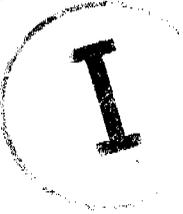




Steve -

8-20-92



This was inadvertently left out of the letter I mailed yesterday.

Nancy Logan

Water Well permit  
# 47338

Mr. Don Hopkins  
Lacana Mining Inc.  
P.O. Box 1150  
Lovelock, NV 89419

Subject: Water Well Report, Relief Car

Dear Don:

Hydro-Search, Inc. (HSI) was retained by Lacana Mining Inc. to provide hydrologic consultation for construction and testing of water supply wells capable of producing 400 gallons per minute (gpm) for the Relief Canyon Project. HSI field representatives observed and evaluated drilling and geophysical logging operations, specified the casing schedule, and supervised construction, development, and testing procedures. Results of this work and listing of specifications and materials used to construct the wells are presented herein.

Two wells were constructed. One, WW-9, is located in the SW 1/4 SW 1/4, Section 18, T.27N., R.34E. in valley fill materials. A second, WW-5, is located in NE 1/4 NE 1/4, Section 20, T.27N., R.34E. in consolidated bedrock materials. Potter Drilling Company, Fallon, Nevada was the drilling contractor.

Well WW-9, Water Rights Permit #47338

This possibility for development of a water supply was tested first because of its' proximity to the place of use of the water, thereby possibly avoiding a lengthy pipeline.

The 9-7/8-inch pilot hole for WW-9 was drilled to a depth of 640 feet. The upper 570 feet consisted of poorly consolidated, interbedded sand, silt, clay, and gravel. The bottom 60 feet was comprised of consolidated volcanic rock. Based on the geologic and geophysical logs, and various drilling characteristics indicating pervious, water-saturated materials, (e.g., thinning of the drilling fluid during drilling, lowering of the fluid level overnight, etc.), a 180-foot production well was designed to produce from coarse-grained materials in the upper portion of the valley fill. Johnson well screen and double-standard perforated well casing were installed opposite zones that appeared productive from the geophysical log. The geologic and geophysical logs and well construction summary for WW-9 are enclosed.

Hydro-Search, Inc.

333 Flint Street • Reno, Nevada 89501  
CONSULTING HYDROLOGISTS-GEOLOGISTS  
Phone (702) 322-4173



from 267 to 585 feet. A substantial amount of water was produced from the lower portion of this pilot hole. The pilot hole was reamed to 13-inch diameter to a total depth of 560 feet (Well Construction Summary).

Caving problems from about 267 to 300 feet in the breccia and Cane Springs Limestone (log of borehole) resulted in delays and substantially increased the cost of the reaming operation. The caving problems were finally solved by cementing the unstable portions of the hole. Because the major water-producing zone occurs from about 440 to 560 feet, the water-production capability of the well was not affected by the cementing of the interval between 267 and 300 feet.

An attempt was made to case the lower portion of the hole with 300 feet of 10-3/4 inch O.D., double-perforated pipe and low carbon steel Johnson well screen. The casing string hung up at about 279 feet near the top of the cemented zone. It appears that a constriction or dogleg occurs in the hole in the general area of the previous caving problem. At this point, an 8-5/8 inch O.D. casing string consisting of double perforated pipe and Johnson low carbon steel screen was installed for completion of the well as shown in the attached Well Construction Summary.

Test Pumping

A vertical line-shaft turbine pump was installed in WW-5 at a depth of 250 feet for development and test pumping purposes. The pump was installed by William P. Wilson, Inc., Fernley, Nevada. The static water level prior to development was 49 feet. The well was developed by surging and pumping for about 3 hours. Very minor amounts of silt were observed in the discharge water. During initial development pumping and after the first few surges, the water was a brownish color for 10 to 20 minutes, possibly due to removal of foaming agents used during the drilling process. Near the end of the development process, the water remained clear, even after surging. Water level recovery was rapid, rising from 152 feet to 51 feet in about 5 minutes.

A step-drawdown test consisting of 4 steps was conducted on WW-5. The static water level prior to the test was 49.02 feet. The final 2 steps were extended in an attempt to evaluate any limitations on the well's capacity or hydraulic barriers in the aquifer. The information from the test is summarized in Table 1 and the data are presented graphically in Figure 1. The relationships between drawdown, yield, and specific capacity are shown in Figure 2. The well's recovery was monitored and is also shown in Figure 1. After 100 minutes of recovery, the water level was only 0.52 feet below the pre-test level.



Log No. 40296 p3

Hydro-Search, Inc.  
333 Flint Street • Reno, Nevada 89501  
CONSULTING HYDROLOGISTS-GEOLOGISTS  
Phone (702) 322-4173

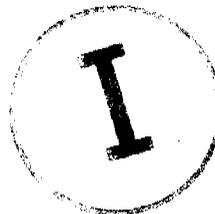


Table 1. Data From Step-Drawdown Test on WW-5, June 6, 1984

<u>Step</u>	<u>Duration</u> <u>minutes</u>	<u>Elapsed</u> <u>Time,</u> <u>minutes</u>	<u>Q, gpm</u>	<u>Drawdown,</u> <u>feet</u>	<u>Specific Capacity,</u> <u>gpm/ft</u>
1	120	120	360	21.54	16.7
2	120	240	500	47.23	10.6
3	180	420	640	77.23	8.3
4	210	630	660	85.06	7.8

Higher pumping rates could not be maintained during the pumping test due to a clogged fuel filter on the diesel engine. Following termination of the test, the fuel filter was changed and pumping was resumed at rates as high as 740 gpm with a drawdown of 94 feet after 90 minutes (specific capacity, 7.9 gpm/ft).

### Water Quality

Water samples taken during the pumping test of WW-5 indicate that the water meets U.S. EPA Primary and Secondary (except TDS (520 mg/l) which exceeds EPA Secondary Standard of 500 mg/l) and Nevada Division of Health drinking water standards. The water is a very hard (254.6 mg/l equivalent CaCO<sub>3</sub>), sodium-calcium bicarbonate type with a moderate concentration of dissolved inorganic chemical constituents (TDS = 520 mg/l by evaporation at 175°C, water analysis enclosed). Prior to human consumption of water from WW-5, the well, discharge piping, storage tank, and plumbing system should be disinfected. A sample should be submitted to the State Health Laboratory for coliform bacteria analysis and approval for potable use.

### Conclusions

Based on data from the step-drawdown test, WW-5 should produce on the short-term in excess of the project water demand of 400 gpm with minimal drawdown. The design criteria for the production pump submitted by our letter (Berger to Hopkins), dated June 8, 1984, were based on the step-drawdown test data.

The long-term productivity of the well cannot be evaluated because a long-term (24- to 72-hour) constant discharge test was not run. The well possibly is capable of as much as 800 gpm on a long-term basis. Regular monitoring during production pumping will help in the early detection of potential limitations to the pumping rate, such as discharging boundaries. After installation of the production pump, an individual from Lacana should be designated to regularly check and record water level and drawdown, cumulative

Ground Water • Hydrology • Geology • Water Quality • Geothermal

Suite 311 • 3303 Northland Drive • Austin, Texas 78731 • (512) 458-5249

Suite 130, Building Four • 777 South Wadsworth Boulevard • Denver, Colorado 80226 • (303) 989-3995



Log No. 40296 184  
**Hydro-Search, Inc.**  
333 Flint Street • Reno, Nevada 89501  
CONSULTING HYDROLOGISTS-GEOLOGISTS  
Phone (702) 322-4173



discharge, discharge rate, amperage drawn by the pump motor, and a quick check of water quality such as temperature, odor, taste, and sediment. HSI would be available to evaluate these data on an informal, cost-free basis.

\* \* \* \* \*

HSI sincerely appreciates the opportunity to play a part in bringing the Relief Canyon Project into production. Please call if you have any questions or if we can be of further assistance.

Very truly yours,

HYDRO-SEARCH, INC.

Forrest L. Fox  
Hydrogeologist

John V.A. Sharp, Ph.D.  
Manager, Reno Operations

FLF,JVAS:pal



# LOG OF BOREHOLE

Log No. 40296 P86  
BOREHOLE 10W79

PAGE 1 OF 4

LOC. or COORDS. T27N, R34E.  
Section 18 SW1/4 SW1/4  
GROUND ELEV. ~ 4640  
TOTAL DEPTH \_\_\_\_\_  
BOREHOLE DIAM. 9 7/8" two conc. O-

DRILLER Potter Drilling Co.  
Fallon, NV  
RIG Portadrill  
BIT(S) 9 7/8" long tooth two conc., 9 7/8" button tri-cone  
FLUID Bentonite

START	FINISH
DATE <u>4-17-84</u>	_____
TIME <u>0800</u>	_____
GEOPHYS. LOG <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
HOW LEFT _____	

LOCATION Bellet Canyon, Nevada  
LOGGED BY L F

PROJECT Lacarne Mining (1469-84)

DEPTH	PENE RATE	CIRC. RET/LOSS	AIRLIFT O (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
0	<u>42.8</u>					4-17-84 Water Trade 1111 local's
0-951						Mixed sand, silt, gravel and boulders Boulders are noted in symbol column
20-1005	<u>60</u>					
-1015						Water Trade 50" x 4' x 20' = 2493 gal.
40-1022 1026	<u>85.7</u>					
-1036	<u>60</u>					Sand and gravel predominate.
-1051 1113	<u>37.5</u>					Sand is fine to medium sized, gravel is 3/8" and larger. Returns are broken w/ sub rounded edges.
-1138	<u>24</u>					Material is silicious with a minor carbonate present
-1145 1225 1243 1312	<u>24</u>					
-1332	<u>60</u>					
-1355 1411	<u>26</u>					
-1506 1615	<u>21.8</u>					
-1625	<u>15</u>					Bit change to button (9 7/8") at 120' due to excessive grinding of bit.
-1642	<u>42.8</u>					
-1654	<u>29.9</u>					
-1704 1735	<u>30</u>					
-1753	<u>33</u>					
-1757	<u>75</u>					sand and minor clay at 150-155
-1802 1811	<u>60</u>					

# LOG OF BOREHOLE

Log No. 40296 P 7 BOREHOLE W 9  
 PAGE 2 OF 4

LOC. or COORDS. T. 27N, R. 31E.  
Sec. 18, SW, SW  
 GROUND ELEV. \_\_\_\_\_  
 TOTAL DEPTH \_\_\_\_\_  
 BOREHOLE DIAM. 9 7/8" O-

DRILLER Patterson Drilling Co.  
Fallon NV  
 RIG Parade drill  
 BIT(S) 9 7/8" 2 cone length biticone bits  
 FLUID Bentonite / polymer & detergent

START \_\_\_\_\_ FINISH \_\_\_\_\_  
 DATE 4-17-84  
 TIME 0800  
 GEOPHYS. LOG  YES  NO  
 HOW LEFT \_\_\_\_\_

LOCATION Relief Canyon, Nevada  
 PROJECT Lacana (1969-84)

DEPTH	PENE. RATE	CIRC. RET. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
160	60					<p><u>Gravel - sand</u>                      Viscosity 40                      182.5' Total depth                      4-18-84                      Mud down about 40' overnight                      Water Table 1</p>
1811	60					
1821	50					
1827	50					
1833	99					
0734	50					
0738	50					
0744	50					
0754	50					
0800	21.4					
0805	42.8					<p><u>silty-sand w/ clay</u>                      High (90-60%) clay in returns in this section of hole                      Materials are still silicious w/ very little carbonate present</p>
0815	60					
0829	60					
0836	60					
0841	75					
0845	75					
0849	60					
0853	60					
0903	60					
0908	60					
0916	60					
0921	60					
0926	42.8					
0933	60					
0938	60					
0951						
1024						
1028						
1039						
1043						
1051	99					
1054	75					
1058						

# LOG OF BOREHOLE

Log No. 40296 pg 8

BOREHOLE WW-9

PAGE 3 OF 4

LOC. or COORDS. T.27N, R.34E

Sec. 18, SW, SW

GROUND ELEV. \_\_\_\_\_

TOTAL DEPTH \_\_\_\_\_

BOREHOLE DIAM. 9 7/8" 0-

DRILLER Petter Drilling

Fellow W

START

FINISH

DATE 4-17-54

TIME 0200

GEOPHYS. LOG  YES  NO

HOW LEFT \_\_\_\_\_

RIG Portadrill

BIT(S) 9 7/8" 200' length, tricone bottom

FLUID Bentonite (w/ Polymer) + Detergent

LOCATION Petrol Company  
LOGGED BY F

PROJECT Lacuna Mining (1469-BA)

DEPTH	PENE. RATE	CIRC. RET. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
320-1050	99					Unconsolidated alluvium consisting of: silt, sand and gravel sized clay (sand and clay predominates)
1101	75					
1106						
1115	99					
340-1118	99					
1121	60					
1126						
1138	60					
360-1143	42.8					
1150	37.5					
1202	15.7					
1211	60					
1224	75					
380-1229	75					
1233	75					
1237	37.5					
1245	150					
400-1247	99					Silty sand; contains clay and gravel s
1250						
1253						
1258	99					
1300	99					Silty sand
420-1306						↓
1309	150					
440-1314	200					
1317	150					
1319						
460-1338	150					
1338	150					
1340						
1342						
480-1344						

# LOG OF BOREHOLE

Log No. 40296 pg. 9

BOREHOLE WW-9

PAGE 4 OF 4

LOC. or COORDS. T27N, R34E  
Sec 18 SW, SW  
 GROUND ELEV. \_\_\_\_\_  
 TOTAL DEPTH \_\_\_\_\_  
 BOREHOLE DIAM. 9 7/8"

DRILLER Patterson  
 RIG Powerdrill  
 BIT(S) \_\_\_\_\_  
 FLUID Benionite

START \_\_\_\_\_ FINISH \_\_\_\_\_  
 DATE 7-17-84  
 TIME 0800  
 GEOPHYS. LOG  YES  NO  
 HOW LEFT \_\_\_\_\_

LOCATION Relief Canyon, MN  
 LOGGED BY \_\_\_\_\_

PROJECT Lacrosse (1469-04)

430  
500  
550  
600  
620  
640

DEPTH	PENE RATE	CIRC RET	AIRLIFT (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
1347						
1352	180					Silty sand w/ clay 50' x 4' x 20' = 333.33 2473 gal.
1354	150					
1356	150					
1359	99					
1406						Reddish siltstone w/ sand and clay
1408						
1410	150					
1412	150					
1415	99					
1417	150					
1423						
1425						
1428	99					
1430	150					
1432	150					
1443	150					
1445						
1447						
1449	116					Water Table 1
1451						
1453						
1455	150					
1505	99					
1508	25					
1517	13					
1540	75					
1545						
1552	50					
1558	33					
1607	17					
1622						
1675						
176	76					
1832						
1850	8					
1857						
1911	10					
1925						

Volcanics  
↓

Consolidated Material: Chips are sand 1/16" and consist of volcanics such as andesite, with chunks of glass and pumice

8-19-84  
 Fluvial beds of glacial origin