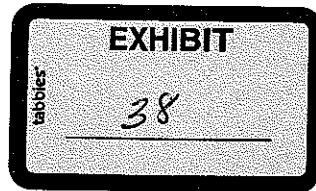


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SCANLAN ENGINEERING

Groundwater and Environmental Engineering

July 1, 1999

Jo Beeman
Beeman & Hofstetter
608 West Franklin Street
Boise, ID 83702-5509

Subject: MacGregor - Belvidere and Raspberry Ranches

Dear Jo:

This letter report provides a summary of information developed following my visit to the above referenced properties with Carol MacGregor on June 7, 1999. Figure 1 shows the location of the properties and associated water features. Details follow.

BELVIDERE HOT SPRINGS

Location

Based on my review of map data and measured distances during my site visit, the hot springs are located in the NESENE of Section 13, T13N, R3E. This location assumes that the fence line between the Pancheri and MacGregor properties follows, or is slightly south of, the 1/16th section line. The fence line is 170 feet north of the centerline of West Mountain Road. The lower bathhouse is approximately 470 feet east of the centerline of the County Road and 50 feet south of the fence line between the Pancheri and MacGregor properties. The upper bathhouse is approximately 400 feet from the County Road and 80 feet south of the fence.

As additional confirmation of the spring location, IDWR's field exam for water right 65-12891 and USGS Water Resources Investigations Open File Report 80-1020 both indicate that the spring is located in the NESENE of Section 13, T13N, R3E.

Description of Belvidere Hot Springs

Belvidere Hot Springs consists of an area of at least one acre with diffuse geothermal discharge. The spring area is concentrated within a fenced area approximately 120 feet by 75 feet on the MacGregor property, although evidence of geothermal discharge also is visible outside of the fenced area on both the MacGregor and Pancheri properties. The spring area trends in a North 60 East direction, suggesting the possible presence of a geologic structure (i.e., fault) or other subsurface feature trending N60E.

Within the fenced portion of the MacGregor property, two main areas of discharge are visible. Both of these spring vents historically had been developed with bathhouses, although only remnants of these structures are currently visible. At the time of my visit, the discharge from the

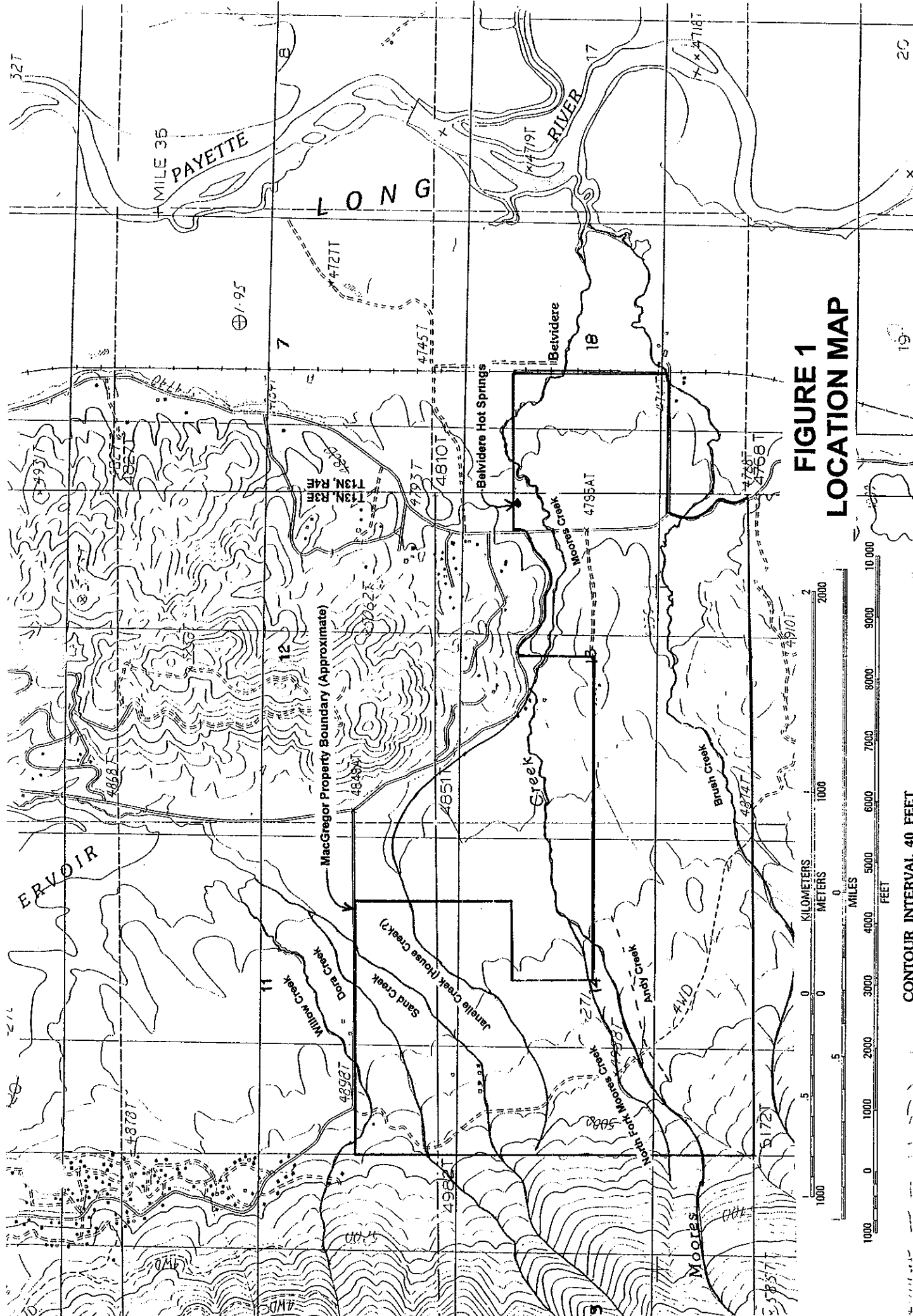


FIGURE 1 LOCATION MAP

CONTOUR INTERVAL 40 FEET

upper bathhouse vent was visually estimated at approximately 20 gpm (gallons per minute). Surface temperature was 104 degrees F. The discharge from the lower bathhouse vent was visually estimated at approximately 50 gpm. Surface temperature was 121 degrees F. East of the fence surrounding the spring area, total combined discharge from the spring area was estimated at 100 to 150 gpm with a temperature of 92 degrees F.

Data for Belvidere Hot Springs is mentioned in several publications. Excerpts are copied and attached. The best description is found in "Geothermal Investigation of the Cascade Area", July 1976, by Boise State University. The report indicates that the hot spring is located along the north-trending Cascade Valley Fault. A series of hot springs are found along this fault, including (from south to north) Cabarton, Belvidere, Cascade, Flat Creek, and Gold Fork. (Although not mentioned in the report, it is possible that the Belvidere Hot Spring is located at the intersection of the north-trending Cascade Valley Fault and an unmapped fault trending N60E.) The discharge temperature for Belvidere hot springs was reported to be 121 degrees F. Based on silica concentration in the water and a mixing model, the authors estimated that the temperature of the hot spring source could be as high as 325 degrees F.

A chemical analysis in USGS Water Resources Investigations Open File Report 80-1020 indicates that the spring has a temperature of 120 degrees F and a discharge of 20 gpm. The water is a sodium bicarbonate type with total dissolved solids of 256 mg/l. Based on various geochemical methods, the USGS report estimated that the temperature of the aquifer source ranges from 117 to 232 degree F. Based on these geochemical models, a source temperature of approximately 180 degrees F appears to be likely.

For comparison purposes, the surface water temperatures at other hot springs along the Cascade Valley Fault range from 100 degrees F at Flat Creek to 160 degrees F at Cabarton.

Existing Water Rights for Belvidere Hot Springs

Based on information provided by your office, I understand that the following water rights are recorded or claimed for Belvidere Hot Springs on the MacGregor property.

- **65-01972.** Eastern Western Corporation holds a decreed water right for 0.04 cfs (18 gpm) and 1.2 afy for domestic use from a spring tributary to Moores Creek. Priority date is May 1, 1901. The diversion point and place of use are located in the NESE of Section 13.
- **65-01973.** Eastern Western Corporation holds a decreed water right for 0.01 cfs (4.5 gpm) and 1.2 afy for domestic use from a spring tributary to Moores Creek. Priority date is May 1, 1901. The diversion point and place of use are located in the NESE of Section 13.
- **A65-17557.** Eastern Western Corporation filed a claim in the SRBA for 0.02 cfs from a hot spring believed to be Belvidere Hot Springs, but it appears that the point of diversion and place of use was listed incorrectly one-quarter mile to the east in Section 18. In any event, the claim will not be recommended by IDWR because it was not claimed in the previous decree of the Payette River Basin.

6/22/99
to 13458
DVT/maiden

The following water rights owned by the Pancheris are related to Belvidere Hot Springs.

- **65-12891.** Duane and Darwin Pancheri hold a licensed water right for 0.40 cfs (180 gpm) and 47.7 afy for heating purposes from a spring with the point of diversion listed as the SENENE and NESENE of Section 13. Places of use are SESW, NWSE, and SWSE Section 18, T13N, R4E. Priority date is October 19, 1988.

Review of the license file for 65-12891 shows that the spring is developed by a buried drain system located approximately 50 feet north of the fence between the MacGregor and Pancheri properties. From the buried drain system, water flows by gravity through 10-inch pipe approximately 2100 feet east, and then 4-inch pipe for 2800 feet to the south side of Brush Creek. Two buried valves along the pipeline are accessed through steel pipes that look like well casings. The system serves three homes, one swimming pool, and one shop located on the south side of Brush Creek.

- **65-13332.** Joan and Darwin Pancheri hold a permit for 0.10 cfs (45 gpm) for heating purposes from a spring with a point of diversion listed as SENENE Section 13. Place of use is the NENE Section 13. Use is described as heating of one home and one shop. Priority date is July 2, 1991.

This water right uses the spring source for heating the home and shop located north of the springs. A $\frac{3}{4}$ hp pump with 1.5-inch diameter pipe was proposed as the means to deliver water to the house.

Based on the rights described above, it appears that MacGregor has the senior water right to the hot water source, but only for a small portion of the available flow. The majority of the spring discharge (in terms of both flow rate and acre feet) and the related heat value is covered by water rights owned by the Pancheris.

Potential for Additional Geothermal Development

There is potential for additional development of the geothermal water source at Belvidere Hot Springs provided that steps are taken to prevent injury to existing water rights. At least two options could be considered.

- The first option would be to develop the hot springs by collecting the natural discharge. This option might be similar to the previous spring development by Pancheri, and consist of one or more collection pipes routed to a pump sump. The water could then be pumped to a place of use. The advantage of this option is that there is less chance to impact existing water rights. Development would take advantage of flow that naturally discharges from the spring and is not currently diverted by others. The disadvantage of this option is that the natural discharge rate and surface temperature will limit the extent to which the spring can be developed.
- The second option would be to drill one or more wells at the hot spring location to develop hotter water that can be pumped on demand. This option would seek to intersect geothermal

water that is believed to be flowing upward through fractured granite bedrock. An advantage of this option is that the water can be intersected prior to mixing with cooler shallow groundwater. In addition, the water can be pumped as needed, using the geothermal aquifer for storage. Therefore, water (and heat) would not be lost by natural discharge at the spring. The disadvantage of this option is that there is significant potential to impact the flow rate or temperature at the spring developed by the Pancheris. Also, geothermal drilling is costly, due to requirements for multiple casing strings to be cemented in place.

Regardless of which option is selected, I would recommend that temperatures and discharge rates from the spring area on both the Pancheri and MacGregor properties be monitored and documented before the spring is developed. This monitoring should be used to document natural flow (including seasonal variations) and actual use of the water. Based on this monitoring, mitigation (if necessary) can be established in the future.

Cold Groundwater at Belvidere and Little Ranch House

Carol asked about the potential to develop a cold groundwater source at the Belvidere property for domestic use and for temperature moderation at the hot springs. She is also interested in the existing well at the Little ranch house. The following information was found.

Potential for Development of Cold Groundwater Wells at Belvidere Hot Springs. Drilling by the Pancheris on their property to the north of the hot springs provides an indication of cold groundwater potential in this area. The Pancheris drilled two wells in June 1991 in the area north of the MacGregor property. The first well was located in the NENE Section 13, probably in the vicinity of the house. This 99-foot deep well produced 10 gpm of 52 degree F water, and had a static water level of 28 feet. A second well was drilled in the NWNW Section 18, probably somewhere north and east of the hot springs. This well produced more than 100 gpm of 60 degree F water from sand and gravel zones between 38 and 47 feet. The well is slightly artesian, and flows at 0.5 gpm.

Based on the drill log for the second Pancheri well, there is good potential for developing cold groundwater in the general vicinity of Belvidere Hot Springs. The best location for a cold water well will be south and east of the hot spring, where the depth to granite bedrock will be several hundred feet. In that area, it is possible that sand and gravel aquifers yielding 100 gpm or more of cold groundwater could be developed with properly constructed wells.

Drilling Log for Well at Little Ranch House. IDWR well log files were searched by legal description for a log of the well at the Little ranch house. Carol thought that the well was drilled by Eastern-Western Corporation within the past few years. However, no log could be located for the quarter-quarter section where the well is located (NESW or SENW of Section 13). The closest recorded well that has been constructed in recent years (based on location description) was drilled in 1989 for Gulf Pacific Cattle Company in the SWNE of Section 13. This well produced 4.7 gpm. An older well, drilled for Frank Bilbao in 1974, is described as located in the NWSE of Section 13. The Bilbao well produced 12 gpm.

The data base was also searched by owner's name for any wells drilled for Eastern-Western Corporation. Two wells were located. These wells were drilled for Eastern-Western in 1994, but at a location approximately 15 miles north of Belvidere.

IRRIGATION WATER RIGHT SUMMARY - RASPBERRY AND BELVIDERE RANCHES

I did not conduct a formal water right search for these properties. However, based on information provided by your office, the irrigation water rights associated with the Raspberry and Belvidere Ranches are summarized in Table 1.

**Table 1 – Irrigation Water Rights
Raspberry and Belvidere Ranches**

Water Right No.	Owner	Stage	Source	Priority	rate (cfs)	acres
65-03406	MacGregor	decree	House Creek, NF Moores Cr	April 1, 1897	1.56	78
65-03407	MacGregor	decree	Dora Creek	April 1, 1897	1	50
65-03408	MacGregor	decree	House Creek, Sand Cr	April 1, 1897	0.72	46
65-01979	A.L. Cattle, Inc.	decree	Brush Creek	June 1, 1918	6.24	312
65-11280	A.L. Cattle, Inc.	decree	Andy Creek, SF Moores Cr	June 1, 1902	1.06	53

The water rights authorize diversion of 10.58 cfs for irrigation of 539 acres. Each water right is for one miners inch per acre, except for 65-03408 which is for 0.78 miners inches per acre.

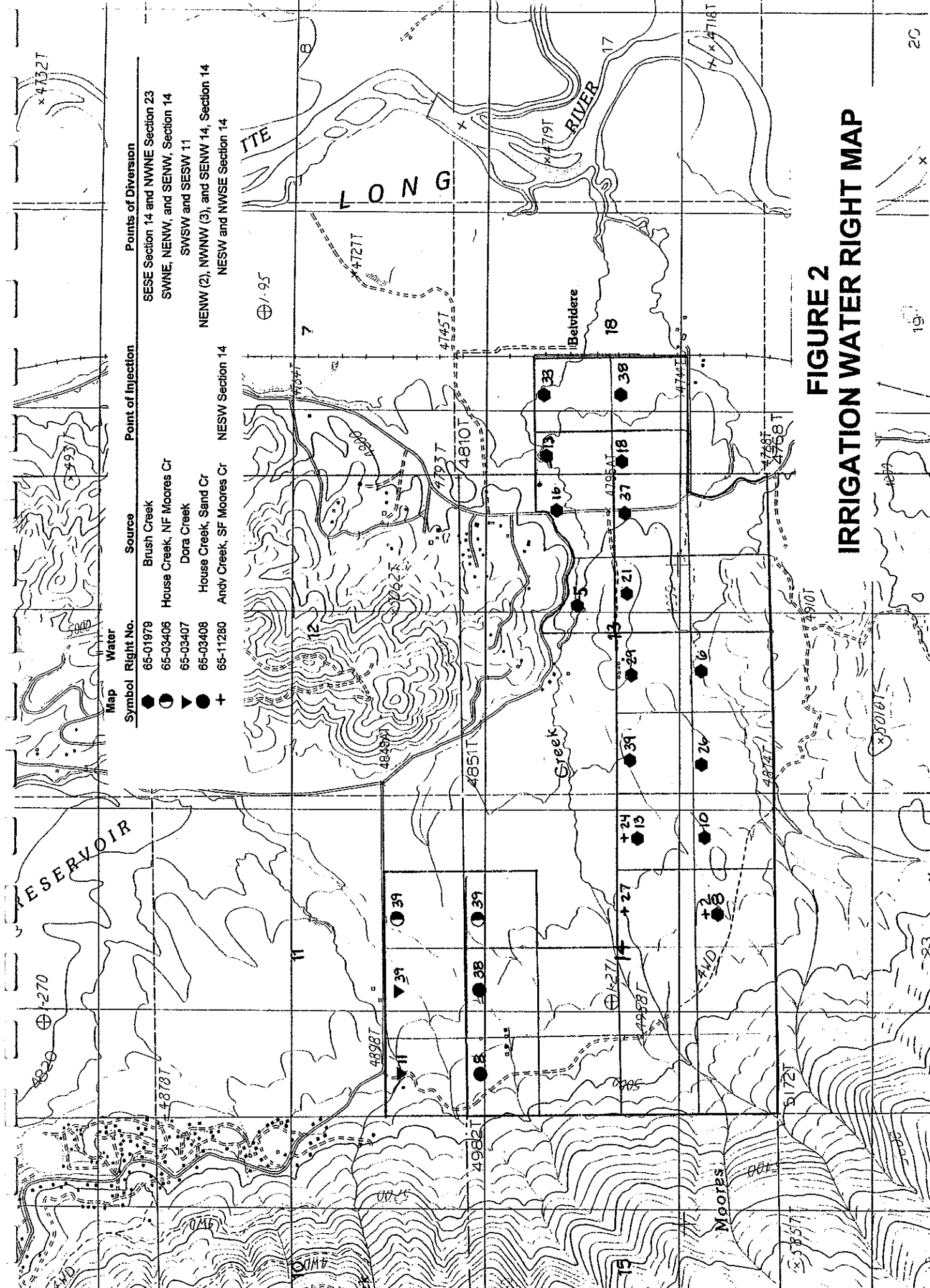
A water right map is provided as Figure 2. The water right map should be studied to determine if the existing place of use has adequate water rights. For instance, there are only 8 acres of authorized irrigation in the area west of the existing Raspberry Ranch house, and no authorized irrigation in the 240-acre area (i.e., six ¼- ¼ sections) south of the Raspberry Ranch house. Although this area is mostly timbered, there may be some irrigation occurring. If so, a new application for permit should be submitted to allow irrigation of this area when adequate water is available.

Points of diversion for each water right are listed on the table attached to Figure 2. The points of diversion are described by 40-acre tract, and most of the rights have multiple diversion points which provide good flexibility for water use. The tracts authorized for diversion should be reviewed to confirm that existing diversion points are described.

A copy of a stipulation regarding some of these rights is attached. The stipulation indicates that although water right 65-11280 is junior to Pancheri's right 65-11250, it will be considered as a prior right for distribution purposes as long as the following conditions are met.

1. Use of water under right 65-11280 shall not be expanded to new lands.
2. The method of irrigation under 65-11280 cannot be changed.
3. The place of use or point of diversion for water right 65-11280 cannot be changed without written consent from the Pancheris.

I note that the water right information received from your office included a permit for irrigation in the name of Davis Cattle Company. This permit lists a place of use for irrigation on both



Map Symbol	Water Right No.	Source	Point of Injection	Points of Diversion
●	65-01979	Brush Creek		SESE Section 14 and NWNE Section 23
○	65-03406	House Creek, NF Moores Cr		SWNE, NENW, and SENW, Section 14
▼	65-03407	Dora Creek		SWSW and SESW 11
●	65-03408	House Creek, Sand Cr		NENW (2), NWNW (3), and SENW 14, Section 14
+	65-11280	Andy Creek, SF Moores Cr	NESW Section 14	NESW and NWSE Section 14

**FIGURE 2
IRRIGATION WATER RIGHT MAP**

MacGregor and Pancheri lands. I suspect that the place of use listed on this permit is a typographical error. The actual place of use is probably six miles north (i.e., one township) in Township 14 North.

WATER SUPPLY FOR NEW HOME AT RASPBERRY RANCH

While on site, Carol and I discussed options for water supply to a proposed new home at the property. The new home would be located near Janelle Creek (House Creek?), south of the existing ranch house. Carol indicated that previous well drilling for domestic use at the Raspberry Ranch had been disappointing, due to low yields and poor water quality. A 400-foot well that was recently drilled yielded only 4 gpm. We then discussed the alternative of developing a spring near the head of Janelle Creek. At the time of my visit, springs were flowing at the property boundary, approximately 120 feet in elevation above the ranch house. This elevation would supply a static pressure of approximately 52 psi to a new home. Water quality (in terms of taste) should be excellent, although there is always potential for bacterial or giardia contamination from such a shallow source.

As a first step to develop the spring, a source area should be identified in late summer or early fall when seasonal springs have dried up. Once located, the selected spring area can be excavated. Perforated pipe in a drain rock filled trench could be used to develop the spring. The drain rock should be encased in geotextile filter fabric. Buried 2-inch diameter pipe could then extend approximately 1500 feet from the developed spring to the house. A water right application should be submitted for the spring.

It is interesting to note that a well located approximate 1 mile to the north of the ranch house reportedly encountered artesian flow with a shut in pressure of approximately 97 psi at depth of 300 feet. It is possible that such a zone could be present at Raspberry, although previous drilling would indicate that the zone would have to be at depths of more than 400 feet.

RECOMMENDATIONS

The following additional work items are recommended.

Hot Springs

1. Determine the level of development desired at the springs. If the level of development requires a heat source equivalent to, or less than, the existing spring discharge, then assume that the spring can be developed at the surface. If more heat is required than currently discharges from the springs, well drilling will be required.
2. Submit an application for water right permit. The desired level of development will influence the rate of flow requested by the application.
3. Carol should meet with the Pancheris to discuss the proposed water use prior to advertisement of the application. She should request permission to monitor the temperature and discharge from their spring source for one full year before additional development takes place.

Well at Little Ranch House

1. Test pump the well using the installed pump or a test pump to determine if the existing well can supply adequate flow for a new home.

Irrigation Water Rights

1. Conduct a water right search to determine if additional water rights are appurtenant to these properties.
2. Examine the water right map and compare the authorized acres to actual irrigated acres.
3. Compare the authorized points of diversion to the actual points of diversion.
4. Apply for additional water rights as needed to irrigate any areas that lack adequate water rights (in terms of authorized acres).

Water Supply for New Well at the Raspberry Ranch

1. Apply for a water right to develop a spring at the head of Janelle Creek. However, Carol must realize that a spring source is not necessarily protected from contamination by giardia or other pathogens. If a protected water source is required, then she should consider a deep well.

Please contact me with any questions. We should set up a meeting with Carol I to discuss these findings.

Sincerely,



Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor

Attachments: Excerpts from "Geothermal Investigation of the Cascade, Idaho Area"
Excerpts from "Thermal Springs in the Payette River Basin, West-Central Idaho"
Well Logs – Belvidere Area
Pertinent File Data – Water Right 63-12891
Pertinent File Data – Water Right 63-13332
Stipulation and Order – Pancheris/Littles/A.L. Cattle Inc.

Boise, Idaho

July, 1976

GEOHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA

by

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DEPARTMENT OF GEOLOGY AND GEOPHYSICS

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GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA.

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through the Cascade damsite. Geomorphic evidence suggests left lateral movement along one or both of these faults. Microseismic monitoring indicates continued activity along faults in this immediate area.

Fault Controlled Hot Springs

Eleven hot springs are located within, or immediately adjacent to, the area mapped in this project (Plate I); all of them are within twelve miles of Cascade and all are fault controlled. In addition, one former hot spring on Little Pearso1 Creek, about four miles east of Cascade, has dried up in the last 20 years and several former hot springs on the fault trace about one mile northwest of Cascade are now flooded by the reservoir. Silica analysis and projected temperatures at depth were done on seven of these springs. The four hot springs near the Boiling Springs Guard Station, just off the south-western portion of the map, were not included in these analyses.

Silica analyses were done by the standard molybdosilicate method (Taras and other, 1971, p.303) using a Bausch and Lomb Spectronic 20 spectrophotometer. The mixing model used to project temperatures at depth is the one established by Fournier and Truesdell (1974). For the purposes of establishing a mixing model, a temperature of 10°C and a silica content of 25 ppm was used for all cold water mixes based on analyses of representative samples collected near hot springs.

From Table 1 it can be seen that surface temperatures of hot springs range from 36°C to 71°C, while silica contents range from 42.9 ppm to 68 ppm. A mixing model using these hot spring temperatures and silica contents along with a cold water temperature of 10°C and silica content

<u>Hot Springs</u>	<u>Location</u>	<u>Silica ppm</u>	<u>Temperature °C</u>	
			<u>Surface</u>	<u>Mixing Model</u>
Cabarton	SW $\frac{1}{4}$, Sec. 31, T13N, R4E	68.0	71.0 ^o	147 ^o
Arling	NW $\frac{1}{4}$, Sec. 13, T15N, R3E	56.6	40.0	179
Gold Fork	SW $\frac{1}{4}$, Sec. 35, T16N, R4E	62.3	50.5	165
Flat Creek	SW $\frac{1}{4}$, Sec. 21, T15N, R4E	47.5	38.0	158
Cascade	NE $\frac{1}{4}$, Sec. 36, T14N, R3E	42.9	38.5	140
Little Creek	NE $\frac{1}{4}$, Sec. 5, T14N, R5E	48.6	36.0	168
Belvidere	NE $\frac{1}{4}$, Sec. 13, T13N, R3E	60.0	49.5	163

TABLE 1: Silica analyses and mixing model temperatures
of hot springs near Cascade

of 25 ppm predicts temperatures at depth ranging from 140°C to 179°C (Figures 2-8).

It should be noted that five of these hot springs are located on or near the Cascade Valley fault which marks the western edge of Cascade Valley and extends northward through Little Valley. These hot springs, from south to north are Cabarton, Belvidere (also called Sky Ranch), Cascade, Flat Creek and Gold Fork.

Hydrothermal Alteration Zones

Zones of rock alteration exist along several faults in the Cascade area. In an attempt to determine the extent to which hydrothermal solutions were responsible for this rock alteration, eleven samples were collected for powder analysis by x-ray diffraction techniques.

Table II shows the locations of samples collected and results of the x-ray analyses. In fault zones where hydrothermal alteration has occurred kaolinite is usually found. Such fault zone kaolinite, however, may have been formed at depth because hot waters flowing out at the surface tend to deposit silica rather than alter rock (Clayton R. Nichols, personal communication, 1975). Kaolinite was found in significant amounts in two of the alteration zones and it was found in minor amounts in three others. Zeolite minerals are often found where there has been extensive fracturing and mylonitization of rock and they are usually associated with illite and montmorillonite (Clayton R. Nichols, personal communication, 1975).

The basalt is fractured and well jointed at the surface and, where encountered below the water table in extensive occurrences, it is permeable enough to provide adequate yields for nearly all domestic or stock requirements for individual wells.

Valley Fill and Surficial Deposits - The valley fill materials and surficial deposits are the most extensively developed aquifers in the valley. This silt, sand and gravel provides ground water for over 90% of all homes in the Cascade-Long Valley area. Most wells are quite shallow, less than 100 feet in depth, and have poor yields. Locally some wells produce up to 30 gpm, but most are in the 2-5 gpm range.

Artesian zones are present in several areas. These areas of artesian pressure are the result of clay lenses lying above permeable sands. The pressure generated is generally quite low with water levels rising only a foot or two upon penetration of the confining layer. One very significant anomaly occurs near the south end of Cascade Reservoir. A well in the NW/4, NW/4, Sec 11, T13N, R3E penetrates 260 feet of white clay and boulders below a soil and clay overburden. White sand was encountered at 300 feet which contained water under 220 feet of artesian head. This is by far the highest artesian pressure noted in the valley and is probably the result of ground water entering the sand from the granitic rocks on the sides of the valley and being trapped beneath a thick layer of clay.

This occurrence and other weak artesian pressures in the valley strongly indicate that recharge to the aquifer beneath the valley floor is occurring at a multitude of levels from the granitic rocks adjacent to the valley. As the water moves laterally away from the mountains, it becomes

THERMAL SPRINGS IN THE PAYETTE
RIVER BASIN, WEST-CENTRAL IDAHO

By R. E. Lewis and H. W. Young

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations

Open-File Report 80-1020



October 1980

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ILLUSTRATIONS

- PLATE 1. Map showing locations of sampled thermal springs and selected nonthermal springs, Payette River basin, west-central Idaho--in pocket
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common ions, silica, and the minor elements arsenic, boron, lithium, and mercury, are given in table 1. In addition, chemical analyses of water from three thermal springs sampled by Young and Mitchell (1973) and five thermal springs for which only partial analyses are available are included. Spring locations are shown on plate 1.

Chemical Character

All the thermal springs discharge fresh water (less than 600 mg/L dissolved solids) of a sodium bicarbonate type, at temperatures between 34° and 86°C. These waters are slightly alkaline--pH ranges from 8.0 to 9.6. Generally, the higher pH values are associated with waters having lower concentrations of dissolved solids. Concentrations of chloride and fluoride are variable and show no definite correlation with temperature. Concentration of boron is low compared with other thermal waters in Idaho, and is, to a degree, correlative with water temperature.

Nonthermal spring waters are either a calcium or sodium bicarbonate type. Water temperature measured in these springs is 7.0°C or less and, generally, is representative of local, ambient conditions. Concentrations of dissolved solids in these near-neutral waters (pH ranges from 6.2 to 7.3) are 90 mg/L or less.

Chemical Geothermometers

Aquifer temperatures in the Payette River basin were estimated using the silica geothermometer (Fournier and Rowe, 1966) and the Na-K-Ca geothermometer (Fournier and Truesdell, 1973). Temperatures estimated by these chemical geothermometers are valid only for hot-water systems and only if the following basic assumptions are met (Fournier, White, and Truesdell, 1974): (1) The chemical reactions at depth are temperature dependent; (2) an adequate supply of chemical constituents used for the thermometry is present in the aquifer; (3) chemical equilibrium is established at depth between the hot water and the specific aquifer minerals; (4) there is negligible reequilibration of the chemical composition of the hot water as it rises to the surface; and (5) hot water rises rapidly to the surface with no dilution or mixing of hot and cold waters.

Dissolved silica (SiO_2) reported in chemical analyses is actually present as silicic acid (H_4SiO_4) and various dissociated species, particularly H_3SiO_4^- . In neutral to slightly acid waters, dissolved silica ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) consists mostly of H_4SiO_4 , and, under these conditions,

(Chemical constituents in ml as per liter, except where noted)
 -- = Constituent analyzed for
 < = less than

Spring no.	Date of collection	Flow rate ¹ (gal./min)	Specific conductance (umhos)	pH	Water temperature ² (°C)	Hardness as CaCO ₃	Noncarbonate hardness	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Percent sodium	Sodium-adsorption ratio (SAR)	Potassium (K)	Bicarbonate ³ (HCO ₃)	Carbonate ³ (CO ₃)	Alkalinity as CaCO ₃	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Silica (SiO ₂)	Dissolved solids (calculated)	Nitrite plus nitrate as N (NO ₂ +NO ₃)	Phosphorus, total as P	Arsenic (As) (ug/L)	Boron (B) (ug/L)	Lithium (Li) (ug/L)	Mercury (Hg) (ug/L)		
Nonthermal																													
17N-28-15BABL	6-28-79	2	85	7.3	7.0	31	0	7.8	2.9	3.9	20	0.3	1.8	51	0	42	2.6	0.4	<.1	45	90	0.11	0.02	0	0	2	<.4	<.01	
15N-5E-23DACIS	6-27-79	2	20	6.2	4.0	5	1	1.7	2	2.4	53	5	2	12	0	10	7.7	7.3	2	17	29	<.01	.02	1	0	0	<.4	<.01	
13N-5E-21CAHIS	6-26-79	4	21	6.2	6.5	2	0	1.7	1.1	1.9	58	5	2	7	0	6	1.4	7.4	<.1	13	22	<.01	.02	0	0	0	<.4	<.01	
9N-9E-32RADIS	8-31-79	2	52	6.6	4.5	17	0	3.8	1.9	3.1	27	3	6	29	0	24	1.9	7.4	1.1	14	42	.13	.02	0	10	10	<.4	<.01	
Thermal																													
16N-4E-35OCBIS	6-27-79	94	304	9.5	50.0	2	0	1.1	<.1	70	98	18	7	49	36	100	12	11	9.0	63	215	<.01	.01	11	50	30	<.4	<.01	
15N-1E-13BECIS	8-2-79	798	279	9.5	34.0	4	0	1.2	1.1	60	97	14	6	17	45	89	43	16	2.6	60	210	<.01	.01	3	10	8	<.4	<.01	
15N-4E-21BECIS	6-27-79	31	206	9.6	26.0	4	0	1.2	1.1	43	96	9.8	5	12	34	84	7.8	2.5	3.1	48	146	<.01	.01	3	10	8	<.4	<.01	
13N-1E-11ADIS	6-26-79	20	433	9.3	49.0	2	0	1.2	<.1	85	98	21	1.0	56	34	102	24	28.5	5.3	61	256	<.01	.01	21	310	40	<.4	<.01	
13N-4E-31CABIS	6-26-79	70	514	9.0	71.0	4	0	1.5	<.1	110	97	25	2.1	68	25	97	43	40	11	72	329	<.01	.01	39	400	60	<.4	<.01	
13N-6E-29ABIS	7-7-79	50	334	9.5	53.0	4	0	1.6	1.1	64	96	13	1.3	32	36	86	31	7.8	15	80	240	<.01	.01	6	50	30	<.4	<.01	
12N-5E-20CCIS	7-8-79	12	337	9.5	46.5	5	0	1.3	<.1	65	97	16	1.1	34	34	84	16	6.5	16	73	219	<.01	.01	6	60	60	<.4	<.01	
10BDDIS	7-8-79	22	337	9.3	50.0	5	0	1.3	<.1	65	97	16	1.1	34	34	84	16	6.5	16	73	219	<.01	.01	6	60	60	<.4	<.01	
22BECIS	6-5-79	134	331	8.9	86.0	4	0	1.4	1.1	74	96	16	1.9	95	18	108	12	11	12	86	259	<.01	.01	10	90	80	<.4	<.01	
36DBACIS	8-8-79	334	266	8.9	38.0	7	0	2.8	<.1	54	94	8.9	1.9	77	5	71	26	5.8	12	54	196	.03	.02	5	50	50	<.4	<.01	
11N-5E-29OCBIS	8-8-79	50	293	8.8	49.0	8	0	3.1	<.1	57	96	4.8	1.9	99	4	88	24	9.6	13	74	277	<.01	.01	6	70	90	<.4	<.01	
11N-7E-16BACIS	7-24-79	90	315	9.3	65.0	5	0	1.8	1.1	65	95	13	1.8	13	35	69	36	3.9	15	82	236	.02	.03	14	50	80	<.4	<.01	
10N-4E-33CBIS	11-27-78	500	402	8.4	75.0	5	0	1.9	1.1	90	96	17	3.2	130	2	110	27	19	13	110	331	.01	<.01	9	120	100	<.4	<.01	
10N-10E-31BCCIS	3-13-79	360	378	9.3	84.0	4	0	1.5	<.1	77	96	17	3.2	18	38	78	50	8.0	17	91	282	<.01	<.01	1	70	110	<.4	<.01	
10N-11E-31ADIS	5-7-79	75	381	9.6	67.0	5	0	1.9	1.1	77	95	15	2.6	1	45	76	46	9.5	15	82	267	.02	<.01	2	90	110	<.4	<.01	
9N-3E-25BACIS	11-22-78	32	622	8.0	79.5	16	0	6.1	1.1	120	92	13	5.3	160	0	131	88	39	12	120	470	.01	<.01	5	240	150	<.4	<.01	
9N-7E-33BACIS	5-7-79	3	287	9.3	37.0	4	0	1.4	<.1	79	97	18	1.8	40	31	84	39	5.7	20	93	270	<.01	<.01	2	20	120	<.4	<.01	
9N-8E-31BACIS	3-13-79	20	369	9.2	63.5	4	0	1.4	<.1	79	97	18	1.8	40	31	84	39	5.7	20	93	270	<.01	<.01	2	20	120	<.4	<.01	
32CBACIS	2-27-79	350	321	9.1	64.0	5	0	1.9	<.1	70	96	14	1.3	29	29	72	39	3.9	16	67	232	.02	<.01	2	50	110	<.4	<.01	
Thermal																													
9N-9E-22DCALIS	7-29-79	13	---	---	54.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8N-5E-18CCIS	6-8-72	1.5	317	---	40.0	6	0	2.4	1.1	66	95	11	1.9	85	1	71	42	5.1	3.1	48	216	---	---	---	---	---	---	---	
6DCBIS	11-23-79	14	359	9.0	42.0	8	0	2.9	1.1	77	95	12	1.2	67	20	88	37	7.3	15	75	262	.01	<.01	6	110	120	<.4	<.01	
6DCBIS	2-26-79	75	343	9.1	51.0	12	0	5.0	<.1	72	92	8.9	1.3	61	22	87	36	7.8	15	63	245	.01	<.01	6	110	130	<.4	<.01	
10ADIS	11-22-78	10	344	9.0	54.0	5	0	2.0	<.1	76	96	15	1.2	59	19	80	40	5.7	14	78	259	.01	<.01	4	90	80	<.4	<.01	
10BDDIS	11-27-78	90	345	9.2	54.5	5	0	2.0	1.1	75	96	14	1.0	40	23	78	38	5.7	14	74	249	.01	<.01	4	70	70	<.4	<.01	
11BACIS	2-26-79	35	352	9.1	60.0	5	0	1.8	<.1	78	96	16	1.4	49	28	87	41	5.4	17	66	254	.01	<.01	5	90	160	<.4	<.01	
11BACIS	7-25-79	5	346	9.2	56.5	5	0	---	---	---	---	---	---	43	26	79	---	---	---	---	---	---	---	---	---	---	---	---	---
8N-6E-1ADIS	2-27-79	175	343	9.2	59.5	5	0	2.0	<.1	75	96	15	1.1	39	29	80	38	6.7	17	63	242	.01	<.01	6	80	100	<.4	<.01	
7N-1E-9BDDIS	9-5-79	50	780	8.0	64.0	22	0	8.4	2.2	160	92	15	8.0	180	0	148	120	61	16	110	573	<.01	<.01	10	710	220	<.4	<.01	
9CDBIS	8-4-72	20	529	---	45.0	47	0	15	2.4	99	80	6.3	5.3	169	0	139	57	30	8	94	397	<.01	<.01	---	---	---	<.4	<.01	

¹Flow rate is for entire spring complex.
²Water temperature is highest temperature at spring vents or temperature of sampled vent.
³Total alkalinity distributed as carbonate and bicarbonate at the spring temperature and pH.
 *Analyses taken from Young and Mitchell (1973).
 *Temperature may be higher because vents were underwater.
 *Shown in Young and Mitchell (1973) as BCBIS.

silica geothermometers give good estimates of reservoir temperatures. In alkaline waters, hydroxide (OH^-) reacts with silicic acid to reduce the proportion of silicic acid to total dissolved silica. The total concentration of dissolved silica measured in the laboratory ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) must therefore be reduced by the concentration of H_3SiO_4^- occurring at the pH level of the spring water, to obtain an accurate estimate of the reservoir temperature.

For thermal waters having pH greater than 8.2, reported values for dissolved silica were corrected for dissociation of silicic acid at the spring temperature, and reservoir temperatures were estimated assuming equilibrium with both quartz and chalcedony (table 2). The pH of water in the thermal aquifer would be slightly lower than the pH measured at the spring, and calculation of aquifer pH might increase the H_3SiO_4^- -corrected quartz temperature by 5° or 10°C (R. H. Mariner, written commun., 1980). Calculation of aquifer pH requires consideration of acid-base equilibria, distribution of acidic gases between steam and water, and the effect of temperature on the equilibria (Ellis and Mahon, 1977). Most of the calculations are time consuming and require computer methods, such as those presented by Truesdell and Singers (1973).

Concentration of magnesium in thermal waters sampled generally was 0.1 mg/L or less, so corrections for magnesium in the Na-K-Ca geothermometer suggested by Fournier and Potter (1979) were not applied. Applying the magnesium correction to the Na-K-Ca geothermometer for one thermal spring having a magnesium concentration of 2.4 mg/L increased the estimated reservoir temperature by 6° to 90°C .

Reservoir temperatures calculated from water analyses for 26 thermal springs in the Payette River basin are given in table 2, along with selected chemical reaction coefficients. In applying the H_3SiO_4^- -corrected silica geothermometer for thermal springs having water temperature at the land surface generally greater than 65°C , best estimates were obtained by assuming that quartz was controlling the SiO_2 concentration. For springs having temperatures at the surface generally less than 65°C , better estimates of reservoir temperature were obtained by assuming that chalcedony was controlling the SiO_2 concentration. If, however, the calculated free energy of formation showed the waters were unsaturated with chalcedony; or, if the estimated temperature was less than the temperature of the spring, then quartz was assumed to be controlling the SiO_2 concentration.

Using a plot of reservoir temperatures estimated by the silica and the Na-K-Ca geothermometers, Fournier, Sorey, Mariner, and Truesdell (1979) showed waters that plot on or

Table 2. Estimated aquifer temperatures and free energy of formation for selected thermal springs

Spring No.	Water temperature at the surface (°C)	Estimated aquifer temperatures based on geothermometers					Free energy of formation ¹				Reference No. (fig. 2)
		Silica quartz-conductive (°C)	Silica quartz-conductive H ₃ SiO ₄ -corrected (°C)	Sodium-potassium-calcium (°C)	Silica-chalcedony (°C)	Silica-chalcedony H ₃ SiO ₄ -corrected (°C)	Aragonite	Calcite	Chalcedony	Quartz	
16N- 4E-35CCB1S	50.0	113	69	71	84	37	0.1	0.2	-0.2	0.3	1
15N- 3E-13BBC1S	34.0	110	61	61	81	28	-0.1	0	-0.1	-0.5	2
15N- 4E-21DCC1S	36.0	100	62	53	70	30	0	0.1	-0.1	-0.5	3
13N- 3E-13ADA1S	49.0	111	79	83	82	47	0	0.1	0	-0.5	4
13N- 4E-31CAB1S	71.0	120	91	117	91	61	0.1	0.2	-0.1	-0.3	5
13N- 6E-29DAB1S	53.0	125	76	82	97	45	0.2	0.3	-0.1	-0.4	6
12N- 5E- 2DAC1S	50.0	120	86	81	92	55	0	0	-0.1	-0.6	7
22BBC1S	86.0	129	101	100	101	71	-0.3	0.4	-0.2	-0.2	8
36DBA1S	38.0	105	93	57	76	62	-0.3	0.2	-0.3	-0.9	9
5E-29CDB1S	49.0	121	107	61	93	77	-0.1	0	-0.4	-0.9	10
11N- 7E-16AAB1S	65.0	126	84	91	99	52	-0.3	0.4	-0.2	-0.3	11
10N- 4E-33CBD1S	75.0	143	132	138	116	105	-0.3	0.2	-0.4	-0.8	12
10N-10E-31BCC1S	84.0	132	81	145	105	50	-0.5	0.6	-0.5	-1.1	13
10N-11E-31ADD1S	67.0	126	63	134	99	31	-0.6	0.7	-0.5	-1.1	14
9N- 3E-25BAC1S	79.5	148	143	144	122	116	-0.1	0.2	-0.5	-0.9	15
9N- 8E-31ACA1S	63.5	127	90	99	99	60	-0.1	0.2	0	-0.4	16
32CBA1S	64.0	116	86	79	87	55	-0.2	0.3	-0.1	-0.4	17
8N- 5E- 1BCC1S	40.0	100	89	62	70	59	-0.5	0.4	-0.3	-0.8	18
6DCB1S	42.0	122	104	69	94	74	-0.1	0.1	-0.4	-1.0	19
6DCC1S	51.0	113	88	60	84	58	-0.6	0.7	-0.1	-0.6	20
10ADD1S	54.0	124	101	76	96	71	-0.1	0	-0.2	-0.8	21
10BDD1S	54.5	121	89	70	93	58	-0.1	0.2	-0.1	-0.6	22
11BAA1S	60.0	115	87	84	86	56	-0.2	0.2	0	-0.4	23
8N- 6E- 1ADB1S	59.5	113	80	74	84	49	-0.3	0.3	-0.1	-0.3	24
7N- 1E- 8DDA1S	64.0	143	138	152	116	112	0	0.1	-0.6	-1.1	25
9CDC1S	45.0	134	133	290	107	106	-0.5	-0.4	-0.8	-1.3	26

¹Values are departure from theoretical equilibrium in kilocalories; (+) values indicate supersaturation, (-) values indicate unsaturated. Calculations from computer program SOLMNEQ (Kharaka and Barnes, 1973).

²Magnesium corrected (Fournier and Potter, 1979).

near the equal-temperature line ($T^{\circ}_{\text{SiO}_2} = T^{\circ}_{\text{Na-K-Ca}}$; slope = 1) are likely to be unmixed waters or waters that have reequilibrated with the aquifer minerals after mixing. Waters that plot significantly above the equal-temperature line probably contain anomalous concentrations of silica, owing to evaporation or to dissolving amorphous silica from the aquifer material. The Na-K-Ca geothermometer uses ratios of constituents and is less sensitive to concentration changes that occur during evaporation than is the silica geothermometer.

Waters that plot significantly below the equal-temperature line may be due to: (1) Mixing with another type water without sufficient time to equilibrate with the surrounding rock (in mixed waters, silica-estimated temperatures are generally decreased more than Na-K-Ca estimated temperatures); (2) precipitation of silica during cooling, whereas Na-K-Ca proportions remain unchanged; or (3) precipitation of calcite or aragonite due to loss of carbon dioxide without adjustment of sodium and potassium through reaction with clays, zeolites, or other minerals (Fournier and others, 1979).

Figure 2 is a plot of reservoir temperatures estimated using silica and Na-K-Ca geothermometers for thermal springs in the Payette River basin. Most thermal springs plot on or near the equal-temperature line. As suggested by Fournier and others (1979), these waters are probably unmixed waters that have lost some heat through conduction or are mixed waters that have had time to reequilibrate. Several springs (samples 5, 7, 13, and 14) plot significantly below the equal-temperature line and may indicate a mixed water or water from which calcite and aragonite have precipitated. Table 2 shows that, with the exception of sample 7, waters from these springs are supersaturated with calcite or aragonite, which may indicate a possible loss of calcium without an adjustment of the sodium and potassium concentrations. For these samples, the silica geothermometer probably gives the better estimate of reservoir temperature.

Only two springs (samples 10 and 26) plot significantly above the equal-temperature line in figure 2. These waters are thought to have dissolved amorphous silica from the aquifer materials (calculated free energy of formation of amorphous silica is 0, which indicates equilibrium with this phase). For these springs, the Na-K-Ca geothermometer probably gives the better estimate of reservoir temperature.

Estimated reservoir temperatures determined from the silica and Na-K-Ca geothermometers are highly variable and range from 53° to 143°C. Along the North Fork of the

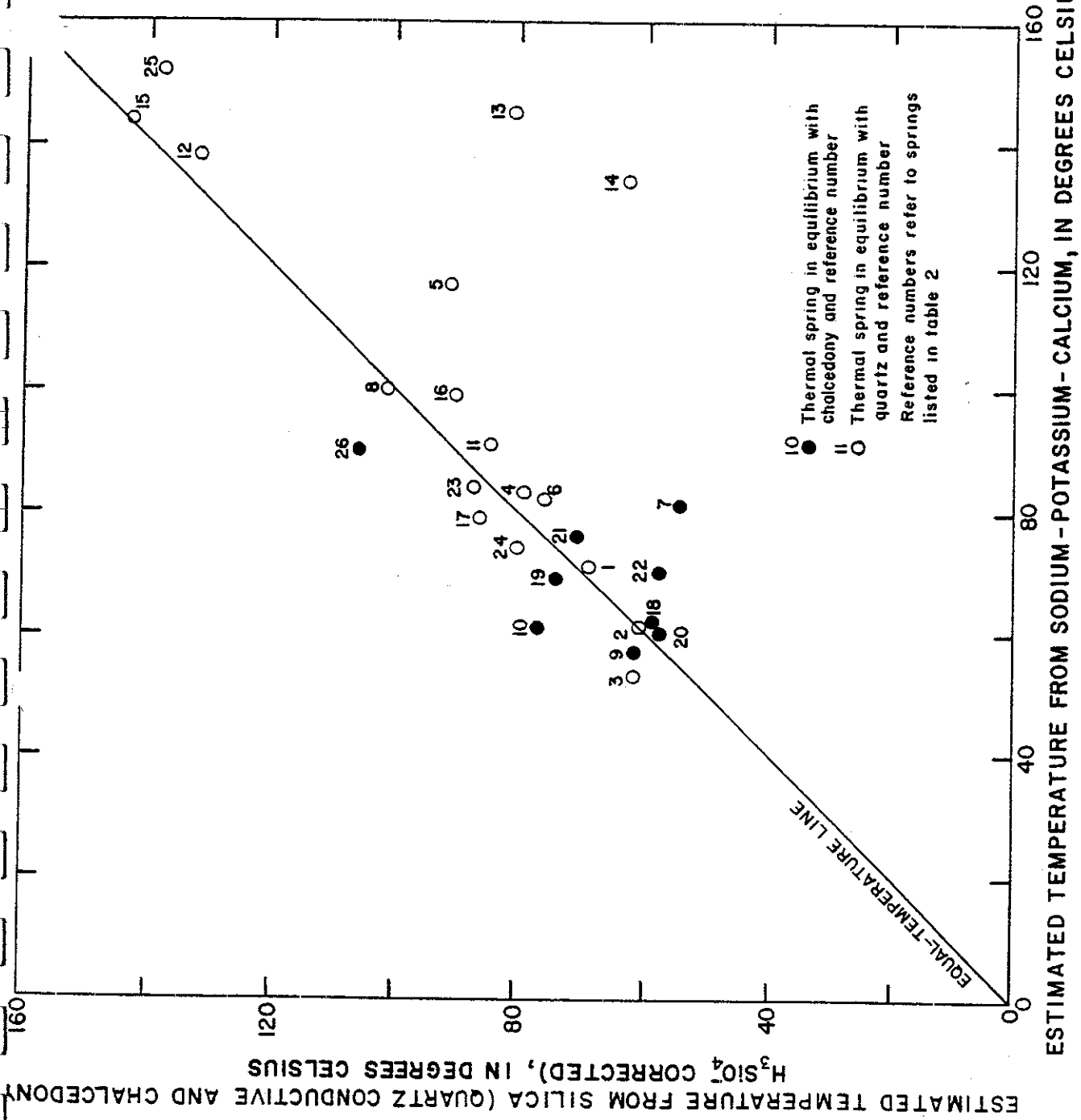


Figure 2.-- Comparison of reservoir temperatures estimated by the silica and sodium-potassium-calcium geothermometers

Payette River, estimated reservoir temperatures range from 53° to 91°C. Along the Middle and South Forks of the Payette River, estimated reservoir temperatures range from 57° to 138°C and 58° to 99°C, respectively. Estimated reservoir temperatures along the Payette River from Banks, Idaho, range from 90° to 143°C.

Assuming conductive heat loss, reservoir temperatures for six thermal springs were estimated using the sulfate-water isotope geothermometer described by McKenzie and Truesdell (1977): 16N-4E-35CCB1S, 71°C; 13N-4E-31CAB1S, 75°C; 13N-6E-29DAB1S, 71°C; 9N-3E-25BAC1S, 139°C; 9N-8E-32CBAL1S, 88°C; and 8N-5E-10BDD1S, 76°C. Additional temperatures of 89° and 94°C were estimated for thermal springs 12N-5E-22BBC1S and 10N-10E-31BCC1S, respectively, by Nehring and others (1979).

Isotopes

Samples of thermal and nonthermal water from selected springs in the Payette River basin were collected for analyses of oxygen-18, deuterium, and tritium. In this report, isotope data are presented in tabular and graphical format (tables 3 and 4 and fig. 3); interpretations concerning age or relation of the various waters are offered only insofar as they apply to the Payette River basin and are considered preliminary. A discussion of the isotopic composition and possible relations of thermal waters in the Payette, Salmon, and Boise River basins will be presented in a final report.

Tritium

Tritium (H^3) is produced naturally in small quantities in the upper atmosphere during bombardment by subatomic particles. The tritium, incorporated in water molecules, enters the water cycle in rain and snow. Having a half life of about 12.3 years, tritium can be used to determine how long a particular water may have been stored out of contact with the atmosphere. The transit or residence time can be determined from the concentration of tritium in the discharge water, if the amount of tritium in the recharge water and the nature of the subsurface flow regime are known.

Before extensive thermonuclear testing began in 1954, tritium in the atmosphere ranged from 10 to 20 TU (tritium unit). One TU equals a $^3H/H$ ratio of about 10, or about 3.2 picocuries per liter. By 1963, worldwide tritium levels had increased several orders of magnitude. Tritium levels in precipitation have since declined and now (1980) average about 50 TU.

Well Log Search for 13N 03E 13

NOTE: The data you are looking at may not be all of the data available. In the Northern Region all data that is available has been entered into the computer. In all other regions no data before July 1, 1987 has been entered. From July 1, 1987 to July 1, 1992 only partial data has been entered for the Western, Southern, and Eastern regions. From July 1, 1992 to the present all data for all regions has been entered and will show on this report only if the well log has been received. If you cannot locate well log information through our web search queries that you know exists, please contact your regional office. See our [region map](#) to determine regional boundaries. This data was last updated on 06/26/99.

NAME (S)	TWN	RNG	SC	TRACT	LT	A	DIA	DEPTH
BOEHM, IRLE W	13N	03E	13	NE NW	28	L	6"	265ft
BROWN, LOU	13N	03E	13	SE SE		L	6"	77ft
CHASE, KEVIN	13N	03E	13	NW NE		L	6"	99ft
DAVIS, GARY	13N	03E	13	NW NW		L	6"	160ft
GORCZYCA, JIM	13N	03E	13	NW NE			6"	361ft
GORCZYCA, ROBIN	13N	03E	13	NW NE			6"	361ft
GULF PACIFIC CATTLE CO	13N	03E	13	SW NE		L	6"	140ft
KYLE, MIKE	13N	03E	13	NE NW		L	6"	207ft
LEWIS, TED	13N	03E	13	NW NE			6"	118ft
PANCHERI, DARWIN	13N	03E	13	NE NE		L	6"	99ft
PANCHERI, JOAN	13N	03E	13	NE NE		L	6"	99ft
PEGAN, CHARLES M	13N	03E	13	NE NW			6"	182ft
SPARKS, JEFF	13N	03E	13	NW NE		L	6"	99ft
SWANBY, GREG	13N	03E	13	NW SW			6"	140ft
WOODARD, WARREN	13N	03E	13	NE NE			6"	124ft
WORTHEN, SCOTT	13N	03E	13	NE NW		P	0"	0ft

16 record(s) found.

Note: the number of records found is not necessarily the number of unique

Legend/key

FORM WD8001NP

Well Log Search for Eastern Western

NOTE: The data you are looking at may not be all of the data available. In the Northern Region all data that is available has been entered into the computer. In all other regions no data before July 1, 1987 has been entered. From July 1, 1987 to July 1, 1992 only partial data has been entered for the Western, Southern, and Eastern regions. From July 1, 1992 to the present all data for all regions has been entered and will show on this report only if the well log has been received. If you cannot locate well log information through our web search queries that you know exists, please contact your regional office. See our region map to determine regional boundaries. This data was last updated on 06/26/99.

NAME (S)	TWN	RNG	SC	TRACT	LT A	DIA	DEPTH	
EASTERN WESTERN CORPORATION	16N	03E	25	SW NW		6"	39ft	6Pm 13gpm
EASTERN WESTERN CORPORATION	16N	03E	25	SW SE		6"	49ft	18 gpm

2 record(s) found.

Note: the number of records found is not necessarily the number of unique

Legend/key

FORM WD8001NP

casing	swl	date
40	19	7/20/94
50	5	7/20/94

1. WELL OWNER Name <u>Gulf Pacific Cattle Co.</u> <u>Box 25</u> <u>McCall, Id. 83411</u> Owner's Permit No. <u>65-29-2-049</u>	7. WATER LEVEL Department of Water Resources Static water level <u>35'</u> feet below land surface. Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>52°F.</u> Quality <u>clear</u> Describe artesian or temperature zones below																																								
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement Abandonment (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)	8. WELL TEST DATA ☐ Pump ☐ Builer ☐ Air ☐ Other _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Discharge G.P.M.</th> <th>Pumping Level</th> <th>Hours Pumped</th> </tr> <tr> <td><u>4.7</u></td> <td><u>140</u></td> <td><u>1</u></td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </table>	Discharge G.P.M.	Pumping Level	Hours Pumped	<u>4.7</u>	<u>140</u>	<u>1</u>																																		
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USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

State of Idaho
Department of Water Administration
WELL DRILLER'S REPORT

1. DRILLER'S NAME
Frank Bilbao
South Cascade Idaho

2. WELL LEVEL
Depth *23* feet from top of casing
to bottom of well

3. WELL TEST DATA
☒ Pump ☒ Hand ☐ Other

4. WELL TEST DATA
Discharge (G.P.M.) *12 gal*
Draw Down *23.48*
Hours Pumped *2*

5. WELL USE
☒ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type)

6. LITHOLOGIC LOG

Hole Diam.	Depth		Material	Water	
	From	To		Yes	No
6	0	10	Topsoil		X
	10	32	clay		X
	32	42	sandy		X
	42	60	clay		X
	60	69	sandy gravel	X	
	69	74	sandy		X

7. METHOD DRILLED
☒ Auger ☐ Rotary ☐ Dug ☐ Other

8. WELL CONSTRUCTION
Casing: *6* inches Total depth *74* feet
Material: ☒ Steel ☐ Concrete
Diameter: *6* inches From *74* feet To *74* feet

9. PERFORATIONS
Type of seal used? ☐ Yes ☒ No
Packer used? ☒ Yes ☐ No
Hole size? ☐ Factory ☒ Knife ☐ Torch
Hole size: *24* inches by *62* feet To *28* feet

10. WELL INSTALLATION
Well is installed? ☐ Yes ☒ No
Name of contractor's name _____ Model No. _____
Type of pump _____ Slot size _____ Set from _____ feet to _____ feet
Type of pump _____ Slot size _____ Set from _____ feet to _____ feet
Gravel packed? ☐ Yes ☒ No Size of gravel _____ feet
Placed from _____ feet to _____ feet
Surface seal depth *50* Material used in seal ☐ Cement grout
☒ Pudding clay ☐ Well cuttings
Sealing procedure used ☐ Sherry pit ☐ Temporary surface casing
☒ Overbore to seal depth

11. LOCATION OF WELL
Sketch map location must agree with written location.

12. DRILLER'S CERTIFICATION
Firm Name *HASH drilling* Firm No. *281*
Address *327 - S. 9th St. Payette* Date _____
Signed by (Firm Official) *Ray Hallway*
and (Operator) *Ray Hallway*
County *Valley*
N.E. 1/4 Sec. *13* T. *17* N. 1/4 R. *3* E. *10*

1 WELL OWNER Name <u>DARWIN - R. JOHN PANCHERI</u> Address <u>15501 STAGE COACH RD. Nampa, Id.</u> Drilling Permit No. <u>65-91-2-018</u> Water Right Permit No. _____	7 WATER LEVEL Static water level <u>23</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>52</u> °F. Quality <u>good</u> <i>Describe artesian or temperature zones below</i>																																																																
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USE ADDITIONAL SHEETS IF NECESSARY -- FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

1. WELL OWNER Name <u>DARWIN OR JEAN PANCHERI</u> Address <u>15501 STAGECOACH RD. NAMPA, ID.</u> Drilling Permit No <u>65-91-2-042</u> Water Right Permit No _____	7. WATER LEVEL Static water level _____ feet below land surface Flowing? ☒ Yes ☐ No G.P.M. flow <u>1/2</u> Artesian closed in pressure _____ p.s.i. Controlled by: ☐ Valve ☒ Cap ☐ Plug Temperature <u>60 OF.</u> Quality <u>good</u> Describe artesian or temperature zones below																																																																																																																												
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6	19	22	BROWN SAND W/CLAY STREAKS	☒																																																																																																																									
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6	57	63	BROWN SAND W/CLAY STREAKS	☒																																																																																																																									
6	63	70	BROWN CLAY W/ SAND STREAKS		☒																																																																																																																								
6	70	130	BROWN DECOMPOSED GRAVEL	☒																																																																																																																									
4. METHOD DRILLED ☒ Rotary ☒ Air ☐ Hydraulic ☐ Reverse rotary ☐ Cable ☐ Dug ☐ Other	10. Work started <u>6-5-91</u> finished <u>6-6-91</u>																																																																																																																												
5. WELL CONSTRUCTION Casing schedule: ☒ Steel ☐ Concrete ☐ Other <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Thickness</th> <th>Diameter</th> <th>From</th> <th>To</th> </tr> </thead> <tbody> <tr> <td>250 inches</td> <td>6 inches</td> <td>1 foot</td> <td>66 feet</td> </tr> <tr> <td>inches</td> <td>inches</td> <td>feet</td> <td>feet</td> </tr> <tr> <td>inches</td> <td>inches</td> <td>feet</td> <td>feet</td> </tr> <tr> <td>inches</td> <td>inches</td> <td>feet</td> <td>feet</td> </tr> </tbody> </table> Was casing drive shoe used? ☐ Yes ☒ No Was a packer or seal used? ☐ Yes ☒ No Perforated? ☒ Yes ☐ No How perforated? ☐ Factory ☒ Knife ☐ Torch ☐ Gun Size of perforation <u>1/8</u> inches by <u>1</u> inches <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Number</th> <th>From</th> <th>To</th> </tr> </thead> <tbody> <tr> <td>80 perforations</td> <td>38 feet</td> <td>42 feet</td> </tr> <tr> <td>200 perforations</td> <td>47 feet</td> <td>57 feet</td> </tr> <tr> <td>perforations</td> <td>feet</td> <td>feet</td> </tr> </tbody> </table> Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Model No _____ Type _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____ feet to _____ feet Placed from _____ feet to _____ feet Surface seal depth <u>18</u> Material used in seal: ☒ Cement grout ☐ Puddling clay ☐ ☐ Bentonite Sealing procedure used: ☐ Slurry pit ☒ Temp. surface casing ☐ Overbore to seal depth Method of joining casing: ☐ Threaded ☒ Welded ☐ Solvent Weld ☐ Cemented between strata Describe access port <u>SANITARY WELL SEAL</u>	Thickness	Diameter	From	To	250 inches	6 inches	1 foot	66 feet	inches	inches	feet	feet	inches	inches	feet	feet	inches	inches	feet	feet	Number	From	To	80 perforations	38 feet	42 feet	200 perforations	47 feet	57 feet	perforations	feet	feet	11. DRILLERS CERTIFICATION I/We certify that all minimum well construction standards were complied with at the time the rig was removed. Firm Name <u>GESTRIM WELL DRILLING</u> Firm No. <u>408</u> Address <u>HC 39 Box 10, Doreville, Id.</u> Date <u>6-6-91</u> Signed by (Firm Official) <u>[Signature]</u> and <u>[Signature]</u> (Operator)																																																																																												
Thickness	Diameter	From	To																																																																																																																										
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perforations	feet	feet																																																																																																																											
6. LOCATION OF WELL Sketch map location must agree with written location. Subdivision Name _____ Lot No _____ Block No _____ County <u>VALLEY</u> NW 1/4 NW 1/4 Sec. <u>18</u>, T. <u>13</u> N. <u>3</u> E. <u>3</u> W. <u>1</u>	USE ADDITIONAL SHEETS IF NECESSARY — FORWARD THE WHITE COPY TO THE DEPARTMENT																																																																																																																												

State of Idaho
Department of Water Resources

WATER RIGHT LICENSE

WATER RIGHT NO. 65-12891

Priority: October 19, 1988

Maximum Diversion Rate:

0.44 CFS

Maximum Diversion Volume:

51.3 AF

This is to certify, that DUANE PANCHERI
DARWIN PANCHERI

RT 1 BOX 48

MELBA ID 83641

has complied with the terms and conditions of the permit, issued pursuant to Application for Permit dated October 19, 1988; and has submitted Proof of Beneficial Use on August 21, 1989. An examination indicates that the works have a diversion capacity of .440 cfs of water from:

SPRING

tributary to MOORES CREEK

source, and a water right has been established as follows:

<u>BENEFICIAL USE</u>	<u>PERIOD OF USE</u>	<u>RATE OF DIVERSION</u>	<u>ANNUAL VOLUME</u>
HEATING	01/01 to 12/31	0.40 CFS	47.7 AF
DOMESTIC	01/01 to 12/31	0.04 CFS	3.6 AF
	Totals	0.44 CFS	51.3 AF

LOCATION OF POINT(S) OF DIVERSION:

NESENE , Sec. 13, Township 13N, Range 03E
SENESE , Sec. 13, Township 13N, Range 03E
VALLEY County

PLACE OF USE: HEATING

TWN RGE SEC

13N 04E 18

SESW

NWSE

SWSE

PLACE OF USE: DOMESTIC, same as HEATING use

CONDITIONS/REMARKS:

1. The maximum diversion volume is defined as the maximum allowable volume of water that may be diverted annually from the source under this right. The use of water confirmed by this right is limited to the amount which can actually be beneficially used. The maximum diversion volume may be adjusted to more accurately describe the beneficial use or to implement accepted standards of diversion and use efficiency.
2. This water right is appurtenant to the described place of use.
3. This right is subject to all prior water rights and may be forfeited by five years of non-use.
4. Modifications to or variance from this license must be made within the limits of Section 42-222, Idaho Code, or the applicable Idaho law.

RECEIVED

JUN 24 1992

State of Idaho
Department of Water Resources

WATER RIGHT LICENSE

WATER RIGHT NO. 65-12891

CONDITIONS/REMARKS:

5. Use of water under this water right will be regulated by the watermaster of State Water District No. 65.
6. Domestic use is for 3 homes and a shop.

This license is issued pursuant to the provisions of Section 42-219, Idaho Code. Witness the seal and signature of the Director, affixed at Boise, this 5 day of January, 1992.

[Signature]
for R. Keith Higginson, Director

RECEIVED

JAN 24 1992

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
BENEFICIAL USE FIELD REPORT

A. GENERAL INFORMATION

- Permit No. 65-12891
1. Owner: Darwin and/or Duane Pancheri Phone No. 467-1348 or 495-25
Current Address: 15501 Stagecoach Rd. Nampa ID, 83686
2. Accompanied by: Joan Pancheri EXAM. DATE: 10/17/89
Address: as above Phone No. as above
Relationship to Permit Holder: Spouse of Darwin Pancheri
3. Source: Spring tributary to Moore's Creek

B. OVERLAP REVIEW

1. Other water rights with same place of use: 65-06628 -02696 -11250 ☐ Copies Attached N/A
2. Other water rights with same point of diversion: 65-01972 -01973 -11250 -88430
-12127 -01988 ☐ Copies Attached ☐ Copies of Field Exam's Attached N/A

C. SYSTEM DESCRIPTION

1. Diversion System Diagram: Indicate all major components and distances between components. Indicate weir size/ditch size/pipe i.d. as applicable. ☒ Alternative diagram attached

See top of alternative diagram

SEP 04 1991

Scale: 1" = NOT TO SCALE

2. ☒ Copy of U.S.G.S. Quadrangle Attached ☐ Aerial Photo Attached N/A
Showing location(s) of point(s) of diversion and place(s) of use (required). (required for irrigation of 10 acres or more).
☒ Photo of Diversion and System Attached
(required for all but single household domestic groundwater, and stockwater).

System Description (continued)

3. Narrative: Description (As operating at time of measurement. Indicate pressure, number of sprinklers, etc)

A hot spring (approx. 101°F) is utilized via a drain system and approx 2100 ft. of 10" pipe & then ³⁰⁰⁰ ft. of 4" pipe. Two control valves for this gravity system are found with 115' of source. Water is used to heat 3 homes & 1 shop as well as to irrigate $\frac{1}{2}$ acre of yard (External domestic use). The hot water is used in a swimming pool at one home. Discharged water (measured discharge temps of 90 & 94°F) is returned to Branch Creek via 4" overflow pipes and a small ditch paralleling one of the discharge pipes. The system has been operating since 1978.

☐ See Remarks on page 4 for continuation

4.

Well or Diversion Identification No.*	Motor Make	Hp	Motor Serial No.	Pump Make	Pump Serial No. or Discharge Size
		N/A	(gravity system)		

*Code to correspond with No. on map and aerial photo

5. Point(s) of Diversion:

Ident. No.	Gov't. Lot	1/4	1/4	1/4	Sec.	Twp.	Rge.	County	Method of Determination/Remarks
		SE	NE	NE	~~13~~	13N	3E	Valley	USGS 7 1/2' quad and
		NE	SE	NE	13				ORTHOphoto quad. Used compass,
									engineers 100' tape, and pacing to
									plot plat.

6. Place(s) of Use:

Indicate Method of Determination USGS 7 1/2' quad

Twp.	Rge.	Sec.	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Totals
			NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	
13N	4E	18																	

NOTED

JAN 24 1992

Do not use this space

Do not use this space

D. FLOW MEASUREMENTS

☐ Additional Data Sheets Attached

Measurement Equipment	Type	Make	Model No.	Serial No.	Size	Calib. Date
N/A						

2. Measurements:

Flow - no measurements possible

For sq. ft. of heating areas & other details, see Attachment #1.

E. FLOW CALCULATIONS

☒ Additional Computation Sheets Attached

1. Measured Method: none

2. Alternate Method for Checking Purposes: see additions / pg. , Attachment #1

F. PUMP EFFICIENCY DATA (Optional) N/A

Discharge Pressure: _____ psi x 2.31 = _____ ft (1); Dynamic pumping level: _____ ft (2)

Total Head: (1) + (2) = _____ (3) ; Flow rate: _____ cfs (4)

Water HP: (3) x (4) ÷ 8.8 = _____ (5)

Meter Input KW: 3.6 x _____ KH x _____ CTR or _____ MULT x _____ PTR x _____ N/ _____ T = _____ (6)

Meter Input HP: (6) x 1.34 = _____ (7)

Panel Input KW: _____ Ave PF x _____ Ave Volts x _____ Ave Amps x .001732 = _____ (6)

Panel Input HP: (6) x 1.34 = _____ (7) Efficiency: (5)/(7) x 100 = _____ %

$$V. (.24)(365)(1.9835) = 144.8 \text{ afa}$$

G. VOLUME CALCULATIONS

1. Volume Calculations for Irrigation: N/A

$V_{IR} = (\text{Acres Irrigated}) \times (\text{Irrigation Requirement}) =$ _____

$V_{DR} = [\text{Diversion Rate (cfs)}] \times (\text{Days in Irrigation Season}) \times 1.9835 =$ _____

$V = \text{Smaller of } V_{IR} \text{ and } V_{DR} =$ _____

2. Volume Calculations for Other Uses:

Domestic 3 Homes, 1 shop: 2 homes int. only = (2)(.6) = 1.2 afa
1 home & shop, int + ext = (2)(1.2) = 2.4 afa (3.6)
 $V. (.10)(365)(1.9835) = 72.4 \text{ afa}$

HEATING

Although Hot H2O runs continuously since also used for domestic, estimate that heat needed $\approx 12 \text{ hrs/day}$, 80% of year for that area (292 days).
720 cfs x 448.8 gals. 60 min. 12 hrs 292 days 720 cfs = 1579 afa

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JAN 24 1992

Internal
R

H. REMARKS AND OVERLAP REVIEW ANALYSIS

P/D would have to be approx. 1000' E. of Cabarton Rd. to be in QQQ
 shown on permit. Using NE corner of intersection of Cabarton & Reservoir Rds.,
 measured 175' N. & paced 500' East, then paced 50' N. to spring area.
 No method of measurement was available for the diversion. The return flow from
 swimming pool (terminal use end of 4" delivery line) via a very small ditch & 4" pipe (see
 photograph #5) did not allow a flowmeter or Sgal. bucket measurement. However, see attached
 copy of 10/19/88 corr. memo from original application. This supports flow rate in
 permit.
 Limit rec'd flow to .20 cfs per *50 Prof fee paid (Receipt 000020). Increased
 rate for 0/4 but still within permit & proof of b.w. limits.
 Overlap - see attachment #2.

I. RECOMMENDATIONS

1. Recommended Amounts

Beneficial Use	Period of Use		Rate of Diversion Q (cfs)	Annual Volume V (afa)
	From	To		
Heating	1/1	12/31	.20	57.9 ~~Not recommended~~
Domestic	1/1	12/31	.10	3.6
Totals:			.20	61.5

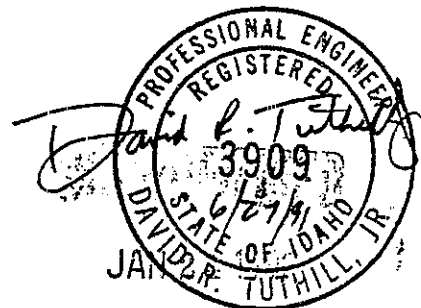
2. Recommended Amendments

- ☒ Change P.D. as reflected above ☐ Add P.D. as reflected above ☐ None
☐ Change P.U. as reflected above ☐ Add P.U. as reflected above ☐ Other

J. AUTHENTICATION

Field Examiner's Name Steven M. Lester
 Signature Steven M. Lester *SL* LW 5/2/91
 Certification Date _____
 Field Report Preparation Date 10/17/89 CONSULTANT SEAL

K. Licensing recommendation shall be prepared by an Idaho Department of Water Resources employee on a computer printout attached hereto.



MILE 35
PAYETTE

56-145

4733A1

T 132

gov't lots in W^{1/2}W^{1/2} and SESE 5.18

PLA { PLV ~~PLV~~ 20

20

but not

x

96-1-96

24E

36

ERVOIR

SEE GOV'T CAT
plot for 13N 3E S-13
for additional info
concerning spring located

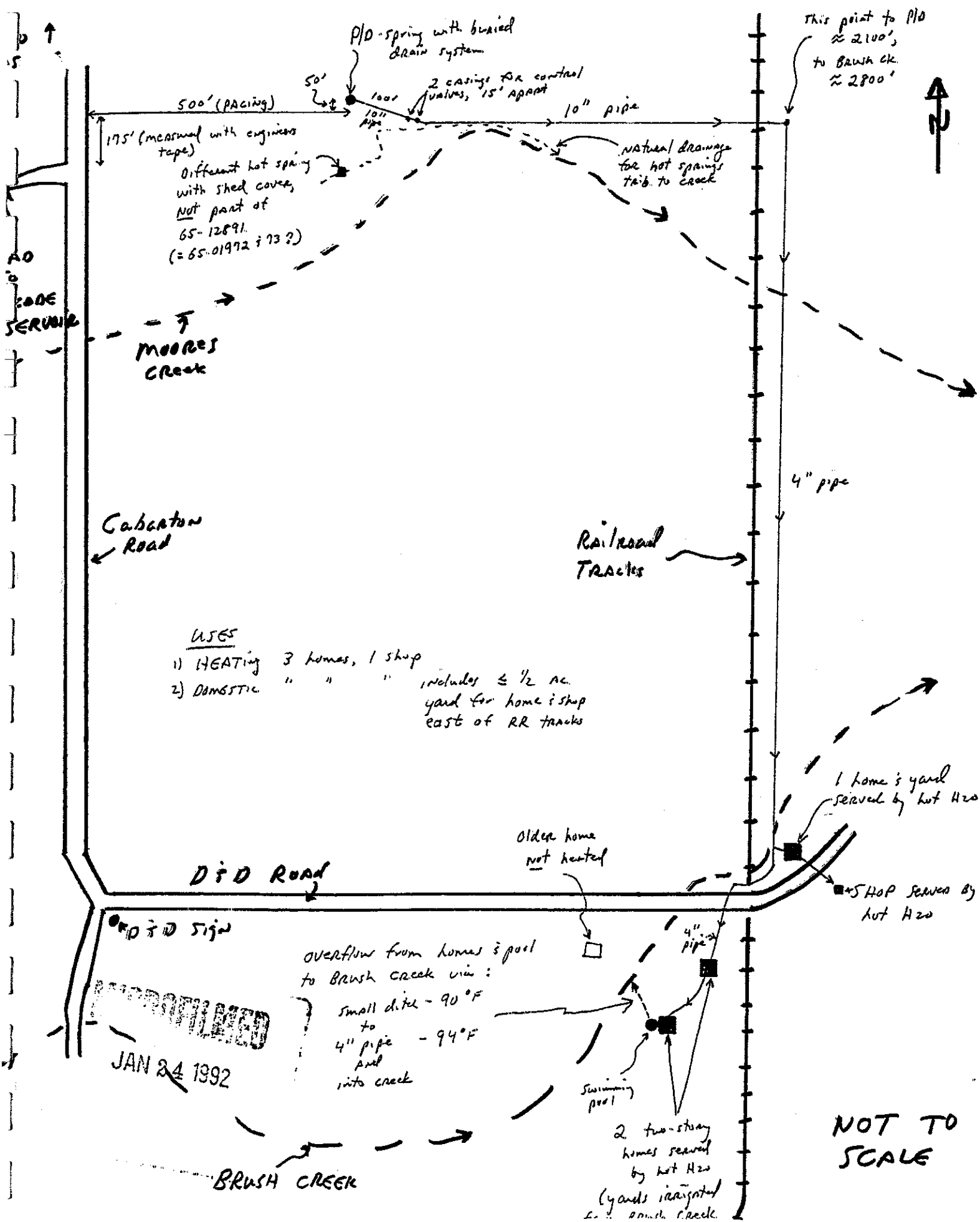
close enough to show

Fun 000.
ROAD TO
RESERVATION

[Handwritten signature]

Old Creek

65-12891 ALTERNATIVE DIAGRAM



CONVERSATION MEMORANDUM

DATE

10/19/88

X
Cataldi

FILE

65-12891

NAME OF PARTY

Pancheri

EMPLOYEE

Steve Loster

RE:

Estimating flow for heating per Admin. memo 23:

3 2-story homes, 1 shop

sq. ft. = $2200 + 1000 + 1800 + 720 = 5720$, round to 5800 since area estimates may be low.

← homes → ← shop

Source temp. = $101^{\circ}F$ $t_i = 70^{\circ}F$ (assumed) $t_o = -8^{\circ}F$ (assumed $\approx$ Pocatello)

efficiency is average.

→ for 2-story units

$$E = [e \cdot \Delta T] [8A]$$

where $\Delta T = t_i - t_o = 70 - (-8) = 78$ and e extrapolate

$$E = [(52.6)(78)] [(6.8)(5800)] = 19,036,992$$

$$W = \frac{Q}{500 (\Delta T_s)}$$

where $Q = E$ and $\Delta T_s = (6.6)(101 - 70) = 18.6$

$$W = \frac{19,036,992}{(500)(18.6)} = 2047 \text{ gpm} = 4.56 \text{ cfs}$$

Applicants want to use .40 cfs for heating, within the suggested range.

JAN 24 1992

ALLOW FOR LICENSING:

.20 cfs (150 proof paid)

↓

Domestic (4 units) = .10 cfs

Heating = .20 cfs

TOTAL = .20 cfs

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SEP 22 1989

Attachment #1

65-12891 Exam

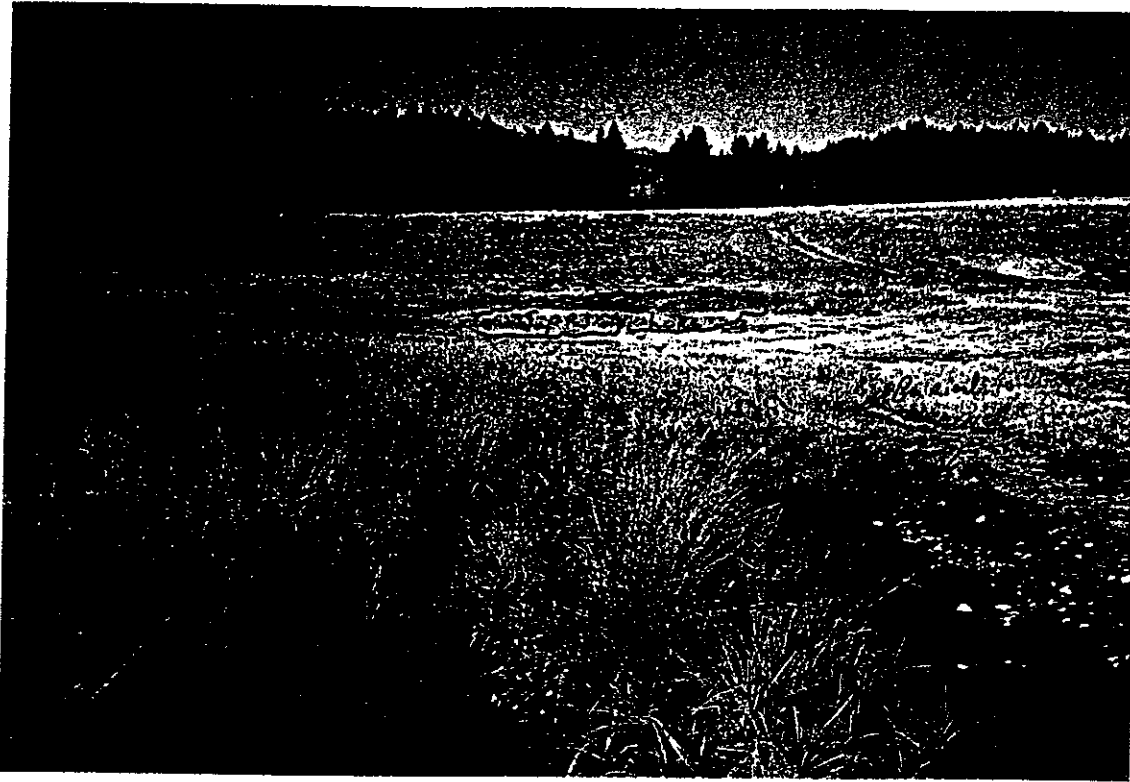


PHOTO ONE- Looking NW at spring area



PHOTO TWO- Not a well casing - this is a cover for 1 of 2 valves on 10" buried pipe from pld. This valve is about 100' SE of pld. Natural drainage for hot water is seen in plots #1 & 2.

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OCT 24 1992

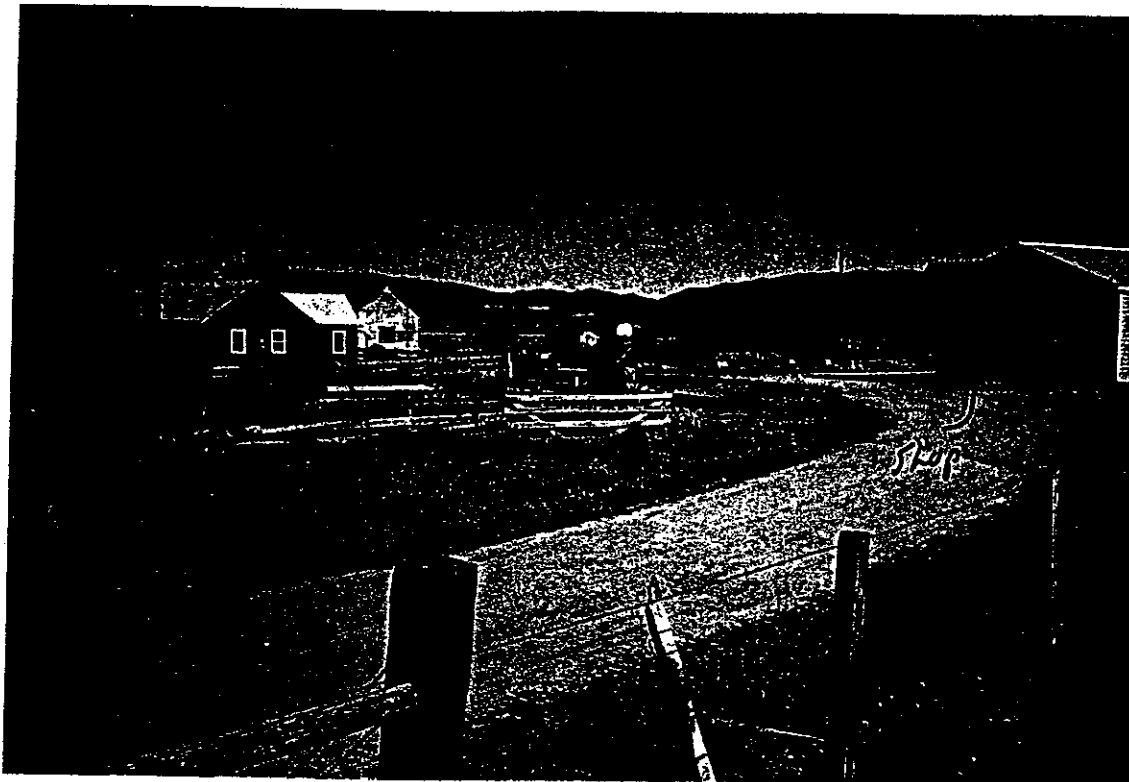


PHOTO THREE--

Plu Looking NE at home & shop on east side of Railroad tracks.



PHOTO FOUR--

Plu, 2 other homes between RR tracks & Brush creek. View is SW. Yards here are irrigated with Brush ck. water (65-06628).

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JAN 24 1992



PHOTO FIVE-

4" return flow pipe from swimming pool
to Birch Creek. Measured 94°15' at this
pipe.

JAN 24 1990

State of Idaho
Department of Water Resources

Permit To Appropriate Water

NO. 65-13332

Proposed Priority: July 2, 1991

Maximum Diversion Rate:

0.10 CFS

This is to certify, that **JOAN PANCHERI**
DARWIN PANCHERI
15501 STAGECOACH RD.
NAMPA, ID 83686

has applied for a permit to appropriate water from:

SPRING

tributary of **MOORES CREEK**

and a permit is **APPROVED** for development of water as follows:

BENEFICIAL USE

PERIOD OF USE

RATE OF DIVERSION

HEATING

01/01 to 12/31

0.10 CFS

LOCATION OF POINT(S) OF DIVERSION:

NESENE

Sec. 13, Township 13N, Range 03E

SENESE

Sec. 13, Township 13N, Range 03E

VALLEY County

PLACE OF USE: HEATING

TWN RGE SEC

13N 03E 13

NENE

CONDITIONS/REMARKS:

1. Proof of construction of works and application of water to beneficial use shall be submitted on or before **September 1, 1992**.
2. Subject to all prior water rights.
3. Use of water under this permit is subject to control by the watermaster of State Water District No. 65.
4. A lockable device, subject to the approval of the Department, shall be installed on the diverting works in a manner that will provide the watermaster suitable control of the diversion prior to diversion of water under this permit.
5. Use of water under this permit shall be non-consumptive.
6. Single point of diversion on or near line between SENESE and NESENE, S13, T13N, R03E.
7. Heating use is for 1 home and 1 shop.

This permit is issued pursuant to the provisions of Section 42-204, Idaho Code. Witness the seal and signature of the Director, affixed at Boise, this

27th day of August, 1991.

MICROFILMED

SEP 04 1991

R. Keith Higginson
for
R. Keith Higginson, Director

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
APPLICATION FOR PERMIT

To appropriate the public waters of the State of Idaho

- 1 Name of applicant Darwin &/or Joan Pancheri Phone 467-1348
Post office address 15501 Stagecoach - Rd. Nampa Id. 83686
- 2 Source of water supply Spring which is a tributary of Moore's Creek
- 3 Location of point of diversion is SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of NE $\frac{1}{4}$, Govt. Lot —
Sec. 13 Township 13N Range 3E B.M. Valley County; additional
points of diversion if any: NESENE S.13 T13N R3E
- 4 Water will be used for the following purposes:
Amount .10 for heating purposes from 1/1 to 12/31 (both dates inclusive)
(cfs or acre-feet per annum)
Amount — for — purposes from — to — (both dates inclusive)
(cfs or acre-feet per annum)
Amount — for — purposes from — to — (both dates inclusive)
(cfs or acre-feet per annum)
Amount — for — purposes from — to — (both dates inclusive)
(cfs or acre-feet per annum)
- 5 Total quantity to be appropriated is (a) .10 and/or (b) —
cubic feet per second acre feet per annum
- 6 Proposed diverting works:
a. Description of ditches, flumes, pumps, headgates, etc. drain system & collection pipe,
3/4 hp. pump & 1 1/2" mainline to buildings.
b. Height of storage dam — feet; active reservoir capacity — acre-feet; total
reservoir capacity — acre-feet; period of year when water will be diverted to storage:
— to — inclusive.
c. Proposed well diameter is — inches; proposed depth of well is — feet.
d. Is ground water with a temperature of greater than 90°F being sought? —
- 7 Time required for the completion of the works and application of the water to the proposed beneficial use is
1 years (minimum 1 year).

SEP 04 1991

8. Description of proposed uses (if irrigation only, go to item 9):

- a. Hydropower; show total feet of head and proposed capacity in KW. _____
- b. Stockwatering; list number and kind of livestock. _____
- c. Municipal; show name of municipality. _____
- d. Domestic; show number of households. _____
- e. Other; describe fully. heating of

1 home 2600 ft² (see 7/1/91
1 Shop 1400 ft² COM. memo)

9. Description of place of use:

- a. If water is for irrigation, indicate acreage in each subdivision in the tabulation below.
- b. If water is used for other purposes, place a symbol of the use (example: D for Domestic) in the corresponding place of use below. See instructions for standard symbols.

TWP	RANGE	SEC.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
13N	3E	13	G																

Total number of acres to be irrigated _____

10. Describe any other water rights used for the same purposes as described above. 65-12891 is
same source but other ~~land~~ buildings

11. a. Who owns the property at the point of diversion? Applicant
- b. Who owns the land to be irrigated or place of use? Applicant
- c. If the property is owned by a person other than the applicant, describe the arrangement enabling the applicant to make this filing. _____

12. Remarks: Single point of diversion on line between SEENE
and NEENE, S13, T13N, R03E
Heating is for 1 home and 1 shop.

SEP 04 1991

13. Map of proposed project: show clearly the proposed point of diversion, place of use, section number, township and range number.

Scale: 2 inches equal 1 mile.

BE IT KNOWN that the undersigned hereby makes application for permit to appropriate the public waters of the State of Idaho as herein set forth.

x James L. Sanchez
(Applicant)

2000-270

RESERVOIR

SEE GOVT. OFF.
plot for 13N 3E
for additional info
concerning spring loc.

close enough to
line to show in
road to
preserving

MAP COPIED FROM FIELD
 REPORT OF 65-12891.
 Exam NEW RIGHT PROPOSER SAME ;
 PLO BEST FOR NEW HOME ;
 SHOP

65/12

MILE 35
PAYETTE

166

T132

ROAD TO
RESERVING

СВАРТУ
РВАО

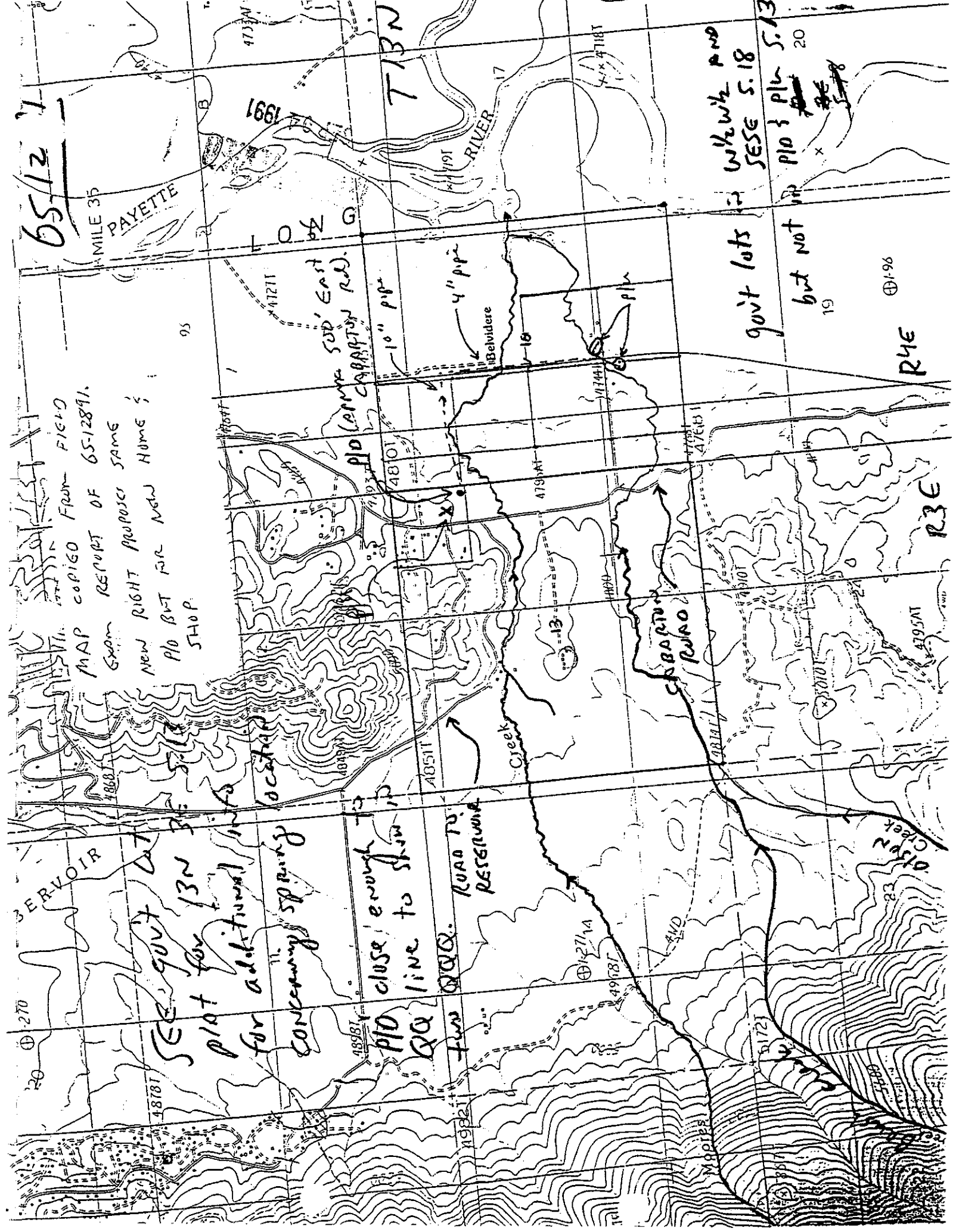
gov't lots in $W\frac{1}{2}W\frac{1}{2}$ and
SESE S. 18
S. 13

but not

96-103

R4E

23E



110
COPY

*I hereby certify that this
is a true and correct copy
of the original Stipulation and
Order filed in this cause on
the 30th day of December, 19
at 1:43 p.m.*

JIM JONES
Attorney General
State of Idaho
Statehouse, Room 210
Boise, Idaho 83720
Telephone: (208) 334-2400

PHILLIP J. RASSIER
JOSEPHINE P. BEEMAN
Deputy Attorneys General
Department of Water Resources
450 West State Street
Boise, ID 83720
Telephone: (208) 334-4448

John R. Dostert
District Judge

IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT OF THE
STATE OF IDAHO, IN AND FOR THE COUNTY OF GEM

IN THE MATTER OF THE GENERAL	)	Civil No. 3667
DETERMINATION OF THE RIGHT TO	)	
THE USE OF SURFACE AND GROUND-	)	STIPULATION AND ORDER:
WATER OF THE PAYETTE RIVER	)	PANCHERIS/LITTLES/
DRAINAGE BASIN	)	A. L. CATTLE INC.

The director of the Idaho Department of Water Resources, Darwin Pancheri and Joan L. Pancheri, Duane Pancheri and Laura Pancheri ("Pancheris" herein), the estate of Myrn H. Little, and A. L. Cattle, Inc. stipulate to the following water rights for the Pancheris, the estate of Myrn H. Little, and A. L. Cattle, Inc. within the Brush Creek drainage which is tributary to the North Fork of the Payette River. All of these water rights are listed in complete detail in the attached Exhibit A, but are listed in an abbreviated form here.

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JUL 24 1996

1. Brush Creek, tributary to North Fork, Payette River
65-6628 (Pancheris): 12.56 cfs for irrigation with a
priority date of 4/1/1912;
65-1979 (A. L. Cattle, Inc.): 6.24 cfs for
irrigation with a priority date of 6/1/1918;
2. Moores Creek, tributary to Brush Creek
65-11250 (Pancheris): 4.86 cfs for irrigation with a
priority date of 5/1/1899;
3. Andy Creek, tributary to South Fork Moores Creek, and
South Fork Moores Creek, tributary to Moores Creek
65-11280 (A. L. Cattle, Inc.): 1.06 cfs for
irrigation with a priority date of 6/1/1902.

With respect to right 65-11280 (in the name of A. L. Cattle, Inc.), the Pancheris and A. L. Cattle, Inc. agree as follows. Although right 65-11280 on Andy Creek is junior in priority to the Pancheri's downstream right 65-11250 on Moores Creek, it will be considered for distribution purposes to be a prior right as long as the following conditions are satisfied:

a. The use of water by A. L. Cattle, Inc., its successors and assigns under right 65-11280 will not be expanded to lands not shown to be irrigated on the attached Exhibit A. That is if the Exhibit shows a given number of acres irrigated in a quarter section, A. L. Cattle, Inc. will not increase the number of acres being irrigated in that fractional section.

b. A. L. Cattle, Inc. agrees, for and on behalf of itself, successors and assigns, not to change the method of irrigating under 65-11280 even though the method of irrigating can be changed without increasing the consumptive use, such as changing from the present method of irrigating, flood irrigation, to sprinklers.

JUL 24 1996

1 c. A. L. Cattle, Inc. agrees for and on behalf of
2 itself, its successors and assigns not to change
3 either the place of use of the water or the points of
4 diversion without first obtaining the written consent
5 of the Pancheris or the Pancheris' successors and
6 assigns.

7 d. A. L. Cattle, Inc. agrees, for and on behalf of
8 itself, its successors and assigns to use the water
9 in such a manner that all water not needed for the
10 propagation of crops will either be left in the
11 natural drainage or will be returned back to Moores
12 Creek upstream from the Pancheris' point of diverison
13 as it presently exists.

14 e. The enforcement of those conditions which occur
15 after the water is diverted from the natural channel
16 will be the responsibility of the private parties,
17 except that Water Resources may also exercise its
18 authority under Title 42, Idaho Code.

19 4. Springs, tributary to Moores Creek

20 65-1972 (estate of Myrn H. Little): .04 cfs for
21 domestic purposes with a priority date of 5/1/1901;

22 65-1973 (estate of Myrn H. Little): .01 cfs for
23 domestic purposes with a priority date of 5/1/1901.

24 The Pancheris, the estate of Myrn H. Little and A. L.
25 Cattle, Inc. further agree, based upon this stipulation, to
26 withdraw the objections that each had filed affecting their
27 respective rights on Brush Creek, Moores Creek and Andy Creek.

Dated this 30th day of December, 1986.

RINGERT, CLARK, HARRINGTON,
'REID, CHRISTENSON & KAUFMAN,
CHARTERED

By:

W. F. Ringert 12-30-86
William F. Ringert, a member
of the firm
Attorneys for Darwin Pancheri,
Joan L. Pancheri, Duane
Pancheri, and Laura Pancheri

Saul Spron 29 December 198

Louie Gorrone, Attorney for
Claimant Agnes Brailsford,
Personal Representative of the
Estate of Myrn H. Little,
Deceased and for Claimant
A. L. Cattle, Inc.

JIM JONES
Attorney General

Josephine P. Beeman 26 December
Josephine P. Beeman
Deputy Attorney General
Idaho Department of Water
Resources

JIM JONES

Attorney General

State of Idaho

Statehouse, Room 210

Boise, Idaho 83720

Telephone: (208) 334-2400

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JUL 24 198

PHILLIP J. RASSIER
JOSEPHINE P. BEEMAN
Deputy Attorneys General
Department of Water Resources
450 West State Street
Boise, ID 83720
Telephone: (208) 334-4448

IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT OF THE
STATE OF IDAHO, IN AND FOR THE COUNTY OF GEM

IN THE MATTER OF THE GENERAL)
DETERMINATION OF THE RIGHT TO)
THE USE OF SURFACE AND GROUNDWATER)
OF THE PAYETTE RIVER DRAINAGE)
BASIN)

Civil No. 3667

ORDER

The foregoing stipulation having come duly and regularly
before the court and good cause appearing therefore,

IT IS HEREBY ORDERED that the objections filed by the
Pancheris as to their rights 65-6622, 65-6629, 65-6628, and
65-11250 be dismissed with prejudice; further that the objections
to and protests filed against Pancheris' water rights by A. L.
Cattle, Inc. and the estate of Myrn H. Little and against the
water rights of A. L. Cattle, Inc. and the estate of Myrn H.
Little by Pancheris be dismissed with prejudice and without
attorneys fees and costs to any party.

IT IS FURTHER ORDERED that A. L. Cattle, Inc.'s water
rights 65-1979, 65-11280 and the estate of Myrn H. Little's water
rights 65-1972 and 65-1973 listed in the attached Exhibit A are
deemed admitted and conceded by the Pancheris, their heirs,

JUL 24 1996

successors and assigns as true and accurate, and subject to the conditions stated on pages 2 and 3 of the Pancheris/Littles/A. L. Cattle Inc. stipulation.

IT IS FURTHER ORDERED that the Pancheris' water rights 65-6628 and 65-11250 listed in the attached Exhibit A are deemed admitted and conceded by A. L. Cattle, Inc. and the estate of Myrn H. Little and their successors and assigns as true and accurate, and subject to the conditions stated on pages 2 and 3 of the Pancheris/Littles/A. L. Cattle Inc. stipulation.

DATED this 30 day of December, 1986.

/s/
JIM R. DOOLITTLE
District Judge

1
2 JIM JONES
3 Attorney General
4 State of Idaho
5 Statehouse, Room 210
6 Boise, Idaho 83720
7 Telephone: (208) 334-2400

8 PHILLIP J. RASSIER
9 JOSEPHINE P. BEEMAN
10 Deputy Attorneys General
11 Department of Water Resources
12 450 West State Street
13 Boise, ID 83720
14 Telephone: (208) 334-4448

15
16
17 IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT OF THE
18 STATE OF IDAHO, IN AND FOR THE COUNTY OF GEM

19
20 IN THE MATTER OF THE GENERAL) Civil No. 3667
21 DETERMINATION OF THE RIGHT TO)
22 THE USE OF SURFACE AND GROUND-) STIPULATION AND ORDER:
23 WATER OF THE PAYETTE RIVER) PANCHERIS AND LESLIE
24 DRAINAGE BASIN)
25

26
27 The director of the Idaho Department of Water
Resources, Darwin Pancheri and Joan L. Pancheri, Duane Pancheri
and Laura Pancheri ("Pancheris" herein), and William John
Leslie ("Leslie" herein) stipulate to the following water
rights for the Pancheris and Leslie, and A. L. Cattle, Inc.
within the Brush Creek drainage which is tributary to the North
Fork of the Payette River. All of these water rights are
listed in complete detail in the attached Exhibit A, but are
listed in an abbreviated form here.

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I hereby certify that this is
a true and correct copy of
the original stipulation and
order filed in this cause
on the 30th day of December
1986, at 1:50 p.m.
J. R. D. [Signature]
District Judge

1. Andy Creek, tributary to South Fork Moores Creek
65-3420 (Leslie): 2.08 cfs for irrigation with a
priority date of 4/1/1894;
2. House Creek, tributary to North Fork Moore's Creek
65-3419 (Leslie): 2.62 cfs for irrigation with a
priority date of 4/1/1894;
3. Moores Creek, tributary to Brush Creek
65-11250 (Pancheris): 4.86 cfs for irrigation with a
priority date of 5/1/1899;
4. North Fork Moores Creek, tributary to Moores Creek
65-3419 (Leslie): 2.62 cfs for irrigation with a
priority date of 4/1/1894;
65-3420 (Leslie): 2.08 cfs for irrigation with a
priority date of 4/1/1894;
5. South Fork Moores Creek, tributary to Moores Creek
65-3420 (Leslie): 2.08 cfs for irrigation with a
priority date of 4/1/1894;
6. Springs, tributary to Moores Creek
65-3418 (Leslie): 0.04 cfs for irrigation with a
priority date of 4/1/1910.

With respect to rights 65-3418, 65-3419, 65-3420 (in the name of Leslie), the Pancheris and Leslie agree as follows. Although right 65-3418 on springs tributary to Moores Creek is junior in priority to the Pancheris' downstream right 65-11250 on Moores Creek, it will be considered for distribution purposes to be a prior right as long as the following conditions are satisfied:

a. The use of water by Leslie, his successors, heirs and assigns under rights 65-3418, 65-3419, and 65-3420 will not be expanded to lands not shown to be irrigated on the attached Exhibit A. That is if the Exhibit shows a given number of acres irrigated in a quarter section, Leslie will not increase the number of acres being irrigated in that fractional section.

1 b. Leslie agrees, for and on behalf of himself, his
2 successors, heirs and assigns, not to change the
3 method of irrigating under rights 65-3418, 65-3419,
4 and 65-3420 even though the method of irrigating can
be changed without increasing the consumptive use,
such as changing from the present method of
irrigating, flood irrigation, to sprinklers.

5 c. Leslie agrees for and on behalf of himself, his
6 successors, heirs and assigns not to change either
7 the place of use of the water or the points of
8 diversion without first obtaining the written consent
9 of the Pancheris or the Pancheris' successors, heirs
and assigns. A replacement to a damaged headgate
will not constitute a change in point of diversion
where the point of diversion is not substantially
changed.

10 d. Leslie agrees, for and on behalf of himself, his
11 successors, heirs and assigns to use the water in
12 such a manner that all water not needed for the
13 propagation of crops will either be left in the
14 natural drainage or will be returned back to Moores
15 Creek upstream from the Pancheris' point of diversion
16 as it presently exists. The parties to this
17 stipulation acknowledge the existence of a rotation
18 agreement between Leslie and MacGregor which is
19 attached as Exhibit B.

20 e. The enforcement of those conditions which occur
21 after the water is diverted from the natural channel
22 will be the responsibility of the private parties,
23 except that Water Resources may also exercise its
24 authority under Title 42, Idaho Code.

25
26 The Pancheris and Leslie further agree, based upon
27 this stipulation, to withdraw the objections that each had
filed affecting their respective rights on Andy Creek, House
Creek, Moores Creek, North Fork Moores Creek and South Fork
Moores Creek.

1
2 Dated this 29th day of December, 1986.
3

4 RINGERT, CLARK, HARRINGTON,
5 REID, CHRISTENSON & KAUFMAN,
6 CHARTERED

7 By: W F Ringert
8 William F. Ringert, a member
9 of the firm
10 Attorneys for Darwin Pancheri,
11 Joan L. Pancheri, Duane
12 Pancheri, and Laura Pancheri
13

14 COLLINS & MANLY

15 By: William D. Collins 26 December 1986
16 William D. Collins,
17 Attorneys for William John
18 Leslie
19

20 JIM JONES
21 Attorney General

22 Josephine P. Beeman 26 December 1986
23 Josephine P. Beeman
24 Deputy Attorney General
25 Idaho Department of Water
26 Resources
27

JUL 24 1986

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IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT OF THE
STATE OF IDAHO, IN AND FOR THE COUNTY OF GEM

IN THE MATTER OF THE GENERAL	)	Civil No. 3667
DETERMINATION OF THE RIGHT TO	)	
THE USE OF SURFACE AND GROUNDWATER	)	ORDER
OF THE PAYETTE RIVER DRAINAGE	)	
BASIN	)	

The foregoing stipulation having come duly and regularly
before the court and good cause appearing therefore,

IT IS HEREBY ORDERED that the objections filed by the
Pancheris as to their rights 65-6622, 65-6629, 65-6628, and
65-11250 be dismissed with prejudice; further that the objections
to and protests filed against Pancheris' water rights by Leslie
and against the water rights of Leslie by Pancheris be dismissed
with prejudice and without attorneys fees and costs to any party.

IT IS FURTHER ORDERED that Leslie's water rights
65-3418, 65-3419 and 65-3420 listed in the attached Exhibit A are
deemed admitted and conceded by the Pancheris, their heirs,
successors and assigns as true and accurate, and subject to the
conditions stated on pages 2 and 3 of the Pancheris and Leslie
stipulation.

IT IS FURTHER ORDERED that the Pancheris' water right
65-11250 listed in the attached Exhibit A is deemed admitted and

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conceded by Leslie, his successors, heirs and assigns as true and accurate, and subject to the conditions stated on pages 2 and 3 of the Pancheris and Leslie stipulation.

DATED this 30 day of December, 1986.

/s/
JIM R. DOOLITTLE
District Judge

12/86

PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 1

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-3420	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 OTHER RIGHTS: 65-3416	04-01-1894	IRRIGATION	04-15 10-15	2.08 CFS	BENEFICIAL USE
	REMARKS: 2 P/D IN SWNE, S14, T13N, R3E. SOURCES ARE MOORES CREEK, NORTH FORK AND MOORES CREEK, SOUTH FORK TRIB. MOORES CREEK AND ANDY CREEK TRIB. MOORES CREEK, SOUTH FORK. PT. OF INJECTION INTO ANDY CREEK IN NESW S14 T13N R 3E. PT. OF REDIVERSION IN SWNE S14 T13N R 3E.					
	POINT OF DIVERSION: T13N R03E S14					
	SWNE NESW					
	PLACE OF USE: IRRIGATION					
	T13N R03E S13	SENE 9				
	S14	SENE 20				
	104 ACRES TOTAL					
65-11280	A. L. CATTLE, INC. C/O AGNES BRALLSFORD P.O. BOX 180 HAGERMAN, ID 83332	06-01-1902	IRRIGATION	04-15 10-15	1.06 CFS	BENEFICIAL USE
	REMARKS: PT. OF INJECTION INTO ANDY CREEK IN NESW, S14, T13N, R3E. PT. OF REDIVERSION IN NWSE, S14, T13N, R3E. SOURCES FOR THIS RIGHT ARE MOORES CREEK, SOUTH FORK TRIB. MOORES CREEK AND ANDY CREEK TRIB. MOORES CREEK, SOUTH FORK.					
	POINT OF DIVERSION: T13N R03E S14					
	NESW NWSE					
	PLACE OF USE: IRRIGATION					
	T13N R03E S14	NWSE 24				
	53 ACRES TOTAL					

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RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-6628	PANCHERI, DARVIN PANCHERI, JOAN L. PANCHERI, DUANE PANCHERI, LAURA MELBA, ID 83641 OTHER RIGHTS: 65-2696. REMARKS: 2 P/D IN SESW, S18, T13N, R4E. POINT OF DIVERSION: T13N R03E S13 T13N R04E S18 PLACE OF USE: IRRIGATION T13N R04E S17 LT04(SW) 3 S18 LT04(SW) 5 S19 LT05(NENE) 32 SES 32 S20 LT11(NW) 17 S29 LT04(NW) 1 S30 LT05(NENE) 23 628 ACRES TOTAL	04-01-1912	IRRIGATION	04-15 10-15	12.56 CFS	BENEFICIAL
65-1979	A. L. CATTLE, INC. C/O AGNES BRAILSFORD P.O. BOX 180 HAGERMAN, ID 83336 OTHER RIGHTS: 65-11260 POINT OF DIVERSION: T13N R03E S14 T13N R03E S13 PLACE OF USE: IRRIGATION T13N R03E S13 S14 T13N R04E S18 LT02(SW) 13 312 ACRES TOTAL	06-01-1918	IRRIGATION	04-15 10-15	6.24 CFS	BENEFICIAL

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PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 3

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-3407	MAGREGOR LAND & LIVESTOCK CO. INC. P.O. BOX 5128 BOISE, ID 83705 OTHER RIGHTS: 65-11411 REMARKS: 2 P/D IN SWSW, S11, T13N, R3E AND 3 P/D IN SESE, S11, T13N, R3E. POINT OF DIVERSION: T13N R03E S11 SESW SESW PLACE OF USE: IRRIGATION T13N R03E S11 50 ACRES TOTAL	04-01-1897	IRRIGATION	04-15 10-15	1.00 CFS	DEGREE
	SOURCE: DORA CREEK		TRIBUTARY: SAND CREEK			
65-3419	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 REMARKS: SOURCES ARE HOUSE CREEK, TRIB. MOORES CREEK, NORTH <u>CREEK</u> AND MOORES CREEK, NORTH FORK, TRIB. MOORES CREEK. POINT OF DIVERSION: T13N R03E S11 SESE S13 S14 PLACE OF USE: IRRIGATION T13N R03E S11 SESE 39 S12 S13 S14 131 ACRES TOTAL	04-01-1894	IRRIGATION	04-15 10-15	2.62 CFS	BENEFICIAL USE
	SOURCE: HOUSE CREEK		TRIBUTARY: MOORES CREEK, NORTH FORK			

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PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLEE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 4

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-3406	MAGREGOR LAND & LIVESTOCK CO. P.O. BOX 5126 BOISE, ID 83705	04-01-1897	IRRIGATION	04-15 10-15	1.56 CFS	DECREE
	REMARKS: 2 P/D FROM HOUSE CREEK IN NEMW, S14, T13N, R3E. SOURCES ARE MOORES CREEK, NORTH FORK, TRIB. MOORES CREEK: HOUSE CREEK, TRIB. MOORES CREEK, NORTH FORK.					
	POINT OF DIVERSION: T13N R03E S14					
	SWNE NEMW SENW					
	PLACE OF USE: IRRIGATION T13N R03E S11 SWSE 39 S14 NWNE 39					
	78 ACRES TOTAL					
65-3408	MAGREGOR LAND & LIVESTOCK CO. INC. P.O. BOX 5128 BOISE, ID 83705	04-01-1897	IRRIGATION	04-15 10-15	.72 CFS	DECREE
	REMARKS: 2 P/D IN NEMW, S14, T13N, R3E AND 3 P/D IN NEMW, S14, T13N, R3E FROM SAND CR., TRIB. WILLOW CREEK. SOURCES ARE SAND CR., TRIB. WILLOW CR.; HOUSE CR., TRIB. MOORES CR., NORTH FORK.					
	POINT OF DIVERSION: T13N R03E S14					
	NEMW NEMW SENW					
	PLACE OF USE: IRRIGATION T13N R03E S14 NEMW 38					
	46 ACRES TOTAL					

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PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

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RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-11250	PANCHERI, DARWIN PANCHERI, JOAN L. PANCHERI, DUANE PANCHERI, LAURA MELBA, ID 83641 OTHER RIGHTS: 65-2534, 65-2696. POINT OF DIVERSION: T13N R03E S13 PLACE OF USE: IRRIGATION T13N R04E S07 SWSW 16 S17 LT04(SW1W) 8 S18 NENE 27 NWSE 24	05-01-1899	IRRIGATION	04-15 10-15	4.86 CFS	BENEFICIAL USE
	SOURCE: MOORES CREEK TRIBUTARY: BRUSH CREEK					
65-3419	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 REMARKS: SOURCES ARE HOUSE CREEK, TRIB. MOORES CREEK, NORTH CREEK AND MOORES CREEK, NORTH FORK, TRIB. MOORES CREEK. POINT OF DIVERSION: T13N R03E S11 SESE S13 NW1W S14 SWNE PLACE OF USE: IRRIGATION T13N R03E S11 SESE 39 S12 SWSW 12 S13 NW1W 30 S14 NENE 39 131 ACRES TOTAL	04-01-1894	IRRIGATION	04-15 10-15	2.62 CFS	BENEFICIAL USE
	SOURCE: MOORES CREEK, NORTH FORK TRIBUTARY: MOORES CREEK					
	243 ACRES TOTAL					

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PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A -- LISTING OF WATER RIGHTS

PAGE 6

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-3420	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 OTHER RIGHTS: 65-3418 REMARKS: 2 P/D IN SWNE, S14, T13N, R3E. SOURCES ARE MOORES CREEK, NORTH FORK AND MOORES CREEK, SOUTH FORK TRIB. MOORES CREEK AND ANDY CREEK TRIB. MOORES CREEK, SOUTH FORK. PT. OF INJECTION INTO ANDY CREEK IN NWSW S14 T13N R 3E. PT. OF REDIVERSION IN SWNE S14 T13N R 3E.	04-01-1894	IRRIGATION	04-15 10-15	2.06 CFS	BENEFICIAL USE
	POINT OF DIVERSION: T13N R03E S14 SWNE NWSW					
	PLACE OF USE: IRRIGATION T13N R03E S13 SWNW 36 S14 NENE 1			SENE 9 SENE 20 SENE 38		
	104 ACRES TOTAL					
65-3406	MAGREGOR LAND & LIVESTOCK CO. P.O. BOX 5128 BOISE, ID 83705 REMARKS: 2 P/D FROM HOUSE CREEK IN NENW, S14, T13N, R3E. SOURCES ARE MOORES CREEK, NORTH FORK, TRIB. MOORES CREEK: HOUSE CREEK, TRIB. MOORES CREEK, NORTH FORK. POINT OF DIVERSION: T13N R03E S14 SWNE NENW SENW	04-01-1897	IRRIGATION	04-15 10-15	1.56 CFS	DEGREE
	PLACE OF USE: IRRIGATION T13N R03E S11 SWSE 39 S14 NENE 39					
	76 ACRES TOTAL					

JUL 24 1996

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PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 7

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-3420	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 OTHER RIGHTS: 65-3418 REMARKS: 2 P/D IN SWNE, S14, T13N, R3E. SOURCES ARE MOORES CREEK, NORTH FORK AND MOORES CREEK, SOUTH FORK TRIB. MOORES CREEK AND ANDY CREEK TRIB. MOORES CREEK, SOUTH FORK. PT. OF INJECTION INTO ANDY CREEK IN NESE S14 T13N R 3E. PT. OF REDIVERSION IN SWNE S14 T13N R 3E. POINT OF DIVERSION: T13N R03E S14 SWNE NESE PLACE OF USE: IRRIGATION T13N R03E S13 SWNE 36 S14 SESE 9 SENE 20 104 ACRES TOTAL	04-01-1894	IRRIGATION	04-15 10-15	2.08 CFS	BENEFICIAL USE
65-11280	A. L. CATTLE, INC. C/O AGNES BRAILSFORD P.O. BOX 180 HAGERMAN, ID 83332 OTHER RIGHTS: 65-1979 REMARKS: PT. OF INJECTION INTO ANDY CREEK IN NESE, S14, T13N, R3E. PT. OF REDIVERSION IN NWSE, S14, T13N, R3E. SOURCES FOR THIS RIGHT ARE MOORES CREEK, SOUTH FORK TRIB. MOORES CREEK AND ANDY CREEK TRIB. MOORES CREEK, SOUTH FORK. POINT OF DIVERSION: T13N R03E S14 NESE NWSE PLACE OF USE: IRRIGATION T13N R03E S14 NESE 24 NWSE 27 SWSE 2 53 ACRES TOTAL	06-01-1902	IRRIGATION	04-15 10-15	1.06 CFS	BENEFICIAL USE

JUL 24 1996

12/86

PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

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RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD		MAXIMUM DIVERSION	STAGE
				FROM	TO		

SOURCE: SAND CREEK

TRIBUTARY: WILLOW CREEK

65-3408

MACGREGOR LAND & LIVESTOCK CO. INC.
P.O. BOX 5128
BOISE, ID 83705

04-01-1897 IRRIGATION

04-15 10-15

.72 CFS

DEGREE

REMARKS: 2 P/D IN NENW, S14, T13N, R3E AND 3 P/D IN NNNW, S14, T13N, R3E
FROM SAND CR., TRIB. WILLOW CREEK.
SOURCES ARE SAND CR., TRIB. WILLOW CR.; HOUSE CR., TRIB.
MOORES CR., NORTH FORK.
POINT OF DIVERSION:
T13N R03E S14 NENW
T13N R03E S14 NWC
T13N R03E S13 SENE



JUL 24 1996

12/86

PANCHERI/LITTLE/A.L. CATTLE STIPULATION
 PANCHERI/LESLIE STIPULATION
 EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 9

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
65-1972	LITTLE, MYRN H. C/O AGNES BRALLSFORD P.O. BOX 180 HAGERMAN, ID 83332 POINT OF DIVERSION: T13N R03E S13 PLACE OF USE: T13N R03E S13	05-01-1901 01-01 12-31	DOMESTIC		.04 CFS 1.20 AFA	BENEFICIAL USE
	SOURCE: SPRING TRIBUTARY: NOORES CREEK					
65-1973	LITTLE, MYRN H. C/O AGNES BRALLSFORD P.O. BOX 180 HAGERMAN, ID 83332 POINT OF DIVERSION: T13N R03E S13 PLACE OF USE: T13N R03E S13	05-01-1901 01-01 12-31	DOMESTIC		.01 CFS 1.20 AFA	BENEFICIAL USE
65-3418	LESLIE, WILLIAM JOHN 2404 NORTH 21ST BOISE, ID 83702 OTHER RIGHTS: 65-3420 POINT OF DIVERSION: T13N R03E S13 PLACE OF USE: IRRIGATION T13N R03E S13	04-01-1910 IRRIGATION		04-15 10-15	.04 CFS	BENEFICIAL USE
	2 ACRES TOTAL					

JUL 24 1986

12/86

PANCHERI/LITTLE/A.L. CATTLE STIPULATION
PANCHERI/LESLIE STIPULATION
EXHIBIT A - LISTING OF WATER RIGHTS

PAGE 10

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
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DISALLOWED CLAIMS

65-6622

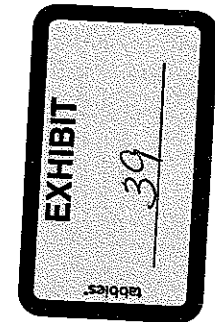
PANCHERI, DARWIN
PANCHERI, JOAN L.
PANCHERI, DUANE
PANCHERI, LAURA
HELBA, ID 83641
REMARKS: NO BENEFICIAL USE FOUND-USE FORFEITED OR ABANDONED.

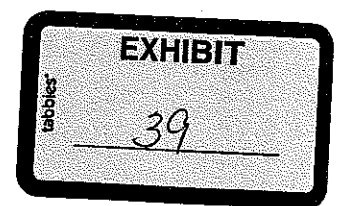
65-6629

PANCHERI, DARWIN
PANCHERI, JOAN L.
PANCHERI, DUANE
PANCHERI, LAURA
HELBA, ID 83641
REMARKS: RECOMMENDED AS RT. 65-11250.

JUL 24 1986

Scanlin Draft Report
August 4, 2003





AN ENGINEERING

and Environmental Engineering

August 4, 2003

Carol MacGregor
P.O. Box 569
Cascade, ID 83611

Subject: Draft Response to IDWR Regarding Test Well Proposal

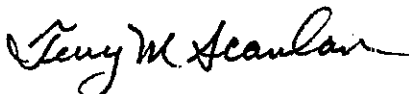
Dear Carol:

Enclosed for your review and comment please find a draft response to Rob Whitney's email of July 1, 2003, and Gary Spackman's letter of June 5, 2003.

I have contacted Dr. Paul Donaldson at Boise State University in an effort to obtain a copy of his report to Eastern Western Corporation regarding test well siting studies in 1995. I am waiting to receive the report and will include it in the final response to IDWR.

Please contact me after you have reviewed this information.

Sincerely,



Terry M. Scanlan, P.E.

Cc: Jo Beeman ✓

RECEIVED AUG - 5 2003

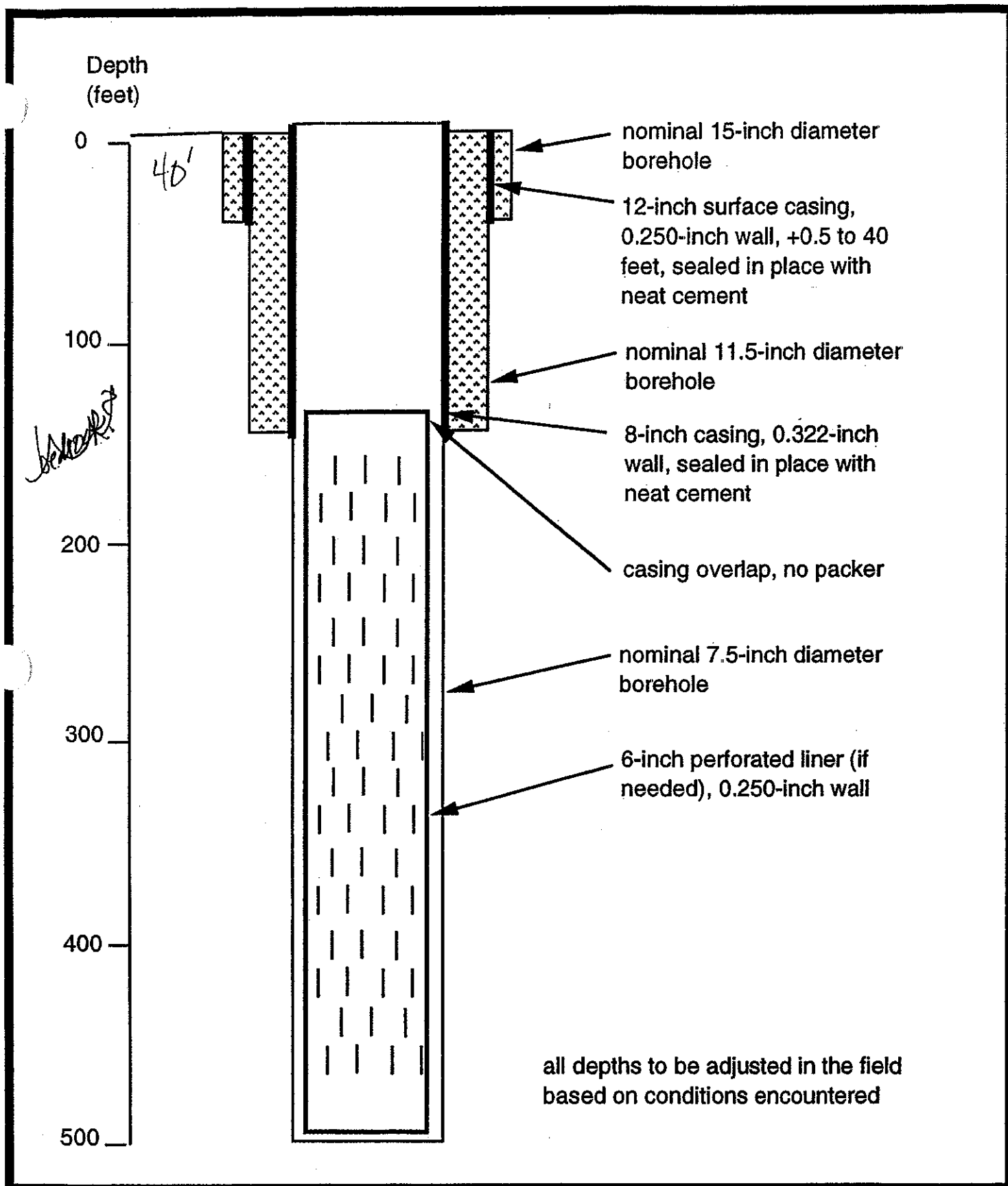


FIGURE 1
MACGREGOR GEOTHERMAL TEST WELL CONCEPT

**ATTACHMENT A
MONITORING DATA**

Proposed Geothermal Monitoring Plan - Belvidere Hot Spring Area March 12, 2001

A geothermal monitoring program is proposed to provide data related to pending Applications for Permit 65-13912, 65-13913, 65-13986. The applications have been submitted by Carol Lynn MacGregor and have been protested by Duane and Laura Pancheri and Darwin and Joan Pancheri. The Pancheris divert water from the hot spring under water rights 65-13332 and 65-12981.

The purpose of the monitoring program is to document (1) existing discharge rates and temperatures at the springs and (2) existing diversion rates and source temperatures under water rights 65-13332 and 65-12981. The proposed monitoring program will supplement initial monitoring conducted on January 27, 2001. Monitoring should take place for a one-year period beginning in the spring of 2001.

This plan has been jointly prepared by Terry Scanlan (consultant to MacGregor) and Sheri Chapman (consultant to the Pancheris). Data shall be collected jointly by Scanlan and Chapman (unless otherwise agreed to by the parties). As part of this plan, Chapman shall be allowed to enter the MacGregor property for scheduled monitoring events or with pre-notification to (and approval by) MacGregor or MacGregor's representatives. Similarly, Scanlan shall be allowed to enter the Pancheri property for scheduled monitoring events or with pre-notification to (and approval by) the Pancheris or their representatives.

Monitoring Locations and Methods

Darwin Pancheri System (Water Right Permit No. 65-13332). Darwin Pancheri's system is very simple and additional flow measurements might not be necessary. However, monthly spot checks of source temperatures are recommended as part of the monitoring discussed below. Since pumping rate is easily monitored (with bucket and stopwatch) at the point where the water discharges back to the creek, the pumping rate should be measured occasionally for additional verification. Temperatures shall be measured at the pump intake.

Duane Pancheri System (Water Right License No. 65-12891). Flow measurements and temperature measurements at Duane Pancheri's system are recommended. Measurements should be collected quarterly, beginning in the spring of 2001. Measurements, using a bucket and stopwatch, should be as follows.

1. The pool should be partially drained to allow access to the 4-inch pipe
2. With the tomato can in place, flow rate should be measured at (1) the 4-inch pipe that discharges to the pool, (2) the pipe that discharges to the pool from the two homes, and (3) the pipe that discharges into Brush Creek from the home and shop
3. The can should then be removed from the 4-inch pipe, flows should be allowed to reach equilibrium, and flow rates should be re-measured at all three locations.

Geothermal Monitoring Plan

-2-

March 12, 2001

Note that in the non-heating season, steps 2 and 3 would probably be reversed (i.e., measure initially with tomato can out, and then with tomato can in).

In addition to the flow monitoring, source temperature should be measured on a monthly basis for a one-year period. Measurements should be made through the pipeline vent using a thermometer with a probe that can be lowered through the vent into the pipe. Water level in the vent pipe should also be measured to determine if pipe pressure (and therefore, flow rate) varies. If significant variations in flow rate are detected, then installation of a totalizing flow meter in the 4-inch pipeline should be considered.

Spring Discharge Monitoring (Pancheri Stockwater Source). The discharge from the MacGregor spring area and the overflow from the Pancheri spring source (if any) are combined approximately 50 feet southwest of Darwin Pancheri's pump. Since the Pancheri's utilize this surface water for irrigation and stockwater purposes, monitoring is recommended to document existing conditions. Monitoring can best be conducted using a v-notch weir and staff gage. Recommended weir location is a few feet north of the MacGregor-Pancheri fence. This weir area should be fenced from livestock. Measurements of flow and temperature should be collected on a monthly basis for a period of one year.

In addition to the main weir on the Pancheri side of the fence, an additional weir that measures the flow from the MacGregor springs only is proposed. The MacGregor weir measurement could be subtracted from the Pancheri weir measurement to estimate the surface discharge from the springs on the Pancheri property. The MacGregor weir and spring area shall be fenced from livestock.

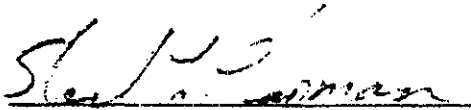
Temperatures should be monitored at the two MacGregor bathhouse sites on a monthly basis.

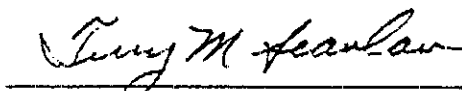
Baseline Monitoring Report

Following the completion of one-year of baseline monitoring, a summary report of the monitoring results shall be prepared. The report will provide a summary of monitoring methodology and results. The report shall be prepared jointly by Chapman and Scanlan, and shall be submitted to the parties.

Monitoring Costs. The parties agree to pay costs for their respective consultants. MacGregor shall pay costs for installation of weirs. Scanlan and Chapman shall participate in weir installation. If data are collected by one consultant or an outside third party for the benefit of both parties, the cost of that acquisition shall be shared equally by both parties.

By signing below, Scanlan and Chapman agree that the above-described methodology will provide accurate data for the purposes described.


Sheri L. Chapman


Terry M. Scanlan

SCANLAN ENGINEERING

Groundwater and Environmental Engineering

November 28, 2002

Mr. Gary Spackman
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705

Subject: Applications for Permit 65-13992 and 65-13993

Dear Gary:

Carol MacGregor and I have reviewed Sheri Chapman's letter of November 5, 2002, requesting termination of baseline monitoring associated with Applications 65-13992 and 65-13993. As described in Sheri's letter, significant and valuable data have been collected in an attempt to characterize (1) the discharge from the geothermal resource in this area and (2) the diversion of geothermal water under the Pancheri water rights (65-12891 and 65-13332). A copy of the data summary is attached for your information.

Although the discovery period has ended, we believe that continued monitoring of diversion under the Pancheri water rights is warranted. The Pancheri's have indicated that they will oppose any depletion to the discharge from the springs that might impact their water rights. In such a situation, accurate flow monitoring is necessary to protect both parties from allegations of hydraulic impacts or over diversion. We feel that accurate diversion data can only be obtained through flow metering. Therefore, please consider this letter as a request for the Department to order the immediate installation of totalizing flow meters on the pipelines that supply these water rights. Furthermore, we request that totalized flows be reported to the Department on a monthly basis until further notice. It is important for data collection to begin prior to the end of December so that totalized flows can be collected for calendar year 2003.

The totalizing flow meters are needed to document spring diversions both before and after test well drilling. Carol would like to conduct test drilling in the summer of 2003. Will the Department issue drilling permits for one or more test wells at that time?

We look forward to your response regarding our request for installation of flow meters, monthly flow metering, and issuance of test well permits. We are available to meet with you and the protestants for further discussions if necessary.

Sincerely,


Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor
Sheri Chapman
Duane Pancheri
Darwin Pancheri

Date	MacGregor				Darwin Pancheri			
	Upper Pool	Seep S. of Upper Pool	Lower Pool	MacGregor Weir	pipe vent	Pancheri Weir	Sump	Pump Sump
	temp	temp	temp	temp	temp	temp	temp	temp
06/07/1999	104		121					
08/03/2000	102.4		119.5	10				
09/01/2000	92.0		116.0	10				
10/18/2000				15				
01/27/2001			116.6		111.9		104	88
05/05/2001	102.7		118.0		112.6		103.3	106.5
07/07/2001	100.8		118.9		112.6	7		108.1
07/21/2001	104.5		119.1		113.5	8		104.4
08/08/2001	100.0		118.4		112.8	13	106.3	107.1
09/26/2001	101.5	111.8	117.1		111.9	13	107.4	108.1
11/02/2001	98.8	112.1	117.5		111.0	13	104.7	106.9
02/16/2002	95.9	112.6	117.3		110.8	15	105.3	86.2
03/09/2002	93.2	112.6	118.8		108.7		104.5	85.6
06/01/2002	101.8	112.3	120.6		113.2	8	59.7	flooded
07/18/2002	102.4	111.7	117.0		112.6	11	106.2	108
10/09/2002	100.8	110.8					104.7	0

Flow is gallons per minute
Temperature is degrees F

Duane Pancheri									
Date	Shop House		Pool		Tomato Can In		Tomato Can Out		Total
	temp	temp	temp	temp	flow	flow	flow	flow	
06/07/1999									
08/03/2000									
09/01/2000									
10/18/2000									
01/27/2001	88		95	7.6			1	89	97
05/05/2001	87.3	87.4	97.9	6.2	4.1	62.5	5.2	1	73.1 79.3
07/07/2001									
07/21/2001									
08/08/2001	92.5		101.8				5.4	0.5	54 59.9
09/26/2001									
11/02/2001	88.0	88.7	98.6	6.0	3.7	58.9	<1	70.2	76+/-
02/16/2002									
03/09/2002	80.8			6.2					
06/01/2002	88.9	89.2	95.9	6.3	4.6	63.5	5.0	<1	74 80+/-
07/18/2002									
10/09/2002	90.3	86	101.5	5.2	2.1	60.6	1	62.3	68

Flow is gallons per minute
Temperature is degrees F

ATTACHMENT B
EXCERPTS FROM "GEOTHERMAL
INVESTIGATION OF THE CASCADE AREA",
JULY 1976, BOISE STATE UNIVERSITY

Boise, Idaho

July, 1976

GEOHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA

by

Monte D. Wilson
James K. Applegate
Sheri L. Chapman
Paul R. Donaldson

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

BOISE STATE UNIVERSITY

GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA.

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GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA.

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GEOHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA

Monte D. Wilson
James K. Applegate
Sherl L. Chapman
Paul R. Donaldson

ABSTRACT

Field and laboratory investigations show the existence of a geothermal resource in the Cascade area of west-central Idaho which may have development potential for non-electrical uses. Numerous high angle faults cut the Idaho batholith in this area; displacements on some of these faults are as great as 10,000 feet and many of them have associated alteration zones. X-ray analyses of samples collected from these zones indicate substantial hydrothermal alteration. Fault controlled hot springs have temperatures at the surface of up to 71° C and temperatures at depth, based on the silica geothermometer, of up to 179° C.

Microseismic monitoring in the area suggests that east-west trending faults are active, supporting the plausibility of an accessible geothermal resource.

The domestic ground water supply for most of the area is from very shallow wells, most of which are developed in the upper 200 feet of the valley floor derive their water from joints rather than from fault systems. Preliminary data indicate no connection between the thermal systems and the water supply for the area.

GEOLOGY

Regional Geology

The study area is located along the western margin of the Idaho batholith. It is in the Northern Rocky Mountain geomorphic province with the Seven Devils section of the Columbia Intermontane geomorphic province bordering it on the west (Thornbury 1965, p.445).

An extensive system of faults in this region was described by Anderson (1934, p.25) and by Capps (1941, p.7), with the Long Valley fault being the largest fault in this system. Many of the other faults mapped during field work on this project are parts of this regional branching system.

Lithologic Units

Idaho Batholith Granitic Rocks

For the purposes of this study rocks of the Idaho batholith were mapped as a single lithologic unit rather than being subdivided into various compositional types. Reasons for using this approach to mapping are primarily that the geothermal potential is apparently not controlled by details of lithology and also that zones of lithologic variation are both large and gradational, so that they are best mapped on a regional scale rather than on a restricted scale such as the map for this report.

Because of its location on the margin of the Cretaceous Idaho batholith, the Cascade area is in a belt with gradation of rocks from directionless granite of the central batholith to gneiss and schist of

the batholith border. There is a systematic increase in metamorphic intensity going eastward across the area. Schmidt (1964, p.8) has recognized and mapped six major rock zones trending north and south to northeast-southwest through this region. Three of these rock zones make up most of the bedrock in the Cascade area, they are: 1) the quartz diorite gneiss of Donnelly which is present in the western and northwestern part of the map area, 2) the quartz diorite of Little Valley which underlies the central portion of the map area and, 3) the granodiorite of Gold Fork which underlies the eastern and southeastern portions of the map area.

Columbia River Basalts

Along the western boundary of the study area, rocks of the Idaho batholith border zone have been eroded and are overlain by flows of the Columbia River Basalts of Miocene age. These flows are dipping westerly at moderate angles. They were not mapped in detail during field work on this project, so their contacts on the geologic map (Plate 1) must be considered approximate. Isolated remnants of basalt are located along the eastern margin of Long Valley and in the southern part of Little Valley, near the northeastern corner of the map. These basalts have been downfaulted into the granitic rocks of the Idaho batholith, and each of these isolated basalt outcrops is proximal to a conspicuous fault or faults. These basalt outcrops are remnants of flows which were formerly much more extensive in this region (Capps, 1941, p.5, Bond, 1963). Several quarries are located in these basalt remnants, with much of the basalt being crushed and used in road building.

Latah (?) Formation

Associated with the Columbia River Basalts is a sequence of poorly consolidated silt and clay layers which is interpreted to be primarily of lacustrine origin. Most of this sequence is stratigraphically lower than the basalts, but there is some interbedding of the upper lacustrine strata with the lower basalt flows. Schmidt and Mackin (1970, p.4), on the bases of stratigraphic position and pollen studies, tentatively correlated this unit with the Latah Formation of Tertiary age. Because of its poorly resistant nature, this unit is not well exposed on the surface. However, it can be seen in excavations, and is particularly well exposed in the basalt quarry about one mile northwest of the Cascade Dam. A few specimens of *Equisetum* sp. were found at this locality, but no other plant megafossils are known to have been collected from this formation in the Cascade area.

Surficial Deposits

A detailed study and map of surficial deposits in this area was published in 1970 by Schmidt and Mackin. Most surficial deposits in the Cascade area are either alluvium or glacial drift, primarily moraines and outwash. Colluvium and lacustrine strata are also present but these materials comprise smaller portions of the surficial deposits. Most of these surficial materials were deposited during the Quaternary Epoch, but Schmidt and Mackin (1970, p.11) suggest that some of them, mostly sediments on the floors of the fault block valleys, are of Pliocene age.

Structural Geology

Faults

Earlier workers such as Anderson (1934) and Capps (1941) who described block faulting in west-central Idaho considered it to be a northward continuation of Basin-and-Range structures. This conclusion was apparently based on the following similarities between structures in the two areas: types of movement are similar; strikes of major faults are similar; and age span of movement is similar, although age is better documented in the Basin-and-Range Province.

The largest faults in the Cascade area trend north-south and north-northeast, however, as can be seen by the map (Plate I), other faults trend northeast, east-northeast, northwest and west-northwest while still others are curved in plan. Most faults in the area appear to be high angle with dip-slip movement as best as can be interpreted from field evidence, which is admittedly scanty. Considerable fault movement occurred after the Columbia River Basalt was emplaced in Miocene time and before the intensive glaciation of the early Pleistocene. Two early workers (Anderson, 1934, p.26 and Capps, 1941, p.6) have assigned a late Pliocene age to the major faulting. While this age determination may be accurate for the major faulting, the differences in geomorphic expression as well the offsetting relationships show that faulting has occurred at different times in various parts of the area and probably occurred at many different times along each of the large faults. Recent seismic and microseismic observations show continued activity. Long Valley, Cascade Valley and Round Valley are all basically fault-bounded structures which

can properly be called grabens.

The Long Valley fault trends approximately north-south through the map area. This fault is reported (Capps, 1941, p.7) to extend as a single fault from Boise to Grangeville, a distance of 160 miles. Field observations made during this study show that although the system of faults may indeed extend for 160 miles, the Long Valley fault as a continuous fracture is not nearly so long. The Long Valley fault separates West Mountain, with its cap of westerly dipping basalts, from Long Valley, 3,000 feet below. A total throw on this fault of at least 10,000 feet is determined by combining the 3,000 foot West Mountain escarpment with the 7,000 feet of sedimentary fill indicated by a gravity survey (Kinoshita, 1962) to exist in Long Valley near the northern margin of the study area for this project. Glacial sediments obscure the fault trace and prove that it has not experienced significant movement since these materials were deposited starting in early Pleistocene time. Despite its large displacement and relative recency, (10,000 feet of displacement, and offsetting of Miocene strata) there are no known hot springs or other geothermal indications along the Long Valley fault. Two faults in the map area (Plate I) appear to have lateral components. One of these is herein termed the Scott Valley fault, and it strikes north-south through the eastern part of the map where it makes the western margins of Scott Valley and Horsethief Basin. This is an oblique fault with the east block having moved down and north relative to the west block which moved up and south. The other location where lateral movement is indicated involves the north 60° west fault going through the south edge of the town of Cascade and/or the north 75° west fault going

through the Cascade damsite. Geomorphic evidence suggests left lateral movement along one or both of these faults. Microseismic monitoring indicates continued activity along faults in this immediate area.

Fault Controlled Hot Springs

Eleven hot springs are located within, or immediately adjacent to, the area mapped in this project (Plate I); all of them are within twelve miles of Cascade and all are fault controlled. In addition, one former hot spring on Little Pearsoi Creek, about four miles east of Cascade, has dried up in the last 20 years and several former hot springs on the fault trace about one mile northwest of Cascade are now flooded by the reservoir. Silica analysis and projected temperatures at depth were done on seven of these springs. The four hot springs near the Boiling Springs Guard Station, just off the south-western portion of the map, were not included in these analyses.

Silica analyses were done by the standard molybdosilicate method (Taras and other, 1971, p.303) using a Bausch and Lomb Spectronic 20 spectrophotometer. The mixing model used to project temperatures at depth is the one established by Fournier and Truesdell (1974). For the purposes of establishing a mixing model, a temperature of 10°C and a silica content of 25 ppm was used for all cold water mixes based on analyses of representative samples collected near hot springs.

From Table 1 it can be seen that surface temperatures of hot springs range from 36°C to 71°C, while silica contents range from 42.9 ppm to 68 ppm. A mixing model using these hot spring temperatures and silica contents along with a cold water temperature of 10°C and silica content

<u>Hot Springs</u>	<u>Location</u>	<u>Silica ppm</u>	<u>Temperature °C</u>	
			<u>Surface</u>	<u>Mixing Model</u>
Cabarton	SW $\frac{1}{4}$, Sec. 31, T13N, R4E	68.0	71.0 ⁰	147 ⁰
Arling	NW $\frac{1}{4}$, Sec. 13, T15N, R3E	56.6	40.0	179
Gold Fork	SW $\frac{1}{4}$, Sec. 35, T16N, R4E	62.3	50.5	165
Flat Creek	SW $\frac{1}{4}$, Sec. 21, T15N, R4E	47.5	38.0	158
Cascade	NE $\frac{1}{4}$, Sec. 36, T14N, R3E	42.9	38.5	140
Little Creek	NE $\frac{1}{4}$, Sec. 5, T14N, R5E	48.6	36.0	168
Belvidere	NE $\frac{1}{4}$, Sec. 13, T13N, R3E	60.0	49.5	163

TABLE 1: Silica analyses and mixing model temperatures
of hot springs near Cascade

of 25 ppm predicts temperatures at depth ranging from 140°C to 179°C (Figures 2-8).

It should be noted that five of these hot springs are located on or near the Cascade Valley fault which marks the western edge of Cascade Valley and extends northward through Little Valley. These hot springs, from south to north are Cabarton, Belvidere (also called Sky Ranch), Cascade, Flat Creek and Gold Fork.

Hydrothermal Alteration Zones

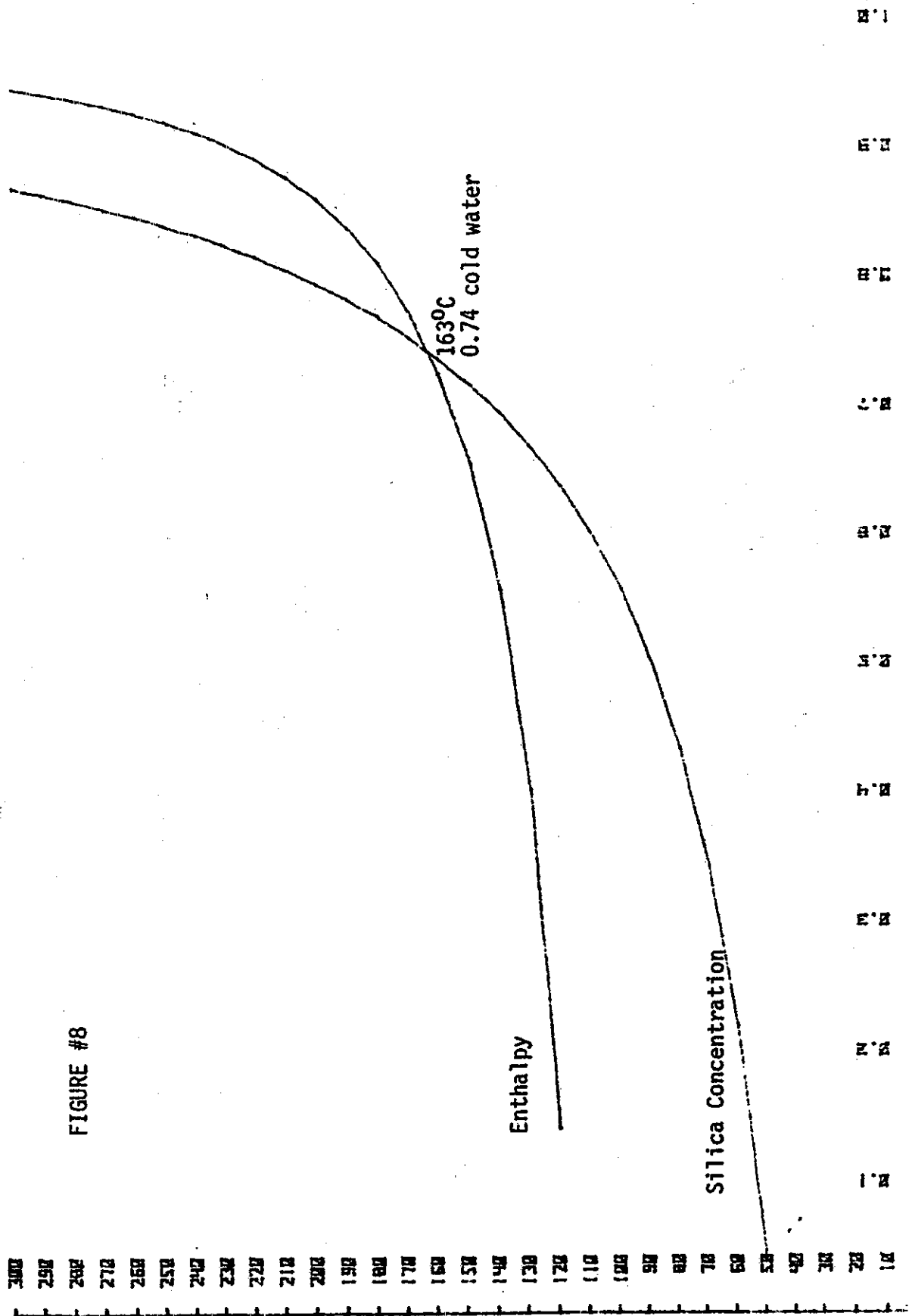
Zones of rock alteration exist along several faults in the Cascade area. In an attempt to determine the extent to which hydrothermal solutions were responsible for this rock alteration, eleven samples were collected for powder analysis by x-ray diffraction techniques.

Table II shows the locations of samples collected and results of the x-ray analyses. In fault zones where hydrothermal alteration has occurred kaolinite is usually found. Such fault zone kaolinite, however, may have been formed at depth because hot waters flowing out at the surface tend to deposit silica rather than alter rock (Clayton R. Nichols, personal communication, 1975). Kaolinite was found in significant amounts in two of the alteration zones and it was found in minor amounts in three others. Zeolite minerals are often found where there has been extensive fracturing and mylonitization of rock and they are usually associated with illite and montmorillonite (Clayton R. Nichols, personal communication, 1975).

Y-AXIS=TEMPERATURE
X-AXIS=FRACTION COLD WATER
#7 SKY RANCH (BELVIDERE)

SILICA PPM OF COLD SPRING 25.2

FIGURE #8



factor of water quality or quantity.

Thermal Water

Introduction

The thermal water occurrences found in the study area are directly related to geologic structure as previously outlined in previous sections of this report. Hot springs and wells are located at several locations as shown in Plate II, and all of these locations lie upon or adjacent to fault zones as shown in Plate I. It is primarily due to this structural affinity that a reasonably accurate assessment of the potential for development of the resource can be made.

Possible Thermal Reservoir Units

Generally, water temperatures from many of the springs and wells issuing from or penetrating the valley fill materials are higher than temperatures that are considered normal in springs and wells close to fault zones in granite. For this reason, these two units may be considered as possible reservoir units or sources of thermal water.

Granitic Rocks - The granitic rocks exposed on the boundaries of the Cascade-Long Valley study area contain a high number of hot springs (Plate I). These rocks from the basement complex in the area; and because granitic rocks are generally dense and impermeable, they may not contain significant volumes of hot water. However, because the hot water in the area appears to be concentrated near large fracture zones and drillers' logs often indicate a significant thickness of decomposed granite near the upper surface of the unit, it may be that those portions of the unit constitute a significant aquifer. Unfortunately, sufficient data do not yet exist to make that specific an assessment.

Valley Fill - A few wells drilled into the valley fill near fault zones yield water of moderate temperature (42.50C). It is believed that water leaking from fault zones in the granitic rocks enters the valley fill and move laterally out into the valley. Because of the layered structure of the valley fill and the large number of relatively impermeable lenses, there may be a significant amount of hot water leaking from the granitic rocks into the valley fill that is yet undiscovered. The shallow wells do not provide sufficient data because they have penetrated only a very minor section of the valley fill. As in the granitic rocks, however, the lack of deep well data precludes any true assessment of the unit's potential as a thermal aquifer.

Thermal Water Quality

Analyses of four thermal wells or springs are shown on Table III. Interpretation of these samples analyzed by the U.S. Geological Survey (Young and Mitchell, 1973) demonstrates the separation between the thermal and non-thermal systems in the valley as we know them. While mixing between the two systems does occur upon ascension of the hot water, the difference in ionic constituents and the lack of correlation between ratios of several of the ions indicates a very different circulation pattern between the hot water and the cold water present in the valley.

As shown in Table III, the thermal water in the valley is alkaline, has a high sodium and chloride content and a relatively high total dissolved solids content. The cold water is acid and has low sodium and chloride content and very low total dissolved solids content. The primary reason for the wide variability in chemical constituents is believed to be the result of circulation pattern, temperature of the water and time of travel within the aquifer system.

It should be noted that the quality of the thermal waters analyzed is excellent in comparison to hot springs and wells in other areas of the nation and world, and in fact could be utilized for irrigation of all crops now growing in the valley. The sodium absorption ratio (SAR) for Cabarton Hot Springs, the highest in total dissolved solids, is 4.6. Generally, water having an SAR value less than 10 is considered to be suitable for irrigation of the crops grown in this area.

Recharge Characteristics

Any discussion of recharge to the geothermal system must necessarily be limited because of the lack of data available. However, some conclusions can be drawn, based on the results of this study.

The chemistry of the thermal water in the study area is notably low in dissolved solids and conductivity. This, coupled with the knowledge of the geology of the area, indicates the water is: (1) of meteoric origin, (2) has not traveled great distances in the reservoir rock, and (3) has a relatively direct connection with the recharge area. Additionally, the thermal system probably acts as a minor source of recharge for the cold water system beneath the valley floor. Because of the lack of definite hydrologic parameters, no assessment of the quantity of recharge to the thermal system can be made.

Conclusions and Recommendations

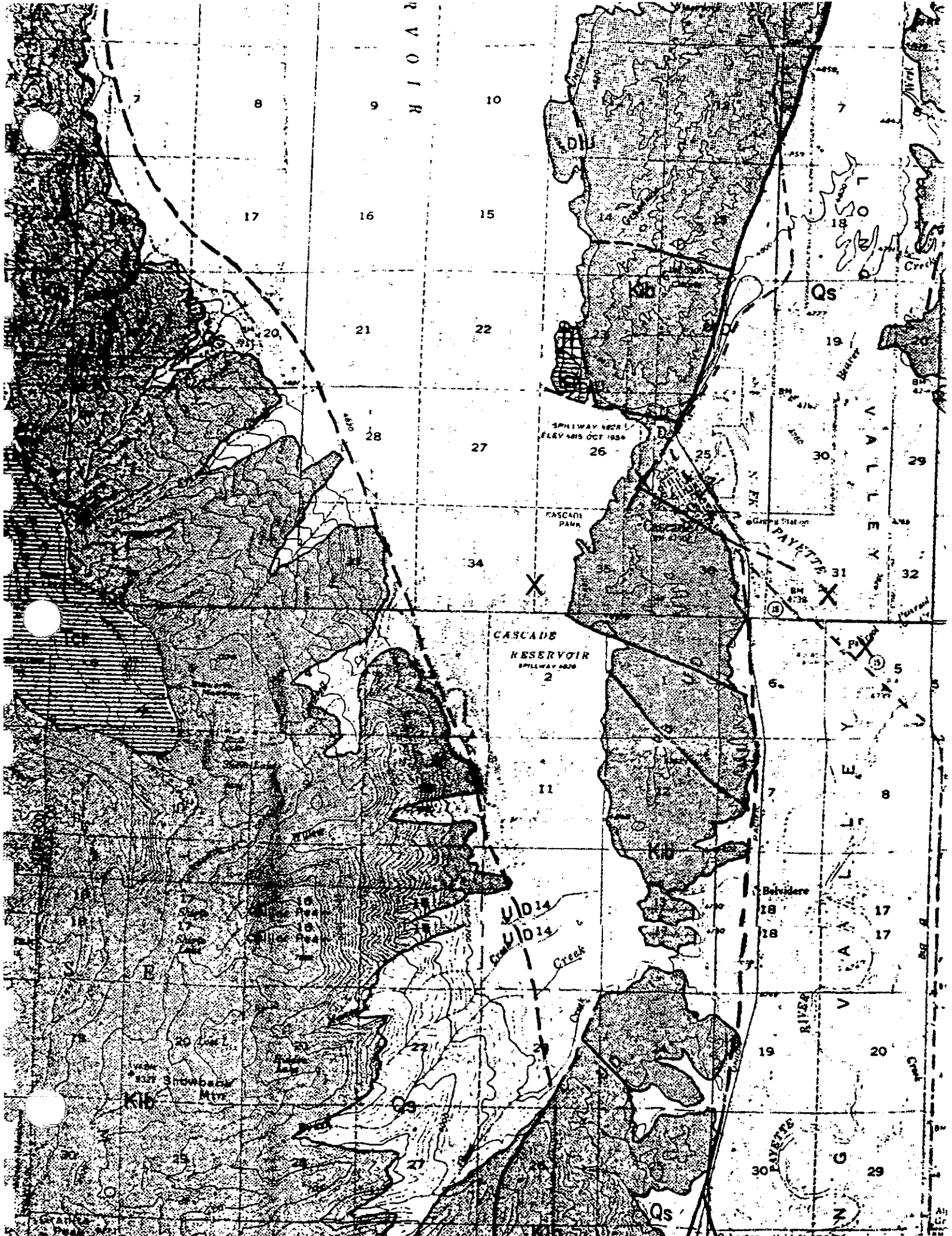
Based upon the investigation conducted in the Cascade-Long Valley area, several conclusions regarding both the thermal and non-thermal ground water systems can be drawn. These are as follows:

- 1 Water supplies in the valley are sufficient for all uses now being made. The river and stream system provides adequate water for irrigation of all agricultural land.
- 2 The major non-thermal aquifer is the valley fill and alluvium, and it is adequate to supply water for nearly all wells on the valley floor and future ground water development.
- 3 The valley fill aquifer contains a large number of artesian zones, most of which are untapped and are capable of supplying fair yields to wells.
- 4 The hydrologic parameters, such as the storage coefficient and transmissivity, have not been calculated because of a lack of adequate pumping well data.
- 5 Water quality in the cold water system is considered to be poor for domestic purposes because of the high iron and manganese content. Other constituents, however, are within acceptable limits.
- 6 Known thermal water occurrences in the valley are related to the geologic structure. Locations of existing hot springs are directly controlled by the presence of fault and fracture patterns.
- 7 Both the granitic rocks and valley fill offer potential as reservoirs for thermal water. A significant untapped thermal aquifer may exist at depth in the valley fill.
- 8 Quality of the present geothermal resource is good. Samples analyzed show that hot water issuing from springs and wells in the area can be utilized for nearly all uses, including irrigation of crops.
- 9 Recharge to both the non-thermal and thermal systems is probably

meteoric in origin. Chemical differences in the water are the result of the longer time of travel and heat in the thermal reservoir.

Several recommendations can be made for further study in the Cascade-Long Valley area. These include:

- 1 Resistivity techniques should be utilized to determine the possibility of a large thermal aquifer present in the valley fill..
- 2 Based upon the results of the resistivity, study participants should confer and agree upon the location and depth of at least two drill sites on the valley floor for test holes. These holes should be constructed in such a manner as to permit packer testing. Parameters of transmissivity and storage should be determined, as well as geological analysis of penetrated formations and water quality changes with depth.
- 3 One additional drill site should be located in such a manner as to assess the capability of the granitic rocks to function as a thermal aquifer. Location of the well site should take into account geologic structure with emphasis on fault patterns and the proximity to the ultimate place of use, should development occur.



ATTACHMENT C
EXCERPTS FROM USGS WATER RESOURCES
INVESTIGATIONS OPEN FILE REPORT 80-1020

THERMAL SPRINGS IN THE PAYETTE
RIVER BASIN, WEST-CENTRAL IDAHO

By R. E. Lewis and H. W. Young

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations

Open-File Report 80-1020



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common ions, silica, and the minor elements arsenic, boron, lithium, and mercury, are given in table 1. In addition, chemical analyses of water from three thermal springs sampled by Young and Mitchell (1973) and five thermal springs for which only partial analyses are available are included. Spring locations are shown on plate 1.

Chemical Character

All the thermal springs discharge fresh water (less than 600 mg/L dissolved solids) of a sodium bicarbonate type, at temperatures between 34° and 86°C. These waters are slightly alkaline--pH ranges from 8.0 to 9.6. Generally, the higher pH values are associated with waters having lower concentrations of dissolved solids. Concentrations of chloride and fluoride are variable and show no definite correlation with temperature. Concentration of boron is low compared with other thermal waters in Idaho, and is, to a degree, correlative with water temperature.

Nonthermal spring waters are either a calcium or sodium bicarbonate type. Water temperature measured in these springs is 7.0°C or less and, generally, is representative of local, ambient conditions. Concentrations of dissolved solids in these near-neutral waters (pH ranges from 6.2 to 7.3) are 90 mg/L or less.

Chemical Geothermometers

Aquifer temperatures in the Payette River basin were estimated using the silica geothermometer (Fournier and Rowe, 1966) and the Na-K-Ca geothermometer (Fournier and Truesdell, 1973). Temperatures estimated by these chemical geothermometers are valid only for hot-water systems and only if the following basic assumptions are met (Fournier, White, and Truesdell, 1974): (1) The chemical reactions at depth are temperature dependent; (2) an adequate supply of chemical constituents used for the thermometry is present in the aquifer; (3) chemical equilibrium is established at depth between the hot water and the specific aquifer minerals; (4) there is negligible reequilibration of the chemical composition of the hot water as it rises to the surface; and (5) hot water rises rapidly to the surface with no dilution or mixing of hot and cold waters.

Dissolved silica (SiO_2) reported in chemical analyses is actually present as silicic acid (H_4SiO_4) and various dissociated species, particularly H_3SiO_4^- . In neutral to slightly acid waters, dissolved silica ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) consists mostly of H_4SiO_4 , and, under these conditions,

Table 1. Chemical analysis of water from thermal and selected nonthermal springs
(Chemical constituents in milligrams per liter, except where noted)
-- = Constituents not analyzed for;
< = less than.

Spring no.	Date of collection	Flow rate ¹ (gal/min)	Specific conductance (umhos)	pH	Water temperature ² (°C)	Hardness as CaCO ₃	Noncarbonate hardness	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Percent sodium	Sodium-adsorption ratio (SAR)	Potassium (K)	Bicarbonate ³ (HCO ₃)	Carbonate ³ (CO ₃)	Alkalinity as CaCO ₃	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Silica (SiO ₂)	Dissolved solids (calculated)	Nitrate plus nitrate as N (NO ₃ +NO ₂)	Phosphorus, total as P	Arsenic (As) (ug/L)	Boron (B) (ug/L)	Lithium (Li) (ug/L)	Mercury (Hg) (ug/L)
Nonthermal																											
17N-28-15BARI	6-28-79	2	85	7.2	7.0	31	0	7.8	2.9	3.9	20	0.3	1.8	51	0	42	2.6	0.4	<.1	45	90	0.11	0.02	0	2	<4	<0.01
15N-58-23DARI	6-27-79	2	20	6.2	4.0	5	1	4.7	1.2	2.4	53	1.5	3.3	12	0	10	1.7	3.3	2	177	29	<0.01	0.02	1	0	<4	<0.01
13N-58-21CARI	6-26-79	4	21	6.2	6.5	3	0	1.1	1.1	1.9	58	1.5	2.2	7	0	6	1.4	2.4	<.1	13	22	<0.01	0.02	0	0	<4	<0.01
9N-98-32BARI	8-31-79	2	52	6.6	4.5	17	0	3.8	1.9	3.1	27	1.3	1.6	29	0	24	1.9	4	<.1	14	42	0.13	0.02	0	10	10	<0.01
Thermal																											
16N-48-35CARI	6-27-79	94	304	9.5	50.0	3	0	1.1	<.1	70	98	18	7	49	36	100	12	11	9.0	63	215	<.01	0.01	11	50	30	<.01
15N-38-13BARI	8-2-72	798	279	--	34.0	4	0	1.3	1.1	60	97	14	6	17	45	89	41	16	2.6	60	210	--	--	--	--	--	--
15N-48-21CARI	6-27-79	31	206	9.6	36.0	4	0	1.3	1.1	43	96	9.8	1.5	32	34	84	7.8	2.5	3.1	48	146	<.01	0.01	3	10	8	<.01
13N-48-31BARI	6-26-79	20	433	9.3	49.0	2	0	1.2	<.1	85	98	21	1.0	56	34	102	24	28	5.3	61	256	<.01	0.01	21	310	40	<.01
13N-48-31CARI	6-26-79	70	514	9.0	71.0	4	0	1.5	<.1	110	97	25	2.1	68	25	97	43	40	11	72	329	<.01	0.01	39	400	60	<.01
13N-62-29BARI	7-7-79	50	334	9.5	53.0	4	0	1.6	1.1	64	96	13	1.3	32	36	86	31	7.8	15	80	240	<.01	0.01	6	50	30	<.01
12N-58-20CARI	7-8-79	12	--	--	46.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7N-8-79	22	--	337	9.3	50.0	3	0	1.3	<.1	65	97	16	1.1	34	34	84	16	6.5	16	73	219	<.01	0.01	6	60	60	<.01
10BARI	--	--	--	--	66.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
22BARI	134	331	8.9	86.0	--	4	0	1.4	1.1	74	96	16	1.9	95	18	108	12	11	12	86	259	<.01	0.01	10	90	80	<.01
36BARI	334	266	8.9	38.0	--	7	0	2.8	<.1	54	94	8.9	9	77	5	71	26	5.8	12	54	196	0.03	0.02	5	50	50	<.01
11N-52-29CARI	8-8-79	50	293	8.8	49.0	8	0	3.1	<.1	97	96	4.8	1.9	99	4	88	24	9.6	13	74	277	<.01	0.01	6	70	90	<.01
11N-78-16BARI	7-24-79	90	315	9.3	65.0	5	0	1.8	1.1	65	95	13	1.8	13	35	69	36	3.9	15	82	236	0.02	0.03	14	50	80	<.01
10N-48-33CARI	11-27-78	500	402	8.4	75.0	5	0	1.9	1.1	90	96	17	3.2	130	2	110	27	19	13	110	331	0.01	<.01	9	120	100	<.01
10N-108-31BARI	3-13-79	360	378	9.3	84.0	4	0	1.5	<.1	77	96	17	3.2	18	38	78	50	8.0	17	91	282	<.01	0.01	1	70	110	<.01
10N-118-31BARI	5-7-79	75	381	9.6	67.0	5	0	1.9	1.1	77	95	15	2.6	1	45	76	46	9.5	15	82	267	0.02	<.01	1	70	110	<.01
9N-38-25BARI	11-22-78	32	622	8.0	79.5	16	0	6.1	1.1	120	92	13	5.3	160	0	131	88	39	12	120	470	0.01	<.01	2	90	110	<.01
9N-78-35BARI	5-7-79	3	287	9.3	37.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9N-88-32CARI	2-27-79	350	369	9.2	63.5	4	0	1.4	<.1	79	97	18	1.8	40	31	84	39	5.7	20	83	270	<.01	<.01	2	20	120	<.01
34CARI	350	321	9.1	64.0	--	5	0	1.9	<.1	70	96	14	1.3	29	29	72	39	3.9	16	67	232	0.02	<.01	2	50	110	<.01
Thermal																											
9N-98-22CARI	7-29-79	13	--	--	54.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8N-58-18CARI	6-8-72	1.5	317	--	40.0	6	0	2.4	1.1	66	95	11	1.9	85	1	71	42	5.1	3.1	48	216	--	--	--	--	--	--
6N-58-60CARI	11-23-78	75	359	9.0	42.0	8	0	2.9	1.1	77	95	12	1.2	67	20	88	37	7.3	15	75	262	0.01	<.01	6	110	120	<.01
6N-58-60CARI	2-26-79	75	343	9.1	51.0	12	0	5.0	<.1	72	92	8.9	1.3	61	22	87	36	7.8	15	63	245	0.01	<.01	4	90	80	<.01
10BARI	11-22-78	10	344	9.0	54.0	5	0	2.0	<.1	76	96	15	1.2	59	19	80	40	5.7	14	78	259	0.01	<.01	4	90	80	<.01
10BARI	11-27-78	90	345	9.2	54.5	5	0	2.0	1.1	75	96	14	1.0	40	23	78	38	5.7	14	74	249	0.01	<.01	4	70	70	<.01
11BARI	2-26-79	35	352	9.1	60.0	5	0	1.8	<.1	78	96	16	1.4	49	28	87	41	5.4	17	66	254	0.01	<.01	5	90	160	<.01
11BARI	7-25-79	5	346	9.2	59.5	--	--	--	--	--	--	--	--	43	26	79	--	--	--	--	--	--	--	--	--	--	--
8N-68-18BARI	2-27-79	175	343	9.2	59.5	5	0	2.0	<.1	75	96	15	1.1	38	29	80	38	6.7	17	63	242	0.01	<.01	6	80	100	<.01
7N-18-9BARI	9-5-79	50	780	8.0	64.0	22	0	8.4	2.2	160	92	15	8.0	180	0	148	120	61	16	110	573	<.01	<.01	10	710	220	<.01
8N-4-72	20	20	529	--	45.0	47	0	1.5	2.4	99	80	6.3	5.3	169	0	139	57	30	8	94	397	--	--	--	--	--	--

Flow rate is for entire spring complex.
Water temperature is highest temperature at spring vents or temperature of sampled vent.
Total alkalinity distributed as carbonate and bicarbonate at the spring temperature and pH.
Analyses taken from Young and Mitchell (1973).
Temperature may be higher because vents were underwater.
Shown in Young and Mitchell (1973) as BCBI3.

silica geothermometers give good estimates of reservoir temperatures. In alkaline waters, hydroxide (OH^-) reacts with silicic acid to reduce the proportion of silicic acid to total dissolved silica. The total concentration of dissolved silica measured in the laboratory ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) must therefore be reduced by the concentration of H_3SiO_4^- occurring at the pH level of the spring water, to obtain an accurate estimate of the reservoir temperature.

For thermal waters having pH greater than 8.2, reported values for dissolved silica were corrected for dissociation of silicic acid at the spring temperature, and reservoir temperatures were estimated assuming equilibrium with both quartz and chalcedony (table 2). The pH of water in the thermal aquifer would be slightly lower than the pH measured at the spring, and calculation of aquifer pH might increase the H_3SiO_4^- -corrected quartz temperature by 5° or 10°C (R. H. Mariner, written commun., 1980). Calculation of aquifer pH requires consideration of acid-base equilibria, distribution of acidic gases between steam and water, and the effect of temperature on the equilibria (Ellis and Mahon, 1977). Most of the calculations are time consuming and require computer methods, such as those presented by Truesdell and Singers (1973).

Concentration of magnesium in thermal waters sampled generally was 0.1 mg/L or less, so corrections for magnesium in the Na-K-Ca geothermometer suggested by Fournier and Potter (1979) were not applied. Applying the magnesium correction to the Na-K-Ca geothermometer for one thermal spring having a magnesium concentration of 2.4 mg/L increased the estimated reservoir temperature by 6° to 90°C .

Reservoir temperatures calculated from water analyses for 26 thermal springs in the Payette River basin are given in table 2, along with selected chemical reaction coefficients. In applying the H_3SiO_4^- -corrected silica geothermometer for thermal springs having water temperature at the land surface generally greater than 65°C , best estimates were obtained by assuming that quartz was controlling the SiO_2 concentration. For springs having temperatures at the surface generally less than 65°C , better estimates of reservoir temperature were obtained by assuming that chalcedony was controlling the SiO_2 concentration. If, however, the calculated free energy of formation showed the waters were unsaturated with chalcedony; or, if the estimated temperature was less than the temperature of the spring, then quartz was assumed to be controlling the SiO_2 concentration.

Using a plot of reservoir temperatures estimated by the silica and the Na-K-Ca geothermometers, Fournier, Sorey, Mariner, and Truesdell (1979) showed waters that plot on or

Table 2. Estimated aquifer temperatures and free energy of formation for selected thermal springs

Spring No.	Water temperature at the surface (°C)	Estimated aquifer temperatures based on geothermometers					Free energy of formation ¹				Reference No. (fig. 2)
		Silica quartz-conductive (°C)	Silica quartz-conductive H ₂ SiO ₄ corrected (°C)	Sodium-potassium-calcium (°C)	Silica-chalcedony (°C)	Silica-chalcedony H ₂ SiO ₄ corrected (°C)	Aragonite	Calcite	Chalcedony	Quartz	
16N- 4E-35CCB1S	50.0	113	69	71	84	37	0.1	0.2	-0.2	0.3	1
15N- 3E-13BBC1S	34.0	110	61	61	81	28	-1.1	0	-1.1	.5	2
15N- 4E-21DCC1S	36.0	100	62	53	70	30	0	.1	-1.1	.5	3
13N- 3E-13ADA1S	49.0	111	79	83	82	47	0	.1	0	.5	4
13N- 4E-31CAB1S	71.0	120	91	117	91	61	.1	.2	-1.1	.3	5
13N- 6E-29DAB1S	53.0	125	76	82	97	45	.2	.3	-1.1	.4	6
12N- 5E- 2DAC1S	50.0	120	86	81	92	55	0	0	-1.1	.6	7
22BBC1S	86.0	129	101	100	101	71	.3	.4	-2	.2	8
36DBA1S	38.0	105	93	57	76	62	-3	.2	.3	.9	9
11N- 5E-29CDB1S	49.0	121	107	61	93	77	-1	0	.4	.9	10
11N- 7E-16AAB1S	65.0	126	84	91	99	52	.3	.4	-2	.3	11
10N- 4E-33CBD1S	75.0	143	132	138	116	105	.3	.2	.4	.8	12
10N-10E-31BCC1S	84.0	132	81	145	105	50	.5	.6	-5	-1	13
10N-11E-31ADD1S	67.0	126	63	134	99	31	.6	.7	-5	-1	14
9N- 3E-25BAC1S	79.5	148	143	144	122	116	.1	.2	.5	.9	15
9N- 8E-31ACA1S	63.5	127	90	99	99	60	.1	.2	0	.4	16
32CBA1S	64.0	116	86	79	87	55	.2	.3	-1.1	.4	17
8N- 5E- 1BCC1S	40.0	100	89	62	70	59	.5	.4	.3	.8	18
6DCB1S	42.0	122	104	69	94	74	.1	.1	.4	1.0	19
6DCC1S	51.0	113	88	60	84	58	.6	.7	.1	.6	20
10ADD1S	54.0	124	101	76	96	71	-1	0	.2	.8	21
10BDD1S	54.5	121	89	70	93	58	.1	.2	.1	.6	22
11BAA1S	60.0	115	87	84	86	56	.2	.2	0	.4	23
8N- 6E- 1ADB1S	59.5	113	80	74	84	49	.3	.3	-1.1	.3	24
7N- 1E- 8DDA1S	64.0	143	138	152	116	112	0	.1	.6	1.1	25
9CDC1S	45.0	134	133	290	107	106	-5	-4	.8	1.3	26

¹Values are departure from theoretical equilibrium in kilocalories; (+) values indicate supersaturation, (-) values indicate unsaturated. Calculations from computer program SOLMNEQ (Kharaka and Barnes, 1973).

²Magnesium corrected (Fournier and Potter, 1979).

near the equal-temperature line ($T^{\circ}_{\text{SiO}_2} = T^{\circ}_{\text{Na-K-Ca}}$; slope = 1) are likely to be unmixed waters or waters that have reequilibrated with the aquifer minerals after mixing. Waters that plot significantly above the equal-temperature line probably contain anomalous concentrations of silica, owing to evaporation or to dissolving amorphous silica from the aquifer material. The Na-K-Ca geothermometer uses ratios of constituents and is less sensitive to concentration changes that occur during evaporation than is the silica geothermometer.

Waters that plot significantly below the equal-temperature line may be due to: (1) Mixing with another type water without sufficient time to equilibrate with the surrounding rock (in mixed waters, silica-estimated temperatures are generally decreased more than Na-K-Ca estimated temperatures); (2) precipitation of silica during cooling, whereas Na-K-Ca proportions remain unchanged; or (3) precipitation of calcite or aragonite due to loss of carbon dioxide without adjustment of sodium and potassium through reaction with clays, zeolites, or other minerals (Fournier and others, 1979).

Figure 2 is a plot of reservoir temperatures estimated using silica and Na-K-Ca geothermometers for thermal springs in the Payette River basin. Most thermal springs plot on or near the equal-temperature line. As suggested by Fournier and others (1979), these waters are probably unmixed waters that have lost some heat through conduction or are mixed waters that have had time to reequilibrate. Several springs (samples 5, 7, 13, and 14) plot significantly below the equal-temperature line and may indicate a mixed water or water from which calcite and aragonite have precipitated. Table 2 shows that, with the exception of sample 7, waters from these springs are supersaturated with calcite or aragonite, which may indicate a possible loss of calcium without an adjustment of the sodium and potassium concentrations. For these samples, the silica geothermometer probably gives the better estimate of reservoir temperature.

Only two springs (samples 10 and 26) plot significantly above the equal-temperature line in figure 2. These waters are thought to have dissolved amorphous silica from the aquifer materials (calculated free energy of formation of amorphous silica is 0, which indicates equilibrium with this phase). For these springs, the Na-K-Ca geothermometer probably gives the better estimate of reservoir temperature.

Estimated reservoir temperatures determined from the silica and Na-K-Ca geothermometers are highly variable, and range from 53° to 143°C. Along the North Fork of the

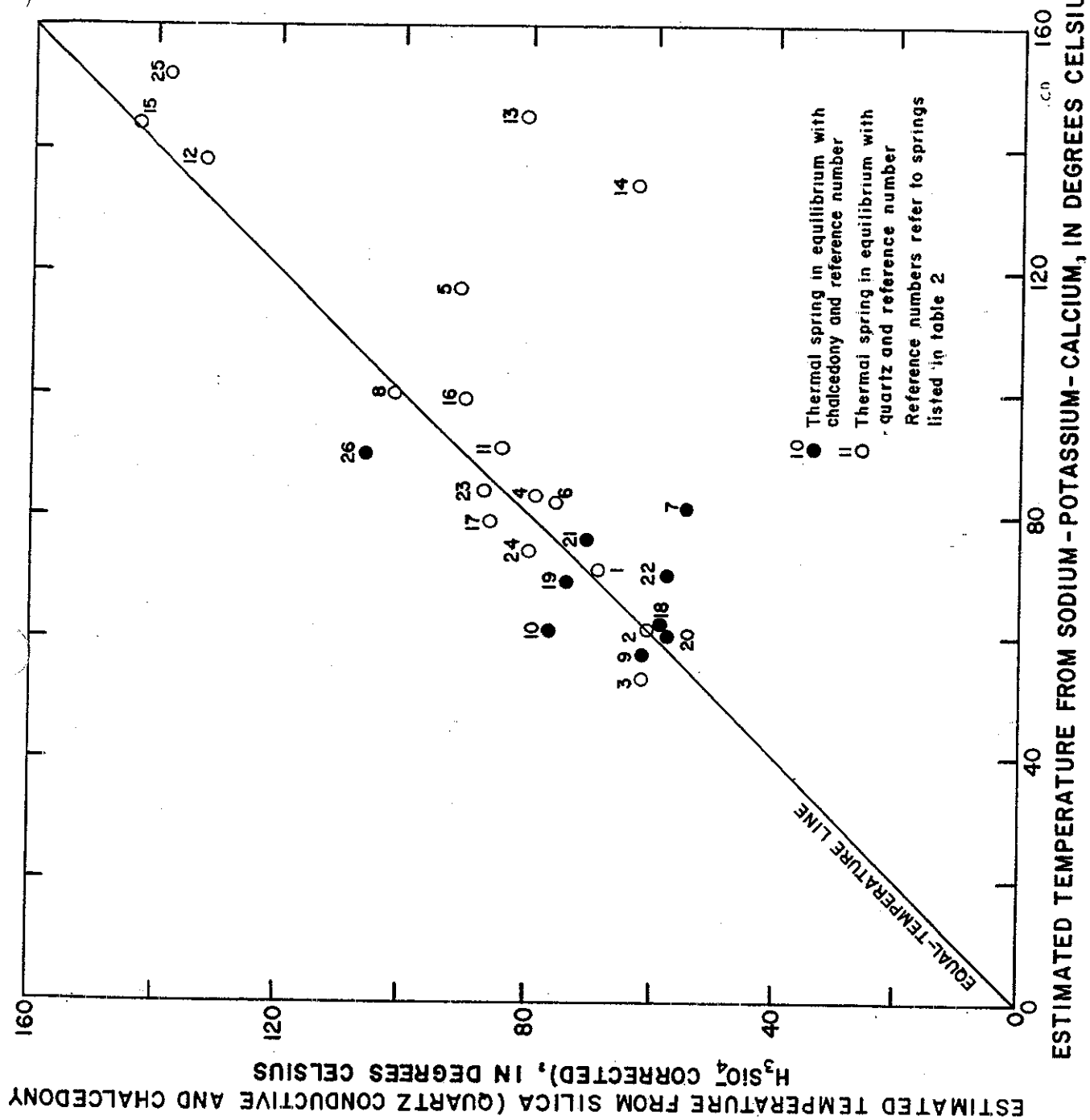


Figure 2.-- Comparison of reservoir temperatures estimated by the silica and sodium-potassium-calcium geothermometers

53° to 91°C. Along the Middle and South Forks of the Payette River, estimated reservoir temperatures range from 57° to 138°C and 58° to 99°C, respectively. Estimated reservoir temperatures along the Payette River from Banks, Idaho, range from 90° to 143°C.

Assuming conductive heat loss, reservoir temperatures for six thermal springs were estimated using the sulfate-water isotope geothermometer described by McKenzie and Truesdell (1977): 16N-4E-35CCB1S, 71°C; 13N-4E-31CAB1S, 75°C; 13N-6E-29DAB1S, 71°C; 9N-3E-25BAC1S, 139°C; 9N-8E-32CBAL1S, 88°C; and 8N-5E-10BDD1S, 76°C. Additional temperatures of 89° and 94°C were estimated for thermal springs 12N-5E-22BBC1S and 10N-10E-31BCC1S, respectively, by Nehring and others (1979).

Isotopes

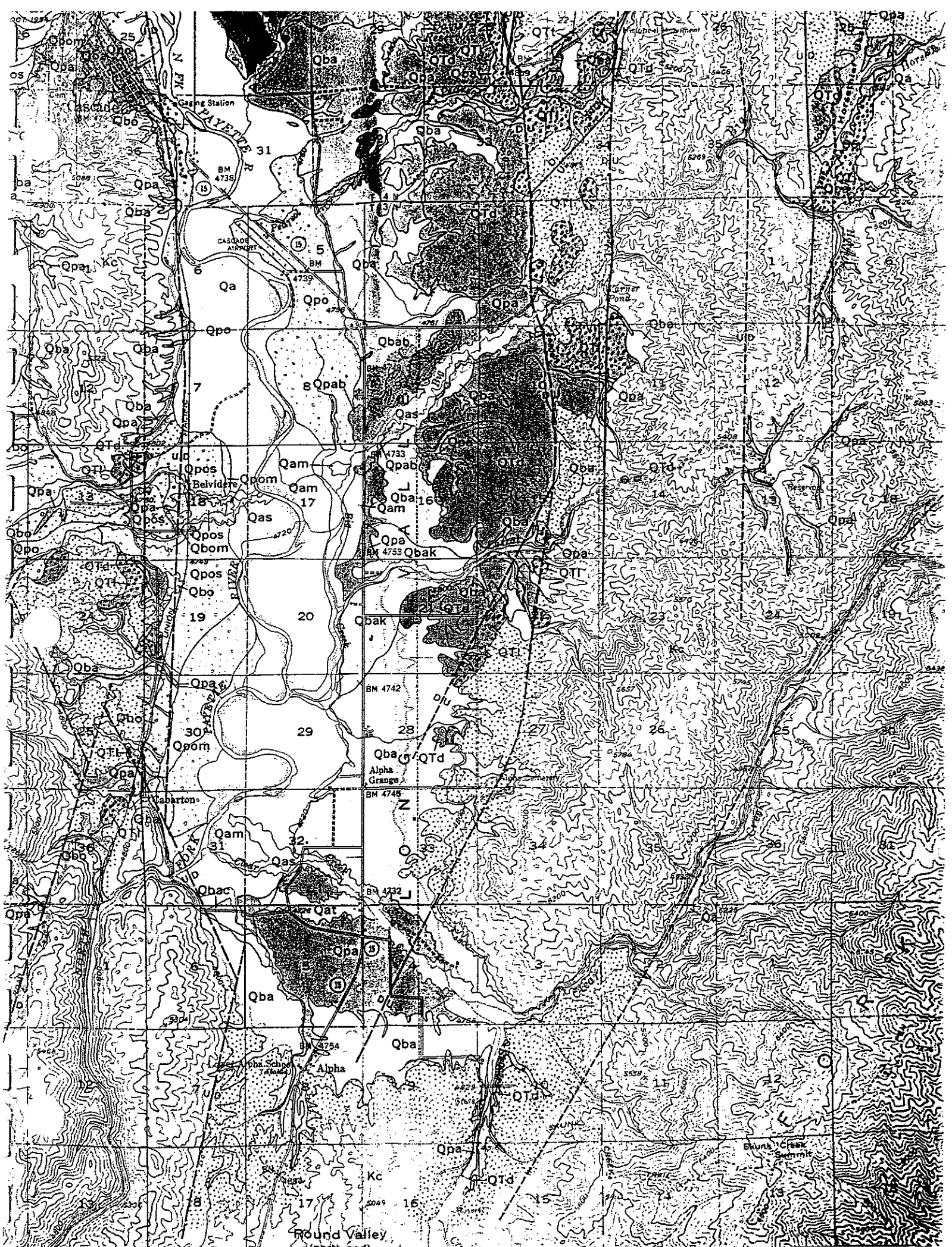
Samples of thermal and nonthermal water from selected springs in the Payette River basin were collected for analyses of oxygen-18, deuterium, and tritium. In this report, isotope data are presented in tabular and graphical format (tables 3 and 4 and fig. 3); interpretations concerning age or relation of the various waters are offered only insofar as they apply to the Payette River basin and are considered preliminary. A discussion of the isotopic composition and possible relations of thermal waters in the Payette, Salmon, and Boise River basins will be presented in a final report.

Tritium

Tritium (H^3) is produced naturally in small quantities in the upper atmosphere during bombardment by subatomic particles. The tritium, incorporated in water molecules, enters the water cycle in rain and snow. Having a half life of about 12.3 years, tritium can be used to determine how long a particular water may have been stored out of contact with the atmosphere. The transit or residence time can be determined from the concentration of tritium in the discharge water, if the amount of tritium in the recharge water and the nature of the subsurface flow regime are known.

Before extensive thermonuclear testing began in 1954, tritium in the atmosphere ranged from 10 to 20 TU (tritium unit). One TU equals a $^3H/H$ ratio of about 10, or about 3.2 picocuries per liter. By 1963, worldwide tritium levels had

ATTACHMENT D
GEOLOGIC MAP FROM USGS BULLETIN 1311-A



EXPLANATION

SURFICIAL DEPOSITS

Qa	Qam	Qas
----	-----	-----

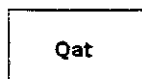
Alluvium on flood plains

Includes some colluvium in small stream valleys

Qa, alluvium undivided

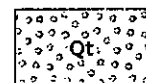
Qam, main-stream deposit; designated only where necessary

Qas, side-stream deposit; designated only where necessary



Terrace alluvium

Noncyclic terraces of larger streams



Morainal deposit

Cirque moraines and rock glaciers of the Neoglaciation

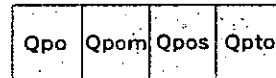


Landslide deposits



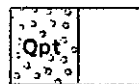
Alluvium and colluvium

Mostly cyclic periglacial deposits of small streams South of Cascade, source stream is partly designated:
Qpab, Big Creek



Outwash

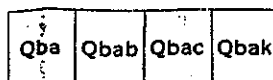
Qpo, outwash undivided
Qpom, main-stream deposit; designated only where necessary
Qpos, side-stream deposit; designated only where necessary
Qpto, moraine and outwash in ice-scoured cirque and valley floors; mostly stagnation moraine re-worked by melt water



Morainal deposit

Qpt, morainal deposit

Circular overprint on bedrock color where drift is thin and patchy on abundantly exposed glaciated bedrock



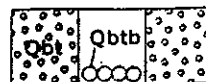
Alluvium and colluvium

Mostly cyclic periglacial deposits of small streams South of Cascade, source streams are partly designated:
Qbab, Big Creek
Qbac, Clear Creek
Qbak, Corral Creek



Outwash

Qbo, outwash undivided
Qbom, main-stream deposit; designated only where necessary
Qbos, side-stream deposit; designated only where necessary



Morainal deposit

QUATERNARY

Holocene

Pinedale Glaciation

Pleistocene

Bull Lake Glaciation

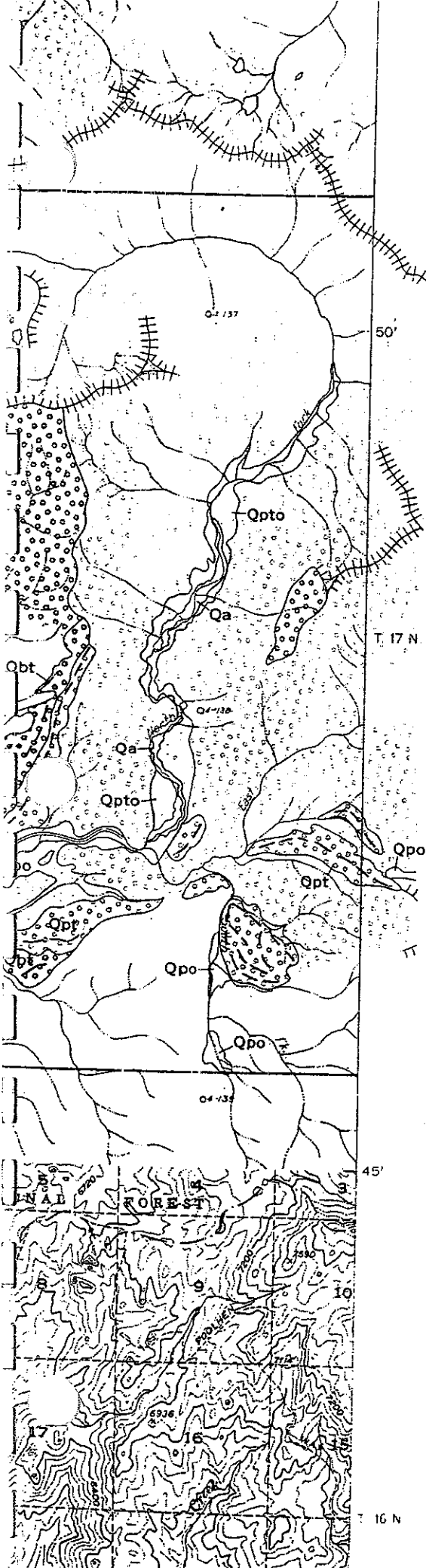
115° 50' 00"

T 19 N.

55

18 N

Buckhorn Lake



Qbt, morainal deposit
 Qbtb, boulder line partly buried by younger outwash (Qbo)
 Circular overprint on bedrock color where drift is thin and patchy on abundantly exposed glaciated bedrock; less accurately mapped than comparable Pinedale areas



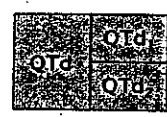
Lag gravel

Resistant cobbles and pebbles residual from eroded pre-Bull Lake surficial deposits (QTt and QTd). Mostly associated with remnant erosion surfaces



Till

Deposits deeply weathered and truncated by erosion; probably of different ages. Source of deposit east of Cascade is not apparent, whereas the source of the deposit southeast of Little Payette Lake probably was Lake Fork drainage

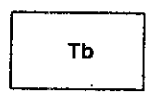


Fluvial and lacustrine deposits

Deposits of various origins probably including fault-trough fills, aggradational deposits, and glacial deposits. Many are faulted and moderately tilted. All are truncated by erosion and deeply weathered where relief is low; most contain small amounts of detrital gold. Large valley floor deposit east of Lakefork townsite may be proglacial outwash related to oldest morainal deposits on Lake Fork (QTt)

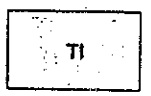
QTd₁ and QTd₂ subscripts distinguish adjoining deposits of distinctly different ages and origins; unit 1 is younger than unit 2, but correlation outside local area is not implied

BEDROCK



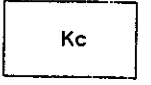
Columbia River Basalt

Contacts on West Mountain not accurately located



Latah(?) Formation

Unconsolidated sediments interbedded with Columbia River Basalt flows but chiefly underlying lowest basalt flows



Cretaceous and older crystalline rocks
 Schist, gneiss, and granitic rock; associated with the Idaho batholith

ATTACHMENT E
CORRESPONDENCE FROM UNPUBLISHED
INVESTIGATION AND WELL SITING STUDY FOR
EASTERN WESTERN CORPORATION



ASSOCIATED EARTH SCIENCES INC.

• BIOLOGY • GEOLOGY • ENGINEERING • SOIL SURVEYS • SOIL AND WATER QUALITY
• RESOURCE PLANNING AND SITE INVESTIGATIONS

7025 Emerald St., Suite 200A

Boise, Idaho 83704

(208) 377-2248

October 19, 1995

Mr. Michael McGinley
Eastern Western Corporation
P.O.Box 3228
Portland, OR 97208-3228

Scanlon Eng.
600 E Riverpark Lane
83706

Subject: Hydrothermal Well

Location: SE of NE of NE 1/4 Sec.13 T.12N. R.3E.

This report summarizes results of studies made by Boise State University (BSU) Geology Department regarding hot water potentials at SE NE NE Sec 13 T12N R3E in Valley County, Idaho.

Field work disclosed a fault scarp believed to be associated with the bath house hot spring. It can be seen about 150 yards west of the hot spring and was projected to pass close to the spring area. The broken rocks dip 55-65 degrees to the south and have a strike of N.70 degrees E.. No other springs were seen associated with this fault at other locations, but if they occur, it may be in or beneath the valley fill. Other faults in the area were not visibly traced to the vicinity of the hot spring.

After some difficulty with equipment, the BSU Geology Department completed their field surveys and a report of their results. It has taken a longer time than I expected for me to obtain that report and arrange a meeting with Dr. Paul Donaldson. During the interview he gave me his interpretation of the test results included in that report, most of which were in the report.

The results of BSU's field testing produced less guidance than I had hoped. As you have seen in the BSU report, the zone of low resistivity passes through the central portion of the four transects. The low resistivity is believed to indicate the area most favorable for intercepting hydrothermal solutions with a well. Dr. Donaldson discussed the areas of highest probability in the central portion of the zone near transect three. A location selected for drilling in the southern portion of the zone near line three may produce the hottest water, but it would take a greater drilling depth to reach and test the fault zone where the maximum opportunity is believed to occur.

His recommendation was to first try a small diameter test well. It would be located a distance of about 400-450 feet southwesterly from the bath house at an intersect with transect

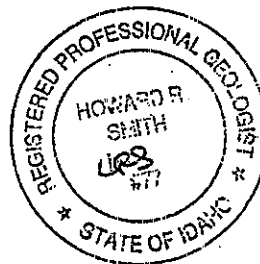
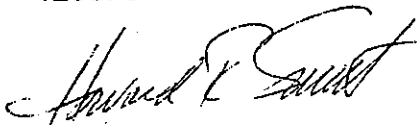
line three. Here the conditions of temperature, rock fractures, pressures, volume of water, location of the fault etc. could be checked on the way down to the fault zone which lies at an estimated depth of about 800 feet at this point. If conditions appear favorable in the test well, drilling a production well slightly to the south, about 500-600 feet from the bath house, to a depth of 1000-1200 or so, should be considered. The deeper well theoretically would produce hotter water, but not necessarily more water. This would depend upon the rock fracturing present. The exact position and dip of the fault is unknown but these figures are estimates based on an average of 60 degrees dip as seen in the outcrop to the west.

Part of the lack of clarity in the test results, according to Dr. Donaldson, may be due to a thick section of valley fill in the central portion of the valley. The main Payette River valley fault, trending nearly north-south about 2000 feet to the east, has a large displacement that resulted in a drop of the valley on the east side in respect to the west side of the fault. The age and relationship of the hot spring fault to the large fault is unknown and the thickness of Moorea, Brush and Olson Creeks' valley alluvium is also unknown until a well is drilled.

Dr. Donaldson stated further testing in the "best area" discussed could be conducted using Resistivity Depth Soundings. This system tests one local area at a time using electronic/magnetic currents. He agreed, however, because of testing delays and additional cost it would probably be better to use the present information and proceed with a test well.

If you have further questions or need further clarification regarding these recommendations, please let me know.

Howard R. Smith, PG
4925 Allamar Dr.
Boise, ID 83704
(208)375-7891



June 30, 1994

Copy

Mr. Michael McGinley
Eastern Western Corp.
P.O. Box 3228
Portland, OR 97208-3228

Subject: Hydrothermal Well
Location: SE of NE of NE 1/4 Sec.13 T.13N. R.3E.

The following information outlines work I have done at this point on the hot water development on Eastern Western land near Cascade, Idaho:

Consultation has been made with other geologists, geologic literature and water well logs have been checked. I met with the Idaho Department of Water Resources regarding hot water development. There I obtained the necessary forms for establishing water rights and at their suggestion, contacted the Boise State University Geology Department to obtain their recommendations on hot water development near Cascade, Idaho. I believe a drilled well is necessary to maximize hot water production. A surface excavation would yield only a small volume because of the low flow rate of the springs.

I met with a group from the Geology Department on June 7 to discuss geologic conditions at the site and possible procedures for hot water development. The group consisted of Dr. Paul Donaldson, Dr. Jack Pelton and five graduate students, a team attached to the Geology Department. They perform subsurface investigative work for the public and apparently charge close to their cost of operation. In return, they gain experience and make a little money for the school. They appear conscientious, talented and should do a good job at minimum cost. They recommended a subsurface investigation using the electric resistivity method. There has been some delay getting the paper work started because they have been busy with other work, but they should be able to proceed on the field work soon after the papers are signed, if this arrangement is satisfactory with you. Enclosed is a blank sample of the contract. I hoped they would fill in some of the blanks but as soon as there is mutual agreement, activities should proceed smoothly.

The geologic picture in the vicinity of the hot springs is complicated because of the apparent number of faults present and the lack of knowledge of subsurface conditions. The actual number of faults present is unknown, but surface conditions indicate at least two are present, both more or less parallel to a larger fault near the county road intersection, located a short distance to the northwest. Also, the angles of dip on the fault planes are unknown, but this will be important to know in planning the location of the well.

It is general belief that hot water occurs here in deep granitic rocks zones due to compression from overlying rocks, radioactive decay and residual heat from the Idaho Batholith. Escaping hot water tends to follow faults and fractured rocks toward the surface. Migrating water usually does not follow a simple vertical path but more of a zig-zag

pattern following broken rocks. Upon initial investigation, it seemed drilling near the springs would be satisfactory, but when considering the interest in obtaining maximum hot water, I believe it would be better to use technical facilities available and employ subsurface investigations prior to drilling. The electric resistivity method records zones of electrolytes, lower density and saturation at depth.

Although there are no guarantees, the presence of hot water discharge at the springs demonstrates the possibility of a moderate volume of hot water available from deeper rocks. Hot water may be leaking to other points in the valley and going undetected because of the thick section of valley fill to the south and east, and the moderate volume of cold water flowing through the alluvium. Since the BSU survey should locate the most advantageous location to drill and the necessary depth, it is possible the location may fall on Joan and Darwin Pancheri's land a short distance to the north and would require an easement.

During the initial discussion with the BSU group they said they might obtain sufficient data from two transects, for a cost of about \$2500. Now they are thinking more in terms of four transects. I can understand their desire to obtain the best information before making a decision. But we might request an evaluation after two or three transects instead of automatically going to four. There is also the possibility, with the complicated geologic structure present, they may request more than four before they are satisfied. The cost apparently is \$1250 per transect.

If you have any questions, please let me know.

Yours truly,

Howard R. Smith, PG

Howard R. Smith

4925 Allamar Dr.

Boise, ID 83704

(208) 375-7891

377-5569

Enclosed: Documents from BSU

Copy to R.W. Fodrea ✓



BOISE STATE UNIVERSITY • 1910 UNIVERSITY DRIVE • BOISE, IDAHO 83725

CENTER FOR GEOPHYSICAL INVESTIGATION OF THE SHALLOW SUBSURFACE TELEPHONE: (208) 385-1419
FAX: (208) 385-4061

July 25, 1994

TO: Michael E. McGinley
 Eastern-Western Corp.
 P O Box 3228
 Portland, OR 97208-3228

FROM: Paul R Donaldson, PhD *Paul R Donaldson*
 CGISS
 Boise State University
 Boise, Idaho 83725

RE: Geophysics project near Cascade Idaho

The work we propose for the project near Cascade Idaho, outlined at our recent meeting with Howard Smith consists of four dipole-dipole resistivity profiles. The profiles would be parallel to each other and perpendicular to the suspected fault trace. They would be arranged to include the surface projection of the fault near one end with the majority of the coverage including the expected down dip zone. The location of the profiles will rely primarily on discussion with Howard Smith concerning his understanding of the structural geometry. He will stake and flag the profile locations at points where each intersect his best estimation of the fault surface-projection. The profiles will be located on approximately 200 foot spacing with a station spacing of approximately 100 ft along each profile. Each profile will be about 1000-1200 feet in total length and will yield an electrical "pseudosection". Utilized together they will yield contour maps at a variety of depths of investigation. Dr. Jack Pelton has provided Howard Smith with a few literature references that review these tools applied to problems similar to yours.

The technique we propose is sensitive to conditions that vary the electrical properties of the area being investigated. At depths of interest to you the earth's electrical properties are controlled primarily by porosity, fluid saturation and fluid conductivity which in turn is controlled by fluid temperature and salinity. At your site the bulk porosity is probably dominated by fracture porosity. It can be anticipated that the fault zone should produce anomalous electrical conditions and will be the exploration target. Our goal will be to verify the position and geometry of the fault. We will also be looking for clues that indicate if porosity and/or

temperature variations are suggested in the data that might further constrain a drilling target. Ultimately, we will provide our recommendations for a geothermal test well based on the data gathered or possibly what additional work we might recommend before a final drilling decision is made. The total cost for the work we propose is \$5,000. The work could be scaled upward to include a larger area of investigation or add more detail if warranted and agreed to after the initial investigation.

In addition to locating the profile positions, we will rely on you or your representatives to secure all access permission necessary for us to complete this project.

Our deliverables will include a written report with appropriate figures and diagrams which will summarize the data we acquire and include our interpretations and recommendations.

Before we can proceed, a signed contract must be in place. The contract may be initiated by either your company or by Boise State University. If you have a contract you prefer to use, please submit a signed copy to Carol Joyce, CGISS Department, Boise State University, Boise, Idaho 83725. If you want BSU to prepare the contract please let Carol know as soon as possible to allow the paper work to be initiated. Also, questions regarding the contract agreement should be directed to Carol. Her telephone number is (208) 385-3920.

ATTACHMENT F
WELL DRILLERS REPORTS

IDAHO DEPARTMENT OF WATER RESOURCES WELL DRILLER'S REPORT

7882-84

Office Use Only			
Inspected by _____			
Twp _____	Rge _____	Sec _____	
_____ 1/4	_____ 1/4	_____ 1/4	
Lat: _____	Long: _____		

1. DRILLING PERMIT NO. -D-0025-754
Other IDWR No. _____

2. OWNER:

Name Darwin Pancheri

Address 9325 Missouri Ave.

City Nampa State ID _____ Zip 83686

3. LOCATION OF WELL by legal description:

Sketch map location must agree with written location

N

W	E	Twp. <u>13</u>	North ☒ or South ☐
		Rge. <u>4</u>	East ☒ or West ☐
		Sec. <u>713</u>	1/4 <u>SW</u> 1/4 <u>SW</u> 1/4
		10 acres	40 acres
		NE	NE
Gov't lot _____		County <u>Valley</u>	

Lat: _____ Long: _____

Address of Well Site 2nd Ranch on left - Caberton
City Cascade RD _____

(Give at least name of road + Distance to Road or Landmark)

Lt. _____ Blk. _____ Sub. Name _____

4. USE:

- ☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEAL/FILTER PACK		AMOUNT		METHOD
Material	From	To	Sacks or Pounds	
Cuttings	0	4'		Overbore
Bentonite	4'	25'	11S	Overbore

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 78'

Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	+2'	78'	.250	Steel	☒	☐	☒	☐
4 1/2"	72'	152'	Sc40	PVC	☐	☒	☐	☒

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS

☒ Perforations Method saw
☐ Screens Screen Type _____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
92'	152'	1/4"	160	4.5"	PVC	☐	☒
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

39ft. below ground

Artesian Pressure _____ lb

Depth flow encountered _____ ft. Describe access port or control devices: _____

11. WELL TESTS:

☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min.	Drawdown	Pumping Level	Time
10		120'	30 Min.
8		67'	2 Hrs.

Water Temp. _____ Bottom hole temp. _____

Water Quality test or comments: _____

Depth first Water Encountered 30'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Water				Remarks: Lithology, Water Quality & Temp.	Y	N
Bore Dia	From	To				
10"	0	2'		Top Soil		☒
10"	2'	12'		Brown Clay		☒
10"	12'	15'		Brown Sand		☒
10"	15'	25'		Brown Sand & Gravel		☒
6"	25'	30'		Brown Sand & Gravel		☒
6"	30'	70'		Brown Decomposed Granite		☒
6"	70'	78'		Brown Clay		☒
6"	78'	125'		Brown Decomposed Granite		☒
6"	125'	145'		Coarse Brown/White Decom. Granite		☒
6"	145'	160'		Brown Decomposed Granite		☒

RECEIVED

OCT 24 2002

WATER RESOURCES
WESTERN REGION

Completed Depth: 142' (Measurable)

Date: Started 10/07/02 Completed 10/08/02

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Down Right Drilling & Pump

Firm No. 637

Firm Official Larry King

Date 10-23-02

Supervisor or Operator Tony Harbitt
(Sign once if Firm Official & Operator)

Date 10-23-02

Date: 10/18/2002 Time: 10:27 AM

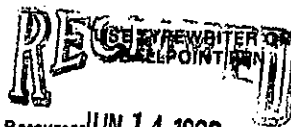
State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

[illegible]

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources JUN 14 1989
within 30 days after the completion or abandonment of the well.



WELL OWNER

Name Gulf Pacific Cattle Co.
Address At Box 25
Malba, Id 83641
Owner's Permit No 65-89-80-049-000

7. WATER LEVEL

Static water level 3.5' feet below land surface.
Flowing? ☐ Yes ☒ No G.P.M. flow _____
Artesian closed in pressure _____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature 52°F. Quality clear
Describe artesian or temperature zones below.

Department of Water Resources

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

8. WELL TEST DATA

☐ Pump ☐ Baller ☐ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
<u>4.7</u>	<u>140</u>	<u>1</u>

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Test ☐ Municipal
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

9. LITHOLOGIC LOG

022356

Bore Diam.	Depth		Material	Water	
	From	To		Yes	No
<u>8"</u>	<u>0</u>	<u>3</u>	<u>TOP SOIL</u>		☒
<u>8"</u>	<u>3</u>	<u>18</u>	<u>Decomp granite</u>		☒
<u>6"</u>	<u>18</u>	<u>20</u>	<u>Solid granite</u>		☒
<u>6"</u>	<u>20</u>	<u>60</u>	<u>" "</u>		☒
<u>6"</u>	<u>60</u>	<u>140</u>	<u>" "</u>		☒

4. METHOD DRILLED

☒ Rotary ☒ Air ☐ Hydraulic ☐ Reverse rotary
☐ Cable ☐ Dug ☐ Other _____

5. WELL CONSTRUCTION

Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____

Thickness	Diameter	From	To
<u>.250</u> inches	<u>6</u> inches	<u>1</u> feet	<u>19</u> feet

Was casing drive shoe used? ☐ Yes ☒ No
Was a packer or seal used? ☐ Yes ☒ No
Perforated? ☐ Yes ☒ No
How perforated? ☐ Factory ☐ Knife ☐ Torch
Size of perforation _____ inches by _____ inches

Number	From	To

Well screen installed? ☐ Yes ☒ No

Manufacturer's name _____

Type _____ Model No. _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____

Placed from _____ feet to _____ feet

Surface seal depth 20' Material used in seal: ☐ Cement grout

☒ Bentonite ☐ Puddling clay ☐ _____

Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing

☒ Overbore to seal depth

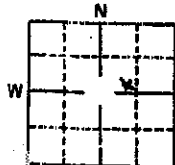
Method of joining casing: ☐ Threaded ☐ Welded ☐ Solvent

☐ Cemented between strata

Describe access port Sanitary well seal

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name _____

Lot No. _____ Block No. _____

County Valley

SW 1/4 NE 1/4 Sec. 13, T. 13 N, R. 30 W.

10.

Work started 6.9.89 finished 6.12.89

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Menasco Drilling Firm No. 391

Address McCall, Id. Date 6.12.89

Signed by (Firm Official) [Signature]

and

(Operator) [Signature]

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

[illegible]

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Administration within 30 days after the completion or abandonment of the well.

Department of Water Administration

1. WELL OWNER Name <u>Frank Bilbo</u> Address <u>South Cascade Idaho</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>23</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Temperature _____ ° F. Quality _____ Artesian closed-in pressure _____ p.s.i. Controlled by ☐ Valve ☐ Cap ☐ Plug																																															
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____		8. WELL TEST DATA ☐ Pump ☒ Bailer ☐ Other Discharge G.P.M. <u>12 gal</u> Draw Down <u>23-48</u> Hours Pumped <u>2</u>																																															
3. PROPOSED USE ☒ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type) _____ ☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection		9. LITHOLOGIC LOG <table border="1"><thead><tr><th rowspan="2">Hole Diam.</th><th colspan="2">Depth</th><th rowspan="2">Material</th><th colspan="2">Water</th></tr><tr><th>From</th><th>To</th><th>Yes</th><th>No</th></tr></thead><tbody><tr><td>6</td><td>0</td><td>10</td><td>top soil</td><td></td><td>X</td></tr><tr><td></td><td>10</td><td>32</td><td>clay</td><td></td><td>X</td></tr><tr><td></td><td>32</td><td>42</td><td>sand</td><td></td><td>X</td></tr><tr><td></td><td>42</td><td>60</td><td>clay</td><td></td><td>X</td></tr><tr><td></td><td>60</td><td>69</td><td>sandy gravel</td><td>X</td><td></td></tr><tr><td></td><td>69</td><td>74</td><td>filling</td><td></td><td>X</td></tr></tbody></table>		Hole Diam.	Depth		Material	Water		From	To	Yes	No	6	0	10	top soil		X		10	32	clay		X		32	42	sand		X		42	60	clay		X		60	69	sandy gravel	X			69	74	filling		X
Hole Diam.	Depth		Material		Water																																												
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4. METHOD DRILLED ☒ Cable ☐ Rotary ☐ Dug ☐ Other																																																	
5. WELL CONSTRUCTION Diameter of hole <u>6</u> inches Total depth <u>74</u> feet Casing schedule: ☒ Steel ☐ Concrete Thickness <u>0.15</u> inches Diameter <u>6</u> inches From <u>0</u> feet To <u>74</u> feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet Was a packer or seal used? ☐ Yes ☒ No Perforated? ☒ Yes ☐ No How perforated? ☐ Factory ☒ Knife ☐ Torch Size of perforation _____ inches by _____ inches Number <u>24</u> perforations From <u>62</u> feet To <u>68</u> feet _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Type _____ Model No. _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☐ Yes ☒ No Size of gravel _____ Placed from _____ feet to _____ feet Surface seal depth <u>59</u> Material used in seal ☐ Cement grout ☒ Pudding clay ☐ Well cuttings Sealing procedure used ☐ Slurry pit ☐ Temporary surface casing ☒ Overbore to seal depth																																																	
6. LOCATION OF WELL Sketch map location must agree with written location.  Subdivision Name _____ Lot No. _____ Block No. _____ County <u>Valley</u> <u>N. 1/4 S. 6 E. 1/4 Sec. 13 T. 17 N. R. 3 E. 1/4</u>		10. Work started <u>7-19-74</u> finished <u>7-25-74</u>																																															
		11. DRILLERS CERTIFICATION Firm Name <u>HASH drilling</u> Firm No. <u>281</u> Address <u>327-3.7 1st payette</u> Signed by (Firm Official) <u>James Hollaway</u> and <u>Ray Hollaway</u> (Operator)																																															

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the well.

1. WELL OWNER Name <u>Gary Peterson</u> Address <u>H.C. 71 Box 4660</u> <u>CASCADE ID 97611</u> Owner's Permit No _____	7. WATER LEVEL Static water level <u>30</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed-in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature _____ OF Quality _____																																		
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____	8. WELL TEST DATA ☒ Pump ☐ Bailor ☐ Air ☐ Other: _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Discharge G.P.M.</th> <th>Pumping Level</th> <th>Hours Pumped</th> </tr> <tr> <td><u>59.4</u></td> <td><u>90 FT</u></td> <td><u>2 Hrs</u></td> </tr> </table>	Discharge G.P.M.	Pumping Level	Hours Pumped	<u>59.4</u>	<u>90 FT</u>	<u>2 Hrs</u>																												
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4. METHOD DRILLED ☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary ☒ Cable ☐ Dug ☐ Other _____	RECEIVED RECEIVED MAY 14 1985 MAY 15 1985 Department of Water Resources Western Regional Office																																		
5. WELL CONSTRUCTION Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Thickness</th> <th>Diameter</th> <th>From</th> <th>To</th> </tr> </thead> <tbody> <tr> <td><u>0.250</u> inches</td> <td><u>6</u> inches</td> <td><u>0</u> feet</td> <td><u>114</u> feet</td> </tr> <tr> <td>_____ inches</td> <td>_____ inches</td> <td>_____ feet</td> <td>_____ feet</td> </tr> <tr> <td>_____ inches</td> <td>_____ inches</td> <td>_____ feet</td> <td>_____ feet</td> </tr> <tr> <td>_____ inches</td> <td>_____ inches</td> <td>_____ feet</td> <td>_____ feet</td> </tr> </tbody> </table> Was casing drive shoe used? ☐ Yes ☒ No Was a packer or seal used? ☐ Yes ☒ No Perforated? ☒ Yes ☐ No How perforated? ☒ Factory ☐ Knife ☐ Torch Size of perforation <u>4</u> inches by <u>4</u> inches <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Number</th> <th>From</th> <th>To</th> </tr> </thead> <tbody> <tr> <td><u>1/4 x 4</u> perforations</td> <td><u>45</u> feet</td> <td><u>55</u> feet</td> </tr> <tr> <td><u>1/2 x 4</u> perforations</td> <td><u>65</u> feet</td> <td><u>75</u> feet</td> </tr> <tr> <td><u>1/4 x 4</u> perforations</td> <td><u>90</u> feet</td> <td><u>100</u> feet</td> </tr> </tbody> </table> Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Type _____ Model No. _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☒ Yes ☐ No ☐ Size of gravel <u>1/2</u> - Placed from <u>35</u> feet to <u>114</u> feet Surface seal depth <u>25 FT</u> Material used in seal: ☐ Cement grout ☒ Well cuttings ☐ Pudding clay Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing ☒ Overbore to seal depth Method of joining casing: ☐ Threaded ☒ Welded ☐ Solvent ☐ Weld ☐ Cemented between strata Describe access port _____		Thickness	Diameter	From	To	<u>0.250</u> inches	<u>6</u> inches	<u>0</u> feet	<u>114</u> feet	_____ inches	_____ inches	_____ feet	_____ feet	_____ inches	_____ inches	_____ feet	_____ feet	_____ inches	_____ inches	_____ feet	_____ feet	Number	From	To	<u>1/4 x 4</u> perforations	<u>45</u> feet	<u>55</u> feet	<u>1/2 x 4</u> perforations	<u>65</u> feet	<u>75</u> feet	<u>1/4 x 4</u> perforations	<u>90</u> feet	<u>100</u> feet		
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11. DRILLERS CERTIFICATION I/We certify that all minimum well construction standards were complied with at the time the rig was removed. Firm Name <u>Boise Valley Pump and Drilling</u> Firm No. <u>207</u> Address <u>9950 S. GARDEN</u> Date <u>9-24-84</u> Signed by (Firm Official) <u>Don - 577</u> and (Operator) <u>Don - 577</u>																																			

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

Form 238-7
3/95

IDAHO DEPARTMENT OF WATER RESOURCES WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only			
Inspected by _____			
Twp _____	Rge _____	Sec _____	
1/4 _____	1/4 _____	1/4 _____	
Lat: _____		Long: _____	
☒ Air		☐ Flowing Artesian	

1. DRILLING PERMIT NO. 65-96-W-0325-000
Other IDWR No. _____

2. OWNER:
Name Dean Bentley
Address 7080 W. McMillan Rd.
City Meridian State ID Zip 83642

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

Twp <u>13</u> North ☒ or South ☐	
Rge <u>3</u> East ☒ or West ☐	
Sec. <u>12</u> 1/4 <u>NE</u> 1/4 <u>SE</u> 1/4	
Gov't Lot _____	County <u>Valley</u>
Lat: _____	Long: _____
Address of Well Site <u>200 Pandocosa Lane</u>	
City <u>Cascade</u>	

City Cascade
Bldg. _____ Sub. Name Caberton Ranchettes Subd.

4. USE:
☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEA/FILTER PACK			AMOUNT		METHOD
Material	From	To	Sack	or Pounds	
Chip Bentonite	0	19	2 sacks		Over bore to Seal Depth.
Cement	"	"	2 sacks		Filled from top.
1/4" Pea Gravel	34'	210'	4 yds		Down.

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____
Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
8"	+1	19'	25	Steel	☒	☐	☒	☐
5"	+1	214	138	Steel	☐	☒	☒	☐
5"	"	"	258	Steel	☐	☒	☒	☐

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS

☒ Perforations Method Star Wheel Air Perforator
☐ Screens Screen Type _____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
75'	80'	1/2"	25	5"	Steel	☐	☒
110'	140'	1/2"	250	5"	Steel	☐	☒
150'	160'	1/2"	100	5"	Steel	☐	☒
170'	180'	1/2"	50	5"	Steel	☐	☒

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

47 ft below ground Artesian pressure _____ lb.
Depth flow encountered _____ ft. Describe access port or control devices: 8" Sanitary DRI Seal

11. WELL TESTS:

Yield gal/min.	Drawdown	Pumping Level	Time
<u>5</u>		<u>190</u>	<u>4 hrs</u>

Water Temp. 47° Bottom hole temp. 47°
Water Quality test or comments: Good

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water
10	0	2	Top Soil	
10	2	4	Brown Clay	X
10	4	18	Brown Clay Decom Brown Granite	X
8	18	27	Brown Clay Decom Brown Granite	X
8	27	35	Med Hard Brown Granite	X
8	35	37	Fractured	X
8	37	47	Med Hard Gray Brown Granite	X
8	47	51	Fractured Softer Granite	X
8	51	60	Med Hard Gray Granite	X
8	60	61	Fracture 1/4 GPM	X
8	61	74	Med Hard Gray Granite	X
8	74	75	Fracture 1/4 GPM	X
8	75	83	Med Hard Gray Granite	X
8	83	84	Fracture	X
8	84	105	Lt Brown Hard Granite	X
8	105	110	Fractured Dk Brown Granite	X
8	110	115	Hard Lt Brown Granite	X
8	115	130	Med Hard to Soft Fractured	X
8	"	"	Brown Granite	X
8	130	150	Med Hard Brown Granite	X
8	150	151	Gray Caliche	X
8	151	160	Softer Brown Granite 1/2 GPM	X
8	160	180	Soft to Med Hard Granite	X
8	180	200	Soft to Med Hard Granite 1/2 GPM	X
8	200	208	Soft Brown Granite	X
8	208	211	Fracture	X
8	211	280	Soft Brown Granite 1/2 Med Hard	X

RECEIVED RECEIVED

DEC 09 1996 NOV 29 1996

Department of Water Resources
Completed Depth 280
Date: Started 10-11-96 Completed 10-25-96
(Measurable)
WATER RESOURCES
WESTERN REGION

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Gustin Well Drilling Firm No. 408
Firm Official [Signature] Date 10-31-96
and [Signature]
Supervisor or Operator [Signature] Date 10-31-96
(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

1. WELL OWNER

Name George Mendonhall
Address 834 Troutman Way Boise, Id 83712
Drilling Permit No. 65-43-W-0257
Water Right Permit No. _____

7. WATER LEVEL

Static water level 6' feet below land surface
Flowing? ☐ Yes ☒ No G.P.M. flow _____
Artesian closed in pressure _____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature 47 °F. Quality Clear
Describe artesian or temperature zones below.

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Well diameter increase ☐ Modification
☐ Abandoned (describe abandonment or modification procedures such as liners, screen materials, plug depths etc. in lithologic log section 9.)

8. WELL TEST DATA

☐ Pump ☐ Bailor ☒ Air ☐ Other _____
Discharge G.P.M. 10 Pumping Level 140 Hours Pumped 2

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Monitor
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

4. METHOD DRILLED

☒ Rotary ☒ Air ☐ Auger ☐ Reverse rotary
☐ Cable ☐ Mud ☐ Other _____
(backhoe, hydraulic, etc.)

5. WELL CONSTRUCTION

Casing schedule ☒ Steel ☐ Concrete ☐ Other _____
Thickness 2.512 inches Diameter 6 inches From 1 feet To 163 feet
Was casing drive shoe used? ☒ Yes ☐ No
Was a packer or seal used? ☐ Yes ☒ No
Perforated? ☐ Factory ☒ Knife ☐ Torch ☐ Gun
How perforated? ☐ Factory ☒ Knife ☐ Torch ☐ Gun
Size of perforation? _____ inches by _____ inches
Number _____ From _____ To _____
_____ perforations _____ feet _____ feet
_____ perforations _____ feet _____ feet
_____ perforations _____ feet _____ feet
Well screen installed? ☐ Yes ☐ No
Manufacturer _____ Type _____
Top Packer or Headpipe _____
Bottom of Tailpipe _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet
Diameter _____ Slot size _____ Set from _____ feet to _____ feet
Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____
Placed from _____ feet to _____ feet

Surface seal depth 20 Material used in seal: ☒ Cement grout
☐ Bentonite ☐ Pudding clay ☐ _____
Sealing procedure used: ☐ Slurry pit
☐ Temp. surface casing ☒ Overbore to seal depth
Method of joining casing: ☐ Threaded ☒ Welded
☐ Solvent Weld ☐ Cemented between strata

Describe access port Sanitary Well Seal

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name _____

Lot No. _____ Block No. _____

County Valley

Address of Well Site Pondosa St. Casaca, Id.
(give at least name of road)

SE 1/4 SE 1/4 Sec 12 R 13 N ☒ or S ☐
E ☒ or W ☐

9. LITHOLOGIC LOG

Bore Diam.	Depth		Material	Water	
	From	To		Yes	No
3"	0	2	TOP FILL		
3"	2	20	Decomp. granite.		X
6"	20	40	Decomp. granite		X
	40	60	Hard grey granite		X
	60	80	" "		X
	80	100	Softer granite		X
	100	110	Hard grey granite	X	
	110	130	Soft granite		X
	130	144	Hard granite		X
	144	155	Soft Brown granite		X
	155	163	Hard granite		X
6"	163	190	Hard granite		X

RECEIVED

AUG 29 1993

Department of Water

AUG 18 1993

Department of Water Resources
Western Regional Office

10.

Work started 8.12.93 finished 8.14.93

11. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Mengalo Drilling Firm No. 391

Address McCall, Id. Date 8.16.93

Signed by Drilling Supervisor [Signature]

and
(Operator) [Signature]

(If different than the Drilling Supervisor)

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT
Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by _____
Twp _____ Rge _____ Sec _____
_____ 1/4 _____ 1/4 _____ 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 00001082
Other IDWR No. 05-97-W-0213-000

2. OWNER:
Name MEKE FACKRELL
Address Box 353
City CASCADE State ID Zip 83611

3. LOCATION OF WELL by legal description:

Sketch map location must agree with written location



Twp. 13 North ☒ or South ☐
 Rge. 3 East ☒ or West ☐
 Sec. 13 $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$
 Gov't Lot _____ County VALLEY $\frac{10$ acres $\frac{20$ acres $\frac{160$ acres
 Lat: _____ Long: _____
 Address of Well Site: 219 PONDEROSA LN.
 City: CASCADE

(Give all lands in this oil and gas lease to the Government)

LI 11 Blk _____ Sub Name CABARTON RANCHETTS

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement, etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEAL/FILTER PACK			AMOUNT	METHOD
Material	From	To	Sacks or Pounds	
BENTONITE	19	0	5 BAGS	OVER ROPE TO
CEMENT	19	0	1 BAG	SEAL PAPTH FALL
8-13000000 SAND	181	50	2000 LBS	FROM TOP DOWN

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____

Was drive shoe seal tested? ☒ YES ☐ NO How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	-1	-20'	250	STEEL	X	☐	X	☐
4"	-7	B1	160m	PVC	☐	X	X	☐
							☐	☐

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS

Perforations	Method
--------------	--------

X Screens Screen Type SAWED

From	To	Slot Size	Number	Gage Meter	Material	Casing	Linear
81	181	.020	100	4"	PVC		18
							13
							13

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

17 ft. below ground Artesian pressure _____ lb.

Depth flow encountered _____ ft. Describe access port or control devices: SANITARY WELL SEAL

11. WELL TESTS:

☐ Pump ☐ Bailer

Yield gal./min	Drawdown	Pumping Level	Time
3		175	1 hr

Water Temp. 54°

Bottom hole temp. 54°

Water Quality test or comments: GOOD, LITTLE SILVER SMALL

Depth first Water Encountered 94

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

[illegible]

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name GESTRA WEL DREHN 6 Firm No. 408

Firm Official Robert A. Lutz Date 7-16-97

Supervisor or Operator Lee Bo Date 7-16-77

(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

RECEIVED

1. WELL TAG NO. D 0018957

DRILLING PERMIT NO.

Other IDWR No.

OCT 10 2001

2. OWNER:

Name Jackie Lee

City of Water Resources

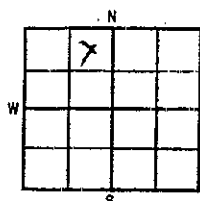
Address 59 Badger Hollow Rd

City Cascade

State ID Zip 83611

3. LOCATION OF WELL by legal description:

Sketch map location must agree with written location.



Twp 13 North ☒ or South ☐
Rge 3 East ☒ or West ☐
Sec 13 1/4 NE 1/4 NW 1/4
Gov't Lot County Valley
Lat : : Long : :
Address of Well Site 59 Badger Hollow Rd
City Cascade

(Give at least name of road + Distance to Road or Landmark)

Li. 37

Bk.

Sub.

Name Robert Lee West

Subd. E22

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEAL/FILTER PACK			AMOUNT		METHOD
Material	From	To	Sacks or Pounds		
Benzoite	0	18	10 bag		poored from Tub down

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s)

Was drive shoe seal tested? ☐ Y ☒ N How?

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6	71	19	.250	STACI	☒	☐	☐	☐
4	-6	140	160	PVC	☐	☒	☐	☐
4	160	180	160	PVC	☐	☒	☐	☐
4	260	280	160	PVC	☐	☒	☐	☐

Length of Headpipe Length of Tailpipe

9. PERFORATIONS/SCREENS

Perforations

Method Sanded

Screens

Screen Type

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
140	160	40	40	4	PVC	☐	☒
180	240	120	120	4	PVC	☐	☒
280	331	120	120	4	PVC	☐	☒

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

68 ft. below ground Artesian pressure lb.

Depth flow encountered ft. Describe access port or

Control devices: Sanitary Well Seal

11. WELL TESTS:

☐ Pump ☐ Bailor ☒ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
75		330	2hr

Water Temp. 50

Bottom hole temp.

Water Quality test or comments: good

Depth first Water Encounter 150

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
10	0	3	Top Soil		
10	3	18	Brown decom granite		X
6	18	20	Brown decom granite		X
6	20	30	Med hard Brown granite		X
6	30	35	Soft Brown granite		X
6	35	77	Med hard Brown granite w/soft top		X
6	77	78	Rose quartz		X
6	78	95	Med hard brown granite		X
6	95	145	Med hard Brown granite w/soft top		X
6	145	120	Med hard Brown granite w/Frac		X
6	120	140	Med hard Brown granite		X
6	140	170	Med hard Brown granite w/Frac		X
6	170	172	Rose quartz		X
6	172	190	hard Brown granite w/Frac		X
6	190	192	Fresh Brown granite	X	
6	192	201	hard gray granite		X
6	201	232	hard gray granite w/Frac	X	
6	232	235	hard Brown granite w/Frac		X
6	235	248	hard gray w/Frac		X
6	248	256	hard Brown granite w/Rose quartz		X
6	256	264	hard gray brown granite		X
6	264	272	hard brown granite w/Frac		X
6	272	283	hard gray granite w/Frac	X	
6	283	294	Broken Tan granite	X	
6	294	300	hard gray granite		X
6	300	320	hard gray granite w/Frac	X	
6	320	331	hard gray granite		X

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OCT 10 2001

WATER RESOURCES

WESTERN REGION

Completed Depth 331 (Measurable)
Date: Started 9-10-00 Completed 9-14-00

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name Gustin well drilling Firm No. 408

Firm Official Robert Lee Date 9-25-01

and Driller or Operator [Signature] Date 9-23-01

(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORTUSE TYPEWRITER OR
BALLPOINT PENState law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the well.

WELL OWNER

Name John Dush, Ernie Dush
Address Bain, Idaho
Owner's Permit No. _____

7. WATER LEVEL

Static water level 16 feet below land surface
Flowing? ☐ Yes ☐ No G.P.M. flow _____
Artesian closed-in pressure _____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature 80 °F. Quality hard
Describe artesian or temperature zones below.

2. NATURE OF WORK

- ☒
- New well
- ☐
- Deepened
- ☐
- Replacement
-
- ☐
- Abandoned (describe abandonment procedures such as materials, plug depths, etc in lithologic log)

8. WELL TEST DATA

☐ Pump ☒ Bailer ☐ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
<u>20</u>	<u>280</u>	<u>2</u>
<u>10</u>	<u>280</u>	<u>1</u>

3. PROPOSED USE

- ☒
- Domestic
- ☐
- Irrigation
- ☐
- Test
- ☐
- Municipal
-
- ☐
- Industrial
- ☐
- Stock
- ☐
- Waste Disposal or Injection
-
- ☐
- Other _____ (specify type)

9. LITHOLOGIC LOG

Bore Diam.	Depth		Material	Water	
	From	To		Yes	No
6"	0	4	sandy soil		X
	4	12	brown clay		X
	12	30	brown sandy clay		X
	32	35	decomposed granite		X
	35	85	sandy stone		X
	85	104	brown sandy clay		X
	104	107	sand with silt	X	
	107	135	decomposed granite		X
	135	230	sand & silt	X	
	230	237	decomposed granite		X
	237	245	sandy clay		X
	245	270	silt & sand		X
	270	340	decomposed granite	X	

4. METHOD DRILLED

- ☐
- Rotary
- ☐
- Air
- ☐
- Hydraulic
- ☐
- Reverse rotary
-
- ☒
- Cable
- ☐
- Dug
- ☐
- Other _____

5. WELL CONSTRUCTION

Casing schedule: ☒ Steel ☐ Concrete ☐ Other

Thickness	Diameter	From	To
<u>250</u> inches	<u>6</u> inches	<u>1</u> foot	<u>279</u> feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet

- Is casing drive shoe used?
- ☒
- Yes
- ☐
- No
-
- Is a packer or seal used?
- ☐
- Yes
- ☒
- No
-
- Perforated?
- ☐
- Yes
- ☒
- No
-
- How perforated?
- ☐
- Factory
- ☐
- Knife
- ☐
- Torch
-
- Size of perforation _____ inches by _____ inches

Number	From	To
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name _____

Type _____ Model No. _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____

Placed from _____ feet to _____ feet

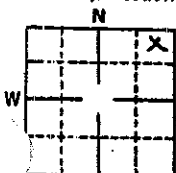
Surface seal depth 30 Material used in seal: ☐ Cement grout☒ Bentonite ☒ Pudding clay ☐ _____Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing☐ Overbore to seal depthMethod of joining casing: ☐ Threaded ☒ Welded ☐ Solvent

Weld

☐ Cemented between strataDescribe access port sanitary seal

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name _____

Lot No. _____ Block No. _____

County ValleyNE 1/4 SE 1/4 Sec. 13, T. 13 N., R. 3 E.

10.

Work started 9-26-83 finished 10-18-83

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were
complied with at the time the rig was removed.W. W. Garringer - Well Drilling Firm No. 373

William W. Garringer

Address W. Black Canyon Hwy Date 6-20-84

Emmett Idaho 83617

Signed by (Firm Official) William W. Garringer

and

(Operator) W. W. Garringer

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

WELL OWNER

Name Robert & Janet Shellworth

Address P.O. Box 753 Cascade, Id. 83611

Owner's Permit No. _____

7. WATER LEVEL

Static water level 25' feet below land surface.

Flowing? ☐ Yes ☒ No G.P.M. flow _____

Artesian closed in pressure _____ p.s.i.

Controlled by: ☐ Valve ☐ Cap ☐ Plug

Temperature 116 OF. Quality Good

2. NATURE OF WORK

☒ New well
☐ Deepened
☐ Replacement

☐ Abandoned (describe method of abandoning) _____

3. PROPOSED USE

☒ Domestic
☐ Irrigation
☐ Test
☐ Municipal

☐ Industrial
☐ Stock
☐ Waste Disposal or Injection

☐ Other _____ (specify type)

4. METHOD DRILLED

☐ Rotary
☐ Air
☐ Hydraulic
☐ Reverse rotary

☒ Cable
☐ Dug
☐ Other _____

5. WELL CONSTRUCTION

Casing schedule: ☒ Steel ☐ Concrete ☒ Other P.V.C.

Thickness	Diameter	From	To
<u>250</u> inches	<u>6"</u>	<u>Inches + 2'</u>	<u>feet 30'</u>
<u>P.V.C. 125</u> inches	<u>5"</u>	<u>Inches - 10'</u>	<u>feet 80'</u>
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet

Is casing drive shoe used? ☐ Yes ☒ No

Is a packer or seal used? ☐ Yes ☒ No

Perforated? ☒ Yes ☐ No

How perforated? ☐ Factory ☐ Knife ☐ Torch Saw

Size of perforation 1/8 inches by 1 inches

Number	From	To
<u>60</u> perforations	<u>50</u> feet	<u>65</u> feet
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name _____

Type _____ Model No. _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____

Placed from _____ feet to _____ feet

Surface seal depth 25' Material used in seal: ☒ Cement grout

☐ Puddling clay ☐ Well cuttings

Sealing procedure used: ☐ Slurry pit ☒ Temp. surface casing

☒ Overbore to seal depth

Method of joining casing: ☐ Threaded ☒ Welded ☐ Solvent

☐ Cemented between strata

Describe access port _____

6. LOCATION OF WELL

Sketch map location must agree with written location.

N

W

E

S

13

Subdivision Name Carbarton

West Sub. _____

Lot No. _____ Block No. _____

County Valley B.M. _____

N.E. 1/4 N.W. 1/4 Sec. 13, T. 13 N/S, R. 3 E/W.

9. LITHOLOGIC LOG

Hole Diam.	Depth		Material	Water	
	From	To		Yes	No
8"	0'	2'	overburden		x
8"	2'	15'	decomposed granite		x
8"	15'	60'	granite gray		x
6"	60'	62'	decomposed granite	x	
6"	62'	90'	granite dark gray		x

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JUL 27 1979

Department of Water Resources

Western Regional Office

10. Work started 6/19/79 finished 7/11/79

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Garys Well Drilling Firm No. 317

Address Star Route Cascade, Id Date July 24, 1979

Signed by (Firm Official) Wayne Wilson

and _____

(Operator) _____

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

[illegible]

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

WELL OWNER

Name W. (Bill) JonesAddress 10408 Ustick Blvd. Boise Ida.

Owner's Permit No. _____

2. NATURE OF WORK

- ☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe method of abandoning)

3. PROPOSED USE

- ☒ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type)
☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection

4. METHOD DRILLED

- ☒ Cable ☐ Rotary ☐ Dug ☐ Other

5. WELL CONSTRUCTION

Diameter of hole 6" inches Total depth 81' feetCasing schedule: ☒ Steel ☐ Concrete

Thickness	Diameter	From	To
<u>.250</u> inches	<u>6"</u> inches	<u>+ 2</u> feet	<u>81</u> feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet

Was casing drive shoe used? ☐ Yes ☒ NoWas a packer or seal used? ☐ Yes ☒ NoPerforated? ☒ Yes ☐ NoHow perforated? ☐ Factory ☐ Knife ☒ TorchSize of perforation 1/8 inches by 6 inches

Number	From	To
<u>100</u> perforations	<u>60'</u> feet	<u>80'</u> feet
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name _____

Type _____ Model No. _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Gravel packed? ☐ Yes ☒ No Size of gravel _____

Placed from _____ feet to _____ feet

Surface seal depth 20' Material used in seal ☒ Cement grout☐ Pudding clay ☐ Well cuttingsSealing procedure used ☐ Slurry pit ☒ Temporary surface casing☒ Overbore to seal depth

7. WATER LEVEL

Static water level 321 feet below land surfaceFlowing? ☐ Yes ☒ No G.P.M. flow _____Temperature 16 ° F. Quality good

Artesian closed in pressure _____ p.s.i.

Controlled by ☐ Valve ☐ Cap ☐ Plug

8. WELL TEST DATA

☐ Pump ☒ Bailor ☐ Other

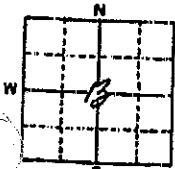
Discharge G.P.M.	Draw Down	Hours Pumped
10 to 12	20	4 hrs.

9. LITHOLOGIC LOG

Hole Diam.	Depth		Material	Water	
	From	To		Yes	No
8"	0'	4'	overburden		X
8"	4'	25'	conglomerate clay- brown		X
6"	25'	60'	mild granite		X
6"	60'	81'	decomposed granite - gravelly white-----		X

Department of Water Resources
Western Regional Office

6. LOCATION OF WELL

Sketch map location must agree with written location. 65Subdivision Name Garborton WestLot No. 15 Block No. _____County Valley R.M. _____X Sec. 13 T. 13 N.S.R. 3 EW10. Work started May 17, 1977 finished June 15, 1977

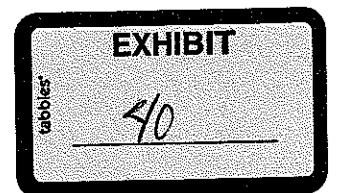
11. DRILLER'S CERTIFICATION

Firm Name Bozys Well Drilling Firm No. 317Address P.O. Box 571 Cascade Ida. Date Sept. 9, 1977Signed by (Firm Official) Ray W. Wilsonand
(Operator)

USE ADDITIONAL SHEETS IF NECESSARY

FORWARD THE WHITE COPY TO THE DEPARTMENT

Scanlin Report
September 2, 2003



SCANLAN ENGINEERING

Groundwater and Environmental Engineering

September 2, 2003

Mr. Rob Whitney
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705

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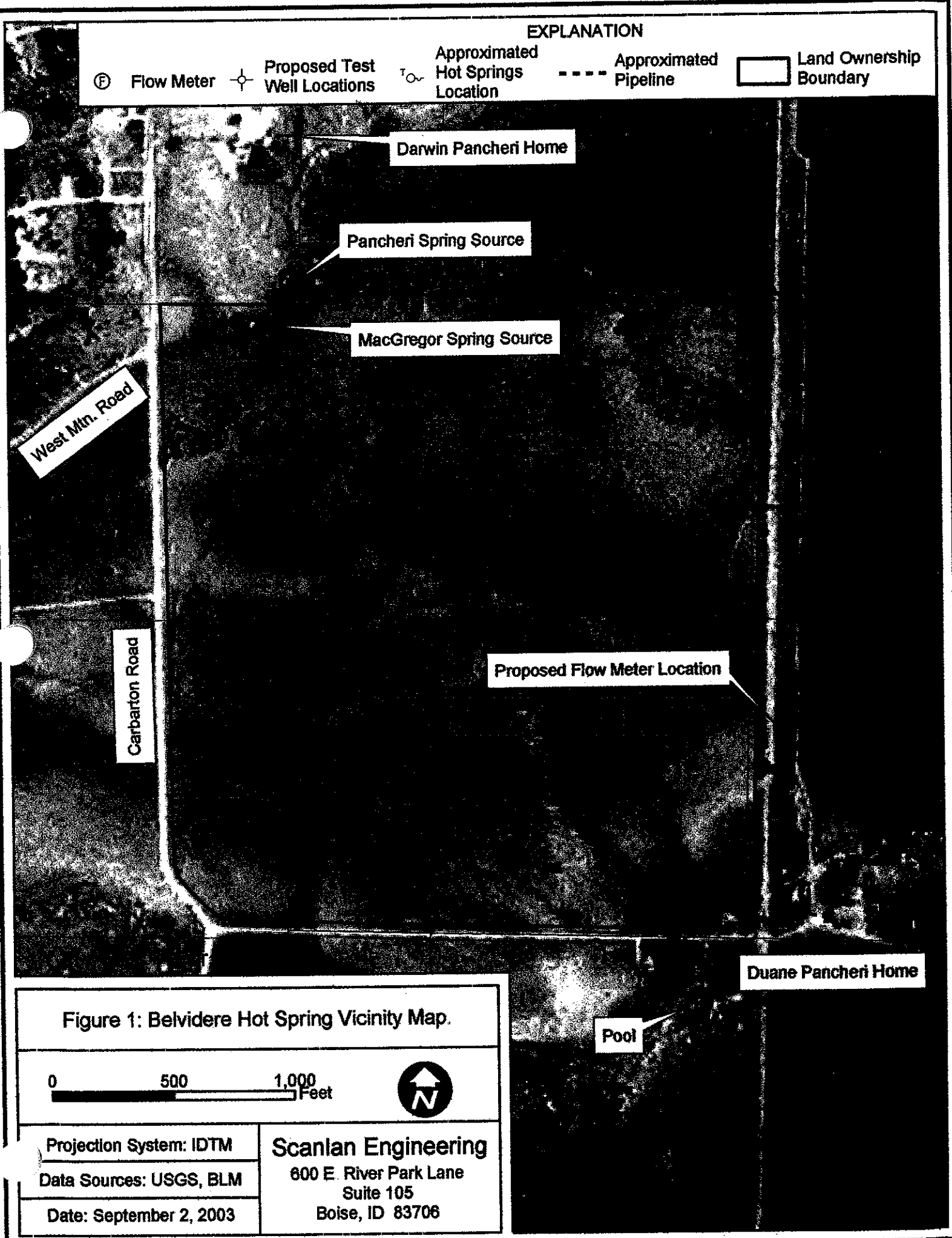
Subject: MacGregor Test Well Proposal

Dear Rob:

In response to your email of July 1, 2003, and Gary Spackman's letter of June 5, 2003, this letter provides additional information related to Carol MacGregor's proposal for test well drilling at Belvidere.

The following items were requested

1. Data gathered from well logs, interviews with driller's in the area, and geological surveying in the area that will better describe the formations that will be encountered, and the nature of the low temperature geothermal aquifer sought to be appropriated including the venting system through which the aquifer is discharging. The data should be summarized and conclusions about the data should be written.
2. A detailed description of the method of construction that will protect the low temperature geothermal system and minimize risk of injury to other water rights. The description should contain both a diagram of the proposed well and a narrative of the proposed construction.
3. A detailed description of the test that will be performed on the well and any other water sources, and what data will be gathered. The detail must include methods and timing of measurement and data gathering.
4. Provide monitoring information collected to date, and an indication of whether the parties intend to collect any additional flow and temperature measurement and/or install flow and totalizing meters.
5. A proposed monitoring plan for the well and springs if the well is completed as a production well.
6. A proposed bond amount and mitigation plan sufficient enough to insure proper abandonment of the well or test hole and to protect existing water right holders from injury due to losses in temperature, pressure, or quantity.



EXPLANATION

- ⊕ Flow Meter ⊕ Proposed Test Well Locations ⌊ Approximated Hot Springs Location - - - - - Approximated Pipeline □ Land Ownership Boundary

Darwin Pancheri Home

Pancheri Spring Source

MacGregor Spring Source

West Mtn. Road

Carbarton Road

Proposed Flow Meter Location

Duane Pancheri Home

Pool

Figure 1: Belvidere Hot Spring Vicinity Map.

0 500 1,000 Feet



Projection System: IDTM

Data Sources: USGS, BLM

Date: September 2, 2003

Scanlan Engineering

600 E. River Park Lane
Suite 105
Boise, ID 83706

These items are addressed below. A map of the project area is provided as Figure 1.

SPRING CHARACTERIZATION

Description of Belvidere Spring. Belvidere Hot Spring consists of an area of approximately one acre in size with diffuse geothermal discharge. The spring area is concentrated within a fenced area approximately 120 feet by 75 feet on the MacGregor property, although evidence of geothermal discharge also is visible outside of the fenced area on both the MacGregor and Pancheri properties. The spring area trends in a North 60 East direction, suggesting the possible presence of a geologic structure (i.e., fault) or other subsurface feature trending N60E.

Within the fenced portion of the MacGregor property, two main areas of discharge are visible. Both of these spring vents historically had been developed with bathhouses (65-1972 and 65-1973), although only remnants of these structures are currently visible.

- The measured temperature at the upper bathhouse pool has ranged from 93 to 105 degrees F over the past few years. A seep adjacent to the upper pool has a temperature of 110 to 113 degrees F. The discharge rate from the upper pool vicinity is probably 10 to 20 gpm.
- The maximum surface temperature at the lower bathhouse pool has ranged from 116 to 121 degrees F over the past few years. Estimated discharge rate from the lower pool area is 10 to 30 gpm.

Combined flow rate from the upper and lower bathhouse areas is probably about 60 gpm, based on weir measured flows of approximately 50 gpm east of the bathhouses, plus approximately 10 gpm of unmeasured flow that discharges toward the Pancheri property.

On the Darwin Pancheri property, geothermal discharge from the spring has been developed with an infiltration gallery. According to the field examination for water right 65-12891, the infiltration gallery discharges by gravity flow through a buried 10-inch diameter PVC pipe that extends eastward for 2100 feet. The 10-inch pipe then reduces to 4-inch diameter and extends 3000 feet to the south to the Duane Pancheri house and shop (water right 65-12891). A pump station near the infiltration gallery diverts water from the 10-inch pipe to the Darwin Pancheri home (water right 65-13332). Flow rate in the pipeline (as measured at the Duane Pancheri home with the Darwin Pancheri pump off) has ranged from 60 to 80 gpm in five measurements since May 2001. Note that a measurement of 114 gpm (i.e., 17 gpm pumped to Darwin Pancheri plus 97 gpm by gravity flow through the pipeline) was made on January 27, 2001. The bucket used for volumetric measurement on January 27, 2001 was reportedly marked for a 4-gallon capacity, but this calibration was not verified by Scanlan Engineering. Measured temperature at the upper end of the pipeline has ranged from 109 to 113 degrees F, with temperatures typically of about 112 to 113 degrees F.

Based on flow monitoring since 2001, the combined surface discharge from the spring vicinity on both the MacGregor and Pancheri properties is probably in the range of 110 to 180 gpm, with an estimated average temperature of approximately 112 degrees F.

Monitoring Data Collected at Belvidere Hot Spring. Monitoring data collected by Scanlan and/or Chapman are provided as Attachment A. In order to adequately monitor spring discharge, a totalizing flow meter on the Pancheri pipeline is needed. The flow meter should be installed as soon as possible. A meter location near the lower end of the 4-inch diameter portion of the pipeline is proposed in order to provide an easily accessible location. Any assistance that your Department can provide to expedite installation of this meter would be appreciated.

Published Data Related to the Hot Spring. Data for Belvidere Hot Spring is found in several publications. Excerpts are copied and attached.

Perhaps the most detailed published description of the springs is found in "Geothermal Investigation of the Cascade Area", July 1976, by Monte Wilson, James Applegate, Sheri Chapman, and Paul Donaldson (Boise State University). The report indicates that the Belvidere Hot Spring is located along the north-trending Cascade Valley Fault. A series of hot springs are found along this fault, including (from south to north) Cabarton, Belvidere, Cascade, Flat Creek, and Gold Fork. The discharge temperature for Belvidere hot springs was reported to be 121 degrees F. Based on silica concentration in the water and a mixing model, the authors estimated that the temperature of the hot spring source could be as high as 325 degrees F. See Attachment B.

A chemical analysis in USGS Water Resources Investigations Open File Report 80-1020 (Lewis, R.E., and H.W. Young, 1980, Thermal Springs in the Payette River Basin, West Central Idaho) indicates that the spring has a temperature of 120 degrees F and a discharge of 20 gpm. The water is a sodium bicarbonate type with total dissolved solids of 256 mg/l. Based on various geochemical methods, the USGS report estimated that the temperature of the aquifer source ranges from 117 to 232 degree F. See Attachment C.

Geologic mapping of the local area is provided in USGS Bulletin 1311-A (Schmidt, D.L. and J.H. Mackin, 1970, Quaternary Geology of Long and Bear Valleys, West-Central Idaho). The mapping shows the spring site as overlain by glacial outwash. Cretaceous bedrock of the Idaho Batholith is present in the high elevation areas on the westerly side of Cabarton Road. The bedrock is part of the upthrown Cascade fault block. The fault block is bounded on the east by the Cascade Valley fault. The geologic map shows the fault approximately 2000 feet east of the spring. See Attachment D.

Unpublished Reports. An investigation of the Belvidere Hot Spring was commissioned by a previous property owner (Eastern Western Corporation) in the mid 1990s for purposes of selecting a geothermal test well site. The investigation apparently included surface geologic mapping and resistivity survey. The mapping located a fault scarp 150 yards to the west of the hot spring, and suggested that a fault zone striking N70E extended close to the spring area. The resistivity investigation suggested drilling at a location 400 to 450 feet southeast of the bathhouses. The geologist that directed the study estimated that the depth to the fault zone was 800 feet in that area. A copy of the report and related correspondence from that study are provided as Attachment E.

Well Driller's Reports. Well driller's reports on file at the Idaho Department of Water Resources were collected for the area surrounding the spring. The search area consisted of Section 18, T13N, R4E and Section 13, T13N, R3E. No logs were located in Section 19. The well driller's reports are compiled in Attachment F.

Summary and Conclusions Related to Spring Geology and Hydrology. Based on personal observations and a review of published and unpublished data, the following conclusions are provided related to the geology and hydrology of Belvidere Hot Spring.

1. The source of hot water is probably upward flow through fractures in the granitic rock of the Idaho Batholith. It is possible that Belvidere Hot Spring is located at or near the intersection of the north-trending Cascade Valley Fault and an unmapped fault trending in a northeasterly direction.
2. The spring area is overlain by alluvial and glacial deposits. Depth to bedrock in the vicinity of the spring vents is unknown. Bedrock is found at the surface within a few hundred feet to the west of the spring vents.
3. It is unknown whether a significant portion of the geothermal water moving upward through the fractured rock is lost as subsurface flow through the valley fill, or if the majority of the geothermal flow reaches the surface and discharges from the spring.
4. The temperature of the geothermal water at depth is probably greater than the temperature at the discharge point. Maximum surface temperature is approximately 121 degrees F.

DRILLING PROSPECTUS

Given the unknown subsurface conditions in the vicinity of the spring, it is difficult to prepare a definitive drilling plan.

Anticipated geologic conditions in the near vicinity of the hot springs consist of between 10 and 150 feet of sand, gravel, and clay sediments overlying granitic bedrock. Depth to bedrock likely increases to the south and east. Shallow groundwater with a temperature in the range of 45 to 120 degrees F is anticipated in the overburden materials above the bedrock. Water temperatures of 45 to 180 degrees are anticipated in the bedrock.

Two well sites are initially proposed. One well site will be at the location suggested by the resistivity survey, approximately 450 feet southeast of the MacGregor spring vents. The other well will probably be located approximately 200 feet south from the MacGregor spring vents. These sites are approximately 300 to 600 feet from Pancheri spring source. The actual well sites will be staked prior to drilling contractor mobilization.

Well Construction. Drilling depths and casing lengths will be adjusted based on subsurface conditions. The drilling method utilized will probably be air rotary, although mud rotary will be

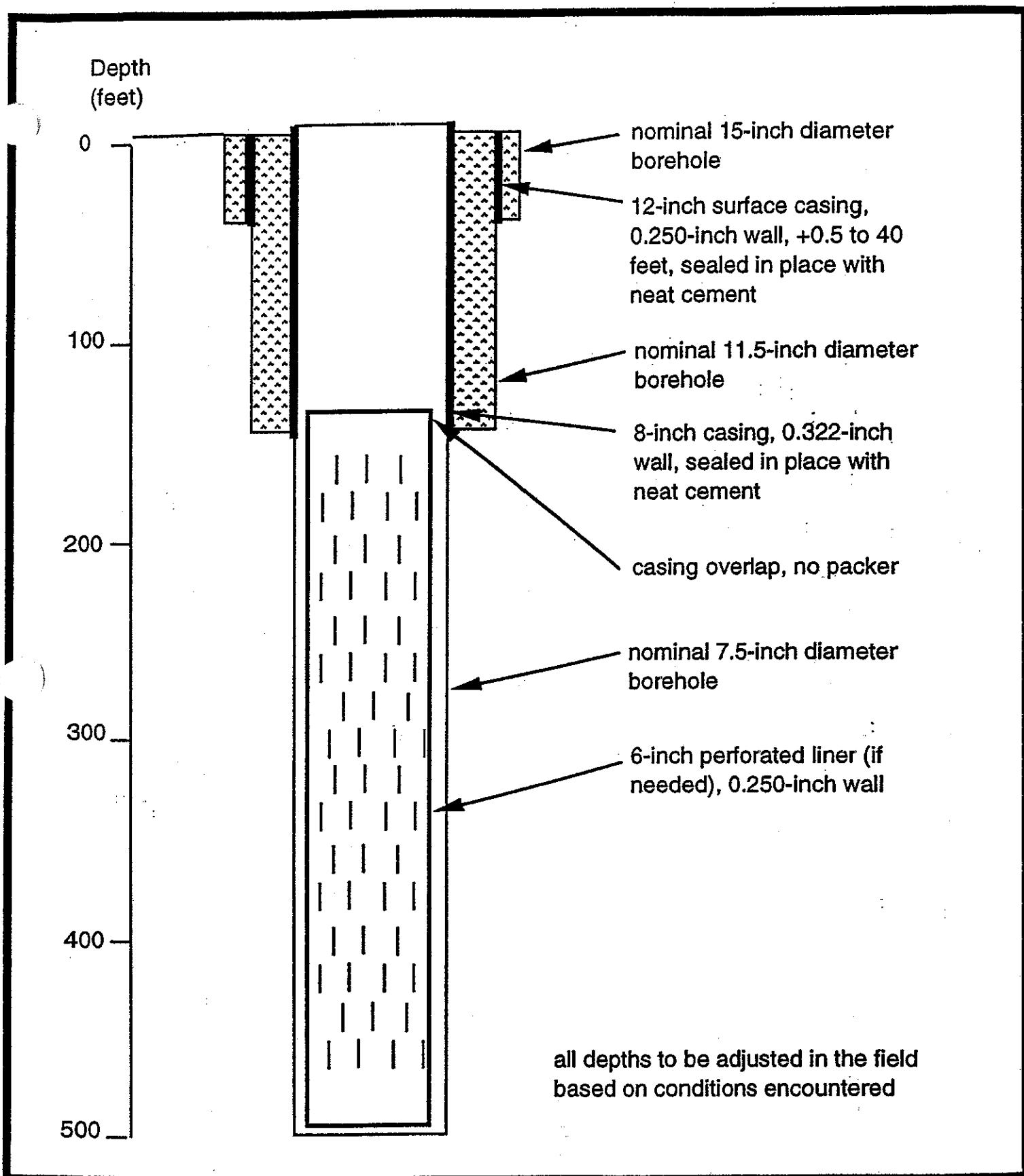


FIGURE 2
MACGREGOR GEOTHERMAL TEST WELL CONCEPT

used for open-hole drilling through unconsolidated or unstable materials. Initially, we anticipate that well construction will include the following.

1. A 12 25-inch I.D. surface casing (0.250-inch wall, 12 75-inch O.D.) shall be set and sealed to a depth of approximately 40 feet, unless bedrock or a substantial clay layer are encountered first. The 12-inch casing will be installed within a minimum 15-inch diameter hole. The casing shall be sealed with neat cement installed from the bottom of the annular space to the surface. The top of the 12-inch casing shall be equipped with a flange.
2. Below the surface casing, a nominal 12-inch diameter borehole will be drilled to bedrock using open hole drilling techniques appropriate for the formation. Following drilling, geophysical surveys (resistivity, natural gamma, temperature) will be run to document stratigraphy and temperature. If drilling characteristics and temperatures suggest the presence of geothermal aquifer zones, then an attempt will be made to develop a well for test purposes. If there are no indications of significant geothermal water-bearing zones, a 7 981-inch I.D. (0.322-inch wall, 8 625-inch O.D.) well casing shall be set and sealed a minimum of 20 feet into bedrock. The casing shall be sealed with neat cement installed from the bottom to the surface. The top of the 8-inch casing shall be equipped with a flanged tee.
3. Below the 8-inch casing, an open borehole (nominal 7 5-inch) will be advanced. If caving conditions are encountered, the borehole may be lined with 6-inch (0.250-inch wall) perforated liner pipe. Target depth for the each shall be 500 feet, but actual well depth may be adjusted up or down depending on conditions encountered.

A conceptual well design is provided as Figure 2. Note that bentonite chips may be used for well seals if warranted by formation conditions (the presence of open fractures) or borehole conditions (large annulus). Based on the results of the first test well, additional wells may be drilled as necessary to (1) better assess the geothermal resource, (2) develop the resource, and (3) assure continued delivery of the resource to senior water rights.

The proposed drilling contractor is Gestrin Drilling. Mr. Gestrin has drilled many of the existing wells in the local area, including wells on the Pancheri property both north and south of the MacGregor property. He has reviewed the proposed well design.

Drilling Oversight. Scanlan Engineering will provide oversight of drilling activities, including final design placement of casings and seals. The Department of Water Resources will be notified in the event of a significant change from the design contemplated by this drilling prospectus.

The drilling contractor will collect drill cuttings at 10-foot intervals and at each formation change. Bottom-hole temperatures will be measured using a maximum reading thermometer whenever drilling tools are removed from the borehole.

TESTING AND MONITORING PLAN

Monitoring. Discharge rate and temperature at the MacGregor spring vents and from the Pancheri infiltration gallery will be monitored before, during, and after drilling and testing. Flow will be monitored with V-notch weirs set in the stream channels below the springs. A totalizing flow meter on the Duane Pancheri pipeline will also be monitored. Monitoring of the totalizing flow meter on the Pancheri pipeline should be conducted for several weeks or months prior to drilling and testing in order to document any trends in flow rate. The flow meter should be installed as soon as possible.

Temperature should be monitored at the existing measuring points (upper bathhouse vent, lower bathhouse vent, MacGregor weir, Pancheri weir, Pancheri pipeline vent, Pancheri pump sump).

Monitoring frequency shall vary depending on the type of activity that is taking place. For instance, monitoring of flow and temperature is recommended on a weekly basis for at least four weeks prior to and following drilling. During active drilling periods, monitoring should take place on a daily basis.

Monitoring frequency following development of a successful well shall be at monthly intervals for the first year of operation, and quarterly intervals thereafter during the permit period.

Testing. The test well, if successful, will be tested by pumping or by artesian flow. Temperatures and flows from the spring will be monitored during any well tests.

We anticipate that the test pumping or artesian flow testing would be conducted for a minimum of 24 hours, and potentially as long as several weeks. A definitive test plan is difficult to prepare until the well is drilled and estimates of production rate and temperature are obtained. However, for purposes of this plan, we propose the following test procedure.

- 1 Shut the well in (if flowing artesian) or allow water level to stabilize (if not flowing) for a minimum of 24 hours before pump testing or flow testing. During this period, monitor both temperature and flow at the existing monitoring locations described above.
- 2 Flow or test pump the well using typical well testing protocol. For instance, water level, pressure, or well flow rate measurements should be collected on a log-time scale during constant rate (or constant flow), with measurement intervals of approximately 1 minute for the first 10 minutes, 5 minutes from 10 to 100 minutes, 20 minutes from 100 to 500 minutes, and one hour intervals from 500 to 1500 minutes, 6-hour intervals from 1500 to 3000 minutes, and 12 or 24-hour intervals after 3000 minutes.
- 3 Temperature measurements and spring flow measurements at the existing monitoring locations should be taken on minimum two-hour intervals during the first day of the test, and at the same intervals as pressure or well flow measurements after the first day of the test.

MITIGATION AND BONDING

Bond. A bond of \$20,000 will be posted prior to drilling in order to provide funding for well abandonment. The \$20,000 amount is based on IDAPA 37.03.09.030.02, and assumes that a bottom hole temperature in excess of 150 degree F is possible.

Mitigation. Mitigation for impacts to existing water rights will depend on the type of impact. For instance, a temporary impact during test pumping can potentially be mitigated (if necessary) by pumping hot water from the test well to the water users.

If exploration or water development activities by MacGregor reduce geothermal water supply below the amount that historically has been both legally and physically available to the Pancheris, then MacGregor would mitigate impacts for material injury to the Pancheri water rights pursuant to Idaho law. Potential mitigation methods to address material injury to the beneficial use of the Pancheri water rights could include:

1. Provide well water of a temperature and rate (within water right volume limitations) to address material injury to the Pancheri water rights. The water would be delivered to the Pancheris at the MacGregor/Pancheri property line or other mutually acceptable location.
2. Supply an alternate heat source to Pancheris (electric, natural gas, etc) to the extent necessary to address material injury to the beneficial use of the Pancheri water rights.
3. Increase the efficiency of the Pancheri delivery or heating system in order to address material injury to the beneficial use of the Pancheri water rights.

Please contact me with any questions or comments. We look forward to your response.

Sincerely,



Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor
Jo Beeman
Sheri Chapman
Scott Campbell

Attachments

- A Monitoring Data
- B Excerpts From "Geothermal Investigation Of The Cascade Area",
July 1976, Boise State University
- C Excerpts From USGS Water Resources Investigations Open File Report 80-1020
- D Geologic Map From USGS Bulletin 1311-A
- E Correspondence From Unpublished Investigation And Well Siting Study For Eastern
Western Corporation
- F Well Drillers Reports

**ATTACHMENT A
MONITORING DATA**

Proposed Geothermal Monitoring Plan - Belvidere Hot Spring Area March 12, 2001

A geothermal monitoring program is proposed to provide data related to pending Applications for Permit 65-13912, 65-13913, 65-13986. The applications have been submitted by Carol Lynn MacGregor and have been protested by Duane and Laura Pancheri and Darwin and Joan Pancheri. The Pancheris divert water from the hot spring under water rights 65-13332 and 65-12981.

The purpose of the monitoring program is to document (1) existing discharge rates and temperatures at the springs and (2) existing diversion rates and source temperatures under water rights 65-13332 and 65-12981. The proposed monitoring program will supplement initial monitoring conducted on January 27, 2001. Monitoring should take place for a one-year period beginning in the spring of 2001.

This plan has been jointly prepared by Terry Scanlan (consultant to MacGregor) and Sherl Chapman (consultant to the Pancheris). Data shall be collected jointly by Scanlan and Chapman (unless otherwise agreed to by the parties). As part of this plan, Chapman shall be allowed to enter the MacGregor property for scheduled monitoring events or with pre-notification to (and approval by) MacGregor or MacGregor's representatives. Similarly, Scanlan shall be allowed to enter the Pancheri property for scheduled monitoring events or with pre-notification to (and approval by) the Pancheris or their representatives.

Monitoring Locations and Methods

Darwin Pancheri System (Water Right Permit No. 65-13332). Darwin Pancheri's system is very simple and additional flow measurements might not be necessary. However, monthly spot checks of source temperatures are recommended as part of the monitoring discussed below. Since pumping rate is easily monitored (with bucket and stopwatch) at the point where the water discharges back to the creek, the pumping rate should be measured occasionally for additional verification. Temperatures shall be measured at the pump intake.

Duane Pancheri System (Water Right License No. 65-12891). Flow measurements and temperature measurements at Duane Pancheri's system are recommended. Measurements should be collected quarterly, beginning in the spring of 2001. Measurements, using a bucket and stopwatch, should be as follows.

1. The pool should be partially drained to allow access to the 4-inch pipe.
2. With the tomato can in place, flow rate should be measured at (1) the 4-inch pipe that discharges to the pool, (2) the pipe that discharges to the pool from the two homes, and (3) the pipe that discharges into Brush Creek from the home and shop.
3. The can should then be removed from the 4-inch pipe, flows should be allowed to reach equilibrium, and flow rates should be re-measured at all three locations.

Geothermal Monitoring Plan

-2-

March 12, 2001

Note that in the non-heating season, steps 2 and 3 would probably be reversed (i.e., measure initially with tomato can out, and then with tomato can in).

In addition to the flow monitoring, source temperature should be measured on a monthly basis for a one-year period. Measurements should be made through the pipeline vent using a thermometer with a probe that can be lowered through the vent into the pipe. Water level in the vent pipe should also be measured to determine if pipe pressure (and therefore, flow rate) varies. If significant variations in flow rate are detected, then installation of a totalizing flow meter in the 4-inch pipeline should be considered.

Spring Discharge Monitoring (Pancheri Stockwater Source). The discharge from the MacGregor spring area and the overflow from the Pancheri spring source (if any) are combined approximately 50 feet southwest of Darwin Pancheri's pump. Since the Pancheri's utilize this surface water for irrigation and stockwater purposes, monitoring is recommended to document existing conditions. Monitoring can best be conducted using a v-notch weir and staff gage. Recommended weir location is a few feet north of the MacGregor-Pancheri fence. This weir area should be fenced from livestock. Measurements of flow and temperature should be collected on a monthly basis for a period of one year.

In addition to the main weir on the Pancheri side of the fence, an additional weir that measures the flow from the MacGregor springs only is proposed. The MacGregor weir measurement could be subtracted from the Pancheri weir measurement to estimate the surface discharge from the springs on the Pancheri property. The MacGregor weir and spring area shall be fenced from livestock.

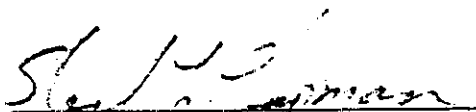
Temperatures should be monitored at the two MacGregor bathhouse sites on a monthly basis.

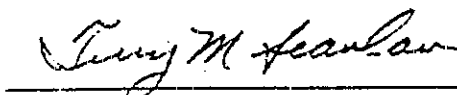
Baseline Monitoring Report

Following the completion of one-year of baseline monitoring, a summary report of the monitoring results shall be prepared. The report will provide a summary of monitoring methodology and results. The report shall be prepared jointly by Chapman and Scanlan, and shall be submitted to the parties.

Monitoring Costs. The parties agree to pay costs for their respective consultants. MacGregor shall pay costs for installation of weirs. Scanlan and Chapman shall participate in weir installation. If data are collected by one consultant or an outside third party for the benefit of both parties, the cost of that acquisition shall be shared equally by both parties.

By signing below, Scanlan and Chapman agree that the above-described methodology will provide accurate data for the purposes described.


Sheri L. Chapman


Terry M. Scanlan

SCANLAN ENGINEERING

Groundwater and Environmental Engineering

November 28, 2002

Mr. Gary Spackman
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705

Subject: Applications for Permit 65-13992 and 65-13993

Dear Gary:

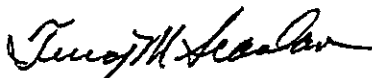
Carol MacGregor and I have reviewed Sherl Chapman's letter of November 5, 2002, requesting termination of baseline monitoring associated with Applications 65-13992 and 65-13993. As described in Sherl's letter, significant and valuable data have been collected in an attempt to characterize (1) the discharge from the geothermal resource in this area and (2) the diversion of geothermal water under the Pancheri water rights (65-12891 and 65-13332). A copy of the data summary is attached for your information.

Although the discovery period has ended, we believe that continued monitoring of diversion under the Pancheri water rights is warranted. The Pancheri's have indicated that they will oppose any depletion to the discharge from the springs that might impact their water rights. In such a situation, accurate flow monitoring is necessary to protect both parties from allegations of hydraulic impacts or over diversion. We feel that accurate diversion data can only be obtained through flow metering. Therefore, please consider this letter as a request for the Department to order the immediate installation of totalizing flow meters on the pipelines that supply these water rights. Furthermore, we request that totalized flows be reported to the Department on a monthly basis until further notice. It is important for data collection to begin prior to the end of December so that totalized flows can be collected for calendar year 2003.

The totalizing flow meters are needed to document spring diversions both before and after test well drilling. Carol would like to conduct test drilling in the summer of 2003. Will the Department issue drilling permits for one or more test wells at that time?

We look forward to your response regarding our request for installation of flow meters, monthly flow metering, and issuance of test well permits. We are available to meet with you and the protestants for further discussions if necessary.

Sincerely,


Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor
Sherl Chapman
Duane Pancheri
Darwin Pancheri

Date	MacGregor				Darwin Pancheri			
	Upper Pool	Seep S. of Upper Pool	Lower Pool	MacGregor Weir	pipe vent	Pancheri Weir	Sump	Pump Sump
	temp	temp	temp	temp	temp	temp	temp	temp
06/07/1999	104		121					
08/03/2000	102.4		119.5	10				
09/01/2000	92.0		116.0	10				
10/18/2000				15				
01/27/2001			116.6		111.9		104	88
05/05/2001	102.7		118.0		112.6		103.3	106.5
07/07/2001	100.8		118.9		112.6	7		108.1
07/21/2001	104.5		119.1	54	113.5	99.7		104.4
08/08/2001	100.0		118.4	45	112.8	91.4+/-	106.3	107.1
09/26/2001	101.5	111.8	117.1	45	111.9	93.8	107.4	108.1
11/02/2001	98.8	112.1	117.5	flooded	111.0	86+/-	104.7	106.9
02/16/2002	95.9	112.6	117.3	96.6	110.8	88+/-	105.3	
03/09/2002	93.2	112.6	118.8	88	108.7	80+/-	104.5	86.2
06/01/2002	101.8	112.3	120.6	flooded	113.2	flooded	59.7	flooded
07/18/2002	102.4	111.7	117.0	103.8	112.6	97.2	106.2	108
10/09/2002	100.8	110.8		101.5		85.8	104.7	

Flow is gallons per minute
Temperature is degrees F

Duane Pancheri									
Date	Shop House		Tomato Can In		Tomato Can Out		Shop House		Total
	temp	Pool temp	flow	Pool flow	flow	Pool flow	flow	Pool flow	
06/07/1999									
08/03/2000									
09/01/2000									
10/18/2000									
01/27/2001	88	95	7.6				1	89	97
05/05/2001	87.3	87.4	6.2	4.1	62.5	5.2	1	73.1	79.3
07/07/2001									
07/21/2001									
08/08/2001	92.5	101.8				5.4	0.5	54	59.9
09/26/2001									
11/02/2001	88.0	88.7	6.0	3.7	58.9	<1		70.2	76+/-
02/16/2002									
03/09/2002	80.8		6.2						
06/01/2002	88.9	89.2	6.3	4.6	63.5	5.0	<1	74	80+/-
07/18/2002									
10/09/2002	90.3	86	5.2	2.1	60.6	1		62.3	68

Flow is gallons per minute
Temperature is degrees F

**ATTACHMENT B
EXCERPTS FROM "GEOTHERMAL
INVESTIGATION OF THE CASCADE AREA",
JULY 1976, BOISE STATE UNIVERSITY**

Boise, Idaho

July, 1976

GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA

by

Monte D. Wilson
James K. Applegate
Sherl L. Chapman
Paul R. Donaldson

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

BOISE STATE UNIVERSITY

GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA.

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GEOHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA.

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GEOTHERMAL INVESTIGATION OF THE CASCADE, IDAHO AREA

Monte D. Wilson
James K. Applegate
Sherl L. Chapman
Paul R. Donaldson

ABSTRACT

Field and laboratory investigations show the existence of a geothermal resource in the Cascade area of west-central Idaho which may have development potential for non-electrical uses. Numerous high angle faults cut the Idaho batholith in this area; displacements on some of these faults are as great as 10,000 feet and many of them have associated alteration zones. X-ray analyses of samples collected from these zones indicate substantial hydrothermal alteration. Fault controlled hot springs have temperatures at the surface of up to 71° C and temperatures at depth, based on the silica geothermometer, of up to 179° C.

Microseismic monitoring in the area suggests that east-west trending faults are active, supporting the plausibility of an accessible geothermal resource.

The domestic ground water supply for most of the area is from very shallow wells, most of which are developed in the upper 200 feet of the valley floor derive their water from joints rather than from fault systems. Preliminary data indicate no connection between the thermal systems and the water supply for the area.

GEOLOGY

Regional Geology

The study area is located along the western margin of the Idaho batholith. It is in the Northern Rocky Mountain geomorphic province with the Seven Devils section of the Columbia Intermontane geomorphic province bordering it on the west (Thornbury 1965, p.445).

An extensive system of faults in this region was described by Anderson (1934, p.25) and by Capps (1941, p.7), with the Long Valley fault being the largest fault in this system. Many of the other faults mapped during field work on this project are parts of this regional branching system.

Lithologic Units

Idaho Batholith Granitic Rocks

For the purposes of this study rocks of the Idaho batholith were mapped as a single lithologic unit rather than being subdivided into various compositional types. Reasons for using this approach to mapping are primarily that the geothermal potential is apparently not controlled by details of lithology and also that zones of lithologic variation are both large and gradational, so that they are best mapped on a regional scale rather than on a restricted scale such as the map for this report.

Because of its location on the margin of the Cretaceous Idaho batholith, the Cascade area is in a belt with gradation of rocks from directionless granite of the central batholith to gneiss and schist of

the batholith border. There is a systematic increase in metamorphic intensity going eastward across the area. Schmidt (1964, p.8) has recognized and mapped six major rock zones trending north and south to northeast-southwest through this region. Three of these rock zones make up most of the bedrock in the Cascade area, they are: 1) the quartz diorite gneiss of Donnelly which is present in the western and northwestern part of the map area, 2) the quartz diorite of Little Valley which underlies the central portion of the map area and, 3) the granodiorite of Gold Fork which underlies the eastern and southeastern portions of the map area.

Columbia River Basalts

Along the western boundary of the study area, rocks of the Idaho batholith border zone have been eroded and are overlain by flows of the Columbia River Basalts of Miocene age. These flows are dipping westerly at moderate angles. They were not mapped in detail during field work on this project, so their contacts on the geologic map (Plate 1) must be considered approximate. Isolated remnants of basalt are located along the eastern margin of Long Valley and in the southern part of Little Valley, near the northeastern corner of the map. These basalts have been downfaulted into the granitic rocks of the Idaho batholith, and each of these isolated basalt outcrops is proximal to a conspicuous fault or faults. These basalt outcrops are remnants of flows which were formerly much more extensive in this region (Capps, 1941, p.5, Bond, 1963). Several quarries are located in these basalt remnants, with much of the basalt being crushed and used in road building.

Latah (?) Formation

Associated with the Columbia River Basalts is a sequence of poorly consolidated silt and clay layers which is interpreted to be primarily of lacustrine origin. Most of this sequence is stratigraphically lower than the basalts, but there is some interbedding of the upper lacustrine strata with the lower basalt flows. Schmidt and Mackin (1970, p.4), on the bases of stratigraphic position and pollen studies, tentatively correlated this unit with the Latah Formation of Tertiary age. Because of its poorly resistant nature, this unit is not well exposed on the surface. However, it can be seen in excavations, and is particularly well exposed in the basalt quarry about one mile northwest of the Cascade Dam. A few specimens of *Equisetum* sp. were found at this locality, but no other plant megafossils are known to have been collected from this formation in the Cascade area.

Surficial Deposits

A detailed study and map of surficial deposits in this area was published in 1970 by Schmidt and Mackin. Most surficial deposits in the Cascade area are either alluvium or glacial drift, primarily moraines and outwash. Colluvium and lacustrine strata are also present but these materials comprise smaller portions of the surficial deposits. Most of these surficial materials were deposited during the Quaternary Epoch, but Schmidt and Mackin (1970, p.11) suggest that some of them, mostly sediments on the floors of the fault block valleys, are of Pliocene age.

Structural Geology

Faults

Earlier workers such as Anderson (1934) and Capps (1941) who described block faulting in west-central Idaho considered it to be a northward continuation of Basin-and-Range structures. This conclusion was apparently based on the following similarities between structures in the two areas: types of movement are similar; strikes of major faults are similar; and age span of movement is similar, although age is better documented in the Basin-and-Range Province.

The largest faults in the Cascade area trend north-south and north-northeast, however, as can be seen by the map (Plate I), other faults trend northeast, east-northeast, northwest and west-northwest while still others are curved in plan. Most faults in the area appear to be high angle with dip-slip movement as best as can be interpreted from field evidence, which is admittedly scanty. Considerable fault movement occurred after the Columbia River Basalt was emplaced in Miocene time and before the intensive glaciation of the early Pleistocene. Two early workers (Anderson, 1934, p.26 and Capps, 1941, p.6) have assigned a late Pliocene age to the major faulting. While this age determination may be accurate for the major faulting, the differences in geomorphic expression as well the offsetting relationships show that faulting has occurred at different times in various parts of the area and probably occurred at many different times along each of the large faults. Recent seismic and microseismic observations show continued activity. Long Valley, Cascade Valley and Round Valley are all basically fault-bounded structures which

can properly be called grabens.

The Long Valley fault trends approximately north-south through the map area. This fault is reported (Capps, 1941, p.7) to extend as a single fault from Boise to Grangeville, a distance of 160 miles. Field observations made during this study show that although the system of faults may indeed extend for 160 miles, the Long Valley fault as a continuous fracture is not nearly so long. The Long Valley fault separates West Mountain, with its cap of westerly dipping basalts, from Long Valley, 3,000 feet below. A total throw on this fault of at least 10,000 feet is determined by combining the 3,000 foot West Mountain escarpment with the 7,000 feet of sedimentary fill indicated by a gravity survey (Kinoshita, 1962) to exist in Long Valley near the northern margin of the study area for this project. Glacial sediments obscure the fault trace and prove that it has not experienced significant movement since these materials were deposited starting in early Pleistocene time. Despite its large displacement and relative recency, (10,000 feet of displacement, and offsetting of Miocene strata) there are no known hot springs or other geothermal indications along the Long Valley fault. Two faults in the map area (Plate I) appear to have lateral components. One of these is herein termed the Scott Valley fault, and it strikes north-south through the eastern part of the map where it makes the western margins of Scott Valley and Horsethief Basin. This is an oblique fault with the east block having moved down and north relative to the west block which moved up and south. The other location where lateral movement is indicated involves the north 60° west fault going through the south edge of the town of Cascade and/or the north 75° west fault going

through the Cascade damsite. Geomorphic evidence suggests left lateral movement along one or both of these faults. Microseismic monitoring indicates continued activity along faults in this immediate area.

Fault Controlled Hot Springs

Eleven hot springs are located within, or immediately adjacent to, the area mapped in this project (Plate I); all of them are within twelve miles of Cascade and all are fault controlled. In addition, one former hot spring on Little Pearso1 Creek, about four miles east of Cascade, has dried up in the last 20 years and several former hot springs on the fault trace about one mile northwest of Cascade are now flooded by the reservoir. Silica analysis and projected temperatures at depth were done on seven of these springs. The four hot springs near the Boiling Springs Guard Station, just off the south-western portion of the map, were not included in these analyses.

Silica analyses were done by the standard molybdosilicate method (Taras and other, 1971, p.303) using a Bausch and Lomb Spectronic 20 spectrophotometer. The mixing model used to project temperatures at depth is the one established by Fournier and Truesdell (1974). For the purposes of establishing a mixing model, a temperature of 10°C and a silica content of 25 ppm was used for all cold water mixes based on analyses of representative samples collected near hot springs.

From Table 1 it can be seen that surface temperatures of hot springs range from 36°C to 71°C, while silica contents range from 42.9 ppm to 68 ppm. A mixing model using these hot spring temperatures and silica contents along with a cold water temperature of 10°C and silica content

<u>Hot Springs</u>	<u>Location</u>	<u>Silica ppm</u>	<u>Temperature °C</u>	
			<u>Surface</u>	<u>Mixing Model</u>
Cabarton	SW $\frac{1}{4}$, Sec. 31, T13N, R4E	68.0	71.0 ⁰	147 ⁰
Arling	NW $\frac{1}{4}$, Sec. 13, T15N, R3E	56.6	40.0	179
Gold Fork	SW $\frac{1}{4}$, Sec. 35, T16N, R4E	62.3	50.5	165
Flat Creek	SW $\frac{1}{4}$, Sec. 21, T15N, R4E	47.5	38.0	158
Cascade	NE $\frac{1}{4}$, Sec. 36, T14N, R3E	42.9	38.5	140
Little Creek	NE $\frac{1}{4}$, Sec. 5, T14N, R5E	48.6	36.0	168
Belvidere	NE $\frac{1}{4}$, Sec. 13, T13N, R3E	60.0	49.5	163

TABLE 1: Silica analyses and mixing model temperatures
of hot springs near Cascade

of 25 ppm predicts temperatures at depth ranging from 140°C to 179°C (Figures 2-8).

It should be noted that five of these hot springs are located on or near the Cascade Valley fault which marks the western edge of Cascade Valley and extends northward through Little Valley. These hot springs, from south to north are Cabarton, Belvidere (also called Sky Ranch), Cascade, Flat Creek and Gold Fork.

Hydrothermal Alteration Zones

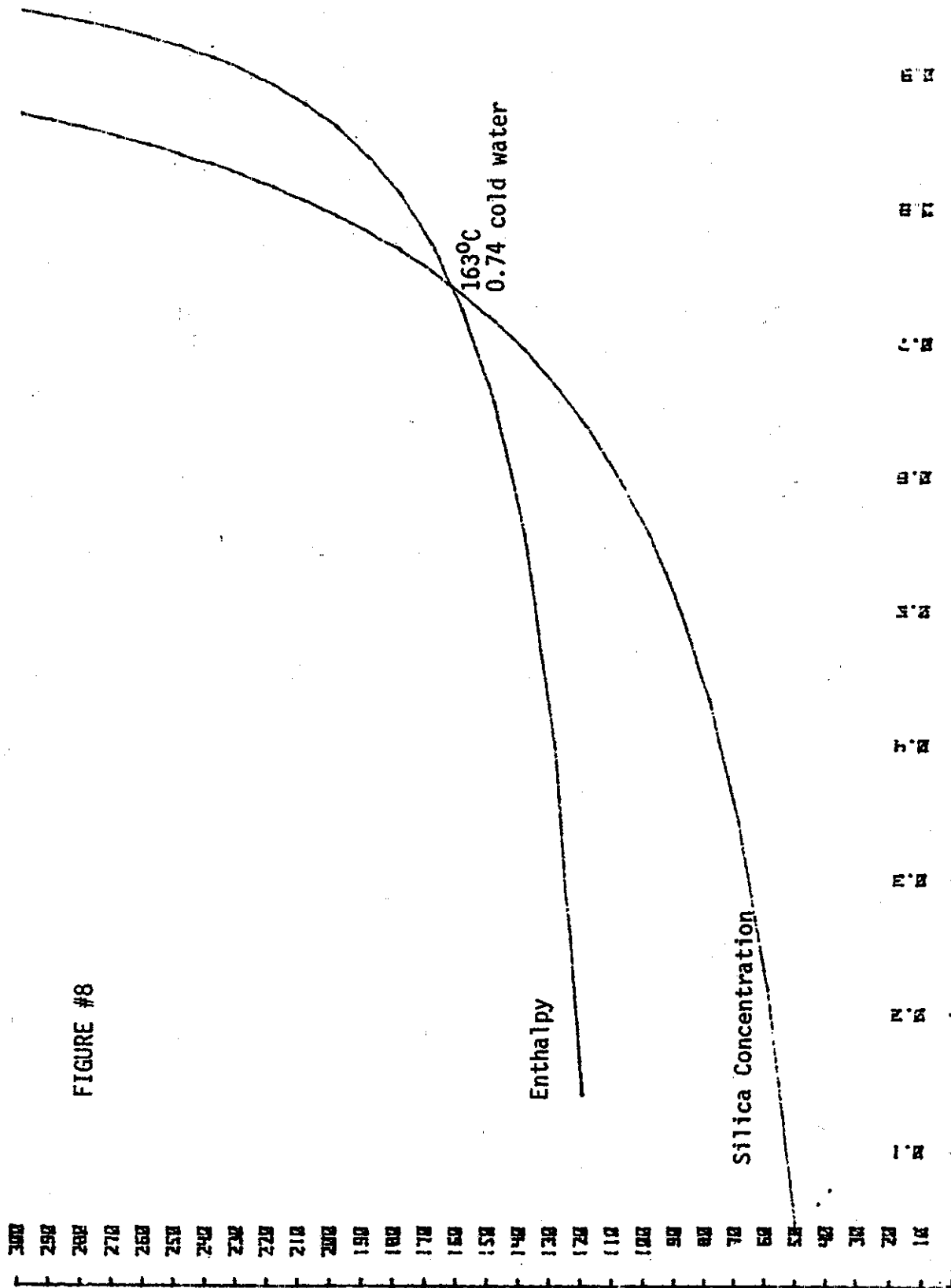
Zones of rock alteration exist along several faults in the Cascade area. In an attempt to determine the extent to which hydrothermal solutions were responsible for this rock alteration, eleven samples were collected for powder analysis by x-ray diffraction techniques.

Table II shows the locations of samples collected and results of the x-ray analyses. In fault zones where hydrothermal alteration has occurred kaolinite is usually found. Such fault zone kaolinite, however, may have been formed at depth because hot waters flowing out at the surface tend to deposit silica rather than alter rock (Clayton R. Nichols, personal communication, 1975). Kaolinite was found in significant amounts in two of the alteration zones and it was found in minor amounts in three others. Zeolite minerals are often found where there has been extensive fracturing and mylonitization of rock and they are usually associated with illite and montmorillonite (Clayton R. Nichols, personal communication, 1975).

SILICA PPM OF COLD SPRING 25.1

X-AXIS=TEMPERATURE
X-AXIS=FRACTION COLD WATER
#7 SKY RANCH (BELVIDERE)

FIGURE #8



factor of water quality or quantity.

Thermal Water

Introduction

The thermal water occurrences found in the study area are directly related to geologic structure as previously outlined in previous sections of this report. Hot springs and wells are located at several locations as shown in Plate II, and all of these locations lie upon or adjacent to fault zones as shown in Plate I. It is primarily due to this structural affinity that a reasonably accurate assessment of the potential for development of the resource can be made.

Possible Thermal Reservoir Units

Generally, water temperatures from many of the springs and wells issuing from or penetrating the valley fill materials are higher than temperatures that are considered normal in springs and wells close to fault zones in granite. For this reason, these two units may be considered as possible reservoir units or sources of thermal water.

Granitic Rocks - The granitic rocks exposed on the boundaries of the Cascade-Long Valley study area contain a high number of hot springs (Plate I). These rocks from the basement complex in the area; and because granitic rocks are generally dense and impermeable, they may not contain significant volumes of hot water. However, because the hot water in the area appears to be concentrated near large fracture zones and drillers' logs often indicate a significant thickness of decomposed granite near the upper surface of the unit, it may be that those portions of the unit constitute a significant aquifer. Unfortunately, sufficient data do not yet exist to make that specific an assessment.

Valley Fill - A few wells drilled into the valley fill near fault zones yield water of moderate temperature (42.50C). It is believed that water leaking from fault zones in the granitic rocks enters the valley fill and move laterally out into the valley. Because of the layered structure of the valley fill and the large number of relatively impermeable lenses, there may be a significant amount of hot water leaking from the granitic rocks into the valley fill that is yet undiscovered. The shallow wells do not provide sufficient data because they have penetrated only a very minor section of the valley fill. As in the granitic rocks, however, the lack of deep well data precludes any true assessment of the unit's potential as a thermal aquifer.

Thermal Water Quality

Analyses of four thermal wells or springs are shown on Table III. Interpretation of these samples analyzed by the U.S. Geological Survey (Young and Mitchell, 1973) demonstrates the separation between the thermal and non-thermal systems in the valley as we know them. While mixing between the two systems does occur upon ascension of the hot water, the difference in ionic constituents and the lack of correlation between ratios of several of the ions indicates a very different circulation pattern between the hot water and the cold water present in the valley.

As shown in Table III, the thermal water in the valley is alkaline, has a high sodium and chloride content and a relatively high total dissolved solids content. The cold water is acid and has low sodium and chloride content and very low total dissolved solids content. The primary reason for the wide variability in chemical constituents is believed to be the result of circulation pattern, temperature of the water and time of travel within the aquifer system.

It should be noted that the quality of the thermal waters analyzed is excellent in comparison to hot springs and wells in other areas of the nation and world, and in fact could be utilized for irrigation of all crops now growing in the valley. The sodium absorption ratio (SAR) for Cabarton Hot Springs, the highest in total dissolved solids, is 4.6. Generally, water having an SAR value less than 10 is considered to be suitable for irrigation of the crops grown in this area.

Recharge Characteristics

Any discussion of recharge to the geothermal system must necessarily be limited because of the lack of data available. However, some conclusions can be drawn, based on the results of this study.

The chemistry of the thermal water in the study area is notably low in dissolved solids and conductivity. This, coupled with the knowledge of the geology of the area, indicates the water is: (1) of meteoric origin, (2) has not traveled great distances in the reservoir rock, and (3) has a relatively direct connection with the recharge area. Additionally, the thermal system probably acts as a minor source of recharge for the cold water system beneath the valley floor. Because of the lack of definite hydrologic parameters, no assessment of the quantity of recharge to the thermal system can be made.

Conclusions and Recommendations

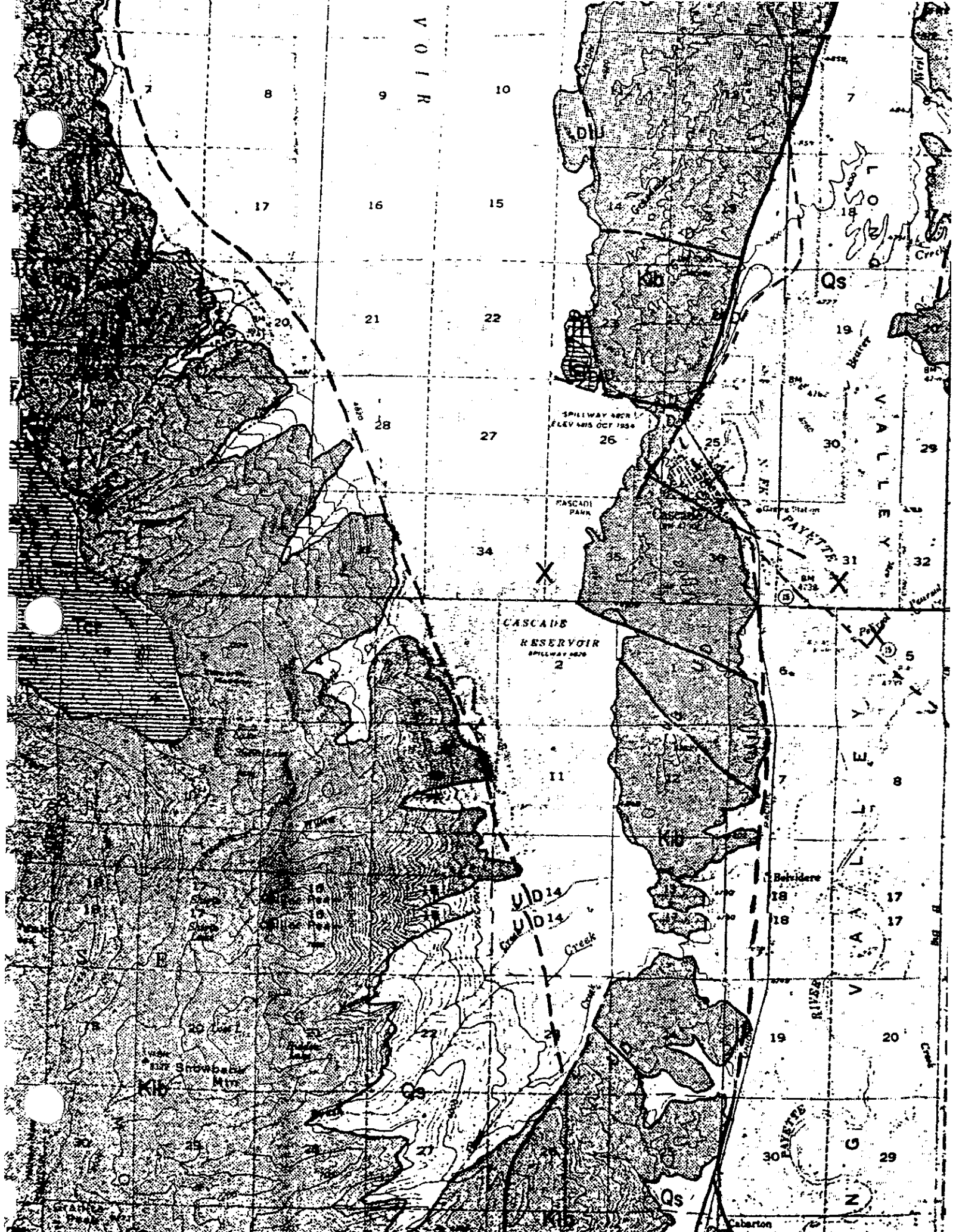
Based upon the investigation conducted in the Cascade-Long Valley area, several conclusions regarding both the thermal and non-thermal ground water systems can be drawn. These are as follows:

- 1 Water supplies in the valley are sufficient for all uses now being made. The river and stream system provides adequate water for irrigation of all agricultural land.
- 2 The major non-thermal aquifer is the valley fill and alluvium, and it is adequate to supply water for nearly all wells on the valley floor and future ground water development.
- 3 The valley fill aquifer contains a large number of artesian zones, most of which are untapped and are capable of supplying fair yields to wells.
- 4 The hydrologic parameters, such as the storage coefficient and transmissivity, have not been calculated because of a lack of adequate pumping well data.
- 5 Water quality in the cold water system is considered to be poor for domestic purposes because of the high iron and manganese content. Other constituents, however, are within acceptable limits.
- 6 Known thermal water occurrences in the valley are related to the geologic structure. Locations of existing hot springs are directly controlled by the presence of fault and fracture patterns.
- 7 Both the granitic rocks and valley fill offer potential as reservoirs for thermal water. A significant untapped thermal aquifer may exist at depth in the valley fill.
- 8 Quality of the present geothermal resource is good. Samples analyzed show that hot water issuing from springs and wells in the area can be utilized for nearly all uses, including irrigation of crops.
- 9 Recharge to both the non-thermal and thermal systems is probably

meteoric in origin. Chemical differences in the water are the result of the longer time of travel and heat in the thermal reservoir.

Several recommendations can be made for further study in the Cascade-Long Valley area. These include:

- 1 Resistivity techniques should be utilized to determine the possibility of a large thermal aquifer present in the valley fill..
- 2 Based upon the results of the resistivity, study participants should confer and agree upon the location and depth of at least two drill sites on the valley floor for test holes. These holes should be constructed in such a manner as to permit packer testing. Parameters of transmissivity and storage should be determined, as well as geological analysis of penetrated formations and water quality changes with depth.
- 3 One additional drill site should be located in such a manner as to assess the capability of the granitic rocks to function as a thermal aquifer. Location of the well site should take into account geologic structure with emphasis on fault patterns and the proximity to the ultimate place of use, should development occur.



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ATTACHMENT C
EXCERPTS FROM USGS WATER RESOURCES
INVESTIGATIONS OPEN FILE REPORT 80-1020

THERMAL SPRINGS IN THE PAYETTE
RIVER BASIN, WEST-CENTRAL IDAHO

By R. E. Lewis and H. W. Young

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations

Open-File Report 80-1020



October 1980

common ions, silica, and the minor elements arsenic, boron, lithium, and mercury, are given in table 1. In addition, chemical analyses of water from three thermal springs sampled by Young and Mitchell (1973) and five thermal springs for which only partial analyses are available are included. Spring locations are shown on plate 1.

Chemical Character

All the thermal springs discharge fresh water (less than 600 mg/L dissolved solids) of a sodium bicarbonate type, at temperatures between 34° and 86°C. These waters are slightly alkaline--pH ranges from 8.0 to 9.6. Generally, the higher pH values are associated with waters having lower concentrations of dissolved solids. Concentrations of chloride and fluoride are variable and show no definite correlation with temperature. Concentration of boron is low compared with other thermal waters in Idaho, and is, to a degree, correlative with water temperature.

Nonthermal spring waters are either a calcium or sodium bicarbonate type. Water temperature measured in these springs is 7.0°C or less and, generally, is representative of local, ambient conditions. Concentrations of dissolved solids in these near-neutral waters (pH ranges from 6.2 to 7.3) are 90 mg/L or less.

Chemical Geothermometers

Aquifer temperatures in the Payette River basin were estimated using the silica geothermometer (Fournier and Rowe, 1966) and the Na-K-Ca geothermometer (Fournier and Truesdell, 1973). Temperatures estimated by these chemical geothermometers are valid only for hot-water systems and only if the following basic assumptions are met (Fournier, White, and Truesdell, 1974): (1) The chemical reactions at depth are temperature dependent; (2) an adequate supply of chemical constituents used for the thermometry is present in the aquifer; (3) chemical equilibrium is established at depth between the hot water and the specific aquifer minerals; (4) there is negligible reequilibration of the chemical composition of the hot water as it rises to the surface; and (5) hot water rises rapidly to the surface with no dilution or mixing of hot and cold waters.

Dissolved silica (SiO_2) reported in chemical analyses is actually present as silicic acid (H_4SiO_4) and various dissociated species, particularly H_3SiO_4^- . In neutral to slightly acid waters, dissolved silica ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) consists mostly of H_4SiO_4 , and, under these conditions,

Table 1. Chemical analyses of water from thermal and selected nonthermal springs
(Chemical constituents in milligrams per liter, except where noted)
-- = Constituents not analyzed for,
< = Less than.

Spring no.	Date of collection	Flow rate ¹ (gal/min)	Specific conductance (umhos)	pH	Water temperature ² (°C)	Hardness as CaCO ₃	Noncarbonate hardness	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Percent sodium	Sodium-adsorption ratio (SAR)	Potassium (K)	Bicarbonate ³ (HCO ₃)	Carbonate ³ (CO ₃)	Alkalinity as CaCO ₃	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Silica (SiO ₂)	Dissolved solids (calculated)	Nitrate plus nitrite as N (NO ₃ +NO ₂)	Phosphorus, total as P	Arsenic (As) (µg/L)	Boron (B) (µg/L)	Lithium (Li) (µg/L)	Mercury (Hg) (µg/L)
17N-2E-15BACIS	6-28-79	2	85	7.3	7.0	31	0	7.8	2.9	3.9	20	0.3	1.8	51	0	42	2.6	0.4	<.1	45	90	0.11	0.02	0	2	<4	<.01
15N-5E-23DACIS	6-27-79	2	20	6.2	4.0	5	0	1.7	2.2	2.4	23	5.5	2.2	12	0	10	7.7	3.2	1.2	17	29	<.01	0.02	1	0	<4	<.01
13N-5E-21CACIS	6-26-79	4	21	6.2	6.5	3	0	1.7	2.2	2.4	23	5.5	2.2	12	0	10	7.7	3.2	1.2	17	29	<.01	0.02	1	0	<4	<.01
9N-9E-32BACIS	8-31-79	2	52	6.6	4.5	17	0	3.8	4.9	3.1	27	1.3	1.6	29	0	24	1.9	1.4	<.1	14	42	0.13	0.02	0	10	10	<.01
16N-4E-35CCBIS	6-27-79	94	104	9.5	50.0	3	0	1.1	<.1	70	98	18	7	49	36	100	12	11	9.0	63	215	<.01	0.01	11	50	30	<.01
15N-3E-11BACIS	8-2-72	798	279	9.5	34.0	4	0	1.3	1.1	60	97	14	6	17	45	89	43	16	2.6	60	210	--	--	--	--	--	--
15N-4E-21DACIS	6-27-79	31	206	9.6	36.0	4	0	1.3	1.1	43	96	9.8	5	32	34	84	7.8	2.5	3.1	48	146	<.01	0.01	3	10	8	<.01
13N-3E-11BACIS	6-26-79	20	431	9.3	49.0	4	0	1.2	<.1	85	98	21	1.0	56	34	102	24	28	5.3	61	256	<.01	0.01	21	310	40	<.01
13N-4E-31CBIS	6-26-79	70	514	9.0	71.0	4	0	1.5	<.1	110	97	25	2.1	68	25	97	43	40	11	72	329	<.01	0.01	39	400	60	<.01
13N-6E-29BACIS	7-7-79	50	334	9.5	53.0	4	0	1.6	1.1	64	96	13	1.3	32	36	86	31	7.8	15	80	240	<.01	0.01	6	50	30	<.01
12N-5E-20CCIS	7-8-79	12	337	9.3	46.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10N-4E-33CBIS	7-8-79	10	337	9.3	50.0	3	0	1.3	<.1	65	97	16	1.1	34	34	84	16	6.5	16	73	219	<.01	0.01	6	60	60	<.01
10N-4E-33CBIS	7-8-79	22	331	8.9	66.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10N-4E-33CBIS	6-5-79	134	331	8.9	86.0	4	0	1.4	1.1	74	96	16	1.9	95	18	108	12	11	12	86	259	<.01	0.01	10	90	80	<.01
10N-4E-33CBIS	8-8-79	334	266	8.9	38.0	7	0	2.8	<.1	54	94	8.9	9	77	5	71	26	5.8	12	54	196	0.03	0.02	5	50	50	<.01
11N-7E-16BACIS	8-8-79	50	293	8.8	49.0	8	0	3.1	<.1	97	96	4.8	9	99	4	88	24	9.6	13	74	277	<.01	0.01	6	70	90	<.01
11N-7E-16BACIS	7-24-79	90	315	9.3	65.0	5	0	1.8	1.1	65	95	13	1.8	13	35	69	36	3.9	15	82	216	0.02	0.03	14	50	80	<.01
10N-4E-33CBIS	11-27-78	500	402	8.4	75.0	5	0	1.9	<.1	90	96	17	2.2	130	2	110	27	19	13	110	331	0.01	0.01	9	120	100	<.01
10N-10E-31BCCIS	3-13-79	360	378	9.3	84.0	4	0	1.5	<.1	77	96	17	3.2	18	38	78	50	8.0	17	91	282	<.01	0.01	1	70	110	<.01
10N-11E-31BCCIS	5-7-79	75	381	9.6	67.0	5	0	1.9	1.1	77	95	15	2.6	1	45	76	46	9.5	15	82	267	0.02	0.01	2	90	110	<.01
9N-3E-25BACIS	11-22-78	32	622	8.0	79.5	16	0	6.1	1.1	120	92	13	5.3	160	0	131	88	39	12	120	470	0.02	0.01	5	240	150	<.01
9N-7E-35AACIS	5-7-79	3	287	9.3	37.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9N-8E-31ACIS	3-13-79	20	369	9.2	63.5	4	0	1.4	<.1	79	97	18	1.8	40	31	84	39	5.7	20	83	270	<.01	0.01	2	20	120	<.01
9N-3E-25BACIS	2-27-79	350	321	9.1	64.0	5	0	1.9	<.1	70	96	14	1.3	29	29	72	39	3.9	16	67	232	0.02	0.01	2	50	110	<.01
9N-9E-22CCIS	7-29-79	13	--	--	54.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8N-5E-18CCIS	6-8-72	1.5	317	--	40.0	6	0	2.4	1.1	66	95	11	9	85	1	71	42	5.1	3.1	48	216	0.01	0.01	6	110	120	<.01
6N-5E-18CCIS	11-23-78	14	359	9.0	42.0	8	0	2.9	1.1	72	95	12	1.2	67	20	88	37	7.3	15	75	262	0.01	0.01	6	110	120	<.01
6N-5E-18CCIS	2-26-79	75	343	9.1	51.0	12	0	5.0	<.1	72	92	8.9	1.3	61	22	87	36	7.8	15	63	245	0.01	0.01	6	110	130	<.01
10N-4E-33CBIS	11-22-78	10	344	9.0	54.0	5	0	2.0	<.1	76	96	15	1.2	59	19	80	40	5.7	14	78	259	0.01	0.01	4	90	80	<.01
10N-4E-33CBIS	11-27-78	90	345	9.2	54.5	5	0	2.0	1.1	75	96	14	1.0	40	23	78	38	5.7	14	74	259	0.01	0.01	4	90	80	<.01
11N-4E-33CBIS	2-26-79	35	352	9.1	60.0	5	0	1.8	<.1	78	96	16	1.4	49	28	87	41	5.4	17	66	254	0.01	0.01	5	90	70	<.01
11N-4E-33CBIS	7-25-79	5	346	9.2	56.5	--	--	--	--	--	--	--	--	43	26	79	--	--	--	--	--	--	--	--	--	--	--
8N-6E-18BACIS	2-27-79	175	343	9.2	59.5	5	0	2.0	<.1	75	96	15	1.1	39	29	80	38	6.7	17	63	273	0.01	0.01	6	100	100	<.01
7N-1E-8BACIS	9-5-79	50	780	8.0	64.0	22	0	8.4	2.2	160	92	15	8.0	180	0	148	120	61	16	110	573	<.01	0.01	10	710	220	<.01
8N-4E-72	8-4-72	20	529	--	45.0	47	0	15	2.4	99	80	6.3	5.3	169	0	139	57	30	8	94	397	--	--	--	--	--	--

¹Flow rate is for entire spring complex.
²Water temperature is highest temperature at spring vents or temperature of sampled vent.
³Total alkalinity distributed as carbonate and bicarbonate at the spring temperature and pH.
Analyses taken from Young and Mitchell (1973).
Temperature may be higher because vents were underwater.
Shown in Young and Mitchell (1973) as BCBIS.

silica geothermometers give good estimates of reservoir temperatures. In alkaline waters, hydroxide (OH^-) reacts with silicic acid to reduce the proportion of silicic acid to total dissolved silica. The total concentration of dissolved silica measured in the laboratory ($\text{H}_4\text{SiO}_4 + \text{H}_3\text{SiO}_4^-$) must therefore be reduced by the concentration of H_3SiO_4^- occurring at the pH level of the spring water, to obtain an accurate estimate of the reservoir temperature.

For thermal waters having pH greater than 8.2, reported values for dissolved silica were corrected for dissociation of silicic acid at the spring temperature, and reservoir temperatures were estimated assuming equilibrium with both quartz and chalcedony (table 2). The pH of water in the thermal aquifer would be slightly lower than the pH measured at the spring, and calculation of aquifer pH might increase the H_3SiO_4^- -corrected quartz temperature by 5° or 10°C (R. H. Mariner, written commun., 1980). Calculation of aquifer pH requires consideration of acid-base equilibria, distribution of acidic gases between steam and water, and the effect of temperature on the equilibria (Ellis and Mahon, 1977). Most of the calculations are time consuming and require computer methods, such as those presented by Truesdell and Singers (1973).

Concentration of magnesium in thermal waters sampled generally was 0.1 mg/L or less, so corrections for magnesium in the Na-K-Ca geothermometer suggested by Fournier and Potter (1979) were not applied. Applying the magnesium correction to the Na-K-Ca geothermometer for one thermal spring having a magnesium concentration of 2.4 mg/L increased the estimated reservoir temperature by 6° to 90°C .

Reservoir temperatures calculated from water analyses for 26 thermal springs in the Payette River basin are given in table 2, along with selected chemical reaction coefficients. In applying the H_3SiO_4^- -corrected silica geothermometer for thermal springs having water temperature at the land surface generally greater than 65°C , best estimates were obtained by assuming that quartz was controlling the SiO_2 concentration. For springs having temperatures at the surface generally less than 65°C , better estimates of reservoir temperature were obtained by assuming that chalcedony was controlling the SiO_2 concentration. If, however, the calculated free energy of formation showed the waters were unsaturated with chalcedony; or, if the estimated temperature was less than the temperature of the spring, then quartz was assumed to be controlling the SiO_2 concentration.

Using a plot of reservoir temperatures estimated by the silica and the Na-K-Ca geothermometers, Fournier, Sorey, Mariner, and Truesdell (1979) showed waters that plot on or

Table 2. Estimated aquifer temperatures and free energy of formation for selected thermal springs

Spring No.	Water temperature at the surface (°C)	Estimated aquifer temperatures based on geothermometers					Free energy of formation ¹				Reference No. (fig. 2)
		Silica quartz-conductive (°C)	Silica quartz-conductive H ₂ SiO ₄ corrected (°C)	Sodium-potassium-calcium (°C)	Silica-chalcedony (°C)	Silica-chalcedony H ₂ SiO ₄ corrected (°C)	Aragonite	Calcite	Chalcedony	Quartz	
16N- 4E-35CCB1S	50.0	113	69	71	84	37	0.1	0.2	-0.2	0.3	1
15N- 3E-13BBC1S	34.0	110	61	61	81	28	-0.1	0	-0.1	0.5	2
15N- 4E-21DCC1S	36.0	100	62	53	70	30	0	.1	-0.1	.5	3
13N- 3E-13ADA1S	49.0	111	79	83	82	47	0	.1	0	.5	4
13N- 4E-31CAB1S	71.0	120	91	117	91	61	.1	.2	-0.1	.3	5
13N- 6E-29DAB1S	53.0	125	76	82	97	45	.2	.3	-0.1	.4	6
12N- 5E- 2DAC1S	50.0	120	86	81	92	55	0	0	.1	.6	7
22BBC1S	86.0	129	101	100	101	71	.3	.4	-0.2	.2	8
36DBA1S	38.0	105	93	57	76	62	-0.3	-0.2	.3	.9	9
11N- 5E-29CDB1S	49.0	121	107	61	93	77	-0.1	0	.4	.9	10
11N- 7E-16AAB1S	65.0	126	84	91	99	52	.3	.4	-0.2	.3	11
ON- 4E-33CBD1S	75.0	143	132	138	116	105	-0.3	-0.2	.4	.8	12
ON-10E-31BCC1S	84.0	132	81	145	105	50	.5	.6	-0.5	-0.1	13
10N-11E-31ADD1S	67.0	126	63	134	99	31	.6	.7	-0.5	-0.1	14
9N- 3E-25BAC1S	79.5	148	143	144	122	116	.1	.2	.5	.9	15
9N- 8E-31ACA1S	63.5	127	90	99	99	60	.1	.2	0	.4	16
32CBA1S	64.0	116	86	79	87	55	.2	.3	-0.1	.4	17
8N- 5E- 1BCC1S	40.0	100	89	62	70	59	-0.5	.4	.3	.8	18
6DCB1S	42.0	122	104	69	94	74	.1	.1	.4	1.0	19
6DCC1S	51.0	113	88	60	84	58	.6	.7	.1	.6	20
10ADD1S	54.0	124	101	76	96	71	-0.1	0	.2	.8	21
10BDD1S	54.5	121	89	70	93	58	.1	.2	.1	.6	22
11BA1S	60.0	115	87	84	86	56	.2	.2	0	.4	23
8N- 6E- 1ADB1S	59.5	113	80	74	84	49	.3	.3	-0.1	.3	24
7N- 1E- 8DDA1S	64.0	143	138	152	116	112	0	.1	.6	1.1	25
9CDC1S	45.0	134	133	290	107	106	-0.5	-0.4	.8	1.3	26

¹Values are departure from theoretical equilibrium in kilocalories; (+) values indicate supersaturation, (-) values indicate unsaturated. Calculations from computer program SOLMNEQ (Kharaka and Barnes, 1973).

²Magnesium corrected (Fournier and Potter, 1979).

near the equal-temperature line ($T^{\circ}_{\text{SiO}_2} = T^{\circ}_{\text{Na-K-Ca}}$; slope = 1) are likely to be unmixed waters or waters that have reequilibrated with the aquifer minerals after mixing. Waters that plot significantly above the equal-temperature line probably contain anomalous concentrations of silica, owing to evaporation or to dissolving amorphous silica from the aquifer material. The Na-K-Ca geothermometer uses ratios of constituents and is less sensitive to concentration changes that occur during evaporation than is the silica geothermometer.

Waters that plot significantly below the equal-temperature line may be due to: (1) Mixing with another type water without sufficient time to equilibrate with the surrounding rock (in mixed waters, silica-estimated temperatures are generally decreased more than Na-K-Ca estimated temperatures); (2) precipitation of silica during cooling, whereas Na-K-Ca proportions remain unchanged; or (3) precipitation of calcite or aragonite due to loss of carbon dioxide without adjustment of sodium and potassium through reaction with clays, zeolites, or other minerals (Fournier and others, 1979).

Figure 2 is a plot of reservoir temperatures estimated using silica and Na-K-Ca geothermometers for thermal springs in the Payette River basin. Most thermal springs plot on or near the equal-temperature line. As suggested by Fournier and others (1979), these waters are probably unmixed waters that have lost some heat through conduction or are mixed waters that have had time to reequilibrate. Several springs (samples 5, 7, 13, and 14) plot significantly below the equal-temperature line and may indicate a mixed water or water from which calcite and aragonite have precipitated. Table 2 shows that, with the exception of sample 7, waters from these springs are supersaturated with calcite or aragonite, which may indicate a possible loss of calcium without an adjustment of the sodium and potassium concentrations. For these samples, the silica geothermometer probably gives the better estimate of reservoir temperature.

Only two springs (samples 10 and 26) plot significantly above the equal-temperature line in figure 2. These waters are thought to have dissolved amorphous silica from the aquifer materials (calculated free energy of formation of amorphous silica is 0, which indicates equilibrium with this phase). For these springs, the Na-K-Ca geothermometer probably gives the better estimate of reservoir temperature.

Estimated reservoir temperatures determined from the silica and Na-K-Ca geothermometers are highly variable and range from 53° to 143°C. Along the North Fork of the

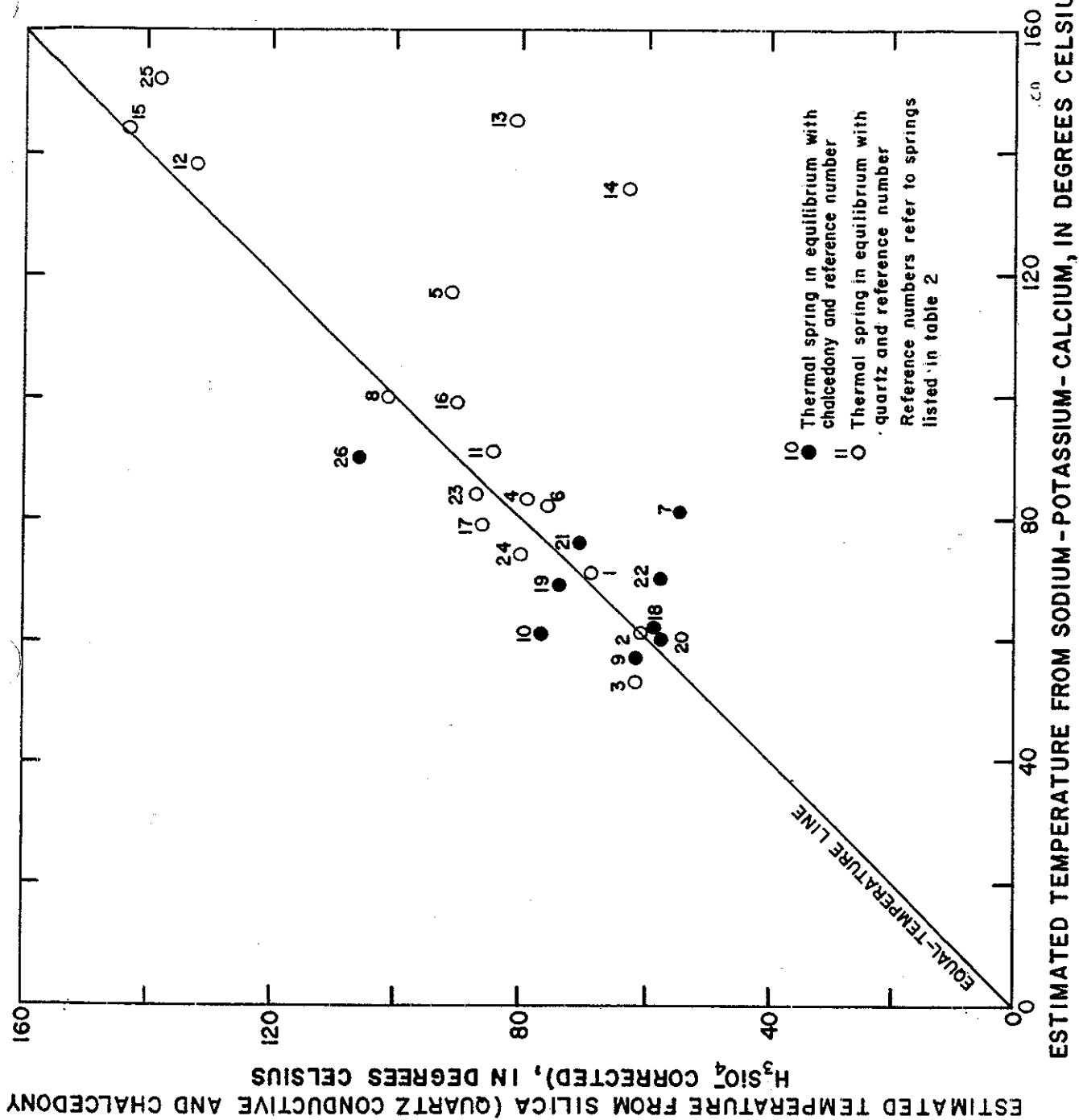


Figure 2. --- Comparison of reservoir temperatures estimated by the silica and sodium-potassium-calcium geothermometers

53° to 91°C. Along the Middle and South Forks of the Payette River, estimated reservoir temperatures range from 57° to 138°C and 58° to 99°C, respectively. Estimated reservoir temperatures along the Payette River from Banks, Idaho, range from 90° to 143°C.

Assuming conductive heat loss, reservoir temperatures for six thermal springs were estimated using the sulfate-water isotope geothermometer described by McKenzie and Truesdell (1977): 16N-4E-35CCB1S, 71°C; 13N-4E-31CAB1S, 75°C; 13N-6E-29DAB1S, 71°C; 9N-3E-25BAC1S, 139°C; 9N-8E-32CBAL1S, 88°C; and 8N-5E-10BDD1S, 76°C. Additional temperatures of 89° and 94°C were estimated for thermal springs 12N-5E-22BBC1S and 10N-10E-31BCC1S, respectively, by Nehring and others (1979).

Isotopes

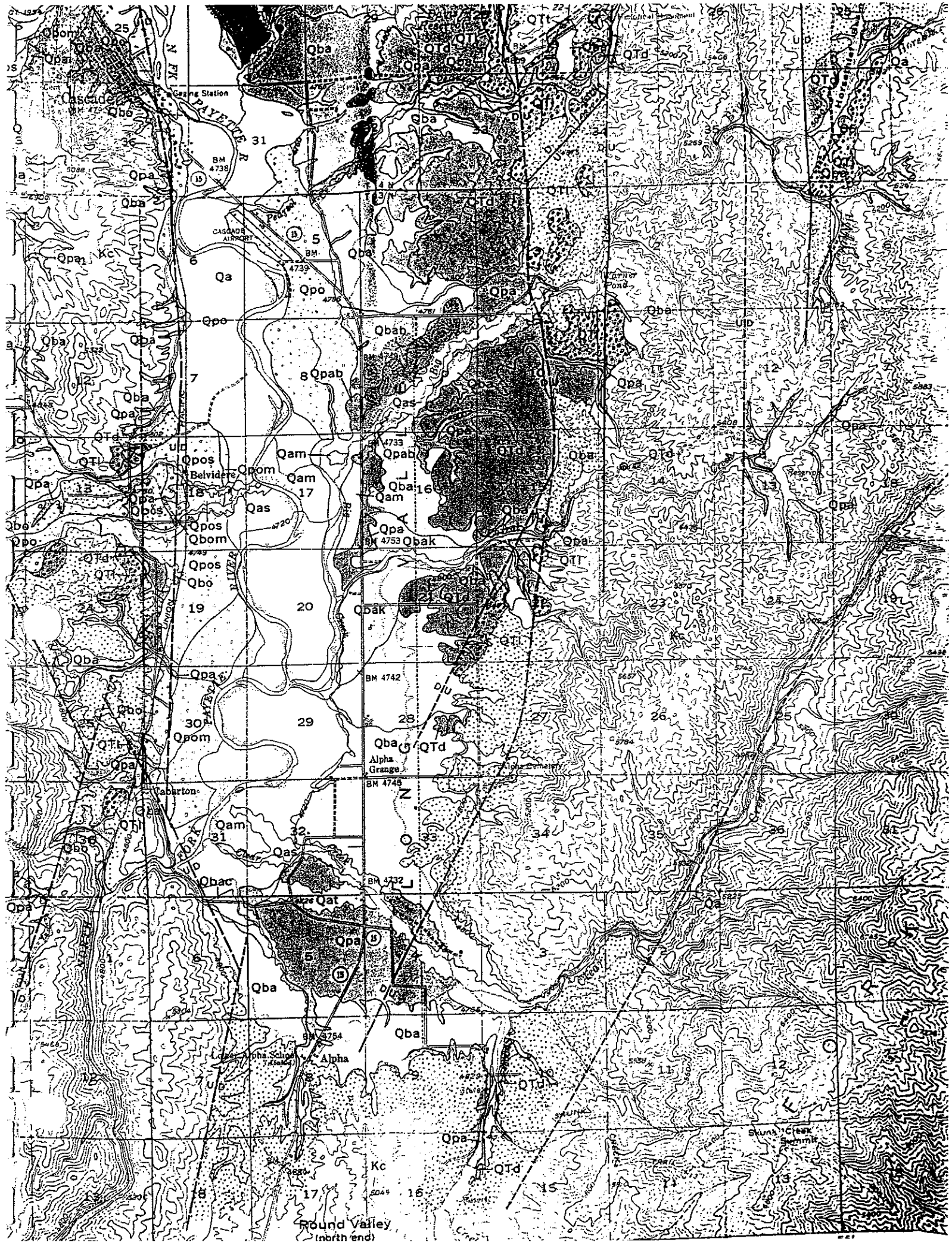
Samples of thermal and nonthermal water from selected springs in the Payette River basin were collected for analyses of oxygen-18, deuterium, and tritium. In this report, isotope data are presented in tabular and graphical format (tables 3 and 4 and fig. 3); interpretations concerning age or relation of the various waters are offered only insofar as they apply to the Payette River basin and are considered preliminary. A discussion of the isotopic composition and possible relations of thermal waters in the Payette, Salmon, and Boise River basins will be presented in a final report.

Tritium

Tritium (H^3) is produced naturally in small quantities in the upper atmosphere during bombardment by subatomic particles. The tritium, incorporated in water molecules, enters the water cycle in rain and snow. Having a half life of about 12.3 years, tritium can be used to determine how long a particular water may have been stored out of contact with the atmosphere. The transit or residence time can be determined from the concentration of tritium in the discharge water, if the amount of tritium in the recharge water and the nature of the subsurface flow regime are known.

Before extensive thermonuclear testing began in 1954, tritium in the atmosphere ranged from 10 to 20 TU (tritium unit). One TU equals a $^3H/H$ ratio of about 10, or about 3.2 picocuries per liter. By 1963, worldwide tritium levels had

ATTACHMENT D
GEOLOGIC MAP FROM USGS BULLETIN 1311-A



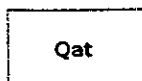
EXPLANATION

SURFICIAL DEPOSITS

Qa	Qam	Qas
----	-----	-----

Alluvium on flood plains

Includes some colluvium in small stream valleys
Qa, alluvium undivided
Qam, main-stream deposit; designated only where necessary
Qas, side-stream deposit; designated only where necessary



Terrace alluvium

Noncyclic terraces of larger streams

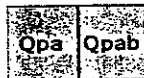


Morainal deposit

Cirque moraines and rock glaciers of the Neoglaciation

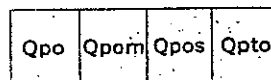


Landslide deposits



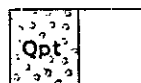
Alluvium and colluvium

Mostly cyclic periglacial deposits of small streams. South of Cascade, source stream is partly designated.
Qpb, Big Creek



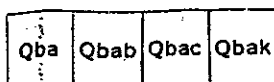
Outwash

Qpo, outwash undivided
Qpom, main-stream deposit; designated only where necessary
Qpos, side-stream deposit; designated only where necessary
Qpto, moraine and outwash in ice-scoured cirque and valley floors; mostly stagnation moraine re-worked by melt water



Morainal deposit

Qmt, morainal deposit
Circular overprint on bedrock color where drift is thin and patchy on abundantly exposed glaciated bedrock



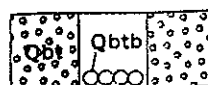
Alluvium and colluvium

Mostly cyclic periglacial deposits of small streams. South of Cascade, source streams are partly designated.
Qbab, Big Creek
Qbac, Clear Creek
Qbak, Corral Creek



Outwash

Qbo, outwash undivided
Qbom, main-stream deposit; designated only where necessary
Qbos, side-stream deposit; designated only where necessary



Morainal deposit

Qbt morainial deposit

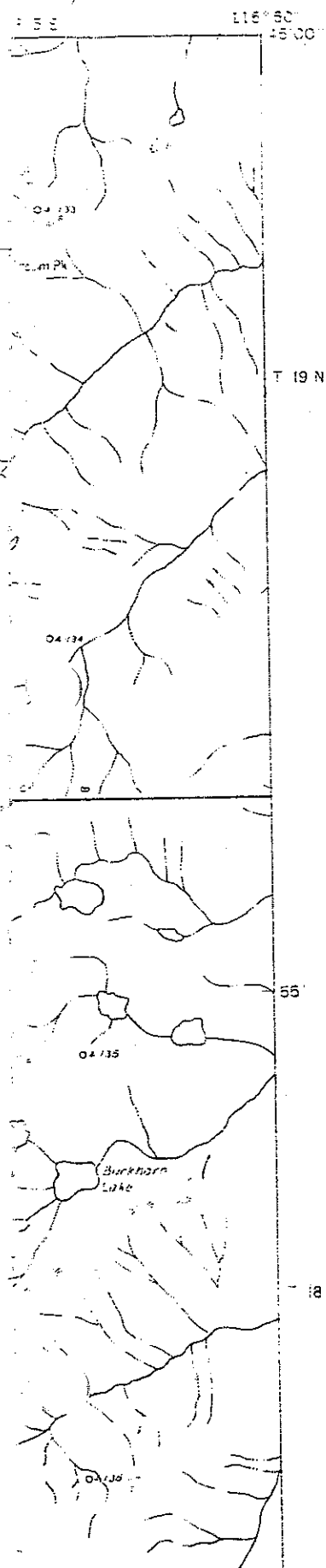
Holocene

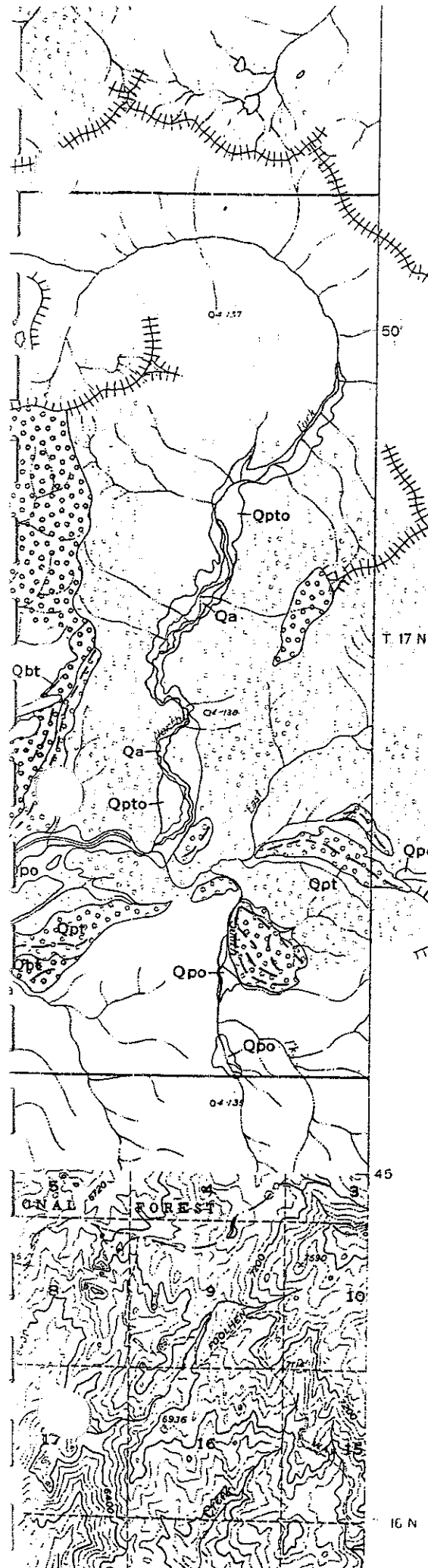
Pinedale Glaciation

Pleistocene

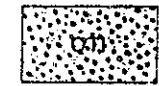
Bull Lake Glaciation

QUATERNARY





Qbtb, boulder line partly buried by younger outwash (Qbo)
 Circular overprint on bedrock color where drift is thin and patchy on abundantly exposed glaciated bedrock; less accurately mapped than comparable Pinedale areas



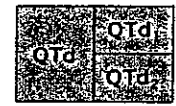
Lag gravel

Resistant cobbles and pebbles residual from eroded pre-Bull Lake surficial deposits (QTt and QTd) Mostly associated with remnant erosion surfaces



Till

Deposits deeply weathered and truncated by erosion; probably of different ages. Source of deposit east of Cascade is not apparent, whereas the source of the deposit southeast of Little Payette Lake probably was Lake Fork drainage

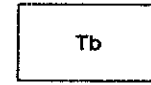


Fluvial and lacustrine deposits

Deposits of various origins probably including fault-trough fills, aggradational deposits, and glacial deposits. Many are faulted and moderately tilted. All are truncated by erosion and deeply weathered where relief is low; most contain small amounts of detrital gold. Large valley floor deposit east of Lakefork townsite may be proglacial outwash related to oldest morainal deposits on Lake Fork (QTt)

QTd₁ and QTd₂ subscripts distinguish adjoining deposits of distinctly different ages and origins; unit 1 is younger than unit 2, but correlation outside local area is not implied

BEDROCK



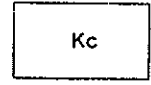
Columbia River Basalt

Contacts on West Mountain not accurately located



Latah(?) Formation

Unconsolidated sediments interbedded with Columbia River Basalt flows but chiefly underlying lowest basalt flows



Cretaceous and older crystalline rocks
 Schist, gneiss, and granitic rock; associated with the Idaho batholith

ATTACHMENT E
CORRESPONDENCE FROM UNPUBLISHED
INVESTIGATION AND WELL SITING STUDY FOR
EASTERN WESTERN CORPORATION



ASSOCIATED EARTH SCIENCES INC.

• BIOLOGY • GEOLOGY • ENGINEERING • SOIL SURVEYS • SOIL AND WATER QUALITY
• RESOURCE PLANNING AND SITE INVESTIGATIONS

7025 Emerald St., Suite 200A

Boise, Idaho 83704

(208) 377-2248

October 19, 1995

Mr. Michael McGinley
Eastern Western Corporation
P.O.Box 3228
Portland, OR 97208-3228

Scanlon Eng.
600 E Riverpark Lane
83706

Subject: Hydrothermal Well

Location: SE of NE of NE 1/4 Sec.13 T.12N. R.3E.

This report summarizes results of studies made by Boise State University (BSU) Geology Department regarding hot water potentials at SE NE NE Sec 12 T12N R3E in Valley County, Idaho.

Field work disclosed a fault scarp believed to be associated with the bath house hot spring. It can be seen about 150 yards west of the hot spring and was projected to pass close to the spring area. The broken rocks dip 55-65 degrees to the south and have a strike of N.70 degrees E.. No other springs were seen associated with this fault at other locations, but if they occur, it may be in or beneath the valley fill. Other faults in the area were not visibly traced to the vicinity of the hot spring.

After some difficulty with equipment, the BSU Geology Department completed their field surveys and a report of their results. It has taken a longer time than I expected for me to obtain that report and arrange a meeting with Dr. Paul Donaldson. During the interview he gave me his interpretation of the test results included in that report, most of which were in the report.

The results of BSU's field testing produced less guidance than I had hoped. As you have seen in the BSU report, the zone of low resistivity passes through the central portion of the four transects. The low resistivity is believed to indicate the area most favorable for intercepting hydrothermal solutions with a well. Dr. Donaldson discussed the areas of highest probability in the central portion of the zone near transect three. A location selected for drilling in the southern portion of the zone near line three may produce the hottest water, but it would take a greater drilling depth to reach and test the fault zone where the maximum opportunity is believed to occur.

His recommendation was to first try a small diameter test well. It would be located a distance of about 400-450 feet southwesterly from the bath house at an intersect with transect

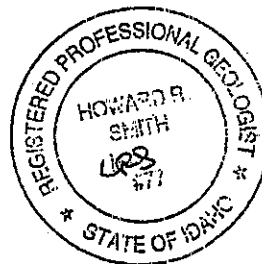
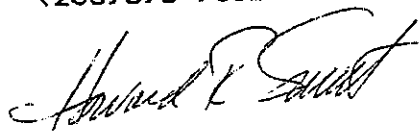
line three. Here the conditions of temperature, rock fractures, pressures, volume of water, location of the fault etc. could be checked on the way down to the fault zone which lies at an estimated depth of about 800 feet at this point. If conditions appear favorable in the test well, drilling a production well slightly to the south, about 500-600 feet from the bath house, to a depth of 1000-1200 or so, should be considered. The deeper well theoretically would produce hotter water, but not necessarily more water. This would depend upon the rock fracturing present. The exact position and dip of the fault is unknown but these figures are estimates based on an average of 60 degrees dip as seen in the outcrop to the west.

Part of the lack of clarity in the test results, according to Dr. Donaldson, may be due to a thick section of valley fill in the central portion of the valley. The main Payette River valley fault, trending nearly north-south about 2000 feet to the east, has a large displacement that resulted in a drop of the valley on the east side in respect to the west side of the fault. The age and relationship of the hot spring fault to the large fault is unknown and the thickness of Moores, Brush and Olson Creeks' valley alluvium is also unknown until a well is drilled.

Dr. Donaldson stated further testing in the "best area" discussed could be conducted using Resistivity Depth Soundings. This system tests one local area at a time using electronic/magnetic currents. He agreed, however, because of testing delays and additional cost it would probably be better to use the present information and proceed with a test well.

If you have further questions or need further clarification regarding these recommendations, please let me know.

Howard R. Smith, PG
4925 Allamar Dr.
Boise, ID 83704
(208) 375-7891



RESISTIVITY INVESTIGATIONS

CABARTON HOT SPRINGS AREA

NEAR CASCADE, IDAHO

REPORT PREPARED FOR

EASTERN-WESTERN CORPORATION

PORTLAND, OREGON

PAUL R DONALDSON, PhD

CENTER FOR GEOPHYSICAL INVESTIGATION
OF THE SHALLOW SUBSURFACE

BOISE STATE UNIVERSITY

AUGUST 30, 1995

1.0 Summary

An electrical resistivity investigation was commissioned by the Eastern-Western Corporation at a site near Cascade, Idaho which includes the Cabarton Hot Springs. The Field data were acquired during June and August, 1995. The split data acquisition periods resulted due to equipment problems encountered during the initial acquisition period. All data are summarized and discussed in this report.

2.0 Objectives

The analysis is focused primarily on indications of controls, stratigraphic or structural, that might influence the migration and surface leakage of geothermal fluids in the area. Such a diagnosis may provide insight about locating a drill-hole that might intersect the source or a subsurface conduit controlling the movement of the fluids. It is reasonable to hope that, at depth, a drill-hole intersecting such a controlling feature might produce higher temperature and/or greater volumes of geothermal fluids than are naturally leaking at the surface nearby.

3.0 Resistivity Profiles

Four resistivity profiles were acquired utilizing a standard dipole-dipole array. This approach simultaneously measures variations laterally and vertically along a line, allowing analysis of data roughly approximating a cross-sectional view. The profiles follow a N25W heading with a 60 m (about 200 ft) separation. The profiles are 420-450 m in length and each extends 60-90 m beyond the fence bounding the northern extent of land controlled by Eastern-Western. This results in data coverage at least to the fence line and extending about 300 m (1000 ft) to the SE for each of the profiles. Electrode geometry precludes data acquisition along the entire length of the lines.

3.1 Data Acquisition

All data were acquired with a Zonge Engineering GDP 16 digital recording system. The signal source was generated with a Geotronics FT 4 transmitter which was synchronized to the receiver by a Zonge XMT 16 transmitter controller. A standard 8-sec period time-domain signal was utilized. Several cycles (minimum 4) of the signal were stacked for each data point to enhance the signal-to-noise ratio. A real-time statistical analysis of data was monitored to ensure high data quality. Any questionable data were discarded and repeated to satisfaction before being stored to memory. All data are judged to be very good quality.

3.2 Data Analysis and Interpretation

The dipole-dipole resistivity data is summarized in four plots appended to this report. Each plot represents an individual profile labeled 1R, 2, 3, or 4 and summarizes the data from South to North. The first profile is labeled 1R because the data were acquired from N to S but reversed before plotting to correspond to the S to N data acquisition utilized for the other three profiles and to follow the convention of N generally being at the top of a page or plot. The left edge of each plot nominally represents the ground surface with (to repeat) S at the bottom and N at the top of each plot. The location map following the data plots summarizes the position of each profile relative to the fences bounding the property to the N and W.

Electrical resistivity in the shallow part of the earth's crust is controlled primarily by porosity and the temperature and salinity of the fluids filling those pore spaces. Addressing the purposes of this investigation, those areas exhibiting lower resistivity would provide guidelines for recommending exploratory drilling.

A commonly accepted model for hot-spring activity, such as that observed on the property, consists of a fault or faults intersecting a geothermal aquifer. The aquifer may be at great depth but the fault provides a conduit to transport the fluids upward, in some cases leaking to the surface due to a pressure differential. In such a case, even though the aquifer may be too deep to reasonably access, the fault zone may provide a reasonable drilling target from which the fluids may be recovered. A NE trending fault has been interpreted to cross this area with a surface trace somewhere in the vicinity of the hot springs (Howard Smith, personnel communication).

3.2.1 Profile 1R

This first (most westerly) profile exhibits only one coherent zone of anomalously low resistivities, found near the southern extent of the profile. The trend extends weakly toward the surface nearer the midpoint, suggesting a SE dip. The contrast in resistivity is not very dramatic but the zone is reasonably well defined.

3.2.2 Profile 2

Profile 2 exhibits a comparable zone, shifted a bit further to the N. The resistivity contrast, while still not large in magnitude, appears to define a zone of uniformly lower resistivity. The inferred dip is again to the SE.

3.2.3 Profile 3

In profile 3 we find a well defined zone of reduced resistivity

positioned near the middle of the profile. The suggested dip is again to the SE and if we make the reasonable assumption that the zones are correlative from profile to profile, they seem to be defining a roughly SW-NE trend.

3.2.4 Profile 4

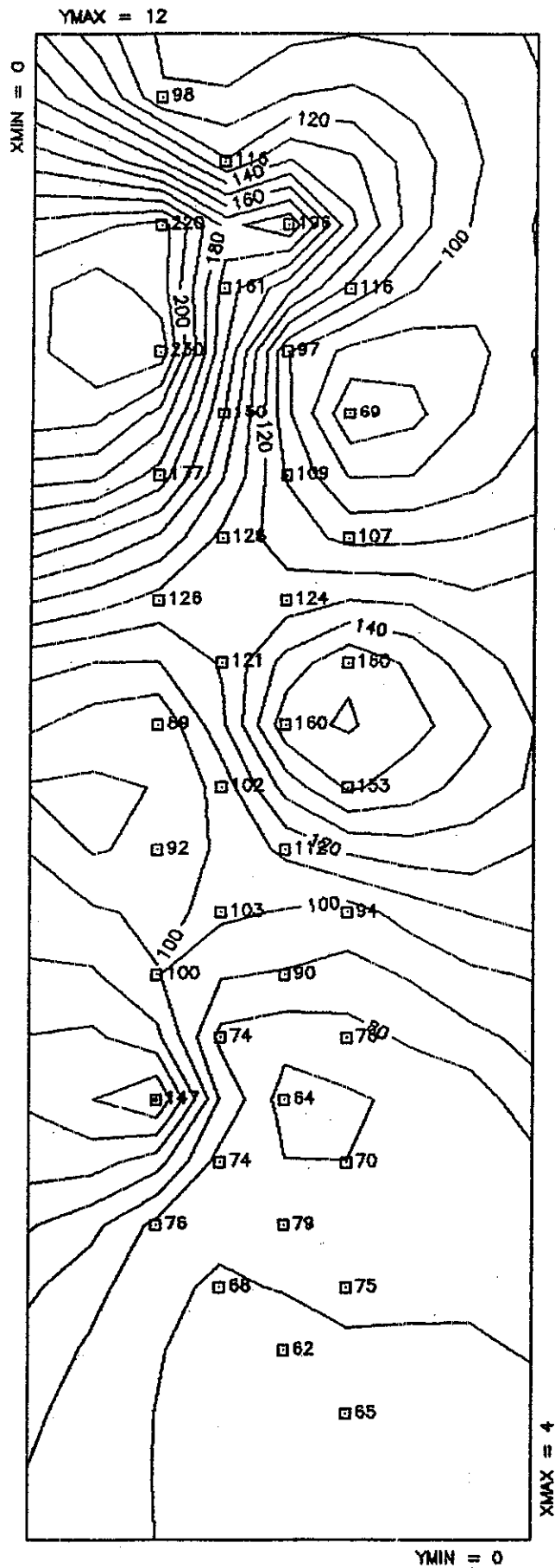
This final (most easterly) profile continues the pattern of a low resistivity zone indicating SE dip and shifted to the N relative to the previous profiles. This supports the conclusion of a SW-NE trending zone of reduced resistivity which may be indicative of geothermal fluid conduits.

4.0 Conclusions and Recommendations

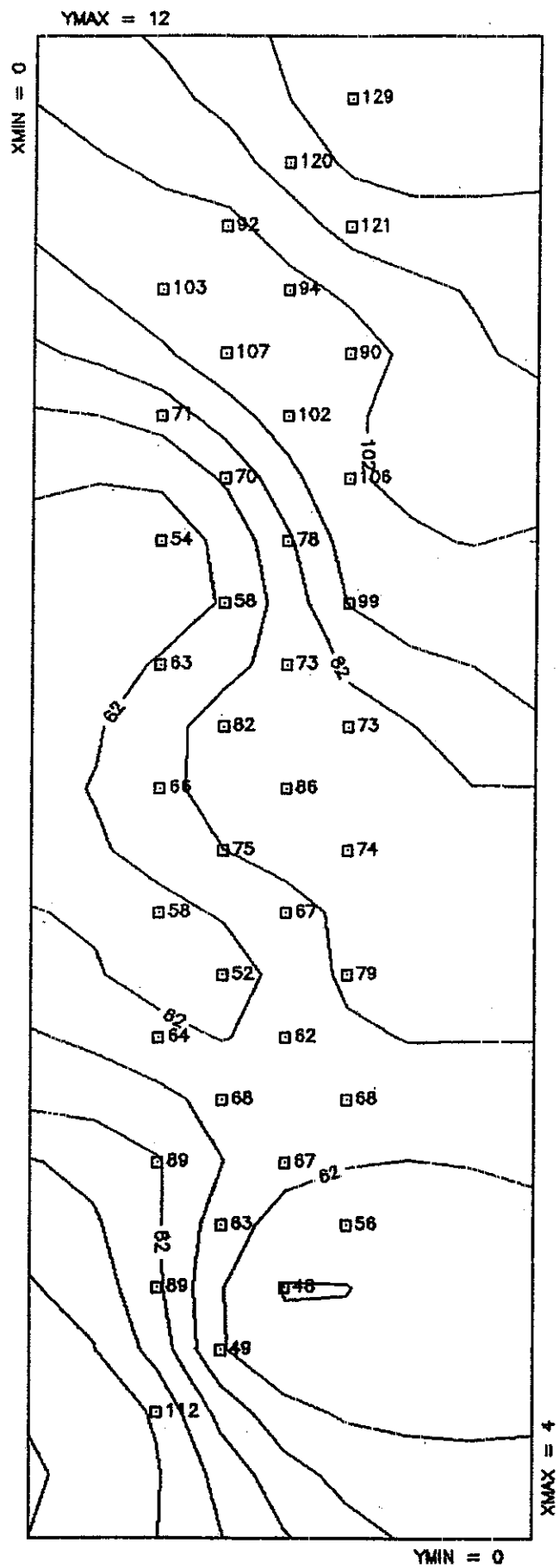
The location map following the profiles summarizes the data analysis discussed above. The low resistivity trend shown is best defined in profiles 2-4 which have therefore been given greater weight than profile 1 in defining the apparent trend. The entire zone is rather broad (about 300 ft) and includes, in general, the full anomaly width along each profile. The nature of the data is to smear the anomaly relative to the dimensions of the source or cause of the anomaly. In general, then, the middle of the trend represents the heart of the source.

It should be reiterated that the anomalies are quite subtle and do not suggest a strong contrast in resistivity with the surrounding material.

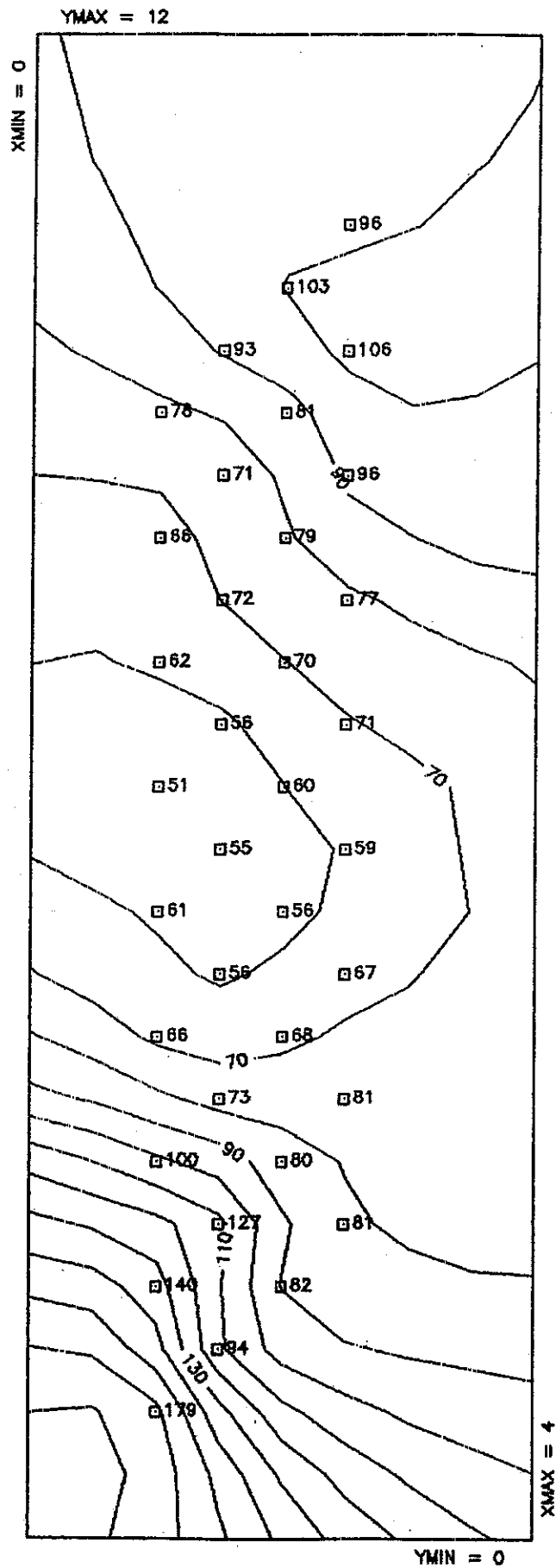
Best judgement, based on these results, would be to recommend exploratory drilling within this trend, if such is planned. The indications of dip to the SE suggest that anomaly intersection will occur at increasing depth to the SE within the trend. Also, since the anomalies are better defined to the NE, a reasonable suggestion might be to choose a site near profile 3, and near the central part of the indicated trend.



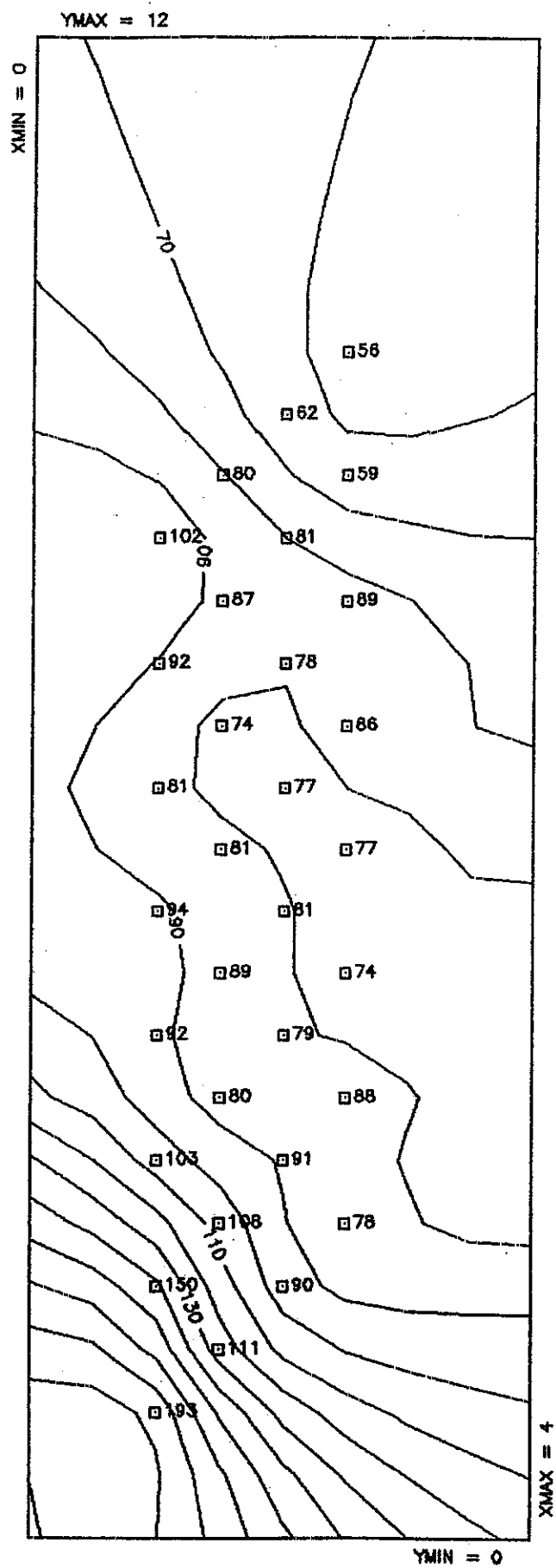
RESISTIVITY PROFILE 1R: S-N

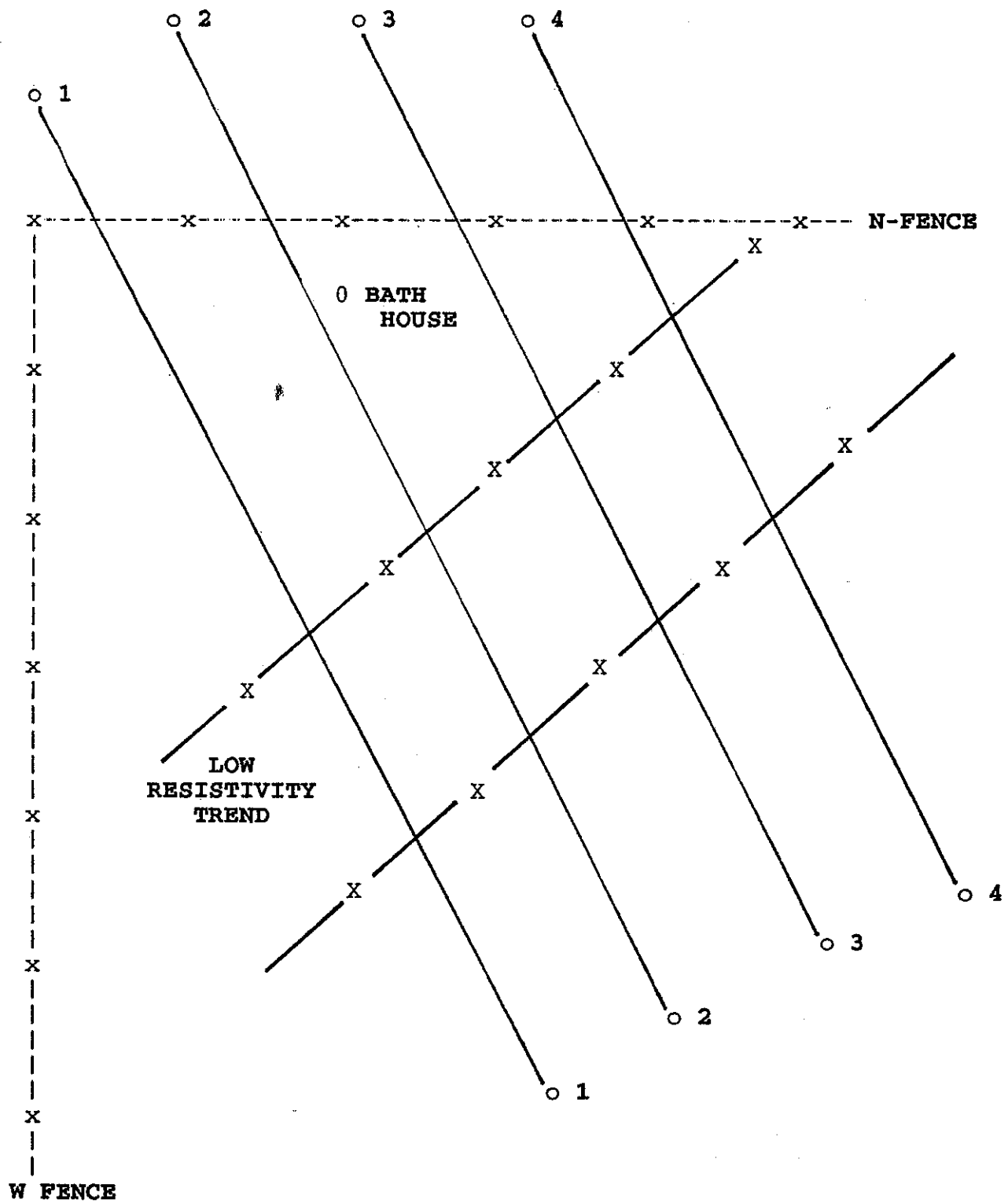


RESISTIVITY PROFILE 2:S-N



RESISTIVITY PROFILE 3: S-N





Profile Locations
MAP SCALE: 1 in = 200 ft

June 30, 1994

Copy

Mr. Michael McGinley
Eastern Western Corp.
P.O. Box 3228
Portland, OR 97208-3228

Subject: Hydrothermal Well
Location: SE of NE of NE 1/4 Sec.13 T.13N. R.3E.

The following information outlines work I have done at this point on the hot water development on Eastern Western land near Cascade, Idaho:

Consultation has been made with other geologists, geologic literature and water well logs have been checked. I met with the Idaho Department of Water Resources regarding hot water development. There I obtained the necessary forms for establishing water rights and at their suggestion, contacted the Boise State University Geology Department to obtain their recommendations on hot water development near Cascade, Idaho. I believe a drilled well is necessary to maximize hot water production. A surface excavation would yield only a small volume because of the low flow rate of the springs.

I met with a group from the Geology Department on June 7 to discuss geologic conditions at the site and possible procedures for hot water development. The group consisted of Dr. Paul Donaldson, Dr. Jack Pelton and five graduate students, a team attached to the Geology Department. They perform subsurface investigative work for the public and apparently charge close to their cost of operation. In return, they gain experience and make a little money for the school. They appear conscientious, talented and should do a good job at minimum cost. They recommended a subsurface investigation using the electric resistivity method. There has been some delay getting the paper work started because they have been busy with other work, but they should be able to proceed on the field work soon after the papers are signed, if this arrangement is satisfactory with you. Enclosed is a blank sample of the contract. I hoped they would fill in some of the blanks but as soon as there is mutual agreement, activities should proceed smoothly.

The geologic picture in the vicinity of the hot springs is complicated because of the apparent number of faults present and the lack of knowledge of subsurface conditions. The actual number of faults present is unknown, but surface conditions indicate at least two are present, both more or less parallel to a larger fault near the county road intersection, located a short distance to the northwest. Also, the angles of dip on the fault planes are unknown, but this will be important to know in planning the location of the well.

It is general belief that hot water occurs here in deep granitic rocks zones due to compression from overlying rocks, radioactive decay and residual heat from the Idaho Batholith. Escaping hot water tends to follow faults and fractured rocks toward the surface. Migrating water usually does not follow a simple vertical path but more of a zig-zag

pattern following broken rocks. Upon initial investigation, it seemed drilling near the springs would be satisfactory, but when considering the interest in obtaining maximum hot water, I believe it would be better to use technical facilities available and employ subsurface investigations prior to drilling. The electric resistivity method records zones of electrolytes, lower density and saturation at depth.

Although there are no guarantees, the presence of hot water discharge at the springs demonstrates the possibility of a moderate volume of hot water available from deeper rocks. Hot water may be leaking to other points in the valley and going undetected because of the thick section of valley fill to the south and east, and the moderate volume of cold water flowing through the alluvium. Since the BSU survey should locate the most advantageous location to drill and the necessary depth, it is possible the location may fall on Joan and Darwin Pancheri's land a short distance to the north and would require an easement.

During the initial discussion with the BSU group they said they might obtain sufficient data from two transects, for a cost of about \$2500. Now they are thinking more in terms of four transects. I can understand their desire to obtain the best information before making a decision. But we might request an evaluation after two or three transects instead of automatically going to four. There is also the possibility, with the complicated geologic structure present, they may request more than four before they are satisfied. The cost apparently is \$1250 per transect.

If you have any questions, please let me know.

Yours truly,

Howard R. Smith, PG

Howard Smith

4925 Allamar Dr.

Boise, ID 83704

(208) 375-7891

377-5569

Enclosed: Documents from BSU

Copy to R.W. Fodrea ✓



BOISE STATE UNIVERSITY • 1910 UNIVERSITY DRIVE • BOISE, IDAHO 83725

CENTER FOR GEOPHYSICAL INVESTIGATION OF THE SHALLOW SUBSURFACE TELEPHONE: (208) 385-1419
FAX: (208) 385-4061

July 25, 1994

TO: Michael E. McGinley
 Eastern-Western Corp.
 P O Box 3228
 Portland, OR 97208-3228

FROM: Paul R Donaldson, PhD *Paul R Donaldson*
 CGISS
 Boise State University
 Boise, Idaho 83725

RE: Geophysics project near Cascade Idaho

The work we propose for the project near Cascade Idaho, outlined at our recent meeting with Howard Smith consists of four dipole-dipole resistivity profiles. The profiles would be parallel to each other and perpendicular to the suspected fault trace. They would be arranged to include the surface projection of the fault near one end with the majority of the coverage including the expected down dip zone. The location of the profiles will rely primarily on discussion with Howard Smith concerning his understanding of the structural geometry. He will stake and flag the profile locations at points where each intersect his best estimation of the fault surface-projection. The profiles will be located on approximately 200 foot spacing with a station spacing of approximately 100 ft along each profile. Each profile will be about 1000-1200 feet in total length and will yield an electrical "pseudosection". Utilized together they will yield contour maps at a variety of depths of investigation. Dr. Jack Pelton has provided Howard Smith with a few literature references that review these tools applied to problems similar to yours.

The technique we propose is sensitive to conditions that vary the electrical properties of the area being investigated. At depths of interest to you the earth's electrical properties are controlled primarily by porosity, fluid saturation and fluid conductivity which in turn is controlled by fluid temperature and salinity. At your site the bulk porosity is probably dominated by fracture porosity. It can be anticipated that the fault zone should produce anomalous electrical conditions and will be the exploration target. Our goal will be to verify the position and geometry of the fault. We will also be looking for clues that indicate if porosity and/or

temperature variations are suggested in the data that might further constrain a drilling target. Ultimately, we will provide our recommendations for a geothermal test well based on the data gathered or possibly what additional work we might recommend before a final drilling decision is made. The total cost for the work we propose is \$5,000. The work could be scaled upward to include a larger area of investigation or add more detail if warranted and agreed to after the initial investigation.

In addition to locating the profile positions, we will rely on you or your representatives to secure all access permission necessary for us to complete this project.

Our deliverables will include a written report with appropriate figures and diagrams which will summarize the data we acquire and include our interpretations and recommendations.

Before we can proceed, a signed contract must be in place. The contract may be initiated by either your company or by Boise State University. If you have a contract you prefer to use, please submit a signed copy to Carol Joyce, CGISS Department, Boise State University, Boise, Idaho 83725. If you want BSU to prepare the contract please let Carol know as soon as possible to allow the paper work to be initiated. Also, questions regarding the contract agreement should be directed to Carol. Her telephone number is (208) 385-3920.

ATTACHMENT F
WELL DRILLERS REPORTS

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

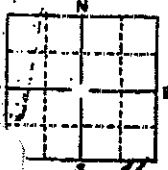
[illegible]

USE ADDITIONAL SHEETS IF NECESSARY -- FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Administration within 30 days after the completion or abandonment of the well.

Department of Water Administration

1. WELL OWNER Name <u>Frank Bilbao</u> Address <u>South Cascade Idaho</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>23</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Temperature _____ ° F. Quality _____ Artesian closed-in pressure _____ p.s.i. Controlled by ☐ Valve ☐ Cap ☐ Plug																																															
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____		8. WELL TEST DATA ☐ Pump ☒ Bailer ☐ Other Discharge G.P.M. <u>12 gal</u> Draw Down <u>23-48</u> Hours Pumped <u>2</u>																																															
3. PROPOSED USE ☒ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type) _____ ☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection		9. LITHOLOGIC LOG <table border="1"><thead><tr><th rowspan="2">Hole Diam.</th><th colspan="2">Depth</th><th rowspan="2">Material</th><th colspan="2">Water</th></tr><tr><th>From</th><th>To</th><th>Yes</th><th>No</th></tr></thead><tbody><tr><td>6</td><td>0</td><td>10</td><td>top soil</td><td></td><td>X</td></tr><tr><td></td><td>10</td><td>32</td><td>clay</td><td></td><td>X</td></tr><tr><td></td><td>32</td><td>42</td><td>sand</td><td></td><td>X</td></tr><tr><td></td><td>42</td><td>60</td><td>clay</td><td></td><td>X</td></tr><tr><td></td><td>60</td><td>69</td><td>sandy gravel</td><td>X</td><td></td></tr><tr><td></td><td>69</td><td>74</td><td>plug</td><td></td><td>X</td></tr></tbody></table>		Hole Diam.	Depth		Material	Water		From	To	Yes	No	6	0	10	top soil		X		10	32	clay		X		32	42	sand		X		42	60	clay		X		60	69	sandy gravel	X			69	74	plug		X
Hole Diam.	Depth		Material		Water																																												
	From	To		Yes	No																																												
6	0	10	top soil		X																																												
	10	32	clay		X																																												
	32	42	sand		X																																												
	42	60	clay		X																																												
	60	69	sandy gravel	X																																													
	69	74	plug		X																																												
4. METHOD DRILLED ☒ Cable ☐ Rotary ☐ Dug ☐ Other																																																	
5. WELL CONSTRUCTION Diameter of hole <u>6</u> inches Total depth <u>74</u> feet Casing schedule: ☒ Steel ☐ Concrete Thickness <u>0.15</u> inches Diameter <u>6</u> inches From <u>0</u> feet To <u>24</u> feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet Was a packer or seal used? ☐ Yes ☒ No Perforated? ☒ Yes ☐ No How perforated? ☐ Factory ☒ Knife ☐ Torch Size of perforation _____ inches by _____ inches Number <u>24</u> perforations From <u>62</u> feet To <u>68</u> feet _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Type _____ Model No. _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☐ Yes ☒ No Size of gravel _____ Placed from _____ feet to _____ feet Surface seal depth <u>29</u> Material used in seal ☐ Cement grout ☒ Puddling clay ☐ Well cuttings Sealing procedure used ☐ Slurry pit ☐ Temporary surface casing ☒ Overbore to seal depth																																																	
6. LOCATION OF WELL Sketch map location must agree with written location.  Subdivision Name _____ Lot No. _____ Block No. _____ County <u>Valley</u> <u>N.E. 1/4 Sec 13 T. 17 N. R. 3 E.</u>		10. Work started <u>7-19-74</u> finished <u>7-25-74</u>																																															
		11. DRILLERS CERTIFICATION Firm Name <u>HABH Drilling</u> Firm No <u>281</u> Address <u>327-9.7 1st payette</u> Date _____ Signed by (Firm Official) <u>James Hollaway</u> and <u>Ray Hollaway</u> (Operator)																																															

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

Form 238-7
3/95

IDAHO DEPARTMENT OF WATER RESOURCES WELL DRILLER'S REPORT Use Typewriter or Ballpoint Pen

Office Use Only			
Inspected by			
Twp	Rge	Sec	
1/4	1/4	1/4	
Lat:	:	Long:	:
☒ Air ☐ Flowing Artesian			

1. DRILLING PERMIT NO. 65-96-4-0325-000
Other IDWR No. _____

2. OWNER:
Name Dean Bentley
Address 7080 W. McMillan Rd.
City Meridian State ID Zip 83642

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

N
W
E
S

Twp	13	North	X	or	South	[]
Rge	3	East	X	or	West	[]
Sec	12	1/4	NE	1/4	SE	1/4
Govt Lot	County <u>Valley</u>					
Lat:	:	Long:	:	:	:	:

Address of Well Site 300 Pendergast Lane
City Cascade
(Give at least name of road - Distance to Road or Landmark)

Li 7 Blk _____ Sub. Name Cabaret Ranchettes Subd.

4. USE:
☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEA/FILTER PACK			AMOUNT		METHOD
Material	From	To	Feet	or Pounds	
Chip Bentonite	0	19	2 sacks		Once bore to
Cement	"	"	2 sacks		Seal Depth
1/4 in Gravel	34	340	4 yds		Filled from top
					Down

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____
Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
8"	+1	19 1/2"	230	Steel	☒	☐	☒	☐
5"	+1	214	138	Steel	☐	☒	☒	☐
5"	"	"	258	Steel	☐	☒	☒	☐

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS

☒ Perforations Method Star Wheel Air Perforator
☐ Screens Screen Type _____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
75'	80'	1/4" x 1/4"	25	5"	Steel	☐	☒
110'	140'	1/4" x 1/4"	250	5"	Steel	☐	☒
150'	160'	1/4" x 1/4"	100	5"	Steel	☐	☒
170'	180'	1/4" x 1/4"	50	5"	Steel	☐	☒

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

47 ft. below ground Artesian pressure _____ lb.
Depth flow encountered _____ ft. Describe access port or control devices: 8" Sanitary Well Seal

11. WELL TESTS:

Yield gal./min.	Drawdown	Pumping Level	Time
5		190	4 hrs

Water Temp. 47° Bottom hole temp. 47°
Water Quality test or comments: Good

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
10	0	2	Top Soil		X
10	2	4	Brown Clay		X
10	4	18	Brown Clay Decom Brown Granite		X
8	18	27	Brown Clay Decom Brown Granite		X
8	27	35	Med Hard Brown Granite		X
8	35	37	Fractured		X
8	37	47	Med Hard Gray Brown Granite		X
8	47	51	Fractured Soft Brown Granite		X
8	51	60	Med Hard Gray Granite		X
8	60	61	Fracture 1/4 GPM	X	
8	61	74	Med Hard Gray Granite		X
8	74	75	Fracture 1/4 GPM	X	
8	75	83	Med Hard Gray Granite		X
8	83	84	Fracture		X
8	84	105	Lt Brown Hard Granite		X
8	105	110	Fractured Dk Brown Granite		X
8	110	115	Hard Lt Brown Granite		X
8	115	130	Med Hard to Soft Fractured	X	
8	"	"	Brown Granite	X	
8	130	150	Med Hard Brown Granite		X
8	150	151	Gray Caliche		X
8	151	160	Soft Brown Granite 7/8 in		X
8	160	180	Soft to Med Hard Granite		X
8	180	200	Soft to Med Hard Granite 7/8 in	X	
8	200	208	Soft Brown Granite		X
8	208	211	Fracture		X
8	211	280	Soft Brown Granite 7/8 in Med Hard		X

RECEIVED RECEIVED

DEC 09 1996 NOV 29 1996

Department of Water Resources
Completed Depth 280' (Measurable)
Date: Started 10-11-96 Completed 10-25-96

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Gustin Well Drilling Firm No. 408

Firm Official Robert Gustin Date 10-31-96

and Supervisor or Operator Date 10-31-96

(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

1. WELL OWNER

Name George Mendenhall
 Address 884 Truitt Ave Boise, Id 83712
 Drilling Permit No. 65-13-10-0257
 Water Right Permit No. _____

7. WATER LEVEL

Static water level 6' feet below land surface
 Flowing? ☒ Yes ☒ No G.P.M. flow _____
 Artesian closed in pressure _____ p.s.i.
 Controlled by: ☐ Valve ☐ Cap ☐ Plug
 Temperature 47 °F. Quality Clear
Describe artesian or temperature zones below.

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Well diameter increase ☐ Modification
☐ Abandoned (describe abandonment or modification procedures such as liners, screen materials, plug depths, etc. in lithologic log section 9.)

8. WELL TEST DATA

☐ Pump ☐ Bailor ☒ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
<u>10</u>	<u>140</u>	<u>2</u>

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Monitor
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

4. METHOD DRILLED

☒ Rotary ☒ Air ☐ Auger ☐ Reverse rotary
☐ Cable ☐ Mud ☐ Other _____ (backhoe, hydraulic, etc.)

5. WELL CONSTRUCTION

Casing schedule ☒ Steel ☐ Concrete ☐ Other _____
 Thickness 12.5 inches Diameter 6 inches From 1 feet To 16.3 feet
 _____ inches _____ inches _____ feet _____ feet
 _____ inches _____ inches _____ feet _____ feet
 Was casing drive shoe used? ☒ Yes ☐ No
 Was a packer or seal used? ☐ Yes ☒ No
 Perforated? ☒ Yes ☐ No
 How perforated? ☐ Factory ☐ Knife ☐ Torch ☐ Gun
 Size of perforation? _____ inches by _____ inches
 Number _____ From _____ To _____
 _____ perforations _____ feet _____ feet
 _____ perforations _____ feet _____ feet
 _____ perforations _____ feet _____ feet
 Well screen installed? ☐ Yes ☐ No
 Manufacturer _____ Type _____
 Top Packer or Headpipe _____
 Bottom of Tailpipe _____
 Diameter _____ Slot size _____ Set from _____ feet to _____ feet
 Diameter _____ Slot size _____ Set from _____ feet to _____ feet
 Gravel packed? ☐ Yes ☒ No Size of gravel _____
 Placed from _____ feet to _____ feet

9. LITHOLOGIC LOG

Bore Diam.	Depth		Material	Water	
	From	To		Yes	No
8"	0	2	TOP FILL		
8"	2	20	Decomp. granite		X
6"	20	40	Decomp. granite		X
	40	60	Hard grey granite		X
	60	80	" "		X
	80	100	Softer granite		X
	100	110	Hard grey granite	X	
	110	130	Soft granite		X
	130	149	Hard granite		X
	149	155	Soft brown granite		X
	155	163	Hard granite		X
6"	163	190	Hard granite		X

RECEIVED

AUG 29 1993

Department of Water Resources

Department of Water Resources
 Western Regional Office

10.

Work started 8.12.93 finished 8.14.93

11. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
 Firm Name Mengisco Drilling Firm No. 391
 Address McCall, Id. Date 8.16.93
 Signed by Drilling Supervisor [Signature]
 and _____
 (Operator) [Signature]
 (If different than the Drilling Supervisor)

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name _____
 Lot No. _____ Block No. _____
 County Valley
 Address of Well Site Powderhorn St. Cascade, Id.
 (give at least name of road)

SE 1/4 SE 1/4 Sec 12 T. 13 N ☒ or S ☐
 R. 3 E ☒ or W ☐

USE ADDITIONAL SHEETS IF NECESSARY — FORWARD THE WHITE COPY TO THE DEPARTMENT

Form 239-7
3/95

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only			
Inspected by			
Twp	Rge	Sec	
1/4	1/4	1/4	
Lat:	Long:		
☒ Air	☐ Flowing Artesian		

1. DRILLING PERMIT NO. 00001082
Other IDWR No. 65-97-41-0213-000

2. OWNER:
Name MIKE FACKRELL
Address Box 353
City CASCADE State ID Zip 83611

3. LOCATION OF WELL by legal description:

Sketch map location must agree with written location.

N		Twp. <u>13</u>		North ☒ or South ☐	
E		Rge. <u>3</u>		East ☒ or West ☐	
S		Sec. <u>12</u>		1/4 <u>NE</u> 1/4 <u>SE</u> 1/4	
W		Gov't Lot		County <u>VALLEY</u> 10 acres 150 acres	
		Lat:		Long:	
Address of Well Site <u>219 PONDEROSA LN.</u>					
City <u>CASCADE</u>					

Li. 11 Bk. Sub. Name CABARTON RANCHETS

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEA/FILTER PACK			AMOUNT		METHOD
Material	From	To	Sacks or Pounds		
BEST CHIPS	19	0	5 BAGS		OVER BORE TO
CEMENT	19	0	1 BAG		SEAL DEPTH FEEL
2-1/2" CEMENT SAND	181	50	2000 LBS		FROM TOP DOWN

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s)

Was drive shoe seal tested? ☐ Y ☒ N How?

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	+1	-20'	25	STEEL	☒	☐	☒	☐
4"	-7	81	16	PVC	☐	☒	☒	☐

Length of Headpipe Length of Tailpipe

9. PERFORATIONS/SCREENS

☐ Perforations Method

☒ Screens Screen Type SAWED

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
81	181	0.020	100'	4"	PVC	☒	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

17 ft below ground Artesian pressure lb.

Depth flow encountered ft Describe access port or control devices: SANITARY WELL SEAL

11. WELL TESTS:

Yield gal./min	Drawdown	Pumping Level	Time
<u>2</u>		<u>175</u>	<u>1 Hr</u>

Water Temp. 54° Bottom hole temp. 54°

Water Quality test or comments: GOOD, LITTLE SWEET SMELL

Depth first Water Encountered 94

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
9	0	3	TOP SOIL		☒
9	3	17	BROWN SANDY CLAY		☒
9	17	19	GRAY BROWN DECOMPOSED GRAY		☒
6	19	20	GRAY BROWN DECOMPOSED GRANITE		☒
6	20	48	SOFT GRAY GRANITE		☒
6	48	50	FRAC. BROWN GRANITE		☒
6	50	65	SOFT GREY GRANITE w/ MED HED SPTS		☒
6	65	75	SOFT GREY GRANITE		☒
6	75	94	BIVE GREY GRANITE w/ COITCKE	☒	☒
6	94	110	SOFT GREY GRANITE w/ FRAC.	☒	☒
6	110	125	SOFT BLUE GREEN GRANITE w/ BROWN COITCKE & FRAC	☒	☒
6	125	140	SOFT GREY GREEN GRANITE		☒
6	140	181	SOFT GRAY GREEN GRANITE w/ FRAC	☒	☒

RECEIVED

AUG - 6 1997

RECEIVED

WATER RESOURCES
WESTERN REGION

AUG 14 1997

Department of Water Resources

Completed Depth 181 (Measurable)
Date: Started 7-15-97 Completed 7-16-97

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name GESTIN WELL DRILLING Firm No. 408

Firm Official John M. Minton Date 7-16-97

and Supervisor or Operator Jim Bo Date 7-16-97

(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

RECEIVED
USE TYPEWRITER OR
BALLPOINT PEN

SEP 16 1988

NOV 29 1988

State law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the well.

Department of Water Resources
WELL OWNER

Name Scott Wurthen
Address 10701 Reutzel Dr.
Boise, ID 83709
Owner's Permit No. 65-PP-2-141

7. WATER LEVEL

Static water level 140 feet below land surface.
Flowing? ☐ Yes ☒ No G.P.M. flow _____
Artesian closed-in pressure _____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature 55 °F. Quality clear
Describe artesian or temperature zones below.

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe abandonment procedures such as
materials, plug depths, etc. in lithologic log)

8. WELL TEST DATA

☒ Pump ☐ Bailer ☒ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
<u>1 1/2</u>	<u>240</u>	<u>1</u>

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Test ☐ Municipal
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

9. LITHOLOGIC LOG

Bore Diam.	Depth		Material	Water	
	From	To		Yes	No
<u>10"</u>	<u>0</u>	<u>40</u>	<u>Decomp. granite</u>		☒
<u>6"</u>	<u>40</u>	<u>100</u>	<u>Blue granite</u>		☒
<u>6"</u>	<u>100</u>	<u>160</u>	<u>"</u>		☒
<u>6"</u>	<u>160</u>	<u>200</u>	<u>crystal + granite</u>		☒
<u>6"</u>	<u>200</u>	<u>250</u>			

4. METHOD DRILLED

☒ Rotary ☒ Air ☐ Hydraulic ☐ Reverse rotary
☐ Cable ☐ Dug ☐ Other _____

5. WELL CONSTRUCTION

Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____

Thickness	Diameter	From	To
<u>250</u> inches	<u>16"</u>	<u>1</u> feet	<u>40</u> feet

Was casing drive shoe used? ☒ Yes ☐ No

Was a packer or seal used? ☐ Yes ☒ No

Perforated? ☒ Yes ☐ No

How perforated? ☐ Factory ☐ Knife ☒ Torch

Size of perforation 6 inches by 18 inches

Number	From	To
<u>100</u> perforations	<u>20</u> feet	<u>39</u> feet

Well screen installed? ☐ Yes ☒ No

Manufacturer's name _____
Type _____ Model No. _____

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Diameter _____ Slot size _____ Set from _____ feet to _____ feet

Gravel packed? ☒ Yes ☐ No ☐ Size of gravel _____

Placed from 20 feet to 40 feet

Surface seal depth 20 Material used in seal: ☐ Cement grout

☒ Bentonite ☐ Puddling clay ☐ _____

Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing

☒ Overbore to seal depth

Method of joining casing: ☐ Threaded ☒ Welded ☐ Solvent

Weld _____

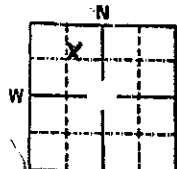
☐ Cemented between strata

Describe access port Sanitary Well Seal

10. Work started 8-26-88 finished 8-27-88

6. LOCATION OF WELL

Sketch map location must agree with written location.



Subdivision Name _____

Lot No. _____ Block No. _____

County Valley

NE 1/4 NW 1/4 Sec. 13, T. 130 N, R. 30 W.

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were
compiled with at the time the rig was removed.

Firm Name Menasco Drilling Firm No. 391

Address Mscall, Id. Date _____

Signed by (Firm Official) CSH

and
(Operator) CSH

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORTUSE TYPEWRITER OR
BALLPOINT PENState law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the well.

WELL OWNER Name <u>John Aschen, Eric Dwyer</u> Address <u>Bain, Idaho</u> Owner's Permit No. _____	7. WATER LEVEL Static water level <u>16</u> feet below land surface. Flowing? ☐ Yes ☐ No G.P.M. flow _____ Artesian closed-in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>80</u> °F. Quality <u>hard</u> Describe artesian or temperature zones below.																																																																								
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)	8. WELL TEST DATA ☐ Pump ☒ Bailer ☐ Air ☐ Other _____ <table border="1" style="width:100%"><thead><tr><th>Discharge G.P.M.</th><th>Pumping Level</th><th>Hours Pumped</th></tr></thead><tbody><tr><td><u>20</u></td><td><u>280</u></td><td><u>2</u></td></tr><tr><td><u>10</u></td><td><u>280</u></td><td><u>1</u></td></tr></tbody></table>	Discharge G.P.M.	Pumping Level	Hours Pumped	<u>20</u>	<u>280</u>	<u>2</u>	<u>10</u>	<u>280</u>	<u>1</u>																																																															
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11. DRILLERS CERTIFICATION I/We certify that all minimum well construction standards were complied with at the time the rig was removed. W. W. Garringer - Well Drilling Firm No. <u>373</u> William W. Garringer 1480 W. Black Canyon Hwy. Date <u>6-20-84</u> Emmett Idaho 83617 Signed by (Firm Official) <u>William W. Garringer</u> and (Operator) <u>W. W. Garringer</u>																																																																									

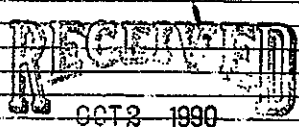
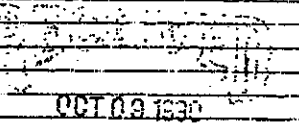
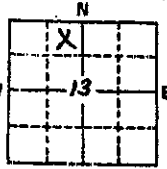
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[illegible]

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

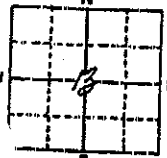
State law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the well.

WELL OWNER Name <u>TRIC W. BOCHM</u> Address <u>28 Palomar Ridge Rd. Box 278</u> <u>CASCADE, IDAHO 83611</u> Owner's Permit No. <u>65-90-W-076-000</u>	7. WATER LEVEL Static water level <u>41</u> feet below land surface. Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed-in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>50</u> °F. Quality <u>good</u> Describe artesian or temperature zones below.																																																																
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Well diameter increase ☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)	8. WELL TEST DATA ☐ Pump ☐ Bailor ☒ Air ☐ Other _____ <table border="1" style="width: 100%; border-collapse: collapse;"><tr><th>Discharge G.P.M.</th><th>Pumping Level</th><th>Hours Pumped</th></tr><tr><td><u>1 1/2</u></td><td><u>265</u></td><td><u>1</u></td></tr></table>	Discharge G.P.M.	Pumping Level	Hours Pumped	<u>1 1/2</u>	<u>265</u>	<u>1</u>																																																										
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USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

WELL OWNER Name <u>W. (Bill) Jones</u> Address <u>10108 Ustick Blvd. Boise Ida.</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>30.1</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Temperature <u>16</u> ° F. Quality <u>good</u> Artesian closed-in pressure _____ p.s.i. Controlled by ☐ Valve ☐ Cap ☐ Plug																												
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6. LOCATION OF WELL Sketch map location must agree with written location. <u>65</u>  Subdivision Name <u>Carborton West</u> Lot No. <u>15</u> Block No. _____ County <u>Valley</u> B.M. _____ 1/4 Sec. <u>13</u> T. <u>13</u> N/S. R. <u>3</u> E/W				10. Work started <u>May 17, 1977</u> finished <u>June 15, 1977</u>																										
11. DRILLER'S CERTIFICATION Firm Name <u>Gay's Well Drilling</u> Firm No. <u>327</u> Address <u>P.O. Box 571 Cascade Ida.</u> Date <u>Sept. 9, 1977</u> Signed by (Firm Official) <u>Ray W. Wilson</u> and _____ (Operator) _____																														

IDAHO DEPARTMENT OF WATER RESOURCES WELL DRILLER'S REPORT

788284

Office Use Only			
Inspected by _____			
Twp _____	Rge _____	Sec _____	
Lat _____	Long _____		

1. DRILLING PERMIT NO. -D-0025-754

Other IDWR No. _____

2. OWNER:

Name Darwin Pancheri

Address 9325 Missouri Ave.

City Nampa State ID Zip 83686

3. LOCATION OF WELL by legal description:

Sketch map location must agree with written location

N

W	E	Twp. <u>13</u>	North ☒ or South ☐
		Rge. <u>4</u>	East ☒ or West ☐
		Sec. <u>713</u>	SW 1/4 10 acres NE 1/4 160 acres NE
S		Gov't lot _____ County <u>Valley</u>	

Lat: _____ Long: _____

Address of Well Site 2nd Ranch on left - Caberton
City Cascade RD

(Give at least name of road + Distance to Road or Landmark)

Lt. _____ Blk. _____ Sub. Name _____

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEAL/FILTER PACK		AMOUNT		METHOD
Material	From	To	Sacks or Pounds	
Cuttings	0	4'		Overbore
Bentonite	4'	25'	11S	Overbore

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 78'

Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	+2'	78'	.250	Steel	☒	☐	☒	☐
4 1/2"	72'	152'	Sec40	PVC	☐	☒	☐	☒

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS

☒ Perforations Method saw

☐ Screens Screen Type _____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
92'	152'	1/4"	160	4.5"	PVC	☐	☒

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

39ft. below ground

Artesian Pressure _____ lb

Depth flow encountered _____ ft. Describe access port or control devices: _____

11. WELL TESTS:

☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Pumping Level	Time
10		120'	30 Min.
8		67'	2 Hrs.

Water Temp. _____ Bottom hole temp. _____

Water Quality test or comments: _____

Depth first Water Encountered 30'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Water				Remarks: Lithology, Water Quality & Temp.	Y	N
Bore Dia	From	To				
10"	0	2'		Top Soil		☒
10"	2'	12'		Brown Clay		☒
10"	12'	15'		Brown Sand		☒
10"	15'	25'		Brown Sand & Gravel		☒
6"	25'	30'		Brown Sand & Gravel		☒
6"	30'	70'		Brown Decomposed Granite		☒
6"	70'	78'		Brown Clay		☒
6"	78'	125'		Brown Decomposed Granite		☒
6"	125'	145'		Coarse Brown/White Decom. Granite		☒
6"	145'	160'		Brown Decomposed Granite		☒

RECEIVED

OCT 24 2002

WATER RESOURCES
WESTERN REGION

Completed Depth: 142' (Measurable)

Date: Started 10/07/02 Completed 10/08/02

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Down Right Drilling & Pump

Firm No. 637

Firm Official Samuel King

Date 10-23-02

Supervisor or Operator Tony Hackett
(Sign once if Firm Official & Operator)

Date 10-23-02

Date: 10/18/2002 Time: 10:27 AM

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well. JUN 14 1989

RECEIVED
JUN 14 1966

JUN 14 1989

WELL OWNER Name <u>Gulf Pacific Cattle Co.</u> <u>RT1 Box 25</u> Address <u>Melba, ID 83641</u> Owner's Permit No. <u>65-89-20-049-000</u>	7. WATER LEVEL Department of Water Resources Static water level <u>35'</u> feet below land surface. Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>50°F.</u> Quality <u>clear</u> Describe artesian or temperature zones below.																																								
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc in lithologic log)	8. WELL TEST DATA ☐ Pump ☐ Baller ☐ Air ☐ Other _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Discharge G.P.M.</th> <th>Pumping Level</th> <th>Hours Pumped</th> </tr> <tr> <td style="text-align: center;"><u>4.7</u></td> <td style="text-align: center;"><u>140</u></td> <td style="text-align: center;"><u>1</u></td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </table>	Discharge G.P.M.	Pumping Level	Hours Pumped	<u>4.7</u>	<u>140</u>	<u>1</u>																																		
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3. PROPOSED USE ☒ Domestic ☐ Irrigation ☐ Test ☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection ☐ Other _____ (specify type)	9. LITHOLOGIC LOG 022356 <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Bore Diam.</th> <th colspan="2">Depth</th> <th rowspan="2">Material</th> <th colspan="2">Water</th> </tr> <tr> <th>From</th> <th>To</th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>8"</td> <td>0</td> <td>3</td> <td>TOP SOIL</td> <td></td> <td>☒</td> </tr> <tr> <td>8"</td> <td>3</td> <td>12</td> <td>DEEP GRANITE</td> <td></td> <td>☒</td> </tr> <tr> <td>6"</td> <td>12</td> <td>20</td> <td>SOFT GRANITE</td> <td></td> <td>☒</td> </tr> <tr> <td>6"</td> <td>20</td> <td>60</td> <td>" "</td> <td></td> <td>☒</td> </tr> <tr> <td>6"</td> <td>60</td> <td>140</td> <td>" "</td> <td></td> <td>☒</td> </tr> </tbody> </table>	Bore Diam.	Depth		Material	Water		From	To	Yes	No	8"	0	3	TOP SOIL		☒	8"	3	12	DEEP GRANITE		☒	6"	12	20	SOFT GRANITE		☒	6"	20	60	" "		☒	6"	60	140	" "		☒
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4. METHOD DRILLED ☒ Rotary ☒ Air ☐ Hydraulic ☐ Reverse rotary ☐ Cable ☐ Dug ☐ Other _____	10. Work started <u>6.9.89</u> finished <u>6.12.89</u>																																								
5. WELL CONSTRUCTION Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Thickness</th> <th>Diameter</th> <th>From</th> <th>To</th> </tr> </thead> <tbody> <tr> <td><u>.250</u> inches</td> <td><u>6</u> inches</td> <td><u>1</u> foot</td> <td><u>15</u> feet</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> Was casing drive shoe used? ☐ Yes ☒ No Was a packer or seal used? ☐ Yes ☒ No Perforated? ☐ Yes ☒ No How perforated? ☐ Factory ☐ Knife ☐ Torch Size of perforation _____ inches by _____ inches Number _____ From _____ To _____ _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Type _____ Model No. _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____ Placed from _____ feet to _____ feet Surface seal depth <u>20'</u> Material used in seal: ☐ Cement grout ☒ Bentonite ☐ Puddling clay ☐ _____ Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing <u>Overbore to seal depth</u> Method of joining casing: ☐ Threaded ☐ Welded ☐ Solvent Weld ☐ Cemented between strata Describe access port: <u>Sanitary well seal</u>	Thickness	Diameter	From	To	<u>.250</u> inches	<u>6</u> inches	<u>1</u> foot	<u>15</u> feet													11. DRILLERS CERTIFICATION I/We certify that all minimum well construction standards were complied with at the time the rig was removed. Firm Name <u>MENASO Drilling</u> Firm No. <u>391</u> Address <u>Melba, ID</u> Date <u>6.12.89</u> Signed by (Firm Official) <u>[Signature]</u> and <u>[Signature]</u> (Operator)																				
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6. LOCATION OF WELL Sketch map location must agree with written location. Subdivision Name _____ Lot No. _____ Block No. _____ <u>Valley</u> <u>SW 1/4 NE 1/4 Sec. 13, T. 13 N., R. 3 E.</u>																																									

USE ADDITIONAL SHEETS IF NECESSARY - FORWARD THE WHITE COPY TO THE DEPARTMENT

Agreement for Specifications
& Locations for Flow Meters

Page 2

**AGREEMENT FOR
SPECIFICATIONS AND LOCATIONS FOR FLOW METERS**

1. Flow meter for water right 65-12891 (Laura and Duane Pancheri):
Model (or equal): Water Specialties ML-03 (low velocity, 50 to 500 gpm flow range); Specifications attached.

Location of installed flow meter for 65-12891:
4-inch pipeline on south side of Brush Creek (See attached map):
Easting: 338646.50; Northing: 375210.42
(GPS coordinates, Scanlan Engineering, Arcview aerial photograph)
Point of Diversion for 65-12891 ("Pancheri Spring Source" on map identifies the infiltration gallery which is the common point of diversion for 65-12891 and 65-13332):
Easting: 338016.00; Northing: 375783.14
(GPS coordinates, Rob Whitney, IDWR field exam, June 2003)
2. Flow meter for water right 65-13332 (Joan and Darwin Pancheri):
Model (or equal): 1-inch Niagara MTX Model 122 (2 to 50 gpm flow range); Specifications attached show this model has a 1-1/4 inch connection.

Location of installed flow meter for 65-13332:
Discharge pipe in pump house (See attached map)
Easting: 338047.09; Northing: 375770.70
(GPS coordinates, Rob Whitney, IDWR field exam, June 2003)
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COSTS

1. Dr. MacGregor will pay for the meters and installation at each location. The meters will be in place for at least one year, following installation, but no longer than three years following installation. At any time after one year, Dr. MacGregor may remove either or both meters, but will remove both meters at the end of three years. Dr. MacGregor will be responsible for maintenance while either or both meters are in place.
2. The Pancheris may add continuous dataloggers to the totalizing flow meters, if they wish at their expense. The Pancheris do not choose to add a continuous datalogger at the time the flow meters are installed, but may later.

INSTALLATION

1. Installation of both flow meters is to be completed by July 30, 2004. Both installation sites are on Pancheri property.
2. The contractor for the installations will be Interwest Supply.
3. The Pancheris may assist, if they wish.
4. Sheri Chapman will be contacted so that he may be present at the installation.
5. Dr. MacGregor will make arrangements to complete the installations by July 30, 2004.
6. Following July 30, 2004, if the Pancheris want to add a continuous datalogger to either or both flow meters, Terry Scanlan must review and agree to the datalogger specifications; and Mr. Scanlan must be contacted so that he may be present at the installation.

DATA COLLECTION

1. Once installed, the totalizing flow meters can be read by Terry Scanlan, or Sheri Chapman, or a mutual designee of Mr. Chapman and Mr. Scanlan, or IDWR staff, including Water District 65 personnel.
2. The totalizing flow meters installed on the Pancheri properties can be accessed for purposes of reading on Monday between the hours of 12:00 noon and 3:00 p.m. every two weeks following execution of this agreement. Access to the Pancheri properties for reading the totalizing flow meters may occur on a more frequent basis as agreed in writing by the parties.
3. The flow meters are to be monitored for a minimum of a year.

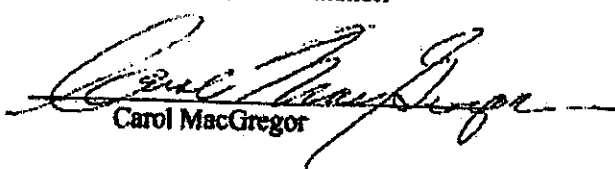
Date: June _____, 2004

Laura or Duane Pancheri

Date: June _____, 2004

Joan or Darwin Pancheri

Date: June 16, 2004


Carol MacGregor

7:21026124F (Final)

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Date: June 19, 2004

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Laura or Duane Pancheri

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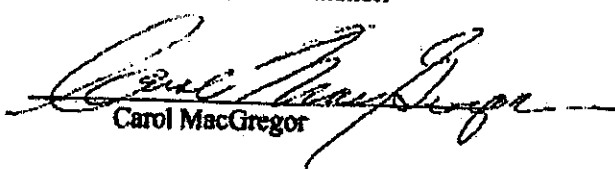
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Darwin Pancheri
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Duane Pancheri
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SCANLAN ENGINEERING

Groundwater and Environmental Engineering

July 26, 2002

Carol MacGregor
1109 Warm Springs Avenue
Boise, ID 83712

Subject: Belvidere Spring Monitoring – July 18, 2002

Dear Carol:

A summary of spring monitoring conducted on July 18, 2002 is provided below. As far as I know, this is the first measurement since November 2, 2001. I was not assisted in these measurements, as Sherl Chapman had another commitment that day.

Temperature measurements were made with a YSI model 30 SCT meter. Flow measurements were made with v-notch weirs.

July 26, 2002 Measurements (by Scanlan)

	Temperature (Deg F)	Flow Rate (gpm)	Remarks
Darwin Pancheri Property			
Pancheri Weir	97.2	8	0.14' on staff gage
Pump Return Flow		0	
Pump Sump Surface (maximum)	106.2		
Pump Sump Overflow	108.0		
2" Diameter Pipeline Vent	113.2		3.22 feet (depth to water below top of pipe)
MacGregor Property			
South Spring Channel Weir	103.8	45	0.28' on staff gage
Lower Hot Pool (maximum)	120.6		
Upper Hot Pool (maximum)	102.4		
Seep 10' south of Upper Pool	111.7		

An updated summary of monitoring data is enclosed. Please call me with any questions.

Sincerely,



Terry M. Scanlan

RECEIVED JUL 29 2002

Carol MacGregor

-2-

July 26, 2002

Cc: Sherl Chapman
Duane Pancheri
Darwin Pancheri

Date	MacGregor				Darwin Pancheri			
	Upper Pool	Seep S. of Upper Pool	Lower Pool	MacGregor Weir	pipe vent	Pancheri Weir	Sump	Pump Sump
	temp	temp	temp	temp	temp	temp	temp	temp
06/07/1999	104		121					
08/03/2000	102.4		119.5	10				
09/01/2000	92.0		116.0	10				
10/18/2000				15				
01/27/2001			116.6				104	88
05/05/2001	102.7		118.0		111.9		103.3	106.5
07/07/2001	100.8		118.9		112.6			108.1
07/21/2001	104.5		119.1	54	112.6	99.7		104.4
08/08/2001	100.0		118.4	45	113.5	91.4+/-		107.1
09/26/2001	101.5	111.8	117.1	45	112.8	93.8	106.3	108.1
11/02/2001	98.8	112.1	117.5	flooded	111.9	86+/-	107.4	106.9
02/16/2002	95.9	112.6	117.3	96.6	111.0	88+/-	105.3	86.2
03/09/2002	93.2	112.6	118.8	88	110.8	80+/-	104.5	85.6
06/01/2002	101.8	112.3	120.6	flooded	108.7	flooded	59.7	flooded
07/18/2002	102.4	111.7		103.8	113.2	97.2	106.2	108
				45	3.22	8		0

Flow is gallons per minute
Temperature is degrees F

Duane Pancheri									
Date	Shop House		Pool		Tomato Can In		Tomato Can Out		Total
	temp	temp	temp	temp	Shop flow	House flow	Shop flow	House flow	
06/07/1999									
08/03/2000									
09/01/2000									
10/18/2000									
01/27/2001	88		95	7.6			1	89	97
05/05/2001	87.3	87.4	97.9	6.2	4.1	62.5	5.2	1	73.1 79.3
07/07/2001									
07/21/2001									
08/08/2001	92.5		101.8				5.4	0.5	54 59.9
09/26/2001									
11/02/2001	88.0	88.7	98.6	6.0	3.7	58.9		<1	70.2 76+/-
02/16/2002									
03/09/2002	80.8			6.2					
06/01/2002	88.9	89.2	95.9	6.3	4.6	63.5	5.0	<1	74 80+/-
07/18/2002									

Flow is gallons per minute
Temperature is degrees F

SCANLAN ENGINEERING

Groundwater and Environmental Engineering

October 12, 2002

Carol MacGregor
1109 Warm Springs Avenue
Boise, ID 83712

RECEIVED OCT 16 2002

Subject: Belvidere Spring Monitoring – October 9, 2002

Dear Carol:

A summary of spring monitoring conducted on October 9, 2002 is provided below. Sheri Chapman assisted me in these measurements.

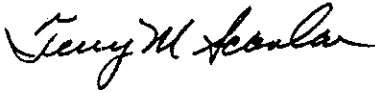
Temperature measurements were made with a YSI model 30 SCT meter. Flow measurements were made with v-notch weirs and a 5.5 gallon bucket with stop-watch.

October 9, 2002 Measurements (by Chapman and Scanlan)

	Temperature (Deg F)	Flow Rate (gpm)	Remarks
Darwin Pancheri Property			
Pancheri Weir	85.5	11	0.16' on staff gage
Pump Sump Surface (maximum)	104.7		
2" Diameter Pipeline Vent	112.6		3.18 feet (depth to water below top of pipe)
MacGregor Property			
South Spring Channel Weir	101.5		weir washed out underneath
Lower Hot Pool (maximum)	117.0		
Upper Hot Pool (maximum)	100.8		
Seep 10' south of Upper Pool	110.8		
Duane Pancheri Property			
<u>Tomato Can In</u>			
Shop Discharge	90.3	5.2	64 sec/5.5 gallons
House Discharge	86.0	2.1	158 sec/5.5 gallons
Pool Inflow	101.5	60.6	5.44 sec/5.5 gallons
<u>Tomato Can Out</u>			
Shop Discharge			not measured
House Discharge		1	15-20% of 5.5 gal in 1 min
Pool Inflow		62.3	4.45 sec/5.5 gallons

An updated summary of monitoring data is enclosed. Please call me with any questions.

Sincerely,

A handwritten signature in cursive script, reading "Terry M. Scanlan".

Terry M. Scanlan

Cc: Sheri Chapman
Duane Pancheri
Darwin Pancheri

Duane Pancheri										
Date	Shop House		Pool		Tomato Can In			Tomato Can Out		
	temp	temp	temp	temp	Shop	House	Pool	Shop	House	Total
06/07/1999										
08/03/2000										
09/01/2000										
10/18/2000										
01/27/2001	88		95	7.6				1	89	97
05/05/2001	87.3	87.4	97.9	6.2	4.1	62.5		5.2	1	73.1 79.3
07/07/2001										
07/21/2001										
08/08/2001	92.5		101.8					5.4	0.5	54 59.9
09/26/2001										
11/02/2001	88.0	88.7	98.6	6.0	3.7	58.9		<1	70.2	76+/-
02/16/2002										
03/09/2002	80.8			6.2						
06/01/2002	88.9	89.2	95.9	6.3	4.6	63.5		5.0	<1	74 80+/-
07/18/2002										
10/09/2002	90.3	86	101.5	5.2	2.1	60.6		1	62.3	68

Flow is gallons per minute
Temperature is degrees F



December 29, 2004

Julie Klein Fischer
White Peterson
5700 East Franklin Road, Suite 200
Nampa, ID 83687-7901

Subject: Monitoring Update - Belvedere Hot Springs

Dear Julie:

Enclosed for your files are monitoring data for Belvedere Hot Springs. The most recent measurement event was Monday, December 27, 2004.

Please contact me with any questions.

Sincerely,

Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor

MacGregor														Darwin Pancheri					
	Upper Pool temp	Seep S. of Upper Pool temp	Lower Pool temp	MacGregor temp	Weir flow	pipe vent temp	DTW (ft)	Pancheri Weir temp	flow	Sump temp	Inlet temp	pump return temp	flow						
6/7/1999	104		121																
8/3/2000	102.4		119.5																
9/1/2000	92.0		116.0																
10/18/2000																			
1/27/2001	102.7		116.6	100.2		111.9	2.96			104		88	16.6						
5/5/2001	100.8		118.0			112.6	3.19			103.3	106.5		0						
7/7/2001	104.5		118.9	106.2	54	112.6	3.18	99.7	7		104.4		0						
8/8/2001	100.0		119.1	104.2	45	113.5	2.56	91.4+/-	8	106.3	107.1		0						
9/26/2001	101.5	111.8	118.4	106.3	45	112.8	3.30	93.8	13	107.4	108.1		0						
11/2/2001	98.8	112.1	117.1	flooded		111.9	3.05	86+/-	13	104.7	106.9		0						
2/16/2002	95.9	112.6	117.5	96.6	54	111.0	2.72	88+/-	13	105.3		86.2	7.3						
3/9/2002	93.2	112.6	117.3	88	54	110.8	2.75	80+/-	15	104.5		85.6	7.2						
6/11/2002	101.8	112.3	118.8	flooded		108.7	2.01	flooded		59.7	flooded		0						
7/18/2002	102.4	111.7	120.6	103.8	45	113.2	3.22	97.2	8	106.2	108		0						
10/9/2002	100.8	110.8	117.0	101.5		112.6	3.18	85.8	11	104.7			0						
8/2/2004		111.9	118.2																
8/16/2004		113.0	119.3			113.9													
9/20/2004	103.1	113.0	120.6			111.9							14						
11/22/2004	100.9	113.0	120.6			111.4							12.2						
12/27/2004	100.6	112.6	121.5			111.4				102.7	106.7	90.1	12						

Flow is gallons per minute

Temperature is degrees F

Belvedere Hot Springs - Flow Meter Monitoring Data

Duane Pancheri Meter				
Date	Time	Inst. Flow	Total Flow	Average Flow
8/2/2004	11:13	66	249800	
8/16/2004	14:41	60	1619700	67.3
9/20/2004	14:47	76	5213600	71.3
11/22/2004	14:30	75	12003700	74.9
12/27/2004	14:49	79	15780700	74.9

Darwin Pancheri Meter				
Date	Time	Inst. Flow	Total Flow	Average Flow
8/16/2004	14:30	0	1299	0.0
9/20/2004	14:47	14	63732	1.2
11/22/2004	13:48	12.2	1221400	12.8
12/27/2004	14:34	12	1832800	12.1

MacGregor				Darwin Pancheri										
	Upper Pool temp	Seep S. of Upper Pool temp	Lower Pool temp	Lower Pool flow	MacGregor Weir temp	MacGregor Weir flow	pipe vent temp	DTW (ft)	Pancheri Weir temp	Pancheri Weir flow	Sump temp	Pump Sump Overflow temp	pump return temp	flow
Date														
06/07/1999	104		121											
08/03/2000	102.4		119.5	10							104	106.5	88	16.6
09/01/2000	92.0		116.0	10							103.3	108.1		0
10/18/2000				15										0
01/27/2001														
05/05/2001	102.7		116.6		100.2		111.9	2.96			104	106.5		0
07/07/2001	100.8		118.0				112.6	3.19				108.1		0
07/21/2001	104.5		118.9		106.2	54	112.6	3.18	99.7	7		104.4		0
08/08/2001	100.0		119.1		104.2	45	113.5	2.56	91.4+/-	8	106.3	107.1		0
09/26/2001	101.5	111.8	118.4		106.3	45	112.8	3.30	93.8	13	107.4	108.1		
11/02/2001	98.8	112.1	117.1		flooded		111.9	3.05	86+/-	13	104.7	106.9		0
02/16/2002	95.9	112.6	117.5		96.6	54	111.0	2.72	88+/-	13	105.3		86.2	7.3
03/09/2002	93.2	112.6	117.3		88	54	110.8	2.75	80+/-	15	104.5		85.6	7.2
06/01/2002	101.8	112.3	118.8		flooded		108.7	2.01	flooded		59.7	flooded		0
07/18/2002	102.4	111.7	120.6		103.8	45	113.2	3.22	97.2	8	106.2	108		0
10/09/2002	100.8	110.8	117.0		101.5		112.6	3.18	85.8	11	104.7			0

Flow is gallons per minute
Temperature is degrees F

Duane Pancher									
		Tomato Can In			Tomato Can Out				
Date	Shop temp	House temp	Pool temp	Shop flow	House flow	Pool flow	Shop flow	House flow	Pool Total flow
06/07/1999									
08/03/2000									
09/01/2000									
10/18/2000									
01/27/2001	88		95	7.6			1	89	97
05/05/2001	87.3	87.4	97.9	6.2	4.1	62.5	5.2	1	73.1 79.3
07/07/2001									
07/21/2001									
08/08/2001	92.5		101.8				5.4	0.5	54 59.9
09/26/2001									
11/02/2001	88.0	88.7	98.6	6.0	3.7	58.9		<1	70.2 76+/-
02/16/2002									
03/09/2002	80.8			6.2					
06/01/2002	88.9	89.2	95.9	6.3	4.6	63.5	5.0	<1	74 80+/-
07/18/2002									
10/09/2002	90.3	86	101.5	5.2	2.1	60.6		1	62.3 68

Flow is gallons per minute
Temperature is degrees F

Duane Pancheri										
Date	Shop House Pool			Tomato Can In			Tomato Can Out			
	temp	temp	temp	Shop flow	House flow	Pool flow	Shop flow	House flow	Pool flow	Total
6/7/1999										
8/3/2000										
9/1/2000										
10/18/2000										
1/27/2001	88		95	7.6			5.2	1	89	97
5/5/2001	87.3	87.4	97.9	6.2	4.1	62.5	5.2	1	73.1	79.3
7/7/2001										
7/21/2001										
8/8/2001	92.5		101.8				5.4	0.5	54	59.9
9/26/2001										
11/2/2001	88.0	88.7	98.6	6.0	3.7	58.9		<1	70.2	76+/-
2/16/2002										
3/9/2002	80.8			6.2						
6/1/2002	88.9	89.2	95.9	6.3	4.6	63.5	5.0	<1	74	80+/-
7/18/2002										
10/9/2002	90.3	86	101.5	5.2	2.1	60.6		1	62.3	68
8/2/2004										66
8/16/2004										60
9/20/2004										76
11/22/2004										75
12/27/2004										79

Flow is gallons per minute

Temperature is degrees F

**SPF**

Water Engineering, LLC
water resource consultants

February 8, 2005

Julie Klein Fischer
White Peterson
5700 East Franklin Road, Suite 200
Nampa, ID 83687-7901

Subject: Monitoring Update - Belvedere Hot Springs

Dear Julie:

Enclosed for your files are monitoring data for Belvedere Hot Springs. The most recent measurement event was Monday, February 7, 2005.

Please contact me with any questions.

Sincerely,

Terry M. Scanlan, P.E., P.G.

Cc: Carol MacGregor

Belvedere Hot Springs - Flow Meter Monitoring Data

Duane Pancheri Meter				
Date	Time	Inst. Flow	Total Flow	Average Flow
8/2/2004	11:13	66	249800	
8/16/2004	14:41	60	1619700	67.3
9/20/2004	14:47	76	5213600	71.3
11/22/2004	14:30	75	12003700	74.9
12/27/2004	14:49	79	15780700	74.9
2/7/2005	14:37	76	20305400	74.8

Darwin Pancheri Meter				
Date	Time	Inst. Flow	Total Flow	Average Flow
8/16/2004	14:30	0	1299	0.0
9/20/2004	14:47	14	63732	1.2
11/22/2004	13:48	12.2	1221400	12.8
12/27/2004	14:34	12	1832800	12.1
2/7/2005	14:55	12	2558870	12.0

Duane Pantheri						
Date	Shop House temp	Pool temp	Shop House flow	Can In flow	Shop House flow	Can Out flow
6/7/1999						
8/3/2000						
9/1/2000						
10/18/2000						
1/27/2001	88	95	7.6		1	89
5/5/2001	87.3	87.4	6.2	4.1	5.2	73.1
7/7/2001						97
7/21/2001						79.3
8/8/2001	92.5	101.8			5.4	0.5
9/26/2001						54
11/2/2001	88.0	88.7	6.0	3.7	<1	70.2
2/16/2002						76+/-
3/9/2002	80.8		6.2			
6/1/2002	88.9	89.2	6.3	4.6	5.0	<1
7/18/2002						74
10/9/2002	90.3	86	5.2	2.1	1	62.3
8/2/2004						68
8/16/2004						66
9/20/2004						60
11/22/2004						76
12/27/2004						75
2/7/2005						79
						76

Flow is gallons per minute
Temperature is degrees F

		MacGregor				Darwin Pancheri							
		Upper Pool temp	Seep S. of Upper Pool temp	Lower Pool temp	MacGregor Weir temp	pipe vent temp	Pancheri Weir temp	Sump temp	Pump Sump Inlet temp	pump return temp	flow		
Date		104		121									
6/7/1999		102.4		119.5									
8/3/2000		92.0		116.0									
9/1/2000													
10/18/2000													
1/27/2001													
5/5/2001		102.7		116.6	100.2	111.9	2.96	104	106.5	88	16.6		
7/7/2001		100.8		118.0		112.6	3.19	103.3	108.1		0		
7/21/2001		104.5		118.9	106.2	112.6	3.18		108.1		0		
8/8/2001		100.0		119.1	104.2	113.5	2.56	106.3	104.4		0		
9/26/2001		101.5	111.8	118.4	106.3	112.8	3.30	107.4	107.1		0		
11/2/2001		98.8	112.1	117.1	flooded	111.9	3.05	104.7	108.1		0		
2/16/2002		95.9	112.6	117.5	96.6	111.0	2.72	105.3	106.9		0		
3/9/2002		93.2	112.6	117.3	88	110.8	2.75	104.5		86.2	7.3		
6/1/2002		101.8	112.3	118.8	flooded	108.7	2.01	59.7	flooded	85.6	7.2		
7/18/2002		102.4	111.7	120.6	103.8	113.2	3.22	106.2	108		0		
10/9/2002		100.8	110.8	117.0	101.5	112.6	3.18	104.7			0		
8/2/2004													
8/16/2004			111.9	118.2		113.9							
9/20/2004		103.1	113.0	119.3		111.9					14		
11/22/2004		100.9	113.0	120.6		111.4		102.7		90.1	12.2		
12/27/2004		100.6	112.6	121.5		111.4		100.4	106.7		12		
2/7/2005		101.1	113.0	120.6	97.7	111.6		101.1	106.3	86.9	12		

Flow is gallons per minute
Temperature is degrees F

Examination and Evaluation
of Geothermal Sites in Idaho

Examination and Evaluation of Geothermal Sites in the State of Idaho with Emphasis Given to Potential for Electrical Generation or Direct Use

By

Jim St. Marie
Idaho Water Resource Research Institute
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September, 2002

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Energy

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Abstract

Several geothermal occurrences in the state of Idaho were examined for their potential for electrical generation and direct use. Five sites were studied in detail with respect to their current conditions and developments, and the potential for future power generation projects: Crane Creek Hot Springs, Raft River, Big Creek Hot Springs, Vulcan Hot Springs KGRA, and the Magic Reservoir Hot Spring area. From this evaluation, Crane Creek Hot Springs was determined to be the best prospect for future development, in light of the current state of private-sector development at the Raft River site. The Vulcan KGRA and Big Creek Hot Springs are considered to be low priority candidates for electrical generation because of their remote locations and other conditions. Additional hydrogeologic information is needed for the Magic Reservoir area to determine the feasibility of a project in this area.

In terms of direct use of geothermal fluids, the cities of Cascade and Lava Hot Springs, and the Bruneau Dunes State Park were all determined to be suitable for new developments or expansions to existing developments. Cascade and Lava Hot Springs are prime candidates for district heating programs using geothermal resources. Bruneau Sand Dunes State Park is a prime candidate for the space heating of a proposed interpretive center using an existing geothermal well.

Idaho possesses a great number of geothermal occurrences, and future developments are not limited to the sites examined in this report. Additional potential, especially with respect to the wide range of direct-use applications, may be feasible in other geothermal resource areas throughout the state.

Section 1. Overview-Geothermal Power and Direct Use

Idaho has been gifted with a large geothermal resource, which is evidenced by the occurrence of 308 hot springs and 745 geothermal wells (IDWR, 2002). These resources were used for centuries by native Americans, and have been developed over the past 100+ years for recreation, district heating, domestic heating, aquaculture, and greenhouse operations. A geothermal power plant at Raft River in south-central Idaho generated electricity for a short time in the early 1980's as part of a United States Department of Energy test. This report describes some of the potential development projects, both power generation and direct use, that may be possible with the use of geothermal energy.

A number of sites in Idaho with geothermal power-generation potential have been examined in the past by governmental and private organizations. A literature search was conducted in the beginning phase of this study to develop initial rankings for the potential geothermal sites in Idaho.

Sites examined included areas where there are hot springs, but no geothermal wells (such as the Big Creek Hot Springs area in Lemhi County) and areas with surface occurrences and very hot wells (such as the Crane Creek area in Washington County, and the Raft River area in Cassia County). The data examined for this report included water temperature at surface and in wells, as well as geochemical data, most notably the thermometric calculations based upon the water chemistry.

The sites examined for their electricity-generation potential in the first phase of this study are (Figure 1):

- Crane Creek Hot Springs area in Washington County
~176° Celsius (°C) reservoir estimate, power estimates to 179 megawatts (MW).
- Raft River Known Geothermal Resource Area (KGRA) in Cassia County
~140°C reservoir, proven 5 MW producer.
- Big Creek Hot Springs area in Lemhi County
~160°C reservoir estimate, power estimates 20-50 MW
- Vulcan KGRA in Valley County
~150°C reservoir estimate, power estimates to 50 MW
- Magic Reservoir area in Blaine and Camas Counties
~149°C reservoir estimate

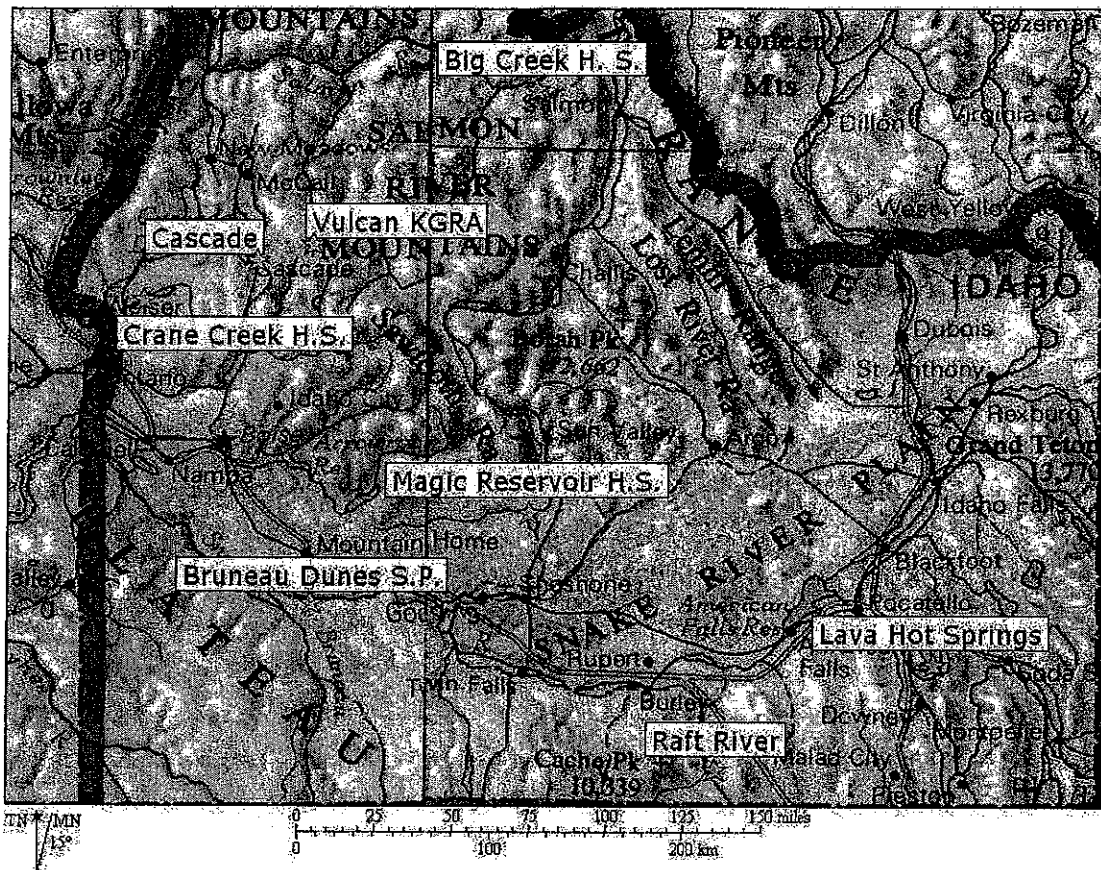


Figure 1. Location of sites examined in this study for electrical generation and direct use.

There are many sites in Idaho that have the potential for direct-use facilities. In this study, three potential sites were selected on the basis of a combination of current use, local interest, or both. The locations that were examined include (Figure 1):

- Cascade in Valley County.
- Lava Hot Springs in Bannock County.
- Bruneau Dunes State Park in Owyhee County

The sites were examined for their respective resources, and the accessibility of those resources.

Section 2. Regulatory Environment

As with any large development project, ownership of the property in question, or the permission to use the property in question, is necessary. In the case of privately-owned property, this requirement may be easily fulfilled. However, in the case of publicly-owned lands, permission must be obtained in the form of permits and leases issued by the federal agency responsible for the lands being developed. In addition to leasing issues, water rights to divert the resource must be acquired through the Idaho Department of Water Resources (IDWR).

Federal Leases

The Geothermal Steam Act of 1970 (United States Code, Title 30 Chapter 25, Sections 1001-1025) requires that geothermal leasing on National Forest System lands be subject to the consent of the United States Department of Agriculture (USDA), Forest Service, rather than the Department of Interior (Bureau of Land Management). The leases are subject to conditions prescribed by the USDA to protect the lands for the purpose for which they were withdrawn or acquired. The Department of the Interior is not authorized to issue prospecting permits for geothermal resources that might occur in National Forest System lands, but the Forest Service may issue a prospecting permit. According to the Boise office of the Bureau of Land Management, as of February 2002, there are currently no geothermal leases or claims on federal lands filed in Idaho. A check with the U.S. Forest Service in Idaho confirms that there are no geothermal leases on Forest Service land in the state.

Geothermal Rights

The Geothermal Resources Act (Idaho Code Title 42, Chapter 40) defines any ground water having a bottom-hole temperature of greater than 100°C as a "geothermal resource." Geothermal resources are put into a classification separate from water resources or mineral resources, and permits separate from those resources must be obtained for their extraction and use.

Water Rights

Article 15 of the Idaho Constitution declares that all waters within the State, both surface and ground, are "subject to the regulations and control of the state in the manner prescribed by law". In addition to leases for any development on federal land, any proposed power-generation facility would also require that water rights be conveyed by the State of Idaho. These rights would have to include any non-

thermal ground water and/or surface water used for cooling or other applications in addition to the geothermal rights.

If the surface water rights to a potential development have not been established prior to 1971 or not adjudicated in the Snake River Basin Adjudication (SRBA), the owner or developer must apply for a water right with the Idaho Department of Water Resources. If a ground water right has not been established prior to 1963 or not adjudicated in the SRBA, the owner or developer must apply with IDWR for the ground water rights. It is unlikely that any potential development would have the water rights in place considering the length of these "grandfather" periods, so the necessary water rights (surface and ground water) for potential developments must be obtained from the IDWR through an application and permitting process.

Energy Regulation

The Public Utility Regulatory Policies Act of 1978 (PURPA), Sections 201 and 210 (since amended), encourages the generation of electricity by small producers (those with a capacity of less than 80 MW), including those utilizing geothermal energy to generate electricity. Under the regulations set forth by PURPA, electric utilities are required to sell electric energy to qualifying cogeneration and small power production facilities and to purchase electrical energy from such facilities.

This 80 MW threshold should not be a problem with any of the sites examined in this study. Indeed, most estimates for electrical generation at potential Idaho sites are lower than this, although the Crane Creek area does have one estimate that is nearly two times the threshold (Bloomquist et al., 1985). Any estimates higher than the PURPA limit of 80 MW are likely to be optimistic, perhaps unreasonably so, and the actual, sustainable level of power generation will probably be much lower than estimated.

A small number of companies manufacture modular geothermal (both flash and binary-cycle) generators that can be installed quickly. Several such geothermal power plants in California and Nevada were constructed in under a year. Some companies, such as Ormat, will build and operate an electrical plant and sell the electricity to the local utility company as provided under PURPA. Other companies, such as Barber-Nichols, will provide design, manufacturing, installation, and testing services, but do not operate the finished plant. Either of these options could be attractive for a development company or a small, rural power cooperative that may or may not want to operate its own generating facility.

Section 3. Electrical Generation

There are three general methods for the geothermal generation of electricity: dry steam, flashed steam, and binary.

1. Dry Steam

The dry steam method taps an underground reservoir of high-temperature steam. The steam expands under the reduced pressure and drives a steam-turbine generator like conventional thermal power-generation plants (Figure 2). The steam is then vented or cooled, condensed, and returned to the underground reservoir via injection wells. Such a power-generation scheme requires large underground steam-filled aquifers or very hot ($>260^{\circ}\text{C}$) water. The only dry-steam power-generation facility currently operating in the United States is The Geysers complex in California.

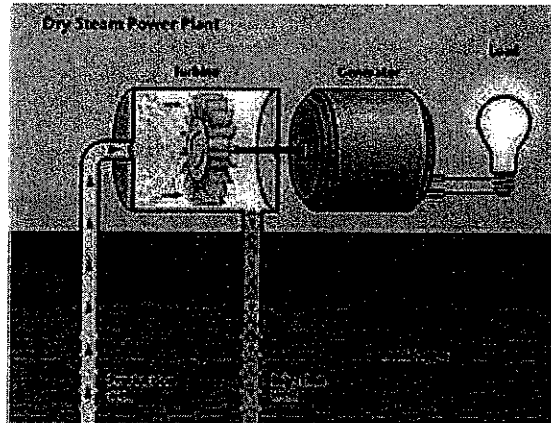


Figure 2. Dry steam electrical generation. (From DOE Geothermal Energy Program web site).

Yellowstone National Park contains dry steam reservoirs, but its status as a national park guarantees that those reservoirs will not be exploited. No such aquifers have been identified in Idaho, although the region near Yellowstone National Park, including the Island Park Caldera region in Fremont County, might contain such a resource. However, this region is sparsely populated, and few thermal wells have been drilled. Even if such a steam aquifer were discovered in the region, the proximity to Yellowstone National Park would probably preclude any development. As a result, the likelihood of developing resources using the dry steam method in Idaho is currently very low. The cost of electricity produced in this manner is approximately 4¢ and 6¢ per kilowatt-hour (kWh) (U.S. Dept. of Energy, 2001), or \$40 to \$60 per MW.

2. Flashed Steam

Flashed-steam power generation taps a reservoir of high-temperature ($>182^{\circ}\text{C}$) water (U.S. Dept. of Energy, *Geothermal Today*, 1999). The decreased pressure at the surface allows some of the water to spontaneously convert (i.e., "flash"), into steam. The steam expands, is separated from the water, and is used to drive a steam-turbine generator. The steam may then be vented, or it may be cooled,

condensed and returned to the aquifer with the remaining water via injection wells (Figure 3). It is possible that a geothermal reservoir suitable for flashed steam generation could be identified and developed in Idaho. Hotter systems in Idaho, such as the Vulcan KGRA and the Big Creek Hot Springs areas may have this potential. The cost of electricity produced in this manner is approximately 4¢ to 6¢ per kWh (Dept. of Energy, 2001), or \$40 to \$60 per MW.

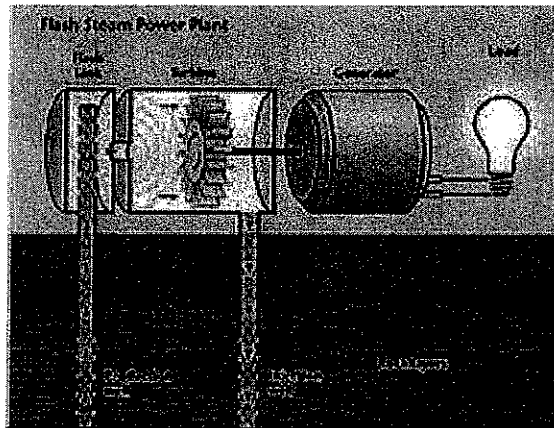


Figure 3. Flashed Steam method of generation. (From DOE Geothermal Energy Program Web Site).

3. Binary

Binary-cycle power plants are designed to use water with temperatures between 107° and 182° C (U.S. Dept. of Energy, *Geothermal Today*, 1999). The heat from the geothermal water is used to boil a second fluid, which is usually an organic compound or a mixture of compounds with a low boiling point. This "working fluid" vaporizes, expands, and drives a turbine generator. The geothermal water is

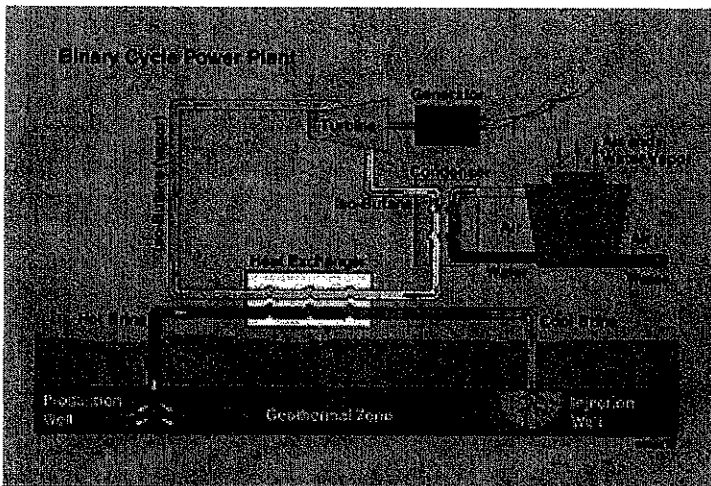


Figure 4. Binary electrical generation method. (From DOE Geothermal Energy Program Web site).

injected back into the aquifer, and the working fluid is cooled, condensed, and recycled (Figure 4). Another method of binary production is to use two working fluids, one of which is pumped down a well to extract the heat from the reservoir through a down-hole heat exchanger, which is then brought back to the surface to boil the second working fluid.

Binary generation does not require fluids as hot as the steam methods, so this method will probably be the one most widely used in the future. Binary generation is not as efficient as the steam methods, but this can be partially countered in that the geothermal fluids can be reduced to a lower working temperature, getting as much energy possible per unit volume (Armstead and Christopher, 1976). Moreover, the potentially corrosive geothermal fluid does not come into contact with the power-generating system and there is no risk of damage to the turbines. One potential problem associated with using hydrocarbon working fluids is that plants may be classified as hazardous-chemical facilities, raising insurance costs. The cost of the generated electricity runs between 5¢ and 8¢ per kW (U.S. Dept. of Energy, 2001), or \$50 to \$80 per MW.

Even though current Idaho residential electrical rates are lower than this rate (Idaho Power Web Site – www.idahopower.com), there would be a market for geothermally-generated electricity, because it qualifies as "green energy" (i.e., electricity generated by renewable methods with a minimum of environmental damage, which includes geothermal, as well as solar and wind power).

Size and space requirements for binary plants vary, but recently constructed plants (in Bloomquist et al., 1989, Appendices) indicate that one acre per megawatt is a good general estimate. This area includes the plant, well field, and support facilities. If cooling ponds are used instead of cooling towers for condensing the working fluid, space requirements may increase by a factor of two or more. Roughly one production well is required to provide two to three MW of electricity. Approximately one re-injection well is required for every two production wells. Actual numbers will vary depending on reservoir temperature, flow rate, etc.

Section 4. Potential for Power Generation

Several potential power-generation sites were examined in this study. The sites listed in this section were examined on the basis of the following factors:

- Location
 - Proximity to markets and/or power grids
 - Approximate population served
- Potential for electrical generation
 - Water temperature
 - Water flow rates
 - Aquifer geology
 - Sustainability of geothermal flows

These sites are presented in their ranked order with the highest potential candidate listed first. It should be noted that various estimates for total power potential have been put forth for a number of these sites in previous reports and publications, and some estimates are quite high (the highest being 179 MW for Crane Creek). However, the criteria for these estimates are rarely documented. Therefore, it is assumed that the authors of these previous reports have given their most optimistic estimates, or estimates of the potential if the entire field were to be developed. It may also be assumed that the likely sustainable power-generating capacity of these sites is some fraction of the previously estimated capacity. Significant fieldwork (geophysics, geochemical, and drilling) would be required in the pre-development and development stages to determine the true sustainable capacity of the field in question.

Five Potential Sites for Power Generation

Previous studies have centered around a small number of sites in the state which have the potential for electrical generation. These sites are considered to have potential based on their surface temperature, as well as estimates of the temperature of the reservoir using geochemical analyses. The sites examined for this study included the following:

- The Crane Creek Hot Springs area east of Weiser in Washington County
- The Raft River area southeast of Burley in Cassia County
- The Big Creek Hot Springs area west of Salmon in Lemhi County
- The Vulcan Hot Springs KGRA east of Cascade in Valley County
- The Magic Reservoir area in Camas and Blaine Counties

1. Crane Creek Hot Springs area (Washington County)

Overview

The Crane Creek Hot Springs area of Washington County is located 12 miles east of the city of Weiser in a predominantly agricultural area (Figure 1). The area was formerly designated as a KGRA with an approximate size of seven square miles (mi²). The springs' surface temperature has been reported at various times ranging from 74° to 77° C. Measurements at the Crane Creek Hot Springs in 2002 yielded a surface temperature of 81° C and an approximate discharge of 30 gallons per minute (gpm). McClain (1979) reported the discharge to be approximately 50 gpm, and that both the silica and Na-K-Ca geochemical thermometers suggest the reservoir temperature is 166° to 176° C. There are at least two other lower temperature hot springs in the immediate vicinity. A watering hole for cattle has been excavated over at least one spring to the west of Crane Creek Hot Springs, and another spring is being used on an adjacent property to the southwest of Crane Creek Hot Springs.

The rocks underlying the Crane Creek area are faulted and gently folded by a north-south trending fault zone (Dansart et al., 1994). In general, the geology consists of tilted blocks of older metavolcanic and metasedimentary rocks with infillings of Miocene basalt and interbedded arkosic sandstone. The aquifer supplying Crane Creek Hot Springs is likely fracture-dominated, and a combination of these different rock formations. Bloomquist et al. (1985 vol.2) calculated the aquifer volume to be 9.3 cubic miles (mi³). A previous geophysical (audio-magnetotelluric) study by the USGS (Hoover et al., 1976) indicated the presence of a shallow conductive zone under Crane Creek Hot Springs (Young and Whitehead, 1975). This may indicate that there is either a substantial reservoir of geothermal water containing significant dissolved ions underlying the area, or that there is a large deposit of conductive minerals, probably deposited by the geothermal system. Either of these scenarios is possible, but Young and Whitehead (1975) describe the geochemistry of the thermal spring waters at Crane Creek as being Na-Cl-SO₄²⁻ with pH values of 7.1 to 8.0. It is unlikely that these waters would be responsible for large-scale metallic deposits, and so it is more likely that the conductivity anomaly below Crane Creek is due to the ionic nature of the reservoir. This study also indicated the presence of a structural "break" that trends roughly north-south, which is interpreted as a fault and is likely the conduit for the geothermal fluids.

McClain (1979) estimated the power potential to be 100 MW and Bloomquist et al. (1985, vol. 2) suggested 179 MW as the field's potential. If these estimates are accurate, the development could require between 100 and 200 acres for the

plant site; it is unknown if this much land is available for development. Additional geologic work will be required to determine the actual field potential.

Mitchell et al. (1984) performed a $\delta D/\delta^{18}O$ isotopic study that indicated the water in the springs may be of Pleistocene age. This could indicate a regional or intermediate groundwater recharge system and possibly slow recharge compared to the area's non-thermal springs. If this is the case, the suitability of the reservoir may be brought into question. However, development using a heat-exchange system as opposed to a fluid-extraction system may still be a very attractive possibility.

Site development:

The Crane Creek area is one of the best choices for a new geothermal power development project in Idaho. The location is convenient to major highways (I-84 and US-95) and to a well-developed power transmission system because of the proximity to the Idaho Power hydroelectric dams on the Snake River. The area is close to the Idaho Power electrical transmission lines coming out of the Hells Canyon dam complex. This is a series of 500kV lines emanating from the dam sites in Hells Canyon. These lines cross the region approximately 7 miles to the west-northwest while running southeast from Brownlee Dam to the Boise metropolitan area. The closest transmission substation on this series of lines is at Midvale, 11 linear miles to the north-northwest of the Crane Creek Hot Springs. The closest transmission substation to the area is in Weiser, approximately 10 linear miles to the west-southwest. However, the capacity of the power lines at the Weiser substation is only 69kV and may not be sufficient for the electric power generated at Crane Creek.

Interwest Development owns 226 acres around Crane Creek Hot Springs, including water rights on Crane Creek. This area abuts BLM land which has no current geothermal leases or claims. Interwest is currently allowing the land to be used for grazing and hopes to use the land as a game bird hunting reserve. Interwest apparently has all of the access required for development, as well as the ability to purchase the adjoining private land. Interwest is strongly favorable to development of this site for electrical generation as well as some kind of cogeneration facility (e.g., ethanol production or food processing) (Leon Blaser, personal communication).

Recommendations

1. Updated geochemistry: The temperature of the reservoir underlying Crane Creek Hot Springs has been estimated to be 160° to 170° C, depending upon the study and the geochemical thermometer used (Young and Mitchell, 1973; Young and

Whitehead, 1975). It would be advisable to conduct new chemical measurements on the water from Crane Creek Hot Springs and to re-calculate the reservoir estimate using the most recently published geothermometer formula. Even though the silica and the Na-Ca-K methods produced similar estimates for the Crane Creek Hot Springs, both methods should be used in the new study for verification purposes.

2. Geologic mapping: The area surrounding Crane Creek Hot Springs has never been geologically mapped in detail. A potential fault zone is visible in the hillside to the southwest of the hot springs in the adjoining property, and may be the fault responsible for Crane Creek Hot Springs. The area should be mapped at a scale of 1:24,000 or smaller in an attempt to reveal any structures that may be allowing geothermal fluids to flow to, or near to, the land surface. This project may be an attractive subject for a graduate-student thesis, and the possibility of graduate research support at the master's degree level should be examined.

3. Geophysical study: The previous audio- magnetotelluric study (Hoover et al., 1976) indicated a shallow conductive zone and a probable fault underlying Crane Creek Hot Springs. This study was rather rudimentary, and further geophysical studies should be undertaken to more accurately determine the subsurface structure in this area. According to Spencer and Russell (1979), the hot springs in the Crane Creek area occur on the east side of the fault zone. Geophysical study could be a very cost-effective method for locating potential drill sites.

4. If the exploratory geophysical and field mapping indicate attractive sites for detailed exploration, one or more exploration wells should be drilled to determine lithologic, structural, geochemical, and temperature information. Interwest Development is concerned with only heat extraction from the reservoir via heat exchanger rather than geothermal fluids via pumping, and the most suitable sites may be at a distance from the springs. By the same token, the areas with the highest heat flow are likely to be those with the highest fluid flow. It is likely that several wells may have to be drilled to determine the site's suitability. The depth of the exploration wells is unknown, but may be predicted using an estimated geothermal gradient. An average gradient, as measured in boreholes or in underground mines, is 2 to 3° C per 100 meters (°C/100m) (Press and Siever, 1974). A lower gradient (e.g., 1.5° C/100m) would result in a lower temperature for a given depth, and a higher gradient (e.g., 5°C/100m) would result in a higher temperature for a given depth. It can be assumed that in the immediate vicinity of the hot springs, the geothermal gradient is higher than normal, but the exact value

cannot be known for certain. Brott, 1976 indicates that the geothermal gradient for three wells in Washington County is 6° to 8° C/100m. If a similar geothermal gradient exists for the Crane Creek area, maximum reservoir temperature may be reached with a 1000 meter well (approximately 3000 feet). This estimate is entirely dependent upon the nature of the temperature gradient. It is likely that one of the reasons for the temperature drop between the reservoir and the spring output is mixing with cool near-surface groundwater. If this hypothesis is true, drilling through this mixing zone may result in a marked increase in water temperature, perhaps close to the estimated reservoir temperature.

Well-drilling can be the most expensive portion of an exploration program, with drilling costs of \$20 to \$25 per foot (for 6-inch wells). Therefore, drilling should commence after suitable targets have been identified.

2. Raft River KGRA (Cassia County)

Overview

The Raft River KGRA lies in Cassia County of south-central Idaho, about six miles north of the Utah border and 15 miles south of the town of Malta. It is one of the most studied geothermal systems in Idaho. The Department of Energy Idaho National Engineering and Environmental Laboratory (INEEL) operated a 5 MW test plant from the fall of 1981 to the spring of 1982. U.S. Geothermal, Inc., of Boise, is in the process of purchasing the Raft River complex from Vulcan Power of Bend, Oregon, and intends to develop the site into a commercial power plant. A few low temperature geothermal springs occur in the area, but the resource was discovered primarily by the drilling of irrigation wells, which was followed by geophysical exploration (Chappell et al., 1978). Allen, et al. (1979) gave a range of bottom-hole reservoir temperatures between 133°-150° C.

The aquifer for the Raft River KGRA is a complex mixture of Tertiary alluvial sediments, sedimentary and metasedimentary rocks, and crystalline rocks which often occur in Basin and Range terranes. Fracturing in the rock is the primary control on the flow of water. Bloomquist et al. (1985 vol. 2) estimate the volume of the aquifer underlying the Raft River KGRA to be approximately 5 mi³. Flows from wells drilled into the aquifer vary greatly. Production ranged from about 15 gpm to 1,250 gpm (Applegate and Moens, 1980).

Site Development

Raft River is the only proven geothermal electricity producer in Idaho. McClain (1979) suggested a 100 MW potential, while Bloomquist et al. (1985)

suggested 12 MW as their best estimate for the area's potential. Based on the work done by the DOE (Bliem and Walrath, 1983), approximately 10 MW can probably be considered a very likely estimate of the field's potential, although greater output may be possible. Much of the work needed prior to full development would be those procedures necessary to pass environmental and regulatory hurdles (e.g., environmental impact statements, water and geothermal rights, etc.).

Recommendations

From the standpoint of development, the Raft River area would likely be the most favorable site in Idaho for electrical production. Much of the necessary infrastructure, including the production and injection wells, is already in place. As stated above, U.S. Geothermal Inc., is planning to develop the Raft River site for electricity generation. As a result, very few (if any) state resources would need to be expended in the development of this resource.

3. Big Creek Hot Springs (Lemhi County)

Overview

Big Creek Hot Springs are located on United States Forest Service land in Lemhi County, approximately 24 miles west-northwest of Salmon, near the Frank Church River of No Return Wilderness. Access to the area is by unimproved and primitive roads.

Big Creek Hot Springs is one of the hottest geothermal systems in Idaho, with a surface temperature of approximately 93° C, (the boiling point of water at the springs' elevation) and a discharge from fifteen vents of approximately 75 gpm (McClain, 1979). Geochemical thermometers indicate that the underground reservoir temperatures are in the 137° to 179° C range (Dansart et al., 1994). Bloomquist et al. (1985 vol. 2) offered a reservoir temperature estimate of 159° C. As such, it is a prime candidate for electrical power development using binary-cycle generation, but the remote location, potential environmental implications, and the sparse population may not justify development.

The aquifer supplying geothermal water to Big Creek Hot Springs is altered granite of the Cretaceous Idaho Batholith, and water flow is controlled by fractures in the rock. Bloomquist et al. (1985 vol. 2) gave an aquifer volume value of 0.8 mi³, based on the estimated area and thickness values used in that study, and as such, cannot be relied upon as a meaningful value. Significant research into the thickness and areal extent of the Big Creek aquifer would be required to determine a more reliable volume.

Site Development

There have been numerous estimates of the electrical potential of the Big Creek Hot Springs area, such as 11 MW (for binary cycle generation) given by Struhsacker (1981), 23 MW from Bloomquist et al. (1985), and according to McClain (1979), the field has a 50 MW potential. All of these figures probably fall into the category of "best estimates," and as a result, the sustainable power that the field can be expected to produce is unknown. Again, significant geologic work would be required to determine the size of the geothermal resource.

Recommendations

The apparent geothermal potential of the Big Creek Hot Springs area alone would make it an attractive candidate for development. However, like Vulcan Hot Springs to the west, Big Creek Hot Springs lies in a scenic, remote, and publicly-owned area. Any power generation facility would be located approximately 10 miles from the closest transmission line to tie into the Idaho Power grid. This line runs from the city of Salmon to the Blackbird mine and is rated at 68 kV.

In order to more accurately delineate the geothermal aquifer, substantial exploration work is needed. Field mapping of the area is a prerequisite to subsurface exploration. However, the value of field mapping may be limited because the bedrock is all Idaho Batholith granite, and the fractures that serve as the fluid conduits may or may not have surface expressions. However, field studies could attempt to identify zones of geothermal alteration that may indicate points of future interest. Other work would most likely consist of geophysical work to determine the nature of the fractures that serve as the fluids' conduits, and hydrogeological studies including the drilling of a number of test wells to determine the production capacity of the aquifer.

The location of Big Creek Hot Springs is probably the main barrier that will be the most challenging to overcome for the development of a power plant. In addition to the construction of the generation facilities, transmission capacity would need to be established, as well as suitable access roads to the remote location. Extensive research is needed to determine the suitability of this site for development. This site would likely require a strongly favorable outlook in terms of the technical, political, and economic factors to drive development forward. The recommendation of this study is that Big Creek Hot Springs remain under consideration, but that other, more readily developable, sites should be considered with higher priority.

4. Vulcan KGRA (Valley County)

Overview

The Vulcan Hot Springs KGRA is located in a remote area of Valley County, over 20 miles east of Cascade. Access is by paved county highway, a Forest Service road, and a 0.75-mile hiking trail. The main vent at Vulcan Hot Springs discharges roughly 500 gpm at a surface temperature of 84° C, and 12 other nearby vents add 100 gpm (Dansart et al., 1994; McClain 1979). Geochemical analysis of the springs indicates a reservoir temperature of about 150° C (Mitchell and Young, 1973). The springs form a hot creek, which has been dammed with logs and tarpaulins at a number of points to create soaking pools.

The aquifer for Vulcan Hot Springs is Cretaceous granite of the Idaho Batholith, and flow is assumed to be fracture-controlled. Bloomquist et al. (1985 vol. 2) give an aquifer volume of 0.8 mi³, which is based upon a "best estimate" of the area and thickness since there are few data for this area.

McClain (1979) estimated the area's electrical potential at approximately 50 MW, although space limitations imposed by the area's rugged topography may limit development potential. The general lack of research data also adds uncertainty to this estimate.

Site Development

Development of the Vulcan Hot Springs KGRA would require a great deal of research and effort. This effort would require geophysical study to determine the subsurface extent of the reservoir and the conduit structures which bring the geothermal water to the surface, geochemical study of the water to confirm reservoir temperature estimates, and well-drilling and reservoir testing to determine the suitability of the reservoir for electrical power generation. Some of this work, specifically the geophysics and drilling, would require the construction of an access road to the springs' discharge area, or would require that all necessary equipment be packed in or flown in by helicopter.

Recommendations

It is unlikely that the Vulcan KGRA will ever be developed due to a number of barriers. First, it is on Forest Service land in a remote and scenic area of a sparsely populated region. Second, the springs are popular as a recreational destination, and development of the springs would probably meet with resistance from hunters, hikers, and campers. Third, the area is a salmon spawning drainage, and development may cause conflict with the Endangered Species Act and raise

objections from environmentalists. In addition, the closest transmission line to the area is about 18 miles to the north and according to an Idaho Power grid map, has a capacity of 69 kV.

Development of the Vulcan Hot Springs KGRA would likely require substantial efforts in road-building and power-transmission capacity, in addition to the actual construction of the generation facility. Any of these required elements would most likely meet with resistance from a number of interested parties, and obtaining the necessary permits would probably be extremely difficult. The recommendation of this report is that development of the Vulcan Hot Springs KGRA not be pursued at this time.

5. Magic Hot Springs area (Blaine, Camas Counties)

Overview

According to Ross (1971), Magic Hot Springs previously discharged near the north edge of Magic Reservoir at 36° C with a discharge of 130 gpm. In 1965, a 259-foot well was drilled near the site of the springs, which discharged 74° C water at a rate of 15 gpm. The springs ceased flowing after the well was completed. Geochemical analysis of the water in this well indicated a reservoir temperature of approximately 149° C (Struhsacker et al., 1984).

Local rock types are basalt, rhyolite, and sediments. The flow of water appears to be controlled by normal faults (Struhsacker et al., 1984). In general, wells drilled near major faults have higher temperature gradients and higher water yields (Dansart et al., 1994). The existence of a number of large geologic structures in the area may indicate the potential for a significant geothermal resource.

No estimates have been made with respect to the electric power potential of the Magic Hot Springs area. Additional geologic data are needed to assess the resource. This would require geophysical studies and the drilling of at least one exploration well determine flow and geothermal gradient information.

The location of the former Magic Hot Springs is approximately two miles from the closest power-transmission line, rated at 138 kV and owned by Idaho Power. The closest substation is also approximately two miles from the Magic Hot Spring location. Other power plants in the area include the Magic Dam hydroelectric project, a new gas-fired power plant, and a planned gas-fired power plant in the area.

Site Development

The Magic Hot Springs area is close to power transmission lines, and with the fossil-fuel power plants in the area, the capacity for additional generation exists. In addition to the generation facilities, the transmission lines necessary to connect the facility to the power grid would have to be erected.

Recommendations

1. Hydrologic study: The primary resource consists of a single well which dried up a single hot spring. Temperature estimates have been made for the reservoir, but there do not seem to be any data on the hydrologic qualities of the reservoir. Testing on the one thermal well should be performed to determine current flow and temperature.
2. Geophysical study: A shallow geophysical study should be performed to determine the subsurface structure, which may point the way to likely sites for exploration and/or production wells.

Section 5. Potential for Direct-Use Projects

In general, the direct use of geothermal fluids for heating, recreation, and aquaculture applications is appropriate when water temperatures are lower than those required for electrical power generation. This encompasses the entire range of low temperature geothermal resources (30 to 100° C), although heat can be extracted from fluids much cooler than that (Forcella, 1984). Of course, geothermal fluids can be extracted without utilizing the thermal energy in any way, such as irrigating crops or watering livestock. Even then, the water's heat can be an asset in the colder months. However, it can also be a detriment during the hot months.

Direct-use involves the removal of either the geothermal fluid (water + heat) from the aquifer, or just the geothermal energy (heat) itself. More complex uses, such as surface and down-hole heat exchangers and even refrigeration units also fall under this category. Some of the specific methods employed are as follows (Forcella, 1984):

1. **Hydronic Heating Systems:** Best when the geothermal fluid can be directly used, these heat-emitting systems (e.g., radiant panels, finned-tube baseboard convector units and forced-air systems) are commonly used for space heating. The primary drawback to these systems is that the geothermal fluid is pumped directly through the heating unit, and these fluids often contain dissolved minerals that can cause corrosion or scale deposition within the units.
2. **Heat Exchangers:** Heat exchangers work by extracting the heat from the geothermal fluid to warm a second fluid. The advantage to this method is that the potentially corrosive or scaling effects of the geothermal fluid are limited to one side of a system, while the radiant heating units on the other side are not affected. Heat exchangers can be operated by pumping water out of a well and into the exchanger, or down-hole exchangers can be used to remove only the heat from the water inside the well without extracting the water.

Three potential sites for direct-use applications.

It is impractical to list all of the sites in Idaho where direct-use applications could be feasible, or even attractive. There are literally hundreds of places where wells have encountered water ranging from a few degrees above mean annual surface temperature to near boiling. Many geothermal direct-use applications are already operating in the state, such as the geothermal heating of the Idaho Capitol Mall Complex, City of Boise buildings, the College of Southern Idaho in Twin Falls, Boise's Warm Springs Water District residential area, numerous greenhouses, resorts, and aquaculture facilities.

As a result, only three potential direct-use sites will be discussed in this report. The interested reader can refer to the Idaho State Geothermal maps (1978, 1994, 2002) or to the Idaho Department of Water Resources web page for information

about the resources throughout Idaho and the various uses of geothermal water in the state (www.idahogeothermal.org).

1. Cascade (Valley County)

Overview

The Cascade, Idaho area overlies a low temperature geothermal resource of unknown size. A number of wells in the vicinity have intersected geothermal fluids in the 29°-37° C range, and a number of other wells have produced water in the 20°-29° C range (Figure 5). All of the thermal wells occur in granite, west of a northeast-trending fault near the site of the now-closed Boise Cascade Corporation sawmill. A portion of the surface trace of a fault can be seen in the Payette River from the mill site. However, heavy glacial cover obscures the remainder of the trace and the orientation of the fault as it moves away from the river. It appears that the fault dips to the east-southeast, and that at least two of the hot wells occur in fractured, decomposed granite on the northwest side of the fault zone.

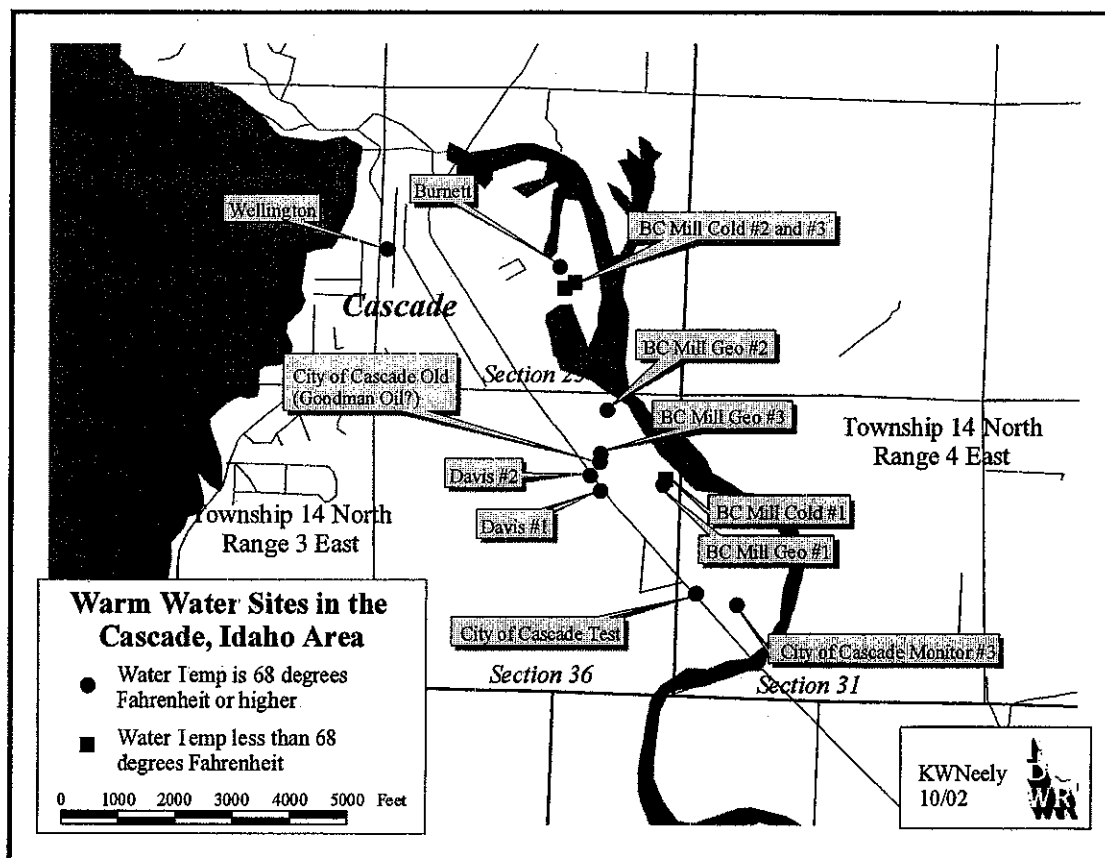


Figure 5. Warm water wells in the Cascade, Idaho Area.

While there are few surface hot springs in the immediate vicinity of Cascade (apart from one submerged in Cascade Reservoir), the region is home to eleven thermal springs within twelve miles of the city that are fault controlled according to Wilson et al. (1976).

Site Development

The city of Cascade has two potential sources of low temperature geothermal water for direct use applications. The first is a well drilled in the 1980's for municipal drinking water in the southern half of the city. According to Mayor Larry Walters of Cascade, this well encountered thermal water of approximately 38° C, was subsequently capped and has not been used since. This well would need to be tested for hydrologic and temperature parameters to determine if it is capable of provide heating water to the city.

The second potential resource is the thermal well on the site of the now-closed Boise Cascade corporation mill. The mill site is being decommissioned, and the future status of the mill site and its property is currently unknown. Negotiations would have to be undertaken to secure the well and its water rights for a city and/or county project.

The Valley County Recreation District is in the early stages of developing a recreation center in Cascade, including a swimming pool complex. At present, the center's projected location is at the north end of the city, near the Payette River's outflow from Cascade Reservoir. This site is approximately 1.5 miles north of the City of Cascade's hot well and 0.8 miles north of the Boise Cascade mill low temperature geothermal well. The original proposed location for the recreation center was in the city park just west of the Boise Cascade mill. This location is within 2,000 feet of the city's low temperature geothermal well and only a few hundred feet from the Boise Cascade well. The temperatures recorded in these wells would be sufficient to heat a swimming pool and associated recreational buildings if the flow is adequate and sustainable.

Another possible use for the geothermal fluids is a district heating program in the city of Cascade. The wells could serve as the head of a trunk line of geothermal fluid that would run down the central business district of Cascade where State Highway 55 passes through the city. Businesses could tap into the geothermal trunk line for heating. If there is sustainable discharge at an adequate temperature, this line could even be continued to the site of the proposed recreation center, where it could be used for space heating, and/or for use in heating the swimming pool, most

likely through a heat exchanger. At this point, the water could be discharged into the Payette River or re-injected into the aquifer system.

In addition to recreation and district heating, the potential for other applications in the Cascade area also exist. These may include greenhouse operations, aquaculture operations (e.g., tropical fish), or food dehydration.

Recommendations

The City of Cascade is a prime candidate for a district-heating program utilizing the low temperature geothermal wells in the area. This could include a business district heating program, the space heating of a proposed recreation center, or both. However, the geothermal system underlying the city seems to be rather "hit or miss," in that one well may tap a geothermal reservoir while a nearby (and deeper) well will produce cool water. Also, while most of the hot wells are close to the river, at least one well has intersected geothermal fluids at about 800 feet depth distant from the river (Ben Wellington, pers. comm., 2002). This disparity would make the development of a system of geothermal wells challenging. Also, it is unknown whether an injection well would be effective in recharging the low temperature aquifer. A study would need to be completed to determine if re-injection would benefit aquifer pressures and the possibility for thermal breakthrough at the production wells.

Exploratory geophysical work should be performed near the existing low temperature geothermal wells in order to determine if there are any structural similarities that may be used to locate and drill other geothermal wells. Each of the low temperature geothermal wells appears to be associated with a fault, but geophysical study may indicate what relationship they have to the faults, and whether they are related to the same fault or separate ones. This geophysical work would likely only need to examine the shallow subsurface (500-1000 feet), as the geothermal wells drilled so far are generally less than 350 feet deep. A widespread geophysical survey may indicate sites attractive for potential production or injection wells.

In addition to geophysical work, reservoir testing needs to be performed on the low temperature geothermal wells belonging to the City of Cascade and the Boise Corporation. This is necessary to determine if the reservoirs intersected by the wells are connected hydrologically. Seeing as how some wells in Cascade have elevated temperatures and others do not, it may be that there are a number of disconnected sources of geothermal fluids underlying Cascade. In addition, injection tests may be

performed to determine if injection of spent fluids after use would positively affect head levels in the geothermal reservoir, and if they would affect water temperatures in the production wells.

Temperature profiles are needed on the existing low temperature geothermal wells in Cascade to determine if there is a specific horizon producing the geothermal waters (although this is probably an unlikely scenario) or to determine if the temperature seen at the wellhead is a result of mixing with colder water from a different level in the well. Temperature profiles could be useful for predicting if the temperature of water from a well might be increased through the judicious use of well casing.

2. Lava Hot Springs (Bannock County)

Overview

The City of Lava Hot Springs (population ~500) is located in Bannock County approximately 30 miles southeast of Pocatello. One of Idaho's truly historic resort areas, Lava Hot Springs centers around the renowned geothermal soaking pools that were used for centuries by Native Americans and which were deeded to the state in 1902 as a health and recreation facility. The State of Idaho, through the Lava Hot Springs Foundation, currently owns and operates the springs (Figure 6). These soaking pools, along with the geothermally-heated Olympic swimming pool complex (also operated by the Lava Hot Springs Foundation), are the basis for the town's resort status. According to the IDWR water rights, the soaking pools utilize 3 cubic feet per second (cfs), which is equivalent to 1346 gpm. The water in the pools is approximately 41° C. Because the sand bottom of the soaking pools covers the spring vents, a direct temperature measurement is not practical. The well that feeds the heat exchanger for the Olympic-size swimming pool has a water right for 0.5 cfs (224 gpm). According to Mark Lowe, director of the Lava Hot Springs Foundation, this water is used only for heating the water in the swimming pool, and discharges into the Portneuf River after it is used.

A number of local businesses, primarily hotels and motels, divert geothermal water from local hot springs and from shallow (less than 100') wells for space heating and for soaking tubs and pools for their guests. In addition, many private residences have soaking tubs built over geothermal springs and wells. The majority of these sites seem to be within a couple hundred feet of the Portneuf River (Figure 6).

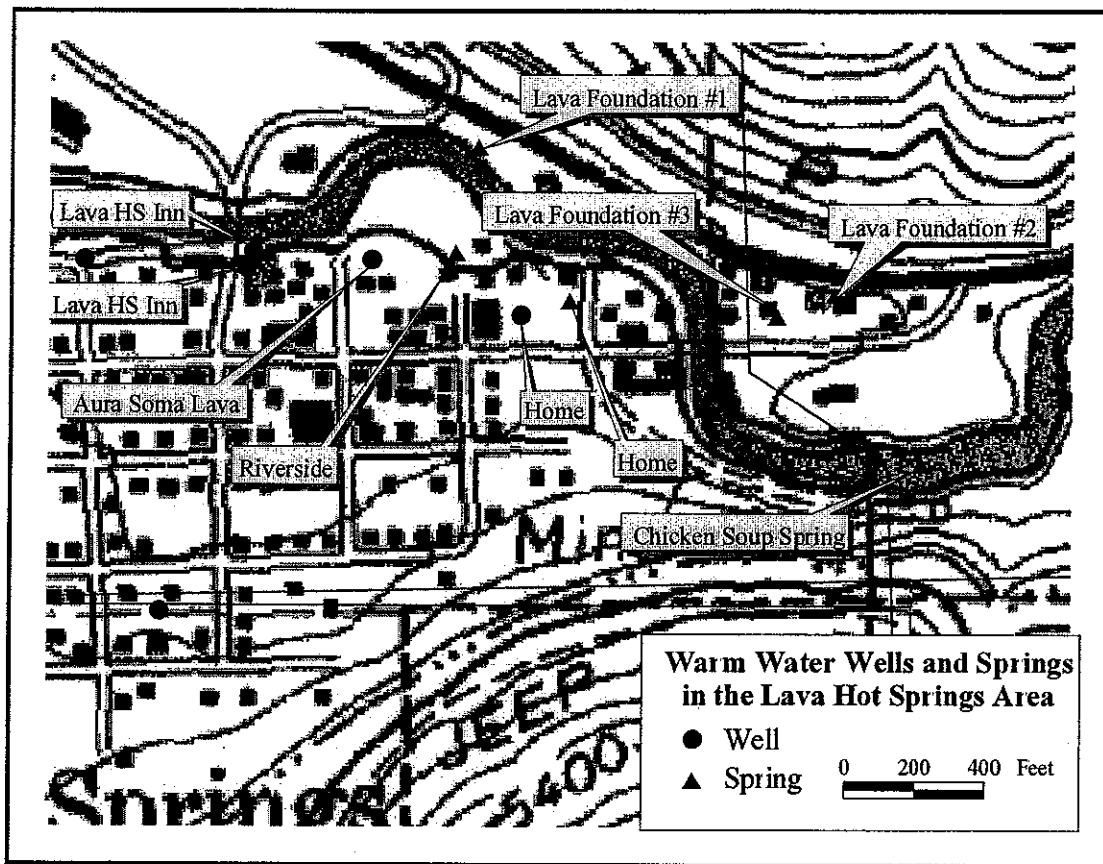


Figure 6. Warm water wells and springs in the Lava Hot Springs Area, Idaho.

At one time, the City of Lava Hot Springs piped geothermal water from the Chicken Soup Spring (the name used by local residents) just east of town. A well was drilled at the Chicken Soup spring to provide water for the city. This well was washed out when the Portneuf River flooded some years ago (none of the local residents spoken to during the reconnaissance trip were able to remember the exact year). The spring discharges from the riverbank with an estimated flow of 1.5 cfs (673 gpm). The temperature of the water was 47° C in August, 2002. The spring is at the end of a dirt road and a dilapidated chain-link fence partially surrounds the site. Schwarze (1960) describes a series of north-south trending normal faults in the area. These faults are likely candidates for the geothermal fluid conduits. However, the hydrogeology of the geothermal system in the Lava Hot Springs area has not been studied in detail and, therefore, is poorly understood.

Site Development

The city of Lava Hot Springs has potential for a space heating project and a district heating program. Mark Lowe indicated that the Community Center, located

on the north side of the river, might be re-fitted for geothermal heat. The line from State Pump House #1 runs north of the Community Center and into the Olympic swimming pool. It may be possible to tap into this line and deliver geothermal water to heat the Community Center.

The Chicken Soup spring, which was previously used for recreation and snow melt, could again be used as a source of geothermal fluids for the town for heating a small number of buildings in the city's downtown area, depending upon the water rights that could be obtained for the spring. The City of Lava Hot Springs has constructed a pipeline from the Chicken Soup Springs to the Lava Spa Motel, and has a lease with this facility to deliver 40 gpm to be used in hot tubs. However, the Lava Spa Motel has not purchased hot tubs so the water is currently returned to the river from the pipeline.

It is strongly recommended that any new development does not divert more water than is currently being discharged by the spring. Any additional development of the geothermal resource underlying the city must be prefaced with a thorough hydrogeological study of the resource. The reason for this is plain: The economic survival of the city is intimately tied to the geothermal resource. Any alteration, however minor, to the geothermal resource could result in an economic damage to the city and its residents, especially if the flow to the soaking pools of the Lava Hot Springs Foundation were reduced. A technical study would require the drilling of a number of test and monitoring wells and the performance of well-interference tests. If such a study shows that additional water can be withdrawn without damaging the flow to the resort, hotels, and local residents, then further exploitation of the resource may be feasible.

Recommendations

The city of Lava Hot Springs sits on a highly attractive geothermal resource. However, the intimate economic ties that the city has to that resource make it difficult to recommend further development because of the potential effects on the existing uses. This is not a simple case of conflicting water rights, but a potential irreversible damage to the city's livelihood. However, the water discharging into the Portneuf River from Chicken Soup Spring is presently unused, and utilization at its current discharge rate would not adversely affect the city's geothermal resource. The discharge should be enough to heat at least one building, if not several buildings, in the downtown area. Candidates for heating may include City buildings, the Lava Hot Springs Museum, or other public buildings. A hydrogeologic study of

the geothermal resource in this area must be conducted as an initial phase of a district-heating project.

A study of the resource was performed by G. Bloomquist of Washington State University, but the results of that study have not yet been received by the IWRR or the IDWR.

3. Bruneau Dunes State Park (Owyhee County)

Overview

The Idaho Department of Parks and Recreation (IDP&R) operates the Bruneau Dunes State Park in Owyhee County. A low temperature geothermal well in the park is currently being used for irrigation. The IDP&R would like to develop this resource for heating a new interpretive center. The well is 990 feet deep, and has a temperature of approximately 37° C. The discharge listed on the IDWR Well Driller's Report is 132 gpm.

Aaron Boston, IDP&R Engineer, indicated that this well is prone to severe drawdown during the summer months, with subsequent recharge to "normal" levels during the winter and spring; this seasonal fluctuation may affect the discharge rate. According to Mr. Boston, the temperature of the well does not seem to vary greatly through this cycle. There may be reasons for this pattern. First, the IDP&R may be pumping too much water from the well. Therefore, use of the water from this well for heating may require the drilling of another well for irrigation. Second, the aquifer may be unconfined, with significant surface recharge due to infiltration of rainwater and snowmelt in the wet months. This may indicate a source of geothermal heat that is independent of the source of the water. If so, a system of down-hole heat exchangers might be used to heat the park buildings.

Recommendations

According to IDP&R Engineer Aaron Boston, the Department of Parks and Recreation is not currently ready for this type of development. However, some preliminary work could be accomplished now in preparation for future development. The use of geothermal by a state agency in a scientific interpretive center would project a favorable image of geothermal heat in Idaho.

Summary for Direct Use

The Cascade, Lava Hot Springs, and Bruneau Sand Dunes sites are the leading candidates for direct-use development projects in Idaho. The potential for development at these sites is fair to excellent. However, each site has barriers to development that will have to be overcome before district heating or other direct use

applications become a reality. In addition to these three sites, a number of other places in Idaho have been studied for district heating projects. Contact the Idaho Department of Water Resources (208-327-7900 or geothermalinfo@idwr.state.id.us) for a listing of these sites, or for additional information about the potential for geothermal direct use in your area of interest.

Section 6. Summary and Recommendations

Power Generation

Idaho has one site, Raft River, where power generation was successful for a short time in the 1980's. Raft River and four other sites were studied for their current power generation potential.

1. Crane Creek

The Crane Creek site in Washington County has high potential for a future power generation facility, but much technical work is needed to prove the resource.

Recommendations for Technical Work:

- a. Cost benefits analysis for determining the feasibility of a power plant, and secondary (direct) use of the geothermal resources.
- b. Updated geochemical study of the waters of Crane Creek Hot Springs.
- c. Geophysical studies of the Crane Creek Hot Springs area.
- d. Detail geologic mapping of the Crane Creek Hot Springs area.
- e. Exploratory drilling in the Crane Creek Hot Springs area **if** prior geophysical work and mapping indicate a favorable situation.

2. Raft River

The Raft River site in Cassia County is being developed by U.S Geothermal, Inc. No technical work needs to be done by the State of Idaho at this time at the Raft River site.

3. Big Creek Hot Springs

The Big Creek site should remain under consideration for electrical development, but no technical work should be directed toward this site until the higher-priority Crane Creek site has been investigated.

4. Vulcan Hot Springs KGRA

No technical work should be pursued at the Vulcan KGRA at this time by IDWR.

5. Magic Reservoir Area

The Magic Reservoir site in Blaine and Camas Counties has very limited hydrogeologic information available at this time. Additional studies to determine the potential of this area can commence after the higher-priority Crane Creek area has been investigated.

Recommendations for Technical Work:

- a. Hydrologic study of the Magic Reservoir Hot Springs area.
- b. Geophysical study of the Magic Reservoir Hot Springs area.

Direct Use

Direct use projects are common throughout southern Idaho. District heating, domestic heating, heating of commercial businesses, recreation, and aquaculture are all current uses of low temperature geothermal resources. Three sites were examined in detail for potential new or expanded developments.

1. Cascade

The Cascade area has proven geothermal resources as evident by the existence of several wells with water temperatures in the 29°-37° C range. However, the capacity of the reservoir system is unknown at this time. The Cascade area has the highest development potential for direct use at this time, and investigations should begin as soon as possible due to a possible window of opportunity with the decommissioning of the Boise Cascade site.

Recommendations for Technical Work:

- a. Cost Benefits analysis to assist the City with planning for new development.
- b. Geophysical study of the Cascade area.
- c. Determination of the availability of resources by thorough reservoir testing (pump tests, temperature profiles, re-injection potential, thermal breakthrough investigations).

2. Lava Hot Springs

The Lava Hot Springs area has proven geothermal resources that are currently being used for heating and recreation. Additional development of the resources could be accomplished by using both the existing Lava Hot Springs Foundation pipeline, and the unused Chicken Soup Spring. This development will not require any new withdrawals from the aquifer system, but would use existing water rights. Technical work with respect to the reservoir is not needed unless additional withdrawals are proposed. However, technical work is needed to determine how to use the water from the Lava Hot Springs Foundation and the Chicken Soup Spring to heat local buildings.

Recommendations for Technical Work:

- a. Determine the infrastructure changes needed to provide geothermal heat to the Community Center.
- b. Determine the infrastructure changes needed to supply geothermal water from the Chicken Soup Springs to downtown buildings on the south side of the river.

3. Bruneau Dunes State Park

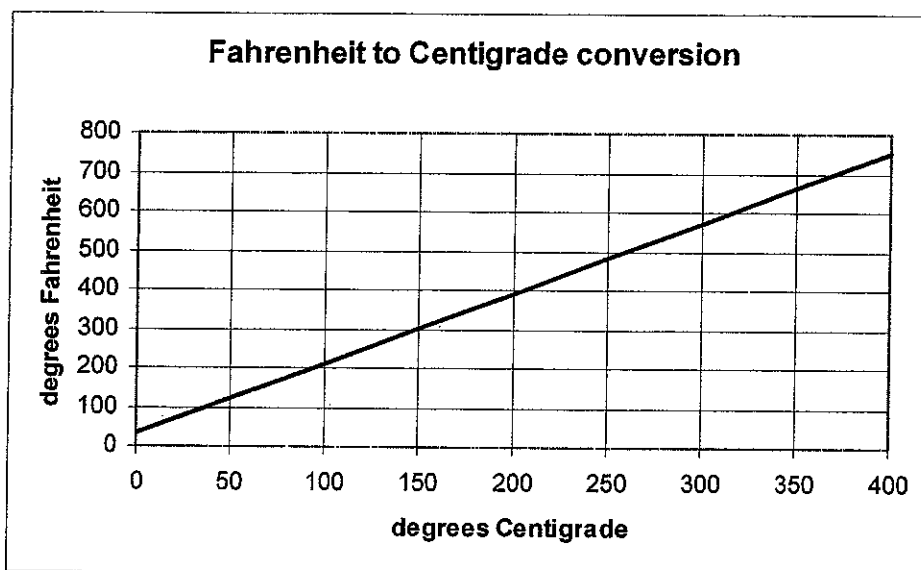
The Bruneau Dunes State Park has a proven low temperature geothermal resource and a desire to use that resource for heating a proposed new interpretive center.

Recommendations for Technical Work:

Investigate heating methods which would be best used in conjunction with the existing low-temperature thermal well in the park and with the new interpretive center.

Appendix 1. Temperature Conversion

Temperatures are given in various reports and publications in either Centigrade or Celsius (metric) scale or in Fahrenheit (imperial) scale. In this report, temperatures are reported in Centigrade. Conversions are based upon the relation $^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32$. The chart below depicts the temperature relations. The boiling point of water is 100°C , or 212°F . The elevated pressure below the surface of the earth inhibits boiling, and the temperatures of subsurface geothermal fluids can be far in excess of the boiling point of water.



References

- Allen, C.A., Chaney, R.E., and McAtee, R.E., 1979, Geochemical Modeling at Raft River, *in* Transactions of the Geothermal Resources Council (Volume Three) Annual Meeting, pp. 1-4.
- Applegate, J.K. and Moens, T.A., 1980, *Geophysical Logging Case History of the Raft River Geothermal System, Idaho*, Los Alamos Scientific Laboratory Informal Report, 30 pp.
- Armstead, H. and Christopher, H., 1976, Summary of Section VII Electricity Production, *Proceedings of the Second United Nations Symposium on the Development and Use of Geothermal Resources* (San Francisco), pp. ciii-cx.
- Bloomquist, R.G., Black, G.L., Parker, D.S., Sifford, A., Simpson, S.J., and Street, L.V., 1985, *Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical Offset in Idaho, Montana, Oregon and Washington*, Bonneville Power Administration Resource Assessment, 2 volumes.
- Bloomquist, R.G., Geyer, J.D. and Sifford B.A., 1989, Innovative Design of New Geothermal Generating Plants, Bonneville Power Administration.
- Bliem, C.J. and Walrath, L.F., 1983, Raft River binary-cycle geothermal pilot plant final report: EG&G Idaho, Inc. Report EGG-2208.
- Boston, Aaron, 2002 personal communication.
- Brott, C.A., Heat Flow and Tectonics of the Snake River Plain, Idaho, Geothermal Investigations in Idaho, Part 8, Idaho Department of Water Resources Water Information Bulletin No. 30, 195 pp.
- Chappell, R.N., Griffith, J.L., Knowles, W.R., and Schultz, R.J., 1978, The Multi-Purpose Geothermal Test and Experimental Activities at Raft River, Idaho, *in* Geothermal Resources Council, TRANSACTIONS, Vol. 2, pp. 83-85.
- Dansart, W.J., Kauffman, J.D., and Mink, L.L., 1994, Overview of Geothermal Investigations in Idaho, 1980 to 1993, Idaho Water Resources Research Institute research technical completion report, 79 pp.
- Forcella, L.S., 1984, *Low Temperature Geothermal Resource Management*, Oregon Department of Energy Report, 28 pp.
- Gawlik, K. and Kutscher, C., 2000, Investigation of the Opportunity for Small-Scale Geothermal Power Plants in the Western United States (Draft), National Renewable Energy Laboratory, 49p.
- Hoover, D.B., Brougham, G.W., and Clark, J.C., 1976, Station and traverse location map, audio-magnetotelluric data log, and telluric profiles for Crane Creek Known Geothermal Resource Area, Idaho, United States Geological Survey Open-File Report #76-409.

Idaho Code, Article 42, Chapter 40.

Idaho Department of Water Resources, 2002, Geothermal Resources: Idaho Department of Water Resources website, (<http://www.idwr.state.id.us/planpol/techserv/gwmon/geotherm.htm>)

Idaho State Constitution, Article 15.

Idaho State Geothermal Map, 1978, 1994, 2002

Lowe, M., 2002, personal communication.

Mabey, D.R., 1983, Geothermal resources of southern Idaho: U.S. Geological Survey Circular 866, 24 p.

McClain, D.V., 1979, Geothermal Energy in Idaho: Site Data Base and Development Status, OIT Geo-Heat Utilization Center & Idaho Energy Office.

Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, *Geothermal Investigations in Idaho Part 9: Potential for Direct Heat Application of Geothermal Resources*, Idaho Department of Water Resources Water Information Bulletin No. 30.

Mitchell, J.C., Bideganeta, K., and Palmer, M.A., 1984, Stable Isotopic Evaluation of Thermal Water Occurrences in the Weiser and Little Salmon River Drainage Basins and Adjacent Areas, West-Central Idaho with Attendant Gravity and Magnetic Data on the Weiser Area, Idaho Department of Water Resources Water Information Bulletin No. 30.

Muffler, L.J.P. (editor), 1979, Assessment of geothermal resources of the United States – 1978: United States Geological Survey Circular 790, 163 pp.

Press, F., and Siever, R.R., 1974 *Earth*, W.H. Freeman, 649 pp.

Ross, S.H., 1971, Geothermal potential of Idaho, Idaho Bureau of Mines and Geology Pamphlet No. 150, 72 pp.

Schwarze, D.M., 1960, *The Geology of the Lava Hot Springs Area, Idaho*, Occasional Papers of the Museum of Idaho State College, No. 4, 51pp.

Spencer, S.G. and Russell, B.F. (eds.), 1979, *Crane Creek KGRA: An Environmental Analysis*, EG&G Idaho, 117 pp.

Spencer, S.G. and Russell, B.F., 1979, *Vulcan Hot Springs KGRA: An Environmental Analysis*, EG&G Idaho, Inc., 125pp.

Struhsacker, D.W., Jewell, P.W., Zeisloft, J., and Evans, S.H., Jr., 1984, The Geology and Geothermal Setting of the Magic Reservoir Area, Blaine and Camas Counties, Idaho.

United States Code, Title 30 Chapter 25, Sections 1001-1025 (Geothermal Steam Act of 1970)

United States Department of Energy, 1999, *Geothermal Today* (1999 Geothermal Energy Program Highlights), 36 pp.

United States Department of Energy, Geothermal Energy Program World Wide Web Site, 2001. (www.eren.doe.gov/geothermal/)

Walters, Larry, 2002, personal communication.

Wellington, Ben, 2002, personal communication.

Wilson, M.D., Applegate, J.K., Chapman, S.L., and Donaldson, P.R., 1976, *Geothermal Investigation of the Cascade, Idaho area*, Department of Geology and Geophysics, Boise State University, 44 pp.

Young, H.W., 1985, Geochemistry and Hydrology of Thermal Springs in the Idaho Batholith and Adjacent Areas, Central Idaho, USGS Water-Resources Investigations Report 85-4172.

Young, H.W., and Mitchell, J.C., 1973, *Geothermal Investigations in Idaho Part 1, Geology and Geochemistry*, Idaho Department of Water Resources Bulletin No. 30.

Young, H.W., and Whitehead, R.L., 1975, *Geothermal Investigations in Idaho, Part 3, An evaluation of thermal water in the Weiser area, Idaho*, Idaho Department of Water Resources Water Information Bulletin No. 30.