# **TECHNICAL MEMORANDUM**

Municipal Well Recharge Estimates
Spanish Springs Valley, Nevada

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Principal Investigator

Christian A. Kropf, Washoe County Department of Water Resources

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# MUNICIPAL WELL RECHARGE ESTIMATES SPANISH SPRINGS VALLEY, NEVADA

#### INTRODUCTION

As the population of Spanish Springs Valley (SSV) continues to increase, so too has the stress on the aquifer supplying potable water to the residents of SSV. This water quantity issue is compounded by the water quality issues posed by over 2,000 septic tanks linked to shallow groundwater contamination.

Currently, approximately 25% of the potable water demand in SSV is met by TMWA wholesale Truckee River water supplied from outside of the basin and around 75% is still supplied from ground water within the basin. Starting in 2009, base load (at approximately 2,100 AFY) will be supplied by TMWA water and peaking supply will come from SSV ground water. This will equate to approximately 60% TMWA water and 40% ground water. At build out in approximately 30 years, water demand is forecast to be 7,668 acre-ft/year (AFY) of which TMWA supply will comprise 78% and groundwater will comprise 22%.

Recharging TMWA wholesale water into the ground water during the off-peak season (November through April) may sustain the usefulness of municipal wells in terms of water quantity and quality withdrawals during peak water-use periods (May through October).

This technical memo attempts to define the maximum amount of water that could be recharged through the existing well field in SSV subject to constraints described herein. Following is a description of calculations and modeled estimates of recharge rates in SSV municipal wells (Washoe County-owned). These findings are preliminary and due to uncertainties associated with subsurface hydrogeologic parameters, can only be considered rough estimates until water is actually recharged through these wells. Wells chosen for recharge were selected by Washoe County Department of Water Resources (WCDWR) engineering and planning staff in consultation with Eco:Logic Consultants.

#### **INITIAL ESTIMATES OF RECHARGE**

A common approach to estimating recharge potential at a well is to assume a well can accept recharge water at a rate of half of the rate of extraction. Initial estimates of recharge were completed using this method and are summarized in Table 1 below. Pumping estimates were calculated based on average pumping rates during the peak pumping season.

Table 1. Initial estimates of recharge into municipal wells in SSV.

Well	DS1	DS2	DS3	DS4	SC2	SC3	SC4	SC6
Pumping Rate (gpm)	380	450	740	344	474	274	344	1896
Recharge Rate (gpm)	190	225	370	172	237	137	172	948

#### **INITIAL ESTIMATES OF RECHARGE - FIRST REVISION**

The estimates above may overestimate the total amount of water to be injected. This is due to pumping rates being taken from instantaneous measurements when the pump is running. None of the wells in SSV run continuously during the peak pumping period, and could therefore overestimate recharge over this time period. Recharge of potable water, however, would occur continuously over the non-peak period.

In order to better estimate this recharge rate, it is more appropriate to use the specific capacity of the aquifer in the vicinity of each well in addition to the potential height of mounding above static water level available for recharge. To provide a factor of safety for homes in the area, mounding will be approximated to no greater than five to ten feet below the land surface. The biggest concern for high mounding heights is the presence of septic drainfield trenches that may be impacted by an elevated groundwater table and vice versa. Specific capacities were calculated from recent well testing completed during Fourth Quarter, 2008 (Widmer, 2009). If specific capacity was not available from these more recent tests, it was either estimated from pumping operations or taken from initial well construction and testing reports.

Specific capacity is "an expression of the productivity of a well, obtained by dividing the rate of discharge of water from the well by the drawdown of the water level in the well" (Fetter, 1994). Estimates of recharge potential based on specific capacities are generally lower, and hence more conservative, than estimated based solely on the pumping rate of a well. Even though the water being injected is potable and essentially free from all suspended material, recharge wells will tend to clog over time.

Recharging into unconsolidated aquifers eventually leads to clogging at the interface between the well and the aquifer (Bouwer, 1988). Clogging can occur for a number of reasons including air entrainment by aeration of water falling into the well, filtration of suspended sediment and organic matter, development of bacterial growth in the aquifer, formation of precipitates due to geochemical reactions, and swelling of clay in the aquifer among others (Fetter, 1994). Due to this clogging, the specific capacity of recharge wells into unconsolidated aquifers is only about half the specific capacity during pumping (Bouwer, 1988).

To estimate recharge in WCDWR municipal wells, ½ of the specific capacity value (gpm/ft) is multiplied by the mounding available (ft) to determine a recharge rate (gpm) for each well. Table 2 presents estimates of recharge using this conservative method. The source of the specific capacity value is from recent well testing activities (Fourth Quarter, 2008) unless otherwise noted.

Table 2.	Revised	recharge	estimates	usina	specific capacity.

Well	DS1	DS2	DS3	DS4	SC2	SC3	SC4	SC6
Static Water Level (ft bls)	51	70	35	61	20	20	88	30
Mounding Available (ft)	41	60	25	51	10	10	78	20
½ Specific Capacity (gpm/ft)	8.4	4.7	15	5.7	3.9	1.5*	1.1	7.2*
Resultant Recharge Rate (gpm)	344	282	375	288	39	15	86	144**

<sup>\*</sup> Specific capacity from initial well construction and testing activities

The total water necessary to recharge at these rates over a six month period from November through April is approximately 1,250 acre feet (AF). Eco:Logic believes this volume of water is available during this period of time and is available at the suggested recharge rates at each wellhead.

Since SC6 is completed in zone of "gray fractured rock", we can assume that the flow is fracture-dominated. Recharge into fractured rock aquifers can be estimated to occur at rates close to pumping rates due to the well-developed porosities of fractured aquifers (Bouwer, 1988). However, the long-term behavior of fractured-rock aquifers is more uncertain than typical alluvial aquifers. The long-term pumping rate for SC6 is ~808 gpm (230,047,000 gallons over 176 days; May 5, 2008 – Oct. 27, 2008) with a maximum pumping rate during operation of 1,900 gpm. Given this value, recharge is probably significantly greater than the 144 gpm recharge estimate from specific capacity alone.

<sup>\*\*</sup> Recharge rate estimate increased to 475 gpm; see below for explanation

An average of the low specific capacity-derived estimate (144 gpm) and the long-term pumping rate-derived estimate (808 gpm) is probably a safe, if not low estimate, at 475 gpm for SC6. Increasing the recharge estimate at SC6 brings the total required volume of water to approximately 1,500 AF. If the well eventually takes up to the long-term pumping rate of 808 gpm, the total required volume of water to be recharged would increase to 1,800 AF.

#### **MODELED RECHARGE**

Recharge values calculated above were modeled in AQTESOLV (Duffield, 1996) in order to estimate the impact on water levels in the vicinity of the wells above. Simulations were run in a predictive mode with initial estimates of recharge.

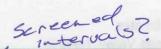
#### Model Considerations, Assumptions, and Input Parameters

AQTESOLV (Duffield, 1996) was used to model potential water level changes in each of the wells selected. The model can be used to simulate injection and pumping scenarios for numerous aquifer types under myriad well specifications and geologic constraints in a steady state or transient setting. When simulating physical parameters in a computer model, numerous considerations and assumptions are necessary. Although the AQTESOLV (Duffield, 1996) model is straightforward, some considerations have to be made in order to best-simulate real world conditions.

The most sensitive input parameter was found to be transmissivity. Values calculated from the original well construction and pumping tests were used in these simulations. Given the sensitivity of this parameter, various scenarios compared fully-penetrating vs. partially-penetrating and full aquifer depth vs. screened aquifer depth only to determine appropriate modeling. Simulated and observed draw downs were compared as a check on model input values. It was found to be more appropriate to use actual well construction and aquifer constraints instead of simulating injection with respect to the screened interval only (e.g. ignoring geology and partial penetration).

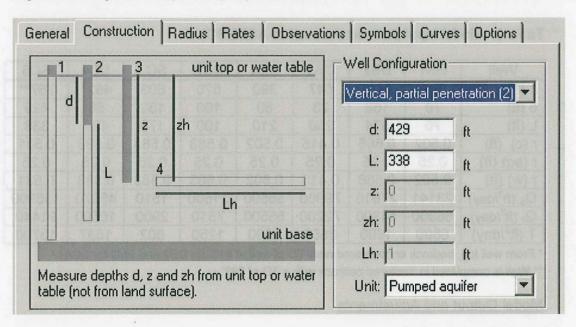
A number of assumptions were made when performing the recharge simulations. What follows is a list of assumptions used when modeling recharge at each well. Figures 1 and 2 graphically describe input parameters necessary in AQTESOLV. Table 3 lists input parameters used in our AQTESOLV simulations.

- Aquifer is unconfined at each of the municipal wells.
  - Aquifer depth was obtained from the well log, if available. Where the aquifer depth is assumed to extend beyond the total depth of the well, geophysical surveys were used to estimate total depth of the aquifer (Widmer, 2007).



- Wells are modeled as they occur/in relation to water level surface and aquifer depth. Well specifications were obtained from well logs.
- Wells were modeled as partially-penetrating, except where well log lithology proved otherwise
- The Neuman (1974) model solution assumes no wellbore storage, no wellbore skin, allows for partial penetration of wells, and variable pumping.
- Pumping rates were modeled as long-term pumping rates (operating continuously) over the peak pumping period (May through October) by taking 2008 pumping volumes divided by the date range in question (typically around 180 days).
- Recharge was modeled as continuous over the off-peak period (November though April).
- Hydraulic conductivity anisotropy ratio (Kv/Kh) was estimated at 0.1 for all wells.
- Storativity was estimated at 0.16 from Fetter, 1994
- Specific yield of 0.1545 from the DRI flow model (Pohll, 2009)
- Transmissivity (T) = K\*b; K = horizontal hydraulic conductivity; b = aquifer thickness
- o  $Q_p$  = Pumping rate;  $Q_r$  = recharge rate

Figure 1. Diagram of aquifer input parameters



General Construction Radius Rates Observations Symbols Curves Options r(c): 0.531 r(c) = inside radius of well casing ft r(eq) = radius of downhole r(eq): 0.25 equipment aquifer top or static water level r(p) = inside radius of packer r(p): 0 r(w) = radius of well (open or perforated interval) filter pack r(w): 0.531 r(sk) = outer radius of well skin (disturbed zone enveloping filter r(sk): 1 pack) aquifer base

Figure 2. Diagram of well input parameters

Table 3. Model input parameters used in AQTESOLV

Well	DS1	DS2	DS3	DS4	SC2	SC3	SC4	SC6
b (ft)	298	743*	647	390	570	603	462*	767**
d (ft)	70	168	23	80	100	130	58	429
L (ft)	70	574	230	210	100	170	426	338
r (c) (ft)	0.502	0.666	0.415	0.502	0.583	0.583	0.583	0.531
r (eq) (ft)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
r (w) (ft)	0.502	0.666	0.415	0.502	0.583	0.583	0.583	0.531
Q <sub>p</sub> (ft³/day)	23141	27810	79960	35500	21500	1510	45670	155900
Q <sub>r</sub> (ft <sup>3</sup> /day)	66300	54300	72200	55500	7510	2900	16500	91440
T (ft²/day)	8690	1600	8555	3300	1250	802	1537	13700

<sup>\*</sup> From well log, bedrock encountered near TD of well at 813' for DS2 and 550' for SC4

#### Model Output and Adjustments

Model output consists of a drawdown over time plot depicting water level elevation over time. Pumping rate has little if any impact on water level elevations resulting from recharge; increasing the pumping rate while keeping the recharge rate constant does not reduce the resultant mound elevation. Figure 3 depicts ground water elevation changes at increasing pumping rates.

<sup>\*\*</sup> Well is completed in fractured bedrock with a TD of 797'

Figure 3. Effect of increasing pumping rate on resultant mounding.

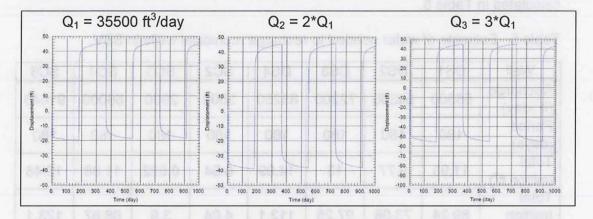


Table 4 describes mounding heights above static water level and proximity to land surface. Where mounds were estimated above land surface or were well below the available mounding potential, the simulations were re-run. These model re-runs are included in Table 4 where applicable and incorporate a new estimate of recharge. Model output plots are included in Appendix A. Well logs are included in Appendix B.

Table 4. Resultant ground water mounds from recharge operations.

Well	DS1	DS2	DS3	DS4	SC2	SC3	SC4	SC6
SWL* (ft bls)	51	70	35	61	20	20	88	30
Seal (ft bls)	52	50	50	70	100	50	70	100
Mounding (ft over static)	33	52	28	31	32	13	15	19
Mound Depth (ft bls)	18	18	7	30	-12	7	73	11
Suitable R*?	X	X	X	63	0 1 3	X	150	X
Increase R?	A20 图象	L CLER	P09.44	X	Cal a	2.839	X	Jee0
Reduce R?					X			
Previous R (ft³/day)	66300	54300	72200	55500	7510	2900	16500	91440
New Mound (ft over SWL)				46	12		59	
Mound Depth (ft bls)				15	8		29	
Revised R (ft³/day)				83250	3000		66000	

<sup>\*</sup>SWL = Static Water Level; R = Recharge

The new adjusted volumes of water necessary to recharge at these rates are calculated in Table 5.

Table 5. Estimate of water needed to recharge municipal wells in SSV.

Well	DS1	DS2	DS3	DS4	SC2	SC3	SC4	SC6
Recharge (ft <sup>3</sup> /day)	66300	54300	72200	83250	3000	2900	66000	91440
Period (days)	180	180	180	180	180	180	180	180
Total (million ft <sup>3</sup> )	11.93	9.77	13	14.99	0.54	0.522	11.88	16.46
Total (million gallons)	89.24	73.08	97.25	112.1	4.04	3.9	88.87	123.1
Total Recharge (AF)	274	224	298	344	12	12	273	378

Total volume of water required to recharge existing municipal wells in SSV during off-peak pumping is approximately 1,815 acre-feet per year. If SC6 can be recharged at the 800 gpm level instead of the 475 gpm level, this will add approximately 250 AFY. The total water required would be closer to 2,000 AFY.

Table 6 includes approximate costs based on \$1.29 per 1,000 gallons (from September 2006 TMWA wholesale agreement).

Table 6. Approximate costs to recharge TMWA water.

Well	DS1	DS	2 E	)S3	DS4	SC2	SC3	SC4	SC6
Cost	\$115,120	\$94,2	73 \$12	25,453	\$144,609	\$5,212	\$5,031	\$114,642	\$158,799

#### **CONCLUSIONS & RECOMMENDATIONS**

It is estimated that County-owned municipal wells in SSV may take up to 2,000 AFY in recharge water. This estimate is based on the historical pumping rates and/or well capacities, specific capacity, available mounding, and modeled simulations for each well. The analytical approach used requires more assumptions than a numerical-based model and therefore, if more descriptive results are necessary, a numerical-based model would be more appropriate. These simulations are an attempt to confirm potential estimates of recharge, and should be used as a starting point from which to begin recharge in the field. Field conditions and continual observations will provide a better feedback mechanism for adjusting recharge volumes over time.

It is recommended that if recharge is to be attempted in SSV, that it begin with a single well using the estimate provided above. A good candidate for recharge would be DS#4 given its proximity to available water, hydrogeologic characteristics near the well, and the available mounding potential above static water level.

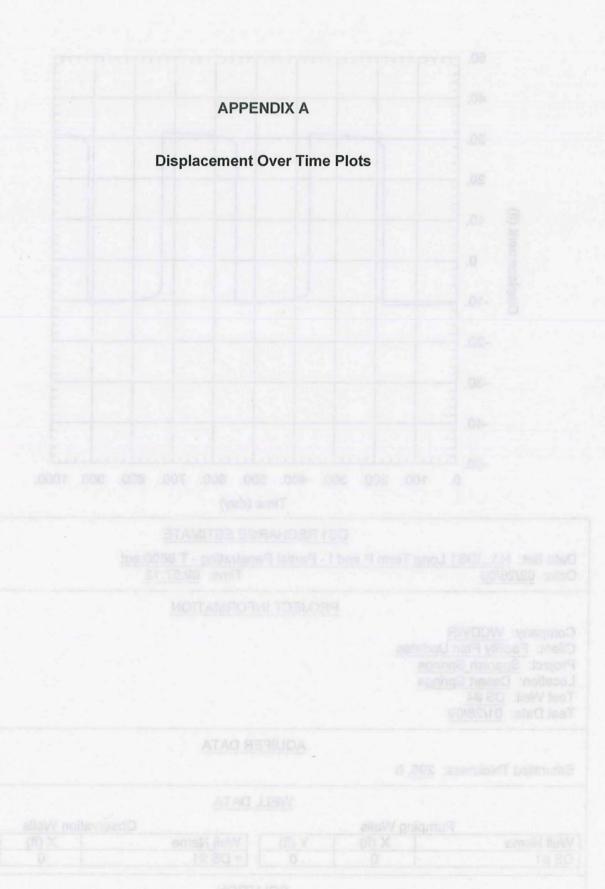
#### REFERENCES

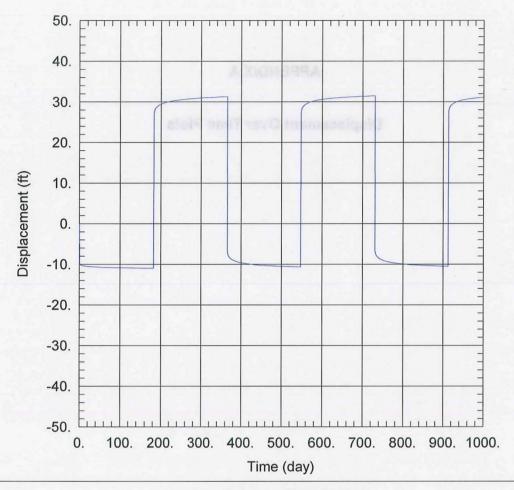
Bouwer, H. Systems for Artificial Recharge of Ground Water, in Artificial Recharge of Ground Water: proceedings of the international symposium: Anaheim, California, August 23-27, 1988. Edited by Johnson, A. I. and Finlayson, D. J.

Fetter, C. W., 1994, Applied Hydrogeology, 3rd edition: New York, Macmillan College Publishing Co., 691 p.

Widmer, M. C., 2007. Letter Report: Spanish Springs Bedrock Elevation Model. Washoe County Department of Water Resources, Reno, Nevada.

Widmer, M. C., 2009. Technical Memo: Municipal Well-testing. Washoe County Department of Water Resources, Reno, Nevada.





#### DS1 RECHARGE ESTIMATE

Data Set: H:\...\DS1 Long Term P and I - Partial Penetrating - T 8690.aqt

Date: 02/26/09 Time: 09:57:12

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: DS #4
Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 298. ft

#### WELL DATA

	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
DS #1	0	0	□ DS #1	0	0	

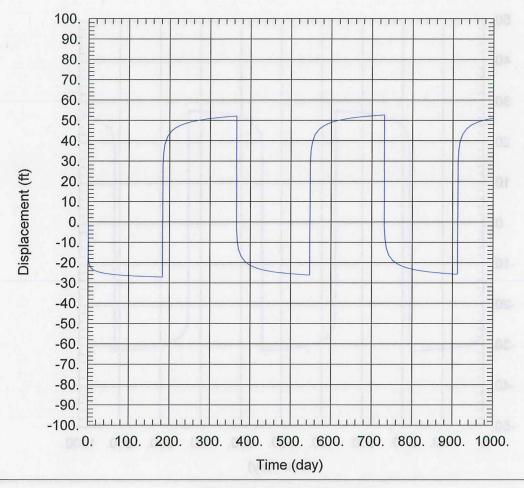
#### SOLUTION

Aquifer Model: Unconfined

T = 8690.  $ft^2/day$ Sy = 0.1545 S = 0.16

 $\beta = \frac{0.10}{2.838E-7}$ 

Solution Method: Neuman



#### DS2 RECHARGE ESTIMATE

Data Set: H:\...\DS2 Long Term P and I - Partial Penetrating - T 1600.aqt

Date: 02/26/09

Time: <u>09:57:53</u>

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: <u>DS #2</u> Test Date: <u>01/28/09</u>

#### **AQUIFER DATA**

Saturated Thickness: 743. ft

#### WELL DATA

aleV.F	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
DS #2	0	0	□ DS #2	0	0	

#### SOLUTION

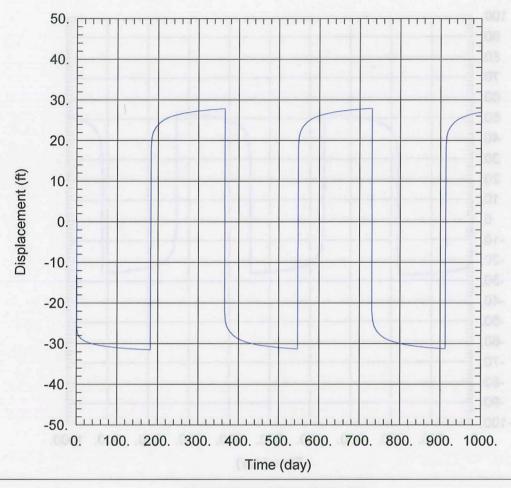
Aquifer Model: Unconfined

T = 1600. ft<sup>2</sup>/day

 $Sy = \frac{1000.1}{0.1545}$ 

Solution Method: Neuman

S = 0.16S = 8.381E-8



#### DS #3 RECHARGE ESTIMATE

Data Set: H:\...\DS3 Long Term P and I - Partial Penetrating - T 8555.aqt

Date: 02/26/09

Time: 09:58:49

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: DS #3
Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 647. ft

#### WELL DATA

	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
DS #3	0	0	□ DS #3	0	0	

#### SOLUTION

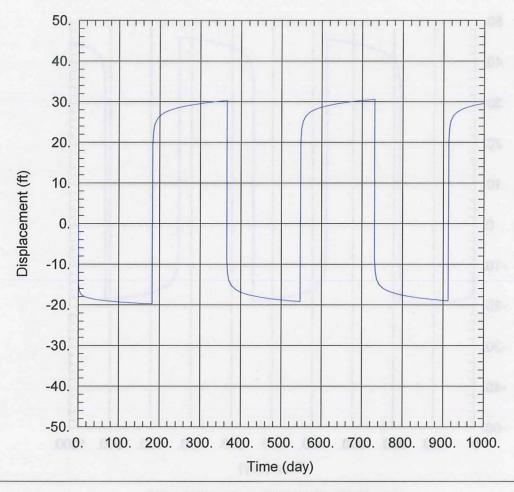
Aquifer Model: Unconfined

T = 8555. ft<sup>2</sup>/day

Sy = 0.1545

Solution Method: Neuman

S = 0.16S = 4.114E-8



#### DS4 ORIGINAL RECHARGE ESTIMATE

Data Set: H:\...\DS4 Long Term P and I - Partial Penetrating - T 3300.aqt

Date: <u>02/26/09</u> Time: <u>09:59:30</u>

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: DS #4
Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 390. ft

#### WELL DATA

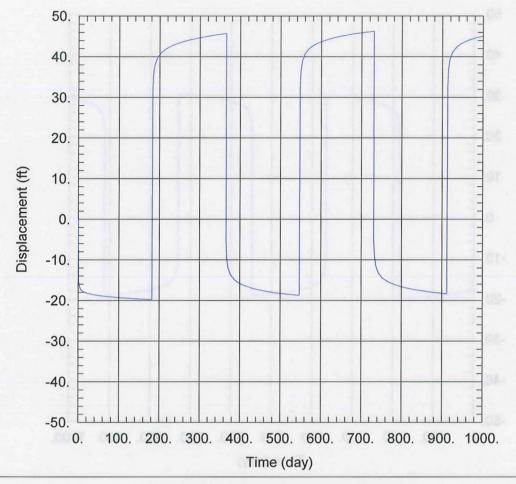
alg/_F	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
DS #4	0	0	□ DS #4	0	0	

#### SOLUTION

Aquifer Model: Unconfined

T = 3300.  $ft^2/day$ Sy = 0.1545 Solution Method: Neuman

S = 0.16S = 1.657E-7



#### DS4 INCREASED RECHARGE ESTIMATE

Data Set: H:\...\DS4 Long Term P and I - Partial Penetrating - T 3300 - INCREASED R.aqt

Time: 10:00:06 Date: 02/26/09

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates Project: Spanish Springs Location: Desert Springs

Test Well: DS #4 Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 390. ft

#### WELL DATA

Weller	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
DS #4	0	0	□ DS #4	0	0	

#### SOLUTION

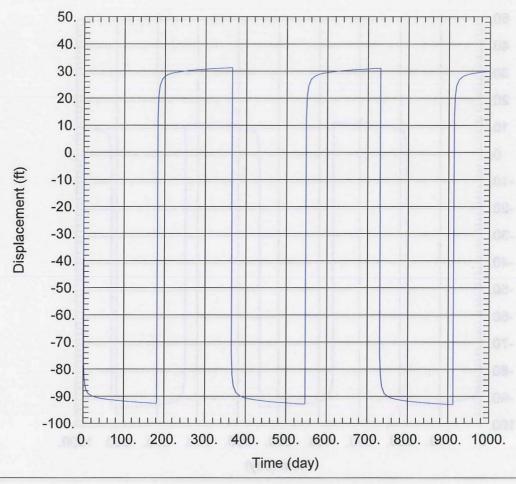
Aquifer Model: Unconfined

 $T = 3300. \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16 $\beta = 1.657E-7$ 



#### SC2 ORIGINAL RECHARGE ESTIMATE

Data Set: H:\...\SC2 Long Term P and I - Partial Penetrating - T 1250.aqt

Date: <u>02/26/09</u> Time: <u>10:00:44</u>

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: <u>SC #2</u> Test Date: <u>01/28/09</u>

#### **AQUIFER DATA**

Saturated Thickness: 570. ft

#### WELL DATA

a Ret. F	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
SC #2	0	0	□ SC #2	0	0	

#### SOLUTION

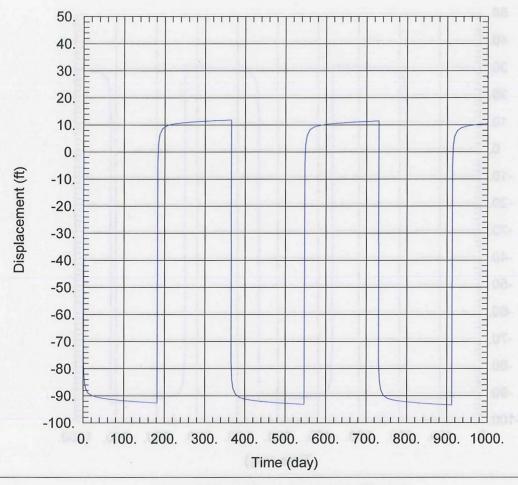
Aquifer Model: Unconfined

 $T = 1250. \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16S = 1.047E-7



#### SC2 DECREASED RECHARGE ESTIMATE

Data Set: H:\...\SC2 Long Term P and I - Partial Penetrating - T 1250 - REDUCED R.aqt

Date: 02/26/09 Time: 10:01:18

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: <u>SC #2</u> Test Date: <u>01/28/09</u>

#### **AQUIFER DATA**

Saturated Thickness: 570. ft

#### WELL DATA

Line alleys	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
SC #2	0	0	□ SC #2	0	0	

#### SOLUTION

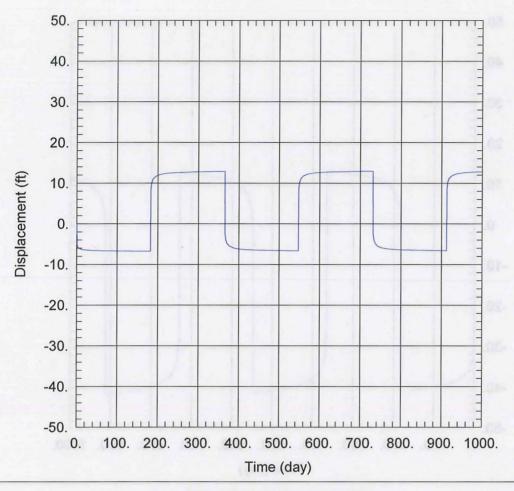
Aquifer Model: Unconfined

 $T = 1250. \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16S = 1.047E-7



#### SC3 RECHARGE ESTIMATE

Data Set: H:\...\SC3 Long Term P and I - Partial Penetrating - T 802.aqt

Date: 02/26/09 Time: 10:01:56

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: SC #3 Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 603. ft

#### WELL DATA

Malla	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
SC #3	0	0	□ SC #3	0	0	

#### SOLUTION

Aquifer Model: Unconfined

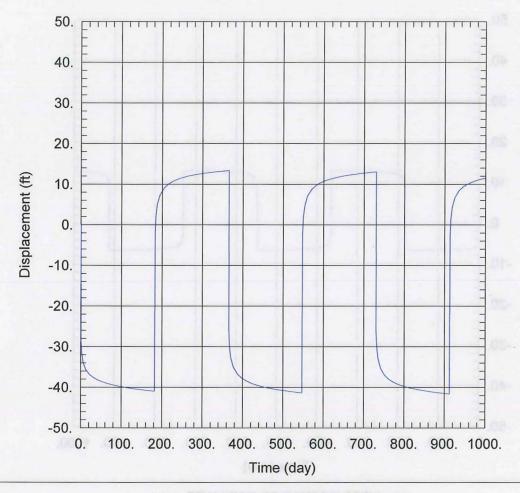
 $T = 802. \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16

 $\beta = 9.357E-8$ 



#### SC4 ORIGINAL RECHARGE ESTIMATE

Data Set: H:\...\SC4 Long Term P and I - Partial Penetrating - T 1537.aqt

Date: 02/26/09

Time: 10:02:30

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: <u>SC #3</u> Test Date: <u>01/28/09</u>

#### **AQUIFER DATA**

Saturated Thickness: 484. ft

#### WELL DATA

Mells	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft) Y (ft)		
SC #3	0	0	□ SC #3	0	0	

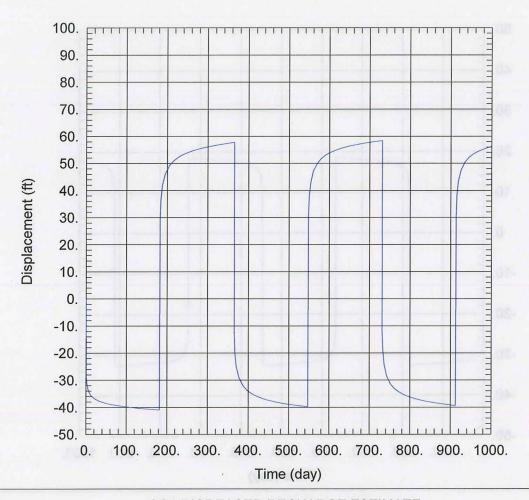
#### SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

 $T = \frac{1537}{0.1545}$  ft<sup>2</sup>/day Sy = 0.1545

S = 0.16S = 1.452E-7



#### SC4 INCREASED RECHARGE ESTIMATE

Data Set: H:\...\SC4 Long Term P and I - Partial Penetrating - T 1537 - INCREASED R.aqt

Date: 02/26/09 Time: 10:03:04

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: SC #3Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 484. ft

#### WELL DATA

atlet/F	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
SC #3	0	0	□ SC #3	0	0	

#### SOLUTION

Aquifer Model: Unconfined

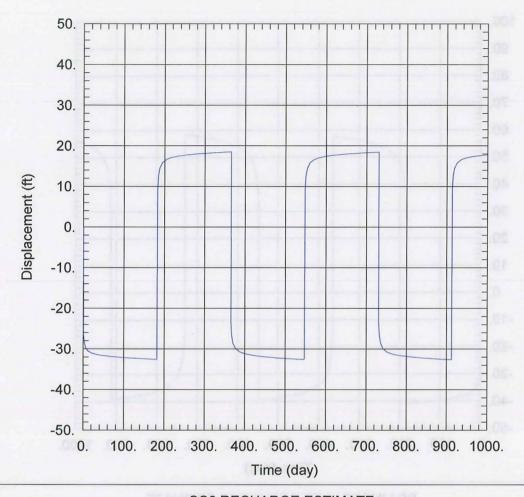
 $T = 1537. \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16

 $\beta = 1.452E-7$ 



#### SC6 RECHARGE ESTIMATE

Data Set: H:\...\SC6 Long Term P and I - Partial Penetrating - T 14540.aqt

Date: <u>02/26/09</u> Time: <u>10:03:45</u>

#### PROJECT INFORMATION

Company: WCDWR

Client: Facility Plan Updates
Project: Spanish Springs
Location: Desert Springs

Test Well: SC #6
Test Date: 01/28/09

#### **AQUIFER DATA**

Saturated Thickness: 767. ft

#### WELL DATA

allo/F	Pumping Wells		Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
SC #6	0	0	□ SC #6	0	0	

#### SOLUTION

Aquifer Model: Unconfined

 $T = 1.37E + 4 \text{ ft}^2/\text{day}$ 

Sy = 0.1545

Solution Method: Neuman

S = 0.16S = 4.793E-8 APPENDIX B Well Logs

Washoe County Department of Water Resources

WHITE—DIVISION OF WATER RESOURCES CANARY—CLIENT'S COPY PINK—WELL DRILLER'S COPY

#### STATE OF NEVADA **DIVISION OF WATER RESOURCES**

#### WELL DRILLER'S REPORT

	1	The state of the s
OF	FICE PSE ONL	V.
Log No.	777	· F
Permit No 52	524,6	2588
Basin 6-8	5	Ţ.
Duotininom.		

PRINT OR TYPE ONLY		PI	lease comp	lete this	form in its entirety
Springwood	Richarn	Dow	o l opmor		NOTICE OF INTENT NO. 15584
1. OWNER SPITINGUOUT	tewart	St	ETOPME		ADDRESS AT WELL LOCATION
MAILING ADDRESS Carson	City N	v 8	9701		тугаший иму
SE SW	J CILLY, IN	3	3701	20	20 Washoe
2. LOCATION 52524/52588		89_1	50-72		N/S R 20 E County
Issued by Water Reso	ources		Parcel No.	••••••	ADDRESS AT WELL LOCATION
3. TYPE OF WOR			4.		PROPOSED USE 5. TYPE WELL
****			75.5	estic [	The second secon
Deepen □ Oth				cipal 2	
Deepen 🖸 Out			- Ividii	cipai c	Industrial Color C
6. LITHOL	OGIC LOG				8. WELL CONSTRUCTION
Material	Water Strata	From	To	Thick-	Diameter 15 inches Total depth 200 feet
D. G. Brown	Strata	0	17	ness 17	inches
D. G. Blown		0	1/	1/	inches 8 5/8 inch
Multi-colored sands					inches Casing record 8 5/8 inch Weight per foot 16.94 Thickness .188
w/traces brown & tan					Weight per 100t
clay		17	75	58	8 5/8 inches +1 From feet 200 To feet
Multi-colored sand w/			1		inches feet feet
fine brown sand trace					inches feet feet
brown & tan clay		75	112	37	inches feet feet
Multi-colored course					inches feet feet
sands w/trace red clay					inches feet feet
& fine sand		112	116	4	Surface seal: Yes 🖾 No 🗆 Type neat cement
Brown clay w/some					Surface scal: Yes 🖾 No 🗆 Type neat cement  Depth of seal 52 feet
multi-colored sands		116	129	13	
					Gravel packed: Yes XX No Gravel packed from 52 feet to 200 feet
Course multi-colored					
sands some brown clay		129	170	41	Perforations:
Multi-colored sands					Perforations:  Type perforation screen [Roscoe Moss]  Size perforation .100
w/some brown sticky		. 70	175		Size perforation .100 From .120 .190
clay		170	175	5	
Multi-colored course					From feet to feet
sands w/ streaks				-	From feet to feet
brown clay		175	200	25	Fromfeet tofeet
DIOWII CIAY		113	200	23	From. feet to
					9. WATER LEVEL
T. D. 200 feet					Static water level 51 feet below land surface
					Flow
0./0	0./00				Water temperature cold of Quality good
Date started	9/90	78787	······	, 19	
Date completed.	9	/5/90	······································	, 19	
7. WELL T	EST DATA				This well was drilled under my supervision and the report is true to the best of my knowledge.
		1-			Name Aqua Drilling & Well Service, Inc
Pump RPM Co.P.M.		10000	After Hours	Pump	Contractor 625 Spice Islands Dr Suite L Sparks
Blew with air to cle	-				Address 625 Spice Islands Dr Suite L Sparks Contractor 89431
Test pumped at 300 G	PM for	/2 h	rs.		Nevada contractor's license number
- 8	व				issued by the state contractor's Board
	V)				Nevada contractor's driller's number 1132 issued by the Division of Water Resources
BAILE	R TEST				Nevada driller's license number issued by the 1509 Division of Water Resources, the on-site driller
G.P.M Dra	w down	fe	et	hours	Signed Kasci in Theal
G.P.M. Dra	w down	fe	et	hours	Signed Kascli Talal By driller performing actual drilling on site or contractor
G.P.M Dra	w down	fe	et	hours	

## WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Log No. 7343

Rec. Bug 22 19 63

Well No.

Permit No. 2 1375

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

	20 72 8 8
Owner E. A. Becker	Driller CASCO 6774-A
Address 5017 Alta Dr., Las Vegas, Nev.	Address 1790 E.Plumb Ln., Reno. Lic. No. 349
Location of well: NE 1/4 SW 1/4 Sec. 3 , T. 80 N/S,	R 20E, in Washoe County
or	
Water will be used for Sub-Division	Total depth of well 815 ft.
Size of drilled hole 26 inch	Weight of casing per linear foot 42.05 1b.
Thickness of casing 0.25 inches	Temp. of water 61 degrees
Diameter and length of casing 15 0.D. X 815 (Casing 12" in diameter and un	total length  nder give inside diameter; casing 12" in diameter give outside diameter.)
If nonflowing well give depth of standing water from surfe	ace 54 ft.
If flowing well describe control works	
	(Type and size of valve, etc.)
Date of commencement of well 5-4-63	Date of completion of well 8-25-63
Type of well rig. Rotary	
LOG OF FORMATIONS	

		LOG	OF FORMATIONS	Water-hearing Formation Casing
From To Thickness feet feet			Type of material	Water-bearing Formation, Casing Ferforations, Etc. 54 ft. to T.D.
0 45 60 80 90 100	45 60 80 90 100 105 110	45 15 20 10 10 5	Decomposed Granite D.G./ boulders	Chief aquifer (water-bearing formation)  from to formation for for formation for for formation for forma
485 490 500 665	485 490 500 665 770	5 10 165 105	Sand/blue clayand gravel(thin at intervals Very fine sand/ blue clay Blue clay Fine sand/ blue clay Blue clay/ med. sand	
770 820	820 835	50 15	Course aand/minor streaks of blue clay Crse. sand, clay streaks/	First water at 54 feet.  Casing perforated
835	840	5	Boulders/clay & sand-hard drilling	from 238.4 to812.6
840	848	8	Boulders/sand-minor clay	Size of perforations machined I/4* X 3**
			(OVER)	919

From feet	To feet	Thickness		Type of material
	The same			ACQUITAGE AND RESISTANCE OF THE PARTY OF THE
				18 C = 0 P C =
	7000		937	WAT IN MUSIC STREET, SINGLE STREET, ST
		gress to		
	ver a	SE L	in the intended the	A TOTAL CONTRACTOR OF THE PARTY
		\$ 0 TRIS	45 23	and the state of t
				CASING RECORD
Diam. casing	From feet	To feet	Length	"Remarks".—Seals, Grouting, Etc.
16* 0.D.	G.L.	812.59	812.59	Cemented from G.L. to 50 ft. outside 16 and 20 wall of hole
	£9-88-			
		GE	NERAL INFO	RMATION—Pumping Test, Quality of Water, Etc.
		wil .		
Tes	ted - 50	00 gpm 1	with I40	ft. drawdown
Gra	vel pac	ked- 50	ft. to 7	I.D. with plus I/4 minus 3/4 round
	- 8 -	mining ex	LO-	A2303, 20, 20, 20, 20 100 100
	WELL DR	ILLER'S ST	ATEMENT	(Not to be filled in by Driller)
This wel above in belief.	l was drill formation is	ed under m	y jurisdiction y best inform	n and the lation and
	Signed L	H1bl Wal	Driller)	on a second
В	Mex D Mgr.	Pierso	n No. 404	
				1 L.A.M. M. 77 DOU /C
Dated	A.		, 19.6	3 VI OI WV 23 9NV 20-1
Dated	A1	gust41	, 19.6	BEANISHE TEALS

36055
WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

#### STATE OF NEVADA

#### DIVISION OF WATER RESOURCES

OFFICE USE ONLY

your .	29287 5	1. 1. j				ERS REPORT	Permit N	10.360.59 PAUSH 3.065
OWNER 2 2. LOCATION PERMIT NO	alling	h J	pri	y 16	200 4	N/S R.20 E 4	Zes .	romid Rd,
New Well Deepen	1 Red &	Recondition			mestic [	Industrial  Sto	ck 🗆	5. TYPE WELL Cable   Rotary   Other   Recent
6.	LITHOLO	OGIC LO	G			8. WELL O	CONSTRUC	CTION 306
Mat	erial	Water Strata	From	То	Thick- ness			
Sandy Clay Sandy Sandy Chay Chay Chay Chay Chay Chay Chay Cha	Clay Clay Clay Clay Clay Clay Clay Clay	15 7 8 11	23 94 55 55 27 186 186 196 196 196 196 196 196 196 19	13 13 13 13 13 13 13 13 13 13 13 13 13 1		inches inches inches inches Surface seal: Yes D No Depth of seal Gravel packed: Yes Gravel packed from Size perforation From From From From From From From From	feet to	feet 30 feet feet feet feet feet feet feet fee
Date started Date completed 7.	WELL TE	III ST DAT	8 5 1	1	929	This well was drilled under rethe best of my knowledge.	CERTIFICATION SUPERVISION	
Pump RPM	G.P.M.	Draw Do	wn .	After Hours	Pump	Address 22 Sour	th Ta	tterm
2.35	19/7/01	400100		anunit j		Nevada contractor's license i		4483
				stanti i		Nevada driller's license num	er 9	5,7
A-10-10-10-10-10-10-10-10-10-10-10-10-10-	BATTE	P TECT	+			my Parth	11/	

Date ....

.....hours

.....hours

Draw down.....feet

Draw down.....feet

Draw down.....feet .....hours

G.P.M.....

WHITE—DIVISION OF WATER RESOURCES

CANARY—CLIENT'S COPY

PER—WELL DRILLER'S COPY

DIVISION OF WATER RES

CALL OF 4

WELL DRILLER'S DES

#### DIVISION OF WATER RESOURCES

OFFICE	USE ONLY
Log No. 296	87
Permit No. 1	443
Basin 6-8	>

PRINT OR TYPE ONLY				ERS REPORT  Form in its entirety
1/. 0	1			NOTICE OF INTENT NO.
OWNER MAU CO DE	wellper	9		Address AT WELL LOCATION 10505 palm
MAILING ADDRESS 2030	palm	spring	is the	Springs Us, Sparks New
sparks, new		434	7 /	
2. LOCATION 3.00 % 3.C	Sec	T.	22 1	N/S R 20 E Washal County
PERMIT NO	ces	Parcel No		Spanish spring Revelo
3. TYPE OF WORK		4.		PROPOSED USE 5. TYPÉ WELL
	dition	W	nestic 🗆	
Deepen 🗆 Other				Industrial Stock Other O
6. LITHOLOG	DIC LOG			8. WELL CONSTRUCTION
	Water From	То	Thick-	Diameter hole 3/4 2 4 inches Total depth 400 feet Casing record 26'-1234'-10
	ottata	50	ness	103/1000
Clay & sand mix	50	55		1)
coassesandy	55	60	-	Diameter From To W 1/6
Class losses	20	W.L.:		12 3/1 oction 0 feet 140 feet
Coarsesion & Fivegrand	60	63		26 inghes 0 feet 70 feet 12 34 societies 0 feet 140 feet 12 4 societies 140 feet 260 feet
Sauds	63	64		124 Scilid inches 260 feet 270 feet
heavin Clay	64	65		10 % 501 d inches 270 fast 300 fast
Sands	65	70		1034 PORFinches 300 feet 390 feet
b Rown clay squas	lde	70		Surface seal! Yes A No Type 700 Neat Cumin
sauds !	70	7/		Depth of sealfeet
beau weby Esand	71	75		Gravel packed: Yes No
beausiclack	75	78		Gravel packed from 6 feet to 700 feet
Sand	78	82		The same of the sa
DROWNCIAY ESAUCIS	83	84		Perforations:  Type perforation 100 slot screen Facting slot
SUNC	84	88		Type perforation 100 Alon Screen Factory 141
beowneily	88	88		Size perforation 120 statemen 3/32 stat
Sand & gravel	91	96		From
prown day	96	98	-	From fact to feet
DIG GARC	98	100		From 10 34 perf 300 feet to 390 feet
brown CIAN	160	101	-	Fromfeet tofeet
SULC CLAY	101	104		
againet	104	106		9. WATER LEVEL
clay & Sauds	106	107		Static water level 45 feet below land surface
Consessed Finegrand	107	127		FlowP.S.1.
gravel with a layous	127	158		Water temperature ° F. Quality
bt Clay		<u>L.</u>		10. DRILLERS CERTIFICATION
PROFITAGINETATE SELLE	1-	10	CS	This well was drilled under my supervision and the report is true to
Date started	7- 1	0	, 19.50	the best of my knowledge.
Date completed			, 190.5.	Name Paul Welliams Wens
7. WELL TES	T DATA			Contractor
7. WELL IES	DATA	Ama M		Address P. O. Bet 8277 Trucke Calf.
Pump RPM G.P.M.	Draw Down	After Hou	ırs Pump	Contractor 45737
0 10	0.1	4		Nevada contractor's license number
Tung rest &	ara.	10		953
E Al	11,0	100		Nevada contractor's drillers number
1 octow s	mo ru	1-00	•	Nove de different Services 957
				Nevada driller's license number
BAILER	TEST			Signed Paul delliams In
G.P.M Dra	w down	feet	hours	
G.P.M Dra	w down	feet	hours	Date 7-20-88
G P M Dra	w down	feet	hours	

WHITE—DIVISION OF WATER RESOURCES GANGRY—CLIENT'S COPY PINK—WELL DRILLER'S COPY

Fage 2 0 6 4

## STATE OF NEVADA DIVISION OF WATER RESOURCES

## WELL DRILLERS REPORT

OFF	ICE USE ON	LY
Log No25		-
Permit No		
Basin		

PRINT OR TYPE ONLY	F	lease com	NOTICE OF INTENT NO. 880				
OWNER Hawa De	celopers		1	ADDRESS AT WELL LO	CATION	NIENI NOS	2
MAILING ADDRESS 10505	salma	names	as.	ADDRESS AT WELD DO			
snerks nev.	894	3/					
LOCATION S Le 4 S	6 14 Sec. 2.	6 T	21	N/S R. 20 E	Wosh		County
PERMIT NO 47793 Issued by Water Reso	189	150 -	22	sponish of	Aringo O	usde	
Issued by Water Reso	urces	Parcel No.			Subdivision Name		
. TYPE OF WOR	K	4.		PROPOSED USE	2000/00/200	5. TYPE W	ELL
New Well Reco	ondition	Don	nestic [	Irrigation	Test 🗆	Cable	Rotary D
Deepen  Othe	er 🗆	Mun	icipal	Industrial 🗆	Stock	Other 🗆	0
LITHOL	ocic Loc			8. WEI	L CONSTRUCTION	ON	
LITHOLO	OGIC LOG	1 11	- 4 4	Diameter hole			feet
Material	Water Strata From	То	Thick- ness	Casing record			
Sand and growel	158	159		Weight per foot			
sandalay	139	167	17.7	Diameter	From	To	
Sauds	167	176		inches	fee	t	feetl
CLAY	170	171		inches		The second secon	
Save	171	174		inches			
Sand Eclay	170	1197		inches			The second second
Sand & growa	ווז	183		1	fee	The second second second	SERVICE SERVICE SERVICE
Clay & Sant	183	189			fee	7	0.000 1004 440 10-01
ciali	189	191		Surface seal: Yes			
Sand	19.1	203		Depth of seal			
send torque	203	208		Gravel packed: Yes			
Classi	308	211		Gravel packed from		0	feet
Sand Finey Rowa	211	217		Otavor packed from			
Clark	217	220		Perforations:			
clay Isand	220	233		Type perforation			
Sand	2.33	239		Size perforation			
Sandy Clay	239	-		From			
Sand Haraiel	201	246		From			
Claus	246	249	*****	From			
Sent	200	252		From			
Clari	353	253		From			
coge se sand	253	250		- 100			
sandy clay	254	260	17 7	9.	WATER LEVEL		
Sand 3	260	269		Static water level		feet below la	nd surface
Clau	264	276			G.P.M		
Seincy clay	270	500		Water temperature			
Send w glavel	212						-
The second second	10.	1000		10. DRILL	ERS CERTIFICAT	LION	
ate started			10	This well was drilled un		and the repor	t is true to
Pate completed				the best of my knowled	ge.		
			, 17	Name			
WELL TI	EST DATA				Contractor		
			-	Address	Contractor		
Pump RPM 1 G.P.M.	Draw Down	After Hou	rs Pump	parties of retail 1 sheets			
	A STATE OF STATE OF	الخارات		Nevada contractor's licer	nse number		
- CC 12		minut.		Nevada contractor's drill	lers number		
3 P							
	A CLUM SOME		restrict.	Nevada driller's license n	umber	Actual Driller	
DAILE	R TEST					Actual Driller	
				Signed			
	raw down				Contractor		
	raw down			Date			***************************************
DM	raw down	* a a *	houre				

white—division of water resources canary—client's copy pink—well driller's copy

Page 3 of 4

#### STATE OF NEVADA DIVISION OF WATER RESOURCES

## WELL DRILLERS REPORT

Log No. 2966	
Permit No.	
Basin	Berry

MAILING ADDR	ESS 105	05 1	Erlin	: Des su	120	ADDRESS AT WELL LO	SAME	
Spark	a new	5	943	7			·-····	
LOCATION.	7793		Dec		A		CO OSTA	County
ERMIT NO. 47793   59-150-27   Parcel No.							Subdivision Name	
LITTE HEYE	TYPE OF WO	RK		4.	-	PROPOSED USE	2802 30	5. TYPE WELL
	. /	condition			estic [	Irrigation 🗆	Test 🗆	Cable Rotary
Deepen		her				Industrial	Stock 🗆	Other 🗆
						1		
•	LITHOI	LOGIC L	OG		44		LL CONSTRUCTI	
Mater	ial	Water Strata	From	То	Thick- ness	Diameter hole		pthfeet
Sandur	0	Strata	285	290	nças	Weight per foot		
Class	Ves		290	295	-	Diameter	From	То
Sandye	124		299	317			fec	etlfeèt
SONICS	1114		317	319	-	inches	fec	etfeet
Clau	- Input		319	321		inches	fee	THE RESERVE OF THE PROPERTY OF
Sound	. 192	1,5 1,0 -34	321	325		inches	fee	
Clarity	Band Lew	8	325	329		inches	fee	
saud			327	230		inches	fee	etfeet
Sandy	CLAU	4 /	330	331		Surface seal: Yes	No 🗆 Type	
Sand			331	334		Depth of seal		feet
CLAU			334	335		Gravel packed: Yes [		
Sand			335	1337		Gravel packed from	feet	tofeet
CLAU			337	340		11/2 11/2		
Sand			340	342		Perforations:		
CLAY			343	355				
Sund			355	357				
Sandy C	lark		357	360		From	Committee of the Commit	
CIALL	-1		360	361		From		
- 0	Clary		361	363		From		
greyer	- 1		363	366		From		
	clay		366	317		From	feet to	feet
Jaw G	- '	-	314	317		9.	WATER LEVEL	A CONTRACTOR
clay	7		315	317		Static water level		
Sand			317	200				
Clay	de Clay		380	303				P.S.
Samo	71		383	385		water temperature	F. Quanty	
1920	MED		1200	1382		10. DRIL	LERS CERTIFICA	TION
Date started						This well was drilled un	nder my supervision	and the report is true
						the best of my knowled		
Date completed					, 19	Name		
						Name	Contractor	<del></del>
•	WELL	TEST DA	TA			Address		
Pump RPM	G.P.M.	Drav	Down	After Hou	rs Pump	0.0000000000000000000000000000000000000	Contractor	
		A. Henri	- 177			Nevada contractor's lice	ense number	
		11		ednick.		Nevada contractor's dri	llers number	
		*						
	323					Nevada driller's license	number	Actual Driller
	BAIL	ER TES	Г					
G.P.M				foot	house	Signed	Contractor	
3.Р.М 3.Р.М				feet				
J. 4 1174								

50

# WHITE-DIVISION OF WATER RESOURCES CANTRY-CLIENT'S COPY PINK-WELL DRILLER'S COPY Page 4 of 4

#### STATE OF NEVADA DIVISION OF WATER RESOURCES

## WELL DRILLERS REPORT

Log No. 2968
Permit No.
Basin

PRINT OR TYPE	E ONLY		P	lease com	plete this	form in its entirety  NOTICE OF INTENT NO. S. S. C
OWNER 124	ress 1050	Devel 5 pa	gren	apain	0	ADDRESS AT WELL LOCATION
LOCATION	Sw 1 3	) e 1/4	Sec. 2	6 T	27	N/S R. 20 E Washe County  Spanish springs Developme Subdivision Name
	TYPE OF WO		_	The second		
New Well	The second second	econdition			nestic [	
Deepen	0	ther		Mun	icipal 1	Industrial  Stock  Other
	LITHO	LOGIC L	og			8. WELL CONSTRUCTION Diameter holeinches Total depthfeet
Mate	rial	Water Strata	From	То	Thick- ness	Casing record
CIAV		Strata	385	387	ness	Weight per footThickness
-11.		19000	387	389	-	Diameter From To
SANCE		+	389	394		inches feet feet
CIAY			3911	379		inches feet feet
1 Add 51	2 4100		394	400	-	inches feet feet
LIAX+5A	NCY.		377	700		inches feet feet
	1000		2 10	-		
			-			inches feet feet
		-	1			inches feet feet
			-	-		Surface seal: Yes No Type
	-		-			Depth of seal
						Gravel packed: Yes No
						Gravel packed fromfeet tofeet
	CC .					Committee of the Commit
	<del></del>					Perforations;
	Ĕr.	-				Type perforation
						Size perforation
	9					Fromfeet tofeet
		+				Fromfeet tofeet
	741					Fromfeet tofeet
		(1)				Fromfeet tofeet
	اوراد	K	-			Fromfeet tofeet
19		71				9. WATER LEVEL
			-			Static water levelfeet below land surface
					1	Flow G.P.M. P.S.I
		29,19				Water temperature
						10. DRILLERS CERTIFICATION
						This well was drilled under my supervision and the report is true to
ate started					,	the best of my knowledge.
ate completed					, 19	
Water Street	THE PROPERTY OF					Name
	WELL	TEST DA	ATA			ACCUSE THE PART AND WILLIAM TO A STATE OF THE PARTY AND A STATE OF THE
	I					Address
Pump RPM	G.P.M.	Drav	Down	After Hou	rs Pump	
	- Description of the		-			Nevada contractor's license number
	N. S. Turanti		7-149			Nevada contractor's drillers number
	936	and Park	1 1 1 1 1			
	L			y sa heter		Nevada driller's license number
	BAII	LER TES	Т			Signed
.P.M		Draw dow	n	feet	hours	
.P.M				feet		
.P.M				feet		

WHITE-DIVISION OF WATER RESOURCES CANARY-CLIENT'S COPY PINK-WELL DRILLER'S COPY

WAShx Co. - well 'A'

#### STATE OF NEVADA DIVISION OF WATER RESOURCES

### WELL DRILLER'S REPORT

	OFFICE USE ON	A STATE OF THE PARTY OF THE PAR
Log No	30706	them.
Permit No.	3/4/61	65
Basin 6	85 ponsh	Spans

PRINT OR TYPE ONI						form in its entirety  NOTICE OF INTENT NO 7801
1. OWNER SOLDING MAILING ADDRESS 2	SS SI	st/Sur	EA	A ASSO	k 15	ADDRESS AT WELL LOCATION
2. LOCATION S	1/4 5/2		35	T	2/	N/S R. ZO E WAShOE County
PERMIT NO. SITE	y Water Resou	rces		Parcel No.		Subdivision Name
3. TYPE	OF WORK	<		4.		PROPOSED USE 5. TYPE WELL
New Well		ondition	 	Dom	estic	Charles and the second of the
6.	LITHOLO	OGIC LOG		Apply a less		8. WELL CONSTRUCTION
. Material		Water Strata	rom	То	Thick- ness	Diameter. 22 inches Total depth. 230 feet inches
compact fill	2079		0	3	3	Casing record
Brown Clity			3	17.	9	Weight per foot
Brown Clay &						
Brown yrelow &	white.		2	20	.58	inches feet feet feet
COICHNIC SAME		-		10	.50	inches feet feet feet feet
Brown Charw	: 14	MAIN COLUMN		A PARTY		inches feet feet
Streaks of sa	lad	2	0	110	4.0	inchesfeetfeet
VIELLOW BROWN P.	reddis4			-		Surface seal: Yes OK No □ Type CEMENT  Depth of seal CO feet
Brown givery A	white					Gravel packed: Yes ☒ No □
VOlcaric SAND	15 8			- 1 - 1	1.	Gravel packed from 1001 feet to 2.30 feet
9 PHUEL		/	10	215	105	
TOTAL CONTRACTOR	-	-	-			Perforations:  Type perforation
UD/CANIC SAH	dwif4	7	15	230	1.5	
Browy Clay LA	y-ers					Size perforation
						Fromfeet tofeet
	T.					Fromfeet tofeet
<u> </u>	38	TAR	-	-		From feet to feet
9	が売			Villa 2		Fromfeet tofeet
99						9. WATER LEVEL
	CZ	7				Static water level 20 feet below land surface
8	<u>u</u> l	9501 0				Flow G.P.M. P.S.I. Water temperature COO. of Quality U. KAOWY
Date started	75		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		, 19.85	
Date completed	19:-				, 1988	10. DRILLER'S CERTIFICATION  This well was drilled under my supervision and the report is true to the
7.	WELL TE	EST DATA				best of my knowledge.  Name OASiS DRILLING INC.
Pump RPM	G.P.M.	Draw Dow	'n	After Hours	s Pump	Contractor
		20		基		Address 10 Box 21421 CARSON City MAN 8
4	25	88		12	16	Nevada contractor's license number issued by the State Contractor's Board 0023129
	51	6.6	-	77		Nevada contractor's driller's number issued by the Division of Water Resources
.1	BAILE	R TEST				Nevada driller's license number issued by the Division of Water Resources, the on-site driller 1386
G.P.M.		w down w down				Signed By driller performing actual drilling on site or contractor
G.P.M.	Dray	w down	fe	et	hours	Date 1/2C, 6- 1788

WHITE-DIVISION OF WATER RESOURCES CANARY-CLIENT'S COPY PINK-WELL DRILLER'S COPY

## STATE OF NEVADA DIVISION OF WATER RESOURCES

#### OMEST SEED LINE OF THE SEED OF

WELL	DKIL	LLK	0	KLI	OKI
TO					

	OFFICE USE ON	
Log No	30707 1	
Permit N	0.51477	
Basin.	85 Spanis	1 apares V
	-	

PRINT OR TYPI	E ONLY		Please com	plete this	form in its entirety			
1. OWNER GO	Idrey wies	4/SU45	ASSO	14015	ADDRESS AT WELL LOCATION			
MAILING ADDR	SPARTS	Val. 89	131	11.5.1.3.1.	PACCEL 1 of MAR # 1747			
2. LOCATION	SE 14 Su	J 1/4 Sec	35 T	21	N/9 R. ZO E WAShore County			
PERMIT NO	Issued by Water Rese	ources	6-635- Parcel No.	PARCEL I OF MAYO # 1747  N/9 R. 20 E WAShore County  Subdivision Name				
New Well Deepen	TYPE OF WOR	condition [	4. Don Mui	nestic [	PROPOSED USE  ☐ Irrigation ☐ Test ☐ Cable ☐ Rotary ☒ ☐ Industrial ☐ Stock ☐ Other ☐			
6.	LITHOL	OGIC LOG		*	8. WELL CONSTRUCTION			
. Mate		Strata	om To	Thick- ness	Diameter 2Z inches Total depth 3.3C feet inches			
With Brown	x stringers		t management		inches			
WHH Brown	yiellow				Casing record 14"			
Reddish Brow		4			Weight per foot			
White Holcan			235	235	Diameter From To To feet 3.30 feet			
(clay Z-3	3 SECTIONS		235	0.52				
Calculating of Paris		1000 Table 1000		-	inches feet feet			
Volcanic	Saule	Bellett.	125	256	inches feet feet			
VOICANIC	3/4///	Industrial Control	253	0.30	inches feet feet feet feet			
	201 LT 9	1 9 1 7	ST LATER					
GIRREI Cla	11144		756	305				
TRACIES of		710 mil 10			Surface seal: Yes ⋈ No □ Type CEMICH.  Depth of seal. 50 feet			
Sack.		Security to	De Decid		Gravel packed: Yes ⋈ No □			
347.0					Gravel packed from 50 feet to 330 feet			
grieri cla	17		305	330	Total packed from the first to the first total from			
	1	D. collection	19. 14 g a		Perforations:			
A dept. com					Type perforation 100 Slot well scriber.			
	L 4 62		1 .00		Size perforation			
The second second					Size perforation			
					From feet to feet			
	) <u></u>		173		Fromfeet tofeet			
9	0		and a	-	Fromfeet tofeet			
4	300				From feet to feet			
	الماء. و		- 4		WATER LOUIS			
				-	9. WATER LEVEL			
					Static water level 20 feet below land surface			
	Ш				Flow			
Date started	10 3 11		***************************************	, 1988				
Date completed	11-00/9			, 19.85	10. DRILLER'S CERTIFICATION  This well was drilled under my supervision and the report is true to the			
7.	WELL T	EST DATA	Fig Best of a		best of my knowledge.  Name CHSiS DRILLING TAKE.  Contractor			
Pump RPM	G.P.M.	Draw Down	After Hou	rs Pump	Contractor			
11/2/18	250		12		Address 13. By Z/47/ Contractor			
	86	10	772		Nevada contractor's license number issued by the State Contractor's Board OO 23/29			
		a with the	of Garage		Nevada contractor's driller's number issued by the Division of Water Resources			
	BAILE	R TEST	Messell edit		Nevada driller's license number issued by the Division of Water Resources, the on-site driller			
G.P.M.	11.1	aw down		Maria Contract Contra	Signed 7. L An 20 By driller performing actual drilling on site or contractor			
G.P.M.		aw down		and the same of the same of	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
G.P.M	Dra	aw down	teet	nours	Date DIEC G- 1981			

CONVERTED TO MONITORING WELL.

DIVISION OF WATER RESOUR S

NORTH WELL
OFFICE USE ONLY
Log No... 20736
Permit No.. 24726

OUTSIDE OF	5C #4				ERS REPURA Basin
COMPOUND.	۸			A STATE OF	s form in its entirety
THE RESERVE OF THE PARTY OF THE	· k	Con	De		ADDRESS 1058 Bradly
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	7		Isan's nev.
2. LOCATION.	1 NIV 14	Sec (	T	20	N/S RRI E Washed County
PERMIT NO.	2.7.2.6				
	T OF WORK		T.		PROPERTY VIEW C CONTROLLER VIEW V
	E OF WORK		4.	mestic F	PROPOSED USE    S. TYPE WELL    Cable   Rotary-
New Well	Reconditio Other	" D		inicipal [	
Deepen 🖸	Other	U	MI	пистрат [	D Industrial D Stock D Other D
6.	LITHOLOGIC LO	G			8. WELL CONSTRUCTION
	Water	T .		Thick-	Diameter hole
Material	Strata	From	To	tiess.	
sand sa	rdy)	0	47	V	Casing record Thickness 1250
grive		47	49	V	Diameter From To
loundy Cl	my	49	101	"	14 inches Officel 572 feet
Clay		101	100	/	inches feet feet
agend		122	100	2	- inches inches feet inches
Cray	, 195	194	100	1	inchesfeetfeet
- string	143	100	245	1	inchesfeetfeet
sange	150	245	366	7	inches
Clay Cou	THE MALE	366	38.3	V	Surface seal: Yes & No D Type Comment
Dund	a to a constant	383	386	v	Depth of seal 5
2001118	In the	386	410	y	Gravel packed: Yes I No D feet to 5 22 feet
dine Col 20	412	4:5	418		Gravel packed from
Esperail		415	477	V	Perforations:
Chars "		4115	449	V	Type perforation Lactorie Sawes
grahal	La Cart	4461	45.5	· / ··	Perforations:  Type perforation of actors Daviel  Size perforation
Clay,		452	497	V.	From 146 feet to 572 feet
sandili.	10 1 ===	497	549	1	From feet to
of mature	Recis 555	344	561	·	From feet to feet
Charle Por	5	1961	600		From feet to feet
***************************************					From feet to feet
					9. WATER LEVEL
	3.1.23.13.1				
the today in the		0.00	- Det		Static water level. 5.6 Feet below land surface, G.P.M. 5.90 Lo.6 C.
					Water temperature 5 7. F. Quality Clean
	en profession	wines on			Transfer transfer and transfer
1	- 10		67	00	10. DRILLERS CERTIFICATION
Date started		77 77	***************************************	1980	This well was drilled under my supervision and the report is true to
Date completed		4.9	***************************************	19.80	the best of my knowledge.
m			B-107	THE RESERVE	0. 11) 11:00
7.	WELL TEST DAT	A			Name Paul Willester
Pump RPM	G.P.M.   Draw Do	NTD A	Mer Hours	Pump	99 1. 4/ 2 #
10 10 to 10			THE PARTY NAMED IN		Address d of Stub Jacobs
				1,	14483
		To be the	1531		Nevada contractor's license number.
					957
	or of the second	of the section	y= .		Nevada driller's license number
	BAILER TEST	3-24	Ben All		Simila A Williams
G.P.M			o)	hours	Signed Carlo
G.P.M				hours	Date 2/2/50
G.P.M.				hours	
			*******		

WHITE—DIVISION OF WATER RESOURCES CANARY—CLIENT'S COPY PINK—WELL DRILLER'S COPY

## PRINT OR TYPE ONLY DO NOT WRITE ON BACK

### STATE OF NEVADA

#### DIVISION OF WATER RESOURCES

#### WELL DRILLER'S REPORT

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

.0	FFICE USE ONL	Y
Log No.	9694	
Permit No		
Basin	85 15	
	1.	1/ 1/
OTICE OF	NTENT NO	38447

1. OWNER WASHOE COUNT	Z				ADDRESS A	T WELL L	NOTICE OF IN	NTENT NO	38447	
MAILING ADDRESS1195-B	APN 084-050-17									
RENO, I	IV.	389	520		<u> </u>					
2. LOCATIONNWYNW.	1/4 Se	c7	T2	00	OS R2	E	WASHOE		County	
PERMIT NO55813				N/A Subdivision Name						
3. WORK PERFORM	IED		4.		PROPOSED		5.			
New Well Replace Recondition Deepen Abandon Other				Dome'stic Municipa	☐ Irrigation ☐ Test ☐ Cable ☐ Rotary ☒ RVC ☐ Industrial ☐ Monitor ☐ Stock ☐ Air ☐ Other					
6. LITHOL	OGIC LO	G			8.		LL CONSTRUCT		Foot	
Material	Water Strata	From	То	Thick- ness	Depth Drin		DIAMETER (BIT		reet	
BROWN SAND			3	3.0	From To					
BROWN CLAY WITH SOME		3								
SMALL SAND			260	257	17½ Inches 100 Feet 800 Feet					
GRAY CLAYS		260	470	210	FeetFeet					
GRAY FRACTURED ROCK		470			CASING SCHEDULE					
(BASALT)			797	327	Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness	From	То	
RUST BROWN CLAY		797	800	3			(Inches)	(Feet)	(Feet)	
			-		12 3/4		250	+3	459	
				-	.20	78.6	.375	+1	€99	
				-		•		L	1	
			-	-	Perforations	3:	COMPANIOUS I	The whar		
				-	Type perforation					
					From. 459	)	feet to 797		feet	
10 U				-	From		feet to		feet	
5.5							feet to			
¥ 3				-			feet to			
- CO							feet to			
					Surface Sea	al: X Yes	□ No	Seal Ty	pe:	
101 F H					Depth of Se	al99	Pumped	N N	eat Cement ement Grout	
- C - C					Placement I	Method:	Pumped		oncrete Grout	
							Poured		oncide Groun	
					Gravel Packed: X Yes No					
78 147					From Sai	0	feet to 8	00	feet	
- 5			* *		9.		WATER LEVEL			
W				-		level	26	feet below	land surface	
					Artesian flo	w	N/A C	P.M. N/	A P.S.I.	
				-	Water temp	erature_COI	D °F Quality	GOOD		
•					10.		LER'S CERTIFICA			
Date at and	OMODE	20		10.07	This well w	as drilled und	der my supervision		is true to the	
Date started					best of my			•		
Date completed	CTORE	Z3U		., 19.9./.	Name		LANG E	XPLORATO	RY DRILLIN	
7. WELL T	EST DAT	Ά					Contractor			
TEST METHOD: Bai		Pump	Air L	ift	Address		Contractor	OX5279		
G.P.M. (Feet	aw Down Below Static	)	Time (Hou	irs)	h		ELKO,	NV 89802	) ************************************	
400 NOT			1		Nevada contractor's license number issued by the State Contractor's BoardQQ21-976					
M	CASUREI				Nevada driller's license number issued by the					
					Division	of Water Res	ources, the on-site d	Iriller 1716	)	
					Signed	By driller p	erforming actual drilling	g on site or cont	ractor	
					Date	11-13	-97°			