REPORT ON
WELL CONSTRUCTION PROGRAM
GLACIER NATIONAL PARK, MONTANA
August 21, 1979 - October 5, 1979

SUBMITTED TO:
NATIONAL PARK SERVICE
DENVER SERVICE CENTER
LAKEWOOD, COLORADO 80215

PREPARED BY:
HKM ASSOCIATES
P.O. BOX 31318
BILLINGS, MONTANA 59107

December 12, 1979
Project No. 6M099.108

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SUMMARY

The National Park Service retained HKM Associates of Billings, Montana to design and supervise the drilling, construction development and testing of water supply wells for six recreational and administrative sites in Glacier National Park, Montana. The subcontractor for the well drilling was Billmayer's Inc., of Kalispell, Montana.

Successful water wells were drilled and tested for five of the sites as summarized below.

Location	Size of Well (In)	Total Depth (ft)	Tested Yield (gpm)	Maximum Yield (gpm)
Goat Haunt Ranger Station	6	39.2	10.5	15
St. Mary Campground	8	157.8	107	80
Lake McDonald	6	70.6	36	80
Lake McDonald	8	77.7	248	366
Fish Creek Campground	8	95.6	273	521

A well drilled to a total depth of 201 feet at Polebridge Ranger Station was unsuccessful and was backfilled, capped, and abandoned as a dry hole. A well drilled in Bowman Creek Campground for the campground was also unsuccessful, backfilled and abandoned as a dry hole.

Due to the unsuccessful well at Polebridge Ranger Station, an investigation was performed on the existing infiltration gallery system supplying this site. Testing of the system revealed the horizontal collector was not producing water, and that the system is presently functioning as a shallow well. Estimated sustained yield of the system is 12 to 15 gpm.

Results of water quality tests made on samples taken from the five successful wells and the Polebridge Infiltration Gallery system indicated water from all sources to be of very high quality. Test results indicated water from all the wells and the existing Polebridge Gallery system to be within the limits of the Primary Drinking Water Standards.

Available water quality data indicated that water from all but the St. Mary Campground well to be very corrosive. Corrosion of distribution lines and steel storage tanks could result from the use of these waters without treatment. Data from the St. Mary Campground analysis indicated water from this well would be relatively stable and should not cause any corrosion problems.

Some of the wells could develop turbidity problems at the beginning of each season due to a combination of the seasonal use pattern, geological and geohydrological conditions.

It's recommended that all production wells be pumped to waste continuously for a period of one to two days before use each year to eliminate possible seasonal turbidity problems.

INTRODUCTION

The main purpose of this report is to present all information obtained in the well drilling program at six separate sites in Glacier National Park Montana, for the National Park Service (NPS). The NPS retained HKM Associates of Billings, Montana to supervise the drilling, construction and development of production water supply wells for each of the six locations listed below.

- Goat Haunt Ranger Station
- St. Mary Campground
- Lake McDonald 6 inch Well
- Lake McDonald 8 inch Well
- Fish Creek Campground
- Polebridge Ranger Station

The well construction phase of the program was initiated August 21, 1979 and completed October 5, 1979. Subcontractor for the well drilling was Billmayer's, Inc., of Kalispell, Montana. All data obtained in the drilling program is presented in Exhibits I through V-A of this report.

This report presents the results of investigations and testing performed on the existing Polebridge Ranger Station Infiltration Gallery System, October 5, 1979. The existing system was tested to define the quantity and quality of water the system could produce as the well drilled for the ranger station produced less than one gallon a minute and was abandoned as a dry hole.

Data is also presented on a well drilled and subsequently abandoned as a dry hole in Bowman Creek Campground for the campground.

SUMMARY OF WELL CONSTRUCTION PROGRAM

All wells except one were drilled by the Air Rotary method using an Ingersoll Rand, Cyclone TH-60 drill. The well for Goat Haunt Ranger Station was drilled by a Bucyrus Erie 22W Cable tool rig.

Development was performed on all wells using compressed air. A portable compressor was used on the Goat Haunt Ranger Station well. The rig compressor on the Cyclone drill was used for development on all the other wells.

GOAT HAUNT RANGER STATION WELL

A 6 inch well 39.2 feet deep was constructed for Goat Haunt Ranger Station between August 24 and 29, 1979. The well was developed by surging with air for 11 hours, September 6 and 7, 1979 and subsequently test pumped at rates ranging between 15 and 20 gpm. Exhibit I contains pertinent data regarding the well.

ST. MARY CAMPGROUND WELL

A 8 inch well 157.8 feet deep was drilled for St. Mary Campground between September 5 and 11, 1979. The well was developed by surging with air for 10 hours September 8, 1979 through September 11, 1979 and subsequently test pumped at a rate of 107 gpm. Exhibit II contains pertinent data concerning the well.

LAKE McDONALD 6 AND 8 INCH WELLS

One 6 inch well 70.58 feet deep was drilled and completed North of Snyder Creek near the Lake McDonald Concessionaire

Resort complex on the Northeast edge of Lake McDonald between September 12 and 14, 1979. The well was developed by surging with air for 8 hours, September 13 and 14, 1979 and subsequently test pumped at a rate of 36 gpm. The well will provide a year round water supply for the Lake McDonald concessionaire caretaker's residence and serve as a backup source for the Lake McDonald Recreational complex.

A single 8 inch well 77.7 feet deep was drilled south of Snyder Creek and immediately adjacent to the Lake McDonald Concessionaire Resort complex September 15 through 20, 1979. The well was developed by surging with air for 8 hours September 19 and 20, 1979 and subsequently test pumped at a rate of 247 gpm. Exhibit III presents all pertinent data regarding both the 6 and 8 inch wells near the Lake McDonald complex.

FISH CREEK CAMPGROUND WELL

A 8 inch well 95.6 feet deep was drilled and completed for Fish Creek Campground September 20 through 28, 1979. The well was developed by surging with air for 11 hours September 27 and 28, 1979 and was subsequently test pumped at a rate of 272 gpm. Exhibit IV presents all data concerning the construction, completion development and testing of the well.

POLEBRIDGE RANGER STATION AND BOWMAN CREEK CAMPGROUND WELLS

A well a total of 201 feet deep was drilled at Polebridge Ranger Station between October 1 and 2, 1979. The well penetrated a saturated thickness of about 6 feet of alluvial deposits of the North Fork of the Flathead River at a depth of 17 to 23 feet below land surface.

Approximately 178 feet of dry semi consolidated Tertiary Sediments underlying the alluvial deposits and consisting mainly of clay were penetrated by the test well. The well was backfilled, capped and abandoned October 2, 1979, as total production was less than one gpm.

A test hole a total of 33 feet deep was drilled near the east end of Bowman Creek Campground October 3, 1979. The test hole penetrated a total of 9 feet of slightly moist to dry alluvial gravel. The underlying deposits consisted of the same semi consolidated clay (Tertiary sediments) as encountered at Polebridge Ranger Station. The hole was subsequently backfilled and abandoned as a dry hole due to the lack of water. Exhibit V presents all available data concerning the Polebridge Ranger Station and Bowman Creek wells.

RESULTS OF TEST PUMPING

An extended pump test was performed on each of the wells completed during this program. Purposes were to further develop the wells and determine production capability of the wells. Drawdown and recovery water level data obtained in the pump tests were used where possible, to estimate the transmissivity of the aquifer penetrated by each of the wells.

A short term pump test was also conducted on the existing Bowman Creek infiltration gallery system at Polebridge Ranger Station. The test was performed to determine the production capability of the existing system as the well drilled at the ranger station under this program was a dry hole.

An infiltration gallery system completed in the alluvium of Bowman Creek is the only source of water for the Polebridge administrative site other than surface water of the North Fork of the Flathead River or Bowman Creek.

GOAT HAUNT RANGER STATION

The 6 inch Goat Haunt Ranger Station well was pumped approximately 21.8 hours at a constant rate of 10.5 gpm, September 8 and 9, 1979. Drawdown at the end of the test was 8.02 feet. Specific capacity of the well (yield of the well in gpm per foot of drawdown) as indicated by the 21.8 hour test was 1.32 gpm/ft.

If the aquifer were capable, the five feet of Slot 60 Well Screen used in this well could transmit 164 gpm at an entrance velocity to the well screen of 0.1 ft/sec. Data collected during the pump test indicated the transmissivity (rate of flow through vertical section of an aquifer whose height is the thickness of the aquifer and whose width is one foot when the hydraulic gradient is 1.00) for the aquifer supplying this well to be about 16,400 gpd/ft. Based on available test data, the well should be capable of producing 15 gpm with a drawdown of about 12 feet. Exhibit I-C presents field data obtained during the pump test performed on the Goat Haunt Ranger Station well.

ST. MARY CAMPGROUND

The 8 inch St. Mary Campground well was pumped 24 hours at a constant rate of 107 gpm September 12 and 13, 1979. Drawdown at the end of the test was 104.16 feet. Specific capacity of the well according to the 24 hour test was 1.03 gpm/ft.

If the aquifer were capable, the 10 feet of Slot 80 Well Screen used in this well could transmit 366 gpm with a screen entrance velocity of 0.1 ft/sec.

The well does not penetrate the full saturated thickness of the aquifer. Available data collected during the pump test indicated water in the aquifer to be in a semi confined or confined state. Transmissivity of that portion of the aquifer penetrated by the well was estimated to be 1600 gpd/ft. Based on available test data, its estimated that this well could produce a maximum of 80 gpm. Drawdown at this rate would be about 80 feet. Exhibit II-C presents field data obtained during the pump test performed on the St. Mary Campground well.

LAKE McDONALD 6-INCH WELL

The 6 inch Lake McDonald Well was pumped 24.3 hours at a constant rate of 36 gpm September 18 and 19, 1979. Drawdown at the end of the test was 2.02 feet. Specific Capacity of the well as indicated by the test was 17.8 gpm/ft. The 5 feet of Slot 80 Well Screen used in this well has the capability of transmitting 183 gpm/ft with a screen entrance velocity of 0.1 ft/sec.

The well as completed does not fully penetrate the total thickness of the unconsolidated aquifer. At the time the well was drilled it was noted that groundwater at this location may occur under a combination of perched and water table conditions. Tighter material consisting of silts and clays were noted as beginning at a depth of 68 to 72 feet below the land surface. Production above this tight zone as tested with air with the drill rig, was estimated

to be between 60 and 70 gpm. Production in the tight zone from 70 feet to the NPS allowed total depth of 80 feet dropped off to a yield estimated to range between 8 and 10 gpm.

Purposes of the well are to serve as the primary year round source for the concessionaire caretakers residence and as a back up well to the Lake McDonald 8 inch production well. Therefor it was decided that drilling deeper than the originally allowed depth of 80 feet in order to obtain a higher yield was not necessary. The well was subsequently completed at a total depth of 70.2 feet below the land surface fully penetrating the more permeable material above the tight zone previously discussed.

Transmissivity of the aquifer penetrated by the well was estimated to be 40000 gpd/ft. Based on available test data, the well should be capable of producing 80 gpm with a drawdown of approximately 5 feet. Exhibit III-C presents field data obtained during the pump test performed on the Lake McDonald 6 inch well.

LAKE McDONALD 8 INCH WELL

The 8 inch Lake McDonald well was pumped approximately 24.2 hours at a constant rate of 248 gpm September 24 and 25, 1979. Drawdown at the end of the test was 5.65 feet. Specific capacity of the well as indicated by data from the test was 43.89 gpm/ft of drawdown. The 10 feet of Slot 80 Well Screen used in this well has the capability of transmitting 366 gpm with a screen entrance velocity of 0.1 ft/sec.

The well does not fully penetrate the total thickness of the unconsolidated gravel aquifer. Transmissivity of that

portion of the aquifer penetrated by the well was estimated to be 66000 gpd/ft. Based on available test data, the well should be capable of producing the 366 gpm design capacity of the well screen with an estimated drawdown of 9 to 10 feet. Exhibit III-C presents field data obtained during the pump test performed on the Lake McDonald 8 inch well.

FISH CREEK CAMPGROUND WELL

The 8 inch Fish Creek Campground well was pumped approximately 23.9 hours at a constant rate of 273 gpm October 1 and 2, 1979. Drawdown at the end of the test was 1.16 feet. Specific capacity of the well as indicated by data from the test was approximately 235 gpm/ft of drawdown. The 5 feet of Slot 60 and 10 feet of Slot 80 Well Screen used in this well has the capability of transmitting 521 gpm with a screen entrance velocity of 0.1 ft/sec. Estimated drawdown in the well at a pumping rate of 521 gpm would be 3 to 5 feet.

The well does not fully penetrate the total thickness of the unconsolidated gravel aquifer. No estimate of transmissivity could be made for that portion of the aquifer penetrated by the well as the pump available for testing purposes was not large enough to produce enough drawdown in the well to determine aquifer characteristics. Exhibit IV-C presents field data obtained during the pump test performed on the Fish Creek Campground well.

POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM

The Polebridge gallery system was tested as part of the drilling program because the well drilled in the alluvium of the North Fork of the Flathead River and the underlying

Tertiary sediments was a dry hole. The alluvium of Bowman Creek at the confluence of Bowman Creek and the North Fork of the Flathead River presents the only source of water other than surface water of the River or Creek for the administrative site. The existing gallery system is located 35 to 40 feet northwest of the Polebridge administrative site and approximately 11 to 12 feet lower than the site. The system consists of a vertical 24 inch inside diameter CMP pipe with open bottom set at a total depth of 7.13 feet from the land surface. The collector system reportedly consists of 12 inch underdrain collector pipe located under Bowman Creek with a 4 inch transmission line from Bowman Creek to the 24 inch vertical pipe. Exhibit VI-B presents available data on the Polebridge infiltration gallery system and the pump test performed on the system.

A limited pump test was performed on the gallery in an attempt to determine the sustained yield of the system. The system was pumped approximately 2.45 hours at an average rate of 15 gpm. Drawdown at the end of the test was 3.08 feet. Specific capacity of the system was 4.9 gpm/ft of drawdown.

Inspection of the system during the test indicated that no water was flowing through the horizontal collector. All the water provided by the system is coming through the bottom of the 24 inch vertical CMP which means the system is essentially functioning as a shallow well. Available data indicated that the existing system without the horizontal collector is capable of producing between 12 and 15 gpm on a sustained basis. Exhibit VI-C presents results of test pumping performed on the Polebridge Infiltration Gallery System October 4, 1979.

WATER QUALITY

One water quality sample was taken from each well and the Polebridge Infiltration Gallery System near the end of the

pump tests. Analyses were performed by Northern Testing Laboratories of Billings, Montana. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods For Chemical Analysis Of Water And Wastes."

Results of the analyses indicated water from all the wells to be of very high quality. Total dissolved solids content ranged from less than 1 mg/l for the sample taken from the Lake McDonald well to 358 mg/l for the St. Mary well. Results of water quality analyses indicated water from all the wells and the Polebridge Infiltration gallery system were within the Primary Drinking Water Standards. Water quality test results also indicated that water from all the wells and the Polebridge system with the exception of manganese (0.09 mg/l) in the St. Mary Campground analysis, were within the recommended limits of the Secondary Drinking Water Regulations. The manganese concentration would not pose a health hazard but more of an undesireable aesthetic effect such as the staining of plumbing fixtures.

Available data indicated that water from all but the St. Mary Campground well to be very corrosive. Corrosion of distribution lines and steel storage tanks could result from the use of these waters without treatment. Data from the St. Mary Campground analysis indicated water from this well would be stable and should not cause any corrosion problems.

During the off season, fine glacial silts and clays may fill in the natural packs created around the screens through initial well development and subsequent use. This could result in turbidity problems in some of the wells at the beginning of each season. It's recommended that all production wells be pumped continually to waste for a period of one to two days before use each year to eliminate possible seasonal turbidity problems.

EXHIBIT I

SUMMARY OF DATA
GOAT HAUNT RANGER STATION
6 INCH WELL

EXHIBIT I-A

VICINITY MAP SHOWING LOCATION

OF

GOAT HAUNT RANGER STATION WELL

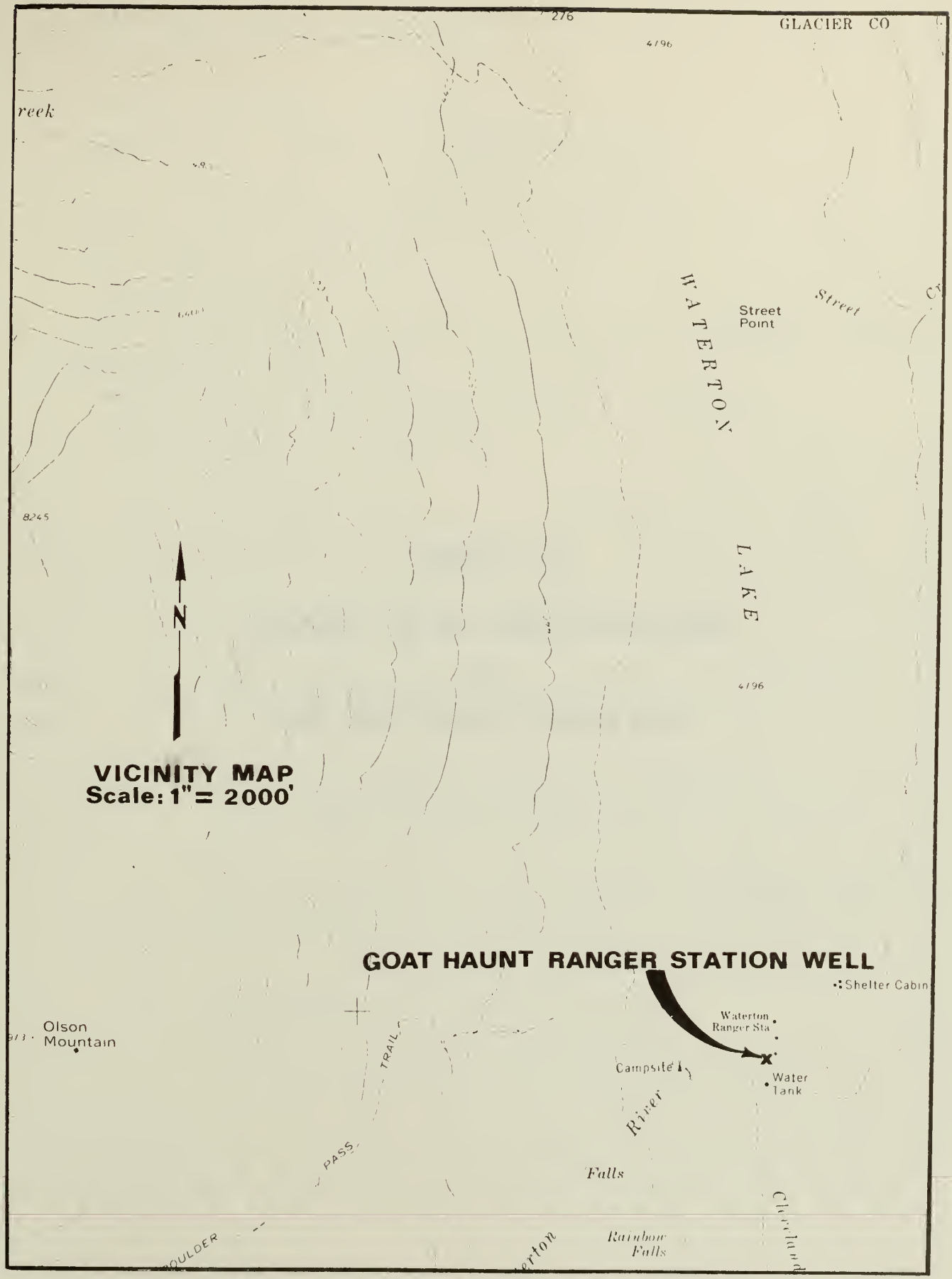


EXHIBIT I-A: VICINITY MAP SHOWING LOCATION
OF GOAT HAUNT RANGER STATION WELL

EXHIBIT I-B

LITHOLOGIC LOG AND COMPLETION RECORD
OF
GOAT HAUNT RANGER STATION WELL

GOAT HAUNT RANGER STATION WELL

Surface Elevation: 4,240 Feet ±

Approximate Location: Latitude 48°57'24",
Longitude 113°52'36"

Top of Casing Above Landsurface: 1.79 feet

Date of Construction: 8/24/79 - 8/29/79

Well Depth: 39.2 Feet

Aquifer: Gravel

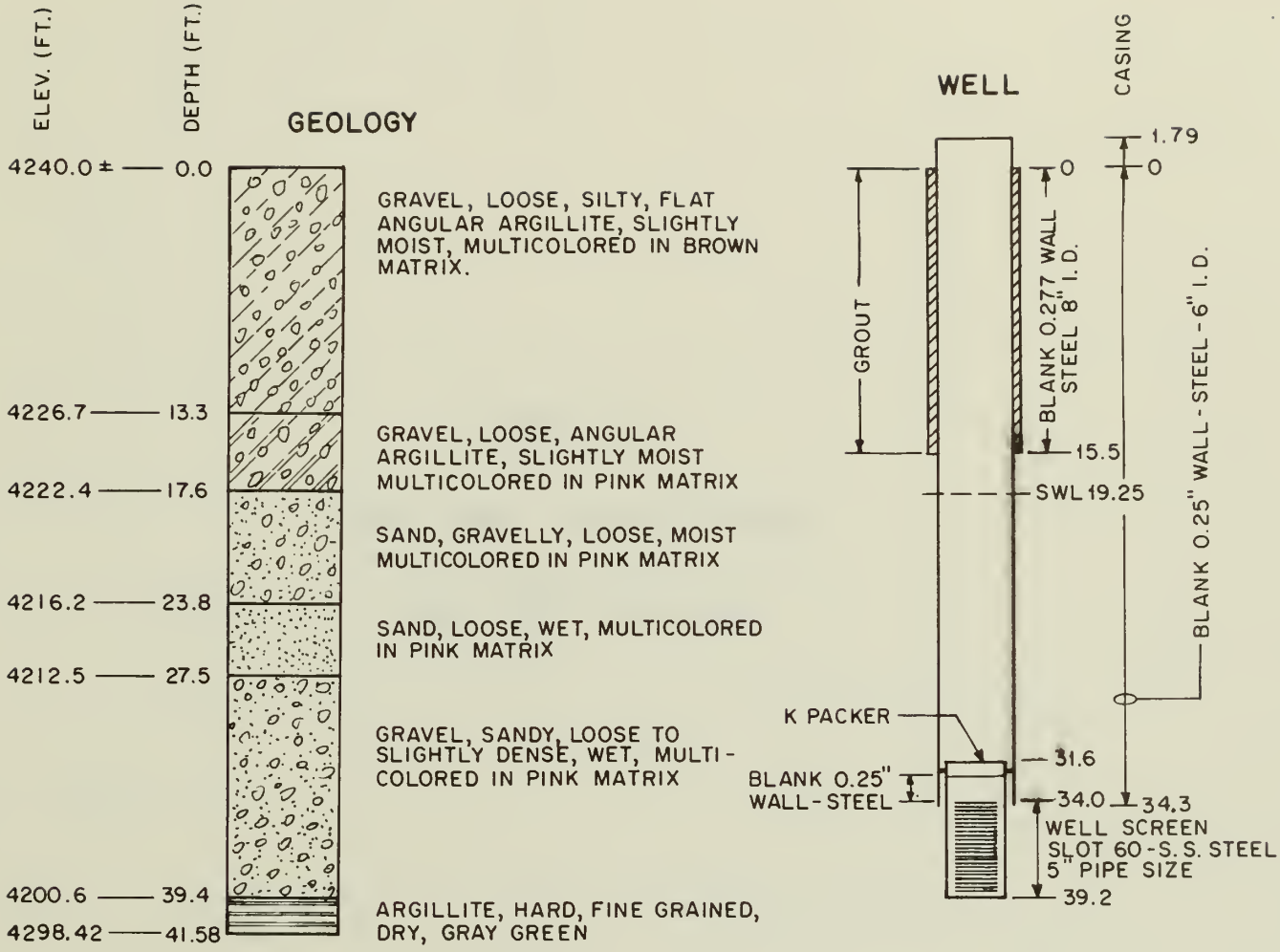
Static Water Level: 19.25 feet (Measured From Top Of Casing)

Elevation At Total Depth: 4,200.8 Feet ±

Casing Size: 6 Inch ID, 0.25 inch wall thickness

Miscellaneous Well Information:

- Well developed by surging with air for 11 hours.
- 0.5 H.P. submersible pump, set 33.42 feet below land surface for test pumping.
- Well pumped 24 hours and 50 minutes at constant rate of 10.55 gpm. Drawdown at end of test at pumping rate of 10.55 gpm was 4.84 feet.
- Well test pumped 42 minutes at pumping rate of 19.13 gpm. Drawdown at end of test at pumping rate of 19.13 gpm was 16.31 feet.
- Design capacity of 5 feet, 5 inch pipe size, slot 60 Stainless Steel well screen, is approximately 164 gpm.
- Well drilled by Cable Tool Method (Bucyrus Erie 22 W Cable Tool Rig)



GOAT HAUNT RANGER STATION

EXHIBIT I-C

GOAT HAUNT RANGER STATION

WELL PUMP TEST DATA

EXHIBIT I-C.1

GENERAL INFORMATION GOAT HAUNT RANGER STATION WELL

Goat Haunt Ranger Station Well

Casing Diameter = 6 inch (ID)
Casing Above Landsurface = 1.79 Feet
Total Depth = 39.2 Feet
Static Water Level = 19.25 feet (Measured From Top of Casing)

Flow Measurement

Flow measured with a 1 gallon bucket and stop watch
Average flow during 24 hour and 50 minute test = 10.55 gpm
Average flow during 42 minute test = ;9.1 gpm

Duration of Test

Pumped 24 hours and 50 minute (9:15 A.M. 9/8/79 - 10:05. A.M. 9/9/79)
Total recovery 40 minutes (10:05 A.M. - 10:45 A.M. 9/9/79)
Pumped 42 minutes (10:45 A.M. - 11:30 A.M. 9/9/79)

Field Party

J. R. McGill	HKM Associates
B. Butcher	Billmayer Water Supply Co.

EXHIBIT I-C.2

GOAT HAUNT RANGER STATION WELL
DRAWDOWN WATER LEVEL MEASUREMENTS
24 HOUR AND 50 MINUTE TEST

Time	Depth to Water (Feet)	Remarks
9/8/79		
8:35 A.M.	19.25	Static Water Level
9:13	19.25	Static Water Level
9:15	---	Pump on at 9:15 A.M.
9:16	22.79	
9:17	23.04	
9:18	23.23	
9:19	23.29	All Water Level Measurements
9:20	23.29	Made From Top of Casing
9:21	23.33	
9:22	23.33	
9:23	23.42	
9:24	23.42	
9:25	23.40	Average Flow = 10.55 gpm
9:30	23.46	
9:40	23.46	
9:50	23.95	
10:00 A.M.	24.02	
1:30 P.M.	24.08	
2:00	24.08	
2:30	24.08	
3:00	24.08	
3:30	24.13	
4:00	24.13	
4:30	24.13	Sampled for water quality at 10:00 A.M. 9/9/79. Field temperature = 7°C and field conductance = 130 Micromhos/cm at 25°C.
5:00 P.M.	24.13	
9/9/79		
10:01 A.M.	27.27	
10:05 A.M.	---	Pump off at 10:05 A.M. 9/9/79

EXHIBIT I-C.3

GOAT HAUNT RANGER STATION WELL
RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth to Water (Feet)	Remarks
9/9/79		
10:01 A.M.	27.27	Pumping level before pump off
10:05	---	Pump off at 10:05 A.M.
10:05.5	24.92	
10:06	21.36	
10:07	19.85	
10:08	19.65	
10:09	19.55	
10:10	19.54	
10:11	19.51	All water level measurements
10:12	19.48	made from top of casing
10:13	19.47	
10:14	19.45	
10:15	19.46	
10:20	19.42	
10:25	19.42	
10:30	19.38	
10:35	19.36	
10:40	19.35	
10:45 A.M.	19.38	End recovery test

EXHIBIT I-C.4

GOAT HAUNT RANGER STATION WELL
DRAWDOWN WATER LEVEL MEASUREMENTS
FOR 42 MINUTE TEST

Time	Depth to Water (Feet)	Remarks
10:45 A.M.	19.38	Static Water Level
10:48	-	Pump On
10:49	29.45	
10:50	30.81	All water level measure-
10:51	31.46	ments made from top of casing
10:52	33.99	
10:57	33.74	Average Flow = 19.1 gpm
11:02	33.84	
11:06	33.89	
11:17	33.29	
11:30 A.M.	33.81	Pump Off

EXHIBIT I-D

RESULTS OF WATER QUALITY ANALYSES

GOAT HAUNT RANGER STATION PRODUCTION WELL

Northern Testing Laboratories
CONSULTING ENGINEERS

Report of: Water Analysis
Goat Haunt Ranger Station

Date October 17, 1979
Job Number 61-152
Sheet 1 of 2
W.O. #2869

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS MT 59107

Sample Identification:

On September 19, 1979, one water sample was delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Lab No.:	33429
Identification:	Goat Haunt Ranger Station
Date Sampled:	9/9/79
Component (mg/l, unless noted otherwise)	
Primary Standards	
Arsenic	-0.005
Barium	-0.5
Cadmium	-0.005
Chromium	-0.02
Lead	-0.02
Mercury	-0.001
Selenium	-0.005
Silver	-0.01
Nitrate as Nitrogen	0.19
Fluoride	0.04
Secondary Standards	
Iron	-0.05
Manganese	-0.02
Sulfate	6
Total Dissolved Solids	34
pH, standard units	6.6
Sodium	2
Calcium	14
Magnesium	6
Total Alkalinity as $CaCO_3$	46

Water Analysis

October 17, 1979
Job No. 61-152
Sheet 2 of 2

Hurlbut, Kersich & McCullough
Billings, MT

Lab No.:	33429
Secondary Standards, continued	
Bicarbonate as HCO_3	56
Carbonate as CO_3	0
Electrical Conductivity, (umhos/cm)	130

A minus sign indicates less than the level reported was present in the sample.

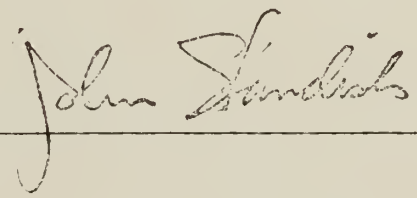
Certified 

EXHIBIT II

SUMMARY OF DATA

ST. MARY CAMPGROUND

8 INCH WELL

EXHIBIT II-A

VICINITY MAP SHOWING LOACTION OF

ST. MARY CAMPGROUND WELL

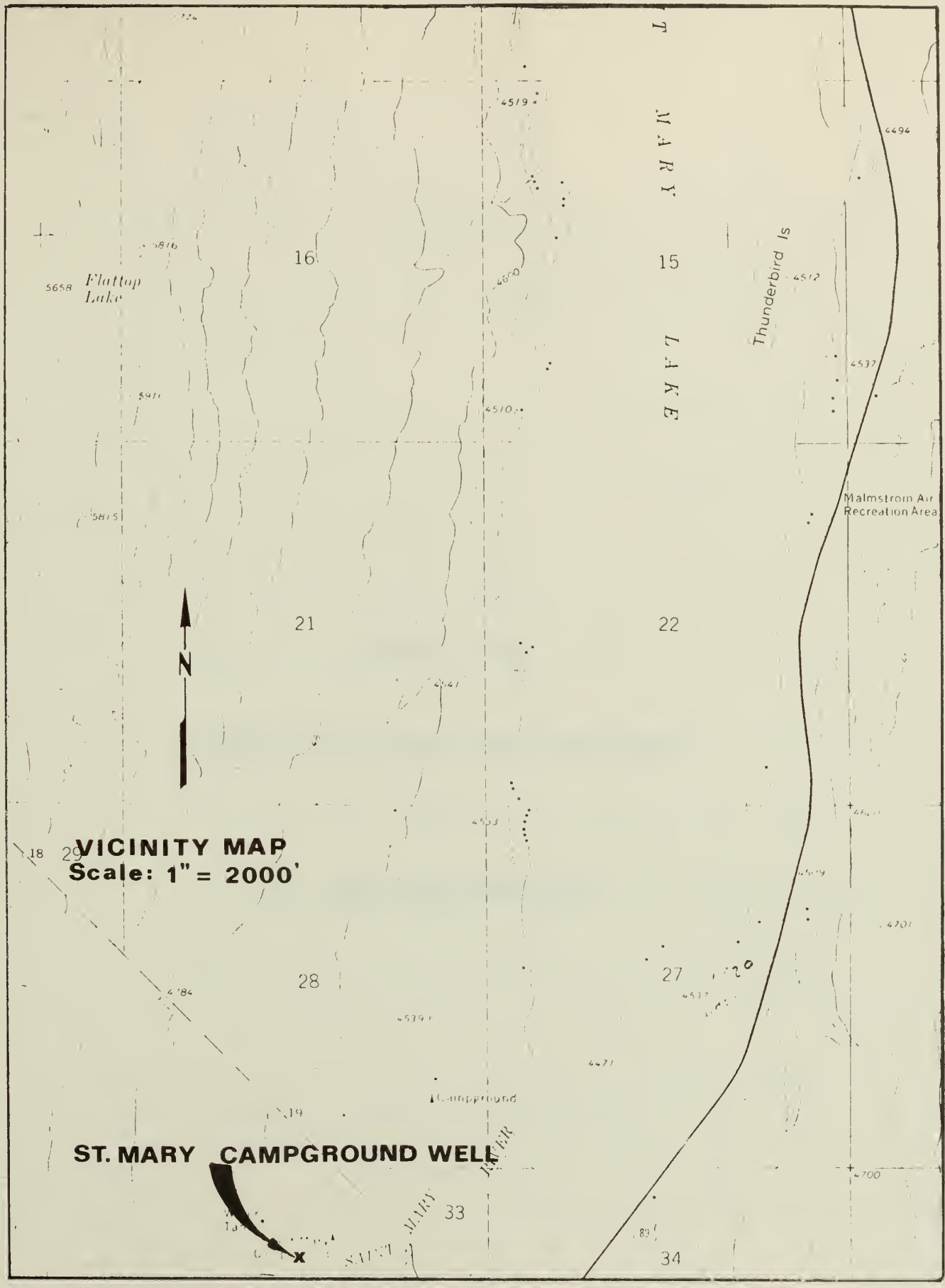


EXHIBIT II-A: VICINITY MAP SHOWING LOCATION OF ST. MARY CAMPGROUND WELL

EXHIBIT II-B

LITHOLOGIC LOG AND COMPLETION RECORD

OF

ST. MARY CAMPGROUND WELL

ST. MARY CAMPGROUND WELL

Surface Elevation: 4,510 Feet ±

Approximate Location: Latitude 48°27'27",
Longitude 113°26'37"

Top of Casing Above Land Surface: 1.33 Feet

Date of Construction: 9/5/79 - 9/11/79

Well Depth: 157.83 Feet

Aquifer: Sand and Gravel

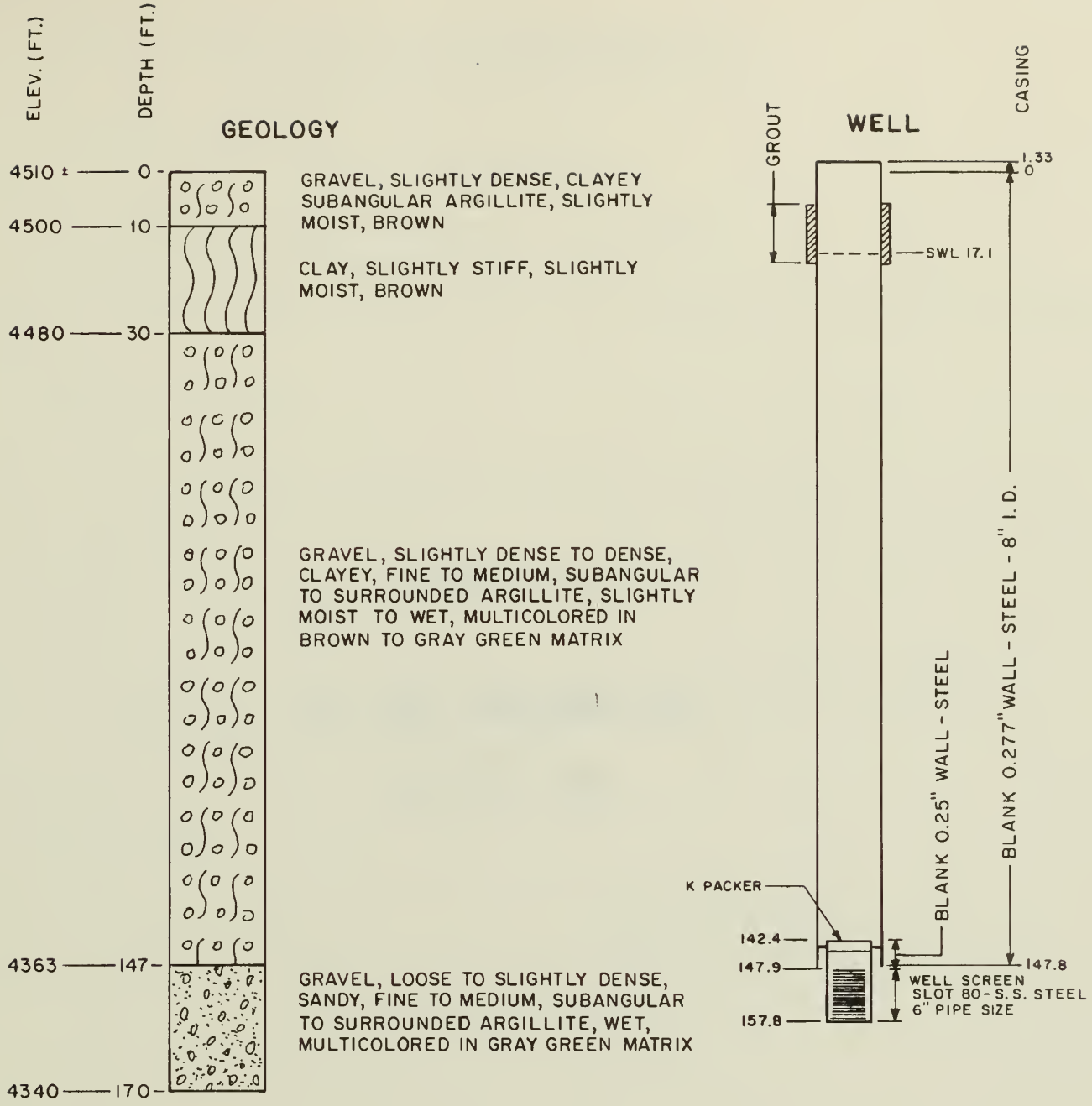
Static Water Level: 17.07 Feet (Measured From Top of Casing)

Elevation At Total Depth: 4,352.17 Feet ±

Casing Size: 8 Inch ID, 0.277 inch wall thickness

Miscellaneous Well Information:

- Well developed by surging with air for 10 hours
- 20 H.P. submersible pump set 128.67 feet below land surface for test pumping
- Well pumped 24 hours at average rate of 107 gpm
- Pumping level did not stabilize by end of test
- Drawdown at end of test at pumping rate of 107 gpm was 104.16 feet
- Design capacity of 10 feet, 6 inch pipe size, Slot 80 Stainless Steel well screen is approximately 366 gpm
- Production well drilled by Air Rotary Method (Ingersoll-Rand Cyclone TH-60)



ST. MARY CAMPGROUND WELL

EXHIBIT II-C

ST. MARY CAMPGROUND WELL

PUMP TEST DATA

EXHIBIT II-C.1

GENERAL INFORMATION ST. MARY CAMPGROUND WELL

St. Mary Campground Well

Casing Diameter = 8 Inch (ID)
Casing Above Landsurface = 1.33 Feet
Total Depth = 157.83 Feet
Static Water Level = 17.07 Feet (Measured from Top of Casing)

Flow Measurement

Flow measured with 2" flowmeter and stopwatch
Average flow during 24 hour test = 107 gpm

Duration of Test

Pumped 24 hours (4:00 P.M. 9/12/79 - 4:00 P.M. 9/13/79)
Recovery monitored 13 hours and 15 minutes (4:00 P.M. 9/13/79 - 9:15 A.M. 9/14/79)

Field Party

J. R. McGill	HKM Associates
B. Butcher	Billmayer Water Supply Co.

EXHIBIT II-C.2

ST. MARY CAMPGROUND WELL
DRAWDOWN WATER LEVEL MEASUREMENTS
24 HOUR TEST

Time	Depth To Water (Feet)	Remarks
9/12/79		
2:00 P.M.	17.07	Static Water Level
2:10	17.06	Static Water Level
		Pumped at rates ranging from 50 to 175 gpm between 2:27 P.M. and 2:51 P.M. to determine 24 hour test pump rate.
3:59	19.46	
4:00	---	Pump on at 4:00 P.M.
4:02	65.96	
4:03	66.20	
4:04	73.00	
4:05	73.15	
4:06	80.00	
4:07	81.46	All water level measurements
4:08	83.47	made from top of casing
4:09	82.63	
4:10	86.92	
4:15	88.94	
4:20	90.00	
4:25	90.77	
4:30	91.57	
4:35	92.08	
4:40	92.63	Average Flow = 107 gpm
4:45	93.04	
4:50	93.43	
4:55	93.83	
5:00 P.M.	94.13	

EXHIBIT II-C.2 (Continued)

Time	Depth To Water (Feet)	Remarks
9/12/79		
5:30 P.M.	95.75	
6:00	96.85	
6:38	98.35	
7:00	99.04	
7:30	105.50	
8:00	105.91	
8:30	107.00	
9:00	107.85	
9:30	108.44	
10:00	109.06	
10:30	109.47	
11:00	109.44	
11:30 P.M.	109.67	
9/13/79		
12:00 A.M.	109.60	
1:00	110.25	
2:00	111.17	
3:00	112.00	
4:00	112.67	
5:00	113.50	
6:00	-	
7:00	115.00	
8:00	116.21	
9:00	116.63	
10:00	117.54	
11:00 A.M.	117.67	
12:00 P.M.	118.60	
1:00	119.45	
2:00	119.77	
3:00	120.20	Sampled for water quality at 3:45 P.M.
4:00 P.M.	121.23	Pump off at 4:00 P.M.

EXHIBIT II-C.3

ST. MARY CAMPGROUND WELL

RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth To Water (Feet)	Remarks
9/13/79		
4:00 P.M.	121.23	Pump Off
4:01	111.81	
4:02	80.08	
4:03	70.85	
4:04	65.39	
4:05	62.17	
4:06	59.64	
4:07	58.30	
4:08	57.02	
4:09	56.29	
4:10	56.13	
4:15	55.83	
4:20	53.00	
4:25	52.08	
5:00	49.21	
5:10	48.80	
5:20	48.39	
5:30	47.98	
5:40	47.55	
5:50	47.19	
6:00	46.80	
6:10	46.52	
8:06	43.91	
11:00 P.M.	41.39	
9/14/79		
7:40 A.M.	36.85	
9:15 A.M.	36.29	End recovery water level measurements

EXHIBIT II-D

RESULTS OF WATER QUALITY ANALYSES

ST. MARY CAMPGROUND WELL

Northern Testing Laboratories
CONSULTING ENGINEERS

Report of: Water Analysis

Date October 17, 1979
Job Number 61-152
Sheet 1 of 2
W.O. #2753

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS MT 59107

Sample Identification:

On October 8, 1979, two water samples were delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Lab No.:	33733	33734
Identification:	St. Mary Campground	Lake McDonald 6" Production
Date Sampled:	Well 9/13/79	Well - 9/19/79
Component (mg/l, unless noted otherwise		
Primary Standards		
Arsenic	-0.005	-0.005
Barium	-0.5	-0.5
Cadmium	-0.005	-0.005
Chromium	-0.02	-0.02
Lead	-0.02	-0.02
Mercury	-0.001	-0.001
Selenium	-0.005	-0.005
Silver	-0.01	-0.01
Nitrate as Nitrogen	0.01	0.13
Fluoride	0.17	0.01
Secondary Standards		
Iron	-0.05	-0.05
Manganese	0.09	-0.02
Sulfate	39	2
Total Dissolved Solids	358	18
pH, standard units	7.5	5.9
Sodium	28	2
Calcium	67	5
Magnesium	28	2
Total Alkalinity as $CaCO_3$	294	16

Water Analysis

October 17, 1979
Job No. 61-152
Sheet 2 of 2

Hurlbut, Kersich & McCullough
Billings, MT

Lab No.:	33733	33734
Secondary Standards, continued		
Bicarbonate as HCO_3	359	19
Carbonate as CO_3	0	0
Electrical Conductivity, (umhos/cm)	630	47

A minus sign indicates less than the level reported was present in the sample.

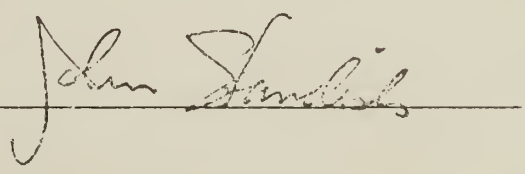
Certified 

EXHIBIT III

SUMMARY OF DATA

LAKE MC DONALD 6 AND 8 INCH WELLS

EXHIBIT III-A

VICINITY MAP SHOWING LOCATION OF

LAKE MCDONALD 6 AND 8 INCH WELLS

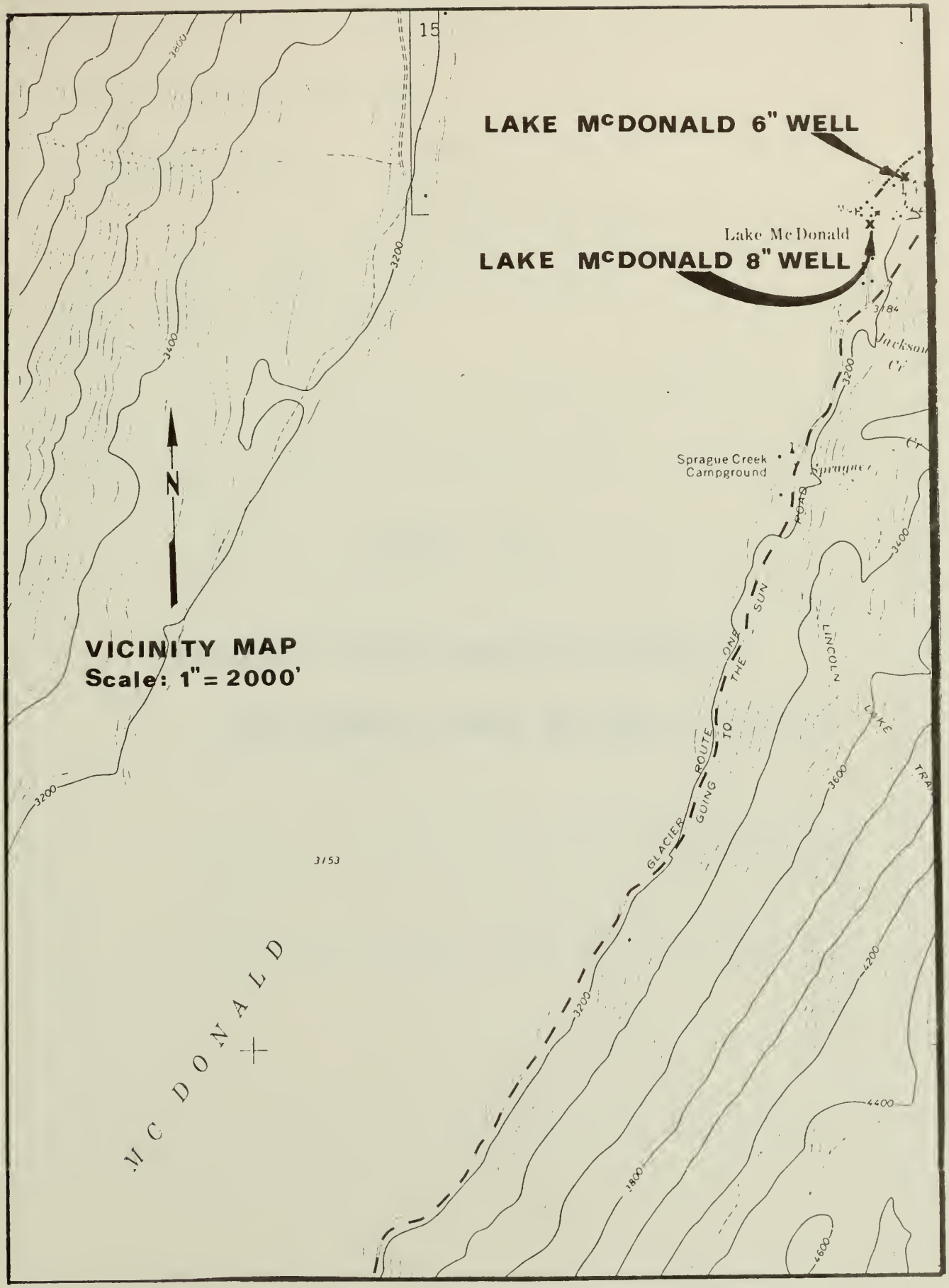


EXHIBIT III-A VICINITY MAP SHOWING LOCATIONS OF LAKE McDONALD 6 AND 8 INCH WELLS

EXHIBIT III-B

LITHOLOGIC LOGS AND COMPLETION RECORDS OF

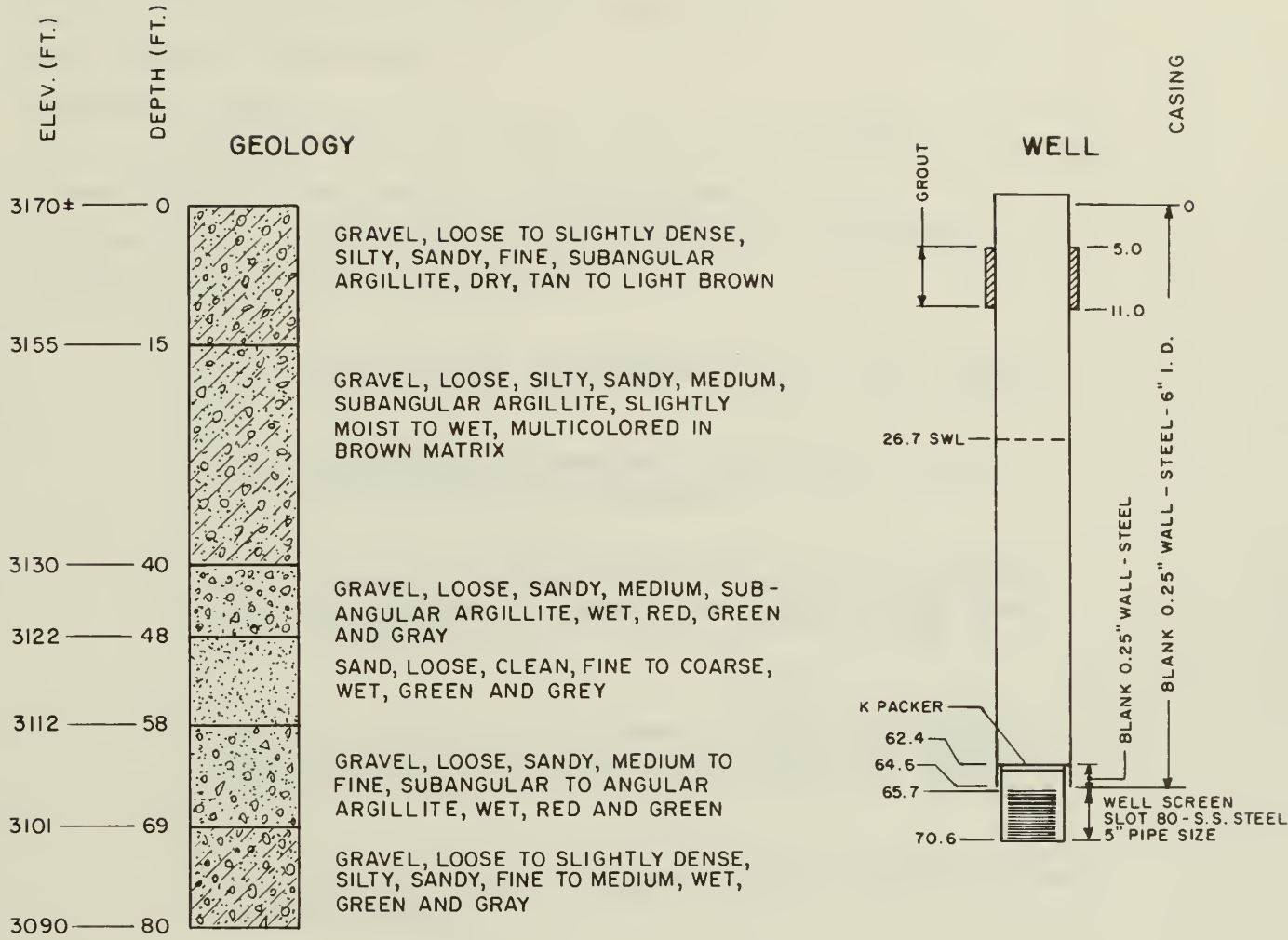
LAKE MCDONALD 6 AND 8 INCH WELLS

EXHIBIT III - B.1

LAKE MC DONALD 6 INCH WELL

Surface Elevation: 3,170 Feet ±
Approximate Location: Latitude 48°37'7",
Longitude 113°52'27"
Top of Casing Above Land Surface: 0.96 Feet
Date of Construction: 9/12/79 - 9/14/79
Well Depth: 70.58 Feet
Aquifer: Gravel
Static Water Level: 26.71 Feet (Measured From Top of Casing)
Elevation At Total Depth: 3,143.29 Feet ±
Casing Size: 6 inch I.D., 0.25 inch wall thickness
Miscellaneous Well Information:

- Well developed by surging with air for 8 hours.
- 1 HP submersible pump set 63.67 feet below land surface for test pumping.
- Well pumped 24 hours and 18 minutes at constant rate of 36 gpm. Drawdown at end of pump test was 2.05 feet.
- Design capacity of 5 feet, 5 inch pipe size, slot 80 Stainless Steel well screen is approximately 183 gpm.
- Well drilled by Air Rotary Method (Ingersoll-Rand Cyclone TH-60).



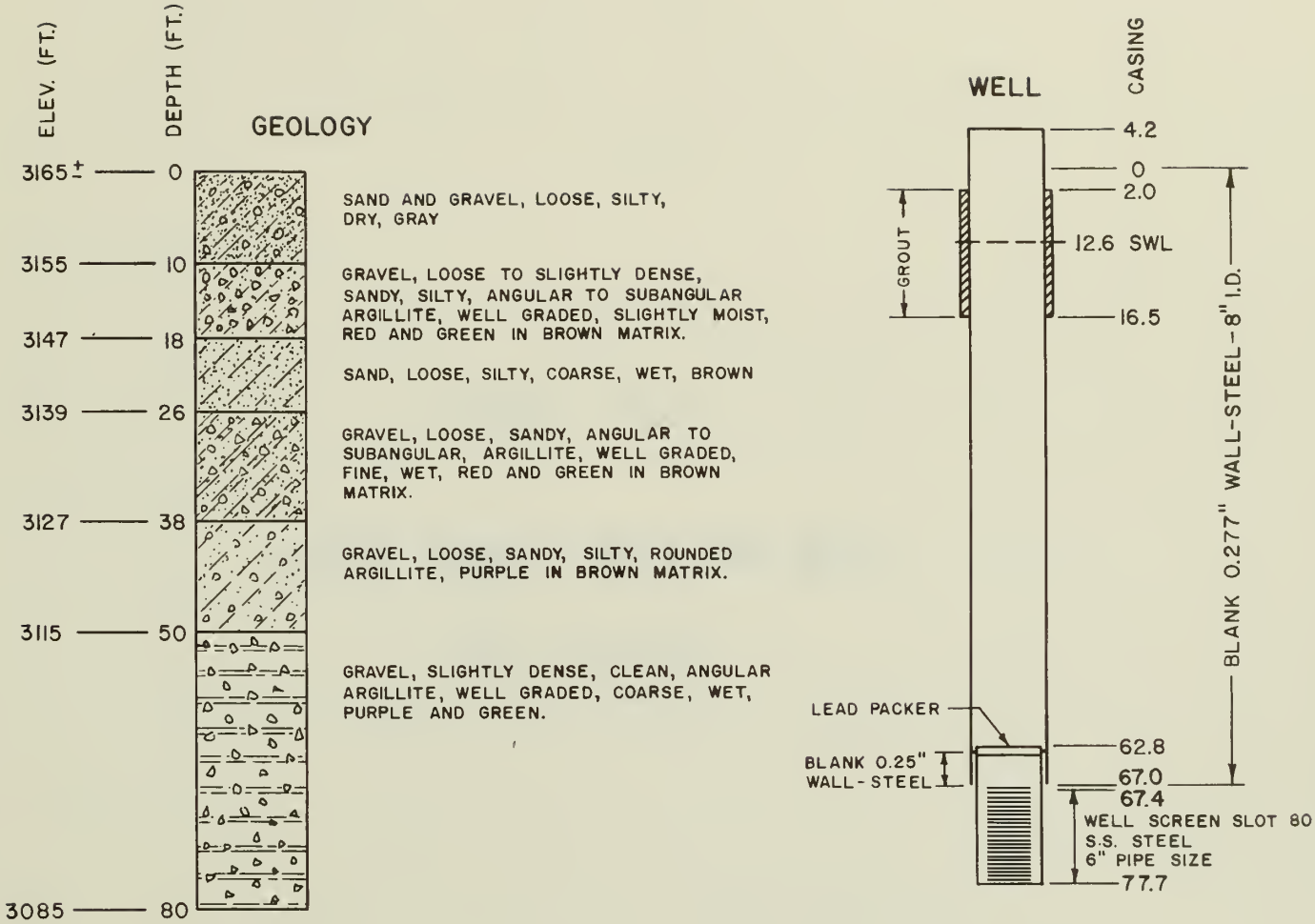
LAKE McDONALD 6" WELL

EXHIBIT III B.2

LAKE MC DONALD 8 INCH WELL

Surface Elevation: 3,165 Feet ±
Approximate Location: Latitude 48°37'
Longitude 113°52'36"
Top of Casing Above Land Surface: 4.21 Feet
Date of Construction: 9/15/79 - 9/20/79
Well Depth: 77.67 Feet
Aquifer: Gravel
Static Water Level: 12.64 Feet (Measured From Top of Casing)
Elevation At Total Depth: 3,087.33 Feet ±
Casing Size: 8 inch I.D., 0.277 inch wall thickness
Miscellaneous Well Information:

- Well developed by surging with air for 8 hours.
- 20 HP submersible pump set 37.79 feet below land surface for test pumping.
- Well pumped 24 hours and 11 minutes at average rate of 247 gpm. Drawdown at end of pump test was 5.65 feet.
- Design capacity of 10 feet, 6 inch pipe size, slot 80 Stainless Steel well screen is approximately 366 gpm.
- Well drilled by Air Rotary Method (Ingersoll-Rand Cyclone TH-60).



LAKE McDONALD 8" WELL

EXHIBIT III-C

LAKE MC DONALD 6 AND 8 INCH WELLS

PUMP TEST DATA

EXHIBIT III-C.1

GENERAL INFORMATION LAKE MCDONALD 6 INCH WELL

Lake McDonald 6 Inch Well

Casing Diameter = 6 inch (ID)

Casing Above Land Surface = 0.96 Feet

Total Depth = 70.58 Feet

Static Water Level = 26.71 Feet (Measured from Top of Casing)

Flow Measurement

Flow measured with 5.4 gallon bucket and stop watch.

Average flow during 24 hour and 18 minute test = 36 gpm.

Duration of Test

Pumped 24 hours and 18 minutes (11:11 A.M. 9/18/79 - 11:29 A.M. 9/19/79)

Monitored recovery 22 hours and 58 minutes (11:29 A.M. 9/19/79 - 10:27 A.M. 9/20/79)

Field Party

J. R. McGill	HKM Associates
B. Butcher	Billmayer Water Supply Co.

EXHIBIT III-C.2 (Continued)

Time	Depth To Water (Feet)	Remarks
9/18/79		
3:00 P.M.	27.45	
3:30	27.97	
4:00	28.00	
4:30 P.M.	28.00	
9/19/79		
9:00 A.M.	28.71	
10:00	28.70	
11:05	28.71	
11:25	28.73	
11:29 A.M.	-	Pump off at 11:29 A.M. 9/19/79.

EXHIBIT III-C.3

LAKE MCDONALD 6 INCH WELL
RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth To Water (Feet)	Remarks
9/19/79		
11:29 A.M.	-	Pump off at 11:29 A.M.
11:30	28.13	
11:31	28.13	
11:32	28.13	
11:33	28.13	
11:34	28.13	
11:35	27.69	
11:36	27.69	
11:38	27.46	
11:39	27.47	
11:40	27.47	
11:45	27.48	
11:50	27.51	
11:55 A.M.	27.51	
12:03 P.M.	27.49	
12:05	27.49	
12:18	27.48	
12:20	27.48	
12:30	27.46	
1:00	27.43	
1:30	27.36	
2:00 P.M.	27.35	
9/20/79		
10:22 A.M.	27.14	End of Recovery Water Level Measurements.

EXHIBIT III-C.5

LAKE MCDONALD 8 INCH WELL
DRAWDOWN WATER LEVEL MEASUREMENTS
24 HOUR AND 11 MINUTE TEST

Time	Depth To Water (Feet)	Remarks
9/24/79		
1:11 P.M.	12.64	Static Water Level
1:19	12.63	Pump on at 1:19 P.M.
1:22	16.05	
1:23	16.16	
1:24	16.10	
1:26	16.42	
1:27	16.48	
1:28	16.47	
1:29	16.54	
1:30	16.48	All water level measurements
1:31	16.54	made from top of casing.
1:32	16.53	
1:33	16.54	
1:34	16.54	
1:35	16.53	
1:40	16.54	
1:45	16.61	
1:50	16.67	
1:55	16.70	
2:00	16.74	
2:05	16.77	
2:10	16.81	Average Flow = 247 gpm
2:15	16.81	
2:20	16.83	
2:25	16.85	
2:30	16.90	
2:40 P.M.	16.94	

EXHIBIT III-C.5 (Continued)

Time	Depth To Water (Feet)	Remarks
9/24/79		
2:50 P.M.	16.89	
3:00	17.02	
3:10	17.04	
3:20	17.07	
3:30	17.13	
3:45	17.17	
4:00	17.19	
4:30	17.27	
5:00	17.38	
5:30	17.41	
6:00	17.49	
6:30	17.56	
7:00	17.60	
7:30	17.65	
8:00	17.69	
9:00	17.75	
10:00	17.81	
11:00 P.M.	17.92	
9/25/79		
12:00 A.M.	17.98	
1:00	18.01	
2:00	18.04	
3:00	18.08	
4:00	18.14	
5:00	18.17	
6:00	18.21	
7:00	18.25	
8:00	18.29	
9:00	18.24	
10:00	18.27	
11:00 P.M.	18.28	
12:00 P.M.	18.26	
1:00	18.29	
1:30 P.M.	-	Pump off at 1:30 P.M.

EXHIBIT - C.6

LAKE MCDONALD 8 INCH WELL

RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth To Water (Feet)	Recovery
9/25/79		
1:30 P.M.	---	Pump off at 1:30 P.M., 9/25/79
1:31	14.77	
1:32	14.68	
1:33	14.63	
1:34	14.58	
1:35	14.55	
1:36	14.53	
1:37	14.50	
1:38	14.50	
1:39	14.46	
1:40	14.45	
1:45	14.39	
1:51	14.30	
1:55	14.26	
2:00	14.25	
2:05	14.25	
2:10	14.09	
2:15	14.11	
2:20	14.10	
2:30	14.02	
2:40	13.97	
2:50	13.92	
3:00	13.90	
5:00	13.50	
6:00 P.M.	13.35	
9/26/79		
8:20 A.M.	12.94	End of Recovery Water Level Measurements.

EXHIBIT III-D

RESULTS OF WATER QUALITY ANALYSES

LAKE MC DONALD 6 AND 8 INCH WELLS

Report of: Water Analysis

Date October 17, 1979
Job Number 61-152
Sheet 1 of 2

W.O. #2753

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS MT 59107

Sample Identification:

On October 8, 1979, two water samples were delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Lab No.:	33733	33734
Identification:	St. Mary Campground	Lake McDonald 6" Production
Date Sampled:	Well 9/13/79	Well - 9/19/79
Component (mg/l, unless noted otherwise		
Primary Standards		
Arsenic	-0.005	-0.005
Barium	-0.5	-0.5
Cadmium	-0.005	-0.005
Chromium	-0.02	-0.02
Lead	-0.02	-0.02
Mercury	-0.001	-0.001
Selenium	-0.005	-0.005
Silver	-0.01	-0.01
Nitrate as Nitrogen	0.01	0.13
Fluoride	0.17	0.01
Secondary Standards		
Iron	-0.05	-0.05
Manganese	0.09	-0.02
Sulfate	39	2
Total Dissolved Solids	358	18
pH, standard units	7.5	5.9
Sodium	28	2
Calcium	67	5
Magnesium	28	2
Total Alkalinity as $CaCO_3$	294	16

Water Analysis

October 17, 1979
Job No. 61-152

Hurlbut, Kersich & McCullough
Billings, MT

Lab No.:	33733	33734
Secondary Standards, continued		
Bicarbonate as HCO_3	359	19
Carbonate as CO_3	0	0
Electrical Conductivity, (umhos/cm)	630	47

A minus sign indicates less than the level reported was present in the sample.

Certified

Northern Testing Laboratories
CONSULTING ENGINEERS

Report of: Water Analysis

Date November 2, 1979
Job Number 61-152
Sheet 1 of 2
W.O. #2824

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS MT 59107

Sample Identification:

On October 8, 1979, two water samples were delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Lab No.:	34127	34128
Identification:	Fish Creek Campground 8" Well	Lake McDonald - 8" Production Well
Date Sampled:	10/2/79	9/25/79
Component (mg/l, unless noted otherwise)		
Primary Standards		
Arsenic	-0.005	-0.005
Barium	-0.5	-0.5
Cadmium	-0.005	-0.005
Chromium	-0.02	-0.02
Lead	-0.02	-0.02
Mercury	-0.001	-0.001
Selenium	-0.005	-0.005
Silver	-0.01	-0.01
Nitrate as Nitrogen	0.04	0.06
Fluoride	0.04	0.01
Secondary Standards		
Iron	-0.05	-0.05
Manganese	-0.02	-0.02
Sulfate	2	1
Total Dissolved Solids	44	-1
pH, standard units	7.7	6.6
Sodium	2	1
Calcium	23	3
Magnesium	6	2
Total Alkalinity as $CaCO_3$	78	12

Water Analysis

November 2, 1979
Job No. 61-152
Sheet 2 of 2

Hurlbut, Kersich & McCullough
Billings, MT

Lab No.:	34127	34128
Secondary Standards, continued		
Bicarbonate as HCO_3	95	15
Carbonate as CO_3	0	0
Electrical Conductivity, (umhos/cm)	160	30

A minus sign indicates less than the level reported was present in the sample.

Certified John Sandels

EXHIBIT IV

SUMMARY OF DATA

FISH CREEK CAMPGROUND

8 INCH WELL

EXHIBIT IV-A

VICINITY MAP SHOWING LOCATION OF

FISH CREEK CAMPGROUND WELL

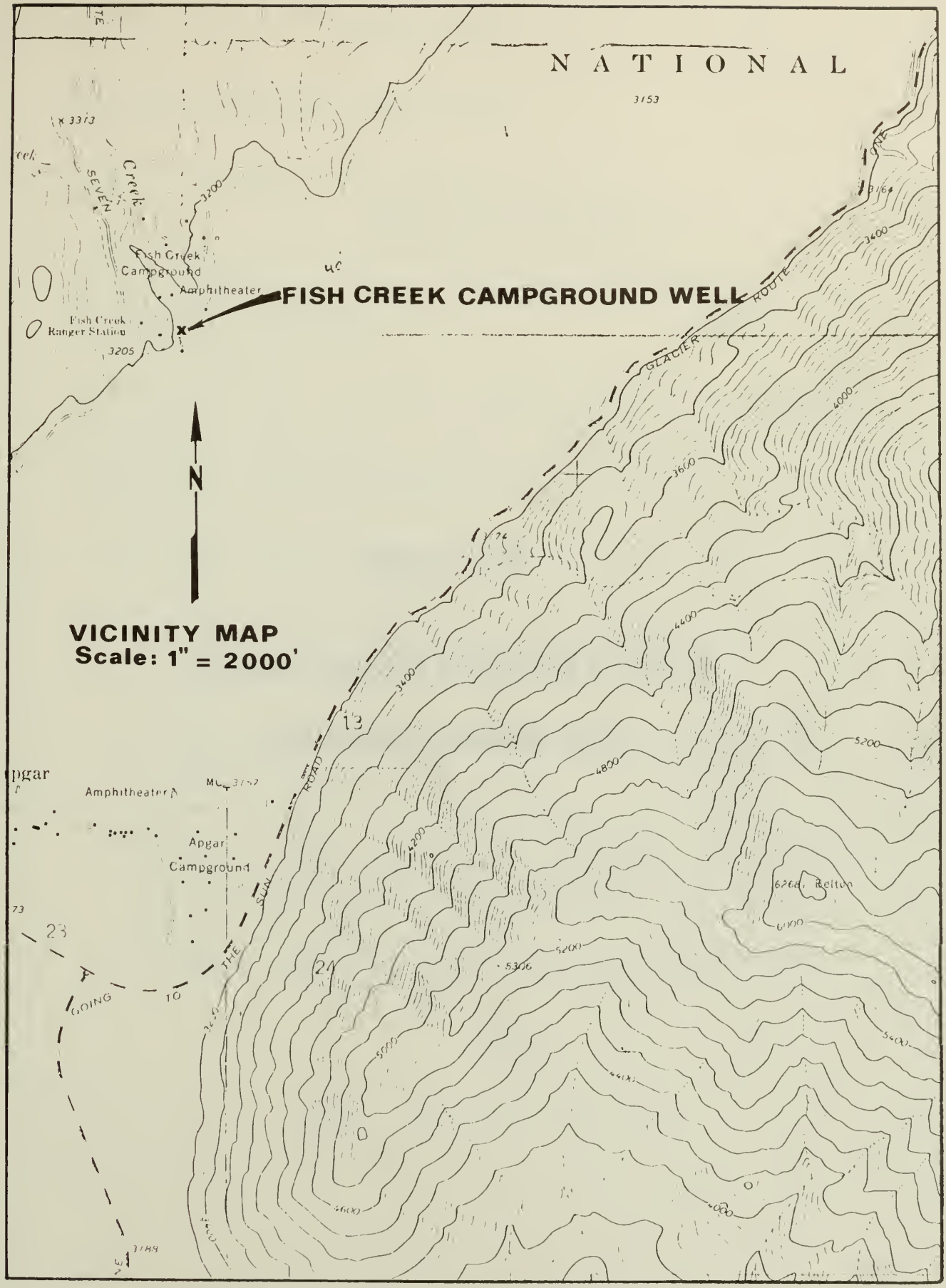


EXHIBIT IV–A: VICINITY MAP SHOWING LOCATION OF FISH CREEK CAMPGROUND WELL

EXHIBIT IV-B

LITHOLOGIC LOG AND COMPLETION RECORD OF

FISH CREEK CAMPGROUND WELL

EXHIBIT IV-B.1

FISH CREEK CAMPGROUND 8 INCH WELL

Surface Elevation: 3,160 Feet ±

Approximate Location: Latitude 48°32'51',
Longitude 113°58'57"

Top of Casing Above Land Surface: 1.67 Feet

Date of Construction: 9/20/79 - 9/28/79

Well Depth: 95.63 Feet

Aquifer: Gravel

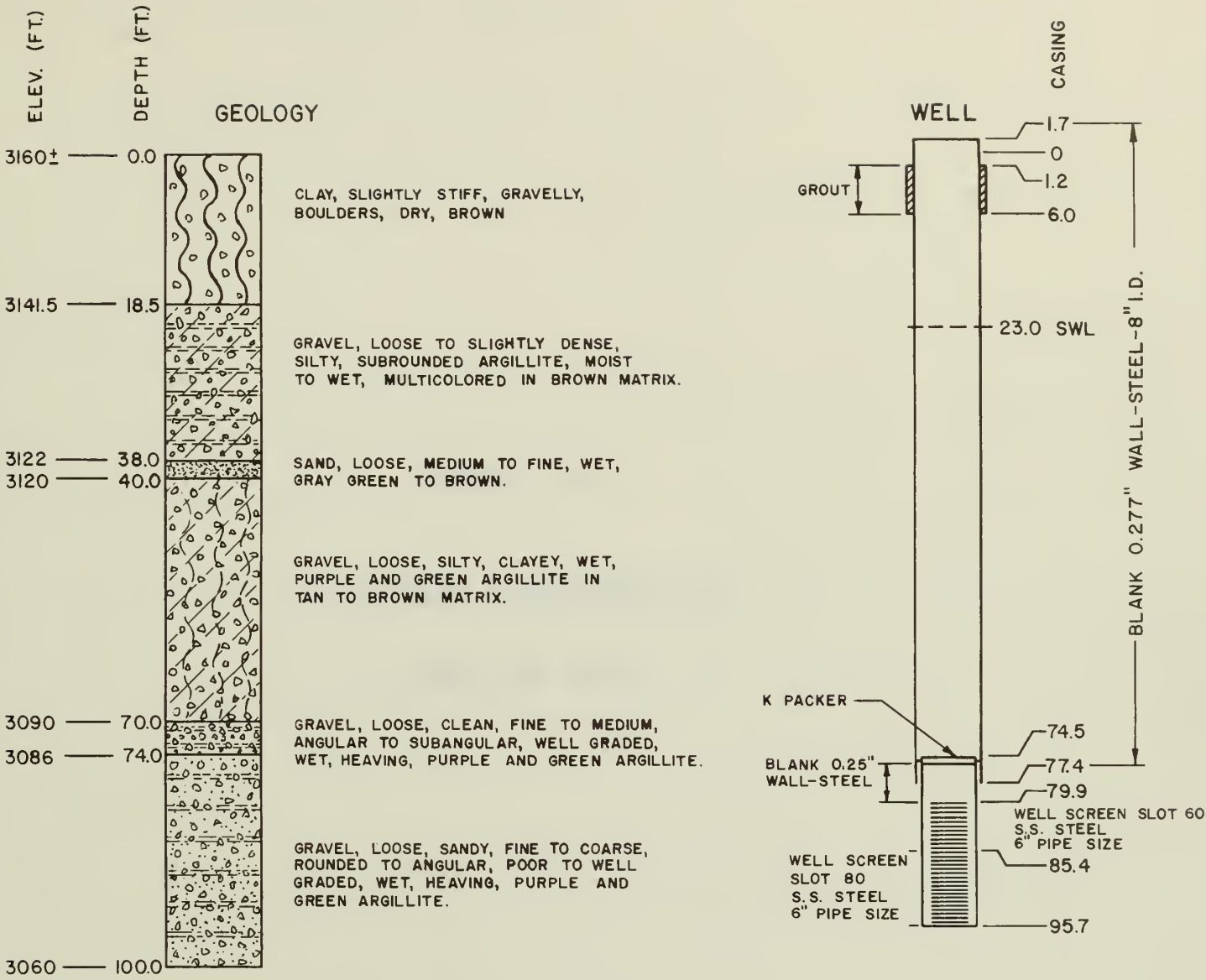
Static Water Level: 23.0 Feet (Measured from top of casing)

Elevation At Total Depth: 3,064.37 Feet ±

Casing Size: 8 inch I.D., 0.277 wall thickness

Miscellaneous Well Information:

- Developed by surging with air for 11 hours.
- 20 HP submersible pump set 63.0 feet below land surface for test pumping.
- Well pumped 23 hours and 54 minutes at average rate of 273 gpm. Drawdown at end of pump test was 1.16 feet.
- Design capacity 10 feet, 7 inch pipe size, slot 80 and 5 feet, 6 inch pipe size, slot 60 Stainless Steel well screen is approximately 521 gpm.
- Well drilled by Air Rotary Method (Ingersoll-Rand Cyclone TH-60).



FISH CREEK 8" WELL

EXHIBIT IV-C

FISH CREEK CAMPGROUND WELL

PUMP TEST DATA

EXHIBIT IV-C.1

GENERAL INFORMATION FISH CREEK CAMPGROUND 8 INCH WELL

Fish Creek Campground 8 Inch Well

Casing Diameter - 8 Inch (ID)
Casing Above Land Surface = 1.7 Feet
Total Depth = 95.7 Feet
Static Water Level = 23.0 Feet (Measured From Top of Casing)

Flow Measurement

Flow measured with 2 inch flow meter.
Average flow during 23 hour and 54 minute test = 273 gpm.

Duration of Test

Pumped 23 hours and 53 minutes (12:36 P.M., 10/1/79 - 12:29 P.M. 10/2/79).

Monitored recovery 1 hour (12:30 P.M. - 1:30 P.M., 10/2/79).

Field Party

J. R. McGill	HKM Associates
B. Butcher	Billmayer Water Supply Co.

EXHIBIT IV-C.2

FISH CREEK CAMPGROUND 8 INCH WELL

DRAWDOWN WATER LEVEL MEASUREMENT

Time	Depth To Water (Feet)	Remarks
10/1/79		
11:30 A.M.	22.80	Static Water Level
12:21 P.M.	22.92	Static Water Level
12:35	23.00	Static Water Level
12:36		Pump on at 12:36 P.M.
12:37	23.65	
12:38	23.59	
12:39	24.23	
12:40	24.31	
12:41	24.13	
12:42	24.13	
12:43	24.15	
12:44	24.31	All Water Level Measurements
12:45	24.10	made from top of casing.
12:46	24.21	
12:47	24.13	
12:48	24.97	
12:49	24.95	
12:50	24.13	
12:55	24.95	
1:00	24.08	
1:05	24.08	Average Flow = 273 gpm
1:10	24.95	
1:15	24.08	
1:20	24.10	
1:25	24.95	
1:30	24.10	
1:40	24.13	
1:50 P.M.	24.13	

EXHIBIT IV-C.2 (Continued)

Time	Depth To Water (Feet)	Remarks
10/1/79		
2:00 P.M.	24.95	
2:30	24.95	
3:00	24.95	
3:30	24.95	
4:00	24.13	
5:00	24.10	
6:00	24.10	
7:00	24.15	
8:00	24.14	
10:00 P.M.	24.14	
10/2/79		
12:00 A.M.	24.15	
4:00	24.15	
7:00	24.18	Sampled for water quality at 11:08 A.M. 10/2/79. Field temperature = 9°C. Field conductivity = 160 micro-mhos/cm at 25 C.
8:00	24.17	
10:00	24.13	
11:00 A.M.	24.18	
12:00 P.M.	24.18	
12:29 P.M.	24.16	Pump off at 12:29 P.M.

EXHIBIT IV C.3

FISH CREEK CAMPGROUND 8 INCH WELL
RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth To Water (Feet)	Remarks
10/2/79		
12:29 P.M.	---	Pump off at 12:29 P.M.
12:30	23.08	
12:31	23.08	
12:32	22.85	
12:33	22.83	
12:34	22.83	
12:35	22.88	
12:36	23.04	
12:37	23.06	
12:38	23.08	
12:39	22.88	
12:40	23.02	
12:45	23.02	
12:50	22.83	
12:55	22.85	
1:00	22.83	
1:05	22.79	
1:10	22.83	
1:20	22.78	
1:30 P.M.	22.81	End of Recovery Water Level Measurements.

EXHIBIT IV-D

RESULTS OF WATER QUALITY ANALYSES

FISH CREEK CAMPGROUND WELL

Northern Testing Laboratories
CONSULTING ENGINEERS

Report of: Water Analysis

Date November 2, 1979
Job Number 61-152
Sheet 1 of 2
W.O. #2824

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS MT 59107

Sample Identification:

On October 8, 1979, two water samples were delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Lab No.:	34127	34128
Identification:	Fish Creek Campground 8" Well	Lake McDonald - 8" Production Well
Date Sampled:	10/2/79	9/25/79
Component (mg/l, unless noted otherwise)		
Primary Standards		
Arsenic	-0.005	-0.005
Barium	-0.5	-0.5
Cadmium	-0.005	-0.005
Chromium	-0.02	-0.02
Lead	-0.02	-0.02
Mercury	-0.001	-0.001
Selenium	-0.005	-0.005
Silver	-0.01	-0.01
Nitrate as Nitrogen	0.04	0.06
Fluoride	0.04	0.01
Secondary Standards		
Iron	-0.05	-0.05
Manganese	-0.02	-0.02
Sulfate	2	1
Total Dissolved Solids	44	-1
pH, standard units	7.7	6.6
Sodium	2	1
Calcium	23	3
Magnesium	6	2
Total Alkalinity as $CaCO_3$	78	12

Water Analysis

November 2, 1979
Job No. 61-152

Hurlbut, Kersich & McCullough
Billings, MT

Lab No.:	34127	34128
Secondary Standards, continued		
Bicarbonate as HCO_3	95	15
Carbonate as CO_3	0	0
Electrical Conductivity, (umhos/cm)	160	30

A minus sign indicates less than the level reported was present in the sample.

Certified

EXHIBIT V

SUMMARY OF DATA

POLEBRIDGE RANGER STATION

AND BOWMAN CREEK CAMPGROUND TEST HOLES

EXHIBIT V-A

VICINITY MAP SHOWING LOCATION OF

POLEBRIDGE RANGER STATION AND BOWMAN CREEK CAMPGROUND
TEST HOLES

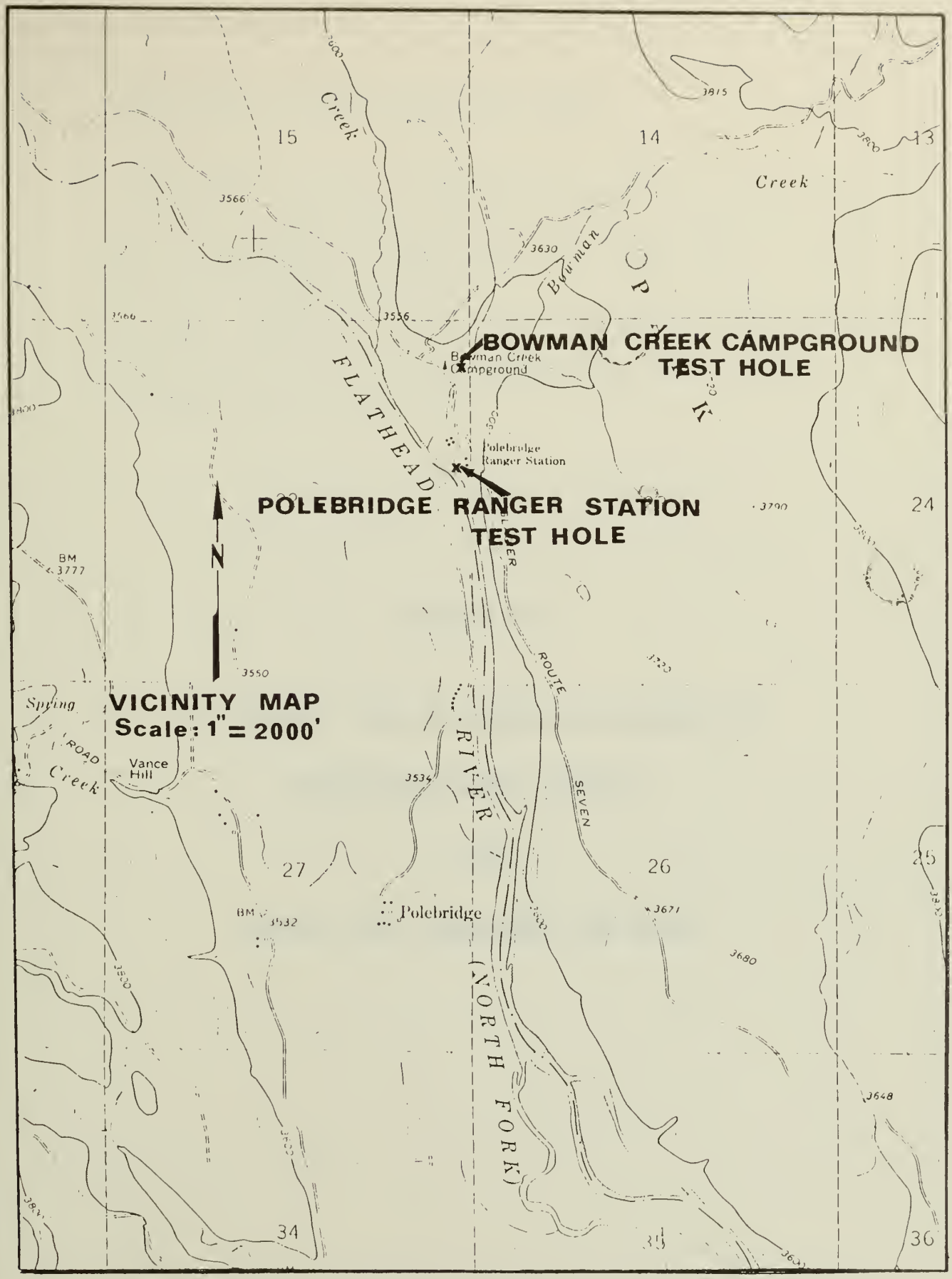


EXHIBIT V-A VICINITY MAP SHOWING LOCATION OF POLEBRIDGE RANGER STATION AND BOWMAN CREEK CAMPGROUND TEST WELLS

EXHIBIT V-B

LITHOLOGIC LOGS AND COMPLETION RECORDS OF

POLEBRIDGE RANGER STATION

AND

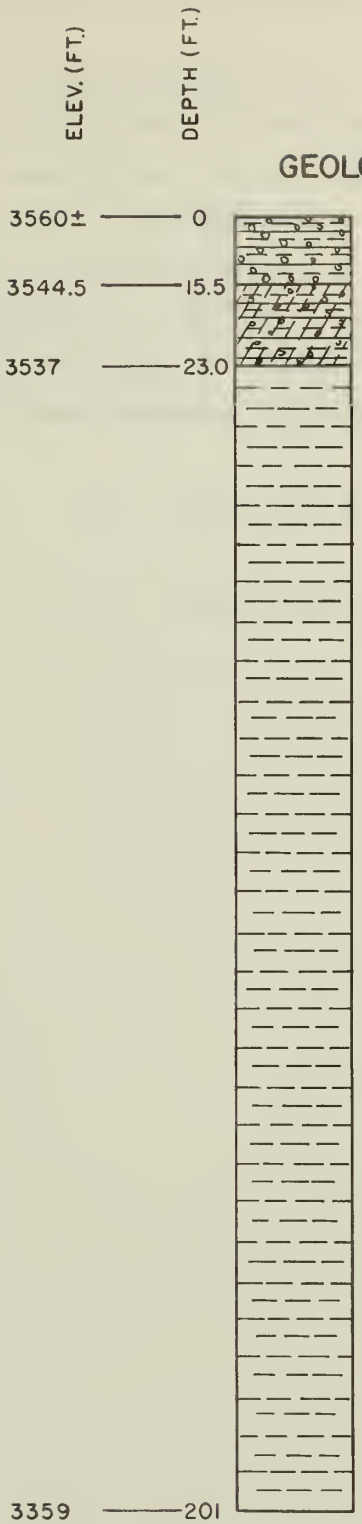
BOWMAN CREEK CAMPGROUND TEST HOLES

POLEBRIDGE RANGER STATION TEST HOLE

Surface Elevation: 3,560 Feet ±
Approximate Location: NW¼ NE¼ SE¼ SE¼ NE¼ Sec. 22, T35N, R21W
Measuring Point: Landsurface
Date of Completion: 10-2-79
Test Hole Depth: 201 Feet
Aquifer: Gravel
Elevation at Total Depth: 3,359 Feet ±
Miscellaneous Information:

- Test well produced less than 1 gpm.

- Abandoned location due to lack of water.



NOTE!

TEST HOLE ABANDONED 10/3/79, WITH 18 FEET-0.25 INCH WALL STEEL CASING (2.0-20.0' BELOW LAND SURFACE). BACKFILLED WITH SAND AND GRAVEL AND CAPPED WELL WITH 2 FEET THICK SURFACE GROUT SEAL

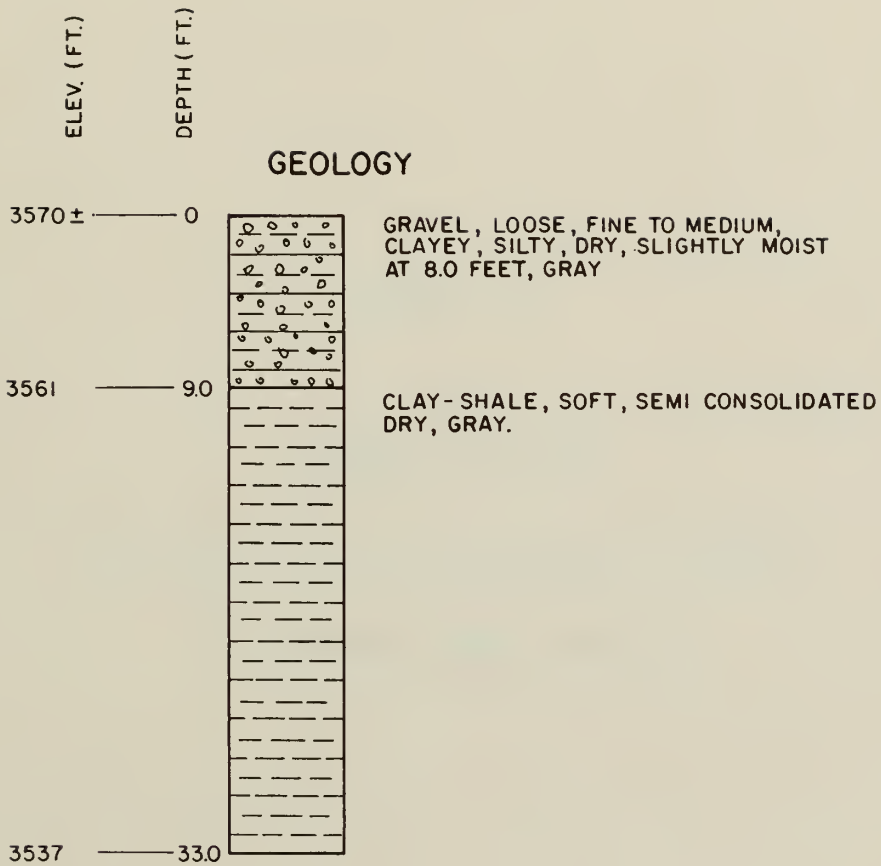
POLEBRIDGE RANGER STATION TEST WELL

BOWMAN CREEK CAMPGROUND

Surface Elevation: 3,570 Feet ±
Approximate Location: NE¼ NE¼ SE¼ NE¼ NE¼ Sec. 22, T35N, R21W
Measuring Point: Land Surface
Date of Completion: 10-3-79
Test Hole Depth: 33 Feet
Aquifer: None
Elevation at Total Depth: 3,537 ±
Miscellaneous Information:

- Test hole was dry.

- Abandoned location due to lack of water.



BOWMAN CREEK CAMPGROUND
TEST HOLE

EXHIBIT VI

SUMMARY OF DATA

EXISTING INFILTRATION GALLERY SYSTEM

POLEBRIDGE RANGER STATION

EXHIBIT VI-A

VICINITY MAP SHOWING LOCATION OF

POLEBRIDGE RANGER STATION

INFILTRATION GALLERY SYSTEM

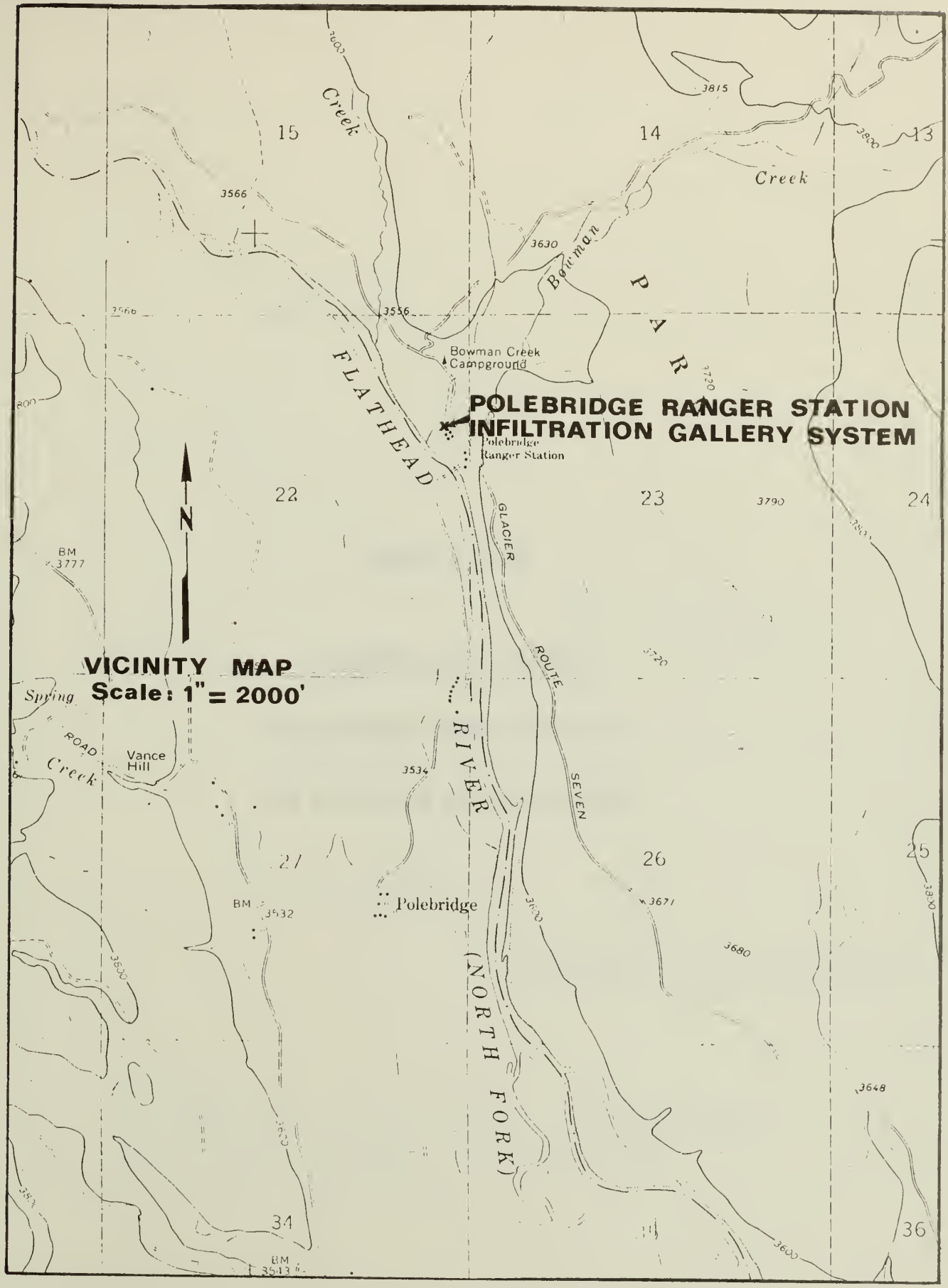


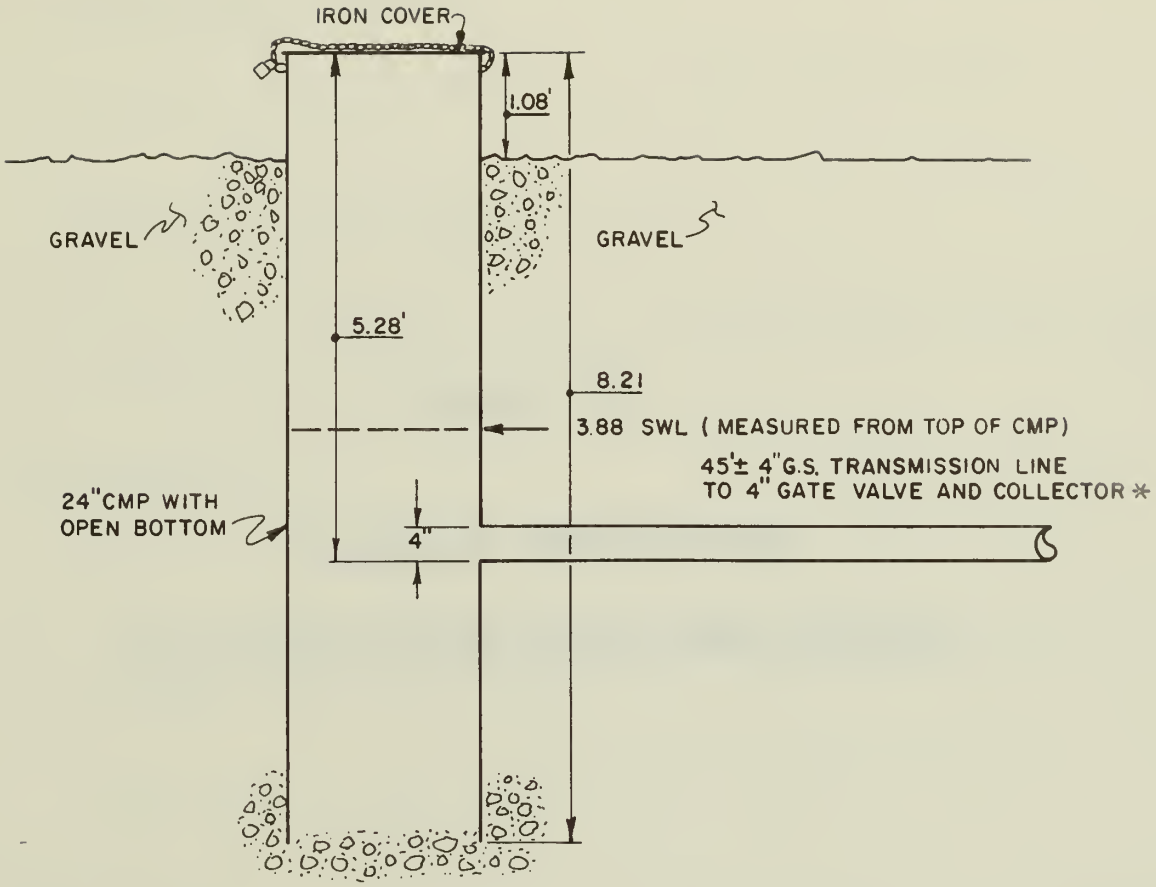
EXHIBIT VI-A: VICINITY MAP SHOWING LOCATION OF POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM

EXHIBIT VI-B

SCHEMATIC OF EXISTING

POLEBRIDGE RANGER STATION

INFILTRATION GALLERY SYSTEM



* COLLECTOR CONSISTS OF 12' OF 12" ID PERFORATED CMP UNDERDRAIN PIPE BURIED APPROXIMATELY 2.5 FEET BENEATH BOWMAN CREEK

SCHEMATIC OF EXISTING POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM

EXHIBIT VI-C

POLEBRIDGE RANGER STATION

INFILTRATION GALLERY SYSTEM PUMP TEST DATA

EXHIBIT VI-C.1

GENERAL INFORMATION POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM

Polebridge Ranger Station Infiltration Gallery System

Clearwell Diameter and Material = 24 inch corrugated metal pipe

Depth of clearwell = 7.13 Feet below land surface

Collector Diameter and Material = 12 Inch perforated corrugated metal pipe

Collector Depth of Burial = 2.5 Feet ± below Bowman Creek Static Water Level = 3.88 Feet (Measured From Top of Pipe).

Flow Measurement

Flow measured with 4.73 gallon bucket and stopwatch.

Average flow during 2 hour and 13 minute test was 15 gpm (12:29 P.M. 10/4/79 - 2:42 P.M. 10/3/79).

Monitored recovery 18 minutes (2:42 P.M. 10/4/79 - 3:00 P.M. 10/4/79)

Field Party

J. R. Mc Gill HKM Associates

EXHIBIT VI-C.2

POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM
DRAWDOWN WATER LEVEL MEASUREMENTS IN CLEARWELL

Time	Depth To Water (Feet)	Remarks
10/4/79		
12:15 P.M.	3.88	Static Water Level
12:26	-	Pump on at 12:26 P.M.
12:29	4.86	
12:31	-	
12:32	5.60	
12:35	6.35	
12:38	6.67	
12:40	-	
12:41	6.94	Average Flow = 15 gpm
12:43	7.17	
12:46	7.25	
12:49	7.29	
12:50	7.33	Sampled for water quality at 2:00 P.M.
12:55	7.29	
1:01	7.33	
1:08	7.27	
1:20	7.10	
1:30	7.00	
1:40	7.04	
1:50	7.04	
2:01	6.96	
2:40	6.46	
2:42 P.M.	-	Pump off at 2:42 P.M.

EXHIBIT VI-C.3

POLEBRIDGE RANGER STATION INFILTRATION GALLERY SYSTEM
RECOVERY WATER LEVEL MEASUREMENTS

Time	Depth To Water (Feet)	Remarks
10/8/79		
2:42 P.M.	-	Pump off at 2:42 P.M.
2:43	5.83	
2:44	5.47	
2:45	5.21	
2:46	5.04	
2:47	4.71	
2:48	4.46	
2:49	4.25	
2:50	4.10	
2:51	4.00	
2:52	3.93	
2:55	3.88	
3:00 P.M.	3.88	End of Recovery Water Level Measurements

EXHIBIT VI-D

RESULTS OF WATER QUALITY ANALYSES

POLEBRIDGE RANGER STATION

INFILTRATION GALLERY SYSTEM

Northern Testing Laboratories
CONSULTING ENGINEERS

Report of: Water Analysis

Date December 6, 1979
Job Number 61-152
Sheet 1 of 2
Invoice No. 3422

Report to: HURLBUT, KERSICH & MCCULLOUGH (2)
ATTN: JIM MCGILL
P O BOX 31318
BILLINGS, MT 59107

Sample Identification:

On November 19, 1979, one water sample was delivered to our laboratory to determine the suitability for domestic consumption. Tests were conducted in accordance with the U.S. Environmental Protection Agency Manual EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." The results of the analysis are as follows:

TEST RESULTS:

Component (mg/l, unless noted otherwise)	
Lab No.:	35542
Identification:	Polebridge Ranger Station
Date Sampled:	11/7/79
Primary Standards	
Arsenic	-0.005
Barium	-0.5
Cadmium	-0.005
Chromium	-0.02
Lead	-0.02
Mercury	-0.001
Selenium	-0.005
Silver	-0.01
Nitrate as Nitrogen	0.12
Fluoride	0.03
Secondary Standards	
Iron	-0.05
Manganese	-0.02
Sulfate	3
Total Dissolved Solids	84
pH, Standard units	6.8
Sodium	2
Calcium	20
Magnesium	6
Total Alkalinity as $CaCO_3$	69

Water Analysis

Hurlbut, Kersich & McCullough
Billings, MT

Job No. 61-152
Sheet 2 of 2

Lab No.:	35542
Secondary Standards, continued	
Bicarbonate as HCO_3	85
Carbonate as CO_3	0
Electrical Conductivity, (umhos/cm)	150

A minus sign indicates less than the level reported was present in the sample.

Certified John Standish