Aquifer Test Work Plan

Introduction

This aquifer test work plan has been developed based upon the guidelines established by the District to fulfill the requirements for a general permit for three wells identified as Bridges Well Nos. 1 & 2 and Odell Well No. 2. As stated in the BSEACD Guidelines (adopted May 12, 2016), 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. Due to the requested pumping volume of greater than 200,000,000 gallons per year, this work plan will encompass the Tier 3 requirements as established by the District's guidelines.

The aquifer test work plan will address the following guidelines as outlined in Appendix A of the BSEACD Guidelines:

1. Initiation, duration, and pumping rate;
2. Aggregate well fields;
3. Well completion;
4. Number and location of monitor wells;
5. Water level data; and,
6. Water quality data.

Upon completion of the aquifer testing and associated analyses, a hydrogeologic report will be completed as outlined in Section III of the BSEACD Guidelines.

Aquifer Test Work Plan

1. Initiation, Duration, And Pumping Rate

An aquifer test will be completed on Bridges Well No. 1, Bridges Well No. 2 and Odell Well No. 2, with a tentative start date in October/November 2016. Each well will be tested individually and pumped at a constant rate to produce at least three times the daily proposed regular permit volume of 2.5 million gallons, depending upon the final pumping rate of each individual well. For better results, EP plans to pump each well for approximately 5 days for each aquifer test; the total volume pumped would amount to approximately 10,800,000 gallons (4.32 times the proposed daily regular permit volume):

- The Bridges Well No. 1 is estimated to produce 550 gpm after acidization is complete. **Total Production Volume for General Permit = 3,960,000 gallons**;
- The Bridges Well No. 2 is estimated to produce 550 gpm after acidization is complete. **Total Production Volume for General Permit = 3,960,600 gallons**;
- The Odell Test Well No. 2 is estimated to produce 400 gpm after acidization is complete **Total Production Volume for General Permit = 2,880,000 gallons**.

The tentative scheduling sequence is below. The schedule does not take into account days off for weather or holidays. The final schedule will be coordinated with BSEACD.

Bridges Well No. 1 Aquifer Test

- Week 1 – Background water levels on pumping well (Bridges Well No. 1) and observation wells (Bridges Wells 2, 3 & 4; and Odell Wells 1, 2 & 3);
    - Install transducers at least 1 week prior to beginning aquifer test on observation wells.
- Week 2 – Acidization and Pumping Phase of Aquifer Test;
    - Day 1 of Week 2 – Remove transducer in Bridges Well No. 1 and acidize. Seal well head at Bridges Well No. 1;
    - Day 2 of Week 2 – Remove well head seal and install test pump;
    - Day 3 of Week 2 – Install test pump
    - Day 4 of Week 2 - Begin aquifer test.
- Week 3 – Recovery Phase of Aquifer Test;
    - Day 2 of Week 3 - Shut pump off on pumping well;
    - Continue water level monitoring during recovery phase of aquifer test. Based upon airline measurement, recovery will take place until 90% recovery is achieved.

Bridges Well No. 2 Aquifer Test

- Week 4 – Background water levels on pumping well (Bridges Well No. 2) and observation wells (Bridges Wells 1, 3 & 4; and Odell Wells 1, 2 & 3);
    - Day 2 of Week 4 – Download data from all transducers monitored by Wet Rock and remove pump in pumping well (Bridges Well No. 1);
    - Day 3 of Week 4 – Remove pump in pumping well;
    - Day 4 of Week 4 –Install transducers at least 1 week prior to beginning aquifer test on observation wells. Acidize Bridges Well No. 2 and seal well head; and
    - Day 5 of Week 4 – Remove well head seal and install test pump.
- Week 5 – Acidization and Pumping Phase of Aquifer Test;
    - Day 1 of Week 5 – Install test pump;
    - Day 2 of Week 5 – Begin aquifer test; and
    - Day 7 of Week 5 – Shut pump off on pumping well.
- Week 6 – Recovery Phase of Aquifer Test;
    - Continue water level monitoring during recovery phase of aquifer test. Based upon airline measurement, recovery will take place until 90% recovery is achieved.

Odell Well No. 2 Aquifer Test

- Week 7 – Background water levels on pumping well (Odell Well No. 2) and observation wells (Bridges Wells 1, 2, 3 & 4; and Odell Wells 1, & 3);
    - Day 1 of Week 7 – Download data from all transducers monitored by Wet Rock and remove pump in pumping well (Bridges Well No. 2);
    - Day 2 of Week 7 – Remove pump in pumping well;
    - Day 3 of Week 7 –Install transducers at least 1 week prior to beginning aquifer test on observation wells. Acidize Odell Well No. 2 and seal well head;
    - Day 4 of Week 7 – Remove well head seal and install test pump; and
    - Day 5 of Week 7 – Install test pump.
- Week 8 – Acidization and Pumping Phase of Aquifer Test;
    - Day 1 of Week 8 – Begin aquifer test; and
    - Day 6 of Week 8 – Shut pump off on pumping well.
- Week 9 – Recovery Phase of Aquifer Test;
    - Continue water level monitoring during recovery phase of aquifer test. Based upon airline measurement, recovery will take place until 90% recovery is achieved.

The discharge rate from the pumping well will be measured using a calibrated flow meter. A certificate showing the calibration will be provided to the District. Discharge rate will be measured at least during the first four (4) hours of the pumping phase or until a constant pumping rate is achieved. During the test, a discharge rate will be measured at least once daily.

Discharge from each pumping well will be managed by the following:

- The initial discharge from the pumping well will be into a holding tank and buffered using potash to neutralize the water until the pH reaches at least 6.5. Once the water reaches a pH of 6.5 it will be released onto the ground.
- At Bridges Well No. 1 and Well No. 2, the water will be discharged onto the Bridges property where it will flow via natural drainage into the property's stock tanks; from the stock tanks the water will overflow back into natural drainage features on the property reaching creek beds.
- At the Odell Well No. 2, the water will be discharged onto a large stock tank on the Odell property where a trash pump will be used to pump water from the stock tank over a small hill to be discharged on the Odell property. Natural drainage of the water will then go towards other stock tanks on the property eventually reaching creek beds.

2. Aggregate Well Fields

The study involves three wells that will be pumped individually to measure their combined effects.

3. Well Completion

During the aquifer testing, the pumping well will be equipped to isolate the target production zone in the Middle Trinity Aquifer (Cow Creek Limestone) with a Baski MD 7.5 packer. A copy of the packer specifications has been provided to BSEACD previously. If the requested permit is granted, EP will complete the wells to public water supply standards mandated by TCEQ regulations.

4. Number and Location of Monitor Wells

For the Tier 3 aquifer test work plan, a network of observation wells will be utilized during the testing. Figure 1 provides a map of the observation wells that will be monitored during the testing. Wells completed in the Upper Trinity Aquifer are represented by yellow circles, wells completed specifically in the Lower Glen Rose Formation are represented by green circles, wells completed specifically in the Cow Creek Formation are represented by dark blue circles, and wells completed in the Middle Trinity are represented by orange circles (Figure 1). During each aquifer test, there will be 18 wells available for observation. Table 1 provides the details of each available observation well.

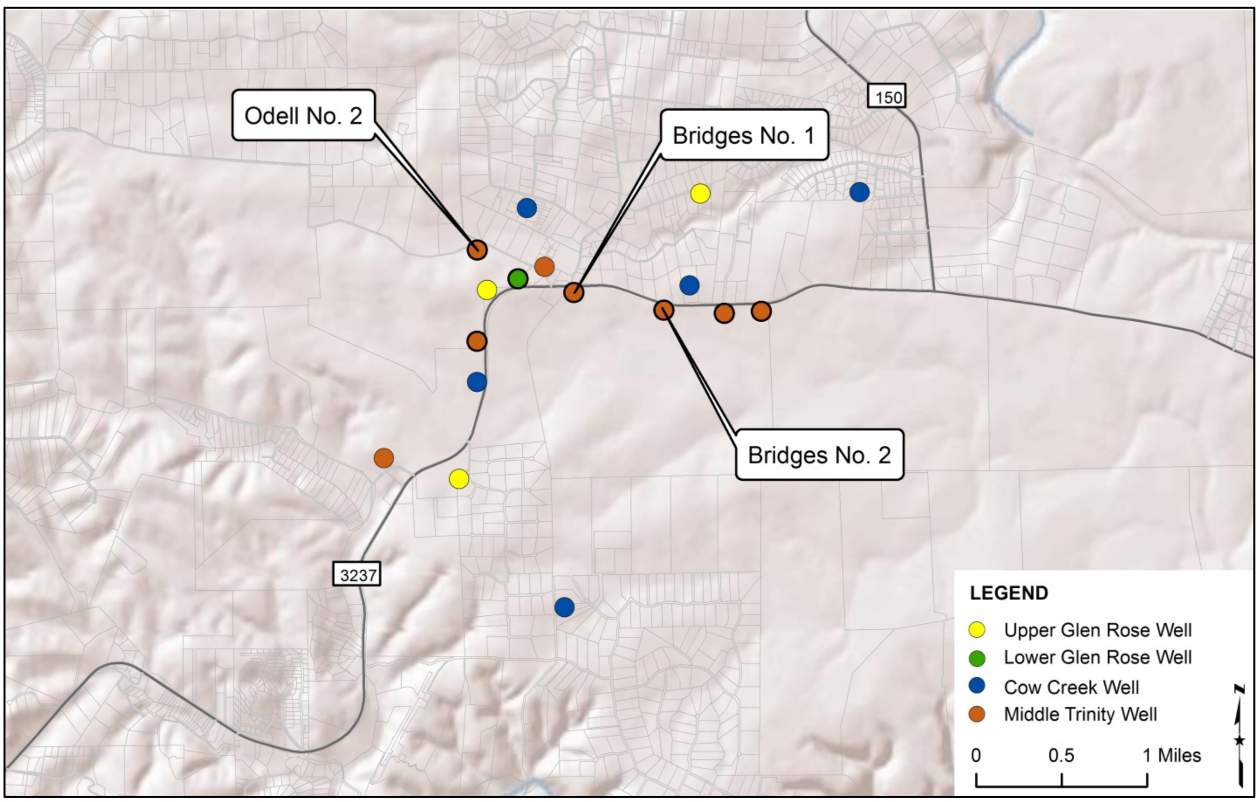


Figure 1: Observation wells near the EP well field

One of the goals of the aquifer testing is to determine the effect, if any, that production from the Cow Creek Limestone has on water levels in wells discretely completed within the Lower Glen Rose and Upper Glen Rose formations. After discussing the aquifer testing plans with the District, it was agreed upon that Odell Well No. 1 will be modified so that it is discretely completed within the Lower Glen Rose Formation. This will be accomplished by setting a cement plug within the Cow Creek Limestone and Bexar Shale up to the base of the Lower Glen Rose Formation, leaving it open and available for observation during the aquifer tests (Attachment A). The Odell Well No. 1 is currently completed with a PVC casing to the top of the Lower Glen Rose Formation and an open hole completion from the Lower Glen Rose Formation to the base of the Cow Creek Member. Placing a cement plug at the bottom of the well through the Cow Creek and Bexar Shale up to the bottom of the Lower Glen Rose Formation will isolate the Lower Glen Rose.

WRGS will provide transducers for the measurement of water levels for the area above the packer within the pumping wells and for the monitoring of the remaining six (6) EP Wells that will be used as observation wells during the aquifer testing. BSEACD will be responsible for setting transducers and monitoring the water level within all other monitoring wells. All data collected from the pumping and observation wells will be shared between WRGS and BSEACD.

Table 1: Well completion data for the EP well field observation wells

Well ID	Elevation (ft. MSL)	Depth (ft. bgs)	Aquifer	Use	Measurement Type	Measured by:
Odell Well No. 1	1,102	903*	Lower Glen Rose	Observation	Transducer	WRGS
Odell Well No. 2	1,093	850	Cow Creek	Production	Transducer	WRGS
Odell Well No. 3	1,063	845	Middle Trinity	Observation	Transducer	WRGS
Bridges Well No. 1	1,040	930	Cow Creek	Production	Transducer	WRGS
Bridges Well No. 2	1,010	905	Cow Creek	Production	Transducer	WRGS
Bridges Well No. 3	1,000	940	Middle Trinity	Observation	Transducer	WRGS
Bridges Well No. 4	994	905	Middle Trinity	Observation	Transducer	WRGS
Las_Lomas	1069.66	n/a	Upper Trinity	Irrigation	Transducer	BSEACD
Alvarado01	1138.41	n/a	Upper Trinity	Unused	Periodic	BSEACD
Jones01	1048.38	350	Upper Trinity	Domestic	Periodic	BSEACD
Wood02	1065.59	n/a	Upper Trinity	n/a	Periodic	BSEACD
Bowman	1031.46	850	Middle Trinity (Cow Creek)	Domestic	Periodic	BSEACD
Ochoa	1071.27	810	Middle Trinity	domestic	Transducer	BSEACD
Gluesenkamp	1003.21	195	Upper Trinity	domestic	Transducer	BSEACD
Lowe	1068.91	860	Middle Trinity (Cow Creek)	domestic	Transducer	BSEACD
Wood04	1079.96	630	Middle Trinity	domestic	Transducer	BSEACD
Wood01	1086.18	790	Middle Trinity (Cow Creek)	domestic	Transducer	BSEACD
Miller_Hank	1053.35	900	Middle Trinity (Cow Creek)	domestic	Transducer	BSEACD
Sierra West	1009.06	982	Middle Trinity (Cow Creek)	Production	Periodic	BSEACD
Notes: ft. = feet; bgs = below ground surface; *Well will be modified so that it is discretely completed within the Lower Glen Rose Formation						

5. Water Level Data

The pumping well for each of the aquifer tests will have:

- A transducer capable of measuring water level to the nearest 0.01 foot and temperature at one minute intervals set within a PVC access tube above the packer;
- A transducer capable of measuring water level to the nearest 0.01 foot and temperature at one minute intervals strapped to the column pipe below the packer (provided by Electro Purification) as requested by BSEACD. We have a large concern with having a transducer strapped to the bottom of the column pipe getting damaged or lost down hole. The cost of a transducer can be well over $1,000. If the transducer is damaged or lost during testing, we will forego strapping a transducer beneath the packer and use the airline measurements.
- An airline running down the length of the well through the packer set above the pump to measure water levels manually using an airline.

Each observation well (i) will have a dedicated transducer capable of measuring the water level to the nearest 0.01 foot and temperature at one minute intervals, or (ii) will be designated to have manual recordings at specified intervals using an electric line.

The water level measurements will begin at least one week prior to the aquifer testing. After the pumping phase of the aquifer test is complete, water level measurements will continue through the recovery phase.

6. Water Quality Data

During the testing, a water quality sample will be collected 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. Field measurements (temperature, pH, and specific conductance) will also be taken.

Water quality samples on each of the pumping wells during each aquifer test will be collected and sent to a certified laboratory for analyses. In addition, field parameters (temperature, pH and specific conductance) will be taken during the first four hours of each aquifer test at the pumping well and once daily during the pumping phase.

7. Well Design for Alternate Completion Design

Attachment A provides the well design schematics for the three test wells (Bridges Well No. 1, Bridges Well No. 2 and Odell Well No. 2) and the modified Odell Well No. 1. The schematics provide the construction design as well as the depths at which the packer will be placed in each of the wells during testing.

During the aquifer test, the pumping well will be outfitted with a Baski MD-7.5 packer designed to separate the Hensell/Bexar Shale from the Cow Creek Limestone (Figure 2). The packer is intended to function by creating a seal within the borehole much like cementing a casing in place, thereby separating the formation above and below the packer. The packer is constructed of reinforced natural rubber with an outer covering of high strength steel collar. The packer is attached to the pump's column pipe with the pump located at the base of the column pipe. The pump, column pipe and packer assembly is installed downhole and then inflated via air to expand within the borehole forming a seal.

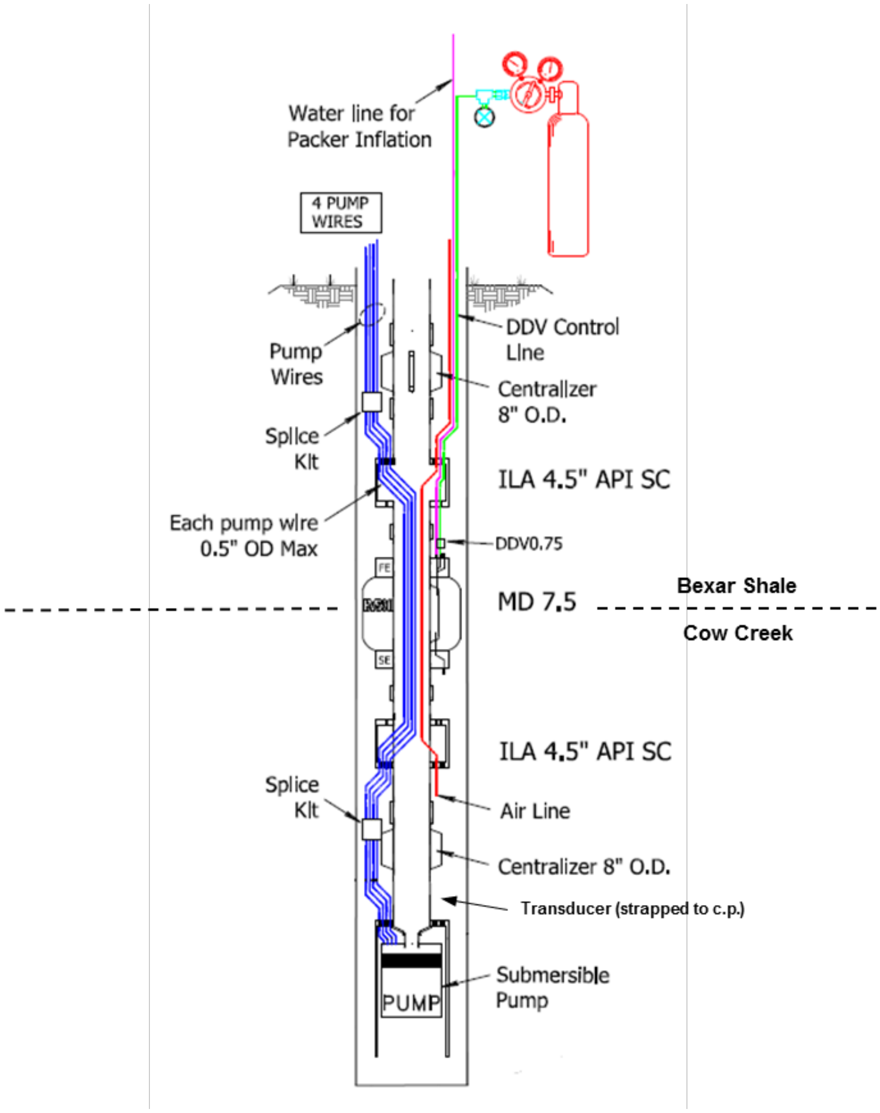


Figure 2: Baski MD 7.5 packer and test pump diagram

Multiple meetings and correspondence with the packer manufacturer (Baski) have been undertaken to custom design the packer to meet the requirements of the aquifer testing. Specifically, this particular packer (Baski MD 7.5) is designed to withstand borehole differential pressures much greater than what we anticipate in the testing. The MD 7.5 is designed to meet a borehole differential pressure of up to 2,100 psi (4,851 ft.) within a 10-inch borehole; we anticipate a borehole pressure differential of no more than 200 psi. Please find attached (Attachment B) the specification sheet for the Baski MD 7.5.

To determine the performance of the packer in the isolation of the Cow Creek, we will first take a pressure reading above and below the packer. If the packer is working properly we will notice a differential in pressure above and below. Additionally, throughout the test this differential should be maintained; if a leak in the packer is caused, then a drop in the pressure above the packer will be experienced.

8. Acidization Procedures

Prior to aquifer testing, Bridges Well No. 1, Bridges Well No. 2, and Odell Well No. 2 will be acidized to more fully develop their production capacities. The acidization procedure for each well will be performed by an authorized contractor in accordance with the following specifications:

- injecting a corrosion inhibitor and 10,000 gallons of 28% hydrochloric acid into the producing interval (Cow Creek Member) via tremie pipe;
- flushing 60,000 gallons of water following acidization into the well via tremie pipe;
- allowing the mixture to remain in the well for at least 48 hours; and,
- pumping the well until the discharge contains no trace of the inhibitor or any sand, silt, or deleterious material. The water will be pumped into a holding tank (buffered using potash to neutralize the water) until the water reaches a pH of 6.5; once the water reaches a pH of 6.5, it will be released onto the ground.

The drilling contractor for the aquifer testing is:

Hydro Resources Mid Continent, Inc.
Mr. Tyler Sutliff (Business Development Manager)
31866 RR 12, Dripping Springs, TX 78620
512-858-4375

Hydro Resources, previously Whisenant & Lyle Water Services, has been in business for over 50 years and has conducted hundreds of acidization jobs on wells. Hydro Resources will subcontract the acidization of the wells to Nine Energy Services, which is the parent company of Crest Pumping Technologies. They were established in 2011 and average approximately 120 acidization jobs per year.

Hydro Resources will be responsible for setting the tremie pipe within the well to the Cow Creek Member and sealing the top of the well. The acid is injected into the formation via pressure similar to a pressure cementation of the well casing. Crest Pumping Technologies will then attach hose from the truck holding the acid to the top of the well head and begin injecting the acid under pressure. Once the acidization is complete, water will be injected via the same tremie pipe to force the acid into the Cow Creek Member. The well head seal is left in place to eliminate any blowback of the acid to the surface and forces it into the formation. The acid, like water will flow towards the path of least resistance. In this case, since it is injected at the Cow Creek Member, the acid will flow into the Cow Creek Formation.

The inhibitor that will be used is Rodind 103 NPF by Henkle. It is of food grade; please find attached the spec sheet in Attachment C.

The use of the well head seal to inject the acid and water under pressure into the formation also protects from any blow back of acid or CO2 pressure. Pressure buildup from the acid is released into the formation and once the acid comes into contact with the limestone it begins to get buffered and spent. Leaving the well head seal on for a minimum of 24 hours allows for the acid to be fully buffered by the limestone. In addition, when working near the acidized well and removing the seal, personal protection equipment, including clothing, goggles and safety helmet will be employed. There is no way to fully eliminate any chance of acid migrating into other formations, however, acid or any liquid will flow into the path of least resistance. In this case that would be the Cow Creek Member. Where there is casing present there is also a cement seal forming a barrier to flow in this direction.

To determine the level of spent acid in the well, water quality testing procedures will include field parameters (pH, conductivity) and a laboratory sample. Field parameters will be taken throughout the aquifer test and a water sample will be collected during the end of the aquifer test and sent to a laboratory for analysis. The results will be compared to previous water quality sampling conducted prior to acidization during aquifer testing that was conducted on these wells in 2014-2015.

It is virtually impossible to calculate the amount of time it will take to develop the acid from the well. Once the acid is in contact with the limestone it is buffered almost immediately. From our experience in acidizing wells, which covers over fifteen (15) years and over thirty (30) wells, the pH of the water the day after acidizing is close to 6.5. The acid dissolves the limestone causing an increase in the concentration of constituents found in the water. For example, the sulfate concentration will increase as does the TDS. The chloride concentration in the water is increased due to the introduction of the acid (HCL).

A good measure of the development is to compare the chloride, pH TDS concentrations from before and after acidization. With that said, there is no way for us to determine the development time because we have no way of determining where the fractures are located and the velocity/direction of the groundwater. The testing of the wells will purge almost 4 million gallons of water from the Bridges Well No. 1 and Well No. 2 and almost 3 million gallons of water from Odell No. 2. This should be sufficient to develop the wells.

During aquifer testing a test pump provided by the drilling contractor will be used. The test pump will be a submersible pump, likely a Grundfos 385S100-13 with a 100 HP 460V 3-Phase motor. A different pump/motor combination may be used depending upon production capacities after acidization.

Discharge from each pumping well will be managed by the following (Figure 3):

- The initial discharge from the pumping well will be into a holding tank and buffered using potash to neutralize the water until the pH reaches at least 6.5. Once the water reaches a pH of 6.5 it will be released onto the ground.
- At Bridges Well No. 1 and Well No. 2, the water will be discharged onto the Bridges property where it will flow via natural drainage into the properties stock tanks; from the stock tanks the water will overflow back into natural drainage features on the property reaching creek beds.
- At the Odell Well No. 2, the water will be discharged onto a large stock tank on the Odell property where a trash pump will be used to pump water from the stock tank over a small hill to be discharged on the Odell property. Natural drainage of the water will then go towards other stock tanks on the property eventually reaching creek beds.

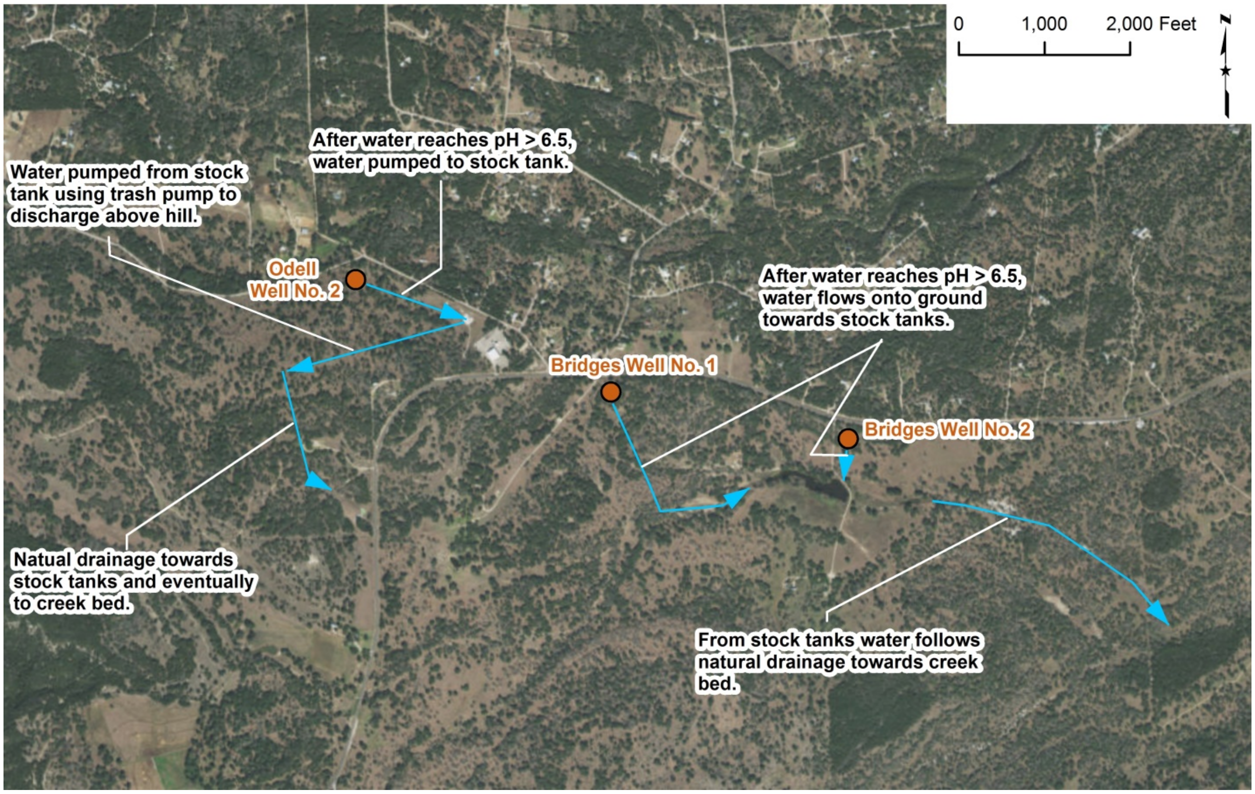


Figure 3: Estimated drainage of water during aquifer testing

The discharge plan described above is what is used for the acidization of public supply wells throughout the State of Texas. The TCEQ requires that the acidized water be held and neutralized until it reaches a pH of 6.5, then it can be discharged onto the ground. The water purged from the well after a pH of 6.5 is not harmful and contains elevated concentrations of the dissolved limestone. Some taste issues for a short period of time may be experienced at adjacent wells during the acidization process.

Like the estimate of development it is difficult to determine the extent of penetration of the acid into the aquifer because of the lack of knowledge of the location, size and connectivity of the fractures. Estimates can be provided for the penetration of the acid, although with little confidence due to the karst nature of the aquifer. Based upon discussion with the BSEACD we have used the TCEQ's formula for injection into wastewater wells.

$$r = \frac{\sqrt{Q}}{\pi(h * \Phi)}$$

Where:

- r = Radius of influence
- Volume of acid/water injected into well (Q) = 70,000 gallons or 9,358 ft^3;
- Formation Thickness (h) = ~80 ft/day (Cow Creek)/ 1 ft. extreme maximum penetration
- Estimated porosity (Φ) = 30%

Injecting 70,000 gallons assuming a thickness of the Cow Creek Member of 80 ft. results in a penetration of approximately 11.13 ft. Assuming a thickness of 1 ft. results in an extreme maximum penetration of approximately 103 ft. Due to the karst nature we cannot provide a confident estimate of penetration into the aquifer, however based upon our experience with acidizing wells in the Trinity Aquifer, we estimate that penetration could be as high as hundreds of feet into the aquifer.

The rationale for leaving the acid in place within the well for 48 hours is for two main reasons:

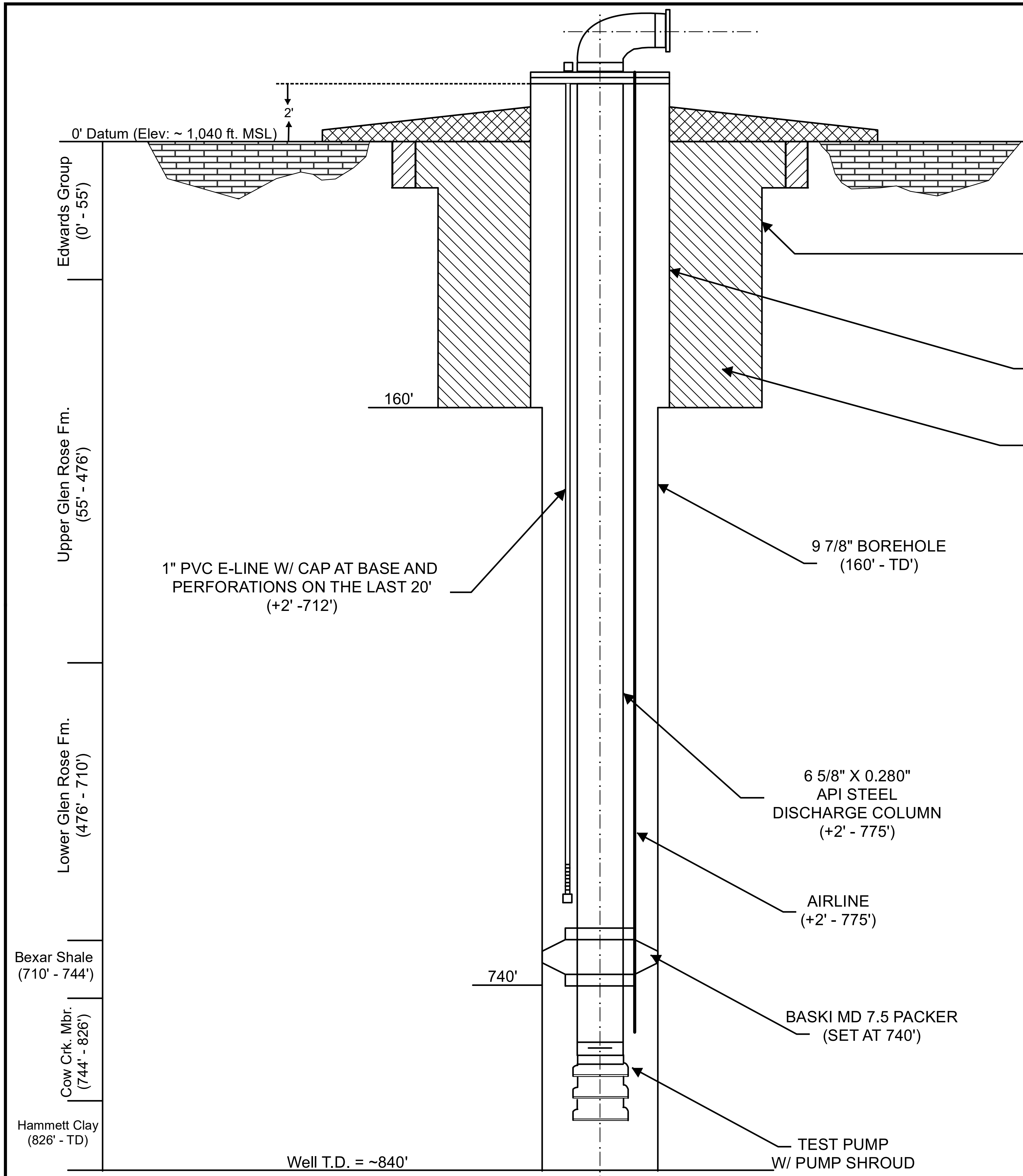
1. We require at least twenty four hours to allow the acid to become buffered by the limestone and for time to reduce the pressure in the well from the acidization, thereby reducing any potential for blow back of acid; and
2. The installation of the test pump takes approximately 24 hours.

Approximately 60,000 gallons of water will be injected during acidization on each well for a total of 180,000 gallons of water. The water used will be sourced from the existing test wells on the property. Other than the inhibitor, no other additives will be used with the acid.

The acid subcontractor, Crest Pumping Technologies, will be responsible for the transportation, storage and injection of the acid. They will be required to meet all applicable state, local and federal guidelines. Transport of the acid will be via semi-truck.

Attachment A

Well Profile Schematics



Notes:

1. Projects constructed on or after January 1, 2014 must comply with the Reduction in Lead in Drinking Water Act that reduces the maximum allowable lead content of pipes, pipe fittings, plumbing fixtures and fixtures to 0.25 percent.

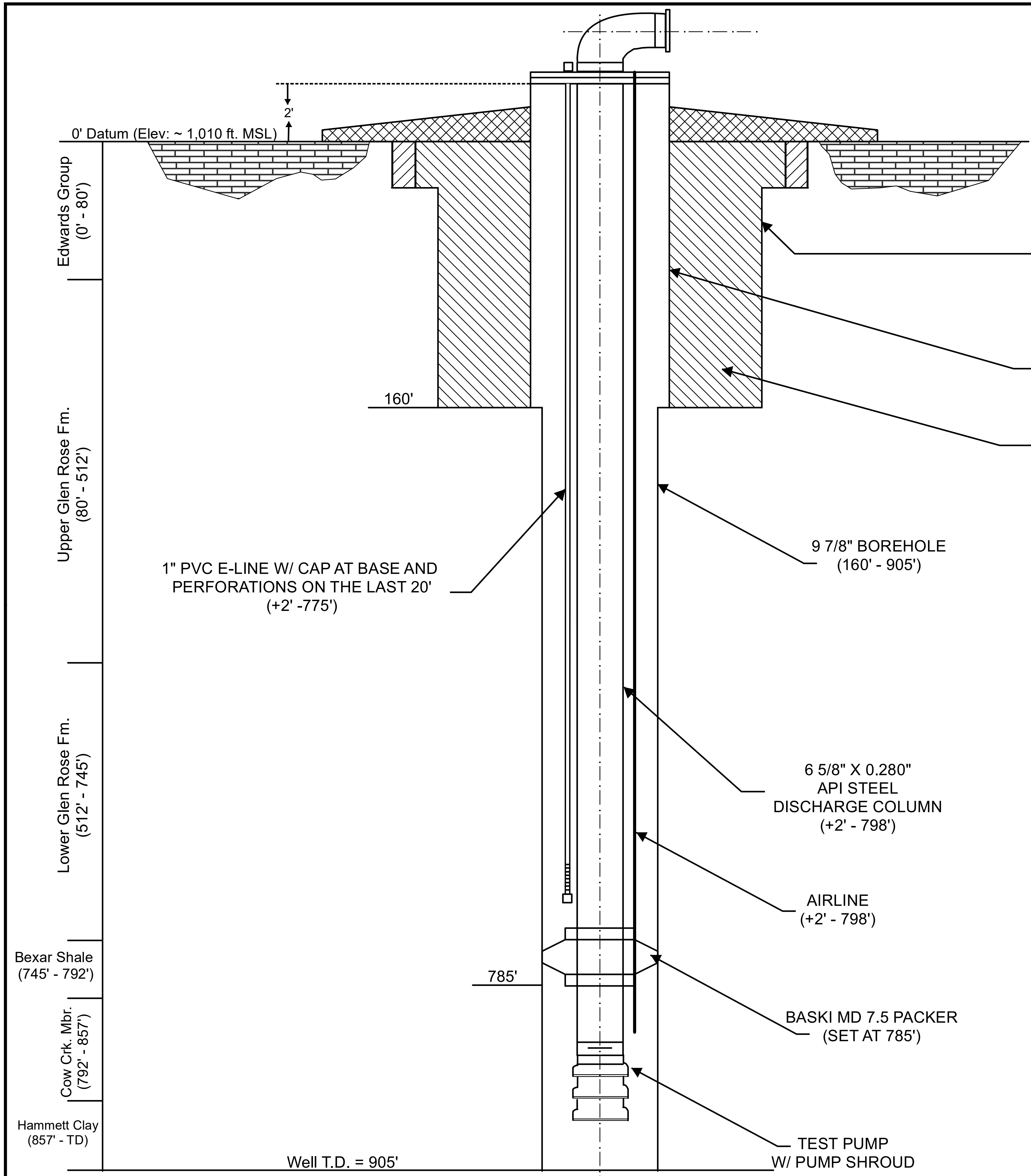
Well Profile: Bridges Well No. 1

Electro Purification, LLC

Hays County, Texas

SCALE: NONE	
APPROVED BY: CLL	DATE: 8-31-16
REVISED BY:	DATE:
DRAWING NO: W-1	
SHEET: 1 OF 4	

Wet Rock Groundwater Services, LLC
Groundwater Specialists
TBPG Firm No: 50038
317 Ranch Road 620 South, Suite 203
Austin, Texas 78734
Ph: 512.773.3226 www.wetrockgs.com



Notes:

1. Projects constructed on or after January 1, 2014 must comply with the Reduction in Lead in Drinking Water Act that reduces the maximum allowable lead content of pipes, pipe fittings, plumbing fixtures and fixtures to 0.25 percent.

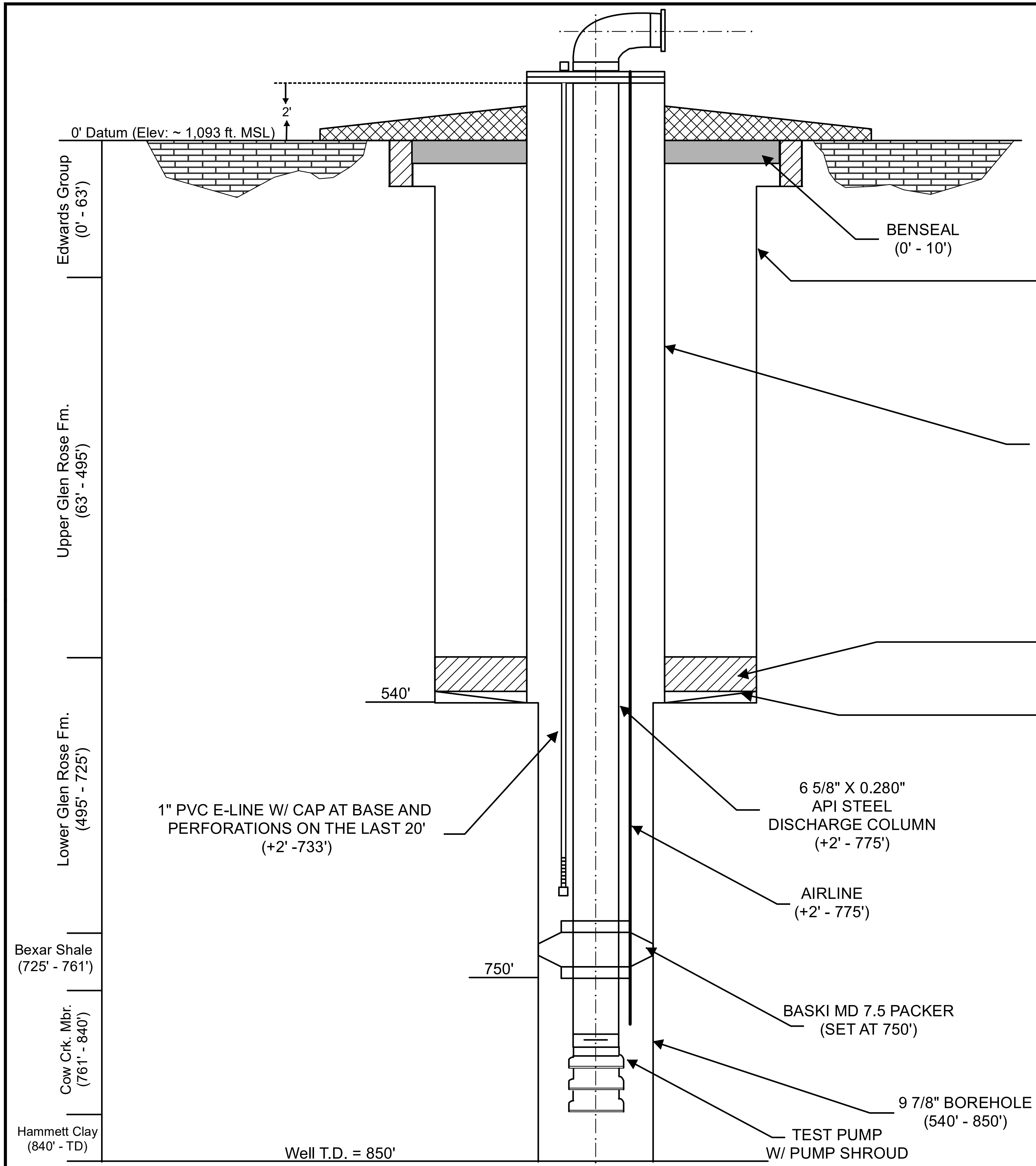
Well Profile: Bridges Well No. 2

Electro Purification, LLC

Hays County, Texas

SCALE: NONE	
APPROVED BY: CLL	DATE: 8-31-16
REVISED BY:	DATE:
DRAWING NO: W-2	
SHEET: 2 OF 4	

Wet Rock Groundwater Services, LLC
Groundwater Specialists
TBPG Firm No: 50038
317 Ranch Road 620 South, Suite 203
Austin, Texas 78734
Ph: 512.773.3226 www.wetrockgs.com



Notes:

1. Projects constructed on or after January 1, 2014 must comply with the Reduction in Lead in Drinking Water Act that reduces the maximum allowable lead content of pipes, pipe fittings, plumbing fixtures and fixtures to 0.25 percent.

Well Profile: Odell Well No. 2

Electro Purification, LLC

Hays County, Texas

SCALE: NONE

APPROVED BY: CLL DATE: 8-31-16

REVISED BY: DATE:

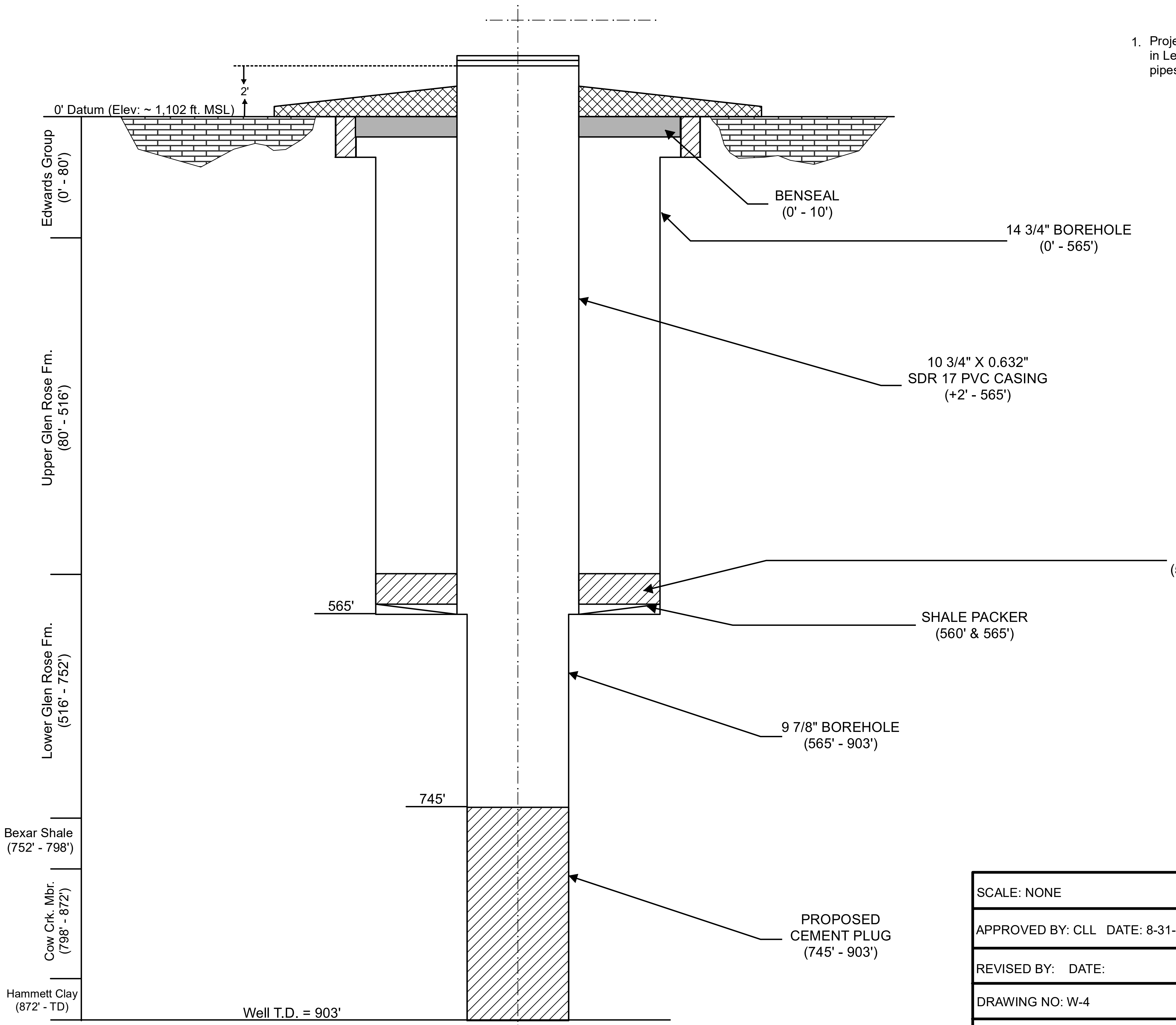
DRAWING NO: W-3

SHEET: 3 OF 4

Wet Rock Groundwater Services, LLC
Groundwater Specialists
TBPG Firm No: 50038
317 Ranch Road 620 South, Suite 203
Austin, Texas 78734
Ph: 512.773.3226 www.wetrockgs.com

Notes:

1. Projects constructed on or after January 1, 2014 must comply with the Reduction in Lead in Drinking Water Act that reduces the maximum allowable lead content of pipes, pipe fittings, plumbing fixtures and fixtures to 0.25 percent.



Well Profile: Odell Well No. 1

Electro Purification, LLC

Hays County, Texas

SCALE: NONE

APPROVED BY: CLL DATE: 8-31-16

REVISED BY: DATE:

DRAWING NO: W-4

SHEET: 4 OF 4

Wet Rock Groundwater Services, LLC
Groundwater Specialists
TBPG Firm No: 50038
317 Ranch Road 620 South, Suite 203
Austin, Texas 78734
Ph: 512.773.3226 www.wetrockgs.com

Attachment B

Baski MD 7.5 Specifications

BASKI

Email: info@baski.com
Website: www.baski.com

Manufacturer of Inflatable Packers, Flow Control Valves, Pitless Units and other products for investigating, controlling and producing the EARTH'S FLUIDS.™

Phone: 1-303-789-1200 • 1-800-55-BASKI
FAX: 1-303-789-0900

SPECIFICATION SHEET: Packer Model MD-7.5

Medium Duty, Sliding-Head Type (USA Pat. No. 4,455,027)

Dimensions and Confined/Unconfined Test Pressures:

Uninflated O.D., max.	7.5"	191 mm
Largest recommended hole size	14"	356 mm
Mandrel pipe size, nominal	4"	102 mm
Approximate mandrel pipe I.D.	3.5"	89 mm
Uninflated element length, min.	60"	1,524 mm
Tested unconfined to	500 psi	35 bar
Tested confined in a 13.5" (343 mm) chamber to	1000 psi	69 bar

Differential Pressure Rating (DPR): in single packer applications, for specific hole sizes

Inside diameter of casing or borehole		Pressure to stretch rubber element		Maximum borehole differential pressure rating		Maximum inflation pressure over the packer submergence	
inches	mm	psi	bar	psi	bar	psi	bar
9.0	229	30	2	2,500	172	3,000	206
10.0	254	40	3	2,100	145	2,500	172
11.0	279	45	3.5	1,500	103	2,000	137
12.0	305	55	4	1,150	79	1,500	103
13.0	330	70	5	650	45	1,000	69
14.0	356	85	6	450	31	800	55

Please call factory for DPR in straddle packer applications.

Construction and Materials:

Element	Construction	Fully-reinforced (reinforcing the entire length of element)
	Materials	Reinforced natural rubber, with outer covering of natural rubber
	Connection to ends	18" (457 mm) high strength steel Continuous Crimp Collar
Heads	Connection	3/8" NPT on top inflation port, 1/4" NPT on bottom
Mandrel	Pipe	4" nominal
	Material	high strength steel, high phosphate electro-less nickel plated
	Connection	API 4.5" (114 mm) O.D. short casing, 8 round, top and bottom
Other	Metal parts	steel and nickel plated steel

Accessories:

In-Line Adapter	Custom ILA4.5SC	Made to order. ILAs of this size are customized for the customer's needs.

Shipping Data:

Approx. net weight	640 lbs.	290 kg
Approx. net length	142" x 10" x 15"	3,607 x 254 x 381mm

Pricing and Terms:

Please call for pricing, FOB Denver factory and valid for 60 days.
Our terms are prepay (wire transfer, Visa, MasterCard, or certified check).
Company checks require approximately two (2) weeks to clear.

Attachment C

Inhibitor Spec Sheet

Technical Process Bulletin

Technical Process Bulletin No.
This Revision: 06/22/2007

Rodine® 103 NPF

Nonfood Compounds
Program Listed AX
129230

1. Introduction:

Rodine 103 NPF is a unique liquid inhibitor designed specifically for use in industrial cleaning operations to prevent acid attack on mild steel, stainless steel and copper or brass.

This inhibitor is similar to Rodine 103; however, it is formulated to be free of nonylphenol ethoxylated (NPE free) surfactants and omits the elemental iodine (I2) source found in Rodine 103. Applications should be reviewed to insure the absence of iodine is approved since this inhibitor may have lessened biocidal activity. Rodine 103 NPF has significantly improved acid inhibition and reduced foaming compared to Rodine 103.

Rodine 103 NPF consists of ingredients that are listed in Section 182 and 582 (Substance Generally Recognized as Safe), Section 184 (Direct Food Substances Affirmed as GRAS), Section 172 (Food Additives Permitted for Direct Additions to Food for Human Consumption). Rodine 103 NPF is registered with NSF International and is listed in their "White Book" and on their website.

Rodine 103 NPF is an effective inhibitor for phosphoric, sulfuric, hydrochloric, hydroxyacetic (glycolic), citric, oxalic, sulfamic, tartaric, sodium bisulfate and acetic acids.

Rodine 103 NPF is added to the above acids for the protection of equipment during chemical cleaning operations and descaling operations, such as:

a. Chemical cleaning of industrial systems (e.g. boilers).

b. A component of janitorial, industrial and vehicle cleaning products.

2. Materials:

Rodine 103 NPF is typically used at a concentration of 2 gallons of inhibitor per 1000 gallons of diluted acid solution. Performance requirements, % acid and temperature may dictate lower or higher Rodine 103 NPF concentrations.

3. Buildup:

Rodine 103 NPF may be added to diluted acids as required. Stability in various acids at high concentration and various storage conditions is still under evaluation. Refer to your Rodine representative for assistance.

The dilute acid, inhibited with Rodine 103 NPF is best circulated through the equipment to be cleaned. When circulation cannot be accomplished, the equipment should be filled with the inhibited acid and sufficient time allowed to remove objectionable deposits.

If heating of acid or equipment is desired to speed up the operation, it should be done prior to the cleaning.

4. Operation:

The maximum protection afforded by Rodine 103 NPF is dependent on the specific acid being used, the composition of the metal surface, the temperature of the cleaning bath and the acceptable etch rate. The following table* lists the maximum cleaning bath temperature expected for each metal and specific acid:

Metal	Acid	Maximum Cleaning Temperature,° F
Cold and Hot Rolled Steel	All acids	120
Copper	All acids	150
304SS	All acids	150
316SS	All acids except Hydrochloric	150
316SS	Hydrochloric acid	100

* This information is only meant as a general guideline. Specific expected etch rates based on laboratory tests may be obtained through your Rodine representative.

5. Storage Requirements:

Rodine 103 NPF and becomes a soft gel at 40° Fahrenheit and freezes at 32° Fahrenheit temperatures. If frozen or gelled, warm and remix if any separation is noted (did not separate in freeze/thaw testing). The product should be stored in a warm location or diluted in an appropriate acid before being shipped to cold location.

6. Waste Disposal Information:

Applicable regulations concerning disposal and discharge of chemicals should be consulted and followed.

Disposal information for Rodine 103 NPF is given on the Material Safety Data Sheet for each product.

The industrial cleaning bath and sludge can be acidic and contain ingredients other than those in the chemical as supplied. Analysis of the solution and/or sludge is required before waste treatment and disposal.

7. Precautionary Information:

Before handling the chemical products used in the process, the first aid and handling recommendations on the Material Safety Data Sheet for the product should be read, understood and followed.

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