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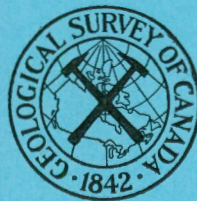
CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 60

NORTHERN SETTLEMENTS
NO. 2

PRELIMINARY NOTES ON GROUNDWATER AND PERMAFROST
YUKON TERRITORY

BY
L. V. BRANDON



OTTAWA
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Introduction

This report has been written following a visit to the Yukon Territory in 1961.

The report comprises brief descriptive notes and chemical analyses on wells at some communities in the Yukon. It is part of a more extensive study of groundwater and permafrost in northern Canada.

The writer wishes to thank Mr. T.J. Stinson of Yukon Drilling, Whitehorse for some of the information on wells referred to here.

Description of Sites

Descriptions of the topography and geology of the sites is not included in this report because most locations are in areas where maps are already published.

Most settlements are in valley flats where wells can be drilled into alluvium or glacial deposits. Aquifers consist of gravel and sands. In many places it is necessary to install a well screen and to carry out considerable development work on a well prior to completion because the aquifers consist of fine-grained sands, and silts are often present. The cost of well screens and development work should be allowed for when contracting for wells in the district.

Dawson City

Two wells for the city water supply are located by the junction of the Klondike and Yukon Rivers. The wells have been excavated into sand and gravel alluvium and obtain water from bank storage along the

Klondike. One well is 38 feet deep.

The temperature of the water is raised by steam heating at the pump house so that water reaches the town main at 39°F.

There are many other locations nearby where water could be obtained from wells drilled into alluvium near the banks.

Mayo

Most of the wells in the town are sand points which have been driven down through silts and alluvium. These supplies are adequate and of good quality except in the southeast part of the town along the Stewart River and near the Anglican Mission. In this locality good well supplies are difficult to obtain. Silt layers with permafrost lenses are present. The quality of water in one well is bad; the water having a high iron sulphate content. (See analysis 4).

It is believed that well supplies are more easily obtained from buried alluvium near the Mayo River rather than near the Stewart River.

Whitehorse - Dawson Highway

Wells are used for local water supplies at the crossing of the Pelly River and at Carmacks. No difficulty is experienced in these locations in obtaining water from wells in river alluvium.

Alaska Highway

Mile 1202 There are several wells at this community which obtain water from sand and gravel lenses at depths varying from 60-110 feet.

Depth to water is reported to be about 45 feet. Permafrost is not present. Three chemical analyses are recorded.

Mile 1168 The well at the C.N. Telegraph station is reported to be 62 feet deep. It probably requires a well screen and some well development owing to sand plugging.

Mile 1164 There is an abandoned and plugged well (12" outer casing, 9" inner casing) at a disused army campsite near the crossing of the Koidern River. Permafrost was reported to be present when this camp was constructed in 1942. The well is reported to have obtained water from a depth greater than 35 feet.

Mile 1124 The Donjek pump station has a well that was drilled in 1960. Its reported depth is 141 feet. The well has a small flow (1-2 g.p.m., approx.). The temperature of the water was found to be 34°F.

Mile 1095 The well at the motel is reported to be 158 feet deep. The well flows at about 20 g.p.m. from a gravel aquifer. The temperature of the water was found to be just above 32°F. The well sometimes starts to freeze up, but complete freezing is prevented by use of a heat coil which has been installed in the well. Several layers of permafrost were reported during the drilling of the well.

Destruction Bay 1083 Two wells drilled for the military construction camp are still in use on the Lake Kluane side of the highway. One is now used by C.N. Telegraphs. Analyses of the water are recorded.

The well at the hotel was drilled in 1954. It is reported to be 99 feet deep. Permafrost layers were reported during drilling. The well has a small flow.

Mile 1026 Haines pump station. The well was drilled in 1953-54 to a reported depth of 87 feet. The static water level is 72 feet below surface. The well obtains water from a sand and gravel aquifer and pumps about 3,000 gallons per day.

Agricultural Experimental Farm Mile 1019 Water for the farm is obtained from Pine Creek. There is a well at Mile 1018 in a valley east of the main farm buildings. The temperature was found to be 36°F. The water has a high sodium sulphate content and the Sodium Adsorption Ratio indicates that the water is unsuitable for irrigation.

Mile 1016, Haines Junction Most of the wells at this community are about 60 feet deep and obtain water from sand lenses. One well was drilled to 360 feet depth at Haines Inn in 1952 and was abandoned. It is probable that insufficient efforts were made to develop a supply from fine sand lenses in silt at a higher elevation.

Whitehorse

The city well field consists of three wells located on the east bank of the river. The wells are used in the winter because the temperature of the well water (39° - 40.5°F) is warmer than the river water during winter time.

Several new subdivisions are being laid out at locations outside the city limits. Wells have been put down at some of these places. Test drilling is recommended at these subdivisions prior to lay-out so that

well fields and a distribution system can be properly planned. The digging of individual wells and septic tanks on each lot may lead to contamination problems.

Teslin Village 804 milepost There are five drilled wells in the village which obtain small but adequate supplies of water. The well at the R.C.M.P. post is high in iron content and needs treatment.

Information on the depth of wells is uncertain. It is probable that water is obtained from sand lenses underlying glacial till and lake silts.

Watson Lake Junction Mile 635

Wells on the northeast side of the highway obtain abundant supplies of water from sand and gravel within 50 feet of surface. On the southwest side of the town there is a glacial till ridge and wells obtain water from sand lenses beneath this.

A town supply could adequately be obtained from a well drilled into gravels near Wye Lake. However, the present distribution and size of lots may make this uneconomic. The use of both wells and septic tanks in the gravels may prove to be unsatisfactory owing to pollution. The water supply at the hotel had a high very nitrate content on the day of sampling.

Carcross

Water is obtained from wells in the fine dune and lake sands throughout the community. A high capacity well would require a screen and much development work.

Old Crow

The settlement is situated on a dry island of silt and alluvium with some organic layers. It is on the north bank of the Porcupine River. The banks of the settlement on the upstream side, where the Old Crow River joins the Porcupine, are 30 feet high and erosion is taking place. The shore line is composed of a gravel cobble beach. Half a mile downstream of the settlement there is a 40 foot cliff on the north bank consisting of a buff sandy till that is well consolidated and this is overlain by lake clay containing vivianite. Sand layers overlie the clay. On the south bank of the river opposite the settlement there are extensive peat deposits. Permafrost is present in the area.

It may be possible to obtain water from wells drilled in the settlement if coarse alluvium is present and if the permafrost is shallow. Test drilling with properly equipped machinery would be necessary at this site before making any predictions about water supply.

Thermal Springs

Chemical analyses of the Takhini, Atlin, B.C., Coal River, B.C., and Liard, B.C. hot springs are included in this report. The springs are described in earlier geologic reports. Warm springs are also reported to exist several miles up Edith Creek. (Edith Creek crosses the Alaska Highway at mile 1146). Other hot spring areas are reported in the McArthur range.

TO ACCOMPANY TOPICAL REPORT NO. 60
NORTHERN SETTLEMENTS NO. 2. YUKON TERRITORY.
CHEMICAL ANALYSES IN PARTS PER MILLION OF SAMPLES TAKEN.

LOCATION	DAWSON	MAYO				ALASKA HIGHWAY													
	Dawson City Main well	Mayo Forestry office well	Mayo D.O.T. Bldg. well	Mayo well near Anglican Mission	Mayo Chateau Mayo Hotel well	Mile 1202 Hotel well	Mile 1202 Customs House well	Mile 1202 Ida's Motel	Mile 1124 Donjek Stn. well	Mile 1095 Motel well	Destruction Bay Military well near Kluane Lake	Destruction Bay Hotel well	Destruction Bay CNT well	Mile 1026 Haines pump Stn. well	Mile 1018 Agric. Exp. farm well	Mile 1016 RCMP	Mile 1016 Brewster's Motel	Mile 1016 Bekkes Motel	Takhini Hot Spring
Date	13 July/62	15 July/62	15 July/62	15 July/62	15 July/62	18 July/62	18 July/62	18 July/62	19 July/62	19 July/62	21 July/62	21 July/62	21 July/62	22 July/62	22 July/62	22 July/62	22 July/62	22 July/62	24 July/62
Appearance and Odour	Clear	Clear	Clear	Orange rust deposit	Clear	Clear	Clear	Slight ppt	Slight rust ppt	A few black particles	Clear	Clear	Clear	Clear	Slight sediment	Clear	Clear	Clear	Few white particles
pH	7.6	7.5	7.5	3.6	7.5	8.1	8.0	8.0	8.0	8.0	8.1	8.3	8.2	8.2	7.7	8.4	8.0	8.1	7.5
Colour	5	5	5	15	20	5	5	25	25	0	0	0	5	0	5	0	0	0	0
Conductivity	204	190	295	2692	255	525	482	805	727	508	612	768	656	331	1571	571	628	689	2676
Hardness: Total	96.5	98.1	147	1028	124	272	252	411	401	232	269	400	332	176	563	300	333	352	1854
: Noncarbonate	27.4	17.2	19.3	1028	29.7	50	30.6	35.1	0.0	0.0	95.7	103	89.4	20.1	514	20.4	56	111	1746
Calcium	25.4	26.3	41.1	246	32.2	84.7	82.1	125	72.1	42.2	30.2	43.0	38.5	53.3	117	33.6	44.8	44.9	586
Magnesium	8.0	7.9	10.7	101	10.6	14.6	11.3	23.8	53.7	30.8	47.0	71.0	57.3	10.3	66	52.5	53.6	58.3	95.1
Sodium	2.1	1.5	4.7	74.2	3.4	3.8	3.7	23.6	9.9	19.3	26.4	16.6	14.2	1.6	140	9.9	10.2	14.4	30.1
Potassium	0.8	0.7	1.3	4.8	1.0	1.4	1.6	5.6	6.4	5.0	4.5	4.8	4.1	0.9	6.6	4.5	4.7	5.6	7.7
Iron Total	0.02	0.14	1.5	394	0.39	0.01	0.09	0.08	3.4	0.05	0.17	0.54	0.63	0.15	1.7	0.18	0.02	0.04	0.62
Manganese	0.01	0.01	0.17	6.7	0.01	0.01	0.03	0.5	0.2	0.3	0.01	0.12	0.02	0.0	0.04	0.0	0.0	0.0	0.0
Copper																			
Zinc																			
Ammonia	0.1	0.1	0.1		0.1	0.1	0.1	0.2	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	84.2	98.4	155	0.0	115	270	270	458	509	288	211	362	296	189	59.9	341	337	294	132
Sulphate	29.8	17.0	25.4	1693	33.9	13.9	22.0	9.1	1.6	40.9	157	142	121	20.4	804	40.2	77.9	141	1721
Chloride	1.5	0.4	3.4	105	0.8	10.2	5.2	24.8	2.6	1.9	0.7	0.8	0.8	0.4	1.6	0.7	0.7	1.5	1.5
Fluoride	0.14	0.08	0.10	1.45	0.13	0.08	0.08	0.16	0.46	0.29	0.44	0.37	0.44	0.08	0.82	0.34	0.29	0.38	4.4
Nitrate	1.4	1.5	0.4	1.4	0.5	32	8.3	63	0.4	1.2	0.5	0.4	0.8	0.4	0.4	0.8	1.1	2.1	7.6
Silica	6.2	4.8	6.7		4.6	13	15	24	26	23	20	18	17	10	12	14	15	14	41
Sum of Constituents	117	109	170	1055	144	306	282	525	424	306	390	476	400	191	1178	330	374	426	2559
% Sodium	4.5	3.2	6.4	8.5	5.6	2.9	3.1	11	5	15	17	8.2	8.4	1.9	35	6.6	6.2	8.0	3.4

TO ACCOMPANY TOPICAL REPORT NO. 60
 NORTHERN SETTLEMENTS NO. 2. YUKON TERRITORY.
 CHEMICAL ANALYSES IN PARTS PER MILLION OF SAMPLES TAKEN. (Continued)

LOCATION	WHITEHORSE		ALASKA HIGHWAY			ATLIN		ALASKA HIGHWAY	
	Whitehorse Municipal well #1	Mile 923 Casa Loma Motel	Teslin RCMP well	Watson Lake Hotel well	Watson Lake Motel well	Atlin Warm Springs	Atlin Cold Springs	Coal River Hot Springs	Liard Hot Springs
Date	25 July/62	25 July/62	29 July/62	31 July/62	31 July/62	29 July/62	29 July/62	1 Aug./62	12 July/60
Appearance and Odour	Clear	Clear	Some reddish precipit.	Some white ppt.	Slight grey ppt.	Clear	Orange prept.	Specks of iron oxide	Clear
pH	8.0	8.3	8.0	7.9	7.7	7.7	7.7	7.3	8.1
Colour	0	0	0	5	0	0	0	0	8
Conductivity	368	470	1042	702	346	401	5824	1217	1301
Hardness: Total	159	247	618	204	168	209	4878	627	738
: Noncarbonate	31.0	26.6	250	57.5	5.5	1.4	0.0	32.8	589
Calcium	28.3	72.5	95.8	56.9	49.5	55.1	8.8	125	234
Magnesium	21.4	15.9	91.9	15.0	10.8	17.3	1180	76.5	37
Sodium	12.2	4.8	6.3	60.5	5.8	2.6	30.3	40.6	15
Potassium	1.9	1.4	2.9	5.2	1.2	0.7	9.2	34.0	9.8
Iron Total	0.27	0.02	2.9	0.02	0.27	0.04	7.4	0.82	Trace
Manganese	0.0	0.0	0.14	0.0	0.04	0.0	0.14	0.08	0.02
Copper			0.0	0.0	0.0	0.0	0.21	0.0	0.0
Zinc									0.3
Ammonia	0.0	0.0		0.0	0.0	0.0	0.0		
Bicarbonate	156	268	449	179	198	253	5961	725	182
Sulphate	55.9	35.6	249	28.8	7.2	11.3	60.5	77.0	566
Chloride	0.9	1.4	2.2	48.4	10.2	0.8	14.0	63.6	18.5
Fluoride	0.24	0.25	0.73	0.06	0.06	0.14	0.08	0.33	3.2
Nitrate	0.8	0.4	0.0	125	4.7	0.0	0.0	0.0	3.0
Silica	12	17	15	31	14	14	74	40	52
Sum of Constituents	210	282	685	458	201	226	4311	814	1036
% Sodium	14	4.0	2.2	38.5	6.9	2.6	1.3	12	4.1