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Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
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Attention: Ms. Dionne Filiatrault, P.Eng.,
Manager of Technical Services

Dear Dionne:

Jericho Diamond Mine
Review of East and Southeast Dams Design Report
NWB Water License NWB1JER0410

At the request of Nunavut Water Board (NWB), Acres International Limited (Acres) has conducted an independent review on the design report of the East and Southeast Dams that was submitted by Tahera Diamond Corporation (Tahera), on behalf of Benachee Resources Inc. (BRI). BRI is a wholly-owned subsidiary of Tahera and is the registered holder of the Nunavut Water Board Water Licence No. NWB1JER0410 (Water Licence). The design report was prepared by EBA Engineering Consultants Ltd., dated August 2005.

Background

Part D of the Water Licence describes the Conditions Applying to Construction. Item 2 of Part D specifically indicated that BRI shall submit to the NWB a detailed design plan and drawings, which outlines the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or waste materials.

The East and Southeast Dams are located at the east end of Long Lake, immediately south of the mine processing plant. The dams are located in small saddles between bedrock ridges. Long Lake will be utilized as the Processed Kimberlite Containment Area (PKCA). Fine processed Kimberlite (fine PK) will be beached off of the dams throughout the life of the mine. The dams are intended to prevent water and tailings from entering into Ash Lake, and into another smaller lake located to the southeast of Southeast Dam. The two dams will be designed for crest elevations at el 524 m, providing a 1 m freeboard above the allowable maximum water level in the Long Lake/PKCA area.

Acres Review and Comments

Based on the review of the design report, as well as the accompanying Construction Specifications for the East and Southeast Dams, Acres has the following comments:

1. General

The design report and the technical construction specifications provided the requirements for the construction of the East and Southeast Dams, as stipulated in Part D Item 2 of the water license. Design information related to the construction materials, dam foundation, and dam slopes are included in the submitted documents.

2. Slope Stability Analysis

The design report did not provide the following detail information:

- Material properties (Section 4.2)
  - Properties for the upstream sloping till zone. Is this fill material assumed to have similar properties as the ice-poor till?
  - Properties of the coarse tailings
  - What zone of the dam's foundation is represented as ice-rich till? Would this zone be removed prior to construction?
- No graphical representations of typical dam sections were shown in which slope stability analyses were performed (Section 4.5 Analyses Results). It was indicated that the analyses were carried out for the deepest dyke cross-section. Is a typical section shown in Drawing ED-4 (top section) the cross section used in the analysis? What values were used in the analyses for the foundation elevation, key trench width, foundation till thicknesses, and depth to bedrock?
- For the end of construction condition, analyses were carried out without water against the dam, and no coarse tailings (Table 3). Was there an assumption used for the excess pore pressure within the dam's foundation till?
- For the rapid drawdown conditions, what was assumed to be the drop of water level in PKCA? Was the water elevation assumed to drop from its maximum elevation 523 m?

3. Design of Liner System for the Dams

The East and Southeast Dams were designed differently from the proposed Divider Dykes. These dams were intended to retain water and minimize any seepage through the dams and their foundation. The proposed dams will consist of a geomembrane liner system, keyed into the dam's frozen foundation.

In order to achieve the frozen foundation, dam construction will require placement of a key trench, backfilled at temperatures below –15°C. In contrast, the placement of the geomembrane layer is more effective if carried out at warmer temperatures. Welding of the geomembrane requires warmer temperatures, and the membrane is brittle and prone to rip/ break at colder temperatures. However, placement of similar frozen dams in the Arctic has been proven to be successful in the past, such as at Ekati Mine. In addition to the geomembrane installation, the dams at Ekati were built with a secondary liner protection using a Geosynthetic Clay Liner (GCL).

The proposed liner system at Jericho only has the geomembrane liner. The till layer that would be placed on the upstream of the dam is not likely to be considered as a secondary impervious barrier, as the till material is assumed to be granular. Even if the till contains abundant fines, the placement of such fill materials at temperature below zero would not be considered to be effective as an impervious barrier.

It is understood that the East and Southeast Dams will also contain a considerable thickness of tailings materials deposited against the upstream slope of the dam. This will likely help in the long-term in reducing seepage flow through the dam. However, as a second impervious

barrier, consideration should be made for replacing one of the two non-woven geotextile layers with a GCL. See also Comment No. 7 in the following for seepage through the dams.

4. Construction Quality Control

As discussed in Section 8 of the design report, the construction quality control is extremely important to achieve the intended purpose of the dam. The Construction Specifications, which accompany the design report must be implemented under the presence and supervision of experience geotechnical engineers who are familiar with dam construction in the Arctic.

The critical issues that require strict quality control during construction include, but not limited to the followings:

- Foundation preparation and inspection.
- Construction of key trench.
- Installation of thermal monitoring system.
- Construction material's specifications.
- Insurance that the geomembrane liner is properly keyed within the dam's foundation.
- Overlapping and welding requirements for the geomembrane liner.
- Material specifications for the various dam fill materials.
- Placement of fill materials.

5. Dam Monitoring

In addition to the installation of survey monitoring points as discussed in Section 9.3, long term monitoring for the dams should also include routine field surveys to determine ground surface crest elevations along the length of the dams and to determine possible settlement. Surveys can be carried out along the center line as well as along the upstream and downstream shoulders of the dams.

6. Liner Bedding Materials

Section 7.5 indicates that the liner bedding material can consist of 20 mm minus crush material, or 40 mm minus esker material with round particles. Would a 40 mm maximum diameter particle be too large to be placed against the geomembrane liner?

In contrast, Section 3.0.1 of the Material Specifications only indicates the minus 20 mm material to be used for liner bedding. It is understood that a similar 20 mm minus material was used as bedding material for the construction of the dam at Ekati utilizing a geomembrane liner.

7. Seepage Analyses

Very limited information was provided in regards to the seepage analysis through the dam. With the challenging dam construction in arctic environment, consideration should be given for a seepage analysis, assuming that the geomembrane liner is not 100% effective. With the presence of upstream till layer, and tailings materials against the upstream side of the dams, a seepage analysis can provide information as to whether a secondary impervious barrier such as

a GCL layer needs to be used for the East and Southeast Dams. Such analysis may also be useful to differentiate the design requirements between the East/Southeast Dams as presented in this design report, and those of the West Dam, in which no tailings materials will be placed against the dam.

In summary, the Design Report and Specifications for the East and Southeast Dams contains all of the necessary requirements for the dam design prior to their construction. Consideration should be made as to whether a secondary impervious barrier, such as a GCL, is required in addition to the geomembrane layer. A seepage analysis should be included to support such a decision. Secondly, the quality control of dam construction is critical in achieving the intended purpose of the two dams to retain tailings water from entering into the surrounding environment. Consequently, dam construction should be carried out by Contractors, who have construction experience in dam construction in the arctic environment, and with technical support from experienced geotechnical engineers. Should you have any further questions or concerns regarding the above, please do not hesitate to contact me.

Yours very truly,

RAH:sep

R. A. Halim, P.Eng.
Senior Geotechnical Engineer

cc: Mr. J. Murdock, NWB

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