GROUNDWATER POSSIBILITIES IN THE AREA AREA OF PROVINCIAL GAOL SITE NEAR PEACE RIVER, ALBERTA

by: O. Tokarsky

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Alberta
RESEARCH COUNCIL

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GROUNDWATER POSSIBILITIES IN AREA OF PROVINCIAL GAOL SITE

NEAR PEACE RIVER, ALBERTA

March, 1965

This report considers only the groundwater possibilities at this site. No mention is made of the surface water possibilites.

Three test holes were drilled in early March 1965 by the Department of Public Works in the alluvial terrace at the site of the new Provincial Gaol near Peace River. I feel that these have quite adequately tested the groundwater potential of the terrace at this location. I would like to briefly summarize and comment on the program.

Test hole #1 - approximately 700 feet from the river's edge: drilled to a total depth of 82 feet and encountered very salty water, 20,000 ppm ~~Cl~~ T.D.S. and 11,540 ppm ~~total solids~~ Chloride and stayed of the same chemistry after bailing for 6 1/2 hours at about 30 gpm. Water first encountered at about 40 feet and rose in hole.

Test hole #2 - 293 feet from hole #1 and approximately 1,000 feet from the river's edge: drilled to 42 1/2 feet - water rose overnight to 34.25 feet from ground level. This was potable water (1,400 ppm total solids and 115 ppm Cl). The recommended maximum concentration of chloride and total solids, respectively, in drinking water is 435 and 2,000 ppm in Alberta, and 250 and 1,000 ppm by U.S. Public Health Service standards. In addition, the water is very hard and quite high in sulfates and alkalinity. The hole was deepened to 53.25 feet and the chloride concentration increased to 2,250 ppm and total solids to 4,974 ppm. This hole was not bailed.

Test hole #3 - approximately 40 feet from river's edge: drilled to 20 feet. Static water level was 16.3 feet from ground level. The water analyzed at 88 ppm chloride

and 1,240 ppm total solids. The hole was deepened to 25 feet and bailed for one hour at 10 gpm; the chloride content rose to 400 ppm and the total solids to 1,360 ppm. After 7 hours of bailing at this rate, the chloride content had risen to 600 ppm and the total solids to 1,690 ppm. It is unfortunate that a water sample was not taken at this depth prior to bailing and drilling continued, taking water samples at 5-foot intervals. This would have given us a thickness for the zone of potable water, from which it is then possible, knowing the specific weight of the different waters, to calculate the amount of salt water rise per foot of drawdown (approximately).

The results of the program indicate that a thin skin of potable water merges downwards through a transitional zone to very salty water. A well, bottomed in the potable water zone and bailed (or pumped) for any length of time at relatively low rates of pumping (in this case at only 10 and 30 gpm) tends to bring up salt water from the underlying zone. The high chloride content in the well water nearest the river is significant because it indicates that the proximity of the river has little freshening effect on the water in the terrace.

Existing Wells

The existing well in the pump house contains potable water, 570 (560 → 530) ppm total solids and 40 ppm Cl. Total depth of the well is 33 feet and depth to water is approximately 30 1/2 feet. This well just penetrates to the top of the water-bearing zone. It has been used for many years and presumably has always been of good quality chemically. However, it is not likely that it has ever been pumped at more than low rates for any period of time. Calculating a water use of 50 gpd per person, water would be used at a rate of 2 gpm by a population of 50 people at this site. It is not likely that this population ever existed at this location, nor is it likely that they would have used

Another existing well drilled by A. LaFleur of Grimshaw to ~80' near test hole #1 obtained salt water ("not fit for the pigs it was drilled for"). This well was filled in.

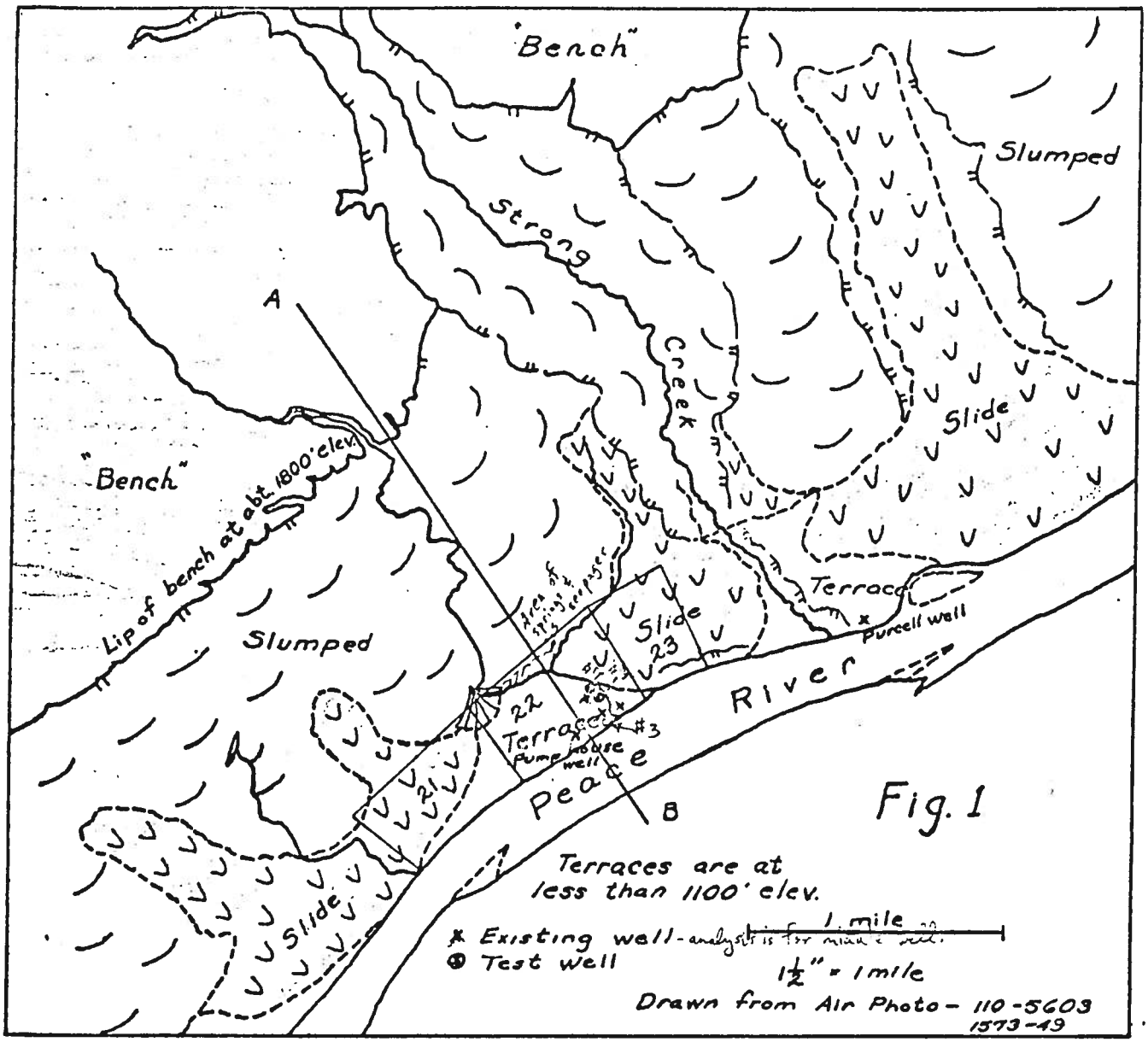


Fig. 1

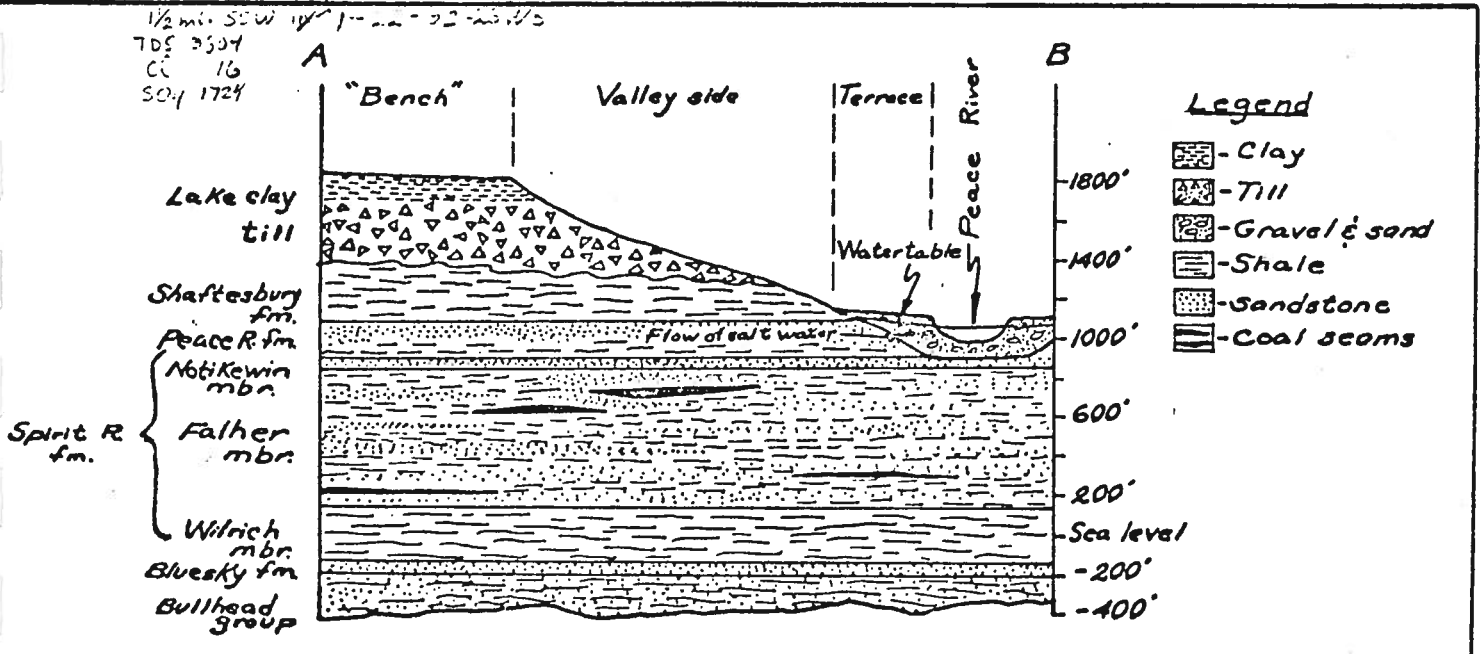


Fig. 2

Schematic Section Along Line A-B
Vertical Scale: 1" = 1000'
Horizontal Scale: Same As Map

the rate of water considered, which is based on use in households having modern conveniences such as automatic washers and modern plumbing.

A well on the property of Mr. Freeland, about 5 miles from the gaol site, has water of similar quality (1,800 ppm total solids and 8 ppm chloride). Water was encountered in this well at a depth of about 100 feet and rose to approximately 65 feet. Normal water use is very low, probably not over 400 gpd (less than 1/3 gpm). In the spring of 1963, however, which was very dry, the well was used quite extensively. By July a strong odor of H_2S was noticed, and silverware washed in the water turned black. This is significant because it is believed the H_2S is associated with the salt water zone. (A very strong H_2S smell was noticed in DPW test well #1 and the drill stem on the drill rig turned black from it). It is considered probable that if the well had been pumped at a higher rate, salty water would have been drawn up into it. d.d. of 1' in a well causes upward movement of as much as 40' of fresh-salt water interface.

Hydro-Geological Setting at Peace River Gaol Site (see Fig. 1)

The gaol site comprises lots 21, 22, and 23 of the Shaftesbury settlement. These are located along the Peace River at elevations of less than 1,100-feet to slightly over 1,200-feet above sea level. The river level itself is at slightly over 1,050 feet. An alluvial terrace comprises the main portion of lot 22, and part of lot 21. All the present buildings are located on this terrace at elevations of just under 1,100 feet. Slide debris of earth and mud, now stabilized and overgrown, derived from the valley sides, make up the higher portions of the site, principally in lots 21 and 23. The valley sides rise to a flat "bench" at about 1,800 feet or slightly more above sea level. This "bench" forms the principal farmland of the Peace River district.

The sand and gravel of the alluvial terrace, on which the test drilling was conducted is believed to rest on sandstones of the Peace River Formation. This formation, where encountered in drilling from the "bench", is salt-water-bearing in concentrations of up to 30,000 ppm total solids. It is believed that there is a hydraulic connection between the Peace River Sandstone and the terrace sands and gravels enabling the saline waters to come up into the terrace. The upper thin potable water zone is due to percolation of rain and meltwater downwards through the sandy clay soil to the water table. Being less dense than the saline water, it would tend to rest over top of it with little mixing of the two, except for a thin transition zone. It is believed that hydrogen sulfide, derived from natural gas in the Peace River Sandstone, may be associated with the saline water.

Other Possible Aquifers (see Fig. 2 for formation types at depth)

Three possibilities for further testing exist. It is believed that these, with the possible exception of deeper drilling below depths of 300 feet, would have very little chance of success. The possibilities are:

(1) Deeper drilling

(2) Drilling into the slide material at either end of the gaol site

(3) Drilling into a small fan of what is probably alluvial silt situated at the base of the valley side.

(1) Deeper drilling is considered unlikely to be successful down to about 250- to 300-feet below the surface. This is the approximate extent of the marine salt-water bearing Peace River Formation and the underlying Notikewin member. A well drilled in Peace River town by Northern Alberta Dairy Pool encountered salty water (10,000 ppm Cl; 17,000 ppm total solids) at 250-feet below ground level, probably from the Notikewin member of the Spirit River Formation.

Below the Notikewin Member, from approximately 300- to 1,000-feet below ground level is the Falher Member of the Spirit River Formation. This consists of alternating sandstones and shales with thin coal seams. The sandstones are mostly fine to very fine grained and loosely to tightly cemented. There is a possibility that some of the loosely cemented sandstones could be aquifers. Coal seams are good aquifers in some places, but may be too thin to yield much water in this case. The Falher Member is believed to represent a continental deltaic facies, and as such should yield water much lower in chloride and total solids than that obtained from the Peace River Formation, although it still may not be potable. E-logs of the interval show that the sandstones are mainly thin (less than 20-feet thick). This combined with their fine-grained nature, possible cementation, and the usual lenticular nature of continental sediments which would limit their lateral extent, would suggest that large quantities of water could not be obtained from them. As far as known, the Falher Member has never been tested for groundwater purposes.

It is not likely that potable water could be obtained in this area below 1,000 feet below ground level, although another continental sandstone, the Bullhead group, is present at 1,300 to 1,400 feet. Gas is produced from this interval in the Tangent field approximately 12 miles southwest of the gaol site.

(2) The slide debris at either end of the gaol site is not considered favorable for groundwater in quantity. These types of slides usually occur in water-saturated clays which will not transmit water readily into a well.

(3) A small fan of alluvial silt occurs in the northwest corner of lot 22, at the point where a small creek emerges from the valley side onto the alluvial terrace. Fans of this type, because of their fine-grained nature, will not usually yield water in any great quantities.

(4) An alkali spring is reported at the base of the valley side. This would appear to be chemically unsuitable.

Recommendations and Conclusions

(1) The alluvial terrace at the site has been adequately tested and found to be unsuitable. Any attempt to try to skim off the thin skin of potable water overlying the salt water would be in the nature of an experiment, and as such, could go wrong at any time and have to be abandoned. Possible ways of developing this source could be (1) by means of horizontal gallery systems and pumping at as low a rate as possible, or (2) by means of shallow wells by the river with recharge pits on the landward side. Again, pumping would have to be at as low a rate as possible. It is not here recommended that the Department of Public Works engage in such experiments unless their engineers can see some hope of success. The initial high total solids content of the potable water would suggest that such experiments would not be successful unless a substantial amount of recharge was obtained.

(2) The only other possible source of groundwater supply would appear to be from the continental Falher Member of the Spirit River Formation at depths of 300- to 1,000-feet below ground level. This formation has possibilities, but as far as known, has never been tested. It is expected, however, that yields would not be high, and that water quality would probably be poor, high in soda and in total solids. Deep drilling at the towns of Spirit River and McLennan to test the continental Dunvegan Formation at depths of about 600 feet encountered water of this quality. It should be remembered that a depth of 300-feet below terrace level is about 1,000-feet below the "bench", which marks the top of the valley sides.

O. Tokarsky,
Groundwater Division,
Research Council of Alberta.
March 12, 1965.

Appendix A

Addendum, June 28, 1965.

After further examinations at the gaol site, notably of the "alkali" spring, and discussions with other members of the Groundwater Division, I would like to suggest the following steps for further exploration with regard to groundwater at the site:

(1) Drilling in the vicinities of test holes 1 to 3 to just encounter the water zone. Bail testing at this depth, and if the results are encouraging, pump-testing, with 2 or more observation holes. Drilling depths involved would be only 20 to 40 feet for each hole.

(2) Assuming failure of step #1, or marginal supply, to continue drilling to greater depth, carefully testing each water-bearing interval for chemical quality of water, and where warranted, for rate of yield. One hole drilled to a depth of somewhere over 300 feet, possibly to 500 or 600 feet, would be required.

(3) Insufficiency of supply after carrying out steps 1 and 2 would warrant drilling on the hillside above the alkali spring. Total drilling depth probably would not exceed 150 feet.

(4) Assuming insufficient yield in step #3, and chemical suitability of the spring water, the spring itself could possibly be developed.

Even if all 4 steps were carried to completion, the total drilling footage probably would not exceed 1,000 feet and could conceivably be less than 700 feet with some bail and pump testing. The expense of such a program would not be great when considering the returns that could be obtained.

O. Tokarsky,
Research Council of Alberta,
Groundwater Division,
June 28, 1965.

Appendix B

SAND ANALYSIS

EDWARD E. JOHNSON, INC.

315 NORTH PIERCE STREET
SAINT PAUL 4, MINN.

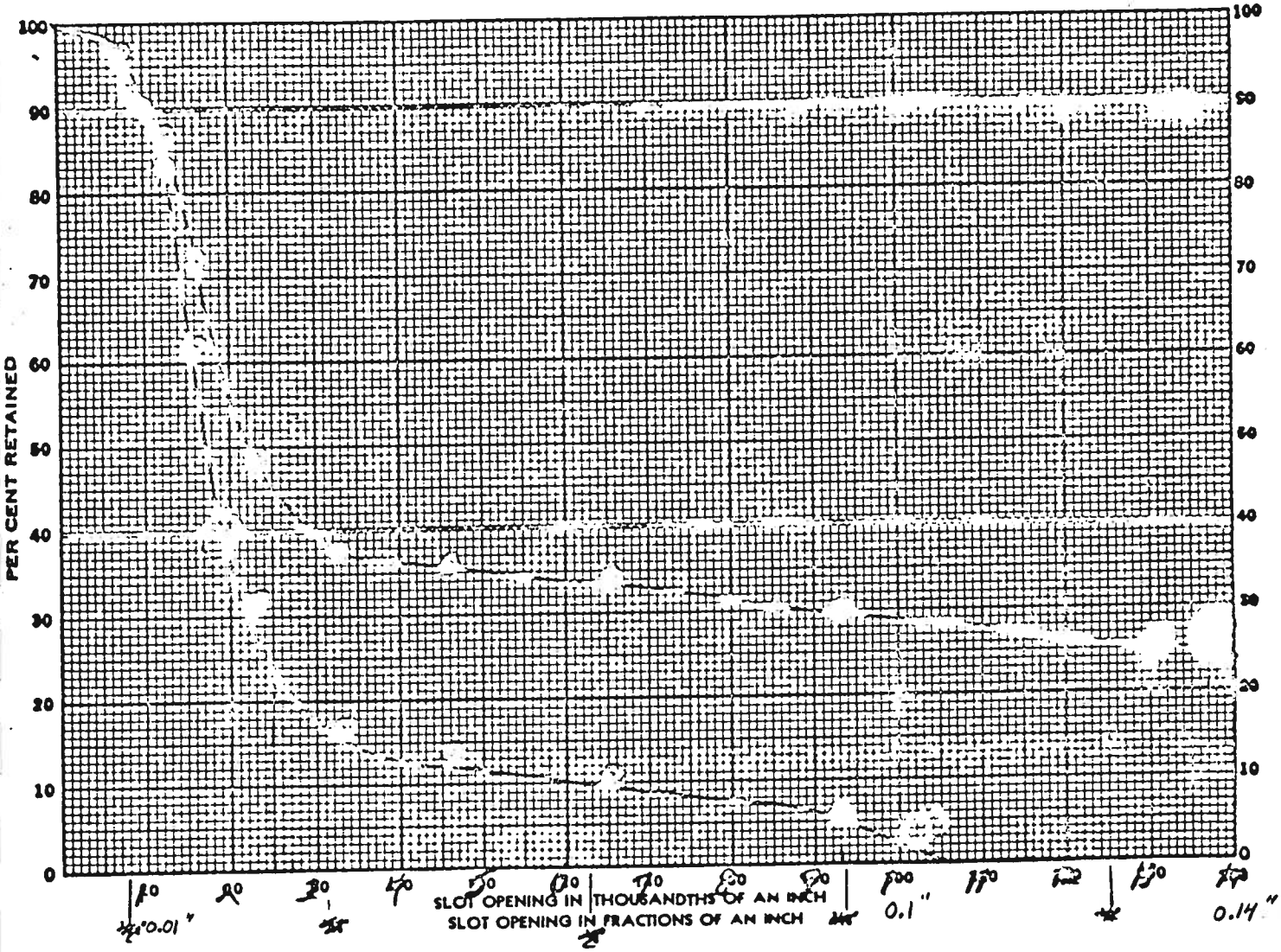
Sample sent in by CORALTA DRILLING LTD Box 4104

Town EDMONTON State ALBERTA Date MARCH 27/65

From well of PEACE RIVER GAOL WELL No 1. 69'-79'

Remarks ① ALL PARTICLES OVER 093 discarded

② INCLUDES ALL PARTS OF SAMPLE



SIEVE OPENINGS	CUMULATIVE PER CENT RETAINED			
.263				
.185				
.131			310	96
.093	28	6	266	20
.065	102	11	412	24
.046	127	14	437	25
.033	155	17	465	28
.023	282	32	592	27
016	555	62	813	72
012	737	83	1017	77
010	772	837 93	1093	76
008			1141	48
007	854	96	1164	23
	Total 895	100	1205	41

NOTES:

SLOT OPENING RECOMMENDED: 25

RECOMMENDED SCREEN: DIA. 6 IN. LENGTH 10 FT.

RAILWAY POWER BY

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS

Appendix C

March 11, 1965.

Mr. Tom Kostiuk,
Department of Public Works,
Terrace Building,
EDMONTON, Alberta.

Dear Sir:

Re: Groundwater possibilities at Peace River
Provincial Gaol Site

I feel that the three test holes put down into the alluvial terrace at this site have fairly adequately tested the groundwater potential of the terrace. It would be extremely difficult to develop the thin skin of potable water that overlies the highly salty water at the rates required, and if it could be done, would undoubtedly require methods that we are unfamiliar with at present. The most discouraging factor, and the one that would seem to condemn such a project at the outset, is the initial quite high content of chloride and total solids (88 and 1,240 ppm, respectively). This would allow little drawing up of water from below during pumping. Horizontal infiltration galleries may be capable of handling this and could be considered. Any attempt to develop this resource would be best done at the experimental level as it could not be relied upon as a continuing source of supply of potable water without preliminary experimentation.

It is not considered likely that deeper drilling would have much chance of success, at least to the 250 to 300 foot level. Deep wells to these depths at Peace River town have encountered water very high in chloride and total solids. As far as is known, deeper drilling for water has not beenattempted. It is felt, however, that this would have only a slim chance of success.

Any water that may be encountered below the depths mentioned may be expected to be of slightly better quality owing to the continental nature of the sediments. Experience shows, however, that even in these cases, in the Peace River area, at fairly great depths, water quality is poor.

I will get off a more detailed report on the groundwater situation at the gaol site to you tomorrow. ✓,

Yours truly,

O. Tokarsky,
Groundwater Geologist.

OT/dc