



October 30, 2018

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

ISSUED FOR USE
FILE: 704-ENG.WARC03522-01
Via Email: kwoloshyn@alexcoresource.com

Attention: Kai Woloshyn – Environmental Manager

Subject: 2018 Annual Geotechnical Inspection – Earth Structures
Bellekeno Mine, Keno City, YT

1.0 INTRODUCTION

NND-EBA Land Protection Corp. operating as NELPCo Limited Partnership (NELPCo) was retained by Alexco Resource Corp (Alexco) to complete the 2018 annual geotechnical inspection of the constructed earth structures related to development at the Bellekeno Mine near Keno City, Yukon. This report does not contain any data from the instrumentation installed on site, as this will be reported in a separate letter.

NELPCo is a limited partnership corporation owned by the NND Development Corporation (NNDDC) and Tetra Tech Canada Inc. (Tetra Tech). The inspection was conducted by Tetra Tech, NELPCo's exclusive engineering services provider. Authorization to complete this work was received by way of an Alexco purchase order (PO #R76458) on August 28/18.

2.0 SCOPE OF SERVICES

The following is Tetra Tech's scope of services for the 2018 annual inspection as was presented in the proposal submitted to Alexco on June 12, 2018:

- Complete a visual inspection of the earth structures identified by Alexco, which includes:
 - Bellekeno Mine
 - Potentially acid generating (PAG) waste storage facility;
 - Bellekeno waste rock pile;
 - Bellekeno 625 water treatment ponds;
 - Lightning Creek bridge abutments (Onek Road);
 - Lightning Creek bridge abutments (Bellekeno Haul Road);
 - Mill water storage pond; and
 - Dry stacked tailings facility (DSTF).

The location of these structures is shown on Figure 1.

- Prepare an inspection report documenting the results of the inspection, and a summary of the stability, integrity, and status of all inspected structures, and any recommendations for remedial actions.

3.0 INSPECTION SUMMARY AND RECOMMENDATIONS

The 2018 annual inspection was completed by Richard Trimble, P.Eng. on August 29th, 2018, in the company of Rob Schneider from Alexco. The following sections summarize observations for each structure and describe recommended remedial actions, if necessary. The recommended remedial actions have been separated into critical geotechnical stability concerns and ongoing facility maintenance issues to assist in the prioritization of remedial efforts. Select photographs taken during the inspection are included where appropriate.

3.1 BELLEKENO MINE

3.1.1 PAG Waste Facility

The PAG waste storage facility is located south of the Bellekeno portal, as shown on Figure 1. The facility has not been used since mining operations were suspended in winter 2013, but currently contains some volume of PAG waste rock and some surface runoff water. At the time of inspection, the perimeter berms appeared intact with no visible sign of instability.



Photo 1: View of PAG waste storage cell south of Bellekeno portal

3.1.2 Bellekeno Waste Rock Pile

The Bellekeno waste rock pile forms a portion of the Bellekeno Haul Road and is located north of the Bellekeno portal, as shown on Figure 1. At the time of the inspection the sideslopes of the waste rock pile appeared to be intact and stable. One minor tension crack was observed (see Photo 2) but no remedial action is required at this time.



Photo 2: Bellekeno waste rock dump used as foundation for access road

3.1.3 Bellekeno 625 Ponds

The Bellekeno 625 water treatment ponds are located north of the Bellekeno 625 portal, as shown on Figure 1. The facility consists of two water treatment ponds that were both operating at the time of inspection. The primary treatment pond was operating at the discharge invert elevation with a freeboard of 0.5 m below the perimeter berm crest at the time of inspection. The secondary pond was also operating at the discharge elevation, with a freeboard of 0.5 m in the south end. Treated water discharges through an HDPE pipe onto the hillside above Lightning Creek. Photo 3 shows the two ponds at the time of the inspection.



Photo 3: Bellekeno 625 water treatment ponds – discharge is from the far end of the facility

As recommended in previous annual geotechnical inspection reports, elevation surveys to monitor for settlement at the north end of the pond should be completed monthly during the snow free seasons, and observed settlement must be repaired by adding fill under the liner at the north end of the ponds to maintain the design freeboard.

The pipe from the treated water pond discharges directly onto the natural soils above Lightning Creek without any protection from erosion. At the time of the inspection the flow from the discharge pipe was low, but regular monitoring should be completed. If any signs of erosion are observed, rip-rap armouring must be installed.

3.1.4 Lightning Creek Bridge Abutments (Onek Road)

The Lightning Creek Bridge on the Onek Road is located east of Keno City, as shown on Figure 1. The bridge is a single span steel structure founded on earth filled timber cribbing abutments. The abutments were stable at the time of the inspection and are sufficiently protected from erosion by rip-rap armouring (Photo 4). No remedial action is required for the Lightning Creek Bridge on the Onek road at this time.



Photo 4: Well armoured bridge abutments at Lightning Creek crossing by the Onek road.

3.1.5 Lightning Creek Bridge Abutments (Bellekeno Haul Road)

The Lightning Creek Bridge on the Bellekeno Haul Road is located southwest of Keno City, as shown on Figure 1. The bridge is a single span steel structure with a wooden deck founded on earth filled timber cribbing abutments. The abutments were stable at the time of the inspection and are sufficiently protected by rip-rap armouring from erosion by Lightning Creek. Although the bases of the abutments are well protected, the approaches need some maintenance to protect the ends of the bridge deck from erosion (see Figure 5). It is recommended that some coarse rockfill be placed at both ends of the approaches, along with a short section of safety berm to maintain stability. If coarse rockfill is used for the safety berm, surface drainage would not be impeded, but must be channeled so that the berm is not eroded away or undercut.



Photo 5: Bellekeno Haul Road bridge crossing Lightning Creek – erosion protection is required at the ends of the approaches to the bridge to protect the abutments and the bridge deck

3.1.6 Mill Water Storage Ponds

The two mill water storage ponds are located at the Keno Hill District Mill Site, west of Keno City, as shown on Figure 1. At the time of the inspection the mill was not operating, but both ponds contained some water, with a freeboard of about 2 m below the perimeter berm crest (Photo 6). The perimeter berms and pond liner appeared intact with no visible signs of instability. No remedial action is required for the mill water storage ponds at this time.



Photo 6: One of the mill water ponds at the Mill Site – stable berms and sideslopes.

3.1.7 Dry Stacked Tailings Facility

The dry stacked tailings facility (DSTF) is located at the Keno Hill District Mill Site west of Keno City, as shown on Figure 1. No tailings have been placed in the DSTF since mining operations were suspended in winter 2013. The tailings placed to date have been regraded, covered with organic growth medium, and seeded as part of progressive reclamation activities. At the top of the DSTF near the south end, there was evidence of minor erosion and deposition of tailings from under the protective cover. Arrangements should be made to fill the eroded area to prevent further erosion.

3.1.8 Instrumentation

None of the instrumentation was read during this inspection – one of the ground temperature cables in the DSTF needs to be replaced, and another needs to be repaired (see 2017 Inspection Report). It was anticipated that readings of all the instrumentation would be completed during the cable replacement. This has yet to be scheduled.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The earth structures inspected pose no significant risk to the environment or human health and safety in their current condition. The remedial actions recommended in the previous sections of this report are summarized in Table 1 below.

Table 1: Summary of Remedial Recommendations

Structure	Stability Recommendations	Maintenance Recommendations
BELLEKENO		
PAG Waste Storage Facility	None	None
Bellekeno Waste Rock Pile	None	None
Bellekeno 625 Water Treatment Ponds	<ul style="list-style-type: none"> Conduct monthly elevation surveys of north perimeter berm crest of secondary pond, during snow free season, to monitor for settlement. 	<ul style="list-style-type: none"> Monitor the erosion from the discharge pipe and install riprap if required.
Lightning Creek Bridge Abutments (Onek Road)	None	None
Lightning Creek Bridge Abutments (Bellekeno Haul Road)	None	<ul style="list-style-type: none"> Construct safety berms to protect the top of the abutments and the edge of the bridge deck.
Mill Water Storage Ponds	None	None
Dry Stacked Tailings Facility (from 2017 Inspection Report)	<ul style="list-style-type: none"> Install new ground temperature cable to replace damaged cable at BH40; Purge and clean BH38 and preserve using liquid suitable for use in permafrost conditions; and Investigate cause of slope indicator derailment in BH28 with downhole camera. Rehabilitate or replace as required. 	<ul style="list-style-type: none"> Continue regular instrumentation readings to monitor DSTF foundation conditions.



5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Resource Corp. and their agents. Tetra Tech Canada Inc. (Tetra Tech) 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. NELPCo's Limitations are provided in Appendix A of this report.

6.0 CLOSURE

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

Respectfully submitted,
NELPCo Limited Partnership



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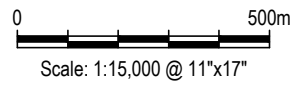
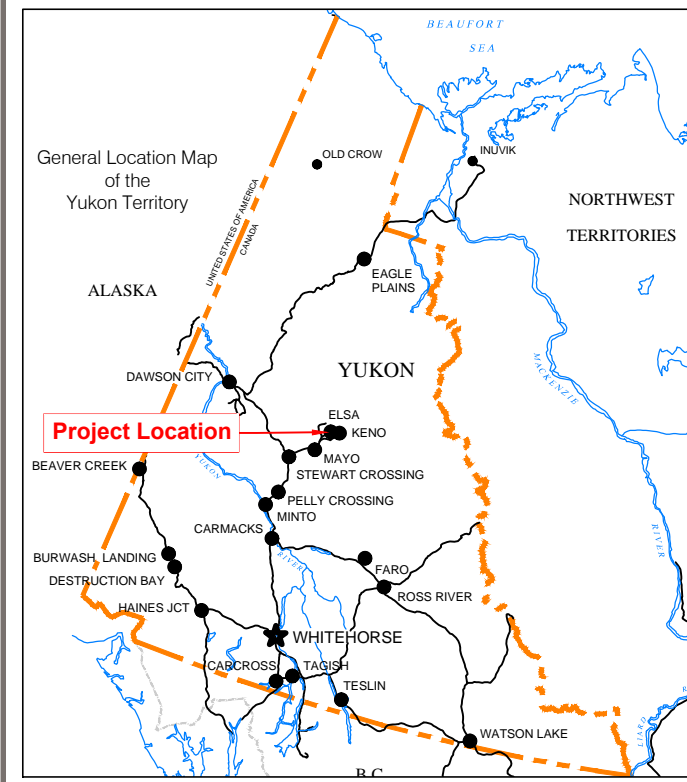
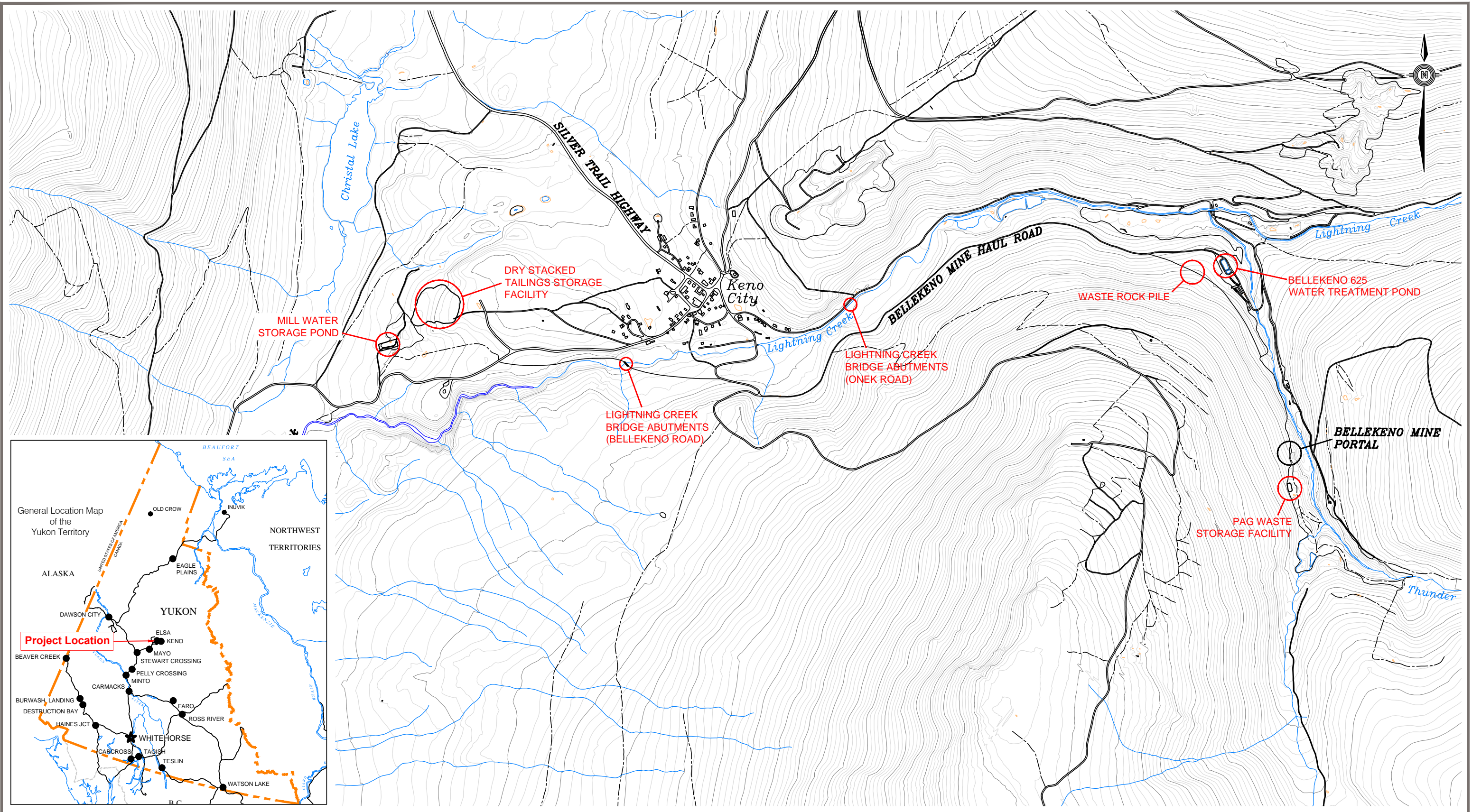
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FIGURES

Figure 1 Site Plan Showing Structure Locations

Q:\Whitehorse\Drawings\Keno\ENG.WARC03522-01 Fig.1 RD.dwg [FIGURE 1] October 29, 2018 - 10:15:58 pm (BY: BUCHAN, CAMERON)



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

CLIENT

**2018 ANNUAL INSPECTION
 BIRMINGHAM MINE SITE - GALENA HILL, YUKON**

**SITE PLAN SHOWING
 STRUCTURE LOCATIONS**

PROJECT NO. ENG.WARC03522-01	DWN CB	CKD JRT	REV 0
OFFICE EBA-WHSE	DATE October 29, 2018		

Figure 1

APPENDIX A

LIMITATIONS ON USE OF DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of NELPCO Limited Partnership's (NELPCo) Client (the "Client") as specifically identified in the NELPCO Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). NELPCO does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by NELPCO.

Any unauthorized use of the Professional Document is at the sole risk of the user. NELPCO accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where NELPCO has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by NELPCO during the performance of the work are NELPCO's professional work product and shall remain the copyright property of NELPCO.

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

1.2 ALTERNATIVE DOCUMENT FORMAT

Where NELPCO submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed NELPCO's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by NELPCO shall be deemed to be the original. NELPCO will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of NELPCO's Instruments of Professional Service shall not, under any circumstances, be altered by any party except NELPCO. NELPCO's Instruments of Professional Service will be used only and exactly as submitted by NELPCO.

Electronic files submitted by NELPCO have been prepared and submitted using specific software and hardware systems. NELPCO makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

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

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of NELPCO.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with NELPCO with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for NELPCO to properly provide the services contracted for in the Contract, NELPCO has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO NELPCO BY OTHERS

During the performance of the work and the preparation of this Professional Document, NELPCO may have relied on information provided by third parties other than the Client.

While NELPCO endeavours to verify the accuracy of such information, NELPCO accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to NELPCO at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

NELPCO is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

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

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards 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. NELPCO 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.

1.9 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.

1.10 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 historical environment. NELPCO 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 exploration and review may be necessary.

1.11 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.

1.12 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.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact 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, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and 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.

1.15 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 satisfactory 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.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters 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 used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

NELPCO 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.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. NELPCO cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.