NAVFAC Geothermal Program Office

China Lake, CA

Doc Name:	**HWAD El Capitan Well**	Date:	1981-2008
Description:			

- Current Project -
Hawthorne Army Ammunition Depot, Mineral County, Reno, Nevada
Featuring a Compilation of Evaluation Reports and Water Analyses on the
El Capitan Geothermal Well for the
Purpose of Developing and Utilizing the Geothermal Resources for a
Hot Water Space Heating System

PUMP TEST OF

EL CAPITAN GEOTHERMAL WELL

HAWTHORNE, NEVADA

Prepared for

NEVADA DEPARTMENT OF ENERGY

400 W. King Street Rm 106

Carson City, Nevada

Prepared by

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November, 1981

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1.0 Findings

1. The pump test results indicate the aquifer will produce hot water in sufficient quantity to meet the peak demands of 780 gallons per minute (gpm) specified for the proposed space heating system, Alternative II.

2. The aquifer transmissivity is 52,000 gallons per day per foot width of aquifer.

3. Water produced during the 10 day pump test remained at a constant temperature of 210° Fahrenheit at a production rate of 532 gallons per minute with a maximum decline in water level of 31 feet.

4. Fluid Chemical results --
   Fluids pumped during the 10 day test appear to be derived from a nearly uniform reservoir and do not relect mixing with local groundwaters.

5. Pumping the El Capitan well did not affect Hawthorne Municipal Well No. 5.

2.0 Recommendations

1. A 30 day pump test should be performed at a higher rate of production after installation of the new pump. Such a test will provide a better check on aquifer transmissivity and enable a more accurate prediction of long term aquifer performance. If the space heating system is expanded in the future, better pump test results will be essential to determine the affect of increased production on the aquifer.

2. At least one observation well should be located approximately 100 feet from the pumping well and used to monitor water level during periods of pumping. Water levels from this well are not affected by well efficiency or turbulent flow from a pump and will be used to calculate the extent of the cone of depression, the specific yield of the aquifer, and a more accurate aquifer transmissivity.

3. When the system is in operation, monitoring well performance on a weekly basis should include measurement of water level, temperature, and line pressure, and recording flow meter and power meter readings. During periods of nonproduction, a monthly measurement of the static water level should be adequate to detect any regional fluctuation in the water table.

3.0 Introduction

3.1 Purpose

El Capitan Club Estates successfully completed a geothermal well 1.5 miles southwest of Hawthorne, Nevada, see Figure 1, in May of 1980 for the purpose of utilizing the hot water for a space heating system. The driller, Sage Brothers Drilling, Inc., briefly developed the well by pumping for 76 hours but did not conduct a constant rate pump test. A formal pump test was deemed necessary by El Capitan Club Estates, Geothermal Development Associates, University of Nevada, Las Vegas, Division of Earth Sciences, and Nevada Department of Energy to assess the well performance and determine if the aquifer could successfully deliver the required production to the space heating system. A 10 day constant rate pump test was conducted from September 14 to 25, 1981 under the direction of hydrogeologic consultant, Lorraine Bruce, to determine the aquifer's ability to transmit water and generally assess well performance.

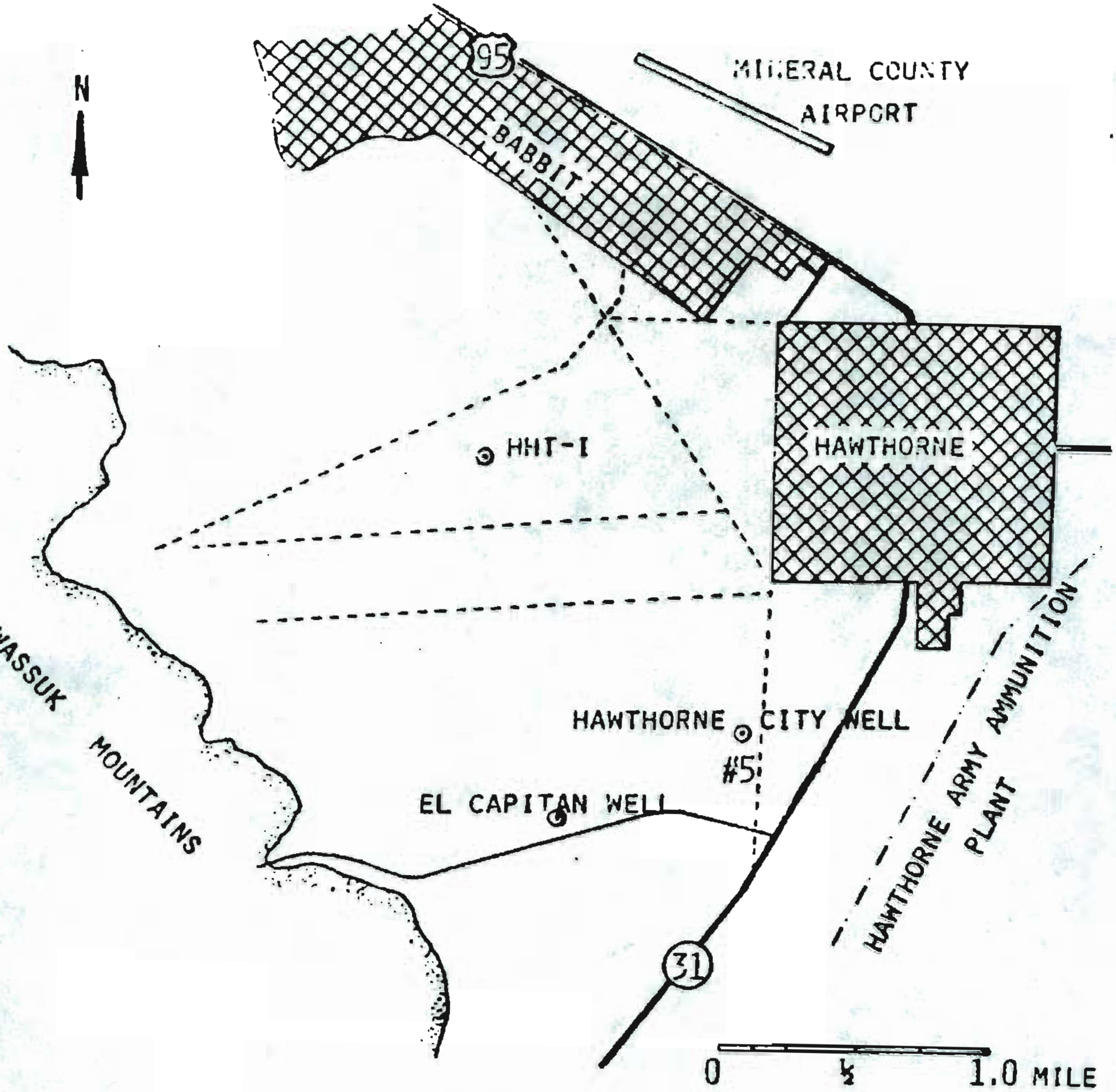
3.2 Work Summary

Specific work items performed under this contract include:

1. Set-up and organization of pump test data collection.
3. On-site direction during pump test start-up.
3. Monitoring of pump test progress.
4. Interpretation of data.
5. Written report of pump test results.

3.3 Acknowledgements

The authors wish to acknowledge the invaluable assistance of Mr. Terry, El Capitan Hotel and Casino and Messers Sousa and Milsap of the Hawthorne Utility District.



HHT-I....University of Nevada Temperature Gradient Hole.

Figure I. Location of El Capitan Geothermal Well and Other Nearby Wells.

4.0 Construction and Subsurface Geology

Sage Brothers Drilling Incorporated completed the geothermal well in May of 1980. According to the well drillers report filed with the Nevada State Division of Water Resources, the well was completed with 12 3/4 inch casing to 1000 feet in depth. The casing was perforated from 590 to 1000 feet and the well was gravel packed from 1000 feet to 55 feet. A cement seal was placed from 55 feet to the surface. The completion interval was selected from the electric log run by Geo-Hydro Data and includes zones interpreted to have increased permeability.

According to the driller's lithologic log, this well is completed in an alluvium of varing composition and size. The driller's log also states that hard drilling was encountered from 490 feet to the total depth of 1000 feet. The geologic environment for this hard drilling may be a weathered, fractured bedrock or a compacted alluvial zone.

In the U.S.DOE sponsored geothermal assessment study of the Hawthorne area, (Area Specific Geothermal Assessment, Nevada, Final Report, contract No. DE-AC08-79NV10039, by Trexler and others), geologic studies indicate that the western part of the basin is filled with alluvial material. A gravity survey was completed in the western portion of the basin and a temperature-gradient hole was drilled 1.5 miles north of the El Capitan well. Data from the gravity survey indicated only a limited variation in depth to bedrock between the El Capitan well and the temperature gradient hole. The lithology of the 800 foot temperature gradient well is alluvial material of uniform composition and variable size. The similarity in lithologies between the two wells and interpretation from the gravity data suggest that the lower portion of the El Capitan well is completed in a compacted alluvial material and not weathered, fractured bedrock.

5.0 Pumping Test

5.1 El Capitan Well Evaluation

A constant rate pump test was conducted from September 14 to September 25, 1981. The well was pumped at 532 gpm for 10 days and monitored during recovery for one day. Water levels, flow rate, and temperature were measured at regular intervals and water samples were collected periodically for chemical analyses.

The 150 horsepower pump used for this test was set at 640 feet below top of casing. Flow rate for the system was measured with an in-line flow meter manufactured by Environtech and water levels in the well were monitored with an airline set at 640 feet.

Static water level before pumping was 485 feet which is 100 feet higher than Sage Brother's reported static level. The 585 foot water level reported by Sage Brothers however was measured during the driller's development testing. The actual static level measured by the driller was 485 feet which agrees with our value.

Water levels measured during the pumping phase of this test listed in Appendix I have been plotted as a semi-log time-drawdown curve illustrated in Figure 2. On the drawdown curve, the difference between the static water level and pumping water levels in feet are plotted against the logarithm of time since pumping began. The resulting curve for this particular test appears as three general phases. The first phase occurs from 2 to 30 minutes into the test and shows a steady decline of five feet. The second phase occurs from 30 to 1080 minutes after pumping started and shows a stable water level with no decline. The stabilization is probably caused by a vertical flow component from partially dewatered sediments. The third phase occurs from 1080 minutes until test shut down at 14,400 minutes and shows a steady water level decline to a maximum drawdown of 31 feet. This third phase is the most important indication of long term aquifer performance since it reflects aquifer conditions the furthest from the well and is not as affected by temporary vertical drainage seen in the second phase. For these reasons the third phase was used to calculate a transmissivity of 52,000 gallons per day per foot width of aquifer using the modified non-equilibrium Cooper-Jacob equation for nonsteady flow.

This third phase or final stage of the drawdown curve can be extended to project future pumping water levels that would result from continued constant pumping at 532 gallons per minute. A projection of this type assumes that the cone of depression encounters no recharge and no impervious boundaries. The extension of the curve for this test shows drawdown levels are not excessive and the well can sustain a constant pumping rate of 532 gallons per minute. A similar analysis for this well at a constant pumping rate of 780 gpm, the peek demand for Alternative II, shows that drawdown is not excessive for short periods of pumping. A precise drawdown curve for 780 gallons per minute for an extended period of pumping cannot be constructed without drawdown data from an observation well.

After pump shut down, the water level recovered to 486 feet in three hours and remained at that level during the 24 hour monitoring period. This recovery level is one foot below the initial static level which is within the accuracy of the pressure gage. Water levels measured during the recovery period, and listed in Appendix I, have been plotted as a residual drawdown curve illustrated in Figure 3. This semi-log plot was constructed by plotting residual drawdown in feet against the logarithum of the ratio (t/t') of total time since pumping started (t) to the time since pumping stopped (t'). Such a plot enables an independent calculation of transmissivity and provides an excellent check of the transmissivity value determined from the pumping data. The transmissivity calulated from the residual drawdown curve is 56,000 gallons per day per foot width of aquifer. This value is in good agreement with the pumping phase transmissivity of 52,000 gallons per day per foot considering the limitations of the analysis.

5.2 Limitation of Results

The accuracy of the transmissivity values calculated for both the pumping and recovery phase of this test are limited by assumptions that the aquifer is confined, isotropic, homogeneous and of infinite areal extent. Such assumptions simplify the calculations and are accepted limitations in the analysis of pump test results but must be assessed qualitatively for each test. The second factor affecting accuracy of transmissivity is the pumping time. Generally the longer the pump test, the more accurate the calculations and therefore the better the predictions for future aquifer performance. The third factor affecting analysis of every pump test is the use of observation wells. This item will be discussed in the next section.

The first limiting assumptions of pump test analysis are that the aquifer is confined, isotropic and homogeneous . This aquifer is probably unconfined and definitely is not isotropic or homogeneous as evidenced by the variable nature of the sediments. The calculated transmissivity value as a result is probably too high for periods of long term pumping. If the well is produced at a constant rate greater than 532 gallons per minute for extended periods of time, the water level should be monitored at regular intervals to insure that drawdown is not excessive.

The other critical limiting assumption is that the aquifer is of infinite areal extent. Considering the geologic setting, the aquifer may be bounded by faults to the east or west of the well. If the cone of depression intersects a relatively impermeable boundary such as a fault, increased drawdown will result possibly limiting the production rate. The long term affects of these potential aquifer limitations on well performance again can only be evaluated on the basis of pumping and water level data collected during the monitoring of production pumping.

The accuracy of the transmissivity value is sufficient to predict that the well production will be adequate for Alternative II space heating plan. If the well is produced at rates higher than 780 gallons per minute for extended periods of time, a more accurate value should be calculated by performing a second pump test. Recommendations for this test will be discussed in section 7.0.

5.3 Hawthorne Well No. 5 Evaluation

During this pump test, water levels were monitored every 24 hours at the Hawthorne Well No. 5 located approximately one mile east of the El Capitan well. Water levels in this well were actually pumping levels since the well was continuously pumped at a variable rate of 850 to 900 gpm during the test. The fluctuations in water levels listed in Appendix 2 are the result of the variable pumping rates and not production of the El Capitan Well.

6.0 Fluid Chemistry

A program of Fluid Sampling was carried out during pump testing of the well. Eleven samples were collected with an approximate frequency of one per day. Sampling included three aliquots from each collection period: a raw untreated portion of 500 ml volume, 200 ml filtered under pressure through a 0.2 micron Nuclepore filter and acidfied to pH ≃2 using HNO_3, and approximately 100 ml acidified with H_2SO_4. The 500 ml raw and 100 ml sulfuric acid treated samples were maintained at ≃4°C until analysis. Use of the 0.2 micron filtration aids in reducing inclusion of unwanted suspended (not dissolved) iron and aluminum species. Anions, excepting NO_3^-, were analyzed in the raw aliquot, cations in the filtered-acidified portion, and nitrates in the sample treated with sulfuric acid.

Analytical results are shown on copies of the data sheets reported by the laboratory; (appendix 4). Dates and times of collection are given in table 1. Sample ECPT-1 was collected during the first period of pumping; however, this was not the first day of the ten day test. Power failure rendered the 12 Sep 81 start useless and a second test was begun on 14 Sep 81.

Fluid chemical analysis results indicate the resourse which supplies water to the El Capitan Well is essentially homogeneous with respect to the ten day study. Some variations in composition seem apparent in the data but this can be explained largely by considering analytical error limits. For example, sulfate levels range from 485 to 510 ppm. A mean value for sulfate during the ten day test is 495 ppm. Error limits given by the analysts for this species are $\pm$ 2%, thus analytical uncertainties can account for variations of approximately $\pm$ 10 ppm from the mean. Only one sulfate level lies outside that variation. Similar reasoning can be used to account for the majority of changes observed in other species.

TABLE I

Collection Times for Fluid Sampling

SAMPLE NUMBER	DATE	TIME
ECPT-1	12 Sep 81	22:20
ECPT-2	14 Sep 81	19:20
ECPT-3	15 Sep 81	22:30
ECPT-4	16 Sep 81	20:20
ECPT-5	17 Sep 81	16:40
ECPT-6	18 Sep 81	18:15
ECPT-7	19 Sep 81	19:15
ECPT-8	20 Sep 81	Not recorded
ECPT-9	21 Sep 81	21:30
ECPT-10	23 Sep 81	07:00
ECPT-11	24 Sep 81	10:15

One notable exception to the limited variation occurs for the bicarbonate ion. This species exhibits both a large increase between two consecutive measurements and a greater overall variation than other dissolved constituents. It is probable these changes are related to changes in CO_2 content of the pumped fluid. Since gas analyses were not performed the relationship cannot be demonstrated.

Some of the observed changes, although small in magnitude, may reflect compositional changes in rocks of the reservoir or recharge areas. Sample ECPT-9 has higher than average levels for Ca, F, and SO_4. This could result from the presence of fluorite and gypsum in rocks through which the fluids pass. In addition, two possible trends are observed: decrease in chloride levels and increase of sulfate levels with increasing time of pumping. If real, the trends suggests possible changes in the location within the reservoir from which the fluids are derived. Because of the small magnitude of the changes and limited pumping period this conclusion must remain questionable.

The relatively samll observed chemical variations and nearly uniform temperatures of the pumped fluids indicate that mixing with various local groundwaters is not a problem.

7.0 Recommended Observation Well

A small diameter observation well should be located in close proximity to the production well to allow monitoring of water level decline during pumping. Water levels from the observation well should be measured at specific time intervals to establish a time drawdown relationship similar to the time drawdown plot constructed for the production well. The important advantage of an observation well is that the water level decline is not influenced by turbulent flow from the pump or by excessive drawdown caused by well inefficiency. The time drawdown curve of an observation well is therefore more representative of aquifer response to pumping. From this curve, transmissivity evaluation is more accurate, specific yield evaluation for the aquifer is possible, and the areal extent of the cone of depression can be determined. It is important to note that the cone of depression cannot be evaluated from pumping well drawdown alone but requires data from an observation well. Therefore, the cone of depression created by pumping the El Capitan well may be accurately determined only by evaluating drawdown at an observation well.

Such an observation well should be located approximately 100 feet up gradient from the production well discharge and completed to 650 feet. The completion interval should be from 590 to approximately 645 feet to adequately monitor the drawdown. The casing should be approximately 6 inches in diameter and constructed of material able to withstand the geothermal conditions. The observation well should be constructed in a similar manner to the production well including gravel packing of the perforated interval, installing a surface cement seal, swabbing the well to remove drilling mud, and development pumping to insure good hydraulic continuity with the aquifer.

The cost of this observation well including casing will probably range from $25.00 to $35.00 per foot at current prices.

8.0 Recommended 30 Day Pump Test

If a higher capacity pump is installed in the El Capitan well, a 30 day constant rate pump test should be performed at a maximum production rate.

This rate is best determined by running a preliminary 12 hour step drawdown test. During this test, water levels should be monitored while the pumping rate is increased at set intervals until the maximum output of the pump or well is attained. A maximum pumping rate that can be sustained for the 30 day constant rate test will be determined from the step drawdown results.

Analysis of a 30 day constant rate pump test should provide an excellent transmissivity value and specific yield particularly if an observation well has been installed. Long term prediction of well production will be more accurate and will aid in design of an expanded space heating option.

9.0 References

Publications

Koenig, B.A., 1981, Hawthorne Area, in Low-to-Moderate Temperature Geothermal Resource Assessment for Nevada, Area Specific Studies, Trexler, D.T., Koenig, B.A., Flynn, T., Bruce, J.L. and Ghusn, G., Jr., University of Nevada; prepared under U.S. DOE contract No. DE-AC08-79NV10039.

APPENDIX 1. El Capitan Well Pump Test Data for Constant Discharge Test

Drawdown Data - El Capitan Well

Pump on:	Date 9/14/81	Time 1100
Pump off:	9/24/81	1100

Date	Clock Time	Time, min.	Depth to Water Below Ground Level, ft.	Discharge gpm	Water Temperature (°F)
9/14/81	1100	0	Static Level 485 ft.	0	
	1101	1	513	532	
	1102	2	508	"	
	1103	3	508	"	
	1104	4	508	"	
	1105	5	509	"	
	1107	7	511	"	
	1109	9	511	"	208°
	1111	11	511	"	
	1113	13	511	"	
	1115	15	512	"	
	1120	20	512	"	
	1125	25	512	"	208°
	1130	30	513	"	
	1135	35	513	"	
	1140	40	513	"	
	1150	50	513	"	209°
	1200	60	512	"	209°
	1220	80	513	"	209°
	1240	100	513	"	
	1300	120	513	"	209°
	1330	150	513	"	209°
	1400	180	513	"	209.5°
	1430	210	513	"	209.5°
	1500	240	513	"	209.5°
	1530	270	513	"	290.5°
	1600	300	513	"	209°
	1630	330	513	"	209°
	1700	360	513	"	209.5°
	1800	420	513	"	210°
	1900	480	513	"	209°
	2000	540	513	"	209.5°
	2100	600	513	"	209.5°
	2300	720	513	"	209.5°
9/15/21	0100	840	513	"	209.5°
	0300	960	513	"	209.5°
	0500	1080	513	"	209.5°
	0800	1260	514	"	209.5°
	1100	1440	513.4	"	209.5°
	1400	1620	514	"	209.5°
	1700	1800	513	"	20915°
	2100	2040	514	532	210°

Pump on: Date 9/14/81 Time 1100
Pump off: 9/24/81 1100

Date	Clock Time	Time, min.	Depth to Water Below Ground Level, ft.	Discharge gpm	Water Temperature (°F)
9/16/81	0100	2280	514	532	209.5°
	0700	2640	514	"	209.5°
	1500	3120	514	"	209°
9/17/81	0300	3840	514	"	209°
	1500	4560	514	"	210°
9/18/81	1500	6000	514	"	209°
9/19/81	1500	7440	515	"	210°
9/20/81	1500	8880	515	"	209.5°
9/21/81	1500	10320	516	"	209°
9/22/81	2100	12120	516	"	209.5°
9/24/81	1100	14400	516	"	

Recovery Data - El Capitan Well

Date	Clock Time	Time, min.	Depth to Water Below Ground Level, ft.
9/24/81	1100	0	516
	1101	1	508
	1102	2	508
	1103	3	509
	1104	4	487
	1105	5	488.7
	1107	7	490
	1109	9	490
	1111	11	490
	1113	13	490
	1115	15	489
	1120	20	488.7
	1125	25	488.7
	1130	30	487.5
	1135	35	488
	1140	40	488
	1150	50	487.7
	1200	60	487.5
	1220	80	487.5
	1240	100	486.8

Recovery Data - El Capitan Well

Date	Clock Time	Time, min.	Depth to Water Below Ground Level, ft.
9/24/81	1300	120	486.8
	1330	150	486.6
	1400	180	486.4
	1430	210	486.4
	1500	240	486.4
	1530	270	486.4
	1600	300	486.4
	1630	330	486.2
	1700	360	486.4
	1800	420	486.8
	1900	480	486.8
	2000	540	486.8
	2100	600	486.8
	2300	720	486.4
9/25	0800	1260	486.4
	1100	1440	486.4

APPENDIX 4

FLUID CHEMICAL ANALYSES

APPENDIX 3.

DIVISION

WELL DRILLERS REPORT

Please complete this form in its entirety

Log No.	
Permit No.	
Basin	

1. OWNER EL CAPITAN CLUB ESTATES ADDRESS P.O. 1187 HAWTHORNE, NV 89415

2. LOCATION NE ¼ SW ¼ Sec. 33 T. 9 N/S R. 30 E. Mineral County
PERMIT NO. 30614

3. TYPE OF WORK		4. PROPOSED USE			5. TYPE WELL	
New Well ☒	Recondition ☐	Domestic ☐	Irrigation ☒	Test ☐	Cable ☐	Rotary
Deepen ☐	Other ☐	Municipal ☐	Industrial ☐	Stock ☐	Other ☐	

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
hard dg w/boulders		0	85	85
hard dg		85	138	53
granite boulders		138	145	7
hard dg		145	159	14
hard dg w/boulders		159	294	135
hard dg w/fractured rock		294	462	168
hard dg w/fractured rock & clay streaks		462	491	29
hard rock		491	497	6
hard rock w/clay streaks		497	565	68
fractured granite w/clay streaks	x	565	797	232
hard dg	x	797	970	173
fractured rock w/clay streaks	x	970	1000	30

Date started 2/14, 19 80
Date completed 5/2, 19 80

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump
[illegible]	Developing		26
[illegible]	600	500	9
[illegible]	700	610	6
[illegible]	900	625	12

BAILER TEST

G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours

8. WELL CONSTRUCTION

Diameter hole 26"/18 5/8" inches Total depth 50'/1000 feet
Casing record
Weight per foot 33.39 Thickness .250

Diameter	From	To
12 3/4 od inches	0 feet	1000 feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☒ No ☐ Type cement grout
Depth of seal 55' w/5" gravel feed pipe feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 55 feet to 1000 feet

Perforations: 410'
Type perforation milled
Size perforation 3" x 1/8" d st
From 590 feet to 1000 feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

9. 640' WATER LEVEL
Static water level 535 Feet below land surface
Flow G.P.M.
Water temperature 210 °F Quality Being Tested

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name SAGE BROS. DRILLING, INC.
Address 1500 E.RANGER RD.
Nevada contractor's license number 7462A
Nevada driller's license number 615
Signed [signature]
Date 5/2/80

SURFACE ELEV. 4520

USE ADDITIONAL SHEETS IF NECESSARY

APPENDIX 2.

Hawthorne City Well #5

DATE	TIME	WATER LEVEL, ft	COMMENTS
9/14/81	1330	569.00	Well is pumping
9/15/81	1345	565.25	Well is pumping
9/16/81	0830	576.17	Well is pumping
9/17/81	0830	577.75	Well is pumping
9/18/81	1429	577.67	Well is pumping
9/19/81	1441	578.83	Well is pumping
9/20/81	1444	578.00	Well is pumping
9/21/81	1552	578.42	Well is pumping
9/22/81	1600	570.33	Well is pumping
9/23/81	1505	577.33	Well is pumping
9/24/81	1015	578.25	Well is pumping
9/25/81	0730	579.50	Well is pumping
9/25/81	1010	579.83	Well is pumping

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CHEMICAL ANALYSIS
PETROLEUM

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Museum of Natural History
Environmental Research Center
Division of Earth Sciences
University of Nevada, Las Vegas
255 Bell Street, Suite 200
Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11472

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 11

Constituents	Parts/million
Calcium	34.5
Magnesium	0.04
Sodium	265.
Potassium	14.3
Carbonate	8.5
Bicarbonate	55.4
Chloride	78.6
Sulfate	500.
Nitrate	(-) 0.4
Fluoride	7.80
Total Iron	0.20
Lithium	0.49
Total Aluminum	(-)0.1
Silica	80.
Boron	1.5
Total Dissolved Solids	1059.
Electrical Conductivity, Micromhos	1650.
pH	8.4

(-) refers to "less than".

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J. J. Eglin

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PETROLEUM

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Museum of Natural History
Environmental Research Center
Division of Earth Sciences
University of Nevada, Las Vegas
255 Bell Street, Suite 200
Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11471

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 10

Constituents	Parts/million
Calcium	34.
Magnesium	0.04
Sodium	260.
Potassium	14.4
Carbonate	5.1
Bicarbonate	27.7
Chloride	78.2
Sulfate	495.
Nitrate	0.4
Fluoride	7.60
Total Iron	0.20
Lithium	0.49
Total Aluminum	(-) 0.1
Silica	78.
Boron	1.5
Total Dissolved Solids	1010.
Electrical Conductivity, Micromhos	1390.
pH	8.4

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Museum of Natural History
Environmental Research Center
Division of Earth Sciences
University of Nevada, Las Vegas
255 Bell Street, Suite 200
Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11470

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 9

Constituents	Parts/million
Calcium	36.5
Magnesium	0.05
Sodium	265.
Potassium	14.8
Carbonate	6.8
Bicarbonate	32.1
Chloride	78.6
Sulfate	510.
Nitrate	0.4
Fluoride	7.90
Total Iron	0.14
Lithium	0.49
Total Aluminum	(-) 0.1
Silica	78.
Boron	1.5
Total Dissolved Solids	1036.
Electrical Conductivity, Micromhos	1380.
pH	8.5

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CHEMICAL ANALYSIS
PETROLEUM

BC LABORATORIES INC

J. J. EGLIN, REG CHEM ENGR
4100 PIERCE ROAD, 93308 BAKERSFIELD, CALIFORNIA 93308 PHONE 327-49

Museum of Natural History
Environmental Research Center
Division of Earth Sciences
University of Nevada, Las Vegas
255 Bell Street, Suite 200
Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11469

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 8

Constituents	Parts/million
Calcium	35.
Magnesium	0.04
Sodium	265.
Potassium	14.4
Carbonate	6.8
Bicarbonate	32.9
Chloride	78.2
Sulfate	500.
Nitrate	0.4
Fluoride	7.60
Total Iron	0.28
Lithium	0.50
Total Aluminum	(-) 0.1
Silica	79.
Boron	1.5
Total Dissolved Solids	1031.
Electrical Conductivity, Micromhos	1380.
pH	8.4

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BY J. J. Eglin
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Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11468

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 7

Constituents	Parts/million
Calcium	36.
Magnesium	0.05
Sodium	265.
Potassium	14.2
Carbonate	6.8
Bicarbonate	43.3
Chloride	81.4
Sulfate	490.
Nitrate	0.4
Fluoride	7.60
Total Iron	0.25
Lithium	0.48
Total Aluminum	(-) 0.1
Silica	79.
Boron	1.5
Total Dissolved Solids	1034.
Electrical Conductivity, Micromhos	1370.
pH	8.5

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Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11467

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 6

Constituents	Parts/million
Calcium	36.
Magnesium	0.05
Sodium	265.
Potassium	14.2
Carbonate	6.8
Bicarbonate	32.9
Chloride	79.3
Sulfate	500.
Nitrate	2.2
Fluoride	7.60
Total Iron	0.87
Lithium	0.48
Total Aluminum	(-) 0.1
Silica	79.
Boron	1.5
Total Dissolved Solids	1032.
Electrical Conductivity, Micromhos	1380.
pH	8.5

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Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11466

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 5

Constituents	Parts/million
Calcium	35.5
Magnesium	0.05
Sodium	255.
Potassium	14.2
Carbonate	5.1
Bicarbonate	27.7
Chloride	82.1
Sulfate	485.
Nitrate	0.4
Fluoride	7.30
Total Iron	1.1
Lithium	0.50
Total Aluminum	(-) 0.1
Silica	77.
Boron	1.5
Total Dissolved Solids	1000.
Electrical Conductivity, Micromhos	1370.
pH	8.5

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Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11465

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 4

Constituents	Parts/million
Calcium	36.
Magnesium	0.04
Sodium	260.
Potassium	14.2
Carbonate	6.8
Bicarbonate	29.5
Chloride	82.1
Sulfate	490.
Nitrate	0.4
Fluoride	7.40
Total Iron	0.27
Lithium	0.50
Total Aluminum	(-) 0.1
Silica	78.
Boron	1.6
Total Dissolved Solids	1010.
Electrical Conductivity, Micromhos	1390.
pH	8.5

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University of Nevada, Las Vegas
255 Bell Street, Suite 200
Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11464

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 3

Constituents	Parts/million
Calcium	36.
Magnesium	0.05
Sodium	260.
Potassium	14.2
Carbonate	6.8
Bicarbonate	30.4
Chloride	83.2
Sulfate	495.
Nitrate	0.4
Fluoride	7.80
Total Iron	0.27
Lithium	0.49
Total Aluminum	(-) 0.1
Silica	78.
Boron	1.5
Total Dissolved Solids	1023.
Electrical Conductivity, Micromhos	1380.
pH	8.4

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Reno, Nevada 89503

Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11463

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 2

Constituents	Parts/million
Calcium	35.
Magnesium	0.05
Sodium	260.
Potassium	14.2
Carbonate	6.8
Bicarbonate	39.0
Chloride	82.5
Sulfate	485.
Nitrate	1.3
Fluoride	7.40
Total Iron	0.70
Lithium	0.49
Total Aluminum	(-) 0.1
Silica	78.
Boron	1.5
Total Dissolved Solids	1031.
Electrical Conductivity, Micromhos	1380.
pH	8.4

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Date Reported: 10/20/81
Date Received: 9/30/81
Laboratory No.: 11462

Purchase Order #72535T

Attention Mr. Brian Koenig

WATER ANALYSIS

Sample Description: ECPT 1

Constituents	Parts/million
Calcium	35.5
Magnesium	0.06
Sodium	265.
Potassium	14.2
Carbonate	6.8
Bicarbonate	34.7
Chloride	89.2
Sulfate	490.
Nitrate	(-) 0.4
Fluoride	7.00
Total Iron	0.23
Lithium	0.49
Total Aluminum	(-) 0.1
Silica	75.
Boron	1.4
Total Dissolved Solids	1026.
Electrical Conductivity, Micromhos	1360.
pH	8.5

(-) refers to "less than".

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STATE OF NEVADA
COMMISSION ON MINERAL RESOURCES
DIVISION OF MINERALS
400 W. King Street, Suite 106
Carson City, Nevada 89703
(775) 684-7040 • Fax (775) 684-7052
http://minerals.state.nv.us/

JIM GIBBONS
Governor

Las Vegas Branch:
1771 E. Flamingo Rd.
Suite #120-A
Las Vegas, Nevada 89119
(702) 486-4343
Fax (702) 486-4345

ALAN R. COYNER
Administrator

FACSIMILE TRANSMITTAL SHEET

DATE: January 31, 2008

TO: Company/Organization: Navy, China Lake

Individual: Andy Sabin
cc:

Fax Number: (760) 939-2449
Phone Number:
Number of Pages: 24
****

SENDER: Nevada Division of Minerals, Carson City Office

Individual: Christy Morris

REMARKS:
El Capitan info

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

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLERS REPORT

Please complete this form in its entirety

OFFICE USE ONLY
Log No. 21059
Permit No. 30619
Basin

1. OWNER EL CAPITAN CLUB ESTATES ADDRESS P.O. 1187 HAWTHORNE, NV. 89415

2. LOCATION NW ¼ SW ¼ Sec. 33 T. 8 N/S R. 30 E Mineral County
PERMIT NO. 30614

3. TYPE OF WORK: New Well ☒ Recondition ☐ Deepen ☐ Other ☐

4. PROPOSED USE: Domestic ☐ Irrigation ☒ Test ☐ Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL: Cable ☐ Rotary ☒ Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
hard dg w/boulders		0	85	85
hard dg		85	138	53
granite boulders		138	145	7
hard dg		145	159	14
hard dg w/boulders		159	294	135
hard dg w/fractured rock		294	462	168
hard dg w/fractured rock & clay streaks		462	491	29
hard rock		491	497	6
hard rock w/clay streaks		497	565	68
fractured granite w/clay streaks	x	565	797	232
hard dg	x	797	970	173
fractured rock w/clay streaks	x	970	1000	30

Date started 2/14 19 80
Date completed 5/2 19 80

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump
1400-2000	Developing		76
1700	600	600	6
1800	700	610	6
1900	800	625	12

BAILER TEST

G.P.M. Draw down feet hours
G.P.M. Draw down feet hours
G.P.M. Draw down feet hours

8. WELL CONSTRUCTION

Diameter hole 26"/18 5/8" inches Total depth 60'/1000 feet
Casing record
Weight per foot 33.38 Thickness .250

Diameter	From	To
12 3/4 od inches	0 feet	1000 feet

Surface seal: Yes ☒ No ☐ Type cement grout
Depth of seal 55' w/5" gravel feed pipe feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 55 feet to 1000 feet

Perforations:
Type perforation milled
Size perforation 3" x 1/8" d st
From 590 feet to 1000 feet

9. WATER LEVEL

Static water level 585 Feet below land surface
Flow G.P.M.
Water temperature 210 °F. Quality Being Tested

10. DRILLERS CERTIFICATION

This well was drilled under my supervision and the report is true to the best of my knowledge.

Name SAGE BROS. DRILLING, INC.
Address 1500 E.RANGER RD.
Nevada contractor's license number 7462A
Nevada driller's license number 615
Signed W. L. Sage
Date 5/5/80

USE ADDITIONAL SHEETS IF NECESSARY

5471

EL CAPITAN GEOTHERMAL WELL EVALUATION

PREPARED FOR

MINERAL COUNTY, NEVADA
PARKS AND RECREATION DEPARTMENT

PROFESSIONAL ENGINEER - STATE OF NEVADA
REGISTERED
RAYMOND C.
KNUTH
CIVIL
No. 6233

2/9/01

Prepared By

Eco:Logic Engineering, LLC
6490 So. McCarran Blvd., Ste. 1
Reno, NV 89509
775-827-2311

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Status Report and Estimated Value of the El Capitan Geothermal Well in Hawthorne, Nevada

Section I. Summary and Conclusions

Eco:Logic, upon request by Mineral County, has conducted an investigation into the status and usability of the El Capitan geothermal well in Hawthorne. In addition to the equipped well, described herein as Well No. 3, there are two older wells at the site that are not in use. The following is a summary of our conclusions.

A. Status.

Well No. 3 is equipped with a vertical turbine pump and located within a well house. The pump is functional and discharges approximately 500 gallons per minute of 200°F water to the surface. The well and pump have not be used for some time, but appear to be functional. The discharge flow meter does not work, and some other minor improvements are needed to the building before the well could be put into service.

Two other wells at the site were failed attempts in the original drilling. Both of these wells need to be formally abandoned, at an estimated total cost of $36,100.

B. Water Quality

The water quality from Well No. 3 was extensively tested in 1982. The water quality does not meet the drinking water standard due to excessive arsenic, fluoride, TDS and sulfate. The arsenic and fluoride levels are high enough that we do not believe the water could be made potable without extensive treatment.

The water quality is marginal for irrigation. The water has a very high Sodium Adsorption Ratio (SAR), which indicates that the water will cause sodium damage. The water could be used for salt-tolerant irrigation, but the crops would have to be selected carefully for salt tolerance.

The water could be used for bathing, such as in a mineral spa. The regulations do not require bathing water to be potable, but to set standards for filtration and disinfection.

C. Costs

Cost estimates are included for the cost of bringing the well into service, abandoning the well and replacing the well. We estimate that it would cost approximately $363,00 to bring the well into service for geothermal heating. The majority of this cost is for the installation of a new injection well, since the two old wells are not usable.

With regard to the cost of operation, we estimate that it requires approximately $0.22 per 1,000 gallons just for the electricity to bring the water to the surface. If the water is used for heating and reinjected, we estimate the cost of operation at approximately

$0.77 per 1,000 gallons, excluding the cost of the geothermal heating equipment and improvements.

D. Water Rights

The only existing water rights on the El Capitan wells is for 1,520 AF per year of **non-consumptive** use. This permit is based on use of the water for geothermal heating and reinjection into the groundwater. Any consumptive use of the water, such as irrigation or for bathing in a mineral spa, would require the acquisition or transfer of consumptive water rights.

E. Recommendations

The Nevada State Engineer will require that Wells 1 & 2 be properly abandoned. The County should budget for this procedure as soon as economics allow. Other possible improvements and uses of the well will depend upon the economics of operating the well as well as the income associated with the operation.

Section II. Background

The El Capitan well is located approximately one and one-half miles southwest of the town of Hawthorne. The general location of the site is shown on the figure below.

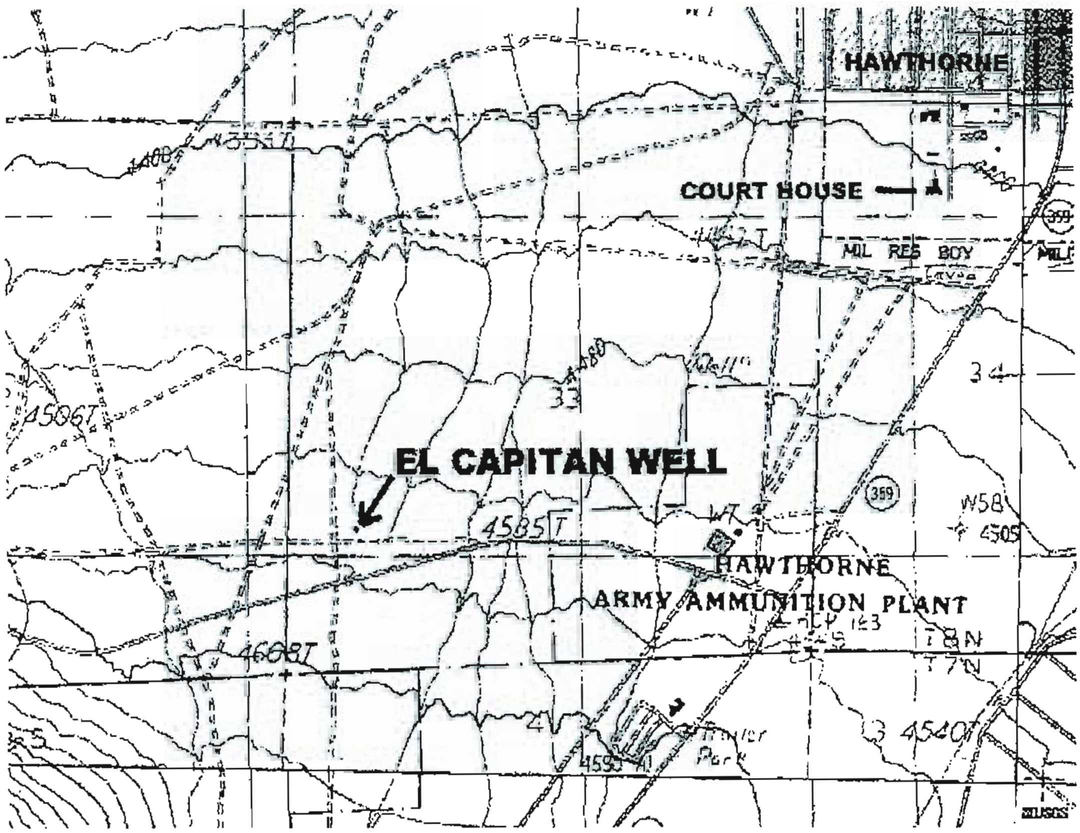

Figure 1 – El Capitan Well Site Plan

There are three wells on the site, although only one was completed successfully and equipped with a pump. The well produces approximately 500 gal/min of geothermal water at a temperature of approximately 200°F. Historically, the well has never been connected to a public water system or heating system.

Section III. Current Status of Wells

A. General Description

There are three wells located at the site. Well 3 is the well equipped with the pump, and is located within a wellhouse inside a fenced enclosure. Wells 1 and 2 are located outside the fence, and are secured with welded steel caps. A concrete base surrounds Well 2.

The fenced enclosure surrounding the wellhouse measures 80 by 100 feet and the fence is of the cyclone wire mesh type. Access is through two double panel gates. The well house is constructed of concrete blocks, and has an attached wood frame section surrounding the well and pump installation. Presumably it was constructed in this manner to facilitate removal of the pump by disassembly of the frame structure, since there is no hatch or other access to the well pump from outside the building. The dimensions of the concrete block portion measure 14 by 16 feet, while the wood-frame section is 10 by 10 feet. The floor is constructed of concrete.

B. Well 1 Description

Few construction details have been recorded for this well. It is located immediately outside the fenced enclosure near the northeast corner of the fence. The limited information indicates it was the first of 2 wells drilled by Edmund Miller. A letter to the Nevada State Engineer from Harry O'Malia states the well was drilled to 525 feet, at which depth tools were lost in the hole. It was subsequently cased with 14" diameter casing to 520 feet, then it was "abandoned". No details of the abandonment procedures are available. Most likely it was not formally plugged and abandoned because the former owner mentioned two "injection" wells at the site during an informal meeting two or three years ago.

C. Well 2 Description

Well 2 is located a short distance south of the fenced enclosure and is surrounded by a concrete pad. Edmund Miller Drilling Co filed the driller's report for the well. It was drilled by the cable-tool method between 2/22/78 and 6/26/78.

Borehole depth – 720 feet
Borehole diameter – 14 inches
Casing – 14 inches dia., 0 to 480 feet & 12 inches dia., 480 to 685 feet

There are no test pumping data for the well because construction deficiencies prevented installation of a pump. These deficiencies are documented in the report of a down-hole television survey taken 9/19/79, subsequent letters (10/6/79 & 12/5/79), and an invoice from Ferd Sturdivent for work he performed on the well. The following is a summary of the problems with the well.

1. Well No. 2 Construction deficiencies:

- The TV survey report indicates the 14" casing has a "bad joint" at 179 feet and the casing is "pushed in."
- A 12-inch diameter liner was installed beginning at a depth of 392 feet. The TV survey report indicates the top of the casing liner was deformed ("pushed in").
- The well is neither plumb nor straight as evidenced by a deviation survey of the well to a depth of 392 feet. Average deviation is 14.2 inches per 100 feet. The AWWA standard is 6 inches per 100 feet. There is a significant "dogleg" or bend in the casing at a depth of 140 feet and another at 300 feet. The degree of the bends are well outside of the AWWA standard, and were sufficient to prevent installation of a pump.
- Attempts to repair the damage to the 12" liner were unsuccessful and actually made matters worse. Swedging the liner caused a rupture of a welded joint at the top of the liner.

D. Well 3 Description

The third well at the site was drilled and constructed by Sage Brothers Drilling 2/14-5/2/80. A detailed driller's report is available. There is also a borehole geophysical log. Well construction details are:

Borehole depth – 1,000 feet.
Borehole diameter – 26", 0 – 60 ft depth; & 18 5/8" from 60 – 1,000 ft depth
Casing diameter – 12 ¾" O.D. ¼ -inch wall thickness
Perforations – 1/8" x 3" factory mill slots from 590 to 1,000 feet.
Static level – "585" feet below the land surface as indicated on the driller's report. This seems to be in error because it is 100 feet deeper than the measurements made by the Univ. of Nevada Earth Sciences Department during their test of the well. The correct level was probably 485 feet.

1. Step Drawdown Testing

Step-drawdown testing was performed by the contractor at the conclusion of the work in 1980, with the following results.

Table 1
Step Drawdown Results

Step	Pumping rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
1	600	15	40.0
2	700	25	28.0
3	800	40	20.0

The step test results suggest the well efficiency is low, but that a negative skin factor was increasing as testing progressed. This suggests the increase in the permeability in the vicinity of the well bore was due to well development. However, poor well efficiency is not an issue because the depth to water is large and the relatively small increase in pumping lift resulting from the increased drawdown due to the low efficiency is insignificant.

2. Aquifer stress testing.

A 10-day duration constant-discharge pumping test was performed by the University of Nevada, Las Vegas Division of Earth Science 9/14-24/81 (Koenig, *et al.*, 1981). The current pump in the well was apparently used for this test.

Static water level – 485 feet below ground level
Pumping rate – 532 gpm
Pumping level at the conclusion of the test – 516 feet b.g.l.
Drawdown at the conclusion of the test – 31 feet

These results are generally consistent with the previous testing performed by the drilling contractor except that there was an even greater negative skin factor. The pumping rate compares well to the 515 gpm measured 1/29/01.

The UNLV test report proffered a value for transmissivity of the aquifer of approximately 52,000 gpd/ft. Based on a cursory review of the data, our review yielded a somewhat lower value (40,000 gpd/ft). For all practical purposes, these values are the same.

The aquifer comprises coarse-grained alluvial deposits that exhibit classic delayed-yield behavior. This probably results from a degree of vertical anisotropy

3. Well 3 Equipment Description

Equipment located within the wellhouse include the pump and motor, piping and associated electrical equipment.

a) Pump Motor

150 HP Newman, 460 volt, 175 amp, Class B, 1770 rpm. Ser. No. s14661701.

b) Pump

16 stage Aurora Verti Line, type 10RM, with 8" diameter pump column. The pump is oil-lubricated. The pump serial number is V79-70485.

Nameplate rating is for 700 gpm from 600 feet at 1770 RPM. No pump curve was provided.

The discharge head is a model 17ACA8.

The discharge head is connected to 8-inch diameter discharge pipe via a Dresser coupling that is welded and bolted to the pump discharge head for thrust protection. There is a swing type check valve, a Sparling Series 100 meter (ser. no. 116353) and a butterfly valve, in this order away from the pump. The meter no longer functions.

The discharge exits through the floor and is routed to an exterior concrete block vault. In the vault are two valves that allow the water to be diverted to a discharge trench or a stand pipe.

c) Electrical

The electrical panel assembly includes:

1. Circle AW J&P Box
2. Circle AW meter Socket w/ meter.
3. Westinghouse Circuit Breaker (Cat. SLB, 400 amp max., 600 volts max., labled "480 volts 400 amps).
4. Circle AW wire way or auxiliary gutter.
5. Circle AW wire way or auxiliary gutter.
6. Square D Type MPZ mini power zone transformer (480 – 240/120 volts).
7. RTE/Delta pump control panel, Class 22-203, Style D73QA, Cat. No. GRP1ZMCP. Heater range 96-105 motor circuit trip setting 2030, max. panel rating of 200 HP.

The installation is neat and appears to have been properly installed. A summary of the costs to date provided by the owner indicates Bill Conley was the electrical engineer of record.

d) Condition of the pump

During the site visit on 1/29/01, the client had SPPCo connect the power to the facility. The initial try to start the pump failed. The problem was related to a breaker at the transformer on the pole that tripped for some reason. The SPPCo lineman suspected this was caused by something other than the pump start. SPPCo fixed the problem and we were able to run the pump.

We ran the pump for approximately 12 minutes. It takes nearly 2 ½ minutes for water to reach the land surface. The meter did not work, but we measured the discharge from the time it took to fill the 1,289 gallon capacity tank underneath the stand pipe.

The discharge was calculated at approximately 516 gpm, but could have been a little more because a small portion flowed through a 2-inch opening near the base of the tank. This compares closely to the 532 gpm reported for the test of the well conducted by UNLV.

The initial discharge was very rusty, but the discharge cleared significantly after 3 or 4 minutes, but there was residual "color" in the water. There was no odor of H_2S gas.

Temperature was measured at 202° F using the in-line thermometer.

The pump ran very smoothly, with no noticeable vibration. The oil dripper was still functional.

e) Conclusions

1. The pump appears to be fully functional.
2. The pump output is 516 to 532 gpm when discharging to atmosphere, not the 700 gpm indicated on the identification plate riveted to the pump discharge.
3. There is no means of evaluating the condition of the column, tubing, and shaft with respect to corrosion without pulling the pump.
4. The condition of the well casing with respect to corrosion cannot be ascertained without pulling the pump and performing a down-hole television survey.
5. The electrical panel looks to be in good condition.

4. Usability

The pump and motor appear to be suitable for use to provide approximately 500 gpm of geothermal water at the surface. Higher heads will reduce the flow rate, and to increase flow rates above 500 gpm would require replacement of the pump.

Section IV. Chemical Quality – Potential Uses of Well and Water

A. Chemical Analyses

At least 15 chemical analyses of the geothermal groundwater from the El Capitan Well were found in the files provided by the owner. Table 2 below lists the average and ranges for the constituents in the water.

Table 2
El Capitan Well Water Quality

Constituent	Maximum (mg/L)	Minimum (mg/L)	Average (mg/L)	Drinking Water Standard
Calcium	36.5	25.4	34.5	
Magnesium	0.3	0	0.1	150
Sodium	295	240	261.3	
Potassium	14.8	8.6	13.3	
Carbonate	8.5	4.1	6.4	
Bicarbonate	244.3	15	48.2	
Chloride	89.2	35	78.0	400
Sulfate	**671.6**	**456**	**502.6**	**500**
Nitrate	2.2	0.2	0.7	10
Fluoride	**8.4**	**7**	**7.6**	**2.0**
Total Iron	1.1	0.14	0.4	0.6
Lithium	0.58	0.48	0.5	
Silica	83	67	77.6	
Boron	2.1	0.96	1.5	
TDS	**1224**	**942**	**1,029.4**	**1000**
EC	1650	1005	1,370.4	
pH	8.7	8.1	8.5	6.5-8.5
Hardness	88	63.9	79.3	
Alkalinity	248.4	24	99.5	
Arsenic	**0.170**	**0.130**	**0.150**	**0.010**
Manganese	0.02	0.01	0.015	0.1
Color	3	3	3.0	15
Turbidity	0.6	0.6	0.6	1.0

B. Suitability for Potable Water Use

Four of the items listed above are in excess of the drinking water standard.

TDS concentration ranges between 908 and 1,224 mg/l. The average concentration of TDS is 1,029 mg/l. The Drinking Water Standard for TDS is 1,000 mg/l.

Sulfate concentration ranges between 456 and 671 mg/l. The average concentration of sulfate is 503 mg/l. The Drinking Water Standard for sulfate is 500 mg/l.

Fluoride concentration ranges between 7.0 and 8.4 mg/l. The average concentration of fluoride is 7.6 mg/l. The Drinking Water Standard in Nevada for fluoride is 2.0 mg/l.

Arsenic concentration ranges between 0.130 and 0.170 mg/l. The average concentration of arsenic is 0.150 mg/l. The Drinking Water Standard for arsenic is 0.010 mg/l.

Based on these data, the geothermal groundwater derived from the El Capitan Well does ***not*** meet the applicable Drinking Water Standards due to excessive fluoride, arsenic, sulfate and marginal TDS. In addition, based on our experience these contaminants, it would very difficult, if not impossible, to treat this water to make it potable.

C. Suitability for Irrigation

A water sample was collected from the well on 1/15/82 and submitted to the Soil and Water Testing Laboratory of the College of Agriculture, University of Nevada-Reno. The report stated "Not recommended for irrigation. Sodium exceeds acceptable limits".

One measure of sodium impacts is the sodium absorption ration (SAR). For the El Capitan well, this varies from 12 to 16. At this SAR, the water is only suitable for irrigation of salt tolerant plants, and should not be used for spray irrigation, since this aggravates sodium damage.

The Boron concentration ranges between 1.0 and 2.1 mg/l, with an average concentration of 1.5 mg/l. This concentration of boron is not suitable for sensitive plants, but is permissible for semi-tolerant plants.

In summary, the water could be used with caution for irrigation of salt-tolerant plants, preferably by flood or drip irrigation to avoid contact with the leaves.

D. Suitability for Geothermal Use

The investigations performed to date on the well all indicate a geothermal resource of approximately 500 gallons per minute of 200°F water. Although there is a potential that the temperatures could decline over time, at least during the 10-day test no significant temperature decline was noted. The single biggest hindrance to using this water is the depth to water in the well. The static water elevation in the well is 485 feet below ground, and would probably be about 500 feet during pumping. Just the electricity cost to raise this water to the ground surface is approximately $0.20 per 1,000 gallons, depending upon the usage.

Chemically the water is typical of geothermal fluids, and should not pose any particular restrictions on use as long as materials of construction commonly used for geothermal fluids are employed. The water would be suitable for use in a mineral bath or spa, provided it was filtered and disinfected in accordance with health department requirements.

Section V. Cost Estimates to Rehabilitate Well and Bring Well Into Service

A. Cost to Bring Well No. 3 Up to Irrigation Standards

It should be noted that the well cannot be used for irrigation without a transfer of water rights to the well. The current water rights are for geothermal use only, and do not allow for any consumptive use, as would be the case with irrigation.

Although Well No. 3 is functional as-is, some additional improvements would be required before the well would be suitable for long-term irrigation use. Table 3 below lists the estimated costs for these improvements.

Please note that this table does not contain any allowance for additional improvements off-site, such as piping to the irrigation site, irrigation pipe, risers, etc.

Table 3 - Estimated Cost to Upgrade El Capitan Well for Irrigation

El Capitan Well					
Estimated Cost to Bring Well Into Production for Irrigation Uses					
Item	**Quantity**	**Units**	**Unit price**		**Item price**
Wellhouse Improvements					
Mobilization/Demobilization	1	lump sum		$ 5,000	$ 5,000
Install Skylight Over Pump	1	lump sum		$ 3,500	$ 3,500
Replace Water Meter	1	lump sum		$ 2,500	$ 2,500
Install Air/vac valve	1	lump sum		$ 1,000	$ 1,000
Add radio telemetry	1	lump sum		$ 5,000	$ 5,000
Install Plywood on Wood Section	1	lump sum		$ 1,000	$ 1,000
Ventilation Improvements	1	lump sum		$ 1,000	$ 1,000
Subtotal, Wellhouse Improvements					**$ 19,000**
Engineering & Hydrogeology				15%	$ 2,900
TOTAL WELLHOUSE IMPROVEMENTS					**$ 21,900**

B. Cost to Bring Well No. 3 Into Service for Geothermal Uses

The current item most lacking to bring the well into service for geothermal use is the lack of a functional injection well. There has been some discussion as to the possibility of using the existing two abandoned wells (wells Nos. 1 & 2) as injection wells.

1. Potential Use of Wells No. 1 and No. 2 as Injection Wells

Neither Well 1 nor Well 2 can be used as injection wells. Low temperature geothermal injection wells in Nevada are regulated by the Division of Environmental Protection as Class V injection wells. A Class V injection well requires an Underground Injection Control (UIC) permit. The UIC permit has very specific permitting requirements coupled with stringent construction standards for the injection wells. Neither of these wells will meet these standards. The principal construction deficiencies include:

- The annular space between the well casing and formation walls must be sealed with cement grout from the top of the injection horizon to the land surface. Neither well was constructed with an annular seal.

- In Well No. 2, the 14" casing and 12" liner must overlap and the annular space between the liner and casing must be sealed with cement grout.

- The casings must be tested for mechanical integrity. There is no record of such testing. In fact, there is evidence of a lack of the mechanical integrity of the casing.

Furthermore, even if the wells could be modified to meet the UIC regulations, the would not be usable as injection wells because of their close proximity to Well 3, the geothermal production well. Injection wells must be strategically placed sufficiently far from production wells to prevent re-cycling of the cooler water that is returned to the aquifer (a condition known as thermal breakthrough). This thermal breakthrough lowers the temperature of the water pumped from the production well. Wells 1 & 2 are located within 100 feet of Well 3.

The potential for thermal breakthrough to occur is related to the pumping and injection rates, the hydraulic gradient, the aquifer properties, and the distance between the pumping and re-injection wells. To illustrate this point, assume the El Capitan well is pumped at the relatively small rate of 100 gpm and the thermal effluent is re-injected via a well located 1,000 feet down-gradient toward the northeast. The water mound that arises around the injection well and the drawdown cone of depression surrounding the production well causes a localized reversal of the gradient back toward the production well. In time, the cooler water from the injection well will migrate back to the production well. To prevent this occurring, the pumping rate must be either reduced to well below 100 gpm or the injection well must be approximately 2,000 feet from the pumping well. At pumping and injection rates of more than 100 gpm, the distance between the pumping and injection well must be more than 2,000 feet.

The separation requirement between the pumping and injection wells has other implications. The groundwater derived from the El Capitan Well contains groundwater with very high concentrations of arsenic and fluoride. The arsenic and fluoride concentration of the groundwater down-gradient of the El Capitan Well near the Town of Hawthorne meets the drinking water standards for these parameters. The Nevada Division of Environmental Protection may not allow injection closer to town because it would result in degradation of the groundwater quality at the point of injection near the Town's water-supply wells.

2. Cost of New Injection Well

In order to use the well for geothermal purposes, a new injection well will be required. As discussed previously, the well will need to be located a minimum of approximately

2000 feet downgradient of Well No. 3. The estimated cost for drilling a new injection well is listed below in Table 4

Table 4
Estimated Cost of a New El Capitan Injection Well

El Capitan Well
Probable Cost of a New Injection Well
10-inch diameter, 1000 feet deep injection well

Item	Quantity	Units	Unit price	Item price
Well Construction				
Mobilization/Demobilization	1	lump sum	$ 39,000	$ 39,000
Substructure, BOP[1]	1	lump sum	$ 10,000	$ 10,000
Drill 20" Borehole	100	linear feet	$ 80	$ 8,000
16" conductor casing	100	linear feet	$ 65	$ 6,500
Cement grout seal	100	linear feet	$ 20	$ 2,000
Mecahical integrity testing	1	lump sum	$ 2,000	$ 2,000
Drill 16" Borehole	900	linear feet	$ 50	$ 45,000
Borehole Geophysical Log	1	lump sum	$ 5,000	$ 5,000
Blank 8" well casing	592	linear feet	$ 32	$ 18,944
Perforated 8" well casing	410	linear feet	$ 44	$ 18,040
Filter pack	900	linear feet	$ 30	$ 27,000
Cement grout seal	100	linear feet	$ 12	$ 1,200
Mechanical integrity testing	1	lump sum	$ 3,000	$ 3,000
Well Development	24	hours	$ 300	$ 7,200
sub-total, construction				**$ 192,884**
Well Testing				
Mobilization	1	lump sum	$ 5,000	$ 5,000
Pump installation/removal	600	linear feet	$ 15	$ 9,000
Well development (pumping)	24	hours	$ 180	$ 4,320
Test Pumping	24	hours	$ 180	$ 4,320
Pipe from El Capitan Well to Injection well	2000	feet	$ 2	$ 4,000
Injection Testing	48	hours	$ 50	$ 2,400
sub-total, testing				**$ 22,640**
Pipeline Cost				
8" diameter Pipeline to Injection Well	2000	linear feet	$ 25	$ 50,000
Total Replacement Cost				**$ 265,524**
Engineering & Hydrogeology			15%	$ 39,829
UIC Permit Fee				$ 2,500
				$ 42,329
Project Total				**$ 257,900**

Notes: 1. Superstructure and blow out prevention required.

3. Cost to Operate Well for Geothermal Uses

Since the exact type of geothermal use cannot be anticipated at this time, for this report we will assume that the geothermal use is near the well, non-consumptive, and will be reinjected into the groundwater. We will not include the cost of the improvements needed to transport the geothermal fluid to the place to use, or to extract the heat.

Table 5 following estimates the costs required to bring Well No. 3 up to standard, abandon Wells Nos. 1 & 2, and construct a new injection well and a pipeline to the well. We have assumed the new injection well will be located approximately 2,000 lineal feet away from the site.

Table 5
Estimated Geothermal Operating Costs

Capital Cost Improvements Needed	**Estimated Cost**	
El Capitan Rehab	$	21,900
New Injection Well	$	257,900
Plug & Abandon 1 & 2	$	36,100
Subtotal	$	315,900
Contingency - 15%	$	47,385
Total Capital Costs	**$**	**363,300**
Operating & Misc. Costs		
Financing Cost, 5%@40 yrs,	$	21,172
Electricity (assume 8 hr/day x 180 day/yr) & $0.10 per kw-hr	$	9,072
Capital Replacement (pump & eqpt @ 10 yrs)	$	2,914
Total Annual Operating Cost	$	33,158
Water Produced Annually (1000 gal)		43,200
Operating Cost per 1,000 gal.	**$**	**0.77**

Section VI. Cost to Abandon Well

A. Cost to Plug and Abandon El Capitan Well No. 3

Table 6 below lists the estimated cost to plug and abandon Well Number 3. This cost is for the proper Abandonment of the well, including ripping the casing and filling the casing with grout.

Table 6
Cost to Plug and Abandon El Capitan Well No. 3

El Capitan Well No. 3				
Item	**Quantity**	**Units**	**Unit price**	**Item price**
Mobilization/demobilization	1	lump sum	$ 10,000	$ 10,000
Demolish Existing Wellhouse	1	lump sum	$ 15,000	$ 15,000
				$ 25,000
12-inch diameter 1,000 feet deep well				
Perforate existing casing	48	hours	$ 275	$ 13,200
Backfill w/ grout	1000	linear feet	$ 10	$ 10,000
				$ 23,200
			SUBTOTAL:	$ 48,200
Engineering & Inspection			15.00%	$ 7,230
Total, Plugging and Abandonment for El Capitan Well			**TOTAL**	**$ 55,400**

1. Salvage Value of Well and Equipment

If the well is abandoned, the existing mechanical and electrical equipment will have a salvage value. The existing pump was installed in 1979, and according to the hour meter, has run approximately 1,000 hours. The original purchase cost of this pump and motor was about $25,000, and the replacement cost for the same pump today would be about $50,000. We estimate that the current salvage value of the pump and motor would be about $10,000, excluding the costs for removal. The electrical equipment dates from 1979, and has limited salvage value in the current market.

B. Cost to Plug and Abandon Wells No. 1 and 2.

Since these two wells are unsuitable for use as injection wells, they will eventually have to be plugged and abandoned. Table 7 below lists the estimated costs for plugging and abandoning Wells Nos. 1 and 2.

Table 7 - Estimated Costs to Plug and Abandon Wells Nos. 1 and 2

14-inch diameter 525 feet deep well							
Perforate existing casing	24 hours	$	275	$	6,600
Backfill w/ grout	520 linear feet	$	12	$	6,240
				$	**12,840**
14-inch diameter 720 feet deep well					
Perforate existing casing	36 hours	$	275	$	9,900
Backfill w/ grout	720 linear feet	$	12	$	8,640
				$	**18,540**
		Subtotal		**$**	**31,380**
Engineering & Inspection			15.00%	$	4,707
Total, Plugging and Abandonment for Wells Nos. 1 & 2		**TOTAL**		**$**	**36,100**

Section VII. Cost to Replace Well

The estimated cost to replace the El Capital Well No. 3 and wellhouse is listed below in Table 8.

Table 8
Estimated Cost to Replace El Capitan Well No. 3

El Capitan Well
Estimated cost to replace 12-inch diameter, 1000 feet deep geothermal well

Item	Quantity	Units	Unit price	Item price
Well Construction				
Mobilization/Demobilization	1	lump sum	$ 39,000	$ 39,000
Substructure, BOP[1]	1	lump sum	$ 10,000	$ 10,000
Drill 26" Borehole	100	linear feet	$ 100	$ 10,000
20" conductor casing	100	linear feet	$ 75	$ 7,500
Cement grout seal	100	linear feet	$ 20	$ 2,000
Drill 19" Borehole	900	linear feet	$ 75	$ 67,500
Borehole Geophysical Log	1	lump sum	$ 5,000	$ 5,000
Blank 12" well casing	592	linear feet	$ 50	$ 29,600
Perforated 12" well casing	410	linear feet	$ 65	$ 26,650
Filter pack	900	linear feet	$ 40	$ 36,000
Cement grout seal	100	linear feet	$ 15	$ 1,500
Well Development	24	hours	$ 300	$ 7,200
sub-total, well construction				**$ 241,950**
Well Testing				
Mobilization	1	lump sum	$ 5,000	$ 5,000
Pump installation/removal	600	linear feet	$ 15	$ 9,000
Well development (pumping)	24	hours	$ 180	$ 4,320
Test Pumping[2]	252	hours	$ 180	$ 45,360
sub-total, testing				**$ 63,680**
Well House and Pump				
Well Pump	1	lump sum	$ 50,000	$ 50,000
Electrical	1	lump sum	$ 15,000	$ 15,000
Well House	1	lump sum	$ 40,000	$ 40,000
Piping	1	lump sum	$ 10,000	$ 10,000
Sitework	1	lump sum	$ 20,000	$ 20,000
sub-total, wellhouse				**$ 135,000**
Total Well Replacement Construction				**$ 440,630**
Engineering & Hydrogeology			15%	$ 66,095
Total Well Replacement Cost				**$ 506,700**

Notes:
1 Superstructure and blow out prevention required
2 10-day test.

Section VIII. Water Rights

A. Wells 1 and 2

1. Permit 30614

Wells No. 1 and No. 2 appear to have been drilled under Permit 30614. The permit number is referenced on the Driller's Reports for Wells 2 and 3. The Nevada State Engineer canceled this permit on October 17, 1991. Neither well is currently in use and from the documents provided, it is clear that they have not been used for at least 21 years. In fact, the owner's agent stated the first well had been abandoned in a letter to the State Engineer.

Because it can be documented that these wells are not in use, are not suitable for use as production wells, and are not suitable for use as injection wells, the State of Nevada has the jurisdiction to require they be formally plugged and abandoned.

B. Well No. 3

1. Permit 48897

Water rights for the El Capitan Well (Well 3 to be consistent with other discussions) are provided under Permit 48897. This permit is a change of the point of diversion for Permit 41534. It was filed March 7, 1985 after Well 3 was completed. The point of diversion is within the NW ¼ SW ¼ of Section 33, Township 8 North, Range 30 East, M.D.B.&M.

The water may be used only for geothermal use.

The diversion rate is 2.1 cubic feet per second (~950 gpm).

The annual *withdrawal* from the well is limited to 1,520 acre-feet per year (equivalent to 2.1 cfs 24 hours a day over a period of year). *Consumptive use* of the water (geothermal fluid) is limited to incidental fluid loss, which cannot exceed 10% of the withdrawal rate (152 AF/year). This incidental fluid loss should not be construed as a consumptive use right of 152 AF/year. Therefore, the permittee (the County) is not allowed pump 152 AF/year for consumptive use. Neither can the County change the point of diversion, manner of use, or place of use of the 152 AF/year the State Engineer allows for incidental fluid loss.

If groundwater from the El Capitan Well is to be used for geothermal purposes and consumed, a consumptive use water right must be acquired either through a new appropriation or transfer of an existing right.

2. Status of Permit 48897

Application of the water to beneficial use was due August 30, 1993. Requests for extensions of time have been granted through 2001 and the permit is in good standing.

C. Potential for new appropriations

The El Capitan Club previously filed two applications to appropriate water for quasi-municipal purposes at locations at or near the El Capitan Well. Application 39320 was filed 10/15/79 for 2.1 cfs. The point of diversion is the same as that for the El Capitan Well (permit 48897). Application 45389 was filed 2/24/82 for 3.5 cfs. The point of diversion for this well was a proposed new well to be located southeast of Well 3. The State Engineer denied the applications. The grounds for denial stem from the fact the place of use was within the service area of Hawthorne Utilities and that granting the applications ". . . would prove detrimental to the public interest and welfare."

An application for a new appropriation, particularly for a relatively small consumptive use, may not meet the same fate as the previous El Capitan applications. It can be argued that a project to use the geothermal resource to provide economic diversification for the community is in the public interest.

D. Water Right Acquisition

In the event an application for a new appropriation is denied by the State Engineer, the County has the option to transfer water rights from existing Mineral County or Hawthorne Utilities permits or certificates. The logical sources of these rights are the certificated water rights for two wells in Corey Canyon. The combined annual duty of Permits 29761 $ 29762 (Certificates 9751 & 9752) is 2,894.4 acre-feet per year (943.4 million gallons per year).

INFORMATION ON THE WELL

Name on the State Records: El Capitan Well # 3

Doolin Well - My son in law took the analysis to have them analysis. They put this name on it.

Depth: 1020 feet

It has a 100 H. P. motor with a 16 Stage Pump.

Static level of the water is 530 feet.

[redacted]

INCORPORATED

Client: Mike Doolin
Address: 450 East Glendale Avenue
Sparks, Nevada 89431
Phone Number: 358-9229
Date Sampled: Unknown

Date Submitted: 11/27/95

Client Reference: Samples labeled as below.
Laboratory Reference Numbers: 95-2274 through 95-2276.
Analysis Performed: Water Quality Panel as below.

Analysis	Result
pH, SU	8.52
Total Alkalinity, as mg $CaCO_3$/L	29
Bicarbonate, mg/L	32
Carbonate, mg/L	1.4
Total Dissolved Solids, mg/L	940
Arsenic, mg/L	0.13
Cadmium, mg/L	<0.005
Chloride, mg/L	70
Fluoride, mg/L	8.4
Lead, mg/L	<0.05
Mercury, mg/L	<0.001
Nitrate (as N), mg/L	<0.5
Selenium, mg/L	<0.005
Silver, mg/L	<0.02
Sulfate, mg/L	440

Analysis By: Hlubucek/Sharp

Approved By: C. W. Sharp

Date: 12/29/95

Laboratory Report Number 4171

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
Fax (702) 355-0817

LABORATORY REPORT

Report To: High Desert Laboratories, Inc.
321 Freeport Boulevard
Sparks, NV 89431

Lab Report No.: 14436
Account No.: HDLAB

Telephone: 359-0330

Fax: 359-4106

Work Authorized By: Bill Sharp
Date Sampled: Unknown
Number of Samples: 1
Source: Doolin Water Well
Chemax Control No. 95-10105

Date Submitted: 12/11/95
Sampled By: Client

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [ ] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ____________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.10	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	180
Bismuth	<0.5	Magnesium	<0.5	Strontium	1.3
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	33	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen Date: 12/19/95

Approved By: Colin A. Zetts Date: 12/20/95

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

and test well temperature profiling all indicate the presence of a geothermal resource in the area.*

Figure 8.2.1 shows the area of elevated ground temperatures and the locations of the test wells that were measured for temperature profiles. The following table summarizes the results of the temperature profiles.

TEST WELL	DEPTH RANGE (FEET)	TEMPERATURE RANGE (°C)	(°F)
HWAAP #3	260 - 450	39.7 - 40.3	103.5 - 104.5
HWAAP #5	210 - 400	40.3 - 40.8	104.5 - 105.4
HHT-1	400 - 600	APPROX. 82	APPROX. 180
HHT-2	350 - 400	58 - 62	136 - 143

Figure 8.2.1 also indicates the location of the El Capitan well which was drilled in May of 1980. Based upon water quality samples, isotherm patterns, and the geology of the area, this well is considered to be part of the same geothermal aquifer which is common to the test wells. In a following study*, the El Capitan well was pumped at a constant rate for ten (10) days to determine the aquifer's ability to transmit water and to assess the long term well potential and operating characteristics.

The pump test of the El Capitan well indicates that the aquifer will produce hot water in sufficient quantity to meet the peak demands of 780 gallons per minute. The aquifer transmissivity is 52,000 gallons per day per foot width of aquifer. The

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*Trexler, D.T., et al., Low-To-Moderate Temperature Geothermal Resource Assessment for Nevada, Area Specific Studies, Nevada Bureau of Mines and Geology, UNR for U.S. DOE, August 1981.

TRIPLICATE
EASE PRINT)

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BUREAU OF LABORATORIES AND RESEARCH
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503

58433

NT CHEMISTRY:

County Mineral
Township 8 N
Range 30 E Section 33
Area Hawthorne

LL WATER: Pump should be delivering clear water before sampling.

te sampled 1-3-82 Date submitted 1-4-82
ner Hawthorne Utilities

WATER SOURCE:
Well ✓ Spring ...... Surface ......
Hot ✓ Cold ...... Depth ...... Ft.
Casing diameter 14 in depth 1000 Ft.
Now in use ...... Yes ☐ No ☒

port to:
Name Hawthorne Utilities
Address Box 1455
City Hawthorne State Nev 89415

ROUTINE DOMESTIC ANALYSIS R-0731 PLEASE CHECK BOX ✓		FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED				FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW			
Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.
	964	Chloride	81	Iron	0.15	Copper	.00	T-PO4	0.01
	83	Nitrate	0.2	Manganese	0.01	Zinc	0.01		
	35	Alkalinity	24	Color	3	Barium	0.01		
	0	Bicarbonate	15	Turbidity	0.6	Boron	2.1		
	253	Carbonate	6	p.H.	8.66	Silica	83		
	10	Fluoride	7.56						
	476	Arsenic	0.170						

RECEIVED
FEB 22 1982

Remarks
F-1.8
As-0.05
Circled Items exceed State of Nevada Drinking Water Stds. The limits are

2-17-82
Consumer Health

DESERT RESEARCH INSTITUTE
University of Nevada System
Water Resources Center

7010 El Rancho Drive
Sparks, Nevada
(702) 673-4750

Mailing Address: P.O. Box 60220
Reno, Nevada 89506

September 4, 1980

El Capitan Enterprises
Hawthorne, Nevada

Chemical Evaluation of El Capitan Well #3

Whenever only one sample is collected from an area in question it must be remembered the results obtained are only indicative of that specific location and time. Attempts to evaluate a geothermal or hydrologic system based upon one 'grab sample' is both dangerous and speculative. A field investigation requires many samples, with duplicates taken at different times. Only then can a credible evaluation be made.

General Chemistry:

The chemistry of the latest sample is different than the chemistry of Hawthorne Utilities Well #5, which is about 1/2 mile away. The water chemistry of El Capitan #3 (see attachement) (EC3) is similar to that of EC2, which was drilled in the vicinity in 1978. The hydraulic connection between these wells has been presumed earlier, when drilling mud was observed in EC2.

Generally, the chemistries of EC2 and EC3 fit well into the criteria for geothermally affected wells in the Hawthorne Valley, as identified in the DRI report #50 of December 1977 ('group I'). Thus it seems as if the El Capitan wells were placed within the presumed zone of upwelling geothermal water, which was suggested in the report.

Geothermometry:

Application of chemical geothermometers yielded a temperature of 197°C for the cation geothermometer and a temperature of 121°C for the quartz geothermometer. These results are consistent with those from the sample reported on April 25, 1980. The wide variations between the two methods cannot be explained, but since the silica-level is below the saturation of amorphous silica at well-head temperature, quartz-temperature is considered to be the more reliable in this case. Thus an original subsurface temperature of about 125°C (257°F) is presumed in the vicinity of the well.

Water Quality:

The level of total dissolved solids of 980 ppm is above the recommended concentration-limit of the US EPA (500 ppm). However, if no better sources of water are available, this water may be utilized for drinking or irrigation. The sulfate, arsenic, boron, and fluoride levels are too high:

	EC3 (ppm)	recommended limits (ppm)
Sulfate (SO_4)	495	250
Arsenic (As)	.15	.05
Boron (B)	2.2	1.0
Fluoride (F)	7.6	1.5

Therefore, ~~due~~ to the high arsenic, sulfate, and fluoride contents, the water is not suitable for drinking purposes. Use as irrigation water might be restricted to plants that tolerate high levels of boron (e.g. alfalfa or some vegetables).

Sincerely,

Burkhard Bohm

Burkhard Bohm

BB:ch

attachment

Soil and Water Testing Laboratory
Division of
Plant, Soil and Water Science
College of Agriculture
Reno, Nevada 89557

Lab No. 113

Fee for Special Tests. ______

WATER ANALYSIS REPORT FORM

Fill in items 1 and 2 and submit one form with each sample. Submit only waters for Agricultural use. Domestic use water must be sent to the State Department of Health.

1. Name William O'Merlier

Address P.O. Box 1187

Hawthorne NV Zip 89415

County Mineral

2. Water Source and Location Well 1000'

T 8N R 31E

Date Collected 7-26-80

Water Use Irrigation

STANDARD TESTS:

Conductivity micromhos/cm	1340
pH	8.5
Cations and Anions (milliequivalents per liter):	
Calcium + Magnesium	1.8
Sodium	10.0
Carbonate	0.2
Bicarbonate	0.5
Chloride	2.3
Estimated Sulfate	8.8
SAR	10.5
pH_c	

CLASSIFICATION: I ______

*II RSC ______

**III EEESP ______

SPECIAL TESTS:

parts per million:	
Nitrate Nitrogen	
Phosphorus	
Boron	0.27
Iron	< .2
Other	

REMARKS:

Date of Report 9-4-80 Analyst D. Thran

*RSC--Residual Sodium Carbonate

**EEESP--Expected Equilibrium Exchangeable Sodium Percentage. A soil irrigated with this water is expected to have an exchangeable sodium percentage of this value.

DESERT RESEARCH INSTITUTE
University of Nevada System
Water Resources Center

Sparks, Nevada
(702) 673-4750

Mailing Address: P.O. Box 60220
Reno, Nevada 89506

WATER ANALYSIS LABORATORY
DATA REPORT FORM

PROJECT: ____________ DATE SAMPLES SUBMITTED: 18 July 1980 DATE FINAL DATA: 26 August 1980

Lab No.	Sample Number	Date	Description	Analysis NO_3-N mg/l	As mg/l	B mg/l	Hg mg/l	Se mg/l	Li mg/l
El Cap	3	7/18/80		<0.1	0.15	2.2	<0.0002	<0.002	0.60

TRIPLICATE
(CASE PRINT)

BUREAU OF LABORATORIES AND RESEARCH
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503

7530

54102

WATER CHEMISTRY:

WELL WATER: Pump should be delivering clear water before sampling.

Date sampled.............Date submitted.............

Owner [illegible]

Report to:

Name [illegible]

Address [illegible] 1376

City [illegible] State NV

P.4
TDS

County Mineral
Township 8N
Range 31E Section 25
Area

WATER SOURCE:
Well............Spring............Surface............
Hot 212° Cold............Depth 1000 Ft.
Casing diameter 12" in depth 1000 Ft.
Now in use............Yes ☑ No ☐

ROUTINE DOMESTIC ANALYSIS PLEASE CHECK BOX	0.20 ✓	FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED				FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW			
Constituent	*P.P.M.*	*Constituent*	*P.P.M.*	*Constituent*	*P.P.M.*	*Constituent*	*P.P.M.*	*Constituent*	*P.P.*
T.D.S. 951	933	Chloride	81	Iron	0.04	Copper	0.00		
Hardness	83	Nitrate	0.1	Manganese	0.01	Zinc	0.37		
Calcium	32	Alkalinity	23	Color	7				
Magnesium	0	Bicarbonate	24	Turbidity	1.0				
Sodium	245	Carbonate	0	p.H.	8.14				
Potassium	10	Fluoride	0.88						
Sulfate	448	Arsenic	0.175						

RECEIVED
AUG 11 1980
Consumer Health
Protection Services

8-7-80

Remarks.............

Circled items exceed State of Nevada
Drinking Water Standards.

As-0.05 [illegible]

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

DATE 26 August 1980

WADS ANALYSIS NUMBER												
Point Type, Temp. °C												
Co., Twp., Rng.	Co.	Twp.	Rng.	Co.	Twp.	Rng.	Co.	Twp.	Rng.	Co.	Twp.	Rng
Sec., Qtrs., Seq. No.												
Point Description	El Capitan Geothermal Well											
Sample Designation Code	El Cap 3											
pH field	8.2											
pH lab	8.72											
TDS (Σ)												
Sp. Cond. µmhos/cm@25°C field	3200											
Sp. Cond. µmhos/cm@25°C lab	1380											

	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm
HCO_3^-	30	0.495						
$CO_3^=$								
Cl^-	82	2.316						
$SO_4^=$	495	10.306						
F^-	7.6	0.400						
NO_3^-								
H_2PO4^-								
$HPO4^=$								
P								
Total Anions		13.317						
Na^+	246	10.68						
K^+	10.1	0.259						
Ca^{++}	35.1	1.754						
Mg^{++}	<0.1							
NH_4^+	2.2	0.611						
Total Cations		13.304						
Anions/Cations		1.001						
SiO_2	74							

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY REPORT
DATE 5.29.80
S Lewis

WADS ANALYSIS NUMBER								
Point Type,	[illegible]							
Co., Twp., Rng.	Co. 17 · Twp. T08 · Rng. R30		Co. · Twp. · Rng.		Co. · Twp. · Rng.		Co. · Twp. · Rng.	
Sec., Qtrs., Seq. No.	33/BC							
Point Description	El Cap							
Sample Designation Code								
pH	8.65							
TDS (Σ)								
Sp. Cond. μmhos/cm@25°C	1437							
	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm
HCO_3^-	25.5	0.417						
$CO_3^=$	5.5	0.183						
Cl^-	87.5	2.468						
$SO_4^=$	502	10.452						
F^-	7.77	0.409						
NO_3^-								
H_2PO4^-								
$HPO4^=$								
P								
Total Anions		13.929						
Na^+	258	11.20						
K^+	10.6	0.271						
Ca^{++}	37.7	1.881						
Mg^{++}	0.06	.005						
~~NH_4^+~~ B^+	2.50	0.694						
Total Cations		14.051						
Anions/Cations		99.1						
SiO_2	78							

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY REPORT
DATE April 7, 1978

WADS ANALYSIS NUMBER								
Point Type, Temp. °C	W	88°C → 190°F						
Co., Twp., Rng.	Co. MI	Twp. 8N Rng. 30E	Co.	Twp. Rng.	Co.	Twp. Rng.	Co.	Twp. Rng.
Sec., Qtrs., Seq. No.	~1 mile SW of Hawthorne, NV							
Point Description	El Capitan Test Hole - Filtered in lab - full of black solids							
Sample Designation Code	NAD 17	520'		probably from dynamite				
pH	7.90 F							
TDS (Σ)								
Sp. Cond. umhos/cm@25°C	1900							
	mg/l	epm	mg/l	epm	mg/l	epm	mg/l	epm
HCO_3^-	255	4.179						
$CO_3^=$								
Cl^-	60	1.69						
$SO_4^=$	564	11.742						
F^-	6.0							
NO_3^-	80	1.286						
H_2PO4^-								
$HPO4^=$								
B	2.2							
Total Anions		19.156						
Na^+	370	16.095						
K^+	16	0.409						
Ca^{++}	47	2.345						
Mg^{++}	0.5	0.041						
NH_4^+								
Total Cations		18.890						
Anions/Cations		0.977						

INFORMATION ON THE WELL

Name on the State Records: El Capitan Well # 3

Doolin Well - My son in law took the analysis to have them analysis. They put this name on it.

Depth: 1020 feet

It has a 100 H. P. motor with a 16 Stage Pump.

Static level of the water is 530 feet.

[redacted]

INCORPORATED

Client: Mike Doolin
Address: 450 East Glendale Avenue
Sparks, Nevada 89431
Phone Number: 358-9229
Date Sampled: Unknown

Date Submitted: 11/27/95

Client Reference: Samples labeled as below.
Laboratory Reference Numbers: 95-2274 through 95-2276.
Analysis Performed: Water Quality Panel as below.

Analysis	Result
pH, SU	8.52
Total Alkalinity, as mg $CaCO_3$/L	29
Bicarbonate, mg/L	32
Carbonate, mg/L	1.4
Total Dissolved Solids, mg/L	940
Arsenic, mg/L	0.13
Cadmium, mg/L	<0.005
Chloride, mg/L	70
Fluoride, mg/L	8.4
Lead, mg/L	<0.05
Mercury, mg/L	<0.001
Nitrate (as N), mg/L	<0.5
Selenium, mg/L	<0.005
Silver, mg/L	<0.02
Sulfate, mg/L	440

Analysis By: Hlubucek/Sharp

Approved By: C.W. Sharp

Date: 12/29/95

Laboratory Report Number 4171

321 Freeport Blvd., Sparks, Nevada 89431 (702) 359-0330
P.O. Box 6535 Reno, Nevada 89513 Fax (702) 359-4106

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
Fax (702) 355-0817

LABORATORY REPORT

Report To: High Desert Laboratories, Inc.
321 Freeport Boulevard
Sparks, NV 89431

Lab Report No.: 14436
Account No.: HDLAB

Telephone: 359-0330
Fax: 359-4106

Work Authorized By: Bill Sharp
Date Sampled: Unknown
Date Submitted: 12/11/95
Number of Samples: 1
Sampled By: Client
Source: Doolin Water Well
Chemax Control No. 95-10105

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [ ] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ____________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.10	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	180
Bismuth	<0.5	Magnesium	<0.5	Strontium	1.3
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	33	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen
Date: 12/19/95

Approved By: Colin A. Zitt
Date: 12/20/95

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

and test well temperature profiling all indicate the presence of a geothermal resource in the area.*

Figure 8.2.1 shows the area of elevated ground temperatures and the locations of the test wells that were measured for temperature profiles. The following table summarizes the results of the temperature profiles.

TEST WELL	DEPTH RANGE (FEET)	TEMPERATURE RANGE (°C)	(°F)
HWAAP #3	260 - 450	39.7 - 40.3	103.5 - 104.5
HWAAP #5	210 - 400	40.3 - 40.8	104.5 - 105.4
HHT-1	400 - 600	APPROX. 82	APPROX. 180
HHT-2	350 - 400	58 - 62	136 - 143

Figure 8.2.1 also indicates the location of the El Capitan well which was drilled in May of 1980. Based upon water quality samples, isotherm patterns, and the geology of the area, this well is considered to be part of the same geothermal aquifer which is common to the test wells. In a following study*, the El Capitan well was pumped at a constant rate for ten (10) days to determine the aquifer's ability to transmit water and to assess the long term well potential and operating characteristics.

The pump test of the El Capitan well indicates that the aquifer will produce hot water in sufficient quantity to meet the peak demands of 780 gallons per minute. The aquifer transmissivity is 52,000 gallons per day per foot width of aquifer. The

*Trexler, D.T., et al., Low-To-Moderate Temperature Geothermal Resource Assessment for Nevada, Area Specific Studies, Nevada Bureau of Mines and Geology, UNR for U.S. DOE, August 1981.

TRIPLICATE
EASE PRINT)

=/ Cap

BUREAU OF LABORATORIES AND RESEARCH
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503

58433

CHEMISTRY:

County Mineral
Township 8 N
Range 30 E Section 33
Area Hawthorne

LL WATER: Pump should be delivering clear water before sampling.
te sampled 1-3-82 Date submitted 1-4-82
ner Hawthorne Utilities

WATER SOURCE:
Well ✓ Spring Surface
Hot ✓ Cold Depth Ft.
Casing diameter 14 in depth 1000 Ft.
Now in use Yes ☐ No ☒

port to:
Name Hawthorne Utilities
Address Box 1453
City Hawthorne State Nev 89415

OUTINE DOMESTIC ANALYSIS 8.0731 ✓
PLEASE CHECK BOX

FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED

FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW

Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.
	964	Chloride	81	Iron	0.15	Copper	.00	T-PO4	0.01
	83	Nitrate	0.2	Manganese	0.01	Zinc	0.01		
	35	Alkalinity	24	Color	3	Barium	0.01		
	C	Bicarbonate	15	Turbidity	0.6	Boron	2.1		
	253	Carbonate	6	p.H.	8.66	Silica	83		
	10	Fluoride	7.56 ~~7.40~~						
	476	Arsenic	0.170						

RECEIVED
FEB 23 1982

marks T 2-17-82
F-1.8 Circled items exceed State of Nevada
As-0.05 Drinking Water Stds. The limits are

DESERT RESEARCH INSTITUTE
University of Nevada System
Water Resources Center

7010 El Rancho Drive
Sparks, Nevada
(702) 673-4750

Mailing Address: P.O. Box 60220
Reno, Nevada 89506

September 4, 1980

El Capitan Enterprises
Hawthorne, Nevada

Chemical Evaluation of El Capitan Well #3

Whenever only one sample is collected from an area in question it must be remembered the results obtained are only indicative of that specific location and time. Attempts to evaluate a geothermal or hydrologic system based upon one 'grab sample' is both dangerous and speculative. A field investigation requires many samples, with duplicates taken at different times. Only then can a credible evaluation be made.

General Chemistry:

The chemistry of the latest sample is different than the chemistry of Hawthorne Utilities Well #5, which is about 1/2 mile away. The water chemistry of El Capitan #3 (see attachement) (EC3) is similar to that of EC2, which was drilled in the vicinity in 1978. The hydraulic connection between these wells has been presumed earlier, when drilling mud was observed in EC2.

Generally, the chemistries of EC2 and EC3 fit well into the criteria for geothermally affected wells in the Hawthorne Valley, as identified in the DRI report #50 of December 1977 ('group I'). Thus it seems as if the El Capitan wells were placed within the presumed zone of upwelling geothermal water, which was suggested in the report.

Geothermometry:

Application of chemical geothermometers yielded a temperature of 197°C for the cation geothermometer and a temperature of 121°C for the quartz geothermometer. These results are consistent with those from the sample reported on April 25, 1980. The wide variations between the two methods cannot be explained, but since the silica-level is below the saturation of amorphous silica at well-head temperature, quartz-temperature is considered to be the more reliable in this case. Thus an original subsurface temperature of about 125°C (257°F) is presumed in the vicinity of the well.

Water Quality:

The level of total dissolved solids of 980 ppm is above the recommended concentration-limit of the US EPA (500 ppm). However, if no better sources of water are available, this water may be utilized for drinking or irrigation. The sulfate, arsenic, boron, and fluoride levels are too high:

	EC3 (ppm)	recommended limits (ppm)
Sulfate (SO_4)	495	250
Arsenic (As)	.15	.05
Boron (B)	2.2	1.0
Fluoride (F)	7.6	1.5

Therefore, ~~due~~ to the high arsenic, sulfate, and fluoride contents, the water is not suitable for drinking purposes. Use as irrigation water might be restricted to plants that tolerate high levels of boron (e.g. alfalfa or some vegetables).

Sincerely,

Burkhard Bohm

Burkhard Bohm

BB:ch

attachment

Soil and Water Testing Laboratory
Division of
Plant, Soil and Water Science
College of Agriculture
Reno, Nevada 89557

Lab No. 113

Fee for Special Tests.

WATER ANALYSIS REPORT FORM

Fill in items 1 and 2 and submit one form with each sample. Submit only waters for Agricultural use. Domestic use water must be sent to the State Department of Health.

1. Name William O'Merlier

Address P.O. Box 1187

Hawthorne NV Zip 89415

County Mineral

2. Water Source and Location Well 1000'

T 8N R 31E

Date Collected 7-26-80

Water Use Irrigation

STANDARD TESTS:

Conductivity
micromhos/cm 1340

pH 8.5

Cations and Anions
(milliequivalents per liter):

Calcium + Magnesium 1.8

Sodium 10.0

Carbonate 0.2

Bicarbonate 0.5

Chloride 2.3

Estimated Sulfate 8.8

SAR 10.5

pH_c

CLASSIFICATION: I

*II RSC

**III EEESP

SPECIAL TESTS:

parts per million:

Nitrate Nitrogen

Phosphorus

Boron 0.27

Iron < .2

Other

REMARKS:

Date of Report 9-4-80 Analyst D. Thran

*RSC--Residual Sodium Carbonate
**EEESP--Expected Equilibrium Exchangeable Sodium Percentage. A soil irrigated with this water is expected to have an exchangeable sodium percentage of this value.

DESERT RESEARCH INSTITUTE
University of Nevada System
Water Resources Center

Sparks, Nevada
(702) 673-4750
Mailing Address: P.O. Box 60220
Reno, Nevada 89506

WATER ANALYSIS LABORATORY

DATA REPORT FORM

PROJECT: ____________ DATE SAMPLES SUBMITTED: 18 July 1980 DATE FINAL DATA: 26 August 1980

Lab No.	Sample Number	Date	Description	Analysis NO_3-N mg/l	As mg/l	B mg/l	Hg mg/l	Se mg/l	Li mg/l
El Cap	3	7/18/80		<0.1	0.15	2.2	<0.0002	<0.002	0.60

RIPLICATE
CASE PRINT)

BUREAU OF LABORATORIES AND RESEARCH
NEVADA DIVISION OF HEALTH

1660 N. Virginia Street
Reno, Nevada 89503

7530

54102

WATER CHEMISTRY:

WELL WATER: Pump should be delivering clear water before sampling.

Date sampled........ Date submitted........

Owner........

Report to:

Name........

Address........

City........ State NV

County Mineral

Township 9N

Range 31E Section 25

Area........

WATER SOURCE:

Well........ Spring........ Surface........

Hot........ Cold........ Depth........ Ft.

Casing diameter........ in depth........ Ft.

Now in use........ Yes ☑ No ☐

ROUTINE DOMESTIC ANALYSIS PLEASE CHECK BOX				FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED		FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW			
Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.
T.D.S. 951	932	Chloride	81	Iron	0.04	Copper	0.00		
Hardness	83	Nitrate	0.1	Manganese	0.01	Zinc	0.37		
Calcium	32	Alkalinity	22	Color	7				
Magnesium	0	Bicarbonate	24	Turbidity	1.0				
Sodium	245	Carbonate	0	p.H.	8.14				
Potassium	10	Fluoride	0.88						
Sulfate	448	Arsenic	0.175						

RECEIVED
1980
Consumer Health
Protection Services

8-7-80

Remarks........

Circled items exceed State of Nevada
Drinking Water Standards cre:

As - 0.05

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

DATE 26 August 1980

WADS ANALYSIS NUMBER								
Point Type, Temp. °C								
Co., Twp., Rng.	Co. Twp. Rng.		Co. Twp. Rng.		Co. Twp. Rng.		Co. Twp. Rng.	
Sec.,Qtrs.,Seq. No.								
Point Description	El Capitan Geothermal Well							
Sample Designation Code	El Cap 3							
pH field	8.2							
pH lab	8.72							
TDS (Σ)								
Sp. Cond. µmhos/cm@25°C field	3200							
Sp. Cond. µmhos/cm@25°C lab	1380							
	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm
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F^-	7.6	0.400						
NO_3^-								
H_2PO4^-								
$HPO4^=$								
P								
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Ca^{++}	35.1	1.754						
Mg^{++}	<0.1							
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Total Cations		13.304						
Anions/Cations		1.001						
SiO_2	74							

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
~~DESERT~~ RESEARCH INSTITUTE

LABORATORY REPORT
DATE 5·29·80
S Lewis

WADS ANALYSIS NUMBER								
[illegible] Type	[illegible]							
Co., Twp., Rng.	Co 7 / Twp T08 / Rng R30		Co. / Twp. / Rng		Co. / Twp. / Rng		Co. / Twp. / Rng.	
Sec., Qtrs., Seq. No.	33/BC							
Point Description	El Cap							
Sample Designation Code								
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WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY REPORT
DATE April 7, 1978

WADS ANALYSIS NUMBER								
Point Type, Temp. °C	W	88°C → 190°F						
Co., Twp., Rng.	Co. Mi / Twp. 8N	Rng. 30E	Co. / Twp.	Rng.	Co. / Twp.	Rng.	Co. / Twp.	Rng.
Sec., Qtrs., Seq. No.	~1 mile SW of	Hawthorne, Nv						
Point Description	FL Christina Test	Hole - Filtered	in lab - full		of black solids			
Sample Designation Code	NAD 17	520'	propably from		dynamite			
pH	7.90 F							
TDS (Σ)								
Sp. Cond. μmhos/cm @25°C	1200							
	mg/l	epm	mg/l	epm	mg/l	epm	mg/l	epm
HCO_3^-	255	4.179						
$CO_3^=$								
Cl^-	60	[illegible]						
$SO_4^=$	564	11.742						
F^-	6.0							
NO_3^-	80	1.286						
$H_2PO_4^-$								
$HPO_4^=$								
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Mg^{++}	0.5	0.041						
NH_4^+								
Total Cations		18.890						
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INFORMATION ON THE WELL

Name on the State Records: El Capitan Well # 3

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Depth: 1020 feet

It has a 100 H. P. motor with a 16 Stage Pump.

Static level of the water is 530 feet.

[redacted]

INCORPORATED

Client: Mike Doolin
Address: 450 East Glendale Avenue
Sparks, Nevada 89431
Phone Number: 358-9229
Date Sampled: Unknown

Date Submitted: 11/27/95

Client Reference: Samples labeled as below.
Laboratory Reference Numbers: 95-2274 through 95-2276.
Analysis Performed: Water Quality Panel as below.

Analysis	Result
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Bicarbonate, mg/L	32
Carbonate, mg/L	1.4
Total Dissolved Solids, mg/L	940
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Cadmium, mg/L	<0.005
Chloride, mg/L	70
Fluoride, mg/L	8.4
Lead, mg/L	<0.05
Mercury, mg/L	<0.001
Nitrate (as N), mg/L	<0.5
Selenium, mg/L	<0.005
Silver, mg/L	<0.02
Sulfate, mg/L	440

Analysis By: Hlubucek/Sharp

Approved By: C. W. Sharp

Date: 12/29/95

Laboratory Report Number 4171

CHEMAX Laboratories, Inc.

Analytical and Environmental Chemists
EPA Lab ID #NV004

(702) 355-0202
Fax (702) 355-0817

LABORATORY REPORT

Report To: High Desert Laboratories, Inc.
321 Freeport Boulevard
Sparks, NV 89431

Lab Report No.: 14436
Account No.: HDLAB

Telephone: 359-0330 Fax: 359-4106

Work Authorized By: Bill Sharp
Date Sampled: Unknown
Number of Samples: 1
Source: Doolin Water Well
Chemax Control No. 95-10105

Date Submitted: 12/11/95
Sampled By: Client

MULTI-ELEMENT SPECTROGRAPHIC ANALYSIS (Semi-Quantitative ICP Scan)

Sample Preparation: [ ] Meteoric Water Mobility Procedure [ ] TCLP Extraction
[X] Digestion for Total Metals [ ] Other: ____________

All results below in ppm: [X] mg/L [ ] mg/kg

Aluminum	<0.25	Gallium	<0.5	Potassium	<2.5
Antimony	<0.5	Iron	0.10	Scandium	<0.5
Arsenic	<0.5	Lanthanum	<0.5	Selenium	<2.5
Barium	<0.25	Lead	<2.5	Silver	<0.25
Beryllium	<0.05	Lithium	<0.5	Sodium	180
Bismuth	<0.5	Magnesium	<0.5	Strontium	1.3
Cadmium	<0.15	Manganese	<0.5	Thallium	<2.5
Calcium	33	Mercury	<2.5	Tin	<0.5
Chromium	<0.05	Molybdenum	<0.25	Titanium	<0.1
Cobalt	<0.5	Nickel	<0.5	Vanadium	<0.15
Copper	<0.05	Phosphorus	<0.5	Zinc	<0.05

Remarks:

Analysis By: Faulstich/Knudsen Date: 12/19/95

Approved By: Colin A. Zitta Date: 12/20/95

992 Spice Islands Drive, Sparks, Nevada 89431 • P.O. Box 21122, Reno, Nevada 89515

and test well temperature profiling all indicate the presence of a geothermal resource in the area.*

Figure 8.2.1 shows the area of elevated ground temperatures and the locations of the test wells that were measured for temperature profiles. The following table summarizes the results of the temperature profiles.

TEST WELL	DEPTH RANGE (FEET)	TEMPERATURE RANGE (°C)	TEMPERATURE RANGE (°F)
HWAAP #3	260 - 450	39.7 - 40.3	103.5 - 104.5
HWAAP #5	210 - 400	40.3 - 40.8	104.5 - 105.4
HHT-1	400 - 600	APPROX. 82	APPROX. 180
HHT-2	350 - 400	58 - 62	136 - 143

Figure 8.2.1 also indicates the location of the El Capitan well which was drilled in May of 1980. Based upon water quality samples, isotherm patterns, and the geology of the area, this well is considered to be part of the same geothermal aquifer which is common to the test wells. In a following study*, the El Capitan well was pumped at a constant rate for ten (10) days to determine the aquifer's ability to transmit water and to assess the long term well potential and operating characteristics.

The pump test of the El Capitan well indicates that the aquifer will produce hot water in sufficient quantity to meet the peak demands of 780 gallons per minute. The aquifer transmissivity is 52,000 gallons per day per foot width of aquifer. The

*Trexler, D.T., et al., Low-To-Moderate Temperature Geothermal Resource Assessment for Nevada, Area Specific Studies, Nevada Bureau of Mines and Geology, UNR for U.S. DOE, August 1981.

TRIPLICATE
EASE PRINT)

E/ Cap

BUREAU OF LABORATORIES AND RESEARCH
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503

58433

CHEMISTRY:

LL WATER: Pump should be delivering clear water before sampling.

te sampled 1-3-82 Date submitted 1-4-82

ner Hawthorne utilities

County Mineral
Township 8 N
Range 30 E Section 33
Area Hawthorne

port to:
Name Hawthorne Utilities
Address Box 1455
City Hawthorne State Nev 89415

WATER SOURCE:
Well ✓ Spring Surface
Hot ✓ Cold Depth Ft.
Casing diameter 14 in depth 1000 Ft.
Now in use Yes ☐ No ☒

OUTINE DOMESTIC ANALYSIS 0.0731 PLEASE CHECK BOX ~~[illegible]~~ ✓		FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED				FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW			
Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.
	294	Chloride	81	Iron	0.15	Copper	.00	T-Pb	0.01
ss	83	Nitrate	0.2	Manganese	0.01	Zinc	0.01		
n	35	Alkalinity	24	Color	3	Barium	0.01		
sium	0	Bicarbonate	15	Turbidity	0.6	Boron	2.1		
	253	Carbonate	6	p.H.	8.66	Silica	83		
um	10	Fluoride	7.56 ~~[illegible]~~						
	476	Arsenic	0.170						

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FEB 22 1982

marks
F-1.8
As-0.05

Circled items exceed State of Nevada Drinking Water Stds. The limits are

T 2-17-82

Consumer's Health

[illegible]

DESERT RESEARCH INSTITUTE
University of Nevada System
Water Resources Center

7010 El Rancho Drive
Sparks, Nevada
(702) 673-4750

Mailing Address: P.O. Box 60220
Reno, Nevada 89506

September 4, 1980

El Capitan Enterprises
Hawthorne, Nevada

Chemical Evaluation of El Capitan Well #3

Whenever only one sample is collected from an area in question it must be remembered the results obtained are only indicative of that specific location and time. Attempts to evaluate a geothermal or hydrologic system based upon one 'grab sample' is both dangerous and speculative. A field investigation requires many samples, with duplicates taken at different times. Only then can a credible evaluation be made.

General Chemistry:

The chemistry of the latest sample is different than the chemistry of Hawthorne Utilities Well #5, which is about 1/2 mile away. The water chemistry of El Capitan #3 (see attachement) (EC3) is similar to that of EC2, which was drilled in the vicinity in 1978. The hydraulic connection between these wells has been presumed earlier, when drilling mud was observed in EC2.

Generally, the chemistries of EC2 and EC3 fit well into the criteria for geothermally affected wells in the Hawthorne Valley, as identified in the DRI report #50 of December 1977 ('group I'). Thus it seems as if the El Capitan wells were placed within the presumed zone of upwelling geothermal water, which was suggested in the report.

Geothermometry:

Application of chemical geothermometers yielded a temperature of 197°C for the cation geothermometer and a temperature of 121°C for the quartz geothermometer. These results are consistent with those from the sample reported on April 25, 1980. The wide variations between the two methods cannot be explained, but since the silica-level is below the saturation of amorphous silica at well-head temperature, quartz-temperature is considered to be the more reliable in this case. Thus an original subsurface temperature of about 125°C (257°F) is presumed in the vicinity of the well.

Water Quality:

The level of total dissolved solids of 980 ppm is above the recommended concentration-limit of the US EPA (500 ppm). However, if no better sources of water are available, this water may be utilized for drinking or irrigation. The sulfate, arsenic, boron, and fluoride levels are too high:

	EC3 (ppm)	recommended limits (ppm)
Sulfate (SO_4)	495	250
Arsenic (As)	.15	.05
Boron (B)	2.2	1.0
Fluoride (F)	7.6	1.5

Therefore, ~~due~~ to the high arsenic, sulfate, and fluoride contents, the water is not suitable for drinking purposes. Use as irrigation water might be restricted to plants that tolerate high levels of boron (e.g. alfalfa or some vegetables).

Sincerely,

Burkhard Bohm

Burkhard Bohm

BB:ch

attachment

Soil and Water Testing Laboratory
Division of
Plant, Soil and Water Science
College of Agriculture
Reno, Nevada 89557

Lab No. 113

Fee for Special Tests. ______

WATER ANALYSIS REPORT FORM

Fill in items 1 and 2 and submit one form with each sample. Submit only waters for Agricultural use. Domestic use water must be sent to the State Department of Health.

1. Name William O'Merlier

Address P.O. Box 1187

Hawthorne NV Zip 89415

County Mineral

2. Water Source and Location Well 1000'

T 8N R 31E

Date Collected 7-26-80

Water Use Irrigation

STANDARD TESTS:

Conductivity micromhos/cm	1340
pH	8.5
Cations and Anions (milliequivalents per liter):	
Calcium + Magnesium	1.8
Sodium	10.0
Carbonate	0.2
Bicarbonate	0.5
Chloride	2.3
Estimated Sulfate	8.8
SAR	10.5
pH_c	

SPECIAL TESTS:

parts per million:

Nitrate Nitrogen	
Phosphorus	
Boron	0.27
Iron	< .2
Other	

REMARKS:

Date of Report 9-4-80 Analyst D. Thran

CLASSIFICATION: I ______

*II RSC ______

**III EEESP ______

*RSC--Residual Sodium Carbonate
**EEESP--Expected Equilibrium Exchangeable Sodium Percentage. A soil irrigated with this water is expected to have an exchangeable sodium percentage of this value.

DESERT RESEARCH INSTITUTE
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7010 El Rancho Drive
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Mailing Address: P.O. Box 60220
Reno, Nevada 89506

WATER ANALYSIS LABORATORY
DATA REPORT FORM

PROJECT: ______ DATE SAMPLES SUBMITTED: 18 July 1980 DATE FINAL DATA: 26 August 1980

Lab No.	Sample Number	Date	Description	Analysis NO_2-N mg/l	As mg/l	B mg/l	Hg mg/l	Se mg/l	Li mg/l
El Cap	3	7/18/80		<0.1	0.15	2.2	<0.0002	<0.002	0.60

RIPLICATE
AGE PRINT

BUREAU OF LABORATORIES AND RESEARCH

7530

NEVADA DIVISION OF HEALTH

54102

1660 N. Virginia Street
Reno, Nevada 89503

County Mineral
Township 8N
Range 31E Section 28
Area

WATER CHEMISTRY:

WELL WATER: Pump should be delivering clear water before sampling.

Date sampled .... Date submitted ....

Owner [illegible]

Report to:
Name [illegible]
Address [illegible]
City [illegible] State NV

WATER SOURCE:
Well ✓ Spring .... Surface ....
Hot [illegible] Cold .... Depth 1020 Ft.
Casing diameter [illegible] in depth 1020 Ft.
Now in use .... Yes ☑ No ☐

P.4
TDS

ROUTINE DOMESTIC ANALYSIS PLEASE CHECK BOX	✓	FOR PARTIAL ANALYSIS CIRCLE CONSTITUENT DESIRED	FOR CONSTITUENTS NOT LISTED BELOW PRINT IN CONSTITUENT DESIRED IN SPACE BELOW

Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.M.	Constituent	P.P.
T.D.S.	951	Chloride	91	Iron	0.04	Copper	0.00		
Hardness	83	Nitrate	0.1	Manganese	0.01	Zinc	0.37		
Calcium	32	Alkalinity	22	Color	7				
Magnesium	0	Bicarbonate	24	Turbidity	1.0				
Sodium	243	Carbonate	0	p.H.	8.14				
Potassium	10	Fluoride	0.88						
Sulfate	448	Arsenic	0.175						

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1980
Consumer Health
Protection Services

8-7-80

Remarks
Circled items exceed State of Nevada
Drinking Water Standards

As-0.05 0.01

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY NO.
DATE 26 August 1980

WADS ANALYSIS NUMBER								
Point Type, Temp. °C								
Co., Twp., Rng.	Co. / Twp.	Rng.	Co. / Twp.	Rng.	Co. / Twp.	Rng.	Co. / Twp.	Rng.
Sec., Qtrs., Seq. No.								
Point Description	El Capitan Geothermal Well							
Sample Designation Code	El Cap 3							
pH field	8.2							
pH lab	8.72							
TDS (Σ)								
Sp. Cond. μmhos/cm@25°C	field 3200							
	lab 1380							
	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm
HCO_3^-	30	0.495						
$CO_3^=$								
Cl^-	82	2.316						
$SO_4^=$	495	10.306						
F^-	7.6	0.400						
NO_3^-								
H_2PO4^-								
$HPO4^=$								
P								
Total Anions		13.317						
Na^+	246	10.68						
K^+	10.1	0.259						
Ca^{++}	35.1	1.754						
Mg^{++}	<0.1							
NH_4^+	2.2	0.611						
Total Cations		13.304						
Anions/Cations		1.001						
SiO_2	74							

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY REPORT
DATE 5.29.80
S Lewis

WADS ANALYSIS NUMBER								
Point Type, [illegible]	[illegible]							
Co., Twp., Rng.	Co. 17 / Twp. T08 / Rng. R30		Co. / Twp. / Rng.		Co. / Twp. / Rng.		Co. / Twp. / Rng.	
Sec., Qtrs., Seq. No.	33/BC							
Point Description	El Cap							
Sample Designation Code								
pH	8.65							
TDS (Σ)								
Sp. Cond. μmhos/cm@25°C	1437							
	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm	mg/ℓ	epm
HCO_3^-	25.5	0.417						
$CO_3^{=}$	5.5	0.183						
Cl^-	87.5	2.468						
$SO_4^{=}$	502	10.452						
F^-	7.77	0.409						
NO_3^-								
H_2PO4^-								
$HPO4^{=}$								
P								
Total Anions		13.929						
Na^+	258	11.20						
K^+	10.6	0.271						
Ca^{++}	37.7	1.881						
Mg^{++}	0.06	.005						
~~NH_4^+~~ B^+	2.50	0.694						
Total Cations		14.051						
Anions/Cations		99.1						
SiO_2	78							

WATER ANALYSIS LABORATORY - WATER RESOURCES CENTER
DESERT RESEARCH INSTITUTE

LABORATORY REPORT
DATE April 7, 1978

WADS ANALYSIS NUMBER				
Point Type, Temp. °C	W 88°C→190°F			
Co., Twp., Rng.	Co. Mi / Twp. 8N / Rng. 30E	Co. / Twp. / Rng.	Co. / Twp / Rng	Co. / Twp. / Rng.
Sec., Qtrs., Seq. No.	~1 mile SW of. Hawthorne, NV			
Point Description	EL Capitan Test Hole - Filtered	in lab - full	of black solids	
Sample Designation Code	NAD 17 520'	probably from	dynamite	
pH	7.90 F			
TDS (Σ)				
Sp. Cond. μmhos/cm@25°C	2000			

	mg/l	epm	mg/l	epm	mg/l	epm	mg/l	epm
HCO_3^-	255	4.179						
$CO_3^{=}$								
Cl^-	60	1.69						
$SO_4^{=}$	564	11.742						
F^-	6.0							
NO_3^-	80	1.286						
H_2PO4^-								
$HPO4^{=}$								
B	2.2							
Total Anions		19.456						
Na^+	370	16.095						
K^+	16	0.409						
Ca^{++}	47	2.345						
Mg^{++}	0.5	0.041						
NH_4^+								
Total Cations		18.890						
Anions/Cations		0.977						