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**November 17, 2020**

Mr. Richard Dwyer, Manager of Licensing
Nunavut Water Board=-p
Gjoa Haven, NU

Via Email: licensing@nwb-oen.ca

**Re: 2AM-LUP2032 Lupin Mines Incorporated Final Closure and Reclamation Plan**

Dear Sir:

This is the submission of the Kitikmeot Inuit Association ("KIA") in response to the updated Lupin 2020 Final Closure and Reclamation Plan (FCRP) and supporting documents for water license 2AM-LUP2032 made by Lupin Mines Inc. (LMI) on October 13, 2020.

## I. BACKGROUND:

The KIA is the Regional Inuit Association for the Kitikmeot Region of Nunavut and the Designated Inuit Organization for Article 20 of the Nunavut Agreement for the Kitikmeot Region. The KIA is not a regulating agency with respect to this project, however we are representing Inuit interest due to the historic importance of Tahikyoak (Contwoyto Lake).

KIA has reviewed the materials filed in support of the FCRP and supporting documents by LMI. We have been assisted in this review by Mr. Steve Januszewski, P.Eng., of SteveJan Consultants Inc. (SJCI).

KIA staff and advisors have reviewed the submitted materials by LMI during the preparation of this submission to the Board.

## II. KIA SUBMISSIONS:

KIA's resources are limited and our work reviewing LMI's submitted materials benefitted from retaining SJCI to assist in the review. Furthermore, the SJCI technical memorandum in response to LMI's Lupin 2020 FCRP and supporting documents is enclosed and forms the submission.

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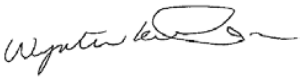
The KIA thanks the Board for the opportunity to address our concerns regarding this file. Should you have any questions or would like any clarification, I can be contacted at srlands@kitia.ca or by phone at (867) 982-3310.

**ALL OF WHICH IS RESPECTFULLY SUBMITTED:**
**ON BEHALF OF THE KITIKMEOT INUIT ASSOCIATION**



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Wynter Kuliktana
Senior Lands Officer
Department of Lands, Environment & Resources
Kitikmeot Inuit Association

Cc: Geoff Clark, Kitikmeot Inuit Association Director of Lands, Environment and Resources

Enclosed: SJCI Techncl Memo Review of LMI FCRP and Supporting Documents 201115.pdf

**SteveJan Consultants Inc.**
192 Werra Road
Victoria, BC V9B 1N4
CANADA
Mobile: 250-850-9002

# TECHNICAL MEMORANDUM

**Date:** **November 15, 2020**

**Subject:** SJCI Comments on Lupin Mine Inc.'s August 2020 Final Closure and Reclamation Plan and Supporting Documents as Provided Under New NWB Water Licence 2AM-LUP2032

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## 1. INTRODUCTION

SteveJan Consultants Inc. (SJCI) has undertaken a review of the Lupin Mines Incorporated (LMI) updated 2020 Final Closure and Reclamation Plan (FCRP, Plan) and supporting documents as made available on the Nunavut Water Board (NWB) ftp website. The Plan is a requirement of a new Water Licence (2AM-LUP2032) for the Lupin Mine as the Company prepares to undertake the final closure and reclamation of the site. The KIA is a stakeholder in the current Lupin closure review process. Mr. Januszewski, Principal Engineer at SJCI had been previously retained by the KIA to assist in the review of LMI documents as they pertained to several conditions in the new Water License. SJCI has been asked by the KIA to review the most recent LMI submission of the 2020 FCRP package, with the KIA needing to submit comments to the NWB before a November 17, 2020 deadline. This Technical Memorandum provides the basis for KIA's response to LMI's August 2020 FCRP and support documents.

Mr. Januszewski is not a geotechnical, geophysical, hydrogeological or other specialized engineer or scientist in his training. However, he has significant experience in general mine closure work, notably with northern sites. As a result, this report is a general high-level review of the FCRP documents and not a specialized detailed engineering or scientific review.

Significant correspondence with the NWB and LMI has been undertaken by a number of regulators during the review of the LMI Water License amendment application and previous FCRP, notably with CIRNAC and ECCC. The KIA have had minimal involvement during this period; although in June 2020, on behalf of the KIA the author provided comments on the LMI response to several specific new Water License requirements made by the NWB (Ref: WL 2AM-LUP2032 Part E, Items 25, 26, 27). These were provided in a KIA submission to the NWB dated June 24, 2020.

LMI has previously submitted a FCRP in July 2018 which has been approved by the NWB. The 2020 FCRP provides additional details on the Plan and was to consider comments made on the previous Plan and proposed new Water License by regulators and stakeholders and provide information on work done at the site over the past two years.

This report involved a review of the FCRP and the listed supporting documents. It presents a number of questions requiring clarification and specific comments on issues of concern as well as a number of observations. It is considered to be an exception-based review; i.e., the FCRP and its supporting documents were considered to be acceptable to the author except where they are mentioned in this report.

Due to the tight timeline for completing this report, neither a technical nor senior review of the draft report were undertaken, by a third party.

**Layout of Report**

This report utilizes the following sections to provide review comments on the FCRP package;

1. Introduction
2. Closure Plan Fundamentals
3. Summary Comments on FCRP
4. Detailed Comments on FCRP
5. Detailed Comments on FCRP Supporting Documents
6. LMI Commitments to Undertake Future Work
7. Continuing Uncertainties
8. Conclusions and Recommendations
9. References

KIA's specific requests are listed in this document as stand-alone *italicized* statements.

## 2. CLOSURE PLAN FUNDAMENTALS

The main components of the approved closure plan include;

- Close all mine openings. This includes plugging 2 air raises, a ramp and securing the blasted-down crown pillars;
- Cover tailings in 4 dry tailings cells within the TCA with a 1.0 m thick layer of esker material. Lower water levels in the 3 tailings ponds, secure dams and install spillways where required. Work towards a passive water flow system across the facility before final discharge through a spillway in Dam 1A;
- Consolidate most of the surface waste rock currently within the main site area as well as the smaller waste rock layers in the perimeter areas into a central area of the main site, including a waste rock "dome". To the extent possible, place remaining waste rock into surface openings. Re-slope all impounded waste rock and cover it with a 1.0 m thick esker material layer to shed water. The goal is to consolidate it and minimize its contact with surface water flows;
- Remove all hazardous materials from the site to licensed disposal facilities;

- Clean and then dismantle or demolish site buildings, structures and surface equipment and then remove them to the site landfill or surface openings;
- Cover areas with Petroleum Hydrocarbons (PHCs) or low-level Arsenic (As)-contaminated soils with a 1.0 m thick layer of esker material;
- Scarify all reclaimed areas to encourage the establishment of natural revegetation;
- Implement and complete the closure plan site works in a 2-1/2 year long Active Phase; and
- Immediately following the Active Phase, undertake a comprehensive Post-Closure Monitoring (and Maintenance) Program (PCMP) for a period of at least 5 years until long-term water quality and other reclamation criteria have been achieved.

And, as stated in the FCRP Executive Summary Item 2) the Global Objectives for the Lupin Mine are**…**

*"…The overarching objective or purpose of the closure plan is to return the Site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. The overall closure goal is supported by the three closure principles of Physical Stability, Chemical Stability and Future Use and Aesthetics for each component of the Project..."*

## 3. SUMMARY COMMENTS ON FCRP

### 3.1 Previous KIA Comments on New Water License Conditions Part E, Items 25-27

The 2020 FCRP does not appear to have Incorporated any of the KIA feedback comments on the 2018 FCRP and/or new Water License conditions (Part E, Items 25, 26, 27). The one notable exception is that the drawings included in the FCRP and which were previously a part of the LMI response to the condition of Water License Part E, Item 26, are now labelled as Approved and are dated and signed by the geotechnical Engineer of Record, as it was considered a deficiency in the SJCI review;

The KIA provided comments on the three Water License conditions and LMI's responses in a cover letter supported by three Technical Memoranda prepared by SJCI in June 2020. A July 2020 response from LMI stated they would address relevant comments and recommendations from intervening parties in an update to the Final Closure and Reclamation Plan and would work with the KIA in the development of a Post-Closure Monitoring Plan. LMI provided responses to a number of the comments presented by the KIA in a memorandum to the NWB dated July 31, 2020. Based on those answers and future commitments, the KIA confirmed its satisfaction with the information provided on August 12, 2020;

A selection of the still outstanding issues from the previous KIA comments include;

**Item 25:** To reduce the risk of generating ML/ARD seepage, selective placement of PAG waste rock with the "worse" material (i.e., with lower NP/AP ratios) to be placed deeper within openings and "cleaner" material (i.e., with higher NP/AP ratios) being placed closer to the top or perimeter of any waste rock impoundments. Instead LMI is considering all surface waste rock to be PAG, and it will be used wherever

plans are for its disposal, without preference to getting the "worse" material further away from possible water and air intrusion as was suggested. Separation and isolated impoundment of the highest As-contaminated soils is planned to be undertaken, but not for the PAG waste rock. This could present a long-term issue for the site and LMI and/or the regulator responsible for the site;

*Although the LMI provided a response, stating that "...the PAG samples were distributed throughout the site…", selective excavation and placement of these material could be achieved. It would be in LMI's best interest to do whatever it can in this regard, as it will help minimize ML/ARD seepage potential in the future.*

The proposed waste rock dome is intended to be sloped to drain surface wasters to the perimeter and then to flow to a number of discharge points. The Water License required a Technical Memorandum to be submitted within 60 days of License approval that was to include, among other items, details on drainage systems and conceptual water features and erosion control measures. These have not been provided.

*LMI should provide details of proposed water, drainage and erosion control structures being proposed for the waste rock "dome".*

**Item 26:** A specification is still missing for the cover fill, also referred to as compacted fill, and esker.

No substantive changes were made to the drawings specifically concerning recognition of changed TCA pond levels during the post-closure phase and the need for outflow spillways, especially from Cells 5 to extend into the new lower water ponds and a request that show design flood event / design storm water flow volume. velocity estimates and water levels through/over all the structures.

*All of the cross-sectional drawings should show design flood event/design storm water flow volume water levels as well as estimates of water velocities.*

The author's previous comment still stands about the long list of work details being left to be resolved in-field by the site engineer that could have been significantly dealt with in advance with more extensive field investigations and more information being provided in the drawings. This makes a review of the methodologies by stakeholders such as the KIA impossible, as decisions concerning methodologies will be made in the field during active reclamation work without stakeholder review in advance.

The design of the drainage channel for Cell 3 closure (Dwg. 8) does not look durable enough as the erosive forces that will take place with over-steepened side walls cut into the esker cover material (with no lining) and a design storm event water level which is shown to be up to the full 0.5m height of the channel could quickly degrade the channel.

*Designs for channels such as the one proposed for Cell 3 closure need to be confirmed as being adequately durable to withstand design storm events.*

Placement of TCA dam slope armoring with compacted fill will involve placement in horizontal lifts, but there is no specification on the height of each lift when it is being constructed, nor a compaction

specification apart from an over-arching "…slopes shall be track packed to limit surface erosion…" See also Drawing 11 & 18 to see how difficult this will be as the additional sloped material to be placed against the dam is not a large enough area and thus getting equipment onto the upstream buttresses will be difficult;

The specifications (Dwg. 1) state the Contractor is to remove any impacted water from the tailings cells during cover material placement and it "…must be managed and discharged in such a way that will not impact the water treatment in Pond 1 and Pond 2…" However, it doesn't state that the water is not be discharged outside of the TCA facility without prior water quality analyses having been undertaken to confirm acceptability and with appropriate approvals granted.

*The FCRP needs to specifically state to the Contractor that there is to be no discharge of TCA water to outside of the facility without prior water quality analyses having been taken to confirm acceptability and with appropriate approvals granted.*

**Item 27:** A range of methodologies are available for dealing with pockets of tailings located outside of the tailings cells, or currently below the water cover in the TCA water ponds, although the FCRP is relying on a limited selection of these, namely cover-in-place (based on Stantec Technical Memorandum dated June 8, 2020). This may not be the best long-term methodology. However, LMI states the civil works contract for this has already been awarded and thus there is no change possible. This is not correct. It would be in LMI's best interest in employing the best methods and ones which in the end will have the best long-term results.

*LMI should provide a listing of all the outlying or yet to be exposed deposits of tailings material and provide a thorough alternatives assessment for all the individual areas with the best solution for each then determined.*

**Uncertainties:** KIA had questioned the uncertainty of there being adequate volumes and quality of esker material that are being proposed to cover significant portions of the site as engineered cover. LMI provided a response stating "… LMI does confirm that there are more than adequate volumes of esker material to carry out the required closure and reclamation activities". A blanket statement does not provide adequate assurance.

*LMI should provide an estimate of the total volume of acceptable quality esker materials required to complete the reclamation program and the timeline on the esker material being extractable (i.e., a methodology) to be employed due to the pile's frozen permafrost state.*

**3.2 General Comments on FCRP**

Significant portions of the new FCRP have not been updated since the 2018 document. A number of tasks proposed for work to be undertaken in 2018 and 2019 after the 2018 FCRP was issued are still included in the 2020 text with the same estimated dates of when the work was to be undertaken. It does not look professional and is confusing. The 2018 Plan was prepared by Golder Associates. The 2020 Plan, although in the same format as the earlier Plan, does not show it as being a Golder product. The

Plan was likely updated by LMI, who did not do as thorough an editing as would have been done by Golder.

LMI considered the estimated 450,000 m3 of contaminated soils, comprising 35,200 m3 PHC-contaminated & 418,000 m3 As-contaminated soils (Ref: FCRP Sec. 4.3.2.3) too large a volume for ex-situ remediation or on-site remediation using methods such as PHC-landfarming or consolidating and covering due to their volumes and time constraints (i.e., wanting to have active reclamation work completed within 2-3 years) (Ref: FCRP Sec. 4.3.2.3). Instead, a risk-based plan has been provided for removing 16,300 m3 of highly As-contaminated soils (Ref: FCRP Sec. 4.3.2.3) into the crown pillar and covering it with esker material layer and for the remainder (As- and PHC-contaminated soils) the Plan is to cover these areas in-situ with esker material covers. Also, the FCRP does not provide any conclusions on the success or failure to date of the small site landfarm that was established in 2017 with an initial volume of 500 m3 of PHC-contaminated soils.

The FCRP proposes a program of covering areas of contaminated soils with an esker material although the use of several different methodologies would likely provide a better long term solution and one which ultimately will require less long-term monitoring and the possible need for later interventions if acceptable long-term levels are not reached. The FCRP is basing this plan on a flowsheet decision matrix (Stantec 2020) which does not provide sufficient detail to adequately assess the numerous areas on site which need to be dealt with individually and which in the end may be best suited to one of several different remediation methodologies. (i.e., the toolbox should not consist of just one tool, as is being proposed).

The FCRP relies on a significant quantity of acceptable quality esker material to be used as an engineered cover for all the required areas. The document does not provide an estimate of how much material will be required and whether there are sufficient volumes available, be it at the Fingers Lake location or from elsewhere, and if not what the back-up plan may be.

## 4. DETAILED COMMENTS ON FCRP

A number of references are made to the use of Discovery Mining Services (DMS) to undertake and/or to oversee others completing a number of the ongoing tasks at the site, namely site monitoring during the Active and Passive Phases of the reclamation and closure work at the site. No information is provided on how the arrangement between LMI and DMS will work. There is no information provided on whether DMS or LMI will be submitting ongoing reporting to NWB and others.

*An overview on the arrangement between LMI and DMS should be provided.*

The Plan includes minimal updating of the reclamation work done at the site since the earlier 2018 DRAFT FCRP was submitted. In multiple places in the 2020 document, reclamation work that has been undertaken to the end of 2017 is mentioned, and any work for 2018 and 2019 and beyond is mentioned as work yet to done.

*LMI should update the August 2020 FCRP to be current and updated showing work completed to the end of 2019 and proposed future work to fulfill the Plan.*

The text states it expects continuing licensing of the FCRP to take 10 months from the date the document was submitted; with the FCRP dated August 2020 (Ref: Executive Summary Item 8.) suggesting approvals may not be in place until mid-year 2021. The text goes on to say that concurrent with the ongoing permitting it will begin implementing the closure tasks at the site. Does this suggest active closure work has already begun at the site? Was a winter road utilized in early 2020 to mobilize heavy equipment and supplies to the site? (Note: This section refers to plans to begin implementation of reclamation activities in 2018). The previous request (above) covers this point.

As stated in the FCRP Section 1.3.5, the KIA have no ongoing direct water compensation issues with the Lupin Mine.

Sec 2.1.2 Climate: The text references others' work in stating that the mean annual temperature at the site will increase by about 4 to 5'C over the next century. It then goes on to discuss the range of climate and temperature changes that may occur. This re-affirms the need to build significant conservatism into the design of civil structures at the site (TCA dams, spillways, engineered covers, etc.) due to the uncertainty as to long-term climate at the site.

Sec 4.3.2.5 Borrow/Quarry: The FCRP acknowledges that current closure costing does not include funds for the reclamation of the quarries and borrow areas. This is a deficiency.

*LMI needs to confirm borrow and quarry areas will be reclaimed upon their closure and that elements will be included in the next iteration of the RECLAIM costing.*

Sec. 4.3.2.9: The FCRP mentions the need for open mine shafts, collapsed crown pillars and the landfill to dispose of all the waste materials that will be generated during the demolition of site structures and mobile equipment that is to be disposed of on site. Has an estimate been prepared to confirm there is sufficient volume available in those repositories? This may be worsened by the additional need for space for the disposal of high As-contaminated soils and waste rock as well into those same repositories, with the volumes of waste rock requiring impoundment may also rise above initial estimates? Is removal of demolition debris to off site using a winter road a possible scenario? The text goes on to state that if there is a shortfall in available space for all the materials being disposed of, then the existing landfill can be raised, or another demolition landfill can be constructed. Plans for such modifications to the closure plan should be provided, well before they are needed, especially as there does not appear to have been an assessment undertaken of the total demolition and non-hazardous materials volumes requiring landfilling. Interestingly, the next section (Sec. 4.3.2.10) states that a new demolition landfill is to be built in the west end of the Upper Sewage Lagoon. It is unclear what the details are of the new facility.

*LMI should provide estimates of wastes requiring impoundment (demolition products and other wastes) as well as the volume of space available for all these materials.*

*LMI should provide conceptual plans for a new demolition landfill in the FCRP as a contingency.*

Sec. 4.3.2.9 Buildings and Equipment: The FCRP mentions the plan of bringing selected mobile equipment from the Ulu Mine to add to the Lupin fleet. Is this still the plan? Especially as the Ulu Mine now has a new owner and functional mobile equipment may be required for that site? This text may be a remnant from the earlier 2018 FCRP.

*LMI should confirm plans on whether it intends to bring equipment from the Ulu site to Lupin.*

Section 5.0 Monitoring: The text refers to the new Water License and the commitment of submitting an updated PCMP. This Plan and the annual reporting to be submitted to NWB will include water quality monitoring results as required in the Water License Schedule J, Tables 1 and 2, but should also include interpretation of the water quality and other site monitoring data (e.g., physical, geotechnical criteria, etc.), and whether they are improving, remaining constant or worsening and why and how it and the other monitoring data are trending towards meeting final closure and monitoring program cessation requirements as well as outlining any resultant additional work being recommended to address any areas of concern.

*LMI should state that the new PCMP will provide analyses and interpretation of all site monitoring data (i.e., not limited to water quality data) and outline contingency plans (of key issues) should the results suggest the need for additional steps*

Section 6.2.2 Golder HHERA: The text describes conclusions from the 2019 Golder HHERA of the site, and it proposes the use of a 1.0 m thick coarse-grained esker material to cover graded areas of low and high-arsenic levels and of PHC contamination. It is understood the goal of using an esker material cover is to minimize water ingress into these contaminated areas below. It is unclear how using a coarse-grained material will achieve this objective; would a fine-grained material be more effective in achieving isolation of the underlying materials?

Later in the same section, the text states that pockets of waste rock on surface and areas with low-level arsenic impacted soils, sometimes intermixed, will be graded and covered with esker material; but there is no mention of whether this material is to be fine or coarse-grained. Are materials being sourced at the Fingers Lake esker deposit being screened into separate fine and coarse-fractioned products? Is it only producing run-of-borrow area product?

*LMI should confirm what size distribution is required of the esker material being proposed for the engineered cover over the various contaminated areas at the site to ensure water infiltration is minimized.*

Section 6.2.3.1 outlines a summary of potential risks determined through undertaking the 2019 HHERA. The text states *"…the surface water quality modelling used conservative assumptions that may have overestimated transport of acidity to Boot Lake and Unnamed Lake, resulting in low predicted pH…*" This may be a possibility, however, this is likely the same methodology Golder has utilized in other site assessments (as stated in the FCRP) and should therefore be relied on in its conclusions.

Section 6.2.3.3 addresses areas requiring remediation or risk managing the identified areas of concern, the text states water quality monitoring of these lakes should be undertaken now and in the future (with the completed FCRP in place) to confirm satisfactory water quality and as a check on the conservatism built into the modelling. It also states that remedial measures may be required if targeted levels are not reached. This will need to be scrutinized by the appropriate agencies through the Active and Post-Closure Phases as regular monitoring reports from the Company are submitted, bolstered by regulatory site inspections.

Section 6.2.4 Regulatory Review: Th text mentions the commitment to a new Post Closure Monitoring Plan and then goes on to describe the ERA and HHERAs that were conducted. These are not typical components of a Regulatory Review section in a Mine Closure Plan.

This section should provide a brief overview of the mandated regulatory review process in Nunavut (but to not repeat what was detailed near the beginning of the FCRP), what was the regulatory review process utilized for this project (history to date, current status and future expectations), and what the outcomes were from the company going through the process.

Section 7 Financial Security: The text does not conform to the standard Financial Security sections seen in mine closure plans.

Typically this section would outline the basis of the security approach used in this cost estimation, how the estimated detailed closure costs were determined, the basis of what cost estimating model is being used and why, major and minor assumptions in the closure tasks and their costs, references back to the closure plan tasks describing costing aspects of those undertakings. Additionally, because the costing is based on the rudimentary RECLAIM Model a section needs to describe all the assumptions that went into the individual line items (i.e., the effort required, the unit cost used, etc.) that might otherwise be included directly in a more detailed model but are not with the RECLAIM model.

The text refers to Appendix G in which 3 sub-sections include the RECLAIM costing, milestones for determining when tasks are considered to have been completed in order to qualify for return of security for that item and a joint LMI/CIRNAC Security Reduction Framework document.

The focus of this section in the FCRP is on security refunds; what the milestones are to confirm specific tasks have been completed. how LMI can apply for security refunds, and ensuring the agencies release the funds in a timely manner. A discussion on how securities are to be returned is a subject that is dealt with in Appendix G-3 and should not form the basis of this section in the FCRP.

The 5% continency allowance included in the RECLAIM costing (app. G-1) is significantly lower than should be accepted for a large project with a number of uncertainties and with costing based on a very rudimentary spreadsheet program. This is worsened by the Framework presented in App. G-2 for giving the company credit for completed tasks. That table does not align with typical return of securities criteria as is used in jurisdictions the author has experience with, namely BC, the Yukon and Ontario.

*The FCRP should provide rationale as to how the 5% Contingency Allowance for the Closure Plan cost estimate was determined.*

It would be interesting to map out the likely reduction in Financial Security being held with the currently planned work schedule and what funds will be left at various future milestone dates. A reasonable financial provision should be in place after completion of the Active Phase, due to the uncertainty of how long monitoring may need to continue until final equilibrium acceptable values and closure criteria are reached, as well as for the possible need for maintenance work, and finally for the possible need for interventions to address deficiencies. No information is provided to ensure there will be sufficient security in place towards the end of the Active Phase should a deficiency arise through the Post-Closure Monitoring and Maintenance Phase.

## 5. DETAILED COMMENTS ON FCRP SUPPORTING DOCUMENTS

The NWB ftp site (…2AM-LUP2032/LMI/3 Tech/1 A and R/2020/…) provides electronic copies of the 2020 FCRP document and 16 supporting documents. Appendix H of the FCRP lists 17 documents that were considered "Technical Memos in Response to Information Requests, Technical Comments, Commitments from PHC/TM or Exhibits during the Application Review Process (2019)". Only the 2019 Golder HHERA report was not included in the above ftp site and was therefore not reviewed herein. This section includes a review of all the other supporting documents.

### 5.1 General Comments

The additional items of uncertainty noted by the author in preparing the earlier Technical Memoranda still apply. These include;

- A better estimate of the total volume of waste rock requiring remediation is required (using 1M m3 without a detailed rationale or reference seems over-simplistic);
- 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 during the reclamation program (i.e., due to its permafrost state it can only be excavated in thin layers. Ref. FRCP Sec 2.3.2);
- Clarification as to why the RECLAIM costing show all the liabilities as being related to Water and none to the Land (ref: FRCP App. G-1)?
- The FCRP mentions that 131,500 m2 of tailings remain to be covered and that this work should be completed in 2019. Has this been done? It is unclear how much additional tailings beach area is to be exposed when the water levels are lowered in the ponds as part of implementing the new TCA configuration and remedial work being undertaken to the dams as required from annual geotechnical inspections; and
- The FCRP states that the remedial work with implementing the passive water flows across the TCA will be completed once the outflow water (over Dam 1A) meets discharge water quality

guidelines. It is uncertain when this may occur (or maybe it already has?). However, any further time until this occurs may provide the opportunity for more detailed studies (engineering design, bathymetry, surveying, depth measurements of existing cover and tailings, etc.) to be undertaken to better understand and nail down more accurately the work required for the Civil Contractor to undertake the works program, as well as for the possible need for other remedial measures which may become apparent.

### 5.2 Specific Comments on Supporting Documents

The sixteen supporting documents provided on the NWB ftp site have been prioritized for likely significance in this high-level review of the LMI FCRP package, due to concern about adequate time being available for the author to undertake reviews of all the documents. All the documents have been reviewed, albeit at a high-level.

#### 5.2.1 Decision Matrix Memo Rev. C, Jan 2020 (App. H-01)

The Decision Matrix is intended to put forward the alternative methodologies to deal with the contaminated areas of the site. However, the document presents a bias from the beginning in favor of the cover-in-place methodology. A number of the arguments in favor of this methodology have similar issues as with the cover-in-place approach (e.g., having to get access to bad material for removal, it being the same as for gaining access to place a cover. Relocation and consolidation of tailings elsewhere has been done in a large number of other mines, …}. Arguments concerning LMI having a closure work schedule and civil contractor already in place, the additional work involved in undertaking a relocation and placement elsewhere are not valid, if that approach has significant benefits.

Hydraulic methods (i.e., hydraulic monitoring) can be done with full containment of runoff waters and is likely the best method to remove shallow areas of contaminated materials, especially over uneven bedrock area. The TCA has a large area of water covered cells as well as dry cells (including several that are yet to be completely covered) that the material could be pumped to, especially as the current plan involves a period of unknown duration for allowing water quality within the TCA to come to acceptable and long-term equilibrium levels prior to switching to the long-term passive water flow-through system for the facility.

Contaminants mixed within soft lakebed sediments are more difficult to deal with. In this case, a number of options are available and should have been considered. They would probably be very local-deposit specific, but could include methods such as 1) leave in place (e.g., if already established with a natural soil cover and vegetation), 2) cover in place, 3) treat in place, 4) hydraulic removal (dredging or hydraulic monitoring), or 5) through physical removal (possibly assisted by cutting in wicking channels where contained water can be drained from the area, making access onto the area with heavy machinery doable), as well as a number of other methods.

A site-wide assessment of all the areas of potential concern and alternative closure methodologies should have been provided to adequately determine the best solutions for all the areas.

With the proposed cover-in-place method, the document does not address the issue of ultimate degradation of the esker material cover over time (through freeze-thaw cycles, cracking, wicking of contaminants up into the cover, formation of erosion gullies, etc.) that will degrade the performance of the cover and may lead to downstream water quality effects as well as localized sediment transport through erosive forces across the covers.

Finally, the report suggests Active Monitoring will demonstrate that the proposed methodology will be successful. But it does not mention the possibility of failure and the need to evaluate alternative remedial measures, which would be better done now rather than in the future when a problem is realized and with more limited resources available.

**5.2.2 Risk Assessment on 2 TCA Dams Rev. 0, Nov 2019 (App, H-12)**

This report was issued to fulfill Technical Commitment 11.

The author is not a geotechnical engineer and as a result cannot comment on the detailed engineering aspects of the arguments being put forward concerning the adequacy of the current designs and as-built configurations of Dams 3D and 4.

However, several general comments include:

- Concerning both dam assessments, the text makes no mention concerning the lowering of the water level on the downstream side of Dam 3D (elev. 481.0 m vs 484.6 m currently); and for Dam 4, that the upstream side of the dam has water up against it (and no tailings) and that water level is also proposed to be lowered, by 1.6 m; and
- The text does not confirm that the two 2006 studies referenced in the report had the TCA in its currently proposed (i.e., 2020) final configurations of tailings and water levels and how these may impact geotechnical stability and downstream water quality (versus with the configurations as they were in 2006).

**5.2.3 Conceptual Design for the Waste Rock Dome, Oct 2019 (App. H-08)**

This report was issued to fulfill Technical Commitment 5.

The Table 1 numbers for the Year 2019 Yearly Unit Flow Volumes were found to be illegible in the pdf document pulled off the NWB Public Registry ftp site.

Although the modelling looks to indicate improved runoff versus current infiltration numbers with the proposed waste rock dome, it also shows that the infiltration will get progressively worse over time (Annual precipitation infiltrating and reporting as toe seeps is estimated to be 25% in 2100 with the work completed and the cover in place vs. 15.8% in 2019).

Figure 2 shows the waste rock dome will be approximately 7 m high (6 m of waste rock and a 1 m thick esker cover) above the surrounding ground. This height above grade will make climatic aspects a

potential concern (i.e., temperature swings, rainfall, depth and duration of maintaining a frozen state, potential for wind-blown fine esker material, etc.)

The report does not include any design details for infiltration requirements of the esker material cover for the dome (or elsewhere). It is unknown what hydraulic conductivity numbers were used for the cover, be it in the winter (i.e., frozen and impervious) or summer (i.e., thawed and pervious) states.

Based on the Commitment, the report was also to estimate stormwater drainage rates. These have not been provided.

It Is noted that Water License 2AM-LUP 2032 does not specify the locations or numbers of seepage monitoring locations around the proposed dome. However, the Design Report states there are typically 13 locations of seepage water emanating from the larger, current main site area. Drawings of the proposed dome show their being significantly less discharge points from the dome.

*In the new PCMP, LMI needs to include long-term monitoring of all the new dome surface seepage water locations as well as for groundwater monitoring in the perimeter area.*

**5.2.4 Geotechnical Review on the Long-Term Stability of TCA Dams Rev. 0, Nov 2019 (App. H-03)**

This report was issued in fulfill Technical Commitment 6.

The author is not a geotechnical engineer and as a result cannot comment on the detailed engineering aspects of this geotechnical review on the long-term stability of the TCA dams.

However, a number of general comments are presented below;

- The Design Basis and Criteria section states that permafrost is assumed to remain at current levels. Is this considered adequate?

  *Based on estimates of average annual temperature rises of 4-5'C by the year 2100 LMI should confirm that modelling only undertaken at current permafrost levels is considered sufficient.*

- From previous documentation it is understood that neither Cells 3 nor 5 have yet been completely covered with the esker material cover. It is not known which areas of these cells are yet to be covered and whether these areas are the areas where proposed re-grading of the surfaces is proposed as shown in Figures 2 & 3 of the Appendix.
- The report shows the proposed surface contouring to be undertaken across Cells 3 & 5 to have any surface water flow into the channels and then towards the outflow structures. Is the "New Tailings Cover" in these cells working with the proposed esker material and not the tailings, before a cover is placed over the areas, or does it suggest existing tailings will be excavated/re-sloped before the 1.0 m esker material cover is placed?

  *LMI should confirm whether the drainage channels being installed in the tailings cells are being cut into tailings or the cover layer.*

- Should the non-woven geotextile in the proposed outflow structures in Dams J & L not have bedding material placed against it rather then the 0.5m thick Boulder Armor with a D50 of 250mm?
- The slope stability analyses shown in the Figures (Nos. A.1 to A.32) provide results for all the dams including the current as-built configurations and final re-sloped scenarios for Dams K & M. But all the analyses are undertaken with the current permafrost level at a depth of 2 m below ground surface.

  *LMI should provide the basis by which using just the one depth of permafrost in the dams is considered sufficient.*

**5.2.5 Coupled Thermal-Seepage Modelling of the Esker Cover for the Waste Rock "Dome", Oct 2019 (App. H-06)**

Section 3.3 - Material Properties: The text mentions that thermal and hydraulic properties of the different materials being assessed in the models (i.e., the esker material and waste rock) were unavailable and were therefore assumed or estimated by the modellers. This likely makes for a deficiency as to the validity (or accuracy) of the model outputs.

*LMI should provide a confirmation of the validity of the model results with the modellers use of typical values for similar (i.e., in-house) materials rather than actual materials from the site.*

The report then states the ground was assumed to remain saturated and frozen for most of the model duration although elsewhere it is stated that it thaws in late summer.

*LMI should provide rationale as to why the modelling assumed the ground to be saturated and frozen through the entire length of the modelling runs.*

Section 4.1 & 4.2 - Model Results for Current and Long-Term Scenarios: This section states the active layer will be subject to seasonal freeze and thaw and this zone of infiltration will move downward from a depth of 2.7-3 m currently and then down to 4 m below surface in the long-term scenario.

In Section 5 – Conclusions: The text states that the infiltration through the esker layer will increase over time and that climate change considered there would be…

*"…an increase in percolation rates at the base of the esker [layer] from 16% to between 22 and 25%...It is recommended that supplemental thermistor strings and, if possible, construction and monitoring of field trials be implemented before the final cover is constructed. The use of field trials typically brings several technical and financial advantages and provides valuable information to refine the cover design and optimize performance…"*

Field trials should have already been undertaken with the monitoring used to determine the optimal cover for the waste rock dome, prior to the facility being built. However, the opportunity for this has passed and now the proposed design needs to be constructed. To be able to predict it will meet long

term closure objectives it should be built with several instrumented data collection sites from within and below the covers, supplemented by regular visual inspections.

### 5.2.6 TCA Waste Rock Review, Aug 2019 (App. H-07)

The report was commissioned to fulfill Technical Commitments Nos. 3 & 4, as requested by CIRNAC.

The report refers significantly on a 2005 URS assessment of waste rock at the site.

It is unknown why Dam 3 was not sampled for ABA parameters in the 2005 program. It is a perimeter dam containing Cells 1 & 2 of tailings within the TCA. The one dam flagged as a potential concern in Table 1 is Dam 5 which is also a perimeter dam. But both of these dams have not had, nor are planned to have any new exposures of their dam slopes and thus are unlikely to have any new generation of ML/ARD seepages. Most of the other samples shown in Table 1 returned acceptable NP/MPA numbers. One of possible concern is Dam 2 with a NP/MPA of 1.03, as it is a perimeter dam and it will have its upstream face freshly exposed as the water level against it is to be dropped from elev. 483.0 to 480.0 m, as part of the closure plan. Depending on the type of rock that comprises the upstream face of the dam, ML/ARD generation from the dam material could become a long-term issue for consideration.

Commitment No. 3 also asked for a review of other waste rock areas on the site (roadways, etc.). The report provides very little assessment of any other work undertaken in these areas including it using 2017 Golder ESA results, except for a mention in the Conclusions and referring back to the TCA but not the other areas of concern across the site.

Otherwise, based on Stantec's assessment and the dams all being in the order of 25 years in age and by all apparent indications (by others), the dams are functioning without ML/ARD issues and the report significantly addresses this issue.

### 5.2.7 Current ARD Sample Locations 2017 (App. H-04.5)

This one-page map of the site is titled Current Acid Rock Drainage Sample Locations and is dated Oct. 17, 2017.

The drawing makes no reference to an accompanying report where results of all the sampling locations are presented, which is presumably the 2017 Phase 1 & 2 Environmental Site Assessment report.

It is unknown why this figure is a part of the supporting documents for the 2020 FCRP but the ESA report itself is not.

### 5.2.8 Surface WQ Model Oct 2019 (App. H-05)

The report was commissioned to fulfill Technical Commitments Nos. 1 & 7, as requested by CIRNAC.

Section 6 - Model Results: The text presents results of the modelling and the annual range of anticipated key parameters at three downstream sites.

The report goes on to say that seasonal effects such as freezing of the waste rock dome area will be controlling factors on water quality based on whether precipitation water runs off the surface or infiltrates into the waste rock and produces seepage from around the toe of the dome. Its modelling shows that in June, all contact water runs off the facility whereas in August and September it infiltrates the waste rock below and exits as seepage from the toe.

Section 7 – Conclusions: The text mentions that geochemical characterization of waste rock will continue using samples collected from the site in August 2019.

*LMI should confirm that geochemical characterization of the waste rock is ongoing or if already completed, make this information available.*

The model suggests variations (seasonally and even monthly) in downstream water quality sampling sites depending on the proportion of precipitation and snowmelt that will report as cover runoff versus infiltration, as mentioned above. It then modelled water quality in the various watersheds that the site runoff waters will flow into. It suggests Lower Sewage Lake and East Lake may see higher metal concentrations due to their smaller watersheds when compared to the larger watershed feeding Boot Lake.

Section 8 – Limitations: The text discusses the nature of uncertainties with the type of modelling undertaken. It states;

*"… the model could potentially overestimate the predicted concentrations in the modelled catchments…The model results are based on the input data collected during site characterization studies and environmental effects monitoring (EEM) studies conducted by Golder and other consultants. Known processes (e.g., metal leaching from waste rock and cover materials) were incorporated based on data as provided. Changes in the Site conditions, input data, or assumptions regarding the site conditions will necessarily result in changes to water quality model predictions."*

*This information should be considered by LMI in preparing the updated Post-Closure Monitoring Program.*

**5.2.9 TCA Cover Rev. 0, Oct 2019 (App. H-09)**

The report was commissioned to fulfill Technical Commitments No. 10, as requested by CIRNAC.

Test pits were excavated at two locations within the TCA, in Cells 1 and 2.

A location map of the 2 cells within the TCA should have been provided showing where the test pits were excavated and where the 7 standpipes are located.

The report compares water levels and water quality in 7 standpipes in Cell 1 collected in 2002 and 2019. No mention is made of why water quality from only 5 of the 7 standpipes is provided.

The report concludes that there was a saturated layer of cover material above the tailings and that there was no evidence of oxidized tailings in the two test pits and that the water quality results in 2002 and 2019 are comparable.

No mention is made why there wasn't comparable data (i.e., 2002 & 2019 water levels and water quality comparison) provided for Cell 2.

**5.2.10 APEC 2017 (App. H-04.4)**

This one-page map of the site is titled Areas of Potential Environmental Concern and is dated Oct. 17, 2017.

As was the case with the earlier Golder drawing (see 5.2.7, above) this drawing makes no reference to an accompanying report where results of all the sampling locations are presented, which is presumably the 2017 Phase 1 & 2 Environmental Site Assessment report.

It is unknown why this figure is a part of the supporting documents for this 2020 review of the FCRP but the ESA report is not.

**5.2.11 Climate Model Rev. 0, Oct 2019 (App. H-02)**

The report was commissioned to fulfill Technical Commitments No. 13, as requested by CIRNAC.

The purpose of the modelling was to assess the potential for long-term permafrost thaw of frozen tailings dams under three climate warming scenarios, these simulating three emission scenarios (Low (LES), medium (AES) and high (HES)).

The report concluded that the LES and AES did not result in long-term progressive permafrost thaw in the TCA dams. The LES and AES were considered to be more realistic climate models than the HES, based on data from the second half of the 20$^{th}$ century in Canada. The HES predicted that there would be long-term progressive permafrost thawing which would result in a permafrost thaw depth of 14 m below ground surface by the year 2100.

It states long-term progressive permafrost thaw is expected to begin in the latter quarter of the 21$^{st}$ century. However, it did not provide any numerical estimates for the permafrost thaw depth for the "more realistic" AES and LES methods for the year 2100.

*LMI should provide the AES and LES numerical estimates of the permafrost thaw depth for the year 2100.*

**5.2.12 Geophysics Rev. 0, Oct 2019 (App. H-11)**

The report was commissioned to fulfill Technical Commitments No. 11, as requested by ECCC.

The request was for geophysical surveys to be undertaken of two selected dams. However, it is unclear which dams were being requested for surveying. LMI selected Dams 3D and 4 and stated the reasons they were selected was because they had thermistors already installed in them and that they represented one internal and one external dam.

The purpose was to assess whether there were any thawed ice core sections in the dams that could lead to seepages through the dams.

The Stantec cover letter introduced the commitment and outlines the subcontractor's task. The cover letter does not provide conclusions on the work undertaken by Aurora Geosciences Ltd. The Aurora report also makes no specific conclusions but rather provides results and interpretations that seem to suggest both dams have continuous ice cores, as per design.

*Stantec should clarify the results and especially the conclusions of the Aurora work to confirm the acceptable conditions of the frozen dam cores, as they were the party that made the commitment and they commissioned the work*.

**5.2.13 Decision Matrix Rev. 0, (App. H-10)**

The report was commissioned to fulfill Technical Commitments No. 8, as requested by CIRNAC.

The purpose of the document was to provide proposed plans on how to deal with tailings or other contaminants which become exposed as a result of lowering the water levels in the TCA tailings ponds.

A single flowsheet decision matrix was presented in the document.

The flowsheet oversimplified the options review in that it suggested either covering contaminated areas or relocating all of the contaminated materials into Cell 3 and/or 5. It presented a bias towards cover-in-place, and not excavating and relocation, nor any other commonly used methods. In fact, a number of different methods may be most effective for the overall TCA, as each contaminated area should be evaluated separately and the methods that work best for each situation should be employed across the entire TCA facility (and the site).

**5.2.14 APEC Tables 2006 (App. H-04.3)**

This group of tables was meant to accompany the site map titled "Areas of Potential Environmental Concern" (in App. H-04.1) both of which are presumably part of a larger complete report, all prepared by Morrow Environmental in 2006, which followed up Morrow's earlier 2004 Ecological Risk Assessment. The main report, the 2006 Phase One and Two Environmental Site Assessment report is not a part of the supporting documents included in the NWB ftp site with the 2020 FCRP and supporting documents.

The tables presented a comprehensive listing of the areas of potential environmental concern, what the contaminants of concern were, what photos were taken, numbers of any test pits dug and sampled and then the specific soil or water quality analyses that should be undertaken. However, it didn't list the specific sample designations of samples that were taken and presumably analyzed.

The 2006 report was issued shortly after the mine ceased production and shut down at the beginning of 2006.

Ongoing assessment work has been undertaken since that time, with the issuance of reports such as Golder's 2017 Updated Phase 1 & II Environmental Site Assessment and their 2019 Human Health and Ecological Risk Assessment report (interestingly neither of which are part of the FCRP package of supporting documents). All of the reports have been utilized in the preparation of the FCRP.

### 5.2.15 APEC Locations Map 2006 (App. H-04.1)

This consists of a site map overlaid by numbered areas of potential environmental concern that are described in Morrow's tables and report, as discussed in 5.2.14, above.

### 5.2.16 Investigation Locations 2006 (App. H-04.2)

This one-page site map shows location of where detailed investigations were undertaken during the 2005 field program by Morrow Environmental. Similar to the other 2 documents from the 2006 Morrow ESA included above (in 5.2.14 & 5.2.15) these three items were part of the Morrow ESA report. This program has been subsequently built upon in more recent studies, most of which were listed in the FCRP References and/or in the Technical Memo provided in Appendix H (which this section of the report provides comments on).

## 6. LMI COMMITMENTS TO UNDERTAKE FUTURE WORK

**Due date unkown:** The Conclusions section of FCRP supporting document Appendix H-5 (Golder 2019) mentions that additional geochemical characterization of waste rock will continue using samples collected from the site in August 2019. It is unknown whether the results of this additional sampling have been published and if so, has it already been considered in follow-up water quality modelling and what were its results, or whether it recommended that any additional work is warranted?

**Due date Feb 28, 2021:** - An updated and expanded Post-Closure Monitoring Plan (PCMP) to be provided within one year of new Water License issuance. This Plan is to incorporate regulatory review comments, where applicable, results of other inputs such as the HHERA and the new Water License 2AM-LUP2032 (Ref: FCRP Sec. 3.2.1).

**Due date unknown:** A QA/QC program for remediation of contaminated soils on the site is to be issued out for comments before the remedial activities commence (Ref: FCRP Sec. 4.3.2.3). The text mentions several aspects of such a program and states that additional details will be provided in the new PCMP.

**Due date unknown:** Engineering drawings and specifications are to be provided to contractors handling the relocation and isolation of the waste rock and a QA/QC program will be developed that will ensure the program is undertaken satisfactorily (Ref: Sec. 4.3.2.7).

**Due date unknown:** An intrusive hazardous materials assessment (including building materials) is to be completed prior to any demolition activities (Ref: Sec. 4.3.2.9).

**Due date - During final reclamation and closure planning:** Sec. 4.3.2.10 of the FCRP states that a risk assessment will be undertaken to evaluate the likelihood of adverse ecological or environmental effects from the future use of the property.

**Due date unknown:** Sec 4.3.2.13 of the FCRP states that engineering drawings and technical specifications will be prepared for the two spillway types required for the TCA, one being the internal dam spillways required immediately and the other being the two final spillways over dam Nos. J & 1A required for the post-closure passive water system envisioned for the TCA.

**2021:** FCRP Table 20 includes a number of locations where new geotechnical instrumentation will be installed, and a number of locations where existing non-functioning instrumentation is to be replaced.

## 7. CONTINUING UNCERTAINTIES

The following uncertainties were noted during the author's review of the FCRP package;

- The final, total quantity of contaminated soils (PHC, As, PAG) requiring remediation as is identified as an uncertainty in the FCRP text (Ref: FCRP Sec. 4.3.2.3);
- The rate of minewater filling the underground mine workings and the possibility of the mine flooding to the collar, or to another lower elevation location where it can flow out onto the surface or into the local groundwater and eventually reach and potentially affect the water quality in one (or more) of the downstream lakes (Ref: Sec. 4.3.2.4 – Contingency Program);
- The quantity of acceptable quality esker material available for identified reclamation tasks (i.e., is there enough?);
- The duration of the new post-closure monitoring (and maintenance) plan. Five years is being proposed; however due to short summer seasons and significant quantities of 1) covered PAG waste rock, 2) soils contaminated with PHC and/or As, and 3) the unknown duration until the re-configuration of the TCA can be made into its final post-closure passive water flow setup and then achieving long-term equilibrium water quality values from the facility, a significantly longer duration of monitoring and/or further remediation plan may be required to ensure seepage and runoff waters from these areas and downstream water quality monitoring sites have reached long-term and satisfactory water quality levels.

## 8. CONCLUSIONS AND RECOMMENDATIONS

### 8.1 Conclusions

The FCRP package (FCRP and supporting documents) provides an updated closure plan for the site and provides adequate supporting documents and references to enable approval of the Plan.

However, a number of deficiencies were noted by the author in reviewing the FCRP package as noted in the report, above.

Although the KIA are a secondary stakeholder in the project and in the review process, it is in their best long-term interest that the site be properly remediated and closed. The site is located in the Kitikmeot Region of western Nunavut. Section 1.3.5 of the FCRP states *"…The KIA is the entity responsible for defending, preserving and promoting social, cultural and economic benefit to Inuit in the Kitikmeot Region…"* CIRNAC is the lead regulatory agency (as the site is located entirely on crown lands) overseeing the closure plan and as such are responsible for the Lupin Mine's ultimate and final closure that meet all the closure requirements and objectives.

### 8.2 Recommendations

LMI and the various regulatory agencies and stakeholders should all consider the items mentioned in this report as it is in everyone's best interest that the site be closed and prepared for the long-term to the best extent possible.

Relevant regulatory agencies will need to carefully monitor progress in implementing the closure tasks, to ensure they are undertaken safely and as per the Plan. This should involve timely reviews of submitted specific progress reports, monitoring data reports, regular annual reporting, specified commitments, etc. These need to be supplemented by regular site inspections, especially during the Active Phase when a significant amount of work towards properly and permanently remediating the site will be undertaken.

<Original signed by>
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## 9. REFERENCES

Nunavut Water Board 2020, *Nunavut Water Board Water License No. 2AM-LUP2032*, February 28, 2020

Stantec 2020, *Reference: Supporting Information to the Contingency Contaminants Management Decision Matrix*, Prepared for LMI, Stantec Consulting Limited, January 2020