



Planning • Management • Engineering
P.O. Box 123 • Port Orchard, WA 98366 • 888-881-0958 • 360-876-0958

June 1, 2023

Memorandum

Tempo Lake Water Company Interaction Between Lake Water and Wells 5 and 7

Introduction:

The Tempo Lake Glade Association is planning to apply herbicides to Tempo Lake to control weeds that are degrading the quality of the lake. Concerns have been expressed as to whether or not applying herbicides to the lake could result in an impact on the water quality of the system's wells.

Background:

The Tempo Lake Water Company (Tempo Lake Water) has seven well sources. Of these only Wells 5 and 7 are currently in use. These two wells are closest to the lake, along with Well 1.

Tempo Lake is partially natural, deepened with a man-made dam at the lake's outlet. The lake is 23 feet deep.

Well 5 is located in the north park. It is 122 feet deep and had a static water level of 29 feet when drilled, and 26 feet a week later when the pump test was conducted. The well log indicates that the top 3 feet consists of rocky topsoil. From 3 feet to 51 feet the geologic formations are primarily hard clays with gravel. This is often referred to as "till" or "hardpan". It appears that these layers are of very low permeability and prevent any significant transport of water. From 51 feet to 93 feet the geology is described as "fractured basalt". It appears that the water for the well comes from the fractured basalt layer. Perforations in the liner are cut from 62 feet to 122 feet. This would indicate that the majority of water bearing formation was found from 62 to 93 feet. From 93 feet to 122 feet the formation is described as hard black basalt. The pump test was conducted at 40 gpm (although there was significant variation in flow rate) with a drawdown of 18 feet to a level of 44 feet. The well recovered to 29 feet after five days. Well 5 was initially pumped at 40 gpm; however, the sustainable production was later found to be closer to 15 gpm.

Well 7 is located in the south park. It is 146 feet deep and had a static water level of 12.5 feet (although the SWL may have been 10.5 feet, conflicting documentation). The top 2 feet is sandy loam (topsoil). From 2 feet to 8 feet is clay silt. From 8 feet to 26 feet is

gravel and sand with water from 16 feet to 26 feet. This sand and gravel layer was estimated to have a capacity of over 100 gpm. The geology is then characterized by clay from 26 feet to 41 feet. At 41 feet bedrock is encountered with soft basalt from 41 to 52 feet, hard basalt from 52-110 feet, and soft, water-bearing basalt from 110-140 feet. Hard basalt was drilled from 140-146 feet. A surface seal was installed from the land surface to 41 feet, effectively sealing the surface and upper formations from the clay and bedrock below. A pump test was conducted at 34 gpm with 124.5 feet of drawdown for a pumping water level of 137 feet. After one week the well recovered to 14.4 feet. The well was later found to have a sustainable yield of about 10 gpm.

Analysis:

Although not in use, and technically not part of this evaluation, it should be noted that Well 1 is completed at the end of a long gravel trench that goes to the lake, and is therefore, hydraulically connected to the lake. As long as the pumping water level in well 1 is greater than the water level in the lake, the well is supplying groundwater; however, if Well 1 were to be used and pumped to where the hydraulic gradient went from the lake to the well, it would be subject to contamination from the lake.

Well 5 withdraws water from the bedrock aquifer. While the exact elevation of the well has not been measured, it would appear that the static water level in the well is naturally lower than that of the lake. This is a strong indication that the water in the lake is not directly connected to the aquifer from which the well is withdrawing as one would expect the water level in the well and the lake to be at the same elevation if the two were connected.

The same can be said of Well 7. The lake level was very evident at 16 feet in the sand and gravel layer that was drilled through from 8 to 26 feet. With a Static Water Level of 12.5 feet, the water in the well is higher than the level of the lake. After 7 days of recovery, the level was 14.4 feet, still higher than the lake level. In addition, the recovery curve data is smooth. If the lake were contributing water to the Well 7 aquifer, one should see an instantaneous change in the rate of recovery as recovery passes the 16 ft level. No such change in the recovery is observed.

It is interesting to note that it appears that Wells 5 and 7 have different relative static water levels. This would indicate that these aquifers are not directly connected.

Tempo Lake has a depth of 23 feet. Wells 5 and 7 have clay layers from 3-51 feet, and 26-41 feet, respectively. Therefore, assuming the geology of the site is representatively uniform between Wells 5 and 7, the bottom of the lake is above the bedrock and separated by a layer of clay. Clay prevents a significant transfer of water. If Well 5 is more representative of the conditions in the middle of the lake, the clay layer would be 15-20 feet thick. If Well 7 is more representative, the clay layer would be 2 feet thick.

Both Wells 5 and 7 had initial pump tests run at approximately 40 gpm, and both wells failed to fully recover, and both wells eventually had sustained production levels well

below the initial pump test results. This would indicate that there is either no connection with the lake, or any connection is very limited.

Finally, as a fairly shallow lake, Tempo Lake's temperature increases significantly throughout the summer and decreases significantly in the winter. While NWS is unaware of any temperature records kept by the water system, we have not heard of nor seen evidence of temperature changes in the water from Wells 5 and 7.

Disclaimers:

This analysis is only a brief evaluation of the available information. A full determination as to whether there is or can be a direct connection between lake water and the well water from Wells 5 and 7 would require the analysis and modeling of a hydrogeologist. Further testing that could be done to better determine the potential for interaction would be to record temperature readings from both the lake and wells, to measure elevations of the lake and the wells more precisely, and to conduct Microscopic Particulate Analysis testing on the well water.

Conclusions:

The available data and evidence indicates that there is not a direct connection between Tempo Lake and Wells 5 and 7. Using herbicides in the lake should not result in a compromise in the water quality of Wells 5 and 7. While it is beyond the scope of this analysis to comprehensively determine if any connection exists and/or if such a connection could result in contamination, all the readily available data indicates that there is not a significant connection between the lake and wells. The only evidence indicating there could be a connection is the fact that the static water levels are in the same "ballpark" as the level of water in the lake; however, as discussed above, one would expect them to be nearly equal if there was a significant connection. No other evidence of a direct hydraulic connection between the lake and wells could be identified.

Certification:

This Memorandum was prepared by Northwest Water Systems, Inc. I hereby certify that this report was completed by myself, or under my direct supervision as a Professional Engineer licensed in the State of Washington.



Todd Krause, PE

Apr 04 05 10:42a

Robert Slaughter

360-456-1463

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Apr 01 05 10:22a

Moerke & Sons Pump & Drill 360-748-8343

p.1

MOERKE & SONS PUMP & DRILLING, INC

1286 N.W. Maryland Avenue

Chehalis, WA 98532

(360) 748-3805

PUMP TEST

TEMPO LAKE GLADE ASSOCIATION

10707 TEMPO LAKE DRIVE

OLYMPIA, WA 98503

DATE: 03-22-05

Well 5

Well Site Address: 0 TEMPO LAKE DRIVE

Well ID#: AKH353

PUMP/Make & Model: JACUZZI 2S435-10

Pump Set At: 63 ft.

SOUNDER / Make & Model: WATERLINE 500

METER / Make & Model: MASTER METER 1.5" Measured in: GALLONS

MINUTES 3/22/2005	GALLONS PER MINUTE	METER READING	LEVEL TO WATER	NOTES
9:25 AM				
0:00:00	0.00	30060	26'	
0:01:00	27.00	30087	29'	
0:02:00	21.00	30108	28'	
0:03:00	19.00	30127	28' 6"	
0:04:00	19.00	30146	28' 6"	
0:05:00	19.00	30165	28' 6"	
0:06:00	20.00	30185	28' 6"	
0:07:00	19.00	30204	28' 6"	
0:08:00	20.00	30224	28' 6"	
0:09:00	20.00	30244	28' 6"	
0:10:00	18.00	30262	28' 6"	
0:11:00	23.00	30285	29'	
0:12:00	25.00	30310	29' 6"	
0:13:00	25.00	30335	29' 6"	
0:14:00	27.00	30362	30'	WATER SLIGHTLY
0:15:00	30.00	30392	30' 2"	CLOUDY
0:20:00	30.00	30542	31'	
0:25:00	29.00	30687	31'	
0:30:00	30.00	30837	31' 1"	
0:35:00	30.00	30982	31' 1"	
0:40:00	29.80	31131	31' 1"	
0:45:00	31.80	31290	32'	
0:46:00	35.00	31325	32' 4"	
0:47:00	35.00	31360	32' 8"	WATER CLEAR
0:48:00	39.00	31399	33'	
0:49:00	41.00	31440	33' 2"	
0:50:00	37.00	31477	33' 3"	
0:51:00	42.00	31519	33' 5"	
0:52:00	37.00	31556	33' 5"	
0:53:00	39.00	31595	33' 5"	
0:54:00	42.00	31637	33' 6"	
0:55:00	37.00	31674	33' 6"	
1:00:00	39.20	31870	33' 8"	
1:05:00	39.00	32065	33' 9"	
1:10:00	39.60	32263	34'	
1:15:00	39.60	32461	34' 1"	

Apr 04 05 10:42a
Apr 01 05 10:22a

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Well 5

1:20:00	39.60	32659	34' 2"
1:25:00	39.40	32856	34' 3"
1:30:00	39.40	33053	34' 4"
1:35:00	40.60	33256	34' 6"
1:40:00	38.60	33449	34' 8"
1:45:00	39.20	33645	34' 9"
1:47:00	47.50	33740	34' 9"
1:48:00	40.00	33780	36' 8"
1:49:00	49.00	33829	36' 9"
1:50:00	47.00	33876	36' 9"
1:51:00	51.00	33927	37'
1:52:00	48.00	33975	37'
1:53:00	49.00	34024	37'
1:54:00	49.00	34073	37' 1"
1:55:00	50.00	34123	37' 3"
1:56:00	48.00	34171	37' 5"
1:57:00	49.00	34220	37' 5"
1:58:00	49.00	34264	37' 5"
1:59:00	54.00	34318	37' 5"
2:00:00	48.00	34366	37' 5"
2:05:00	49.00	34611	37' 6"
2:10:00	49.00	34856	37' 7"
2:15:00	48.80	35100	37' 8"
2:20:00	48.80	35344	37' 8"
2:25:00	49.20	35590	38'
2:30:00	49.00	35835	38' 1"
2:35:00	49.20	36081	38' 3"
2:40:00	49.00	36326	38' 4"
2:45:00	49.00	36571	38' 5"
2:46:00	49.00	36620	38' 5"
2:47:00	50.00	36670	38' 5"
2:48:00	45.00	36715	38' 5"
2:49:00	48.00	36763	38' 3"
2:50:00	49.00	36812	38' 3"
2:51:00	48.00	36860	38' 3"
2:52:00	48.00	36908	38' 3"
2:53:00	50.00	36958	38' 3"
2:54:00	46.00	37004	38' 3"
2:55:00	48.00	37052	38' 3"
2:56:00	48.00	37100	38' 3"
2:57:00	45.00	37145	38'
2:58:00	45.00	37191	38'
2:59:00	47.00	37238	38'
3:00:00	45.00	37285	38'
3:05:00	45.00	37330	38'
3:10:00	37.00	37515	38'
3:15:00	44.80	37739	38'
3:20:00	44.80	37963	38'
3:25:00	44.80	38187	38'
3:30:00	44.40	38409	38' 1"
3:35:00	43.80	38628	38' 1"
3:40:00	43.20	38844	38' 1"
3:45:00	43.20	39060	38'
3:50:00	43.20	39276	38'
3:55:00	41.00	39491	38'
4:25:00	55.26	41149	40'

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Robert Slaughter

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Well 5

4:55:00	48.80	42615	40' 3"
5:25:00	48.90	44082	40' 8"
5:55:00	48.80	45546	41'
6:25:00	48.80	47011	41' 3"
6:55:00	48.80	48490	41' 7"
7:25:00	48.80	49907	42' 2"
7:55:00	48.10	51350	42' 4"
8:55:00	48.00	54230	42' 8"
9:55:00	48.10	57117	43'
10:55:00	42.50	59835	41' 7"
11:55:00	42.60	62391	41' 9" STILL CLEAR
12:55:00	42.60	64947	41' 11"
13:55:00	49.00	67743	43' 8.5"
3/23/2005			
15:55:00	48.15	73522	44' 2.5"
17:55:00	48.90	79396	44' 8"
19:55:00	47.24	85065	45'
21:55:00	47.90	90822	45' 5"
23:55:00	40.00	96186	44' STABILIZED
26 HRS 55 MIN	39.90	100981	44'
27 HRS 55 MIN	39.90	105778	44'
1:30 PM			

RECOVERY

3/23/2005	
0:01:00	39'
0:02:00	38' 3"
0:03:00	38'
0:04:00	37' 9"
0:05:00	37' 6"
0:10:00	37' 5"
0:15:00	37' 2"
0:20:00	36' 11"
0:25:00	36' 8"
0:35:00	36' 7"
0:40:00	36' 3"
0:50:00	36' 1"
1:00:00	35' 11"
1:10:00	35' 9"
1:20:00	35' 7"
1:30:00	35' 5"
1:40:00	35' 3"
3/24/2005	
12:00:00	32'
3/25/2005	
12:30:00	30' 9"
3/28/2005	
1:00:00	29' 1"

Signature: *Bob Slaughter*
Moerke & Sons Pump & Drilling, Inc.



WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

DEPARTMENT OF
ECOLOGY
State of Washington

Construction/Decommission ("x" in circle)

Construction

Decommission ORIGINAL INSTALLATION

Well #7

Notice of Intent Number

PROPOSED USE: Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

TYPE OF WORK: Owner's number of well (if more than one) _____
 New well Reconditioned Method: Dug Bored Driven
 Deepened Cable Rotary Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 146 ft.
 Depth of completed well 146 ft.

CONSTRUCTION DETAILS

Casing Welded 6" Diam. from +2 ft. to 52 ft.
 Installed: Lincor installed 4.5" Diam. from 6 ft. to 146 ft.
 Threaded " Diam. From ft. to ft.

Perforations: Yes No

Type of perforator used skill saw

SIZE of perfor. 6 in. by 1/8 in. and no. of perfor. 80 from 106 ft. to 146 ft.

Screens: Yes No K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____
 Diam. Slot size from ft. to ft.
 Diam. Slot size from ft. to ft.

Gravel/Filter packet: Yes No Size of gravel/sand _____
 Materials placed from ft. to ft.

Surface Seal: Yes No To what depth? 41 ft.

Material used in seal Neat Cement

Did any strata contain unusable water? Yes No

Type of water? 100 ppm Depth of strata 20-26

Method of sealing strata off Surface Seal

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 10.5 ft. below top of well Date 9/11/2012

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes No If yes, by whom? Advanced Drilling

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: 34 gal./min. with 137 ft. drawdown after 52 hrs.

Recovery data (time taken as zero when pump turned off, (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? Yes No

CURRENT

463285

Notice of Intent No. WE15015

Unique Ecology Well ID Tag No. BHK440

Water Right Permit No. _____

Property Owner Name TEMPO LAKE WATER CO

Well Street Address 11043 TEMPO LAKE RD

City OLYMPIA County THURSTON

Location NE1/4-1/4 NE1/4 Sec 28 Twn 17N R 1
 (s, t, r Still REQUIRED)

EWM
 Or
 WWM

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 79080009001

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
SANDY LOAM	0	2
CLAY SILT	2	8
GRAVEL SAND	8	16
GRAVEL SAND WB	16	26
GRAVEL BLUE CLAY	26	34
BLUE CLAY	34	38
BLACK BASALT	38	41
RED SOFT BASALT	41	52
GRAY BASALT	52	80
BLACK BASALT	80	110
BLACK SOFT BASALT WB	110	120
BLACK SOFT BASALT WB	120	140
HARD BLACK BASALT	140	146

RECEIVED

OCT 16 2012

WA State Department of Ecology (SWRO)

Start Date 8/27/12

Completed Date 8/31/12

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller Engineer Trainee Name (print) Robert Laymon

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2588

IF TRAINEE: Driller's License No: _____

Driller's Signature: _____

Drilling Company ADVANCED DRILLING LLC

Address 11530 SCHOOL LAND RD SW

City, State, Zip ROCHESTER, WA, 98579

Contractor's

Registration No. ADVANDL9090C

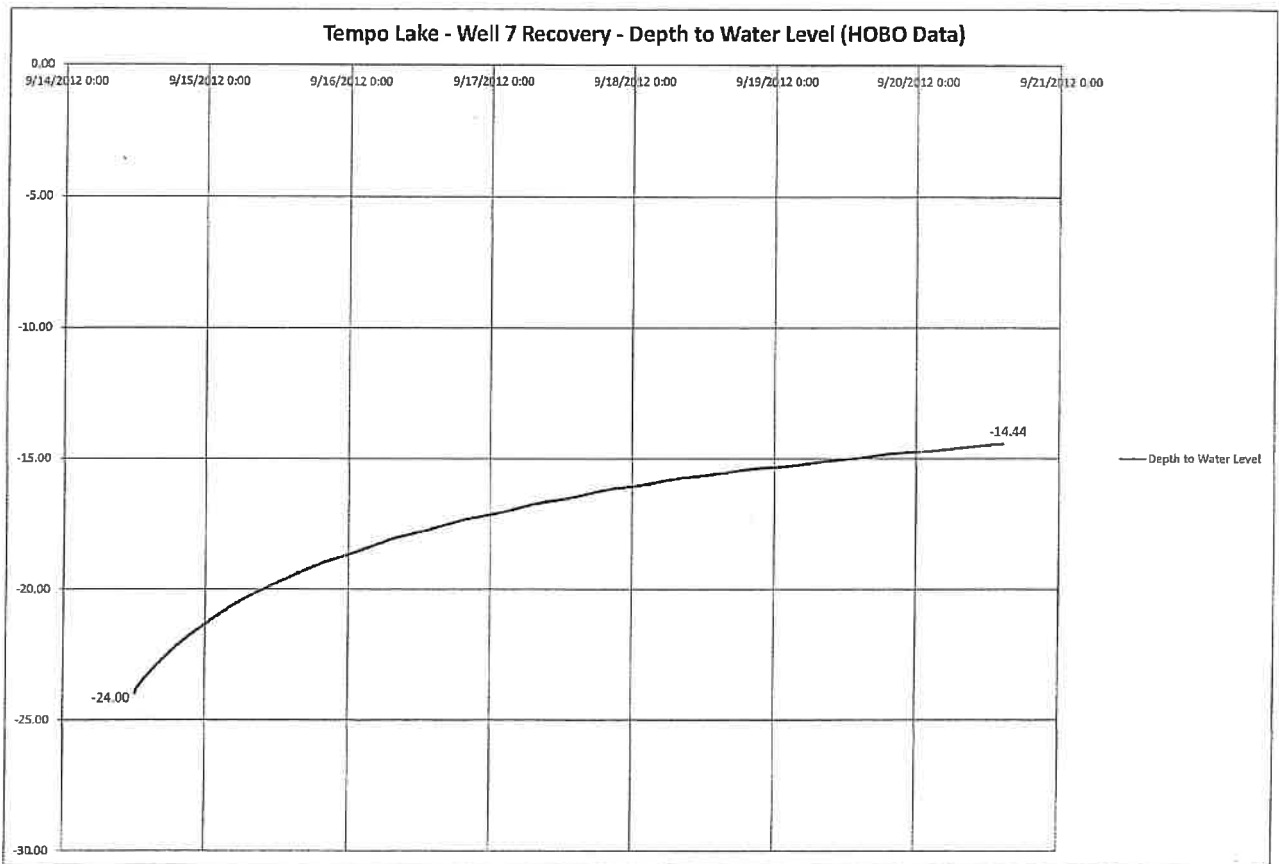
Date 9/19/12

48 HOUR PUMP TEST PAGE 1
Pumping Test Data Collection Sheet

Water System ID: 507		Owner: TEMPO LAKE WATER CO		Well Tag No.: BHK440		
DOH Source ID: 87375		Water System Name:		Well Name: WELL 7		
Type of Test:		Conducted By: ADVANCED DRILLING		Date: 09/11/2007		
Static Water Level (as measured from reference point):				County: THURSTON		
Observation Wells?				Well Elevation (MSL):		
Distance of observation well (r) from pumped well (ft):						
Time	Time (t) since pumping began (min)	Depth to Water Level (ft)	Drawdown (ft)	t/r^2	Pumping Rate (Q) (gpm)	Comments
7:00 PM	1	137.04			38.5	
	2	137.04			38.5	
	3	137.03			38.5	
	4	137.03			38.5	
	5	137.02			38.5	
	6	137.02			38.5	
	7	137.01			38.5	
	8	137.01			38.5	
	9	137			38.5	
	10	137			38.5	
	15	137.01			38.5	
	20	137.02			38.5	
	25	137.02			38	
	30	137.02			38	
	35	137.02			38	
	40	137.02			38	
	45	137.02			38	
	50	137.02			38	
	55	137.02			38	
	60	137.02			38	
08:00		137.02			38	
08:30		137			38	
09:00		137			38	
09:30		137			38	
10:00		137			38	
10:30		137			38	
11:00		137			38	
12:00 AM		137			37	
1:00		137			37	
2:00		137			37	
3:00		137			37	
4:00		137			38.5	
05:00		137.01			36.5	CONT.

Recovery Data Collection Sheet

Water System ID: 507		Owner: TEMPO LAKE WATER CO		Well Tag No.: BHK440		
DOH Source ID: 5737		Water System Name:		Well Name: WELL 7		
Type of Test:		Conducted By:		Date: 09/13/2012		
Static Water Level (as measured from reference point):				County: THURSTON		
Observation Wells?				Well Elevation (MSL):		
Distance of observation well (r) from pumped well (ft):						
Time	Time (t) since pumping began (min)	Time (t') since pumping stopped (min)	t/t'	Depth to Water Level (ft)	Residual Drawdown (ft)	Comments
07:01 PM	1			107		
	2			94		
	3			58		
	4			57		
	5			50		
	6			45		
	7			44 06		
	8			41 10		
	9			41 01		
	10			40 09		
	15			38 09		
	20			37 10		
	25			37 01		
	30			38 05		
	35			38		
	40			36 08		
	45			35 04		
	50			34 11		
	55			34 04		
08:01	60			34 02		
08:31				33 04		
09:01				32 08		
09:31				31		
10:01				30 04		
10:31				29 08		
11:01				29 02		
12:01 AM				28 09		
01:01				27 10		
02:01				27 04		
03:01				26 10		
04:01				26 04		
05:01				25 10		CONT.



-24.00 FT = 24.02 FT PER ADVANCED DRILLING

$$\begin{array}{r} 24.00 \text{ FT} \\ - 14.44 \text{ FT} \\ \hline 9.56 \text{ FT RECOVERY} \end{array}$$

$$\begin{array}{r} 24.02 \text{ FT} \\ - 9.56 \text{ FT} \\ \hline 14.46 \text{ FT} \\ - 2.0 \text{ FT CASING 'STICK UP'} \\ \hline 12.46 \text{ FT VS STATIC 12.5 FT} \\ \text{PER ADVANCED DRILLING} \end{array}$$