Water Resources Division
Resource Management Directorate
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Your file - Votre référence
2AM-LUP2032
Our file - Notre référence
GCdocs # 96486543

July 28, 2021

Mr. Richard Dwyer
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0
sent via e-mail: licensing@nwb-oen.ca

Re: Crown-Indigenous Relations and Northern Affairs Canada's Reply to LMI Response on Dome Design and Comments on the Dome Design Issued for Construction Drawings for water licence No. 2AM-LUP2032 – Lupin Mine Project

Dear Mr. Dwyer,

Thank you for your June 28, 2021 invitation for comments on the Lupin Mines Incorporated's (LMI) June 25, 2021 Dome Design Issued for Construction Drawings.

Part 1 of this letter addresses LMI's responses on Crown-Indigenous Relations and Northern Affairs Canada's (CIRNAC) comments on the Part E, Condition 25 Dome Design and Part 2 provides CIRNAC's comments on the Dome Design Issued for construction drawings 19136158-0002-CM-0001_Rev 1 Proposed Waste Rock Dome (Dwg1), Drawing 19136158-0002-CM-0002 Rev 1 Proposed Waste Rock Dome Sections and Details (Dwg2) and Drawing 19136158-0005-CM-0001 Rev D titled Proposed Waste Rock Removal and Placement (Dwg3).

A technical meeting was held on July 22, 2021, with CIRNAC, LMI, Arcadis Canada Inc., Golder Associates Ltd., Stantec Consulting Ltd. and Nunavut Water Board (NWB) to discuss and resolve outstanding issues in the Final Closure and Reclamation Plan (FCRP). LMI committed to providing more information in writing to address outstanding concerns as soon as possible.

Part 1

Reply to LMI's Specific Responses to CIRNAC Comments on Dome Design

a) **Lack of detailed grading information on the top of "dome" –** LMI in response, states that the grading details are provided in issued for construction drawing 19136158-0002-CM-0001_Rev 1.

"As indicated in Note 7, the final elevation of the top surface will be varied to suit the actual volume of waste rock that is imported from elsewhere on the mill site; however, the design slopes of the surface will not be changed."
CIRNAC concerns were addressed.

b) **Lack of design information on storm / freshet flows –** LMI in response stated that the chutes were designed to accommodate discharge flows in excess of 1 m^3/s.

CIRNAC requests the design calculations for the design flow along with confirmation that the esker material on the dome cover can withstand the movement of this amount of water as it migrates to the surface water management chutes. Also, the design should identify the preferred surface water flow patterns that will be established on the top of the dome so as to confirm if reinforced swales (i.e., boulder or riprap lined channels) are required to move water to the respective chutes.
CIRNAC concerns have not been addressed to date.

c) **Lack of protection against rill erosion on the long (30 to >100 m) 10% slopes -** LMI repeated earlier statements that only direct precipitation and meltwater on slopes will runoff and that the esker material will tend to exhibit "*self-armouring*". No technical information was provided on sheet runoff for maximum storm or freshet, calculations velocities and erosion potential or factor of safety with respect to erosion mitigation. No consideration or discussion of energy dissipating features on long slopes.

CIRNAC is still concerned over the long-term erosion potential of the slopes, particularly if the perimeter berm is compromised over time, and requests the information outlined in the previous paragraph.

d) **Lack of runoff channels from discharge chutes –** LMI's response indicates that due to setting on top of the hill, runoff from chutes will naturally drain away from the toe of the waste rock cover slopes. Note 11 has been added to Drawing (Dwg) 19136158-0002-CM-0001_Rev 1 directing the Contractor to "*construct berms or ditches as necessary to direct flow from drainage chutes away from the toe of the dome fill*". CIRNAC concerns were addressed.

e) Potential for toe erosion from discharge chute runoff flows – LMI stated that the stilling basin will safely dissipate the flow energy and that flow exiting the basins will be low-velocity sub-critical flow over existing natural ground expected to be bedrock or glacial till. No technical information on the stilling basin design was provided to support the statement regarding exit velocities.

Note 11 has been added to Dwg 19136158-0002-CM-0001_Rev 1 directing the Contractor to "*construct berms or ditches as necessary to direct flow from drainage chutes away from the toe of the dome fill*" which suggests that outflow from stilling basins may need to be managed through berms or ditches. The drawing note needs to also address the site conditions and grading requirements in the areas between the stilling basins, (i.e., need to confirm positive surface water flow away from the toe of the dome embankment).

CIRNAC recommends that LMI provide technical information on the stilling basin design to support the statement regarding exit velocities and update Note 11 on Dwg 19136158-0002-CM-0001_Rev 1 to address the site conditions and grading requirements in the areas between the stilling basins.
CIRNAC concerns have not been addressed to date.

f) Lack of specific notes addressing construction constraints that need to be addressed before cover placement – LMI added two notes to drawing 19136158-0002-CM-0001_Rev 1:

- *Note 1: "The subgrade under the dome is to be prepared in accordance with the water licence and final closure and reclamation plan (FCRP) before imported waste rock or cover materials are placed*."
- Note 2: *"The following materials shall be removed from the existing subgrade before imported waste rock is placed: Demolition waste, petroleum hydrocarbon contaminated soils, Arsenic "Hot Spots", Soil or Rock materials impacted with Cyanide or Lead Nitrate and any hazardous waste."*

Note 1 is a broad and undefined statement with no guidance on what is intended in the dome design package related to this note. Without additional guidance on what is needed/expected, LMI, the contractor, CIRNAC and others may all have different interpretations for what is required. LMI should provide clear guidance to

the contractor to ensure what needs to be done is carried out and can be verified as having been done either before waste rock relocation or cover.
CIRNAC concerns have not been addressed to date.

Note 2 is appropriate and provides applicable guidance and expectations for the actions to be undertaken and how it will be managed and approved in the field. CIRNAC finds the term “imported waste rock” unclear. The word “imported” suggests that waste rock is coming from elsewhere on the site. As we understand it, waste rock at the mill site will be consolidated and reshaped into the “dome mound”. LMI should confirm, whether or not there is now an expectation to “import” waste rock from other parts of the site. CIRNAC suggest that the note be revised to remove the word “imported”, if the waste rock is not coming elsewhere from the site.

g) **Failure to show where materials to be removed prior to cover placement are located –** LMI indicated that the location of contaminated materials are shown on Dwg 19136158-0005-CM-0001_Rev D.
CIRNAC concerns were addressed.

h) **Failure to show locations of shaft, crown pillar area that will be buried under the dome –** LMI in response states that locations of shafts, crown pillar area buried under the dome have been added to Dwg 19136158-0002-CM-0001_Rev 1.
CIRNAC concerns were addressed.

General Reply on Item 25 Dome Design Response

In general, it is CIRNAC’s opinion that the Golder memorandum submitted by LMI on 25 June 2021 does not address the concerns raised by CIRNAC in the earlier memorandum issued on 8 June 2020 regarding the dome design. No response was provided with respect to the concerns expressed about the dome top crest perimeter berm design or the lack of any toe stabilization to address the potential for toe erosion due to surface water runoff. With respect to erosion of cover slopes, LMI re-iterated they expect that the esker material will be self armouring. Concerns remain with respect to the long-term stability and integrity of this dome cover structure.

Part 2

Comments on Dome Design Issued For Construction Drawings

i. Drawing 19136158-0002-CM-0001_Rev 1 Proposed Waste Rock Dome

#	Issue	Concern	Recommendation
a	Concrete Foundations	Various mill facility foundations and slabs will be left in place, buried in waste rock and covered. The Dwg does not provide any information on the locations slabs and foundations that will be buried within the dome.	CIRNAC recommends that LMI add the outlines of all slabs and foundations that will be buried within the dome to the site Dwg and where applicable to the sections.
b	Length of Embankment	The embankment between E 489 100 to E 489 375 and N 7 293 800 to N 7 293 975 is greater than 100 m in length with no identified breaks or energy dissipating structures to slow down any sheet flow during high intensity rainfall events. The concern is that the esker material on site has a significant fine grained component and as such may be susceptible to the migration of fines over time.	CIRNAC recommends that LMI review the design to confirm that esker material will not migrate during high intensity rainfall events and provide written confirmation that fine grained materials will be washed out of the embankment cover esker material.
c	West Zone Crown Pillar Cover and Note 4	Note 4 states that the crown pillar and shafts are to be filled before waste rock is placed on top. However, in section 4.3.2.4 of the FCRP, page 4-15, it is stated that capping material will be required over the newly opened and filled West Zone that will consist of a 1.5 m thick mound over the backfill material with 3:1 side slopes and that this capping material will be covered with 1m esker materials graded at 2% slopes to shed water and conform to the surrounding land form. There is nothing on the Drawings 1 or 2 or the notes that identifies the need for this additional cap over the crown pillar. It is our understanding that the cap over the crown pillar was planned to allow for consolidation of the underlying fill materials without creation of a sinkhole in the dome cap and cover.	CIRNAC recommends that LMI revise the Dwg and notes to ensure that the additional capping materials are placed as appropriate prior to placement of the cover.
d	Stilling Basins	The stilling basins should be set at grade surface and not cut into the ground beneath the toe of the embankment as this could lead to ponding and potential freezing of water in the basin thus reducing the effectiveness of the basins during the freshet or other periods of high surface water runoff. Furthermore, additional detail is required to confirm positive drainage of water from the stilling basins away from the toe of the dome embankment.	CIRNAC recommends that LMI amend the stilling basing design to provide additional detail in order to confirm a positive drainage of water from the stilling basins away from the toe of the dome embankment.
e	Drainage at the Toe of the Embankment	It is unclear how the contractor is to understand final grading at the toe of the dome embankment and how to ensure surface water is directed away from the embankment toe, particularly in areas where initial grading work is required to remove undesirable materials. Furthermore, consideration should be given to sizing	CIRNAC recommends that LMI provide additional drawing notes to provide guidance to the contractor as well as to the program stakeholders on how surface water will be directed away from the toe of the dome embankment. Consideration

		the material at the toe of the dome embankment so as to ensure that surface water flow at the toe does not result in riling or loss of fines from the esker material being placed as part of the waste rock cover.	should be given to placing coarser material or armouring at the toe of the dome embankment.

ii. Drawing 19136158-0002-CM-0002 Rev 1 Proposed Waste Rock Dome Sections and Details

#	Issue	Concern	Recommendation
a	Berm Construction	In the "Typical Detail of Perimeter Berm", the berm is shown as comprised of "esker" material. In the "Drainage Chute Typical Profile", the perimeter berm is shown as "10kg Erosion Protection" material. From the drawing it is not clear what materials will be used to construct the berm. It will be helpful to show if there is a transition from esker to "10kg Erosion Protection" material at the top of the chutes.	CIRNAC recommends that LMI clarify berm construction materials .
b	Drainage Chute Typical Profile – Stilling Basins	The typical section shows the stilling basin below the original ground level. Given that LMI has indicated that drainage chutes will discharge on native surfaces that are either rock or glacial till, it is unclear if this detail will apply if the native surface is rock. Does LMI intend to construct the basins into rock, and if not, what will be done in this situation?	CIRNAC recommends that LMI clarify the design of the stilling basins if native rock is found at the toe of the chute discharge location.
c	Drainage Chute Typical Profile, Section Entrance to Drainage Chute – Non-woven Geotextile	These typical sections show the presence of non-woven geotextile in the esker cover beneath the erosion protection layer. LMI did not provide any dimensions with respect to depth of esker materials over the non-woven geotextile fabric, nor are any details provided on anchoring the non-woven geotextile fabric. Normally we would expect that non-woven geotextile be anchored at the top and the sides down the chutes. It should not daylight at surface as indicated on the drawing details.	CIRNAC recommends that details and/or notes should be provided to ensure that the non-woven geotextile is placed, covered, and anchored as appropriate.
d	Esker Cover at Toe of Rock Dome Slope	The "Typical Detail of Edge of Waste Rock Dome" shows 1 m esker cover material extending to the "original ground" surface. No armouring or stabilizing elements are included for the toe of the cover, nor are there any notes with respect to subsoil requirements/conditions at the "original ground" prior to placement of the cover materials.	CIRNAC recommends that LMI Provide: ▪ Notes on any requirements necessary prior to placing materials on original ground along the toe of the dome slopes. ▪ Technical assessment supporting that the toe of slope does not require some form of toe stabilization to mitigate long term erosion potential along the toe.

iii. Drawing 19136158-0005-CM-0001 Rev D titled Proposed Waste Rock Removal and Placement

#	Issue	Concern	Recommendation
a	Contaminated Soil to be Excavated	In the Technical Memorandum it is stated that this drawing shows the locations of Contaminated Soils to be excavated. The drawing actually just shows the locations of test pits with exceedances, no inferred excavation boundaries or depths are provided. Furthermore, the nature of the impact should also be identified so as to help program stakeholders understand the nature of the remedial work that may be required at the previously identified areas of impact. For example, areas of petroleum hydrocarbon impact are expected to be minimal, however metal impacted areas may be more challenging to define in the field during the course of the rehabilitation works. Known areas of arsenic hot spots as well as areas with elevated cyanide or lead nitrate should be identified along with any other hazardous materials so the inspectors and/or other program stakeholders will understand where these issues exist in three-dimensional space (i.e., area and depth interval).	CIRNAC recommends that LMI provide the inferred boundaries and depths of the contaminated soils to be excavated.
b	Area Cleared for Waste Rock Removal	Drawing 3 shows black outlined areas that are designated as “Area Cleared for Waste Rock Removal”. There is no definition of what that actual means. CIRNAC presumes that it means no other works are necessary before starting waste rock removal from these areas. It is not clear how other areas in orange, where waste rock is to be removed, are to be considered if no test pit exceedances have been noted, nor how and on what basis, these areas will be cleared for waste rock removal.	CIRNAC recommends that LMI to provide more details on the order and schedule of construction activities related to the removal of materials from area cleared for waste rock removal, placement of contaminated materials underground and debris as approved underground, filling of surface openings (shafts, vents, portal, waste rock excavation and relocation, cover placement planned for 2021).
c	Portal Area and Landfill Area Mounds at Closure	Drawing 3 shows three separate mounds remaining after the closure works have been completed (the dome, the portal, and the landfill). To date LMI have only provided information on the proposed dome and dome cover and details for the mill site proper but no such information for either the Portal Area or the Landfill Area	CIRNAC recommends that LMI provide plans and sections of the Portal Area and Landfill Areas for review.
d	Crown Pillar and Mine Openings	Crown pillar and mine openings are shown on the drawing 3 but not identified or labeled.	CIRNAC recommends that LMI add labels and notes as

			appropriate to identify surface openings.
#	**Issue**	**Concern/Recommendation**	
e	Drawing Notes	▪ Note 3 requires more detail to clarify that the final design for the closure of the portal opening will be done based on a topographic survey of the area once any demolition works are completed. ▪ Note 5 should clarify where the demolition debris from the removal of the surface main shop is to be placed and how the capping work is to be done. The concrete pad underlying the structure will need to be punctured to accommodate surface water drainage through the pad (given this area is outside the footprint of the dome structure it is inferred that the breaking of the main shop pad would be done later post-completion of the dome structure). ▪ The location of the crown pillar (as defined by the bold black and purple/pink lines should be defined in the legend.	

CIRNAC appreciates the opportunity to participate in this review. If there are any questions, please contact me at (867) 975-4738 or vincent.okonkwo@canada.ca and Sarah Forté (867) 975-3876 or sarah.forte@canada.ca

Sincerely,

Vincent Okonkwo
Environment Assessment Coordinator