92F-7-22

ROBINSON, ROBERTS & BROWN LTD.
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NORTH VANCOUVER, BRITISH COLUMBIA
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AFFILIATED OFFICE
TACOMA, WASHINGTON

COMPLETION REPORT

GROUNDWATER EXPLORATION PROGRAM

ROBERTSON CREEK

for

Southern Section of Pacific Region

Fisheries Service

of the

Department of the Environment

CANADA

March 1972

by

W. L. Brown, P.Eng.

R. A. Dakin, P.Eng.

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INTRODUCTION

This report summarizes the exploration program conducted during March 1972 to locate and develop a groundwater supply near the mouth of Robertson Creek. Robertson Creek flows from the eastern end of Great Central Lake. The flow is artificially controlled by a wier at the lake.

Approximately 900 US gpm of groundwater at a fairly constant temperature was required for the proposed Robertson Creek Salmon Hatchery. An existing water well referred to as PW-1 was drilled in 1964 and was producing approximately 25 US gpm. In addition, two dry test holes were drilled to bedrock, at 15 feet, in the area near Dixon Slough (see Figure: 1).

Four test holes were drilled during the current testing program and two of these holes were screened and developed into production wells. These wells are known as Production Well No. 2 (PW-2) and No. 3 (PW-3).

The productivity of PW-2 is known to be 120 US gpm while yield of PW-3 is estimated to be 35 US gpm. This gives a combined yield of 155 US gpm.

GEOLOGY

The subject area consists of a shallow bedrock valley which has been filled with essentially glacial and fluvio-glacial deposits.

Bedrock

The bedrock near the mouth of the creek consits of interbedded shales and sandstones of the Haslam Formation. This formation overlies the Vancouver altered volcanics which are exposed along the access road above the service bridge. There are a number of places where bedrock is exposed at the ground surface. These locations are shown on Figure: 1. When we made our initial survey of the area, prior to test drilling, the bedrock exposure to the east of TH-1 was covered by 3 feet of snow and as such the eastern boundary of the bedrock valley could not be delineated. This made it very difficult to estimate the expected depth to bedrock at the first test site.

A geologic cross-section A-A (see Figure: 2) was drawn. This shows that the bedrock slopes gently towards the west. We would expect that this slope would flatten out towards the west and turn upwards to meet the rock exposed on the road leading to the researchers residence (see Figure: 1).

Unconsolidated Sediments

The unconsolidated sediments encountered in the test holes can be classified into four general categories. These are as follows:

1. Alluvial Sediments: These are surface silts, sands and gravels which have been deposited by surface waters in recent geologic time. The sediments are composed of material which has been eroded from the glacio-fluvial deposits upstream from the creek mouth. These alluvial sediments do not show good sorting (see sieve curves) which indicates that they were not transported a great distance. The sediments are not uniform in nature and their permeability is highly variable.

2. Glacio-fluvial Sediments: These deposits have been laid down by melt water flowing from the down wasting of a valley glacier. The deposits consist of very silty sands and gravels and a varied glacial lake clay unit. The lower clays of glacio-fluvial sediments were not water-bearing but the sands are.

3. Glacial Sediments: These are the direct deposits of a glacier. The material is typically dense and consists of angular gravels in a matrix of sand and clay. The material is not water-bearing and is commonly known as "Till".

4. Broken Rock: This unit consists of broken rock which lies directly on top of the bedrock. The material did yield some water but the thickness is not sufficient to warrant setting a well screen for testing.

TEST DRILLING AND WELL CONSTRUCTION

A 12-inch diameter casing was used in all the test production holes. This size had been chosen to enable large capacity wells to be designed if highly permeable sediments were encountered.

The logs of the four holes drilled are given (Figures: 3-6) at the back of this report. The test holes were completely abandoned and all casing was pulled out of the ground.

Test Hole No. 1

This hole was drilled and cased to a depth of 27 feet and then drilled open hole a further 15 feet into the soft shales and sandstone of the bedrock.

Production Well No. 2

The hole was drilled and cased to a depth of 48 feet where bedrock was encountered. The bedrock was drilled open hole another foot to make certain that it was in fact bedrock and not just a boulder.

Samples of the more promising water-bearing zones were collected for mechanical sieve analyses. The results of these analyses are shown in Figure: 7. From this data a screen slot size was selected. A screen was then ordered and assembled inside the 12-inch diameter casing. The screen and casing assembly is shown in Figure: 4. A 10-inch diameter pipe was used to finish the well which has a final depth of 38 feet. The eight foot sump below the screen is provided to allow for setting the pump bowls below the well screen to give maximum drawdown.

Test Hole No. 2

This hole was drilled and cased through 99 feet of overburden material. The sandstone of the bedrock was drilled into three feet by drilling open hole. As the analysed sieved samples between depths of 35 and 60 feet looked promising a screen was ordered and installed to test this zone. A 15-foot length of 10/1000 inch slot screen was set between depths of 45 and 60 feet and 10 feet of 100/100-inch slot size screen between 35 and 45 feet. This zone could not be satisfactorily developed so that the screen was reset to test the zone between 25 and 35 feet. This zone did not prove to be satisfactory either and the hole was abandoned. It appears that the water-bearing materials were not sufficiently continuous to yield much water.

Production Well No. 3

The 12-inch diameter casing was drilled and driven to a depth of 77 feet when the sandstone bedrock was encountered. The analysed sieve samples for the water-bearing zones are given in Figure: 10. Using this data a 150/1000-inch slot size opening was selected for an 8-foot length of 10-inch diameter telescopic (8-5/8-inches ID) stainless steel screen. The screen was set between depths 25 and 33 feet (see Figure: 6). A five foot sump was provided to enable setting the pump below the well screen. The 10-inch diameter pipe was run and carried to ground surface so that the well is now 10-inches in diameter. When the screen was in place the 12-inch diameter casing was withdrawn to expose the full length of the screen. The well was then surged and developed for approximately 12 hours. When the formation around the screen had stabilized the well was complete and ready for pump testing.

PUMP TESTING

PW-2

A vertical line shaft turbine pump was set in the well with the pump suction 34 feet below ground surface. A short test was run at 200 gpm to get some idea of the well's productivity. This showed that the well could yield this rate for a period of only 1/2 an hour. The presence of numerous negative boundaries caused the water pumping level in the well to draw down rapidly to the top of the well screen.

A second test was run at 120 US gpm for a period of 17 hours. The pumping water level stabilized in the well after one hour of pumping and did not change for the remainder of the test. When the pump was turned off the water level in the well recovered to its static level in 3 hours.

The pumping level at the rate of 120 US gpm was 19 feet below ground level. The static water is at 7.6 feet below ground.

The top of the screen is at 25 feet below ground so that the total drawdown available is 25-7.6 or 17.4 ft. The measured drawdown is 11.4 ft. If the well is rated at 120 US gpm capacity the safety factor against overpumping the well is $\frac{17.4-11.4}{11.4} = 52.5\%$

Production Well No. 3

The test pump was set with its suction at a depth of 36 feet below ground. The static water level in the well was at a depth of 4 feet. The top of the screen is at a depth of 25 feet so that 21 feet of drawdown is available before the well screen becomes exposed. The initial pump test was run at a rate of 150 gpm but the well could not sustain this rate for more than 12 minutes before the well screen was exposed. A second test was run at 50 US gpm and the well was able to maintain this rate for 1-1/2 hours. Because the pump was not capable of pumping at a lower rate than 50 gpm a 24 hour pump test was not run.

Based on the hydraulic data that is available on the well we estimate the well's productivity to be in the order of 35 US gpm. Before production pumping commences a 24 hour pump test should be run with water level measurements made during the test.

WATER PROPERTIES

1. Temperature

During the pump tests a number of water temperature measurements were made. These were made in the water discharged from the well and in the water of Robertson Creek.

The temperature of the pumped water in PW-2 was 45°F at the start of the test and 44°F by the end of the 17 hours test. The Robertson Creek water had changed from 43°F to 44°F in the same period. This groundwater temperature is considerably lower than would be expected for a true shallow groundwater aquifer in the Alberni Valley area. The temperature of the water pumped from the PW-1 was 47°F which is closer to the near average air temperature of the area (48°F at Robertson Creek). Studies of the relationship between groundwater temperature and ambient air temperature have shown that the groundwater temperature is generally within 3°F of the mean annually daily air temperature.

The temperature of the pumped water in PW-3 was 45°F while the Robertson Creek water remained at 44°F.

2. Water Quality

Water samples were taken from the pumped well PW-2 and from Robertson Creek. The well sample was taken just before the pump was turned off at the end of each pump test. These samples were submitted to a chemical laboratory for analysis of inorganic chemical content. Copies of the Chemist's Reports are given at the back of this report. The Chemist reports that the water is slightly acid, very soft and very low in dissolved mineralization.

The March 20th sample was taken after the short pump test and as we would expect the turbidity and suspended matter content is fairly high. The sample No: 2, taken after the longer test showed a large reduction in suspended matter. In the first well sample the phosphate level was high (0.27 ppm) but after further pumping this was reduced to less than 0.1 ppm. It appears that the presence of nitrates and phosphates in the water may be related to the fertilizing program carried out in Great Central Lake.

The well and creek water are very similar. If the water had been moving through the ground for a long distance we would expect that the dissolved mineralization of the well water would be significantly higher than that of the creek water. We conclude based upon both water quality and temperaure considerations that the river water recharges the groundwater reservoirs.

At this stage it is impossible to estimate the probable range of groundwater temperatures.

PUMP OPERATION AND WELL MAINTENANCE

1. Pumps

Production pumps should be installed with their suctions at the following depths below present ground surface:

PW-2	35 feet
PW-3	36 feet

2. Operation - Wells should not be:

(a) overpumped
(b) back-washed
(c) flushed
(d) vibrated
(e) allow to stand idle
(f) raw-hided.

(a) The well head controls and selected pump must never pump at rates higher than 120 US gpm in PW-2. In PW-3 the controls should be set to keep the pumping level above 20 feet. Special care should be taken to ensure that the start-up surge does not exceed these rates. The pumps should start against closed valves and with full columns. A control valve should be installed for this purpose and to provide control of the discharge.

(b) A simple check valve will prevent back-washing.

(c) If water is allowed to cascade into the well and become aerated the screen will become iron bacteria slimed in a few months. This means that the start-up and shut-down water must not be allowed to enter the well.

(d) The pump mounts must be separated from the well casing. This will insulate pump motor vibrations from the casing and screen. If vibrations become severe the well will start pumping sand.

(e) A well left to stand idle will deteriorate. If the well is not going to be used for some years it should be chemically treated and cleaned before the production pump is set.

(f) If pumps are allowed to start and stop rapidly the well is raw-hided and may start pumping sand. This discharge from the well should be kept as constant as is practicable.

3. Pump House Construction

In designing a pump house for a shaft turbine installation, provision should be made for a means of withdrawing the pump from the well. One wall should be within two feet of the well and there should be a window or removable section of the wall so that machine operators can see the well. Also a 4 foot x 4 foot removable section of the roof should be placed over the pump.

Great care and supervision will be necessary during pump house or manhole construction to ensure that no debris, cement etc. enters the well. We emphasize this as we have had past experience of wells being junked by innocent carelessness.

4. Monitoring Program

A program of water level, water temperature, and flow measurements must be started on a weekly schedule when production starts. This means that an access hole should be provided and maintained free so that a 1/2-inch probe can pass. These records should be reviewed by us at regular intervals during the first year of production.

FUTURE GROUNDWATER EXPLORATION

If more groundwater is required at a later date a second testing program could be implemented to explore four remaining test sites. As the depth of overburden is now known to be comparatively shallow (less than 100 ft) and there does not appears to be any suitable deep water-bearing zones below the till material, a test drilling program using 8-inch diameter test wells would be suitable. If a suitable zone is encountered a well screen could be set and a production well developed. The drilling of 8-inch diameter test holes would result in great savings in drilling costs but would rule out the development of a 500 gpm hole from a test hole. As we now know that such a capacity is unlikely to be developed in the subject area there is no significant disadvantage in using the smaller size casing which will allow the well to be pumped at a maximum rate of 200 US gpm if that amount of water is available.

The four test locations mentioned above are shown in Figure: 1. Test Location: 1 is located to try to develop water from the same aquifer which PW-1 draws from. This well could be about 60 feet deep and would be located about 300 feet from PW-1 to minimize well interference.

Test locations 2 and 3 are designed to produce groundwater from aquifers similar to those beneath PW-2 or PW-3. The test drilling of these locations should be considered only if the groundwater temperatures in wells PW-2 and PW-3 are proven to be satisfactory after an extended period of pumping.

Test Location 4 is designed to probe for the existence of a burried river channel that may have existed in the melt water streams which were controlled by the existing bedrock shape.

We estimate that a test drilling program involving the drilling of four 8-inch diameter holes to 50 feet would cost $7,000 (March 1972 dollars). It would cost an additional $4,000 to convert each hole into a completed and tested production well.

CONCLUSIONS

1. Based upon available data we judge that PW-2 is capable of a yield of 120 US gpm with a safety factor of 52.5% against over pumping.

2. Based upon available data we judge that PW-3 is capable of an estimated yield of 35 US gpm. This must be substantiated by further testing.

3. The aquifers from which the wells draw water are not aerially extensive because both negative and positive boundaries are evident in the pump test data.

4. The aquifers are recharged by water from Robertson Creek.

5. The well water temperature could fluctuate markedly.

6. The inorganic chemical quality of the water from PW-2 meets the requirements laid down by the Canadian Drinking Water Standards and so is fit for human consumption.

7. Wells capable of 200 US gpm capacity could be developed in the Robertson Creek area outside of the present Fisheries boundary.

RECOMMENDATIONS

1. PW-3 should be pumped tested for a period of 24 hours.

2. A sample of pumped water from PW-3 should be collected for analysis of inorganic chemical contents.

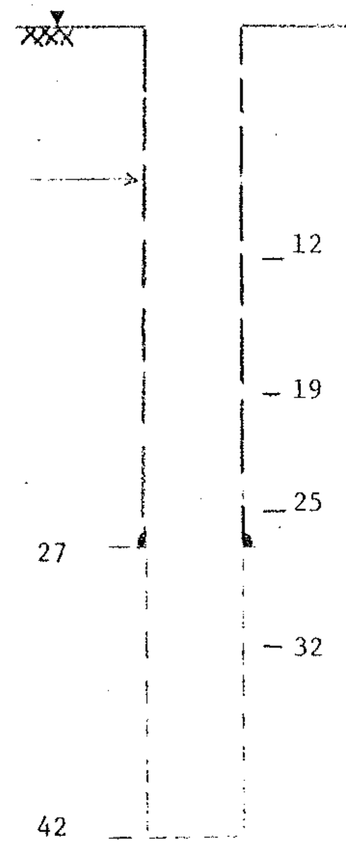
3. The pump operations procedures and pump installation arrangements laid out in this report, should be carefully followed.

4. A well monitoring program should be carried out as outlined.

5. A test drilling program should be carried out to explore for additional water-bearing zones. The cost of a four hole test drilling program is estimated to be $7,000. An additional $4,000 is required to convert each test hole into a production well.

WTN25998

Approximate Ground Elevation (MSL)



12-inch diameter casing

Bottom of 12-inch — 27

Total drilling depth — 42

<u>GRAVEL:</u> sand, silt and boulders

<u>SAND:</u> with gravel, some clay seams, <u>W.B.</u>

<u>SAND:</u> Silty

<u>SHALE:</u> Bedrock

<u>SANDSTONE:</u> Bedrock

NOTES

1. W.B. = water-bearing.
2. A well could be developed to develop some water but quantity would be insufficient. Therefore hole abandoned.

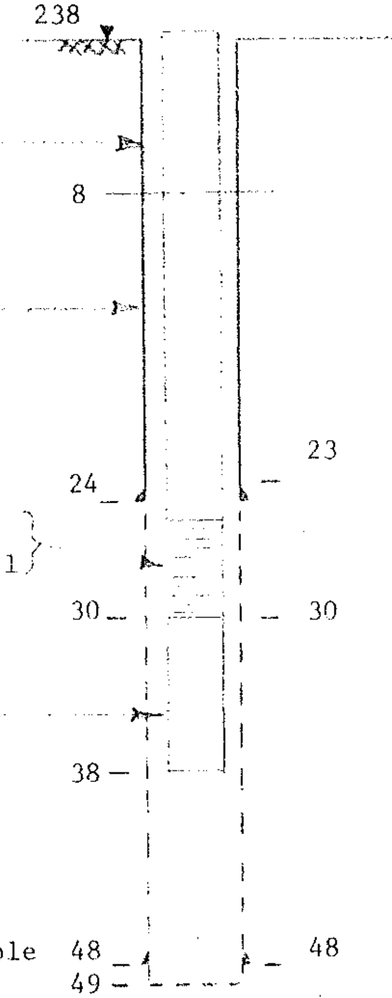
SCALES

Vertical 1-inch = 10 feet
Horizontal N.T.S.

FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	LOG	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA
ROBERTSON CREEK PORT ALBERNI, B.C.	TEST HOLE No: 1	APRIL 1972 — Fig: 3

WTN 25999

Approximate Ground Elevation M.S.L.



12-inch casing

Static Water Level

10-inch casing

Bottom of 12-inch

5 feet of well screen – see note 1

Bottom of Well Screen

10-inch casing

Bottom of Well

12-inch hole back-filled

Bottom of drilled & cased hole

Total Drilling Depth

GRAVEL: with boulders and clay

GRAVEL: sand, clean & W.B.

CLAY: varved, very sticky

SHALE: bedrock

NOTES

1. Well Screen is a stainless steel continuous wire wound 12-inch telescopic size.
   Slot openings are 150/1000 inch
2. W.B. = water-bearing
3. All depths given from existing ground level.

SCALES

Vertical 1-inch = 10 ft.
Horizontal - N.T.S.

FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	LOG	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA
ROBERTSON CREEK PORT ALBERNI, B. C.	PW - 2	APRIL 1972 — Fig: 4

WTN25996

Approximate Ground Elevation (M.S.L.) 233

Static Water Level 4

12-inch Casing (removed)

Bottom of 12-inch 99

Total Drilling Depth 102

	SAND:	Gravel, brown
9	BOULDERS:	Cobbles
12	GRAVEL:	Clay or silt
16	SAND:	Fine to coarse, gravel, W.B.
27	SAND:	Coarse, gravel, some silt W.B.
37	SAND:	Coarse, gravel, cobbles, W.B.
44	SAND:	Fine, silty W.B.
60	SAND:	Fine, silty, some gravel
72	CLAY:	Sticky, verved
83	TILL:	Sticky, many cobbles
97	GRAVEL:	W.B. S.W.L. above gd.
99	SANDSTONE:	Bedrock

NOTES

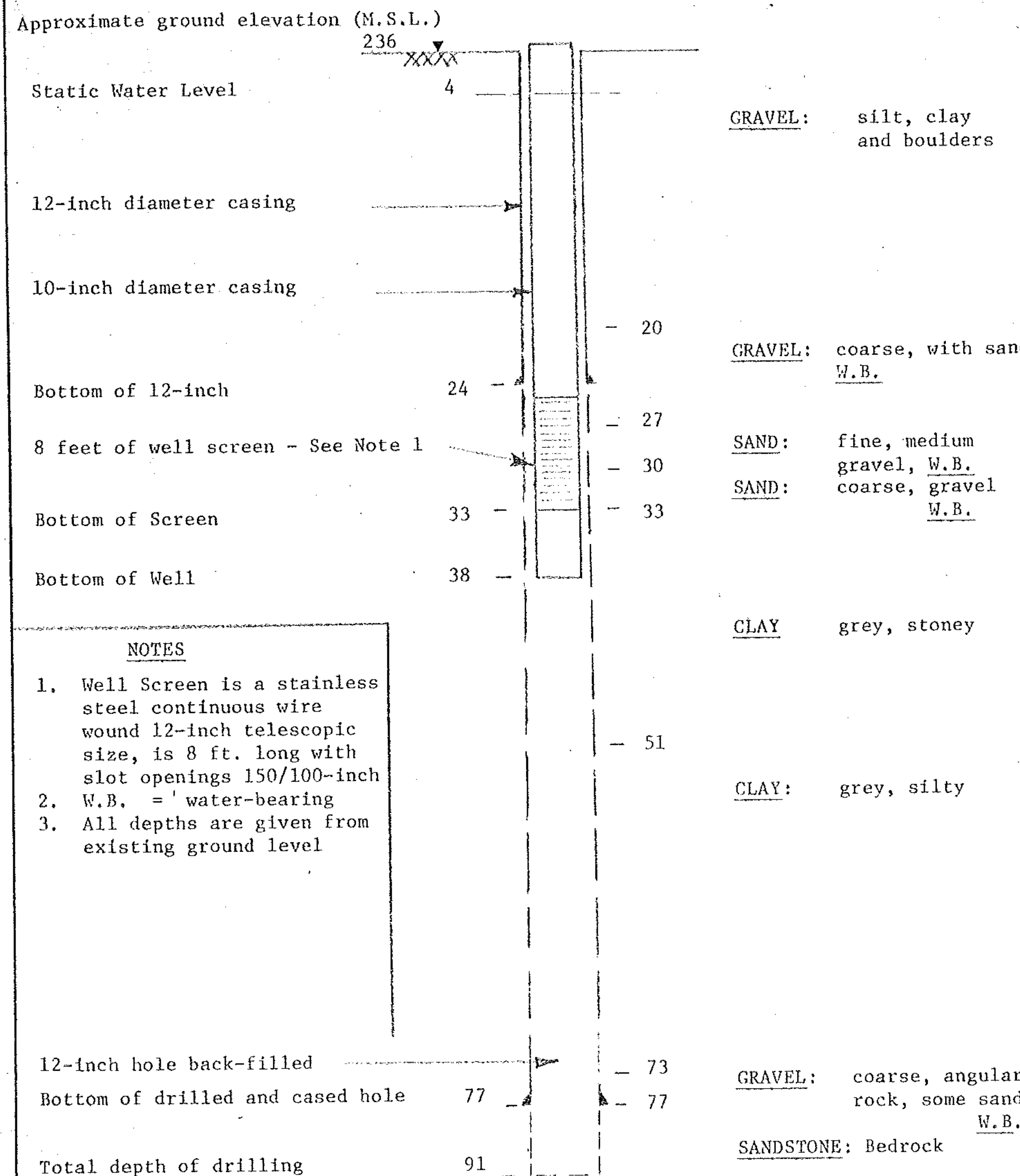
1. A well screen was placed between 32 and 58 feet depth. Little water was developed and hole was abandoned.
2. W.B. = water-bearing
3. All depths given from existing ground level.

SCALES

Vertical - 1-inch = 20 feet
Horizontal - N.T.S.

FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	L O G TEST HOLE No. 2	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA
ROBERTSON CREEK PORT ALBERNI, B. C.		APRIL 1972 Fig: #5

WTN 25997



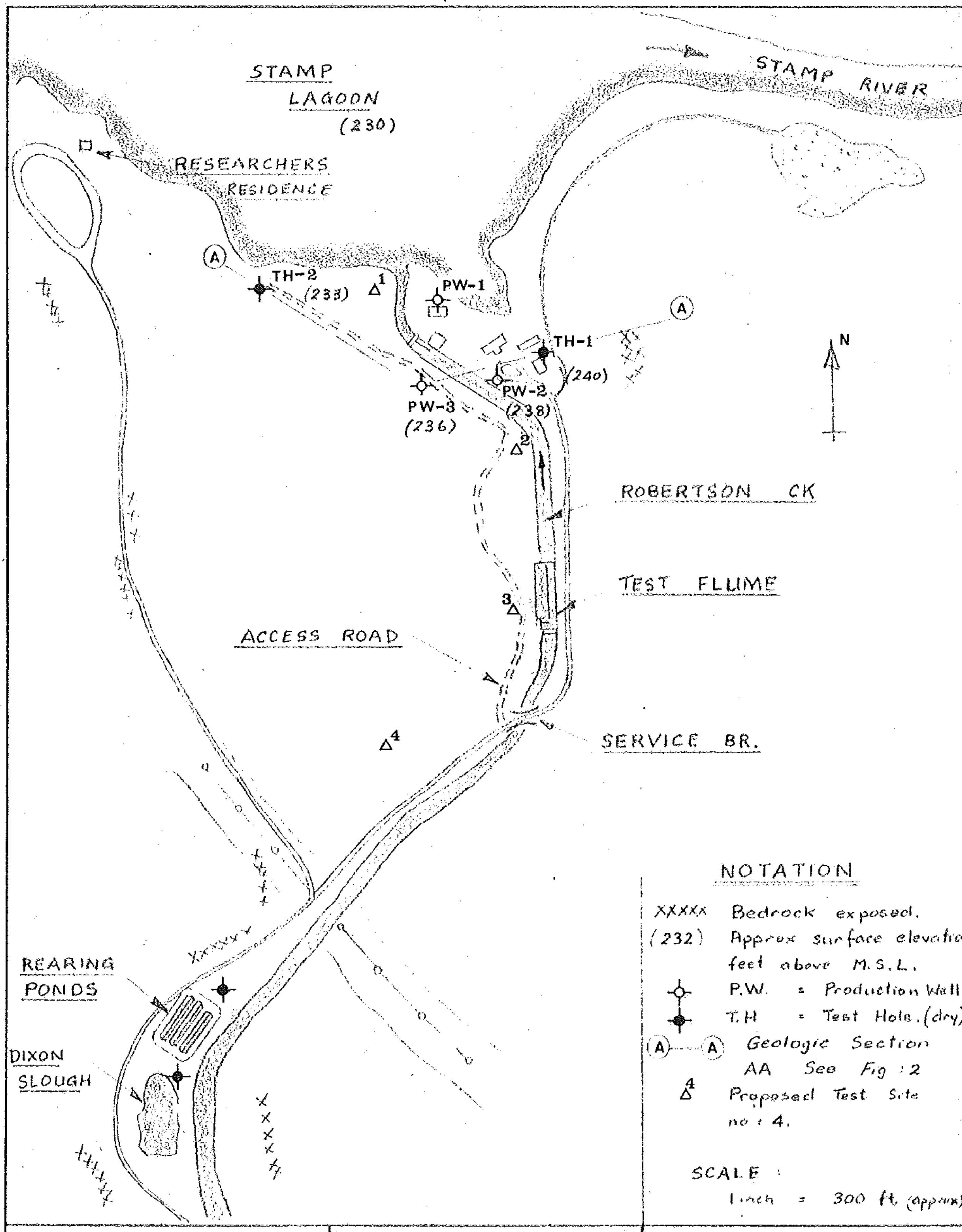
NOTES

1. Well Screen is a stainless steel continuous wire wound 12-inch telescopic size, is 8 ft. long with slot openings 150/100-inch
2. W.B. = water-bearing
3. All depths are given from existing ground level

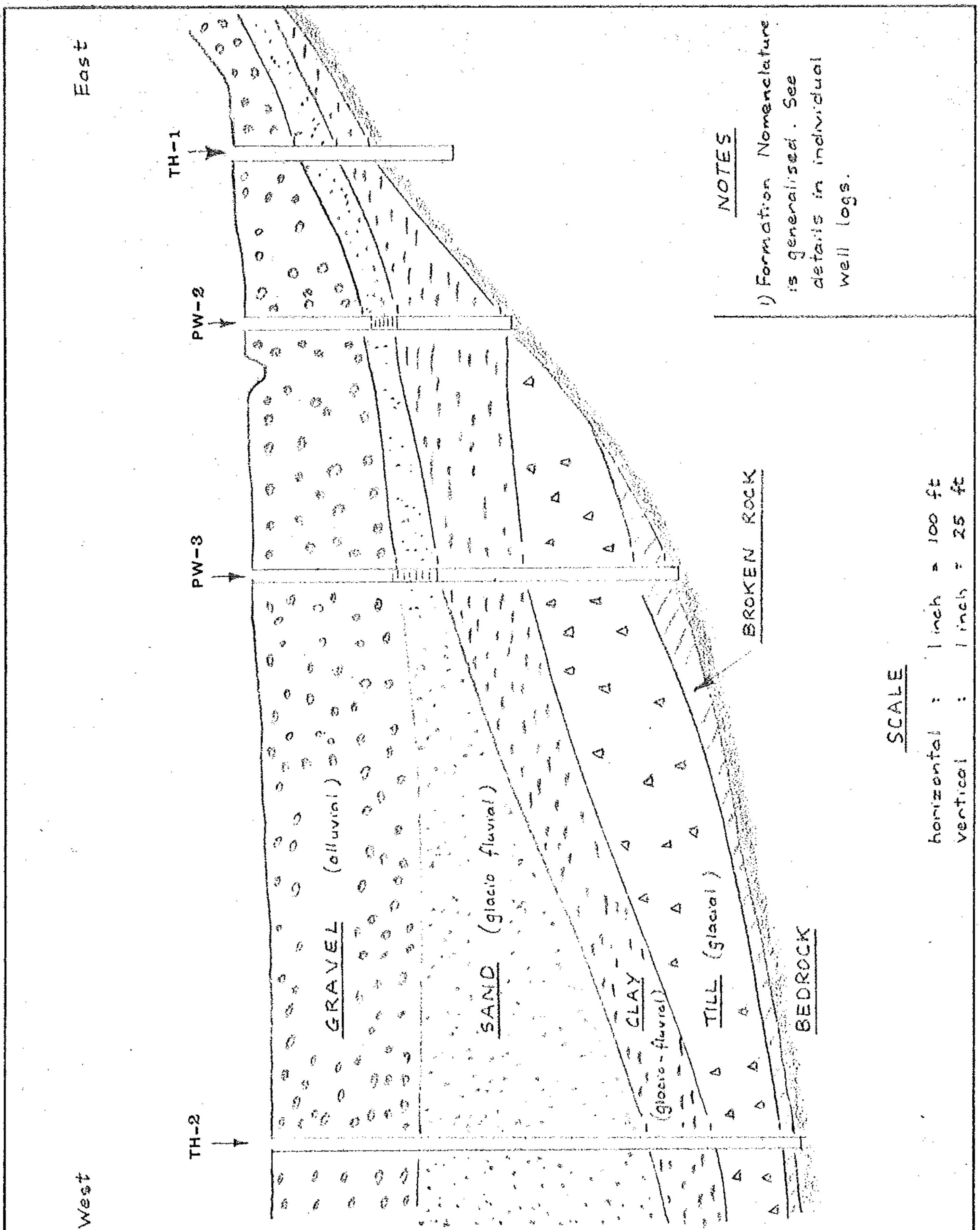
SCALES

Vertical 1 inch = 10 feet
Horizontal N.T.S.

FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	LOG	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA
ROBERTSON CREEK PORT ALBERNI, B.C.	P.W. - 3	APRIL 1972 — Fig: 6

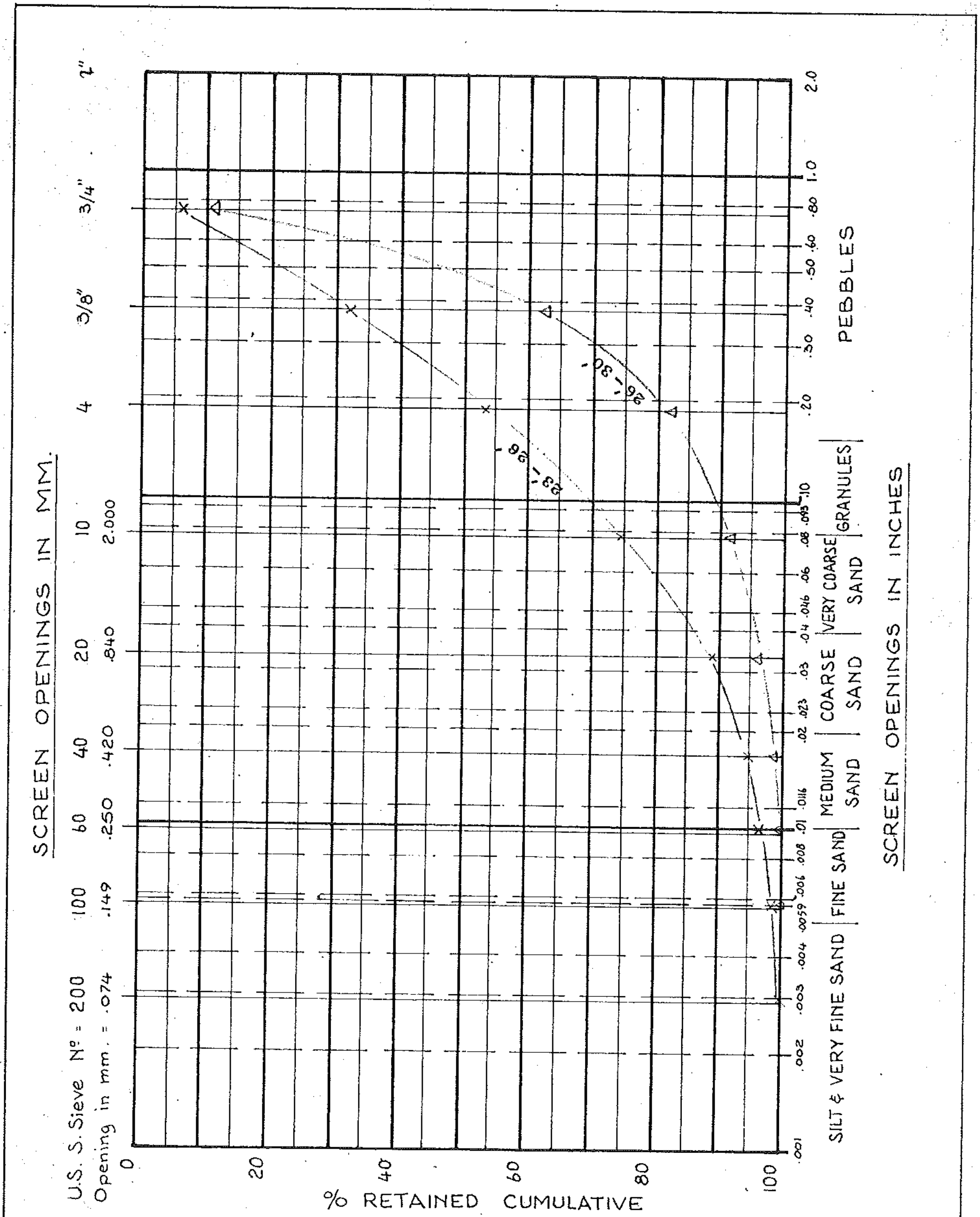


FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	SKETCH MAP showing	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA
ROBERTSON CREEK PORT ALBERNI, B. C.	WELL LOCATIONS	APRIL 1972 — Fig: 1



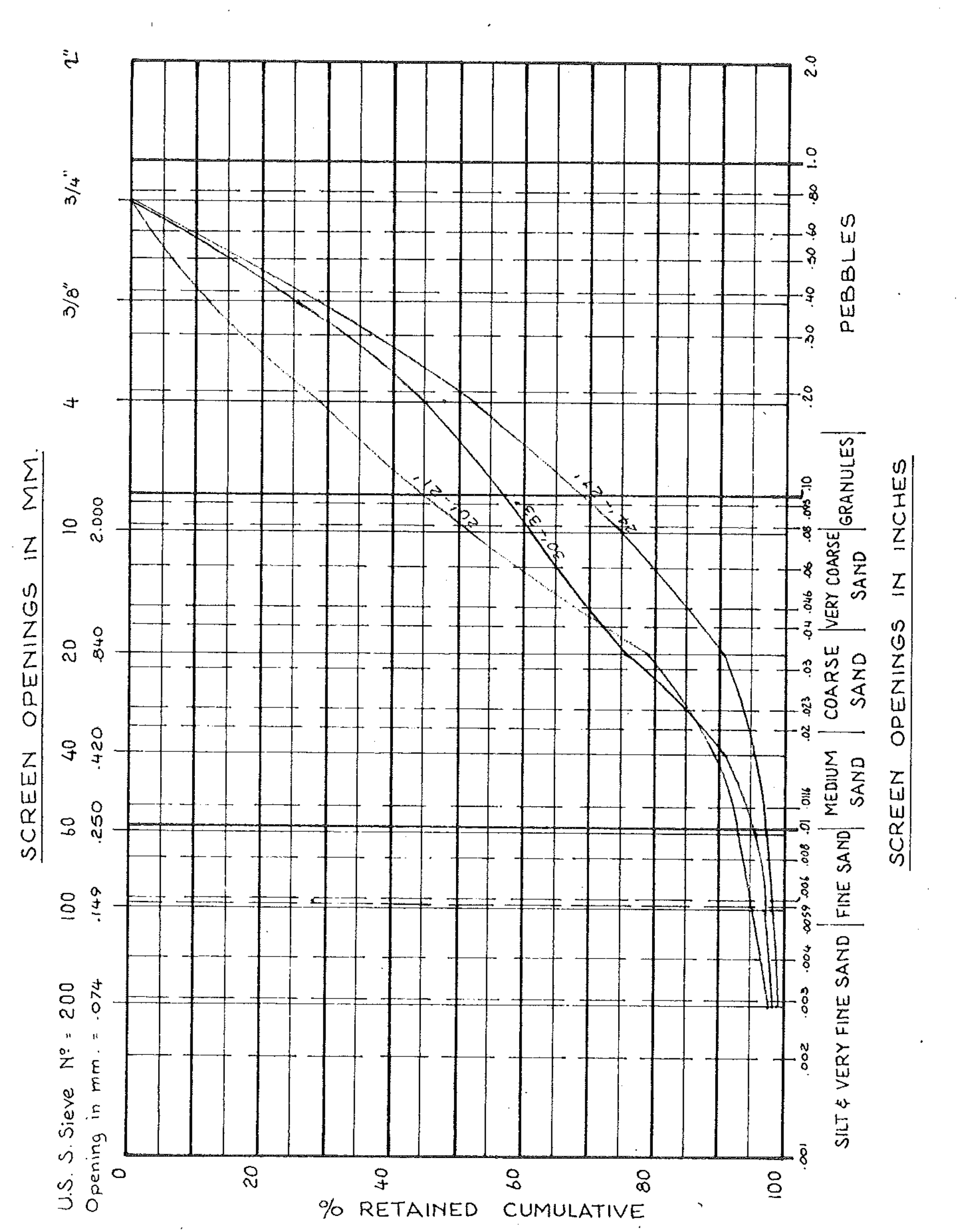
FISHERIES SERVICE DEPARTMENT OF THE ENVIRONMENT	GEOLOGIC SECTION A-A (see Figure: 1)	ROBINSON, ROBERTS & BROWN LTD. CONSULTING GROUNDWATER GEOLOGISTS NORTH VANCOUVER, CANADA	
ROBERTSON CREEK PORT ALBERNI, B. C.		APRIL 1972	Fig: 2

FORM D1-59-1



ROBINSON, ROBERTS & BROWN Ltd. Groundwater Geologists	R.A. SPENCE LTD - Consulting Engineers - Vancouver, 1 - B.C.		
ROBERTSON CREEK FISHERIES SERVICE	SIEVE ANALYSIS PW - 2	By: RAC	Date: Mar 8 '72
		Job:	Dwg: Fig. 7

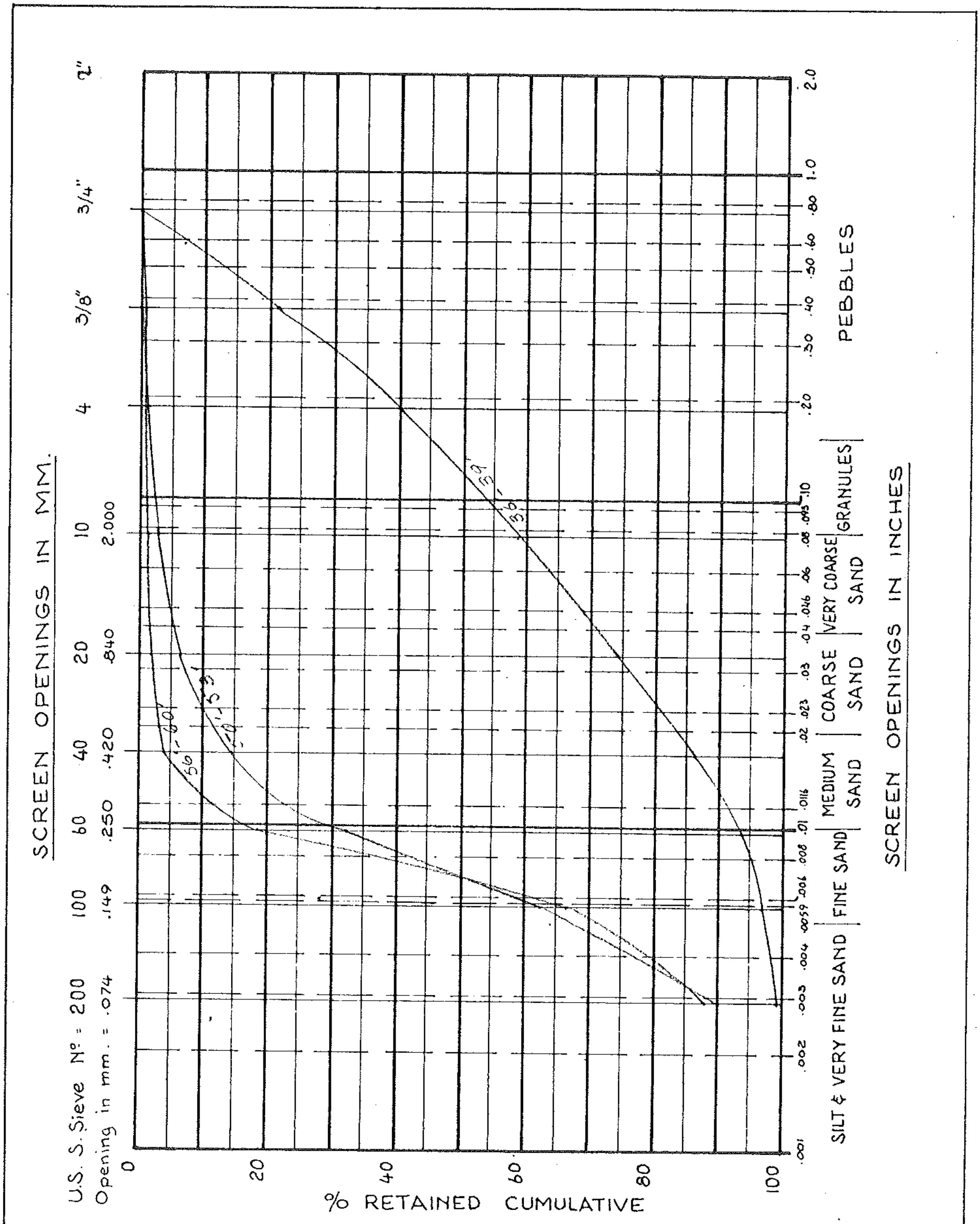
FORM D1-59-1



ROBINSON, ROBERTS & BROWN Ltd. Groundwater Geologists	R.A. SPENCE LTD - Consulting Engineers - Vancouver, 1 - B.C.		
ROBERTSON CREEK FISHERIES SERVICE	SIEVE ANALYSIS TEST HOLE NO: 2	By: BLS	Date: 16.3.72
		Job: 711	Dwg: Fig: 8

BCIL - 2993 - R.A.S.

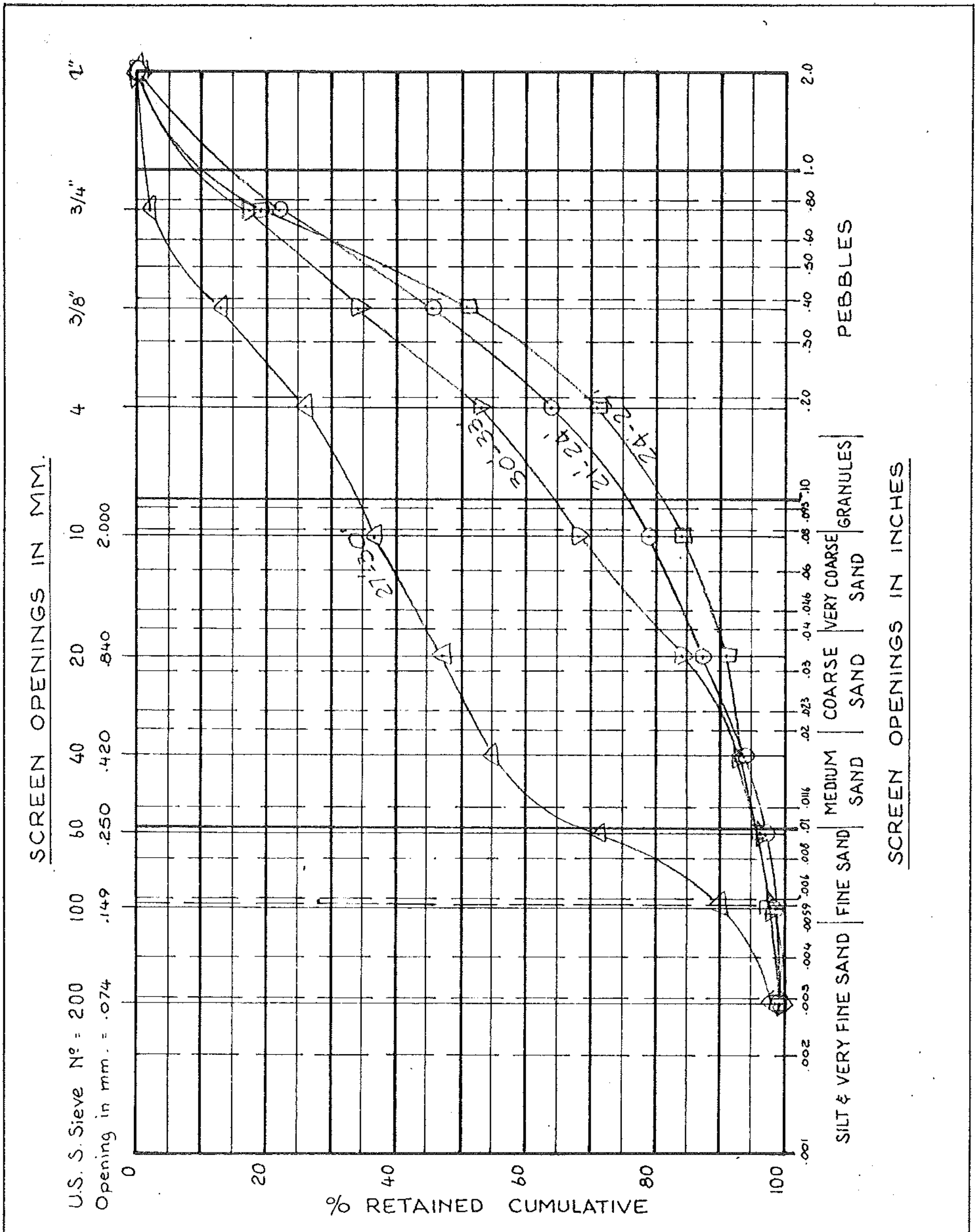
FORM D1-59-1



ROBINSON, ROBERTS & BROWN Ltd. Groundwater Geologists	R.A. SPENCE LTD - Consulting Engineers - Vancouver, 1 - B.C.		
ROBERTSON CREEK FISHERIES SERVICE	SIEVE ANALYSIS TEST HOLE No: 2	By: BLS	Date: 16-3-72
		Job: 711	Dwg: Fig 9

BCIL - 2993 - R.A.S.

FORM D1-59-1



ROBINSON, ROBERTS & BROWN Ltd. Groundwater Geologists	R.A. SPENCE LTD - Consulting Engineers - Vancouver, 1 - B.C.	
ROBERTSON CREEK FISHERIES SERVICE	SIEVE ANALYSIS PW - 3	By: AH/MB Date: May 22/7 Job: 711-RC Dwg: Fig 10

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1650 PANDORA STREET, VANCOUVER 6, B.C. • TELEPHONE 254-7278

Report On Water Samples for Chemical Analysis

File No. 2813 A

Report No.

Reported to Robinson, Roberts & Brown
1632 McGuire
North Vancouver, B.C.

Date March 30, 1972

We have tested the sample of water submitted by you on March 23, 1972 and report as follows:

Sample Identification

The sample was submitted in a plastic bottle labelled -

"Robertson Creek, 1900 hours, March 20, 1972". PW-2

Method of Testing

The sample was tested in accordance with the procedures set down in "Standard Methods for the Examination of Water and Waste Water" 13th Edition, published by the American Public Health Association, 1971.

Form No. 7

Chemical Analysis of Water Sample

Test		1	
pH (electrometric)		6.05	
Color (Pt-Co scale)		L 0.1	ppm
Turbidity (SiO_2 scale)		3.8	ppm
Suspended Matter		6.7	ppm
Fixed		5.8	ppm
Volatile		0.9	ppm
Hardness (Calculated)		18.6	ppm
Dissolved Anions			
Alkalinity			
Bicarbonates	HCO_3	23.	ppm
Carbonates	CO_3	nil	ppm
Hydroxyl Ion	OH	nil	ppm
Chlorides	Cl	2.5	ppm
Sulfates	SO_4	L 1.	ppm
Phosphates	PO_4	0.27	ppm
Nitrates	N	0.12	ppm
Dissolved Cations			
Silica	SiO_2	5.6	ppm
Iron	Fe	L 0.05	ppm
Aluminum	Al	L 0.05	ppm
Calcium	Ca	4.9	ppm
Magnesium	Mg	1.6	ppm
Sodium	Na	2.2	ppm
Potassium	K	0.1	ppm
Manganese	Mn	L 0.05	ppm
Copper	Cu	L 0.01	ppm
Lead	Pb	L 0.01	ppm
Zinc	Zn	L 0.01	ppm
Total Iron	Fe	1.05	ppm
Total Silica	SiO_2	8.2	ppm
Total Dissolved Solids		41.	ppm
Fixed		12.	ppm
Volatile		29.	ppm

L = less than

Remarks

Examination of the above results indicated that the water as represented by the submitted sample was a slightly acid, very soft and lowly mineralized water.

The water met the standards for domestic water supplies as stated by the American Public Health Association on all tests conducted except for phosphates. The phosphate content (0.27 ppm) was slightly over the recommended limit (0.2 ppm) used by the above body.

Prior to its use for drinking purposes we would suggest that the water be tested for its bacteriological purity.

CAN TEST LTD.

D. K. Dixon

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Report On Water Samples for Chemical Analysis

File No. 2853 A

Report No.

Reported to Robinson, Roberts & Brown
1632 McGuire
North Vancouver, B.C.

Date April 10, 1972

We have tested two samples of water submitted by you on April 3, 1972 and report as follows:

Sample Identification

The samples were submitted in plastic bottles labelled -

Sample 1	Robertson Creek Water	PW-2	0420 hours, March 31, 1972
Sample 2	Robertson Creek Water	PW-2	0420 hours, March 31, 1972

Method of Testing

The samples were tested in accordance with the procedures set down in "Standard Methods for the Examination of Water and Waste Water" - 13th Edition, published by the American Public Health Association, 1971.

Chemical Analysis of Water Samples

Test		1	2		
pH (electrometric)		6.40	6.05		
Suspended Matter		2.6	0.5	ppm	
Hardness (Calculated)		12.3	15.0	ppm	
Dissolved Anions					
Alkalinity					
Bicarbonates	HCO_3	15.0	19.0	ppm	
Carbonates	CO_3	nil	nil	ppm	
Hydroxyl Ion	OH	nil	nil	ppm	
Chlorides	Cl	1.0	2.5	ppm	
Sulfates	SO_4	0.7	0.7	ppm	
Phosphates	PO_4	L 0.1	L 0.1	ppm	
Nitrates	N	0.14	0.12	ppm	
Dissolved Cations					
Calcium	Ca	3.3	4.9	ppm	
Magnesium	Mg	1.0	0.7	ppm	
Sodium	Na	0.9	1.7	ppm	
Potassium	K	L 0.1	L 0.1	ppm	
Total Dissolved Solids		30.	32.	ppm	(Evaporated Residue)
Fixed		13.	15.	ppm	
Volatile		17.	17.	ppm	

L = less than

Remarks

Examination of the above results indicated that both samples were slightly acid, very soft and very low in dissolved mineralization.

Both waters met the standards for domestic water supplies as set down by the American Public Health Association on all tests conducted.

Prior to their use for drinking purposes we would suggest that the waters be tested for their bacteriological purity.

CAN TEST LTD.

D. K. Dixon