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Golder Associates Inc.
CONSULTING ENGINEERS

REPORT ON THE GEOPHYSICAL LOGGING AND TV INSPECTION OF BLAINE WELLS NO. 1 AND NO. 2

BLAINE GROUND WATER MANAGEMENT AREA

Prepared for the
City of Blaine, Washington

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1. INTRODUCTION

This report summarizes the findings of the recent TV inspection and geophysical logging of Blaine Wells No. 1 and No. 2 as part of the Blaine Ground Water Management Program (GWMP). The work described in this report was carried out in accordance with the Data Collection and Analysis Plan (DCAP)[1]. The purpose of the geophysical logging activities was to further refine the understanding of the geology and hydrostratigraphy within the Blaine Watershed (Figure 1-1). This work is part of the data collection activities designed to provide a better understanding of the hydrogeology within the Blaine Groundwater Management Area (GWMA) (Figure 1-1), and determine the occurrence and quality of ground water.

1.1 Scope of Work

The scope of work included the following:

- A TV inspection of Wells No. 1 and No. 2 to determine the location and condition of perforations or well screens, and to determine the general condition of the wells;
- A suite of geophysical logs to determine the stratigraphy, water-bearing zones and to assess water quality; and
- Preparation of this report, which summarizes the findings.

The original plan outlined in the DCAP called for geophysical logging of only Well No. 1, and conducting a 4-hour pump test and concurrent spinner log to identify various zones contributing flow to the well. However, a pumping system could not be devised to run concurrently with the spinner. Thus, the additional logging of Well No. 2 was substituted to augment the data collected from Well No. 1, and to obtain information on the lateral extent of the geologic units.

1.2 Background

Well No. 1 is located within the Blaine Watershed as shown in Figure 1-2. Well No. 1 was drilled in 1926 to a depth of 746 feet below ground surface (bgs). Previously available information indicated that 12-inch diameter casing was installed in the well to the final

[1] *Golder Associates, Inc., 1990. Blaine Ground Water Management Area-Data Collection and Analysis Plan.*

completion depth. Based on a report prepared by Shannon and Wilson in 1975[2], the well was originally perforated in a number of locations below 420 feet bgs. However, the well was reportedly later perforated from 50 to 746 feet bgs.

Well No. 2 is located within the Blaine Watershed, approximately 250 feet northwest of Well No. 1 (Figure 1-2). Well No. 2 was reportedly drilled in 1965 to a final depth of 700 feet. A hand-drafted well log obtained from the City indicates that 10-inch diameter casing was installed to a depth of 189 feet bgs, 8-inch casing was installed from ground surface to a depth of 456 feet bgs, and 6-inch casing was installed from approximately 400 feet bgs to a depth of 634 feet bgs. A well screen was installed between 634 and 642 feet bgs, and the borehole was backfilled from 700 to 642 feet bgs prior to placement of the screen. The well log also indicates that the 10-inch casing was perforated between 72 and 82 feet bgs, 151 and 173 feet bgs, and between 178 and 180 feet bgs. The reason for perforating the 10-inch casing is unclear. However, it may have been perforated during the drilling process to ascertain the quantity of water available in the upper 200 feet before proceeding deeper. There is no record of the 8-inch casing being perforated at the same depths, indicating that water zones in the upper 200 feet were sealed off after the 8-inch diameter casing was installed. The log also indicates that the 6-inch casing was pulled from the well at a later date for some unspecified reason.

[2] *Shannon and Wilson, Inc. 1975. Potential Ground Water Supply - Blaine Watershed, Blaine Washington.*

2. DATA COLLECTION

On January 23, and 24, 1992, Blaine City Wells No. 1 and No. 2 were inspected using a color down-hole TV camera and geophysically logged by Welenco of Pasco, Washington, under the direction of Golder Associates. A TV scan was first conducted in each well to determine the condition of the well and the location of perforations. Then, a suite of geophysical logs were run beginning with fluid temperature, followed by fluid resistivity, caliper, spinner, natural gamma, and neutron-neutron. The logs are presented in Appendix A.

The fluid temperature log was run prior to the other logs to prevent the well water from being disturbed which, in turn, could disturb the original water temperature. The fluid temperature log was run from the static-water level down to the bottom of the well at a rate of 30 feet per minute. The temperature log consisted of both a gradient (temperature measured at a single point), and a differential temperature (a measure of the temperature difference between two sensors on the logging tool). The fluid resistivity log was subsequently run in an identical manner and speed as the fluid temperature log. The fluid resistivity log consisted of a fluid resistivity gradient and a differential fluid resistivity log.

The caliper log was run using a three-arm caliper. The caliper was lowered to the bottom of the well and the arms were extended to measure the diameter of the borehole wall and casing. The spinner log (flow meter) was first run from the static water level down, and then from the bottom up. Using this approach, the up and down logs will show a separation if vertical flow in the wellbore is occurring.

The natural gamma log was run from the bottom up at a rate of 20 feet per minute. The natural gamma log was run prior to the neutron-neutron log to prevent the possibility of obscuring the natural gamma log caused by re-radiation from the sediments after being exposed to the neutron radiation source. The neutron-neutron log was then run from the bottom up at a logging speed of 20 feet per minute, to complete the suite of logs run in each well.

3. RESULTS

3.1 Well Construction

3.1.1 Well No. 1

Based on the TV inspection and caliper log, Well No. 1 is constructed as follows:

- 12-inch diameter casing from 0 to 171 feet bgs;
- 8-inch diameter thread-coupled casing from 171 to 676 feet bgs;
- 6-inch diameter (thread-coupled?) casing from 676 to at least 684 feet bgs where sand was encountered (the well is reportedly completed to a depth of 746 feet bgs);

The casing was observed to be perforated at the following depths:

- 172 to 180 feet bgs;
- 422 to 436 feet bgs;
- 443 to 457 feet bgs;
- 548 to 562 feet bgs;
- 568 to 584 feet bgs;
- 589 to 605 feet bgs;
- 610 to 625 feet bgs;
- 631 to 646 feet bgs;
- 653 to 670? feet bgs;
- 678 to at least 684 feet bgs (sand filled to 684 feet bgs).

Most of the perforations were cut using a mills knife or similar tool after the casing had been installed. These perforations are commonly 2 to 3 inches long and about 1/4 to 1/2 inch wide. The perforations occurring between 172 and 180 feet bgs in the 8-inch diameter casing were pre-cut before the casing was installed.

The 8-inch diameter casing appeared to broken around half the circumference at a depth of 173 feet, and around the entire circumference at a depth of 179 feet. The 8-inch diameter casing also appeared to be broken at a depth of 181 feet, and part of the casing above 181 feet has settled into the casing below 181 feet. The caliper log indicates the diameter of the well at this depth is reduced from 8 inches to less than 7 inches. At a depth of 324 feet bgs, a possible break in the 8-inch diameter casing was noted. The 8-inch diameter casing appears to have collapsed along a vertical row of perforations in places between 548 and 562 feet bgs, 568 and 584 feet bgs, 589 and 605 feet bgs, 610 and 625 feet bgs, and 653 and 670 feet bgs. Between 610 and 625 feet bgs, the casing has collapsed along two rows of perforations. The caliper log indicates that, although the casing has collapsed along rows of perforations, the overall diameter of the casing has not been reduced by more than 0.5 inch. Only minor casing corrosion was noted during the TV inspection.

3.1.2 Well No. 2

The TV inspection of Well No. 2 indicated the presence of 8-inch diameter casing from the surface to a depth of 448 feet bgs, where open borehole was discovered. Because of concerns regarding hole stability, the camera was not lowered into the un-cased borehole. The bottom of the well was later found at a depth of 630 feet while conducting the temperature log. Within the 8-inch diameter casing, no obvious perforations were visible. The caliper log indicates that the borehole averages 10 inches in diameter from 448 to 514 feet, with two minor washed-out sections (11 inches in diameter) at 452 and 548 feet. Below 514 feet, the average borehole diameter was about 9 inches with only minor diameter variations.

The hand-sketched log of Well No. 2 indicates that 6-inch diameter casing once extended to 634 feet bgs with a screen at a depth of 634 to 642 feet bgs. The 6-inch casing has been removed. However, it is unknown if the well screen was also removed.

3.2 Overview of Geology

The geology of the Blaine GWMA (Figure 1-1) consists of Quaternary glacial deposits of the Fraser Glaciation and Pre-Fraser glacial and non-glacial deposits. Very little is known of the Pre-Fraser deposits in the area. A few deep wells of up to 750 feet, however, have been drilled within the Blaine Watershed (Blaine Wells No. 1 and No. 2, in addition to a test well TH-1 and test well No. 20 for the Point Roberts Water Association, see Figure 1-2). These wells encountered what is presumed to be Pre-Fraser glacial sediments at depths of greater than about 300 feet bgs. The geologic formations encountered by these wells are presently unknown, but appear to be primarily low-permeability glacial till and/or glacio-marine sediments with occasional thin water-bearing zones of sand.

The Fraser Glaciation consisted of two glacial advances known and the Vashon and Sumas Stades. The two glacial advances are separated by a period of glacial retreat known as the Everson Interstade. The Vashon deposits consist of a sand and gravel outwash deposit known as the Esperance Sand, and a till deposit known as the Vashon Drift, which consists of unsorted clay, silt, sand, and gravel. As the Vashon glacier retreated, the area was invaded by the sea, and the Everson Interstade sediments were deposited. The Everson Interstade deposits consist of the Kulshan glacio-marine drift, the Deming sand, and the Bellingham glacio-marine drift. The deposits consist of interbedded fossiliferous stony clays, stony silt, till-like mixtures, marine clay, deltaic sand and gravel, fluvial and lacustrine clay, silt, sand, gravel, and peat. During the waning stages of the last glacial period, a small glacial re-advance, known as the Sumas Stade, deposited glacial outwash in the Sumas area.[3,4]

[3] *Easterbrook, D.J. 1976. Geologic Map of Western Whatcom County, USGS Miscellaneous Investigations Series Map I-854-B, Scale 1:62,500.*

Two studies[2,5] conducted by Shannon and Wilson of the potential groundwater supply of the Blaine Watershed indicate the presence of three water-bearing zones within the Watershed that they refer to as Aquifer I, II, and III, for the shallow, intermediate, and deep aquifer, respectively. All three of the aquifers exist within 350 feet of ground surface. At greater depth, Shannon and Wilson identified two to three water-bearing zones that they termed the deep confined groundwater system. Well No. 1 is completed within this deep system, and Well No. 2 was reportedly completed within this system at one time.

A detailed discussion of the geology within the Watershed, and within the GWMA will be presented in the final hydrogeologic characterization report.

3.3 Overview of Geophysical Logging

The geophysical logs were run on Wells No. 1 and No. 2 to assess the stratigraphy and to identify water-bearing zones. The geophysical logs consisted of natural gamma, neutron-neutron, caliper, fluid temperature, fluid resistivity, and spinner. The natural gamma and neutron-neutron logs provide information regarding the physical properties of the geologic strata. The natural gamma log measures gamma radiation emitted from naturally radioactive elements contained within the sediments. The most common radioactive element is potassium-40, which is most often found in clays. Thus, the natural gamma log is used to assess clay content of the sediments. The neutron-neutron log measures the amount of neutron radiation remaining after the neutron radiation leaves the source on the logging tool and passes through the surrounding sediments. Neutron radiation is reduced by the presence of hydrogen which occurs most abundantly in water. Thus, the more water present in the surrounding sediments, the less neutron radiation makes it back to the sensor on the logging tool. This can then be related to sediment porosity, which is related to its water-bearing potential. The caliper log also provides geologic stratigraphic information (consolidation of the material) in open borehole sections, and provides casing condition and diameter information. The remaining logs (fluid resistivity, fluid temperature, and spinner) provide information regarding fluid movement within the wells, which in turn provides clues to the location of water-bearing zones, and also provides water-quality information.

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[4] *Armstrong, J.F., Crandell, D.R. Easterbrook, D.J., and Noble, J.B., 1965. Late Pleistocene Stratigraphy and Chronology on Southwestern British Columbia and Northwestern Washington. Geological Society of America Bulletin, Vol. 76, p. 321-330.*

[5] *Shannon and Wilson, Inc. 1986. Re-Evaluation of Groundwater Resources within the Blaine Watershed, Blaine, Washington.*

3.4 Interpretation of Geophysical Logs

3.4.1 Well No. 1

The following general stratigraphy is inferred from the geophysical logs of Well No. 1:

- 0 to 108 feet, low permeability glacio-marine deposits; Everson Interstade
- 108 to 180 feet, potentially water-bearing low-clay content material. Two potential aquifers appear to be present within this zone from 108 to 135 feet bgs and from 172 to 180 feet bgs (the well is perforated from 172 to 180 feet.). These two potential aquifers may correspond with Aquifers I and II, as designated by Shannon and Wilson;
- 180 to 247 feet, low-permeability till or glacio-marine deposits;
- 247 to 255 feet, potentially water-bearing low-clay content material. The well is not perforated at this depth. This zone may correspond with Aquifer III, as designated by Shannon and Wilson;
- 255 to 610 feet, generally low-permeability glacial sediments, with occasional thin (less than 5 feet thick) layers of potentially water-bearing material;
- 610 to 625 feet, water-bearing material; and
- 625 to 684 feet bgs, generally low-permeability glacial sediments with possibly a few water-bearing zones less than 5 feet thick.

The fluid temperature, fluid resistivity, and spinner logs (Appendix A) indicate that there are two major water-bearing zones that are perforated in Well No. 1; one between 172 and 180 feet bgs, and the other between 610 and 625 feet bgs. The temperature of the water column between these two zones remains nearly constant, indicating that water is flowing vertically in the well. If the water column in the well were stagnant, the temperature of the water would increase with depth at the geothermal gradient (approximately 1° F per 100 feet). The fluid resistivity between 180 and 610 feet bgs also remains relatively constant, indicating that the water in this section of the wellbore is coming from the same aquifer.

The spinner log indicates upward flow in the wellbore between the deep aquifer (610 to 625 feet) and the shallow aquifer (172 to 180 feet). The impeller on the spinner logging tool turns at a rate corresponding with the rate of fluid passing by the tool, which, because the tool is moved at a constant rate, corresponds to the rate of vertical movement of water in the wellbore. As the tool was lowered into Well No. 1 below the aquifer at 610 to 625 feet bgs, the impeller slowed down, indicating a reduction of upward flow as the tool passed below the aquifer into stagnant water. On the up-run, the impeller slowed as the tool was being pulled up past the deep aquifer, indicating stagnant conditions below the aquifer and upward moving water (in the same direction as the tool) above the aquifer. A similar, but opposite response occurred at a depth of 172 to 180 feet bgs, indicating stagnant water above 172 feet and upward flowing water below 180 feet. The temperature, fluid resistivity, and spinner logs do not indicate the presence of additional perforated water-bearing zones, although flow contribution from other zones cannot be entirely ruled out. Flow from other zones may just be overshadowed by the effects of the two most productive zones.

The fluid resistivity log indicates that groundwater from the aquifer between 610 and 625 feet has a lower resistivity (higher specific conductance) than the groundwater from the aquifer between 172 and 180 feet bgs. Between 610 and 625 feet bgs, the fluid resistivity decreases slightly to about 18.5 ohm-m. Upward toward the aquifer at 172 to 180 feet bgs, the resistivity remains relatively constant. However, above 172 feet, resistivity of the water increases to over 32 ohm-m. This increased resistivity is due in part to decreasing fluid temperatures near ground surface. However, it is also likely due to a greater interaction of the waters above 172 feet in the wellbore with the water from the aquifer between 172 and 180 feet bgs.

Water quality samples collected and analyzed from the Watershed wells are presented in Table 3-1. This table illustrates that the groundwater from Well No. 1 has a higher specific conductance (130 to 360 mg/L) than the shallower nearby Watershed wells, such as No. 3 and No. 4 (110 to 140 mg/L). This suggests that pumping of Well No. 1 produces groundwater from both the zone between 610 and 625 feet bgs and the shallower zone between 172 and 180 feet bgs.

3.4.2 Well No. 2

The following general stratigraphy is inferred from the geophysical logs of Well No. 2:

- 0 to 90 feet bgs, low-permeability glacio-marine deposits;

- 90 to 185 feet bgs, potentially water-bearing low-clay content sediments. Within this zone, there appear to be two aquifers occurring at depths of between 108 and 116 feet bgs, and between 140 and 146 feet bgs. The aquifer occurring between 108 and 116 feet bgs may correspond with Aquifer I, as designated by Shannon and Wilson. It is unclear if the second aquifer corresponds to Shannon and Wilson's Aquifer II; and

- 185 to 630 feet bgs, low-permeability glacial deposits with high clay content, with a few potential water-bearing zones less than 5 feet thick (the shift in the gamma and neutron logs below 450 feet bgs is likely caused by the shielding effect of the casing between ground surface and 448 feet bgs.).

Fluid temperatures between about 120 and 190 feet bgs change with depth in a fashion typically thought to be caused by vertical movement of water within the wellbore. However, fluid movement within this zone is unlikely, because the 8-inch diameter casing is not perforated within this interval. A possible explanation for the observed temperatures is that vertical flow is occurring outside to the 8-inch diameter casing between perforated sections in the 10-inch diameter casing, which could influence fluid temperatures inside the 8-inch diameter casing. Another possibility is that vertical fluid movement is occurring within the 8-inch diameter casing between breaks in the casing. However, no breaks in the casing were observed during the TV inspection, and therefore the first scenario is considered the most likely explanation for the observed temperature profile.

Below a depth of 200 feet, the fluid temperature, fluid resistivity, and spinner logs indicate no vertical flow in Well No. 2. For example, between 200 and 630 feet bgs, fluid temperature increased at a rate consistent with the geothermal gradient, which is indicative of stagnant conditions. The stagnant conditions in Well No. 2 suggests that the well does not tap more than one major aquifer. If more than one aquifer were tapped by the well, at least some vertical flow between the two aquifers would be expected, since in most cases, the hydraulic head in each aquifer differs enough to induce flow. No major potential water-bearing zones were identified from the natural gamma and neutron-neutron logs of Well No. 2. However, City records indicate that the well has produced up to 330 gpm in the past. Based on the geophysical logs of Well No. 1 (located about 250 feet to the south), which indicates the presence of an aquifer between 610 and 625 feet bgs, and the hand-sketched log of Well No. 2, there appears to be an aquifer at the present bottom of Well No. 2 that is contributing most of the flow to the well.

this well 2 only 500' away for #1!

The specific conductance of samples collected from Well No. 2 over the years averages about 350 mg/L compared with an average of 130 mg/L from samples collected from Wells No. 3 and 4, which are installed in aquifers less than 200 feet from the surface. In addition, sodium concentrations are much higher (50 to 60 mg/L) in Well No. 2 than the sodium concentrations in the other shallow wells (5 to 10 mg/L) (Table 3-1). This suggests that the water obtained from Well No. 2 is not coming from the shallow aquifers tapped by other City wells in the Watershed, and further indicates that the water is coming from an aquifer at the very bottom of the well (630 feet bgs).

4. DISCUSSION

The geophysical logs of City Wells No. 1 and No. 2 indicate the presence of two to three water-bearing zones at a depth of less than 300 feet bgs, which is consistent with the three aquifers identified by Shannon and Wilson. The logs also indicate the presence of a deep water-bearing zone at a depth of about 620 feet bgs, which is consistent with the deep groundwater system described by Shannon and Wilson. This deep zone appears to contribute most or all of the flow to Well No. 2. Well No. 1, however, appears to be producing water from the deep zone (610 to 625 feet) and a shallow zone between 172 and 180 feet bgs. At present, the potential yield of the deep zone is unknown. However, the reported 330 gpm yield of Well No. 2, suggests that the deep aquifer may be capable of yielding enough groundwater to warrant further investigation. A pump test from a properly installed well in the deep aquifer would provide the required information to assess the long-term water supply potential of this aquifer.

Lateral correlation of the geologic strata appears, in general, to be good between Wells No. 1 and No. 2 (located about 250 feet apart), as illustrated by the geologic cross section presented in Figure 4-1. However, a number of important differences indicates that the lateral extent of water-bearing materials in the shallow aquifer system (approximately 100 to 300 feet deep) may vary significantly. For example, the upper-most potential aquifer appears to thin from about 35 feet at Well No.1 to about 8 feet at Well No. 2; the next deepest potential aquifer occurring at Well No. 2 at a depth of between 140 and 146 feet bgs appears to thin or pinch out toward Well No. 1; and, the deeper aquifer found at Well No. 1 at a depth of 172 to 180 feet bgs, appears to thin considerably or is absent at Well No. 2. In addition, a potentially water-bearing zone found at a depth of 247 to 255 feet bgs at Well No. 1 does not seem to be present at Well No. 2. These differences in the water-bearing materials over a lateral distance of only about 250 feet suggests that the character of aquifers encountered at any given location throughout the Watershed and beyond, is likely to vary significantly. A detailed discussion of the local and regional geology and stratigraphic correlation throughout the Watershed and the GWMA will be presented in the final hydrogeologic report.

The deep aquifer identified in Well No. 1 at a depth of 610 to 625 feet bgs may not be present at other locations within the Watershed, or the aquifer properties may differ substantially, as evidenced by Well No. 20 and test well TH-1. Well No. 20 (now abandoned) located about 750 feet southeast of Well No.1 was drilled to a depth of 661 feet bgs without encountering an aquifer below 200 feet bgs. Test well TH-1, located about 2,200 feet northwest of Well No. 1 encountered a water-bearing zone at a depth of 470 to 507 feet bgs, and another at 600 to 616 feet bgs. However, Shannon and Wilson reported that the production potential of these zones was not adequate for development. Thus, it appears that the character of deep aquifers in the Watershed and surrounding area is likely to differ significantly from location to location. However, final judgment as to the potential of the deep aquifer system should be made only after conducting a pump test in a properly designed well installed within the aquifer. The City is considering rehabilitating

Well No. 2, which could then be pump tested for the purposes of evaluating the deep aquifer groundwater supply potential. The results of such an investigation, should it be undertaken, will be presented in the final hydrogeologic report.

Tables

TABLES

Table 3-1

Water Quality of Blaine Municipal Wells

Analyte	Maximum Contaminant Level (mg/l)	Well Number												
		1				2		3						
		(1949)	(1959)	(1979)	(1990)	(1979)	(1990)	(1959)	(1960)	(1962)	(1965)	(1968)	(1969)	(1979)
Arsenic	0.05	-	-	<0.02	<0.01	<0.02	<0.01	-	-	-	-	-	-	<0.02
Alkalinity (CaCO3)	NA	-	-	-	-	-	-	-	57	60	59	62	62	-
Barium	1	-	-	<0.5	<0.25	<0.5	<0.25	-	-	-	-	-	-	<0.5
Bicarbonate (as CaCO3)	NA	78	70	-	-	-	-	70	70	73	72	72	75	-
Carbonate	NA	-	-	-	-	-	-	0	-	0	0	2	0	-
Cadmium	0.01	-	-	<0.001	<0.002	<0.001	<0.002	-	-	-	-	-	-	<0.001
Calcium	NA	12	12	-	-	-	-	12	-	14	14	-	15	-
Chloride	NA	3.3	2.5	17	30	47	35	2.5	-	2.5	2.8	3	2.4	6
Chromium	0.05	-	-	<0.02	<0.01	<0.02	<0.01	-	-	-	-	-	-	<0.02
Color	15 units	-	-	3	5	12	5	5	-	5	0	0	0	5
Fluoride	2	0.2	0.1	0.1	<0.2	0.2	<0.2	0.1	-	0.1	0.2	0.2	0.1	0.1
Hardness(CaCO3)	NA	57	51	65	70	56	60	51	61	57	54	60	58	53
Iron	0.3	0.01	0	<0.1	<0.1	<0.1	<0.1	<0.1	-	0.01	-	<0.01	0.03	<0.1
Lead	0.05	-	-	<0.01	<0.002	<0.01	<0.002	-	-	-	-	-	-	<0.01
Magnesium (Tot)	NA	6.5	5.2	-	-	-	-	5.2	-	5.4	4.8	4.9	4.9	-
Manganese	0.05	0	-	0.03	0.035	0.01	0.018	-	-	<0.05	<0.05	0.01	<0.05	<0.01
Mercury	0.002	-	-	<0.001	<0.0005	<0.001	<0.0005	-	-	-	-	-	-	<0.001
Nitrate (as N)	10	0.1	0.1	0.2	<0.2	0.2	0.3	0.1	-	0.4	0.9	0.8	0.5	0.4
Potassium	NA	2	-	-	-	-	-	1.3	-	1.3	1	1.2	1.2	-
Selenium	0.01	-	-	<0.005	<0.005	<0.005	<0.0005	-	-	-	-	-	-	<0.005
Silica	NA	24	25	-	-	-	-	25	-	25	21	25	24	-
Silver	0.05	-	-	<0.02	<0.01	<0.02	<0.01	-	-	-	-	-	-	<0.02
Sulfate	250	6.7	4.4	-	-	-	-	-	-	-	5.6	6	6.3	-
Sodium	NA	5.8	5.1	-	50	-	60	5.1	-	5.5	5.4	5.5	5.3	-
Spec. Conductance	700 us/cm	133	-	180	360	325	380	129	128	137	133	143	140	120
TDS	500	99	93	-	-	-	-	93	-	98	93	104	99	-
pH	6.5-8.5	-	-	-	-	-	-	7.5	7.4	7.8	7.9	8.4	8.1	-
Temperature deg F	NA	-	-	-	-	-	-	48.2	46.4	-	-	42.8	53.6	-

(*) Indicates exceedance of MCL

Table 3-1 (cont.)

Analyte	Maximum Contaminant Level (mg/l)	Well Number											
		4			5			6	7	Lincoln Park			12th & G St.
		(1979)	(1990)	(1990)	(1975)	(1979)	(1986)	(1990)	(1990)	(1973)	(1979)	(1983)	(1956)
Arsenic	0.05	<0.02	<0.01	-	-	<0.02	0.012	-	<0.01	-	<0.02	<0.01	-
Alkalinity (CaCO3)	NA	-	-	80	89	-	-	82	-	-	-	-	-
Barium	1	<0.5	<0.25	-	-	<0.5	<0.25	-	<0.25	-	<0.5	<0.25	-
Bicarbonate (as CaCO3)	NA	-	-	80	108.6	-	-	82	-	-	-	-	100.8
Carbonate	NA	-	-	<5	-	-	-	<5	-	-	-	-	-
Cadmium	0.01	<0.001	<0.02	-	-	<0.001	<0.002	-	<0.002	-	<0.001	<0.002	-
Calcium	NA	-	-	10	20.8	-	-	16	-	-	-	-	12.3
Chloride	NA	4	5	<5	2.5	4	15	<5	<5	5	5	<5.0	5.5
Chromium	0.05	<0.02	<0.01	-	-	0.04	<0.01	-	<0.01	-	<0.02	<0.01	-
Color	15 units	3	5	<5	4	3	5	<5	5	1	7	5	1
Fluoride	2	0.1	<0.2	-	0.4	0.2	<0.2	-	<0.2	0	0.3	<0.2	-
Hardness(CaCO3)	NA	50	-	-	52	75	80	-	80	80	86	-	60
Iron	0.3	<0.1	<0.1	<0.05	0.23	<0.1	.48*	0.29	<0.01	0.05	<0.1	<0.05	0.05
Lead	0.05	<0.01	<0.002	-	-	<0.01	<0.01	-	<0.002	-	0.01	<0.01	-
Magnesium (Tot)	NA	-	-	4	4.8	-	-	7	-	-	-	-	7.1
Manganese	0.05	<0.01	<0.01	<0.02	0.04	0.04	0.078*	0.03	0.047	0.01	0.02	0.053*	0.01
Mercury	0.002	<0.001	<0.0005	-	-	<0.001	<0.0005	-	<0.0005	-	<0.001	<0.0005	-
Nitrate (as N)	10	0.3	1.1	0.87	0.5	0.2	<0.2	<0.05	<0.2	0.16	0.2	<0.2	0.01
Potassium	NA	-	-	1.4	-	-	-	2.4	-	-	-	-	-
Selenium	0.01	<0.005	<0.005	-	-	<0.005	<0.005	-	<0.005	-	<0.005	<0.005	-
Silica	NA	-	-	20	20.3	-	-	14	-	-	-	-	29.6
Silver	0.05	<0.02	<0.01	-	-	<0.02	<0.01	-	<0.01	-	<0.02	<0.01	-
Sulfate	250	-	-	6	8.6	-	-	12	-	8	-	-	-
Sodium	NA	-	5	5.7	4	-	-	9.1	10	-	-	-	18
Spec. Conductance	700 us/cm	110	140	110	213	164	260	180	200	-	180	-	-
TDS	500	-	-	72	116	-	-	130	-	130	-	-	-
pH	6.5-8.5	-	-	-	7.9	-	-	-	-	-	-	-	7.9
Temperature deg F	NA	-	-	48	-	-	-	48	-	-	-	-	-

(*) Indicates exceedance of MCL

Figures

FIGURES

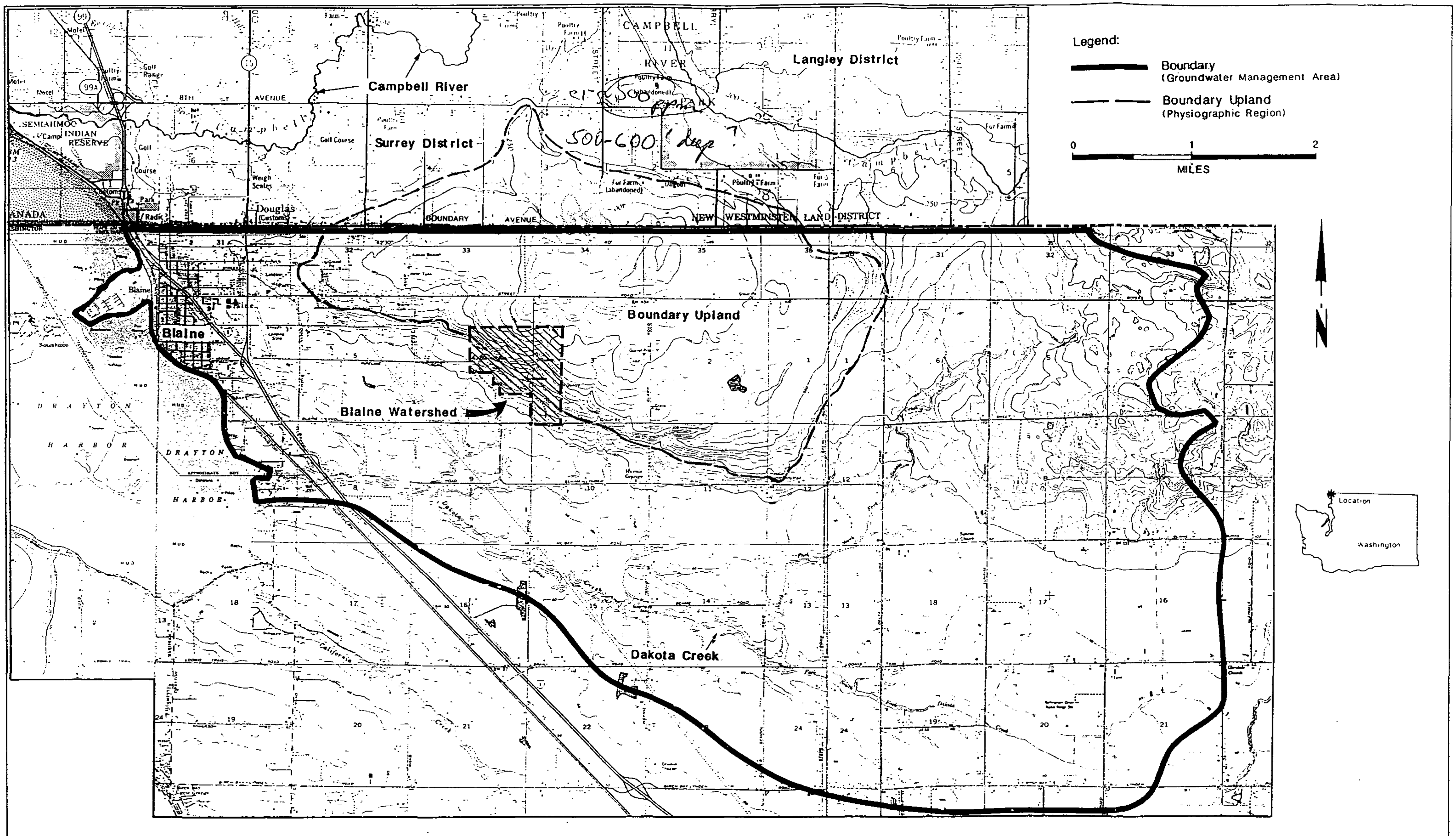

FIGURE 1-1
LOCATION MAP
BLAINE GROUNDWATER MANAGEMENT AREA
BLAINE/GEOPHYS REPORT/WA

PROJECT NO. 903-1060.303 DRAWING NO. 27800 DATE 2/13/92 DRAWN BY TB

Golder Associates

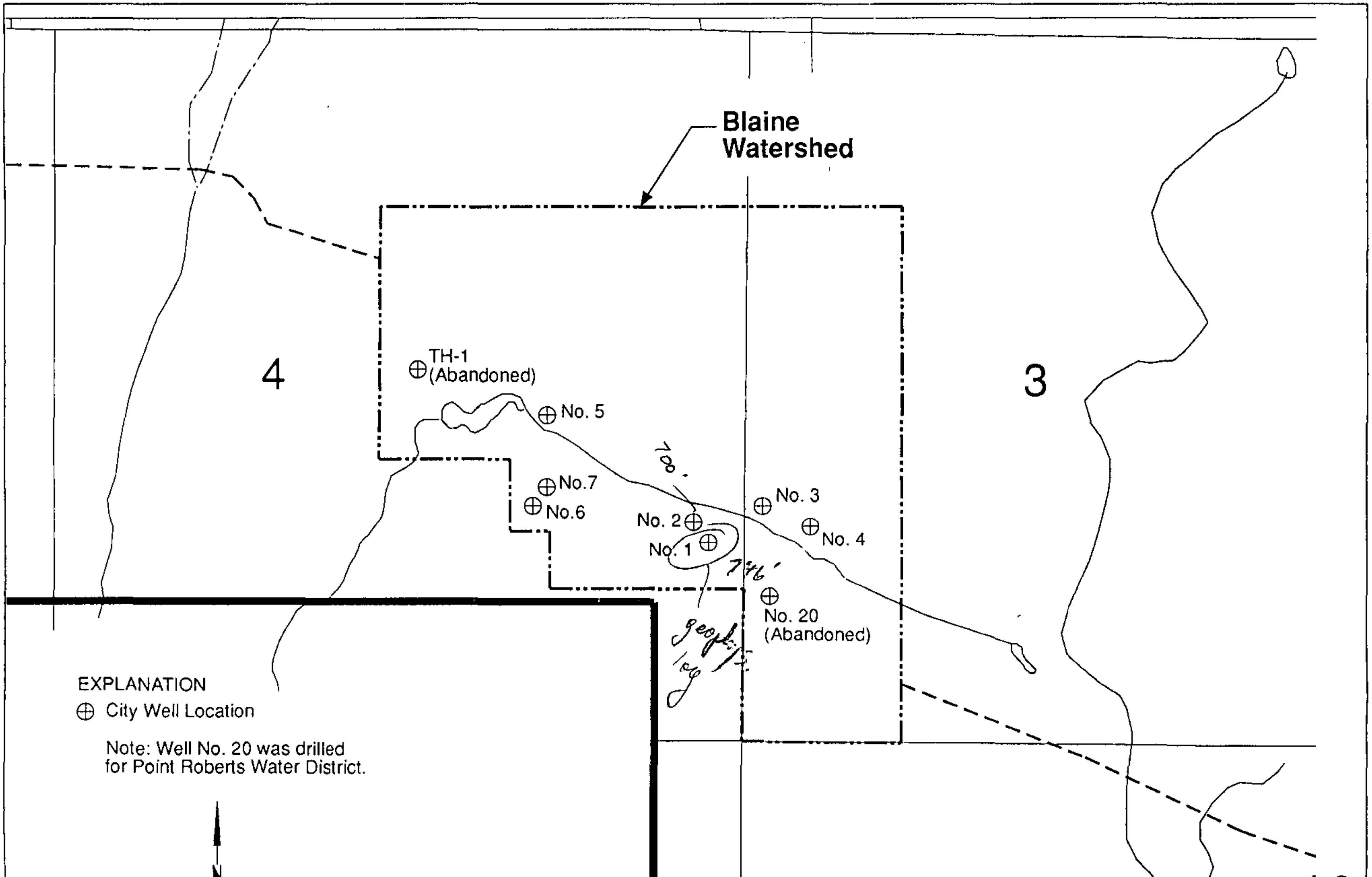

FIGURE **1-2**
BLAINE WATERSHED SITE LOCATION
BLAINE/GEOPHYSICS REPORT/WA

PROJECT NO. 903-1060.303 DRAWING NO. 31239 DATE 2/19/92 DRAWN BY CB

Golder Associates

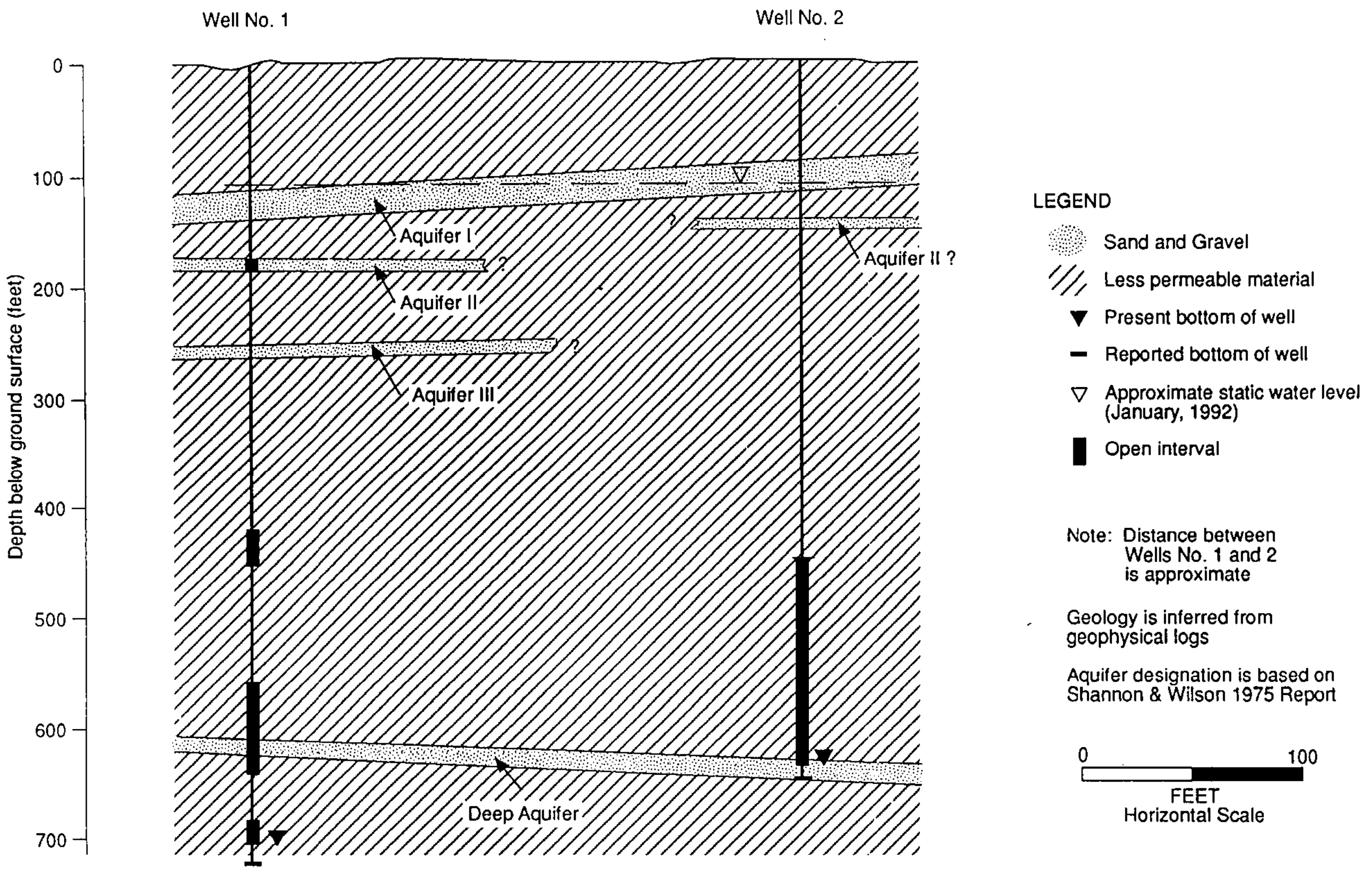

FIGURE **4-1**

GEOLOGIC CROSS-SECTION

BLAINE/GEOPHYSICS REPORT/WA

PROJECT NO. 903 1060.303 DRAWING NO. 27810 DATE 2/25/92 DRAWN BY TB

Golder Associates

Appendix A

APPENDIX A

GEOPHYSICAL LOGS

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Differential Temperature

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 1
FIELD	CITY OF BLAINE
STATE	WASHINGTON
COUNTY	WHATCOM
LOCATION:	
SEC.	
TWP.	
RGE.	
OTHER SERVICES:	VIDEO, FLUID RESISTIVITY, CALIPER, SPINNER, GAMMA-RAY/NEUTRON

PERMANENT DATUM:	TOP OF CASING	ELEV.	N/A
LOG MEASURED FROM	TOP OF CASING	FT. ABOVE PERM. DATUM	
DRILLING MEASURED FROM	TOP OF CASING		
ELEV.: K.B.			
D.F.			
G.L.			

DATE	1-23-92		
RUN NO.	ONE		
TYPE LOG	DIFFERENTIAL TEMP.		
DEPTH-DRILLER	760' ±		
DEPTH-LOGGER	684'		
BOTTOM LOGGED INTERVAL	684'		
TOP LOGGED INTERVAL	107'		
TYPE FLUID IN HOLE	STATIC WATER LEVEL @ 107'		
MAX. REC. TEMP., DEG. F.	57.1°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND	MR. HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
				12"		SURFACE	171'
				8"		181'	677'
				6"		677'	T.D.

EQUIPMENT DATA

Run No.	
Tool Model No.	
Diameter	
Detector Model No.	
Type	
Length	
General	
Hoist Truck No.	T-04 WA
Instrument Truck No.	T-04 WA
Tool Serial No.	TFR-41

LOGGING DATA

Run No.	ONE
Log Type	DIFF. TEMP.
Speed Ft./Min.	30'/MIN.
T.C. Sec.	1 SEC.
Sens. Settings	1°/1INCH
Zero Div. L or R	
API Units/Div.	
Log Start Time	12:14 PM
Log End Time	
Pumping Rate	STATIC CONDITIONS
Fluid Level	107' STATIC LEVEL
Formation Factor	

Remarks: LOGGED DOWN - DIFF. SENS 046 - SPAN @ 400

START TEMP @ 110' = 52.6°

END TEMP @ 684' = 57.1°

Fold Here

welenco

Fluid Resistivity

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 1
FIELD	CITY OF BLAINE
STATE	WASHINGTON
COUNTY	WHATCOM
LOCATION:	
SEC.	
TWP.	
RGE.	
OTHER SERVICES:	VIDEO, DIFFERENTIAL TEMP., CALIPER, SPINNER, GAMMA-RAY/NEUTRON
PERMANENT DATUM:	TOP OF CASING
ELEV.	N/A
LOG MEASURED FROM	TOP OF CASING FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM	TOP OF CASING
ELEV.: K.B.	
D.F.	
G.L.	

DATE	1-23-92		
RUN NO.	ONE		
TYPE LOG	FLUID RESISTIVITY		
DEPTH-DRILLER	684'		
DEPTH-LOGGER	684'		
BOTTOM LOGGED INTERVAL	684'		
TOP LOGGED INTERVAL	108'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	57.1°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH & MR. HEBERER		

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
				12"		SURFACE	171'
				8"		171'	677'
				6"		677'	T.D.

EQUIPMENT DATA

Run No.	
Tool Model No.	
Diameter	
Detector Model No.	
Type	
Length	
General	
Hoist Truck No.	T-04 WA
Instrument Truck No.	T-04 WA
Tool Serial No.	TFR-41

LOGGING DATA

Run No.	ONE
Log Type	FLUID RESISTIVITY
Speed Ft./Min.	30'/MIN. (DOWN)
T.C. Sec.	1 SEC.
Sens. Settings	1 OHM M^2/M PER DIV.
Zero Div. L or R	
API Units/Div.	
Log Start Time	
Log End Time	
Pumping Rate	STATIC CONDITIONS
Fluid Level	107' STATIC FLUID LEVEL
Formation Factor	

Remarks:

Fold Here

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Gamma-Ray Neutron Log

COMPANY: GOLDER ASSOCIATES, INC.
WELL: CITY OF BLAINE, WELL NO. 1
FIELD: CITY OF BLAINE
STATE: WASHINGTON COUNTY: WHATCOM

LOCATION:
SEC. ______ TWP. ______ RGE. ______

OTHER SERVICES: VIDEO, DIFF. TEMPERATURE, FLUID RESISTIVITY, CALIPER, SPINNER

PERMANENT DATUM: TOP OF CASING ELEV. N/A
LOG MEASURED FROM: TOP OF CASING ______ FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM: TOP OF CASING

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

DATE	1-23-92		
RUN NO.	ONE		
TYPE LOG	GAMMA-RAY/NEUTRON		
DEPTH-DRILLER	684'		
DEPTH-LOGGER	684'		
BOTTOM LOGGED INTERVAL	684'		
TOP LOGGED INTERVAL	2'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	57.1°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH & MR. HEBERER		

RUN NO.	BORE-HOLE RECORD: BIT	FROM	TO	CASING RECORD: SIZE	WGT.	FROM	TO
				12"		SURFACE	171'
				8"		171'	677'
				6"		677'	T.D.

EQUIPMENT DATA

Gamma Ray		Neutron	
Run No.	ONE	Run No.	ONE
Tool Model No.	COMPROBE	Log Type	N/N
Diameter	1-11/6"	Tool Model No.	COMPROBE
Detector Model No.	104	Diameter	1-11/6"
Type	SCINT.	Detector Model No.	104
Length	4"	Type	SCINT.
Distance to N. Source	6.5'	Length	6"
		Source Model No.	71-1
General		Serial No.	71-1-228G
Hoist Truck No.	T-04 WA	Spacing	13"
Instrument Truck No.	T-04 WA	Type	AM241be
Tool Serial No.	104	Strength	3 CURIE

LOGGING DATA

General: Run No.	Depths From	Depths To	Speed Ft/Min.	Gamma Ray: T.C. Sec.	Sens. Settings	Zero Div. L or R	API G.R. Units per Log Div.	Neutron: T.C. Sec.	Sens. Settings	Zero Div. L or R	API N. Units per Log Div.
ONE	684'	107'	20'	4	50/769	L-1	5	3	100/488	L-20	10
	107'	4'	20'	4	50/769	L-1	5	3	500/488	L-32	50

Reference Literature:

Remarks: MADE SCALE CHANGE AT STATIC WATER LEVEL, 107'

Fold Here

GAMMA RAY	DEPTHS	NEUTRON
API GAMMA-RAY UNITS		API NEUTRON UNITS
5 — 55		1600 — 2600 / 200 — 400

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Spinner

COMPANY: GOLDER ASSOCIATES, INC.

WELL: CITY OF BLAINE, WELL NO. 1

FIELD: CITY OF BLAINE

STATE: WASHINGTON COUNTY: WHATCOM

LOCATION:

SEC. ____ TWP. ____ RGE. ____

OTHER SERVICES: VIDEO, DIFF.TEMPERATURE FLUID RESISTIVITY CALIPER,G-R/NEUTRON

PERMANENT DATUM: TOP OF CASING, ELEV. N/A

LOG MEASURED FROM: TOP OF CASING ____ FT. ABOVE PERM. DATUM

DRILLING MEASURED FROM: TOP OF CASING

ELEV.: K.B. ____ D.F. ____ G.L. ____

DATE	1-23-92		
RUN NO.	ONE		
TYPE LOG	SPINNER		
DEPTH-DRILLER	684'		
DEPTH-LOGGER	684		
BOTTOM LOGGED INTERVAL	682'		
TOP LOGGED INTERVAL	108'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	57.1°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH & MR.	HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
				12"		SURFACE	171'
				8"		171'	677'
				6"		677'	T.D.

EQUIPMENT DATA

				LOGGING DATA			
Run No.				Run No.	ONE		
Tool Model No.				Log Type	SPINNER		
Diameter				Speed Ft./Min.	VARIES		
Detector Model No.				T.C. Sec.	1 SEC.		
Type				Sens. Settings	1.5 COUNT/DIV		
Length				Zero Div. L or R	0		
				API Units/Div.			
				Log Start Time			
General				Log End Time			
Hoist Truck No.	T-04 WA			Pumping Rate	STATIC CONDITIONS		
Instrument Truck No.	T-04 WA			Fluid Level	107'		
Tool Serial No.				Formation Factor			

Remarks: ON UP RUN, IMPELLER STOPPED TURNING @ 192', MADE SEVERAL TRIES & IMPELLER KEPT GETTING PLUGGED, THE DOTTED CURVE IS DRAFTED ON FROM ONE OF SEVERAL PASSES.
LOGGED DOWN @ 59'/MIN., LOGGED UP @ 84'/MIN.
SEPARATION @ 622' INDICATES UP FLOW. ATTEMPTED TO MAKE STOP COUNTS, NOT ENOUGHFLOW TO TURN IMPELLER.
3" SPINNER, 12 COUNTS PER REV. 4" PITCH.

Fold Here

SPINNER COUNTS	DEPTHS	SPINNER COUNTS
0 — 15		19.5 — 34.5 — 49.5

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Differential Temperature

COMPANY: GOLDER ASSOCIATES, INC.
WELL: CITY OF BLAINE, WELL NO. 2
FIELD: CITY OF BLAINE
STATE: WASHINGTON COUNTY: WHATCOM

LOCATION:
SEC. ____ TWP. ____ RGE. ____

OTHER SERVICES: VIDEO, FLUID RESISTIVITY, GAMMA-RAY/NEUTRON, CALIPER, SPINNER

PERMANENT DATUM: TOP OF CASING, ELEV. N/A
LOG MEASURED FROM: TOP OF CASING FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM: TOP OF CASING

ELEV.: K.B. ____
D.F. ____
G.L. ____

DATE	1-24-92		
RUN NO.	ONE		
TYPE LOG	DIFFERENTIAL TEMPERATURE		
DEPTH-DRILLER	630'		
DEPTH-LOGGER	630'		
BOTTOM LOGGED INTERVAL	630'		
TOP LOGGED INTERVAL	110'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	56.0°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND	MR. HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
ONE	9"	448'	630'	8.25"	I.D.	SURFACE	448'

EQUIPMENT DATA

Run No.	
Tool Model No.	
Diameter	
Detector Model No.	
Type	
Length	
General	
Hoist Truck No.	T-04 WA
Instrument Truck No.	T-04 WA
Tool Serial No.	41

LOGGING DATA

Run No.	ONE
Log Type	TEMPERATURE
Speed Ft./Min.	30'
T.C. Sec.	1 SEC.
Sens. Settings	1°/INCH
Zero Div. L or R	-
API Units/Div.	-
Log Start Time	9:37 AM
Log End Time	
Pumping Rate	STATIC
Fluid Level	
Formation Factor	

Remarks:
START TEMP @ 110' = 51.0°
END TEMP @ 630' = 56.0°

Fold Here

TEMPERATURE SCALE °F

DEPTHS

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Caliper

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 1
FIELD	CITY OF BLAINE
STATE	WASHINGTON
COUNTY	WHATCOM
LOCATION:	
SEC.	
TWP.	
RGE.	
OTHER SERVICES:	VIDEO, DIFF. TEMPERATURE FLUID RESISTIVITY GAMMA-RAY/NEUTRON SPINNER
PERMANENT DATUM:	TOP OF CASING
ELEV.	N/A
LOG MEASURED FROM	TOP OF CASING FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM	TOP OF CASING
ELEV.: K.B.	
D.F.	
G.L.	

DATE	1-23-92		
RUN NO.	ONE		
TYPE LOG	CALIPER		
DEPTH-DRILLER	684'		
DEPTH-LOGGER	684'		
BOTTOM LOGGED INTERVAL	684'		
TOP LOGGED INTERVAL	2'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	57.1°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH & MR.	HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
				12"		SURFACE	171'
				8"		171'	677'
				6"		677'	T.D.

EQUIPMENT DATA

LOGGING DATA

Run No. ONE

Log Type CALIPER

Speed Ft./Min. 40'/MIN

T.C. Sec. .01

Sens. Settings 2"/INCH

Zero Div. L or R

API Units/Div.

Log Start Time

Log End Time

Pumping Rate STATIC CONDITIONS

Fluid Level 107'

Formation Factor

Run No.

Tool Model No.

Diameter

Detector Model No.

Type

Length

General

Hoist Truck No. T-04 WA

Instrument Truck No. T-04 WA

Tool Serial No. 20

Remarks:

Fold Here

CALIPER
HOLE DIAMETER IN INCHES

DEPTHS

welenco

Fluid Resistivity

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 2
FIELD	CITY OF BLAINE
STATE	WASHINGTON
COUNTY	WHATCOM
LOCATION:	
SEC.	
TWP.	
RGE.	
OTHER SERVICES:	VIDEO, TEMP, CALIPER, GAMMA-RAY/NEUTRON SPINNER
PERMANENT DATUM:	TOP OF CASING
ELEV.	N/A
LOG MEASURED FROM	TOP OF CASING
FT. ABOVE PERM. DATUM	
DRILLING MEASURED FROM	TOP OF CASING
ELEV.: K.B.	
D.F.	
G.L.	

DATE	1- 24-92		
RUN NO.	ONE		
TYPE LOG	FLUID RESISTIVITY		
DEPTH-DRILLER	630'		
DEPTH-LOGGER	630'		
BOTTOM LOGGED INTERVAL	630'		
TOP LOGGED INTERVAL	110'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	56.0°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND	MR. HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
ONE	9"	448'	630'	8.25"	LD.	SURFACE	448'

EQUIPMENT DATA

Run No.			
Tool Model No.			
Diameter			
Detector Model No.			
Type			
Length			
General			
Hoist Truck No.	T-04 WA		
Instrument Truck No.	T-04 WA		
Tool Serial No.	41		

LOGGING DATA

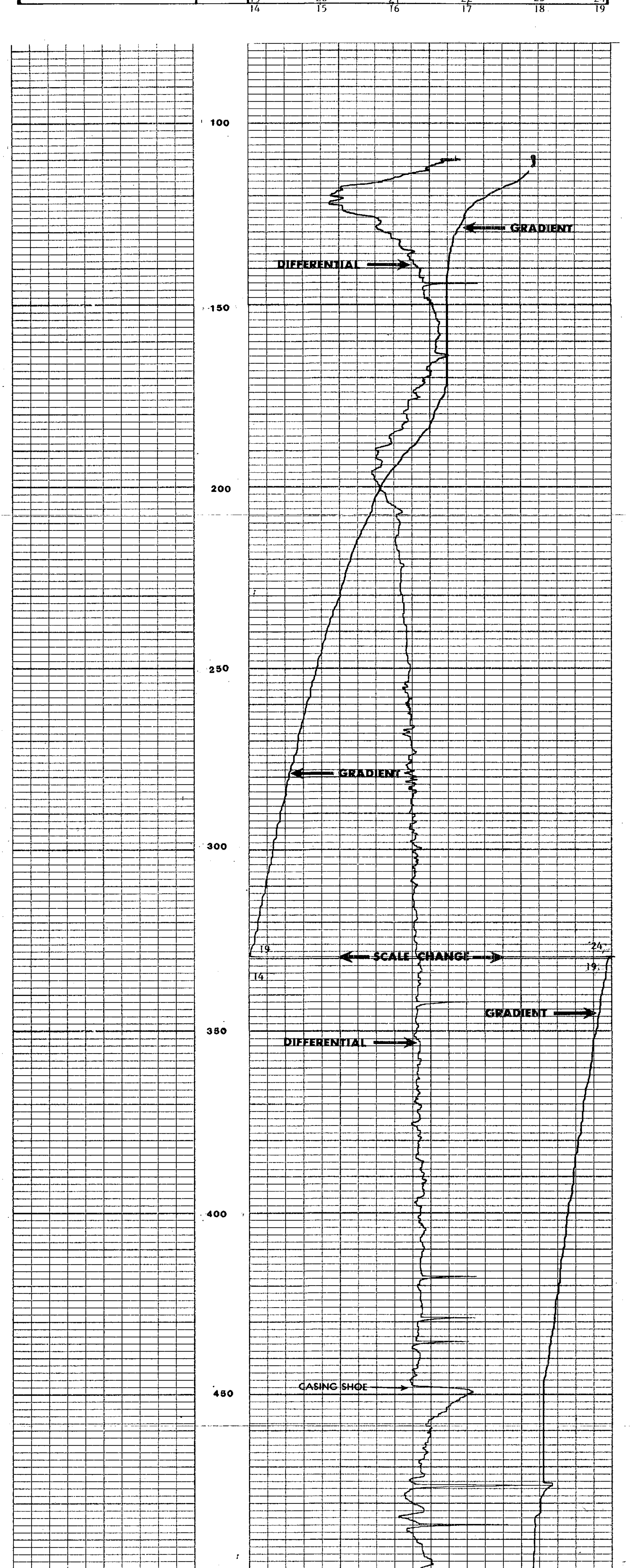
Run No.	ONE		
Log Type	FLUID RESISTIVITY		
Speed Ft./Min.	30'/MIN		
T.C. Sec.	1 SEC		
Sens. Settings	1 OHM/INCH		
Zero Div. L or R	–		
API Units/Div.	–		
Log Start Time	10:47 AM		
Log End Time			
Pumping Rate	STATIC		
Fluid Level	109		
Formation Factor			

Remarks: RAN THIS LOG AFTER RUNNING VIDEO. OPEN HOLE SIZE WAS UNKNOWN. RAN THIS LOG UNCENTRALIZED. SPIKES ON DIFFERENTIAL CURVE CAUSED BY MATERIAL GETTING NEAR THE ELECTRODES. WHILE RUNNING SPINNER RETRIEVED ABOUT 12' OF ELECTRICAL WIRE FROM WELL.

START RESISTIVITY @ 110' = 22.8 OHMS. M^2/M
END RESISTIVITY @ 630' = 17.0 OHMS. M^2/M

Fold Here

	DEPTHS	RESISTIVITY- ohms – m^2/m
		19 20 21 22 23 24 / 14 15 16 17 18 19



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Gamma-Ray Neutron Log

COMPANY: GOLDER ASSOCIATES, INC.
WELL: CITY OF BLAINE, WELL NO. 2
FIELD: CITY OF BLAINE
STATE: WASHINGTON COUNTY: WHATCOM

LOCATION:
SEC. ____ TWP. ____ RGE. ____

OTHER SERVICES: VIDEO, DIFFERENTIAL TEMP., FLUID RESISTIVITY, CALIPER, SPINNER

PERMANENT DATUM: TOP OF CASING ELEV. N/A
LOG MEASURED FROM: TOP OF CASING FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM: TOP OF CASING

ELEV.: K.B. ____ D.F. ____ G.L. ____

DATE	1-24-92		
RUN NO.	ONE		
TYPE LOG	GAMMA-RAY/NEUTRON		
DEPTH-DRILLER	630'		
DEPTH-LOGGER	630'		
BOTTOM LOGGED INTERVAL	629'		
TOP LOGGED INTERVAL	0'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	56.0°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND	MR. HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
ONE	9"	448'	630'	8.25"	I.D.	SURFACE	448'

EQUIPMENT DATA

Gamma Ray		Neutron	
Run No.	ONE	Run No.	ONE
Tool Model No.	COMPROBE	Log Type	N/N
Diameter	1-11/16"	Tool Model No.	COMPROBE
Detector Model No.	104	Diameter	1-11/16"
Type	SCINT.	Detector Model No.	104
Length	4"	Type	SCINT.
Distance to N. Source	6.5'	Length	6"
		Source Model No.	71-1
General		Serial No.	71-1-228C
Hoist Truck No.	T-04 WA	Spacing	13"
Instrument Truck No.	T-04 WA	Type	AM 241 be
Tool Serial No.	104	Strength	3 CURIE

LOGGING DATA

General				Gamma Ray				Neutron			
Run No.	Depths From	Depths To	Speed Ft/Min.	T.C. Sec.	Sens. Settings	Zero Div. L or R	API G.R. Units per Log Div.	T.C. Sec.	Sens. Settings	Zero Div. L or R	API N. Units per Log Div.
ONE	630'	109'	20	4	50/769	L-2	5	3	100/244	L-10	20
ONE	109'	0'	20	4	50/769	L-2	5	3	500/488	L-20	50

Reference Literature:

Remarks: RAN GAMMA-RAY LOG FIRST, THEN INSTALLED NEUTRON SOURCE, THEN RAN NEUTRON LOG.
STATIC WATER LEVEL @ 109', MADE SCALE CHANGE THERE.

Fold Here

GAMMA RAY	DEPTHS	NEUTRON
API GAMMA-RAY UNITS 10 – 60		API NEUTRON UNITS 1000 – 2000 (200 – 600)

welenco

Caliper

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 2
FIELD	CITY OF BLAINE
STATE	WASHINGTON
COUNTY	WHATCOM
LOCATION:	
SEC.	
TWP.	
RGE.	
OTHER SERVICES:	VIDEO, DIFF.TEMPERATURE, FLUID RESISTIVTIY, G/R/NEUTRON, SPINNER

PERMANENT DATUM:	TOP OF CASING
ELEV.	N/A
LOG MEASURED FROM	TOP OF CASING
FT. ABOVE PERM. DATUM	
DRILLING MEASURED FROM	TOP OF CASING
ELEV.: K.B.	
D.F.	
G.L.	

DATE	1-24-92		
RUN NO.	ONE		
TYPE LOG	CALIPER		
DEPTH-DRILLER	630'		
DEPTH-LOGGER	630'		
BOTTOM LOGGED INTERVAL	630'		
TOP LOGGED INTERVAL	0'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	56.0°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND MR.	JON HEBERER	

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
ONE	9"	448'	630'	8.25"	I.D.	SURFACE	448'

EQUIPMENT DATA

Run No.	
Tool Model No.	
Diameter	
Detector Model No.	
Type	
Length	

General

Hoist Truck No.	T-04 WA
Instrument Truck No.	T-04 WA
Tool Serial No.	20

LOGGING DATA

Run No.	ONE
Log Type	CALIPER
Speed Ft./Min.	40'/MIN
T.C. Sec.	.01
Sens. Settings	1/2"/DIV
Zero Div. L or R	
API Units/Div.	
Log Start Time	11:19 AM
Log End Time	11:35 AM
Pumping Rate	STATIC
Fluid Level	109'
Formation Factor	

Remarks:

Fold Here

DEPTHS

CALIPER
HOLE DIAMETER IN INCHES

4 5 6 7 8 9 10 11 12 13 14

welenco

Spinner

COMPANY	GOLDER ASSOCIATES, INC.
WELL	CITY OF BLAINE, WELL NO. 2
FIELD	CITY OF BLAINE
STATE	WASHINGTON COUNTY WHATCOM
LOCATION:	
SEC. TWP. RGE.	
OTHER SERVICES:	VIDEO, DIFF. TEMPERATURE, FLUID RESISTIVITY, G/R/NEUTRON, CALIPER
PERMANENT DATUM	TOP OF CASING ELEV. N/A
LOG MEASURED FROM	TOP OF CASING FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM	TOP OF CASING
ELEV.: K.B. / D.F. / G.L.	

DATE	1-24-92		
RUN NO.	ONE		
TYPE LOG	SPINNER		
DEPTH-DRILLER	630'		
DEPTH-LOGGER	630'		
BOTTOM LOGGED INTERVAL	629'		
TOP LOGGED INTERVAL	110'		
TYPE FLUID IN HOLE	WATER		
MAX. REC. TEMP., DEG. F.	56°		
RECORDED BY	CHRISTY		
WITNESSED BY	MR. BIRCH AND MR. HEBERER		

RUN	BORE-HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
ONE	9"	448'	630'	8.25"	I.D.	SURFACE	448'

EQUIPMENT DATA

Run No.			
Tool Model No.			
Diameter			
Detector Model No.			
Type			
Length			
General			
Hoist Truck No.	T-04 WA		
Instrument Truck No.	T-04 WA		
Tool Serial No.			

LOGGING DATA

Run No.	ONE		
Log Type	SPINNER		
Speed Ft./Min.			
T.C. Sec.			
Sens. Settings			
Zero Div. L or R	"0" = "0"		
API Units/Div.			
Log Start Time	15:10		
Log End Time			
Pumping Rate	STATIC		
Fluid Level	109'		
Formation Factor			

Remarks: NOTE! THIS HAND DRAFTED LOG IS FROM PASSES MADE AT 35'/MIN.
RUN #1 DOWN, RUN #2 UP @ 59'/MIN. & RUN #3 DOWN @ 66'/MIN. ON FIRST DOWN RUN, A PIECE OF ELECTRICAL WIRE WAS SNAGGED WHICH KEPT PLUGGING IMPELLER.

NO NATURAL FLOW NOTICED, NOT ENOUGH FLOW FOR STOP COUNTS.

Fold Here

SPINNER COUNTS	DEPTHS	SPINNER COUNTS
0 — 15		19.5 — 34.5 — 49.5