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TECHNICAL MEMORANDUM

Date: June 22, 2020

Subject: SJCI Comments on Golder's Waste Rock "Dome" Design Technical Memorandum for Lupin Mines Inc. as Requested by Nunavut Water Board in Part E, Item 25 of Lupin Mine Water Licence 2AM-LUP2032

Introduction

SJCI has undertaken a review of the Golder Technical Memorandum (GTM) at the request of the Kitikmeot Inuit Association (KIA), a stakeholder in the current Lupin closure review process. SJCI has been retained by the KIA to assist in the review of several documents recently prepared for Lupin Mines Incorporated (LMI) as had been requested by the Nunavut Water Board (NWB) in a new Water Licence for the Lupin site, 2AM-LUP 2032. Mr. Januszewski, Principal Engineer at SJCI undertook this review. Mr. Januszewski is an Environmental Engineer with a degree in Mineral Processing Engineering and significant experience in mine environmental issues and mine closures. He is not a geo-technical or geo-chemical engineer nor has he had advanced training in these areas and therefore this review is of a more general high-level nature.

Part E, Item 25 of the new Water Licence requested;

"…a Technical Memorandum that provides design details on the Waste Rock Dome, including, but not limited to the following:

a. Cardinal direction cross sections and slopes;
b. Details on drainage systems and conceptual water features; and
c. Erosion control measures and cover stabilization of the dome."

The Water Licence received ministerial approval on April 9, 2020 and the requirement for the supporting technical memorandum was to be received by the NWB within 60 days. The resultant Golder Technical Memorandum was dated June 8, 2020.

The NWB issued out an invitation to stakeholders to make comments on the GTM by e-mail on June 10, 2020. Comments were to be submitted by June 24, 2020.

Background

The Lupin minesite has a considerable amount of potentially acid generating and/or metal leaching waste rock distributed throughout the site. The ESA site assessments have estimated the total volume of waste rock on surface at 1,000,000 m3 (Ref: FCRP 2018, URS 2005).

The Final Closure and Reclamation Plan's goal is to dispose of this material in a number of locations including underground, in shafts, open stopes, in the crown pillars, a landfill and in a central waste storage area on surface. There is too much waste rock on surface to dispose of it all deep underground or locations that are just below or at grade where permafrost would be expected to make the masses inert and less likely to absorb any surface water that falls or flows onto them and then potentially generates metal leaching runoff waters to surface. As a result of this overall lack of secure storage capacity, a central waste storage area on surface or a waste rock "dome" as the NWB has called it, is required. The FCRP refers to there being a number of waste storage areas in the central area of the site. All the final repositories of waste rock are to be covered with a 1 m thick esker material layer.

Reference Documents

The following documents were also utilized in the preparation of this Technical Memorandum:

- Lupin Mine Site Final Closure and Reclamation Plan, Golder July 2018; and
- Water Licence 2AM-LUP2032, April 2020

Summary Comments

The Golder Technical Memorandum (June 8, 2020) addresses the conditions stated in Part E, Item 25 in the new Water Licence.

However, use of a 1.0m thick esker material cover over all the waste rock storage facilities (landfill, open crown pillars, shafts, waste rock dome, etc.) may be optimistic to ensure ML/ARD does not occur. This is based on the proposed cover not being saturated, without a compaction specification and that it will likely not remain frozen throughout the year for this facility as it will be impounding waste rock stacked above the surrounding ground level. The best means of avoiding any issues with the currently proposed placement plans is to bury the highest potential ML/ARD material as deep as possible and have the lowest potential risk material nearest the top (i.e., above grade) or near the outside perimeter of the stacked facility. This will require a good understanding and inventory of the quality of the waste rock across the site and their individual ML/ARD potentials. The alternatives of using a more complex cover or a thicker esker material cover would be more difficult.

Specific Comments

The shape and size of the Waste Rock Dome looks significantly different in the drawing provided in the FCRP (Figure 10) versus what is shown in the Golder Technical Memo (Dwg. 1).

The FCRP (Table 17) states there is some 965,000 m3 of waste rock to be disposed on if the central area, whereas the Golder technical memo states on drawing 1, Note 7 that the Waste Rock Dome has a capacity of 290,000 m3. Possibly the difference lies in the material below the new dome being waste rock and amounting to the difference in the 2 volumes above?

As stated in Golder's 2019 HHERA report, relocation of a portion of the waste rock into the central area, grading it to drain freely and covering it with 1.0 m of esker material requires additional measures for potential ARD (SJ insert: or ML) impacted seepage from these areas that may be seen with reductions of pH in the water in Boot Lake and East Lake. Water quality monitoring of these streams was recommended to confirm the conclusion of negligible/low risks to aquatic life from metals.

Boot Lake appears to be the first waterbody north-west and downslope of the main mine mill pad. The author could not find the location of East Lake in the FCRP or Water Licence. Water quality sampling stations (LUP-EL-01 and LUP-BL-01) are listed as being located on the waters of both lakes close to the shorelines near where the potential seepages would input to the lakes.

The Water Licence does not include a map showing all the stipulated water quality monitoring site locations. Fortunately, the FCRP includes 2 figures (Nos. 8 & 12) that show the locations of all the monitoring program stations for the 1) current site and 2) for the new current site and post-closure site, as applicable.

The Water License includes Sample site(s) LUP-SP-01 to SP-XX to be twice yearly samples of seepage from the Waste Rock Dome, and to include all the seepage locations from it. This is supported by monthly sampling sites being added that are nearer the possible new sources of ML/ARD seepage; those being downslope and at the monitoring wells of the landfill and new demolition landfill facilities.

It appears as though the Water Licence has a typo in it, in that it has sampling site LUP-31 and LUP-35 both being "Seepage from the Landfill Facility" and described the same, whereas it is intended that LUP-35 should likelyy be for "Seepage from the Demolition Landfill Facility". FCRP Figure 12 shows the majority of the sample site locations for the Post-Closure site but unfortunately does not include the upper end of the Upper Sewage Lake where the new Demolition Landfill is to be located, and therefore no sampling locations in and around that facility are shown.

It is suggested the annual reporting of the analytical results from these monitoring locations include a professional geochemical interpretation of the data to confirm whether ML/ARD is of concern and how water qualities are trending.

Notes on the 2 drawings provided in the Golder Technical Memorandum include:

Drawing. 1 – Proposed Waste Rock Dome:

It is not apparent how surface water falling on the top of the new facility is to find its way to the perimeter drainage chutes. The top surface doesn't look to be graded towards the 6 perimeter drains shown. It is understood the goal of the cover is to repel water ingress rather than oxygen, and thus

water should be encouraged to not pool on the top but rather to flow reasonably quickly across the surface to the chutes and then down them; and

The proposed locations of the 6 drainage chutes don't all appear to be discharging into natural draws (or low areas) where the water can then easily flow away from the facility.

Drawing 2 – Proposed Waste Rock Dome Sections and Details:

The design basis for the sizing of the Drainage Chutes and Stilling Basins is not provided. What kind of water flows are expected?

Note 3: Is the D50 min. sizing at 190mm and max. sizing of 350mm mean that half the material must have no material smaller than 190mm is size and no more than half the material is to have a maximum size of 350mm? If so, and with the erosion layer on the top of the chutes being 350mm in thickness, will some of the rock within it be bigger than the chute is in thickness; and

The Drainage Chute Typical Profile drawing shows the location of a Stilling Basin, although there is no apparent depression shown for this feature in the drawing. What are its proposed dimensions?

Uncertainties

During the writing of this memorandum, the following uncertainties with the proposed closure plan were noted and considered important to mention in this Technical Memorandum:

- A better estimate of the total volume of waste rock requiring remediation is required (using 1M m3 without a detailed rationale seems over-simplistic);
- A detailed assessment of the quantities of the various levels of ML/ARD potential (i.e., low, medium, high) of all the waste rock is required; thus enabling a more diligent placement plan for the materials to minimize the risk for future ML/ARD concern;
- LMI should provide an estimate of the total volume of esker material required for the various reclamation tasks that are intended to use this material;
- LMI should confirm the availability of adequate volumes of esker material, and it being available in a timely manner when it is required (i.e., due to its permafrost state it can only be excavated in thin layers. Ref. FRCP Sec 2.3.2);
- Why does the FCRP document, prepared by Golder Associates, not include the name and signatures of the author and its reviewer, as is customary; and
- Why does the RECLAIM costing show all the liabilities as being related to Water and none to the Land (ref: FRCP App. G)?

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