NUNAVUT WATER BOARD
LUPIN MINE WATER LICENCE 2AM-LUP1520



THIRD PARTY TECHNICAL REVIEW OF RECLAMATION SECURITY ESTIMATES FOR THE LUPIN GOLD MINE, NUNAVUT

PREPARED FOR:

Nunavut Water Board
P.O. Box 119
Gjoa Haven, Nunavut
Canada, X0B 1J0

PREPARED BY:

Knight Piésold Ltd.
1650 Main Street West
North Bay, ON P1B 8G5 Canada
p. +1.705.476.2165 | f. +1.705.474.8095

NB102-492/1-1
Rev 0
December 6, 2016

Knight Piésold
CONSULTING
www.knightpiesold.com

ISO 9001
ISO 14001
OHSAS 18001
FS 64925
EMS 550121
OHS 550122

NUNAVUT WATER BOARD
LUPIN MINE WATER LICENCE 2AM-LUP1520

THIRD PARTY TECHNICAL REVIEW OF RECLAMATION SECURITY ESTIMATES FOR THE LUPIN GOLD MINE, NUNAVUT
NB102-492/1-1

Rev	Description	Date
0	Issued in Final	December 6, 2016

Knight Piésold Ltd.
1650 Main Street West
North Bay, Ontario Canada P1B 8G5
Telephone: (705) 476-2165
Facsimile: (705) 474-8095
www.knightpiesold.com

Knight Piésold
CONSULTING

EXECUTIVE SUMMARY

INTRODUCTION

Knight Piésold Ltd. (KP) was retained by the Nunavut Water Board (NWB; the Board) to conduct a third-party review of the Lupin Mine Reclamation Security Estimate.

The NWB requires mine owners to post reclamation security under the authority of a Type A Water Licence. Reclamation security estimates for the Lupin Mine have been prepared by the mine owner (Lupin Mines Incorporated; LMI) and the Department of Indigenous and Northern Affairs Canada (INAC). The discrepancy between estimates presented by LMI and INAC (the Parties) is approximately $20 million. Numerous discussions have been held between the Board and the Parties between 2015 and 2016, and the substantial disagreement remains between the Parties on the appropriate reclamation security to be posted for the Project.

As such, the NWB, under the authority granted by s.30 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, elected to contract an independent third-party to review and evaluate the reclamation security estimates provided by the Parties and to recommend an appropriate reclamation security amount for the Lupin Mine.

BACKGROUND

The Lupin Mine is a gold mine located on the south shore of Contwoyto Lake, Nunavut. The mine operated between 1982 and 2005 and has been on care and maintenance since 2005. During the period of 2011 to 2013, LMI completed works in preparation for a planned re-start of operations in 2015, though the re-start has been postponed pending resurgence in the price of gold.

LMI was issued Type A Water Licence No. 2AM-LUP1520 on August 19, 2015 for the current care and maintenance phase and transition phase of the Project. The Licence allows LMI to continue to use water and deposit waste to conduct various care and maintenance and limited “ramp up” activities at the site of the formerly active Lupin Gold Mine for a period of five years (2015-2020).

LMI (2014) developed a cost estimate in the amount of approximately $24.1 million in support of licensing, and also in support of licensing, INAC retained SENES Consultants (now Arcadis Canada Inc.) to develop reclamation security estimates for the Lupin Mine (SENES, 2014; Arcadis, 2015). INAC’s reclamation security estimate was approximately $45.5 million. Reclamation security was a key discussion point during water licensing in 2015. Upon issuance of Type A Water Licence No. 2AM-LUP1520, LMI was directed to posted reclamation security in the amount of $25.5 million in accordance with Part C, Item 1 of the Licence.

INAC subsequently requested that the NWB amend the licence’s security provisions to increase the reclamation security amount from $25.5 million to approximately $45.5 million. The NWB initiated the relevant amendment process, which is currently ongoing, after determining that INAC provided sufficient rationale to support the requested amendment.

Since that time, the NWB has given the Parties several opportunities to resolve outstanding issues and reaching agreement on a reasonable reclamation security estimate for the undertaking. Substantial disagreement exists between the Parties in respect of the following issues:

a. Effect and extent of material changes to site conditions since the Licence issued in 2015:
   i. Increased petroleum hydrocarbon contamination flagged by INAC over that included in LMI's original estimate;
   ii. Remedial/waste management work completed by LMI since LMI/INAC estimates prepared; and
   iii. Spills/releases or other additional contaminant impacts identified since LMI /INAC estimates prepared;

b. Accounting for interim care and maintenance;

c. Appropriate term for post-closure monitoring and maintenance;

d. Closure planning costs (including potential amendments to water licence, hearings, applications and reports);

e. Use of fuel left on-site (and contribution to mobilization and demobilization costs as well as waste disposal costs);

f. Tailings cover requirements (past, existing and future);

g. Changes in Reclaim (6.1 and 7.0) unit rates since LMI/INAC estimates were prepared;

h. Chemical and waste management/disposal requirements upon site closure and reclamation;

i. Mobilization/De-mobilization requirements for equipment required to complete closure and reclamation;

j. Selection of appropriate contingency amount (overall and in specific sections); and

k. Potential "double counting" in INAC's building decommissioning estimates (use of LMI's higher unit costs without the recognition that these costs included a number of items that were then added on top of the unit costs in other sections of INAC's estimate).

FINDINGS

KP found that despite areas of substantial disagreement between the Parties, that there were items and components where there was close alignment between the estimates. It is evident that both Parties had given careful consideration in developing their respective reclamation security estimates. Though the mine owner's costs were generally lower than INACs, there were a number of site-specific unit rates applied in the owner's cost estimate that were at the upper end or higher than the most recent RECLAIM unit rates. There were several instances where KP's recommended cost estimates were lower than one or both parties.

Our findings are summarized as follows:

- **Direct Costs:**
  - **Underground Mine -** There was little discrepancy between the Parties with respect to reclamation of the underground mine. INAC assumed that hazardous materials haven't been removed from the underground; however, evidence suggests that these materials have been removed.
  - **Tailings Containment Area -** This was an area of substantial disagreement between the parties. The main discrepancy was on the area to be covered and the related quantity of cover. KP elected to adopt the area specified in the IARP. Other discrepancies existed with respect to unit rates and quantities.
  - **Rock Pile -** The primary discrepancy was with respect to unit rates to relocate any acid-generating or metal leaching waste rock. KP recommended a more suitable unit rate that was between the rates presented by the Parties. KP also identified a number of studies that were identified in the IARP that were not included in either reclamation security estimate.
  - **Buildings and Equipment -** Additional information on potential hazardous materials in the buildings was available to KP that had not been made available to INAC. INAC had conservatively assumed considerable costs for building decontamination that were not warranted based on the available additional information and considering the high unit rate for building removal used by LMI. In the end, KP's recommended estimate for buildings and equipment is similar to both that of LMI and INAC.
  - **Chemicals/Contaminated Soil Management -** This was an area of substantial disagreement between the Parties. INAC included substantial costs for hazardous materials removal. LMI has removed considerable hazardous materials from site, but in the absence of a current inventory, KP recommends carrying INAC's cost for hazardous materials removal. KP recommends a revised cost for a contaminated soil investigation that is between the estimates provided by the Parties. With respect to contaminated soil removal, INAC suspects additional contamination beneath the tank farm and increased the reclamation cost accordingly. KP suggests that INAC's assumption around additional contamination has not been confirmed and that it is not appropriate under the circumstances. Any such exceedances can be captured by the contingency applied to the total reclamation security estimate. KP recommends that LMI's quantity of contaminated soil be carried forward, and that an investigation be undertaken in the near future to update the quantity of contaminated soil in the reclamation security estimate based on the findings of the investigation.
  - **Interim Care and Maintenance -** LMI did not include a cost for this as this was not a cost module in the RECLAIM 6.1 package that they utilized for the preparation of their estimate. KP recommends adopting INAC's annual cost for interim care and maintenance, but reducing the duration from 5 years to 3 years.
- **Indirect Costs:**
  - **Mobilization/Demobilization -** During the site visit, the Parties agreed that mobilization and demobilization costs should be based on construction of only a portion of the winter road. KP recommends that this be calculated from the turnoff to the Gahcho Kue Mine.
  - **Post-Closure Monitoring and Maintenance** - INAC recommended post-closure monitoring for a period of 100 years on the basis that the tailings are arsenic-containing and

acid-generating. KP recommends LMI's post-closure monitoring period of 25 years is appropriate where long-term/indefinite water treatment is not required.

- **Engineering -** LMI estimated engineering costs based on 4% of direct costs compared to INAC's estimate of 10% of direct costs. The Mackenzie Valley Land and Water Board (MVLWB) draft guidelines for developing reclamation security estimates recommends 5% of direct costs for projects that have a final abandonment and reclamation plan in place. KP recommends 8% engineering considering that a final ARP remains to be developed and approved through consultation with communities and water licensing.
- **Project Management -** KP agrees with INAC that project management should be 5% of direct costs, not 4% of direct costs as proposed by LMI.
- **Health & Safety / Monitoring and QA/QC -** KP agrees with LMI that these costs are embedded in the engineering, project management and contractor unit rates.
- **Bonding / Insurance -** These costs are included in third-party contractor rates.
- **Contingency** - LMI applied a 10% contingency factor, whereas INAC applied a 20% contingency factor. Based on MVLWB guiadance, KP suggests that 15% contingency better reflects the level of understanding of closure and associated reclamation costs.

RECOMMENDED RECLAMATION SECURITY ESTIMATE

Based on the outcome of this third-party review, KP recommends the reclamation security estimate for the Lupin Mine should be **$ 34,650,000**. A summary breakdown of the resultant recommended reclamation security estimate is presented below in Table 1.

The above reclamation security estimate was derived using reasoned judgement of appropriate costs based:

- On the unit rates in the current version of RECLAIM (version 7.0)
- Available guidance by INAC (2002) and MVLWB (2014). Including the cost estimates and reasoning provided
- Consistency with the IARP
- KP's own experience in estimating mine closure costs and supervising mine reclamation programs.

The review did not include a technical review of the adequacy of the closure measures presented in the IARP, and did not verify the quantities presented in the Parties' reclamation security estimates.

ADDITIONAL WORK TO BE COMPLETED

LMI's March 2016 IARP was referred to as it was consistent with LMI's 2014 cost estimate. However, this version of the IARP has not undergone technical review and approval by the NWB.

During the site visit the Parties discussed that an unknown volume of tailings had been deposited at the northwest corner of Cell 4, which is otherwise not used for tailings disposal. A portion of these tailings are surface exposed and any submerged tailings in this area will become exposed if water levels in Cell 4 are lowered as planned. LMI should determine the appropriate disposal method for these tailings in the next iteration of the IARP.

It is recommended that the costs to address the high priority maintenance items identified by Norwest (2016) during the most recent geotechnical inspection be added to the next update of its reclamation security estimate.

Table 1 Reclamation Security Estimate Comparison

Component/Activity	LMI Estimate	INAC Estimate	Recommended Reclamation Estimate
Direct Costs			
Underground Mine	$439,639	$506,380	$464,639
Tailings Facility	$3,935,562	$7,231,080	$5,121,410
Rock Pile	$1,887,702	$3,580,000	$3,200,000
Buildings and Equipment	$6,664,708	$6,577,883	$6,402,466
Chemicals/Contaminated Soil Management	$2,498,718	$7,212,041	$5,633,866
Surface and Groundwater Management	$0	$0	$ 0
Interim Care and Maintenance	$0	$644,488	$386,693
Total Direct Costs	**$15,426,332**	**$25,751,872**	**$21,209,074**
Indirect Costs			
Mobilization/Demobilization	$4,917,904	$8,078,895	$6,671,462
Post-Closure Monitoring and Maintenance	$830,014	$2,186,376	$830,014
Engineering	$650,254	$2,575,187	$1,696,726
Project Management	$650,254	$287,594	$1,060,454
Health & Safety / Monitoring & QA/QC	$0	$257,519	$0
Bonding / Insurance	$0	$257,519	$0
Contingency	$1,625,634	$5,150,374	$3,181,361
Market Price Factor Adjustment	$0	$0	$0
Total Indirect Costs	**$8,674,060**	**$19,793,464**	**$13,440,017**
TOTAL RECLAMATION ESTIMATE	**$24,100,392**	**$45,545,336**	**$34,649,091**

TABLE OF CONTENTS

PAGE

TABLES

APPENDICES

ABBREVIATIONS

ACMs ..... Asbestos-Containing Materials
Arcadis ..... Arcadis Canada Inc.
ARD/ML ..... Acid Rock Drainage/Metal Leachate
ESA ..... Environmental Site Assessment
IARP ..... Interim Abandonment and Restoration Plan
IFC ..... Issued for Construction
INAC ..... Indigenous and Northern Affairs Canada
KP ..... Knight Piésold Ltd.
LMI ..... Lupin Mines Incorporated
MVLWB ..... Mackenzie Valley Land and Water Board
Norwest ..... Norwest Corporation
NWB ..... Nunavut Water Board
PAG ..... Potentially Acid Generating
TCA ..... Tailings Containment Area

1 – INTRODUCTION

1.1 GENERAL

Knight Piésold Ltd. was retained by the Nunavut Water Board (NWB; the Board) to conduct this third-party review of the Lupin Mine Reclamation Security Estimate.

The Lupin Mine is a gold mine located on the south shore of Contwoyto Lake, Nunavut. The mine operated between 1982 and 2005 and has been on care and maintenance since 2005. During the period of 2011 to 2013, LMI completed works in preparation for a planned re-start of operations in 2015, though the re-start has been postponed pending resurgence in the price of gold.

Reclamation security estimates have been prepared by the mine owner, Lupin Mines Incorporated (LMI, 2014) and by Arcadis Canada Inc. (Arcadis, 2015) on behalf of the Department of Indigenous and Northern Affairs Canada (INAC). There is considerable discrepancy between the mine owner's reclamation security estimate and the one prepared on behalf of INAC. As a result of this discrepancy, NWB asked a neutral third-party contractor to complete a review of both reclamation security estimates.

1.2 BACKGROUND

LMI was issued Type A Water Licence No. 2AM-LUP1520 on August 19, 2015 for both the current care and maintenance phase and a transition phase of the Project. The Licence allows LMI to continue to use water and deposit waste conduct various care and maintenance activities. The current Licence also allows for limited "ramp up" activities at the Lupin Gold Mine site for a period of five years (2015 to 2020).

The recent history with respect to reclamation security for the Lupin Mine is summarized as follows:

- LMI filed an Interim Abandonment and Restoration Plan (IARP) in March 2013 as part of its 2012 annual reporting under its Type A Water Licence.
- LMI filed a reclamation security estimate using RECLAIM version 6.1 in 2014, in support of the water licensing renewal process.
- During the Licence renewal process in 2015, INAC asserted that the current posted reclamation security amount of $25.5M was inadequate.
- NWB issued LMI the current Type A Water Licence in August 2015, with an acknowledgement that INAC could revisit the quantum of security through an licence amendment.
- The Minister of INAC supported the issuance of the water licence in an October 2015 letter, with the stated expectation that the amount of security would be reconsidered in the near term.
- INAC filed a request with the NWB for a licence amendment in regard to the quantum of security on January 22, 2016. The request was accompanied by a RECLAIM estimate of the Lupin closure costs prepared by Arcadis Canada Inc. (Arcadis, 2015). The RECLAIM estimate prepared by Arcadis was in the amount of approximately $45.5M.
- LMI filed a revised IARP with the NWB in March 2016.
- The NWB initiated the Licence amendment process after determining that the rationale provided in INAC's submission was adequate to support the requested amendment.

During the current amendment process, the NWB has given LMI and INAC ("the Parties") multiple opportunities to provide comments with respect to each other's reclamation security estimates, with a view to resolving outstanding issues and reaching an agreement on a reasonable reclamation security estimate. Following Board-coordinated teleconference meetings on August 18 and 24, 2016, there continued to be substantial disagreement between the Parties in respect of the following issues:

a. Effect and extent of material changes to site conditions since the Licence issued in 2015:
   i. Increased petroleum hydrocarbon contamination flagged by INAC over that included in LMI's original estimate;
   ii. Remedial/waste management work completed by LMI since LMI/INAC estimates prepared; and
   iii. Spills/releases or other additional contaminant impacts identified since LMI /INAC estimates prepared;

b. Accounting for interim care and maintenance;

c. Appropriate term for post-closure monitoring and maintenance;

d. Closure planning costs (including potential amendments to water licence, hearings, applications and reports);

e. Use of fuel left on-site (and contribution to mobilization and demobilization costs as well as waste disposal costs);

f. Tailings cover requirements (past, existing and future);

g. Changes in Reclaim (6.1 and 7.0) unit rates since LMI/INAC estimates were prepared;

h. Chemical and waste management/disposal requirements upon site closure and reclamation;

i. Mobilization/De-mobilization requirements for equipment required to complete closure and reclamation;

j. Selection of appropriate contingency amount (overall and in specific sections); and

k. Potential "double counting" in INAC's building decommissioning estimates (use of LMI's higher unit costs without the recognition that these costs included a number of items that were then added on top of the unit costs in other sections of INAC's estimate).

The Parties' estimates differ by approximately $20 million with respect to the amount of reclamation security that should be fixed by the NWB under the Licence. As authorized under s.30 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, the NWB is authorized to engage the services of "…such agents, advisers and experts as are necessary for the proper conduct of its business". On this basis, the NWB determined that in the circumstances of this amendment request and process, it was advisable to engage a third-party contractor to review and evaluate the reclamation security estimates provided by both INAC and LMI to date, and to provide recommendations regarding an acceptable security estimate for the Lupin Mine site.

1.3 SCOPE OF WORK

KP's scope of work was to undertake the following (outlined in our contract with the NWB):

- Conduct an independent review of the Parties' submissions on reclamation security received by the NWB to date.
- With the recognition of the outstanding issues listed under the Background subheading above, provide the Contractor's recommendations regarding an acceptable security estimate for the project: INAC's value, LMI's value or a value derived from the analysis of both INAC's and LMI's estimates. The Contractor was not mandated to developing its own independent reclamation security estimate.
- Provide a short summary of the Contractor's site visit, including Contractor's conclusions and any additional information requests required before the Contractor completes the independent review.
- Provide a report to the NWB regarding the Contractor's conclusions following the review of INAC's and LMI's reclamation security estimates and recommendations regarding an acceptable security estimate for the undertaking.
- Provide (if required) a response to questions or issues raised by the Parties to the Contractor's third party review report.

2 – METHODOLOGY

2.1 GENERAL APPROACH

KP's approach to this review consisted of the following:

- An initial review of available information prior to the site visit
- A site visit on October 6 to 7, 2016 by Amber Blackwell, P.Geo., and Dr. Reagan McIsaac of KP (see a site visit memorandum in Appendix A)
- A detailed review of available information
- Preparation of this summary report and a detailed cost comparison table

While a number of documents on the public registry were reviewed, KP focused its review of the reclamation security estimates on the following key documents:

- Arcadis (2015) - Final RECLAIM Cost Model for the Lupin Mine, Nunavut - Lupin Gold Project - Water Licence Renewal Application. October 22. Arcadis Ref. No. 702380-000.
- LMI (2014) - Lupin Mines Closure Estimate Update - December 2014.
- LMI (2016a) - Lupin Mine Site, Nunavut, Canada - Interim Abandonment and Restoration Plan - March 2016.
- LMI (2016b) - Memo to: Dave Hohnstein, Nunavut Water Board (NWB) and Richard Cook (KP). Re: Follow-up Data and Information resulting from site visit of 6th and 7th October 2016. October 17.

A brief summary memo documenting the site visit is presented in Appendix A. The site visit allowed KP to develop familiarity with the site and through discussions on-site with both LMI and INAC, to understand the basis for the reclamation cost estimates developed by each party.

The subsequent review was completed considering the application of the financial security provisions of the *Mine Site Reclamation Policy for Nuna*vut (INAC, 2002), summarized as follows:

- Total financial security for final reclamation should be equal to the total outstanding reclamation liability for land and water combined. The financial security should be sufficient to cover the highest liability over the applicable time period.
- Reclamation cost estimates for financial security purposes should be based on the cost of having the reclamation work completed by a third-party contractor if the operator defaults.
- Estimates should include a contingency that is appropriate to the particular work to be undertaken.
- A recognized methodology such as RECLAIM or some other appropriate model should be used to calculate reclamation costs.
- Consideration should be given to alternate or innovative forms of security.
- Financial security requirements should be clearly set out in water licences, land leases and other regulatory instruments. Alternatively, the security requirements can be specified within a separate agreement if this approach is more applicable.
- Mine operators should be credited for approved progressive reclamation, and the value of financial security required should be adjusted in a timely fashion.

In addition, the Mackenzie Valley Land and Water Board prepared draft guidelines for the preparation of closure cost estimates in the Northwest Territories (MVLWB, 2014). These guidelines are in draft form and have been prepared by an adjacent jurisdiction. Nonetheless, the draft guideline provides some useful insight into what items should be included in the RECLAIM cost estimating model.

KP completed a detailed review of the basis of the reclamation cost estimates developed by both LMI and INAC. A table was developed to present LMI's and INAC's reclamation cost estimates by project component, along with available descriptions of the proposed work. The most appropriate cost estimate for a given component was identified. For items in which KP does not agree with either party's approach, a recommended approach and resultant cost estimate is provided.

2.2 LIMITATIONS

No substantive limitations were placed on KP during the review. The site visit was sufficient to develop a general understanding of the Lupin Mine in its current condition. Both Parties (LMI and INAC) were available to answer questions.

The site visit, did not include a detailed survey of quantities or inventory of materials. Therefore, no verification of quantities presented in the estimates was completed. The review also did not include a detailed technical review of the adequacy of the closure measures presented in the IARP.

3 – FINDINGS

3.1 GENERAL

The detailed cost comparison is presented as Table B.1 in Appendix B. The assumptions or basis for estimate made by both LMI and INAC are summarized in the table along with KP's comments on the Parties' reclamation security estimates and KP's resultant reclamation security estimate.

Further discussion on each major cost item is provided below, organized based on the RECLAIM 7.0 layout developed and used by INAC, as presented by Arcadis (2015).

3.2 DIRECT COSTS

3.2.1 Underground Mine

Entrances to the underground include five (5) shafts and one portal. Closure measures for the underground include capping or covering the entrances to eliminate access. It is expected that all hazardous materials would be removed from the underground workings prior to removing access. The assumptions made by LMI and INAC in this regard are described below.

- **Control Access -** INAC and LMI have used the same unit rate for capping the 5 raises. There is considerable difference in the unit rates applied to backfilling the open stope and adits: LMI used \$3.50/m^3 based on the RECLAIM 6.1 high unit rate for dozing soil piles. INAC used a rate of \$14.20/m^3 based on the cost to excavate/load/haul/spread/compact. KP noted sufficient stockpiles adjacent the open stope such that LMI's assumption of dozing nearby soil is reasonable.

  INAC included the cost for a crown pillar study and LMI did not include this cost. A crown pill study will be required at the Central and West Zones to confirm that subsidence will not be a hazard post-closure.

- **Remove Hazardous Materials -** INAC included costs to decommission and decontaminate any underground equipment left underground. LMI has indicated that equipment has been removed from the underground workings or area. There is no way to verify that this work was completed without investigating, though during the site visit KP observed electrical junction boxes in cold storage, which supports LMI's assertion that equipment had been removed from the underground workings (Appendix A). Additionally, the underground area is already flooded, so to inspect or remove any remaining material would require dewatering of the underground area.

KP recommends the reclamation costs for this item be revised as follows:

- LMI's/INAC's cost for the five (5) engineered caps
- LMI's cost for backfilling the open stope and adit
- Exclude costs to remove hazardous materials
- INAC's cost for a crown pillar study

3.2.2 Tailings Impoundment

The tailings containment area (TCA) at Lupin consists of:

- Five (5) cells containing tailings (Cells 1 through 5)
- Two (2) ponds (Ponds 1 and 2)
- Eight (8) perimeter dams (Dam 1A, 1B, 1C, and Dam 2 through Dam 6)
- Nine (9) internal dams (Dam 3a through 3e, Dams J through N, and the Divider Dykes)

All dams are constructed from esker sand and gravels, with the perimeter dams incorporating a geosynthetics liner for seepage control. All the perimeter dams are designed as frozen core dams founded on permafrost. Generally, the perimeter dams range in height from 1 to 8 metres. The internal dam heights range from 6 to 12 metres (Norwest, 2016).

KP understands from the site visit that repairs were recently completed on the M dam, and repairs were being completed on a section of the cover where standing water has been known to historically accumulate (Appendix A). During the site visit, it was also noted that the northwest corner of Cell 4 contains exposed tailings. Any submerged tailings would also likely become exposed with a lowering of water levels in Cell 4. The current IARP does not account for the management of these tailings.

The closure concept for tailings is to encapsulate the potentially acid-generating tailings within a water saturated esker material cover. This would effectively isolate the tailings from the environment and limit oxygen transfer through to the sulphide contained in the tailings and thus prevent acid generation. At final closure, a system of rip-rap spillways will be constructed to permit natural water flow to the environment. LMI's 2016 IARP describes a number of proposed work activities:

- Breach the divider dyke
- Construct spillways within J-Dam and Dam 1A
- Dam enhancement using quarried rip rap to reduce slopes to 2.5H:1V
- Covering of tailings with a partially saturated 1-m thick granular cover
- Disposal of the tailings pipeline (8.5 km length) in the mine workings
- Disposal of two tailings pump stations

Progressive reclamation is ongoing and has now been completed at several cells. Currently, Cells 1 and 2 appear to be completely reclaimed, while Cell 3 appears to be approximately 80% covered and Cell 5 appears to be approximately 70% covered. According to Norwest (2016), approximately 84% of the entire TCA has been covered by at least 1 m of sand/gravel cover. The uncovered portions of Cells 3 and 5 represent future areas for tailings deposition that were established during the restart of operations (LMI, 2014).

As the progressive reclamation is being completed, some of the internal dams (3a, 3b, 3c, 3e) are incorporated into the cover and are no longer considered as individual dams (Norwest, 2016).

Water management within the TCA during the current care and maintenance phase involves directing runoff and seepage from Cell 3 into Cell 4. The water in Cell 4 then flows through the Divider Dykes either though the control structure or via seepage into Pond 1. Cell 5 runoff is pumped directly into Pond 1. Pond 1 water level is managed by siphoning water into Pond 2. Water treatment is carried out by treating the water in-situ in Pond 2, by adding in lime to raise the pH. Precipitates from this treatment are deposited in Pond 2. The treated water in Pond 2 is siphoned into the environment in accordance

with the Water Licence requirements (NWB, 2015). Pond 2 does not have any flood overflow structures, such as a spillway or a control gate, to manage the water level. All discharge is retained and restricted until water quality meets the discharge requirement outlined in the Water Licence.

The NWB noted that substantial disagreement exists between the Parties in regard to the tailings cover requirements: past, existing and into the future. Reclamation measures associated with the TCA and the assumptions made by the Parties, are described below.

- **Stabilize Embankment(s) -** According to the 2016 IARP, LMI (2016) was in the process of updating the stability analyses for all dams to meet the latest Canadian Dam Safety Guidelines (CDA, 2013). During the site visit, KP learned that repairs were recently completed on the M dam. A Dam Safety Review was completed by SRK Consulting in 2015 (SRK, 2016) and a Dam Safety Inspection of the TCA containment structures was completed in 2016 by Norwest. Norwest (2016) identified several high priority maintenance items.

  The IARP contemplated dam enhancements involving the placement of quarried rip rap to reduce slopes to 2.5H:1V. LMI assumed that 80,000 m^3 of rip rap would be used to stabilize embankments, whereas INAC estimated the quantity of material required to be 100,000 m^3. Both quantities are similar to one another and neither is supported by engineering design. KP recommends using the mid-point of the two quantities (90,000 m^3). LMI used a specified unit rate of \$15.20/m^3 and INAC used RECLAIM's high unit rate of \$17.80/m^3. Since LMI's specified rate is between the low and high values for this rate, LMI's rate appears reasonable.

  KP also recommends that the costs to address the high priority maintenance items identified by Norwest (2016) be added to the reclamation cost estimate.

- **Cover Tailings -** The IARP proposes a partially saturated soil cover over the tailings. LMI has been actively placing cover in 2016 and Norwest (2016) estimated that 84% of the TCA has been covered.

  LMI and INAC assumed different quantities to cover the tailings. LMI specified 241,328 m^3 of soil cover, corresponding to a 1 m cover over a 241,328 m^2 area as specified in the IARP. INAC used a larger quantity of material of 375,000 m^3, which appeared in LMI's 2012 reclamation estimate. LMI's quantity is consistent with the IARP and is assumed to be more precise on this basis.

  LMI used a unit rate of \$7.24/m^3. LMI's unit cost is based upon prorated actual costs from 2005. INAC used the low RECLAIM unit rate of \$9.30/m^3 for excavate, long-haul, spread and compact. KP recommends that LMI's quantity estimate and INAC's more current unit rate be adopted for this item.

  Tailings observed during the site visit in the northwest corner of Cell 4 will require appropriate closure measures. The likely approach will be to excavate and place the tailings in Cell 4 at a new location that will be beneath the partially saturated cover. The quantity of tailings at this location requiring management is currently unknown, though LMI has demarcated the extent of tailings with wooden stakes. It is recommended that LMI include the management of these tailings in the next revision to its IARP and update the reclamation security estimate for this item, accordingly.

  INAC also included costs for revegetation (\$200,000). While re-vegetation is not specified in the IARP, INAC included this item because of the following requirement in Part I, Item 8 of the current water licence: "…*the Licensee shall implement Progressive Reclamation, including progressive*

covering of the tailings and re-vegetation where feasible, as soon as is realistically possible." KP understands why INAC has included this cost item based on direction provided in the water licence. The reclamation cost estimate, however, should be based on the current version of the IARP. What is feasible with respect to revegetation is a technical determination beyond the scope of this third-party review.

INAC also included ($186,000) for repairs to the existing soil cover.

KP recommends that the latest RECLAIM unit rate used by INAC be adopted for this item; costs for revegetation should be excluded, but costs for cover repair should be included. An allowance of $100,000 should be included to excavate and dispose of tailings from the northwest corner of Cell 4. LMI may seek a credit for progressively covering the tailings.

- **Remove Tailings Discharge -** There is a 6-km long tailings line external to the TCA, and 2.5 km of tailings line within the TCA, according to the IARP.

  Both Parties are in agreement on the cost of this item. KP suggests that this unit rate ($57.33/m) could be replaced with the low RECLAIM unit rate for large pipelines since the pipeline is not being salvaged and will be disposed of on-site. The additional 2.5 km of tailings pipeline located within the TCA should be included in this cost item.

- **Upgrade Spillway -** LMI assumed a rip rap quantity of 20,000 m^3 to construct the two spillways, with a unit rate of $28.37/$m^3$. INAC used the same quantity of rip rap with a slightly higher rate of $30.75. Both rates are based on a long haul and are considerably higher than the rates presented by both Parties for rip rap to be used in stabilizing the embankments. KP recommends applying LMI's unit rate for rip rap used to stabilize the dams ($15.20/$m^3$).

  INAC included costs for excavating the channels and for geotextile fabric, and LMI did not. INAC's quantities appear reasonable, though a long haul/spread and compact unit rate (SC3H) was used for excavating soil under high specifications. It should be sufficient to place and spread the excavated material close to the spillway, such that a lower unit rate such as SC1H could be applied.

- **Specialized Items -** Both Parties included the same costs for installing permanent instrumentation for monitoring.

- **Treat Supernatant -** INAC included an allowance to treat supernatant during reclamation of the TCA, which appears appropriate.

3.2.3 Waste Rock

Approximately 1,000,000 m^3 of waste rock was used in construction of site facilities including dam construction, road building, laydown areas and building foundation preparation (URS, 2005 in Arcadis, 2015). An unknown quantity of waste rock remains stockpiled at the ball field area. A portion of this stockpile was relocated to the TCA in recent years.

Two previous studies characterized waste rock across the site. Arcadis (2015) noted that URS (2005) tested the coarse cobble fraction of waste rock from roadbeds, tailings dams, the airstrip and the mill complex pad. Approximately 30% of the waste rock samples tested contained sulphide concentrations above 0.3%; however only one of these samples had an acidic paste pH. The results of the

2004 program showed that a portion of the Lupin waste rock had the potential for acid generation. The alkaline pH values of the waste rock indicated acid generation had not yet occurred, even in those samples considered potentially acid generating (URS, 2005).

A subsequent Phase I and 2 Environmental Site Assessment (ESA) conducted by Morrow (2006) reported that the median concentration of arsenic in the development waste rock is 1,140 mg/kg. A seepage assessment found that 40% of the seeps sampled in 2005 were acidic (Morrow, 2006).

LMI's reclamation cost estimate does not include any cost to assess or manage potentially acid generating (PAG) waste rock, though this will be required. LMI (Page 9) and INAC both note that further work will be required to evaluate options for final disposal of PAG waste rock, and assess methods for identifying this material during excavation, if segregation of the rock be the preferred disposal option.

The assumptions made by LMI and INAC in regard to the reclamation requirements presented in Table B.1 are described below.

- **Further Geochemical Characterization of Waste Rock -** Further geochemical evaluation of the waste rock across the site will be required to understand the nature and extent of acid rock drainage/metal leaching (ARD/ML), to support an options assessment of final disposal options. INAC identified a cost of $20,000 to cover the geochemical analyses of 100 waste rock samples. However, INAC did not include costs for sample collection (personnel and equipment) or data analysis by a qualified geochemist.

  KP recommends the cost be included to complete a geochemical evaluation aimed at understanding the nature or ARD/ML impacts and hence waste rock disposal options. All associated costs should be included (sample collection, lab testing and data interpretation).

  The Morrow (2006) study identifies a median arsenic concentration in the waste rock well in exceedance of site remediation guidelines. Therefore, the additional geochemical evaluation should include investigation of arsenic.

- **Risk Assessment -** LMI's IARP states that soil with elevated concentrations of metals (including arsenic) identified by the Morrow (2006) study will be managed on a risk-based approach, and that the risk assessment will be completed during final reclamation and closure planning (page 38). A cost will need to be allocated to complete the risk assessment.

- **Waste Rock Options Assessment -** Though a waste rock options study was identified by both LMI and INAC, neither party allocated a cost to complete such a study.

  In the absence of an options study and alternative disposal plans, INAC assumed that 40% of the 1,000,000 m^3 of waste rock (400,000 m^3) of the waste rock may be potentially acid generating (PAG), requiring disposal in the TCA (100,000 m^3) and underground (300,000 m^3).

  KP recommends a cost be allocated to a waste rock disposal options study. The options assessment should address the viability of and site-specific costs associated with disposing of waste rock in the TCA versus underground. For example, the options study should confirm that adequate space exists for any waste rock allocated for disposal underground, and costs to dewater the underground (if required) should be identified.

- **Relocate Dumps -** Both parties assumed 400,000 m^3 of ARD/ML waste rock will require disposal in the TCA or underground. LMI applied a unit rate of \$4.72/m^3, which is the RECLAIM 6.1 rate for excavation and short-haul of waste rock or rip rap. INAC used a unit rate of \$8.90/m^3 (code SC3L for the excavation/load/short haul/spread and compact).

  KP recommends that the RECLAIM 7.0 unit rate RR3 (\$7.00/m^3) be used for this item.

3.2.4 Buildings and Equipment

Most of the original buildings remain at the site, including the mill, powerhouse, headframe, hoist room, maintenance stops and storage buildings. Closure measures include isolating the buildings (removing water, sewer, glycol heating systems), removing any hazardous materials, and demolishing and placing the waste in the closure landfill.

A designated substances survey of the mill buildings was completed by Arctic Response in 2012. This survey identified the following:

- No friable asbestos-containing materials (ACMs) were identified in the survey. The surveyors observed fiberglass pipe insulation at certain locations but noted that large portions of the buildings were not surveyed. Floor and ceiling tiles were analyzed and were determined to be not ACMs (<1% asbestos).
- The majority of paint tested in the survey is lead-containing.
- Mould was identified throughout the buildings.

The recovery plant and lab were assessed to be high risk areas due to the presence or potential presence of chemicals and due to mould contamination (Arctic Response, 2012).

The potential for double counting was identified by the NWB as an issue of substantial disagreement between the Parties. KP found that LMI used high unit rates for building removal that should be sufficient to account for management of hazardous materials associated with building removal. INAC's building decommissioning estimates applied LMI's high unit costs for building removal, but also included costs for building decontamination and hazardous materials removal accounted for elsewhere by INAC.

INAC's building decommissioning estimates applied LMI's high unit costs for building removal without recognition that the costs included a number of items also accounted elsewhere by INAC. The overall cost for buildings is similar between The Parties (LMI estimated \$6,664,708 and INAC estimated \$6,577,883).

The assumptions made by LMI and INAC in regard to the reclamation requirements presented in Table B.1 are described below.

- **Isolate Buildings -** The cost estimates for isolating the buildings (removing waste, water, glycol and sewer connections and distribution) are nearly identical for both Parties.
- **Decontaminate Buildings -** The Parties' costs to decontaminate buildings differs considerably. LMI included a cost of \$193,572 reportedly based on a 2014 contractor rate. In Section 2.1 of LMI's reclamation cost estimate, LMI indicates that all cost estimates were reviewed by an experienced contractor. KP notes that while this is useful, it is not the same as a contractor cost estimate.

INAC included the following costs related to decontamination of buildings:

- Decontaminate oil, fuel - $373,390
- Decontaminate offices/warehouse/accommodations - using the low RECLAIM unit rate of asbestos abatement - $629,299
- Removal of asbestos on building siding - $128,000

INAC's total cost for building decontamination is $1,130,689. INAC appears to have prepared this cost estimate without the Arctic Response (2012) hygiene survey. As Arcadis states in Section 4.6 of its report that the asbestos abatement budget could be amended once the asbestos assessment report was reviewed by Arcadis. While the 2012 survey was not comprehensive, the survey identified fiberglass (not friable asbestos) within the pipe insulation that was observed. Further, representative sampling of floor and ceiling tiles established that these materials were not ACMs. The Arctic Response report notes that asbestos use in building construction had dramatically decreased during the period when the Lupin Mine buildings were constructed in 1982, making the presence of friable ACMs unlikely but still possible.

KP recommends the following:

- Retain LMI's cost estimate for decontamination of fuel and oil.
- Do not include costs for asbestos abatement, as the presence of tile asbestos has not been confirmed and the presence of friable asbestos in pipe insulation is unlikely.
- Include INAC's cost of $25,000 under chemical/soil area for a hazardous materials audit, to be conducted by LMI in the near future (Section 3.2.5). The hazardous materials audit should be sufficiently comprehensive to confirm with a high level of confidence suitable for building decommissioning (and reclamation costing) whether or not ACMs are present and require special management.

Arctic Response (2012) did identify extensive mould contamination throughout the buildings, which will require special protection measures during building decommissioning. However, the unit rate used for building removal (discussed below) is sufficiently high to account for this.

- **Remove Buildings -** LMI and INAC calculated building demolition costs using the same unit rate ($128.00/$m^2$) and similar total building areas (24,711 m^2 and 24,637 m^2, respectively). The unit rate used by both Parties is well above the range of unit rates presented in RECLAIM for steel building teardown ($45-$65/m^2).

- **Landfill for Demolition Waste -** LMI and INAC are in agreement on costs for cleanup of the boneyard and for operation of the landfill.

  LMI has recently constructed a closure landfill. LMI may seek progressive reclamation credits if boneyard clean-up has been undertaken, and for the proportion of landfill operation that includes landfill construction.

- **Grade and Contour Pads -** Both Parties' cost estimates for concrete foundations and site grading are nearly identical. INAC proposed establishing islands of vegetation ($20,000), but this is not in the IARP.

- **Reclaim Roads and Airstrip -** LMI's cost estimate includes scarifying roads and removing 22 culverts. INAC's cost estimate includes these items but also includes scarifying the airstrip. It was agreed between the Parties during the site visit for this assignment that the airstrip

would not be scarified and would remain in place for long-term monitoring and/or future site redevelopment.

KP recommends carrying LMI's cost estimate for these items.

- **Fuel Tanks and Piping -** Both Parties' cost estimates for fuel tanks and piping are based on the same quantities of tanks and piping. LMI used a unit rate for fuel tank disposal of \$91.57/m^2 compared with INAC's unit rate of \$100.00/m^2. INAC's unit rate is based on the RECLAIM rates for steel teardown for salvage of \$67-\$100/m^2. The steel tanks will be landfilled rather than salvaged, and on this basis, KP recommends using RECLAIM's high value for steel teardown (BRS1) of \$65/m^2.

  Both Parties assumed 2,000 m of fuel piping will require decommissioning, though LMI used a unit rate of \$57.33/m and INAC used RECLAIM's high unit rate for pipelines >6 inches in diameter of \$72.00/m. KP recommends that RECLAIM's high unit rate for small pipelines (PSRH) of \$24/m is more appropriate.

- **Other -** There is no cost in either estimate for decommissioning the main water supply line.

  KP recommends that LMI include a cost for removing and landfilling the main water supply line using the low RECLAIM unit rate for small pipelines.

3.2.5 Chemicals, Hazardous Materials and Contaminated Soils

As identified in Section 1.2, the NWB had noted that there remained substantial disagreement between the parties on the following items:

- Increased petroleum hydrocarbon contamination flagged by INAC over that included in LMI's original estimate.
- Remedial/waste management work completed by LMI since LMI/INAC estimates were prepared.
- Spills/releases or other additional contaminant impacts identified since LMI /INAC estimates prepared.
- Chemical and waste management/disposal requirements upon site closure and reclamation.

The assumptions made by LMI and INAC in regard to the reclamation requirements presented in Table B.1 are described below.

- **Hazardous Materials Audit -** LMI (2016) noted that large quantities of hazardous materials have been removed from site since the 2014 reclamation estimate was prepared, and documentation from the hazardous waste disposal contractor was forthcoming. A Hygiene Assessment completed in 2012 (Arctic Response, 2012). The survey identified lead paint and extensive mould damage. Asbestos-containing materials were not identified in the buildings, though the report authors acknowledged that the investigation of pipe insulation was not exhaustive. Chemicals were identified in the lab and cyanide residuals were suspected in the recovery plant. While not a detailed audit, the survey provides a reasonable grasp of site conditions with respect to hazardous materials.

  INAC included a cost estimate of \$25,000 for an audit, suggesting that this would consist of primarily an asbestos survey but also a chemical inventory at the time of closure. Arctic Response (2012) also noted the need for a detailed survey to inventory any ACMs.

KP agrees with INAC and Arctic Response that a comprehensive audit is required to confirm conclusively whether or not ACMs are present and need to be accounted for in building decommissioning.

- **Hazardous Materials Removal -** KP understands from LMI during the site visit that a large quantity of hazardous materials has been removed from site since 2014 (Appendix A). Drums are still located near the tank farm, though the largest quantity of hazardous material remaining at site is fuel. LMI (2016b) stated that fuel has been tested and meets specifications, and is therefore suitable for use. The nature of reclamation costing is to recognize that fuel may be off-spec at the time of final closure, and therefore any on-site fuel will need to be disposed of as off-spec fuel. LMI has not included any costs for the removal and disposal of hazardous materials, including fuel.

  INAC included considerable costs for removal of the following hazardous materials:
  - Waste oil removal - $120,000
  - Waste fuel removal - $2,813,352
  - Waste batteries - $1,250
  - Laboratory reagents - $25,000
  - Disposal fees - $25,000

  INAC's total cost for removal and disposal of these items is $1,577,926. All except the fuel are understood to be estimates; fuel is based upon LMI's fuel inventory in 2014 or 2015. LMI will have consumed a portion of this fuel with the various progressive reclamation activities underway.

  In the absence of hazardous waste manifests provided by LMI and/or an updated hazardous materials inventory is generated (with updated fuel volume), KP recommends that INAC's cost estimate for hazardous materials removal be carried. LMI can apply for a credit once documentation has been provided updating on-site quantities of hazardous materials.

- **Contaminated Soil Investigation -** The Phase 1 and 2 Environmental Site Assessment (ESA) relied upon by LMI was conducted in 2005, and therefore may not reflect current site conditions. As such, a follow up ESA at the time of final closure is appropriate. LMI budgeted $75,706 for an ESA, whereas INAC budgeted $600,000. INAC suspect's hydrocarbon contamination is present beneath the main tank farm (see next item below), so this should be included in the follow up ESA.

  KP recommends that LMI seek one or more cost estimates to have a follow up ESA completed. The cost to complete such a supplemental investigation, in our experience, is in the order of $200,000.

- **Contaminated Soil Removal -** LMI's estimate of the quantity of hydrocarbon-impacted soils requiring remediation was 40,000 m^3 based on an ESA by Morrow in 2006. INAC added a contingency of 25% to this amount because it suspects contamination exists under the tank farms due to a faulty liner. Buried fuel lines to day tanks were also noted as a potential source of contamination. The tanks need to first leak into the containment, and then the containment needs to be faulty. KP noted during the site visit that the liner in the main tank farm was holding water (Appendix A). KP suggests that INAC's assumption around additional contamination that has not been confirmed is not fair to LMI, and any such exceedances can be captured by the contingency applied to the total reclamation cost estimate. Therefore, KP recommends that LMI's quantity be carried forward until new information suggests otherwise.

In terms of unit rates, LMI's unit rate for managing contaminated soils is $60.17/m^3. LMI recently constructed the first cell of a landfarm for on-site treatment, and for this reason, INAC used the RECLAIM low unit rate of $47/m^3.

KP recommends that LMI's volume estimate and the RECLAIM low unit rate used by INAC be adopted to calculate the costs for on-site treatment of hydrocarbon-impacted soils.

3.2.6 Water Management

Neither LMI or INAC included costs in this RECLAIM module. Short-term water treatment costs are included under post-closure monitoring and maintenance (Section 3.3.2).

3.2.7 Interim Care and Maintenance

This is another item for which there remained substantial disagreement between the parties. LMI's reclamation cost estimate was based on RECLAIM model version 6.1, which did not include a module for interim care and maintenance. INAC calculated a cost for interim care and maintenance based on operating the mine site under its current care and maintenance condition for 5 years.

MVLWB (2014) recommends that a period of time is required to transfer ownership of the site, retain a water licence for closure, procure contractors and mobilize to site. There is a reasonably high level of understanding of what will be involved in final closure at the Lupin Mine. However, the current water licence covers care and maintenance and early resumption of mining activities, so a new water licence would likely be required for final closure, and a Final Abandonment and Reclamation Plan would require development and water board approval. The window for mobilization is 2 months out of the year.

Considering these factors, KP recommends a 3-year interim care and maintenance period be assumed.

3.2.8 Summary of Direct Costs Review

The resultant recommended direct costs for reclamation security are presented in comparison to the direct costs in LMI's and INAC's reclamation security estimates in Table 3.1.

The resultant estimate of direct costs from this third-party review was approximately $21.2 million, which is slightly more than the midpoint between the Parties' estimates (the midpoint value is approximately $20.6 million).

Table 3.1 Comparison of Direct Costs

Component/Activity	LMI Estimate	INAC Estimate	Resultant Estimate
Underground Mine	$439,639	$506,380	$464,639
Tailings Facility	$3,935,562	$7,231,080	$5,121,410
Rock Pile	$1,887,702	$3,580,000	$3,200,000
Buildings and Equipment	$6,664,708	$6,577,883	$6,402,466
Chemicals/Contaminated Soil Management	$2,498,718	$7,212,041	$5,633,866
Surface and Groundwater Management	$0	$0	$ 0
Interim Care and Maintenance[1]	$0	$644,488	$386,693
Total Direct Costs	**$15,426,332[2]**	**$25,751,872**	**$21,209,074**

NOTES:

1. LMI DID NOT INCLUDE INTERIM CARE AND MAINTENANCE COSTS AS THIS MODULE WAS NOT INCLUDED IN RECLAIM 6.1.
2. LMI'S TOTAL IN TABLE 3.1 DOES NOT MATCH WITH LMI'S DIRECT COST TOTAL IN LMI'S ESTIMATE; LMI USED RECLAIM 6.1, WHICH INCLUDES POST-CLOSURE MONITORING AS A DIRECT COST. THE TOTALS ABOVE AND PRESENTED IN TABLE B.1 INCLUDE POST-CLOSURE MONITORING AS AN INDIRECT COST, CONSISTENT WITH RECLAIM 7.0.

3.3 INDIRECT COSTS

3.3.1 Mobilization and Demobilization

The cost for mobilization and demobilization was another item of substantial disagreement between The Parties. The assumptions made by LMI and INAC in regard to mobilization and demobilization are described below.

- **Mobilize Heavy Equipment and Misc. Equipment -** LMI costed the mobilization and winterization of heavy equipment at $1,010,000 ($1.01M), compared to INAC's estimate of $1.475M. LMI's proposed equipment fleet appears small, with only one excavator and one dump truck. KP recommends INAC's equipment list and corresponding mobilization cost be adopted. INAC included an allowance to mobilize minor tools and equipment, which is appropriate.
- **Mobilize Workers -** LMI did not include any costs for worker transportation to and from the site on rotation; INAC's estimate appears reasonable and should be adopted.
- **Worker Accommodations -** Camp operation costs were provided by LMI ($489,454) and INAC ($611,875). Both used the same unit rate but LMI assumed 220 man-months and INAC assumed 275 man-months. The man-month rate of $2,225 used by both parties is equivalent to roughly $75/day, which is low for the supply of food to a remote camp site.

  KP recommends INAC's quantity of man-months/man-days be applied at the high RECLAIM rate of $175/man-day to calculate camp costs.

- **Mobilize Fuel -** In Section 2.3 of Appendix A of LMI's cost estimate, LMI notes that 2.3 million litres of fuel is at site, but it has been assumed that fuel will be transported to site for the work. A cost for mobilizing fuel could not be located in LMI's mobilization cost module. LMI's earlier (2012) cost estimate had included a cost to mobilize fuel.

  KP recommends adopting INAC's cost estimate to mobilize fuel to site.

- **Winter Road -** Both Parties calculated the cost of opening the 586 km winter road twice: once for mobilization and a second time to demobilize contractor equipment. During KP's site visit, The Parties agreed that given the number of users of the winter road, that it was punitive for LMI to assume it would need to construct the entire 586 km length to the Lupin Mine. KP agrees that this would be appropriate. Other users in the area in the near term include the EKATI and Diavik mines at Lac De Gras, and the Gahcho Kué Mine. There may be winter roads constructed past Lupin supporting reclamation work at the abandoned Jericho Mine, but this will be incidental.

KP recommends that winter road construction costs be based on the assumption that other users will the road to the turnoff to the Gahcho Kué Mine at roughly km 220. On this basis, LMI should revise its cost estimate based on current tariff rates established by the Tibbitt to Contwoyto Winter Road Joint Venture for the first 220 km to the Gahcho Kué turnoff, and the construction and operation of the subsequent 366 km of winter road to the Lupin Mine as the sole user. Unit rates for winter road construction are not presented in the LMI cost estimate, and different costs are presented for mobilization and demobilization. The revised cost estimate should clearly show the unit rates for road construction and use.

3.3.2 Post-Closure Monitoring and Maintenance

The appropriate term for post-closure monitoring and maintenance was another item for which there remained substantial disagreement between the parties. LMI assumed a post-closure monitoring period of 25 years, which is often selected as an appropriate duration of post-closure monitoring at sites where long-term/indefinite water treatment is not required. INAC recommended post-closure monitoring for a period of 100 years on the basis that the tailings are arsenic-containing and acid-generating, and that an adverse impact on the local environment as a result of a failure within the TCA is too great.

Based on available information, KP recommends that the 25-year post-closure monitoring period be retained.

3.3.3 Engineering

Engineering should include the development of a Final Abandonment and Reclamation Plan and the subsequent preparation of issued for construction (IFC) drawings and specifications for the reclamation work (MVLWB, 2014). Closure concepts are reasonably well advanced in the current IARP, however, a Final ARP is yet to be produced. MVLWB (2014) recommends 5% engineering assuming a Final ARP has already been developed. Additional costs should be included for the development of a Final ARP and the associated water licensing.

KP recommends a rate of 8% of direct costs to cover engineering.

3.3.4 Project Management

Project management includes general project coordination, accounting and project control, QA/QC engineering, and as-built reports.

The MVLWB (2014) states that Project Management is normally 5% of project costs for a reclamation project that is not complex. KP suggests that final closure of the Lupin Mine is not complex. Further, it is expected that reclamation, once underway, can reasonably be completed in a single year. Project management costs should reflect the single year of closure of a relatively straight-forward reclamation project.

It may be worthwhile for LMI to develop project management costs from first principles (i.e., number of QA personnel on-site for a set duration, and other costs), or obtaining a third-party quotation. In the absence of such a cost estimate, KP recommends carrying INAC's rate of 5% of direct costs for project management.

3.3.5 Health and Safety Plans/Monitoring and QA/QC

This item includes the costs to develop a site-specific health and safety plan, training, and compliance monitoring. Health and safety costs are typically incorporated into third-party contractor rates.

MVLWB (2014) suggests that the inclusion of costs for worker health and safety for work related injury is common in government contracting processes. KP notes that inclusion of Health and safety costs in northern mine closure plans prepared using the RECLAIM model has not been consistent, and has ranged from 0% (Mary River and Meadowbank) to 1% (various exploration properties). KP suggests that health and safety is incorporated into the scope of project management.

A specific cost should not be included for health and safety.

3.3.6 Bonding/Insurance

Bonding and insurance is included in third-party contractor rates. A cost should not be included for bonding/insurance.

3.3.7 Contingency

The Parties disagreed as to the appropriate contingency to be applied to the reclamation cost estimate. LMI applied a 10% contingency factor, whereas INAC applied a 20% contingency factor.

Conservative assumptions have been incorporated into the cost estimates for waste rock (assumed 40% potentially acid generating) and possible petroleum hydrocarbon impacts beneath the tank farm. On this basis, a contingency factor in the higher range (20%) adds additional conservatism to INAC's estimate.

MVLWB (2014) suggests the following contingency rates:

- 10% definitive or IFC phase when engineering is mostly complete with some written quote
- 15% preliminary or budget level when little detailed engineering has been completed and costs are based on verbal quotes
- 20% feasibility or advanced conceptual level when engineering may be 10% completed and costs are based on typical unit costs

A number of LMI's rates are based on on-site costs incurred. KP suggests that 15% contingency better reflects the level of understanding of closure and associated reclamation costs.

3.3.8 Market Price Factor Adjustment

The Parties have agreement that there is no need for a market price factor adjustment to the reclamation cost estimates.

3.3.9 Summary of Indirect Costs Review

The resultant recommended indirect costs for reclamation security are presented in comparison to the direct costs in LMI's and INAC's reclamation security estimates in Table 3.2.

Table 3.2 Comparison of Indirect Costs

Component/Activity	LMI Estimate	INAC Estimate	Resultant Third-Party Estimate
Mobilization/Demobilization	$4,917,904	$8,078,895	$6,671,462
Post-Closure Monitoring and Maintenance	$830,014[1]	$2,186,376	$830,014
Engineering (% of direct costs)	4%	10%	8%
Engineering	$650,254	$2,575,187	$1,696,726
Project Management (% of direct costs)	4%	5%	5%
Project Management	$650,254	$1,287,594	$1,060,454
Health & Safety / Monitoring & QA/QC	$0	$257,519	$0
Bonding / Insurance	$0	$257,519	$ 0
Contingency	$1,625,634	$5,150,374	$3,181,361
Market Price Factor Adjustment	$0	$0	$0
Total Indirect Costs	**$8,674,060[1]**	**$19,793,464**	**$13,440,017**

NOTES:

1. AS NOTED IN TABLE 3.1, LMI INCLUDED POST-CLOSURE MONITORING AS A DIRECT COST AS PER RECLAIM 6.1, NOT AS AN INDIRECT COST AS PER RECLAIM 7.0. THEREFORE, THE TOTAL INDIRECT COSTS SHOWN FOR LMI IN TABLE 3.2 DO NOT MATCH THE INDIRECT COST TOTAL OF LMI'S ESTIMATE.

The resultant estimate of indirect costs from this third-party review was approximately $13.4 million, which is slightly less than the midpoint between the Parties' estimates (the midpoint value is approximately $14.2 million).

3.4 OTHER ITEMS

Other items for which substantial disagreement between the Parties was noted by NWB are addressed below.

3.4.1 Closure Planning Costs

NWB noted that the inclusion of closure planning costs such as potential amendments to the water licence, hearings, applications and reports is another area of substantial disagreement between The Parties. There is not a specific RECLAIM module that deals with such costs, but these costs would be incurred by any party (the proponent, or the government in a default situation) to execute the abandonment and reclamation plan. The MVLWB (2014) acknowledges this and recommends that costs be included for:

- Engagement with affected parties during closure planning, active closure and the post-closure phases
- Regulatory compliance costs, including administrative changes, submissions/reporting
- Finalizing the closure plan, including completion of outstanding studies or research
- An initial site assessment

KP recommends that such costs are most appropriately included in engineering costs. Closure planning costs have been incorporated into KP's recommended engineering cost of 8% of direct costs, rather than the standard 5% of direct costs recommended by MVLWB (2014).

3.4.2 Use of Fuel Left On-Site

KP understands the use of fuel located on-site has been raised by LMI during discussions on reclamation security. LMI recently tested its fuel on-site to confirm that it remains suitable for use. As such, though LMI included the cost of mobilizing fuel to site in its 2012 reclamation cost estimate, it does not appear in the 2016 cost estimate.

KP acknowledges that LMI is able to use its fuel on-site to complete near-term reclamation activities. The costing of reclamation works as an activity to be carried out by a third-party in case of default in accordance with INAC (2002) and MVLWB (2014) does not permit the assumption that this fuel will be available and of suitable quality to support final reclamation when it does occur at an unknown time into the future.

3.4.3 Changes in RECLAIM Model Unit Rates

LMI's 2014 reclamation cost estimate was prepared using version 6.1 of the RECLAIM model, which was the current model at that time. Understandably, INAC used version 7.0, which remains the current model. RECLAIM version 7.0 includes updated unit rates. KP has not conducted a line by line comparison of the unit rates between the two models, but notes the following:

- In the absence of other factors, cost inflation will generally result in a small incremental increase in unit rates over time, within the RECLAIM Model and other cost models.
- Labour and fuel costs have generally decreased over the past several years due to a slowdown in both industrial activities within the mining and oil and gas industries across Canada.
- RECLAIM's unit rates should be applied with discretion; the unit rates in the model and/or the model's approach to developing costs may not always be the most appropriate for a given project or situation.

RECLAIM version 7.0 also includes costs modules not included in earlier versions. It is recommended that any future cost estimating should use the latest version of RECLAIM, with unit rates adjusted to be appropriate to the site on a case-by-case basis.

4 – CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

KP was tasked with reviewing the reclamation security estimates prepared by both LMI and INAC for the Lupin Mine. The areas of substantial disagreement between the Parties are noted in Section 1.2.

KP found that despite areas of substantial disagreement between the Parties, that there were items and components where there was close alignment between the estimates. It is evident that both Parties had given careful consideration in developing their respective reclamation security estimates. Though the mine owner's costs were generally lower than INACs, there were a number of site-specific unit rates applied in the owner's cost estimate that were at the upper end or higher than the most recent RECLAIM unit rates. There were several instances where KP recommends cost estimates that are lower than one or both parties.

Our findings are summarized as follows:

- **Direct Costs:**
  - **Underground Mine -** There was little discrepancy between the Parties with respect to reclamation of the underground mine. INAC assumed that hazardous materials haven't been removed from the underground; however, evidence suggests that these materials have been removed.
  - **Tailings Containment Area -** This was an area of substantial disagreement between the parties. The main discrepancy was on the area to be covered and the related quantity of cover. KP elected to adopt the area specified in the IARP. Other discrepancies existed with respect to unit rates and quantities.
  - **Rock Pile -** The primary discrepancy was with respect to unit rates to relocate any acid-generating or metal leaching waste rock. KP recommends a more suitable unit rate that was between the rates presented by the Parties. KP also identified a number of studies that were identified in the IARP that were not included in either reclamation security estimate.
  - **Buildings and Equipment -** Additional information on potential hazardous materials in the buildings was available to KP that had not been made available to INAC. INAC had conservatively assumed considerable costs for building decontamination that were not warranted based on the available additional information and considering the high unit rate for building removal used by LMI. In the end, KP's recommended estimate for buildings and equipment is similar to both that of LMI and INAC.
  - **Chemicals/Contaminated Soil Management -** This was an area of substantial disagreement between the Parties. INAC included substantial costs for hazardous materials removal. LMI has removed considerable hazardous materials from site, but in the absence of a current inventory, KP recommends carrying INAC's cost for hazardous materials removal. KP recommends a revised cost for a contaminated soil investigation that is between the estimates provided by the Parties. With respect to contaminated soil removal, INAC suspects additional contamination beneath the tank farm and increased the reclamation cost accordingly. KP suggests that INAC's assumption around additional contamination has not been confirmed and that it is not appropriate under the circumstances. Any such exceedances can be captured by the contingency applied to the total reclamation security estimate. KP recommends that LMI's quantity of contaminated soil be carried forward, and that an

investigation be undertaken in the near future to update the quantity of contaminated soil in the reclamation security estimate based on the findings of the investigation.

- **Interim Care and Maintenance -** LMI did not include a cost for this as this was not a cost module in the RECLAIM 6.1 package that they utilized for the preparation of their estimate. KP recommends adopting INAC's annual cost for interim care and maintenance, but reducing the duration from 5 years to 3 years.

- **Indirect Costs:**
  - **Mobilization/Demobilization -** During the site visit, the Parties agreed that mobilization and demobilization costs should be based on construction of only a portion of the winter road. KP recommends that this be calculated from the turnoff to the Gahcho Kue Mine.
  - **Post-Closure Monitoring and Maintenance** - INAC recommended post-closure monitoring for a period of 100 years on the basis that the tailings are arsenic-containing and acid-generating. KP recommends LMI's post-closure monitoring period of 25 years is appropriate where long-term/indefinite water treatment is not required.
  - **Engineering -** LMI estimated engineering costs based on 4% of direct costs compared to INAC's estimate of 10% of direct costs. The Mackenzie Valley Land and Water Board (MVLWB) draft guidelines for developing reclamation security estimates recommends 5% of direct costs for projects that have a final abandonment and reclamation plan in place. KP recommends 8% engineering considering that a final ARP remains to be developed and approved through consultation with communities and water licensing.
  - **Project Management -** KP agrees with INAC that project management should be 5% of direct costs, not 4% of direct costs as proposed by LMI.
  - **Health & Safety / Monitoring and QA/QC -** KP agrees with LMI that these costs are embedded in the engineering, project management and contractor unit rates.
  - **Bonding / Insurance -** These costs are included in third-party contractor rates.
  - **Contingency** - LMI applied a 10% contingency factor, whereas INAC applied a 20% contingency factor. Based on MVLWB guiadance, KP suggests that 15% contingency better reflects the level of understanding of closure and associated reclamation costs.

A discussion of the two estimates along with recommendations on the appropriate reclamation security estimate by item and major project component are presented within Section 3 of this report and in Table B.1 in Appendix B.

4.2 RECOMMENDED RECLAMATION SECURITY ESTIMATE

Based on the outcome of this third-party review, KP recommends the reclamation security estimate for the Lupin Mine should be **$34,650,000**. A summary breakdown of the resultant recommended reclamation security estimate is presented below in Table 4.1.

Table 4.1 Reclamation Security Estimate Comparison

Component/Activity	LMI Estimate	INAC Estimate	Recommended Reclamation Estimate
Direct Costs			
Underground Mine	$439,639	$506,380	$464,639
Tailings Facility	$3,935,562	$7,231,080	$5,121,410
Rock Pile	$1,887,702	$3,580,000	$3,200,000
Buildings and Equipment	$6,664,708	$6,577,883	$6,402,466
Chemicals/Contaminated Soil Management	$2,498,718	$7,212,041	$5,633,866
Surface and Groundwater Management	$0	$0	$0
Interim Care and Maintenance	$0	$644,488	$386,693
Total Direct Costs	**$15,426,332**	**$25,751,872**	**$21,209,074**
			Indirect Costs
Mobilization/Demobilization	$4,917,904	$8,078,895	$6,671,462
Post-Closure Monitoring and Maintenance	$830,014	$2,186,376	$830,014
Engineering	$650,254	$2,575,187	$1,696,726
Project Management	$650,254	$1,287,594	$1,060,454
Health & Safety / Monitoring & QA/QC	$0	$257,519	$0
Bonding / Insurance	$0	$257,519	$0
Contingency	$1,625,634	$5,150,374	$3,181,361
Market Price Factor Adjustment	$0	$0	$ 0
Total Indirect Costs	**$8,674,060**	**$19,793,464**	**$13,440,017**
TOTAL RECLAMATION ESTIMATE	**$24,100,392**	**$45,545,336**	**$34,649,091**

The above reclamation security estimate was derived using reasoned judgement of appropriate costs based:

- On the unit rates in the current version of RECLAIM (version 7.0)
- Available guidance by INAC (2002) and MVLWB (2014). Including the cost estimates and reasoning provided.
- Consistency with the IARP
- KP's own experience in estimating mine closure costs and supervising mine reclamation programs

The review did not include a technical review of the adequacy of the closure measures presented in the IARP, and did not verify the quantities presented in the Parties' reclamation security estimates.

4.3 ADDITIONAL WORK TO BE COMPLETED

LMI's March 2016 IARP was referred to as it was consistent with LMI's 2014 cost estimate. However, this version of the IARP has not undergone technical review and approval by the NWB.

During the site visit the Parties discussed that an unknown volume of tailings had been deposited at the northwest corner of Cell 4, which is otherwise not used for tailings disposal. A portion of these tailings are surface exposed and any submerged tailings in this area will become exposed if water levels in Cell 4 are lowered as planned. LMI should determine the appropriate disposal method for these tailings in the next iteration of the IARP.

It is recommended that the costs to address the high priority maintenance items identified by Norwest (2016) during the most recent geotechnical inspection be added to the next update of its reclamation security estimate.

RECLAIM version 7.0 also includes costs modules not included in earlier versions. It is recommended that any future cost estimating should use the latest version of RECLAIM, with unit rates adjusted to be appropriate to the site on a case-by-case basis.

5 – REFERENCES

Arcadis Canada Inc. (Arcadis), 2015. *Final RECLAIM Cost Model for the Lupin Mine, Nunavut - Lupin Gold Project - Water Licence Renewal Application*. October 22. Arcadis Ref. No. 702380-000.

Arctic Response, 2012. *Lupin Mine Hygiene Assessment.*

Canadian Dam Association (CDA), 2013. *Canadian Dam Safety Guidelines 2007 (2013 Edition).*

Indian and Northern Affairs Canada (INAC), 2002. *Mine Site Reclamation Policy for Nunavut*. ISBN 0-662-32073-5. Copyright: Minister of Public Works and Government Services Canada.

Knight Piésold Ltd., 2016. Memorandum to: Sean Joseph. Re: *Site Visit Summary - Third-Party Technical Review of Reclamation Security Estimates - Lupin Mine Water Licence 2AM-LUP1520*. October 2016. North Bay, Ontario. NB16-00594 (NB102-492/1).

Lupin Mines Incorporated (LMI), 2014. *Lupin Mines Closure Estimate Update - December 2014*.

Lupin Mines Incorporated (LMI), 2016a. *Lupin Mine Site, Nunavut, Canada - Interim Abandonment and Restoration Plan - March 2016*.

Lupin Mines Incorporated (LMI), 2016b. Memo to: Dave Hohnstein, Nunavut Water Board (NWB) and Richard Cook, Knight Piésold (KP). Re: *Follow-up Data and Information resulting from site visit of 6th and 7th October 2016*. October 17.

Mackenzie Valley Land and Water Board, 2014. *Guidelines for Closure and Reclamation Cost Estimates for Mines*. Retrieved from: https://mvlwb.com/sites/default/files/wlwb/documents/DRAFT%20MVLWB%20Guidelines%20for%20Closure%20Cost%20Estimates%20-%20Dec%2022_14.pdf.

Morrow Environmental Consultants Inc., 2006. *Phase 1 and 2 Environmental Site Assessment - Lupin Mine Site - Nunavut Territory. Volumes 1 and 2*. January 11. Prepared for Kinross Gold Corporation.

Norwest Corporation, 2016. *2016 Lupin Mine Tailings Containment Area Geotechnical Inspection*. October 31. Project Number: 924-1.

Nunavut Water Board, 2015. Nunavut Water Board Water Licence No. 2AM-LUP1520 (Reissued August 19, 2015). Retrieved from: ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-LUP1520%20LMI/4%20LICENCE/1%20LICENCE/2015%20Amend%20Renew/150821%202AM-LUP1520%20Reissuance-Renewal%20and%20Amended%20Licence-OSJE.pdf.

SRK Consulting Ltd. (SRK), 2016. *Lupin Mine Tailings Management Facility 2015 Dam Safety Review*. Prepared for Lupin Mine Incorporated. January 2016.

6 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Richard Cook, P.Geo. (Ltd.)
Senior Environmental Scientist | Associate

Reviewed:

Steven R. Aiken, P.Eng.
Manager, Environmental Services

Approval that this document adheres to Knight Piésold Quality Systems:

APPENDIX A

SITE VISIT REPORT - KP REF. NO. NB16-00594

(Pages A-1 to A-3)

Knight Piésold CONSULTING

www.knightpiesold.com

MEMORANDUM

To:	Mr. David Hohnstein	Date:	October 21, 2016
Copy To:	Mr. Sean Joseph	File No.:	NB102-00492/01-A.01
From:	Amber Blackwell	Cont. No.:	NB16-00594
Re:	Site Visit Summary - Third-Party Technical Review of Reclamation Security Estimates - Lupin Mine Water Licence 2AM-LUP1520		

1 – INTRODUCTION

Ms. Amber Blackwell and Mr. Reagan McIsaac of Knight Piésold (KP) completed a site visit at the Lupin Mine in the Kitikmeot Region of Nunavut, on October 6-7, 2016. The site visit was conducted as part of a third party technical review of reclamation security estimates from Lupin Mines Incorporated (LMI) and Indigenous and Northern Affairs Canada (INAC). The following individuals also attended the site visit:

- Patrick Downing and Karyn Lewis from LMI
- Ken Bocking from Golder Associates (Golder), on behalf of LMI
- David Hohnstein from the Nunavut Water Board (NWB)
- Ian Parsons from INAC, with Charles Gravelle from Arcadis Canada Inc. (Arcadis)

The objective of the site visit was to become familiar with the current state of the Lupin Mine site.

2 – SITE TOUR

The Lupin Mine site was visited on the afternoon of October 6 and the morning of October 7, 2016. The tour was provided by Patrick Downing from LMI. The key areas observed during the visit included the following:

- Cold storage buildings
- Equipment laydown (cold storage area)
- Underground supplies laydown area
- Landfarm
- Satellite tank farm, waste oil tanks, main tank farm and hazardous waste storage area
- Landfill
- Ball field (waste rock) area
- Tailings containment area (TCA)
- Tailings delivery pipeline
- Esker borrow area
- Sewage ponds
- Water supply pump house
- Crown pillar
- Portal
- Some mine offices
- Mill building
- machine shop, tool cribs and carpenter shop
- Electrical shop
- Fleet vehicles maintenance shop (operational)
- Recreation building, upper lounge, racquet court and gymnasium

The following areas/buildings were not visited:

- The hoist house, due to unsafe conditions (no power/light)
- Some mill offices, as conditions were similar in other offices
- A representative portion of the accommodation buildings

The site visit allowed for an assessment of general conditions at the site. Equipment and materials were not inventoried by KP as part of the site visit.

3 – FINDINGS

The site visit was conducted during sub-zero temperatures with light snow. Light snow covered the ground surfaces. Conditions did not meaningfully impair the ability to view site features during the visit.

Reclamation was observed to be underway at the following areas:

- **Landfarm -** One cell of a landfarm had been recently constructed for the on-site remediation of hydrocarbon contaminated soils; no soils were being treated in the landfarm.
- **Landfill -** An historic landfill has been included in the recent Licence renewal however is not currently utilized.
- **Tailings Containment Area (TCA) -** A portion of the tailings containment area (TCA) had been covered with approximately 1 m thick layer of esker material, and this work was ongoing. Repairs were recently completed on the M dam, and a geotechnical report on this work is pending. Repairs were being completed on a section of the cover where standing water was historically known to accumulate. LMI noted that the tailings discharge pipeline will be disposed of in the landfill contrary to the approved plan of shipping south for disposal.
- **Ball Field -** A portion of the waste rock at the ball field was noted as being potentially acid generating (PAG), and had been relocated to the TCA LMI staff reported that geochemical testing of the remaining waste rock is planned to identify any additional PAG waste rock to be removed to a suitable disposal location to manage ARD risks (i.e., underground or to the TCA).
- **Hazardous Materials -** A quantity of hazardous materials, previously stored adjacent the main tank farm, has been removed off-site.
- **Buildings -** Minimal demolition has occurred, limited to the former paste backfill building at the landfarm location.
- **Crown Pillar -** Fill material is stockpiled adjacent to the open crown pillar excavations and fenced.

It is our understanding that progressive reclamation activities will not be included in our third-party review of closure costs. However, we will note in our review where progressive reclamation activities have been undertaken, understanding that at some point in the future LMI will have an opportunity to seek credits against the reclamation security for progressive reclamation activities undertaken. Alternatively, these progressive reclamation activities can be incorporated into a future reclamation cost estimate to be prepared by LMI in 2017.

A number of items were discussed by the parties during the site visit. From these discussions, the parties agreed to the following:

- **Winter Road Access -** Costs associated with winter road access to the site (for mobilization and demobilization) should be based on the assumption that a portion of the Tibbitt to Contwoyto Winter Road will be constructed and operated by others.
- **Proportion of Waste Rock Assumed to be Acid Generating -** LMI agreed that 40% of the waste rock stored at site is potentially acid-generating.
- **Airstrip -** The airstrip will remain post-closure.
- **Tank Farm -** INAC/Arcadis expressed concern regarding the condition of the liner and the possibility of extensive soil contamination under the tank farm. KP noted that the liner held some water, and LMI reported needing to pump water out of the liner each year.
- **Equipment in the Underground -** INAC/Arcadis had included an allowance for the removal of hazardous materials from the underground. LMI stated that all hazardous materials were removed from the underground prior to flooding, and showed a location in the mill buildings in which electrical panels from the underground were stored.

We noted two follow up items:

- INAC/Arcadis was going to confirm the basis for 30 monitoring wells being recommended downstream the TCA.
- INAC/Arcadis was going to provide detail on the INAC/Arcadis cost estimate for long-term post-closure monitoring.
- LMI indicated that the company would provide follow up information relevant to this review. A technical memo was received from LMI on October 17, 2016.

4 – CLOSURE

We trust this meets the Nunavut Water Board's current requirements. We are advancing our review of the reclamation security cost estimates. Please do not hesitate to contact the undersigned with any questions.

Prepared:

Amber Blackwell, P.Geo. - Staff Geoscientist

Reviewed:

Richard Cook, P.Geo.(Ltd.) - Senior Environmental Scientist | Associate

Approval that this document adheres to Knight Piésold Quality Systems:

/ab

APPENDIX B

RECLAMATION COST ESTIMATE COMPARISON

(Pages B-1 to B-3)

Knight Piésold CONSULTING

TABLE B.1

NUNAVUT WATER BOARD
LUPIN MINE WATER LICENCE 2AM-LUP1520

THIRD PARTY TECHNICAL REVIEW OF RECLAMATION SECURITY ESTIMATES FOR THE LUPIN GOLD MINE, NUNAVUT
RECLAMATION COST COMPARISON

Print Dec-07-16 16:07:37

Component	Reclamation Activity	LMI's Reclamation Estimate	LMI's Assumptions	INAC's Reclamation Estimate	INAC's Assumptions	Discussion of Parties' Reclamation Estimates	Recommended Basis for Resultant Reclamation Security Estimate	Resultant Reclamation Security Estimate (by item)	Resultant Reclamation Security Estimate (by component)
DIRECT COSTS									
Underground Mine	Control Access	$ 439,639	Assumes the capping of 5 shafts, backfilling of adits, and backfilling the open stope.	$ 496,380	1,000 m^3 of waste rock or borrow material would be used to cap the engineered covers used to seal the shaft and vent raises. This quantity of material is based on observation of the work areas (five seals at 200 m^3 each) and material take-offs from site maps provided in the IARP. Five engineered caps would be constructed to seal vertical openings. This quantity is based on the number of openings identified during the site visit. 2,500 m^3 of waste rock would be used to seal the portal opening. This quantity of material is based on observation of the work areas and material take-offs from site maps provided in the IARP (rounded 3 m x 3 m x 50 m plus 25 m x 40 m x 2 m avg.). Assumes that crown pillar study will be completed at closure.	INAC and LMI have used the same unit rate for capping the 5 raises. There is considerable difference in the unit rates applied to backfilling the open stope and adits: LMI used $3.50/$m^3$ based on the RECLAIM 6.1 high unit rate for dozing soil piles. INAC used a rate of $14.20/$m^3$ based on the cost to excavate/load/haul/spread/compact. KP noted sufficient stockpiles adjacent the open stope such that LMI's assumption of dozing nearby soil is reasonable. INAC included the cost for a crown pillar study and LMI did not include this cost. A crown pill study will be required at the Central and West Zones to confirm that subsidence will not be an hazard post-closure.	Revise the reclamation costs to include: • LMI's/INAC's cost for the 5 engineered caps • LMI's cost for backfilling the open stope and adit • INAC's cost for a crown pillar study	$ 464,639	$ 464,639
	Remove Hazardous Materials	$ -	LMI has indicated that all hazardous materials have been removed from the underground.	$ 10,000	Twenty man days (two workers ten days) would be required to decommissioning and decontaminate any underground equipment that will be left underground. This quantity has been taken to be consistent with the number of working days required to decommission other mine sites of similar site.	There is evidence that equipment was removed from the underground (ex. electrical junction boxes in cold storage were observed during site visit). The underground is already flooded, so to inspect or remove any remaining material, would require dewatering of the underground.	Carry LMI's cost estimate for this item.	$ -	
Tailings Containment Area	Stabilize Embankment(s)	$ 1,216,000	LMI included 80,000 m^3 of rip rap to stabilize embankments.	$ 1,780,000	INAC included 100,000 m^3 of waste rock or borrow material would be used to stabilize the tailings containment structures. In the absence of design information for the spillway structure the quantity of rip rap used by LMI has been used for this cost item.	The IARP contemplated dam enhancements involving the placement of quarried rip rap to reduce slopes to 2.5H:1V. LMI assumed that 80,000 m^3 of rip rap would be used to stabilize embankments, whereas INAC estimated the quantity of material required to be 100,000 m^3. Both quantities are not substantially different and neither are supported by designs, KP recommends using the mid-point of the two quantities (90,000 m^3). LMI used a specified unit rate of $15.20/$m^3$ and INAC used RECLAIM's high unit rate of $17.80/$m^3$. Since LMI's specified rate is between the low and high values for this rate, LMI's rate appears reasonable. KP also recommends that the costs to address the high priority maintenance items identified by Norwest (2016) be added to the reclamation cost estimate.	Use the mid-point of the two quantities (90,000 m^3) and LMI's unit rate. Add the high priority maintenance items identified by Norwest (2016) to the reclamation cost estimate (not included; to be developed by LMI).	$ 1,368,000	$ 5,121,410
	Cover Tailings	$ 1,748,138	Area to cover is approximately 241,328 m^2. Given that a 1 m^3 cover is desired over the tailings surfaces, it is assumed that 375,000 m^3 of material is required (assumes an approximate 1.55 compaction ratio).	$ 3,873,500	375,000 m^3 of borrow material would be used to cover the balance of the tailings impoundment area. This quantity is based on an average cover thickness of 1.0 m across an area of 375,000 m^2 and is consistent with the assumptions outlined in the IARP. Fifty hectares of vegetation improvements would be required. This quantity is based on a nominal percentage (approximately 15%) of the total footprint of the TCA. 20,000 m^3 of waste rock or borrow material would be used to repair the existing tailings containment structure cover. This quantity is a provisional amount based on the observations made during the recent geotechnical inspections and in review of the assumptions made by LMI in their RECLAIM estimate.	LMI and INAC assumed different quantities for covering the tailings. LMI specified 241,328 m^3 of soil cover, corresponding to a 1 m cover over a 241,328 m^2 area as specified in the IARP. INAC used a larger quantity of material of 375,000 m^3 which appeared in LMI's 2012 reclamation estimate. LMI's quantity is consistent with the IARP and is assumed to be more precise on this basis. LMI used a unit rate of $7.24/$m^3$. LMI's unit cost is based upon prorated actual costs from 2005. INAC the low RECLAIM unit rate of $9.30 for excavate, long-haul, spread and compact. INAC also included costs for revegetation ($200,000); active revegetation is not part of the current IARP. INAC also included ($186,000) for repairs to the existing soil cover.	Use LMI's quantity estimate and INAC's more current unit rate for soil cover placement. Costs for revegetation should be excluded, but costs for cover repair should be included. LMI can seek a credit for progressively covering the tailings.	$ 2,430,350	
	Excavate and dispose of tailings in northwest corner of Cell 4	$ -	Not included	$ -	Not included	The IARP and the Parties' reclamation security estimates do not account for exposed (and possibly submerged) tailings located in the northwest corner of Cell 4. These tailings likely cannot be reclaimed with a partially saturated cover based on the elevation of tailings and anticipated future lowering of water elevation in Cell 4. LMI has demarcated the extent of exposed tailings in the field; however, the quantity of tailings at this location is unknown.	Recommend adopting an allowance of $100,000 for this item, to excavate the tailings and dispose of the tailings at another location within the TCA that will be mitigated with a partially saturated soil cover.	$ 100,000	
	Remove Tailings Discharge	$ 343,990	Disposal of 6,000 m of piping on-site.	$ 343,980	Disposal of 6,000 m of piping on-site.	There is a 6 km tailings line external to the TCA, and 2.5 km of tailings line within the TCA, according to the IARP. Both parties included the same cost to dismantle and dispose of 6-km of tailings pipeline.	Both Parties are in agreement on the cost of this item. KP suggests that this unit rate ($57.33/m) could be replaced with the low RECLAIM unit rate for large pipelines (PLRL) since the pipeline is not being salvaged and will be disposed of on-site. The additional 2.5 km of tailings pipeline located within the TCA should be included in this cost item if it isn't being buried in-place within the TCA.	$ 187,000	
	Upgrade Spillway	$ 567,434	Production and placement of 20,000 m^3 of rip rap at two spillways. Spillway excavation costs were not included.	$ 1,073,600	30,600 m^3 of earthworks to construct a spillway. In the absence of design information for the spillway structure the quantity of rip rap used by LMI has been used for this cost item. 20,000 m^3 of waste rock/rip rap to line the spillway along with 7,000 m^2 of non-woven geotextile. In the absence of design information for the spillway structure the quantity of rip rap used by LMI has been used for this cost item.	LMI assumed a rip rap quantity of 20,000 m^3 to construct the two spillways, with a unit rate of $28.37/$m^3$. INAC used the same quantity of rip rap with a slightly higher rate of $30.75. Both rates are based on a long haul and are considerably higher than the rates presented by both Parties for rip rap to be used in stabilizing the embankments. KP recommends applying LMI's unit rate for rip rap used to stabilize the dams ($15.20/$m^3$). INAC included costs for excavating the channels and for geotextile fabric, and LMI did not. INAC's quantities appear reasonable, though a long haul/spread and compact unit rate (SC3H) was used for excavating soil under high specifications. It should be sufficient to place and spread the excavated material close to the spillway, such that a lower unit rate such as SC1H could be applied.	Use LMI's unit rate for rip rap specified for stabilizing embankments. Costs will need to be included for excavation of the spillways, though a lower unit rate than that specified by INAC could be used (i.e., SC1H). Include INAC's cost estimate for geotextile.	$ 876,060	
	Specialized Items	$ 60,000	An allowance for the installation of permanent instrumentation.	$ 60,000	An allowance of $60,000 for the supply and installation of instrumentation to monitor the TCS. This allowance is based on experience with the supply and installation of monitoring wells at approximately $2000 per well and thirty wells.	Both parties included the same costs for instrumentation.	KP recommends carrying LMI's cost for this item.	$ 60,000	
	Treat Seepage/Supernatant	$ -	Not included	$ 100,000	An allowance of $100,000 to manage and treat any water that may require treatment as discussed in the Arcadis memorandum of 31 December 2014.	INAC included an allowance to treat supernatant during reclamation of the TCA, which appears appropriate.	KP recommends adopting INAC's allowance for treating the supernatant.	$ 100,000	
Waste Rock	Waste Rock Survey - 100 Samples	$ -	Not included in IARP, but mentioned in LMI, 2016a.	$ 20,000	An allowance of $20,000 has been carried for waste rock testing to confirm quantity of material that would be deemed PAG rock.	Previous geochemical testing of waste rock was conducted by URS (2005). This study was not available for review, and LMI's IARP does not specify the number of samples collected. Further characterization of the waste rock is likely required to understand the nature and distribution of ARD/ML impacts on the waste rock, and hence disposal options. INAC included lab testing costs for 100 samples, but did not include costs for sample collection (personnel and equipment) or data analysis by a qualified geochemist.	KP recommends the cost be included to complete a geochemical evaluation aimed at understanding the nature or ARD/ML impacts and hence waste rock disposal options. All associated costs should be included (sample collection, lab testing and data interpretation). KP has provided an allowance of $100,000 for waste rock sample collection, lab testing, and analysis/reporting.	$ 100,000	$ 3,200,000
	Soil/waste rock risk assessment	$ -	Item included in IARP but not costed.		Not included	LMI noted on page 38 of its IARP that a risk assessment would be conducted to address metals including arsenic, but no cost appears in its reclamation estimate.	LMI to include the cost of conducting a risk assessment on soil and waste rock, as specified in the IARP.	$ 250,000	
	Options Assessment	$ -	Item included in IARP but not costed.		Item included in INAC's comments but not costed.	LMI and INAC agree that an options assessment for waste rock disposal is appropriate, but costs have not been allocated for this. The options assessment should confirm the viability of waste rock disposal in both the TCA and underground, and may want to consider the option of leaving the waste rock in place if a risk assessment supports this option.	LMI to include the cost of conducting an options assessment for waste rock disposal.	$ 50,000	
	Relocate Dumps	$ 1,887,702	Not included	$ 3,560,000	Earthworks using 400,000 m^3 of waste rock to complete various reclamation activities within the waste rock that underlies the mill area of the site. This quantity is comprised of two components whereby 100,000 m^3 of the waste rock would be used in the TCA cover and 300,000 m^3 of waste rock would be placed underground as per LMI RECLAIM estimate. These quantities have not been amended subject to confirmation with the results of waste rock testing however are conservative as it related to mitigating PAG rock issues.	Both parties assumed 400,000 m^3 of ARD/ML waste rock will require disposal in the TCA or underground. LMI applied a unit rate of $4.72/$m^3$, which is the RECLAIM 6.1 rate for excavation and short-haul of waste rock or rip rap. INAC used a unit rate of $8.90/$m^3$ (code SC3L for the excavation/load/short haul/spread and compact). KP recommends that the RECLAIM 7.0 unit rate RR3 ($7.00/$m^3$) be used for this item.	KP recommends that the RECLAIM 7.0 unit rate RR3L ($7.00/$m^3$) be used for this item.	$ 2,800,000	

Knight Piésold CONSULTING

TABLE B.1

NUNAVUT WATER BOARD
LUPIN MINE WATER LICENCE 2AM-LUP1520

THIRD PARTY TECHNICAL REVIEW OF RECLAMATION SECURITY ESTIMATES FOR THE LUPIN GOLD MINE, NUNAVUT
RECLAMATION COST COMPARISON

Print Dec-07-16 16:07:37

Component	Reclamation Activity	LMI's Reclamation Estimate	LMI's Assumptions	INAC's Reclamation Estimate	INAC's Assumptions	Discussion of Parties' Reclamation Estimates	Recommended Basis for Resultant Reclamation Security Estimate	Resultant Reclamation Security Estimate (by item)	Resultant Reclamation Security Estimate (by component)
Chemical/Soil Area	Hazardous Materials Audit	$ -	The IARP and LMI's reclamation estimate to not identify a hazardous materials audit. A hygiene survey was completed in 2012 (Arctic Response, 2012).	$ 25,000	An allowance was added for asbestos abatement work (the abatement budget could be amended once the asbestos assessment report was reviewed by Arcadis).	LMI (2016b) noted that large quantities of hazardous materials have been removed from site since the 2014 reclamation estimate was prepared, and documentation from the hazardous waste disposal contractor was forthcoming. A Hygiene Assessment completed in 2012 (Arctic Response, 2012). The survey identified lead paint and extensive mould damage. Asbestos-containing materials (ACMs) were not identified in the buildings, though the report authors acknowledged that the investigation of pipe insulation was not exhaustive. Chemicals were identified in the lab and cyanide residuals were suspected in the recovery plant. While not a detailed audit, the survey provides a reasonable grasp of site conditions with respect to hazardous materials. INAC included a cost estimate of $25,000 for an audit, suggesting that this would consist of primarily an asbestos survey but also a chemical inventory at the time of closure. Arctic Response (2012) also noted the need for a detailed survey to inventory any ACMs. KP agrees with INAC and Arctic Response that a comprehensive audit is required to confirm conclusively whether or not ACMs are present and need to be accounted for in building decommissioning.	Include INAC's cost for a hazardous materials audit.	$ 25,000	$ 5,633,866
	Hazardous Materials Removal	$ -	LMI did not include any costs for hazardous materials removal.	$ 2,985,852	Based on an August 2015 site visit, INAC estimated 100,000 L of waste oil will require disposal, based on 55 totes (~1000 L each) located in the hazardous materials laydown area and on the order of 40 to 50 totes observed in the accessible areas of the warehouse on site. Also included is the containerization and disposal of 2,344,460 litres of fuel (2,177,211 of diesel and 167,249 of Jet A as measured by Delta Carter on 23 August 2014), and consolidation and disposal of 1000 kg of hazardous material (reagent and other chemicals), 100 kg of batteries, and 5000 kg of miscellaneous chemicals and solvents as observed in various buildings.	KP understands from LMI during the site visit that a large quantity of hazardous materials has been removed from site since 2014. Drums are still located near the tank farm, though the largest quantity of hazardous material remaining at site is fuel. LMI (2016) stated that fuel has been tested and meets specifications, and is therefore suitable for use. The nature of reclamation costing is to recognize that fuel may be off-spec at the time of final closure, and therefore any on-site fuel will need to be disposed of as off-spec fuel. LMI has not included any costs for the removal and disposal of hazardous materials, including fuel. INAC included considerable costs for removal of the following hazardous materials: waste oil ($120,000); waste fuel ($2,813,352); waste batteries ($1,250); laboratory reagents ($25,000); and disposal fees ($25,000). INAC's total cost for removal and disposal of these items is $1,577,926. All except the fuel are understood to be estimates; fuel is based upon LMI's fuel inventory in 2014 or 2015. LMI will have consumed a portion of this fuel with the various progressive reclamation activities underway.	In the absence of hazardous waste manifests provided by LMI and/or an updated hazardous materials inventory (with updated fuel volume), adopt INAC's cost estimate for hazardous materials removal. LMI may apply for a credit once documentation has been provided updating on-site quantities of hazardous materials.	$ 2,985,852	
	Contaminated Soil Investigation	$ 75,706	Includes drilling, technician and analysis, and reporting.	$ 600,000	Completion of a Phase I/II ESA to characterize the environmental liabilities on site (the rate for this work was increased to reflect levels of effort recently quoted by Arcadis for the assessment of environmental liabilities at other mine sites).	The Phase 1 and 2 Environmental Site Assessment (ESA) relied upon by LMI was conducted in 2005, and therefore may not reflect current site conditions. As such, a follow up ESA at the time of final closure is appropriate. LMI budgeted $75,706 for an ESA, whereas INAC budgeted $600,000. INAC suspects hydrocarbon contamination is present beneath the main tank farm (see next item below), so this should be included in the follow up ESA.	Revise cost estimate for a supplemental ESA to $200,000.	$ 200,000	
	Contaminated Soil Removal	$ 2,423,014	From Page 34 of LMI's IARP: *14,000 m^3 of hydrocarbon contaminated soil was estimated to be present in the fuel storage areas (Morrow, 2006).* However, Morrow (2006) states the following: *40,000 m^3 (bank) of hydrocarbon impacted soil is estimated to exist in twelve locations plus an additional 800 m^3 of cyanide and/or nitrate containing soil and 2,000 m^3 of soil with traces of ore fines.* LMI's 2014 reclamation estimate uses the correct quantities from Morrow (2006). LMI's 2014 cost estimate is based on off-site disposal.	$ 2,470,500	Management (consolidation, treatment and grading) of 50,000 m^3 of petroleum hydrocarbon impacted soil (increased from 40,000 m^3 estimated in the LMI RECLAIM estimate whereby the condition of the liners within the tank farms suggest that there will be additional PHC impacted soils beneath the tank farms). The increased volume is based on an area of 200 m by 50 m by an average depth of 1 m beneath the main tank farm. The original PHC impacted soil volume of 40,000 m^3 was also included in the estimate and is based on the areas of the site observed to be impacted with PHC staining and/or olfactory impacts. The estimated area of impact centered primarily on the tank farms, powerhouse, satellite tank farm and drum cache areas is estimated to be on the order of 30,000 to 40,000 m^2 with an inferred depth of impact between 1 to 1.5 m. An allowance for the transfer of 500 m^3 of impacted soil off site that cannot be treated on site and is based on 1% of the total PHC volume estimate.	LMI's estimate of the quantity of hydrocarbon-impacted soils requiring remediation was 40,000 m^3 based on an ESA by Morrow in 2006. INAC added a contingency of 25% to this amount because it suspects contamination exists under the tank farms due to a faulty liner. Buried fuel lines to day tanks were also noted as a potential source of contamination. The tanks need to first leak into the containment, and then the containment needs to be faulty. KP noted during the site visit that the liner in the main tank farm was holding water. KP suggests that INAC's assumption around additional contamination that has not been confirmed is not fair to LMI, and any such exceedances can be captured by the contingency applied to the total reclamation cost estimate. KP recommends that LMI's cost estimate be carried forward until new information suggests otherwise.	Carry LMI's cost estimate for this item.	$ 2,423,014	
Buildings and Equipment	Isolate Buildings	$ 310,239	Isolate buildings (waste, water, glycol, sewer)	$ 311,165	Decontaminate, oil, fuel and glycol systems.	Both Parties have about the same cost for this item.	Carry LMI's cost estimate for this item.	$ 310,239	$ 6,402,466
	Building Decontamination & Consolidation of Hazardous Materials	$ 193,572	Decontaminate, oil, fuel and glycol systems. Based on a quote by a third party contractor.	$ 1,130,689	Costs for building decontamination and consolidation of hazardous materials in INAC's cost estimate appears in the Chemicals/Soil Area cost module. INAC included the following costs related to decontamination of buildings: o Decontaminate oil, fuel - $373,390 o Decontaminate offices/warehouse/accommodations – using the low RECLAIM unit rate of asbestos abatement - $629,299 o Removal of asbestos on building siding - $128,000 INAC's total cost for building decontamination is $1,130,689	The Parties' costs to decontaminate buildings differs considerably. LMI included a cost of $193,572 reportedly based on a 2014 contractor rate. In Section 2.1 of LMI's reclamation cost estimate, LMI indicates that all cost estimates were reviewed by an experienced contractor. KP notes that while this is useful, it is not the same as a contractor cost estimate. INAC included the following costs related to decontamination of buildings: o Decontaminate oil, fuel - $373,390 o Decontaminate offices/warehouse/accommodations – using the low RECLAIM unit rate of asbestos abatement - $629,299 o Removal of asbestos on building siding - $128,000 INAC's total cost for building decontamination is $1,130,689. INAC appears to have prepared this cost estimate without the Arctic Response (2012) hygiene survey. As Arcadis states in Section 4.6 of its report that the asbestos abatement budget could be amended once the asbestos assessment report was reviewed by Arcadis. While the 2012 survey was not comprehensive, the survey identified fiberglass (not friable asbestos) within the pipe insulation that was observed. Further, representative sampling of floor and ceiling tiles established that these materials were not ACMs. The Arctic Response report notes that asbestos use in building construction had dramatically decreased during the period when the Lupin Mine buildings were constructed in 1982, making the presence of friable ACMs unlikely but still possible. Arctic Response (2012) did identify extensive mould contamination throughout the buildings, which will require special protection measures during building decommissioning. However, the unit rate used for building removal (discussed below) is sufficiently high to account for this.	KP recommends the following: o Retain LMI's cost estimate for decontamination of fuel and oil o Do not include costs for asbestos abatement, as the presence of tile asbestos has not been confirmed and the presence of friable asbestos in pipe insulation is unlikely o Include INAC's cost of $25,000 under chemical/soil area for a hazardous materials audit, to be conducted by LMI in the near future. The hazardous materials audit should be sufficiently comprehensive to confirm with a high level of confidence suitable for building decommissioning (and reclamation costing) whether or not ACMs are present and require special management.	$ 218,572	
	Remove Buildings	$ 3,163,008	Based on a quote by a third party contractor.	$ 3,153,536	INAC used a slightly different area calculation and the same rate as LMI.	LMI and INAC calculated building demolition costs using the same unit rate ($128.00/$m^2$) and similar total building areas (24,711 m^2 and 24,637 m^2, respectively). The unit rate used by both Parties is well above the range of unit rates presented in RECLAIM for steel building teardown ($45-$65/m^2).	Carry LMI's cost estimate for this item.	$ 3,163,008	
	Landfill for Demolition Waste	$ 800,000	Includes boneyard clean-up and landfill operation.	$ 800,000	Matches LMI's cost estimate.	LMI and INAC are in agreement on costs for cleanup of the boneyard and for operation of the landfill. LMI has recently constructed a closure landfill.	Carry LMI's cost estimate for this item. LMI may seek progressive reclamation credits if boneyard clean-up has been undertaken, and for the proportion of landfill operation that includes landfill construction.	$ 800,000	
	Grade and Contour Pads	$ 1,210,528	Concrete removal and grading of entire site.	$ 1,225,822	Break up of concrete slabs and grading of entire site.	Both Parties' cost estimates for concrete foundations and site grading are nearly identical. INAC proposed establishing islands of vegetation ($20,000), but this is not in the IARP.	Carry LMI's cost estimate for this item.	$ 1,210,528	
	Reclaim Roads	$ 95,269	Scarify, remove 22 culverts and install water breaks.	$ 94,360	Scarify roads and airstrip, remove culverts.	LMI's cost estimate includes scarifying roads and removing 22 culverts. INAC's cost estimate includes these items but also includes scarifying the airstrip. It was agreed between the Parties during the site visit for this assignment that the airstrip would not be scarified and would remain in place for long-term monitoring and/or future site redevelopment.	Carry LMI's cost estimate for this item.	$ 95,269	
	Tank/Pipe Removal	$ 892,093	Remove tanks/pipes	$ 993,000	Deconstruction of tank farms (including the secondary containment structures).	Both Parties' cost estimates for fuel tanks and piping are based on the same quantities of tanks and piping. LMI used a unit rate for fuel tank disposal of $91.57/$m^2$ compared with INAC's unit rate of $100.00/$m^2$. INAC's unit rate is based on the RECLAIM rates for steel teardown for salvage of $67-$100/m^2. The steel tanks will be landfilled rather than salvaged, and on this basis, KP recommends using RECLAIM's high value for steel teardown (BRS1) of $65/$m^2$. Both Parties assumed 2,000 m of fuel piping will require decommissioning, though LMI used a unit rate of $57.33/m and INAC used RECLAIM's high unit rate for pipelines >6 inches in diameter of $72.00/m. KP recommends that RECLAIM's high unit rate for small pipelines (PSRH) of $24/m is more appropriate.	Use RECLAIM's high value for steel teardown (BRS1H) of $65/$m^2$ for fuel tank decommissioning, and RECLAIM's high unit rate for small pipelines (PSRH) of $24/m for fuel tank piping.	$ 599,850	
	Other - Main Water Supply Line	$ -	Not included	$ -	Not included	Neither reclamation estimate includes the cost to decommission the main water supply line.	Include a cost for removing and landfilling the main water supply line using the an approximately $1/m.	$ 5,000	
Interim Care and Maintenance	Interim Care and Maintenance	$ -	An annual interim care and maintenance cost of $122,850 was calculated by LMI but not included in the estimate.	$ 644,488	INAC included costs for interim care and maintenance for a 5-year period.	MVLWB (2014) recommends that a period of time is required to transfer ownership of the site, retain a water licence for closure, procure contractors and mobilize to site. There is a reasonably high level of understanding of what will be involved in final closure at the Lupin Mine. However, the current water licence covers care and maintenance and early resumption of mining activities, so a new water licence would likely be required for final closure, and a Final Abandonment and Reclamation Plan would require development and water board approval. The window for mobilization is 2 months out of the year. Considering these factors, KP recommends a 3-year interim care and maintenance period be assumed.	Adopt INAC's unit costs but reduce quantity (duration) to 3 years.		$ 386,693
		$ 15,426,332		**$ 25,751,872**			**SUBTOTAL - DIRECT COSTS**		**$ 21,209,074**

Knight Piésold CONSULTING

TABLE B.1

NUNAVUT WATER BOARD
LUPIN MINE WATER LICENCE 2AM-LUP1520

THIRD PARTY TECHNICAL REVIEW OF RECLAMATION SECURITY ESTIMATES FOR THE LUPIN GOLD MINE, NUNAVUT
RECLAMATION COST COMPARISON

Print Dec-07-16 16:07:37

Component	Reclamation Activity	LMI's Reclamation Estimate	LMI's Assumptions	INAC's Reclamation Estimate	INAC's Assumptions	Discussion of Parties' Reclamation Estimates	Recommended Basis for Resultant Reclamation Security Estimate	Resultant Reclamation Security Estimate (by item)	Resultant Reclamation Security Estimate (by component)
INDIRECT COSTS									
Mobilization / Demobilization	Mobilize Heavy Equipment	$ 1,010,000	LMI included costs to mobilize a smaller fleet of heavy equipment than INAC.	$ 1,475,000	Mobilize an equipment fleet (excavators 2, dump truck 4, dozer 2, front end loader 2, crane 1, demolition shears 1 and light duty truck 3).	LMI costed the mobilization and winterization of heavy equipment at $1,010,000 ($1.01M), compared to INAC's estimate of $1.475M. LMI's proposed equipment fleet appears small, with only one excavator and one dump truck. KP recommends INAC's equipment list and corresponding mobilization cost be adopted. Both Parties provided the same allowance for minor tools and equipment, which is reasonable.	Adopt INAC's equipment list and corresponding heavy equipment mobilization cost.	$ 1,475,000	$ 6,671,462
	Mobilize Misc. Equipment	$ -	Not included	$ 100,000	An allowance for mobilizing miscellaneous equipment.	LMI did not include a cost for mobilization of miscellaneous equipment. INAC included an allowance, which is reasonable.	Adopt INAC's cost estimate for mobilizing miscellaneous equipment.	$ 100,000	
	Mobilize Workers	$ -	Not included	$ 242,500	Mobilization of workers, fuel, supplies, tools and consumables as well as a temporary camp during the reclamation work.	LMI did not include any costs for worker transportation to and from the site on rotation; INAC's estimate appears reasonable and should be adopted.	Adopt INAC's cost estimate for mobilizing workers.	$ 242,500	
	Worker Accommodations	$ 489,454	220 man-months of camp operation.	$ 611,875	275 man-months of camp operation.	Camp operation costs were provided by LMI ($489,454) and INAC ($611,875). Both used the same unit rate but LMI assumed 220 man-months and INAC assumed 275 man-months. The man-month rate of $2,225 used by both parties is equivalent to roughly $75/day, which is low for the supply of food to a remote camp site.	Adopt INAC's quantity of man-months/man-days at the high RECLAIM rate of $175/man-day to calculate camp costs.	$ 1,443,750	
	Mobilize Fuel	$ -	Not included	$ 1,946,000	Costs to mobilize 1.4 million litres of fuel.	In Section 2.3 of Appendix A of LMI's cost estimate, LMI notes that 2.3 million litres of fuel is at site, but it has been assumed that fuel will be transported to site for the work. A cost for mobilizing fuel could not be located in LMI's mobilization cost module. LMI's earlier (2012) cost estimate had included a cost to mobilize fuel.	Adopt INAC's cost estimate to mobilize fuel to site.	$ 1,946,000	
	Winter Road	$ 3,418,450	Mobilization and demobilization - ice road.	$ 3,703,520	Construction of two 568 km long winter roads (includes for winter road tariffs).	Both Parties calculated the cost of opening the 586 km winter road twice: once for mobilization and a second time to demobilize contractor equipment. During KP's site visit, The Parties agreed that given the number of users of the winter road, that it was punitive for LMI to assume it would need to construct the entire 586 km length to the Lupin Mine. KP agrees that this would be appropriate. Other users in the area in the near term include the EKATI and Diavik mines at Lac De Gras, and the Gahcho Kué Mine. There may be winter roads constructed past Lupin supporting reclamation work at the abandoned Jericho Mine, but this will be incidental. KP recommends that winter road construction costs be based on the assumption that other users will the road to the turnoff to the Gahcho Kué Mine at roughly km 220. On this basis, LMI should revise its cost estimate based on current tariff rates established by the Tibbitt to Contwoyto Winter Road Joint Venture for the first 220 km to the Gahcho Kué turnoff, and the construction and operation of the subsequent 366 km of winter road to the Lupin Mine as the sole user. Unit rates for winter road construction are not presented in the LMI cost estimate, and different costs are presented for mobilization and demobilization. The revised cost estimate should clearly show the unit rates for road construction and use.	KP recommends LMI revise its cost estimate based on construction of 366 km of winter road for the two seasons as the sole user, and include operation costs / tariffs paid to the TCWRJV as appropriate. The revised cost estimate should clearly present the unit rates for construction and use.	$ 1,464,212	
Post-Closure Monitoring & Maintenance	Monitoring & Inspections	$ 778,914	Includes annual geotechnical inspections and environmental monitoring for 10-years post-closure, along with one environmental effects monitoring (EEM) program.	$ 520,000	Annual geotechnical inspections and site inspection monitoring for the first 10 years post-closure. INAC is proposing post-closure monitoring until year 100 (see post-closure monitoring Years 11 to 100, below).	Both Parties are proposing similar monitoring programs for the first 10 years post-closure. LMI's higher cost estimate is judged to be more reflective of actual costs.	Carry LMI's cost estimate for this item.	$ 778,914	$ 830,014
	Cover Maintenance	$ -	Not included	$ 500,000	A nominal allowance has also been included to cover erosion repair work.	The requirement for cover maintenance post-closure is not practical. The site should be reclaimed to be stable in the long term, and equipment will no longer be located at site to carry out such maintenance. Such costs, if necessary, can be captured in the contingency.	Do not include a cost for these items.	$ -	
	Spillway Maintenance	$ -	Not included	$ 100,000	The number provided by INAC is a nominal allowance. The cost to conduct spillway maintenance cannot be accurately estimated and as such, costs for repair are included as part of the contingency.				
	Post-Closure Water Treatment	$ -	Not included	$ 200,000	The number provided by INAC is a nominal allowance to address potential water treatment concerns. Costs for potential water treatment are included as part of the contingency.	Costs for additional water treatment, if required, can be included in the contingency cost.	Do not include a cost for this item.	$ -	
	Post-Closure Years 11 to 25	$ 51,100	LMI assumes follow-up monitoring until Year 25.	$ 866,376	INAC indicated the post-closure monitoring period should be 100 years. Geotechnical inspections would be undertaken every five years between Years 11 and 100 post closure. Annual site inspection monitoring would be undertaken annually for up to 100 years post closure. Environmental Monitoring would be completed once every 10 years starting 15 years post closure between Years 11 and 100. INAC's rationale for 100 years of post-closure monitoring is that the tailings are arsenic containing and acid generating and therefore require long-term monitoring. INAC notes that while the tailings remain a potential hazard and may require monitoring, care and maintenance beyond 100 years, the net present value of these costs is not material. Furthermore, technological developments would be expected over the next 100 years which are likely to mitigate long terms concerns.	KP suggests LMI's 25 years of post-closure monitoring is more appropriate, and consistent with assumptions in other mine closure plans.	Carry LMI's cost estimate for this item.	$ 51,100	
Engineering		$ 650,254	LMI calculated engineering as 4% of direct costs.	$ 2,575,187	Engineering Costs would be 10% of Direct Costs based on recent experience with mine reclamation programs in the north where the Crown has had to assume responsibility for the mine clean-up program.	Engineering should include the development of a Final Abandonment and Reclamation Plan and the subsequent preparation of issued for construction (IFC) drawings and specifications for the reclamation work (MVLWB, 2014). Closure concepts are reasonably well advanced in the current IARP, however, a Final ARP is yet to be produced. MVLWB (2014) recommends 5% engineering assuming a Final ARP has already been developed. Additional costs should be included for the development of a Final ARP and the associated water licensing.	Apply a rate of 8% for engineering.		$ 1,696,726
Project Management		$ 650,254	LMI calculated project management as 4% of direct costs.	$ 1,287,594	Project Management costs would be 5% of Direct Costs as is consistent with industry standards for this type of work.	Project management includes general project coordination, accounting and project control, QA/QC engineering, and as-built reports. MVLWB (2014) states that Project Management is normally assumed to be 5% of project costs if reclamation projects are not complex. KP suggests that final closure of the Lupin Mine is not complex. Further, it is expected that reclamation, once underway, can reasonably be completed in a single year. Project management costs should reflect the single year of closure of a relatively straight-forward reclamation project. It may be worthwhile developing project management costs from first principles (i.e., number of QA personnel on-site for a set duration, and other costs) or obtaining a third-party quotation.	Apply a rate of 5% for Project Management.		$ 1,060,454
Health and Safety Plans/Monitoring & QA/QC		$ -	Not included	$ 257,519	Health and Safety would be 1% of Direct Costs based on the level of effort observed by Arcadis on recent mine reclamation works.	This item includes the costs to develop a site-specific health and safety plan, training, and compliance monitoring. Health and safety costs are typically incorporated into third-party contractor rates. MVLWB (2014) suggests that the inclusion of costs for worker health and safety for work related injury is common in government contracting processes. KP notes that inclusion of Health and safety costs in northern mine closure plans prepared using the RECLAIM model has not been consistent, and has ranged from 0% (Mary River and Meadowbank) to 1% (various exploration properties). KP suggests this is already incorporated into the scope of project management.	Do not include a cost for health and safety.		$ -
Bonding/Insurance		$ -	LMI indicated that their bonding insurance was included throughout their direct costs.	$ 257,519	Bonding and Insurance would be 1% of Direct Costs as is consistent with industry standards for this type of work.	Bonding and insurance is included in third-party contractor rates.	Do not include a cost for bonding.		$ -
Contingency		$ 1,625,634		$ 5,150,374	Contingency Factor of 20%. The contingency factor remains high given the uncertainty with respect to the total volume of PAG rock and possible petroleum hydrocarbon impacts as may exist beneath the tank farm liners which may result in an additional season of on-site soil treatment.	Conservative assumptions have been incorporated into the cost estimates for waste rock (assumed 40% potentially acid generating) and possible petroleum hydrocarbon impacts beneath the tank farm. On this basis, a contingency factor in the higher range (20%) adds additional conservatism to INAC's estimate. MVLWB (2014) suggests the following contingency rates: 10% definitive or IFC phase when engineering is mostly complete with some written quotes; 15% preliminary or budget level when little detailed engineering has been completed and costs are based on verbal quotes; and 20% feasibility or advanced conceptual level when engineering may be 10% completed and costs are based on typical unit costs. A number of LMI's rates are based on on-site costs incurred. KP suggests that 15% contingency better reflects the level of understanding of closure and associated reclamation costs.	Recommend adopting a contingency of 15%.		$ 3,181,361
Market Price Factor Adjustment		$ -		$ -	- Market Price Factor Adjustment has been set to 0%.	Agree with both parties on 0% market price factor adjustment.	No change		$ -
		$ 8,674,060		**$ 19,793,464**			**SUBTOTAL - INDIRECT COSTS**		**$ 13,440,017**
TOTAL RECLAMATION SECURITY ESTIMATES		**$ 24,100,392**		**$ 45,545,336**			**RECOMMENDED RESULTANT RECLAMATION ESTIMATE (DIRECT AND INDIRECT COSTS)**		**$ 34,649,091**

I:\1\02\00492\01\A\Report\Report 1 Rev 0\Appendix B\[Table B.1 - Cost Comparison Table (2016-12-01 RDW).xlsx]Table 1 - Cost Comparison Table

NOTES:
1. LMI'S INCLUDES $830,014 FOR POST-CLOSURE MONITORING AS A DIRECT COST, WHEREAS INAC'S COST ESTIMATE (RECLAIM 7.0) INCLUDES POST-CLOSURE MONITORING AS AN INDIRECT COST. FOR THIS REASON, THE DIRECT AND INDIRECT COST ESTIMATES SHOWN IN THIS TABLE DO NOT MATCH WITH LMI'S RECLAMATION SECURITY ESTIMATE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	06DEC'16	ISSUED WITH REPORT NB102-492/1-1	RAC	SRA