

TECHNICAL MEMORANDUM

To File ZORRO RANCH/WELLFIELD

June 6, 2014

From Casey W. Cook, P.E. 

Subject ZORRO RANCH WELL 6 TESTING

Introduction

In early 2014, Zorro Ranch reactivated Well 6, which had been mostly unused since the early 2000s. Figure 1 shows the location of the well. We understand the well was reactivated to make up for lost capacity from the Dakota well, which is out of service with a dropped pump. In reviewing whether Well 6 is suitable to make up for lost Dakota capacity, Balleau Groundwater Inc., (BGW) recommended¹ that the Ranch rehabilitate and test Well 6 to determine the capacity and sustainable yield. In May 2014, Rodgers and Co. pulled the pump 6 and rehabilitated the well, then installed a temporary pump for testing. The Ranch authorized BGW to coordinate the testing and to report on well capacity and long-term yield. This technical memorandum provides a documentation of Well 6 rehabilitation and testing, projects the well capacity and yield, and recommends a pump capacity. We find the well to be capable of 15 gpm pumping for 10 hours a day, for diversions of up to 10 acre feet per year for several years. Ongoing regional water level declines and self-induced drawdown eventually will reduce well yield to less than 10 AFY with fewer hours of pumping or a lesser pumping rate.

Background

Well 6 was drilled in 1994 under OSE File No. E-5902, and later renumbered E-6478-S. The well is 215 feet deep and is completed with 6-inch PVC casing with perforations from 100 to 120 and 175 to 215 feet. The drillers log (attached) suggests the well is completed in basin fill alluvium with the primary water-bearing zone identified as a gravel between 172 and 196 ft deep. The basin fill is the primary aquifer of the Estancia Basin. Static water level in 1995 was 87 feet, and is 117 ft today. The 30-foot

¹ Electronic Communication from Casey W. Cook, P.E., of Balleau Groundwater, Inc. to Mr. Brice M. Gordon of Zorro Ranch, March 6, 2014, Well 6 Pumping Test.



BALLEAU GROUNDWATER, INC.

decline, averaging 1.5 ft/yr, is less than regional declines seen at other Ranch wells in deeper formations, but is similar to trends at other basin fill wells in the area. The ongoing regional decline is expected eventually to reduce the capacity of the well.

The proof of completion of well (PCW; attached) indicates Well 6 in 1995 could produce 30 gpm with 100 ft of drawdown. The well is equipped today with a 7.5-hp pump, Grundfos model 40S75-25 (pump curve attached) capable of producing 30 gpm against 580 ft of total dynamic head. The installed pump apparently is different than the 1.5-hp pump reported in the PCW. Discharge at the wellhead is piped three miles and 200 feet uphill to the Ranch's main storage reservoir. We understand the Ranch plans to reroute the piping to the Dakota booster pumps (Figure 1).

Well 6 is permitted under OSE File No. E-6478, along with Ranch Wells 4 and B (File Nos. E-6478 and E-8976), for diversions of up to 15.5 AFY for domestic, ranch and irrigation purposes.

Rehabilitation and Testing

Rodgers and Co. mobilized to Well 6 on May 20, 2014. The crew field tested the installed 7.5-hp pump and motor assembly and found that it performed satisfactorily. The pump as installed can produce 75 gpm for several minutes discharging to the ground with no back pressure, but the pumping water level falls rapidly to the pump inlet because the aquifer and well cannot sustain that rate of pumping. Rodgers removed the pump and swabbed acid into the well to rehabilitate the screen, then left the acid overnight. The following day, the driller brushed the well screen and set a temporary pump to 195 ft deep for removing the acid and for testing. Static water level is about 75 feet above the pump setting.

Rodgers step tested the well on May 21, 2014. BGW coordinated the test and set a logging transducer in the well to record water levels. For the first step, the well was pumped at 21 gpm for 30 minutes with 40 ft drawdown (Figure 2). Water levels were stable for the last 10 minutes. At the second step of 28 gpm, the pumping water level dropped into the lower screen and rapidly toward the pump inlet. The rate was throttled back to around 20 gpm and the crew continued to pump the well for several hours to remove the remaining acid. After shutdown the well was allowed to recover overnight.

On May 22, Well 6 was tested at rates of 24 to 18 gpm for 9 hours (Figure 3). The pump temporarily lost power about an hour into the test. The initial 24 gpm rate caused the pumping water level (PWL) to draw down into the lower screen, so the rate was valved back to 21 then to 18 gpm. Rate control was poor, resulting in an unsteady drawdown trend. The test was shut down after nine hours.

Recovery water levels were monitored for about 39 hours before the test equipment was removed. Recovery data (Figure 4) matched to a Theis (1935)² recovery line indicates aquifer transmissivity (T) of 90 ft²/d and no apparent hydrologic boundaries.

Projection of Well Yield

Test data suggest the well can sustain 15 gpm pumping for up to 10 hours, but rates over 20 gpm can dewater the productive zone and cause PWL to drop to the pump inlet. Well specific capacity at 9 hours is 18 gpm / 60 ft = 0.3 gpm/ft, which is in line with the T from recovery and the capacity reported on the PCW form (30 gpm with 100 ft drawdown = 0.3 gpm/ft). However, due to regional declines, well yield is now limited by a shorter water column and less available drawdown above the 172-foot deep productive interval (55 ft today vs. 85 ft in 1995).

Pumping at 15 gpm for 10 hours a day year round, the well can produce 10 AFY. That level of usage is projected cause 14 ft of drawdown over the next 5 years ($T = 90 \text{ ft}^2/\text{d}$, $S = 0.1$, $r = 0.5 \text{ ft}$). With another 7.5 feet of regional decline (1.5 ft/yr) over that period, non-pumping water level is projected to decline 20 ft in 5 years. Thereafter, pumping the well at 15 gpm will cause the productive zone to dewater, and the pumping rate will have to be reduced. We project the well can provide 10 AFY for a few years, but that yields will decline after that. The well eventually may need to be replaced by a deeper well or by production increased from an existing well if the Ranch wants to maintain the present capacity.

We recommend operating the well to maintain pumping water level above 175 ft to prevent significant dewatering of the production zone. Pumping at 15 gpm for up to a half day day should maintain an acceptable PWL, though the Ranch must monitor water levels and set pump controls to

² Theis, C.V., 1935, The Relation Between Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground Water Storage: Transactions of the American Geophysical Union, Volume 16, pp. 519-524.

prevent drawdown to the pump inlet. A new pump will be needed, as the existing pump capacity is too high for the well.

A 15-gpm pump is recommended to better suit the well capacity. The pump should be set between 190 and 200 feet deep and should provide 200 ft of lift to the wellhead, plus sufficient pressure to convey water to storage or to the Dakota booster pumps as specified by the Ranch engineer. We recommend setting up the well controls with a variable frequency drive and an interconnected water-level sensor that reduces pumping if the PWL approaches the pump inlet. The pump should be set with a one-inch PVC sounding tube and equipped with a logging transducer to track water levels and monitor well performance.

Water Quality

The Ranch submitted a water sample from Well 6 for laboratory analysis (report attached). Water quality is good with conductivity at 421 $\mu\text{mhos/cm}$, and total dissolved solids estimated at 350 ppm. Well 6 water is of better quality than other Ranch wells (Dakota well has conductivity 3500 μmhos and Wells 4, B and K have 1000 μmhos). The major constituents are calcium and bicarbonate; water is considered hard at 181.8 mg/L CaCO_3 . Nitrates are high, but would be removed for indoor use, along with hardness, by the Ranch household RO systems. Water is suitable for irrigation with no treatment and for drinking with RO treatment.

Conclusions

1. Well 6 is capable of yielding 15 gpm. Higher rates above 20 gpm can dewater the primary productive zone and cause water level to fall to the pump inlet.
2. Pumping 15 gpm for 10 hours per day, the well is projected to produce 10 acre feet per year for several years. Yields are expected to decline below 15 gpm and 10 AFY as regional and self-induced drawdowns reduce the available water column.
3. Water from Well 6 is good with 421 μmhos conductivity and is suitable for irrigation use without treatment. The water is hard with high nitrates. Existing household RO treatment will remove those constituents for indoor and drinking use.
4. The existing installed pump is rated for 24 to 55 gpm. A new variable speed pump is required.

Recommendations

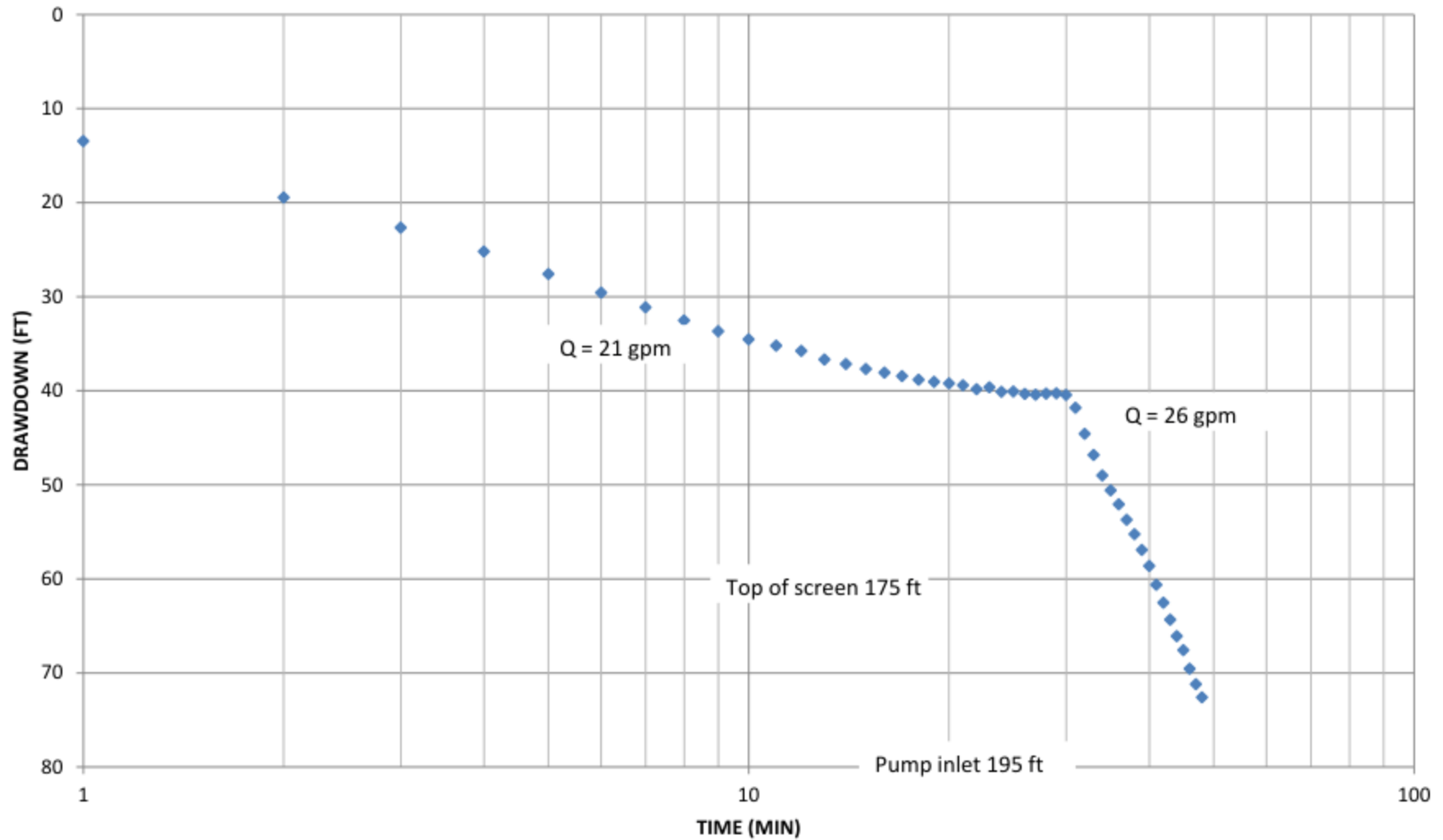
1. Replace the existing pump with one that can produce 15 gpm with a lift of 200 ft plus sufficient pressure at the wellhead to convey water to storage or booster pumps. Control the pump with a variable speed drive and sensors to reduce rate if pumping water level approaches the pump inlet.
2. Set the pump with a PVC sounding tube accessible at the wellhead. Equip the well with a logging pressure transducer to track water levels and well performance.
3. As capacity declines, plan to replace Well 6 in several years with a deeper well or with additional pumping from existing wells.

Attachments: Figures (4)
Well Record
Proof of Completion
Pump Curve
Well 6 Lab Analysis

ZORRO RANCH

WELLFIELD

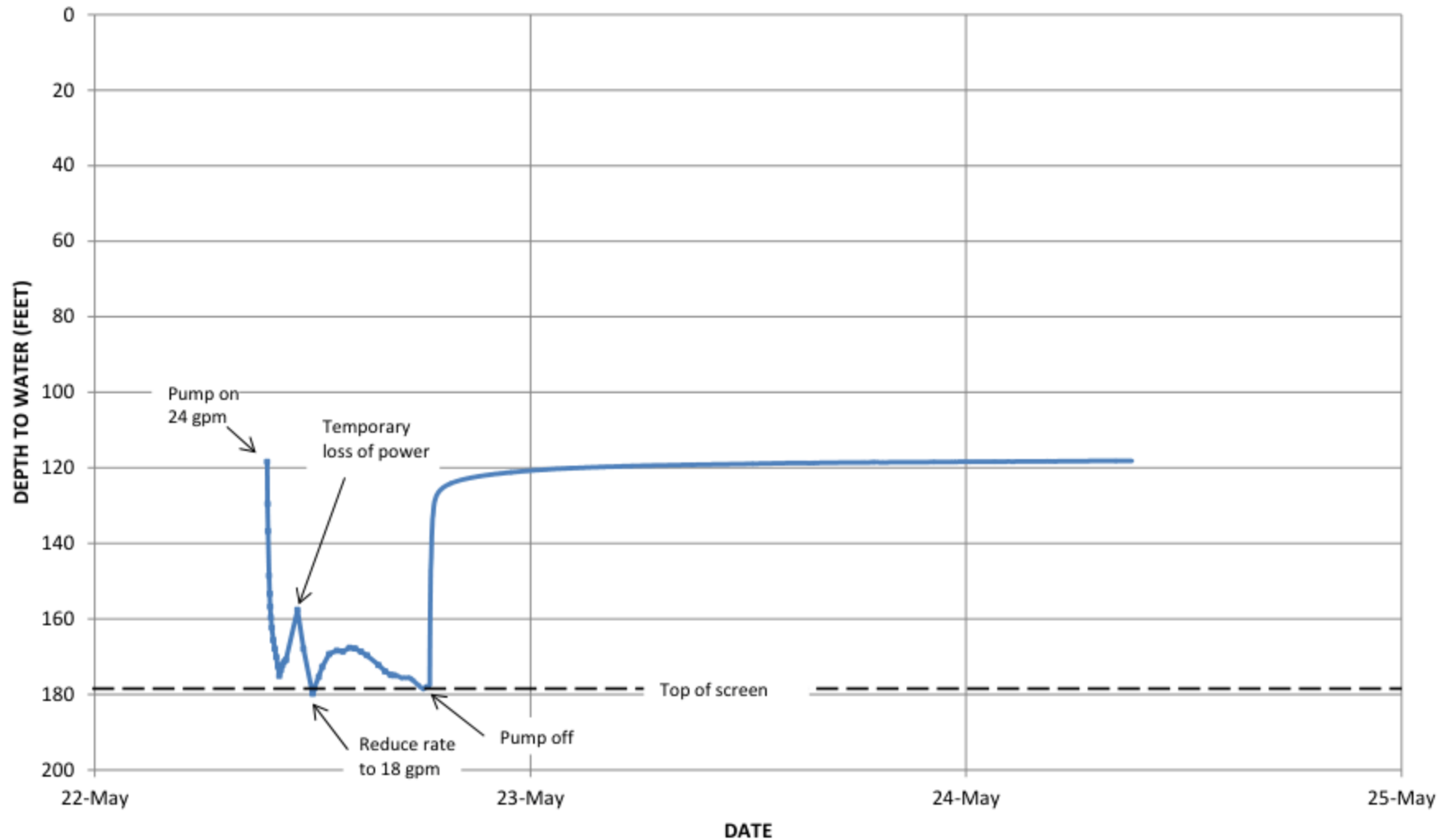
FIGURE 2
WELL 6 STEP TEST



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WELLFIELD

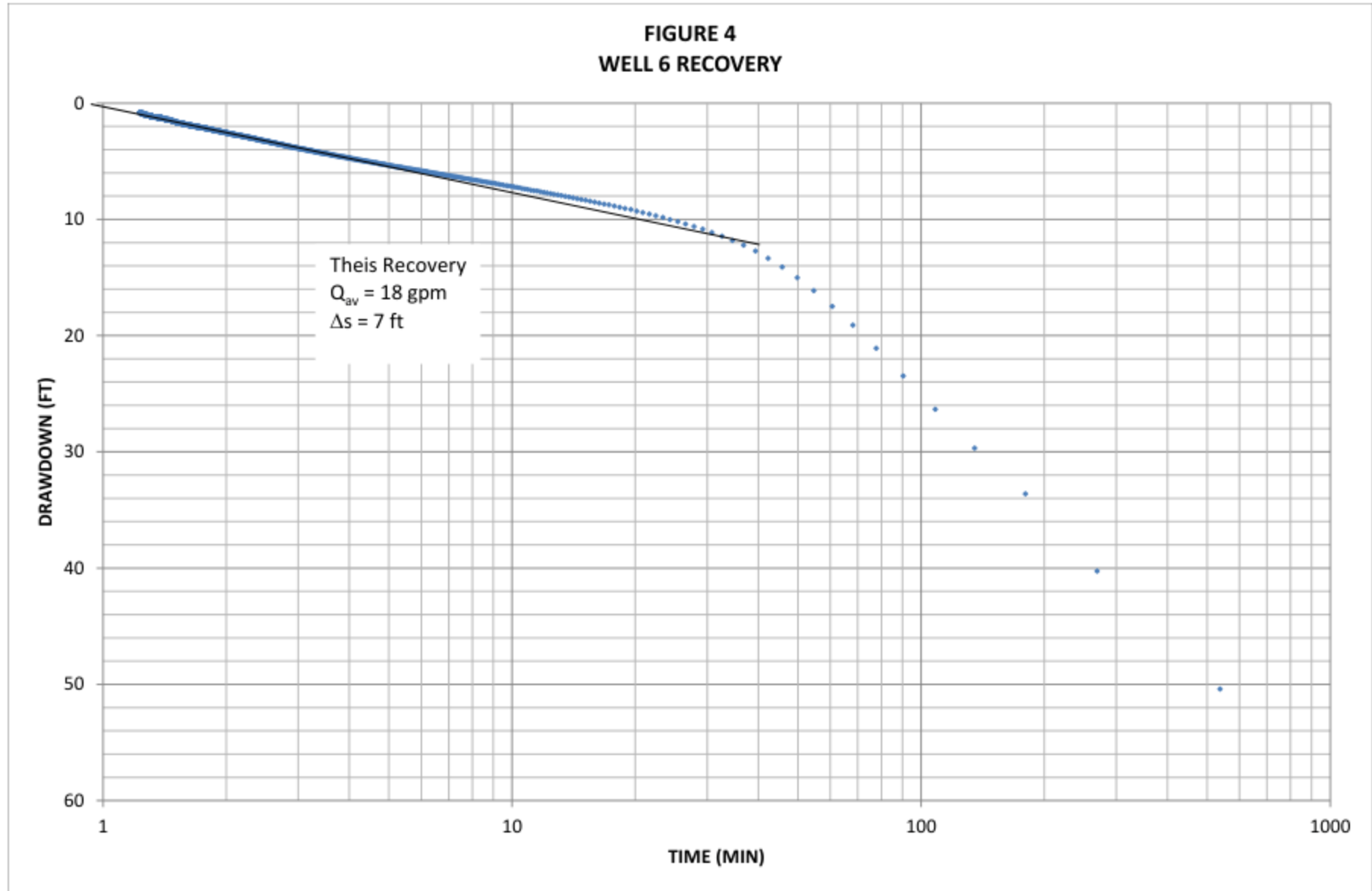
FIGURE 3
WELL 6 TEST HYDROGRAPH



ZORRO RANCH

WELLFIELD

FIGURE 4
WELL 6 RECOVERY



WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well JEFFREY EPGSTEIN c/o ZORRC RANCH Owner's Well No. _____
 Street or Post Office Address P.O. BOX 567
 City and State STANLEY, NE. 87056

Well was drilled under Permit No. E-5902 and is located in the:
 a. 1/4 SE 1/4 SE 1/4 of Section 20 Township 12N Range 9E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
 Subdivision, recorded in HANTA FE County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in
 the _____ Grant.

(B) Drilling Contractor DENNISSON DRILLING License No. 10-49

Address P.O. BOX 86, STANLEY, NE. 87056

Drilling Began 09/23/94 Completed 09/29/94 Type tools ROTARY Size of hole 12" in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 215 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 80 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
96	113	17	YELLOW SAND	
172	198	26	GRAVEL	40 GPM

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6" PVC			0	215	215	NONE	100	120
			0	215	215	NONE	175	215
					(GRAVEL PACKED)			

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor _____
 Address _____
 Plugging Method _____
 Date Well Plugged _____
 Plugging approved by: _____

State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

Date Received

FOR USE OF STATE ENGINEER ONLY

Quad _____ FWL _____ FSL _____

File No. _____ Use _____ Location No. _____

well 6
(re-numbered)
E-6478-1

[illegible]

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a blumline record only Section 1(a) and Section 4 shall be completed.

TOTAL P. 02

1. Name of Water Right Owner Mr. Jeffrey Epstein, Zorro Ranch
Mailing address PO Box 567
City and State Stanley, NM 87056
2. Permit is for supplemental well from shallow ground water.
(supplemental well, change location of well) (artesian or shallow)
3. Description of well:
Located in the NE 1/4 SW 1/4 SE 1/4 of Sec. 20 Twp. 12N Rge. 9E N.M.P.M., or Tract No. _____
of Map No. _____ of the _____ District; total depth, 215 feet; is well cased yes;
outside diameter of top casing (or hole, if uncased), six inches; if artesian, is well equipped with gate
valve n/a; date drilled 9-23 to 9-29 1994; Name of driller Dennisson Drilling.
4. Record of Pumping Test, if made (to be supplied by person or firm making test); Name and address of
person making test, Zorro Ranch and Dennisson Drilling personnel
date of test 1-26 to 1-30 1995; depth to water before test, 87 feet below land surface,
(above, below)
and pumping level during test, 188 feet; length of test, 48 hours; average discharge, 30 G.P.M.;
specific capacity of well, 0.44 gals./min. per foot of drawdown.
Pumping test data submitted with application to appropriate E-6478
5. Permanent Pump Equipment:
(a) Description of pump: Make Jacuzzi; Type 15BS42510-S2;
size of discharge, 1.5 inches; if turbine type, give size of column, _____ inches; diameter of
bowls _____ inches; number of bowls _____; length of suction pipe _____ feet; total length of
column, bowls and suction pipe _____ feet; if centrifugal type, give size of pump _____ inches;
if other type, describe _____;
rated capacity of pump (if known), 30 G.P.M., at _____ rev. per min., from a depth of 213 feet.
(b) Description of power plant: Make New Mex Elect; Type Single phase, 120V;
rated horsepower (if available) 1.5; type of drive connection to pump _____
(direct, gearhead, or belt)
(c) Actual discharge of pump, 30 G.P.M., at _____ rev. per min., from a depth of 188 feet;
Date of test 1-26 to 1-30 1995.
6. If reservoir is used, give approximate size: length n/a feet; width _____; depth _____.
7. If above well replaced an old well to be plugged or abandoned, fill out the following: the well abandoned
is located in the n/a 1/4 1/4 1/4 of Sec. _____, Twp. _____, Rge. _____.
Describe plugging method _____
Name of plugging contractor _____
8. Well Record filed with State Engineer's Office Yes (as E-5902)
(Yes or No)

I, Sue Rotto, Consultant, of Glorieta Geoscience, Inc., agent for the applicant, Jeffrey Epstein, Zorro Ranch,
affirm that the foregoing statements are true to the best of my knowledge and belief and that I am the agent for owner and holder of said water right.
(sole, partial, agent for, etc.,)

Jeffrey Epstein, Zorro Ranch, Permittee

By: Sue Rotto

STATE ENGINEER OFFICE
BOULDER, NEW MEXICO
MAR 11 PM 2:14

STATEMENT OF STATE ENGINEER'S REPRESENTATIVE

I hereby certify that I have inspected the above well and find it constructed in accordance with the conditions
of the permit. Note any exceptions _____

Accepted for filing without benefit of field check by State Engineer
Office personnel.

Well was producing _____ gpm against a _____ head of _____ feet at _____ rpm.
(measured) (estimated)

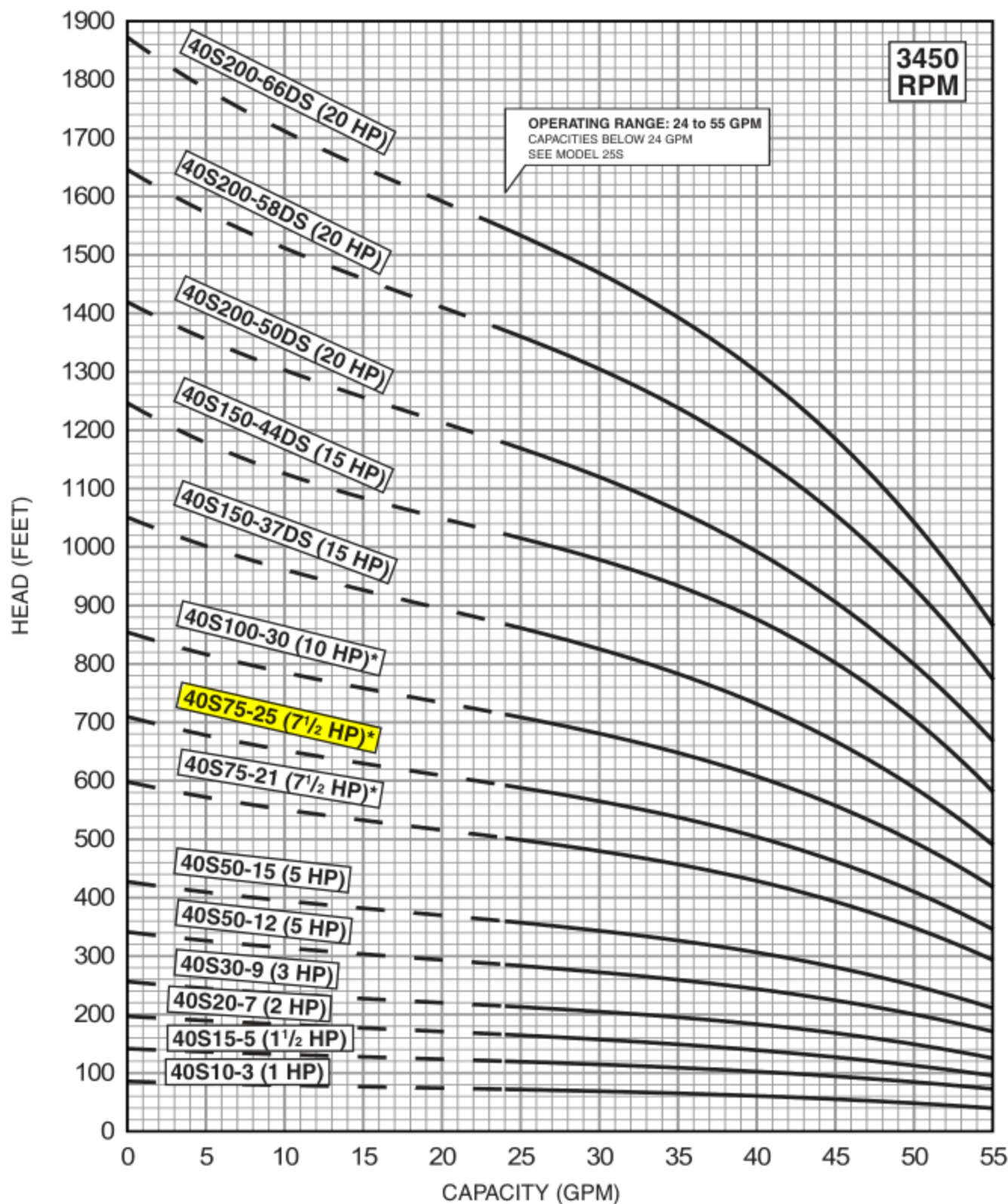
Old well has been _____
(plugged) (capped) (retained for other rights)

By: Robert D. Thompson
Title: Water Resource Specialist
Date: March 14, 1997

FLOW RANGE: 24 - 55 GPM

OUTLET SIZE: 2 " NPT

NOMINAL DIA. 4"



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

4" MOTOR STANDARD, 1-10 HP/3450 RPM.

6" MOTOR STANDARD, 15-20 HP/3450 RPM.

* Also available with 6" motor.

Performance conforms to ISO 9906, 1999 (E) Annex A
Minimum submergence is 5 feet.

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES					APPROX. SHIP WT.
					A	B	C	D	E	
40S10-3	A	1	4"	2" NPT	24.6	11.8	12.8	3.8	3.9	32
40S15-5	A	1 1/2	4"	2" NPT	29.7	13.6	16.1	3.8	3.9	37
40S20-7	A	2	4"	2" NPT	34.5	15.1	19.4	3.8	3.9	41
40S30-9	A	3	4"	2" NPT	43.3	20.6	22.7	3.8	3.9	65
40S50-12	A	5	4"	2" NPT	51.3	23.6	27.7	3.8	3.9	78
40S50-15	A	5	4"	2" NPT	56.2	23.6	32.6	3.8	3.9	84
40S75-21*	A	7 1/2	4"	2" NPT	74.6	29.6	45.0	3.8	3.9	120
40S75-25*	A	7 1/2	4"	2" NPT	81.2	29.6	51.6	3.8	3.9	124
40S100-30*	A	10	4"	2" NPT	103.7	43.9	59.8	3.8	3.9	181
40S150-37DS	A	15	6"	2" NPT	99.5	28.0	71.5	5.4	5.4	244
40S150-44DS	A	15	6"	2" NPT	111.0	28.0	83.0	5.4	5.4	340
40S200-50DS**	B	20	6"	2" MPT	136.0	30.6	105.4	5.4	5.5	319
40S200-58DS**	B	20	6"	2" MPT	149.2	30.6	118.6	5.4	5.5	334
40S200-66DS**	B	20	6"	2" MPT	162.4	30.6	131.8	5.4	5.5	394

NOTES: All models suitable for use in 4" wells, unless otherwise noted.

Weights include pump end with motor in lbs.

* Also available with 6" motor.

** Built into sleeve 2" MPT discharge, 6" min. well dia.

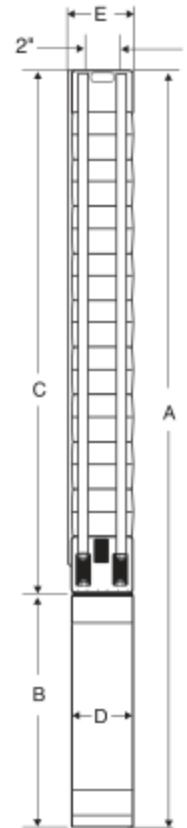


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-44 Stgs.)	DEEP SET (50-66 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	304 Stainless Steel	304 Stainless Steel
Coupling	316/431 Stainless Steel **	329/ 416 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)	LCP (Vectra®)
Split Cone	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	304 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	304 Stainless Steel

NOTES: Specifications are subject to change without notice.

Vectra® is a registered trademark of Hoechst Calanese Corporation.

*Stainless Steel option available.

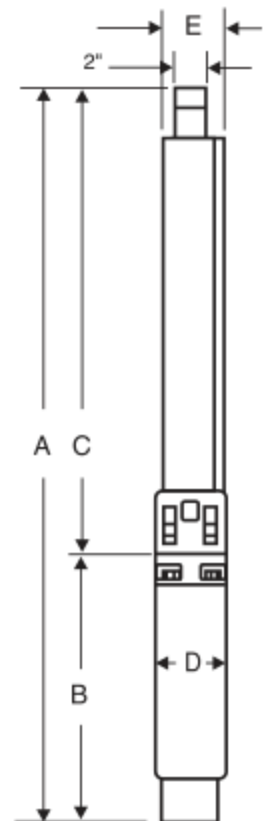


Fig. B

CERTIFICATE OF ANALYSIS

Analysis NO : 101909
Job ID : J[2014MAY15]32319

Branch Org. Code : 020

Zorro Ranch
 49 Zorro Ranch Rd.
 Stanley, NM 87056

Sampled : 05/02/2014
 Received : 05/15/2014
 Completed : 06/03/2014
 Purpose : Presale Activity
 Supply/Source : Private/Well(Deep)
 Sample Point : Well #6
 Description : Raw Water

ATTN: Eric Carriaga-EWT

CATIONS	RESULT	UNITS	ANIONS	RESULT	UNITS
Calcium (Ca)	130	mg/l CaCO3	Bicarb (HCO3)	157.0	mg/l CaCO3
Magnesium (Mg)	51.8	mg/l CaCO3	Fluoride (F)	1.04	mg/l CaCO3
Sodium (Na)	28.7	mg/l CaCO3	Chloride (Cl)	24.0	mg/l CaCO3
Potassium (K)	2.5	mg/l CaCO3	Bromide (Br)	0.104	mg/l CaCO3
Iron (Fe)	<0.002	mg/l	Nitrate (NO3)	16.0	mg/l CaCO3
Manganese (Mn)	<0.001	mg/l	Phosphate (PO4)	<0.080	mg/l CaCO3
Aluminum (Al)	<0.005	mg/l	Sulfate (SO4)	16.4	mg/l CaCO3
Barium (Ba)	0.159	mg/l	Silica (SiO2)	18.4	mg/l CaCO3
Strontium (Sr)	0.742	mg/l			
Copper (Cu)	<0.002	mg/l			
Zinc (Zn)	<0.002	mg/l			

OTHER PARAMETERS	RESULT	UNITS	RESULT	UNITS
pH	7.94		Total Hardness	181.80 mg/l CaCO3
Turbidity	0.05	NTU	TOC (C)	0.25 mg/l
Conductivity	421	uS	Free (CO2) [1]	4.1 mg/l CaCO3

[1] Derived from Alkalinity and pH

The reported results are representative of the sample as received.

OUR REPRESENTATIVE IN YOUR AREA IS:
 Evoqua Water Technologies LLC/Albuquerque
 3800 Rutledge Rd NE, Ste A
 Albuquerque, NM 87109

505-344-8250 Fax 505-345-5937

ANALYZED BY: Jackie Benzel