

Julie.Houle

From: Kai Woloshyn <kwoloshyn@alexcoresource.com>
Sent: Friday, December 20, 2013 3:06 PM
To: Julie.Houle; Robert.Holmes
Cc: Brad Thrall
Subject: 2013 Annual geotechnical Inspection report for Keno Hill Silver District Mining Operations (QML-0009)
Attachments: 2013 Annual Inspection - Bellekeno Mine Surface Engineered Earth Structures_IFU.pdf

Hi Bob and Julie,

Please find attached the 2013 annual geotechnical inspection report for the Keno Hill Silver District Mining Operations as required under clause 12.2 of QML-0009.

Kai Woloshyn, B.Sc.
Environmental Manager
Alexco Resource Corp.
T 867.668.6463 ext 233 M 867.334.3614 F 867.633.4882



A TETRA TECH COMPANY

December 9, 2013

Alexco Resource Corp.
3 – 151 Industrial Road
Whitehorse, YT Y1A 2V3

ISSUED FOR USE
EBA FILE: W14103290

Via Email: kwoloshyn@alexcoresource.com

Attention: Kai Woloshyn – Environmental Manager

Subject: 2013 Annual Inspection – Surface Engineered Earth Structures
Bellekeno Mine, Keno City, YT

1.0 INTRODUCTION

1.1 General

Alexco Resource Corp. (Alexco) retained EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) to complete the 2013 annual inspection of the surface engineered earth structures at the Bellekeno Mine near Keno City, Yukon. Authorization for this work was provided by purchase order (PO #15222) on August 23, 2013. The following structures were identified as requiring inspection:

- Potentially acid generating (PAG) waste storage facility
- Bellekeno 625 water treatment ponds
- Bellekeno waste rock pile
- Lightning Creek Bridge abutments (Onek Road)
- Lightning Creek Bridge abutments (Bellekeno Road)
- Mill water storage pond
- Dry stacked tailings facility (DSTF)

The location of each of the above structures is shown on Figure 1.

1.2 Scope of Services

EBA's scope of services for the 2013 annual inspection of surface engineered earth structures is as follows:

- Complete a visual inspection of the surface engineered earth structures at the Bellekeno Mine prior to September 30, 2013.
- Prepare an inspection report containing the results of the inspection, summary of the stability, integrity, and status of all inspected structures, and any recommendations for remedial actions.

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company
61 Wasson Place

Whitehorse, YT Y1A 0H7 CANADA
p. 867.668.3068 f. 867.668.4349

2.0 INSPECTION SUMMARY AND RECOMMENDATIONS

The 2013 annual inspection of the surface engineered earth structures at the Bellekeno Mine was completed by Mr. Justin Pigage, P.Eng. on September 10, 2013. The following sections summarize inspection results and provide recommended remedial actions for each structure. Photographs taken during the site inspections are attached to this report.

2.1 PAG Waste Storage Facility

The PAG waste storage facility is located immediately south of the Bellekeno portal, as shown on Figure 1. The perimeter berms of the facility appeared intact with no visible signs of instability (Photo 1). Waste in the facility is being stored in accordance with the design (Photo 2).

The north and west anchor trenches are incomplete and should be excavated to properly anchor the liner. Currently piles of loose material anchor the liner in place (Photo 3).

The liner has been placed throughout the facility but the protective geotextile and geonet materials have only been placed in the north half of the facility. Some of the waste rock currently being stored in the facility extends beyond the limits of the protective geotextile and geonet (Photo 4). Sharp angular waste material in direct contact with the liner increases the likelihood of damage and punching failures. The protective geotextile and geonet should be installed over the remainder of the exposed liner.

2.2 Bellekeno 625 Water Treatment Ponds

The Bellekeno 625 water treatment ponds are located northeast of the Bellekeno portal, as shown on Figure 1. The ponds and surrounding structures (vehicle barriers, walkways, and piping) appeared stable at the time of inspection (Photo 5). The facility consists of two water treatment ponds and was operating at the time of the inspection. The water level in the primary pond was at the spillway invert with a freeboard of approximately 0.5 m below the crest of the perimeter berm (Photo 6). The water level in the secondary pond was approximately 1.5 m below the crest of the perimeter berm and 1.0 m below the emergency spillway invert (Photo 7).

At the time of the inspection water was being discharged from the secondary pond downslope of the facility. The partially buried discharge line appeared stable and intact (Photo 8). Erosion protection in the form of rip-rap should be placed immediately below the discharge point to protect the natural slope (Photo 9).

2.3 Bellekeno Waste Rock Pile

The Bellekeno waste rock pile is located beside the Bellekeno Road north of the Bellekeno portal, as shown on Figure 1. The waste rock pile has decreased in overall size from previous inspections because of ongoing construction activities around the property (Photos 10 and 11). The pile and side slopes appeared stable at the time of the inspection (Photo 12). No remedial action is recommended for the Bellekeno waste rock pile.

2.4 Lightning Creek Bridge Abutments (Onek Road)

The Onek Road Lightning Creek Bridge is located east of Keno City, as shown on Figure 1. The bridge was recently constructed and was not in service at the time of the inspection. It is a single span steel structure approximately 6 m in length (Photo 13) founded on compacted earth fill and adjustable wooden timber abutments (Photo 14). The abutments appeared stable at the time of the inspection.

The earth fill abutments are guarded from erosion by rip-rap placed after construction. The rip-rap placed protecting both bridge abutments appears satisfactory (Photo 15). No remedial action is recommended for the Lightning Creek Bridge on the Onek Road.

2.5 Lightning Creek Bridge Abutments (Bellekeno Road)

The Bellekeno Road Lightning Creek Bridge is located southwest of Keno City, as shown on Figure 1. The bridge was in service at the time of the inspection. It is a single span steel structure approximately 9 m in length (Photo 16) founded on earth filled timber cribbing abutments (Photo 17). The abutments appeared stable at the time of inspection.

The earth fill abutments are guarded from erosion by rip-rap placed after construction. The rip-rap protection for both abutments appears satisfactory (Photo 18). No remedial action is recommended for the Lightning Creek Bridge on the Bellekeno Road.

2.6 Mill Water Storage Pond

The mill water storage pond is located at the Keno Hill District Mill Site approximately 1 km west of Keno City, as shown on Figure 1. The pond was operating at the time of the inspection with a water level approximately 2 m below the perimeter berm crest (Photo 19). The perimeter berm appeared stable at the time of inspection and no loose seems, excessive tension or bulging was observed in the liner (Photo 20).

Some minor erosion was noted during the inspection along the exterior berm in the south and west portion of the pond (Photo 21). This area should be monitored closely for signs of increased erosion and armoured with rip-rap or vegetation if erosion continues.

In response to previous safety recommendations, ropes have been installed in several locations around the perimeter of the pond to help personnel climb out of the pond should they fall in (Photo 22).

2.7 Dry Stacked Tailings Facility

The dry stacked tailings facility (DSTF) is located at the Keno Hill District Mill Site approximately 1 km west of Keno City, as shown on Figure 1. Construction and operation of the DSTF was ongoing at the time of the inspection with work being focussed on contouring the sideslopes (Photo 23).

Construction of the lower tailings bench is complete to the design dimensions and elevations. Progressive reclamation of the facility is underway with revegetation of the western face of the lower bench (Photo 24).

The foundation elements of the DSTF (gravel drainage blanket, geosynthetic clay liner, geonet, and geotextile) placed to date appeared properly installed and intact at the time of the inspection. The perimeter berms and surface water collection structures appeared stable and functional (Photo 25).

Some minor tension cracking was observed near the top of the placed tailings on the north slope of the DSTF (Photo 26). This is likely due to the natural drying of placed tailings and should not impact the performance of the facility.

Ongoing routine DSTF instrumentation monitoring and compaction testing (Photo 27) indicates there is no lateral movement of the frozen foundation soils and that compaction of the placed tailings to date is adequate. In general, construction and performance of the DSTF has been consistent with the design to date. No remedial action is recommended for the DSTF.

3.0 CONCLUSION

The structures inspected pose no significant risk to the environment or human health and safety. The remedial actions recommended in the previous sections should be completed as soon as possible. The following Table 1 summarizes the recommended remedial actions for each structure inspected:

Table 1: Summary of Remedial Recommendations

Structure	Remedial Recommendations
PAG Waste Storage Facility	<ul style="list-style-type: none"> • Complete anchor trench for liner on north and west sides of facility. • Complete placement of protective geonet and geotextile over liner in southern half of facility.
Bellekeno 625 Water Treatment Ponds	<ul style="list-style-type: none"> • Armour discharge location with rip-rap to reduce erosion.
Bellekeno Waste Rock Pile	<ul style="list-style-type: none"> • No remedial action recommended.
Lightning Creek Bridge Abutments (Onek Road)	<ul style="list-style-type: none"> • No remedial action recommended.
Lightning Creek Bridge Abutments (Bellekeno Road)	<ul style="list-style-type: none"> • No remedial action recommended.
Mill Water Storage Pond	<ul style="list-style-type: none"> • Monitor south and west exterior perimeter berms for erosion and armour if necessary.
Dry Stacked Tailings Facility	<ul style="list-style-type: none"> • No remedial action recommended.

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Resource Corp. and their agents. EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Resource Corp., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA’s Services Agreement. EBA’s General Conditions are provided in Appendix A of this report.

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

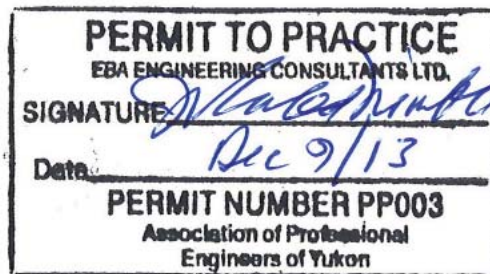
Respectfully submitted,
EBA Engineering Consultants Ltd.



Justin Pigage, P.Eng.
Geotechnical Engineer, Arctic Region
Direct Line: 867.668.9213
jpigage@eba.ca

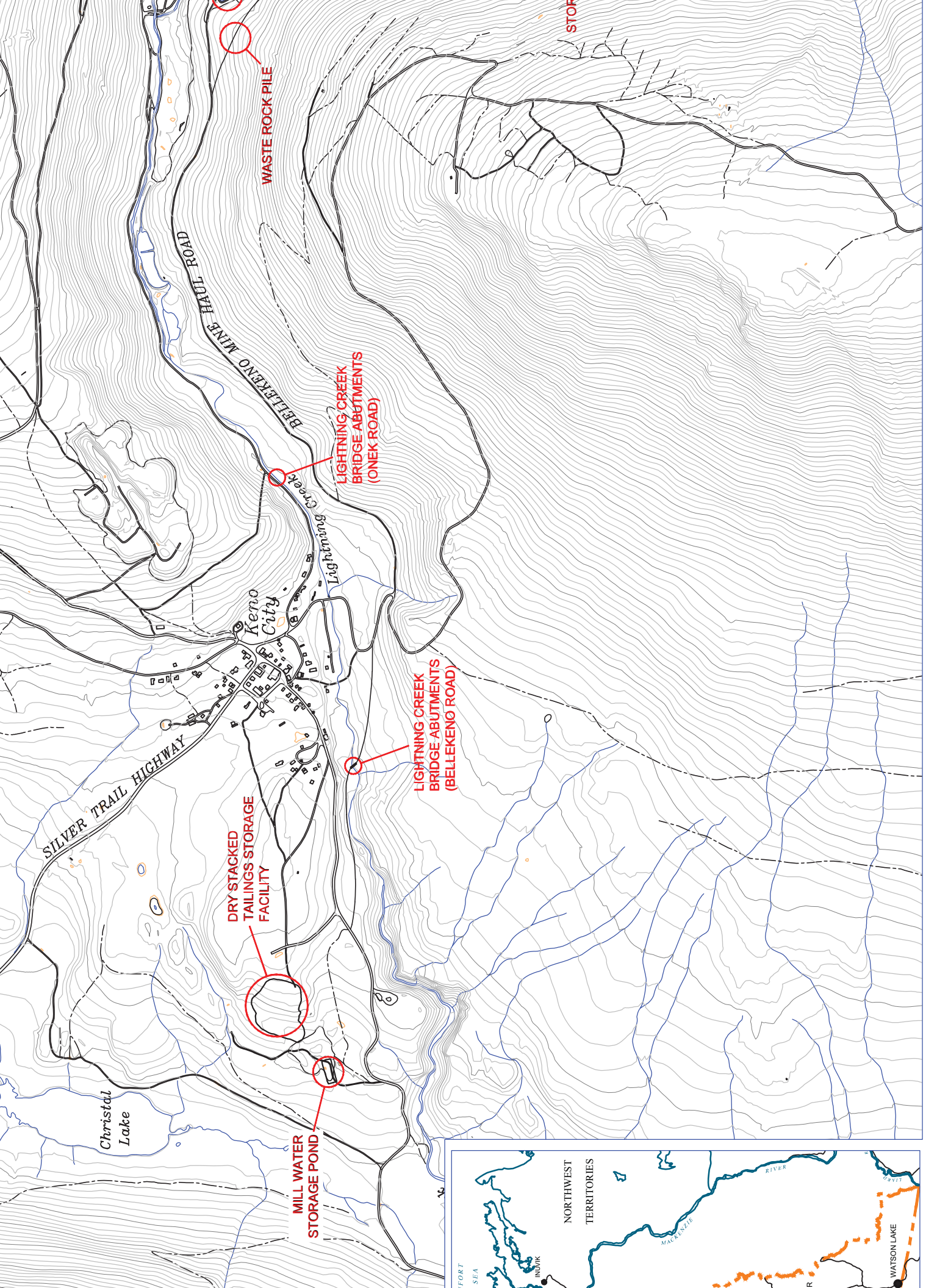


J. Richard Trimble, P.Eng., FEC
Principal Consultant, Arctic Region
Direct Line: 867.668.9216
rtrimble@eba.ca



FIGURES

Figure 1 Site Plan Showing Structure Locations



CLIENT

NOTES
 CONTOUR INFORMATION IS BASED ON DRAWING
 PROVIDED BY ALEXCO RESOURCE INC.



PHOTOGRAPHS



Photo 1: PAG Waste Storage Facility
Perimeter berm
Facing south – September 10, 2013



Photo 2: PAG Waste Storage Facility
Material stored in facility
Facing north – September 10, 2013



Photo 3: PAG Waste Storage Facility
Liner not properly anchored around north and west perimeter
Facing north – September 10, 2013



Photo 4: PAG Waste Storage Facility
Angular waste material in direct contact with liner
Facing west – September 10, 2013



Photo 5: Bellekeno 625 Water Treatment Ponds
Photograph showing condition of facility
Facing north – September 10, 2013



Photo 6: Bellekeno 625 Water Treatment Ponds
Approximately 0.5 m freeboard in pond one
Facing west – September 10, 2013



Photo 7: Bellekeno 625 Water Treatment Ponds
Approximately 1.5 m freeboard in pond two
Facing north – September 10, 2013



Photo 8: Bellekeno 625 Water Treatment Ponds
Partially buried discharge line
Facing west – September 10, 2013



Photo 9: Bellekeno 625 Water Treatment Ponds
Discharge point requiring rip-rap armouring for erosion protection
Facing south – September 10, 2013



Photo 10: Bellekeno Waste Rock Pile
Overview of waste rock pile
Facing west – September 10, 2013



Photo 11: Bellekeno Waste Rock Pile
Overview of waste rock pile
Facing south – September 10, 2013



Photo 12: Bellekeno Waste Rock Pile
Stable pile sideslopes
Facing west – September 10, 2013



Photo 13: Lightning Creek Bridge Abutments (Onek Road)
Lightning Creek Bridge on the Onek Road
Facing north – September 10, 2013



Photo 14: Lightning Creek Bridge Abutments (Onek Road)
Compacted earth fill and wooden timber bridge abutments
Facing east – September 10, 2013



Photo 15: Lightning Creek Bridge Abutments (Onek Road)
Rip-rap armoring providing erosion protection for bridge abutments
Facing north – September 10, 2013



Photo 16: Lightning Creek Bridge Abutments (Bellekeno Road)
Lightning Creek Bridge on the Bellekeno Road
Facing west – September 10, 2013



Photo 17: Lightning Creek Bridge Abutments (Bellekeno Road)
Earth filled timber cribbing bridge abutments
Facing east – September 10, 2013



Photo 18: Lightning Creek Bridge Abutments (Bellekeno Road)
Rip-rap armoring providing erosion protection for bridge abutments
Facing south – September 10, 2013



Photo 19: Mill Water Storage Pond
Approximately 2.0 m of freeboard in mill water storage pond
Facing west – September 10, 2013



Photo 20: Mill Water Storage Pond
Stable perimeter berm
Facing east – September 10, 2013



Photo 21: Mill Water Storage Pond
Minor erosion observed on exterior of perimeter berm on south and west sides
Facing west – September 10, 2013



Photo 22: Mill Water Storage Pond
Safety rope for exiting pond
Facing west – September 10, 2013



Photo 23: Dry Stacked Tailings Facility
Contouring of facility to design grades
Facing west – September 10, 2013



Photo 24: Dry Stacked Tailings Facility
Vegetation on western slope of lower tailings bench
Facing north – September 10, 2013



Photo 25: Dry Stacked Tailings Facility
Perimeter berm and surface water collection system
Facing north – September 10, 2013



Photo 26: Dry Stacked Tailings Facility
Minor tension cracking on north side of facility
Facing east – September 10, 2013



Photo 27: Dry Stacked Tailings Facility
Compaction testing at the dry stacked tailings facility
Facing north – September 10, 2013

APPENDIX A

EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

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 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), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

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. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

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.

3.0 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.

4.0 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.

5.0 LOGS OF TESTHOLES

The testhole 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.

6.0 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 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.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.