Alexandra Hood
De Beers Group of Companies Inc.
Suite 300, 5120 49th Street
Yellowknife, NT
X1A 1P8

RECOMMENDED INSPECTIONS AND MONITORING FREQUENCY FOR NORTH PILE AND WATER MANAGEMENT POND DURING TIMES OF ZERO OCCUPANCY AT THE SNAP LAKE MINE

Ms. Hood,

De Beers Group of Companies Inc. (De Beers) is planning for zero occupancy during the winter at its Snap Lake Mine between approximately the beginning of September and the beginning of April. As the Engineer of Record, Jeffrey Kwok of Golder Associates Ltd. (Golder) has recommended that the key performance instrumentation at the North Pile and water management pond (WMP) dams is to be monitored as identified in a monitoring response framework (Golder 2018a) as a critical control and response action for physical stability of the structures. A recommended monitoring frequency has also been provided to De Beers in Golder (2018b). To help facilitate meeting the monitoring requirements, De Beers has adopted an automated system for most of the key instrumentation to allow collection and review of the data readings.

In consideration of the zero-occupancy plan, historical instrumentation data and trends, and experience on site, Golder has updated the monitoring response framework and instrumentation and water level monitoring frequencies for the North Pile and WMP dams during extended care and maintenance.

Golder recommends that De Beers do the following:

- Add thermistor 14-VTH-08 and vibrating wire piezometers 14-VW-07 and 14-VW-08 at the East Cell Rib Berm 1 to the existing automated system before demobilizing from the site and prior to zero occupancy on site. Rib Berm 1 is a structural embankment of Cell 2 of the East Cell. The instruments in Rib Berm 1 are important and are to be monitored to evaluate the performance of this structure if water levels rise in Cell 2.

- Carry out monthly visual inspections of the facilities and monitor the perimeter sumps and WMP water levels during the times of zero occupancy. Visual observations can be done on site, remotely, by drone or aerial flyover observations, or near real-time land-satellite imagery.

- Provide documentation of photographs and observations of the North Pile and WMP, and water level observations in the sumps and WMP with respect to their threshold values (e.g., 1/3 of sump operating water level) to De Beers key team members and the Engineer of Record.
- Prepare access to each sump and the WMP during winter conditions that will be required to facilitate on-site inspections. De Beers should plan for snow clearance for inspections carried out in person.

- Continue to prepare the sumps to a practical minimum water or ice level prior to freshet to allow water management during the freshet.

- Set up a contingency plan to allow de-icing or pumping to lower the sump or pond water levels if required based on the inspection or prepare to be on site earlier for snow removal and de-icing from the sump, if required.

- Continue to pump the water level to practical minimum for each perimeter sump and decrease the WMP water level as much as practicable before demobilizing from the site.

- Continue to monitor the instrumentation with respect to the response framework and to the frequency outlined in Golder (2018b).

**Closure**

We trust that this document provided is sufficient for your current needs. Should you have any questions, please contact the undersigned.

**Golder Associates Ltd.**

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**ORIGINAL SIGNED AND SEALED**

Jeffrey Kwok, P.Eng.
Associate, Senior Geotechnical Engineer

JEK/PMB/cr

CC: Michelle Peters, Rhys Privite, De Beers Group of Companies

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**ORIGINAL SIGNED**

Paul M. Bedell, M.E.Sc., P.Eng.
Principal, Senior Geotechnical Engineer

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PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.

Signature ______________________________

Date ______________________________

PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

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GOLDER
References


1.0 INTRODUCTION

This technical memorandum presents the monitoring frequencies for baseline and performance monitoring instrumentation installed at the North Pile facility and water management pond (WMP) dams, as well as the monitoring frequencies for the water levels in the perimeter sumps and WMP during extended care and maintenance of the Snap Lake Mine. The frequency of monitoring is to be reviewed prior to any change in status of the mine.

The North Pile performance monitoring instrumentation consists of a series of prisms, thermistors, standpipe piezometers, and vibrating wire piezometers for monitoring the performance of the North Pile embankments during construction and operation (deposition of processed kimberlite), through extended care and maintenance, and eventually to closure and post-closure. The performance monitoring instrumentation plan is presented in Figure 1.

The North Pile baseline instrumentation consists of thermistors and standpipe piezometers for the monitoring of subsurface ground conditions and the collection of water samples prior to embankment construction and deposition of processed kimberlite. The baseline instrumentation plan is presented in Figure 2.

The WMP baseline and performance monitoring instrumentation for Dam 1 and Dam 2 consists of monitoring prisms, thermistors, standpipe piezometers, and vibrating wire piezometers for monitoring the performance of the WMP dams during operation (storage of water), through extended care and maintenance, and eventually to closure and post-closure. The WMP instrumentation plan is presented in Figure 3.

Perimeter sumps are being used to manage seepage and surface water runoff from the North Pile. The perimeter sumps consist of Sumps SP1, SP2, SP3, SP4, and SP5. The water levels in these sumps and the WMP need to be monitored during extended care and maintenance and maintain at a practical minimum when the sumps are free of snow and ice cover.
2.0 INSTRUMENTATION MONITORING FREQUENCIES

2.1 North Pile Performance Monitoring Instrumentation

The recommended minimum frequency for monitoring the North Pile performance monitoring instrumentation is monthly for the thermistors and vibrating wire piezometers listed in Table 1, including selected baseline instrumentation relevant to the overall performance monitoring.

Survey prisms along the downstream slopes of the North Pile are to be monitored quarterly during snow-free conditions for safety concerns, and no movement is expected during winter conditions. Standpipe piezometers are also to be monitored quarterly during snow-free conditions. It is expected that the survey prisms and standpipe piezometers will be monitored around the time of the freshet and just prior to winter freeze-up.

<p>| Table 1: North Pile East Cell and Starter Cell Performance Monitoring Instrumentation and Frequency |
|--------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|</p>
<table>
<thead>
<tr>
<th><strong>Cell Area</strong></th>
<th><strong>Area</strong></th>
<th><strong>Thermistors (monthly)</strong></th>
<th><strong>Vibrating Wire Piezometers (monthly)</strong></th>
<th><strong>Standpipe Piezometers (quarterly)</strong>&lt;sup&gt;(a)&lt;/sup&gt;</th>
<th><strong>Survey Prisms (quarterly)</strong>&lt;sup&gt;(a)&lt;/sup&gt;</th>
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<td>Rib Berm 1</td>
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<td>14-VW-07</td>
<td>14-SP-10</td>
<td>P23 to P25</td>
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<td>Cell 2</td>
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<td>14-VW-05</td>
<td>14-SP-10</td>
<td>P32 to P34</td>
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<td>14-VW-06A</td>
<td>14-SP-11</td>
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<td>14-VW-06B</td>
<td>SP08-10&lt;sup&gt;(b) (c)&lt;/sup&gt;</td>
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<tr>
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<td></td>
<td>TH08-14&lt;sup&gt;(b)&lt;/sup&gt;</td>
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<td>Cell 3</td>
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<td>P35 to P37</td>
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<td>14-SP-08</td>
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<td>Starter Cell</td>
<td>west, south, and east perimeter embankments</td>
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<td>n/a</td>
<td>n/a</td>
<td>P1 to P22</td>
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</tbody>
</table>

(a) Quarterly readings during snow-free conditions.
(b) Selected baseline instrumentation is included that is relevant to the overall performance monitoring of the North Pile.
(c) Standpipe piezometers frozen year round are to be checked for changes from existing conditions.

n/a = not applicable.
2.2 North Pile Baseline Instrumentation

The recommended minimum frequency for monitoring the North Pile baseline instrumentation (with the exception of that indicated as performance monitoring in Table 1) during extended care and maintenance is quarterly as a repeatable trend has been established. Any deviation in trend will require a review of the data by both De Beers Group of Companies Inc. and Golder Associates Ltd. to assess need to modify monitoring frequency.

2.3 Water Management Pond Baseline and Performance Monitoring Instrumentation

The recommended minimum frequency for monitoring the WMP dam performance during extended care and maintenance is quarterly for the instrumentation listed in Table 2. The frequency is to be increased to weekly or fortnightly at the time of freshet.

Table 2: Water Management Pond Dams Instrumentation and Monitoring Frequency

<table>
<thead>
<tr>
<th>WMP Dams</th>
<th>Thermistors (quarterly)</th>
<th>Vibrating Wire Piezometers (quarterly)</th>
<th>Standpipe Piezometers (quarterly) (a)</th>
<th>Survey Prisms (quarterly) (a)</th>
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<td>BH00-10</td>
<td>VWP06-01</td>
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<td>BH-2</td>
<td>VWP06-02</td>
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<td>VWP06-04</td>
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<td>Dam 2</td>
<td>BH-00-16</td>
<td>n/a</td>
<td>SP13-01 (b)</td>
<td>n/a</td>
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</tbody>
</table>

(a) Quarterly readings during snow-free conditions.
(b) Instrument SP13-01 was damaged during snow clearing. Remaining PVC pipe is to be trimmed and resurveyed for future use.

WMP = water management pond; n/a = not applicable.

2.4 Site Specific Weather Station monitoring

The relevant site specific weather data (ex. temperature, snowfall, precipitation etc.) is to be collected at the same time as the North Pile and WMP instrumentation readings.

3.0 WATER LEVEL MONITORING FREQUENCIES

The recommended minimum frequency for monitoring the water (ice) levels at the perimeter sumps (SP1 to SP5) and the WMP during extended care and maintenance is monthly, and is to be increased to weekly or fortnightly at the time of freshet.

During winter conditions, a visual observation method may be adopted to monitor the ice/water levels in the sumps and WMP. This can include observations with respect to a staff gauge installed in the sumps or WMP to monitor the ice/water levels rather than a survey method.
4.0 CLOSING

The reader is referred to the Study Limitations, which follows the text and forms an integral part of this memorandum.

We trust that this document provided is sufficient for your current needs. Should you have any questions, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Geotechnical Engineer

Reviewed by:

ORIGINAL SIGNED AND SEALED

Jeffrey Kwok, P.Eng.
Associate, Senior Geotechnical Engineer

AL/JFC/JEK/PMB/cr

Attachments: Study Limitations
Figures 1 to 3

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.

Signature

Date

PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

Golder Associates
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INSTRUMENTS INCORPORATED INTO THE AUTOMATED SYSTEM ARE
INSTRUMENTATION PLAN
DRAWING TITLE: "SNAP
BEERS, FILE: Thermistor
AS-BUILT SURVEY DATA PROVIDED BY DE BEERS.
AS-BUILT LOCATIONS
VIBRATING WIRE PIEZOMETER
PREPARED
MONITORING PRISM (P) MON 4
MONITORING PRISM (P) MON 7
INSTRUMENT DAMAGED OR DESTROYED
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS
COORDINATES NOTED
AS-BUILT SURVEY DATA PROVIDED BY DE BEERS.
BASELINE INSTRUMENTATION SELECTED FOR PERFORMANCE
MONITORING LOCATIONS 1 & 2, DIVIDER DYE 1 & 2, POWERPOLE 1 & 2,
POWERPOLE 3, DIVIDER DYE 3, POWERPOLE 4, DIVIDER DYE 4,
POWERPOLE 5, DIVIDER DYE 5, POWERPOLE 6, DIVIDER DYE 6,
POWERPOLE 7, DIVIDER DYE 7, POWERPOLE 8, DIVIDER DYE 8.
INSTRUMENTATION INCORPORATED INTO THE AUTOMATED SYSTEM ARE
HORIZONTAL THERMISTOR (OPERATIONS) VERTICAL THERMISTOR (OPERATIONS)
STANDPIPE PIEZOMETER (OPERATIONS) VIBRATING WIRE PIEZOMETER (OPERATIONS)
INSTRUMENTATION INCORPORATED INTO THE AUTOMATED SYSTEM

NOTES:
1. HORIZONTAL THERMISTOR DATA PROVIDED BY DE BEERS, P.E. Thermistor
   Notes 2017.
2. 2013 BOROUGHE AND DPT MONITORING SYSTEM AS PICTURED ON DRAWING TITLE "SNAP
   LINK W/ NODE 4 BOREHOLE AND THERMISTOR LAYOUT" DIM NOT.
3. AS-BUILT SURVEY DATA PROVIDED BY DE BEERS.
**INSTRUMENT DAMAGED OR DESTROYED**

1. TH06-01** (DESTROYED) BH00-13** (DESTROYED)

2. OTHERWISE NOTED.

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<th>DESIGN No.</th>
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<th>CHECK</th>
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<td>GOLDER</td>
<td>RM</td>
<td>BT</td>
<td>JFC</td>
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**LEGEND**

- VERTICAL THERMISTOR (BASELINE)
- STANDPIPE PIEZOMETER (BASELINE)
- INSTRUMENTATION INCORPORATED INTO THEAUTOMATED SYSTEM
- NOTES:
  1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
  2. AS-BUILT SURVEY DATA PROVIDED BY DE BEERS.
  3. SEPTEMBER 2016 STATMAP SHOWN.
  4. READ OUT BOX LOCATION TO BE UPATED AND INCLUDED BY DE BEERS.

**VERTICAL THERMISTOR LOCATIONS**

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**STANDPIPE PIEZOMETER LOCATIONS**

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**INSTRUMENTATION DAMAGED OR DESTROYED**

1. TH06-02** (DAMAGED)

2. OTHERWISE NOTED.
NOTES:
1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. AS-BUILT SURVEY DATA PROVIDED BY DE BEERS.
3. SEPTEMBER 2016 STATMAP SHOWN.
4. READ OUT BOX LOCATION TO BE UPDATED AND INCLUDED BY DE BEERS.