TETRA TECH EBA

July 22, 2016

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Government of Yukon
Department of Energy, Mines and Resources
Box 2703
Whitehorse, Yukon Y1A 2C6

Attention: Mr. Jeff Moore
Type II Project Officer, Assessment and Abandoned Mines

Subject: May 2016 Geotechnical Inspection of Earth Structures
Mount Nansen Site, YT.

1.0 INTRODUCTION

As requested, Tetra Tech EBA Inc. (Tetra Tech EBA) has completed a geotechnical inspection of the earth structures located at the abandoned Mount Nansen mine site west of Carmacks, YT. The intent of the inspection was to provide a geotechnical engineering report on the stability of the tailings, water-retaining, and water diversion structures as part of the on-going care and maintenance program. The format and content of the inspection generally conforms to that recommended in the Canadian Dam Association's (CDA) *Dam Safety Guidelines* (2007, updated 2013). Similar inspections have been completed by Tetra Tech EBA in the past. The scope of work for this study was to include two site inspections in 2016 (one near freshet in the spring (May), and one just before freeze-up in the fall (September)) per Tetra Tech EBA's proposal dated March 17, 2016. The work was subsequently authorized under Contract C00032838 on March 31/16. This letter presents an interim report based on the May inspection, which will be combined with the September inspection to prepare the Annual Geotechnical Inspection Report.

2.0 OBSERVATIONS AND RECOMMENDATIONS

Mr. Richard Trimble, P.Eng. of EBA's Whitehorse Office completed a one-day inspection on May 13, 2016 in the company of Jeff Moore from the Yukon Government, Assessment and Abandoned Mines (YG-AAM), and two representatives from Denison Environmental Services (the site Care and Maintenance Contractor) – Tyrell Vance and Richard Wilkinson. The structures examined were:

- North Interceptor Ditch/Dome Creek Diversion Ditch/Emergency Spillway
- Tailings Dam
- Seepage Collection Dam

Specific observations and recommendations are presented in the following sections of this letter, including selected photos. Other photos taken are available for review in Tetra Tech EBA's files. Prior to the site visit, a site specific Health and Safety Plan was prepared and submitted to YG-AAM to forward to the site maintenance personnel, followed by the completion of an onsite safety orientation prior to accessing the site(s).

Tetra Tech EBA Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

2.1 NORTH INTERCEPTOR DITCH/DOME CREEK DIVERSION/EMERGENCY SPILLWAY

2.1.1 Interceptor Ditch

The ditches above and around the tailings pond, connecting to the emergency spillway are intended to keep runoff water out of the tailings area, and were generally in a similar condition to that observed in previous years. Site personnel indicated that there was minimal ice excavation and cleanout required to keep the ditch flowing over the previous winter. Some evidence of toe erosion by water flow was observed, but not significant --see Photos below.

The primary concern with these ditches is over-steepening of the slopes caused by erosion at the toes of the banks – this will have to be monitored and corrective actions taken when tension cracks are observed at the access road elevation at the crest of the slope. This might normally occur during spring runoff or after large rainfall events. The corrective actions should include flattening the slopes to 1.5:1 and possible riprap placement at the toe of the slope to minimize this over-steepening.

Photo 1:
Interceptor ditch slopes just south of Dome Creek intersection, looking downstream. Undercut slope toes are evident between the two snow patches in about centre of photo (May 13/16)

When maintenance activities along the ditches occur, care should be taken to maintain the width of the access road to be at least 6 m in this area. The excavated material from the upstream side could be re-used as fill on the downstream side to maintain the road width.

Erosion gullies from water entering the interceptor ditch were in the same condition as previous years and should continue to be monitored. These small erosion gullies are significant contributors to sand and silt deposits in the diversion ditch. Riprap has been placed at all these gullies, as previously recommended (see Photo 2). This hasn't been entirely effective in minimizing sand migration into the ditch, but does provide some stability to the

sideslopes at these locations. A complete sand/silt barrier at these locations would require additional annual maintenance to clean out materials on the other side of the ditch, which is not considered necessary at this time.

It is understood that these sand/silt deposits have been cleaned out with a backhoe over the past year, to maintain flow in the ditches. This practice should be continued.

Photo 2:
Armouring to minimize sand deposition from contributory gullies into channel bottom upstream of Dome Creek intersection looking west (May 13/16)

2.1.2 Diversion Ditch

The diversion ditch was in an acceptable and stable condition – no work is required at this time other than regular maintenance to remove silt/sand in the spring and fall of each year, as required to maintain flow and side slope stability. Photo 3 shows the typical condition of the diversion ditch.

Photo 3:
Typical condition of the Dome Creek diversion ditch looking upstream (May 13/16)

2.1.3 Combined Diversion Ditch and Emergency Spillway

The combined diversion ditch and emergency spillway was in an acceptable and stable condition.

The top "velocity check" immediately downstream of the vehicle crossing was previously noted as needing additional boulders in the centre of the stream, which were placed in 2015. Photo 4 shows this area. The Denison Environmental personnel asked if these could be removed in the late fall to facilitate ice removal in the winter – this is acceptable to Tetra Tech EBA provided they are replaced prior to spring freshet, and this was acknowledged by the Denison personnel.

Photo 4:
Velocity check just below bridge showing the addition of several large boulders (in channel at centre of photo) to maintain its effectiveness during periods of high flow – looking east (May 13/16).

Some large willows were observed at the lower end of the emergency spillway – these should be cut down and/or removed before freeze-up. Some of these willows were getting to be of a size that could collect debris and affect flow during high flow events.

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2.2 TAILINGS DAM

The water level in the tailings pond was well below the maximum operating level elevation, was similar to last year, and lower than has been traditionally been observed in the preceding years. The dam itself is considered to be in a stable condition with a large upstream tailings beach. No evidence of previously noted instabilities or seepage on the north abutment was observed, and there were no signs of significant erosion or permafrost thaw features that could affect stability. The surface of the dam was flattened in 2014, and this has assisted in visual monitoring. Vegetation has been adequately removed from all locations noted in previous inspections.

Photo 5:
View to the north along centerline of tailings dam (May 13/16)

Photo 6:
Area of historical permafrost thaw settlement on downstream face, southeast edge (May 13/16)

The southeast edge of the downstream face where it abuts natural terrain has experienced permafrost thaw settlement since construction. These settlement areas were surveyed and monitored for several years in the early 2000's, but have not experience any noticeable settlement in recent years.

It is recommended that some fill be hauled, placed and compacted in these depressions – see Photo 6. Some of the depressions are marked by survey stakes and metal pins, but all are obvious and extend from near the crest down to the toe. The purpose in having this area levelled is to facilitate future observations of permafrost thaw settlement, if any.

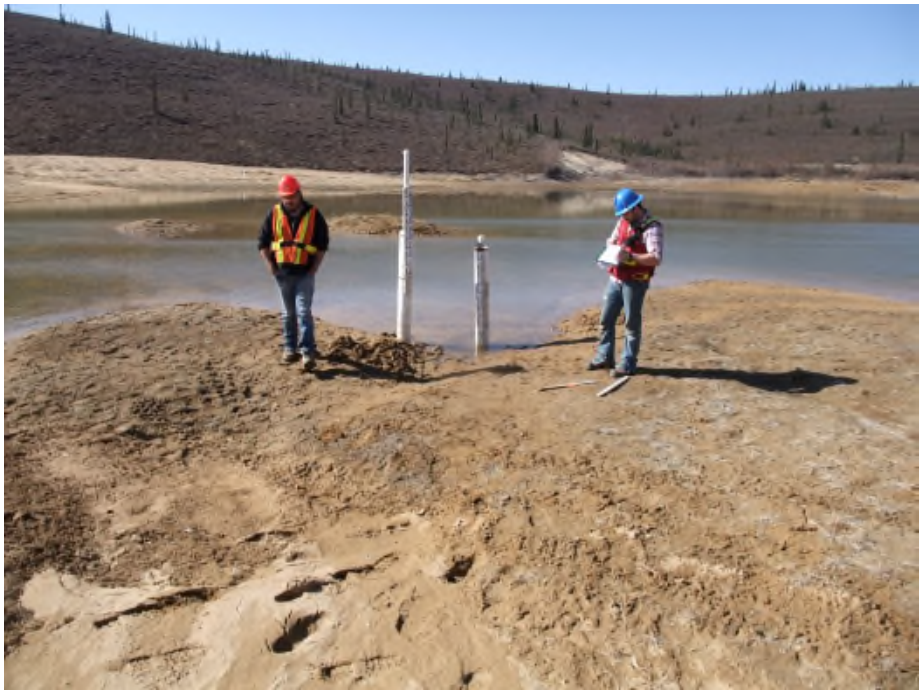


Photo 7:
Low tailings pond water level – water just barely registers on the lower staff gauge (May 13/16)

The water in the pond was recorded at 0.82 m on the first installed staff gauge which corresponds to an elevation of 1095.42 m (per May 2016 elevation survey completed by YG-AAM). This places the water at about 2.38 m below the design "pond operating level" of 1097.80 m. With respect to geotechnical stability, low water levels are always preferred.

It is recommended that the elevations of the staff gauge, pond water level and top of tailings dam be surveyed twice per year (spring and fall) to confirm that seasonal frost heave is not affecting readings on the staff gauge. It is assumed that the elevations of the geodetic benchmark (BM) and top of tailings dam are stable.

2.3 SEEPAGE COLLECTION DAM

The water in the seepage collection pond was recorded at a level of 0.19 m on the staff gauge, and the pumping rate to keep it at this level, according to Denison personnel, was similar to previous years. This pond elevation is close to the usual operating level of the pond over the past year, and according to the onsite maintenance personnel, it is necessary to pump at varying rates over the year to keep it at about this level. The corresponding elevation for the staff gauge reading is about 1077.09 m (per June 2015 elevation survey completed by YG-AAM) or about 1.01 m below the design operating level of 1078.10 m. Photo 8 shows the downstream face of the berm at the time of the inspection.

Photo 8:
View of downstream face of Seepage Collection Pond berm, looking south (May 13/16).

The three minor seeps that have been noted in previous years on the downstream face of the dam were not observed during this inspection.

The other seeps flowing into the pond from the north abutment were still observed, with similar volumes of clear water flowing – this is not a cause for concern. The two seeps from the base of the riprap on the upstream side of the pond were also observed this year, similar to previous years. The seepage water was rusty coloured but free of silt, so no cause for concern.

The ground squirrel holes and burrows along the dam crest that were noted in previous years have been filled in, and it is understood that techniques used by Orkin Canada have been effective in mitigating the ground squirrel issues at this location.

All woody vegetation, including roots, has been removed from the crest of the dam and the upstream face, and within the top 5 m of the downstream face as noted in previous inspection reports.

No stability concerns are noted as a result of this pond inspection.

3.0 SUMMARY OF RECOMMENDATIONS

The following Table has been prepared to summarize the recommendations from the current geotechnical inspection. This table will be updated annually, with completed items being removed from subsequent versions of the Table, and the others carried forward, if still applicable.

Table 1: Summary and Status of Recommended Maintenance and Monitoring Items from June 2016 Geotechnical Inspections

Item Description	Maintenance	Monitoring	Status
North Interceptor, Diversion Ditch and Emergency Spillway	Cut/remove woody vegetation from lower portion of spillway – some of the willows are getting to be a size that could impact flow in the channel.	Monitor the condition of bank sideslopes on a regular basis, and if undercut/over-steepened by erosion, then either repair or provide armour consisting of non-woven geotextile and riprap.	Vegetation to be removed in 2016
Tailings Dam	Add compacted fill to downstream face of dam along southeast edge, to fill in permafrost thaw-settlements and create a flat surface to assist in future monitoring.	Continue to visually monitor permafrost thaw settlement on the downstream face near the south abutment.	Fill to be added in 2016
		Determine elevation of top of staff gauges, water level, and top of tailings dam in spring and fall of each year, relative to adjacent geodetic BM.	Spring 2016 survey completed, add fall 2016 survey
Seepage Collection Dam	No maintenance required.	Monitor seepage zones from below riprap at toe of tailings dam, from base of north terrace, and at the three previously identified locations on the downstream face of the dam. If seepage volumes significantly increase from that observed, or if water becomes silty, notify a geotechnical engineer immediately.	On-going
		Continue to record pumping rates from seepage collection pond, and notify a geotechnical engineer if the rates significantly increase to maintain a constant water pond elevation.	On-going

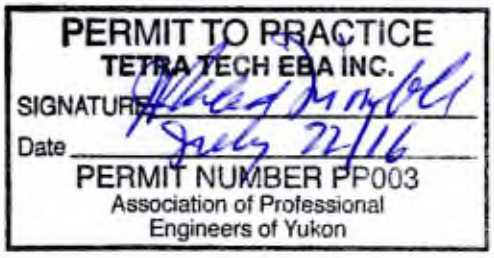
4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon, Energy Mines and Resources and their agents. Tetra Tech EBA Inc. 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 Government of Yukon, Energy Mines and Resources or for any Project other than the site described herein. 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 the attached General Conditions.

5.0 CLOSURE

We trust this report meets your present requirements. The inspections reported herein are specifically related to geotechnical observations completed by the author regarding the north interceptor ditch/Dome Creek diversion/emergency spillway, tailings pond, and seepage collection pond at the time of the inspections. Should geotechnical stability issues be noted by site personnel during other routine inspections, EBA should be notified as these observations may affect the conclusions presented in this report. Should you have any questions or comments, or require any additional information, please contact the undersigned.

Sincerely,
Tetra Tech EBA Inc.



J. Richard Trimble, P.Eng., FEC
Principal Consultant, Arctic Region
Direct Line: 867.668.9216
Email: richard.trimble@tetratech.com

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.

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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.