

APPENDIX B
GEOTECHNICAL REPORT

October 13, 2005

EBA File: 2800161

CH2M HILL Canada Ltd.
2100 Metro Tower II
4720 Kingsway
Burnaby, B.C. V5H 4N2

Attention: Trevor Jones

**Regarding: Geotechnical Desktop Study – Proposed Sewer Line Realignment
Courtenay/Comox, B.C.**

Dear Sir:

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) were retained by CH2M HILL Canada Ltd. (CH2M HILL) to carry out a geotechnical desktop study to provide input for the selection of a preferred route of a proposed realignment of the Courtenay/Comox BC sanitary sewer.

2.0 PROJECT DESCRIPTION

The Regional District of Comox Strathcona (RDSCS) has an existing sewer forcemain that transfers wastewater from Courtenay and Comox out to its treatment plant at the end of Brent Road on Cape Lazo in Comox. The last section of the existing forcemain is located at the base of Willemar Bluffs, which are steep, sandy, coastal bluffs. Recent erosion of the pipe cover has put the integrity of this section at risk. The RDSCS wants to abandon this last section along the coast in favor of an inland route. A new forcemain is proposed running from the south end of Croteau Road to the treatment facility.

The options considered for routing of the proposed alignment are shown in Figure 1.

The objective of the realignment is to relocate the sewer line away from Willemar Bluffs, where the existing pipeline is located at the bottom of steep, coastal bluffs. Erosion of the pipe cover has become an issue in recent years.

3.0 SCOPE OF STUDY

The scope of work provided by EBA was as follows:

- Review available information regarding the subsurface conditions and potential geotechnical issues of concern along the alignments being considered. This included

soil and groundwater conditions, slope stability, and possible contaminated sites information;

- Provide a report which includes an overview of our findings, and our preliminary recommendations for the preferred alignment; and
- Provide a workplan and estimate of cost for further subsurface investigation and engineering for detailed design along the selected route.

4.0 BACKGROUND REVIEW

A review of background information included the following:

- Reports relevant to the study area contained in our files;
- Published soil and bedrock geology maps;
- Available aerial photographs;
- Information on registered contaminated sites from BC Online site registry; and
- Information from BC Ministry of Water Land and Air Protection Water Resources Atlas.

Based on a review of the above information, the surficial materials overlying the area are expected to be a veneer of marine and glacio-marine deposits consisting of sand and gravel with some silt and clay generally less than 1.5 m thick. These deposits may overly till or thick deposits of sand (Quadra sediments).

Information from drill hole logs available through BC Water Resources Atlas is consistent with the above description. Clay was encountered in some of the drill holes located at the east side of the study area near the Lazo Marsh. Fine, low permeability materials are expected in wet land areas.

According to the contaminated sites registry, there are no contaminated sites, or sites having a history of contamination, within the study area.

No areas of slope instability were observed in available aerial photographs.

5.0 SITE VISIT

Ms. Lara Fletcher of EBA accompanied Messrs. Trevor Jones and Gabor Vasarhelyi of CH2M HILL on a site visit to observe local conditions, map soil exposures and meet with public works personnel to obtain additional information. Mr. Jerry Schmidt of EBA also visited portions of the proposed route as part of this study.

Surface soil exposures revealed predominantly sand or sand and gravel with trace silt and varying content of gravel. At the existing treatment plant, cut slopes were in medium grained sand. Stands of pine trees in the vicinity indicate that well drained soils are present.

Near the intersection of Torrence Road and Noel Avenue, a soil exposure revealed sand gravelly sand. On Lazo Road east of the intersection with Torrence Road, sand with trace silt and gravel was exposed. On Noel Avenue west of the intersection with Beckton Drive sand with some gravel and cobbles was exposed at the ground surface of a new residential development. At the north end of Colby Road there was a significant excavation in process. The subsurface material appeared to be gravelly sand with trace boulders.

To the west, in the area of Comox Avenue and Stewart Street an existing excavation revealed competent grey, silty till. Till may underlie granular soils along other sections of the study area. Along Lazo Road to the north end of Noel Avenue and along Brent Road, road cuts expose a uniform grained sand.

Most of the optional routes for the proposed alignment were accessed by vehicle. Sections of the proposed alignment that are not along existing roads, such as crossing the Lazo Marsh, were not investigated.

Mr. Jim Elliott, Treatment Plant Supervisor for the Regional District of Comox Strathcona, reported that to the south of the waste treatment plant, there is ponded water at the surface of the Lazo Marsh in the winter months.

6.0 DISCUSSION AND RECOMMENDATIONS

Based on the review of background information and a site reconnaissance, from a geotechnical perspective, there does not appear to be significant conditions that would warrant the selection of one preferred route over the other.

A conventional trench excavation is considered feasible for the entire alignment.

The invert of the pipe is to be 1.8 m below ground surface.

6.1 PRELIMINARY CONSTRUCTION CONDITIONS

There was no bedrock exposed at the surface along the various proposed alignments. Apart from the Lazo Marsh area, the surficial materials appear to be well drained, medium dense to dense sand and gravel. Some very dense till may be encountered below the granular soils and may exist below the wet area of the Lazo Marsh described below. Based on well logs reported on the BC Water Resources Atlas website, the water table was a minimum depth of 1.8 – 3.0 m (6 – 10 ft) from the ground surface. Therefore, it is considered feasible that construction consists of a conventional trench excavation. The slopes of the excavation may need to be sloped at 1H:1V or flatter where sloughing sand is encountered. Below the water table trench slopes will likely have to be 2H:1V or flatter. Site specific recommendations can be made as excavations are being completed.

As the Lazo Marsh trends southeast, the sewer alignment will have to cross the marsh at some location to reach the existing wastewater treatment plant. EBA anticipates that soft, wet soils may be encountered where the trench excavation crosses the Lazo Marsh. Accessing and working on the line during drier times of the year (i.e. summer) is expected to reduce the potential for difficult working conditions for equipment and labourers due to soft soil conditions. Some dewatering may be required. Unless the base of the excavation is into competent soils it may be necessary to use a coarser bedding material for stability and compaction purposes.

It is expected that the granular materials excavated could be used as trench backfill. Till or soft silt or clay may not be suitable.

6.2 RECOMMENDATIONS FOR SUBSURFACE INVESTIGATION

It is recommended that a subsurface investigation be carried out in order to complete a detailed geotechnical design. It is recommended that one day of testpitting and one day of drilling be carried out. From the intersection of Lazo Road and Balmoral Road to the north end of Morland Road it is assumed that there are no buried utilities and some disturbance of the ground surface is permitted adjacent to the road. Therefore, test pitting could be carried out along this section of the proposed alignment. Proposed test pit locations are shown in Figure 1. Test pits will be excavated to a minimum of 1 m below the pipe invert.

From the south end of Croteau Road to the intersection of Lazo Road and Balmoral Road, and the section along Lazo Road, the properties are more developed and disturbance of the ground surface may be less acceptable. Therefore, it is recommended that drilling be carried out along these proposed sections. Proposed testhole locations are shown in Figure 1. Test holes will also be excavated to a minimum of 1 m below the pipe invert.

The proposed locations of the test pit and drill holes are preliminary only. It is generally preferred to excavate test pits rather than drill holes in order to observe subsurface conditions. It is recommended that a representative of the Town of Comox review the proposed locations with a representative of EBA on site to establish the actual test pit and drill hole locations.

The road ends at the north end of Morland Road where the proposed alignment travels east to the wastewater treatment plant. Therefore, this section of the proposed alignment has not been cleared. It is recommended that holes be excavated to a limited depth using a hand auger.

Soil and groundwater conditions will be logged for each of the test holes/pits. Representative samples will be collected from intermediate depths for soil descriptions and laboratory testing. Standard Penetration Testing (SPT) will be done in all testholes to obtain soil strength (density and consistency) information.

Based on the results of the subsurface investigation, a detailed design report will be completed which will provide the following:

- An overview of the soil and groundwater conditions encountered;
- Allowable bearing pressures for the pump station, discharge chamber and pipeline;
- Requirements for sub-foundation ground preparation; and
- A discussion of other possible construction issues.

The cost of the subsurface investigation and detailed design report is estimated to be approximately \$12,000 as shown in Table 1. This estimate includes clearing of underground services prior to the field investigation, traffic control, and disbursements as well as a 10% contingency on EBA fees and disbursements and a 15% contingency on the contractor costs.

TABLE 1- ESTIMATED COSTS FOR SUBSURFACE INVESTIGATION			
Task	EBA Fees and Disbursements	Contractor Costs	Total Costs
Drilling and Test Pit Program	\$4,660	\$3,250	\$7,910
Reporting and Project Management	\$2,710		\$2,710
Subtotal	\$7,370	\$3,250	\$10,620
Contingency (10% fees, 15% contractor)	\$600	\$500	\$1,100
Total Estimate	\$7,970	\$3,750	\$11,720

7.0 LIMITATIONS OF LIABILITY

This report has been prepared for the exclusive use of CH2M HILL and their authorized agents. Recommendations presented in this report are based on a geotechnical evaluation of a desktop study. No subsurface investigation was carried out. It has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranty is made, either expressed or implied. For further limitations, reference should be made to the Geotechnical Report – General Conditions, which form part of this report.

8.0 CLOSURE

We trust this report meets your present requirements. Should you require any additional information please do not hesitate to contact our office.

Respectfully submitted;

EBA Engineering Consultants Ltd.

Prepared by:



Lara Fletcher, E.I.T.
Project Engineer



Jerry Schmidt, P.Eng.
Senior Geotechnical Engineer

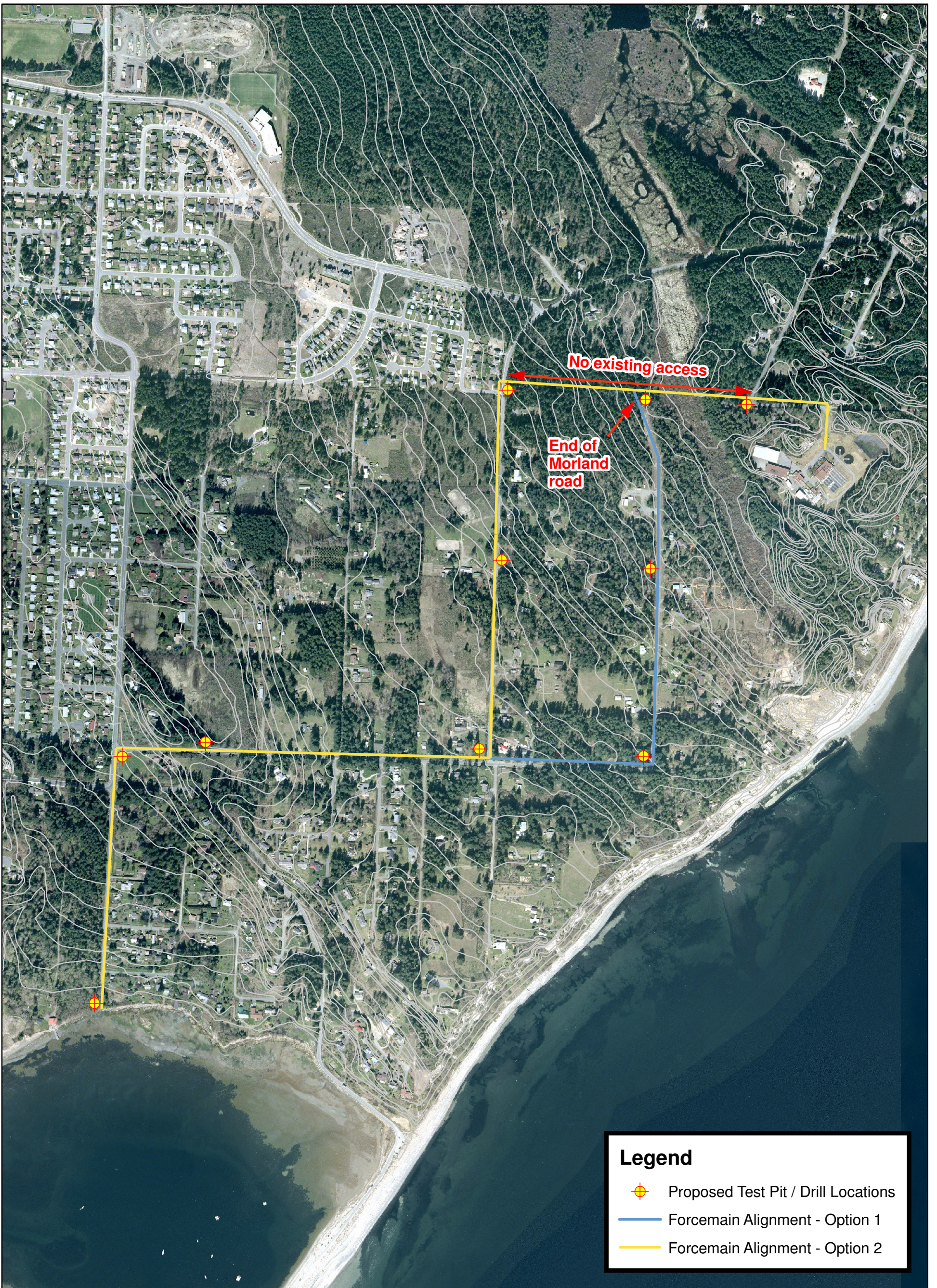
Attachments:

Figure 1 Site Location Plan Showing Proposed Alignments




Appendix A General Report – General Conditions

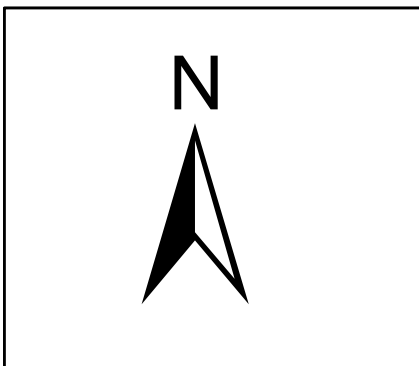


FIGURES




Legend

-  Proposed Test Pit / Drill Locations
-  Forcemain Alignment - Option 1
-  Forcemain Alignment - Option 2



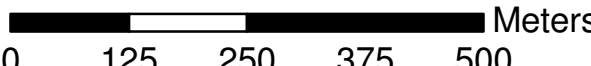
PREPARED BY



PREPARED FOR

EBA Engineering Consultants Ltd.

1:8,000



Meters

0 125 250 375 500

Comox Forcemain

Preliminary Engineering

COMOX, BC SEPT. 2005

Figure 1

Site Plan



APPENDIX

APPENDIX A GENERAL CONDITIONS

EBA Engineering Consultants Ltd. (EBA)
GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

3.0 LOGS OF TEST HOLES

The test hole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive.

Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

4.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

5.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

6.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

7.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

EBA Engineering Consultants Ltd. (EBA)
GEOTECHNICAL REPORT – GENERAL CONDITIONS

8.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

9.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

10.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

11.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

12.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of

samples can be made at the client's expense upon written request, otherwise samples will be discarded.

13.0 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

14.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

15.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.