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February 3, 2004

G5 Management Inc.
8811 Ash Street
RICHMOND, B.C. V6Y 3B4

Attention: Mike Riesterer

Subject: Geology and Conditions for Water Supply for a Proposed Residential Subdivision on a Parcel of Land at Oyster Bay Described as Northwest ¼, and Part of the Southwest ¼, Section 25, and Part of the Northeast ¼, Southeast ¼, Northwest ¼, and Southwest ¼, Section 26, All within Plan 552C, Township 4, Comox District PHCL Reference G714101

Dear Sirs:

1.0 INTRODUCTION

This letter is further to discussions at the G5 Management Inc. (G5MI) property at Oyster Bay between you (Riesterer) and Ed Livingston of Pacific Hydrology Consultants Ltd. (PHCL), on January, about possible sources of water to supply a proposed residential subdivision of about 100 lots, as shown on Oyster Bay Developments Ltd. Layout Plan 010783PS1, prepared by Focus Engineering.

There appears to be several possible ways to supply the proposed subdivision with water. This letter is concerned mostly with the groundwater resource on and around the G5MI property. In preparation of this letter, we were fortunate in having from our files two sets of air photos, one set black and white, the other infrared, which cover much of the area. We also have background information from past work at Oyster River to the south and Campbell River to the north.

2.0 GEOLOGY

The G5 Management Inc. (G5MI) property at Oyster Bay is on the extensive coastal lowland of that part of Vancouver Island. In the subject area, the coastal lowland is underlain by the sedimentary rocks of the Nanaimo Group of Cretaceous age. The Nanaimo Group is made up of 9 formations

and, according to the Geological Survey of Canada Map (**Geology of Vancouver Island** (east half) B.F. 463, 1977), the formation at Oyster Bay is the Northumberland Formation consisting of siltstone, shale and sandstone with an average thickness of 250 m (820 ft). These rocks are exposed on the tidal flat at low tide in an area of the shore covered by gravel with many boulders, a short distance northwest of Iron River Road. Nanaimo Group rocks probably underlie the area from the shore southwest to the Oyster River.

Over most of the G5MI property, the bedrock is covered with glacial and glaciomarine sediments of unknown thickness. The surficial sediments have been mapped by the Geological Survey of Canada and are shown on Map 49-1959, **Surficial Geology Oyster River**. The surficial sediments consist of various loose materials, ranging in grain-size from clay to gravel, overlying a gravelly, bouldery till complex which may be quite thick. The sediments over the till were mostly deposited during the time when the ice of the last glacial episode was melting and when sea level was more than 100 m above present sea level. As the land emerged from the sea, wave action produced a continuous beach which is called marine veneer.

The map of surficial geology cited above, shows an area of "shore deposits" starting approximately at the Iron River Road - Island Highway junction and extending southwestwardly beyond the G5MI property. The infrared photos suggest that this is an area of beach ridges deposited when sea level was a few metres above present sea level. This is an area of northward near-shore currents so the beaches are probably composed of sandy sediments from the delta of Oyster River. This type of deposition along the present shore is cut off by the groyne at the spit which is at the east boundary of the G5MI property.

3.0 WATER SUPPLY

A water supply system for the subdivision must supply an adequate amount of water of quality suitable for domestic use. It should, in our opinion, also supply sufficient water for fire protection. The domestic supply for about 100 connections requires a minimum average flow of about 26.5 lps (35 igpm) along with sufficient storage to meet short periods of peak demand, probably summer weekends. Fire protection demands vary somewhat but may require flow of 27.9 lps (500 igpm) for several hours. This water usually comes entirely from storage.

We understand that there are several possible sources of domestic water and water for fire protection. It may be possible to connect to the Oyster River system to the southeast or to the Willow Point (Campbell River) system to the northwest. It may also be possible to operate an independent system using wells as a water source. Water for fire-fighting may possibly come from one of the systems

mentioned above or from storage on or close to the proposed subdivision. A possible but unlikely source of water for fire fighting could be the sea. A problem which might arise in providing fire protection from either of the two existing systems is the matter of size and length of mains required to provide the required fire flows. This could be overcome by having water storage for fire fighting on or near the subdivision.

Conditions for developing an independent system based on wells in or near the subdivision are not known, but indications from well drilling to the northwest and southeast indicate that there may be two problems:

1. poor water quality because of dissolved iron; and,
2. low capacity of drilled wells.

The required capacity of the domestic supply system is quite low so it may be possible to obtain an adequate quantity of water from three, or less, wells.

The water quality problem of dissolved iron seems to be quite widespread in the Oyster Bay area. The origin of the iron is uncertain but it may be associated with buried organic material (peat, wood, leaves, etc.) in the glacial and glaciomarine sediments. It is possible that water in the underlying bedrock may be free of iron but it may be difficult to obtain enough water from wells drilled into the rock to supply the proposed subdivision. To carry this one step further, if good quality water is found in rock wells and the capacity of the wells is low, it may be possible to use the technique of hydrofracturing to increase well capacities. Even after hydrofracturing, it is unlikely that sufficient water for the proposed subdivision can be provided by one well completed in rock.

It is, of course, possible to treat water to remove iron, and also manganese, which often goes along with the iron, both of which cause staining of plumbing but are not hazardous to health. We briefly discussed iron treatment with a firm which provides water treatment equipment. They pointed out that they would require a chemical analysis of the water to be treated in order to provide a more precise cost of equipment but estimated that the bare equipment cost for treating a flow of 45 igpm would be about \$7,000, and that a plant installed in a building might be triple the bare equipment cost - say, \$21,000, with a yearly operating cost of \$4,000. This would be an ion-exchange type plant which would periodically produce a flow of salt brine with iron; the iron-rich brine could be disposed in the sea. We are not directly involved with water treatment, so an estimate should be obtained from someone involved with water treatment.

4.0 DISCUSSION

We obtained, on the internet, a water well location map and the logs of six wells, all located northwest of the G5MI property. As with many well records on the internet, they are probably incomplete and the locations may not be plotted accurately. The drill holes range in depth from 12.2 to 36.6 m (40 to 120 ft). Wells were completed at depths ranging from 12.2 to 22.9 m (40 to 75 ft). Driller's estimates of well capacities range from a dry hole to 1.1 lps (15 gpm). As far as we know, all of the wells were drilled as domestic wells; by using more well screen and continuing deeper, estimated well capacities might possibly have been greater. Actual well capacities can only be determined by test pumping of individual wells. There are probably more drilled wells in the area northwest of the proposed subdivision. If so, information about them can be obtained by means of a well inventory.

Our interpretation of the available well logs indicates that these wells obtain water from the till complex, which may best be described as ice contact deposits. Ice contact deposits were deposited in contact with melting ice and consist of a complex mixture of till, sand, gravel, silt and even clay. In some places, such deposits contain patches of aquifer which yield moderate amounts of water; in other places they yield little water.

The logs show that none of the wells were drilled into the bedrock to see whether it was possible to get water in rock, particularly better quality water from the fractured rock. However, experience with wells completed in the Nanaimo Group rocks on the Gulf Islands and on Vancouver Island indicate that well capacities are usually low but that water quality is usually fairly good.

From the geologic mapping, and from observation, we believe that there is part of the property where the surficial geology is different and may be favourable for obtaining good quality water from shallow wells. According to the geologic map, it is an area of "shore, deltaic and fluvial deposits". It borders on the shore on the north with the northwestern tip of the area at the intersection between the Iron River Road and the Island Highway. It extends southeastward beyond the G5MI property. It includes the spit built up against a groyne. The infrared photos show a distinct pattern of curved lines, sub-parallel to the shore; these are probably forest-covered old beaches formed at slightly higher sea level. These shore deposits, which are likely to be mostly clean sand, may contain good quality water at shallow depth. The area is extensive but is most accessible along the Island Highway where it could be easily investigated by digging test pits and installing small diameter casings to get water samples for quality testing. Two of the roads of the proposed subdivision extend into the edge of the area of shore deposits.

The question of seawater intrusion in such a shallow aquifer near shore should be discussed. In the entire Oyster Bay area there is a continual flow of groundwater to the sea; this flow tends to protect against seawater intrusion. However, if testing near the Highway showed that the water quality is good and it seems possible to construct wells of sufficient capacity, production wells would be drilled further inland where seawater intrusion is very unlikely. The air photos show a long narrow feature which may be an old gravel pit extending south from the highway, south of the spit. It seems to include a pond, perhaps a place where removal of sand and gravel extended below the water table. It may be possible to sample groundwater in the pit area.

5.0 GROUNDWATER INVESTIGATION

From the previous discussion, it appears that there are three possible sources of groundwater at the proposed subdivision:

1. The shore deposits along the northeast edge of the subdivision.
2. The glacial deposits (till complex) everywhere on the proposed subdivision and which supply water to wells to the northwest.
3. The bedrock (Nanaimo Group of Rocks, which is believed to underlie the entire area).

We suggest that groundwater investigation start with the shore deposits because such investigation is least expensive, the source(s) is on the G5MI property but, if used as a source, would not interfere with the subdivision as proposed. The cost of production wells would probably be quite low. There are two obvious unknowns – the capacity to supply sufficient water and the quality of the water.

5.1 Exploration Program to Investigate Groundwater in Shore Deposits

To further investigate the potential of the shore deposits, we suggest the following steps:

1. If possible, visit the long narrow gravel pit along the east boundary of the G5MI property. This pit is in the area of shore deposits and may indicate the type of sediments which are to be expected in the area. Also check for wells at several nearby buildings which show on the air photos. If there are wells, investigate water quality by enquiring about users experience and testing samples for iron using a field test kit.

2. After investigating access to the area of shore deposits from roads in the proposed subdivision, hire a wheel-mounted backhoe and dig test holes as deep as possible, probably 4 to 5 m and, if the holes reach water, place in each hole a 5 cm (2") diameter plastic pipe with a slotted section at the bottom and backfill the hole. Pumping from this pipe can obtain a clear water sample to test for iron and, if it is low in iron, for more complete chemical analysis. At least three test holes should be dug to properly test the aquifer.
3. If these steps indicate that the shore deposits can serve as a satisfactory aquifer, drill a test-production well and carry out proper test pumping to determine well and aquifer capacity.

The preliminary steps (1) and (2) can be done any time but final test pumping of a test-production well should probably be carried out in late summer - early fall when groundwater levels are at a minimum.

5.2 Investigation of the Till Complex

Investigation of the groundwater resource in the till complex, which apparently supplies water to the existing wells north and northwest of the G5MI property, requires drilling of one or more test-production wells. Since these sediments probably underlie the entire G5MI property, the test drilling can take place anywhere that it does not interfere with the subdivision plan and where, if a well is successful, it can be used as the source for a water supply system.

Drilling should be done using 200 mm (8") diameter casing, preferably by a cable-tool drill. Each hole should be drilled to bedrock. If a possible aquifer is encountered, a test screen should be installed and the well pumped to obtain a clear water sample to be tested for iron and manganese. If the water contains iron, the test screen should be recovered and drilling continued to bedrock unless water treatment for iron removal is being considered. In this case, the well should be completed as a production well in the best aquifer zone and tested to determine the well and aquifer capacities.

6.0 COST ESTIMATE

It is difficult to estimate costs of exploration at an early stage without more information. For this draft letter, we provide the following table very rough estimates for investigation of the shore deposits and the till complex.

Table 1. Cost of Investigation of the Shore Deposits (Steps 1 and 2 only)

Task	Time (hrs)	Fees (\$)	Disbursements (\$)	Total (\$)
1. Supervising engineer	10	1,250.	500.	1,750.
2. Technician	20	800.	600.	1,400.
3. Backhoe and water analyses	-	-	600.	600.
4. Report	10	1,000.	150	1,150.
Estimated Total Cost				4,900.

Table 2. Cost of Investigation of the Till Complex by Drilling Two Test-Production Wells

Task	Time (hrs)	Fees (\$)	Disbursements (\$)	Total (\$)
1. Supervising engineer	10	1,250.	500.	1,750.
2. Technician including additional well inventory	20	800.	1000.	1,800.
3. Drilling of two test wells to estimated depth 30 m (105 ft)	-	-	16,000.	16,000.
4. Water analyses, etc.	-	-	800.	800.
5. Pumping tests	-	-	4,500.	4,500.
6. Report	20	2,000.	250.	2,250.
Estimated Total Cost				27,100.

- Notes:
1. The fee total of each task may be an average of more than one fee category.
 2. The estimate does not include G.S.T.

7.0 CLOSURE

This letter has been prepared to provide our opinion on the potential of developing groundwater as a source of water supply for a proposed residential subdivision of a parcel of land at Oyster Bay, as shown on a plan prepared by Focus Engineering (Oyster Bay Developments Ltd. Layout Plan 010782 PS1).

G5 Management Inc.

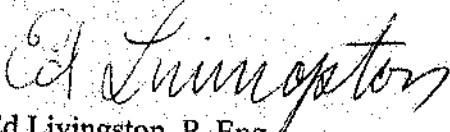
Geology and Conditions for Water Supply for a Proposed Residential Subdivision on a Parcel of Land at Oyster Bay Described as Northwest ¼, and Part of the Southwest ¼, Section 25, and Part of the Northeast ¼, Southeast ¼, Northwest ¼, and Southwest ¼, Section 26, All within Plan 552C, Township 4, Comox District

February 9, 2004 - Page 8

We trust that we have provided the information that you require at this time. However, please do not hesitate to contact us for further information and/or if any questions arise out of the contents of this letter-report.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.



Ed Livingston, P. Eng.

Manager