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ECCC File: 6100 000 009/008
NWB File: 2AM-LUP1520

April 29, 2019

Via email at: licensing@nwb-oen.ca

Stephanie Autut
Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Stephanie Autut:

RE: 2AM-LUP1520 – Lupin Mines Incorporated –Lupin Mine Project– Water Type A Licence Amendment and Renewal

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Nunavut Water Board (NWB) by Lupin Mines Inc. (the Proponent) regarding the Type A Water Licence Amendment and Renewal for the Lupin Mine (the Project) and is providing specialist advice to the Board for consideration. ECCC's specialist advice is provided based on our mandate, in the context of the *Canadian Environmental Protection Act*, the pollution prevention provisions of the *Fisheries Act*, the *Migratory Birds Convention Act,* and the *Species at Risk Act*.

ECCC respectfully requests that the Nunavut Water Board consider that the technical meeting/Pre-hearing conference, tentatively scheduled from June 5 to 6, be held via teleconference rather than in person.

Based on review of the documents provided, ECCC has the following comments:

1. Climate change modeling

Reference(s)

- Lupin Mine Site – Final Closure and Reclamation Plan; Section 2.1.2, p. 2-3

Comment

The Proponent states that "*Because of climate change, predictions are that the mean annual temperature will increase about 4 to 5 ºC over the next century*." However, the source and rationale for use of these projected changes is not provided. A citation is not provided to the source of the projections and it is not specified what climate model(s) these projections are derived from and if they are for a low, medium or high future forcing scenario. Climate projections from multiple climate models for a range of plausible future emission scenarios (low to high future forcing) are required to reflect uncertainty in future climate projections and ensure that the range of potential future climate change is considered. These projections should be used to assess the full range of potential impacts of the environment on the Project and Project on the environment.

ECCC Recommendation(s)

ECCC recommends that the Proponent provide further information on the source, rationale and details of the climate change information provided in the Final Closure and Reclamation Plan. Additionally, ECCC recommends that the Proponent provide relevant climate projections for the region to end of century from a range of emission scenarios (low to high future forcing) from multiple climate models to reflect uncertainty in future climate projections.

2. Tailings Closure Approach and Monitoring

Reference(s)

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section 4.3.2.8 Tailings Impoundment and Containment Systems; Section 6.1 Post Remediation Site Conditions
- Closure Plan for Tailings Containment Area, January 2005. I. Holubec Consulting Inc. Section 8.

Comment

The Tailings Containment Area (TCA) consists of cells that contain tailings solids and/or mine contact water. To date, approximately 1.2M m^2 of exposed tailings have been covered with 1 m of granular esker material; in 2019, the Proponent proposes to cover the remaining 209,500 m^2 of exposed tailings with 1 m of esker material. The proposed closure approach is expected to prevent the development of acidic rock drainage from the tailings (which are potentially acid generating) by encapsulation beneath a partially saturated granular cover as outlined in the approved TCA closure plan (Holubec 2005).

The Final Closure and Reclamation Plan (FCRP) for the Lupin mine notes that the base of the esker material is to be saturated with water, which will inhibit oxidation of the underlying tailings by acting as a barrier for oxygen. The surface layer of esker material is to restrict the rate of evaporation of water from the saturated esker and tailings materials. The closure design does not rely on permafrost encapsulation of the tailings.

Monitoring of the cover performance was done up until 2004, and is reported in the Holubec (2005) report. It does not appear that subsequent further cover monitoring was conducted.

ECCC supports the Closure Phase proposed geotechnical monitoring and instrumentation, as outlined in the FCRP. However, ECCC notes that the proposed monitoring does not include evaluation of the physical stability of the individual layers. In 2004, test pits were excavated to evaluate cover performance, including cryoturbation. At that time, the tailings were performing as expected and were not observed to be penetrating into the esker material, and minor oxidation of the tailings was observed in two of seven test pits. However, ECCC is of the view that revisiting the cover performance would provide more recent information on physical and chemical conditions, and whether the design performance is effective over the long term, i.e. that frost boils are not likely to develop, and that the saturated layer is effective in preventing tailings oxidation.

ECCC is also concerned whether a 1 m cover depth will be sufficient to ensure physical and geochemical stability in perpetuity, and that proposed monitoring in the Post-Closure Phase will not pick up any changes below the surface (as only visual inspections are proposed). Conducting an evaluation and review of the tailings areas that have been covered the longest would provide a supporting indication of performance of the proposed 1 m esker cover and saturated cover design.

ECCC Recommendation(s)

ECCC recommends that the Proponent conduct field investigations during the Closure Phase to obtain updated data on the behaviour and effectiveness of the tailings saturated cover design.

3. Perimeter Dams

Reference(s)

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section
- Closure Plan for Tailings Containment Area, January 2005. I. Holubec Consulting Inc. Sections 5.0 and 7.0.

Comment

Currently, TCA includes eight perimeter dams, which were designed as water-retaining structures and which incorporate permafrost into the design through having frozen cores in the dams (Section 2.3.4 FCRP). Groundwater seepage is not expected under permafrost conditions, and the Proponent proposes to conduct a one-time survey of the frozen cores of the dams using lateral cross sections to confirm the depths to which the dams are frozen (Section 4.3.2.8 FCRP). The survey should identify the current extent of permafrost within the dams.

With respect to the closure of the perimeter dams, it is not clear whether the Proponent has fully evaluated the potential for impacts that could arise from changes to the exposure of the structures and with the lowering of the water levels, along with climate change effects (e.g. seepage or instability). Additionally, details are lacking on how the proposed survey of the frozen cores will inform closure plans for the dams.

ECCC Recommendation(s)

ECCC recommends that the Proponent provide a discussion on the stability and potential for seepage for perimeter dams given the likelihood of the frozen cores thawing due to climate change. ECCC recommends that in their discussion the Proponent consider potential changes to the physical configuration of the dams in the future as a result of climate change.

ECCC also recommends that a report of the survey of the frozen cores of the dams be provided to the Board, and that it include discussion of any implications for closure.

4. Duration of Permanent Monitoring and Timing Clarification

Reference(s)

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section 4.3.2.8 Tailings Impoundment and Containment Systems; Section 5.0 Monitoring Tables 18 and 20
- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates. Appendix G Reclaim Model
- Interim Closure and Reclamation Plan Oct. 2017, Section 7 Closure Monitoring Plan

Comment

The Active Closure Period (Closure Phase) is the 2.5 year period during which active on-site reclamation work is to be completed. Tables and text in the FCRP refer to preparatory work being completed in 2018 and the Active Closure Period starting in 2019 and going until 2021.

The Passive Closure Period (Post-Closure Phase) runs for five years following the completion of active reclamation work. Section 5.0 states that environmental monitoring will be conducted during site visits/inspections to determine the success of the reclamation measures and to confirm that the objectives have been achieved. If monitoring results indicate chemical and physical stability, the Proponent proposes gradually decreasing the frequency of site inspections and/or monitoring.

Table 18 of the FCRP outlines the proposed water quality monitoring for the various stations, and what will be monitored in each phase. ECCC notes that 2019 is the last year proposed for most of the monitoring stations to have water quality sampling done (several of the terrestrial source stations state "Only if still active"). However, Section 4.3.2.1.3 of the FCRP states that, with respect to the release of water in the TCA, "Current water quality monitoring in the TCA will continue and the data will be analyzed to establish that treatment will no longer be required in the future. Only then will the two spillways be constructed."

The October 2017 Interim Closure and Reclamation Plan (ICRP) states that "…The post-closure monitoring will provide the means of assessing when the stated goal of the reclamation measures has been reached…This closure phase of monitoring is anticipated to last for 10 years after site closure and reclamation and every three years after that to the 25 year mark." and that "water quality of effluent discharge and surrounding lakes will be monitored over the reclamation and post-closure periods". The frequency proposed in the ICRP is as follows: "post-closure monitoring activities are separated into two phases; Phase 1 – Annual Monitoring (years 1 through 10) and Phase 2 – Decreasing Frequency with monitoring during years 12, 15, 21 and 24 for a total of 14 years of monitoring over a 25 year period." ECCC notes that this is inconsistent with the timeline shown on Table 18 of the Final Closure Plan, which shows proposed monitoring only up to 2025, and does not provide details of identifying what would trigger reduced monitoring.

With respect to the tailings cover monitoring, Table 20 outlines existing and future instrumentation monitoring for the TCA, which will occur monthly during the Closure Phase, and concurrent with site inspections during the Post-Closure Phase. While Table 20 does not include the sample parameters included with the instrumentation monitoring, Section 4.3.2.8 states that during the Closure Phase the Proponent will continue to monitor the tailings cover performance, with the installation of new thermistors, soil moisture and temperature probes in 2018, and active closure monitoring for 2.5 years. The FCRP states that "Soil moisture sensors will be installed in the tailings cover to provide additional monitoring of the saturation level and groundwater quality above the permafrost within the cover. The sensors will measure volumetric water content, ground temperature, pH, and electrical conductivity. Multiple sensors will be installed in a string at different depths and will be paired with data loggers for daily measurement collection. Porewater samples will be collected during initial installation to correlate key water quality parameters with the collected data. The sensor will allow the determination of the depth of the saturation zone and the porewater water quality…"

ECCC notes that no monitoring is specified for the Post-Closure period, other than visual inspections. Monitoring cover saturation characteristics and quality only to the end of 2020 will not provide sufficient information on conditions in the Post-Closure phase, especially for the recently covered tailings areas. Ongoing physical and chemical monitoring of the cover conditions and performance should continue until there is confidence in long-term stability and quality of the saturated tailings.

The RECLAIM estimate includes annual monitoring for water quality for a ten-year period, which does not match the ICRP or the FCRP.

ECCC Recommendations

ECCC recommends that the Proponent provide clarification of the Post-Closure Phase monitoring activities and duration, and that the Proponent identify the thresholds for water quality and tailings cover performance that would trigger moving to reduced monitoring frequency or intensity.

ECCC recommends that monitoring of the TCA cover and water be done over a period that is sufficient to demonstrate physical and chemical stability and acceptable quality for the long term.

5. One Meter Esker Material Cover

Reference(s)

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section 3.2.1 Tailings Containment Area

Comment

The Proponent states that "In accordance with the approved TCA 2004 Final Abandonment and Restoration Plan (Final TCA ARP) (Kinross 2005), as of the end of the 2017 construction season, a 1 m esker material cover had been placed over approximately 1,311,500 m^2 of the exposed tailings. As of the end of 2017, there remained approximately 123,500 m^2 of exposed tailings in Cell 5 and 86,000 m^2 in Cell 3.". The Proponent intends to complete the placement of the cover by the end of the summer of 2019 as part of the approved Care and Maintenance activities.

The Proponent further stated that the thermistor readings generally indicated that permafrost has re-established within the tailings cells and the thermistors located within Cell 1 indicated that the maximum annual depth of thaw was between 1.5 and 2 m.

ECCC noted that the proposed 1 m esker cover for the tailings is less than the observed thaw depth of between 1.5 and 2 m. This implies that about 0.5 m of the tailings top section will not remain frozen during thaw because the thaw depth (active layer) is deeper than the thickness of the proposed cover depth. The Proponent has proposed to use a closure design that does not rely on permafrost encapsulation. However, this design relies on maintenance of a saturated zone, which extends above the tailings surface. If the saturated zone is not present, Acid Rock Drainage/Metal Leaching (ARD/ML) will be expected to occur in that part of the tailings which is in the active layer.

Another reason for a cap or cover of the tailings area is to reduce, if not prevent water from infiltrating into the tailings and thereby, reduce or prevent water from reaching sulphides in the tailings and or the waste rock that will oxidize to form ARD. However, the stated physical property of the esker material during a test indicates that the esker

material is pervious to water. While this may be favorable for maintaining the saturated zone, should there be intermittent saturation as a result of exposure to air alternating with water in the tailings such conditions would likely result in ARD/ML. It is not clear whether the Proponent has evaluated the use of other types of cover for the tailings including impervious covers.

ECCC Recommendation

ECCC recommends that the Proponent demonstrate how the 1 m cover will be adequate to prevent ARD/ML activities within the tailings after they have been covered and post closure (i.e. in perpetuity) under expected climate conditions. ECCC also recommends that the Proponent provide a discussion of risks/uncertainty associated with the use of a permeable cover for the tailings materials, and what consideration has been given to physical isolation of the tailings with an impermeable cover

6. Waste Rock, Tailings and Acid Rock Drainage/Metal Leaching

Reference(s)

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section 4.3.2.1 Acid Rock Drainage and Metal Leaching; Section 4.3.2.3 Contaminated Soils; 4.3.2.7 Waste Rock
- URS (URS Corporation). 2005. ARD/ML Assessment of Waste Rock at Lupin Mine; February 2005.

Comment

The Proponent stated that the results of the recent ARD/ML investigation (Golder 2017a), indicated that approximately 67% of the waste rock can be classified as potentially acid generating (PAG). The PAG samples were not found to be concentrated in one particular area; rather PAG samples were distributed throughout the waste rock deposits around the site.

In addition, approximately 1,000,000 m^3 of waste rock was historically placed on surface at the site for the development of roadways, laydown yards, and building foundations (URS 2005). Historical analysis of waste rock identified elevated arsenic concentrations (i.e., median concentration of 1,140 mg/kg) exceeding the applicable criteria (Morrow 2006). The deposition/blending of this arsenic rich waste rock with surficial soils has resulted in shallow arsenic impairment (i.e. arsenic impacted material) across the developed portions of the site. Historical analysis has also confirmed that arsenic concentrations are naturally elevated at the site. Recent investigations have identified approximately 418,000 m^3 of arsenic impacted material exceeding the background concentration at developed portions of the site (Golder 2017a). A sub-set of this volume (approximately 16,300 m^3) has been classified as heavily arsenic impacted (i.e., arsenic concentrations greater than 4,000 mg/kg). This heavily arsenic impacted shallow (i.e., less than 2.0 m thick) material is a result of placement of waste rock on mine site pad

and potentially the unintentional distribution of crushed ore on site as part of road construction.

ECCC acknowledges the update to the Phase I and Phase II ESA at the Lupin Mine that was carried out by Golder in 2017 (Golder 2017a) that showed evidence of ARD/ML that has been occurring after decades of waste rock exposure.

The Proponent states that: “Given the advanced state of oxidation of the waste rock, the main objective of the reclamation should be to limit the contact between the waste rock and surface runoff (as opposed to limiting oxygen flux to the waste rock).” To this end, the Proponent proposes to either dispose of waste rock in the mine workings, relocate waste rock to the landfill and cover it with 1.0 m of esker material, or leave it in place and contour with 1.0 m of esker material. The heavily arsenic impacted waste rock will be moved underground. The Proponent acknowledges that there will be some infiltration through the cover to the waste rock for the materials that are left on surface.

ECCC Recommendations

ECCC recommends that the Proponent provide a rationale for the cover depth selected, and discuss options for installing a thicker cover layer that could isolate the waste rock from the active layer and effectively prevent further metal leaching from the waste rock.

ECCC also recommends that the Proponent identify monitoring to be done in the Closure and Post Closure Phases that will identify the extent and pathways of any residual ARD/ML from the waste rock.

ECCC recommends the Proponent discuss further options for mitigation measures, such as consolidation of ARD/ML materials and capping, or surface water management and treatment, to prevent ARD/ML in passive runoff, seepage or other forms of drainage going into water bodies frequented by fish.

7. Asbestos Disposal

Reference

- Lupin Mine Site Final Closure and Reclamation Plan, July 2018. Golder Associates Section 2.1.7 Environmental Site Assessment; Table 14; Section 4.3.2.9 Buildings and Equipment; 4.3.2.11 Landfills and Other Waste Disposal Areas
- Lupin Mine Site, Nunavut, Canada Waste Management Plan (Solid and Hazardous) (Care and Maintenance) March 2016

Comment

The Environmental Site Assessment identified asbestos-containing materials (ACM) that would be associated with demolition of the mine buildings. Table 14 of the FCRP states that there will be removal of asbestos-containing materials with disposal in landfill(s).

Section 4.3.2.9 of the FCRP states that: "ACM will be removed by a HazMat crew before general demolition proceeds and it will be buried safety in the landfill. Disposal of waste asbestos is specifically permitted under the Waste Management Plan (LMI, 2016)."

The 2016 Lupin Waste Management Plan states that:

"Asbestos that has been immersed or fixed in a natural or artificial binder or included in a manufactured product is not considered waste asbestos, it is considered a hazardous waste (and will be disposed of accordingly). Either waste asbestos can be backhauled off-site for disposal in an approved facility or it can be landfilled. The following are guidelines for landfilling waste asbestos:

- Immediately buried and covered with 0.5 m of cover material
- Buried where it will not be disturbed
- The location should be maintained on a map or diagram for future reference

The complete Environmental Guideline for Waste Asbestos is included in Appendix B."

However, ECCC noted that Appendix B contains the Nunavut Guideline for the Burning and Incineration of Solid Waste (2012) which contains no details on asbestos disposal.

The FCRP states that closure of the landfills will incorporate a layer of waste rock capped with 1 m of esker material (as some of the waste rock could be potentially acid generating). The waste rock will be graded to promote positive drainage of surface runoff, to prevent water ponding on the surface, to provide erosion control around the perimeter, and to prevent future human or animal contact with the covered wastes. However, the FCRP does not provide details of the bagging or containers for the ACM.

Hazardous materials should be encapsulated to ensure that they will not be subsequently exposed through erosion or animal activity, or generate leachate through seepage and runoff. However, it is not clear from the details provided in the FCRP that this will be achieved.

For comparison to the proposed FCRP, ECCC refers the Proponent to Table 6-3 in the Solid Waste Management for Northern and Remote Communities ECCC document (http://publications.gc.ca/collections/collection_2017/eccc/En14-263-2016-eng.pdf). The document recommends that if asbestos waste is disposed of in a (municipal) landfill the following three conditions should be met:

1. The MSW facility has permission from regulatory authorities to dispose of asbestos waste;
2. Asbestos waste arrives at the MSW facility either double-bagged in polyethylene bags of at least 0.15 mm (6 mil) thickness or single-bagged and sealed in a puncture-proof container, such as a plastic or metal drum; and
3. Bags and containers are labeled as containing asbestos waste.

Asbestos waste should then be immediately disposed of in a dedicated area of the landfill cell where it will not be disturbed and covered with at least 50 cm of cover material. The location of the asbestos waste should be well signed, marked with a GPS unit and recorded on a site map of the MSW facility for future reference.

Upon closure of the MSW facility, the final cover over the asbestos waste should be at least 1.25 m thick, and permanent signage should be installed to indicate the presence of asbestos waste.

While these guidelines apply to municipal facilities, they may also be useful for the disposal of asbestos at the Lupin Mine. An alternative method could be disposal of the wrapped/containerized materials underground.

Recommendations:

ECCC recommends that the Proponent consider disposal of the asbestos containing materials underground, or provide a rationale why this is not feasible.

If ACM is to be disposed of in one of the landfills, ECCC recommends that the Proponent identify how the above-mentioned guidelines can be incorporated into the disposal plan, and that LMI provide details regarding how the ACM will be packaged, and the proposed final cover depth.

Should you require further information, please do not hesitate to contact Eva Walker at (867) 669-4744 or Eva.Walker@canada.ca.

Sincerely,

A. McLandress

Andrea McLandress, Regional Director, Prairie Northern Region

cc: Georgina Williston, Head, Environmental Assessment North (NT and NU)
ECCC Review Team