

PACIFIC HYDROLOGY CONSULTANTS LTD.
CONSULTING GROUNDWATER GEOLOGISTS

204 - 1929 WEST BROADWAY
VANCOUVER, B.C. V6J 1Z3
TELEPHONE: (604) 738-9232

August 24, 1992

Sunshine Coast Regional District
P.O. Box 800
5477 Wharf Road
SECHELT, B.C. V0N 3A0

Attention: Mr. S.K. Lehmann
Superintendent of Public Works

Subject: Progress Report Concerning Groundwater Exploration at Irvines
Landing

Dear Sirs:

This letter is further to discussions onsite at Irvines Landing on August 17, 1992 among Mr. S.K. Lehmann, Superintendent of Public Works for Sunshine Coast Regional District, Mr. Ed Livingston, P. Eng., and Ms. Katherine Hofmann, Geologist, both of Pacific Hydrology Consultants Ltd., during the shallow digging phase of the groundwater exploration program.

1.0 INTRODUCTION

The purpose of this letter is to report on the progress of the groundwater exploration program outlined in Pacific Hydrology's February 20, 1992 letter to Dayton and Knight Ltd., on the subject "Feasibility of Developing a Groundwater Supply for Irvines Landing Improvement District".

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The aforementioned letter, which discussed the results of a preliminary investigation of groundwater feasibility, recommended that a program of groundwater exploration proceed as follows:

1. Investigate the ownership of Lot C, Plan 14283, and other land on the flat between Keelson Road and Irvines Landing Road. Contact the land owner(s) to see whether they would allow test digging and, if successful, an easement for a community well. At the same time, check ownership of the lot on which Irvines Landing Community Hall is located (REF 2384?).
2. Using a small backhoe, which is capable of digging to a depth of 4 m (13 ft), and starting on the parcel of land owned by the Improvement District at the water intake on Hotel Lake, dig several test pits. Have on hand a small contractor's pump capable of pumping 3 L/sec (41 igpm) to obtain a rough idea of the capacity of any dug hole which makes water.
3. If shallow digging shows that shallow groundwater is not available in sufficient quantity to be of interest to the District, consider test-production drilling, starting with a site in the Intake/Community Hall area.

Authorization for Pacific Hydrology to proceed with the shallow digging phase of the program outlined in Step 2 above was given by Mr. Lehmann in a telephone conversation between Lehmann and Livingston on July 4, 1992.

2.0 FIELD INVESTIGATION

As recommended in the initial investigation, a small excavator, capable of digging to 4 m (13 ft), was used to dig shallow test pits on the parcel of land owned by the Improvement District near the surface water intake in Hotel Lake. Test pits could not be dug in the flat between Keelson Road and Irvines Landing Road because of land ownership.

2.1 Digging

The first pit was dug approximately 6 m (20 ft) north of Hotel Lake Road. It was excavated in well-stratified layers of grey silty sand and brown silt, with occasional very thin layers of coarse sand; large boulders were encountered at a depth about 3.6 m (12 ft) and digging could not continue. Water seeped into the pit at a low rate, about 0.08 to 0.15 L/sec (1 to 2 igpm); such a rate was considerably less than the required capacity of 2.5 L/sec (33 igpm). Rapid slumping occurred below the water table at about 1.2 m (4 ft); the pit was subsequently filled in.

The second pit was dug at a site closer to the surface water intake and Pumphouse and encountered the same stratified silty sand and silt, as well as some mottling in the middle third of the pit. The water table was only slightly higher and the pit made water at the same slow rate as the first pit. The pit was dug to the excavator's limit of 4 m (13 ft) without encountering any change, following which it was likewise filled in.

2.2 Results

The stratified sand and silt encountered in the shallow pits were not permeable enough to permit a satisfactory rate of groundwater flow. Digging deeper with an excavator would be difficult due to the rapid slumping of the saturated sand and silt. Therefore, at the selected test pit sites, it is not feasible to construct a shallow dug well with sufficient capacity to meet the District's requirements.

3.0 SITE GEOLOGY AND HYDROLOGY OF HOTEL LAKE

3.1 Revision of Geology

From Ed Livingston's rapid field reconnaissance of February 18, 1992, it was thought that the compact sandy glacial debris present in exposures along Irvines Landing Road near the west end of Hotel Lake were continuous to the Lake shore; however, as discussed above, the test pits exposed a well stratified sand and silt unit in that area. It is likely that this sequence is continuous southwestward but its actual extent and thickness is unknown at this time.

A discussion with local residents during the field investigation of August 17 revealed the depth of Hotel Lake to be greater than originally estimated (140 ft by depth sounding). This indicates that the thickness of the glacial deposits blocking the rock valley at the southwest end of the Lake may be greater than estimated.

3.2 Hydrology

Evidence for subsurface flow from the Lake westward through the glacial debris to the sea was cited in Pacific Hydrology's February Feasibility Report. The following observations made by Livingston and Hofmann on the perennial nature of the discharge areas tend to confirm this conclusion:

1. The road ditch on the upper side of Kammer Road carried flow at the time of the visit in mid August during the drought period.

2. A new ditch along Irvines Landing Road between Lee Road and Keelson Road also carried a small amount of flow at the time of the mid August visit.

4.0 GROUNDWATER SUPPLY ALTERNATIVES

4.1 Drilling

Since digging has shown that shallow groundwater is not available in sufficient quantity to be of interest to the District, test-production drilling is the next step in the groundwater exploration program. The likelihood of a greater thickness of glacial sediments blocking the Hotel Lake Valley is a further inducement to drill, as there is more potential for the existence of an aquifer at depth.

The objectives of further exploration by drilling are to determine:

1. The thickness of the stratified unit encountered in the test pits and whether it contains sufficiently permeable layers in which a well of the desired capacity can be constructed.
2. The thickness of any other glacial sediments below the stratified unit and if they are permeable.
3. If the surficial sediments do not contain an aquifer, whether the upper part of the bedrock is weathered or fractured and, therefore, whether it has any significant permeability.

From the investigation and site improvements carried out for the shallow digging, and based on hydrogeologic interpretation, there are two

preferred locations for test drilling; these are:

1. At one of the test pit sites close to the Improvement District's Pumphouse near Hotel Lake; obviously, the site closer to the Pumphouse would be a better choice because there is a direct access road.
2. Near Irvines Landing Community Hall, southwest of the District's Pumphouse, preferably south of the old tennis court.

Final selection of which area to drill first should be based on access and costs to connect a successful production well to the system. Since the Community Hall location is at an higher elevation, a drill hole at that site would likely encounter the stratified sand and silt, and also the water table, at a greater depth than a drill hole near the Pumphouse. For this reason, and because the existing piping and power facilities are so close to the test pits, a test hole at the second test pit near the District's Pumphouse represents the more attractive alternative. However, if drilling there is unsuccessful, the casing would be pulled and drilling could proceed at the Community Hall location. For the quantity of water desired, the bedrock would not ordinarily be considered an aquifer to explore; however, if both test holes are unsuccessful, drilling into the upper part of the bedrock to check its permeability could be justified.

4.2 Horizontal Collector

The excavator operator noted that there is another possibility for a water supply source for Irvines Landing, should drilling fail to encounter conditions in which a suitable vertical well can be constructed. This would be to construct a system of horizontal intake pipes buried in clean sand and gravel filters at the edge of Hotel Lake near the location of the present surface water intake pipe. A filter system such as this would require obtaining a permit to alter the shoreline of the Lake. While the experience in the test pit digging is not encouraging that an horizontal collector facility is feasible, further investigation of this alternative can be justified, particularly if test drilling is unsuccessful. An obvious disadvantage of an horizontal collector is source protection.

5.0 GROUNDWATER EXPLORATION AND PRODUCTION WELL COSTS

Based on current industry rates, exploration and production well costs for a maximum program, in which an unsuccessful test hole is drilled followed by completion of a successful screened well at a second site, are estimated to be as follows:

1. Test-Production Drilling/Well Construction	
a. Drill an unsuccessful test hole using 4 m (13 ft) of 200 mm (8") diameter surface casing and 47 m (154 ft) of 150 mm (6") diameter casing	\$ 7,000.
b. Develop a 150 mm diameter production well as part of the same program, including installation and cost of 4.6 m (15 ft) of well screen	12,000.
2. Conduct a suitable pump test	4,000.
3. Engineering, including supervision of drilling by telephone and pump testing onsite, sieve analysis, water quality tests, reporting, etc.	<u>4,500.</u>
	<u>\$ 27,500.</u>

If the first test-hole is completed as a successful production well, the cost of a minimum program is estimated to be about \$20,500., with the "risk cost" of a completely unsuccessful program an estimated \$16,500., including engineering, and the cost to continue one hole into rock.

The engineering item includes an estimated \$300. for chemical and bacteriological water analyses but it may be possible to have the local Health Inspector collect the samples.

6.0 SUMMARY AND CONCLUSIONS

1. The two shallow test pits dug near the existing surface water intake pipe in Hotel Lake have shown that conditions are not suitable for developing a source of shallow groundwater to supply Irvines Landing Improvement District.
2. Two locations in the District which have potential for containing a deep aquifer within the sediments filling Hotel Lake Valley, and which are also favourably situated with respect to the water system, are:
 - a. the site of the test pit closest to the Pumphouse;
 - b. near Irvines Landing Community Hall.
3. The preferred location, based on access and costs, is at the site of the test pit closest to the Pumphouse. However, if a test well at that site is unsuccessful, a second test well could be drilled at the Community Hall.
4. In the event that a test-production drilling program of two holes shows that the thick sediments filling Hotel Lake Valley do not contain an aquifer, further consideration could be given to investigating the feasibility of installing an horizontal collector on the shore of the Lake.
5. The maximum cost of a test-production drilling program of two 150 mm (6") diameter test wells, in which one is completed as a successful screened production well, is estimated to be \$27,500.; if the first test well is successful, the cost of a minimum program is estimated to be in the order of \$20,500. The "risk" cost of a completely unsuccessful program could be as much as \$16,500., if the drilling of one hole is continued into rock.

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Pacific Hydrology is prepared to proceed with the drilling phase of the Irvines Landing Project as soon as the Regional District gives authorization to do so. We can provide draft contract documents suitable for tendering a test-production drilling program, along with a list of contractors who are capable of carrying out the program. If you wish to further discuss the contents of this letter, or if additional information concerning the drilling phase of the program is required, please contact us.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.



Katherine Hofmann,
Geologist



Ed Livingston, P. Eng.

c.c. Dayton & Knight Ltd.