# JUNIOR HIGH SCHOOL
# GEOTHERMAL WELL
# ELKO, NEVADA

MARCH 26, 1985

PROJECT NO: 83-324

PREPARED FOR:

ELKO COUNTY SCHOOL DISTRICT

Prepared by:

WILLIAM E. NORK, INC.

William E Nork

**WILLIAM E. NORK, Inc.**

Reno, Nevada 89503

## TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

# 1.0 FINDINGS

1. The Elko Junior High School well was completed to a depth of 1,971 feet. The well derives ground water primarily from production zones in fractured siliceous sedimentary rocks below a depth of approximately 1,950 feet.

2. Although the well may yield as much as 325 gallons per minute of ground water at a temperature of 190°F under conditions of unrestricted discharge, based upon testing results, the well is rated to flow approximately 294 gallons per minute of 187.25°F ground water under artesian pressure on a continous basis.

3. The chemical quality of the ground water derived from the Junior High School well meets State and Federal Primary Drinking-Water Standards.

4. Cooling of the water to 95°F should not result in carbonate and silicate incrustation of heat exchanger units or pipes so long as system pressure is maintained. Although Stability Indices indicate that corrosion potential is negligible, the presence of dissolved carbon dioxide, hydrogen sulfide, and oxygen gases suggest that the water may be slightly corrosive.

5. The total dissolved solids (T.D.S.) of the ground water derived from the well exceeds the Nevada Department of Environmental Protection standards for direct discharge into the Humboldt River. Alternative methods of disposal include injection back into the aquifer, utilization of the water for irrigation, blending with City of Elko water supplies, and discharge to infiltration/evaporation ponds.

## 2.0 INTRODUCTION

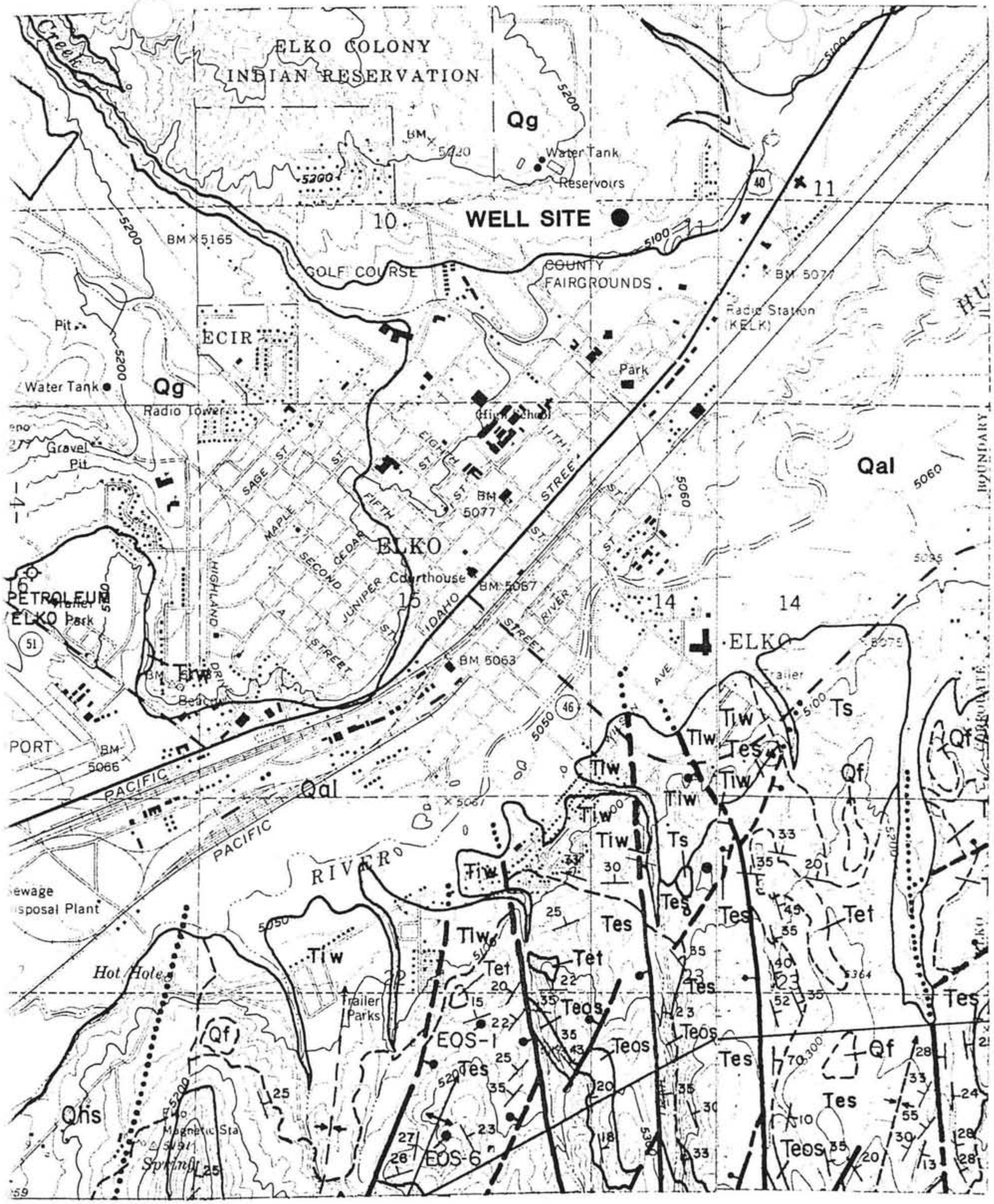
On the basis of the results of a 1,200 feet deep test hole drilled at the site of the new Elko Junior High School in January and April 1984 a geothermal production well was drilled for use in space heating. Drilling operations commenced September 13, 1984. The 1,971 feet deep well was completed February 5, 1985. Upon completion the well was subjected to a series of aquifer stress tests to determine the long-term yield of the well and the chemical quality of the ground water derived from the well. This report summarizes the data derived from the drilling and testing of the well and proposes alternatives for disposal of the heat-spent ground water.

## 3.0 GEOLOGY

Geologic materials in the vicinity of the Elko Junior High School range from unconsolidated alluvial deposits to sedimentary rocks (Solomon and Moore, 1982). Distribution of the various geologic units is given in Figure 1. The oldest units penetrated by the well are members of the Tertiary-aged Elko Formation (Tet, Tes, Teos, and Tec). The Elko Formation comprises several thousand feet of tuff, shale, siltstone, oil shale, claystone, conglomerate, dolomite, limestone, and minor lignite (op. cit.). The Elko Formation does not crop out at the well site but is present on the opposite side of the Humboldt River approximately 1.25 miles to the south. It was encountered in the borehole at a depth of approximately 1,196 feet. Below a depth of 1,838 feet, the Elko Formation appears to be hydrothermally altered (silica replacement) and takes on the appearance of a quartzite. Alternatively, the well may have bottomed in Diamond Peak Formation, a Lower Pennsylvanian/ Upper Mississippian-aged quartzitic sandstone. The Diamond Peak Formation is areally extensive and may be the geothermal reservoir rock in the vicinity of Elko.

The Elko Formation, in general, exhibits low primary permeability and typically yields only small amounts of ground water to wells. However, where fractured as a result of faulting, it would be expected to transmit moderate amounts of ground water, particularly the carbonate members where solution channeling of fractures could be expected. The Elko Formation is transected by numerous north and northeasterly trending faults south of the Humboldt River. These faults likely extend north of the river beneath the well site and promote circulation of the hot water from depth.

The Elko Formation is overlain by Tertiary-aged Indian Well Formation (Tiw) and Tertiary-aged sedimentary deposits (Ts). These may have been penetrated in the borehole between depths of 600 and 1,196 feet. They comprise volcaniclastic sedimentary rocks, tuff, siltstone and sandstone (op. cit.). They are not easily distinquished from each other or from clay, silt, and sand in the form of drill cuttings. These materials are essentially non-water-bearing and are virtually impermeable. They are significant in that they naturally serve to thermally and hydraulically isolate the geothermal aquifer from the shallower cold-water aquifer.



**SCALE**

**1 inch = 2000 feet**

**LEGEND**

| | | |
|---|---|---|
| **RECENT** | **Qal** | **Alluvium** |
| | **Qhs** | **Hot spring deposits** |
| | **Qf** | **Alluvial fill deposits** |
| | **Qg** | **Older alluvium** |
| **TERTIARY** | **Ts** | **Sedimentary deposits** |
| | **Tiw** | **Indian Well Formation** |
| | | **ELKO FORMATION** |
| | **Tet** | **Tuff, shale, and siltstone member** |
| | **Tes** | **Siltstone and oil shale member** |
| | **Teos** | **Oil shale member** |

**Fault, dashed where approximate, dotted where buried: ball on downthrown side**

**Contact, dashed where approximate**

**(Ref.: USGS OPEN FILE REPORTS MF-1410 and MF-1421)**

**Figure 1. Geology in the vicinity of the Elko Junior High School.**

The Tertiary-aged rocks are overlain by Recent-aged (Quaternary) alluvial deposits. Poorly consolidated silt, sand and gravel (Qg) comprise the benches north and south of the Humboldt River. Elsewhere they are as thick as 225 feet (op. cit.) but were not penetrated by the well. Approximately 600 feet of alluvium comprising clay, silt, sand, and gravel (Qal) was penetrated by the well bore. The alluvium can be expected to yield moderate amounts of ground water to wells and has been exploited as the major source of municipal water supply to the City of Elko.

Direct geologic evidence for the resource at the school was sparse. Potential reservoir rocks were not visible at the surface and their presence is obscured by several hundred to more than 1,000 feet of younger geologic deposits. Likewise, expressions of the structure which might control the occurence and magnitude of the resource were also masked. Based on a detailed description of the stratigraphy and structure from the literature, it was reasonably certain that suitable reservoir rocks were present at depth below the site. The depth of these materials, however, was uncertain due to fairly complex geologic structure resulting from numerous faults. Although the faulting made prediction of the depth to the reservoir uncertain, it virtually assured high secondary permeability and a potentially significant heat flow once the source was penetrated.

A thermal survey of the Elko area (Butterfield, 1977) indicated thermal anomolies in the alluvium throughout the Elko area. In the vicinity of the Junior High School, the survey indicated a thermal low. This suggested that the reservoir materials were probably displaced vertically downward and were isolated from the shallow alluvial aquifer by a significant thickness of geologic materials with low thermal and hydraulic conductivities. It follows that if the resource were encountered at depth, the hot water would be expected to flow under artesian pressure and that the water could be hotter than areas exhibiting thermal highs where significant heat was being lost to the shallow aquifer. Drilling results tended to confirm this hypothesis.

# 4.0 WELL CONSTRUCTION

## 4.1 CHRONOLOGIC SUMMARY

Construction of the production well commenced September 13, 1984 by Paul Williams and Sons, a Reno, Nevada-based drilling company. A brief chronology of the drilling is presented below.

| | |
|---|---|
| 9/13/84 | Drilling of the well commenced. |
| 10/08/84 | Drilling of the 17 1/2-inch diameter bore hole to a depth of 1,347.5 feet was completed. |
| 10/09/84 | Installation of 10 3/4-inch O.D. casing commenced. |
| 10/12/84 | Installation of 10 3/4-inch O.D. casing to a depth of 1,347.5 feet was completed. |
| 10/14/84 | Installation of neat cement and bentonite seal in the annular space between 10 3/4-inch O.D. casing and formation walls commenced. |
| 10/16/84 | Installation of the seal in the annular space was completed. |
| 10/23/84 | Drilling of a nominal 10-inch diameter borehole below a depth of 1,347.5 feet commenced. |
| 10/25/84 | Drilling of a nominal 10-inch diameter borehole to a depth of 1,510 feet was completed. |
| 10/27/84 | Geophysical logging (SP, resistivity, and temperature) was conducted. |
| 11/01/84 | Second temperature survey performed. |
| 11/02/84 | Drilling of a nominal 10-inch diameter borehole below a depth of 1,510 feet commenced. |
| 11/11/84 | Drilling of a nominal 10-inch diameter borehole to a depth of 1,801 feet was completed. |
| 11/14/84 | Installation of 8 5/8-inch diameter casing commenced. |
| 11/16/84 | The 8 5/8-inch diameter casing string stopped at a depth of 1,600 feet. |

| | |
|---|---|
| 11/22/84 | Attempts to drive the 8 5/8-inch O.D. casing string to the bottom of the borehole commenced. |
| 12/04/84 | The 8 5/8-inch O.D. casing met refusal at a depth of 1,665.5 feet. |
| 12/11/84 | A 6 5/8-inch O.D. casing string was installed in the well. |
| 12/12/84 | Attempts to drive the 6 5/8-inch O.D. casing to the bottom of the hole commenced. |
| 12/15/84 | The 6 5/8-inch O.D. casing met refusal at a depth of 1,687 feet. |
| 12/17/84 | Attempts to pull the 6 5/8-inch O.D. casing from the hole commenced. |
| 12/18/84 | Plan to pull 6 5/8-inch O.D. casing was abandoned. |
| 12/22/84 | Re-drilling of the hole below a depth of 1,685 feet commenced. |
| 12/31/84 | Drilling of the nominal 6-inch diameter borehole to a depth of 1,827 feet and under-reaming the hole to a depth of 1,800 feet was completed. |
| 1/03/85 | The 6 5/8-inch diameter casing was driven to a depth of 1,701 feet. |
| 1/07/85 | A bailer test to provide an estimate of the well yield at this stage of completion was performed. |
| 1/08/85 | A temperature log of the borehole to a depth of 1,800 feet was performed. |
| 1/09/85 | Operations to retrieve the 6 5/8-inch O.D. casing commenced. |
| 1/11/85 | Retrieval of the 6 5/8-inch O.D. casing was completed. |
| 1/18/85 | The 8 5/8-inch O.D. casing was perforated in place opposite potential water-bearing horizons. |
| 1/22/85 | A heat-flow test to determine the heat output of the well was performed. |
| 1/23/85 | Drilling a nominal 8-inch diameter borehole below a depth of 1,827 feet commenced. |

| | |
|---|---|
| 1/28/85 | Drilling the nominal 8-inch diameter borehole to a depth of 1,876 feet was completed. |
| 1/29/85 | The 6 5/8-inch O.D. casing was reinstalled to a depth of 1,876 feet. |
| 1/30/85 | Drilling a nominal 6-inch diameter borehole below a depth of 1,876 feet commenced. |
| 2/04/85 | Drilling operations were terminated at a depth of 1,971 feet. |

At the time drilling operations were terminated on February 4, 1985, the well was flowing approximately 300 gallons per minute or more of ground water with a temperature of at least 190°F. A log of the formation materials penetrated by the well is presented in Appendix A.

## 4.2 TEMPERATURE SURVEYS

The production well was drilled on the premise that ground water with temperatures greater than 170°F could be derived from the geologic materials beneath the well site below a depth of 1,100 feet. This was based on a temperature survey of the test hole conducted April 30, 1984.

The production well was logged on three occasions at various stages of completion to assess its heat- and ground-water yield potential. The first log of the production well was run October 27, 1984 at which time the well was 1,510 feet deep and after an equilibration time of approximately 30 hours. The results indicated a bottom-hole temperature of 147.5°F. This was nearly 30 degrees less than the April 30, 1984 log of the test hole and was interpreted as indicative of the low thermal and hydraulic conductivity formation materials penetrated thus far. The fluids in the well bore were allowed to equilibrate an additional four days and a second temperature survey performed November 1. This log yielded a general increase in temperature of the fluid in the well of 10 to 20°F. These data tended to confirm the interpretation that formation water temperatures could be as high as 170°F or more but low thermal and hydraulic conductivities of the formation required longer equilibration times to yield accurate results. The surveys suggested that the well would need to be deepened below a depth of 1,510 feet to penetrate sufficiently permeable strata to insure a yield capable of meeting the heat flow demand of the Junior High School. The third and final temperature survey was conducted January 8, 1985 at which time the well was 1,827 feet deep. The day before the survey, a bailer test had been performed in the well (Section 5.1). Bailing resulted in formation waters entering the well bore and as a result the survey yielded temperatures representative of true formation water temperature despite an equilibration time of only 12 hours. The maximum temperature recorded was 195.5°F, and suggested bottom-hole (1,827 feet depth) temperatures in excess of 200°F. However, the permeability of the formation was still insufficient to meet the heat flow demand of the school. For this reason the well was deepened to its ultimate depth of 1,971 feet.

The temperature logs are provided in Appendix B.

## 4.3 WELL CONSTRUCTION

The well was constructed to isolate the production zones from the shallow, alluvial, cold water aquifer exploited by the City of Elko for its municipal water supply. This was accomplished by installing blank casing down to a depth of 1,347.5 feet and sealing the annulus with a neat cement and bentonite slurry. The seal was pumped under pressure from the bottom of the casing to land surface.

The major geothermal water production zone is fractured quartzite or silicified siltstone below a depth of 1,950 feet. Small amounts of geothermal water are derived from fractured shale and claystone above this depth. The production zone was completed open hole to minimize well losses and maximize the artesian flow from the well.

Well construction details and a log of formation materials penetrated are illustrated in Figure 2. Additional construction details are listed below.

Casing Schedule

| Depth interval | Remarks |
|---|---|
| 0-1,347.5 | Blank 10 3/4-inch O.D. X 0.250-inch wall thickness steel well casing, specification ASTM A 53B |
| 1,205-1,666 | 8 5/8-inch O.D. X 0.250-inch wall thickness steel well casing, specification ASTM A 53B: double factory mill slot perforations 1,405 to 1,425; 1,525 to 1,585; and 1,645 to 1,665 feet and in-situ perforations 1,425 to 1,435 and 1,620 to 1,645 feet depth |

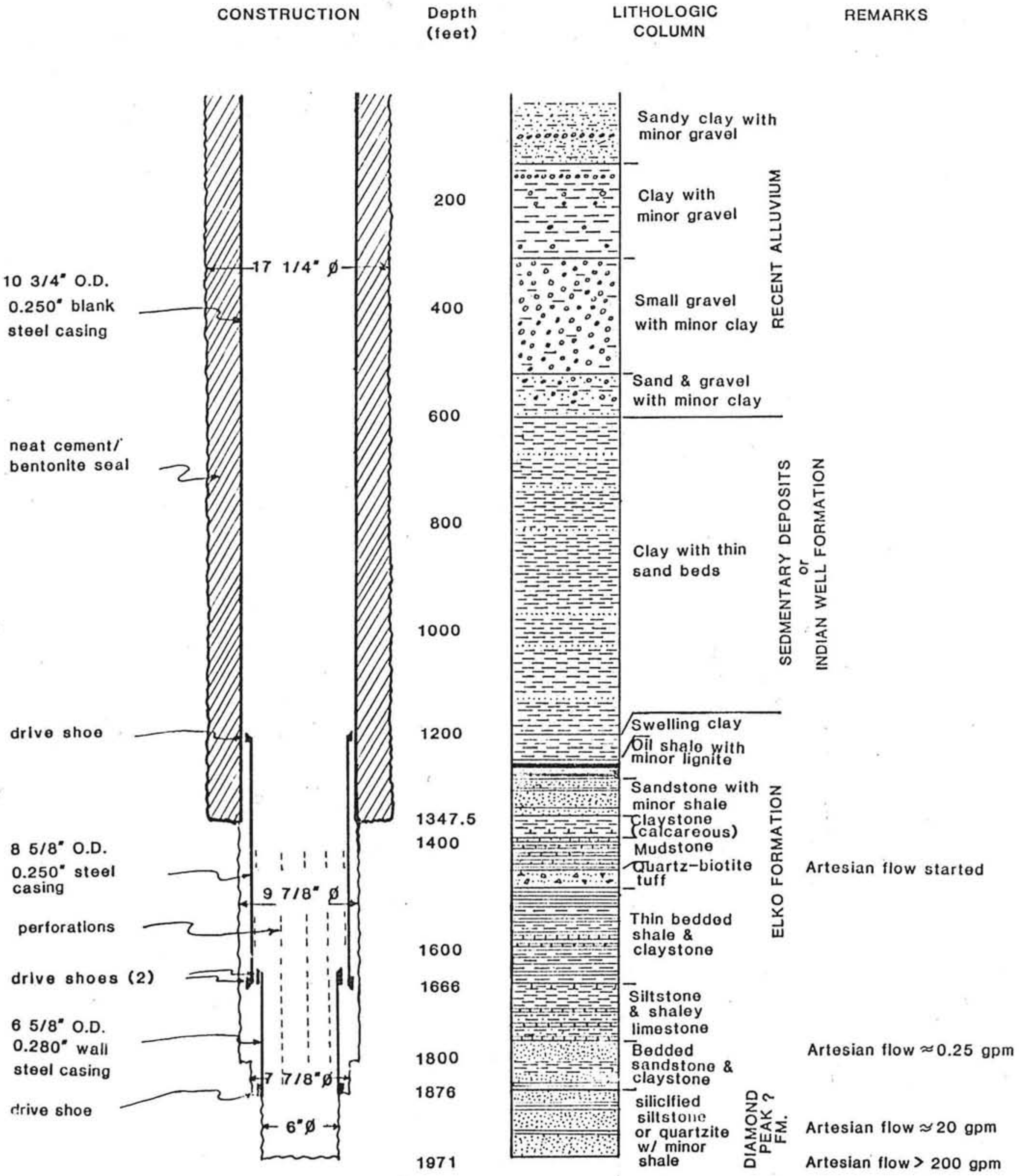


Figure 2. Elko Junior High School well construction and lithologic log

| | |
|---|---|
| 1,660-1,876 | 6 5/8-inch O.D. x 0.280-inch wall thickness steel well casing, specification ASTM A 53B: double factory mill slot perforations 1,669 to 1,869 feet depth |

The well head was completed with a 10-inch diameter flange at a depth of approximately 4.5 feet below land surface and equipped with a 10-inch diameter gate valve to control the artesian flow. Shut-in pressure upon completion of well construction was measured at 25 p.s.i.g.

## 5.0 AQUIFER TESTING

### 5.1 BAILER TEST

A bailer test was performed January 8, 1985 to evaluate the yield potential of the well as completed to a depth of 1,827 feet. The well was bailed for approximately 30 minutes with a 78 gallon bailer (average rate of 38 gpm). The results were analyzed by a method derived by Skibitzke (1958) and yielded a value of transmissivity of less than 100 gpd/ft. This low value indicated that the well, at this stage of completion, could not meet the minumum heat-flow requirement of 45 gpm of 170°F ground water necessary to heat the Junior High School.

### 5.2 HEAT-FLOW TEST

On January 22, 1985 a test which would simulate the withdrawal of heat from the well from a down-the-hole-heat exchanger was performed. This was accomplished by circulating a known volume of water down a pipe installed in the well and recording the increase in water temperature at the surface. The heat output of a down-the-hole heat exchanger was calculated and summarized in Table 1 below.

Table 1. Junior High School Well heat-flow test results (well depth of 1,827 feet).

| Flow rate (gpm) | Duration (minutes) | Temperature in (°F) | Temperature out (°F) | BTU |
|---|---|---|---|---|
| 94 | 90 | 62.6 | 86.0 | $1 \times 10^6$ |
| 42 | 960 | 62.6 | 77.9 | $3.3 \times 10^5$ |

The test reults indicated that the amount of heat generated from the well from a down-the-hole heat exchanger would be insufficient to meet the heat demand of the school. As a consequence, the well was deepened below a depth 1,827 feet.

### 5.3 AQUIFER STRESS TESTS

Aquifer stress tests were conducted February 8 through 11, 1985. The testing sequence consisted of a 12-hour step-drawdown test and a 48-hour constant-head flow test followed by 24 hours of (monitored) recovery. Pumping of the well was unnecessary due to the flowing artesian conditions in the aquifer at this locale. Results of the tests are summarized below.

### Step-drawdown Test

The step-drawdown test consisted of four steps of three hours duration each. Flow rates ranged from 165 gallons per minute (gpm) to 294 gpm. Testing commenced at 1200 hours 2/8/85. Shut-in (static) pressure at the start of the test was 25.5 p.s.i.g.

Table 2. Elko Junior High School Well step-drawdown test results.

| Step | Duration (minutes) | Flow Rate (gpm) | Temperature (°F) | Drawdown (p.s.i.g.) |
|---|---|---|---|---|
| I | 180 | 165 | 177.8 | 1.25 |
| II | 180 | 200 | 183.2 | 7.25 |
| III | 180 | 250 | 185.0 | 14.50 |
| IV | 180 | 294 | 185.7 | 22.8 |

The results indicate that the temperature of the discharge increases as flow from the well increases. Conversely, temperature of the discharge of the well will be less than the observed maximum of 185.7°F at lower flow rates.

Pressure in the well recovered almost instantaneously after shutting the valve and was 36 p.s.i.g. within one hour after conclusion of the test. A portion of this increase in head is attributed to development of the well during the test.

### Constant-Head Flow test

Based on the results of the step-drawdown test a 48-hour duration constant-head flow test was performed. Testing commenced 1100 hours 2/9/85. Shut-in pressure prior to the start of the test was 30.75 p.s.i.g. Flow varied from 273 gpm of 63.5°C temperature water (2,236 pounds per minute at 146.3°F) at the start of the test to 294 gpm of 86.25°C temperature water (2,373 pounds per minute at 187.25°F) after six hours and remained essentially constant for the remainder of the test. The maximum discharge of the well is somewhat higher than the 294 gpm observed during the test and may be as high as 325 gpm. Back pressure caused by the flow-metering device is responsible for the slightly lower observed flow rate. At this higher flow rate the temperature will approach 190°F. Test data are given in Figure 3 and tabulated in Appendix C.

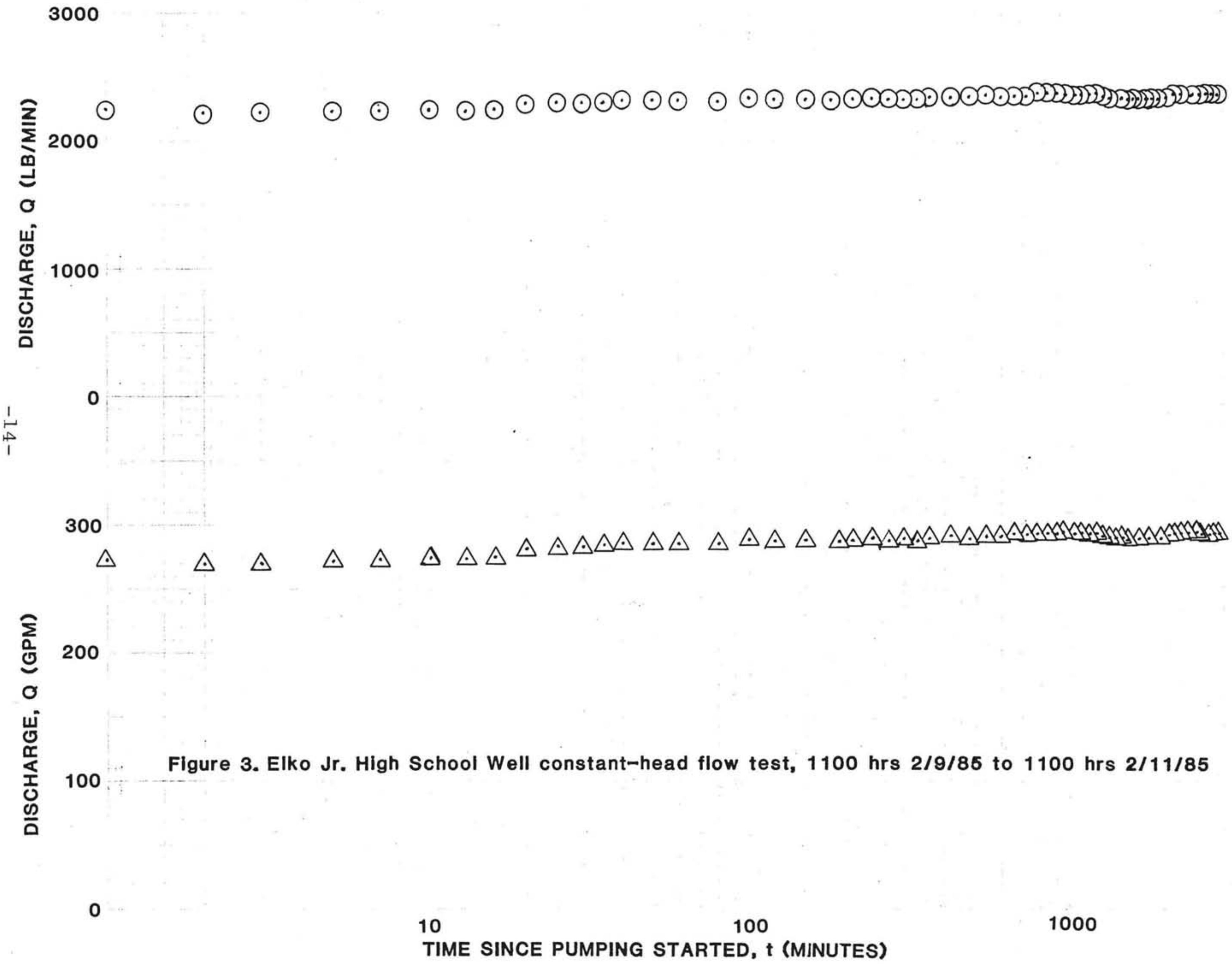


Figure 3. Elko Jr. High School Well constant-head flow test, 1100 hrs 2/9/85 to 1100 hrs 2/11/85

Shut-in (recovery) pressure was monitored for a period of 24 hours after the conclusion of the flow test. Artesian pressure recovered almost instantaneously and was 30.75 p.s.i.g. (100 per cent recovery) at the end of this period.

Detailed examination of the test data suggest that a flow rate of 294 gpm was insufficient to stress the aquifer. This inability to stress the aquifer precluded a determination of the aquifer transmissivity (the overall ability of the aquifer to transmit ground water). Suffice it to say that the transmissivity of the aquifer must be extraordinarily large for this to occur at a flow rate of 294 gpm. In addition, the coefficient of storage could not be determined due to the absense of a suitable observation well. The cost of drilling an observation well solely for this test was out of the question in terms of cost and time. Nonetheless, testing results suggest a very substantial resource well in excess of the demand which will be placed upon it by the District's heating system alone.

Water samples for chemical analysis were collected after six, 24 and 48 hours of testing. Results of the analyses are discussed in Section 6.0.

Because stress tests conducted to date have not defined the hydraulic characteristics of the aquifer, development of the resource beyond that contemplated by the District should include detailed aquifer stress tests complete with multiple observation wells. These tests will allow for rational development of the geothermal resource without risking over-exploitation.

## 5.4 LONG-TERM YIELD OF THE WELL

Testing results indicate that the well can be expected to yield approximately 294 gpm of 86.25°C water (2,340 pounds per minute at 187.25°F) on a sustained basis virtually indefinitely under flowing artesian conditions. This translates to more than 15,000,000 BTU's of heat per hour available for space-heating and other purposes.

The average demand of the district space-heating system is estimated at approximately 150 gpm with peak flows approaching 290 gpm (Petty, 1985). At this low average flow rate, the well will not apply a significant stress to the aquifer.

# 6.0 WATER CHEMISTRY

## 6.1 WATER QUALITY

Water samples for chemical analysis were collected from the well discharge after 6, 24, and 48 hours of testing. Results of the chemical analyses are listed in Table 3. Examination of the data shows that with the exception of iron, the water meets all State and Federal Primary and Secondary Drinking Water Standards. The recommended Secondary Standard for iron is 0.3 mg/l and the acceptable Secondary Standard is 0.6 mg/l. The water derived from the production well contained 1.81 mg/l. High levels of iron do not constitute a health hazard, but may cause staining of plumbing fixtures and clothing. The water may be classified as a very hard, sodium bicarbonate water. Softening may be required for some domestic uses if it were to be used directly for in-the-home use. Figure 4 compares the water derived from the well with average chemistry of Elko's municipal water and water derived from the Elko Heat well.

Gas was observed escaping from the discharge during the flow tests. Analyses results indicate that the water contains carbon dioxide gas at a very low partial pressure suggesting the presence of other gases. Analyses also indicate the presence of hydrogen sulfide gas (detected in the field) and dissolved oxygen. The quantity of dissolved oxygen is anomolously high - higher than that which can be dissolved in the water at 86°C - so it is unlikely that the oxygen became entrained in the sample during collection. Also, hydrogen sulfide gas and dissolved oxygen are not normally found together in ground water. This incongruity suggests that water charged with dissolved oxygen picked up the hydrogen sulfide enroute to the surface and was discharged before it could equilibrate. The oxidation of the $H_2S$ in the sample containers appears to have caused the slight difference between field and laboratory pH.

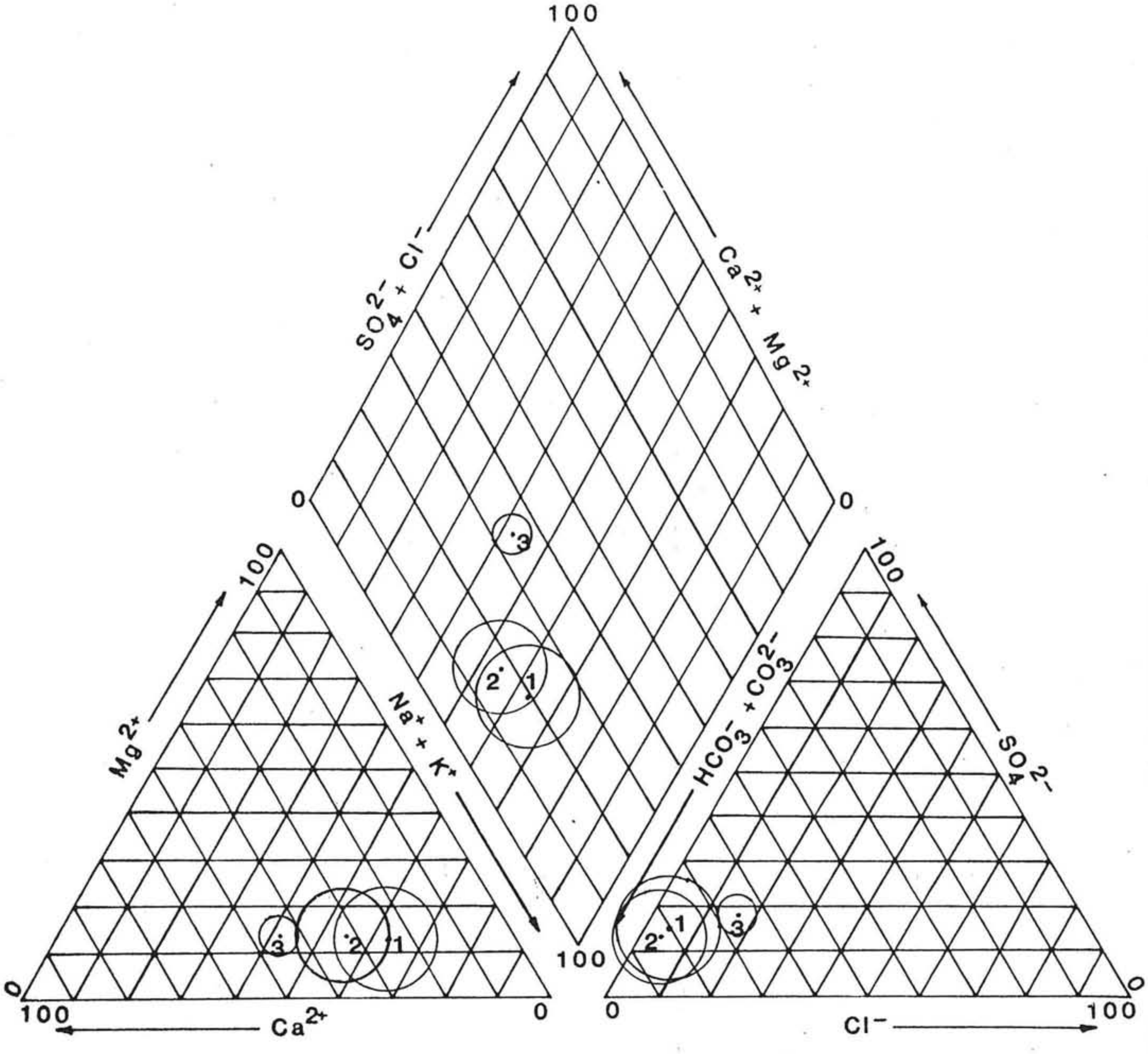
The water does not meet standards for direct discharge into the Humboldt River set by the Nevada Division of Environmental Protection (refer to Table 3). Specifically the water exceeds the standard for temperature, TDS, pH, and BOD even though it meets drinking water standards (except for iron). Alternative methods of disposal are discussed in Section 7.

## 6.2 INCRUSTATION AND CORROSION POTENTIAL

The potential for silicate and carbonate mineral incrustation of pipes and the heat exchanger was examined using the WATEQ computer program. At 86°C the water is undersaturated with

Table 3. Water chemistry data, Elko Junior High School well

| Sample No.<br>Date<br>Time | 324-1<br>2/09/85<br>1700 | 324-2<br>2/10/85<br>1100 | 324-3<br>2/11/85<br>1045 | Drinking Water Standard | Discharge Standard |
|---|---|---|---|---|---|
| Temperature(°C) | 85.75 | 86.25 | 86.25 | | 10 |
| E.C. (lab) | 1,150 | 1,150 | 990 | | |
| pH (field) | 7.0 | 6.6 | 6.7 | | 7-9 |
| pH (lab) | 6.45 | 6.50 | 7.80 | | |
| TDS | 750 | 748 | 654 | 1,000 | 320 |
| Suspended solids | | | 11.0 | | 80 |
| BOD | | | 10.0 | | 3 |
| DO | | | 6.5 | | >5 |
| Hardness ($CaCo_3$) | 188 | 202 | 208 | | |
| Fecal colliform | | | <2 | | 100 |
| Ca | 57 | 58 | 68.9 | | |
| Mg | 10.10 | 10.20 | 12.50 | 150 | |
| Na | 248 | 245 | 180 | | 8 |
| K | 36.60 | 36.00 | 36.50 | | |
| Fe | | | 1.81 | | |
| Mn | | | 0.03 | | |
| $HC0_3$ | 485.60 | 495.30 | 500.20 | | |
| $C0_3$ | <0.01 | <0.01 | <0.01 | | |
| $SO_4$ | 76 | 76 | 71 | 500 | |
| Cl | 15.0 | 15.0 | 18.0 | 400 | 18 |
| $NO_3$ (as N) | 0.02 | 0.02 | 0.03 | 45 | 1.0 |
| F | 1.83 | 2.01 | 1.86 | 1.4-2.4 | |
| $PO_4$ | | | 0.02 | | 0.35 |
| As | | | 0.003 | 0.05 | |
| Ba | | | 0.25 | 1.0 | |
| B | | | 0.986 | | |
| Cd | | | <0.0010 | 0.01 | |
| Cr | | | <0.001 | 0.05 | |
| Cu | | | <0.01 | 1.0 | |
| Pb | | | <0.001 | 0.05 | |
| Hg | | | | 0.002 | |
| Se | | | <0.001 | 0.01 | |
| Ag | | | <0.001 | 0.05 | |
| Zn | | | 0.009 | 5.0 | |
| $Si0_2$ | 76.0 | 76.0 | 77.80 | | |



1. **Elko Junior High School**
2. **Elko Heat Company***
3. **City of Elko Municipal Water (Average)***

**FIGURE 4 TRILINEAR DIAGRAM**

**Lattin and Hoppe, 1983**

respect to to calcium carbonate. As the water is cooled it becomes less saturated with calcium carbonate (Figure 5), reducing the potential for carbonate incrustation so long as pressure is maintained and carbon dioxide gas is not allowed to escape. Maintaining pressure in the system will prevent the release of carbon dioxide gas and a concomitant increase in pH which results in a decrease in the solubility of calcium carbonate.

At 86°C the water is undersaturated with respect to amorphous silica (the most common silica incrustation) and saturated with respect to chalcedony. Cooling the water down to 35°C causes it to become supersaturated with chalcedony and saturated with respect to cristobalite. However, reaction times for these minerals are so slow that deposition should not pose a problem. At 35°C the water remains undersaturated with amorphous silica (Figure 6). It is therefore recommended that the water not be cooled sustantially below 35°C (95°F) to reduce the potential for silica deposition within the system.

The incrustation/corrosion potential of the water was also investigated using Ryznar's stability index (Ryznar, 1944). The stability index was calculated to be 6.4 . Empirical studies (op. cit.) indicated that for the range of approximately 6.2 to 7.0 waters were generally neither corrosive nor incrusting.

The corrosive potential of water is increased by the presence of hydrogen sulfide gas, elevated temperature, dissolved oxygen, and dissolved carbon dioxide gas. Since all of these are present in waters derived from the Junior High School well, the potential for corrosion must be assumed to exist. Consequently, heat exchanger units and pipes which come into direct contact with the geothermal waters should be constructed of corrosion-resistant materials.

## 6.3 GEOTHERMOMETER EVALUATION

Reservoir temperatures were calculated using techniques developed by Fournier (1977) and Fournier and Potter (1979). Only those geothermometers which tend to give the most reliable results for low to moderate-temperature reservoirs (EG&G and LBL, 1982) were calculated. Results are summarized in Table 4.

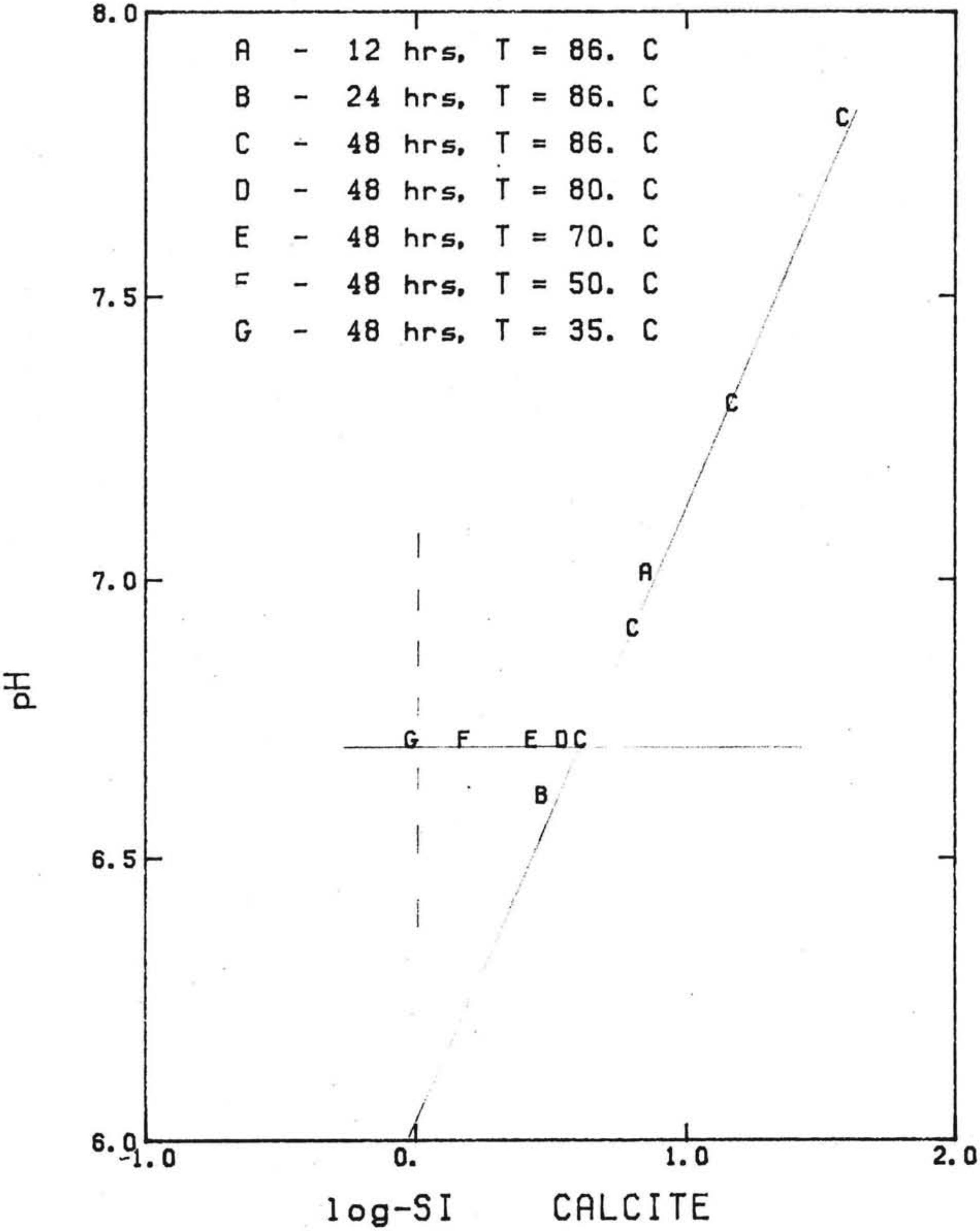


FIGURE 5. Calcite stability for the Elko Junior High School Well

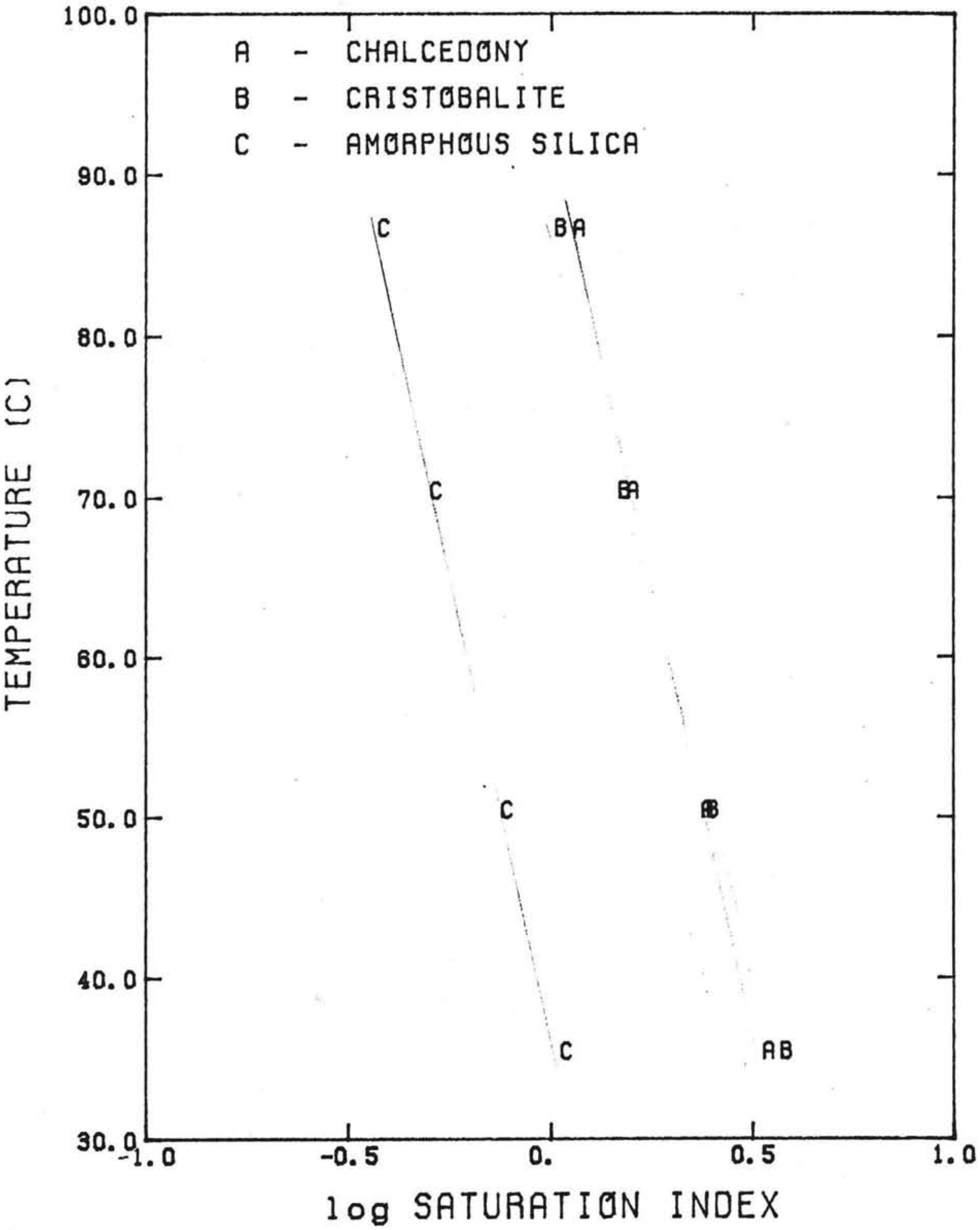


FIGURE 6. Silica stability for the Elko Junior High School Well

Table 4. Geothermometer analysis results.

| Geothermometer | Temperature (°C) |
|---|---|
| Quartz | 123.6 |
| Chalcedony | 96.0 |
| Na-K-Ca | 126.0 |
| Na-K-Ca (corrected) | 86.5 |

These results yield values for reservoir temperature somewhat higher than those for the geothermal aquifer from wells and springs west of Elko (Lattin and Hoppe, 1983 and Garside and Schilling, 1979) and suggest a general increase in temperature from west to east.

# 7.0 FLUID DISPOSAL ALTERNATIVES

There are at least five alternatives for disposal of the heat-spent water. These are:

1. Injection of the water back into the geothermal aquifer.

2. Discharge of the water directly into the Humboldt River.

3. Using the water for irrigation purposes.

4. Mixing the geothermal waters with City water and augmenting the municipal water supply.

5. Disposal via infiltration ponds near the Humboldt River.

The first alternative is undesireable due to high capital and operating costs. An injection well which allows for disposal of the fluid in the same horizon from which it was extracted would have to be constructed at a cost close to that of the production well. Pumping of the fluid would be required to overcome artesian pressure of the aquifer in order to inject the fluid back into the production zone in compliance with Nevada DEP regulations. The only desireable result is that of maintaining the artesian pressure of the aquifer. Note: Injection of water is demanded under non-consumptive use permit conditions. The Elko Jr. H.S. well enjoys a consumptive use permit and injection is, therefore, not required.

The second alternative is nearly as unattractive as the first. The water does not meet discharge criteria for the Humboldt River set by the Nevada Division of Environmental Protection (NDEP). Costly treatment such as reverse osmosis is necessary to reduce the level of total dissolved solids to meet the standard. In addition, discharge of the water into the Humboldt River and eventual evapotranspiration seems wasteful in a water-deficient state such as Nevada even though space heating is considered a beneficial use of the resource.

The third alternative is attractive because the water is available for an additional beneficial use - irrigation - after the heat is extracted. The water is suitable for irrigation purposes without any treatment. A disadvantage with this alternative is storage of the fluid during the heating (non-irrigation) season. The amount of water generated could exceed 200 to 300 acre-feet per year depending on the heat demand during the season. The cost of the storage facility may have to be included in the overall system cost if the water cannot be stored in existing facilities. Potential users of this water are the golf course (City of Elko), plant science departments of the high school or junior college, and the Elko County Fairgrounds.

The fourth alternative is attractive and feasible. The heat-spent water may be used to augment the City of Elko municipal water supply system as is the case for Wells, Nevada. The water meets all State and Federal Primary and Secondary Drinking-Water Standards with the exception of iron. Blending of the city and Junior High School well waters was analyzed using the PHREEQE computer program (INTERA, 1983). The effects of mixing average Elko municipal water (Lattin and Hoppe, 1983) with geothermal ground water cooled to 35°C are summarized below.

1. Iron level. A blend of 70 per cent city water and 30 per cent geothermal water will reduce the concentration of iron to the secondary standard (0.6 mg/l). However, iron staining of clothing and plumbing fixtures may still occur. Removal of the iron by chlorination and filtration should reduce the potential for staining and have the added benefit of oxidizing the dissolved hydrogen sulfide gas, thereby removing any objectionable odor.

2. pH. The values will remain within the range for city water (7.74) and geothermal water (6.7) (Figure 7).

3. Hardness. Both the city water and the geothermal water are very hard (hardness as $CaCo_3$ > 200 mg/l). Blending the waters will have negligible affect on hardness.

4. Corrosion potential. Ryznar Index ranges from 6.8 for pure city water to 6.4 for pure geothermal water. Blending the waters will result in stability indices between 6.4 and 7.0 suggesting no change in corrosion or calcite incrustation potential.

5. Incrustation potential. For mixtures of city water (at 15 °C) and cooled geothermal water (35°C) of between 10 and 90 per cent city water, the blend will be undersaturated with with respect to calcite (Figure 8). For blends less than 70 per cent city water, the mixture is oversaturated with iron carbonate. However, iron removal suggested in number 1 above will remedy this. Heating the mixtures of water to 140°F for domestic hot water increases saturation with respect to calcite and siderite (Figure 9) but the potential for precipitation does not appear to be any greater than that which exists for city water alone.

Even though these results appear to be favorable, it is recommended that they be verified by performing bench tests for a wide range of mixing ratios.

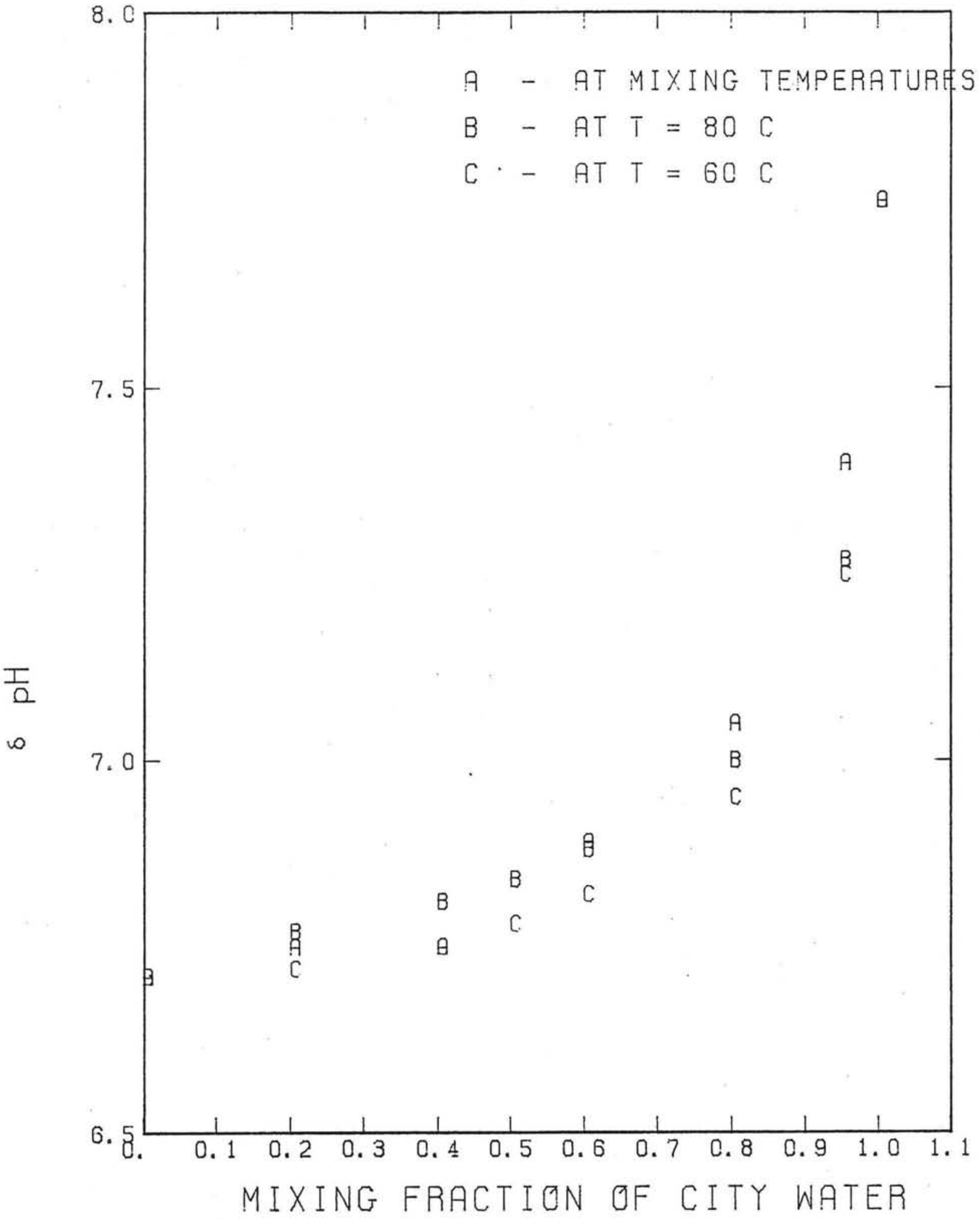


**Figure 7. pH of blends of City and Elko Junior High School waters.**

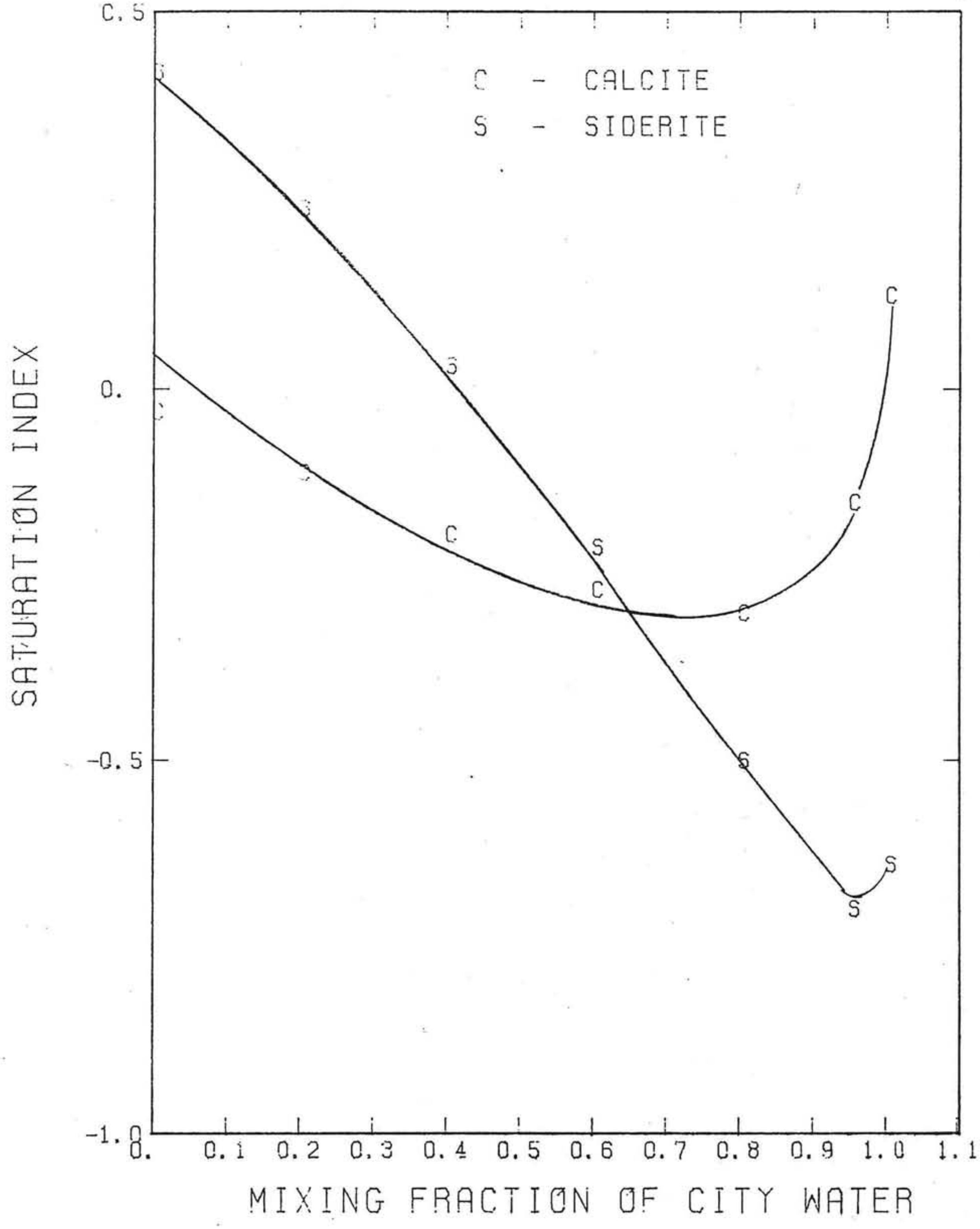


**Figure 8. Calcite and siderite saturation for blends of City and Junior High School waters.**

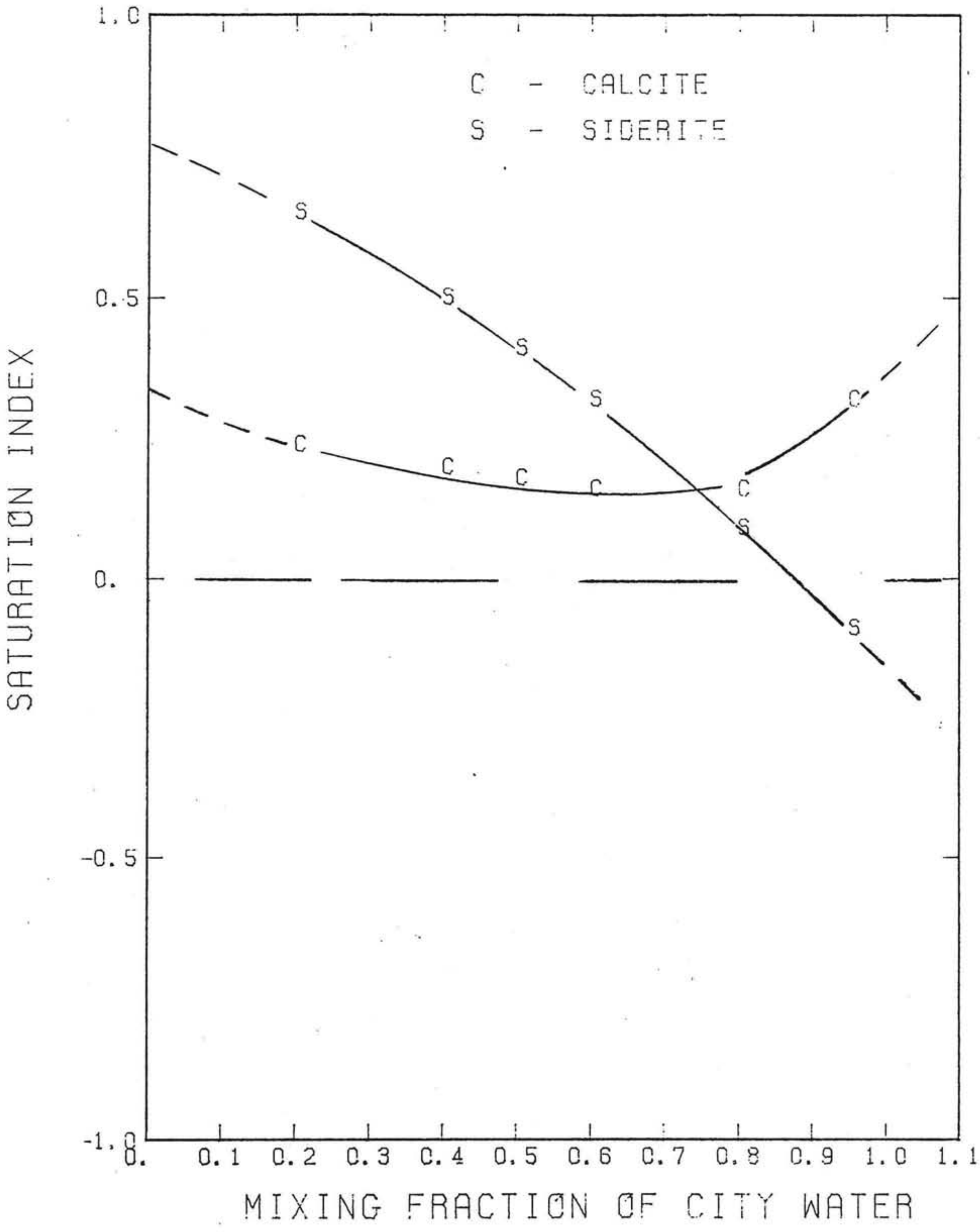


**Figure 9.** Calcite and siderite saturation for blends of City and Junior High School waters at 60 C.

The fifth alternative is to dispose of the water via infiltration ponds near the Humboldt River. The heat-spent water will cool further in the ponds; infiltrate the shallow, highly permeable alluvium; and ultimately enter the river. Because the water will not be discharged directly into the river, the DEP discharge standards are not applicable to this diffuse source. Inherent in this method are costs to operate and maintain the ponds. These costs however will be significanlty less than the cost of operating and maintaining an injection well system.

# SOURCES OF INFORMATION

Butterfield, F., 1977. Thermal survey for ground water, Elko, Nevada: consulting report prepared for the City of Elko, Nevada.

EG&G Idaho, Inc. and Lawrence Berkeley Laboratory, 1982. Low-to-moderate temperature hydrothermal reservoir engineering handbook: IDO-10099-1.

Fournier, R.O., 1977. "Chemical Geothermometers and mixing models for geothermal systems," Geothermics, 5, pp. 41-50.

Fournier, R.O. and R.W. Potter III, 1979. "Magnesium correction to the Na-K-Ca chemical geothermometer," Geochemica Cosmochemica Acta, 43, pp.1543-1550.

Garside, L.J. and J.H. Schilling, 1979. Thermal waters of Nevada: Nevada Bur. Mines and Geol. Bull 91.

INTERA Environmental Consultants, Inc., 1983. PHREEQE: A geochemical speciation and mass transfer code suitable for nuclear waste performance assessment: ONWI-435.

Lattin, M.W. and R.D. Hoppe, 1983. Direct use of geothermal energy, Elko, Nevada district heating.

Petty and Associates, 1985. private communication.

Ryznar, J.W., 1944. "A new index for determining amount of $CaCO_3$ scale formed by water," A.W.W.A. Jour., Vol. 36, No. 4, pp. 473-486.

Skibitzke, H.E., 1958. An equation for potential distribution about a well being bailed: U.S.G.S. Ground Water Note 35.

Solomon, B.J. and S.W. Moore, 1982. Geologic map and oil shale deposits of the Elko West quadrangle: U.S.G.S. MF-1421.

Solomon, B.J. and S.W. Moore, 1982. Geologic map and oil shale deposits of the Elko East quadrangle: U.S.G.S. MF-1410.

# APPENDIX A

# LITHOLOGIC LOG

LOG OF BOREHOLE

BOREHOLE [illegible] PAGE ___ of 15

LOC. or COORDS. ______

DRILLER Paul [illegible]

GROUND ELEV. ______

TOTAL DEPTH 1,970

RIG IR T-4

BOREHOLE DIAM. 17½ 0-1347; 10" 1347-1822; 7⅞ 1822-1970; [illegible]

BIT(S) ______

FLUID WATER

| | START | FINISH |
|---|---|---|
| DATE | 9/12/84 | 2/4/85 |
| TIME | | |

GEOPHYS LOG X YES __ NO

HOW LEFT COMPLETED

PROJECT ELKO JR HIGH SCHOOL 84-324

LOCATION ELKO NV

LOGGED BY DCS

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | FT/HR | | | | | | |
| | | | | | | | NOTE - CASED W/ 13⅜" ∅ [illegible]<br>BLANK CASING TO 1347'<br>DRILLED THRU [illegible]<br>FILLED PIPE W/ [illegible] WATER [illegible] |
| NEW [illegible]<br>1350 | [illegible] | | | NA | SOFT SHALE OR CLAYSTONE | | DRILLING [illegible] BELOW CASING<br>[illegible] 92°F RET<br>ROUGH @ 1353 SOFT SHALE [illegible] SOFT [illegible]<br>[illegible] A LITTLE<br>[illegible] 92°<br>[illegible] |
| | | | | | CLAYSTONE [illegible] | | [illegible] 93°F @1360 |
| 1360 | 5 | | | | | | [illegible] @ 1363' [illegible]<br>[illegible] 96°F @1365<br>[illegible] 50/50 [illegible]<br>THEN [illegible] 1368 0 TO [illegible] |
| | 12 | | | | | | 97° @ 1370 |
| 1370 | | | | | | | ROUGH @ 1373 -<br>[illegible] CALCITE [illegible]<br>W/ V FINE SAND [illegible] LT [illegible] |
| | [illegible] | | | | SANDY CLAYSTONE<br>CLAYSTONE | | [illegible] 99° @ 1375<br>LT BROWN CLAYSTONE [illegible] |
| 1380 | | | | | | | [illegible] @ 1380<br>RATE DECREASE [illegible] @ 1383<br>99°F @ 1386 |
| | | | | | SANDY CLAYSTONE | | LT GREY [illegible] CLAYSTONE<br>W/ FINE SAND |
| 1390 | | | | | | | |
| | 10 | | | | | | [illegible]<br>[illegible] SANDY CLAYSTONE [illegible]<br>[illegible] 101°F @ [illegible] |
| 1400 | | | | | | | |

# LOG OF BOREHOLE

BOREHOLE ELKO JR HIGH SCHOOL PAGE 2 of 15

LOC. or COORDS.

DRILLER PAUL WILLIAMS & SONS

GROUND ELEV. 5,116

TOTAL DEPTH

RIG IR T4

BOREHOLE DIAM. 17½", 0-1347; 9⅞", 1347 -

BIT(S) 9⅞ BUTTON TRICONE

FLUID WATER

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG __YES __NO

HOW LEFT

LOCATION ELKO, NV

LOGGED BY DCP

PROJECT ELKO JR HIGH SCHOOL WELL 84-524

| DEPTH | PENE-TRATE | CIRC. | | A-LIFT Q (gpm) | MATERIAL | SYM-BOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | RET. | LOSS | | | | |
| | FI/HR | | | NA | SANDY CLAYSTONE (MUD STONE) | | 10?° @ 1400<br>DRILLED FASTER 1402-1407 POSSIBLE [illegible] RED (SMALL AMT OF ASPHALT)<br>102° @ 1405 |
| | 10 | | | | | | ROUGH SPOT @ 1408 7.5" ○ FLOW IN PIPE |
| 1410 | 10 | | | | CALCAREOUS SHALE | | CHANGE TO BROWN CALCAREOUS (@ 1408) SHALE USING A LOT OF [illegible] WANTS TO DRILL FAST. OBVIOUSLY MORE COMPETANT<br>104 @ 1410 |
| | | | | | | | END 13/[illegible] MINUTE ARTESIAN FLOW & START OF DAY [illegible] OF FILL<br>105° |
| 1420 | 12 | | | | CALCAREOUS SHALE W/ SOME LIME-STONE | | V. ROUGH [illegible] @ 1421 FRACTURED<br>104° @ 1423<br>MIXTURE OF LT GREY, DARK GREY & BROWN EFFERVESCES W/ HCl CHIPS TO 0.1" POSSIBLE LT GREY DOLOMITE<br>POSSIBLE LIMESTONE BEDS BEGINNING @ 1428 |
| 1430 | | | | | BROWN SHALE W/ CALCITE<br>OIL BEARING | | SOME REDDISH BROWN [illegible] CUTTINGS MIXTURE OF DARK GREY SHALE & LT GREY L.S.<br>BROWN SHALE @ 1429 - DRILLING SMOOTHER (CLEANED CUTTINGS FROM PIT & ADDED WATER @ ~1429) SMALL FRACTURES @ 1432<br>105° @ 1430<br>GREENISH [illegible] STARTED TO JUMP, POSSIBLE [illegible] CHANGING TO GREY COLOUR<br>POSSIBLE FRACTURES @ 1435<br>SOME STRINGERS OF TAR |
| | 10 | | | | | | DRILLING SMOOTHER [illegible] @ 1437 |
| 1440 | | | | | | | LESS CACO3 1440-1445<br>ADDED WATER TO PIT<br>THIN BED LT GREY CLAYSTONE 1444'<br>104° @ 1444<br>Δ TO DK GREY CALC SHALE @ 1445<br>MOSTLY |
| | | | | | CALCAREOUS SHALE<br>THIN BEDDED SHALE & CLAYSTONE | | |
| 1450 | 15 | | | | | | HARDER @ 1452<br>SMOOTH DRILLING, VERY UNIFORM IN CHARACTER (LT. GREY CLAYSTONE W/ [illegible] DK GREY SHALE CHIPS - POSSIBLY CONTAMINATION |
| 1460 | | | | | QUARTZ-BIOTITE TUFF | | 105° @ 1460<br>SMALL (< 1MM) BIOTITE GRITTY - SMALL [illegible]<br>105° @ 1465 |
| 1470 | | | | | | | 10?° @ 1470 |

## LOG OF BOREHOLE

BOREHOLE ELKO J. [illegible]

PAGE 3 of 15

LOC. or COORDS.

DRILLER

START FINISH

DATE

GROUND ELEV.

TIME

TOTAL DEPTH

RIG

GEOPHYS LOG YES NO

BOREHOLE DIAM.

BIT(S)

HOW LEFT

FLUID

LOCATION

LOGGED BY

PROJECT

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | | | | | | LT GREY, FEW [illegible] CHERT, MINOR SILT |
| | 15 | | | | QUARTZ-BIOTITE TUFF | | SOME [illegible] - POSSIBLY CONTAMINATION FROM ABOVE |
| | | | | | | | [illegible] & BROWN<br>[illegible] - SOME CHERT[illegible]<br>[illegible] 105'@1477<br>CUTTINGS BELOW 1475 [illegible] LT GREY<br>[illegible] NO ABOVE [illegible] CHIPS ([illegible]) |
| 1480 | | | | | CALCAREOUS [illegible] SHALE | | |
| | | | | | [illegible] TUFF [illegible] | | |
| 1490 | | | | | | | DRILLING ROUGHER [illegible] 1054 @ 1490<br>NOTICEABLY [illegible]<br>& SLIGHTLY CALCAREOUS<br>[illegible] GREY [illegible] |
| 1500 | | | | | | | [illegible] |
| 1510 | | | | | | | HARD BROWN CLAYSTONE, POSSIBLY SILICEOUS & FRACTURED, FILLED W CALCITE VEINS<br>(STRAY RED CHERT CLAST)<br>THINLY LAMINATED. SOME SMALL PYRITE XTALS |
| | | | | | | | V SLIGHTLY CALCAREOUS |
| 1515 | | | | | | | 12[illegible] |
| | 10 | | | | | | DRILLING SMOOTHED @ 1517<br>HARD SILICEOUS SHALE & V. HARD DRILLING [illegible] 1215<br>SOME LT GREY TUFF |
| 1520 | | | | | | | T.=74°F 1250<br>SILICEOUS OIL SHALE, DK GREY & BROWN |
| | 15 | | | | | | LT GREY TUFF, [illegible] THE BIT |
| 1525 | | | | | | | HARD DK GREY SHALE 1252 |

# LOG OF BOREHOLE

BOREHOLE ELKO JR HIGH SCHOOL

PAGE 4 of 15

LOCATION

LOGGED BY

PROJECT

LOC. or COORDS.

DRILLER

GROUND ELEV.

TOTAL DEPTH

RIG

BOREHOLE DIAM.

BIT(S)

FLUID

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG ☐ YES ☐ NO

HOW LEFT

| DEPTH | PENE-TRATE | CIRC. | | A-LIFT Q(gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | RET. | LOSS | | | | |
| | | | | | SHALE | | A LITTLE ROUGH @ 1525 1252<br>HARD, SILICEOUS DARK GREY SHALE |
| | 14 | | | | | | |
| | | | | | CLAYSTONE | | Δ TO GREY ~~MU~~ CLAYSTONE, SOFT<br>Δ'D COLOR OF RETURNS |
| | | | | | | | MIXTURE OF DARK GREY & BROWN SHALE, FISSLE |
| 1530 | | | | | SHALE / MINOR CLAYST | | SAME AS ABOVE W/ SOME CALCITE VEINS 1317 94°F<br>(CALCITE IS CLEAR) W/ SOFT CLAY BEDS |
| | 10 | | | | CLAYSTONE | | Δ TO MOSTLY MED GREY CLAYSTONE. FINE LAMINATIONS IN LARGER CHIPS |
| | | | | | | | SAME AS ABOVE, W/ SOME LT BROWN CLAYSTONE |
| 1535 | | | | | SHALE & CLAYSTONE | | MED GREY CLAYSTONE & DK GREY FISSILE SHALE<br>W/ VEIN CALCITE (CLEAR) 1345 |
| | 15 | | | | | | GREY BROWN FISSILE SHALE, SOFT, FAINTLY CALCAREOUS<br>W/ CALCITE |
| 1540 | | | | | | | INTERBEDDED SHALE, CLAYSTONE & SILTSTONE<br>LT. BROWN CLAYSTONE 95°F 1410 1444 |
| | | | | | MINOR SILTSTONE | | |
| | 15 | | | | | | Δ TO MORE CLAYSTONE |
| | | | | | | | ROUGH @ 1544 1502 |
| 1545 | | | | | | | |
| | 15 | | | | | | ROUGH @ 1546 HARD BLACK SHALE 1519<br>MINOR PYRITE LOST FLUID [illegible]<br>~1½' OF PIT BEFORE<br>IT SEALED ITSELF |
| 1550 | | | | | SHALE & CLAYSTONE | | OIL BEARING<br>FRACTURED @ 1550 97°F 1543 |
| | 10 | | | | | | SAME AS ABOVE |
| 1555 | | | | | | | 1610 |
| | 13 | | | | | | FRACTURED @ 1557 1621 |
| 1560 | | | | | | | 97°F 1630 |

# LOG OF BOREHOLE

BOREHOLE [illegible] PAGE [illegible] of 15

LOC. or COORDS. ______ DRILLER ______

GROUND ELEV. ______

TOTAL DEPTH ______ RIG ______

BOREHOLE DIAM. ______ BIT(S) ______

FLUID ______

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG __YES __NO

HOW LEFT ______

LOCATION ______

LOGGED BY ______

PROJECT ______

| DEPTH | PENE-TRATE | CIRC. RET | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | | | | GREY & LT BROWN CLAYSTONE | | CLAYSTONE, MOSTLY MED GREY, SOME LT BROWN/TAN CALCITE - PROBABLY FROM VEINS OR FRAC FILLING |
| | | | | | | | HAD TO THICKEN DRILLING FLUID TO LIFT 1/4" CHIPS<br>END 11/2<br>START 11/3 0858 [illegible] |
| 1565 | | | | | MED GREY SHALE & CLAYSTONE | | MIXTURE OF MED GREY CLAYSTONE & SHALE<br>[illegible] CLAYSTONE THINLY LAMINATED<br>[illegible] SOFT CLAY, LT BROWN<br>MORE CALCITE<br>[illegible] |
| | 15 | | | | | | |
| | | | | | | | ROUGH [illegible] CALCITE VEINS<br>RED BROWN SHALE ~100°F 0918 |
| 1570 | | | | | | | SIMILAR TO ABOVE, LT BROWN CLAYSTONE IS SLIGHTLY CALCAREOUS, THINLY LAMINATED<br>ROUGHER [illegible] |
| | | | | | | | LT GREY CLAYSTONE W/ CALCITE [illegible] |
| | 7.5 | | | | | | |
| | | | | | | | ROUGH @ [illegible]<br>FRACTURES FILLED W/ CALCITE 0941 |
| 1575 | | | | | | | |
| | 5 | | | | | | HARD [illegible] CHIPS [illegible]<br>BROWN CALCAREOUS SILTSTONE 10[illegible]<br>REQUIRES 20-25 K# WT TO DRILL |
| 1580 | | | | | | | BROWN, HARD [illegible] SILTSTONE 100°F 1020 |
| | | | | | | | [illegible] MED BROWN SHALE<br>THEN HARDER. FRAC ACROSS BEDS ([illegible]) |
| | 7.5 | | | | BROWN CALCAREOUS SHALE | | MED-DARK BROWN SHALE HARD, SLIGHTLY CALCAREOUS |
| 1585 | | | | | | | VERY ROUGH @ [illegible] & HARD BROWN<br>[illegible] CALCAREOUS [illegible] 1106 |
| | | | | | LIMESTONE | | |
| | 5 | | | | CALCAREOUS SHALE | | |
| 1590 | | | | | | | MIXTURE OF BROWN SHALE & LT BROWN CLAYSTONE 1152 |
| | | | | | SHALE & CLAYSTONE | | |
| | 5 | | | | | | ROUGH @ 1593 1201 |
| 1595 | | | | | | | 1255 |

# LOG OF BOREHOLE

BOREHOLE ELKO JR HIGH SCHOOL PAGE 6 of 15

LOC. or COORDS. ____
DRILLER PAUL WILLIAMS
GROUND ELEV. ____
TOTAL DEPTH ____
RIG ____
BOREHOLE DIAM. ____
BIT(S) ____
FLUID ____

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG ___YES ___NO
HOW LEFT ____

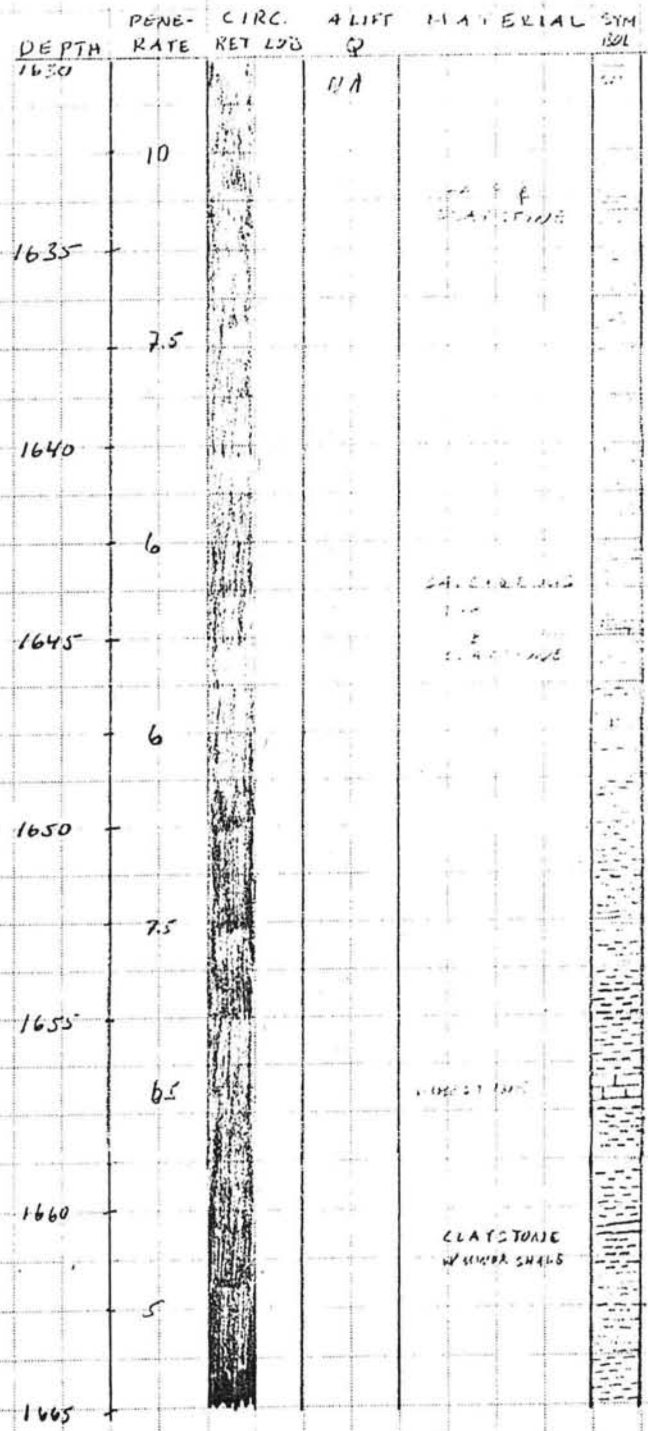
LOCATION ELKO NV
LOGGED BY DCB
PROJECT ELKO JR HIGH SCHOOL 84-324

1.75
7/90

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | | | | | | MED-DARK BROWN & MED GREY SHALE<br>THINBEDDED MINOR RED-BROWN SILTSTONE<br>A SMALL AMT OF LT GREY BIOTITE ? TUFF 1251 |
| | 6 | | | | | | |
| | | | | | CLAYSTONE<br>&<br>SHALE | | 101°F 1342 |
| 1600 | | | | | | | MED TO DARK GREY SHALE<br>& LT TO RED-BROWN CLAYSTONE<br>COLOR MIXTURE & UNEVEN DRILLING SUGGEST THIN BEDS |
| | 6 | | | | | | ROUGH @ 1602.5 [illegible] 1411<br>[illegible] |
| 1605 | | | | | | | 1428 |
| | | | | | | | AN LARGER CHIPS OF BROWN CLAYSTONE, SOFTER THAN ABOVE. LESS SHALE, SHALE SOFTER W/ LT GREY TO BLACK SHALE |
| 1610 | | | | | | | SHALE BECOMES [illegible], SOFTER<br>COULD ALL BE CLAYSTONE BROWN 101 1515 |
| | | | | | CLAYSTONE | | |
| | 6 | | | | | | CHIPS ARE MUCH SMALLER BELOW THIS DEPTH |
| 1615 | | | | | | | 1557<br>1559 |
| | | | | | | | MIXTURE OF CUTTINGS TYPES SUGGESTS THIN BEDS, AS DOES DRILLING ACTION & SMALL CHIP SIZE |
| | 10 | | | | SHALE<br>&<br>CLAYSTONE<br>(THIN BEDS) | | |
| 1620 | | | | | | | ROUGH @ 1620 102 1641 |
| | 6 | | | | | | LOSING THE RED-BROWN CHIPS.<br>BROWN CLAYSTONE [illegible] & BROWN & GREY SHALE |
| 1625 | | | | | | | BETTER RETURNS, MORE SHALE THAN ABOVE 1728 |
| | 6 | | | | | | SIMILAR TO ABOVE<br>BROWN, SHALE, LT BROWN (TAN) MUDSTONE |
| | | | | | | | 1807 |
| 1630 | | | | | | | |

**WILLIAM E. NORK, INC.**
1026 West First Street
RENO, NEVADA 89503
(702) 322-2604

SHEET NO 5 OF 12
CALCULATED BY ______ DATE ______
CHECKED BY ______ DATE ______
SCALE ______



DESCRIPTION & COMMENTS

104°F 1827

[illegible] GREY & BROWN SHALE & CLAY

ROUGH @ 1633 1826

FRACTURED - SOME CLEAR CALCITE (VEINS)

[illegible] [illegible] ([illegible] SCET) 1840

SMOOTHED OUT @ 1640 105°F 1720

[illegible] LT. BROWN, GREY SHALE & CLAYSTONE
SLIGHTLY CALCAREOUS

[illegible] GREY LIMESTONE

V. ROUGH 1648-50 108°F 2240 11/3
PROBABLY FRACTURED - LARGER CHIPS
END 11/3/84 107°F 2125 11/5
SOME [illegible] CHIPS & MANY CLAY BALLS
1 - 3/8" ROUNDED CHERT PEBBLE - CONTAMINATION? 107°F 1252
ADD'L ICE COLD WATER TO PIT

MIXTURE OF GREY & BROWN CLAYSTONE
SOME CALCITE IN FRACTURES
MOST LIKELY LAYERED
MINOR [illegible] SHALE

100°F 1335
1346

ROUGH @ 1655. PROBABLY FRACTURED
CALCITE VEINS.
& 1656.5
MINOR GREY LIMESTONE

98°F 1425

SAME AS ABOVE

100°F 1520

# LOG OF BOREHOLE

BOREHOLE ELKO JR HIGH SCHOOL

PAGE 8 of 15

LOC. or COORDS.

GROUND ELEV.

TOTAL DEPTH

BOREHOLE DIAM.

DRILLER PAUL WILLIAMS & SONS

RIG IR T4

BIT(S) 9 7/8 BUTTON TRICONE

FLUID BENTONITE

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG ___YES ___NO

HOW LEFT

LOCATION ELKO, NV

LOGGED BY DCB

PROJECT ELKO JR HIGH SCHOOL

| DEPTH | PENE-TRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1665 | | | | | CLAYSTONE | | CLAYSTONE MED. BROWN & GREY<br>HARD, WAXY SHEEN<br>1528 |
| | | | | | | | END 11/[illegible] |
| 1670 | | | | | | | |
| | | | | | | | END 11/8<br>START 11/9<br>FRACTURED 1673 |
| 1675 | | | | | | | SOME CLEAR CALCITE, PROBABLY FILLING FRACTURES |
| 1680 | | | | | | | 1680 |
| | | | | | | | 1682<br>FRACTURED - SOME SPARRY CALCITE<br>1683 |
| 1685 | | | | | | | ROUGH 1685-86 |
| | | | | | | | T = 112°F 1630 |
| | | | | | | | LOST 1" FLUID IN [illegible] - [illegible]<br>1687-1690' COULD BE LT BROWN LIMESTONE<br>ROUGH [illegible] FRACTURED<br>SOME L.S. CHIPS<br>T=112°F 1707 |
| 1690 | | | | | | | SMOOTHED OUT @ 1692 & BECAME HARDER<br>SOME [illegible] OR SILICEOUS CLAYSTONE |
| | 4 | | | | CLAYSTONE & SHALE | | |
| 1695 | | | | | | | T=110°F 1822<br>1877<br>ROUGH @ 1695.5' |
| | 23 | | | | | | ROUGH @ 16[illegible]<br>1905 |
| 1700 | | | | | | | 2005 |

LOG OF BOREHOLE

BOREHOLE ELKO JHS PAGE 7 of 15

LOC. or COORDS. ______ DRILLER ______ START FINISH

DATE ______ ______

GROUND ELEV. ______ TIME ______ ______

TOTAL DEPTH ______ RIG ______ GEOPHYS LOG __YES __NO

BOREHOLE DIAM. ______ BIT(S) ______ HOW LEFT ______

FLUID ______

LOCATION ELKO, NV

LOGGED BY DCB

PROJECT ELKO JR HIGH SCHOOL 24-324

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1700 | 2.5 | | | | CALCAREOUS [illegible] | | BROWN & TAN SILTSTONE [illegible] GREY CLAYSTONE, [illegible] [illegible] MORE GREY SILTSTONE SILTSTONE [illegible] CALCAREOUS<br>LITTLE [illegible], THEN SAME AS ABOVE UNFRACTURED 2100 |
| 1705 | 2.5 | | | | | POOR CUTTINGS RET | ROUGH @ 1704.5' 2158<br>2210<br>[illegible] VERY HARD, UNFRACTURED, [illegible] @ 1708.5' |
| 1710 | 1.5 | | | | | | T=113°F 0017<br>Δ @ 1711' BROWN SILTY LIMESTONE & BROWN TAN & GREY [illegible] & [illegible] SOME FLUID LOSS<br>HARDER 1712-16, BRITTLE W/ NO FRACTURES |
| 1715 | | | | | [illegible] & CALCAREOUS SILTSTONE | | 0352<br>1715 VERY HARD, FRACTURED, LOST 1" OF FLUID FROM PIT<br>BLACK [illegible] & DARK GREY SILTY LIMESTONE |
| 1720 | 4 | | | | | | MIXED W/ LT BROWN CALCAREOUS SILTSTONE T=115°F 0550 |
| 1725 | 5 | | | | | | 0703<br>SIMILAR TO ABOVE SOME CALCITE FRACTURE FILLING |
| 1730 | 4 | | | | | | T=116°F 0810<br>[illegible] A MIXTURE OF BROWN SILTY / SHALEY LIMESTONE & LT BROWN CALC SILTSTONE |
| 1735 | | | | | | | T=116°F 0922 |

BOREHOLE ELKO J.H.S. PAGE 10 of 15

LOC. or COORDS. ____________ DRILLER ____________

GROUND ELEV. ____________

TOTAL DEPTH ____________ RIG ____________

BOREHOLE DIAM. ____________ BIT(S) ____________

FLUID ____________

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG __YES __NO

HOW LEFT ____________

LOCATION ____________

LOGGED BY ____________

PROJECT ____________

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1735 | | | | | SHALEY LIMEST. & CALCAREOUS SILTSTONE | | DARK BROWN SILTY LIMESTONE, TAN CALCAREOUS SILTSTONE 0922<br>SOME CHIPS ART SILICIOUS<br>SOME CALCITE, PROBABLY VEINS/ FRAC FILLING |
| | 4.5 | | | | | | |
| 1740 | | | | | | | T=116°F 1030<br>1159 |
| | 4 | | | | | | [illegible]<br>THIN BED(S)? GREY SANDSTONE - FINE [illegible] FRACS W/ CALCITE |
| 1745 | | | | | | | [illegible] W/ CaCO3 [illegible] 1315<br>[illegible] TAN & GREY [illegible] CALC. SILTSTONE |
| | | | | | | | [illegible] |
| 1750 | | | | | | | T=110°F 1420<br>1425 |
| | 5 | | | | | | LESS [illegible] THAN ABOVE, ELSE SIMILAR |
| 1755 | | | | | | | 1755 DRILLER [illegible] ACTIVE<br>RATE [illegible] 1530 |
| | 4 | | | | | | 1757<br>SIMILAR TO ABOVE<br>FRACTURES HEALED W/ CaCO3 (SPAR) |
| 1760 | | | | | | | INCREASED RPMS & WT T=117?F 1645 |
| | 5 | | | | | | VERY UNIFORM, SMOOTH [illegible] BELOW 1761<br>SIMILAR TO ABOVE W/ FRACS HEALED |
| 1765 | | | | | | | |
| | 5 | | | | | | |
| | | | | | | | T=118°F 1856 |
| 1770 | | | | | | | |

LOG OF BOREHOLE

BOREHOLE ELEZ 1 H 2

PAGE 12 of 15

LOC. or COORDS. ______
DRILLER ______
GROUND ELEV. ______
TOTAL DEPTH ______
RIG ______
BOREHOLE DIAM. ______
BIT(S) ______
FLUID ______

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG ___YES ___NO
HOW LEFT ______

LOCATION ______
LOGGED BY ______
PROJECT ______

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1770 | 4.5 | | | | CALCAREOUS SILTSTONE | | SIMILAR TO ABOVE - MIXTURE OF BROWN & TAN LIMESTONE & CALC. SILTSTONE<br>SOME BROWN & GREY SHALE - SILICIOUS<br>[illegible]<br>[illegible] 1850<br>POOR RETURNS. CUTTINGS NOT RETURNING TO SURFACE ALTHOUGH FLUID IS CIRCULATING 1810 2040 |
| 1775 | 5 | | | | | POOR CUTTINGS RETURN | |
| 1780 | 5 | | | | | | T-119°F 2148<br>1780-1781 [illegible] 2025<br>ROUGH [illegible] |
| 1785 | 1 | | | | QUARTZITE (DIAMOND PK) OR SILICIFIED SILTSTONE | | V. ROUGH @ 1785 2317 2400<br>V. [illegible] & HARD @ 1787<br>1 F. HR 2.45 HRS |
| 1790 | | | | | | | DRILLING SMOOTHED OUT T=119°F 0340<br>DARK BROWN TO NEARLY BLACK QUARTZITE. SOME [illegible] QUARTZ<br>(SOME CONTAMINATION FROM ABOVE)<br>QUARTZITE(?) MAY ACTUALLY BE SILICIFIED SILTSTONE |
| 1795 | 5 | | | | | | V. FINE GRAINED 0438<br>MINOR PYRITE - V. SMALL XTALS |
| 1800 | | | | | | | T=120°F 0533 |

BOREHOLE ELKO J.H.S. PAGE 13 of 15

LOC. or COORDS.

DRILLER

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GROUND ELEV.

TOTAL DEPTH

RIG

GEOPHYS LOG ☐ YES ☐ NO

BOREHOLE DIAM.

BIT(S)

HOW LEFT

FLUID

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1805 | FT/HR |  | | | CLAYSTONE | | REAMED 6" ϕ TO [illegible]"ϕ 1801-1827 1/25/85 |
| 1810 | | | | | | | |
| 1815 | | | | | | | |
| 1820 | | | | | | | |
| 1825 | | | | | | | DRILLING w/ 7⅞ TOOTHED TRICONE [illegible] 1/25/85 |
| 1830 | | | | | | | @ 1832, SOFT "BLACK" SHALE |
| 1835 | | | | | SHALE | | @ 1838.5 [illegible] DRILLING BECAME ROUGH<br>LOST ~1/2 [illegible] PIT SEALED ITSELF<br>DARK GREY F.GR [illegible] PYRITE w/ QTZ VEINLETS<br>@ ~1840 |
| 1840 | 1<br>3<br>8 | | | | QUARTZITE<br>ROUGH SHALE | | TRIPPED HOLE & ADDED BUTTON BIT 1/25 2[illegible]<br>ROUGH @ 1844<br>[illegible] 9/25 START 1/26 1042 T=75°F 1127 |
| 1845 | 10 | | | | | | ROUGH 1847-1849<br>DARK BROWN SHALE w/ SOME GREY SILTSTONE AND SOFT |
| 1850 | 10 | | | | [illegible] | | HARDER @ 1850 FRACTURED T=77°F 1153<br>[illegible], [illegible] @ [illegible]<br>SOME TAN LIMESTONE POSSIBLY [illegible] HARD [illegible] |
| 1855 | | | | | | | [illegible] T=10[illegible]°F 1222 |
| | | | | | | | HARDER QTZITE POSSIBLY MED GREY L.S.<br>DRILLING [illegible] @ 1859.5<br>BLACK V.FINE GRAINED QTZITE OR BLACK SILICIFIED SHALE T=105°F 1348 |
| 1860 | 1 | | | | QUARTZITE OR SILICIFIED SILTSTONE | | 1/27 0918 / 1/26 1631 |
| 1865 | 1 | | | | | | A LITTLE ROUGH @ 1864.5 THEN [illegible] (0930) T=101°F<br>SOME QTZ-FILLED VEINS, FINELY DISSEMINATED PYRITE(?)<br>DK-MED. GREY QTZITE<br>SOFTER @ 1866.5 T=105°F [illegible]<br>SLIGHTLY ROUGHER @ 1867 & 1867.25<br>V. ROUGH @ 1868.75 T=105°F 1204 1324 1414 |
| | 1.5 | | | | | | |
| 1870 | | | | | | | V. ROUGH @ 1873.5 SET 6"ϕ CASING<br>DRILLING w/ 6"ϕ TRICONE T=107°F |
| 1875 | | | | | | | [illegible] 1876.75<br>START 7/1/85 |
| 1880 | | | | | | | |

LOCATION

LOGGED BY

PROJECT

# LOG OF BOREHOLE

BOREHOLE ELKO JR. HIGH SCHOOL PAGE 14 of 15

LOC. or COORDS. ____________ DRILLER ____________

GROUND ELEV. ____________

TOTAL DEPTH ____________ RIG ____________

BOREHOLE DIAM. ____________ BIT(S) ____________

FLUID ____________

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG __YES __NO

HOW LEFT ____________

LOCATION ____________

LOGGED BY ____________

PROJECT ____________

| DEPTH | PENETRATE | CIRC. RET. | CIRC. LOSS | A-LIFT Q (gpm) | MATERIAL | SYMBOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| 1880 | FT/HR | | | | | | |
| 1885 | | | | | | | |
| | 5.5 | | | | | | |
| 1890 | | | | | | | |
| 1895 | | | | | | | |
| 1900 | | | | | | | |
| 1905 | | | | | | | HOLE FLOWING ~ 2 ½ GPM<br>END 2/1/85 |
| 1910 | | | | | | | |
| 1915 | | | | | | | |
| 1920 | 4.5 | | | | | | |
| 1925 | | | | | | | |
| 1930 | | | | | | | 107°F RETURNS<br>HOLE FLOWING 4GPM<br>END 2/2/85 |
| 1935 | | | | | | | |
| 1940 | | | | | | | |
| | 3 to 4 | | | | | | |
| 1945 | | | | | | | |
| 1950 | | | | | | | |
| 1955 | | | | | | | 141°F RETURNS<br>HOLE FLOWING 15GPM<br>END 2/3/85 |

# LOG OF BOREHOLE

BOREHOLE *ELKO JR. HIGH SCHOOL* PAGE *15* of *15*

LOC. or COORDS. ______ DRILLER ______

GROUND ELEV. ______

TOTAL DEPTH ______ RIG ______

BOREHOLE DIAM. ______ BIT(S) ______

FLUID ______

| | START | FINISH |
|---|---|---|
| DATE | | |
| TIME | | |

GEOPHYS LOG ___YES ___NO

HOW LEFT ______

| DEPTH | PENE-TRATE | CIRC. | | A-LIFT Q (gpm) | MATERIAL | SYM-BOL | DESCRIPTION AND COMMENTS |
|---|---|---|---|---|---|---|---|
| | | RET. | LOSS | | | | |
| 1950 | | ▨ | | | | | |
| 1955 | | ▨ | | | | | |
| 1960 | | ▨ | | | | | |
| 1965 | | ▨ | | | | | |
| 1970 | | ▨ | | | | | FLOWING > 300 GPM @ 190°F<br>END 2/14/85 |

LOCATION ______

LOGGED BY ______

PROJECT ______

# APPENDIX B

# TEMPERATURE LOGS

# GEO-HYDRO-DATA

INCORPORATED

# ELECTRIC WELL LOG

COMPANY ELKO COUNTY SCHOOL DISTRICT

WELL EC. JR. HIGH

FIELD ELKO

COUNTY ELKO STATE NEVADA

LOCATION

Sec. Twp. Rge.

TYPE LOG

Permanent Datum GROUND LEVEL Elev.

Log Measured From [illegible] 0 Ft. Above Perm. Datum

Drilling Measured From GROUND LEVEL

Elev. K.B.

D.F.

G.L.

| | | | |
|---|---|---|---|
| Date | 27 Oct. 84 | | |
| Run No. | [illegible] | [illegible] | |
| Depth — Driller | 1510 | | |
| Depth — GHD | 1453 | | |
| Btm. Log Inter. | 1450 | | |
| Top Log Inter. | 300 | [illegible] | |
| Casing — Driller | 10" @ 1347 | | |
| Casing — GHD | | | |
| Bit Size | 9 7/8 @ 1510 | | |
| Bit Size | | | |
| Bit Size | | | |
| Type Fluid in Hole | [illegible] | | |
| Source of Sample | [illegible] | | |
| PPM TDS | [illegible] | | |
| Fluid Level | | | |
| Dens. / Visc. | | | |
| pH / Fluid Loss | | | |
| Rm @ Meas. Temp. | | | |
| Rmf @ Meas. Temp. | | | |
| Rmc @ Meas. Temp. | | | |
| Time Since Circ. | 30 | | |
| Logging Speed | 20 | 40 | |
| Tool Type and No. | temp 2 | [illegible] 2 | |
| Unit No. | [illegible] | | |
| Location | [illegible] | | |
| Invoice No. | [illegible] | | |
| Recorded By | M. Alexander | [illegible] | |
| Witnessed By | Dale [illegible] | [illegible] | |
| Other | | | |

SCALE CHANGES: Depth / Type Log / Scale Up Hole / Scale Down Hole

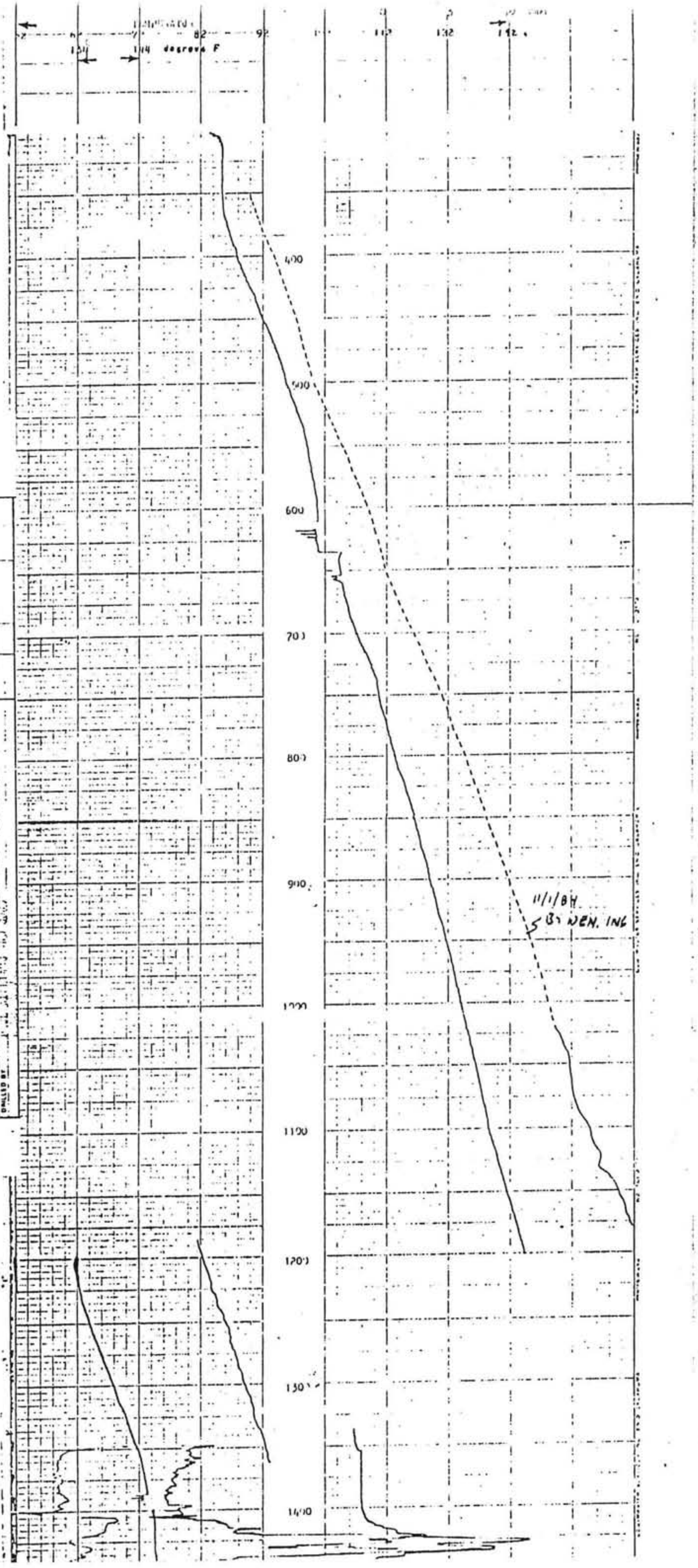
EQUIPMENT

REMARKS

DRILL METHOD

DRILLED BY

P.O. Box 418 Tehachapi, California 93561 805-822-4161



11/1/84
By WEN. INC

# GEO-HYDRO-DATA
INCORPORATED

# ELECTRIC WELL LOG

COMPANY ELKO SCHOOLS
WELL Jr. HIGH WELL
FIELD ELKO
COUNTY ELKO
STATE NV.

COMPANY ELKO SCHOOLS

WELL Jr. HIGH SCHOOL

FIELD ELKO

COUNTY ELKO STATE NEVADA

LOCATION
WEST SIDE of New Jr. High
Sec.______ Twp.______ Rge.______

TYPE LOG
TEMPERATURE

Permanent Datum G.L. Elev.______
Log Measured From G.L. 0 Ft. Above Perm. Datum
Drilling Measured From G.L.

Elev.: K.B.______
D.F.______
G.L.______

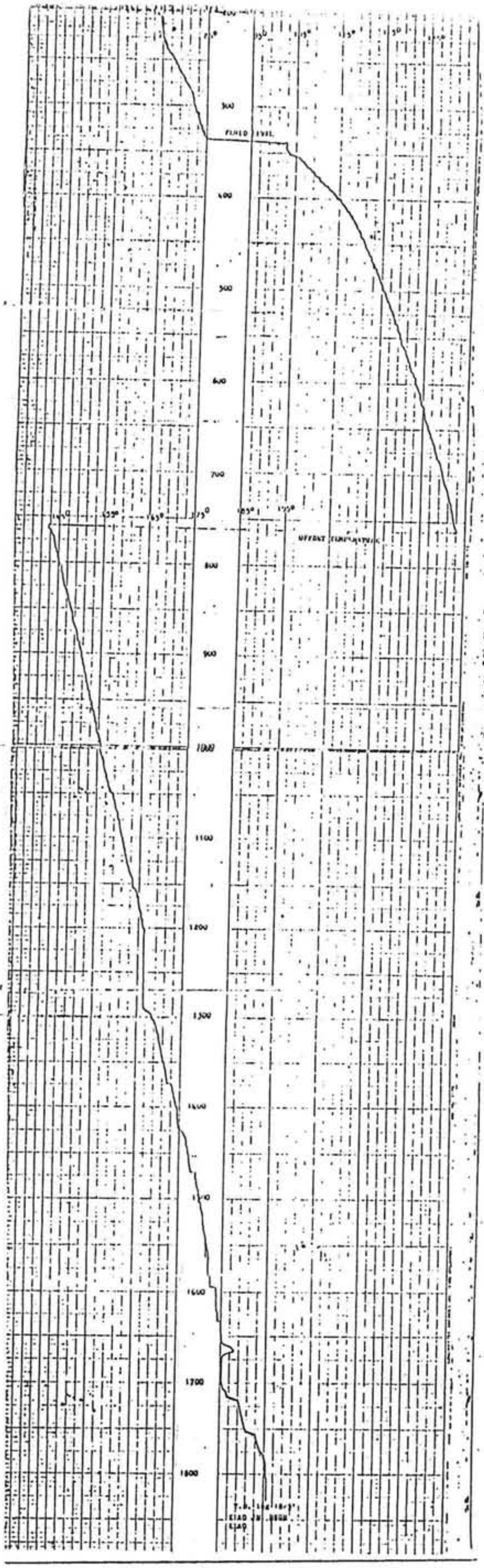
| | | | |
|---|---|---|---|
| Date | JAN.8,1985 | | |
| Run No. | TWO | | |
| Depth — Driller | 1825 ft. | ft. | ft. |
| Depth — GHD | 1825 ft. | ft. | ft. |
| Btm. Log Inter. | 1825 ft. | ft. | ft. |
| Top Log Inter. | 200 ft. | ft. | ft. |
| Casing — Driller | VAR. in. @ 1704 ft. | in. @ ft. | in. @ ft. |
| Casing — GHD | ft. | ft. | ft. |
| Bit Size | VAR. in. to ft. | in. to ft. | in. to ft. |
| Bit Size | in. to ft. | in. to ft. | in. to ft. |
| Bit Size | in. to ft. | in. to ft. | in. to ft. |
| Type Fluid In Hole | | | |
| Source of Sample | | | |
| PPM TDS | | | |
| Fluid Level | 340 ft. | ft. | ft. |
| Dens. / Visc. | | | |
| pH / Fluid Loss | ml | ml | ml |
| Rm @ Meas. Temp. | @ °F | @ °F | @ °F |
| Rmf @ Meas. Temp. | @ °F | @ °F | @ °F |
| Rmc @ Meas. Temp. | @ °F | @ °F | @ °F |
| Time Since Circ. | 12 hr. | hr. | hr. |
| Logging Speed | 15 ft./min. | ft./min. | ft./min. |
| Tool Type and No. | TEMP.-8 | | |
| Unit No. | 2 | | |
| Location | STOCKTON,CA. | | |
| Invoice No. | 3783 | | |
| Recorded By | DEWEY SHANHOLTZER (ASSOCIATE GEOLOGIST) | | |
| Witnessed By | G. BALL (WATERRESOURCES,RENO) | | |
| other | P. WILLIAMS (DRILLER) C. KNIGHT (ELKO SCHOOL | | |

P. O. Box 418 Tehachapi, California 93561 (805) 832-4101

Fold Here

SCALE CHANGES
Type Log
Depth
Scale Up Hole
Scale Down Hole

REMARKS: CONSULATNT-GEORGE BALL, WATERRESOURCES, RENO, NV.
DRILL METHOD: STD. ROTARY
DRILLED BY: PAUL WILLIAMS & SONS
SPARKS, NV.



# APPENDIX C

## FIELD DATA SHEETS

Project No. 85-329

# PUMPING TEST DATA

Page 1 of 3

WELL NO. ELKO JR HIGH

TYPE OF PUMPING TEST STEP-D.D.
[✓ PUMPING]/RECOVERY DATA
M.P. FOR WATER LEVELS 4.5 FT BELOW [illegible]
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S)
NA
PUMP ON: DATE 2/8/85 TIME 1200
PUMP OFF: DATE 2/8/85 TIME 2400

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI / FT | [✓ s] or s' | " | Q | |
| 1200 | 0 | | | 25.5<br>58.9 | 0 | 0 | | 25.2°C |
| 1202 | 2 | | | 16.5<br>37.11 | [illegible] | 6 | | |
| 1205 | 5 | | | 17.0<br>33.14 | [illegible] | 6¼ | | 35°C (95°) |
| 1207 | 7 | | | 17.25<br>[illegible] | 19.22 | 6½ | | |
| 1210 | 10 | | | 17.75<br>41.10 | 17.8 | 6½ | | 40.25°C |
| 1215 | 15 | | | 18.5<br>42.74 | 16.16 | 6¾ | | 45.25°C |
| 1220 | 20 | | | 19.5<br>45.05 | 13.85 | 7 | | 50.0°C |
| 1225 | 25 | | | 20.5<br>46.2 | 12.7 | 7 | | 52°C<br>Q TURNED BLACK |
| 1230 | 30 | | | 20.75<br>46.73 | 12.12 | 7¼ | | AIR (GAS) IN Q |
| 1235 | 35 | | | 21.0<br>[illegible] | 10.21 | 7¼ | | 62°C |
| [illegible] | 40 | | | 21.25<br>[illegible] | 9.71 | 7½ | | [illegible] @ 1238<br>[illegible] |
| [illegible] | 50 | | | 21.75<br>[illegible] | [illegible] | 7½ | | DISCHARGE INTO STORM SEWER [illegible]<br>72°C |
| 1300 | 60 | | | 22.0<br>[illegible] | 5.77 | 7¾ | | [illegible]°C |
| | - | | | 22.15<br>[illegible] | 5.17 | [illegible] | | 79°C |
| [illegible] | 70 | | | [illegible] | 4.07 | | | 80°C |
| [illegible] | [illegible] | | | 25.25<br>[illegible] | 4.07 | | | [illegible]<br>[illegible] |
| [illegible] | [illegible] | | | [illegible] | 3.46 | | | 81°C |
| [illegible] | [illegible] | | | [illegible]<br>55.44 | 3.46 | " | | |
| [illegible] | [illegible] | | | [illegible] | 2.9 | " | | 81°C |
| [illegible] | 165 | | | [illegible] | 2.9 | " | | [illegible] |
| [illegible] | [illegible] | | | 24.25<br>[illegible] | 2.9 | | | [illegible] |
| [illegible] | [illegible]/182 | | | 17.5<br>45.05 | [illegible] | 11 ± | | INCR Q TO [illegible]<br>82.5°C |
| [illegible] | 5/185 | | | 19.5<br>[illegible] | 13.32 | 11 ± | | 82.25°C |
| [illegible] | 15/195 | | | 18.25<br>42.16 | 16.74 | ~12 | | 82.75°C |
| 1520 | 20/200 | | | 18.1<br>41.81 | 17.09 | ~12 | | 83°C<br>SEWER LINE DISCHARGE TEMP = [illegible] |
| 1530 | 30/210 | | | 18.1<br>41.81 | 17.09 | ~12 | | 83°C |
| 1540 | 40/220 | | | 18.1<br>41.81 | 17.09 | ~12 | | 85.25°C |
| 1550 | 50/230 | | | 18.25<br>[illegible] | 16.74 | ~12 | | 83.2[illegible] |
| 1600 | 60/240 | | | 18.25<br>42.16 | 16.74 | [illegible] | | [illegible]<br>83.25°C |
| 1615 | 75/[illegible] | | | 18.5<br>42.74 | 16.16 | " | | 83.25°C<br>[illegible] |
| [illegible] | 90/[illegible] | | | [illegible]<br>42.74 | 16.16 | " | | [illegible]5°C [illegible] WATER<br>[illegible] |

WILLIAM E. NORK, INC.

Project No. [illegible]

# PUMPING TEST DATA

Page 2 of 3

WELL NO. ELKO JR HIGH

TYPE OF PUMPING TEST STEP-DD

[✓ PUMPING]/RECOVERY DATA

M.P. FOR WATER LEVELS 4 FT BELOW L.S.D

DISTANCE FROM PUMPING WELL NA

LOCATION

[✓ PUMPING]/OBSERVATION WELL

OTHER OBSERVATION WELL(S)

NA

PUMP ON: DATE 2/3/85 TIME 1200

PUMP OFF: DATE 2/3/85 TIME 2400

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI / FT | (S) or s' | IN | Q | |
| 1645 | 105 / 285 | | | 18.25 / 42.16 | 16.74 | ~12 | | 83.75°C |
| 1700 | 120 / 300 | | | 18.25 / 42.15 | 16.74 | ~12 | | 84°C |
| 1715 | 135 / 315 | | | 18.2 / [illegible] | 16.74 | ~12 | | 84°C |
| 1730 | 150 / 330 | | | 18. / [illegible] | 16.74 | ~12 | | 84°C |
| 1745 | 165 / 345 | | | 18. / [illegible] | 16.74 | ~12 | | 84°C |
| 1800 | 180 / 360 | | | [illegible] | [illegible] | ~12 | [illegible] | END STEP II, START STEP III<br>84°C |
| 1802 | 2 / 362 | | | 13.25 / 13.[illegible] | | ~18 | [illegible] | |
| 1805 | 5 / 365 | | | 11.0 / 25.41 | 33.49 | ~18 | | 84.5°C |
| 1810 | 10 / 370 | | | 11.0 / 25.41 | 33.49 | ~18 | | 84.5°C |
| 1815 | 15 / 375 | | | 11.0 / 25.41 | 33.49 | ~18 | 2.50 | 84.5°C |
| 1820 | 20 / 380 | | | 11.0 / 25.41 | 33.49 | ~18 | " | 84.5°C<br>OUTFLOW T = 127°F |
| 1825 | 25 / 385 | | | 11.0 / 25.41 | 33.49 | ~ | " | 84.5°C |
| 1830 | 30 / 390 | | | 11.0 / 25.41 | 33.49 | | | 84.5°C |
| 1840 | 40 / 400 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.5°C |
| 1850 | 50 / 410 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.5°C |
| 1900 | 60 / 420 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.5°C |
| 1915 | 75 / 435 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.8°C |
| 1930 | 90 / 450 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.96°C |
| 1945 | 105 / 465 | | | 11.0 / 25.41 | 33.49 | ~ | | 84.99°C |
| 2000 | 120 / 480 | | | 11.0 / 25.41 | 33.49 | ~ | | 85.°C |
| 2015 | 135 / 495 | | | 11.0 / 25.41 | 33.49 | ~ | | 85.°C |
| 2030 | 150 / 510 | | | 11.0 / 25.41 | 33.49 | ~ | | 85.°C |
| 2045 | 165 / 525 | | | 11.0 / 25.41 | 33.49 | ~ | | 85.°C |
| 2100 | 180 / 540 | | | 11.0 / 25.41 | 33.49 | ~ | | 85.°C |
| 2102 | 2. / 542 | | | 2.5 / 5.78 | – | 24½ | | 85.°C |
| 2105 | 5 / 547 | | | 2.66 / 6.41 | | 24½ | | 85.01°C |
| 2110 | 10 / 552 | | | 2.66 / 6.41 | | 24½ | | 85.1°C temp out flow 90° |
| 2115 | 15 / 557 | | | 2.66 / 6.41 | | 24½ | | 85.3°C |
| 2120 | 20 / 562 | | | 266 / 641 | | ~ | | 85.3°C |
| 2125 | 25 / 567 | | | 2.66 / 6.41 | | ~ | | 85.3°C |
| 2130 | 30 / 57[illegible] | | | 2.66 / 6.41 | | ~ | | 85.3°C |

Project No. 85-324

# PUMPING TEST DATA

Page 5 of 5

WELL NO. ELKO JR HIGH

TYPE OF PUMPING TEST STEP-DD
[✓ PUMPING]/RECOVERY DATA
M.P. FOR WATER LEVELS
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S)
NA
PUMP ON: DATE 2/8/85 TIME 1200
PUMP OFF: DATE TIME

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI / FT | Ⓢ or s' | | Q | |
| 2140 | 40 / 582 | | | 2.66 / 6.41 | | 24½ | | 85.3$^{c}$ |
| 2150 | 50 / 592 | | | 2.66 / 6.41 | | 24½ | | 85.3$^{c}$ |
| 2200 | 60 / 602 | | | 2 60 / 6.41 | | 24 ½ | | 85.[illegible]$^{c}$ temp outflow 118° |
| 2215 | 75 / 617 | | | 2.66 / 6.41 | | 24½ | | 85 3$^{c}$ |
| 2230 | 90 / 632 | | | 2.66 / 6.41 | | 24 ½ | | 85.4$^{c}$ |
| 2245 | 105 / 647 | | | 2.66 / 6.41 | | 24 ½ | | 85.4$^{c}$ |
| 2300 | 120 / 662 | | | 266 / 6.41 | | 24½ | | 85.4$^{c}$ temp outflow 125° |
| 2315 | 135 / 677 | | | 266 / 6.41 | | 24½ | | 85.3$^{c}$ |
| 2330 | 150 / 692 | | | 2.66 / 6.41 | | 24½ | | 85 4$^{c}$ |
| 2345 | 165 / 707 | | | 2.66 / 6.41 | | 24½ | | 85.4$^{c}$ |
| 2400 | 180 / 722 | | | 2.66 / 6.41 | | 24 1/2 | | 85.4$^{c}$ temp [illegible] outflow 130° |
| 2402 | 2 / 721 | | | 37.5 / 86.62 | | 0 | | 82.5$^{c}$ |
| 2405 | 5 / 727 | | | 37.5 / 86.62 | | 0 | | 76.$^{c}$ |
| 24 10 | 10 / 732 | | | 37.5 / 86.62 | | 0 | | 74.9$^{c}$ |
| 24 15 | 15 / 737 | | | 37.5 / 86.62 | | 0 | | 71$^{c}$ |
| 2420 | 20 / 742 | | | 37.09 / 85.67 | | 0 | | 68$^{c}$ |
| 2425 | 25 / 747 | | | 36.66 / 84.68 | | 0 | | 66$^{c}$ |
| 24 30 | 30 / 752 | | | 36.66 / 84.68 | | 0 | | 63$^{c}$ |
| 24 40 | 40 / 762 | | | 36.66 / 84.68 | | 0 | | 59.5$^{c}$ |
| 24 50 | 50 / 772 | | | 36.3 / 83.85 | | 0 | | 55.2$^{c}$ |
| 0100 | 60 / 782 | | | 36 / 83.16 | | 0 | | 51.9$^{c}$ . |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Project No. 85-524

# PUMPING TEST DATA

Page 1 of 3

WELL NO. ELKO JR HIGH SCHOOL

TYPE OF PUMPING TEST VARIABLE Q / CONSTANT Q
[✓ PUMPING]/RECOVERY DATA
M.P. FOR WATER LEVELS 4.5 FT BELOW L.S.D
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S)
N/A
PUMP ON: DATE 2/9/85 TIME 1100
PUMP OFF: DATE 2/11/85 TIME 1100

3.17 LB/GAL

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI | [✓ s] or s' | | Q | |
| 1100 | 0 | | | 30.75 | | 0 | | |
| 1101 | 1 | | | 2.75 | | 21 | 273<br>2241 | |
| 1102 | 2 | | | 2.75 | | 20 5/8 | 270<br>2217 | T = 59°C<br>2241.3 LB/MIN |
| 1103 | 3 | | | 2.75 | | 20 5/8 | 270<br>2217 | |
| 1105 | 5 | | | 2.5 | | 20 3/4 | 272<br>2230 | |
| 1107 | 7 | | | 2.5 | | 21 | 273<br>2236 | T=63.5°C |
| 1110 | 10 | | | 2.5 | | 21 1/2 | 275<br>2245 | T=62.5°C SOME GAS IN Q NOW |
| 1113 | 13 | | | 2.5 | | 21 1/2 | 274<br>2239 | |
| 1116 | 16 | | | 2.5 | | 21 5/8 | 276<br>2249 | T= 72°C |
| 1120 | 20 | | | 2.5 | | 22 1/2 | 282<br>2293 | T=75 |
| 1125 | 25 | | | 2.5 | | 22 3/4 | 283.5<br>2302 | T=77°C |
| 1130 | 30 | | | 2.5 | | 22 3/4 | 283.5<br>2296 | E.C. = 750 MMHO/CM pH: 7.01<br>T = 80.75°C |
| 1135 | 35 | | | 2.5 | | 23 | 285<br>2307 | T = 83°C |
| 1140 | 40 | | | 2.5 | | 23 1/4 | 286.5<br>2318 | T = 83.25°C |
| 1150 | 50 | | | 2.5 | | 23 3/8 | 287<br>2319 | T = 84°C |
| 1200 | 60 | | | 2.5 | | 23 3/8 | 287<br>2319 | T = 84.25°C |
| 1220 | 80 | | | 2.5 | | 23 3/8 | 287<br>2318 | T = 85°C |
| 1240 | 100 | | | 2.5 | | 23 5/8 | 288<br>2334 | T = 85°C |
| 1300 | 120 | | | 2.75 | | 23 5/8 | 288<br>2334 | T = 85.25°C<br>OUTSIDE T = 122°F |
| 1330 | 150 | | | 1.9 | | 23 5/8 | 288<br>2334 | T = 85.5°F |
| 1400 | 180 | | | 2.9 | | 23 1/2 | 288<br>2326 | T = 85.5°F |
| 1430 | 210 | | | 2.9 | | 23 5/8 | 289<br>2334 | T = 85.5°F |
| 1500 | 240 | | | 2.9 | | 23 3/4 | 290<br>2342 | T = 85.75°F E.C. = 800 MMHO/CM<br>pH = 7.0 2340 LB/GAL |
| 1530 | 270 | | | 2.9 | | 23 5/8 | 289<br>2326 | T = 85.75 |
| 1600 | 300 | | | 2.9 | | 23 5/8 | 289<br>2326 | T = 85.75°C |
| 1630 | 330 | | | 2.9 | | 23 5/8 | 289<br>2326 | T = 85.75°C |
| 1700 | 360 | | | 2.9 | | 23 3/4 | 290<br>2334 | T=85.75°C SAMPLE -1<br>pH: 7.01 E.C. : 870 MMHO |
| 1800 | 420 | | | 2.9 | | 24 1/4 | 292.5<br>2362 | T= 85.75°C |
| 1900 | 480 | | | 2.9 | | 23 3/4 | 290<br>2342 | T = 85.9°C |
| 2000 | 540 | | | 2.75 | | 24 1/2 | 292.5<br>2362 | T= 86°C<br>E.C. = 850 MMHO |
| 2100 | 600 | | | 2.75 | | 24 1/2 | 292.5<br>2362 | T=86°C<br>E C = 900 MMHO |

WILLIAM E. NORK, INC.

PROJECT NO. [illegible]

## PUMPING TEST DATA

Page [illegible] of [illegible]

WELL NO. [illegible]

TYPE OF PUMPING TEST [illegible]
[✓ PUMPING]/RECOVERY DATA
M.P. FOR WATER LEVELS [illegible]
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S) NA
PUMP ON: DATE 2/9/85 TIME 1100
PUMP OFF: DATE 2/11/85 TIME 1100

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | 30.75 | s or s' | INCHES | Q | |
| 2200 | 660 | | | 2.9 | | 24½ | 294<br>2374 | T= 86°C E.C.=900µMHO |
| 2300 | 720 | | | 2.9 | | 24½ | 294<br>2374 | T= 86°C E C =900µMHO |
| 2400 | 780 | | | 2.8 | | 24 ¾ | 295.5<br>2386 | T= 86°C E.C =875µMHO |
| 0100 | 840 | | | 2.99 | | 24 ¾ | 295.5<br>2386 | T=86°C E C =875µMHO |
| 0200 | 900 | | | 2.9 | | 24 ¾ | 295.5<br>2386 | T=86°C E.C =875µMHO |
| 0300 | 960 | | | 2.85 | | 24½ | 294<br>2374 | T= 86°C E C = 800µMHO |
| 0400 | 1020 | | | 2.9 | | 24½ | 294<br>2374 | T= 86°C E.C =875µMHO |
| 0500 | 1080 | | | 2.9 | | 24 ¾ | 295.5<br>2386 | T= 86°C E.C. = 875µMHO |
| 0600 | 1140 | | | 2.8 | | 24 ¾ | 295.5<br>2386 | T=86°C E.C =875µMHO |
| 0700 | 1200 | | | 2.8 | | 24 ¾ | 295.5<br>2386 | T=86°C E.C =875µMHO |
| 0800 | 1260 | | | 2.8 | | 24¼ | 292.5<br>2362 | T= 86°C pH = 6.9 E.C = 875 µMHO OUTFLOW T = 123°F |
| 0900 | 1320 | | | 2.75 | | 24 | 291<br>2348 | T = 86.25°C |
| 1000 | 1380 | | | 2.75 | | 24 | 291<br>2348 | T = 86.25°C |
| 1100 | 1440 | | | 2.75 | | 24 | 291<br>2348 | T=86.25°C SAMPLE 85-324-2 E.C. = 850 µMHO/CM pH = [illegible] |
| 1200 | 1500 | | | 2.75 | | 23 ⅞ | 290<br>2340 | T= 86.25°C |
| 1300 | 1560 | | | 2.7 | | 23 ⅞ | 290<br>2340 | T= 86.25°C (187.25°F) |
| 1400 | 1620 | | | 2.8 | | 23 ⅞ | 290<br>2340 | T= 86.25°C E.C. STORM SEWER [illegible] |
| 1500 | 1680 | | | 2.8 | | 23 ⅞ | 290<br>2340 | T= 86.25°C E.C OF OUTFLOW [illegible] µMHO |
| 1600 | 1740 | | | 2.8 | | 23 ⅞ | 290<br>2340 | T= 86.25°C E.C. = 875 µMHO/CM |
| 1700 | 1800 | | | 2.8 | | 23¾ | 290<br>2340 | T= 86.25°C |
| 1800 | 1860 | | | 2.8 | | 23¾ | 290<br>2340 | T= 86.25°C E.C. = 875 µMHO/CM pH = 6.7 |
| 1900 | 1920 | | | 2.8 | | 24 | 291<br>2348 | T= 86.25°C OUTFLOW T = 123°C |
| 2000 | 1980 | | | 2.9 | | 24 | 291<br>2348 | T.=86.25°C E.C. 875 µMHO |
| 2100 | 2040 | | | 2.8 | | 24½ | 294<br>2373 | T: 86.25 |
| 2200 | 2100 | | | 2.9 | | 24 ¾ | 295.5<br>2385 | T=86.25°C E.C 875 µMHO |
| 2300 | 2160 | | | 2.9 | | 24 ¾ | 295.5<br>2385 | T=86.25°C |
| 2400 | 2220 | | | 2.9 | | 24¾ | 295.5<br>2385 | T=86.25°C E.C. 850 µMHO |
| 0100 | -2280 | | | 2.85 | | 24¾ | 295.5<br>2385 | T=86.25°C |
| 0200 | 2340' | | | 2.90 | | 24 ¾ | 295.5<br>2385 | T= 86.35°C E.C. 850 µMHO |
| 0300 | 2400 | | | 2.85 | | 24 ¾ | 295.5<br>2385 | T= 86.15°C |
| 0400 | 2460 | | | 2.85 | | 24 ¾ | 295.5<br>2385 | T= 86.25°C E.C. 825 µMHO |

LR CAL

= 8.07

WILLIAM E. NORK, INC.

PROJECT NO. [illegible]

# PUMPING TEST DATA

Page 3 of 3

WELL NO. ELKS JR HIGH SCHOOL

TYPE OF PUMPING TEST VARIABLE Q / CONSTANT S
[✓ PUMPING]/RECOVERY DATA
M.P. FOR WATER LEVELS
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S) NA
PUMP ON: DATE 2/9/85 TIME 1100
PUMP OFF: DATE 2/11/85 TIME 1100

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI | [✓ s] or s' | in | Q | |
| 0500 | 2520 | | | 2.85 | | 24 3/4 | 295.5<br>2385 | T= 86.25°C |
| 0600 | 2580 | | | 2.85 | | 24 1/2 | 294<br>2373 | T= 86.25°C E.C 875 MMHO |
| 0700 | 2640 | | | 2.85 | | 24 3/4 | 295.5<br>2385 | T= 86.25°C |
| 0800 | 2700 | | | 2.85 | | 24 3/4 | 295.5<br>2385 | T= 86.25°C E.C.875 MMHO |
| 0900 | 2760 | | | 2.85 | | 24 3/4 | 295.5<br>2385 | T= 86.25°C |
| 1015 | 2835 | | | 2.4 | | 24 1/2 | 294<br>2373 | T = 86.25°C |
| 1100 | 2880 | | | 2.5 | | 24 1/2 | 294<br>2373 | T = 86.25 E.C = 875<br>pH = 6.7 SAMPLE #3 |

WILLIAM E. NORK, INC.

# PUMPING TEST DATA

WELL NO. [illegible]

TYPE OF PUMPING TEST SHUT-IN ([illegible] CONSTANT-HEAD TEST)
PUMPING/[✓ RECOVERY] DATA
M.P. FOR WATER LEVELS [illegible] FT BELOW [illegible]
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S)
N/A
PUMP ON: DATE 2/4/85 TIME 1100
PUMP OFF: DATE 2/4/85 TIME 1100

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI | s or [✓ s'] | | Q | |
| 1100 | 2880 | 0 | ∞ | 2.8 | | | | |
| 1100.5 | 2880.5 | 0.5 | 5760 | 37.1 | | | | |
| 1101 | 2881 | 1 | 2881 | 37.5 | | | | |
| 1102 | 2882 | 2 | 1441 | 37.25 | | | | |
| 1103 | 2883 | 3 | 961 | 37.5 | | | | |
| 1105 | 2885 | 5 | 577 | 37.5 | | | | |
| 1107 | 2887 | 7 | 412.4 | 37.5 | | | | |
| 1110 | 2890 | 10 | 289 | 37.5 | | | | |
| 1113 | 2893 | 13 | 222.5 | 37.25 | | | | |
| 1116 | 2896 | 16 | 181 | 37.25 | | | | |
| 1120 | 2900 | 20 | 145 | 37.25 | | | | |
| 1145 | 2925 | 45 | 65 | 37.25 | | | | |
| 1150 | 2930 | 50 | 57.6 | 37 | | | | |
| 1200 | 2940 | 60 | 49 | 36.5 | | | | |
| 1220 | 2960 | 80 | 37 | 36.25 | | | | |
| 1240 | 2980 | 100 | 29.8 | 36.0 | | | | |
| 1300 | 3000 | 120 | 24.2 | 36.0 | | | | |
| 1330 | 3030 | 150 | [illegible] | 36.0 | | | | |
| 1400 | 3060 | 180 | 17 | 35.5 | | | | |
| 1430 | 3090 | 210 | 14.7 | 360 | | | | |
| 1500 | 3120 | 240 | 13 | 35.9 | | | | |
| 1600 | 3180 | 300 | 10.6 | 34.5 | | | | |
| 1700 | 3240 | 360 | 9.1 | 34 | | | | |
| 1830 | 3330 | 450 | 7.4 | 33.5 | | | | |
| 1930 | 3390 | 510 | 6.7 | 33.0 | | | | |
| 2100 | 3480 | 600 | 5.8 | 33.0 | | | | |
| 2200 | 3540 | 660 | 5.4 | 32.25 | | | | |
| 2300 | 3600 | 720 | 5.0 | 32.25 | | | | |
| 0300 | 3840 | 960 | 4.0 | 31.0 | | | | |
| 0730 | 4110 | 1230 | 3.34 | 30.75 | | | | |
| 1100 | 4320 | 1440 | 3.0 | 30.[illegible] | | | | |

2[illegible]0
720
500

**WILLIAM E. NORK, INC.**

# PUMPING TEST DATA

WELL NO. ELKO JR HIGH SCHOOL

TYPE OF PUMPING TEST SHUT-IN (FOLLOWING A CONSTANT-HEAD TEST)
PUMPING/[✓ RECOVERY] DATA
M.P. FOR WATER LEVELS 4.5 FT BELOW LSD.
DISTANCE FROM PUMPING WELL —
LOCATION

[✓ PUMPING]/OBSERVATION WELL
OTHER OBSERVATION WELL(S) N/A
PUMP ON: DATE 2/9/85 TIME 1100
PUMP OFF: DATE 2/11/85 TIME 1100

| CLOCK TIME | ELAPSED TIME (minutes) | | t/t' | WATER LEVEL MEASUREMENT (feet) | | PUMPING RATE (gpm) | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | t | t' | | PSI | s or [✓ s'] | | Q | |
| 1330 | 4470 | 1590 | 2.8 | 30.0 | | | | |
| 1530 | 4590 | 1710 | 2.7 | 29.5 | | | | |
| 2100 | 4920 | 2040 | 2.4 | 29.0 | | | | |

**WILLIAM E. NORK, INC.**
1026 West First Street
RENO, NEVADA 89503
(702) 322-2604

SHEET NO. 1 OF
CALCULATED BY DGB DATE 1/22/85
CHECKED BY WEN DATE 1-23-85
SCALE

ELKO JR. HIGH SCHOOL WELL HEAT-FLOW TEST

| CLOCK TIME | Q |  | $T_{IN}$ | $T_{OUT}$ | REMARKS |
|---|---|---|---|---|---|
|  | INCH | GPM | °F | °F |  |
|  |  |  |  |  | FLOW MEASURED W/ 90° V-NOTCH WEIR |
| 1510 | – | – | – | – | TURNED CITY WATER ON. |
| 1515 | – | – | – | – | STARTED MUD PUMP TO OPEN CHECK VALVE. |
| 1518 | – | – | – | – | FLOW STARTED |
| 1519 | 4½ | 94 | – | 72.5 | NOTE - OUTFLOW T CALIBRATED W/ Hg THERMOMETER |
| 1521 | " | " | – | 74.3 | INSTALLED THERMOMETER IN INLET |
| 1526 | " | " | 41 | 76.1 |  |
| 1530 | " | " | 41 | 77.9 |  |
| 1535 | " | " | 42.8 | 76.1 | DISCHARGE Δ'D COLOR FROM BLACK TO RUSTY |
| 1545 | " | " | 45.5 | 80.6 |  |
| 1550 | " | " | 46.4 | 79.7 |  |
| 1555 | " | " | 48.2 | 76.1 | BUBBLES IN Q. CITY WATER REACHING THE SURFACE @1553 |
| 1600 | " | " | 50.9 | 84.2 | DISCHARGE IS NOW CLEAR |
| 1605 | " | " | 55.4 | 86.0 |  |
| 1610 | " | " | 58.1 | 86.0 |  |
| 1620 | " | " | 60.8 | 86.9 |  |
| 1630 | " | " | 62.6 | 86.9 |  |
| 1640 | " | " | 62.6 | 86.0 |  |
| 1644 | 3½ | 50 | 62.6 | 85.1 | SHUT OFF MUD PUMP. FLOW DUE TO CITY PRESSURE ONLY |
| 1700 | " | " | 61.7 | 82.4 |  |
| 1708 | 3 | 34 | 61.7 | 81.5 |  |
| 1738 | 3¼ | 42 | 61.7 | 79.7 | BILL PETTY TO AIRPORT @ 1420 |
| 1808 | " | " | 61.7 | 79.7 |  |
| 1909 | " | " | 61.7 | 78.8 | NO NOTICABLE TURBIDITY |
| 2155 | " | " | 61.7 | 78.8- |  |
| 2256 | " | " | 61.7 | 77.9 |  |
| 0112 | " | " | 62.6- | 77.9 | 1/23/85 |
| 0530 | " | " | 62.6- | 77.9 |  |
| 0735 | " | " | 62.6 | 77.9 |  |
| 0840 | " | " | 62.6 | 77.9 | SHUT WATER OFF @ 0841 |