KODIAK HOLDINGS LTD.

SUBSURFACE CONDITIONS
IN THE VICINITY OF
YOUR SEWER INSTALLATION CONTRACT
IN SURREY

PACIFIC HYDROLOGY CONSULTANTS LTD.

MARCH 21, 1985

E. LIVINGSTON, P. Eng.
A. BADRY

PACIFIC HYDROLOGY CONSULTANTS LTD.

CONSULTING GROUNDWATER GEOLOGISTS

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

March 21, 1985

Kodiak Holdings Ltd.
P. O. Box 2100
PRINCE GEORGE, B. C.
V2N 2J6

Attention: Mr. Mike Stringer,
President

Subject: Subsurface Conditions in the Vicinity of Your Sewer Installation Contract in Surrey

Dear Sir:

This letter-report is further to several meetings with you and your brother Erik and also to a meeting with the members of the engineering staff of the Corporation of the District of Surrey at their office on March 20.

We understand that the situation is as follows:

1. On the basis of your bid, you were awarded a contract to install a section of concrete sanitary sewer pipe in the vicinity of 150th Street and 104th Avenue in the Guildford area.

2. For information to aid in the preparation of your bid, the District of Surrey gave you a copy of a report titled, Subsurface Investigation, 1.4 km Trunk Sanitary Sewer,

.../2

150 Street, 104 and 108 Avenues, Surrey, B. C. prepared by Hardy Associates (1978) Ltd. Hardy's Project No. is VG-03215; the report is dated February 28, 1983. We have on hand a copy of this report.

3. You started work at the east end of the contracted section of the sewer advancing westward to 150 Street. Conditions to 150 Street were approximately as expected. Because of the eastward slope of the land, the depth of burial became deeper, reaching almost 6 m at 150 Street. Some water was encountered but it did not seriously interfere with progress of the work.

4. At 150 Street, an unexpected condition was encountered that made progress southward along 150 Street virtually impossible using the methods and equipment that had been used up to that time. The unexpected condition is a bed of saturated sand under compact till. The water level in the sand is less than 2 m below ground surface.

5. When this condition was encountered in late February, a manhole was installed and Kodiak stopped work.

6. Members of the Surrey District engineering staff observed the subsurface conditions when the work was stopped.

7. You immediately informed the District of Surrey and explained that you were unable to proceed further without altering your methods.

8. You contacted our firm on March 13 and E. Livingston visited the site with you and your brother Erik on March 14.

GEOLOGY AND GROUNDWATER HYDROLOGY OF THE SITE AREA

The site area is part of the Surrey Upland which is generally underlain by thick glacial debris.

There is little subsurface information because the area has been supplied with piped water since it was developed about 1970 and very few water wells have been drilled. The glacial debris consists of sandy, silty, stony till overlain by a variable thickness of outwash sand, gravel and silt.

The till in the Surrey area is quite sandy and very compact. It contains many stones from pebble size to very large boulders. It is slowly permeable - much more permeable than the clay tills found in many other areas.

The area under discussion is quite close to an height of land on which is located a large water reservoir that is part of the water system which serves the area. The water is from the Greater Vancouver System. The natural groundwater flow system (excluding any contributions from manmade sources) consists of flow from the height of land radially in all directions. Natural recharge conditions are good with permeable soil over slowly permeable till or, in some places, over more permeable outwash gravel. Part of the groundwater moves along the top of the till and is partially discharged into local depressions in which the remnants of old sloughs can still be seen. Part of the water moves down through the till to feed larger groundwater flow systems.

Generally, the area under discussion is close enough to the height of land (the source of natural recharge) so that comparatively small flows of groundwater

are expected. The amount of water encountered in the excavation of the sewer line and the amount of shallow groundwater observed around several apartment buildings in the area seems to be greatly in excess of what would be expected from natural recharge in light of the limited recharge area. Also, such a short flow system would tend to show considerable seasonal variations in groundwater discharge. Local apartment building managers say that conditions are worse shortly after heavy rain but that water problems continue through the time of minimum natural recharge from June to late October.

CONSTRUCTION PROBLEMS

Up to the present there is only one condition that has stopped further progress on the sewer contract. This condition is the presence of saturated sand under till, below 150 Street between the alignments of 105 and 106 Avenues. This is the place where the sewer line advancing from the east reaches 150 Street.

Kodiak reports the unexpected condition as follows:

1. Except for pavement and shallow fill, the excavation is in compact sandy, silty, stony till to a depth of 3.5 to 4 metres, below which there is loose sand saturated with water which rises to within 1 to 2 metres of the surface of the pavement.

2. The sand extends to a depth below 5.9 metres which is the depth to the bottom of the pipe specified in the Contract.

3. Pumping and bailing of the water to lower the water level sufficiently to permit placing pipe causes much sand to flow into the hole. This undermines the till on both sides and creates a dangerous condition; it also undermines the street on both sides of the excavation.

The Hardy Report, mentioned previously, shows conditions at this location that are fundamentally different from the conditions actually encountered. The site discussed in the previous paragraph is located approximately midway between testholes 3 and 4 for which logs are included in the Hardy Report. The log of testhole 3, which is directly on the route of the Kodiak contract, shows till to the bottom of the hole at a depth of 6.6 metres. Testhole 4 shows till to the bottom of the hole at a depth of 3.2 metres where, according to a note on the log - "refusal on boulder" - the hole was halted because of a boulder. We understand that, in order to check the information in the Hardy Report, Kodiak dug a testhole with a backhoe at testhole 3 and found the sand below the till at a depth of 3.5 to 4 metres.

The question might arise at this point as to whether the field procedure used by Hardy Associates was capable of showing the actual condition found at testhole 3. Testhole 6, which is not on the route of the Kodiak contract but is about 525 m north on 150 Street, shows a condition similar to that found at testhole 3. Testhole

6 shows the following:

0 - 1.5 m fill
1.5 - 2.8 m sand
2.8 - 4.0 m till
4.0 - 5.5 m sand and gravel.

The water level is shown at 2.9 m so the sand and gravel is saturated.

Testholes 1 and 2 are on 104 Avenue directly on the route of the Kodiak contract. These show till to the bottom of the holes at 4.6 m and 5.9 m respectively.

It is clear from the previous discussion that a contractor bidding on this sewer installation contract would have every reason to believe that the excavation for the line would be in till to the bottom, especially in the deeper part of the excavation along 150 Street and along 104 Avenue. There is no evidence from any source to suggest that conditions would be other than those shown by the logs of the drill holes in the Hardy Report. The section DISCUSSION AND RECOMMENDATIONS in the Hardy Report confirms this in the statement, "The test holes indicate that a trench to the proposed invert levels for the sanitary trunk sewer will penetrate well into the till material at every test hole location." (Page 2).

If conditions were as Kodiak had

been led to believe by the existing information at the time the contract was undertaken, there is little doubt that the method used by Kodiak would have been able to complete the work through the section along 150 Street successfully.

POSSIBLE EXCAVATION PROBLEMS ALONG 104 AVENUE

After work stopped on the excavation along 150 Street, Mr. Mike Stringer of Kodiak carried out an investigation of groundwater along the route of the remainder of the contract along 150 Street and 104 Avenue. This investigation consisted of interviewing several managers of apartment buildings and at least one building owner. This investigation disclosed that there are severe problems with shallow groundwater, including drainage problems; there are also problems with settlement of foundations and backup of sewers that are likely related to shallow groundwater.

Mr. Livingston of our firm accompanied Mssrs. Mike and Erik Stringer on March 14 in a rapid inspection of several buildings. The condition of several of these buildings is quite bad and would, in our opinion, be difficult and expensive to correct. We understand from this inspection that these buildings are 11 to 14 years old and that severe troubles with water and settlement started about 8 years ago.

We bring up this matter for several reasons:

1. These conditions suggest that deep excavation close to the existing buildings along the planned route of the sewer might lead to severe problems unless special methods of ground support are used.

2. These conditions indicate that there is much more groundwater in the area than can be accounted for by natural recharge from precipitation.

3. The statements of those concerned, that problems developed about 8 years ago, suggest that groundwater conditions changed at about that time. This indicates that much of the groundwater is related to human activity.

It is important to point out here that the condition which stopped the excavation is quite separate from the above. The excavation was stopped by a hydrogeologic condition which is fundamentally different from that shown in the Hardy Report.

We brought up the matter of problems with buildings very close to the route of the excavation in the meeting on March 20 with Surrey Engineering Staff because we believe that we would be negligent in not calling it to the attention of the District.

The two problems are related only in that there seems to be a very large amount of groundwater in that area - much more than would be expected from natural recharge.

It seems rather unlikely that a

considerable reduction in the amount of groundwater in the area would permit excavation along 150 Street without using very special and expensive methods.

SUMMARY AND CONCLUSIONS

Pacific Hydrology Consultants Ltd. does not design sewers, excavations or other civil engineering works, so we are not in a position to make recommendations about what should be done in this situation. Based on our understanding and review, the situation may be summarized as follows:

1. Work stopped on a sanitary sewer contract when a bed of loose water-bearing sand was encountered under till in a deep trench.

2. An engineering report prepared for the Corporation of the District of Surrey by Hardy Associates (1978) Ltd. shows that conditions are fundamentally different than those actually encountered. If conditions had been as shown in the engineering report, work could have continued.

3. There seems to be much more groundwater in the area than can be explained by natural recharge.

4. A brief investigation of conditions on the route of the sewer along 104 Avenue indicates that the planned deep excavation, which is very close to buildings that show signs of considerable settlement, may lead to serious problems unless special ground support techniques are used.

5. Reduction of the amount of groundwater in the area would

not likely permit excavation along 150 Street without special measures to deal with the saturated sand under the till.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.

E. Livingston

E. Livingston, P. Eng.