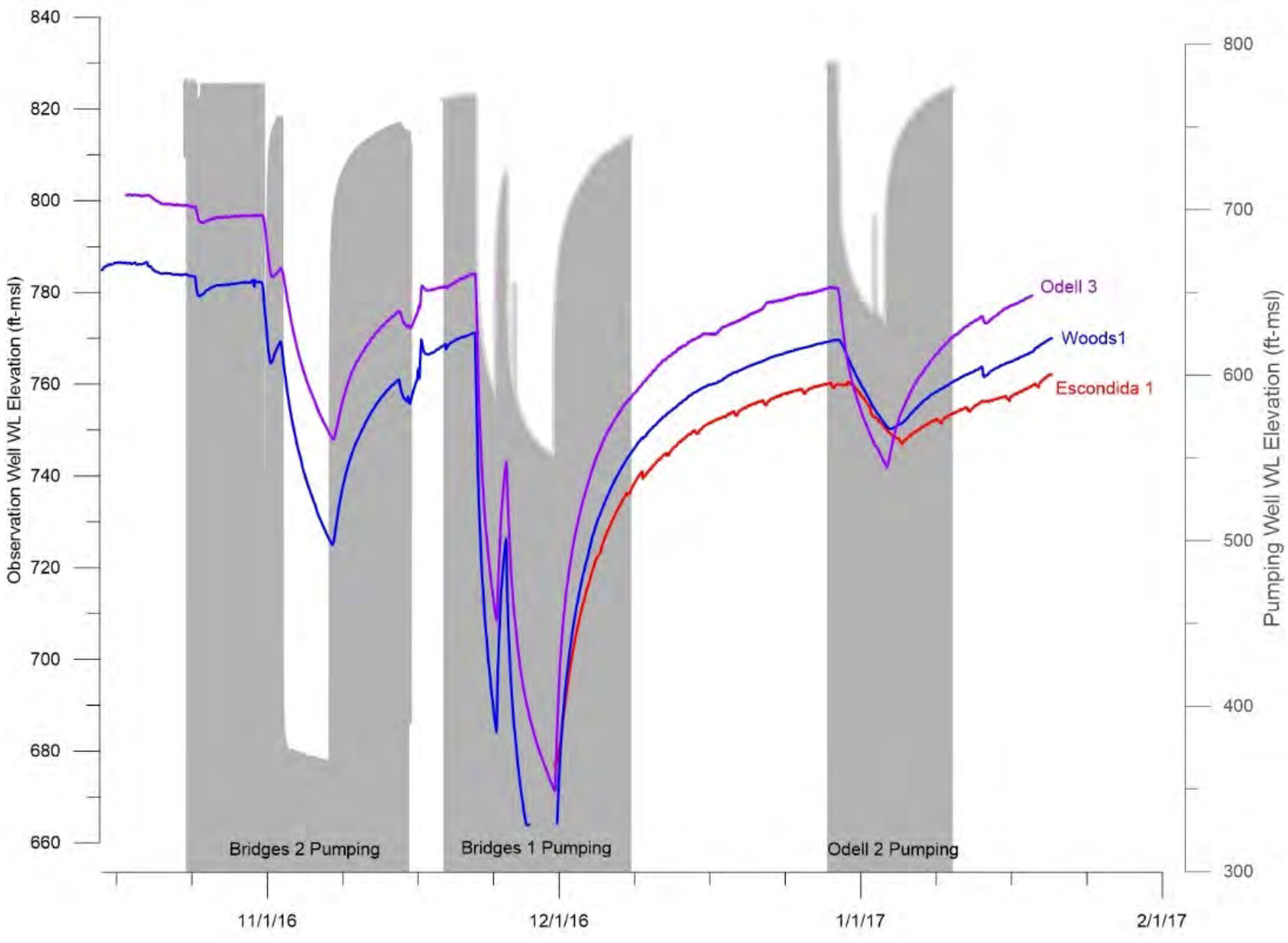


Figure 12. Hydrograph of the Odell 3, Woods 1, and Escondida observation wells.

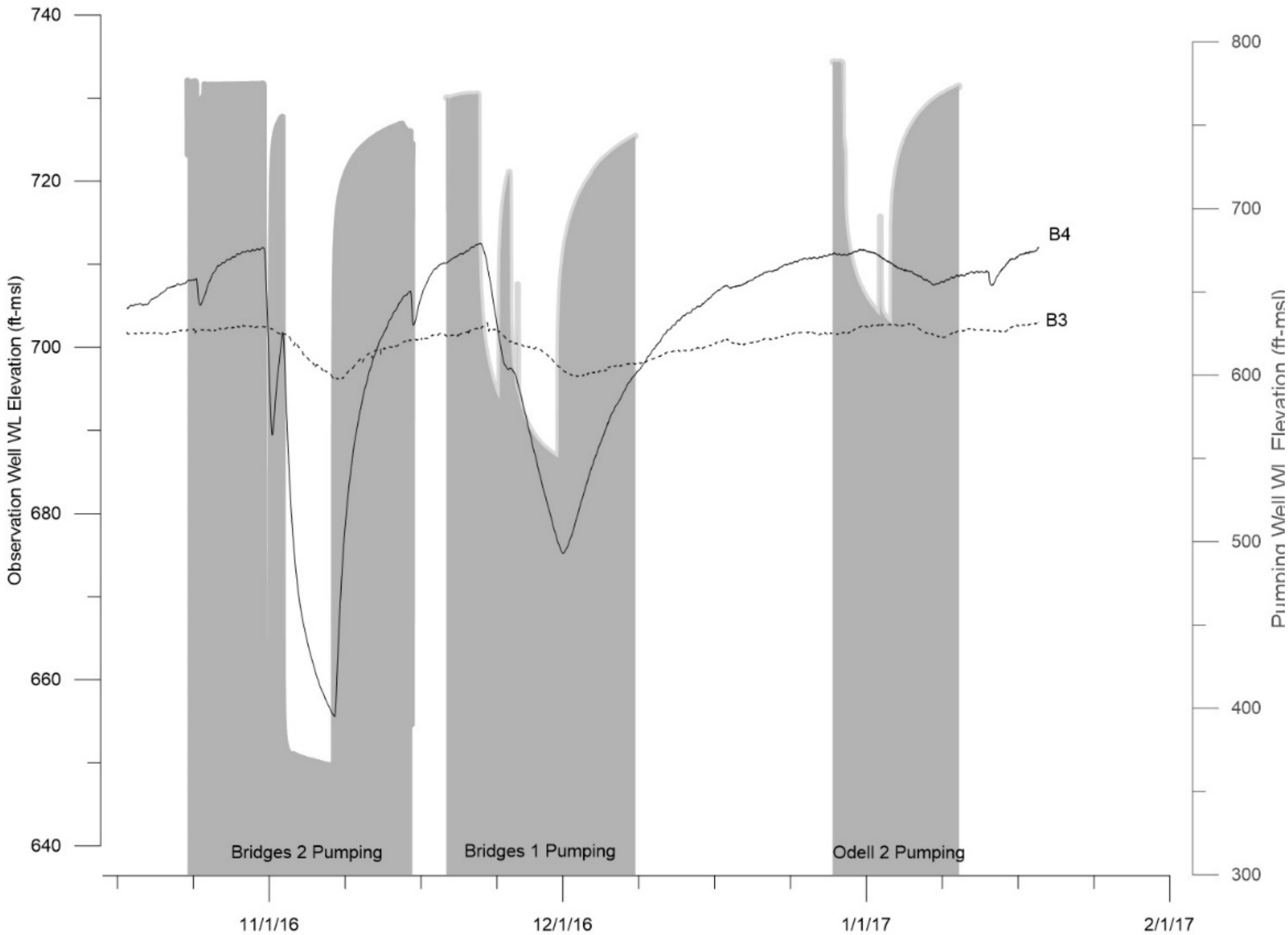


Figure 13. Hydrograph of the Bridges 3 and 4 observations wells. *Bridges 3 (B3) is the furthest east observation well completed in the Cow Creek.*

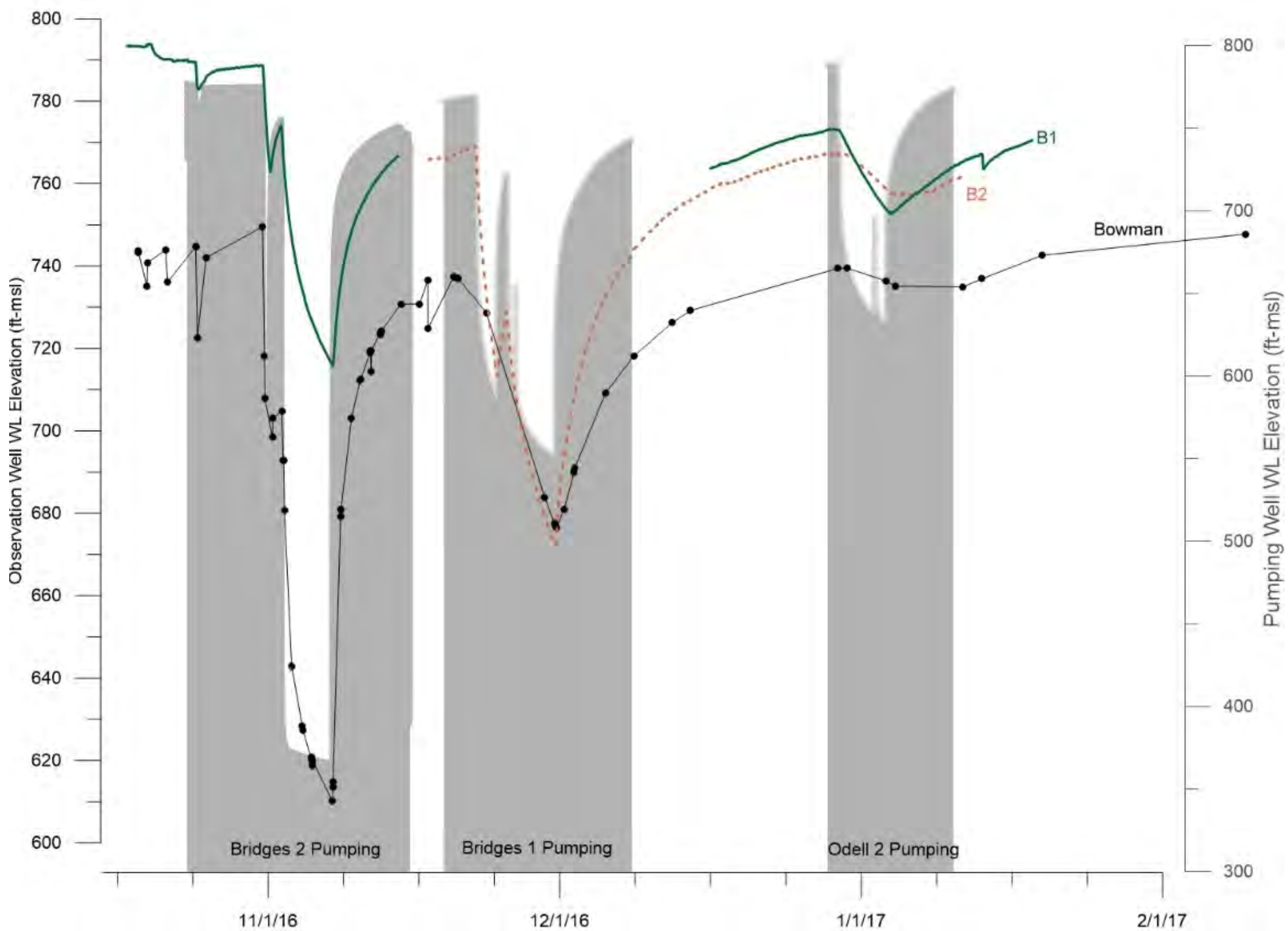


Figure 14. Hydrograph of the Bridges 1, Bridges 2, and Bowman observations wells.

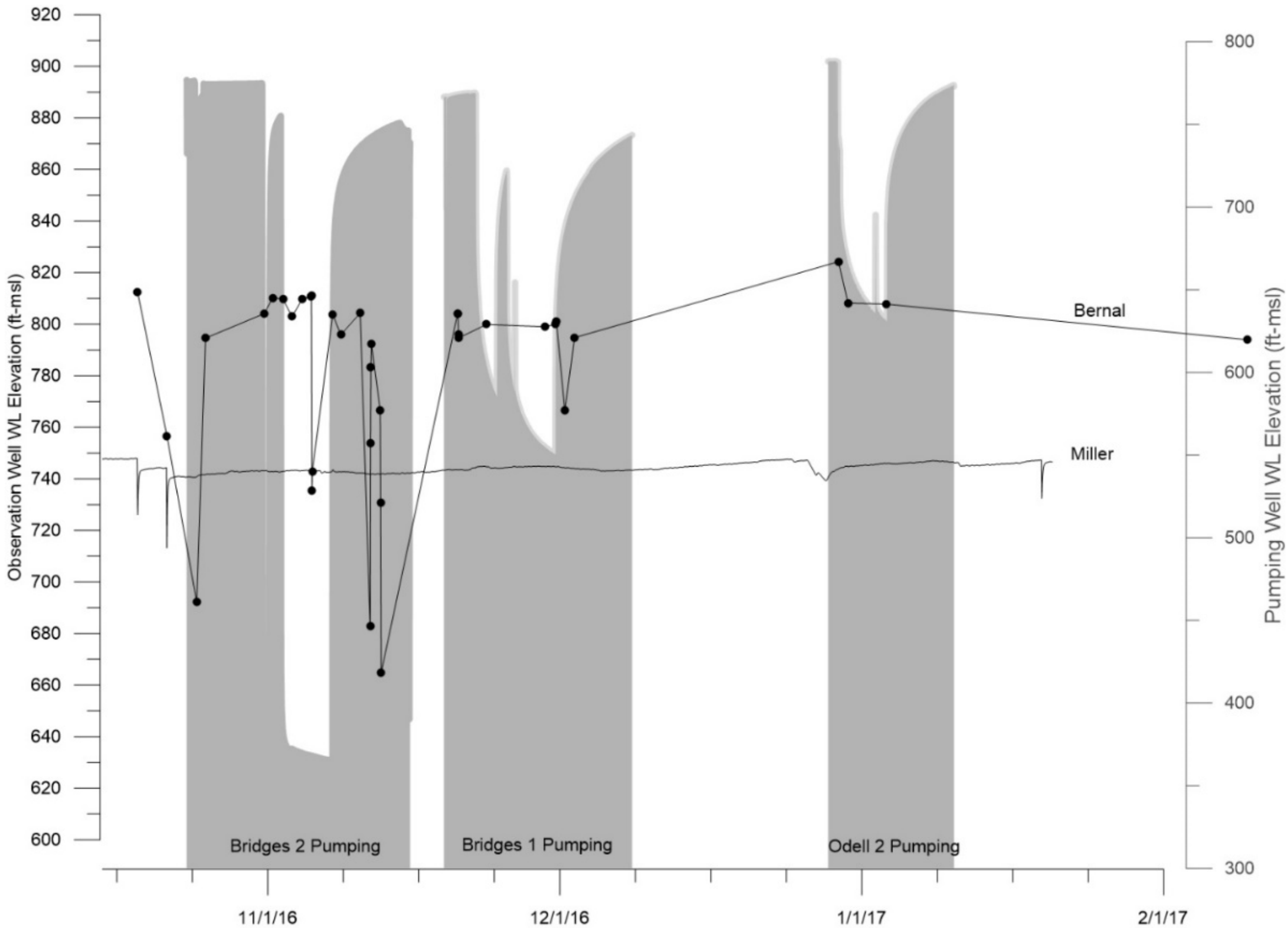


Figure 15. Hydrograph of Bernal and Miller wells. *Hydrograph of two observation wells completed in the Cow Creek that either had no discernible response (Miller), or the data was equivocal or ambiguous (Bernal). These wells are located about 1 mile to the south of the EP well field.*

Glen Rose Wells

A key assumption in the assessment of drawdown and potential impacts is the source of water to the pumping wells. In order to better understand those impacts a temporary packer was used to isolate the Cow Creek formation from the overlying Lower and Upper Glen Rose formations in all three EP pumping wells. The Cow Creek formation is the target production zone and proposed final completion for the production wells. A transducer was strapped to the pump below the packer, and a transducer was placed above the packer to discretely measure drawdown in the Cow Creek and any drawdown above the packer in the Glen Rose units.

The aquifer test data indicate that the majority of drawdown occurred within the Cow Creek formation. Thus, the packer performed as intended and appears to have provided isolation of the Cow Creek in the borehole of the pumping wells. When inflated, the water levels in the upper zones rose in elevation, which is consistent with the shallower aquifer system in the area (**Figures 16 and 17**). The continued rise in water levels after pumping suggests that the packer worked as designed. However, the water-level decline suggests a delayed response to pumping in the overlying formations. **Figures 16-18** provide an example of the head response in the upper zone to pumping of the lower zone. In Bridges #2 there was a measureable drawdown of about 8 ft and recovery of about 5 ft in the upper zone that can be attributed to pumping and subsequent recovery in the lower zone. Similar responses were noted in Bridges #1 and Odell #2 wells. Deflation of the packer or other activities appear to confound the absolute measurement and cause some large changes in water levels.

To further address this question of source water, Odell #1 well was recompleted as a Lower Glen Rose observation well, prior to the aquifer testing, to measure the potential effects from pumping from the Cow Creek on the overlying Lower Glen Rose. **Figure 19** is a hydrograph from Odell #1 well. Given that the background trends are either static or rising during the period of testing (**Figure 2**), the drawdown observed in Odell #1 appears to be related to pumping in Bridges #1 and Odell #2. However, the response appears to be subdued by about 10 ft and delayed in time.

Figure 20 is a hydrograph of the Gluesencamp, Jones, Phillips, and Carnes observation wells. These wells are completed in the Upper Glen Rose except for Carnes, which is a Lower Glen Rose well. Background trends are either static or rising during the period testing (**Figures 2a-2c**). Accordingly, the declines measured in Phillips and Carnes appear to be a subdued and delayed response to the EP pumping and recovery. The Jones well (very close to Bridges #1) has a larger magnitude, but also delayed, response to the EP pumping and recovery. The Gluesencamp water level reflects a shallow perched aquifer and does not respond to the EP aquifer test.

Other observation wells completed into the Glen Rose include Czerwienski, Page, and Green. Those wells either had no response or the data was highly equivocal. The Wood 04 observation well was generally rising during much of the test. There is a slight decline during the pumping of Bridges #1, but it is very subdued and equivocal. After the pumping of Odell #2 there is a significant decline in water level of about 60 ft that could be interpreted as a delayed response to the pumping of Odell #2. However, the data is equivocal since a similar response was observed prior to the aquifer testing in July 2016.

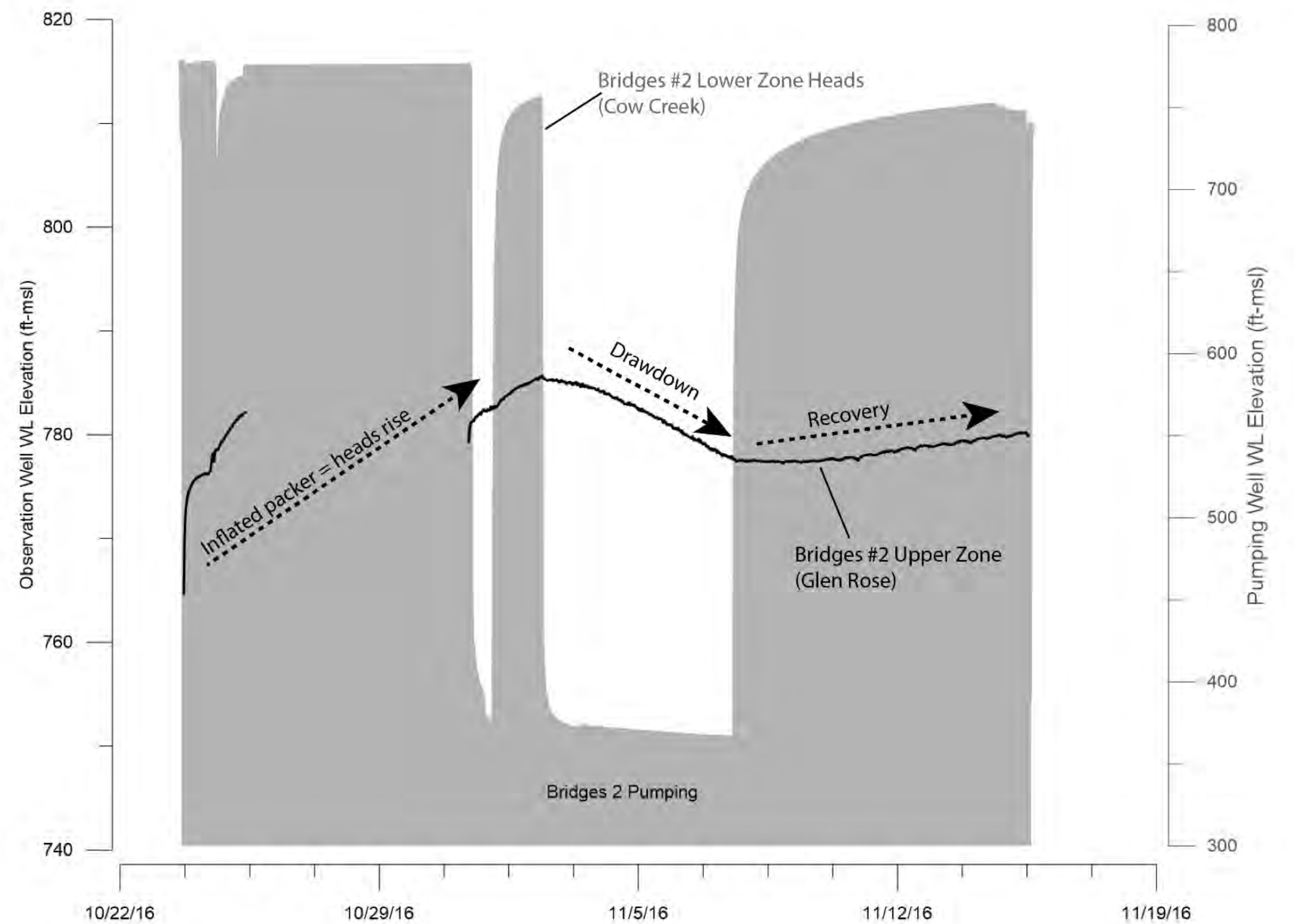


Figure 16. Bridges #2 Upper and Lower Zones. *Hydrograph showing Bridges #2 lower zone (Cow Creek) water-level elevation (in grey) compared to the upper zone (Upper and Lower Glen Rose) water-level elevation (black line). There is an apparent 8 ft decline in the upper zone, and subsequent 5 ft recovery that corresponds to the pumping of the lower zone. Note the water-level elevations of each zone have their own y-axis and the head in the upper zone is higher than the lower zone.*

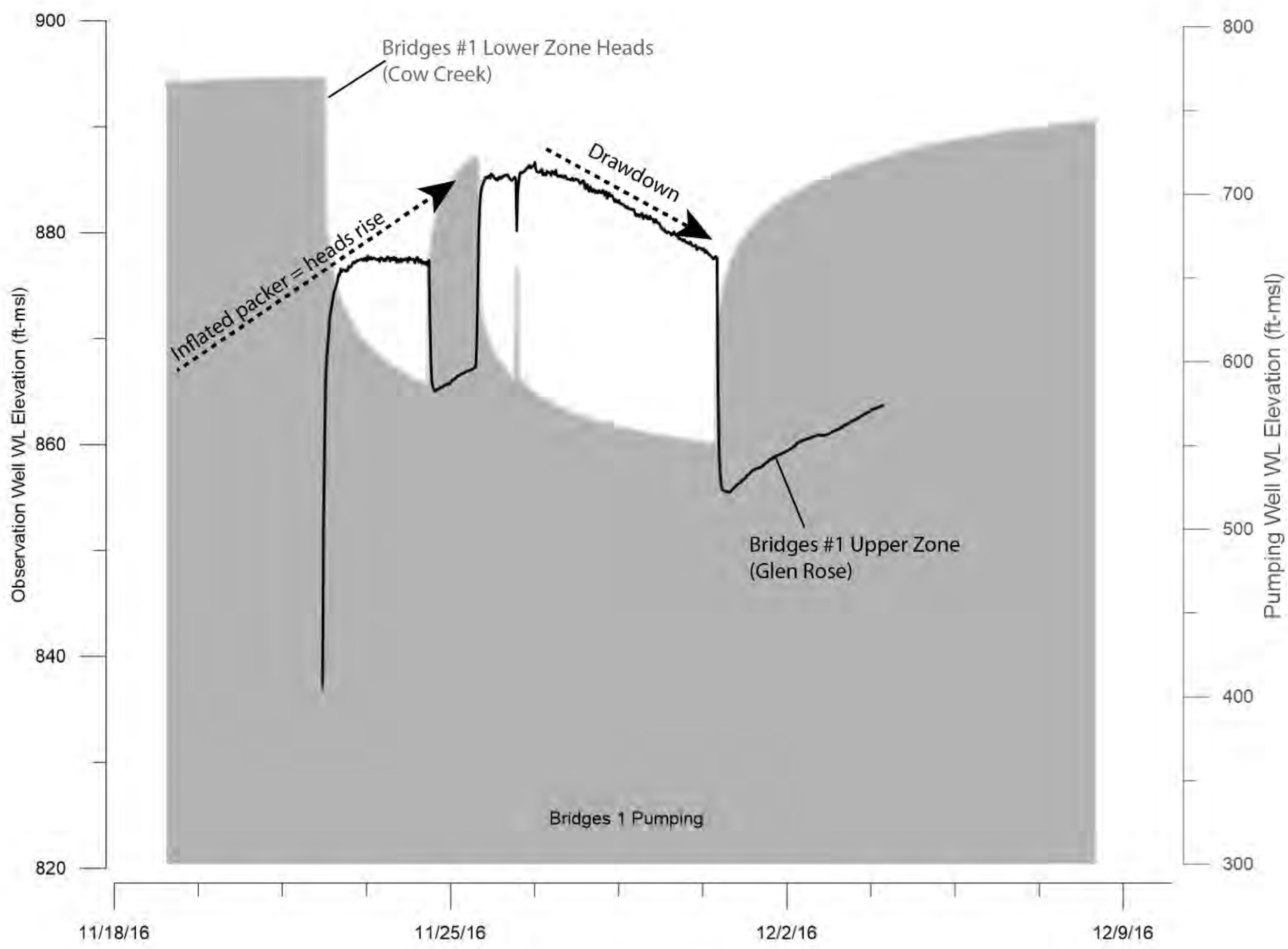


Figure 17. Bridges #1 Upper and Lower Zones. *Hydrograph showing Bridges #1 lower zone (Cow Creek) water-level elevation (shaded) compared to the upper zone (Upper and Lower Glen Rose) water-level elevation (black line). Note the water-level elevations of each zone have their own y-axis and the head in the upper zone is higher than the lower zone.*

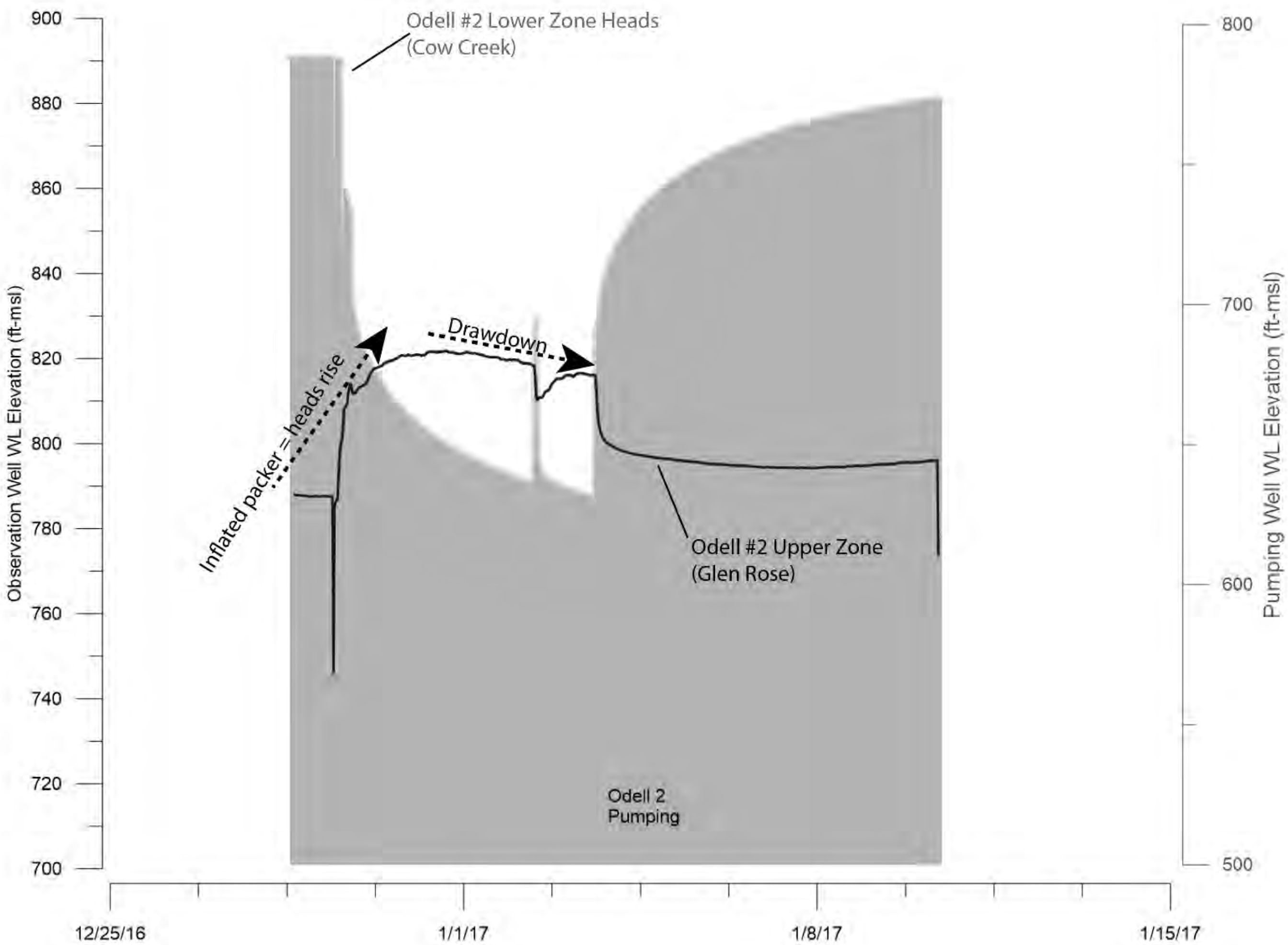


Figure 18. Odell #2 lower and upper zone. *Hydrograph showing Odell #2 lower zone (Cow Creek) water-level elevation (in grey) compared to the upper zone (Upper and Lower Glen Rose) water-level elevation (black line). The upper zone heads continued to rise after pumping began in the lower zone. Note the water-level elevations of each zone have their own y-axis and the head in the upper zone is higher than the lower zone.*

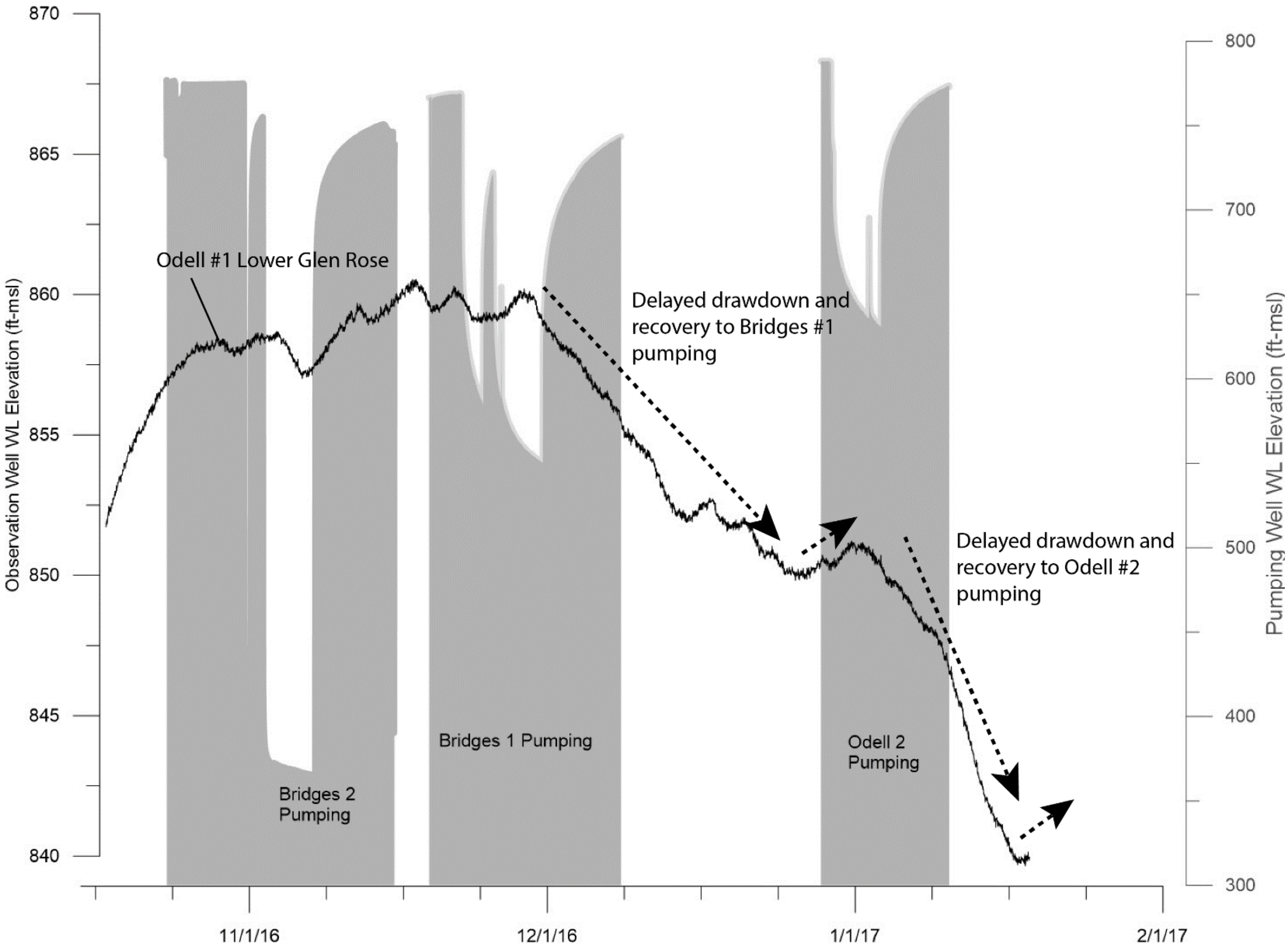


Figure 19. Odell #1 Hydrograph. *Hydrograph of the three pumping wells and the Odell #1 (black line). Drawdown in Odell #1 is about 10 feet in response to Bridges #1 and Odell #2 pumping. However, the response to Odell #2 pumping in Odell #1 appears to be delayed. Note the water-level elevations of each zone have their own y-axis and the head in the upper zone is higher than the lower zone.*

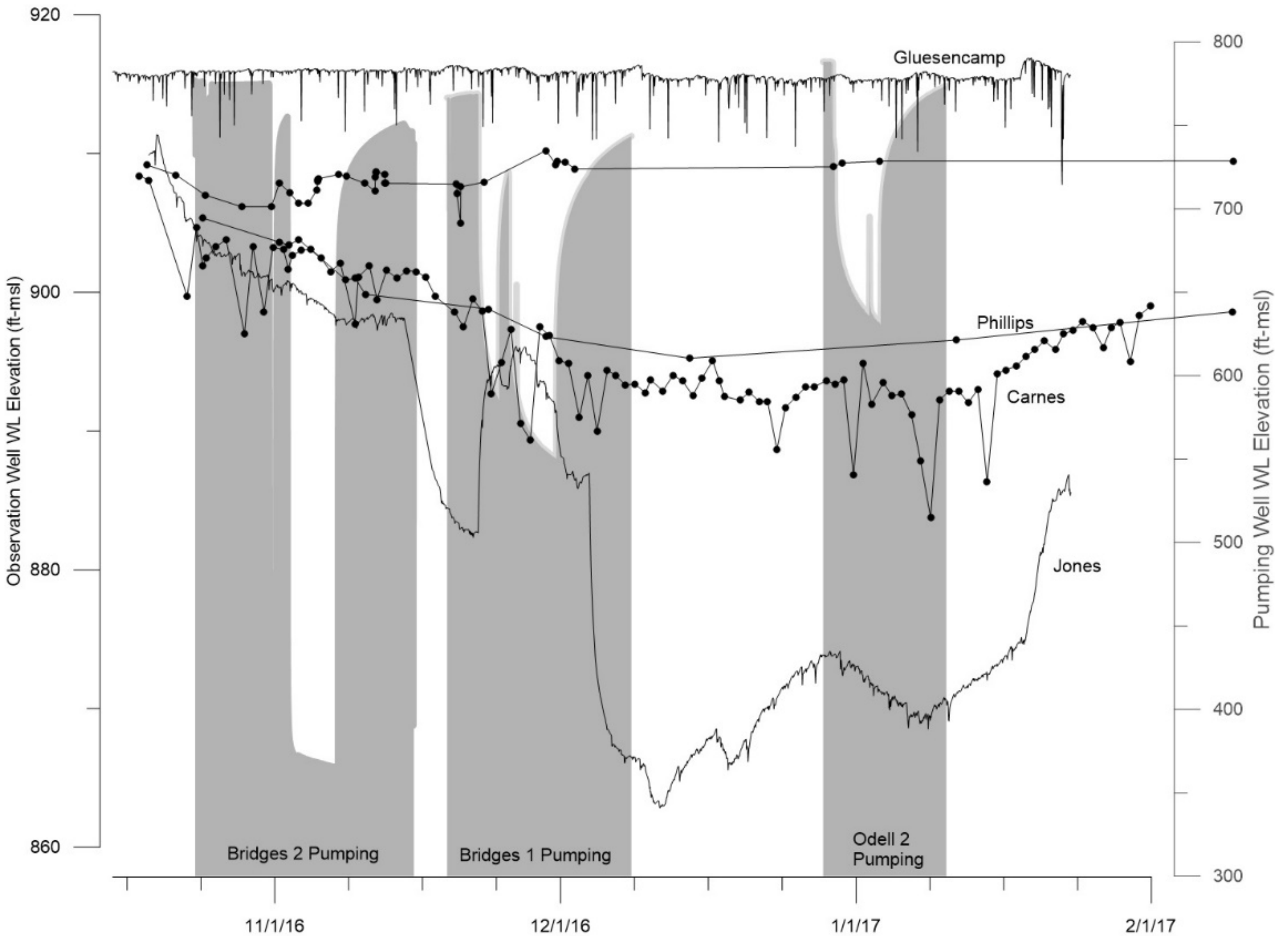


Figure 20. Hydrograph of Glen Rose Wells. *Hydrographs of the Gluesencamp, Jones, Phillips, and Carnes observation wells. These wells are located north of the EP well field. Given the background trends, there appears to be a slow and delayed response in the Phillips and Carnes wells to the pumping and recovery. The Jones well has a delayed, but clearer response to pumping but also appears delayed. The Gluesencamp water level reflects a shallow perched aquifer and does not respond to the EP aquifer test.*

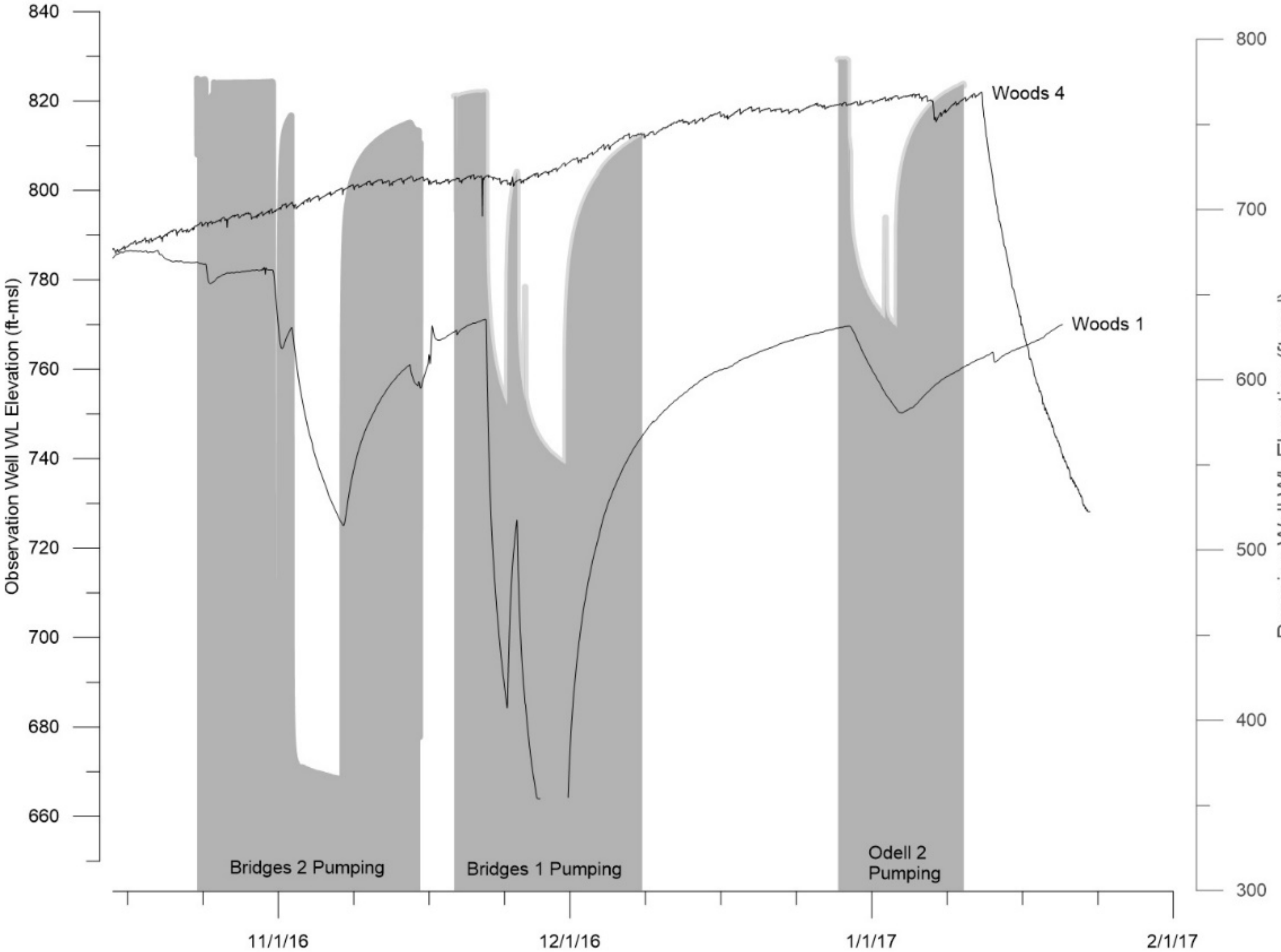


Figure 21. Hydrograph of the Woods 1 (Cow Creek) and Woods 4 (Lower Glen Rose) wells. *The Wood 1 shows a response to all three aquifer tests. The Woods 4 well may have a subtle response to the Bridges #1 pumping. The water-level decline in Woods 4 after the Odell #2 pumping could be due to pumping, but is also similar in appearance to a response in July 2016 when no aquifer test was occurring.*

Water Chemistry

The District sampled seven of the observation wells in the vicinity of the EP well field prior to the aquifer testing in 2015. The analyses were done on behalf of the Texas Water Development Board (TWDB) and included a broad suite of chemical analyses. In addition, isotopes of carbon and hydrogen were analyzed for relative age dating purposes. The 2015 data was collected to establish a baseline and to better understand the hydrogeology in the vicinity of the proposed EP project.

This data is publically available from the TWDB Water Data Interactive website at: (http://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer).

In association with the aquifer test, the District and The Edwards Aquifer Authority (EAA) sampled wells in the vicinity of the EP area to better understand the effects of acidization and high rates of pumping. EAA collected a time series of chemistry samples from 10 of the observation wells prior to, during, and after the aquifer testing in late 2016 and early 2017 (n=92). The data are compiled in **Appendix C**. Results reflect the complexity of chemistry stemming from different hydrogeologic units, well completions, and hydrodynamics. There is a wide natural variability of chemistry that occurs within the EP area with groundwater ranging from fresh calcium-bicarbonate to saline calcium-sulfate facies.

The water chemistry variability can even occur in the same well depending upon the hydrologic conditions. For example, TDS values within the Lowe observation well (Cow Creek) appears to have natural variability of TDS ranging from 1,840 mg/L (7/22/15) to 2,310 mg/L (10/18/16) representing different head conditions. Variations have also been noted in other wells including Wood 04, Wood 01, and Ochoa. However, the Bowman well is relatively consistent over the time period prior to aquifer testing with TDS varying from 455 mg/L on 4/8/15 to 471 mg/L on 10/18/16.

Few samples were taken from wells completed in the shallow aquifer due to a focus placed upon on the deeper wells and aquifers more likely affected by pumping. Upper Glen Rose wells include Phillips, Gluesencamp, and Green. In general, the shallowest groundwater system is composed of the Upper Glen Rose and is locally very karstic (e.g. Gluesencamp). There are also several springs in the area that are locally perched water-table aquifers (e.g. Indian Springs; 57-64-819). Consistent with other data in the region, the water is generally very fresh (less than 1,000 mg/L TDS) with recharge locally derived as supported by the elevated levels of nitrates (greater than 1 mg/L) and young age (pMC greater than 75%; Tritium greater than 1.0 TU).

Wells completed in both the Upper and Lower Glen Rose include Wood04 and Carnes (**Appendix A**). Similar to other wells in the region with similar completions, the chemistry in these wells is highly variable with TDS ranging from fresh (348 mg/L; Carnes) to brackish (greater than 1,000 mg/L; Woods 04). Sulfate ions are the primary constituent of TDS in these elevated TDS wells.

Five wells completed in the Cow Creek had a series of chemistry samples taken over the period of aquifer testing (**Figures 23 to 25**). In general, these five wells have a range of TDS from 427 mg/L (Miller) to 1,840 mg/L (Lowe). Elevated levels of sulfates are characteristic of these wells and contribute the majority to the TDS. Consistent with other isotopic data in the region, the water is very old (pMC less than 10%; Tritium less than 0.3 TU) and has low levels of nitrates, suggesting very distal sources, or isolated from local surface recharge. During aquifer testing, the TDS values varied in Cow Creek wells that also showed corresponding changes in water levels. **Figures 23 and 24** suggest that the increased pumping and cone of depression likely induced flow from other sources that increased the TDS in those wells. Conversely, **Figure 25** suggests that the pumping and cone of depression induced flow from other sources that decreased the TDS in those wells.

The data provided also show temporary elevated levels of TDS, sulfate, copper, iron, lead, and fluoride in some of the wells. Samples taken in 2015 also indicated elevated levels of these constituents and thus cannot be attributed to the acidization and pumping.

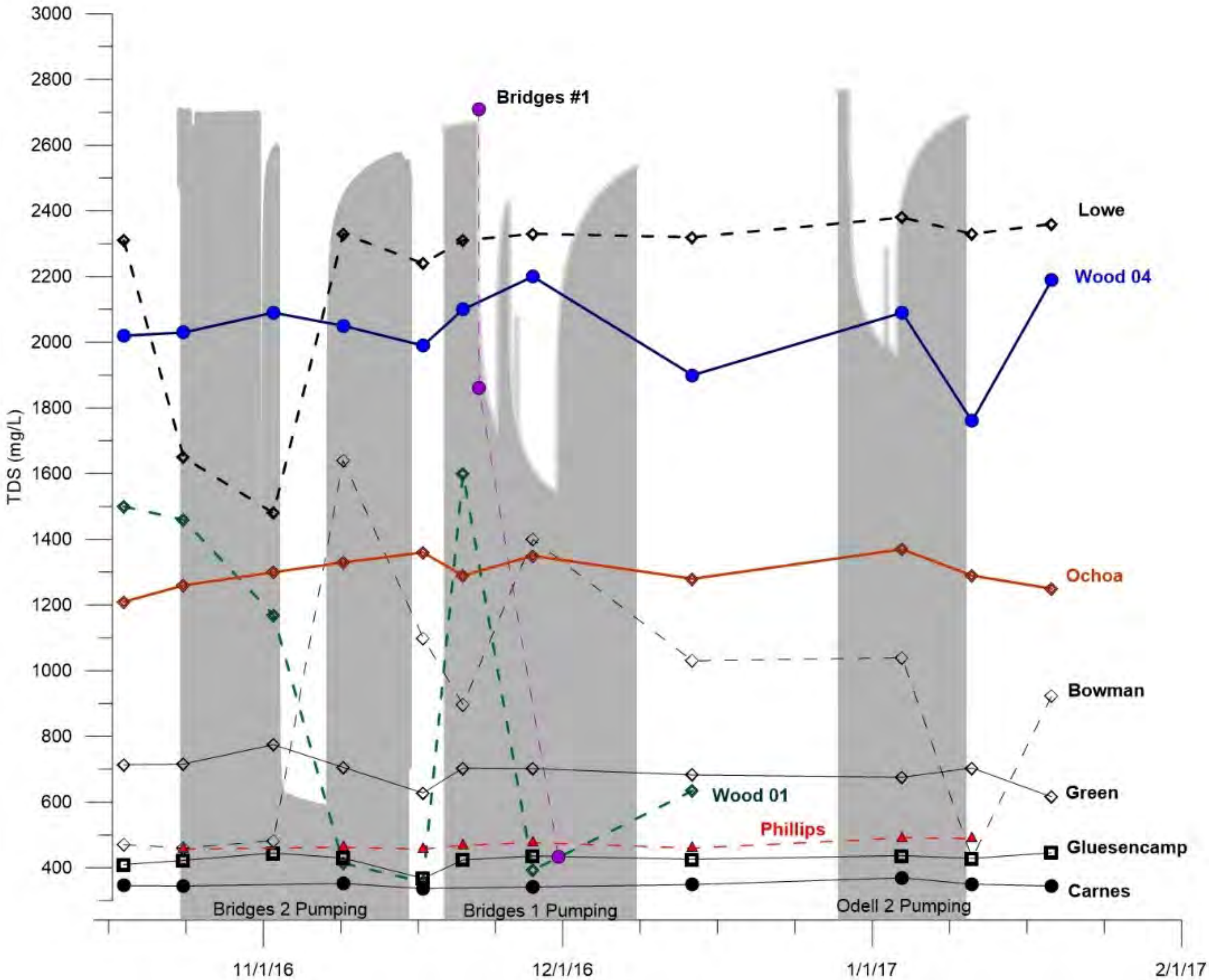


Figure 22. Chemograph of TDS data from pumping and observation wells. *Data from Bridges #2 were off the graph scale immediately after purging of acid residual with concentrations at 19,900 mg/L (10/24/16 13:03), 16,500 mg/L (10/24/16 13:34), and then 732 mg/L (11/15/16 13:10). A single value was obtained for Odell #2 of 484 mg/L (1/3/2017) after the acid residual was purged.(Cow Creek wells= Bridges #1; Bowman, Wood 01, Ochoa, and Lowe; Glen Rose wells =Carnes, Phillips, Gluesencamp, and Wood 04)*

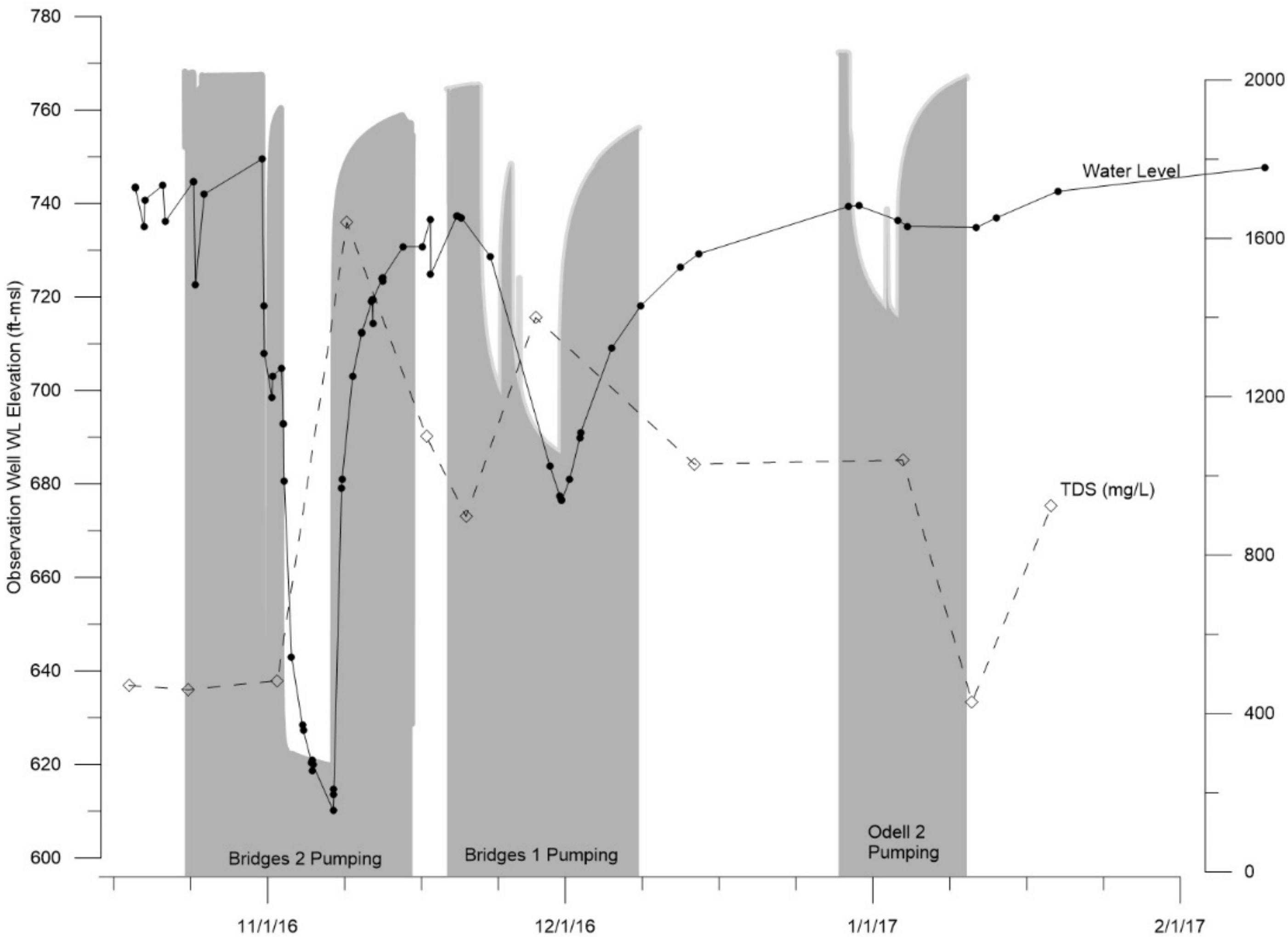


Figure 23. Hydrograph and chemograph from the Bowman observation well. *Drawdown in the vicinity appears to have increased the TDS levels in the Bowman well from 471 mg/L to a temporary peak of more than 1,640 mg/L.*

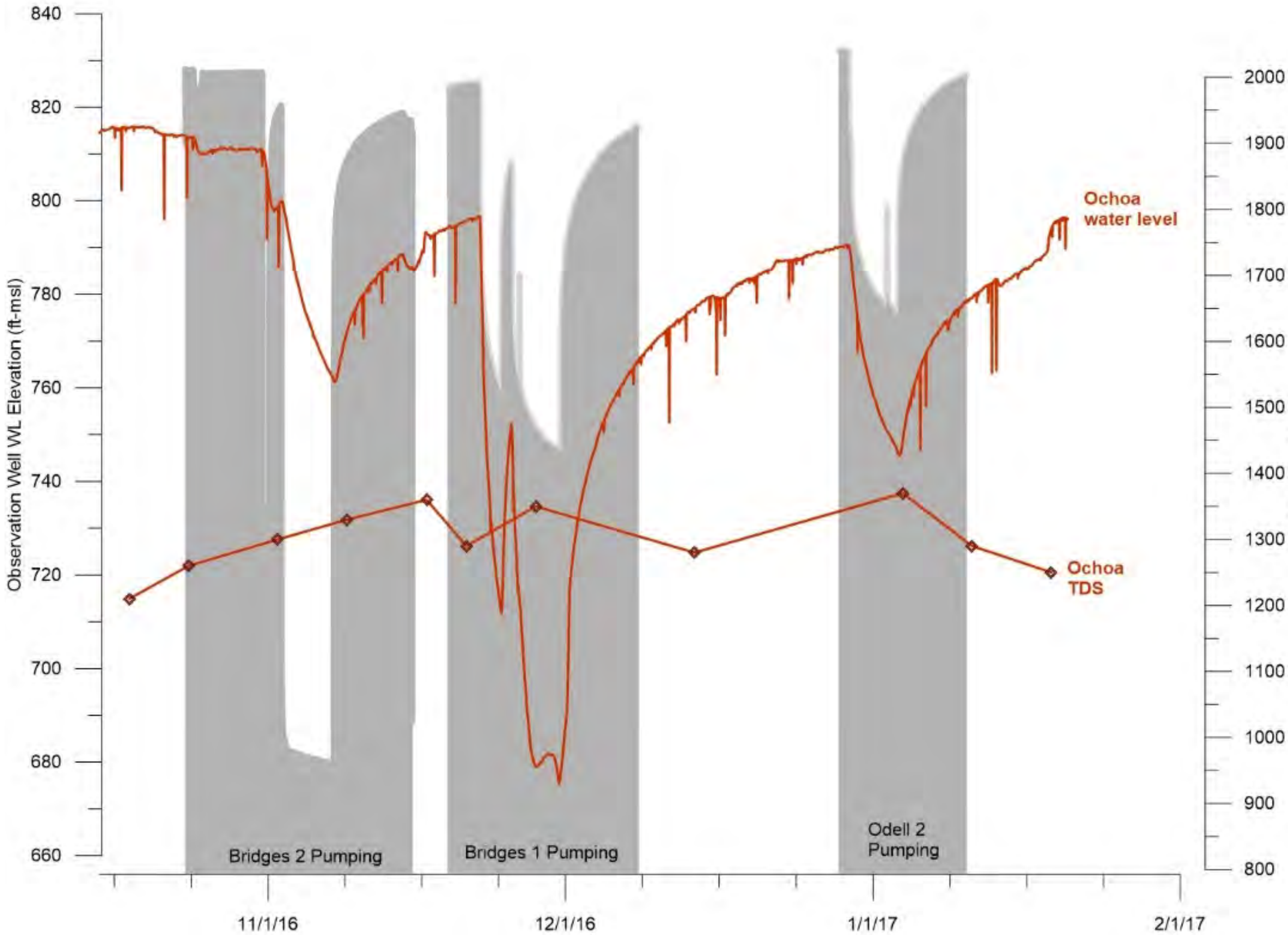


Figure 24. Hydrograph and chemograph from the Ochoa observation well. *TDS appears to have increased over the period of the aquifer test from a baseline of 1,210 mg/L to a peak of 1,350 mg/L.*

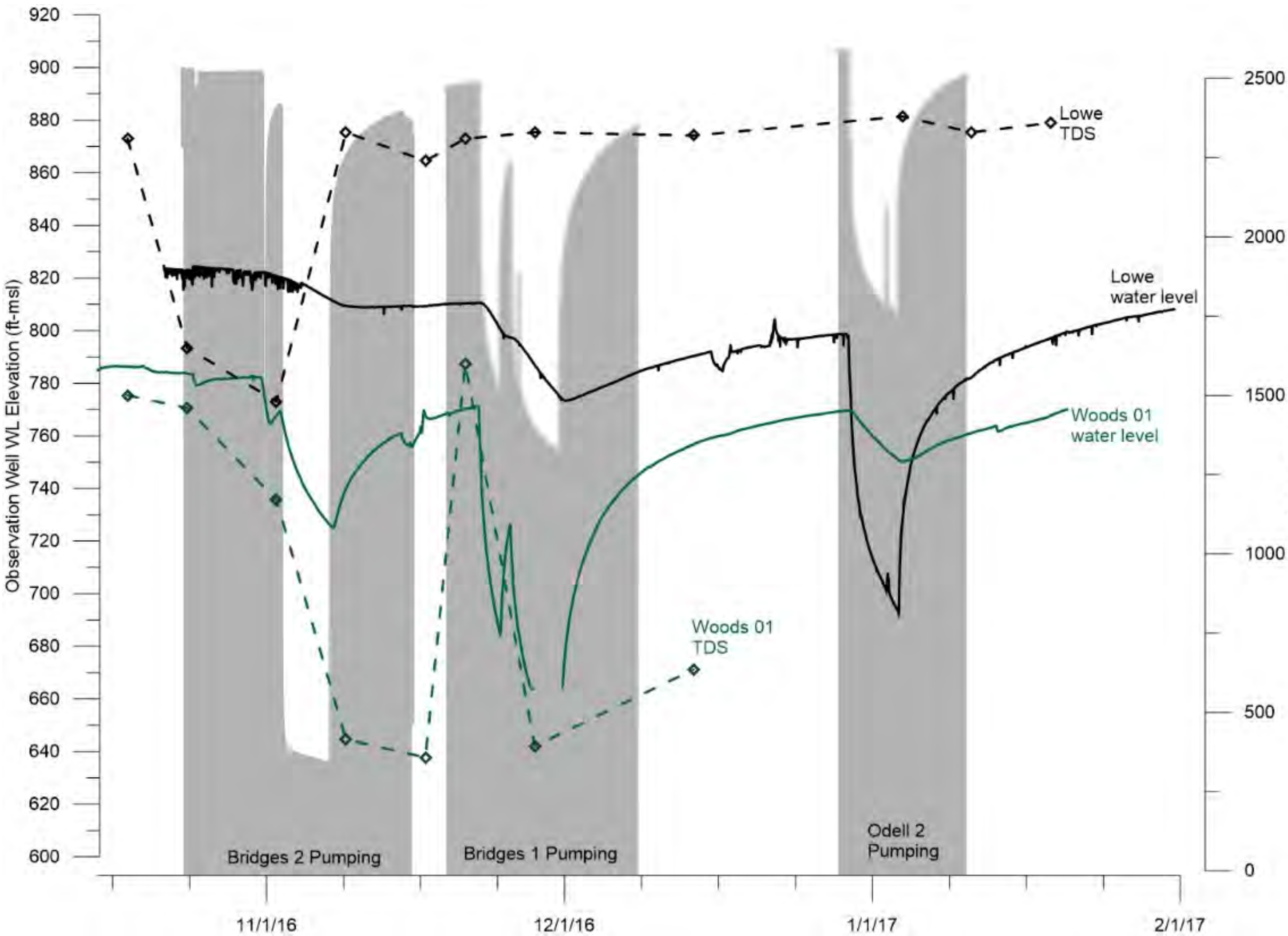


Figure 25. Hydrograph and chemograph from the Lowe and Woods 01 observation wells. *TDS appears to have decreased in the Woods 01 well from a baseline of 1,350 mg/L to a low of 353 mg/L when pumping occurred in the Bridges #2 and #1 wells. Similarly the TDS appears to have decreased in the Lowe well from 2,310 to 1,480 mg/L when the Bridges #2 pumping occurred.*

Multiport Well Data

In cooperation with Hays County, the District installed a multiport monitoring well in March 2016 located about ¼ mile north-northeast of Bridges #1 (**Figure 1**). The multiport well provides detailed hydrogeologic information on the complex geologic units in the study area and is completed with 14 discretely completed zones ranging from the upper portions of the Upper Glen Rose (near upper boundary of Upper Trinity) to the Hammett Shale (lower confining unit of Middle Trinity). Heads and baseline geochemical data have been collected since completion of the well (**Figure 26**). Further data will be collected including permeability, and additional geochemical and head data.

Head and geochemical data shown in **Figure 26** illustrate the complex stacked aquifer system in the study area. Initial data suggest the upper aquifer (Zones 10-12) corresponds to the Upper Trinity (Upper Glen Rose) and is karstic and has fresh water (less than 1,000 mg/L). Zone 9 (Upper Glen Rose) contains gypsum beds that behave as an aquitard and contribute to very high TDS (greater than 3,000 mg/L). Zones 8 and 7 appear to be an aquifer composed locally of a reef within the Lower Glen Rose. The Cow Creek aquifer (Zones 3 and 2) appears to be hydrologically separate from the overlying formations based upon the heads and TDS in Zones 4, 5, and 6. Additional data will help to fully characterize the aquifer and aquitard units.

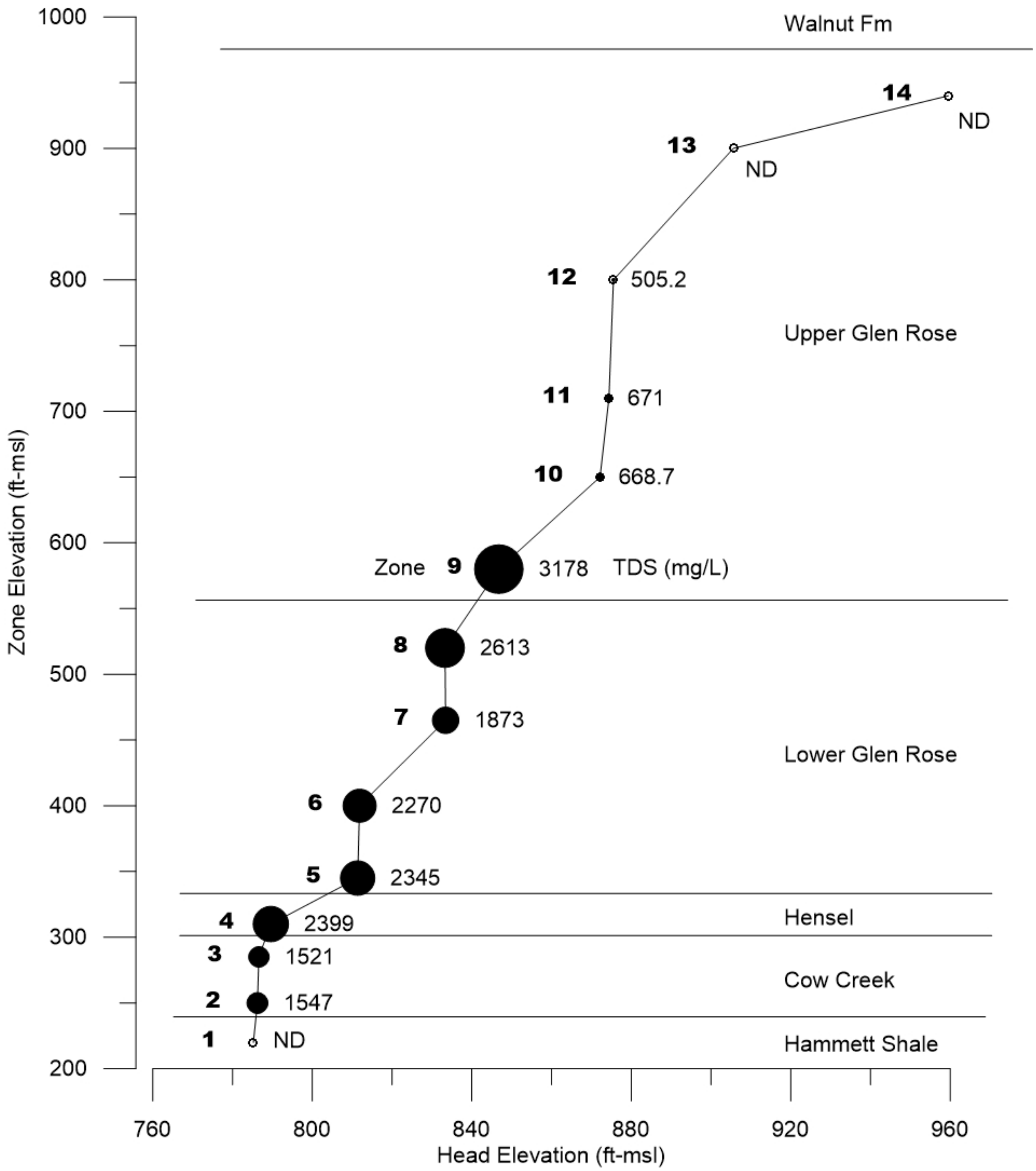


Figure 26. *Hydrograph of May 2016 water levels from the Driftwood (Hays County) Multiport well compared to TDS data collected in June 2016. Dot size is relative to the TDS data. Stratigraphy shown for reference. ND= no data*

Conclusions

The aquifer test and data collected by WRGS, BSEACD, and the EAA constitutes a very robust and good data set. The data and the evaluation in this memo needs to be considered in the conceptual model of the aquifer, the calculation of aquifer parameters, and ultimately an evaluation of potential for unreasonable impacts. The primary conclusions from the aquifer test data include:

1. Production from the Cow Creek test wells during the aquifer test was derived primarily from the Cow Creek formation. The magnitude of drawdown in the Cow Creek was much larger (up to an order of magnitude) than occurred in wells completed in the overlying Glen Rose units (**Figure 9**).

2. Faulting and fracturing appear to strongly influence the drawdown in the vicinity of the proposed well field as illustrated by the asymmetric drawdown in **Figure 9**. Faults may be locally behaving as no-flow boundaries and a contributing factor in the lack of recovery in Cow Creek observation wells (**Figure 11**).

3. Observation well data support a hydrologic connection between the Cow Creek and the overlying Upper and Lower Glen Rose units close to the pumping wells. High rates of pumping appear to induce flow from these overlying units. The effects of drawdown in these overlying units are much smaller in magnitude and also delayed in time when compared to the water-level responses in Cow Creek observation wells.

4. The Hensel formation that overlies the Cow Creek appears to act as a leaky aquitard. The temporary packers used to isolate the Cow Creek indicate a hydrologic separation in the pumped wells. However, the Hensel appears to be at least locally permeable, perhaps along fracture or fault zones, as indicated by the delayed water-level responses in observation wells completed in the overlying units.

5. Geochemical sampling combined with water-level responses supports the concept that high degrees of pumping may induce cross-formational flows into the Cow Creek from other (overlying) units, or perhaps portions of the Cow Creek with different water chemistry. Results indicate that high levels of pumping and drawdown may induce flows that can either reduce, or increase, TDS in nearby Cow Creek observation wells.

6. Data from this aquifer test suggests the Cow Creek aquifer is semi-compartmentalized by faulting and stratigraphy.

7. Data from the multiport monitor well will help to refine and quantify aspects of the conceptual model.

References

BSEACD, 2016, Guidelines for Hydrogeologic Reports and Aquifer Testing, Barton Springs Edwards Aquifer Conservation District, adopted May 12, 2016, 16 p.

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TWDB, 2017, Water Data for Texas <https://waterdatafortexas.org/groundwater/well/5764705>; Accessed February 10, 2017.

USGS, 2017a, USGS 08171290 Blanco Rv at Halifax Rch nr Kyle, TX <https://waterdata.usgs.gov/tx/nwis/dv/?site_no=08171290&agency_cd=USGS&referred_module=sw>; Accessed February 10, 2017.

USGS, 2017b, USGS 08170990 Jacobs Well Spg nr Wimberley, TX <https://waterdata.usgs.gov/tx/nwis/dv/?site_no=08170990&agency_cd=USGS&referred_module=sw>; Accessed February 10, 2017.

Wet Rock Geological Serivces (WRGS), 2017, Hydrogeologic Report of the Electro Purification, LLC Cow Creek Well Field: Hays County, Texas. Report of Findings WRGS 17-001, 80 p + appendices

Appendix A: Well Completion Diagrams

The diagrams are derived from driller's logs, the well owner, and best professional judgement.

Appendix B: Aquifer Test work Plan

Submitted by WRGS.

Appendix C: Water Chemistry Results

Digital data in spreadsheet are available upon request.

Appendix D: Water Level Data

A transducer and manual measurements are available in digital format (spreadsheets) upon request.

Appendix A

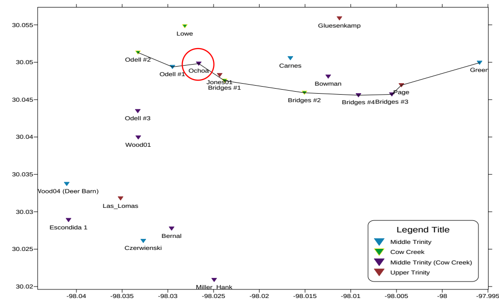
Well Name: Las_Lomas | Well ID: 1006

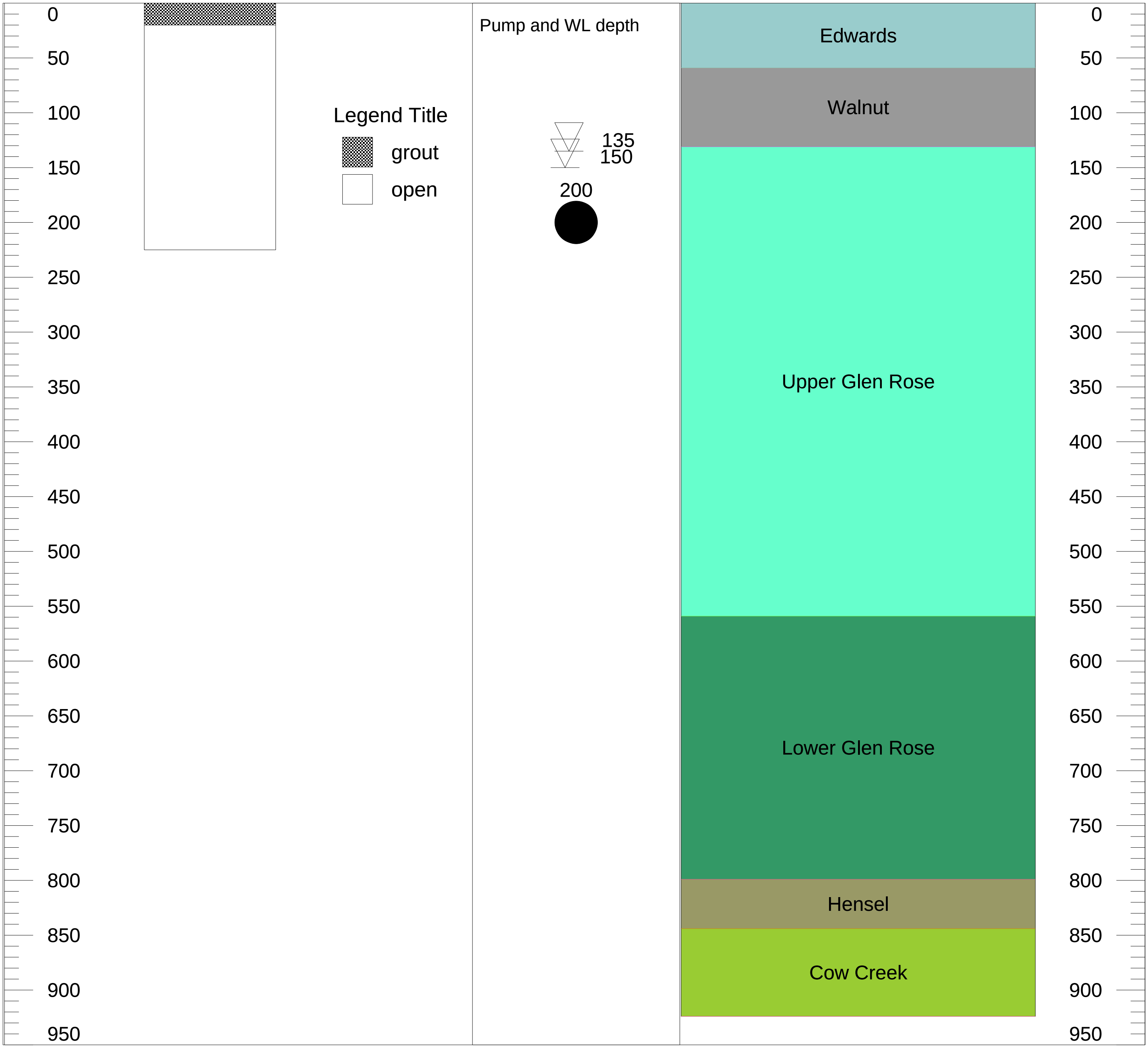
DDlat: 30.03178 | DDlong: -98.035172

Elev: 1069.66 | Aquifer: Upper Trinity

Borehole depth (ft): 225 | Location: 1006 Camino de Rancho

Date Drilled: unknown





Yield (gpm):

Pump depth (ft):

TDS (mg/L):

Comments:

Project: EP Monitoring 2016

Well Name Czerwienski

Well ID 105

DDlat 30.0261

DDlong -98.032688

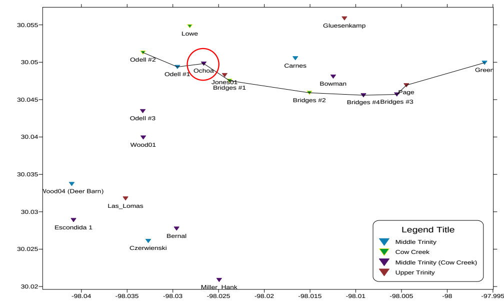
Elev 1134

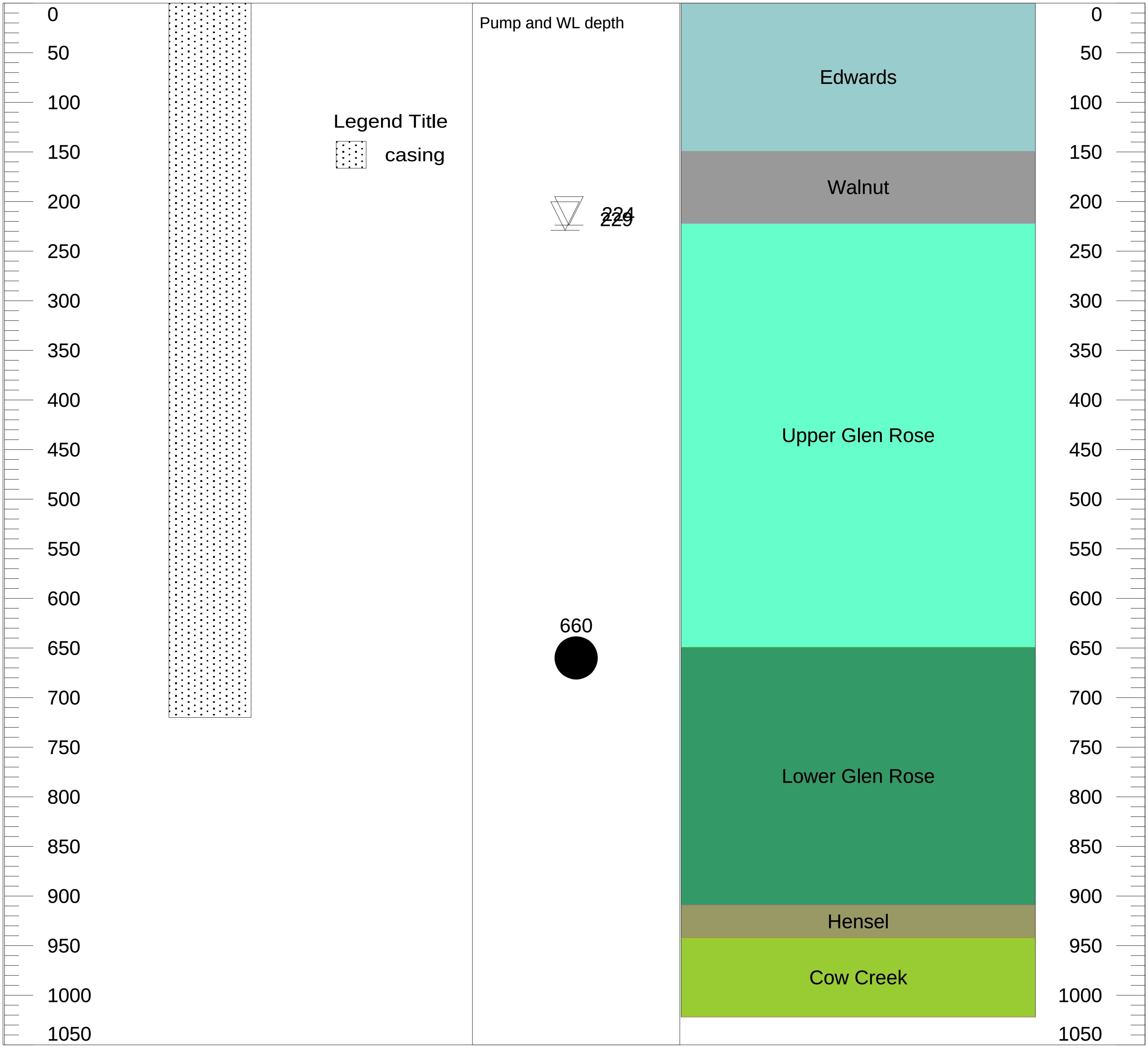
Aquifer Middle Trinity

Borehole depth (ft) 700

Location 105 Camino De Roble

Date Drilled unknown





Yield (gpm)

Comments

Pump depth (ft) 660

TDS (mg/L) 421

Project EP Monitoring 2016

Appendix A

Well Name Bernal

Well ID 198272

DDlat 30.02775

DDlong -98.029591

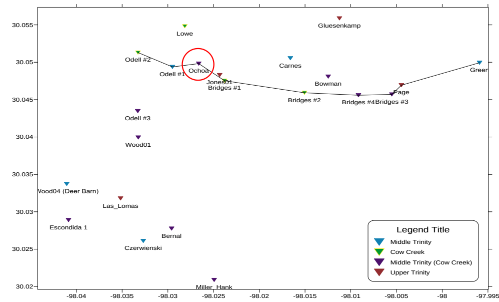
Elev 1118.02

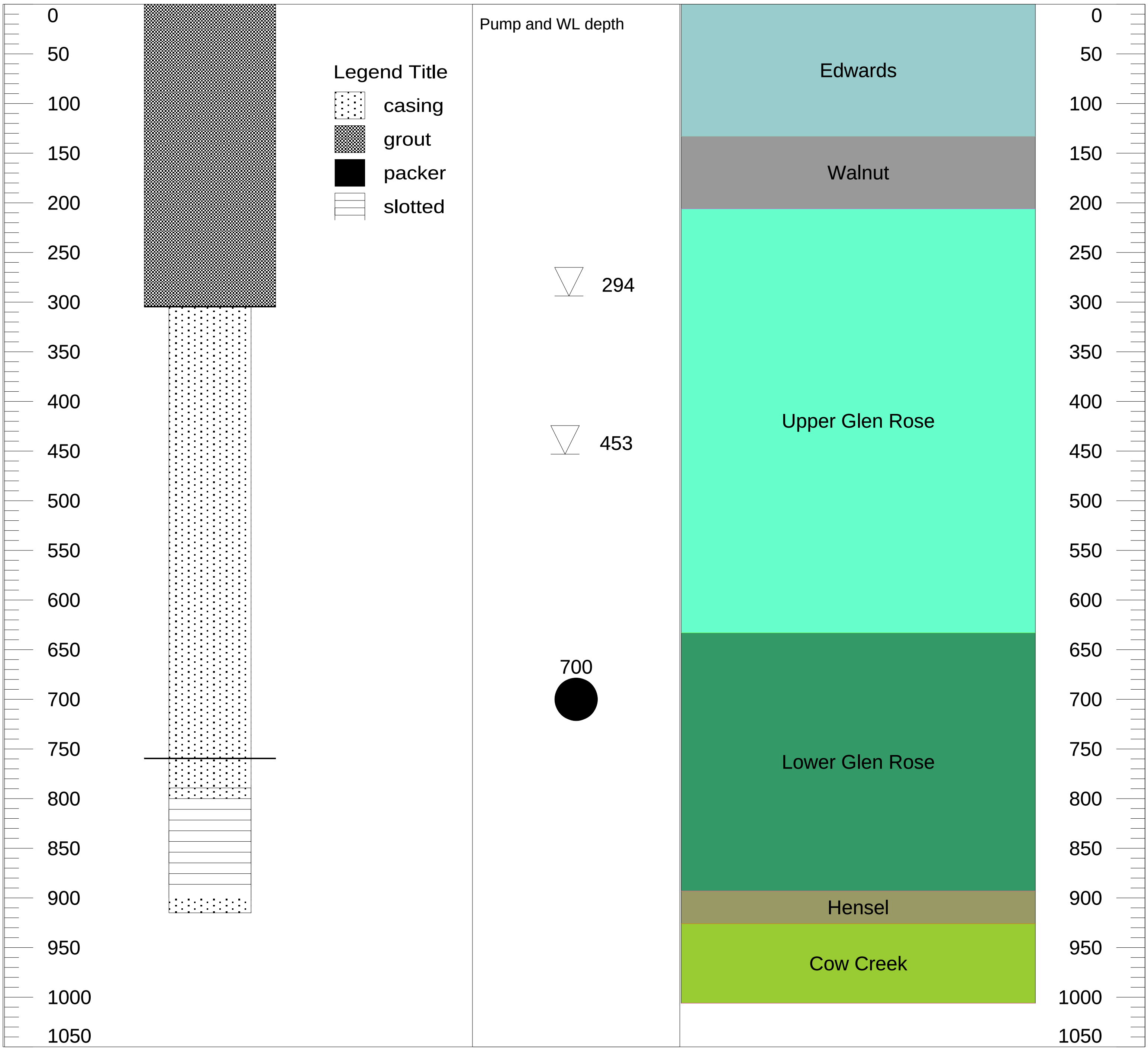
Aquifer Middle Trinity (Cow Creek)

Borehole depth (ft) 915

Location 100 Sendero Arbolado

Date Drilled 21-Sep-09





Yield (gpm) 15

Comments

Pump depth (ft) 700

TDS (mg/L) 530

Project EP Monitoring 2016

Appendix A

Well Name Carnes

Well ID 351

DDlat 30.05054

DDlong -98.016605

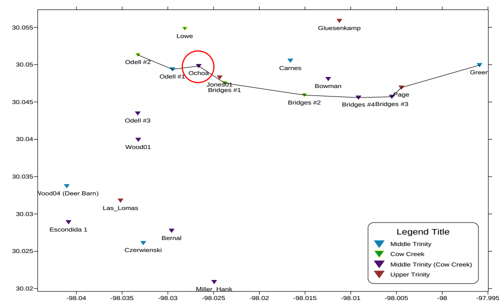
Elev 1028

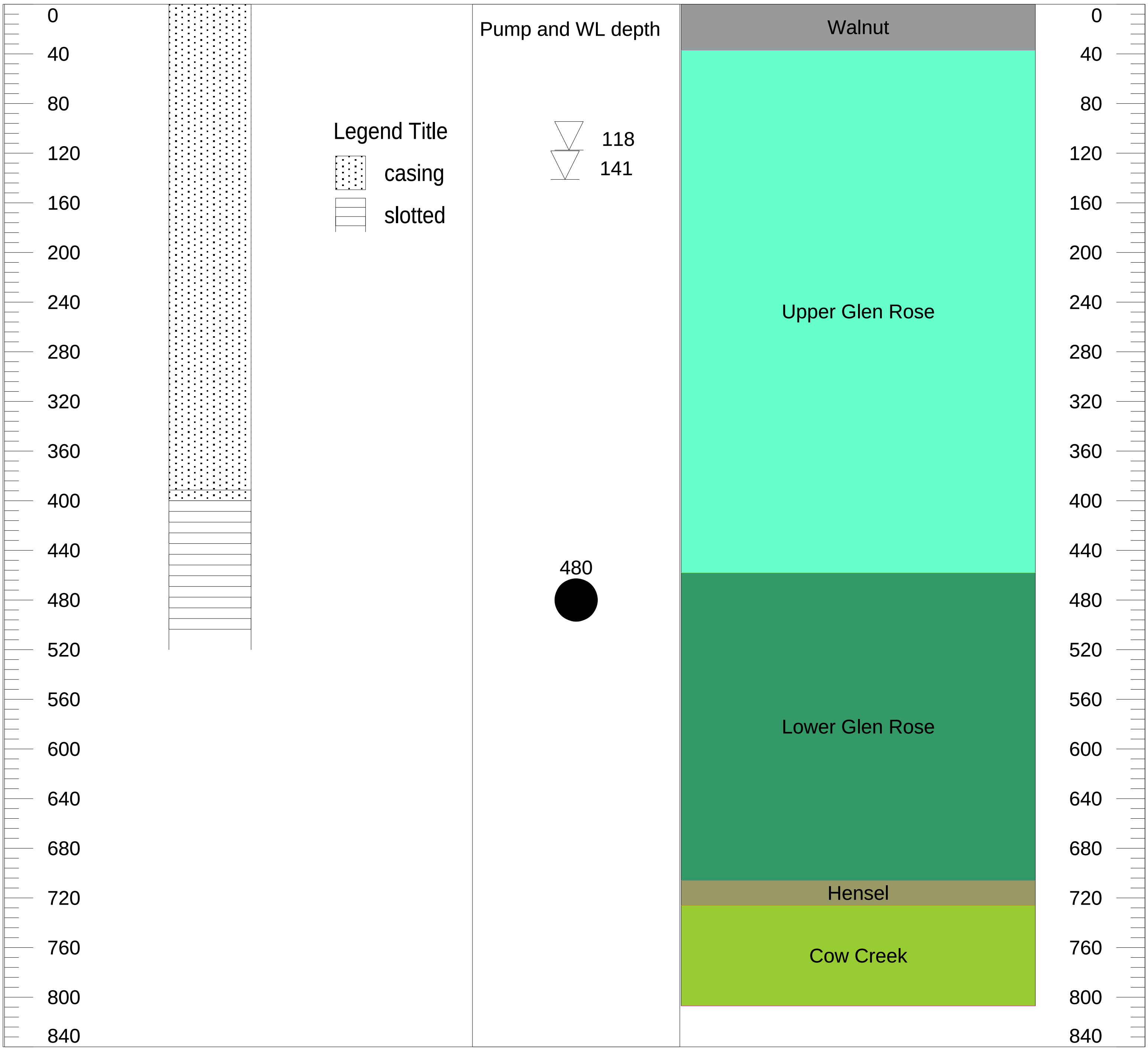
Aquifer Middle Trinity

Borehole depth (ft) 520

Location 351 Limestone Ln

Date Drilled unknown





Yield (gpm)

Comments

Pump depth (ft)

TDS (mg/L)

Project EP Monitoring 2016

Well Name: Bridges #3

Well ID: 353110

DDlat: 30.0457

DDlong: -98.005508

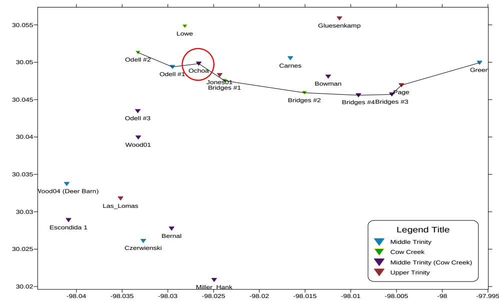
Elev: 1004

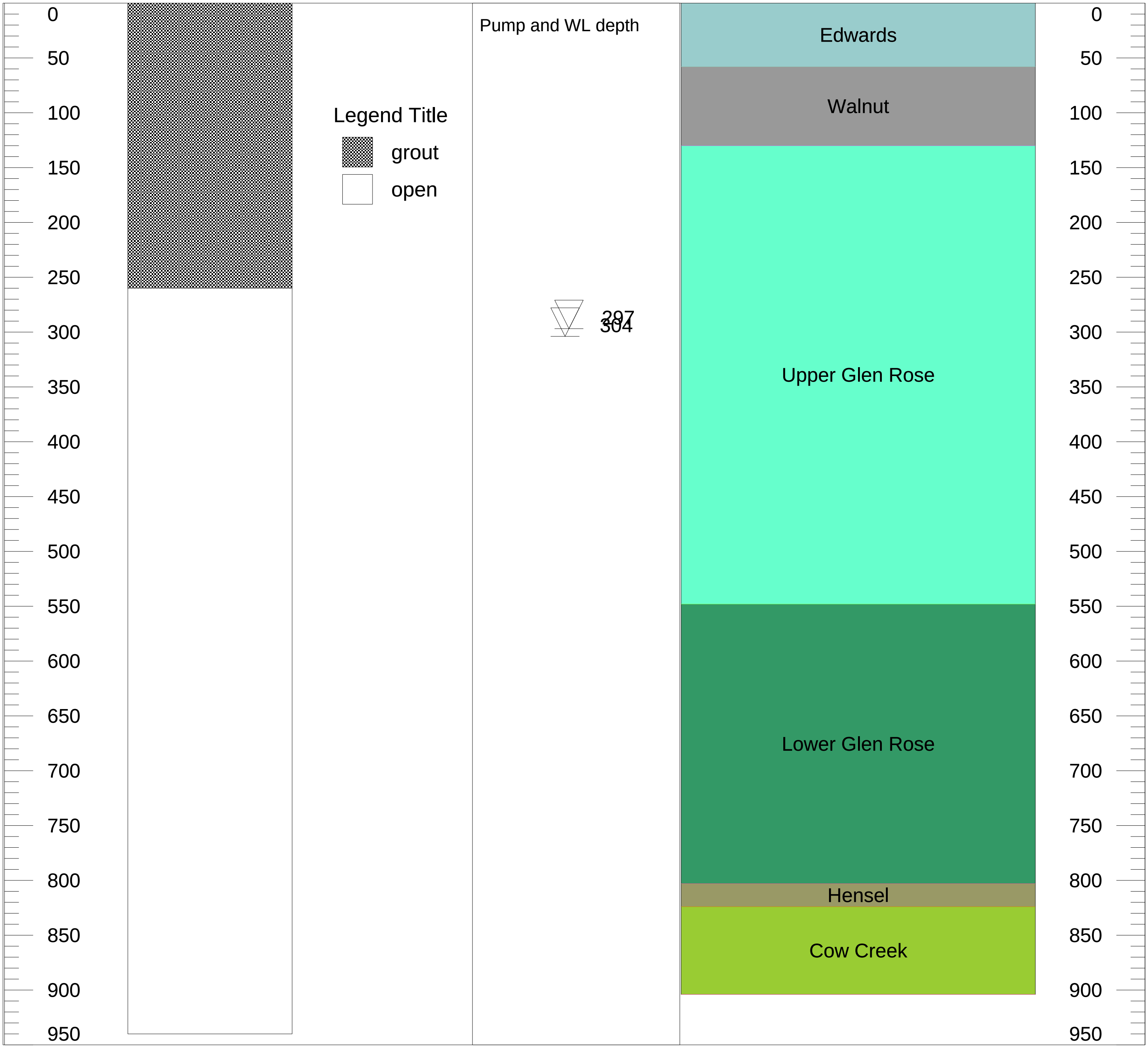
Aquifer: Middle Trinity (Cow Creek)

Borehole depth (ft): 940

Location:

Date Drilled: 03-Jan-14





Yield (gpm):

Comments:

Pump depth (ft):

TDS (mg/L):

Project: EP Monitoring 2016

Appendix A

Well Name: Bridges #1

Well ID: 364899

DDlat: 30.04753

DDlong: -98.023799

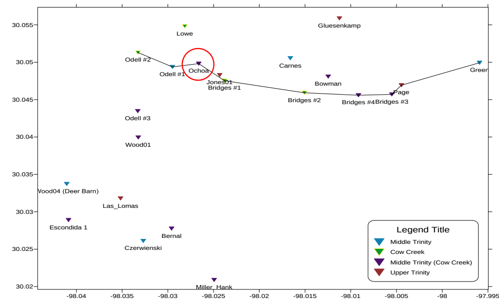
Elev: 1045

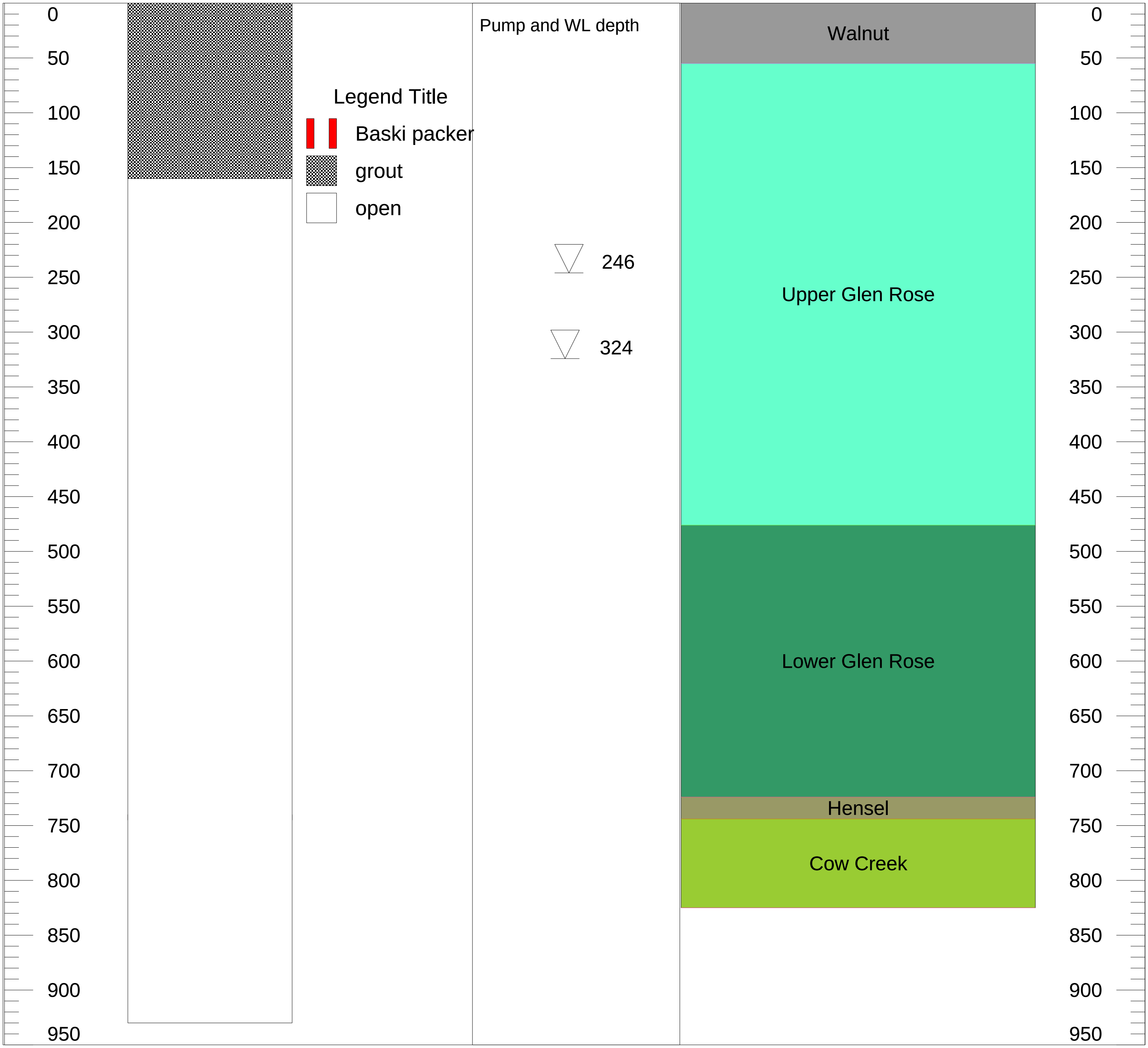
Aquifer: Cow Creek

Borehole depth (ft): 930

Location:

Date Drilled: 20-Dec-13





Yield (gpm)

Comments

Pump depth (ft)

TDS (mg/L)

Project: EP Monitoring 2016

Appendix A

Well Name: Bridges #2

Well ID: 36490

DDlat: 30.04592

DDlong: -98.015065

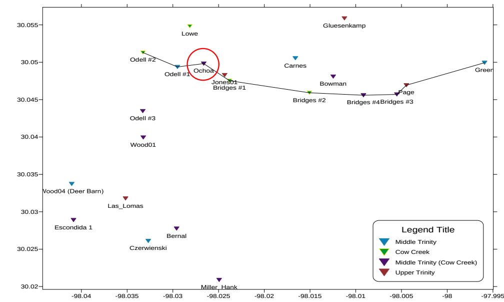
Elev: 1005

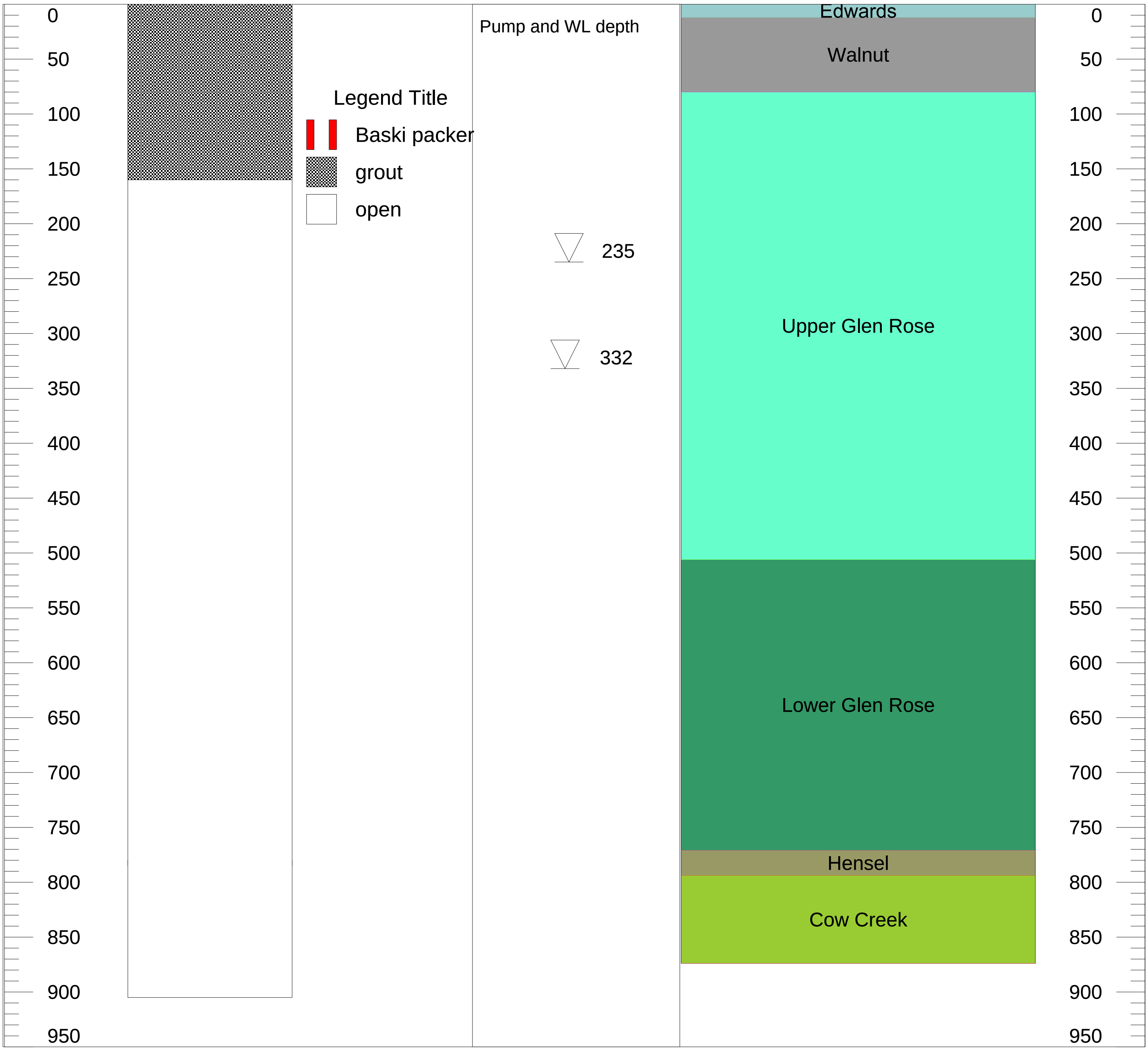
Aquifer: Cow Creek

Borehole depth (ft): 905

Location:

Date Drilled: 14-Jan-14





Yield (gpm)

Comments

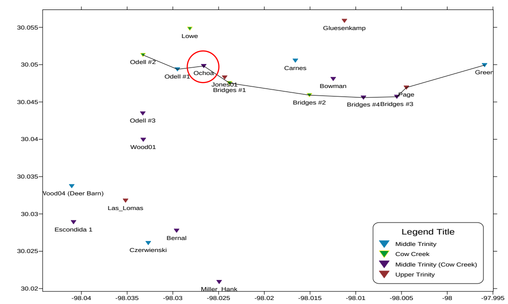
Pump depth (ft)

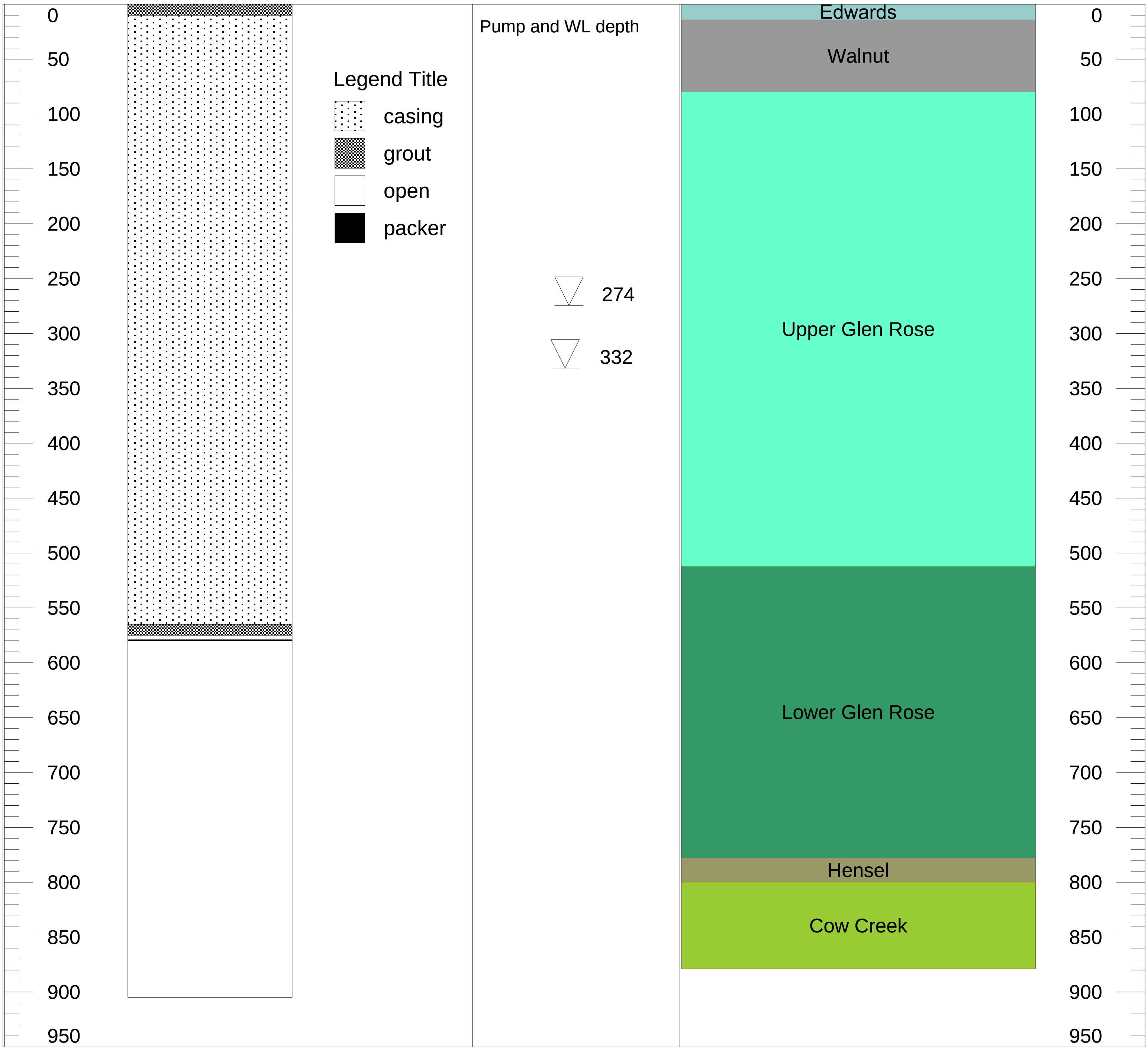
TDS (mg/L)

Project: EP Monitoring 2016

Appendix A

Well Name: Bridges #4
Well ID: 388352
DDlat: 30.04559
DDlong: -98.009159
Elev: 990
Aquifer: Middle Trinity (Cow Creek)
Borehole depth (ft): 905
Location:
Date Drilled: 27-Jan-15

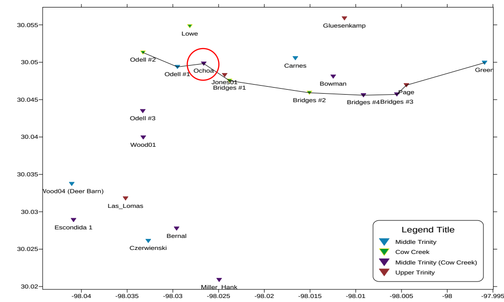


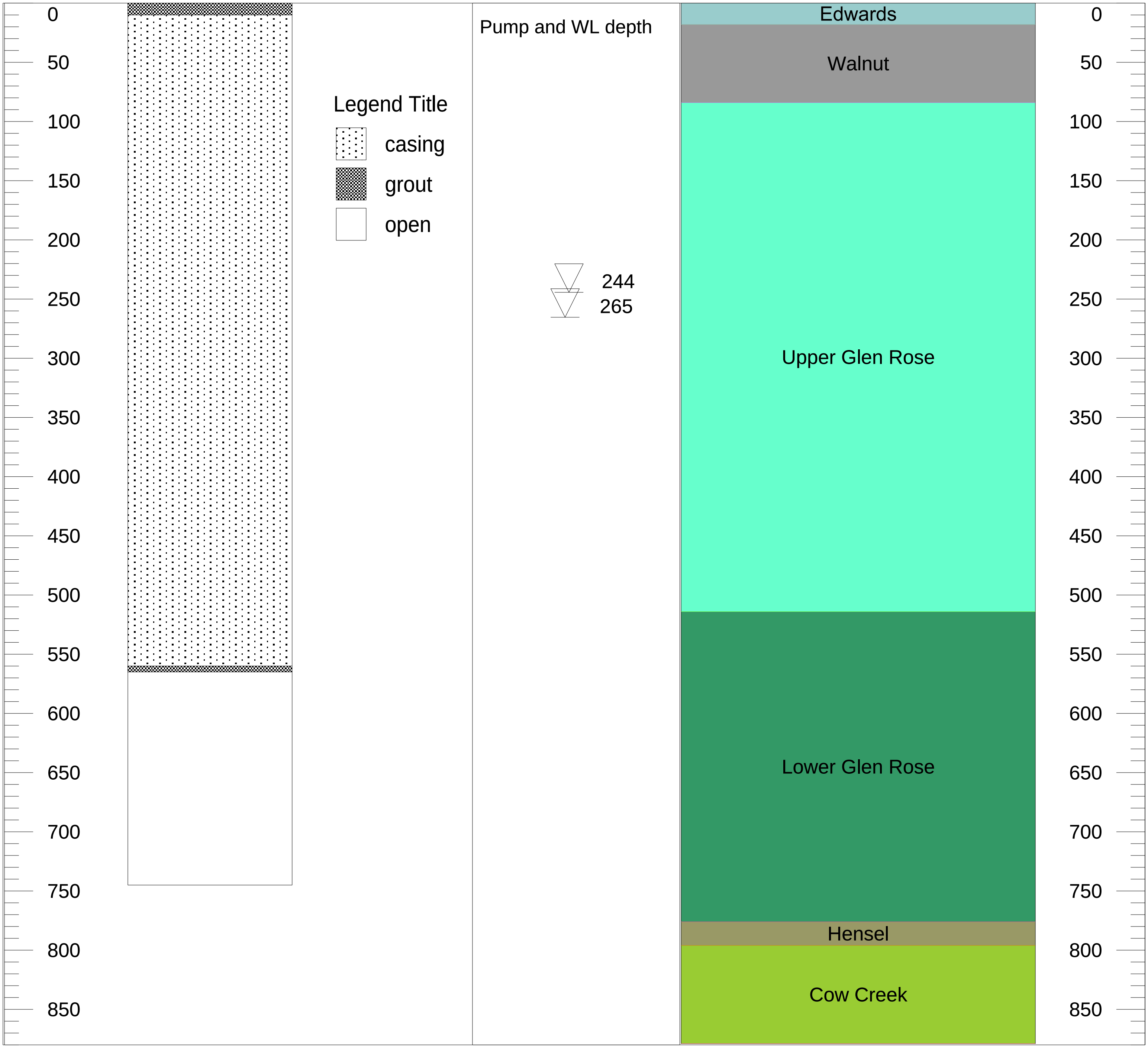


Yield (gpm):
Comments:
Pump depth (ft):
TDS (mg/L):
Project: EP Monitoring 2016

Appendix A

Well Name: Odell #1
Well ID: 388355
DDlat: 30.04937
DDlong: -98.029498
Elev: 1096
Aquifer: Middle Trinity
Borehole depth (ft): 745
Location:
Date Drilled: 19-Jan-15





Yield (gpm):

Comments: plugged back

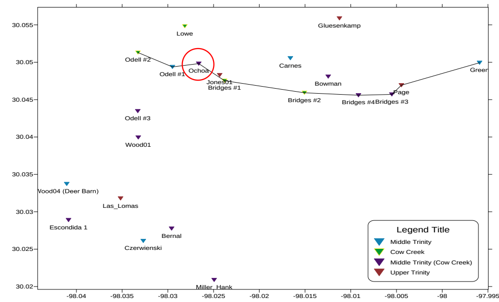
Pump depth (ft):

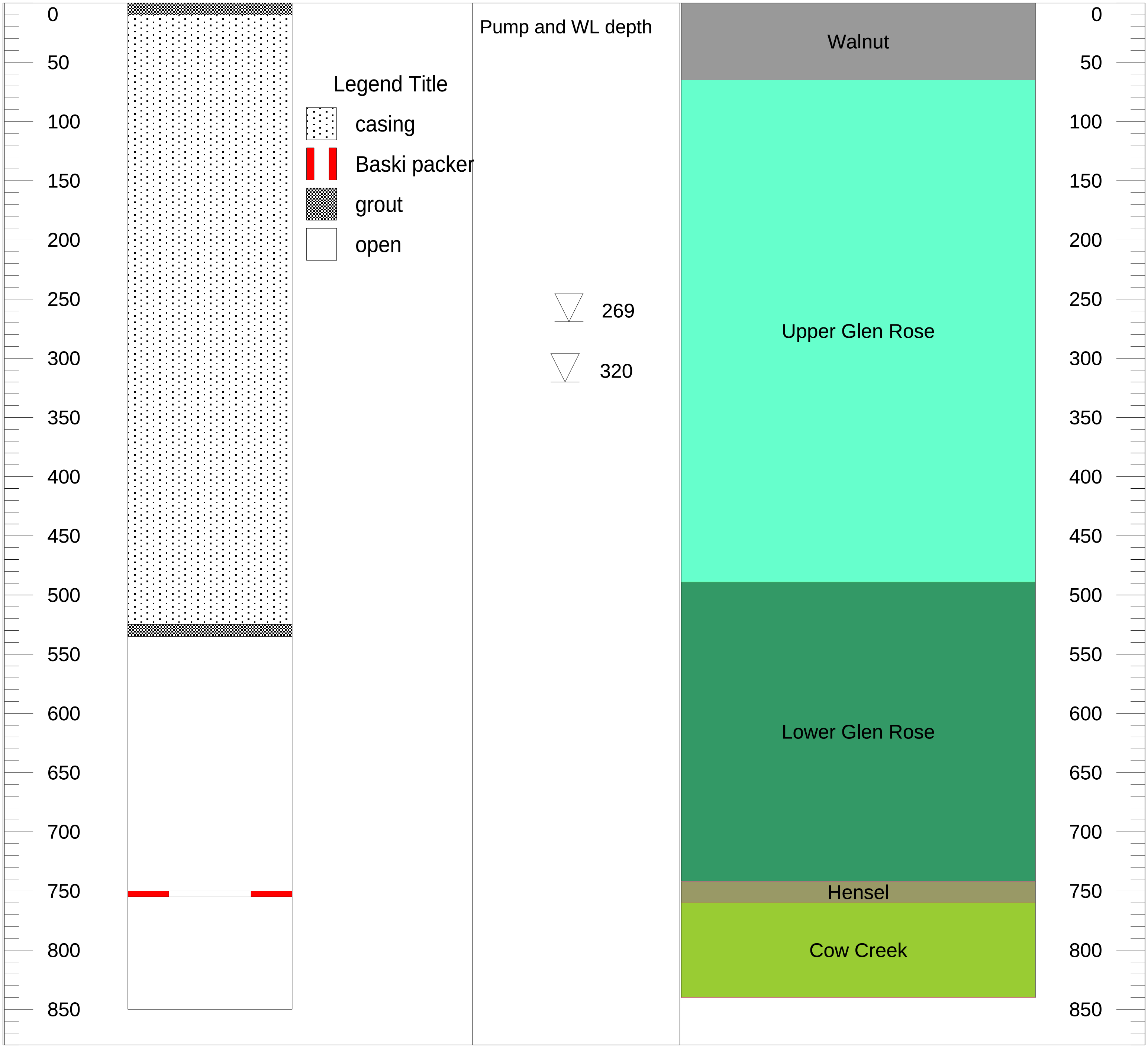
TDS (mg/L):

Project: EP Monitoring 2016

Appendix A

Well Name: Odell #2
Well ID: 388364
DDlat: 30.0513
DDlong: -98.033266
Elev: 1097
Aquifer: Cow Creek
Borehole depth (ft): 850
Location:
Date Drilled: 10-Feb-15





Yield (gpm):
Pump depth (ft):
TDS (mg/L):
Comments:
Project: EP Monitoring 2016

Appendix A

Well Name Odell #3

Well ID 388365

DDlat 30.04347

DDlong -98.033288

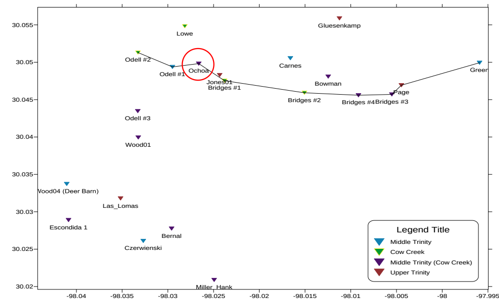
Elev 1068

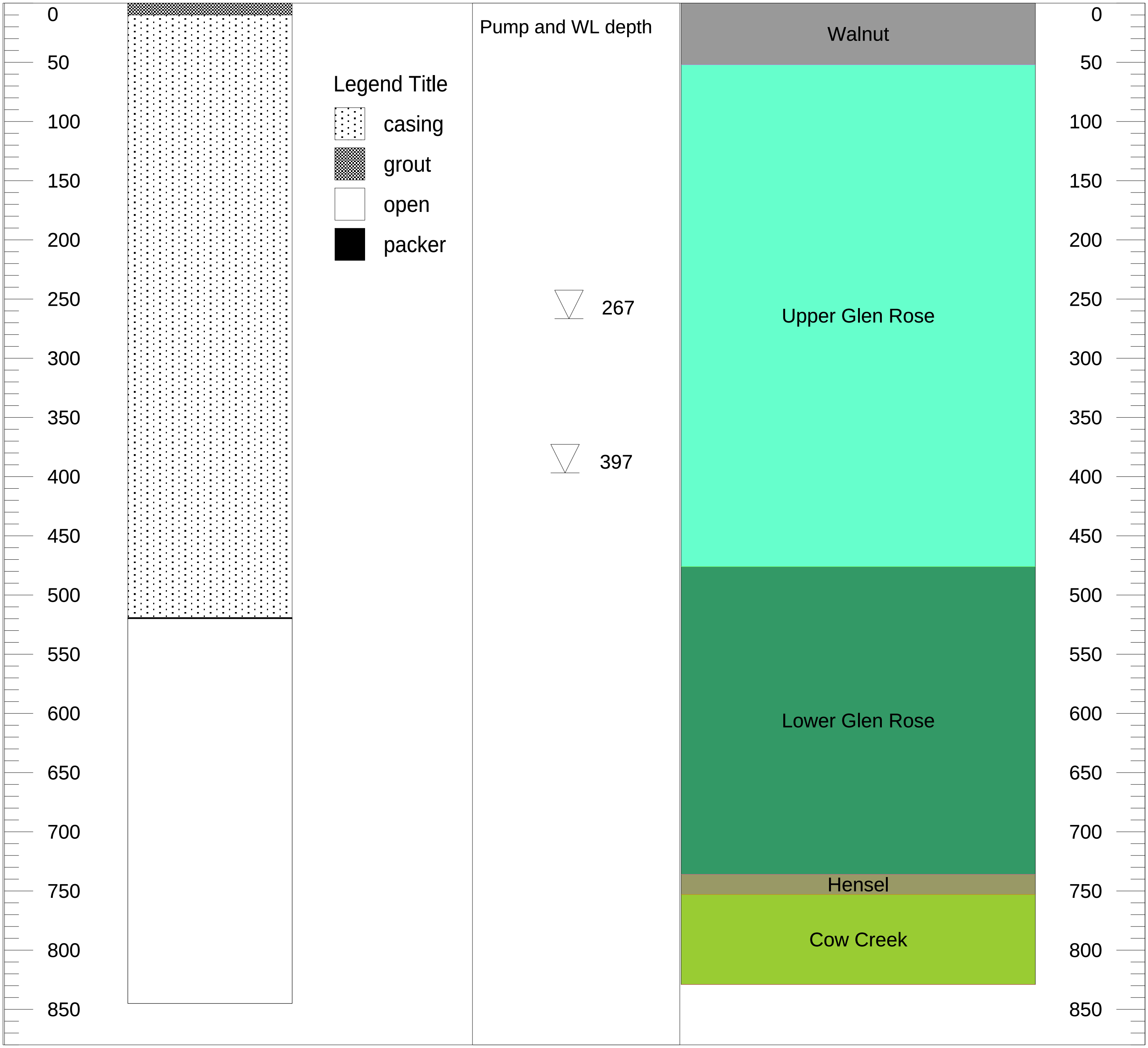
Aquifer Middle Trinity (Cow Creek)

Borehole depth (ft) 845

Location

Date Drilled 29-Jan-15





Yield (gpm)

Comments

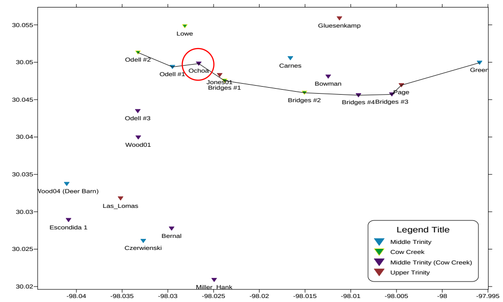
Pump depth (ft)

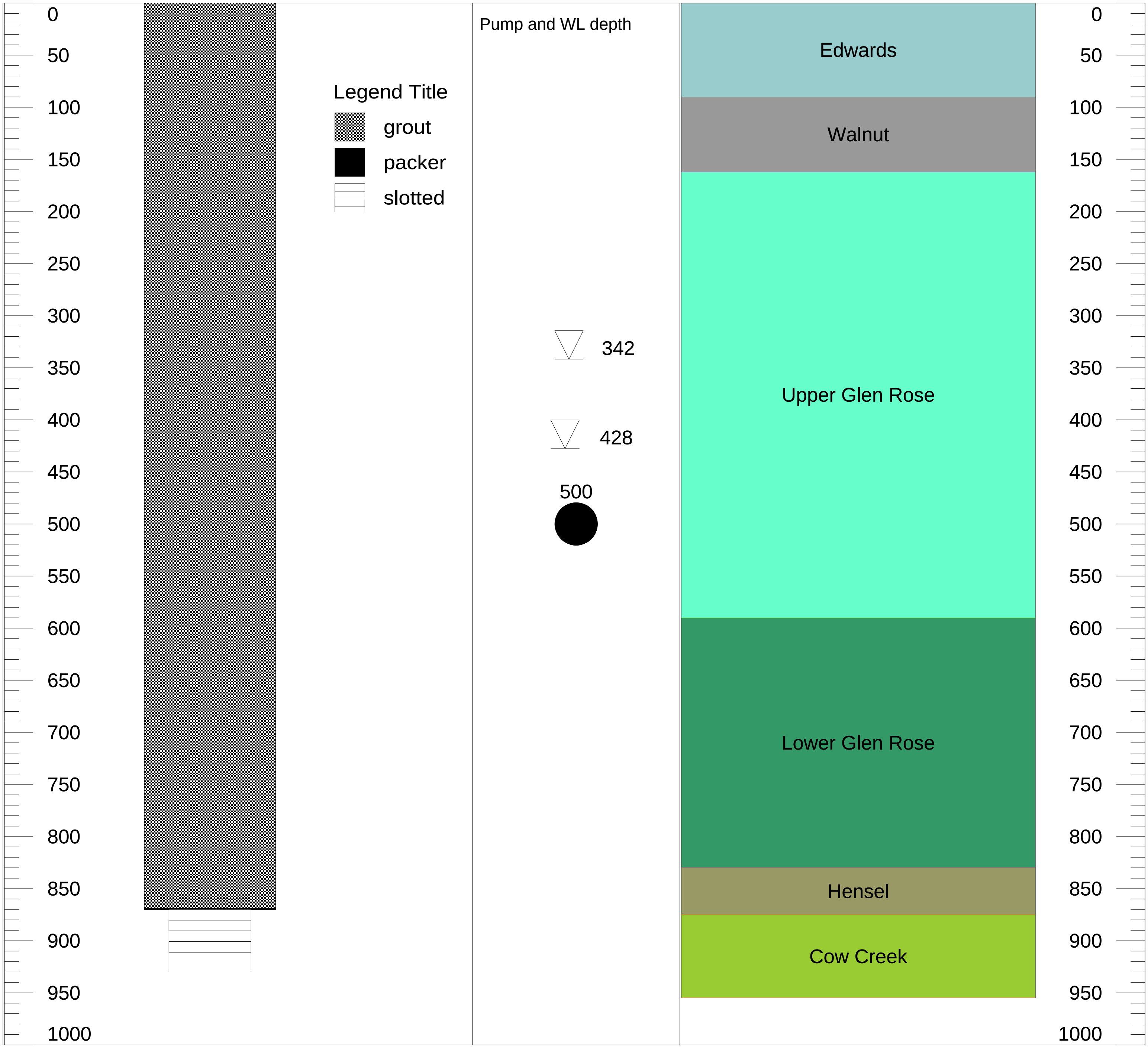
TDS (mg/L)

Project EP Monitoring 2016

Appendix A

Well Name	Escondida 1	Well ID	435981
DDlat	30.02889	DDlong	-98.040862
Elev	1104	Aquifer	Middle Trinity (Cow Creek)
Borehole depth (ft)	930	Location	5000 FM 3237 Wimberley, TX
Date Drilled	12-Sep-16		

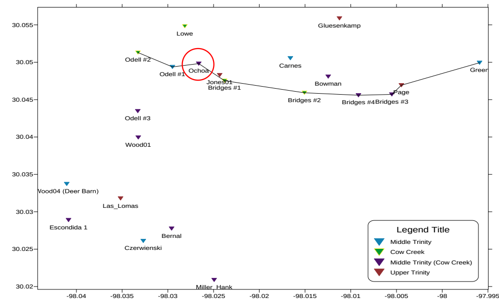


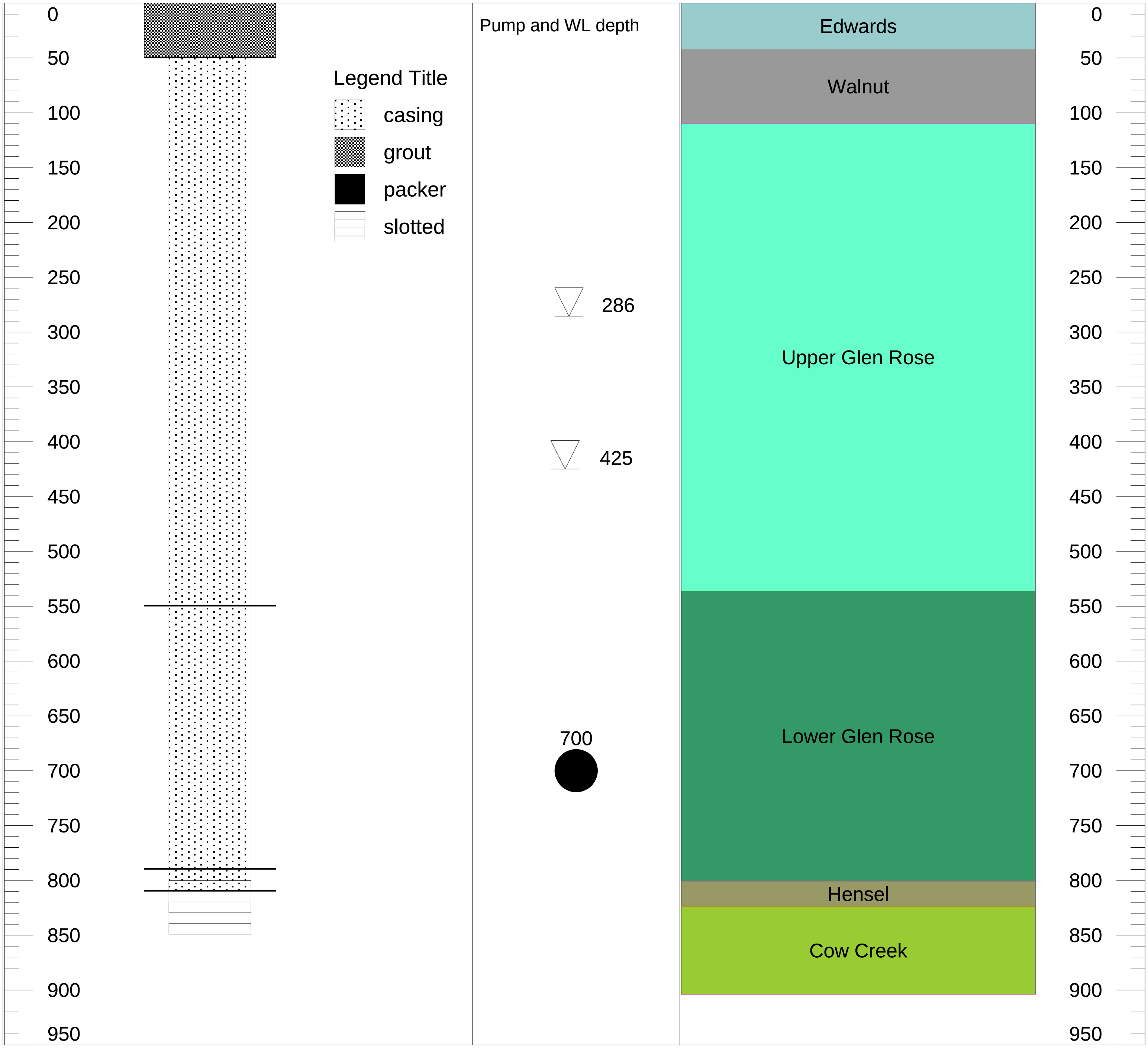


Yield (gpm)		Comments	aquifer test available
Pump depth (ft)			
TDS (mg/L)		Project	EP Monitoring 2016

Appendix A

Well Name	Bowman	Well ID	5764604
DDlat	30.04808	DDlong	-98.012465
Elev	1035	Aquifer	Middle Trinity (Cow Creek)
Borehole depth (ft)	850	Location	7505 FM 3227
Date Drilled	20-Dec-13		





Yield (gpm)	50	Comments	
Pump depth (ft)			
TDS (mg/L)	455	Project	EP Monitoring 2016

Well Name Ochoa

Well ID 5764605

DDlat 30.04982

DDlong -98.026624

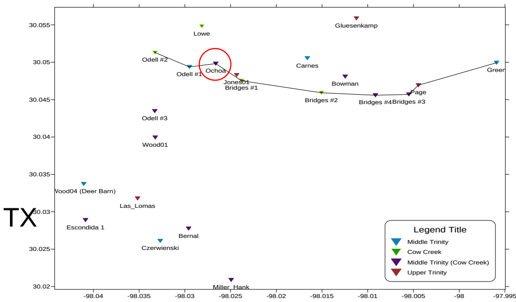
Elev 1073

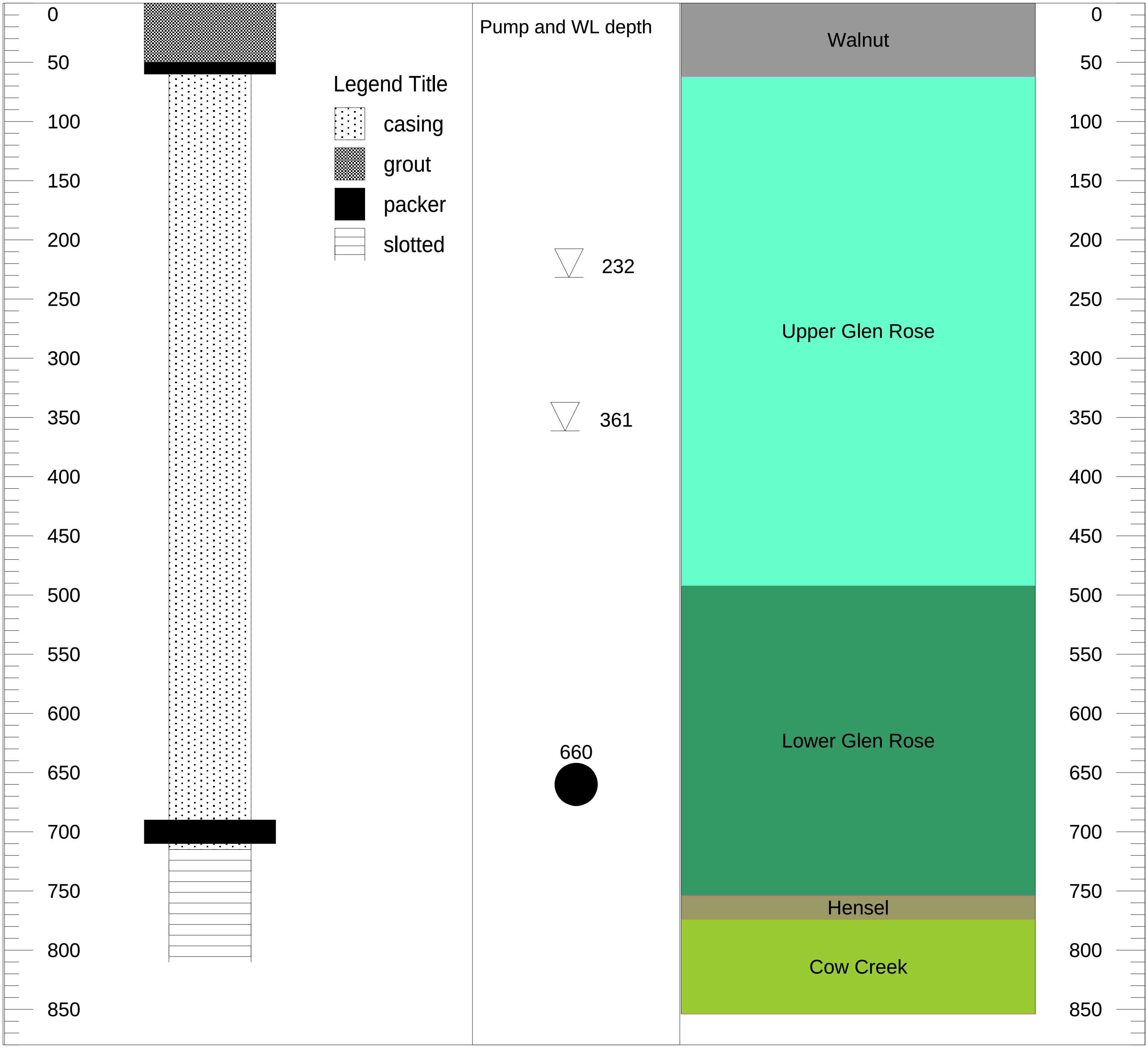
Aquifer Middle Trinity (Cow Creek)

Borehole depth (ft) 810

Location 126 Bumblebee Lane, Wimberley, TX

Date Drilled 27-Mar-02





Yield (gpm) 50

Comments

Pump depth (ft) 660

TDS (mg/L) 1065

Project EP Monitoring 2016

Appendix A

Well Name Gluesenkamp

Well ID 5764606

DDlat 30.05587

DDlong -98.011238

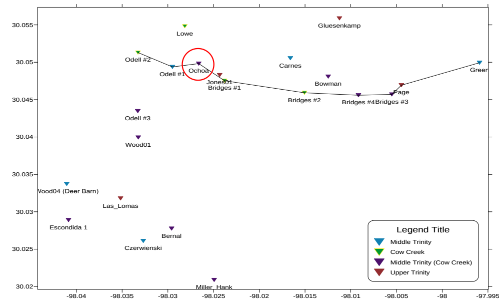
Elev 1007

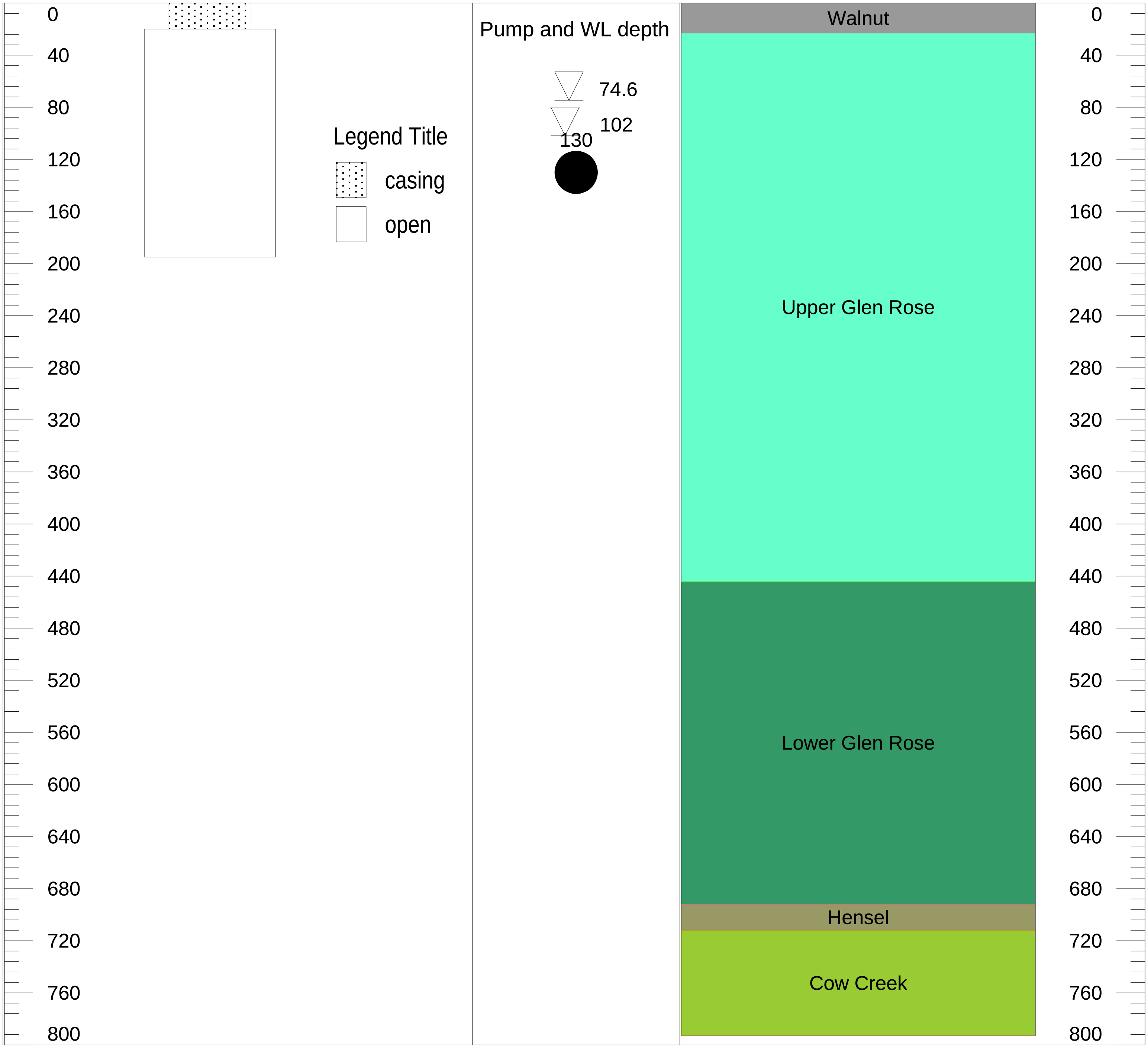
Aquifer Upper Trinity

Borehole depth (ft) 195

Location 700 Billie Brooks Dr

Date Drilled unknown





Yield (gpm)

Comments

Pump depth (ft)

TDS (mg/L) 388

Project EP Monitoring 2016

Appendix A

Well Name Lowe

Well ID 5764607

DDlat 30.05481

DDlong -98.028147

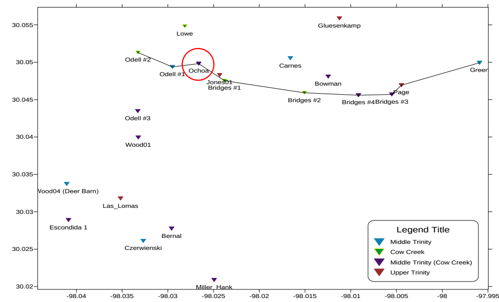
Elev 1070

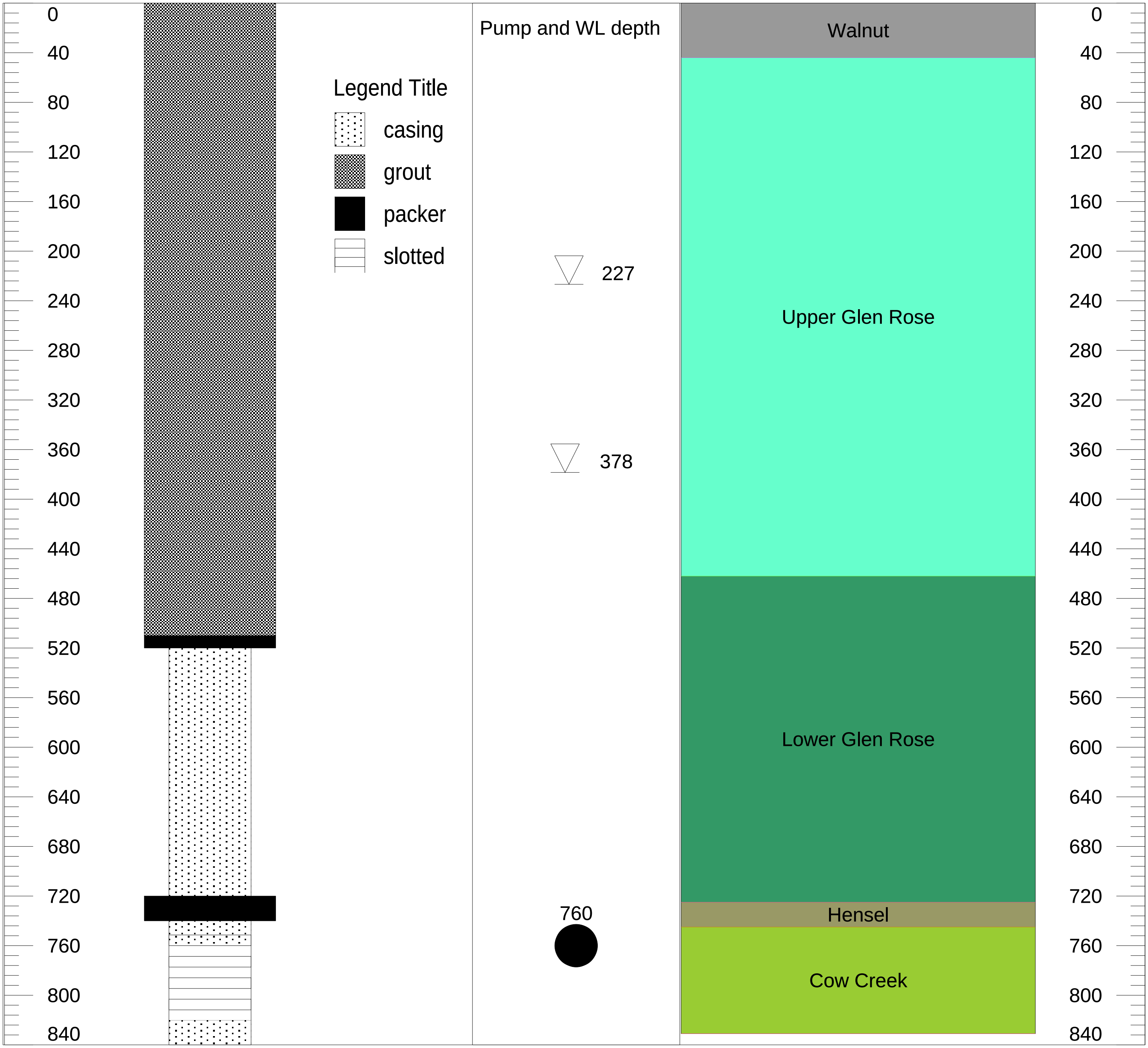
Aquifer Cow Creek

Borehole depth (ft) 860

Location 891 Jennifer Lane

Date Drilled 15-Apr-15





Yield (gpm) 50

Comments

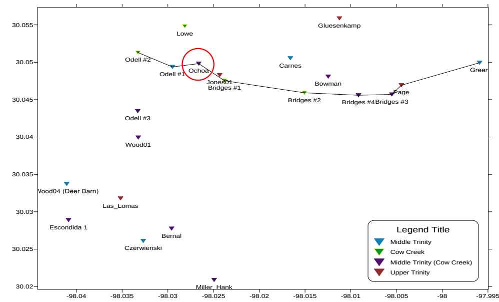
Pump depth (ft) 760

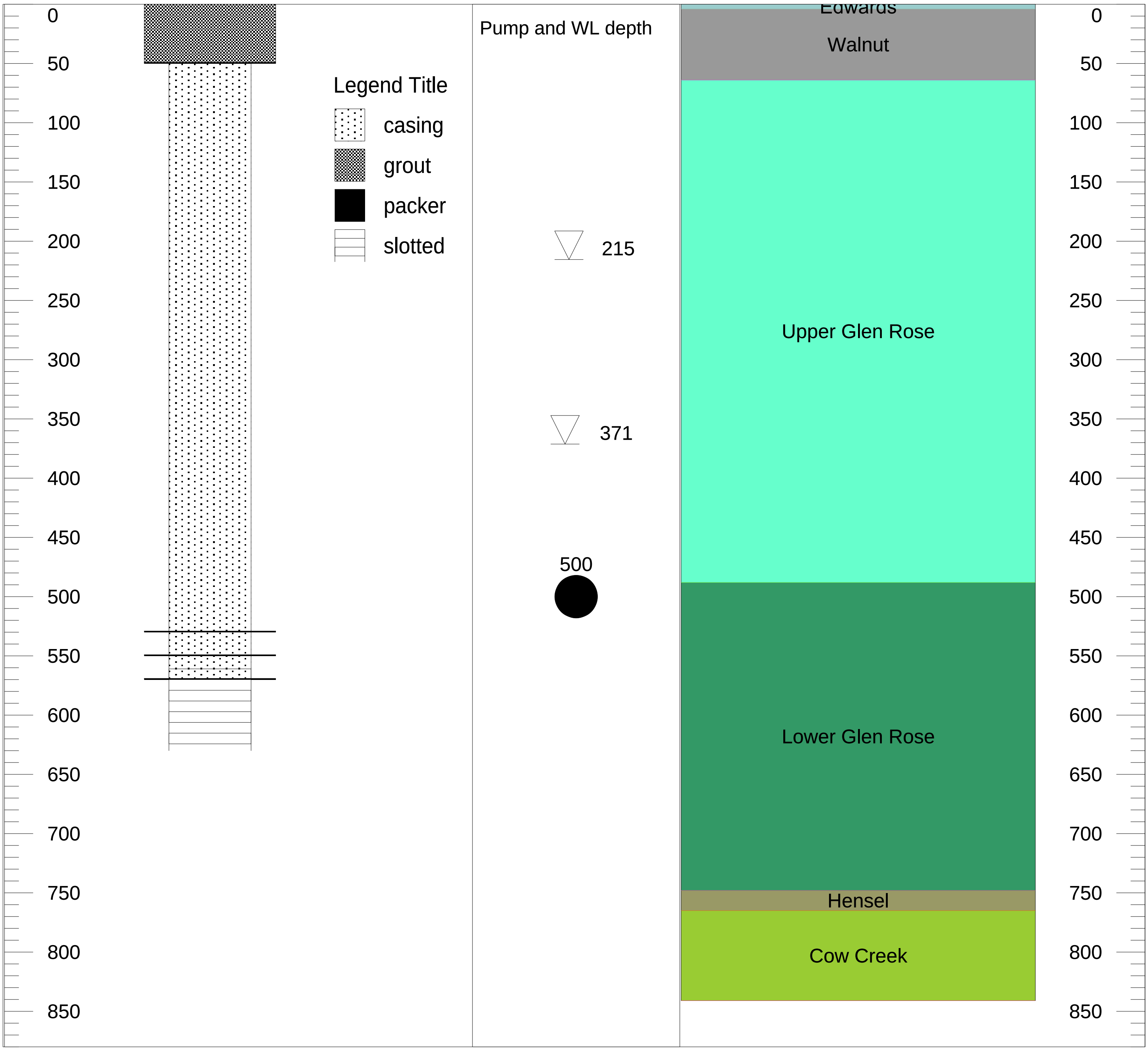
TDS (mg/L) 1840

Project EP Monitoring 2016

Appendix A

Well Name: Wood04 (Deer Barn)
Well ID: 5764818
DDlat: 30.03372
DDlong: -98.041058
Elev: 1081
Aquifer: Middle Trinity
Borehole depth (ft): 630
Location: 501 Deer Lake
Date Drilled: 15-Nov-05





Yield (gpm): 100
Comments: estimated pump depth
Pump depth (ft): 500
TDS (mg/L): 937
Project: EP Monitoring 2016

Appendix A

Well Name Wood01

Well ID 5764907

DDlat 30.03994

DDlong -98.033235

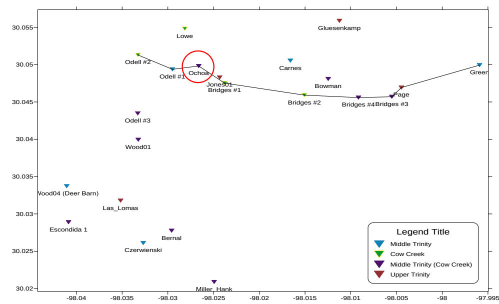
Elev 1067

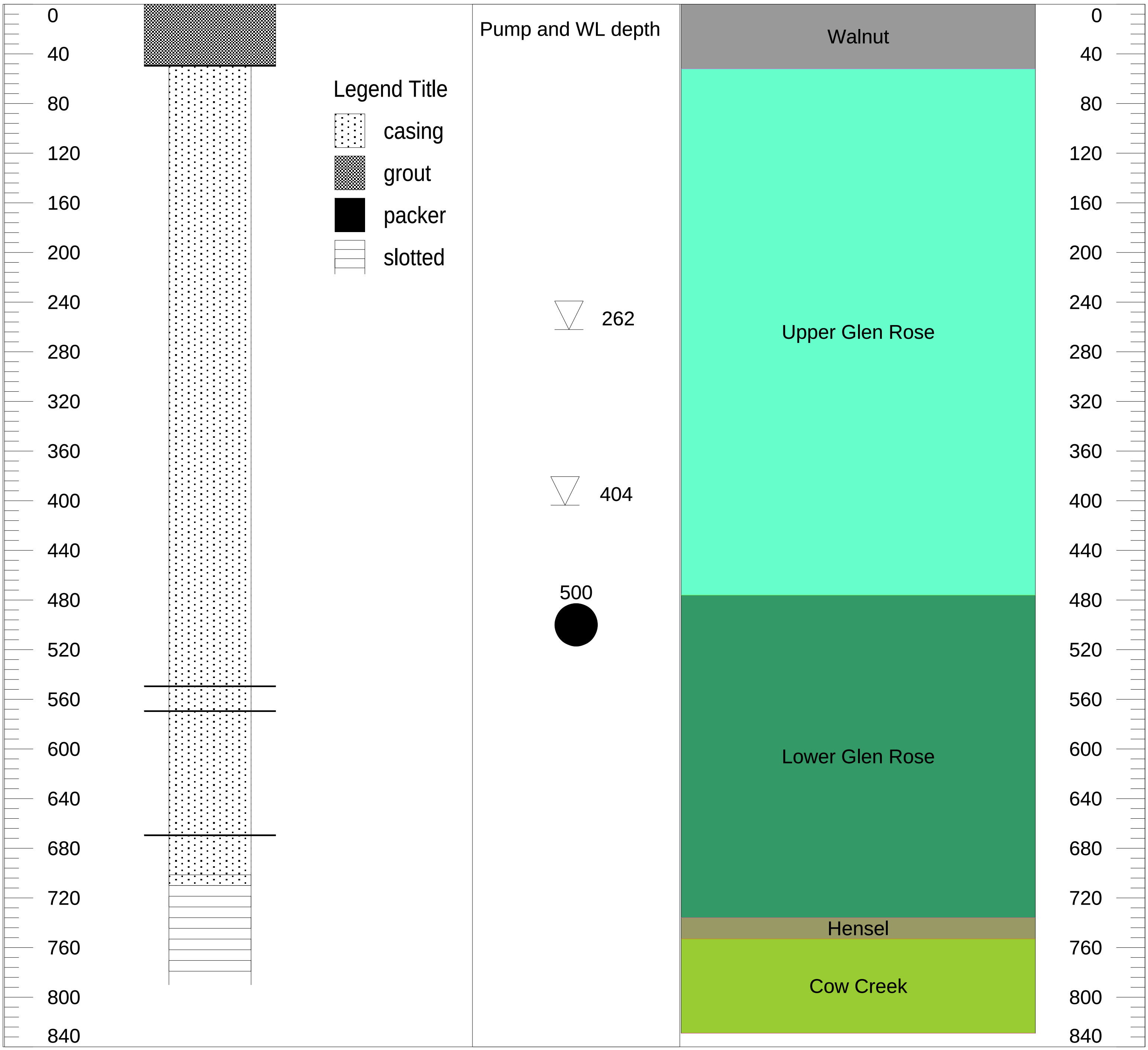
Aquifer Middle Trinity (Cow Creek)

Borehole depth (ft) 790

Location BRYARWOOD RANCH

Date Drilled 08-Oct-10





Yield (gpm) 100

Pump depth (ft) 500

TDS (mg/L) 1357

Comments estimated pump depth

Project EP Monitoring 2016

Appendix A

Well Name Miller_Hank

Well ID 5764908

DDlat 30.02088

DDlong -98.024938

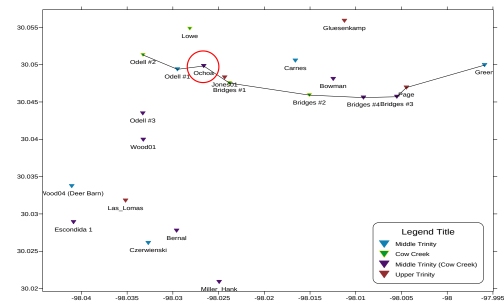
Elev 1066

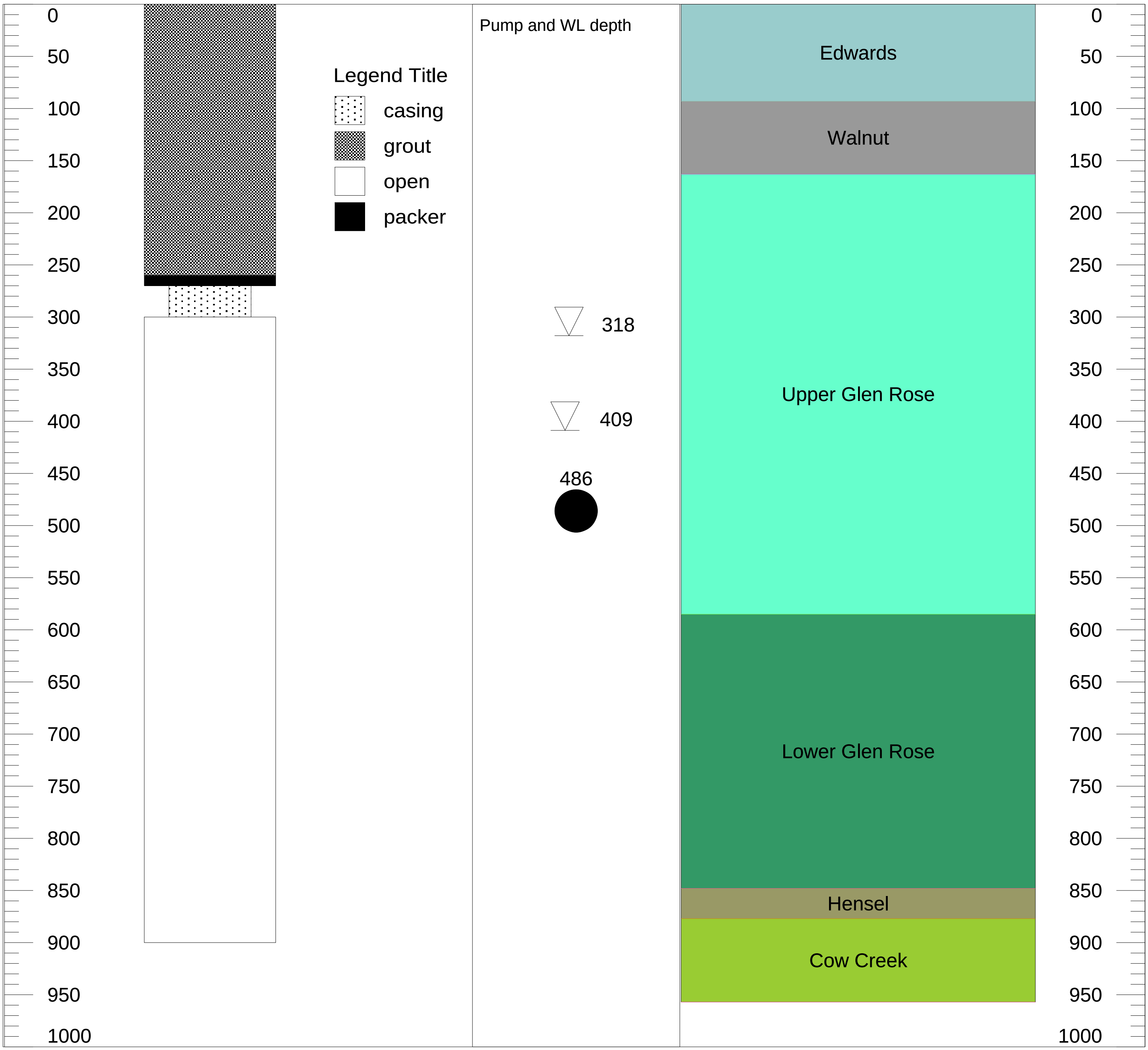
Aquifer Middle Trinity (Cow Creek)

Borehole depth (ft) 900

Location 333 Windmill Cove

Date Drilled 24-Aug-05





Yield (gpm) 7

Comments

Pump depth (ft)

TDS (mg/L) 427

Project EP Monitoring 2016

Well Name Jones01

Well ID 6755

DDlat 30.04829

DDlong -98.024335

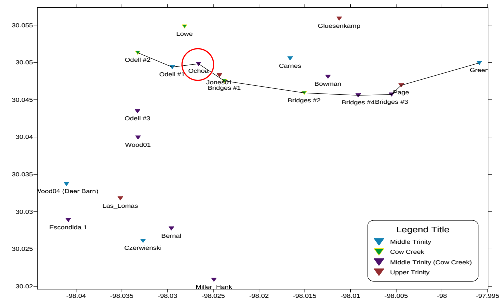
Elev 1049

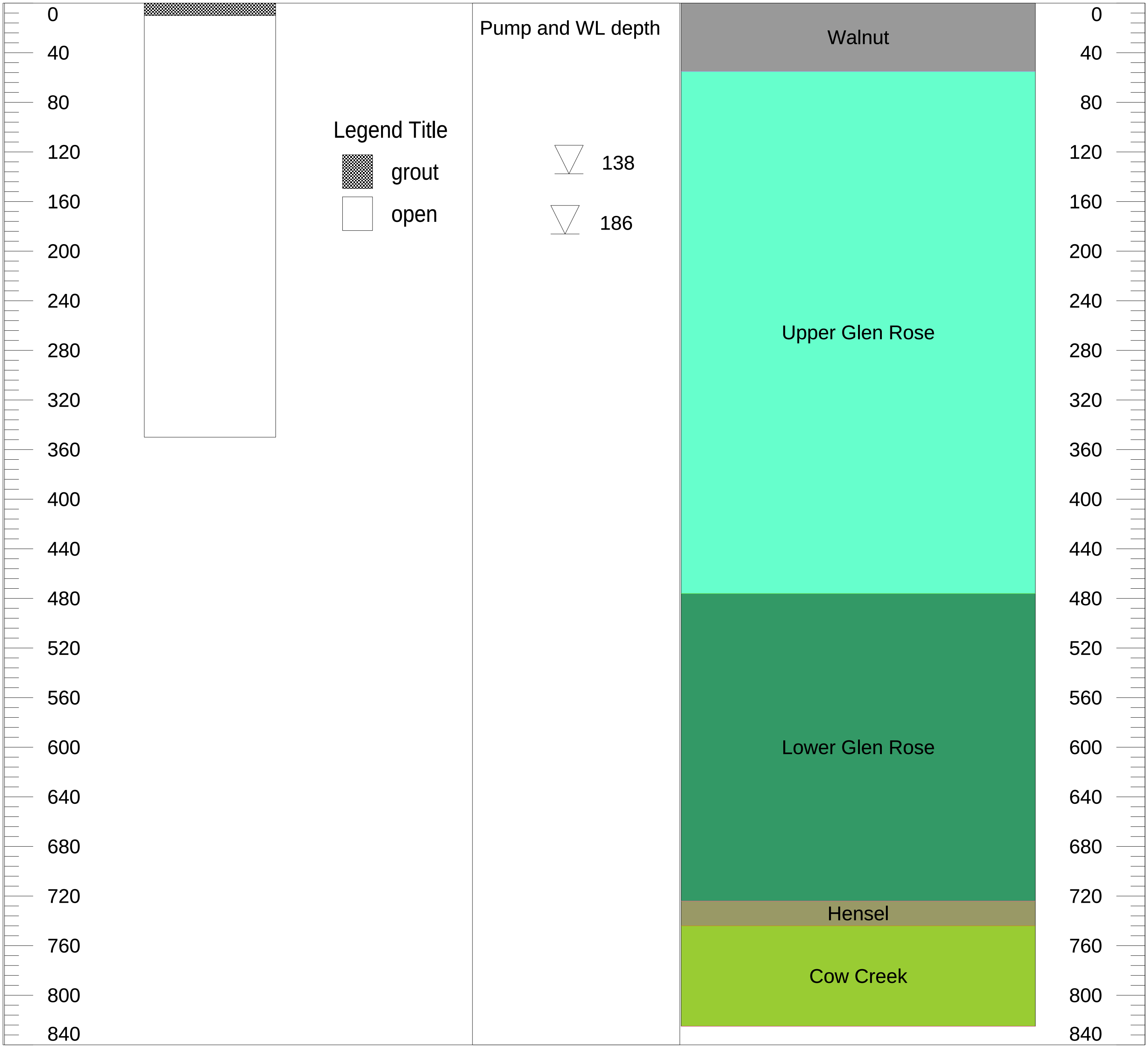
Aquifer Upper Trinity

Borehole depth (ft) 350

Location 6755 FM 3237

Date Drilled unknown





Yield (gpm)

Comments

Pump depth (ft)

TDS (mg/L)

Project EP Monitoring 2016

Well Name: Page

Well ID: 8101

DDlat: 30.04693

DDlong: -98.004464

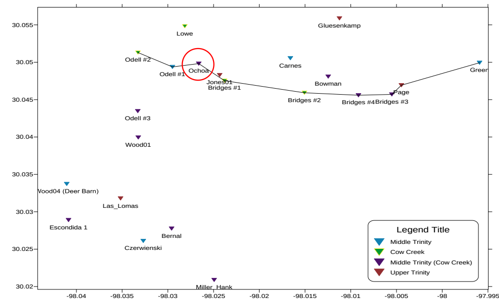
Elev: 1007

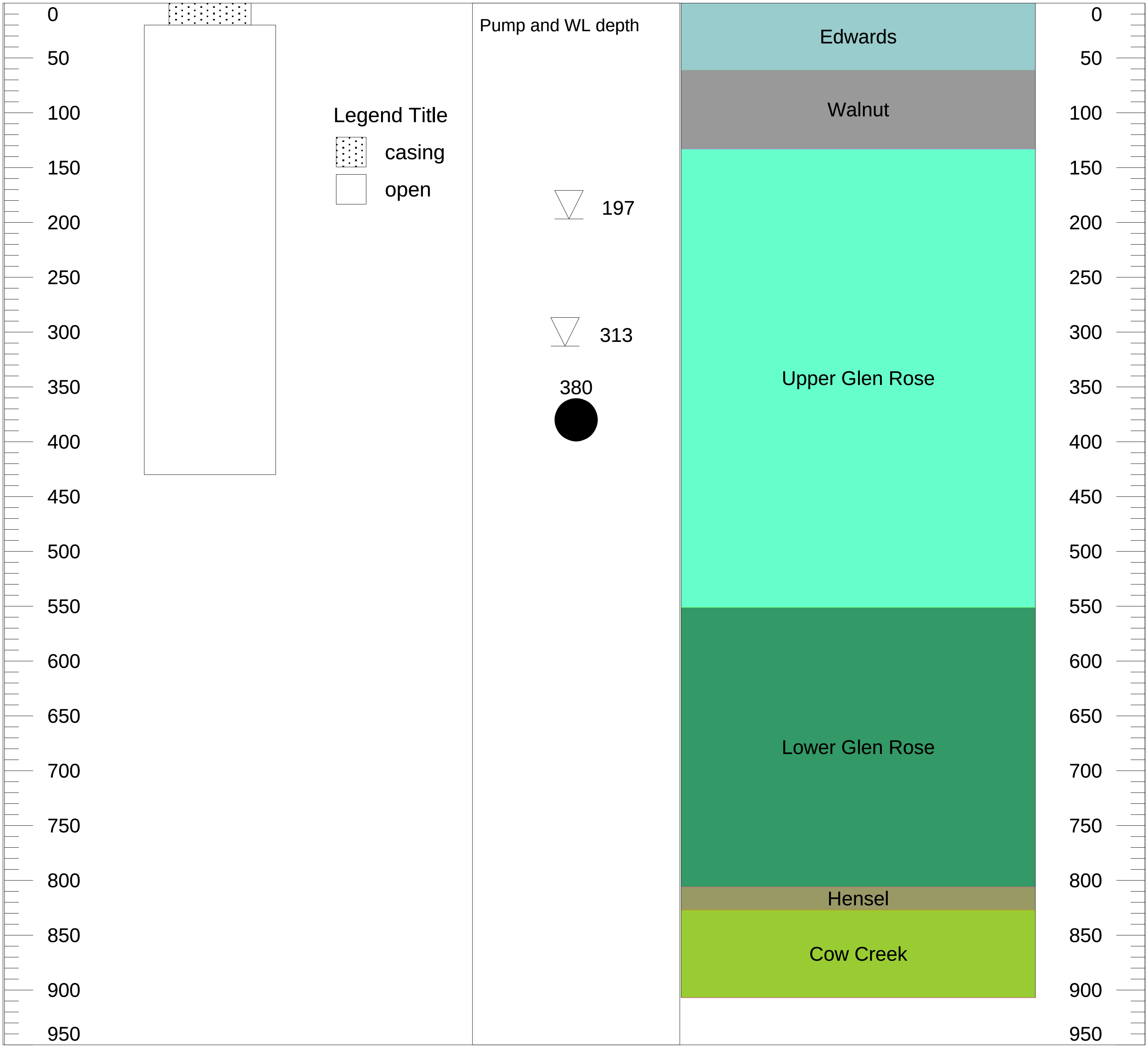
Aquifer: Upper Trinity

Borehole depth (ft): 430

Location: 8101 FM 3237, Driftwood 78619

Date Drilled: unknown





Yield (gpm):

Comments:

Pump depth (ft):

TDS (mg/L):

Project: EP Monitoring 2016

Well Name: Green

Well ID: 8601

DDlat: 30.04994

DDlong: -97.995917

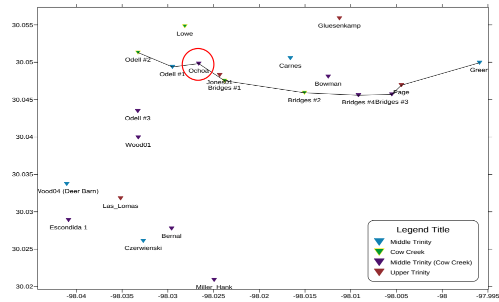
Elev: 1000

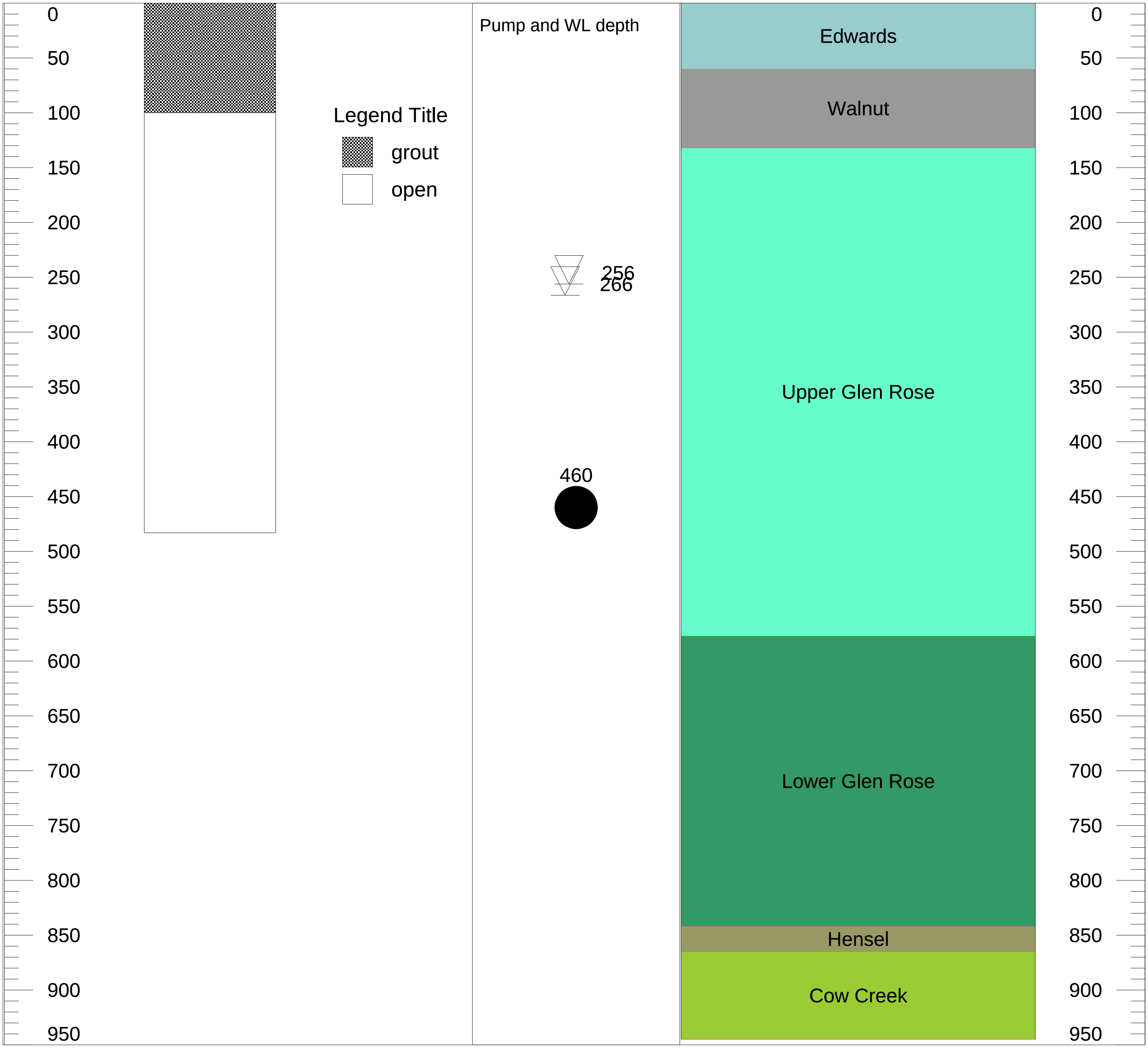
Aquifer: Middle Trinity

Borehole depth (ft): 483

Location: 8601 FM 3237

Date Drilled: 01-Dec-97





Yield (gpm):

Comments:

Pump depth (ft): 460

TDS (mg/L):

Project: EP Monitoring 2016

Wet Rock Groundwater Services, L.L.C.
Groundwater Specialists
TBPG Firm No: 50038
317 Ranch Road 620 South, Suite 203
Austin, Texas 78734 • Ph: 512-773-3226
www.wetrockgs.com

Mr. John Dupnik, P.G.
General Manager
Barton Springs Edwards Aquifer Conservation District
1124 Regal Row
Austin, TX 78748

November 24, 2015

RE: **Electro Purification – Work Plan for Hydrogeologic Report and Aquifer Testing**

Electro Purification (EP) has submitted both temporary and regular permit applications to Barton Springs/Edwards Aquifer Conservation District (BSEACD) pursuant to HB 3405 for an aggregate public supply well field consisting of six wells completed within the Middle Trinity Aquifer. While the applications on file only seek authority to produce up to 100 ac-ft/y from the Middle Trinity Aquifer, EP's plans include obtaining a regular permit in the amount of 2.5 Million Gallons per Day (MGD) or approximately 2,800 acre-feet/year. Water produced from the completed wells will be utilized by Goforth SUD and offer potential wholesale customers, including the City of Buda, to supply retail customers with the respective public supply water service area. There are a total of seven test wells on two properties (Bridges Tract and Odell Tract) located along Ranch to Market (RM) Road 3237 approximately 9 miles northwest of the City of Kyle and 5.5 miles northeast of Wimberley. Six of the seven wells are planned to be completed into public supply wells; the Bridges Test Well No. 3 may be converted into a monitoring or exempt domestic/livestock well or plugged. This Work Plan has been developed to demonstrate the well field's ability to produce up to 2.5 MGD without adverse impact to either the aquifer or any neighboring well.

As stated in the BSEACD guidelines, hydrogeologic studies provide essential information for water-resource management for both the District and the permittee. Hydrogeologic studies and aquifer tests are essential tools to assess and document the potential influences on local wells and to understand the local aquifer characteristics. The work plan for the hydrogeologic report and aquifer testing will be conducted based on the following objectives:

1. Provide a detailed description of the project to include location, pumping demands, pumping schedules (frequency, peak demand hours, and pumping rates), and the location and volume of the water;

2. Describe the geologic and hydrogeological properties of the Trinity Aquifer in the area of the well field;

3. Take an inventory of potential recharge and discharge locations influencing or being influenced by the well field;

4. Give surrounding parties sufficient public notice of an aquifer test to be performed on the wells;

5. Design, perform, and analyze the results of the aquifer tests at the EP well field; and

6. Report water quality sample analysis results and evaluate potential water level and water quality impacts from the well field.

Description of the Well Site and Water System

Included in the well site and water system description will be textual description and map of the well field and system-configuration, including distribution and storage. Also included will be a description and table of the anticipated storage volume, pumping frequency, duration, peak demand, and rates will be included.

Geology and Aquifer Description

A hydrogeologic conceptual model of the well field will be developed and discussed. Aquifer aspects, such as the aquifer conditions, thickness, and lateral continuity will be described by incorporating geophysical logs performed on the wells, available driller's logs, and applicable published literature from the area within 2 miles of the well field. These data will also aid in the development of detailed geologic and hydrogeologic stratigraphy at the well sites and in the surrounding area.

We propose to utilize geophysical logs to develop two localized cross sections. Site investigations will also be carried out in order to evaluate surface geology and recharge/discharge features. We propose to utilize water levels from wells that are completed within the Middle Trinity Aquifer to develop a localized potentiometric surface map in conjunction.

Inventory of Recharge / Discharge Features

An inventory of all known wells (private and public water source), surface ponds or reservoirs, major karst features, springs, or any other source of water recharge and discharge for the project well site and surrounding area will be assessed and mapped for a 2 mile radius from the proposed well field. Two maps showing all recharge and discharge features on small and large cartographic scales will be included.

Public Notice

A public notice approved by the District will be sent via certified mail to all adjacent property and well owners within a 1/2 mile radius of each well to be tested. Those who are interested in participating in the aquifer test will be included if they are able to provide useful additional data and information (observation wells). In addition to notifications via certified mail, a newspaper advertisement will be circulated in the Austin American Statesman newspaper within the district at least 20 days prior to the aquifer testing.

Aquifer Test Design and Operation

A map and description of the production wells, including well schematics and completion information will be included in both textual and illustrative forms in the report. Equipment used in monitoring water levels, flow, and quality will be described in detail.

Below describes the methodology of the aquifer tests:

- An aquifer test will be completed on each of the following six wells (Bridges 1, 2 & 4; Odell 1, 2 & 3). Each well will be tested individually and pumped at the following rates and durations to produce at least three to five times the daily proposed permit volume of 2.5 million gallons (depending upon the final pumping rate of each individual well):

- Bridges Test Well No. 1 - 625 gpm for 5 days;
- Bridges Test Well No. 2 - 400 gpm for 5 days;
- Bridges Test Well No. 4 – 87 gpm for 5 days;
- Odell Test Well No. 1 – 104 gpm for 5 days;
- Odell Test Well No. 2 – 320 gpm for 5 days; and
- Odell Test Well No. 3 – 200 gpm for 5 days

- The recovery period for each aquifer test will continue until 90% recovery is achieved or constant water levels are measured for over 2 hours in the respective Well;

- During each of the six (6) aquifer tests, the six (6) EP wells will be monitored using a transducer. EP will coordinate with the District to develop an agreed upon number and location (horizontal and vertical) of observation wells offsite that will be monitored and measured by the District and data provided to EP. The observation wells located offsite will be completed in various formations/aquifers consisting of the Upper Trinity Aquifer, Lower Glen Rose Formation only and the Cow Creek Member only. The observation wells will range in distances within 2 miles of the well field. Wells used as observation wells will have evidence to show that each well is completed within the targeted aquifer/formation. Evidence of each well's completion will be documented by a downhole video survey or gamma/resistivity/caliper log;

- The pumping well for each of the six (6) aquifer tests will be equipped with an inflatable packer set at the base of the Bexar Shale/top of the Cow Creek Member with the production pump located beneath the packer to seal off [communication with or production from] other zones/formations. A transducer will be set above the packer and an airline will be set below the packer to measure water levels above and below the inflatable packer;

- A water quality sample will be taken during the aquifer test for each well which will be sampled for the following constituents: pH, TDS, nitrate, nitrite, arsenic, fluoride, aluminum, copper, iron, manganese, zinc, sulfate and chloride;

Discharge rate from the pumping well will be determined by a calibrated flow meter attached to the discharge column on the well head. Precipitation and stream flow on the Trinity Aquifer recharge zone will be reported within the hydrogeologic report from rain gauges and USGS flow stations.

Aquifer Test Analyses

Descriptions of the aquifer test, pre and post pumping test water levels, drawdown and recovery will be presented in this section. A graph of the arithmetic (non-log) water level elevation versus time for all the data from each monitored well will be included. From these graphs, long and short term trends, the lack of full recovery of water levels, and evidence of aquifer boundaries can be addressed if necessary. The transmissivity and storage coefficients will be calculated using the Cooper-Jacob or Theis methods. Assumptions associated with each method, such as recharge, partial penetration of wells, fluctuating pumping rate, delayed yield, leakage, atmospheric responses, regional water-level trends, and interference from other wells will be discussed.

Evaluation of Potential Water Level and Water Quality Impacts

The effects of pumping from the investigated wells on the affected aquifer and surrounding wells will be evaluated. A map of the maximum measured drawdown during aquifer testing will be provided. Spring flow at Barton Springs and Jacobs Well, will be discussed and graphs of spring flow at Barton Springs and Jacobs Well, along with hydrographs of available Middle Trinity wells within 2 miles of the well field, will be produced.

Theoretical drawdown from the well being tested, based upon transmissivity and storage coefficients calculated from the aquifer test, will be used to estimate drawdown over a 10 year period based upon the production schedule contracted by EP. The following summarizes the annual production schedule for the next 10 years:

1. Year 1: 1,120 ac-ft/yr (1.0 MGD)
2. Year 2: 1,400 ac-ft/yr (1.25 MGD)
3. Year 3: 1,680 ac-ft/yr (1.50 MGD)
4. Year 4: 1,960 ac-ft/yr (1.75 MGD)
5. Year 5: 2,240 ac-ft/yr (2.0 MGD)
6. Year 6: 2,520 ac-ft/yr (2.25 MGD)
7. Year 7: 2,800 ac-ft/yr (2.50 MGD)
8. Year 8: 2,800 ac-ft/yr (2.50 MGD)
9. Year 9: 2,800 ac-ft/yr (2.50 MGD)
10. Year 10: 2,800 ac-ft/yr (2.50 MGD)

The accurate estimation of water levels due to pumping within a karst aquifer such as the Middle Trinity Aquifer over long term periods of production is difficult. The heterogeneity of the aquifer in addition to potential disconnects between the Cow Creek Member and other formations causes traditional methods of estimating drawdown such as the Modified Nonequilibrium Equation or Theis Equation to be fraught with error. Although in the area of the EP wells, there is no Groundwater Availability Model (GAM), the use of a GAM to estimate drawdown from a well also has limitations due to scaling. The Theis Equation has several assumptions used to derive the formula which include:

1. The water-bearing formation is uniform in character and the hydraulic conductivity is the same in all directions;

2. The aquifer is uniform in thickness and infinite in areal extent;

3. The aquifer receives no recharge from any source;

4. The well penetrates, and receives water from the full thickness of the aquifer;

5. The water from storage is discharged instantaneously when the head is lowered;

6. The pumping well is 100% efficient;

7. All water removed from the well comes from aquifer storage;

8. Laminar flow exists through the well and aquifer; and,

9. The water table or potentiometric surface has no slope.

It is important to note that several of the assumptions used to derive the Theis Equation are not appropriate to karst aquifers such as the Middle Trinity Aquifer in general, and specifically wells completed within the Cow Creek Member. These include assumptions 1, 3, 7 and 8. The Middle Trinity Aquifer is a karst aquifer and is fractured, not uniform in character or in hydrogeologic properties (transmissivity and storativity). In addition, the assumption that the formation receives no recharge from any source and that all water removed from the well comes from aquifer storage is not met in this case. Driscoll (1986) states, *"The assumption that an aquifer receives no recharge during the pumping period is one of the six fundamental conditions upon which the nonequilibrium formulas (Theis) are based. Therefore, all water discharged from a well is assumed to be taken from storage within the aquifer… It is known, however that most formations receive recharge. Hydrographs from long-term observation wells monitored by the US Geological Survey, various state agencies, and similar data-gathering agencies in other parts of the world show that most water-bearing formations receive continual or intermittent recharge."*

Drawdown calculated using the Theis non-equilibrium formula is overestimated due to the assumptions outlined above. Over a period of time such as 10 years, the overestimation is further increased and represents a "worst case scenario" of drawdown impacts. To meet the District's requirements we propose to estimate drawdown using the Theis equation for a period of 1 year and 10 years of production at distances up to 2 miles away from the well field.

The drawdown estimates calculated using the Theis equation will then be used to develop "trigger levels" at determined index wells which will prompt reduction in production from the well field if those water levels are met. Index wells surrounding the well field at various distances will be identified or newly constructed which will be completed solely within the Cow Creek Member, Lower Glen Rose Formation and Upper Glen Rose Formation. In lieu of multiple index wells, one Westbay Well discretely completed with the formations described above may be used. If the aquifer testing shows no discernible impact from production at the well field to a certain formation (Ie: Upper Trinity, Lower Glen Rose) then trigger levels for those specific formations will not be used in determining production cutbacks from the EP project. In addition, based upon the drawdown estimates, wells that may require mitigation due to their construction and/or pump setting will be identified.

Water quality trends that may have occurred due to the groundwater withdrawals will be evaluated and discussed. During the pumping test, field measurements such as pH, specific conductance, and TDS will be measured during the first 4 hours and for the final 2 hours of the pumping test. During the pumping test, water samples will be collected and taken to a certified laboratory for analysis. Analytical results will be provided in the report appendices. Water quality assessment will also be carried out in cooperation with the District, which has the ability to take field and some basic laboratory measurements.

Please call me at 512-773-3226 if you have any questions or require additional information.

Respectfully,

Wet Rock Groundwater Services, L.L.C.

Kaveh Khorzad, P.G.
President/ Senior Hydrogeologist

Cc:
Mr. Bart Fletcher; Mr. Tim Throckmorton – Electro Purification, LLC
Mr. Ed McCarthy – Jackson, Sjoberg, McCarthy & Townsend, LLP

Appendix C

Well Name	Date	Lab	Aquifer Name	pH	TDS	Charge Balance	Sodium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Alkalinity-bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Silicon (µg/L)	Vanadium (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)
A-MDL		**TestAmerica--EAA**		**0.315**	**10**		**0.727**	**0.407**	**0.113**	**1.98**	**5**	**0.192**	**0.377**	**70.7**	**1.44**	**1.09**	**70**	**8.1**	**1.24**	**8.54**
Bowman	4/8/2015 11:08	ELS-TWDB	Cow Creek	7.45	455		10.9	5.71	45.1	69.7	332	10	129	14100	<1	<2	139	31	<1	<1
Bowman	10/18/2016	TestAmerica--EAA	Cow Creek	7.32	471	-0.0918102	14	6.43	60.7	57.4	256	10.8	121	6470	<1.44	<1.09	132	33.3	<1.24	<8.54
Bowman	10/24/2016	TestAmerica--EAA	Cow Creek	7.13	460	-0.1232698	12.7	7.99	50	63.9	259	10.6	120	6400	<1.44	<1.09	147	34.9	<1.24	<8.54
Bowman	11/2/2016	TestAmerica--EAA	Cow Creek	7.12	483	-0.157959	11.7	7.21	45.8	61.2	262	10.7	120	6420	<1.44	<1.09	121	30.6	<1.24	<8.54
Bowman	11/9/2016	TestAmerica--EAA	Cow Creek	6.84	1640	-0.43367138	7.06	3.38	67.9	329	244	9.84	838	5800	<1.44	<1.09	<70	35.8	<1.24	<8.54
Bowman	11/17/2016	TestAmerica--EAA	Cow Creek	6.98	1100		8.59	5.61	53.5	206	252	10.2	478	6500	<1	<1.09	115	33	<1.24	<8.54
Bowman	11/21/2016	TestAmerica--EAA	Cow Creek	6.97	897	-0.3618157	9.76	6.06	50.1	146	252	9.57	368	6720	<1.44	<1.09	111	33.2	<1.24	<8.54
Bowman	11/28/2016	TestAmerica--EAA	Cow Creek	7.07	1400	-0.332609	9.52	5.01	70.7	298	240	9.89	639	6840	<1.44	<1.09	107	37.6	<1.24	<8.54
Bowman	12/14/2016	TestAmerica--EAA	Cow Creek	7.11	1030	-0.3875781	9.21	5.27	47.3	190	245	9.68	464	6370	<1.44	<1.09	105	32.3	<1.24	<8.54
Bowman	1/4/2017	TestAmerica--EAA	Cow Creek	6.9	1040	-0.33393	10	5.34	50.8	214	247	10.2	453	6130	<1.44	<1.09	107	33.3	<1.24	<8.54
Bowman	1/11/2017	TestAmerica--EAA	Cow Creek	7.07	429		11.6	1.16	31.8	101	314	20.4	26.8	6080	1.45	<1.09	<70	52.9	<1.24	<8.54
Bowman	1/19/2017	TestAmerica--EAA	Cow Creek	6.97	924	-0.310906	11.3	6.46	53.1	192	251	10.5	403	6950	<1.44	<1.09	120	41.2	<1.24	<8.54
Bridges No. 1	11/22/2016 10:50	ELS--BSEACD	Cow Creek	ND	3790	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/22/2016 13:55	ELS--BSEACD	Cow Creek	ND	2710	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/22/2016 14:45	ELS--BSEACD	Cow Creek	ND	1860	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/30/2016	PCS--WRGS	Cow Creek	7.2	432	-0.1441748	12.6	ND	ND	79.4	282	21	108	ND	ND	5	ND	ND	ND	ND
Bridges No. 2	10/24/2016 13:03	ELS--BSEACD	Cow Creek	ND	19900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 2	10/24/2016 13:34	ELS--BSEACD	Cow Creek	ND	16500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 2	11/15/2016	PCS--WRGS	Cow Creek	6.9	732	-0.3861027	13.7	ND	ND	135	332	138	149	ND	ND	5	ND	ND	ND	ND
Carnes	10/18/2016	TestAmerica--EAA	Upper Glen Rose	7.16	346	0.30880996	6.14	0.815	41	79.1	270	19.8	12.6	5730	1.5	<1.09	<70	36.1	<1.24	<8.54
Carnes	10/24/2016	TestAmerica--EAA	Upper Glen Rose	7.12	345	0.26247917	6.52	0.961	33	78.3	272	18.9	12.6	5940	1.9	<1.09	<70	46.8	<1.24	<8.54
Carnes	11/9/2016	TestAmerica--EAA	Upper Glen Rose	7.09	352	0.2408738	6.5	1.06	32.7	76.6	272	19.8	14	5300	<1.44	<1.09	<70	43.3	<1.24	<8.54
Carnes	11/17/2016	TestAmerica--EAA	Upper Glen Rose	7.17	337		5.95	1.07	29.7	70.5	276	19.6	13.3	5690	<1	<1.09	<70	43.4	<1.24	<8.54
Carnes	11/28/2016	TestAmerica--EAA	Upper Glen Rose	6.91	342	0.285576	7.19	1.17	36	81.7	266	19.7	13.3	6420	1.89	<1.09	<70	47.5	<1.24	<8.54
Carnes	12/14/2016	TestAmerica--EAA	Upper Glen Rose	7.18	349	0.21570719	6.42	1.02	29.8	72.7	267	21.1	13.6	6260	<1.44	<1.09	<70	45.5	<1.24	<8.54
Carnes	1/4/2017	TestAmerica--EAA	Upper Glen Rose	6.84	370	0.243351	6.77	0.911	32.7	74.9	274	19.8	13.5	5510	<1.44	<1.09	<70	45.7	<1.24	<8.54
Carnes	1/11/2017	TestAmerica--EAA	Upper Glen Rose	7.25	350		6.93	1.05	35.4	75.9	272	20.1	14.3	6820	<1	<1.09	<70	46.4	<1.24	<8.54
Carnes	1/19/2017	TestAmerica--EAA	Upper Glen Rose	7.1	345	0.257336	7.12	1.09	35	79.2	276	20.7	13.8	6500	<1.44	<1.09	<70	52.3	<1.24	<8.54
Gluesencamp	4/8/2015	ELS-TWDB	Upper Glen Rose	7.12	383		9.63	1.09	29.1	86.8	320	16.4	27.6	12100	1.75	<2	<50	47.9	<1	<1
Gluesencamp	10/18/2016	TestAmerica--EAA	Upper Glen Rose	7.1	410	0.31476131	10.2	0.978	38.7	129	307	19.3	26.8	5520	<1.44	<1.09	<70	65.5	<1.24	<8.54
Gluesencamp	10/24/2016	TestAmerica--EAA	Upper Glen Rose	7.02	423	0.2070156	10.9	1.18	31.3	100	312	19.2	26.9	5640	1.92	<1.09	<70	55.8	<1.24	<8.54
Gluesencamp	11/2/2016	TestAmerica--EAA	Upper Glen Rose	7.03	445	0.1805588	10.4	1.1	28.8	95.4	311	19.3	26.8	5600	<1.44	<1.09	<70	49.4	<1.24	<8.54
Gluesencamp	11/9/2016	TestAmerica--EAA	Upper Glen Rose	6.93	430	0.2164143	11.2	1.29	31.3	105	317	19.3	27.1	5600	<1.44	<1.09	<70	54.5	<1.24	<8.54
Gluesencamp	11/17/2016	TestAmerica--EAA	Uppfer Glen Rose	7.03	368		10.6	1.33	29.2	99.7	330	19.5	27.2	6090	<1	<1.09	<70	53.3	<1.24	<8.54
Gluesencamp	11/21/2016	TestAmerica--EAA	Upper Glen Rose	6.9	424	0.18402441	10.6	1.27	29.5	97.3	316	19.4	27.2	5900	2.77	<1.09	<70	53.3	<1.24	<8.54
Gluesencamp	11/28/2016	TestAmerica--EAA	Upper Glen Rose	6.72	436	0.24864149	11.2	1.31	33.6	110	309	20.2	26.6	6160	1.71	<1.09	<70	57.6	<1.24	<8.54
Gluesencamp	12/14/2016	TestAmerica--EAA	Upper Glen Rose	7.07	426	0.1603895	10.4	1.14	27.4	95	311	22.5	27.4	5810	<1.44	<1.09	<70	49.9	<1.24	<8.54
Gluesencamp	1/4/2017	TestAmerica--EAA	Upper Glen Rose	6.82	437	0.19199	11.2	1.05	29.4	99	309	20.7	27.2	5280	<1.44	<1.09	<70	54.2	<1.24	<8.54
Gluesenkamp	1/11/2017	TestAmerica--EAA	Upper Glen Rose	7.07	429		11.6	1.16	31.8	101	314	20.4	26.8	6080	1.45	<1.09	<70	52.9	<1.24	<8.54

Well Name	Date	Strontium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Manganese (µg/L)	Nickel (µg/L)	Lead (µg/L)	Zinc (µg/L)	Antimony (µg/L)	Aluminum (µg/L)	Iron (µg/L)	Mercury (mg/L)	Bromide (mg/L)	Nitrate as N (mg/L)	Selenium (µg/L)	Fluoride (mg/L)	pMC	Tritium (TU)
A-MDL		**7.68**	**1.4**	**2**	**11.6**	**2.17**	**0.733**	**3.55**	**16.1**	**50**	**101**	**0.00013**	**0.63**	**0.206**	**1.08**	**0.04**	**ND**	**ND**
Bowman	4/8/2015 11:08	5700	<1	<1	<1	ND	<1	<4	<1	5.84	<50	<0.0002	0.0625	<0.02	<4	1.29	0.0201	0.06
Bowman	10/18/2016	9710	<1.4	4.05	<11.6	<2.17	<0.733	32.2	<16.1	<50	<101	0.000184	0.418	0.319	<1.08	1.83	ND	ND
Bowman	10/24/2016	7580	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.427	<0.206	2.55	1.7	ND	ND
Bowman	11/2/2016	6720	<1.4	<2	<11.6	<2.17	<0.733	9.86	<16.1	<50	<101	<0.00013	0.417	0.163	<1.08	1.35	ND	ND
Bowman	11/9/2016	3890	<1.4	<2	<11.6	<2.17	<0.733	7.63	<16.1	<50	150	<0.00013	<0.63	<0.206	3.67	0.68	ND	ND
Bowman	11/17/2016	4970	<1.4	<2	<11.6	<2.17	<0.733	14.7	<16.1	<50	<101	0.000353	<0.63	0.336	1.43	0.862	ND	ND
Bowman	11/21/2016	5740	<1.4	<2	<11.6	<2.17	<0.733	25.9	<16.1	<50	<101	<0.00013	<0.63	0.358	<1.08	1.06	ND	ND
Bowman	11/28/2016	5130	<1.4	14.2	<11.6	<2.17	<0.733	54.1	<16.1	<50	<101	<0.00013	<0.63	0.394	2.81	0.856	ND	ND
Bowman	12/14/2016	5290	<1.4	<2	<11.6	<2.17	<0.733	10.1	<16.1	<50	<101	0.000443	<0.63	<0.206	<1.08	1.3	ND	ND
Bowman	1/4/2017	5710	<1.4	7.55	<11.6	<2.17	<0.733	48.6	<16.1	<50	<101	<0.00013	<0.63	1.29	2.12	1.07	ND	ND
Bowman	1/11/2017	1110	<1.4	110	<11.6	<2.17	0.856	59.3	<16.1	<50	<101	0.000165	0.64	1.5	<1.08	0.243	ND	ND
Bowman	1/19/2017	6320	<1.4	5.6	<11.6	<2.17	1.37	241	<16.1	<50	<101	<0.00013	<0.63	0.328	2.06	0.891	ND	ND
Bridges No. 1	11/22/2016 10:50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/22/2016 13:55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/22/2016 14:45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 1	11/30/2016	ND	ND	<5	10	ND	<5	82	ND	<10	58	ND	ND	<0.2	ND	1.37	ND	ND
Bridges No. 2	10/24/2016 13:03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 2	10/24/2016 13:34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bridges No. 2	11/15/2016	ND	ND	<5	15	ND	<5	57	ND	<10	460	ND	ND	<0.2	ND	1.73	ND	ND
Carnes	10/18/2016	368	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.418	0.505	<1.08	0.276	ND	ND
Carnes	10/24/2016	483	1.66	3.27	<11.6	35	1.01	27.1	<16.1	152	<101	<0.00013	0.417	0.48	1.73	0.271	ND	ND
Carnes	11/9/2016	544	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.417	0.488	2.06	0.268	ND	ND
Carnes	11/17/2016	500	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000149	0.416	0.509	1.91	0.244	ND	ND
Carnes	11/28/2016	531	<1.4	4.11	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.422	0.498	3.64	0.252	ND	ND
Carnes	12/14/2016	559	<1.4	3.86	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000212	0.412	0.5	1.75	0.322	ND	ND
Carnes	1/4/2017	519	<1.4	6.76	<11.6	<2.17	<0.733	3.84	<16.1	<50	<101	0.000559	<0.63	0.924	<1.08	0.296	ND	ND
Carnes	1/11/2017	639	<1.4	517	<11.6	<2.17	<0.733	197	<16.1	<50	<101	0.000158	0.589	0.938	<1.08	0.27	ND	ND
Carnes	1/19/2017	612	<1.4	4.21	<11.6	<2.17	1.85	335	<16.1	<50	<101	<0.00013	0.448	0.532	2.74	0.26	ND	ND
Gluesencamp	4/8/2015	1090	1.42	3.54	<1	ND	2.36	8.11	<1	<4	<50	<0.0002	0.118	1.54	<4	0.21	0.8276	1.47
Gluesencamp	10/18/2016	1410	<1.4	<2	<11.6	<2.17	1.45	86.6	<16.1	<50	<101	0.000137	0.459	1.24	<1.08	0.221	ND	ND
Gluesencamp	10/24/2016	1160	<1.4	<2	<11.6	<2.17	0.822	21.9	<16.1	<50	<101	<0.00013	0.455	1.22	<1.08	0.245	ND	ND
Gluesencamp	11/2/2016	1040	<1.4	3.98	<11.6	<2.17	<0.733	23	<16.1	<50	<101	<0.00013	0.452	1.18	<1.08	0.187	ND	ND
Gluesencamp	11/9/2016	1100	<1.4	5.93	<11.6	<2.17	<0.733	24.7	<16.1	<50	<101	0.00015	0.46	1.18	2.14	0.259	ND	ND
Gluesencamp	11/17/2016	990	<1.4	2.99	<11.6	<2.17	<0.733	20.7	<16.1	<50	<101	0.00013	0.458	1.22	2.3	0.209	ND	ND
Gluesencamp	11/21/2016	1010	<1.4	3.89	<11.6	<2.17	<0.733	9.47	<16.1	<50	<101	<0.00013	0.454	1.2	<1.08	0.206	ND	ND
Gluesencamp	11/28/2016	1150	<1.4	4.1	<11.6	<2.17	<0.733	24.4	<16.1	<50	<101	<0.00013	0.453	1.19	2.01	0.219	ND	ND
Gluesencamp	12/14/2016	1050	<1.4	4.22	<11.6	<2.17	<0.733	16.3	<16.1	<50	<101	<0.00013	0.451	1.11	<1.08	0.263	ND	ND
Gluesencamp	1/4/2017	1060	<1.4	3.08	<11.6	<2.17	<0.733	3.91	<16.1	<50	<101	<0.00013	0.638	1.48	<1.08	0.246	ND	ND
Gluesenkamp	1/11/2017	1110	<1.4	110	<11.6	<2.17	0.856	59.3	<16.1	<50	<101	0.000165	0.64	1.5	<1.08	0.243	ND	ND

Well Name	Date	Lab	Aquifer Name	pH	TDS	Charge Balance	Sodium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Alkalinity-bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Silicon (µg/L)	Vanadium (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)
Gluesencamp	1/19/2017	TestAmerica--EAA	Upper Glen Rose	7.27	446	0.2094607	12.1	1.34	30.7	108	312	21.6	29.7	6060	<1.44	<1.09	<70	52.2	<1.24	<8.54
Green	10/18/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.08	714	-0.2194136	14.9	9.16	99.2	68.6	298	14.4	242	5880	<1.44	<1.09	419	16.8	<1.24	<8.54
Green	10/24/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.07	716	-0.2293127	13	11.1	82	77.5	297	14.1	224	5780	<1.44	<1.09	441	17.2	<1.24	<8.54
Green	11/2/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.06	775	-0.281035	12	10.4	76.7	79.3	296	13.7	247	5520	<1.44	<1.09	390	15.6	<1.24	1.17
Green	11/9/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	6.98	706	-0.249245	10.9	9.6	73.2	78.2	299	13	217	5180	<1.44	<1.09	<70	21.7	<1.24	<8.54
Green	11/17/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.05	628		8.87	8.43	63.3	76.6	312	12.2	184	5830	<1	<1.09	249	21.6	<1.24	<8.54
Green	11/21/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	6.96	704	-0.2628828	11.6	9.87	74.1	79.5	299	13	230	5910	<1.44	<1.09	387	15.5	<1.24	<8.54
Green	11/28/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	6.8	702	-0.192896	13.2	10.6	80.8	93.7	301	13.7	220	6270	<1.44	<1.09	432	16.7	<1.24	<8.54
Green	12/14/2016	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.07	683	-0.2205254	9.25	7.9	67.5	83.8	304	11.8	197	6690	<1.44	<1.09	271	28.9	<1.24	<8.54
Green	1/4/2017	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	6.86	676	-0.22781	9.93	7.34	71.9	79.5	310	12.1	202	5680	<1.44	<1.09	282	26.2	<1.24	<8.54
Green	1/11/2017	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.07	704		11.3	8.87	81.1	81.4	305	12.1	209	6900	<1	<1.09	307	27.1	<1.24	<8.54
Green	1/19/2017	TestAmerica--EAA	Upper Glen Rose (possibly Middle GR)	7.07	616	-0.189298	10.9	8.59	74.2	68.3	305	12.3	175	6540	<1.44	<1.09	277	34.3	<1.24	<8.54
Lowe	7/22/2015	ELS-TWDB	Cow Creek	7.19	1840		17.6	13.2	183	263	322	17.7	1160	12300	<1	6.3	220	27.7	<1	<1
Lowe	10/18/2016	TestAmerica--EAA	Cow Creek	6.86	2310	-0.3462215	19.7	12.6	237	346	232	14.7	1210	6310	<1.44	1.56	354	18.8	<1.24	<8.54
Lowe	10/24/2016	TestAmerica--EAA	Cow Creek	6.98	1650	-0.3856888	15	12.7	148	233	243	15	852	6530	<1.44	1.81	309	22.1	<1.24	<8.54
Lowe	11/2/2016	TestAmerica--EAA	Cow Creek	6.98	1480	-0.411924	14.7	11.5	129	205	242	15.2	795	6810	<1.44	<1.09	256	19.4	<1.24	<8.54
Lowe	11/9/2016	TestAmerica--EAA	Cow Creek	6.85	2330	-0.453666	17.2	15.5	198	292	233	16.5	1320	5760	<1.44	<1.09	<70	16.3	<1.24	<8.54
Lowe	11/17/2016	TestAmerica--EAA	Cow Creek	6.91	2240		17.3	15.9	197	284	237	16.3	1110	7040	<1	1.76	421	15.6	<1.24	<8.54
Lowe	11/21/2016	TestAmerica--EAA	Cow Creek	6.8	2310	-0.410364	17.9	15.9	204	280	247	15.4	1180	6910	<1.44	1.91	415	16.1	<1.24	<8.54
Lowe	11/28/2016	TestAmerica--EAA	Cow Creek	6.69	2330	-0.430763	17.9	15.6	209	320	234	15.6	1340	7130	<1.44	<1.09	449	17.1	<1.24	<8.54
Lowe	12/14/2016	TestAmerica--EAA	Cow Creek	6.89	2320	-0.4877605	17.1	15.1	184	294	232	13.3	1400	6470	<1.44	1.67	401	16.5	<1.24	<8.54
Lowe	1/4/2017	TestAmerica--EAA	Cow Creek	6.7	2380	-0.45542	17.5	14.1	197	304	230	15.9	1350	5630	<1.44	<1.09	407	14.1	<1.24	<8.54
Lowe	1/11/2017	TestAmerica--EAA	Cow Creek	6.91	2330		19.8	17.3	226	330	234	15.8	1340	6760	<1	<1.09	468	19.6	<1.24	<8.54
Lowe	1/19/2017	TestAmerica--EAA	Cow Creek	6.84	2360	-0.441784	18.9	16.5	211	315	229	14.5	1380	6550	<1.44	2.04	423	37.3	<1.24	<8.54
Miller	7/22/2015	ELS--TWDB	Cow Creek	7.48	427		9.28	6.42	59.6	52.5	340.47	8.67	99	12300	<1	<2	208	71.3	<1	<1
Miller	1/19/2017	TestAmerica--EAA	Cow Creek	7.3	428	0.4309376	9.64	7.12	56.9	46.5	267	9.29	89.3	6200	<1.44	<1.09	227	91.1	<1.24	<8.54
Ochoa	4/8/2015	ELS-TWDB	Cow Creek	7.18	1065		11.1	7.78	94	158	269	11	596	13500	<1	<2	72	17.8	<1	<1
Ochoa	10/18/2016	TestAmerica--EAA	Cow Creek	7.3	1210	0.7354294	14.2	8.36	136	174	258	13.6	589	6100	<1.44	<1.09	209	19.3	<1.24	<8.54
Ochoa	10/24/2016	TestAmerica--EAA	Cow Creek	7	1260	0.73177466	13.4	11.4	125	171	250	13.4	517	6430	<1.44	1.57	236	15.8	<1.24	<8.54
Ochoa	11/2/2016	TestAmerica--EAA	Cow Creek	7.02	1300	0.706271	12.5	10.4	112	159	258	13.5	660	6120	<1.44	<1.09	224	15.1	<1.24	<8.54
Ochoa	11/9/2016	TestAmerica--EAA	Cow Creek	6.97	1330	0.7259098	12.9	10.5	120	163	239	13.5	657	5680	<1.44	1.66	<70	16.2	<1.24	<8.54
Ochoa	11/17/2016	TestAmerica--EAA	Cow Creek	7.02	1360		13.1	11	122	173	251	13.3	611	6980	<1	<1.09	255	17.3	<1.24	<8.54
Ochoa	11/21/2016	TestAmerica--EAA	Cow Creek	6.89	1290	0.70240381	12.3	10.3	114	150	257	13	633	6380	<1.44	<1.09	242	16.3	<1.24	<8.54
Ochoa	11/28/2016	TestAmerica--EAA	Cow Creek	6.77	1350	0.74052644	13.8	11.1	129	175	247	13	674	6570	<1.44	<1.09	256	15	<1.24	<8.54
Ochoa	12/14/2016	TestAmerica--EAA	Cow Creek	7	1280	0.70250576	12.2	9.84	106	155	251	12.9	637	6350	<1.44	<1.09	238	17.4	<1.24	<8.54
Ochoa	1/4/2017	TestAmerica--EAA	Cow Creek	6.75	1370	0.72875	14	10.4	124	165	251	12.9	671	5930	<1.44	<1.09	248	15.1	<1.24	<8.54

Appendix C

Well Name	Date	Strontium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Manganese (µg/L)	Nickel (µg/L)	Lead (µg/L)	Zinc (µg/L)	Antimony (µg/L)	Aluminum (µg/L)	Iron (µg/L)	Mercury (mg/L)	Bromide (mg/L)	Nitrate as N (mg/L)	Selenium (µg/L)	Fluoride (mg/L)	pMC	Tritium (TU)
Gluesencamp	1/19/2017	1020	<1.4	5.1	<11.6	<2.17	0.921	79.1	<16.1	<50	<101	<0.00013	0.496	1.16	3.81	0.225	ND	ND
Green	10/18/2016	13300	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000233	0.462	0.208	<1.08	3.27	ND	ND
Green	10/24/2016	14600	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000135	0.828	0.334	1.94	3.53	ND	ND
Green	11/2/2016	11900	<1.4	<2	<11.6	<2.17	<0.733	3.67	<16.1	<50	<101	<0.00013	0.824	0.368	1.94	3.06	ND	ND
Green	11/9/2016	13100	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000161	0.442	0.228	1.36	3.07	ND	ND
Green	11/17/2016	15100	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000389	0.433	0.267	<1.08	2.28	ND	ND
Green	11/21/2016	12300	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.81	0.336	<1.08	3.22	ND	ND
Green	11/28/2016	13400	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000191	0.447	0.19	<1.08	3.89	ND	ND
Green	12/14/2016	17300	<1.4	2.99	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	<0.63	0.266	1.17	1.72	ND	ND
Green	1/4/2017	7870	<1.4	6.32	<11.6	<2.17	<0.733	6.42	<16.1	<50	<101	<0.00013	0.615	0.719	<1.08	2.5	ND	ND
Green	1/11/2017	15300	<1.4	61.3	<11.6	<2.17	<0.733	23.3	<16.1	<50	<101	<0.00013	0.628	0.74	<1.08	2.06	ND	ND
Green	1/19/2017	16000	<1.4	10.8	<11.6	<2.17	1.25	199	<16.1	<50	<101	<0.00013	0.862	0.406	2.25	1.89	ND	ND
Lowe	7/22/2015	12300	<1	2.19	4.3	ND	<5	<250	<1	10.8	<50	<0.0002	0.146	<0.02	<4	2.94	0.1084	0.34
Lowe	10/18/2016	17800	7.71	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	221	<0.00013	<0.63	<0.206	<1.08	3.41	ND	ND
Lowe	10/24/2016	9730	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	251	<0.00013	0.826	<0.206	1.83	2.8	ND	ND
Lowe	11/2/2016	8230	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	188	<0.00013	0.826	<0.206	<1.08	2.1	ND	ND
Lowe	11/9/2016	11900	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	329	0.000174	0.924	<0.206	2.77	5.2	ND	ND
Lowe	11/17/2016	12200	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	331	0.000209	0.858	<0.206	1.48	4.05	ND	ND
Lowe	11/21/2016	13100	<1.4	<2	<11.6	<2.17	<0.733	5.34	<16.1	<50	354	<0.00013	0.85	<0.206	<1.08	3.59	ND	ND
Lowe	11/28/2016	12300	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	323	<0.00013	0.846	<0.206	<1.08	5	ND	ND
Lowe	12/14/2016	12200	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	269	0.000373	<0.63	<0.206	1.34	3.46	ND	ND
Lowe	1/4/2017	12200	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	245	<0.00013	<0.63	<0.206	<1.08	3.48	ND	ND
Lowe	1/11/2017	13000	<1.4	83.9	<11.6	<2.17	<0.733	32.2	<16.1	<50	306	0.000187	1.21	<0.206	1.96	3.34	ND	ND
Lowe	1/19/2017	12100	<1.4	<2	<11.6	<2.17	4.18	791	<16.1	<50	317	<0.00013	<0.63	<0.206	1.52	3.52	ND	ND
Miller	7/22/2015	9140	<1	<1	<1	ND	<1	<4	<1	<4	<50	<0.0002	0.0606	<0.02	<4	2.98	0.008	0.03
Miller	1/19/2017	8750	<1.4	<2	<11.6	<2.17	1.54	271	<16.1	<50	167	<0.00013	0.453	<0.206	2.22	2.56	ND	ND
Ochoa	4/8/2015	9650	<1	<1	<1	ND	<1	<4	<1	<4	<50	<0.0002	<0.1	<0.02	<4	2.5	0.1724	0.27
Ochoa	10/18/2016	14500	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.81	<0.206	<1.08	3.82	ND	ND
Ochoa	10/24/2016	8530	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.828	<0.206	1.52	3.41	ND	ND
Ochoa	11/2/2016	9400	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.828	<0.206	<1.08	2.64	ND	ND
Ochoa	11/9/2016	9400	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.82	<0.206	1.77	4.28	ND	ND
Ochoa	11/17/2016	9000	<1.4	<2	<11.6	<2.17	<0.733	6.28	<16.1	<50	<101	0.000168	0.822	<0.206	1.67	3.87	ND	ND
Ochoa	11/21/2016	9750	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.828	<0.206	<1.08	3.05	ND	ND
Ochoa	11/28/2016	9310	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.814	<0.206	2.11	3.53	ND	ND
Ochoa	12/14/2016	9530	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000236	<0.63	<0.206	<1.08	3	ND	ND
Ochoa	1/4/2017	9890	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	<0.63	<0.206	<1.08	3.28	ND	ND

Well Name	Date	Lab	Aquifer Name	pH	TDS	Charge Balance	Sodium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Alkalinity-bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Silicon (µg/L)	Vanadium (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)
Ochoa	1/11/2017	TestAmerica--EAA	Cow Creek	7.05	1290		15.8	12	139	189	252	13.5	646	7040	<1	<1.09	280	19.6	<1.24	<8.54
Ochoa	1/19/2017	TestAmerica--EAA	Cow Creek	7.09	1250	0.7159833	13.1	10.3	112	169	255	13.4	625	6650	<1.44	1.12	236	85.1	<1.24	<8.54
Odell No. 2	1/3/2017	PCS--WRGS	Cow Creek	6.8	484	-0.23486	11.2	ND	ND	116	278	93	75	ND	ND	5	ND	ND	ND	ND
Phillips	10/24/2016	TestAmerica--EAA	Upper Glen Rose	7.04	457	0.17305432	13.9	1.95	30.9	107	329	29.4	30.9	6210	3.57	<1.09	<70	66.9	<1.24	<8.54
Phillips	11/9/2016	TestAmerica--EAA	Upper Glen Rose	6.9	463	0.1785197	13.8	2.14	31.5	107	324	29.6	31	5980	<1.44	<1.09	<70	65.1	<1.24	<8.54
Phillips	11/17/2016	TestAmerica--EAA	Upper Glen Rose	6.99	457		13.2	2.13	29.3	103	321	30.4	31.3	6190	1.81	<1.09	77	61.9	<1.24	<8.54
Phillips	11/21/2016	TestAmerica--EAA	Upper Glen Rose	6.92	469	0.12754855	13.6	2.17	30	97.5	329	34.6	31.3	6790	4.63	<1.09	<70	61.4	<1.24	<8.54
Phillips	11/28/2016	TestAmerica--EAA	Upper Glen Rose	6.73	477	0.1904129	14.6	2.16	33.3	114	324	37.2	31.1	6480	3.01	<1.09	<70	67.5	<1.24	<8.54
Phillips	12/14/2016	TestAmerica--EAA	Upper Glen Rose	6.99	460	0.12937178	13.8	1.97	27.5	101	318	35.6	31.7	6260	2.29	<1.09	<70	64	<1.24	<8.54
Phillips	1/4/2017	TestAmerica--EAA	Upper Glen Rose	6.79	491	0.171511	15.7	1.92	31.6	106	323	33.3	31.2	5940	3.28	<1.09	70.1	63.6	<1.24	<8.54
Phillips	1/11/2017	TestAmerica--EAA	Upper Glen Rose	7.04	489		17.3	2.27	36	115	322	33.7	31.5	7060	3.32	<1.09	75.3	67.7	<1.24	<8.54
Wood01	4/8/2015	ELS-TWDB	Cow Creek	7.26	1357		14.4	10.7	138	180	256	12.5	821	13900	<1	<2	72.6	13.8	<1	<1
Wood01	10/18/2016	TestAmerica--EAA	Cow Creek	7.08	1500	-0.3967919	8.42	4.21	79	288	267	12.4	747	5810	<1.44	<1.09	170	41.5	<1.24	<8.54
Wood01	10/24/2016	TestAmerica--EAA	Cow Creek	6.96	1460	-0.3136949	9.28	5.22	64.8	297	263	12.7	589	5630	<1.44	1.16	180	42.5	<1.24	<8.54
Wood01	11/2/2016	TestAmerica--EAA	Cow Creek	6.98	1170	-0.354738	8.32	4.1	55	234	268	12.4	515	5520	<1.44	<1.09	117	46.5	<1.24	<8.54
Wood01	11/9/2016	TestAmerica--EAA	Cow Creek	6.99	414	0.0817476	7.82	2.97	40.4	72.6	282	12.3	49	5200	<1.44	<1.09	<70	44.8	<1.24	<8.54
Wood01	11/17/2016	TestAmerica--EAA	Cow Creek	7.07	357		7.51	3.14	38.7	76.8	289	12.3	55	6130	<1	<1.09	82.6	43.5	<1.24	<8.54
Wood01	11/21/2016	TestAmerica--EAA	Cow Creek	6.86	1600	-0.4794053	8.39	4.64	59.7	246	271	11.9	759	5770	1.64	1.45	171	41.5	<1.24	<8.54
Wood01	11/28/2016	TestAmerica--EAA	Cow Creek	6.75	393	0.11851608	7.35	2.86	40.7	74.1	281	12.1	43.7	6080	<1.44	<1.09	79.6	46.5	<1.24	<8.54
Wood01	12/14/2016	TestAmerica--EAA	Cow Creek	7.13	635	-0.1916603	7.72	3.28	41	112	276	12.4	173	5800	<1.44	<1.09	85.9	44.4	<1.24	<8.54
Wood04	1/28/2015	ELS-TWDB	Lower Glen Rose	7.3	937		9.75	6.14	91.1	150	333.15	11.5	480	12700	<1	<2	55	17.9	<1	<1
Wood04	10/18/2016	TestAmerica--EAA	Lower Glen Rose	7.05	2020	-0.3909312	15.7	9.61	203	287	242	15.7	1100	6280	<1.44	<1.09	242	12.2	<1.24	<8.54
Wood04	10/24/2016	TestAmerica--EAA	Lower Glen Rose	6.87	2030	-0.3680261	14.4	12.4	180	299	240	16.2	998	6480	<1.44	<1.09	268	17.4	<1.24	<8.54
Wood04	11/2/2016	TestAmerica--EAA	Lower Glen Rose	6.93	2090	-0.465718	12.9	11.3	162	280	237	15.9	1170	6030	<1.44	<1.09	223	15	<1.24	<8.54
Wood04	11/9/2016	TestAmerica--EAA	Lower Glen Rose	6.83	2050	-0.444863	13.8	11.9	174	286	241	15.9	1160	5830	<1.44	<1.09	<70	16	<1.24	<8.54
Wood04	11/17/2016	TestAmerica--EAA	Cow Creek	6.91	1990		13.6	12.2	168	271	244	15.7	1110	6270	<1	<1.09	275	15.3	<1.24	<8.54
Wood04	11/21/2016	TestAmerica--EAA	Lower Glen Rose	6.85	2100	-0.471625	13.5	11.7	172	264	241	15.6	1190	6510	1.47	1.65	270	16.1	<1.24	<8.54
Wood04	11/28/2016	TestAmerica--EAA	Lower Glen Rose	6.7	2200	-0.4610521	14	11.7	171	290	237	15.2	1210	6480	<1.44	<1.09	267	16.9	<1.24	<8.54
Wood04	12/14/2016	TestAmerica--EAA	Lower Glen Rose	6.91	1900	-0.4899932	12.2	10	140	257	240	12.8	1110	6160	<1.44	<1.09	236	18.4	<1.24	<8.54
Wood04	1/4/2017	TestAmerica--EAA	Lower Glen Rose	6.73	2090	-0.43496	14.9	11.3	175	308	234	15.5	1180	5800	<1.44	<1.09	270	17.8	<1.24	<8.54
Wood04	1/11/2017	TestAmerica--EAA	Cow Creek	7.02	1760		14.6	10.7	160	295	244	14.4	968	6690	<1	<1.09	259	22	<1.24	<8.54
Wood04	1/19/2017	TestAmerica--EAA	Lower Glen Rose	6.88	2190	-0.421404	15.5	13	190	302	234	14.5	1180	6610	<1.44	1.59	300	30.2	<1.24	<8.54

Well Name	Date	Strontium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Manganese (µg/L)	Nickel (µg/L)	Lead (µg/L)	Zinc (µg/L)	Antimony (µg/L)	Aluminum (µg/L)	Iron (µg/L)	Mercury (mg/L)	Bromide (mg/L)	Nitrate as N (mg/L)	Selenium (µg/L)	Fluoride (mg/L)	pMC	Tritium (TU)
Ochoa	1/11/2017	10400	<1.4	35	<11.6	<2.17	<0.733	10.6	<16.1	<50	<101	<0.00013	1.22	<0.206	2.68	2.64	ND	ND
Ochoa	1/19/2017	10900	3.35	2.92	<11.6	9.77	14.3	2420	<16.1	58.2	<101	<0.00013	0.882	<0.206	2.97	2.68	ND	ND
Odell No. 2	1/3/2017	ND	ND	<5	10	ND	<5	34	ND	<10	140	ND	ND	<0.2	ND	1.06	ND	ND
Phillips	10/24/2016	2140	<1.4	<2	<11.6	2.55	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.494	0.939	<1.08	0.333	ND	ND
Phillips	11/9/2016	2080	<1.4	15.9	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.482	0.997	2.27	0.361	ND	ND
Phillips	11/17/2016	1810	<1.4	8.98	<11.6	2.55	5.53	<3.55	<16.1	<50	<101	0.000185	0.485	1.08	1.3	0.338	ND	ND
Phillips	11/21/2016	1910	<1.4	12.3	<11.6	2.31	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.477	1.09	<1.08	0.268	ND	ND
Phillips	11/28/2016	2040	<1.4	13.9	<11.6	2.78	<0.733	<3.55	<16.1	<50	<101	0.000161	0.478	1.07	4.48	0.332	ND	ND
Phillips	12/14/2016	2020	<1.4	15.1	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.475	1.06	1.49	0.4	ND	ND
Phillips	1/4/2017	2190	<1.4	17.8	<11.6	2.59	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.673	1.42	<1.08	0.329	ND	ND
Phillips	1/11/2017	2290	<1.4	17.7	<11.6	3	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.694	1.43	<1.08	0.319	ND	ND
Wood01	4/8/2015	9120	<1	<1	<1	ND	<1	6.66	<1	<4	<50	<0.0002	<0.2	<0.02	<4	3.48	0.0044	0.02
Wood01	10/18/2016	15200	<1.4	<2	<11.6	<2.17	<0.733	112	<16.1	<50	<101	0.000157	0.802	0.382	<1.08	0.97	ND	ND
Wood01	10/24/2016	10900	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.798	0.386	<1.08	0.862	ND	ND
Wood01	11/2/2016	9760	<1.4	<2	<11.6	<2.17	<0.733	12.1	<16.1	<50	<101	<0.00013	<0.63	0.388	<1.08	0.672	ND	ND
Wood01	11/9/2016	7710	<1.4	2.92	<11.6	<2.17	<0.733	7.79	<16.1	<50	<101	<0.00013	0.426	0.288	2.66	0.541	ND	ND
Wood01	11/17/2016	6920	<1.4	<2	<11.6	<2.17	<0.733	7.14	<16.1	<50	<101	0.000207	0.427	0.31	<1.08	0.502	ND	ND
Wood01	11/21/2016	9960	<1.4	<2	<11.6	<2.17	<0.733	8.97	<16.1	<50	<101	<0.00013	<0.63	0.388	<1.08	1.96	ND	ND
Wood01	11/28/2016	7190	<1.4	<2	<11.6	<2.17	<0.733	6.6	<16.1	<50	<101	0.000233	0.418	0.288	1.29	0.52	ND	ND
Wood01	12/14/2016	8240	<1.4	2.44	<11.6	<2.17	<0.733	4.72	<16.1	<50	<101	<0.00013	0.423	0.285	1.13	0.771	ND	ND
Wood04	1/28/2015	6540	1.37	2.02	<1	ND	<1	12.5	<1	<4	<50	<0.0002	0.11	0.648	<4	2.23	0.3189	0.52
Wood04	10/18/2016	14300	<1.4	<2	<11.6	<2.17	1.2	<3.55	<16.1	<50	<101	0.000151	<0.63	1.15	<1.08	3.41	ND	ND
Wood04	10/24/2016	11600	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.834	0.466	<1.08	3.06	ND	ND
Wood04	11/2/2016	9670	<1.4	<2	<11.6	<2.17	<0.733	4.09	<16.1	<50	<101	<0.00013	0.828	0.414	<1.08	2.88	ND	ND
Wood04	11/9/2016	12300	<1.4	<2	<11.6	<2.17	0.8	<3.55	<16.1	<50	<101	<0.00013	1.03	0.41	<1.08	4.16	ND	ND
Wood04	11/17/2016	9680	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000326	0.826	0.354	1.1	4.14	ND	ND
Wood04	11/21/2016	11000	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	<0.00013	0.826	0.358	<1.08	3.07	ND	ND
Wood04	11/28/2016	9770	<1.4	3.26	<11.6	<2.17	0.986	4.79	<16.1	<50	<101	0.000175	0.83	0.336	2.54	3.57	ND	ND
Wood04	12/14/2016	9190	<1.4	<2	<11.6	<2.17	<0.733	<3.55	<16.1	<50	<101	0.000656	<0.63	0.98	1.17	2.94	ND	ND
Wood04	1/4/2017	11900	<1.4	3.12	<11.6	<2.17	<0.733	3.63	<16.1	<50	<101	<0.00013	1.21	1.33	<1.08	3.34	ND	ND
Wood04	1/11/2017	9480	<1.4	76.3	<11.6	<2.17	1.37	31	<16.1	<50	<101	<0.00013	1.2	1.55	2.1	2.24	ND	ND
Wood04	1/19/2017	12800	<1.4	<2	<11.6	<2.17	2.18	277	<16.1	<50	132	<0.00013	<0.63	<0.206	3.14	3.46	ND	ND

Appendix D: Water Level Data Example (spreadsheet available upon request)

Date&Time	Escondida1_DTW	Escondida1_Elev	Gluesenkamp_DTW	Gluesenkamp_Elev	Jones01_DTW	Jones01_Elev	LasLomas_DTW	LasLomas_Elev	Lowe_dtw	Lowe_elev	Miller_DTW	Miller_Elev	Ochoa_dtw	Ochoa_Elev	Page_DTW	Page_Elev	Wood01_DTW	Wood01_Elev	Wood04_DTW	Wood04_Elev
1/4/17 10:00	356.99	748.71	92.14	915.49	177.94	871.06	139.87	868.65	331.68	739.62	321.48	745.82	320.48	754.22	211.19	797.01	318.32	750.60	261.08	821.02
1/4/17 11:00	357.05	748.65	94.22	913.41	178.97	870.03	139.87	868.65	330.66	740.64	321.50	745.80	319.93	754.78	209.72	798.48	318.28	750.64	261.06	821.04
1/4/17 12:00	357.12	748.58	92.69	914.94	178.50	870.50	139.89	868.64	329.72	741.58	321.53	745.77	319.64	755.06	209.00	799.20	318.20	750.73	261.11	820.99
1/4/17 13:00	357.16	748.54	92.39	915.24	179.12	869.89	139.88	868.64	328.79	742.51	321.55	745.75	319.10	755.61	211.31	796.90	318.19	750.73	260.91	821.19
1/4/17 14:00	357.25	748.45	92.29	915.34	178.55	870.45	141.52	867.00	328.01	743.29	321.55	745.75	319.64	755.06	209.78	798.42	318.16	750.76	261.18	820.92
1/4/17 15:00	357.44	748.26	92.25	915.38	178.34	870.66	140.10	868.42	327.15	744.15	321.51	745.79	318.58	756.12	220.26	787.94	318.13	750.79	261.02	821.09
1/4/17 16:00	357.41	748.29	92.22	915.41	178.84	870.16	140.01	868.51	326.37	744.93	321.48	745.82	318.43	756.27	233.94	774.26	318.10	750.82	261.03	821.07
1/4/17 17:00	357.44	748.26	92.20	915.44	178.50	870.50	139.97	868.55	325.61	745.69	321.52	745.78	317.72	756.99	231.40	776.80	317.98	750.94	261.10	821.00
1/4/17 18:00	357.43	748.27	92.41	915.22	178.33	870.67	139.96	868.56	324.80	746.50	321.44	745.86	318.08	756.62	225.43	782.78	317.98	750.94	260.90	821.20
1/4/17 19:00	357.48	748.22	92.27	915.36	178.22	870.78	139.94	868.58	323.47	747.83	321.44	745.86	317.01	757.69	224.49	783.71	317.92	751.00	260.94	821.16
1/4/17 20:00	357.47	748.23	92.23	915.40	178.13	870.87	139.91	868.61	322.77	748.53	321.41	745.89	318.35	756.35	221.22	786.98	317.85	751.07	260.96	821.14
1/4/17 21:00	357.48	748.22	92.22	915.41	178.40	870.60	139.91	868.62	322.08	749.22	321.36	745.94	316.31	758.39	218.92	789.28	317.80	751.12	260.99	821.11
1/4/17 22:00	357.62	748.08	92.23	915.40	178.22	870.78	139.91	868.61	321.47	749.83	321.34	745.96	315.93	758.77	217.26	790.94	317.67	751.25	260.76	821.34
1/4/17 23:00	357.72	747.99	92.20	915.43	178.30	870.70	139.94	868.58	320.82	750.48	321.34	745.96	315.73	758.97	216.06	792.14	317.67	751.25	260.82	821.28
1/5/17 0:00	358.11	747.59	92.19	915.44	178.15	870.85	139.93	868.59	320.24	751.06	321.38	745.92	315.32	759.38	215.55	792.65	317.57	751.35	260.84	821.26
1/5/17 1:00	358.29	747.41	92.21	915.42	178.09	870.91	139.95	868.57	319.69	751.61	321.35	745.95	315.20	759.50	215.92	792.28	317.57	751.35	260.71	821.39
1/5/17 2:00	358.34	747.37	92.21	915.42	178.10	870.91	139.94	868.58	319.11	752.19	321.29	746.01	314.69	760.01	212.90	795.30	317.53	751.39	260.75	821.35
1/5/17 3:00	358.36	747.34	92.22	915.41	178.25	870.75	139.99	868.53	318.60	752.70	321.29	746.02	316.44	758.26	213.82	794.38	317.54	751.38	260.79	821.32
1/5/17 4:00	358.42	747.28	92.22	915.41	178.40	870.61	139.95	868.57	318.05	753.25	321.32	745.98	314.10	760.60	211.60	796.60	317.50	751.42	261.19	820.91
1/5/17 5:00	358.47	747.23	96.48	911.15	178.40	870.60	139.97	868.55	317.55	753.75	321.29	746.01	313.72	760.98	213.39	794.81	317.42	751.50	260.64	821.46
1/5/17 6:00	358.56	747.14	92.34	915.29	178.39	870.61	139.94	868.58	317.05	754.25	321.25	746.05	313.50	761.20	211.14	797.06	317.41	751.51	260.66	821.44
1/5/17 7:00	358.75	746.95	92.67	914.96	178.60	870.40	139.95	868.57	316.48	754.82	321.23	746.07	313.15	761.55	209.83	798.37	317.36	751.56	260.77	821.34
1/5/17 8:00	358.34	747.37	92.44	915.19	178.44	870.56	139.96	868.56	316.05	755.25	321.21	746.09	313.06	761.64	208.99	799.21	317.29	751.63	260.51	821.60
1/5/17 9:00	358.22	747.48	92.35	915.29	178.75	870.25	139.94	868.58	315.54	755.76	321.24	746.06	312.73	761.97	210.38	797.82	317.20	751.72	260.59	821.51
1/5/17 10:00	358.03	747.67	92.32	915.31	178.68	870.32	139.99	868.53	315.12	756.18	321.15	746.15	312.92	761.78	209.20	799.00	317.04	751.88	260.57	821.53
1/5/17 11:00	357.92	747.78	92.28	915.35	178.84	870.17	139.97	868.55	314.57	756.73	321.22	746.08	312.16	762.54	208.46	799.74	316.98	751.94	260.67	821.43
1/5/17 12:00	357.83	747.87	92.36	915.27	178.63	870.37	140.00	868.52	314.16	757.14	321.21	746.09	311.86	762.84	210.25	797.95	316.93	752.00	261.39	820.71
1/5/17 13:00	357.88	747.82	92.47	915.16	178.57	870.43	139.99	868.53	313.70	757.60	321.18	746.12	311.62	763.09	209.08	799.12	316.79	752.13	260.71	821.39
1/5/17 14:00	357.82	747.88	92.35	915.28	178.57	870.43	139.94	868.58	313.26	758.04	321.21	746.09	311.41	763.29	208.29	799.91	316.76	752.16	260.72	821.38
1/5/17 15:00	357.88	747.82	92.33	915.30	178.75	870.25	139.99	868.53	312.94	758.36	321.16	746.14	311.16	763.54	210.92	797.28	316.66	752.26	260.77	821.33
1/5/17 16:00	357.72	747.99	92.33	915.30	178.61	870.39	139.97	868.55	312.45	758.85	321.14	746.16	310.89	763.81	209.31	798.89	316.57	752.35	260.81	821.29
1/5/17 17:00	357.66	748.04	92.42	915.21	178.56	870.44	139.97	868.55	312.08	759.22	321.16	746.14	310.65	764.05	208.37	799.84	316.50	752.42	260.63	821.47
1/5/17 18:00	357.51	748.19	92.32	915.31	178.81	870.19	139.97	868.55	311.66	759.64	321.06	746.24	310.42	764.28	210.35	797.85	316.41	752.51	260.65	821.46
1/5/17 19:00	357.39	748.31	93.53	914.10	178.86	870.14	139.95	868.57	311.26	760.04	321.08	746.22	327.90	746.80	229.42	778.78	316.27	752.65	260.71	821.39
1/5/17 20:00	357.27	748.43	96.59	911.04	178.79	870.21	139.91	868.61	310.89	760.41	321.05	746.25	310.04	764.67	253.16	755.04	316.21	752.71	260.73	821.38
1/5/17 21:00	357.20	748.50	92.51	915.12	178.70	870.31	139.91	868.61	310.50	760.80	321.01	746.29	309.77	764.93	267.63	740.57	316.04	752.88	260.48	821.62
1/5/17 22:00	357.24	748.46	92.40	915.23	178.90	870.10	139.89	868.63	310.14	761.16	321.01	746.29	309.54	765.16	277.37	730.83	315.95	752.98	260.55	821.55
1/5/17 23:00	357.06	748.64	92.32	915.31	178.70	870.30	139.88	868.64	309.77	761.53	321.01	746.29	309.29	765.42	291.72	716.49	315.83	753.09	261.54	820.56
1/6/17 0:00	356.95	748.75	92.29	915.34	178.65	870.36	139.88	868.64	309.37	761.93	320.99	746.32	309.01	765.69	299.02	709.18	315.72	753.20	261.24	820.86
1/6/17 1:00	356.87	748.83	92.27	915.36	178.70	870.30	139.86	868.67	309.00	762.30	321.01	746.29	308.78	765.92	313.54	694.66	315.62	753.30	261.21	820.89
1/6/17 2:00	356.97	748.73	92.27	915.36	178.64	870.36	139.83	868.69	308.69	762.61	321.02	746.28	308.53	766.17	313.53	694.67	315.54	753.38	261.25	820.85
1/6/17 3:00	356.84	748.87	92.21	915.42	178.59	870.41	139.87	868.65	308.34	762.96	321.05	746.25	308.73	765.97	308.11	700.09	315.38	753.54	261.46	820.64
1/6/17 4:00	356.71	748.99	92.21	915.42	178.59	870.41	139.85	868.67	308.04	763.26	321.10	746.20	308.23	766.48	307.49	700.71	315.34	753.58	262.14	819.96
1/6/17 5:00	356.64	749.06	92.19	915.44	178.58	870.42	139.82	868.70	307.69	763.61	321.06	746.24	307.97	766.74	302.55	705.65	315.23	753.69	261.46	820.64
1/6/17 6:00	356.56	749.14	93.30	914.33	178.58	870.42	139.80	868.72	307.40	763.90	321.10	746.20	307.79	766.91	303.37	704.83	315.18	753.74	261.48	820.62
1/6/17 7:00	356.48	749.22	92.26	915.37	178.59	870.42	139.79	868.73	307.08	764.22	321.14	746.17	307.59	767.12	299.60	708.60	315.06	753.86	261.52	820.58
1/6/17 8:00	356.42	749.28	92.20	915.43	178.84	870.17	139.73	868.79	306.74	764.56	321.11	746.20	307.37	767.33	281.58	726.62	315.00	753.92	261.26	820.84
1/6/17 9:00	356.40	749.31	92.17	915.46	179.34	869.66	139.72	868.81	306.41	764.89	321.15	746.15	318.58	756.12	262.82	745.38	314.85	754.07	261.28	820.82
1/6/17 10:00	356.32	749.38	92.14	915.49	179.55	869.45	139.72	868.80	306.13	765.17	321.10	746.20	307.11	767.59	246.71	761.49	314.78	754.14	261.28	820.82
1/6/17 11:00	356.20	749.50	93.05	914.58	180.05	868.95	139.72	868.80	305.81	765.49	321.10	746.20	306.82	767.88	239.13	769.07	314.65	754.27	261.04	821.06
1/6/17 12:00	356.24	749.46	92.19	915.44	180.40	868.60	139.70	868.82	305.49	765.81	320.98	746.32	306.62	768.08	230.42	777.78	314.58	754.34	261.08	821.03
1/6/17 13:00	356.09	749.61	92.14	915.49	179.92	869.08	139.76	868.76	305.49	765.81	320.99	746.31	306.45	768.25	224.77	783.43	314.46	754.46	261.10	821.00
1/6/17 14:00	356.04	749.67	92.15	915.48	179.68	869.32	139.75	868.77	305.49	765.81	320.96	746.34	306.34	768.36	223.79	784.41	314.39	754.53	260.92	821.18
1/6/17 15:00	355.92	749.78	92.32	915.31	179.54	869.46	139.68	868.84	305.22	766.08	320.88	746.42	306.13	768.57	220.09	788.11	314.29	754.63	260.95	821.15
1/6/17 16:00	356.14	749.56	92.19	915.44	179.64	869.36	139.70	868.82	304.94	766.36	320.89	746.41	305.97	768.73	219.95	788.25	314.24	754.68	260.96	821.14
1/6/17 17:00	356.09	749.61	92.14	915.49	179.56	869.44	139.69	868.83	304.66	766.64	320.85	746.45	306.08	768.63	220.52	787.69	314.14	754.78	261.08	821.02
1/6/17 18:00	355.98	749.72	92.10	915.53	179.46	869.55	139.64	868.88	304.37	766.93	320.87	746.44	305.75	768.95	224.16	784.04	314.09	754.84	262.26	819.84
1/6/17 19:00	355.84	749.86	92.07	915.56	179.42	869.58	139.71	868.81	304.11	767.19	320.88	746.42	305.62	769.08	234.97	773.23	314.04	754.88	262.09	820.01
1/6/17 20:00	355.75	749.95	92.03	915.60	179.58	869.42	139.56	868.96	303.90	767.40	320.86	746.44	305.42	769.28	239.30	768.90	313.90	755.02	262.03	820.07
1/6/17 21:00	355.64	750.06	92.17	915.46	179.48	869.52	139.57	868.95	303.63	767.67	320.85	746.45	305.30	769.40	242.05	766.15	313.83	755.09	262.00	820.10
1/6/17 22:00	355.70	750.00	92.04	915.59	179.60	869.40	139.54	868.98	303.38	767.92	320.77	746.53	305.06	769.64	247.51	760.69	313.75	755.17	261.94	820.16