LUPIN MINES INCORPORATED

A wholly owned indirect subsidiary of Mandalay Resources Corporation

Final Closure and Reclamation Plan

Rev1 (August 2020)

Submitted to:
Nunavut Water Board
Licence No: 2AM-LUP2032
PO Box 119
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EXECUTIVE SUMMARY

The Lupin Mine (Lupin or Lupin Mine or Site) is located approximately 285 kilometres (km) southeast of Kugluktuk, in the Kitikmeot Region of Nunavut and is owned by Lupin Mines Incorporate (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation. It is an underground gold mine that was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004. The mine resumed production in March 2004 until February 2005. From 2005 until 2019 the Site remained in Care and Maintenance. In July 2018, LMI initiated a water licence amendment and renewal process that culminated in the issuance of amended Type A Water Licence 2AM-LUP2032 on February 29, 2020 by the Nunavut Water Board (NWB) and approval by the Minister of Crown Indigenous Relations and Northern Affairs Canada (CIRNAC) on April 9, 2020. LMI continued active preparatory work and initiated year one of the active closure phase in Q1 of 2020.

An important part of closing the mine will be ensuring that the site is returned to a condition that protects the health and safety of Nunavut residents and the environment around the Lupin Mine. LMI is committed to ensuring that this occurs through the implementation of the NWB approved Final Closure and Reclamation plan (FCRP or the Plan) for remediation of the Lupin Mine that considers the historic uses of this area by Inuit. Included in the document are:

- an overview of LMI and their approach to final reclamation
- a history of the site and reclamation completed to date
- a description of baseline (pre-mining) environmental conditions
- a description of mine operations and existing project facilities
- a description of current environmental conditions
- an overview of progressive reclamation and their associated post operational activities
- details of the permanent closure and reclamation activities for each mine facility or component including:
  - closure objectives
  - proposed remediation activities
  - scheduling
  - environmental conditions and assessment of post reclamation risks to human and environmental health
  - associated financial liabilities

This Plan has been prepared taking into account various documents in support of the FCRP which provide detailed accounts of scientific and engineering studies (Refer to Appendix F: Environmental Studies/Reclamation Research/Engineering Studies and Design Reports).

The following highlights components of the FCRP:

1) **Regulatory Framework –** The property consists of five contiguous mining leases on crown land under the *Territorial Lands Act*.

LMI currently holds a Type A Water Licence 2AM-LUP2032 (Water Licence) for the Lupin Gold Mine. The Water Licence is valid until 27 February 2032. This FCRP was approved for implementation by the Nunavut Water Board (NWB or Board) in accordance with Part I, Item 2 of water licence 2AM-LUP2032.

This FCRP has been prepared based on the current site conditions and it provides the concepts and activities for the full closure and reclamation of the Site, taking into account relevant comments and recommendations provided by intervening parties and the Board during the review process of the Application in 2019.

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

3) **Physical Environment –** The area of the mine site is of sparse vegetation, in the barren land tundra of Nunavut. It is typified as having sparse low lying vegetation which is extremely tolerant and well adapted to the climatic conditions. Some of the more prevalent types of habitat that can be found throughout the area include upland and lowland tundra, wet meadows and gentle slopes.

Climate in this region is classed as semi-arid subarctic, with an average annual precipitation of approximately 300 millimetres (mm). August is the wettest month with average rainfall of 59.8 mm. The annual average temperature is -10.9 degrees Celsius (°C); July is the warmest month with average temperature of 11.7 °C, whereas January is the coldest month with a monthly average of -29.7 ºC.

The Site is located in the tundra zone of the Canadian Shield, in an area of continuous permafrost. Terrain in the vicinity of the Site is generally low and undulating, ranging between 470 and 505 m elevation. Numerous shallow lakes and streams occur in depressions throughout the area.

Much of the Site exhibits bedrock at surface, and it is typified by “tombstone” topography over some of its area. These “tombstone” features resemble grave markers and occur as a result of ice- jacking action in heavily jointed rocks where joints tend to be pseudo-vertical and near-horizontal. The frost heave blocks are of various sizes and are scattered in a chaotic fashion. Removal of a block raised by this action would reveal an underlying mass of permanent ice.

Contwoyto Lake is the major water body in the region, with a surface area of approximately 95,900 ha and a drainage area of 8,000 square kilometres (km^2). Contwoyto Lake has two outlets in the Burnside River, which flows from the northwest end of the lake towards Bathurst Inlet, and the Back River at the southeast end of the lake, which flows into Pellatt Lake. The main body of Contwoyto Lake lies to the east and south of the mine site. To the north of the mine, a portion of the lake extends to the west and south, terminating in a narrow bay (Sun Bay) which lies directly west of the mine site.

The aquatic habitat in the receiving environment immediately downstream of the tailings area is comprised of three shallow lakes, two streams (Seep Creek and Concession Creek), two shallow ponds, and two embayment areas of Contwoyto Lake (Inner and Outer Sun Bay). Most of the small lakes and ponds freeze to the bottom in winter. Due to low winter flows, both Seep Creek and Concession Creek freeze to the bottom in winter. As a consequence, over wintering habitat for fish is limited primarily to Outer Sun Bay and the main body of Contwoyto Lake.

4) **Overview Mine Operations –** The Lupin gold deposit is situated in an Archean metaturbidite sequence of the Contwoyto Formation, part of the Yellowknife Supergroup of supracrustal metasedimentary and meta-volcanic rocks of the Slave Geologic Province. The rocks have been subjected to both regional and contact metamorphism and to several phases of deformation and intrusion. The bedrock at the Site consists of a mixture of low grade metamorphosed argillite, siltstone, slate, greywacke, and quartzite, generally phyllite.

The Lupin ore unit is composed of the Centre Zone, East Zone, West Zone and L19 Zone, all of which are contained within a continuous, isoclinally folded, steeply dipping unit of amphibolitic iron formation within the Contwoyto Formation. This unit has been followed for a strike length of 3,000 m and a dip length of 1,500 m.

Initial geological information indicated enough ore reserves to provide six years of production, based on the potential to develop in excess of two million tons of ore with a mill designed to process an average of 950 tonnes per day.

In August 1980, the decision was made to proceed with development and construction of the Lupin Mine. Waste rock generated from the development of the underground workings was used to build the pad surrounding the mill and as roadbed material. Plant design was based on being able to air freight all the components to site. The transportation of personnel to the site was accomplished with a Convair 640, which also carried a total of 7 million pounds of supplies such as perishables and repair parts during construction.

The Lupin Mine was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004.

From 1983 to 1993, the Lupin Mine underwent a number of other expansions and operational changes to increase the mining and milling capacity to a nominal 2,300 tonnes per day. The main production shaft was deepened on two separate occasions to a final depth of 1,210 m below surface and the old sinking compartment was converted into a cage compartment. In April 2001, a production winze was commissioned between the 1050 level and 1340 level. This infrastructure allowed mucking below the elevation of the crusher to be carried out more productively, thus extending the depth, and life, of the mine. The -15% decline drift, or ramp, which permits mobile equipment to access all the mine levels, extends from surface to the 1560 m level. The lowest developed level in the mine is at the 1550 m elevation. In December 1994, the paste backfill plant was completed, which provided critical ground support in production areas while reducing the amount of tailings reporting to the Tailings Containment Area (TCA).

The mine resumed production in March 2004 until February 2005. Mill throughput in these last years of operation, March 2004 to February 2005, averaged approximately 1,200 tonnes per day, significantly less than in previous years. Production ceased in 2005; at that time, the Site was put under care and maintenance. No active mining has since occurred.

5) **Decommissioning and Remediation –** This FCRP has been prepared on the assumption that all facilities and installations that comprise the Lupin Mine Operations will ultimately be decommissioned, removed, or reclaimed under the terms of the land lease and in accordance with the reclamation requirements set out in the Water Licence.

a. Mine Workings (Underground) –

The Lupin underground workings include a 1,210 m vertical shaft and a decline drift, or ramp, to a depth of 1,560 m. A secondary hoist system (Winze) was installed in 2001 allowing hoist access to 1,340 m. The current mine depth is 1,550 m. There are also two other shafts open to surface: a fresh air raise and an exhaust raise. Incorporated into the underground facility were maintenance shops, an electrical shop and a primary crushing station. The winze and underground mine equipment were removed from site when the mine entered care and maintenance in 2006. All hazardous materials were removed from the underground workings. Any equipment left (disposed of) in the underground workings was drained of fluids.

Shafts will be backfilled to prevent animal or human entrance. Crown Pillars will be blasted down where required for stability or disposal. Contaminated soil and waste rock will be disposed of into open crown pillars. The combined volume available for underground disposal for the West Zone stope, the haulage shaft, the fresh air raise, and exhaust raise totals approximately 75,066 m^3 of underground storage volume. Crown pillars will be backfilled with rock fill (up to 1.5 m above surface to allow for settlement, then capped with 1.0 m of esker material.

The Lupin Mine was also serviced by an access ramp, which has already been sealed with a soil and rock plug and a locked fence installed to prevent access during the current phase of care and maintenance.

The permanent closure of the access ramp (also known as the portal) will be established by the following: “To prevent future access to people and wildlife, a 10 m long plug of rock fill will be placed in the adit and portal area. The areas above the shaft and raises, and all remaining surface expressions of the underground workings (including the portal area depression if additional backfill material is needed), will be backfilled to above grade with waste rock from surface and then capped with esker material." (CIRNAC TC No. 1). Refer to Section 4.3.2.4.

b. Borrows and Quarries –

The sand and gravel used for road and dam construction as well for covering the TCA cells since 1995 was obtained from the Fingers Lake esker. The Fingers Lake esker will continue to provide the cover material for the remaining TCA cells and will also be used for the reclamation of the other components of the Lupin Mine as described in Section 4.0. During closure implementation, the Finger Lakes esker area will be contoured and esker material will be used in the placement of erosion protection in drainage paths.

The two existing bedrock quarry areas; one within the TCA area and the other one near the Fingers Lake esker, are small and inactive and there are no plans to use these areas further during closure implementation.

c. Waste Rock–

Waste rock was generally used throughout the Site as pads, roadbed materials, in dam construction, airstrip stabilization, underground backfill, and laydown yards or for other purposes such as building foundation preparation. The estimated volume of waste rock on surface is about 1,000,000 m^3. Mine operations did not produce any stockpiles of overburden or unprocessed low grade ore.

Information on the geochemical characterization of the waste rock and for additional assessment of acid rock drainage (ARD) potential of mill site, airstrip access roads, and dams is provided in Section 2.1.8. Environmental site assessments in 2006 and 2017 indicated that up to 67% of the waste rock can be classified as Potentially Acid Generating (PAG) and that PAG samples were distributed across the site. Accordingly, the main objective of the reclamation of the waste rock is to limit the contact between the waste rock and surface water.

During closure implementation, waste rock containing high levels of As, CN, or P_bNO_3 will be disposed of in open shafts or crown pillars. Waste rock from perimeter areas will be disposed of into shafts or open crown pillars, into the landfill, or it will be consolidated into the central waste rock area. The waste rock remaining on surface will be contoured to shed water and then it will be capped with 1.0 m of esker material.

d. Tailings Containment Area –

As described in Sections 3.2.1 and 3.3.1, the tailings from Lupin milling and ore processing operations were deposited within a number of cells in the Lupin TCA. In accordance with the approved TCA 2004 Final Abandonment and Restauration Plan (Final TCA ARP) (Kinross 2005), as of the end of the 2017 construction season, a 1.0 m esker material cover had been completed over approximately 1,311,500 m^2 of the exposed tailings. As of the end of 2017, there remained approximately 123,500 m^2 of exposed tailings in Cell 5 and 86,000 m^2 in Cell 3. LMI intends to complete the placement of the cover by the end of the summer of 2019 as part of the approved Care and Maintenance activities.

The tailings pipeline will be removed and buried in the landfill. The treatment plant will be demolished and rubble will be disposed of in the landfill. Permanent monitoring instrumentation will be installed for the continued monitoring of site conditions.

Per Section 2.3.4 and Section 2.3.7.3, the arsenic treatment facility, a steel frame/metal clad building, is located at the TCA between Ponds 1 and 2 at the south end of J-Dam. It is used during operations to treat the water in Pond 1 prior to discharge into Pond 2. Pond 2 is the last point of control prior to discharge into the receiving environment. The treatment plant or facility was used for mixing of reagents (ferric sulphate and lime) for water treatment operations during the early 1990's and has been inactive since 1996. The facility has been partially decommissioned. All remaining components were flushed after use. LMI proposes to demolish the treatment plant and dispose of the debris in the landfill (FCRP, Section 4.3.2.8).

During closure implementation, the water inventory in the TCA ponds will be treated with lime and then released to lower the pond water levels. Permanent closure spillways will be constructed through Dam 1A and J Dam and lined with rip rap and geotextile. If any tailings are exposed when the ponds are lowered, the tailings will either be covered in place with 1.0 m of esker material or relocated to a covered area. LMI has developed a decision matrix/tree that determines how exposed tailings will be handled on a case by case basis when lowering the water level in the TCA. Refer to Appendix H-1: Supporting Information to the Contingency Contaminants Management Decision Matrix.

Several other actions are required to complete the permanent closure of the TCA. Constructing permanent open channel spillways through Dam 1A and J Dam is required to re-establish natural drainage through the TCA watershed. Once it has been documented that ongoing treatment is no longer required, the TCA will be made passive by constructing engineered spillways to re-establish natural drainage through the TCA watershed. For additional details on the permanent closure spillways to be constructed through Dam 1A and J Dam refer to Section 4.3.2.8 and Section 4.3.2.13 of the FCRP.

LMI will provide final spillway designs as directed by the NWB at least 60 days prior to proposed start of construction, in accordance with Part G, Item 1 of the current Licence.

e. Mill Complex –

All metallurgical reagents used during operation in the Mill Complex, with the exception of lime, have been shipped off site during the current care and maintenance phase. The mill was given a complete wash down with the intent of gold recovery (visible gold that settles within the system) and any residual contaminants (from chemical use) were removed to the tailings impoundment prior to the current care and maintenance phase.

Mill buildings will be demolished; rubble will be disposed of in open crown pillars or landfill. Materials that can be economically salvaged will be consolidated and shipped off-site. Any concrete foundation slabs will be hoe-rammed, left in place and covered with 0.3 m of granular fill. Any asbestos containing materials will be safely disposed of in the landfill.

f. Landfill(s) and Other Waste Disposal –

The waste management facilities used at the Site are: an incinerator, a temporary "boneyard" (for decommissioned tanks, buildings, and equipment), a solid non-hazardous waste landfill, a landfarm, two burn pits (annual applications to DIAND are required for open burning) and waste oil storage. Waste materials that cannot be disposed of in a management facility on site are appropriately segregated, stored such that they are inaccessible to wildlife and later shipped to a third party waste receiver in Yellowknife, NWT.

Recyclable containers, primarily food and beverage containers, will be segregated and shipped off-site for management by a third party waste receiver.

All non-hazardous wastes will be disposed of in the existing landfill, including ash which will be removed from burn pits. Waste rock will be used to infill voids and create a stable contoured surface which drains freely. All non-hazardous and non-burnable waste (scrap metal, plastics, residue from burning) historically will be disposed at the site landfill and buried with waste rock on a regular basis. The waste in the landfill will be covered progressively during use.

All hazardous materials that cannot be disposed at the landfill, such as paints, batteries, solvents, chemicals and glycols will be assembled in a staging area and then shipped off-site for disposal.

The mine currently uses a small landfill adjacent to the Lower Sewage Lagoon. The approximate compacted volume of debris (non-hazardous, inert materials) to be generated during closure activities, by demolition of all of the buildings, the contents suitable for disposal, tanks, pipelines, etc. is estimated to be approximately 55,290 cubic metres. Barring salvage opportunities, landfill disposal will also be required for the approximately 20,000 cubic metres of materials stored on surface laydowns. No hazardous waste will be disposed of in the landfill.

With the aim of confining the demolition debris to the smallest practical area which can accommodate the anticipated quantity, while not impacting a presently undisturbed area, a new landfill (Demolition Landfill) is proposed to be constructed within the west end of the Upper Sewage Lagoon. This site is located in a natural basin, is readily accessible, and can be easily monitored.

LMI completed a Phase I & Phase II ESA (Golder, 2017a). In 2019 LMI executed a Human Health Ecological Risk Assessment (HHERA) to establish specific standards. LMI will use a combination of field screening and confirmatory lab analysis techniques to ensure that the PHC soil remediation program meets Nunavut guidelines (Government of Nunavut, 2009). For additional information related to the HHERA refer to 6.2 for post remediation risks to human and environmental health.

Support Infrastructure –

i. Accommodation Facilities

Accommodation facilities will be demolished; rubble will be disposed the landfill.

ii. Freshwater Supply

The freshwater for the site is obtained from Contwoyto Lake approximately 1.5 km from the complex. A causeway/breakwater extending out into the lake supports a pump house building and docking facilities.

The freshwater supply pumps were decommissioned in 2006; as a care and maintenance requirement. Currently, freshwater is trucked from the breakwater on Contwoyto Lake to a water storage tank at the accommodation buildings. The water supply system will be removed for final closure; however the breakwater will be left in place for future use.

iii. Arsenic Treatment Facility

This facility, a steel frame/metal clad building, is located at the TCA between Ponds 1 and 2, at the south end of J-Dam. It was used for mixing of reagents (ferric sulphate and lime) for water treatment operations during the early 1990's and has been inactive since 1996. The facility has been partially decommissioned. All remaining components were flushed after use. The facility will be demolished and the rubble will be disposed in the landfill.

iv. Explosives Magazine

The explosives storage magazine is located 2 km west of the TCA and consists of 2 steel-frame/metal clad buildings for Ammonium Nitrate/Fuel Oil (ANFO) storage, and historically numerous Sea-Containers for the storage of stick powder and other blasting products. There are currently no explosives on-site and no Sea-Containers at the explosives magazine. The storage facility will be used temporarily for the blasting of the West Zone crown pillar and then it will be demolished and the rubble will be disposed of in the landfill.

v. Roads and Airstrips

Roadways were constructed in part with mine development waste rock. Roads will be rehabilitated for closure (scarified and graded, cut through access roads and removal of culverts).

The old airstrip that was used during construction had been used as a laydown area after the new airstrip was operational. This area was slowly phased out as a storage location and, in 1998, the gravel/esker fill strip was graded to conform to the natural landscape with cuts and backsloping applied where necessary to promote natural drainage and reduce erosion. The surface was scarified utilizing a grader with a ripping attachment.

The main airstrip is 1,950 m (6400 ft.) in length and it was constructed of crushed waste rock produced from development underground. The drainage course in the area has been altered slightly in a lateral direction; however all runoff from both the east and west sides of the strip report in a northerly direction, eventually to Contwoyto Lake. The airstrip fueling facility has been removed and the fuelling area has been reclaimed. The airstrip will be left in place for public use after closure.

vi. Sewage and Refuse Facilities

The sewage facilities consist of several lift stations within the camp and an 800 m long 6 inch diameter insulated steel pipeline to the first of two sewage lakes. Alternatively, when, during Care and Maintenance, camp capacity requirements do not warrant its use; sewage and grey water are collected in a sewage tank at the accommodation buildings. The tank is then hauled to the Upper Sewage Lake wherein waste is deposited. A sewage line to convey camp sewage directly to the Upper Sewage Lake may be utilized.

Grey water originating from log cabin (guesthouse or office cabin or manager's house) use may be deposited in an adjacent leach pit. All sewage is to be discharged to the Sewage Lakes Disposal Facilities.

A 'permeable' type dam with an emergency overflow and a syphon exists between the first and second lake. Discharge from the second lake is controlled by the use of syphons. Water accumulating in the Lower Sewage Lake is tested prior to discharge to the environment. Discharge procedures are described in the Liquid Waste Management Plan.

For closure, the upper and lower dams will be breached and the breaches will be lined with rip rap and geotextile. The invert of the spillway will be set so that a small residual pond will remain in the former Upper Sewage Lake in order to reduce the possible transport of suspended solids. Natural revegetation of the former sewage lakes will be encouraged. Other sewage facilities will be dismantled and removed for closure.

vii. Tailings Pipeline

The tailings line has been flushed thoroughly with clean water and then partially dismantled, but left in place. For closure, the piping will be disposed of in the landfill. The tailings line foundation will be generally left intact with the exception of areas where drainage is controlled by culverts. The removal of culverts and the backsloping of the openings will ensure that minimal erosion takes place and proper drainage is achieved. Any other areas of water pooling along the tailings lines during spring melt will be opened up to provide unlimited drainage. The management of PAG material in the tailings line foundation and elevated metal concentrations in the adjacent soil will be as described in Section 4.3.2.3.

viii. Fuel Storage

The fuel storage facilities at Lupin included a main tank farm (including a system of 14 diesel tanks, 1 jet A tank and 9 individual tanks), a satellite tank farm (STF) (including a system of 10 diesel tanks and 2 gasoline tanks and a waste oil tank farm which included 2 waste oil tanks). In addition, there were 5 glycol tanks on-site and various individual tanks. Geomembrane liners were used for containment purposes.

At the end of 2017, there was an ample inventory of diesel fuel in storage at the site and it had been tested and verified as still useable. Most of this fuel will be consumed in undertaking the closure measures; diesel fuel that remains after closure is completed will be burnt on site. After the tanks are emptied they will be purged according to regulations and then cut up and disposed of in the landfill.

In 2014 buried pipes were removed between the main tank farm and satellite tank farm. The fuel remaining in the satellite tank farm was used up in 2015. In 2017, a portion (approximately 500 m^3) of petroleum contaminated soils associated with the STF were removed and relocated to the landfarm for bioremediation. After treatment, the bioremediated soil will be used for site grading. It is planned that the remaining volume of contaminated soil will be relocated to underground locations for disposal, and that the tanks will be cleaned, and transported to the boneyard in 2018 for salvage or landfill disposal.

An updated Phase 1 and 2 Environmental Site Assessment carried out in 2017 indicated that there was a total of about 34,700 m^3 of petroleum hydrocarbon contaminated (PHC) soils present in a number of locations on the site. The PHC soils will be cleaned up and disposed of in the underground mine workings.

ix. Chemical Storage

During operations the mine had an inventory of chemicals which included: cyanide, lime, lead nitrate, zinc dust, flocculants, and ferric sulphate in major quantities and miscellaneous refinery reagents in much lesser quantities. Of the chemicals listed, only lime is held on-site during care and maintenance.

During closure implementation, any remaining paints, solvents, chemicals, glycols and hazardous materials will be drummed and shipped to off-site disposal; waste oil will be burned in the incinerators; diesel fuel will mostly be consumed during closure operations, with any remaining fuel being burned in incinerators; fuel tanks will be purged and disposed in accordance with the Canadian Environmental Protection Act Regulation; hydrocarbon contaminated soils will be buried in the underground workings (i.e., in shafts or open crown pillar voids); soil currently in landfarm will be disposed of in the shafts and crown pillar. Fluids drained from on-site equipment will be burned in the incinerators where permitted or shipped off-site for disposal.

6) **Long Term Community Values –** throughout the reclamation process, LMI will continue to identify and discuss potential forms of benefit to northern communities including: disposal of assets; contracts and employment. LMI began community engagement in 2011 wit the Kitikmeot Inuit Association. Meetings have been held with community representative and agencies as described in Appendix C of the FCRP.

7) **Post-Closure Management and Monitoring –** LMI will provide a project management team to oversee all remediation activities. Upon completion of active remediation, post-closure management of the site will be handled remotely by Discovery Mining Services (DMS) out of Yellowknife, Northwest Territories consistent with approach taken by LMI and DMS during the Care and Maintenance Phase. Post-Closure monitoring of the site will be conducted to confirm global objectives of physical stability, chemical stability, and future use and aesthetics are effective at the site after closure. A Post-Closure Monitoring plan has been developed and is provided in the FCRP (refer to Section 5.0). It is anticipated that active monitoring will occur for 2.5 years and passive monitoring will take approximately 5 years following completion of the reclamation work, or until the global objectives for the mine site can be confirmed.

   In accordance with Part J, Item 13 of the Type A Water Licence 2AM-LUP2032, LMI shall, within one year following the approval of the Licence, submit to the Board for approval a Post Closure Monitoring Plan in accordance with Schedule J of the Licence. (TM/PHC Commitment No. 14)

8) **Implementation –** Remediation of the Lupin Mine site, as outlined in this plan, will require approval pursuant to the *Nunavut Project and Planning Assessment Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. It is anticipated that this FCRP will be submitted to the Nunavut Water Board in July of 2018, as part of a water licence application.

   Throughout the licensing review process, LMI intends to continue public consultation on the FCRP. Reviews by the boards and regulatory agencies will also have formal requirements for public consultation.

   Although the schedule of the licensing process will ultimately be determined by the boards and authorizing agencies, it is anticipated the process will take 10 months from the date of submission to the regulatory agencies.

   Concurrent with the regulatory review process, LMI intends to continue implementation of the approved final closure of the TCA and ongoing care and maintenance measures to support full remediation.

   Under the schedule provided in this Plan, LMI intends to continue implementation of the approved reclamation activities in 2018 and proposes to complete the active reclamation of all major surface infrastructure in 2.5 years with passive closure period monitoring to occur for an additional 5 years.

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LIST OF ACRONYMS, ABBREVIATIONS

ACM	Asbestos-containing Materials
ANFO	Ammonium Nitrate/Fuel Oil
APEC	Areas of Potential Environmental Concern
ARD	Acid Rock Drainage
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CCME	Canadian Council of Ministers of the Environment
CHVs	Combustible Headspace Vapors
CIRNAC or Minister	Crown-Indigenous Relations and Northern Affairs Canada
CMP	Care and Maintenance Plan
CoC	Contaminants of Concern
CWQG	Canadian Water Quality Guidelines
DIAND	Department of Indian Affairs and Northern Development (commonly referred to as CIRNAC or INAC representing Crown - Indigenous Relations and Northern Affairs Canada)
DL	Detection Limit
DMS	Discovery Mining Services
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
EEMER	EEM Electronic Reporting System
ERA	Ecological Risk Assessment
ESA	Environmental Site Assessment
FCRP or the Plan	Final Closure and Reclamation Plan
Final TCA ARP	Final Tailings Containment Area Abandonment and Restoration Plan
FIR	Final Interpretative Report
HHERA	Human Health and Ecological Risk Assessment
IARP	Interim Abandonment and Reclamation Plan
ICRP	Interim Closure and Reclamation Plan
IOL	Inuit Owned Lands
KIA	Kitikmeot Inuit Association
LMI	Lupin Mines Incorporated
LOC	Letter of Credit
Lupin or Lupin Mine or the Site	Lupin Gold Mine
Mandalay	Mandalay Resources Corporation
ML	Metal Leaching
MDMER	*Metal and Diamond Mining Effluent Regulations*
NIRB	Nunavut Impact Review Board
NPC	Nunavut Planning Commission
NuPPAA	Nunavut Planning and Project Assessment Act
NWB or Board	Nunavut Water Board
NWNSRTA or Act	*Nunavut Waters and Nunavut Surface Rights Tribunal Act*

NWR	*Nunavut Waters Regulations*
NWT	Northwest Territories
PAG	Potentially Acid Generating
PCB	polychlorinated biphenyls
PCMP	Post Closure Monitoring Plan
PCOC	Potential Contaminants of Concern
PHC	Petroleum Hydrocarbons
POPs	Preferred Operating Procedures
QA/QC	Quality Assurance/Quality Control
RCM	Recognized Closed Mine
RCP	Representative Concentration Pathway
SSTL	Site-Specific Target Level
STF	Satellite Tank Farm
SWIM	Single Window Information Manager
TAP	Technical Advisory Panel
TC	Technical Comment
TCA	Tailings Containment Area
TM/PHC	Technical Meeting and Pre-hearing Conference
VHVs	Volatile Headspace Vapors
WSCC	Workers' Safety and Compensation Commission
WQMP	Water Quality Management Plan

LIST OF UNITS

°C	degrees Celsius
µg	microgram
ha	hectare
km	kilometre
km^2	square kilometre
L	litre
m	metre
m^2	square metre
m^3	cubic metre
mm	millimetre

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1.0 INTRODUCTION

1.1 Project and Company Information

Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation (Mandalay), has prepared this Final Closure and Reclamation Plan (FCRP or the Plan) for the Lupin Gold Mine (Lupin or the Lupin Mine or the Site). The Mine is 100% owned by LMI. All rights, title, interests, liabilities, and obligation for the Site rest with LMI.

Mandalay is a Canadian based company focused on producing assets in Australia, Chile, and Sweden, a development project in Chile and the exploration and development of the past-producing Lupin Gold Mine and the Ulu gold project, both located in Nunavut, Canada.

Mandalay is committed to remediation of the site as evidenced in past performance. Since it acquired the Lupin site in 2014, Mandalay has completed numerous care and maintenance activities that are discussed in Section 3.0.

The Lupin Mine was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004. The mine resumed production in March 2004 until February 2005. Since 2005, the Site has remained in Care and Maintenance.

General site maintenance and facilities upgrades have been undertaken at Lupin Mine since 2006 in accordance with the Interim Closure and Restoration Plan (ICRP) or Care and Maintenance Plan (CMP). These activities have been carried out to assess operational requirements in case the Lupin Mine would resume operations. The activities underway at the time of application for renewal/amendment were screened by the Nunavut Impact Review Board (NIRB) under file 99WR053 and were approved by the Nunavut Water Board (NWB or Board) under the previous Water Licence 2AM-LUP1520. LMI intends to complete the full active closure and reclamation of the Lupin Mine over the next 2.5 years.

This FCRP uses currently accepted management practices and appropriate mine closure techniques to comply with accepted protocols and standards. This Plan has been prepared based on the current site conditions and it provides the concepts and activities for the full closure and reclamation of the Site. This FCRP upon acceptance will supersede any ICRP and CMP.

In accordance with the Type A Water Licence 2AM-LUP2032, Part B, Item 13, the FCRP (Golder, 2018) was approved by the Nunavut Water Board (NWB). For additional information related to regulatory requirements related to the current licence refer to Section 1.3.

1.2 Site Location and Access

The Lupin Mine is located in the Kitikmeot Region, 285 kilometres (km) southeast of Kugluktuk, Nunavut, 400 km and north of Yellowknife, Northwest Territories (NWT). The Site is on the western shore of Contwoyto Lake, approximately 60 km south of the Arctic Circle (Figure 1).

The Lupin Mine property is accessible by fixed wing or rotary aircraft from Yellowknife. The airport serving the Site is at 65° 46’ 00” N and 111° 14’ 41” W. A 1,950 metres (m) long gravel airstrip suitable for Boeing 737 and C-130 Hercules sized aircraft is located on the mine property. A facility to handle float-equipped aircraft is located on the shore of Contwoyto Lake.

The Site is also accessible via the Tibbitt to Contwoyto winter road, which could be operated between February and April. The winter road, it is approximately 570 km from the end of the Ingraham Trail, located near Yellowknife,

NWT to the Site. Following the closure of the Jericho Mine (km 600) in 2008, construction of the winter road beyond the Ekati Diamond Mine (Km 405) has occurred periodically, not annually. The Lupin spur has been inactive for several years, but can be reactivated to allow for the delivery of bulk items. Winter road routing is shown on Figure 1.

LMI mobilized equipment and resources on the Winter Road in the first Quarter of 2020.

1.3 Regulatory Requirements

The regulatory requirements for decommissioning, reclamation and closure of the Lupin Mine are outlined primarily in the Water Licence and federal land leases. It should also be noted that additional regulatory requirements related to the *Fisheries Act*, Inuit Water Rights under the Nunavut Agreement, and land use planning and environmental assessment requirements are also mandated. LMI has prepared this FCRP as the foundation for all regulatory requirements provided in this section.

For a full listing of applicable acts, regulation, guidelines, or policies that govern the Site refer to APPENDIX A.

1.3.1 Water Licence Requirements

The original Water Licence for mining and milling at Lupin was issued by the Northwest Territories Water Board on 1 June 1981. Several Amendments and renewals have occurred since that time.

The Lupin Mine is currently licenced in accordance with the legislative requirement of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA or Act) and *Nunavut Water Regulations* (NWR or Regulations) by the NWB under a Type A Water Licence 2AM-LUP2032 (Water Licence). The current Water Licence was issued by the Board on 28 February 2020, approved by the Minister of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC or Minister) on 9 April 2020. The Licence expires on 27 February 2032. LMI has maintained the Water Licence in good standing and is in compliance with terms and conditions set out therein.

LMI, by way of submission of the FCRP(Ver0), in accordance with the previous water licence 2AM-LUP1520, provided the Board, in writing, confirmation of intent to move to Final Closure and Reclamation phase for the Site.

The FCRP considered all applicable terms and conditions provided in Part I and Schedule I of the Water Licence 2AM-LUP1520 and 2AM-LUP2032 including: the Mine Site Reclamation Guidelines for the Northwest Territories (INAC 2007); the Mine Site Reclamation Policy (INAC 2002); an updated Environmental Site Assessment (ESA) including detailed rock characterization study; and the ICRP as well as any approved technical supporting documents included in the ICRP (Care and Maintenance) plan dated March 2013. Refer to Appendix B for a summary of concordance with previous final closure reclamation requirements as required in the terms and conditions of the current and previous Type A water licences and APPENDIX F for a list of Environmental Studies/Reclamation Research/Engineering Studies and Design Reports.

This Rev1 of the FCRP has been prepared based on the current site conditions and it provides the concepts and activities for the full closure and reclamation of the Site. The Plan reflects relevant comments and recommendations provided by intervening parties and the Board during the review process for the Application for renewal/amendment.

This FCRP supersedes any previous ICRP, CMP or version of the FCRP.

1.3.2 Land Lease Requirements

LMI holds five surface leases under the *Territorial Land Act* for mining on crown lands administered by CIRNAC. A list of the surface land leases pertaining to the Lupin Mine is presented in Table 1 and shown on Figure 3.

Table 1: Surface Leases, Lupin

Name	Type	Description	Expiry	Area (ha)
76E/14-1-12	Surface Lease	Minesite, Tailings Containment Area	31-Mar-2042	1,048.52
76E/14-2-13	Surface Lease	Airstrip	31-Mar-2042	52.99
76E/11-2-7	Surface Lease	Fingers Lake Quarry, access road	31-Mar-2042	191.90
76E/11-3-7	Surface Lease	Fingers Lake Waterlot - dock	31-Mar-2042	0.61
76E/14-10-6	Surface Lease	VOR Navigation aid site	31-Mar-2042	0.09

1.3.3 Fisheries Act Requirements (Metal and Diamond Mining Effluent Regulations Requirements)

Environment and Climate Change Canada (ECCC) is responsible for the *Canadian Environmental Protection Act*, the *Fisheries Act* – pollution prevention measure and the Fisheries Act – *Metal and Diamond Mining Effluent Regulations* (MDMER). Note: LMI does not hold any stand-alone Fisheries Authorizations for the mine.

The MDMER under the *Fisheries Act* came into force on 1 June 2018 (Government of Canada 2002). The MDMER stipulates the conditions under which deleterious substances may be discharged to the aquatic environment by metal and diamond mines (EC 2012). Specifically, these regulations impose limits on the release of deleterious substances, which include: cyanide, arsenic, copper, lead, nickel, zinc, radium-226, and total suspended solids, as well as prohibiting the discharge of effluent that is acutely lethal to fish.

While operations at the Lupin Mine ceased in 2005, it has not been officially designated as having “closed mine status” under the MDMER. Therefore, the regulatory requirements outlined by the MDMER are applicable to the Mine.

To be officially designated as having “Closed Mine Status”, LMI is required to

- provide written notice of that intention to the authorizing officer designated under the MDMER
- maintain the mines rate of production at less than 10% of its design rated capacity for a continuous period of three years starting on the day that the written notice is received by the authorization officer
- conduct a biological monitoring study during the three-year period referred to above and in accordance with Division 3 of Part 2 of Schedule 5

If LMI has complied with all of the requirements set out above, the mine becomes a recognized closed mine after the expiry of the three-year period.

When the mine is discharging effluent, monitoring requirements under the MDMER include:

- Weekly, or less frequently as per the MDMER, sample effluent from the final discharge point and analyze for deleterious substances;

- Monthly, or less frequently as per the MDMER, sample effluent from the final discharge point and analyze for acute lethality;
- Four times per calendar year, but not less than one month between sampling events, sample effluent for chemical characterization and sub lethal toxicity testing; and
- Four times per calendar year, but not less than one month between sampling events, sample receiving environment (exposure and reference areas) water quality for chemical characterization.

The other requirement of the MDMER is to conduct the Environmental Effects Monitoring (EEM) program. The objective of the EEM program, as defined in the Metal Mining Technical Guidance for EEM document (EC 2012), is to evaluate the effects of mine effluent on fish, fish habitat, and use of fisheries resources by humans. The guiding principles of the EEM program are that it be scientifically defensible, cost-effective, and flexible around site-specific requirements, without subjecting field crews to unsafe sampling conditions. The EEM program is comprised of:

- Biological monitoring of fish and fish habitat (i.e., benthic invertebrate communities) in the receiving environment (exposure area) and in the reference area(s). More specifically, an EEM program consists of four key elements:
  - effluent and water quality monitoring and reporting
  - development and submission of a study design for biological monitoring
  - implementation of the study design in the field
  - data assessment, interpretation, and submission of an interpretative report

Five phases of EEM have been conducted at Lupin Mine. Phase 1 was conducted as a Periodic Monitoring – Surveillance program in 2005 (Golder 2006). Phase 2 EEM was conducted as a Periodic Monitoring – Confirmation program in 2008 (AECOM 2009). Both the Phase 1 and Phase 2 EEM programs identified significant differences in benthic invertebrate community and fish endpoints between the exposure and reference areas. As such, Phase 3 was conducted as an Investigation of Cause study in 2010 to determine cause for the differences (AECOM 2011). Following Investigation of Cause, the next phase of EEM was conducted as a Periodic Monitoring – Surveillance program. A Phase 4 EEM Study Design was developed and submitted to Environment Canada, but the biological investigation was not completed as all activities at the Mine were suspended in August 2013.

The Phase 5 EEM program was designed as a Periodic Monitoring – Surveillance program involving fish and benthic invertebrate community surveys (Golder 2017d). Results indicated that there was no difference in the benthic invertebrate community between the exposure and reference areas but there was a difference in fish size between areas. Based on results from the Phase 5 study, and the EEM guidance document, the next regular EEM study should be completed as a Periodic Monitoring – Surveillance program, designed similar fashion to Phase 5.

On 30 January 2019, LMI provided notification under Part 4, Section 32 of the MDMER of its intent to close the Lupin Mine and achieve “Recognized Closed Mine” (RCM) status, and confirmed that all records, books of account, or other documents required by the MDMER shall be kept at the offices of Mandalay Resources Corporation. ECCC confirmed receipt of the notice of intent on 5 February 2019, and confirmed the mine would become a RCM starting on 30 January 2022, provided that the requirements of Part 4, Section 32 of the MDMER have been met.

ECCC further noted that all requirements of the MDMER for operating mines, including effluent and water quality monitoring and reporting, remain in effect until the mine becomes an RCM.

In compliance with monitoring requirements of the MDMER, LMI submitted the Lupin Mine Phase 6 (Final) Environmental Effects Monitoring Study Design on 15 January 2019 to the Minister of Environment (c/o the Regional Director for Prairie and North) via the EEM electronic reporting system (EEMER) in the Single Window Information Manager (SWIM). The Phase 6 Study Design describes the Final EEM study per Schedule 5, Section 18 of the MDMER. Recommendations and requirements identified by the Technical Advisory Panel (TAP) following their review of the Phase 5 EEM study design (Mandalay Resources Corporation 2016) and the Phase 5 EEM interpretative report (Golder 2017d) were incorporated into the Final study design.

The MDMER requires that the final study be conducted not sooner than six months after the final study design has been submitted; as such, the final study was implemented in August 2019. The Final Interpretative Report (FIR; Golder 2020) was submitted to ECCC in June 2020. Receipt of the FIR was acknowledged by ECCC on 8 June 2020; comments and review by the Technical Advisory Panel (TAP) are pending.

During the application review process in 2019, ECCC confirmed that the MDMER effluent discharge limits will be changing as of 1 June 2021. As such, the NWB imposed in Part E, item 5 effluent quality limits for effluent discharged from the Tailings Containment Area and additional limits (Part E, Item 6) for effluent limits in effect from 1 June 2021 until LMI attains RCM under the MDMER.

For additional information related to the EEM program and monitoring for the Site refer to Section 5.0.

1.3.4 Land Use Planning and Environmental Assessment Requirements

Consistent with the Boards Reasons for Decision dated 11 May 2015, correspondence is on the NWB public registry from the Nunavut Planning Commission (i.e., email dated 26 February 2014) indicating that as the project is located outside the boundaries of the two approved land use plans in Nunavut, no conformity determination was required and not further review by the Nunavut Planning Commission would be required as it relates to the current Water Licence. This was reconfirmed during the Application renewal/amendment process in correspondence from the NPC dated 1 February 2019 (NPC File # 148938) for Lupin Mine closure and reclamation and on 14 January 2019 (NPC File #148975) for Lupin Mine winter access winter road.

In 1999, the NIRB screened the renewal application to determine whether it had significant impact potential and whether it required review prior to processing by the NWB. The NIRB Screening decision indicated that the project proposal could be processed without review under the Nunavut Agreement. Since 1999 and following several amendments and/or renewals NIRB determined the Project had not been significantly modified and the application was exempt from requirements from further screening. In addition, the NIRB reminded LMI that the activities proposed (including final closure of the site) remain subject to the terms and conditions recommended by NIRB in their original Screening Decision Report (NIRB 99WR053) issued 16 November 1999. NIRB clearly states their decision “is based on specific consideration that reflect the primary objectives of the Land Claims Agreement. Our consideration in making this decision included: clean up/restoration of the site upon abandonment. Terms and Conditions related to reclamation are outlined in Section 55 to 58 of the report, as follows:

> *55. The Licensee shall remove all scrap metal, discarded machinery and parts, barrels and kegs, building and building material upon abandonment.*

56. *The Licensee shall undertake ongoing restoration for any land or improvements, which are no longer, required for the Licensee's operation on the land.*

57. *The Licensee shall cap all drill holes and cut off any drill casings that remain above ground to ground level upon abandonment of the operation.*

58. *The Licensee shall complete all clean up and restoration of the lands used prior to the expiry date of the permit.*

In addition, the NIRB report also requires LMI to "*submit to the NWB and NIRB a summary report of activities undertaken and any abandonment and restoration of the site*." (NIRB Report, Section 62)

LMI assumes the final closure of the Lupin Mine does not constitute a significant modification requiring further review under the Nunavut Agreement and that the original NIRB Screening Decision Report (NIRB 99WR053) and reconfirmed by NIRB in 2011 for the project apply. This assumption and approach is consistent with the determination made for final closure of the Polaris Mine and Nanisivik Mine, both located in Nunavut, projects originally screened under *Canadian Environmental Assessment Act*, grandfathered in the Nunavut Agreement and subsequently screened by NIRB.

In July 2015 the *Nunavut Planning and Project Assessment Act* (NuPPAA) came into force. Transitional provisions of the NuPPAA confirm the project assessed and approved under the Agreement is not subject to the Act; however, it is noted that procedurally the NPC is the agency responsible for determination of screening under NuPPAA. NPC reconfirmed in correspondence on 1 February 2019 that the Amendment/Renewal Application was exempt from screening by the NIRB because the Application does not involve changes to the general scope the previously assessed activities.

1.3.5 Inuit Water Rights under the Nunavut Agreement

The Lupin Mine is entirely on crown land administered by CIRNAC. Inuit Beneficiaries of the Kitikmeot Region are represented by the Kitikmeot Inuit Association (KIA). The KIA is the entity responsible for defending, preserving, and promoting social, cultural, and economic benefit to Inuit in the Kitikmeot Region.

In accordance with Article 20 of the Nunavut Agreement Inuit have the exclusive rights to the use of water on, in or flowing through Inuit Owned Lands (IOL). The project is entirely on Crown Lands. The Lupin Mine does not adversely affect the change in quality, quantity, or flow of water on IOL and has to date never been requested by the KIA to pay compensation related to mining at the Site. As confirmed in the most recent public hearing, on October 31st, 2014, KIA provided confirmation to the NWB that there is no outstanding water compensation issues regarding the Lupin site relating to Section 63 of the NWNSRT Act. (NWB 2015b)

At the Technical Meeting and Pre-hearing Conference (TM/PHC) held in accordance the regulatory review process in June 2019 in Kugluktuk, the KIA confirmed that there were no outstanding water compensation issues for the Lupin Mine. Refer to the NWB Reasons for Decision re: Water Licence 2AM-LUP2032.

1.3.6 Consultation

1.3.6.1 Government Consultation

LMI presented a "Working Draft" of the FCRP to the NWB in Edmonton in February 2018. Subsequent to this meeting a Draft was formally presented to CIRNAC in April and July 2018. The issues and concerns that were

raised during these meeting was considered in the planning and completion of Ver0 FCRP. Throughout the regulatory review process, CIRNAC and ECCC provided information requests, technical comments and final submissions of which LMI's responses have been integrated into Rev1 of the FRCP.

1.3.6.2 Community Consultation

LMI recognized the importance of maintaining on-going dialogue with the local communities most affected by the forthcoming closure and reclamation of the Lupin Mine Site.

1.4 Purpose of the Final Closure and Reclamation Plan

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

The overarching objective of the Plan follows the Mine Site Reclamation Guidelines for the Northwest Territories (INAC 2007) and the Mine Site Reclamation Policy (INAC 2002). These guidelines will be adhered to ensure that the closure principles are met.

Furthermore, all applicable legislation will be complied with to confirm that, to the extent possible once closure and reclamation has been completed:

- Type A Water Licence requirements are met
- Mining lease obligations are met
- *Fisheries Act* obligations are met
- Traditional values are protected including Inuit Water Rights
- Responsible reclamation practices are used to protect public and employee health, safety, and welfare
- Potential impacts from contaminants are minimized or prevented
- The requirement for long-term maintenance and monitoring associated with the Project components are minimal or nil
- The cumulative degradation of abandoned areas affected by the mining activities is prevented, and natural recovery of disturbed lands is enhanced
- The affected areas will be returned to a condition that is compatible with the surrounding, original undisturbed area with respect to its future potential/productivity uses
- Shareholder value is protected
- LMI and shareholder goals are met

Progressive reclamation at the Lupin Mine has been on-going since 1988. The main progressive reclamation activities carried out on-site include:

- the placement of a 1 m thickness esker material cover on the majority of the exposed tailings at the Tailings Containment Area (TCA)
- the installing thermistors strings installation for monitoring purposes
- reclamation work at the underground mine workings, at unused roads, at the original Twin Otter airstrip and at unused equipment storage areas
- a landfarm was also constructed and commissioned in 2017 to allow bioremediation of petroleum hydrocarbon impacted soils from the cleanup of the Satellite Tank Farm (STF)

Details on the progressive reclamation activities carried out at the Site are provided in Section 3.0.

The hiring of Inuit beneficiaries is a priority for LMI. On-site contractors work to hire support workers from Kuglugtuk and other Kitikmeot communities whenever possible. The data and information collected during the operations stage of the Lupin Mine and during the current state of care and maintenance have been used in the preparation of this Plan.

1.5 Approach to Development of the Final Closure and Reclamation Plan

Concurrent with the regulatory review process, LMI intends to continue implementation of the approved final closure of the TCA and ongoing care and maintenance measures to support full remediation. LMI is committed to responsible closure and reclamation practices for the protection of human, wildlife and aquatic life health, and for minimizing impacts on the environment. This commitment is in agreement with the three closure principles listed in the INAC (2007) guidelines for mine closure and on which the overall closure objective of this Plan is supported:

- **Physical stability:** The components of the reclaimed site should be constructed or modified at closure so that they do not erode, subside or move under extreme design events, and therefore do not pose a threat to humans, wildlife, or environmental health and safety;
- **Chemical stability:** The components of the reclaimed site should be chemically stable so as to prevent adverse soil, water and air quality effects that might pose a risk to humans, wildlife or environmental health and safety; and
- **Future use and aesthetics:** The reclaimed site should be compatible with the surrounding lands at the completion of the reclamation activities.

These principles and their broad objectives were used to support the identification of closure objectives that are specific to each the Project components which are presented in this Plan.

1.6 Closure and Reclamation Planning Team

The Proponent of the Project:	Lupin Mines Incorporated (LMI)
The address for the Proponent is:	Lupin Mines Incorporated Mandalay Resources Corporation 76 Richmond Street East, Suite 330 Toronto, Ontario M5C 1P1 Canada
The primary contact person for the Project is:	Karyn Lewis

The Proponent of the Project:	Lupin Mines Incorporated (LMI)
	Project Manager, Lupin Mine and Ulu Gold Project Mandalay Resources Corp./Lupin Mines Incorporated/Bonito Capital Corp. General Administration, Mandalay Resources Inc. M: 778-368-7340
Acting on behalf of the Proponent:	Lead Consultants Golder Associates Ltd. (Golder) (Environmental) 16820 107 Avenue Edmonton, Alberta T5P 4C3 Canada Stantec Consulting Ltd (Engineering) 200-325 25 Street SE Calgary, Alberta T2A 7H8 Canada

1.7 Definition of Terms

A glossary of commonly used terms in this Plan is included in Appendix C. A list of acronyms and abbreviation along with units and symbols was provided above.

1.8 Approach to Inclusion of Long-Term Community Values

LMI is committed to maintaining the highest level of integrity in its corporate responsibilities toward resource development and environmental stewardship. LMI is committed to environmental protection throughout the exploration, development, operation, and eventual closure and rehabilitation of each of its projects by applying sound judgment, by meeting or exceeding legislative requirements and by minimizing adverse impacts its activities may have on the environment.

LMI is committed to the sustainable development of the Kitikmeot region and will strive to maximize the benefits of the Project for all parties involved while minimizing or eliminating any negative impacts or long-term influences on the environment and local communities.

LMI is committed to keeping the communities impacted by the Mine informed of the final closure of the Site, advancements or setbacks, and to create constructive dialogue between all parties. Consequently, numerous mine elements have been planned based on community input. This practice of information sharing will continue through development of the FCRP and will provide a framework for addressing future opportunities and concerns.

LMI is committed to the following:

- Supporting the local community for procuring resources and personnel wherever possible.
- Maintaining open lines of communication between all parties involved.
- Understanding and integrating the Project within a context of ecosystem integrity, social health, and economic stability. LMI's objective is to minimize disturbance to the local environment during operations, and leave the site in as natural a state as possible after closure. Post-closure monitoring will be a key component in ensuring this objective is realized.

To achieve these goals, LMI will:

- Be responsible for its actions and their consequences on the environment.
- Instill the ethics of environmental responsibility through education and communication with all employees, contractors, consultants and suppliers.
- Instill in all employees the recognition that environmental management is an important priority of the Company and integrate environmental considerations into all mine closure planning.
- Implement and maintain ethical business practices and an effective risk management system, including an up-to-date timeline of all permits, expiration dates, and planned permit renewal activities.
- As part of its design and operating philosophy, to the extent practicable and commercially reasonable, minimize potential adverse impacts on the natural environment, for example, including, but not limited to: minimizing land disturbances in the design, construction and operation of our projects with the goal, to the extent practicable and commercially reasonable, of remediating disturbed areas in such a way that they can revert to their original state or to some other beneficial use.
    - maximizing energy efficiency of our mining and process equipment to reduce absolute energy needs per unit of output
    - reviewing options and alternatives to utilize renewable energy and low-carbon energy sources
    - minimizing water use and recycling water as much as possible
    - minimizing discharges (reportable or otherwise) and conducting prompt remediation and required regulatory reporting should they occur
    - reducing use of consumables and reusing or recycling them where practical
    - reducing degradation of equipment through wear and damage that causes needs for premature capital equipment replacement
- Evaluate environmental performance by conducting operational and environmental monitoring programs required by law, as well as audits and other monitoring activities not necessarily required by law but that may be useful in measuring our performance and identify opportunities for improvement.
- Keep up-to-date with changes and potential changes to environmental regulations and evolving government guidelines.
- Keep up to date on technological developments that could be used to mitigate or avoid impacts.
- Encourage conservation and pollution prevention measures by requiring contractors and suppliers to provide operational guidelines that outline their own procedures and responsibilities to reduce, recycle and reuse materials when working on Mandalay-related activities.
- Assess environmental conditions regularly at all stages of mine development and closure to identify issues or areas in need of attention and to establish strategies for their management.
- Be consistent with the current state of practice in the industry for environmental protection and management.

- Implement effective and transparent engagement and communication with our stakeholders when significant environmental issues arise. Respond to concerns in a timely and productive manner, identifying concerns, and where Mandalay activities are the cause, taking corrective measures to alleviate the concerns and prevent their recurrence.
- LMI will ensure that it maintains feasible reclamation plans at each site as well as adequate financial reserves to reclaim each site after completion of commercial activities.

There are two potential forms of benefit to northern communities, may including:

- Disposal of assets; and
- Decommissioning contracts and employment.

1.9 Approach to Inclusion and Management of Information

To assist the NWB in review of the FCRP, LMI compiled a concordance assessment to all applicable final closure terms and conditions for Type A water licences issued by the Board (Refer Appendix B). All available information including data, research and studies required for the development and/or implementation of closure and reclamation measures have where appropriate been incorporated in this FCRP. Links to Type A water licence documentation for final closure are accessible through links provided in the concordance assessment which link directly to the documents on the NWB public registry. A supplemental list of Environmental Studies/Reclamation Research/Engineering Studies and Design Reports is provided in Appendix F.

This FCRP has been prepared based on the current site conditions and it provides the concepts and activities for the full closure and reclamation of the Site. This FCRP Rev 0 was approved by the Board on issuance of the Licence 2AM-LUP2032 Part B, Item 13 and supersedes the ICRP. For detailed history of closure plan development refer to APPENDIX D.

Rev 1 of the FCRP reflects relevant comments and recommendations provided by intervening parties and the Board during the review process for the Application for renewal/amendment as required in accordance with Part I, Item 2 of Water Licence 2AM-LUP2032.

2.0 PROJECT DESCRIPTION

2.1 Environmental Setting

2.1.1 Geology

2.1.1.1 Bedrock Geology and Mineralogy

The Lupin gold deposit is situated in an Archean metaturbidite sequence of the Contwoyto Formation, part of the Yellowknife Supergroup of supracrustal metasedimentary and metavolcanic rocks of the Slave Geologic Province. The rocks have been subjected to both regional and contact metamorphism and to several phases of deformation and intrusion. The bedrock at the Site consists of a mixture of low grade metamorphosed argillite, siltstone, slate, greywacke, and quartzite, generally phyllite (Geocon 1980).

The Lupin ore unit is composed of the Centre Zone, East Zone, West Zone and L19 Zone, all of which are contained within a continuous, isoclinally folded, steeply dipping unit of amphibolitic iron formation within the Contwoyto Formation. This unit has been followed for a strike length of 3,000 m and a dip length of 1,500 m. Several phases of deformation have resulted in steeply plunging fold noses and steeply dipping fold limbs. The resulting pattern is 'M' shaped, consisting of a northerly-plunging syncline and adjacent anticlines to the west and east. The West Zone forms the west limb of the west anticline, the Centre Zone the west limb of the syncline and the East Zone the east limb of the syncline. Most of the gold occurred in the West Zone and Centre Zone. A lesser amount was found in the East Zone. The L-19 Zone did not contain economic concentrations of gold and was not mined.

The iron formation is a well laminated unit and consists of both silicate facies and sulphide facies metamorphosed to an amphibolite and quartz rich rock. The gold is found primarily within the sulphide rich iron formation. The ore at Lupin consists of amphibole, quartz, garnet, pyrrhotite, arsenopyrite, minor pyrite and traces of chalcopyrite. The gold is fine grained (generally less than 100 microns in diameter) and is associated mainly with the pyrrhotite and arsenopyrite. Although not common, visible gold is sometimes found and is usually in close proximity to quartz veining. Also found in trace amounts are scheelite, apatite, epidote, calcite, tourmaline, and some arsenides (notably loellingite). Arsenopyrite occurs as metacrysts, up to 2 centimetres (cm) in diameter, which often have loellingite cores. Much of the gold associated with these arsenides occurs at the arsenopyrite - loellingite boundaries within these metacrysts. Gold is also finely disseminated within pyrrhotite and silicates, and is rarely visible to the naked eye.

The McPherson Zones (M1 and M2) are in iron formation lenses separate from the main Lupin ore unit, contain economic quantities of gold, and were mined. They trend parallel to the West Zone at approximately 60 m and 80 m east of it near the latitude of the shaft. The M1 and M2 Zones contain a higher proportion of pelitic beds than the main Lupin ore unit. Gold is locally present in the pelitic beds, and visible gold is more common in the M1 and M2 Zones than in mineralized zones of the main ore body.

2.1.1.2 Surficial Geology

Where bedrock is not present at surface, the ground surface typically consists of glacial till which is occasionally overlain by glacio-fluvial and glacio-lacustrine sand and gravel deposits (in the form of eskers and lake shore deposits). The till is a silty sand with gravel and boulder content and is underlain by weathered and competent low grade clastic metamorphosed bedrock of the Yellowknife Supergroup. The esker material used for progressive reclamation is described further in Section 2.3.2.

2.1.2 Climate

Climate in this region is classed as semi-arid subarctic, with an average annual precipitation of approximately 300 millimetres (mm). August is the wettest month with average rainfall of 59.8 mm. The annual average temperature is -10.9 degrees Celsius (°C); July is the warmest month with average temperature of 11.7 °C, whereas January is the coldest month with a monthly average of -29.7 ºC. Table 2 shows the monthly temperature at the Lupin Mine, as measured at the weather stations.

Table 2: Monthly Average Temperature at Lupin (1982-2015)

	Mean Monthly Temperature (ºC)												
Date[(a)]	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg**
1982	-36.0	-28.5	-27.5	-19.8	-5.6	4.9	11.5	7.3	0.9	-7.2	-26.0	-29.8	-13.0
1983	-30.9	-33.4	-28.8	-17.2	-14.0	5.2	10.3	9.3	2.4	-9.4	-14.0	-27.1	-12.3
1984	-32.2	-25.8	-25.2	-12.0	-3.9	8.1	12.7	9.7	-0.1	-9.2	-21.8	-32.4	-11.0
1985	-27.7	-34.7	-26.5	-19.6	-1.6	6.5	7.8	6.3	0.8	-10.0	-23.5	-25.0	-12.3
1986	-31.8	-26.9	-27.6	-19.0	-5.7	3.0	10.5	7.0	1.5	-9.6	-24.1	-24.9	-12.3
1987	-24.7	-25.1	-26.0	-15.2	-6.9	5.4	10.1	5.4	4.1	-8.1	-21.2	-19.6	-10.2
1988	-31.6	-31.7	-22.7	-15.4	-10.1	7.1	11.5	10.4	3.7	-8.3	-25.5	-27.4	-11.7
1989	-33.4	-22.5	-29.7	-15.3	-8.2	7.9	12.3	12.7	1.6	-7.9	-26.0	-29.2	-11.5
1990	-32.8	-34.6	-21.3	-14.6	-7.4	4.3	10.9	6.1	1.0	-9.3	-24.9	-31.3	-12.8
1991	-31.5	-30.6	-28.1	-13.9	-1.8	7.5	11.4	10.1	0.0	-10.7	-22.7	-27.8	-11.5
1992	-29.2	-29.0	-23.0	-17.5	-5.8	4.3	11.0	8.2	-1.2	-8.4	-18.6	-26.0	-11.3
1993	-25.7	-28.3	-21.4	-17.1	-5.7	4.8	10.4	9.2	0.5	-8.9	-21.9	-29.0	-11.1
1994	-34.4	-33.6	-21.7	-17.5	-2.4	8.1	13.9	10.6	2.2	-5.0	-18.5	-23.5	-10.2
1995	-25.0	-28.3	-25.6	-15.2	-7.1	7.6	8.9	8.9	0.8	-9.3	-20.6	-29.9	-11.2
1996	-31.7	-26.7	-25.9	-16.3	-5.8	9.7	14.3	7.6	5.1	-9.5	-20.4	-26.9	-10.5
1997	-30.3	-27.5	-27.6	-16.0	-6.5	6.0	13.4	9.7	4.7	-10.6	-15.1	-23.0	-10.2
1998	-33.4	-25.6	-22.1	-10.7	-0.4	8.3	13.9	11.4	3.6	-4.1	-12.8	-22.2	-7.8
1999	-28.6	-23.3	-19.6	-13.3	-4.8	6.9	8.4	8.8	2.3	-8.9	-16.9	-24.8	-9.5
2000	-26.8	-24.9	-22.3	-16.1	-3.9	7.3	15.1	9.0	1.0	-8.7	-18.8	-29.5	-9.9
2001	-25.4	-27.7	-23.8	-15.8	-4.7	3.8	12.4	8.5	5.9	-9.6	-20.5	-23.2	-10.0
2002	-28.3	-30.1	-25.5	-19.9	-8.4	7.4	12.0	8.1	2.8	-9.0	-17.3	-20.2	-10.7
2003	-27.2	-32.0	-26.7	-13.5	-5.4	5.6	13.4	10.3	3.7	-4.3	-18.9	-25.1	-10.0
2004	-33.0	-29.1	-29.6	-19.3	-11.2	5.2	11.6	6.5	0.8	-10.6	-22.0	-29.7	-13.4
2005	-29.1	-29.5	-23.9	-11.4	-8.7	4.8	9.4	8.7	0.2	-7.0	-17.4	-20.6	-10.4
2006	-26.1	-23.3	-18.5	-13.4	-0.1	10.2	11.2	11.3	4.5	-6.0	-20.9	M	-7.7
2007	M	-28.3	-27.8	-14.3	-6.5	5.3	12.8	7.0	-0.8	-7.6	-22.1	-27.0	M
2008	-27.6	M	M	-15.8	-4.1	5.9	12.2	8.3	0.2	-6.0	-18.4	M	M
2009	M	M	M	M	M	M	M	M	4.3	-9.3	-17.0	-25.3	M
2010	-27.5	M	M	-8.8	-8.7	6.6	12.6	9.7	2.4	-5.6	-16.3	-24.4	M
2011	M	M	M	-19.7	-2.8	5.4	13.3	10.7	3.7	-5.4	-19.9	-24.6	M
2012	-28.6	M	M	-15.3	-1.1	9.4	13.5	10.3	6.4	-6.6	-21.3	-29.2	M
2013	-31.6	M	M	-17.9	-5.1	10.8	9.9	11.2	3.8	-3.6	M	-29.3	M
2014	M	M	M	-16.3	-3.0	9.4	13.5	7.9	0.6	-7.4	-20.5	-25.4	M
2015	-27.5	M	M	-17.5	-1.9	7.9	10.4	11.1	3.2	-10.0	M	-24.6	M
Avg[(b)]	**-29.7**	**-28.5**	**-24.9**	**-15.8**	**-5.4**	**6.7**	**11.7**	**9.0**	**2.3**	**-8.0**	**-20.2**	**-26.2**	**-10.9**

a) Between 1982 and 2006 data was collected from station 23026HN and between 2007 to 2016 data collected from station 230N002
b) Averaged precipitation values do not include missing or invalid data
M = Missing or invalid data from weather stations

Based on years with complete records, the mean annual temperature at Lupin is about -10.9 ºC. According to Boyd (1973), the freezing index in the area was about 3300 ºC-days. Because of climate change, predictions are that the mean annual temperature will increase about 4 to 5 ºC over the next century. Notwithstanding this predicted increase, continuous permafrost will still persist at the Lupin site.

Snowfall represents about 46% of the total annual precipitation. Snowfall can occur during any month, although heaviest snowfalls generally occur in October. The prevailing winds in the Lupin Mine area are from the northwest.

Snowmelt is generally complete by the end of June. Break-up on Contwoyto Lake begins in mid-July, although in some years the lake is not ice-free until early August. Small lakes in the region are ice free by early July. Ice starts to reform on small lakes of the surrounded area in late August or early September. Complete freeze-over of Contwoyto Lake occurs in October.

The winter climate at this latitude is severe in intensity and duration and is followed by a short, warm summer. In winter, between 1 and 3 m of ice develop on the surface of the lakes and it is the rate of melting of this ice that greatly influences summer conditions. The interaction between climate and morphology of the individual lakes gives rise to great differences in the thermal regime of the lakes.

Table 3 shows the monthly precipitation from snow and rain, as measured at the Lupin Mine weather station, between 1982 and 2006. Precipitation readings were taken manually until 2006 when an automated system was installed by Environment Canada. The automated system does not separate measured precipitation into snowfall or rainfall, making it difficult to interpret. The automated system does record temperature and wind speed.

Table 3: Monthly Precipitation at Lupin Mine Weather Station (1982-2006)

	Total Monthly Precipitation mm (1 cm of snow = equivalent to 1 mm of water)												
Date	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
1982	0.8	3.0	M	13.2	12.8	44.9	36.0	62.4	36.6	21.3	14.1	15.0	260.1
1983	24.6	5.5	16.8	16.5	18.0	10.4	77.7	75.2	77.0	41.8	10.8	6.0	380.3
1984	6.8	19.4	16.2	19.3	17.8	60.0	69.6	53.7	19.8	25.4	13.2	9.2	330.4
1985	9.2	11.6	10.4	25.8	10.2	19.4	89.0	46.6	44.7	24.0	9.4	6.6	306.9
1986	20.0	9.2	5.2	19.7	29.2	17.5	18.0	100.8	30.0	28.0	13.6	12.8	304.0
1987	11.6	6.6	5.6	6.6	8.6	67.8	41.8	47.1	35.0	34.1	45.0	25.4	335.2
1988	1.8	3.6	4.2	6.0	10.8	50.3	32.4	18.7	43.4	32.2	22.2	8.2	233.8
1989	20.0	4.0	10.2	3.1	36.1	6.3	35.0	27.5	33.7	11.7	14.4	16.5	218.5
1990	11.8	6.0	12.0	8.3	2.4	23.4	23.3	54.0	48.5	20.1	9.2	14.7	233.7
1991	7.9	13.2	12.4	26.1	14.0	12.4	42.8	76.2	46.5	26.4	17.6	19.4	314.9
1992	17.6	8.6	9.8	20.4	21.4	21.2	14.8	47.0	31.2	43.8	15.4	4.2	255.4
1993	6.1	19.2	13.2	6.2	28.4	24.0	87.0	28.8	29.9	19.4	14.8	12.0	289.0
1994	3.4	2.2	22.0	8.2	15.4	39.2	13.8	47.2	43.4	29.2	11.0	14.8	249.8
1995	5.2	3.4	38.8	6.6	11.2	20.8	40.2	79.0	49.4	37.0	7.4	23.8	322.8
1996	5.6	18.4	4.4	8.0	24.8	53.2	57.7	156.0	68.8	12.4	13.6	6.6	429.5
1997	6.6	6.6	6.8	12.8	27.2	21.2	18.2	58.6	25.4	46.2	12.6	17.8	260.0
1998	5.2	7.2	5.6	17.8	19.2	38.4	32.2	57.4	61.8	51.7	17.0	21.6	335.1
1999	9.6	6.6	14.4	25.0	25.2	19.6	62.4	57.2	85.2	23.8	13.4	30.8	372.8
2000	3.8	5.4	7.0	12.4	18.6	5.0	27.2	49.2	58.6	43.4	14.0	7.8	252.4
2001	6.4	7.0	24.6	30.2	40.2	6.4	44.4	46.4	9.4	20.0	27.6	12.0	274.6
2002	7.6	2.2	6.4	15.8	4.4	35.6	67.0	92.8	52.2	14.2	20.2	11.2	329.6
2003	3.8	0.4	19.8	3.4	22.2	18.4	44.0	69.2	36.0	28.4	31.3	15.6	292.5

Table 3: Monthly Precipitation at Lupin Mine Weather Station (1982-2006)

	Total Monthly Precipitation mm (1 cm of snow = equivalent to 1 mm of water)												
Date	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
2004	10.8	12.4	9.2	18.4	6.0	21.2	12.2	111.0	61.2	29.2	30.2	3.4	325.2
2005	14.2	6.2	12.6	18.8	11.2	59.4	28.8	64.2	26.6	33.2	20.2	12.4	307.8
2006	14.6	6.8	16.8	16.8	9.2	63.7	21.6	35.4	11.2	20	M	M	M
Avg.	***9.4***	***7.8***	***12.2***	***14.6***	***17.8***	***30.4***	***41.5***	***62.5***	***42.6***	***28.7***	***17.4***	***13.7***	***300.6***

M = Missing data; not used on average calculation

The Climate Normals, climate averages and extremes for the Lupin site compiled by Environment Canada at Station 23026HN for the 1981 to 2010 period are listed in Table 4.

Table 4: Climate Normals 1981-2010 for Station 23026HN

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Temperature												
Daily Avg. (°C)	-29.9	-28.5	-24.8	-15.8	-5.9	6.4	11.5	8.8	2.1	-8.4	-20.4	-26.2
Standard Deviation	3.2	3.5	3.1	2.6	3.3	1.9	1.9	1.8	1.9	1.9	3.7	3.6
Daily Max. (°C)	-26.3	-24.9	-20.9	-11.5	-2.1	10.8	16.3	12.6	4.8	-5.8	-16.9	-22.6
Daily Min. (°C)	-33.4	-32.1	-28.7	-20.1	-9.6	1.9	6.7	5	-0.6	-10.9	-23.9	-29.7
Extreme Max (°C)	-5	-5	0.5	6	17.5	27.5	31	27.5	21	13	0	-4.5
Precipitation												
Rainfall (mm)	0	0	0	0.4	5.3	26.8	41.1	59.8	25.5	1.6	0	0
Snowfall (cm)	9.4	7.8	12.2	14.3	12.5	3.6	0.4	2.6	17.1	27.1	17.4	13.7
Precipitation (mm)	9.4	7.8	12.2	14.6	17.8	30.4	41.5	62.5	42.6	28.7	17.4	13.7
Extreme Daily Rainfall (mm)	0	0	0	5.8	10.2	36.8	41.8	38.6	34.2	10.8	0.2	0
Date (yy/dd)	82/01	82/01	82/01	05/22	92/26	87/13	83/09	86/29	99/10	88/08	87/02	82/01
Extreme Daily Snow Fall (cm)	11.6	14.2	10	13.8	14.3	13.4	3.4	8.8	17	31.8	14	10
Date (yy/dd)	92/02	93/01	03/14	91/08	89/11	92/15	85/18	85/19	83/27	98/28	87/09	87/08
Extreme Daily Precipitation (mm)	11.6	14.2	10	13.8	14.3	36.8	41.8	38.6	34.2	31.8	14	10
MNDate (yy/dd)	92/02	93/01	03/14	91/08	89/11	87/13	83/09	86/29	99/10	98/28	87/09	87/08

Source: Environment Canada Website

The Hydrologic Atlas of Canada indicates that the annual evaporation in the area of the Lupin Mine is about 105 to 110 mm per year.

During the regulatory review process, ECCC and CIRNAC requested clarification regarding climate change.

LMI confirmed:

- LMI predictions are based on the CGCM3/T47 model using the IPCC SRES A1B scenario. The model was accessed via the ECCC website. The prediction is for the 100 years between 2000 and 2100. (CIRNAC TC No.9)
- The mean annual temperature is projected to increase by approximately 4 to 5 °C by the end of the century (2100). The projection comes from a single climate model (CGCM3/T47) for a mid-range socio-economic emission scenario (SRES A1B), where the emission scenario indicates the level of greenhouse gases projected to be present. In Canada's Changing Climate Report Chapter 8: Changes Across Canada mean

annual temperature is projected to increase in Northern Canada based on the median of the climate model ensemble and the emissions scenario or representative concentration pathway (RCP) chosen. The projected change in mean annual temperature for the project is consistent with the range of projected increases from Canada's Changing Climate Report. (CIRNAC TC No.9)

- The prediction of 4 to 5℃ was based on the CGCM3/T47 model using the IPCC SRES A1B scenario. The model was accessed via the ECCC website. The prediction is for the 100-year period between 2000 and 2100. This result is intermediate between the B1 scenario (2.5 to 3.0℃) and the A2 scenario (> 4.5℃). (ECCC TC No.1)
- A single climate model (CGCM3/T47) and medium range emissions scenario (SRES A1B) was downloaded from the Canadian Climate Data and Scenarios website from Environment and Climate Change Canada at the time of writing the report. This information is no longer available on this website as it was updated in February 2019. In Canada's Changing Climate Report Chapter 8: Changes Across Canada, mean annual temperature is projected to increase between for Northern Canada based on the median of the climate model ensemble and the emissions scenario or representative concentration pathway (RCP) chosen. The projected change in mean annual temperature for the project is consistent with the range of projected increases from Canada's Changing Climate Report." (ECCC TC No.1)

At the TM/PHC, LMI committed to provide clarification with respect to the climate change modelling using a range of emission scenarios (low to high future forcing) from multiple climate models and considering multiple parameters (precipitation, permafrost thaw, etc.), which will be determined following consultation with climate change experts, for consideration in the Final Reclamation and Closure Plan (TM Commitment No.13). Refer to the Technical Memorandum in Appendix H-2 regarding Lupin Mine Tailings Containment Area Dams Thermal Modelling Results for response to TM/PHC Commitment No.13. (Stantec, 2019a).

2.1.3 Topography

The Site is in the tundra zone of the Canadian Shield, in an area of continuous permafrost. It was glaciated multiple times during the Pleistocene age. The most recent glaciation was the late Wisconsin glacial stage, which reached a maximum extent about 14,000 years BP and disappeared about 6,000 years BP. Terrain in the vicinity of the Site is generally low and undulating, ranging between 470 and 505 m elevation. Numerous shallow lakes and streams occur in depressions throughout the area.

While the Site area is predominantly bedrock at surface, it is typified by “tombstone” topography over some of its area. These “tombstone” features resemble grave markers and occur as a result of ice- jacking action in heavily jointed rocks where joints tend to be pseudo-vertical and near-horizontal. The frost heave blocks are of various sizes and are scattered in a chaotic fashion. Removal of a block raised by this action would reveal an underlying mass of permanent ice (Geocon 1980; Golder 1990).

2.1.4 Vegetation

The Lupin Mine is located within an area of sparse vegetation, in the barren land tundra of Nunavut. It is typified as having sparse low lying vegetation which is extremely tolerant and well adapted to the climatic conditions. Some of the more prevalent types of habitat that can be found throughout the area include upland and lowland tundra, wet meadows and gentle slopes.

Throughout the Site there is diverse types of vegetation consisting of grasses and sedges; ground cover such as mosses, Labrador tea, cranberry, bilberry, bearberry, and arctic white heather. In wet areas, predominant species include cotton grass, bog rush, and other aquatic grasses. Dwarf birch and willows populate trenches, and colourful flowering plant species include fireweed, Lapland rosebay, azalea and saxifrage to list a few.

2.1.5 Hydrology

Contwoyto Lake is the major water body in the region, with a surface area of approximately 95,900 hectares (ha) and a drainage area of 8,000 square kilometres (km^2). Contwoyto Lake has two outlets in the Burnside River, which flows from the northwest end of the lake towards Bathurst Inlet, and the Back River at the southeast end of the lake, which flows into Pellatt Lake. The main body of Contwoyto Lake lies to the east and south of the mine site. To the north of the mine, a portion of the lake extends to the west and south, terminating in a narrow bay (Sun Bay) which lies directly west of the mine site.

As shown on Figure 3, aquatic habitat in the receiving environment immediately downstream of the tailings area is comprised of three shallow lakes (colloquially referred to as Dam 2 Lake, Dam 1a Lake, and Unnamed Lake), two streams (Seep Creek and Concession Creek), two shallow ponds, and two embayment areas of Contwoyto Lake (Inner and Outer Sun Bay). Dam 2 Lake is a small lake (maximum depth of 7 m), bordered on the north by a gravel pit and the east by the TCA (AECOM 2011). With the exception of Dam 2 Lake, all of the small lakes and ponds freeze to the bottom in winter. Much of Inner Sun Bay also freezes to the bottom. Due to low winter flows, both Seep Creek and Concession Creek freeze to the bottom in winter. As a consequence, over wintering habitat for fish is limited primarily to Outer Sun Bay and the main body of Contwoyto Lake (RCP/RL&L 1985).

Concession Creek drains Concession Lake via Unnamed Lake (also known as East Lake) to Inner Sun Bay. Seep Creek enters the Sun Bay drainage system along the east side of Unnamed Lake. Lower Concession Creek (i.e. that section between Unnamed Lake and Inner Sun Bay) varies in width between 25 and 75 m, depending on seasonal discharges. Side channels are active during spring freshet. Stream depth generally is less than 1 m, except during spring freshet when depths approach 1.5 m. The substrate is primarily large boulders with large and small cobbles occupying the interstices.

Seep Creek is approximately 6.5 km in length, flowing from its source in Dam 2 Lake and Dam 1a Lake (via separate branches which join about 2 km downstream) to Unnamed Lake (also known as East Lake). The stream channel in upper Seep Creek generally is poorly defined, often flowing through marshy areas, or between large

boulders or through bedrock fractures. This section of the creek generally is less than 0.5 m in depth and less than 2 m wide. The dominant substrate type is boulders, although localized areas of cobble and gravel are present. Lower Seep Creek (i.e. the 400 m section upstream of Unnamed Lake [also known as East Lake]) is characterized by a well-developed channel varying in width from 1 to 4 m, although during freshet, maximum wetted width was about 20 m. The dominant substrate type is boulders, with localized areas of cobbles and gravel (RCP/RL&L 1985).

Inner Sun Bay (approximate area of 150 ha) is primarily shallow (mean depth of 1.7 m), with a maximum depth of about 6.5 m. Over 91% of the surface area is shallower than 3 m, and much of the bay freezes to the bottom in winter. Outer Sun Bay is deeper (greater than 10 m).

2.1.6 Water Quality

Water quality at Lupin Mine Site was assessed in 1985 before and after the first effluent discharge event and between 2005 and 2016 (Mudroch and Sutherland 1988; Golder 2004) in support of EEM programs (Golder 2006, 2017d; AECOM 2009, 2011). In 1985 samples were collected exclusively from the Exposure Area, while between 2005 and 2016 samples were collected at both Exposure Area (Seep Creek downstream of the tailings discharge) and Reference Areas (Fingers Lake and Unnamed Creek southeast of Fingers Lake) (Figure 12 and Golder 2017d [Figure 2.1-2]).

2.1.6.1 Exposure Area

In 1985, water quality was measured at stations in Seep Creek, Inner Sun Bay, and Outer Sun Bay in August (just before treated effluent discharge) and September (during the first discharge event). Conductivity values recorded at all stations in September were elevated compared to those measured in August. In September, concentrations of all metals, with the exception of arsenic, were found to be significantly higher than the concentrations measured in August. In addition, the September concentrations for arsenic, copper, and zinc exceeded Canadian Water Quality Guidelines (CWQG) (Mudroch and Sutherland 1988; Golder 2004).

Between 2005 and 2016, a total of twelve water quality samples were collected in late August-early September in the Exposure Area in support of the EEM programs (Golder 2006, 2017d; AECOM 2009, 2011) (Table 5). Water quality results were compared to the CWQG for the protection of freshwater aquatic life (CCME 1999). Summary statistics were calculated on these data to describe existing conditions in the Exposure Area (Table 6). From this dataset, mean pH (field and laboratory) for the Exposure Area was below the CWGQ range minimum value of 6.5 and mean concentrations of aluminum, cadmium, copper, nickel, and zinc exceeded applicable CWQG (CCME 1999). Although mean concentrations of arsenic, iron, and lead were below applicable CWQG, concentrations of these parameters occasionally exceeded the CWQG (Golder 2006, 2017; AECOM 2009, 2011).

Table 5: Water Quality Sampling Stations in the Exposure and Reference Areas for EEM Phases 1 to 5*

Area	Station ID	Phase 1 (2005)	Phase 2 (2008)	Phase 3 (2010)	Phase 5 (2016)[a]
Exposure Area	SCD1	√	√	√	-
	Seep Creek Pond 1 and 2	√	-	-	-
	SCP1	-	√	√	√
	SCP3	-	-	-	√
	SCP5	-	√	-	√
	LUP-20[b]	-	√	√	-
Reference Area 1	FC2	√	√	√	-
	Fingers Lake	√	-	-	-
	FL1	-	√	-	√
	FL-3	-	-	-	√
	FL5	-	√	√	√
Reference Area 2	R2-1	-	-	√	√
	R2-2	-	-	√	-
	R2-3	-	-	√	√
	R2-5	-	-	-	√

* Note: EEM Phase 6 was implemented in 2019 with the Final Interpretative Report submitted to ECCC in 2020.

Source: Golder (2006, 2017); AECOM (2009, 2011).

[a] Phase 4 study was not completed as all activities at the Mine were suspended in August 2013;

[b] LUP-20 is formerly known as SNP925-20.

√ = sample collected; - = no sample collected.

2.1.6.2 Reference Areas

Between 2005 and 2016, in support of the EEM studies, a total of eleven water samples were collected from Fingers Lake of Reference Area 1 and six water samples were collected from the small waterbodies in Reference Area 2 (Golder 2006, 2016; AECOM 2009, 2011) (Table 5). Water quality results were compared to the CWQG for the protection of freshwater aquatic life (CCME 1999). Summary statistics were calculated for these data to describe existing conditions in each reference area (Table 7 and Table 8).

Table 6: Summary of Water Quality in the Exposure Area, 2005 to 2016*

Parameter	Unit	CWQG	Exposure Area							
			Median	Mean	Min	Max	SD	nd	Count	% Above Guideline
										C
Field Measured										
pH	-	6.5 - 9.0	**5.7**[(C)]	**5.6**[(C)]	**5.3**[(C)]	**5.9**[(C)]	0.31	0	3	100
Temperature	°C	-	7.6	7.5	2.2	14	4.4	0	10	-
Conventional Parameters										
pH	-	6.5 - 9.0	**5.8**[(C)]	**6.0**[(C)]	**4.9**[(C)]	6.9	0.69	0	9	67
Specific conductivity	µS/cm	-	121	166	65	738	187	0	12	-
Hardness, as $CaCO_3$	mg/L	-	29	53	23	186	53	0	9	-
Total alkalinity, as $CaCO_3$	mg/L	-	<2.5	2.0	2.0	6.2	1.5	8	12	-
Total suspended solids	mg/L	-	<1.5	1.5	<1.5	8.0	2.1	11	12	-
Nutrients										
Nitrate	mg-N/L	2.9	0.014	0.53	<0.003	**5.7**[(C)]	1.6	5	12	8.0
Total ammonia	mg-N/L	8.7 - 1,988[(a)]	0.015	0.053	0.0071	0.51	0.14	4	12	-
Total Metals										
Aluminum	µg/L	5.0 - 100[(b, c)]	**80**[(C)]	**121**[(C)]	31	**461**[(C)]	115	0	12	75
Arsenic	µg/L	5.0	2.9	3.7	1.7	**8.2**[(C)]	2.2	0	12	25
Cadmium	µg/L	0.047 - 0.27[(d)]	**0.062**[(C)]	**0.10**[(C)]	0.023	**0.41**[(C)]	0.13	1	12	50
Copper	µg/L	2.0 - 4.0[(d)]	**4.0**[(C)]	**6.3**[(C)]	**3.1**[(C)]	**20**[(C)]	5.1	0	12	100
Iron	µg/L	300	164	210	30	**760**[(C)]	195	0	12	17
Lead	µg/L	1.0 - 7.0[(d)]	<0.025	0.15	0.013	**1.4**[(C)]	0.39	5	12	8.0
Mercury	µg/L	0.026	<0.01	0.0039	<0.000005	<0.01	0.0022	8	9	-
Molybdenum	µg/L	73	<0.05	0.076	<0.03	0.24	0.077	7	12	-
Nickel	µg/L	25 - 150[(d)]	**38**[(C)]	**53**[(C)]	18	**170**[(C)]	48	0	12	67
Selenium	µg/L	1.0	<0.05	0.082	<0.04	0.48	0.13	8	12	-
Zinc	µg/L	30	**40**[(C)]	**67**[(C)]	8.2	**314**[(C)]	91	0	12	67

Table 6: Summary of Water Quality in the Exposure Area, 2005 to 2016*

Parameter	Unit	CWQG	Exposure Area							
			Median	Mean	Min	Max	SD	nd	Count	% Above Guideline C
Others										
Cyanide	mg/L	0.0050	<0.001	0.0010	<0.001	<0.005	0.00090	12	12	-
Radium-226	Bq/L	-	<0.005	0.0040	<0.005	0.010	0.0023	10	12	-

Notes: due to variable detection limits between the study years, where a result was reported as less than the detection limit, the statistic was calculated by assuming the non-detectable result was equal to the detection limit.

*EEM Phase 6 was implemented in 2019 with the Final Interpretative Report submitted to ECCC in 2020.

(a) = the ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (8.6771 mg-N/L) is based on the combination of field pH (6.9) and water temperature (13.8°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

(b) = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (4.9 to 6.9). The guideline is calculated based on the individual pH for each sample.

(c) = guideline is pH dependent: 5 µg/L at pH < 6.5 and 100 µg/L at pH ≥ 6.5.

(d) = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (23 to 186 mg/L). The guideline is calculated based on the individual hardness value for each sample.

(C) = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

Table 7: Summary of Water Quality for Reference Area 1, 2005 to 2016*

Parameter	Unit	CWQG	Reference Area 1							
			Median	Mean	Min	Max	Standard Deviation	nd	Count	% Above Guideline C
Field Measured										
pH	-	6.5 - 9.0	**6.4**[(C)]	**6.4**[(C)]	**6.3**[(C)]	6.5	0.10	0	3	67
Temperature	°C	-	8.1	7.5	3.1	12	3.5	0	9	-
Conventional Parameters										
pH	-	6.5 - 9.0	6.6	6.6	**6.3**[(C)]	6.9	0.19	0	8	13
Specific conductivity	µS/cm	-	13	13	12	15	1.3	0	11	-
Hardness, as $CaCO_3$	mg/L	-	5.0	5.2	4.0	7.0	1.3	0	8	-
Total alkalinity, as $CaCO_3$	mg/L	-	<2.5	2.1	<2.5	5.8	1.5	8	11	-
Total suspended solids	mg/L	-	<1.5	0.95	<1.5	<3.0	0.35	11	11	-
Nutrients										
Nitrate	mg-N/L	2.9	<0.006	0.014	<0.003	0.10	0.030	9	11	-
Total ammonia	mg-N/L	13 - 49[(a)]	<0.025	0.0098	<0.005	<0.025	0.0047	11	11	-
Total Metals										
Aluminum	µg/L	5.0 - 100[(b, c)]	16	15	**5.1**[(C)]	37	9.1	0	11	27
Arsenic	µg/L	5.0	1.3	1.5	1.2	2.1	0.29	0	11	-
Cadmium	µg/L	0.040[(d)]	-0.0085	0.0061	<0.001	<0.025	0.0046	10	11	-
Copper	µg/L	2.0[(d)]	<0.3	0.28	<0.3	0.56	0.15	6	11	-
Iron	µg/L	300	28	34	18	94	22	0	11	-
Lead	µg/L	1.0[(d)]	<0.025	0.035	<0.01	0.28	0.081	9	11	-
Mercury	µg/L	0.026	<0.01	0.0038	<0.000005	<0.01	0.0023	8	8	-
Molybdenum	µg/L	73	<0.03	0.017	0.0084	<0.05	0.0054	9	11	-
Nickel	µg/L	25[(d)]	0.44	0.49	0.34	0.65	0.10	0	11	-
Selenium	µg/L	1.0	<0.05	0.024	<0.04	<0.05	0.0023	11	11	-
Zinc	µg/L	30	<0.4	0.78	<0.4	2.7	0.94	8	11	-

Table 7: Summary of Water Quality for Reference Area 1, 2005 to 2016*

Parameter	Unit	CWQG	Reference Area 1							
			Median	Mean	Min	Max	Standard Deviation	nd	Count	% Above Guideline C
Ungrouped										
Cyanide	mg/L	0.0050	<0.001	0.0010	<0.001	<0.005	0.00093	11	11	-
Radium-226	Bq/L	-	<0.005	0.0034	<0.0025	<0.01	0.0015	10	11	-

Notes: due to variable detection limits between the study years, where a result was reported as less than the detection limit, the statistic was calculated by assuming the non-detectable result was equal to the detection limit.

*EEM Phase 6 was implemented in 2019 with the Final Interpretative Report submitted to ECCC in 2020.

(a) = the ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (13.1408 mg-N/L) is based on the combination of field pH (6.8) and water temperature (10.8°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

(b) = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.3 to 6.9). The guideline is calculated based on the individual pH for each sample.

(c) = guideline is pH dependent: 5 µg/L at pH < 6.5 and 100 µg/L at pH ≥ 6.5.

(d) = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (4 to 7 mg/L). The guideline is calculated based on the individual hardness value for each sample.

(C) = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

Table 8: Summary of Water Quality for Reference Area 2, 2010 and 2016*

Parameter	Unit	CWQG	Reference Area 2							
			Median	Mean	Min	Max	Standard Deviation	nd	Count	% Above Guideline C
Field Measured										
pH	-	6.5 - 9.0	**6.0(C)**	**6.1(C)**	**5.9(C)**	**6.4(C)**	0.26	0	3	100
Temperature	°C	-	11	11	8.3	13	1.6	0	5	-
Conventional Parameters										
pH	-	6.5 - 9.0	6.7	6.6	**6.5(C)**	6.7	0.15	0	3	33
Specific conductivity	µS/cm	-	15	21	10	37	12	0	6	-
Hardness, as $CaCO_3$	mg/L	-	5.3	7.3	3.2	13	4.5	0	6	-
Total alkalinity, as $CaCO_3$	mg/L	-	2.7	2.3	<2.5	4.2	1.3	3	6	-
Total suspended solids	mg/L	-	<3.0	1.1	<1.5	<3.0	0.41	6	6	-
Nutrients										
Nitrate	mg-N/L	2.9	<0.006	0.0023	<0.003	<0.006	0.00082	6	6	-
Total ammonia	mg-N/L	15 - 121(a)	0.010	0.0088	<0.005	<0.025	0.0043	3	6	-
Total Metals										
Aluminum	µg/L	5.0 - 100(b, c)	**22(C)**	**23(C)**	**16(C)**	**34(C)**	8.3	0	6	67
Arsenic	µg/L	5.0	0.69	0.70	0.54	0.90	0.11	0	6	-
Cadmium	µg/L	0.040(d)	0.0086	0.0090	<0.005	<0.025	0.0043	4	6	-
Copper	µg/L	2.0(d)	1.5	1.7	0.88	**3.0(C)**	0.90	0	6	33
Iron	µg/L	300	85	102	52	168	48	0	6	-
Lead	µg/L	1.0(d)	<0.025	0.027	<0.01	0.090	0.032	3	6	-
Mercury	µg/L	0.026	<0.01	0.0050	<0.01	<0.01	0	3	3	-
Molybdenum	µg/L	73	<0.05	0.020	<0.03	<0.05	0.0055	6	6	-
Nickel	µg/L	25(d)	4.3	4.6	1.8	8.3	3.0	0	6	-
Selenium	µg/L	1.0	<0.05	0.023	<0.04	<0.05	0.0027	6	6	-
Zinc	µg/L	30	1.0	0.78	<0.4	1.7	0.61	3	6	-

Table 8: Summary of Water Quality for Reference Area 2, 2010 and 2016*

Parameter	Unit	CWQG	Reference Area 2							
			Median	Mean	Min	Max	Standard Deviation	nd	Count	% Above Guideline C
Ungrouped										
Cyanide	mg/L	0.0050	<0.005	0.0015	<0.001	<0.005	0.0011	6	6	-
Radium-226	Bq/L	-	<0.01	0.0038	<0.005	<0.01	0.0014	6	6	-

Notes: due to variable detection limits between the study years, where a result was reported as less than the detection limit, the statistic was calculated by assuming the non-detectable result was equal to the detection limit.

*EEM Phase 6 was implemented in 2019 with the Final Interpretative Report submitted to ECCC in 2020.

(a) = the ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (14.7480 mg-N/L) is based on the combination of field pH (6.7) and water temperature (10.5°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

(b) = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (5.9 to 6.7). The guideline is calculated based on the individual pH for each sample.

(c) = guideline is pH dependent: 5 µg/L at pH < 6.5 and 100 µg/L at pH ≥ 6.5.

(d) = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (3 to 13 mg/L). The guideline is calculated based on the individual hardness value for each sample.

(C) = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

2.1.7 Environmental Site Assessment

Schedule I of the Water Licence, conditions applying to abandonment, reclamation, and closure planning require the FCRP to address ESA plans in accordance with Canadian Standards Association criteria (Item k).

Canadian Standards Association criteria for Phase I ESA's establishes a consistent framework for preparing for and undertaking an investigation and interpreting and reporting the information gathered. Phase I framework does not involve selection or implementation of any measuring, sampling, analytical, or remediation activities.

Criteria for Phase II ESA establishes a framework for developing a sampling plan, preparing for and undertaking an investigation for sampling and measuring and interpreting and reporting the information gathered.

According to the 2006 Annual Report filed with the NWB, the final report on the Phase 1 and Phase 2 ESAs for the Lupin Mine site, conducted during July 2005 by Morrow Environmental was provided to the Board in August 2006. Part I, Item 9 of the Water Licence required LMI to update the ESA conducted for the project in 2006. Further Item 10, requires that the updated ESA include a detailed rock characterization study or program to determine the total quantity (inventory) of PAG material associated with the site and identification of any potential contamination that may be linked to such material. For additional details on the rock characterization study refer to Section 2.2.2.

LMI conducted an updated Phase I and II ESA in 2017 with the results provided to the NWB on October 18, 2017.

In summary, the updated Phase II ESA identified approximately 35,200 cubic metres (m^3) of petroleum hydrocarbon impacted soil at 13 historical maintenance, fueling, and fuel storage locations across the Site. In addition, approximately 400 m^3 of lead nitrate and/or cyanide impacted soils was identified at three historical cyanide storage locations and approximately 16,300 m^3 of arsenic impacted "hot spots" were identified at two locations. The updated Phase I and II ESA recommended that an updated Human Health and Ecological Risk Assessment (HHERA) be considered for the Site to develop site specific remediation criteria for metals.

As part of the ESA update, an asbestos-containing materials (ACMs) assessment at the Lupin Mine was carried out in 2017 (Golder 2017c). The assessment was carried out to evaluate the ACMs that may be impacted by future operation of the mine or demolition of the mine buildings. A total of 299 samples (non-intrusive sampling method) of suspect asbestos-containing building materials were collected and tested for asbestos content during the assessment, 46 of the samples were found to contain asbestos, mostly in vinyl flooring, duct mastic, window caulking and fire stop; location details are provided in Golder (2017c).

In addition to the asbestos assessment, it was noted that additional common hazardous building materials are likely present, including: lead-based paint, lead containing materials, polychlorinated biphenyls (PCB) in fluorescent light ballasts, potentially mercury soil contamination, mercury in thermostats and mercury vapour in fluorescent light tubes or bulbs, ozone-depleting substances in items or systems such as refrigerators and air conditioning units, potentially naturally occurring radioactive materials, radioactive materials in smoke detectors and exit signs, and miscellaneous building maintenance chemicals.

The ACM study included a recommendation that an intrusive hazardous building materials assessment be completed prior to any demolition activities to properly identify and quantify potentially hidden and additional potential hazardous building materials. LMI supports this recommendation and will implement upon award of demolition contracts.

During the regulatory review process, with respect to asbestos disposal, ECCC recommended LMI consider disposing of asbestos-containing materials underground and following applicable guidelines if asbestos-containing materials are disposed of in the landfill and buried (ECCC TC No.7). In response, LMI confirmed:

- Non-friable asbestos is present on site. Friable asbestos in the form of the paper backing on the vinyl sheet flooring has been identified in various buildings. All identified asbestos-containing materials located on site will be removed prior to the demolition of buildings. Asbestos waste including contaminated disposable clothing and materials used in the asbestos abatement will be packaged for disposal in two labelled asbestos waste bags (double bagged) with a minimum thickness of six mil. This packaging is in general accordance with the WSCC Northwest Territories & Nunavut Codes of Practice (Asbestos Abatement) September 2018. Asbestos waste packaged in this manner will reduce the potential for worker exposure to friable asbestos fibres while handling the waste and meets the intent of the Department of Environment “Environmental Guidelines for Waste Asbestos”. The waste will also be disposed of as per these guidelines which includes at least 0.6 m of soil to be placed on top of the asbestos waste bags within 24-hours in a specified asbestos disposal area which will be marked for future reference.
- commitment to following appropriate guidelines for the disposal of asbestos containing materials

2.1.8 Geochemistry

During the regulatory review process CIRNAC and ECCC requested clarification regarding site geochemistry (CIRNAC TC No. 6, 10, 14 (i), 20 & 21 and ECCC TC No. 6). LMI confirmed:

- The Phase I and II Environmental Site Assessment (Morrow 2006) was completed by LMI and filed on the NWB public registry. Consistent with standard practice, the ESA included a review of previous reports relevant to the evaluation of the site quality ESA Section 2.2 and Section 6.1. Based on the information reviewed during the Phase 1 ESA, Areas of Potential Environmental Concern (APEC) were identified that required investigation during the Phase 2 ESA. The APECs and a discussion of the Potential Contaminants of Concern (PCOC) is presented in Tables M through U of the report (Morrow 2006). Refer to Appendix H-4.3 of this Plan. (CIRNAC TC No. 10)
- The Phase 2 ESA investigation and the acronyms for the laboratory analysis are discussed in Section 8 of the ESA report (Morrow 2006). The location of each APEC is shown on Drawing A053017-004, refer to Appendix H-4.1 of this Plan. Photographs of selected APECs are provided in Appendix II of the ESA report (Morrow 2006). (CIRNAC TC No. 10)
- Fieldwork associated with the Phase 2 ESA was completed between July 13 and July 27, 2005. The investigation locations are shown on Drawing A053017-005 (Refer to Appendix H-4.2 of this Plan). A complete inventory of the investigation locations in relation to the NAD-83 coordinate system is provided in Table V of the ESA report (Morrow 2006). The methodology for the fieldwork was generally in accordance with Morrow’s Preferred Operating Procedures (POPs) which are based on industry standards or best practice techniques. The locations were placed to investigate each of the APECS identified by the Phase 1 ESA, as presented and discussed in Tables M through U (Morrow 2006) (Refer to Appendix H-4.3). Analytical results specific to PAG screening are provided in Section 9.3.7 of the ESA report (Morrow 2006). Current

ARD sampling locations are provided in Golder 2017a. Refer to Appendix H-4.5 of this Plan. (CIRNAC TC No. 10)

- LMI completed a comprehensive update to the Phase 1 & 2 ESA (Golder 2017a). For additional information related to the extensive sampling completed on site, refer to Table 6 to 29 of the Golder Updated Phase I and II ESA Report (Golder 2017a). Update for 2017 APEC refer to Appendix H-4.4. (CIRNAC TC No. 10)
- LMI confirmed areas of excavation within the central area will be brought up to the final grade by filling with waste rock (unclassified as to PAG or NPAG status), graded to a dome shape, and covered with 1.0 m of esker material. The cover is intended to reduce infiltration, thus mitigating the volume and quality of seeps from the domed area. (CIRNAC TC No. 14(i)).
- Morrow (2006) indicated that 32% of the waste rock was classified as PAG, 30% was classified as uncertain and 33% was classified as NPAG. Previous cost estimates assumed that 40% of the waste rock would be classified as PAG and removed. The Golder Updated Phase I and II ESA Report (Golder 2017a) concluded that 67% of the waste rock was PAG and further that it was not possible to designate specific areas that were PAG or were NPAG. Therefore, the decision was made to treat all waste rock on the mine/mill site as if it were PAG. As shown on Figure 10 in the FCRP, waste rock will be removed from about 19 hectares of area (coloured orange on Figure 10) and it will be consolidated with existing waste rock, regraded, and covered (i.e., the purple area of about 30 hectares on Figure 10). (CIRNAC TC No. 20)
- Areas of the property where waste rock will not be removed include: the airstrip (because it is being left in an operating condition) and the roads to the TCA (in order to provide access in the post-closure period). (CIRNAC TC No.20)
- Coupled thermal modeling and seepage modeling was completed to predict infiltration through the cover considering climate change. The results were used in conjunction with geochemistry to predict the water quality of seeps at the edges of the cover on the waste rock. LMI incorporated estimates with their final hearing submission and in the HHERA (date to directed by the NWB). (CIRNAC TC No.21)
- TCA thermistors have been monitored since 1988 and have been installed at various depths, progressively with TCA cover placement. The full list of installed thermistors, as well as their past and future monitoring frequencies were included the FCRP Table 20: Existing and Future Instrumentation Monitoring. The TCA Engineer of Record collects and reviews this data, with analyses included Lupin annual reports. Existing thermistors installed within the TCA are deemed sufficient to monitor the performance of the TCA. (CIRNAC TC No.21)
- Additional information was provided prior to the hearing with respect to instrumentation of the cover on the waste rock. (CIRNAC TC No.21)
- Based on results from the Phase 1 & 2 ESA and subsequent update, LMI summarizes the extent of waste rock in Figure 10 of the FCRP which represents the extents of waste rock to be excavated, relocated and/or covered. The area of the final covered waste rock dome is estimated at about 30 hectares; the area of waste rock removal is estimated at about 19 hectares. (CIRNAC TC No.21)
- For additional information regarding ECCC TC No. 6 refer to Section 4.3.2.1.

Further during the TM/PHC held in June 2019, LMI committed in TM/PHC Commitment No. 1 & 5, to the completion of a Human Health Ecological Risk Assessment (HHERA) to include geochemical, thermal and seep modelling studies. For additional information refer to Technical Memoranda regarding:

- Closure Geochemical Source Term and Seepage Water Quality Model for Performance Evaluation of the Esker Cover for the Waste Rock "Dome" at Lupin Mine (Golder 2019a) to address Commitment No.7 from the TM/PHC. Refer to Appendix H-5 to this Plan; and
- Coupled Thermal-Seepage Modelling for Performance Evaluation of the Esker Cover for the Waste Rock "Dome" at Lupin Mine. (Golder 2019b). Refer to Appendix H-6 to this Plan.

A summary of the HHERA is provided in Section 6.2.

2.1.8.1 Tailings

Tailings are primarily composed of the gangue minerals amphibole and quartz, which account for over 80% of the volume. Pyrrhotite and arsenopyrite make up an additional 17% (Klohn 1995). The tailings have been shown through various studies to be capable of generating acid upon oxidation. The tailings are a fine grained material with 80 to 87% less than 75 µm (SRK 2015). Solid phase arsenic concentrations range from 6,750 to 8,410 mg/kg (SRK 2015).

Extensive studies completed in the past have shown that the Lupin tailings, given the proper conditions, will oxidize and produce the by-products necessary for the formation of acidic runoff. Typical Lupin tailings contain approximately 3% sulphur (total) and have a Neutralizing Potential to Maximum Potential Acidity (NP/MPA) ratio of less than three.

Included in these studies were a 1991-1992, 30 week column leach program (kinetic test) and a follow- up 16 week leaching program in 1993 on mitigative measures for Cell 5 (then known as Area 3) tailings (Klohn 1992a). In addition, a 1992 study was completed on the assessment of water chemistry and remedial measures for the Lupin Tailings Management System with regard to the effects of the (formerly) exposed tailings within Pond 2 (Klohn 1992b and Klohn 1993). One of the results of this study was the decision to build M Dam, which now separates Cell 5 from Pond 2, and prevents the inflow of raw tailings into the pond.

2.1.8.2 Waste Rock

In 2004 samples were collected from waste rock deposited in roadbeds, tailings dams, the airstrip and the mill complex pad. The material sampled was generally the coarse cobble fraction of the waste rock. About 30% of the waste rock samples had sulphide concentrations above 0.3%; however, only one of these samples had an acidic paste pH. The results of the 2004 program indicated 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). The median concentration of arsenic in the development waste rock was 1,140 mg/kg. The study also noted that approximately 35% of the development rock was capped with sand and gravel cover 0.15 m or thicker (Morrow 2006). The data set evaluated included the analysis of coarse rock fragments. The analysis of coarse rock fragments does not directly indicate what impacts the waste rock may have on the receiving environment.

An assessment to evaluate the water quality of seepage from waste rock at the mill/mine complex was conducted in 2005. The ESA detected groundwater and seepage with depressed pH and elevated metal concentrations in isolated locations. Forty (40) percent of the seeps sampled in 2005 were acidic (Morrow 2006).

An update to the Phase I and Phase II ESA at the Lupin Mine was carried out by Golder in 2017 (Golder 2017a). The scope of this update included the collection of development/waste rock and overburden grab soil samples for the purpose of completing an updated Acid Rock Drainage / Metal Leaching (ARD/ML) evaluation. The results of the ARD/ML investigation indicated that approximately 67% of the combined (2006 and 2017) waste rock dataset are classified as Potentially Acid Generating (PAG). The PAG samples were not concentrated in one or more specific areas; rather the PAG samples were distributed throughout the Site. Direct measurement of acidic pH values in groundwater and seepage water confirmed that acid generation was occurring after several decades of waste rock exposure.

2.2 Overview of Mine Development and Operations

Figure 2 provides a timeline which summarizes the history of the development, operation and post-operational care and maintenance of Lupin Mine. The Lupin Mine was discovered in 1960 as a result of reconnaissance sampling and mapping programs conducted by the Canadian Nickel Company Ltd, a subsidiary of Inco Limited. Between 1961 and 1964 the Canadian Nickel Company Ltd. conducted exploration in the Lupin area, which included geological mapping, geophysical surveying, trenching, stripping and channel sampling.

In February 1979, Echo Bay Mines obtained an option on the Lupin property from Inco and proceeded with an underground exploration program. The geological information indicated enough ore reserves to provide six years of production, based on the potential to develop in excess of two million tons of ore with a mill designed to process an average of 950 tonnes per day.

In the summer of 1980, prior to a production commitment, a 1,960 m long gravel landing strip capable of handling a C130 Hercules was prepared. In August 1980, the decision was made to proceed with development and construction of the Lupin Mine. Waste rock generated from the development of the underground workings was used to build the pad surrounding the mill and as roadbed material. Plant design was based on being able to air freight all the components to site.

Engineering, procurement and construction management of the surface facilities was contracted to Bechtel Canada Limited, while the contract for mine development and underground construction was awarded to J.S. Redpath Limited. The Lupin Mine was constructed and commissioned for a total cost of $135 million dollars.

Mine site construction started in August 1980 and was completed on schedule in March 1982 when pre-production commissioning began. The transportation of personnel to the site was accomplished with a Convair 640, which also carried a total of 7 million pounds of supplies such as perishables and repair parts during construction. During the twenty-month construction period, the Hercules aircraft made some 1,100 flights, carrying 25 tonnes of construction material per trip. This material included all the contained machinery and construction equipment, 2,200 tonnes of structural steel and the cement required to mix 7,300 m^3 of concrete. The floor area of the main complex was 9,290 square metres (m^2). During peak periods, the construction crew numbered up to 400 people on-site.

From 1983 to 1993, the Lupin Mine underwent a number of other expansions and operational changes to increase the mining and ore processing capacity to a nominal 2,300 tonnes per day. The main production shaft was deepened on two separate occasions to a final depth of 1,210 m below surface and the old sinking compartment was converted into a cage compartment. In April 2001, a production winze was commissioned between the 1050 level and 1340 level. This infrastructure allowed mucking below the elevation of the crusher to be carried out more productively, thus extending the depth, and life, of the mine. The -15% decline drift, or ramp, which permits mobile equipment to access all the mine levels, extends from surface to the 1560 m level. The lowest developed level in the mine is at the 1550 m elevation. In December, 1994, the paste backfill plant was completed, which provided critical ground support in production areas while reducing the amount of tailings reporting to the TCA.

Operations were temporarily suspended at Lupin between January 1998 and April 2000, and again from August 2003 to March 2004. Mill throughput in the last year of operation, March 2004 to February 2005, averaged approximately 1, 200 tonnes per day, significantly less than in previous years. Production ceased in 2005; at that time, the Site was put under care and maintenance. No active mining has since occurred.

2.3 Description of Mine Facilities

Figure 3 shows the general arrangement of the Lupin Mine Site. Other than the transportation requirement for materials and supplies necessary to sustain the workforce and industrial operations, the Lupin Mine site is completely self-contained and relatively compact.

Figure 4 shows the current conditions of the mine / mill / camp complex. There are two main areas: the residential complex consisting of accommodations, kitchen and recreation center; the industrial complex comprised of ore processing facilities, as well as, maintenance areas, head frame, hoist room, powerhouse, and warehouse and office facilities. The freshwater pump house is situated approximately 1.6 km northwest of the camp, on the shore of Contwoyto Lake.

In association with the above, there are a number of support areas consisting of: shops and yards (maintenance, surface, backfill, and carpentry), storage/laydown areas (cold storage buildings), the main fuel tank farm; camp sewage facilities, mill tailings line, a recently constructed landfarm and a weather/aircraft control office with exploration shack. Only the main tank farm is currently being used for the storage of bulk fuel.

The TCA (Figure 5) is situated approximately 3 km south of the mine site. As shown on Figure 3, the only physical connections between the TCA and the mine site are a road and the 8 inch diameter insulated tailings line, used to transport the tailings slurry from the mill to the deposition point in the tailings cells. The explosives magazine is located approximately 2 km west of the TCA and is accessible by road from the TCA road network. There are currently no explosives on-site.

2.3.1 Underground Mining

The Lupin underground workings include a 1,210 m vertical shaft and a decline drift, or ramp, to a depth of 1,560 m. A secondary hoist system (Winze) was installed in 2001 allowing hoist access to 1,340 m. The current mine depth is 1,550 m. Incorporated into the underground facility were maintenance shops, an electrical shop and a primary crushing station. A surface projection of the underground mine workings is shown on Figure 6.

Shaft sinking began in 1982 to an original depth of 370 m below the surface collar. The shaft was deepened twice since then, first to the 780 m elevation during 1984-86 and the second time to its final depth of 1,210 m during

1988-90. The 2-drum ASEA production hoist, originally installed in 1987, was upgraded to 1,720 hp in 1992. This allowed 10-tonne capacity skips to be hoisted in the two skipping compartments. In 1992, the manway compartment above the 250 m level and the sinking compartment below the 250 m level were converted to a cage compartment. The hoistroom was modified to accommodate a fully automated cage hoist. After the end of operations, the doors to the shaft were welded shut to prevent inadvertent access.

The Lupin Mine is also serviced by an access ramp, which extends from surface to the bottom of the mine. For the most part, the ramp is a closed spiral and is located under the plunging south nose of the ore body. The 5 m wide x 3.5 m high ramp grades at -15% over its entire length. The termination of the ramp is at the 1,560 m level horizon. The ramp provided for movement of men and materials within the mine and allowed for efficient deployment of resources as required. The ramp has been sealed with a soil and rock plug and a locked fence installed to prevent access during the current phase of care and maintenance.

A 1,000 hp, 84 inch diameter Joy axivane fan mounted on surface, supplied fresh air to the mine via a 3 m diameter fresh-air raise. A similarly sized Joy fan is also mounted on surface, over a 3.4 x 3.4 m raise, and helps exhaust contaminated air from the mine.

Almost all of the lateral and ramp development at the Lupin Mine was accomplished with electric - hydraulic drills and diesel scoop trams. A number of sublevels were developed with pneumatic drills and slushers during the last few years of operation.

Standard mechanized drift dimensions were as follows:

- Ramp: 5.0 m wide x 3.5 m high, -15%
- Access Drifts: 4.6 m wide x 3.5 m high
- Central Zone (CZ) Ore Drifts: 4.0 m wide x 3.5 m high +2% grade
- West Zone (WZ) Ore Drifts: 2.0 m wide x 3.2 m high +2% grade

Raises up to 20 m in length (stope slots, mill holes, and vent raise extensions) were driven by conventional open raising methods, longhole drop raises or longhole inverse raises. Longer raises were driven with an Alimak or raise boring machine.

Production at the Lupin Mine began with sublevel longhole open stoping in the Centre and East Zones. Stope heights were typically 80 m and were as long as the strike of the ore body. Every fourth sublevel was developed as an extraction horizon complete with a haulage way, draw points, ore pass and waste pass. All of the mining above 810 m in these two zones was done by this method. The West Zone is the narrowest zone at Lupin. It was first mined by shrinkage and later by a ‘Raise Platform Mining’ method, which involved driving closely spaced raises and then breasting between them from an Alimak raise climber. This method was in turn replaced with sublevel longhole stoping similar to the Centre Zone but utilizing much smaller equipment.

As mining progressed to greater depths and the accumulated volume of stope excavation increased, rock stress and ground control issues became an increasing concern. The stoping method was modified to integrate both waste and paste backfill into the mining cycle. Stope dimensions were decreased in both height and strike length as one technique used to control dilution. The method involved longitudinal retreat mining 20 m high panels over

a relatively short strike length (20 m maximum in the Centre Zone and 15 m in the West Zone), remote mucking the stope empty, and then filling with paste before mining the adjacent panel. This mining method was used at the mine since 1995.

The paste backfill plant was commissioned in October 1994 and was one of the first such systems operating in Canada at that time. The process involved taking the filter cake from the second stage filters in the mill (tailings), conveying it to the paste plant where it was mixed in a pan mixer with cement and water to create the paste. The paste was pumped to the shaft utilizing one of two positive placement pumps. Once delivered to the shaft, the paste flowed by gravity through the 6 inch diameter fill line and was distributed throughout the mine. Design capacity of the paste system was 120 short tonnes per hour. Between January 1995 and December 2004, over 1.8 million tonnes of paste backfill, equating to more than 30% of all tailings produced by the mine in that time period, were placed in the underground stopes. The paste backfill plant was decommissioned and removed from site following 2004. There are no paste backfill holes to the underground workings.

During the last few years of mining, several of the crown pillars of the Lupin Mine orebody were recovered. The crown pillars were the portions of the East, Centre and West zones between surface and 27 m level that were left behind when the initial mining was carried out. The East Zone crown pillar was recovered in 1997 and completely backfilled with waste rock and non-hazardous waste material in 1998. Mining of most of the Centre Zone crown was completed in 2003 and it was backfilled with pastefill that same year. A small portion of the Centre Zone crown pillar was mined during 2004 and remains open for the deposition of waste material. The West Zone crown pillar was mined between 1996 and 2004, and has been left open for the future disposal of demolition debris and soils. The crown pillar openings will be completely filled in, and the surface capping material contoured, during reclamation activities at the mine site.

The winze and underground mine equipment were removed from site when the mine entered care and maintenance in 2006. All hazardous materials were removed from the underground workings. Any equipment left (disposed of) in the underground workings was drained of fluids.

During operations, mine water from the underground workings was discharged either into the TCA or into the sewage lakes system in accordance with Part E(12) of the Water Licence. Underground working water chemistry was reported to the NWB prior to any discharge to the environment.

2.3.2 Borrow/Quarries

Figure 5 and Figure 7 show the locations of borrow pits and quarries on the property. The sand and gravel used for road and dam construction as well for covering the TCA cells since 1995 was obtained from the Fingers Lake esker, which is located approximately 10 km south of the mine (4 km southeast of the TCA). The Finger Lakes esker borrow area is the largest area that has been disturbed by borrowing activities. The other borrow areas within the TCA area are small and they have been inactive for a number of years.

The Fingers Lake esker will continue to provide the cover material for the remaining TCA cells and will also be used for the reclamation of the other components of the Lupin Mine as described in Section 4.0. The frozen nature of the material within the esker dictates that only shallow layers of material can be removed during excavation and hauling. In general, this “thaw scrape” approach results in a larger area of the esker surface being disturbed but allows for easier restoration work upon cessation.

The two existing bedrock quarry areas; one within the TCA area and the other one near the Fingers Lake esker, are small and inactive and there are no plans to use these areas further during closure implementation.

The range of metal concentrations of potential chemicals of concern in the esker material placed on Cell 3 of the TCA are listed in Table 9 (SRK 2015).

Table 9: Range of Metal Concentration of Potential Chemicals of Concern in Esker Material

Metal	Minimum (mg/kg)	Maximum (mg/kg)
Arsenic	8	12.8
Cadmium	0.036	0.79
Cobalt	5.02	190
Copper	16.8	188
Lead	1.04	1.27
Molybdenum	0.17	0.33
Nickel	16.7	493
Selenium	<0.02	<0.02
Zinc	20.7	178

Esker Material Properties

Part I, Item 1 (d) in the previous Water Licence (No. NWB1LUP0008) required 'a comprehensive assessment of material suitability, including geochemical and physical characterization and availability for restoration needs, with attention to top-dressing materials, including maps, where appropriate, showing sources and stockpile locations of all borrow materials'. The information resulting from that assessment is included below, for the purposes of reference and information.

A comprehensive assessment of the properties of the esker material was conducted by Golder Associates in 2004 (2004a). The following laboratory tests were completed on representative samples of the esker material:

- Grain size distribution and maximum and minimum density to generally characterize the esker material
- Cyclic wetting and drying to assess the physical stability of the esker material
- Chemical analysis of the tailings decant water
- Chemical analysis of leachate fluid from a mixture of esker material and tailings decant water to assess the chemical stability of the esker material

The following conclusions were reported by Golder in 2004:

- The results of sieve analyses indicate that the esker material is classified as gravely sand according to the Modified Unified Soil Classification System.
- The results of 20 cycles of wetting and drying indicate that the percentage of mass lost by the specimen over the course of the test was 0.31%. This value is considered to be within the accuracy of the testing method; consequently, the results indicate that the esker material is physically stable.

- Comparisons of the results of chemical analysis of the tailings decant water with that of the tailings decant water after it was leached through the esker material show negligible change in metals content. Based on these results, it does not appear that the esker material will physically degrade on exposure to the tailings decant water. Further, it appears that the chemistry of the tailings decant water will change relatively little if this fluid leaches through the esker material. It is, therefore, concluded that the esker material is a suitable cover material for the tailings deposition cells.

The details of this study are contained in the report *Studies Related to Water Licence Requirements and in Support of Reclamation Planning*, completed by Golder Associates (Golder 2004a). This report was filed with the NWB during the last licence renewal process.

Rip Rap Quarry Material Properties

A rip rap quarry was developed within the footprint of the TCA to provide the coarse broken rock needed to enhance dam stability, provide additional armour for the faces of the embankments, and for use as inert cover material. Approximately 15,000 m^3 of broken rock were sourced from the quarry. The quarry is located just north of Cell 3 and east of the perimeter road (Figure 5). The quarry was located on a on a hilly barren outcrop of phyllite. The quarry is inactive and there is no plans to use this area further during closure implementation.

Four rock samples were taken from the quarry area and tested for ARD potential. Table 10 lists the results of this testing. All samples showed that the rock was well suited to be used as cover material and would not be a concern for possible ARD generation.

Table 10: Riprap Quarry Sample ARD Potential Test Results

Sample	Fizz	NNP	NP	pH	MPA	NP:MPA	S%
50133	1	3	5	7	1.6	3.20	0.05
50134	1	14	15	8.6	0.6	24.00	0.02
50135	1	5	5	7.8	0.5	16.00	0.01
50136	1	8	8	8.1	0.5	26.88	0.01

An area of approximately 6,000 m^2 (78 m x 78 m) was excavated by blasting to a depth of 2.5 m. There was little to no overburden in the footprint of the quarry area, so stripping was not required. Access to the quarry site was immediately off the road to the west of K Dam, so any effect on the tundra was minimized.

As the quarry location was originally on a hill top, there is a little depression remaining after completion of the quarry operation. The quarry essentially removed the top of the hill. All drainage off the former hill drained into Pond 2. The quarry was configured such that this drainage pattern did not change.

As shown on Figure 3, a second bedrock quarry was developed just north of the esker borrow area. A small area of a bedrock outcrop has been blasted at this location. Use of this quarry has apparently been limited to date.

During the regulatory review process, CIRNAC requested a conceptual plan for locations where rip rap is to be provided and details on the source of the rip rap. LMI confirmed:

- Rip-rap will be salvaged from existing dams, where it will no longer be required since it was placed to protect against wave erosion and the closure water levels will be lower. The rip-rap will not be quarried or salvaged from areas identified as potentially acid generating (PAG). Prior to the rip-rap being salvaged, samples will

be collected for geochemical testing. If areas of concern are identified they will be covered in place. Existing suitable rip-rap will be salvaged, the final slopes will be re-graded using existing materials to stable slopes as determined by the engineer of record, and the rip-rap will be replaced at the closure water levels. No rip-rap will be quarried from the existing quarry on site, however if further rip-rap quantities are required they will be obtained from the esker area boulder pile. (CIRNAC TC No.11)

At the TM/PHC, LMI committed to provide further geotechnical details of engineered structures (e.g., from which dams will rip-rap material be taken from to change slope and which dams will be enhanced, cross sections and details) to ensure long term stability and erosion control. (TM/PHC Commitment No. 6). Refer to the Technical Memorandum in Appendix H-3 regarding Geotechnical Review on the Long-Term Stability of TCA Dams for response to TM/PHC Commitment No.6. (Stantec, 2019b).

2.3.3 Waste Rock

The production of waste rock was considerable during the early development stages of the mine. Excess waste rock was brought to surface where it was either stockpiled or used as construction material at the Site. In the latter stages of the mine life, excess waste rock generation was reduced and the waste rock produced was normally moved to other areas of the underground workings as backfill material.

Waste rock was generally used throughout the Site as roadbed materials, in dam construction, airstrip stabilization, underground backfill, and laydown yards or for other purposes such as building foundation preparation. Approximately 1,000,000 m^3 of rock was placed on surface (URS 2005).

Mine operations did not produce any stockpiles of overburden or unprocessed low grade ore.

Information on the geochemical characterization of the waste rock is provided in Section 0.

2.3.4 Tailings Containment Area

Figure 5 shows the current conditions in the TCA. The TCA is located approximately 6 km south of the Lupin Mine, and covers an area of about 361 ha within the 750 ha lease. The containment is divided into three main components: solids retention cells (cells 1 through 5), polishing ponds (Pond 1 and Pond 2) and the End Lake area (not used). The tailings cover approximately 1,521,000 m^2 of the TCA. Since 1995, as further described in Sections 2.4.4 and 3.2.1, an esker material cover has been placed over approximately 1,311,500 m^2 of the tailings. The esker material cover serves to eliminate wind dispersal of dry tailings, to protect against contact with exposed tails by fauna, and the embedded moisture layer prevents oxidation of the underlying tails.

A detailed history of the design and operation of the TCA is contained in the approved TCA 2004 Final Abandonment and Restauration Plan (Final TCA ARP) (Kinross 2005). The tailings facility consists of multiple frozen core perimeter dams.

Table 11 provides a summary of perimeter and internal dams associated with the TCA. During active operations, the tailings management philosophy involved discharge of tailings into a closed system that allowed for solids accumulation and some supernatant water storage within five main cells, and also for the treatment of water prior to discharge into the environment. The cells within the impoundment allowed for separation of the liquid from the solid tailings as well as provided treatment through natural degradation.

Table 11: Perimeter and Internal Dams

Perimeter Dams	Internal Dams
Dam 1A	Dam 3D
Dam 1B	J-Dam
Dam 1C	K-Dam
Dam 2	L-Dam
Dam 3	M-Dam
Dam 4	N-Dam
Dam 5	Divider dyke
Dam 6	

Cells 1 and 2 have been filled and covered and retain ponded precipitation only in low lying areas of the cover. Contouring of the cover on Cell 1A directs run-off and precipitation from Cell 1A to a surface water conveyance ditch across Dam 3. Cell 3 has capacity for a small amount of run-off and precipitation and is directed into Cell 4. Cell 4 has acted as a water management pond, retaining water within the system prior to releasing it into Pond 1. Cell 5 retains run-off and precipitation, with water directed into Pond 1. Supernatant water and runoff storage occurs within one of two ponds – Pond 1 and Pond 2. Pond 1 acts as a buffering pond to manage the water chemistry. A water treatment plant (see Section 2.3.7) is located on J-Dam between Ponds 1 and 2, and was used during operations to treat the water in Pond 1 prior to discharge into Pond 2. Pond 2 is the last point of control prior to discharge into the receiving environment. Water is managed in Cell 3 and Cell 5 and Pond 1 through pumping and the use of syphons, while Cell 4 maintains a gated culvert. Syphons are used to discharge water from Pond 1 into Pond 2, and from Pond 2 into the receiving environment. Pond 2 currently has no flood overflow structure, but is required to maintain a minimum 1.0 m of freeboard at all times.

The TCA is impounded through natural terrain relief together with a series of engineered retaining structures. The main water retaining perimeter dams are Dam 1A and Dam 2, which contain Pond 2, and J-Dam which retains Pond 2 and Dam 4 in Cell 4. Dams 5 and 6 within Cell 3 are low level dams. No tailings have been impounded against Dams 1B, 1C, or 5. A design to raise Dam 6 was completed in 2003 (BGC 2003) to increase the tailings capacity in Cell 3; however this raise was never constructed.

All perimeter dams have been designed with a geomembrane liner for initial control of seepage and to promote the establishment of permafrost within the dams. K-Dam, which is an internal structure, was also designed with a synthetic liner for initial seepage control. A tailings beach, approximately 10 m in depth, has been placed on the upstream side of this dam.

Tailings Cells 1 and 2 are separated from Pond 1 by Dam 3D. The stability of this esker fill dam was enhanced in 1995 by the addition of a 10 m wide downstream berm, constructed of 75,000 m^3 of quarried waste rock, placed at a slope between 1.5H:1V to 2.0H:1V. The addition of this waste rock has also increased the erosion protection of the dam.

Ponds 1 and 2 are separated by J-Dam, which was constructed with esker material and mine development waste rock. HDPE syphon pipes over J-Dam are currently used to transfer water from Pond 1 into Pond 2, reducing the risk of overtopping should the dam freeboard be encroached.

The frequency of water discharge from TCA into the receiving environment has been variable over the life of the mine. Discharge occurred annually between 1985 and 1997, and then every two to four years until 2015. Since the Site entered care and maintenance in 2005, there have been five water treatment campaigns to reduce the volume of water within the facility. These campaigns have occurred in 2005, 2009, 2012, and 2015. The annual reports illustrate the annual volume of water discharged to the environment.

The details of the many investigations in support of the saturated zone cover design are contained in the approved Final TCA ARP (Kinross 2005). The partially saturated granular cover design key features are summarized below:

- A basal saturated layer of esker material that inhibits oxidation of the underlying tailings by limiting the oxygen flux through the saturated zone.
- A surface layer that restricts the rate of evaporation of the saturated esker and tailings materials.

The esker cover serves to eliminate wind dispersal of dry tailings, protect against contact with exposed tails by fauna, and the embedded moisture layer prevents oxidation of the underlying tails. A study conducted to assess the presence of recent windblown tailings adjacent to the TCA detected no deposition of tailings material on surface (SRK 2015).

2.3.5 Mill Complex

The Lupin Mine ore processing remained basically unchanged throughout the life of the mine. It utilized the Merrill-Crowe process for gold recovery, whereby a powdered zinc mixture was added to a gold bearing cyanide solution to precipitate out the gold. Lead nitrate was used in low doses to activate the zinc. The gold precipitate was then dried and melted in a furnace, and poured into doré bars. All metallurgical reagents, with the exception of lime, have been shipped off site during the current care and maintenance phase. The mill was given a complete wash down with the intent of gold recovery (visible gold that settles within the system) and removal of any residual contaminants (from chemical use) to the tailings impoundment prior to the current care and maintenance phase.

2.3.6 Landfill and Other Waste Disposal Areas

The waste management facilities used at the Site are: an incinerator, a temporary “boneyard” (for decommissioned tanks, buildings, and equipment), a landfill, a landfarm, two burn pits (annual applications to CIRNAC are required for open burning) and waste oil storage. Waste materials that cannot be disposed of in a management facility on site are appropriately segregated, stored such that they are inaccessible to wildlife and later shipped to a third party waste receiver in Yellowknife, NWT.

The waste management facilities are operated in accordance with the *Waste Management Plan (Solid and Hazardous).*

Recyclable containers, primarily food and beverage containers, are segregated and shipped off-site for management by a third party waste receiver.

The landfill is licenced under the Type A Water Licence (NWB, 2015) to dispose of “relevant inert, non-hazardous and non-combustible waste generated at the Project.” The licence refers to the Landfill Management Plan (LMI, 2016).

All hazardous materials that cannot be disposed at the landfill, such as paints, batteries, solvents, chemicals and glycols are assembled in a staging area and then shipped off-site for disposal.

With the aim of confining the demolition debris to the smallest practical area which can accommodate the anticipated quantity, while not impacting a presently undisturbed area, a new landfill (Demolition Landfill) is proposed as a contingency, to be constructed within the west end of the upper sewage lagoon. This site is located in a natural basin, is readily accessible, and can be easily monitored. Present water level in the lagoon would be drawn down upon closure through the syphon located at the dike at the east end of the pond, with that water reporting to the lower lagoon. The present sewage capacity of the upper pond has not been needed since the cessation of mining and milling operations due to the reduced number of people that would be residing in camp for the closure and reclamation activities.

After the water level has been lowered in the upper lagoon, initial deposition of debris would take place from the west end. The advantage of this option is that the sewage lagoon is already a disturbed area, having received waste for the past 24 years. Also, it can be accessed directly from the main haul road to the TCA, thus minimizing disturbance to the surrounding tundra. All non-hazardous demolition debris would be deposited down slope in 2-metre high lifts, compacted by dozers. Additional lifts of debris will then be placed on top, as required. The final lift will be covered by 1.0 metre of esker material, packed and contoured so that water will not pool on the surface.

2.3.6.1 Incinerator

An incinerator has been used to incinerate combustible, inert solids throughout the life of the Lupin Mine. A new incinerator was installed in 2012 to replace the outdated site incinerator. The incinerator is a cinder block building that is secure from wildlife. The Inciner8 Model A600X incinerator is a dual stage forced air commercial incinerator that operates on diesel fuel or kerosene. The incinerator is operational and is currently used to burn the domestic and kitchen waste. The Operations and Maintenance Procedure for the incinerator is appended to the *Waste Management Plan (Solid and Hazardous).*

The types of materials that are acceptable for incineration include: organic waste (such as kitchen waste), wood, paper, cardboard, air filters, domestic waste, light plastics (bags, thin plastics), cooking waste oil (small amounts, used as incinerator fuel) and poor grade diesel fuel (small amounts, used as incinerator fuel).

Ashes from the incinerator are placed in drums and disposed at the onsite landfill. Incinerator ash samples can be collected and tested for metals to confirm suitability for landfilling in accordance with Part E(27) of the Water Licence. In the event ash is not suitable for landfilling, drums are shipped to a licensed waste disposal facility in the south. The shipment is typically as backhaul on aircraft supplying the site.

2.3.6.2 Landfill

The refuse disposal area used at the Site (the landfill) is located to the southeast of the mine and north of the second lower sewage lake. The landfill has been used since the Mine started operations. All non-burnable waste (scrap metal, plastics, residue from burning) and non-hazardous materials were historically disposed of and buried with waste rock on a regular basis. A portion of this facility is utilized in accordance with the *Waste Management Plan (Solid and Hazardous)* (LMI, 2016b) and it's Appendices: *Landfill Management Plan* and the *Liquid Waste Management Plan*. The waste in the landfill is covered progressively during use. The waste items accepted for landfilling are listed in the *Landfill Management Plan*.

2.3.6.3 Landfarm

As part of the care and maintenance activities at Lupin in 2016 and 2017, the NWB permitted the use of a double-containment landfarm facility with a leakage detection pipe under Motion No. 2017-A1-013, Modification No.1 to Licence No. 2AM-LUP1520. LMI submitted as-built documentation of the initial landfarm design and operational procedures to the NWB in the summer of 2017, as part of the license modification requirements. This landfarm is located on the foundation of the former paste backfill building and remediated soil will be re-used on-site during closure activities. The landfarm was put into operation in August 2017 when it was loaded with about 500 m^3 of petroleum hydrocarbon contaminated soil from the cleanup of the dismantled Satellite Tank Farm. This soil is currently undergoing bioremediation in the landfarm.

The facility is operated in accordance with the *Waste Management Plan (Solid and Hazardous)* and it's Appendix: *Landfarm Management Plan* and the *Liquid Waste Management Plan*.

2.3.6.4 Burn Pits

One burn pit is located on site adjacent to the landfill, and a second one is at the north end of the Site. Permits to open burn are applied for on an annual basis through INAC. The waste items accepted for open burning are listed in the *Lupin Mine Landfill Management Plan* (Appendix B of that Plan).Non-hazardous oversized materials, including untreated wood products, were historically burned in the burn pits to reduce the volume of waste entering the landfill.

2.3.7 Support Infrastructure

2.3.7.1 Accommodation Facilities

The major component of the accommodations is the sleeping and eating quarters which consist of over 200 modular units and separately framed areas to form the complex. In 2012 and 2013, 150 rooms were refurbished. The other components consist of recreation and gymnasium facilities which are steel frame/metal clad construction.

2.3.7.2 Freshwater Supply

The freshwater for the site is obtained from Contwoyto Lake approximately 1.5 km from the complex. A causeway/breakwater extending out into the lake supports a pump house building and docking facilities.

The freshwater supply pumps were decommissioned in 2006; as a care and maintenance requirement. The pumps are currently stored at the mine site and were refurbished in 2013 in preparation for reinstallation. When the pumps are not in place, freshwater is trucked from the breakwater on Contwoyto Lake to a water storage tank at the accommodation buildings.

2.3.7.3 Arsenic Treatment Facility

This facility, a steel frame/metal clad building, is located at the TCA between Ponds 1 and 2, at the south end of J-Dam. It was used for mixing of reagents (ferric sulphate and lime) for water treatment operations during the early 1990's and has been inactive since 1996. The facility has been partially decommissioned. All remaining components were flushed after use.

2.3.7.4 Explosive Magazine

The explosives storage magazine is located 2 km west of the TCA and consists of 2 steel-frame/metal clad buildings for Ammonium Nitrate/Fuel Oil (ANFO) storage, and historically numerous Sea-Containers for the storage of stick powder and other blasting products. There are currently no explosives on-site and no Sea-Containers at the explosives magazine.

2.3.7.5 Roads and Airstrips

A considerable amount of roadway exists at the TCA, with the largest portion being the access to the explosives magazine and the access to the Fingers Lake esker (Figure 3). The roadways were constructed in part with mine development waste rock.

The old airstrip that was used during construction had been used as a laydown area after the new airstrip was operational. This area was slowly phased out as a storage location and, in 1998, the gravel/esker fill strip was graded to conform to the natural landscape with cuts and backsloping applied where necessary to promote natural drainage and reduce erosion. The surface was scarified utilizing a grader with a ripping attachment.

The main airstrip is 1,950 m (6400 ft.) in length and it was constructed of crushed waste rock produced from development underground. The drainage course in the area has been altered slightly in a lateral direction; however all runoff from both the east and west sides of the strip report in a northerly direction, eventually to Contwoyto Lake. The airstrip fueling facility has been removed and the area has been reclaimed.

2.3.7.6 Sewage and Refuse Facilities

The sewage facilities consist of several lift stations within the camp and an 800 m long 6 inch diameter insulated steel pipeline to the first of two sewage lakes. Alternatively, when, during Care and Maintenance, camp capacity requirements do not warrant its use; sewage and grey water are collected in a sewage tank at the accommodation buildings. The tank is then hauled to the Upper Sewage Lake wherein waste is deposited. A sewage line to convey camp sewage directly to the Upper Sewage Lake may be utilized.

Grey water originating from log cabin (guesthouse or office cabin or manager's house) use may be deposited in an adjacent leach pit. All sewage is to be discharged to the Sewage Lakes Disposal Facilities.

A 'permeable' type dam with an emergency overflow and a syphon exists between the first and second lake. Discharge from the second lake is controlled by the use of syphons. Water accumulating in the Lower Sewage Lake is tested prior to discharge to the environment. Discharge procedures are described in the *Liquid Waste Management Plan*.

The refuse landfill was discussed in Section 2.3.6.

2.3.7.7 Tailings Lines

A steel tailings line exists between the mill complex and the Tailings Containment Area. The initial 6 inch line was removed in 2001. The newer 8 inch line extends the entire 6 km distance to the impoundment. The line extends further within the impoundment for an additional 2.5 km. Various small buildings along the line house valves for either dumping of the line to controlled sumps or switching flow direction. Development waste rock was used to construct part of the tailings line foundation.

2.3.7.8 Fuel Storage

The fuel storage facilities at Lupin included a main tank farm (including a system of 14 diesel tanks, 1 jet A tank and 9 individual tanks), a satellite tank farm (STF) (including a system of 10 diesel tanks and 2 gasoline tanks and a waste oil tank farm which included 2 waste oil tanks). In addition there were 5 glycol tanks on-site and various individual tanks. Geomembrane liners were used for containment purposes.

In 2014 buried pipes were removed between the main tank farm and satellite tank farm. The fuel remaining in the satellite tank farm was used up in 2015. In 2017, a portion (approximately 500 m^3) of petroleum contaminated soils associated with the STF were removed and relocated to the landfarm for bioremediation. It is planned that the remaining volume of contaminated soil will be relocated to underground locations for disposal, and that the tanks will be cleaned, and transported to the boneyard in 2018 for salvage or disposal in landfill.

2.3.7.9 Chemical Storage

During operations the mine had an inventory of chemicals which included: cyanide, lime, lead nitrate, zinc dust, flocculants, and ferric sulphate in major quantities and miscellaneous refinery reagents in much lesser quantities. Of the chemicals listed, only lime is held on-site during care and maintenance.

3.0 PROGRESSIVE RECLAMATION AND POST OPERATIONAL ACTIVITIES

3.1 Summary

By definition, Progressive Reclamation is a closure related activity that is undertaken while a mine is still in operation. At Lupin Mine, there are several examples of closure activities that were undertaken before the mine shut down in 2005. Progressive reclamation at the Lupin Mine started in 1988.

Since the shut down in 2005, the Site has been continuously under care and maintenance; it has never been in an abandoned condition. Furthermore, a substantial number of closure activities have been undertaken since 2005. Herein, these activities are described as “post-operational activities”.

Table 8 provides a summary of progressive reclamation and post-operational activities that have been undertaken to date on the Site. These activities are described further in subsequent sections.

Table 12: Summary of Progressive Reclamation and Post-Operational Activities

Period	Description
Completed Progressive Reclamation	
Tailings Containment Area (TCA)	
1988	A test portion of Cell 1 (Cell 1A) was covered with esker material as final cover layer with thermistor strings installed.
1995	1 m layer of esker material was placed on Cell 1 and on a portion of Cell 2 with thermistor strings installed.
1994 and following years	Thermistors data collected, analyzed and interpreted.
1997	Additional cover work was completed on Cell 2 (¾ complete with a 1 m cover of esker material).
2003	Designated Cells 3A and 3B of Cell 3, were covered by approximately 1 m of esker material. Total area covered of approximately 62,350 m^2.
2003	Additional site information accumulated in support of the 'Partially Saturated Granular Cover' program for tailings reclamation.
2004	Major portion of Cell 3, the remainder of Cell 2, and a small portion of Cell 5 were covered by a minimum of 1 m of esker material. Total area covered of approximately 328,794 m^2.
2004	Additional site information was accumulated in support of the 'Saturated Granular Zone Cover' program for tailings reclamation.
2005	Major portion of Cell 5 and another portion of Cell 3 were covered by a minimum of 1 m of esker material. Total area covered of approximately 383,001 m^2, bringing the total of exposed tails covered to approximately 1,280,000 m^2.
Other Areas	
to 2005	The following components were reclaimed: ▪ unused roads ▪ equipment storage areas ▪ original Twin Otter airstrip ▪ all associated piping removed from the original construction camp water supply lake - piping roadway also reclaimed ▪ fueling station at the main airstrip ▪ arsenic treatment facility partially decommissioned (all remaining components were flushed after use)
Regular basis to 2005	All non-burnable waste (scrap metal, plastics, residue from burning) was disposed at the site landfill and buried with waste rock.
1998	Reclamation work was completed where the East Zone and Centre Zone was mined from the surface. The Crown Pillar area was reclaimed to the extent possible through filling in the mined out areas of the East Zone and Centre Zone.
2003	The Centre Zone Crown Pillar open stope, which was previously open from the 27 m level to surface, was filled with cemented tailings paste backfill and then topped with surface material.
Completed Post-Operational Activities	
Tailings Containment Area (TCA)	
2006	Final report on the Phase 1 and Phase 2 ESA of the Lupin Mine Site was provided to the NWB
Monthly basis until 2006	Data from the TCA thermistor strings was collected on a monthly basis until October 2006.

Table 12: Summary of Progressive Reclamation and Post-Operational Activities

Period	Description
Annual basis	Dam safety inspections were carried out and continue.
2013 - ongoing	Repairs to Dam M, Dam N and covering Cell 5 with esker material were carried out and continue.
2016 - ongoing	Covering of Cell 5 was resumed in 2016, currently ongoing. The total of exposed tails covered in Cell 5 to 2017 was approximately 1,311,500 m^2. There remains approximately 123,500 m^2 in Cell 5 and 86,000 m^2 in Cell 3 of exposed tailings. Minor cover repairs were made to existing tailings cover where required in 2016 and 2017.
2018	Covering of Cell 5 resumed in 2018. Approximately 19,136 m^3 of esker material was placed in Cell 5 during 2018 to cover exposed tailings. An area of approximately 104,500 m^2 remains to be covered In Cell 5 and approximately 86,000 m^2 remains to be covered in Cell 3, for a total area of approximately 190,500 m^2 remaining to be covered within the Tailings Containment Area.
2019	Continued with general site and TCA Care and Maintenance (i.e., Dam K).
Other Areas	
Following cessation of operations	The mill portion of the complex was given a complete wash down with the intent of gold recovery. Any residual contaminants (from chemical use) were removed and buried in the tailings impoundment.
	All metallurgical reagents, with the exception of lime, were shipped off site.
	The steel frame structure of the paste backfill building was removed along with the equipment from the plant and a cold storage building.
2006	The winze and underground mine equipment were removed from site. All hazardous materials were removed from the underground workings. Any equipment left (disposed of) in the underground workings was drained of fluids.
2006 - 2013	The underground mine workings ramp was sealed with a soil and rock plug and a locked fence installed to prevent access. The freshwater supply pumps were decommissioned in 2006. The pumps are currently stored at the mine site.
2011	Important maintenance was conducted on the main fuel tank and satellite tank farms.
2012 - 2015	Significant reclamation activities were resumed with the shipment of hazardous materials and other waste off-site for disposal at approved facilities. The shipment of significant quantities of hazardous materials and other waste off-site continued in 2013 and was resumed in 2015.
2014	Numerous fuel tanks and buried pipes were decommissioned and removed.
2014 - 2015	Repairs were completed to the upper and lower sewage lagoon dams.
2015 - 2016	Hazardous waste materials were consolidated and shipped of site for disposal. During 2015 and 2016 a total of 139,363 kg were shipped out. During 2017, an additional 15,345 kg were shipped.
2016 - 2017	A pilot landfarm to remediate hydrocarbon soil from the Satellite Tank Farm was constructed. The Landfarm was put into operation in late August 2017.
2016	Dam 5 repairs and upgrades were completed on the upper and lower sewage lagoons.
2017	The Phase 5 EEM Cycle was completed and filed with Environment Canada.

Table 12: Summary of Progressive Reclamation and Post-Operational Activities

Period	Description
2017	As per the Water Licence, an updated Phase I and II ESA was completed. As part of the ESA update, an asbestos-containing materials (ACMs) assessment at the Lupin Mine was also completed.
2018	ChemKleen Environmental Solutions cleaned and took out of service a total of twenty-two (22) fuel tanks. Specifically, four (4) yellow coloured vertical diesel tanks (63,500L each) at the Main Tank Farm, ten (10) horizontal diesel tanks (93,000Leach) and two (2) gasoline tanks (24,000L each) from the Satellite tank farm, three (3) horizontal tanks (500 gallon, 50,000L and 93,000L) and three (3) vertical tanks (65,000L each) from the Boneyard were cleaned and certified for tank withdrawal and marked 'Out of Service'.
	Soil sampling from the Tailings Containment Area and the Landfarm at the Mine site took place in September 2018 to obtain additional information for closure planning. The Pond 2 substrate will be tested for overall characterization and chemical stability. The Landfarm was sampled to assess the treatment of hydrocarbon contaminated soils that were placed in the facility in 2017.
	Hazardous Materials - approximately 39,288 kg of various material was removed from the Lupin site for disposal. A summary of materials removed from site and the volumes of materials remaining on site for either removal or consumption is included in the 2018 Annual report.
2019	General Care and Maintenance
2019-2020	The Phase 6 EEM Final Study Design was completed and filed with Environment Canada. Field program implemented in August 2019 with final report filed in 2020.

3.2 Completed Progressive Reclamation

3.2.1 Tailings Containment Area

As part of ongoing restoration activities, and as described in the 1988, 1995, 2003, 2004, and 2005 Annual Reports to the NWB, exposed tailings in completed cells has been progressively covered with between 1.0 to 2.0 m of esker material.

In 1988, a test portion of Cell 1, referred to as Cell 1A, was filled and covered with esker material as a final cover layer. Temperature monitoring thermistor strings were installed at various depths in this area to provide an indication of the amount of esker material needed to maintain the tailings frozen and allow the active thaw zone to be restricted to the esker cover.

In 1994, Echo Bay Mines Ltd. retained the services of Klohn-Crippen Consultants Ltd. for the engineering, geophysical and data interpretation of a test plot area on Cell 1 (Klohn 1995). Results of the geophysical portion of the study were inconclusive; however considerable background information was generated with regard to the chemistry of the tailings prior to covering.

In 1995, a continuation of the 1994 study incorporated the more standard physical measurement techniques of thermistors, frost probing and frost tubes at the study area. The scope was broadened when the decision to expand the esker cover program was made and Cell 1 was covered. These data, along with those generated by the additional thermistors installed in the following years, provided excellent information of the thermal response of the covered tails. The thermistor readings generally indicated that permafrost has re-established within the tailings cells and the thermistors located within Cell 1 indicated that the maximum annual depth of thaw was between 1.5 and 2 m. 3.2.1

In 1995, a 1 m layer of esker material was placed on Cell 1 and a portion of Cell 2 with thermistor strings installed to monitor the temperature below the ground surface. In 1997, additional cover work was completed on Cell 2 (¾ complete with a 1 m cover).

Progressive reclamation activities in the TCA during 2003 saw two areas within Cell 3, designated cells 3A and 3B, covered by approximately 1 m of esker material. The work was carried out between 5 August and 23 September 2003, with a total area covered of approximately 62,350 m^2.

In 2003, additional site information was accumulated in support of the 'Partially Saturated Granular Cover' program for reclamation of the TCA. Monitoring of pore water quality and the saturation status of the esker cover in Cell 1 continued from the previous year. Further to this work, a test pad was constructed in Cell 1 by effectively isolating a 20 m by 40 m area from the rest of the cell. This was accomplished by installing an impermeable liner in a 2.4 m deep trench surrounding the area, anchored well below the active zone. A thermistor and 2 water sample pipes were installed within the test pad area.

Progressive reclamation activities in the TCA during 2004 saw a major portion of Cell 3, the remainder of Cell 2, and a small portion of Cell 5 covered by a minimum of 1 m of esker material. The work was carried out between July 6 and September 19, 2004, with a total area covered of approximately 328,794 m^2.

In 2004, additional site information was accumulated in support of the 'Saturated Granular Zone Cover' program for reclamation of the TCA. Monitoring of pore water quality and the saturation status of the esker cover in Cell 1 continued from the previous two years. Further to this work, a series of 9 pits were excavated through the esker cover in Cells 1, 1A, 2 and 3 to check for cover thickness, moisture content, and condition of tails/cover interface. This work confirmed that a saturated zone exists at the base of the esker cover which effectively isolates the underlying tailings from an oxidizing environment. A detailed description of this program and data from of the many investigations in support of the saturated zone cover design are contained in the Final TCA ARP (Kinross 2005). See Section 3.2.1.

Progressive reclamation activities in the TCA during 2004 saw a major portion of Cell 3, the remainder of Cell 2, and a small portion of Cell 5 covered by a minimum of 1 m of esker gravel. The work was carried out between July 6 and September 19, 2004, with a total area of approximately 328,794 m^2 being covered.

Reclamation activities in the TCA during 2005 saw a major portion of Cell 5 and a small portion of Cell 3 covered by a minimum of 1 m of esker gravel. The work was carried out between 23 June and 28 September 2005, with a total area covered of approximately 383,001 m^2. General site maintenance and facilities upgrades were completed with a view to potentially resume production, which would have involved resuming disposal of tailings in the TCA. Covering ceased after 2005 because the remnant areas of exposed tailings were saturated for most of the year and the exposed areas would have been available to be used if the mine restarted. By 2005, approximately 1,280,000 m^2 of exposed tails had been covered.

During the regulatory review process, ECCC requested clarification regarding the adequacy of the 1 m cover to prevent ARD/ML activities within the tailings after they have been covered and post closure (i.e., in perpetuity) under expected climate conditions. Further, ECCC requested clarification of risk/uncertainties associated with the use of a permeable cover for the tailings materials, and what consideration has been given to physical isolation of the tailings within an impermeable cover. (ECCC TC No. 5)

In response, LMI confirmed:

- predictions are based on the CGCM3/T47 model using the IPCC SRES A1B scenario. The model was accessed via the ECCC website. The prediction is for the 100 years between 2000 and 2100. (CIRNAC TC No.9)
- the cover performance will be monitored by the existing and to-be installed instrumentation and evaluated during the Cell 1 cover field evaluation.

Refer to Section 4.3.2.8 for additional information regarding permanent closure and reclamation of the Tailings Impoundment and Containment Systems.

In addition, LMI committed to submit within one year of approval of the renewed/amended licence a Post Closure Monitoring Plan (PCMP) that incorporates, where appropriate, regulatory review comments, ongoing field work, HHERA results, and any other direction from the NWB. (TH/PHC Commitment No. 14). The PCMP will be developed in accordance with Part J, Item 13 and Schedule J of Water Licence 2AM-LUP2032. For addition information related to Monitoring refer to Section 5.0.

3.2.2 Other Progressive Reclamation

In addition to the work in the TCA, progressive reclamation has taken place in numerous other areas including many unused roads, and equipment storage areas. This included the original Twin Otter airstrip located south of the mine site parallel with the second sewage lake. All associated piping was removed from the original construction camp water supply lake and the roadway taken out of service by re-grading and scarifying the roadbed to promote natural re-vegetation of the ground. The fueling station at the main airstrip was also decommissioned and removed. The arsenic treatment facility was partially decommissioned. All remaining components were flushed after use.

All non-hazardous and non-burnable waste (scrap metal, plastics, residue from burning) historically were disposed at the site landfill and buried with waste rock on a regular basis. The waste in the landfill is covered progressively during use.

In 1998, while under care and maintenance, further reclamation work was completed where the East Zone and Centre Zone had been mined from the surface. The Crown Pillar area, the area where the ore zone is present near the surface, was reclaimed to the extent possible through filling in the mined out areas of the East Zone and Centre Zone.

The Centre Zone Crown Pillar open stope, which was previously open from the 27 m level to surface, was filled with cemented tailings paste backfill during 2003. Approximately 100,266 dry short tonnes of paste, at a cement content of close to 1%, were placed in the opening. Once the paste dried, it was then topped with surface material that had been stored when the original ground cover was removed to obtain access for mining. This activity has served a dual purpose by backfilling of one of the open crown pillars at surface as a step towards reclamation of the Site, and by reducing the amount of tailings directed towards the surface TCA impoundment.

3.3 Completed Post-Operational Activities

3.3.1 Tailings Containment Area

The Lupin property was sold to a new operator in 2005 and the mine has remained in care and maintenance since 2005. In 2006, the final report on the Phase 1 and Phase 2 ESA of the Lupin Mine Site was provided to the NWB (Morrow 2006). A surface water conveyance ditch on Dam 3 was relocated in 2010. In 2016, Lupin Mines resumed covering of Cell 5. Since 2016, activities have included: repairs to Dam M, Dam N and covering Cell 5 with esker material. Minor cover repairs we made to existing tailings cover where required in 2016 and 2017. Covering of Cell 5 continued during the 2017 season bringing the total of exposed tails covered to approximately 1,311,500 m^2.

Collection of data from all thermistor strings installed at the TCA continued on a monthly basis until October 2006. The information collected to 2006 indicated that sub-zero temperatures continued to be maintained at depth with no indications of warming (BGC 2006). Results obtained between 1995 and 2005 showed that October is usually the month when the active layer has penetrated the deepest and significant cooling has begun on surface (BGC 2006).

The geotechnical conditions and routine maintenance of the perimeter dams has been reported in the annual geotechnical inspection reports current to 2017. Commencing with the 2012 annual geotechnical report, the geotechnical conditions of the internal dams has additionally been reported. Temperature monitoring of the dams (based on installed thermistors) indicates that the cores remain frozen year-round (actively monitored thermistors

are shown on Figure 5). The 2017 dam frozen core thermistor readings indicated that the thaw depth of the dams (active layer) ranged from 2.0 m to 3.0 m and varied between TCA locations (Norwest 2017a).

Data collected from the groundwater monitoring pipes, installed in 2002 and monitored up to 2004, indicated that the saturated zone thickness within the cover ranged from 0.2 m to 0.6 m, measured upwards from the tailings to cover contact surface. The water level readings and water quality results are presented in the report "Studies Related to Water Licence Requirements and in Support of Reclamation Planning" (Golder 2004a).

Between 2005 and 2016, no esker material cover was placed and the data collection to assess the performance of the soil covers was infrequent. In 2016, LMI reinitiated the assessment of cover performance data by the engineers responsible for the annual geotechnical inspections, and this, including new instrumentation outlined in Section 5.0, will continue as part of the on-going annual inspections. The 2016 and 2017 cover performance data indicated that the cover active layer (thaw depth) ranged from 1.0 m to 1.5 m, and varied between reporting years and TCA locations.

As of 2017, there remained approximately 123,500 m^2 to cover in Cell 5 and 86,000 m^2 to cover in Cell 3.

Covering of Cell 5 resumed in 2018. Approximately 19,136 m^3 of esker material was placed in Cell 5 during 2018 to cover exposed tailings. An area of approximately 104,500 m^2 remains to be covered In Cell 5 and approximately 86,000 m^2 remains to be covered in Cell 3, for a total area of approximately 190,500 m^2 remaining to be covered within the Tailings Containment Area.

In 2019, LMI continued with general care and maintenance activities on site at the TCA and in the main mine site area.

3.3.2 Other Post-Operational Activities

Following cessation of operations, the mill portion of the complex was given a complete wash down with the intent of gold recovery (i.e., the recovery of visible gold that settles within the system). Any residual contaminants (from chemical use) were removed and buried in the tailings impoundment.

All metallurgical reagents, with the exception of lime, have been shipped off site.

The steel frame structure of the paste backfill building has been removed and equipment from the plant was removed for resale or salvage. A cold storage building has also been removed.

The winze and underground mine equipment were removed from site in 2006. All hazardous materials were removed from the underground workings. Any equipment left (disposed of) in the underground workings was drained of fluids.

The underground mine workings ramp has been sealed with a soil and rock plug and a locked fence installed to prevent access.The freshwater supply pumps were decommissioned in 2006. The pumps are currently stored at the mine site. The pumps were refurbished in 2013, but they remain in storage.

In October 2011, important maintenance was conducted on the main fuel tank and satellite tank farms. Significant reclamation activities resumed in June 2012 with the shipment of hazardous materials and other waste off-site for disposal at approved facilities. The shipment of significant quantities of hazardous materials and other waste off-

site continued in 2013 and resumed in 2015. The volume and types of materials shipped off-site for disposal are reported in the 2012 and 2013 monthly reports to the NWB and also in the 2015 and 2016 annual reports.

Reclamation activities during 2014 consisted of the decommissioning and removal of numerous fuel tanks and buried pipes as reported in the 2014 annual report. Repairs were also completed to the upper and lower sewage lagoon dams in 2015. Hazardous waste materials have been consolidated and shipped off site for disposal. During 2015 and 2016 a total of 139,363 kg were shipped out. During 2017, an additional 15,345 kg were shipped.

In 2016, reclamation included construction of a pilot landfarm to remediate hydrocarbon soil from the Satellite Tank Farm (STF). The Landfarm was put into operation in late August 2017. Dam 5 repairs and upgrades were completed on the upper and lower sewage lagoons.

As per the Water Licence, an updated Phase I and II ESA was completed in 2017 (Golder 2017a). The objective of the updated Phase I ESA was to identify potential sources of soil and groundwater quality impairment based on the historical activities. The scope of work for the updated Phase II ESA was developed to assess current soil and groundwater quality based on the 2006 assessment results (Morrow 2006) and then refined based on the findings of the updated Phase I ESA and the current site conditions.

As part of the ESA update, an Asbestos Containing Materials(ACM) assessment at the Lupin Mine was carried out by Golder in 2017 (Golder 2017c). The assessment was carried out to evaluate the ACMs that may be impacted by future demolition of the mine buildings.

In 2018 ChemKleen Environmental Solutions facilitated the cleaning and taking out of service of a total twenty-two (22) fuel tanks. Specifically: four (4) yellow coloured vertical diesel tanks (63,500L each) at the Main Tank Farm, ten (10) horizontal diesel tanks (93,000L each) and two (2) gasoline tanks (24,000L each) from the Satellite tank farm, three (3) horizontal tanks (500 gallon, 50,000L and 93,000L) and three (3) vertical tanks (65,000L each) from the Boneyard were cleaned and certified for tank withdrawal and marked ‘Out of Service’.

Soil sampling from the Tailings Containment Area and the Landfarm at the Mine site took place in September 2018 to obtain additional information for closure planning. The Pond 2 substrate will be tested for overall characterization and chemical stability. The Landfarm was sampled to assess the treatment of hydrocarbon contaminated soils that were placed in the facility in 2017.

Regarding hazardous materials, approximately 39,288 kg of various material was removed from the Lupin site for disposal. A summary of materials removed from site and the volumes of materials remaining on site for either removal or consumption is included in the 2018 Annual report.

The Phase 6 EEM Final Study Design was completed and filed with Environment Canada. The field program was implemented in August 2019 and the final report was filed in 2020.

4.0 PERMANENT CLOSURE AND RECLAMATION

4.1 Definition of Permanent Closure and Reclamation

Permanent closure is defined as the final closure of a mine site with no foreseeable intent by the existing proponent to return to either active exploration or mining. Permanent closure indicates that the proponent intends to have no further activity on the site aside from post-closure monitoring and potential contingency actions. Permanent closure does not, however, preclude the proponent or another party from pursuing opportunities at the existing site or in the area at a time beyond the foreseeable future.

Lupin Mines Incorporated has decided to commence with the permanent closure and reclamation of the Site.

4.2 Permanent Closure Objectives and Criteria

There are a number of environmental and safety considerations to address when mines are closed. Environment Canada's *Environmental Code of Practice for Metal Mines* summarizes the key objectives of mine closure as follows (adapted from EC 2009):

- Ensure public and wildlife safety by preventing inadvertent access to mine openings and other infrastructure
- Provide for the stable, long-term storage of waste rock and tailings
- Ensure that the site is self-sustaining and prevent or minimize environmental impacts
- Rehabilitate disturbed areas for a specified land use (e.g., return of disturbed areas to a natural state or other acceptable land use)

While the general objectives above apply to the project as a whole, there are also closure considerations specific to the different mine components. A summary of potential aspects is shown in Table 13. (It should be noted that Table 9 provides a general list and that some of these considerations do not specifically apply at Lupin Mine.) Additional detail is provided in the sub-sections of Section 4.3.

Table 13: Mine Components and Closure Considerations

Mine Components	Closure Considerations
Quarries	▪ Slope and bench stability ▪ Groundwater and rainwater management ▪ Security and unauthorized access ▪ Wildlife entrapment ▪ Effects of drainage into and from the pit/quarry
Waste Rock Storage Facilities	▪ Slope stability ▪ Effects of leaching and seepage on surface and groundwater ▪ Dust generation ▪ Visual impact
Tailings Storage Facilities	▪ Embankment stability ▪ Changes in tailings geochemistry ▪ Effects of seepage ▪ Surface water management and discharge ▪ Dust generation ▪ Access and security

Table 13: Mine Components and Closure Considerations

Mine Components	Closure Considerations
Water Management Facilities	▪ Restoration or removal of dikes, settling ponds, sumps, pumps, pipelines, and/or culverts which are no longer needed ▪ Site surface water drainage and discharge ▪ Maintenance of closure water management facilities
Infrastructure at Mill and Camp	▪ Removal of buildings and foundations ▪ Clean-up of workshops, fuel and reagents ▪ Removal of power and water supply ▪ Removal of haul and access roads ▪ Disposal of scrap and waste materials ▪ Re-profiling of site
Landfill/Waste Disposal Facilities	▪ Disposal or removal from site of hazardous wastes ▪ Disposal and stability of treatment sludge ▪ Removal of sewage and water treatment facilities ▪ Prevention of groundwater contamination

Source: adapted from EC 2009, Table 3.4

Closure criteria are used to measure the success of meeting closure objectives. The following are examples of the types of criteria that will be applied:

- Applicable water quality criteria or guidelines
- Target surface water and/or permafrost levels
- Evidence of post-closure wildlife and fish use
- Satisfactory inspections related to drainage and slope stability

4.3 Permanent Closure and Reclamation Plan

4.3.1 Reclamation Principles

Further to the approach to the development of the FCRP presented in Section 1.5, the goal of specific restoration practices is to minimize, or preferably eliminate, degradation of disturbed areas and to initiate, encourage and accelerate the natural recovery. The facilities and specific disturbed areas of concern with regard to the Lupin Mine that require permanent reclamation and closure activities and special management are covered in the following sections.

4.3.2 Reclamation Components

Figure 10 shows the planned configuration of the mine and mill site area after permanent closure has been implemented. Figure 11 shows the planned configuration of the TCA after permanent closure has been implemented. Table 14 lists the measures that will need to be implemented to achieve permanent closure at both locations. The following subsections provide descriptions of the measures for each component.

Table 14: Summary of Measures for Final Closure (REVISED 19 March 2019)

Component	Description	Preparatory Work	Closure Phase		Post-Closure Phase				
		2019	2020	2021	2022	2023	2024	2025	2026
			Active Stage		Passive Stage				
Underground Mine	Backfilling of shafts to prevent animal or human entrance			X					
	Blasting down crown pillars where required for stability or disposal – to be carried out under approved care and maintenance plan		X						
	Disposing of contaminated soil, waste rock and demolition rubble into open crown pillars – to be carried out under approved care and maintenance plan			X					
	Backfilling of crown pillars with rock fill (to 1.5 m above surface to allow for settlement) – to be carried out under approved care and maintenance plan			X					
	Capping rock fill in crown pillars with 1.0 m of esker material			X					
Waste Rock	Excavate waste rock from perimeter areas and dispose in the open crown pillars, landfill(s) or central waste rock area[a] – to be carried out under approved care and maintenance plan			X					
	Excavate waste rock containing high levels[b] of As, CN or $PbNO_3$ and dispose in shafts or crown pillars to be carried out under approved care and maintenance plan			X					
	Contouring remaining waste rock and capping with 1.0 m of esker material			X					
	Place a 10 m long plug of rock fill in the adit and portal area			X					
Tailings Containment Area	Removal of tailings pipeline; bury in landfill		X						
	Remove any tailings from emergency dump and dispose in crown pillar		X						
	Complete covering of remaining tailings area with 1.0 m of esker material – to be carried out under approved Final TCA Closure Plan		X						
	Demolish treatment plant; dispose in landfill(s)			X					
	Installation of permanent monitoring instrumentation – to be carried out under approved Final TCA Closure Plan	X							
	Regrading granular slopes on M Dam		X						
Buildings and Equipment	Removal of asbestos containing materials, disposal in landfill(s)		X						
	Remove salvageable materials; consolidate for shipment off-site		X		X				
	Removal of above-ground mechanical and electrical equipment		X						
	Demolition of ancillary buildings (shops, storage, camp); disposal of rubble in open crown pillars or landfill(s)		X						
	Demolition of mine and mill buildings; disposal of rubble in open crown pillars or landfill(s)		X						
	Hoe ram concrete foundation slabs; leave in place and cover		X						
	Removal of freshwater supply system pumphouse; remove pipeline and dispose in the landfill(s)		X						
	Placement of 0.3 m granular fill over slabs (except in central area where they will be covered by waste rock and esker cover)			X					
	Dismantling and removal of sewage pipeline, lagoon shack and pumping facilities			X					
	Disposal of unsalvageable / un-recyclable non-hazardous waste in landfill(s) – to be carried out under existing approved management plan		X	X					
	Burn combustible material – to be carried out under existing approved licence/permit		X	X					
Borrow and Quarry Areas	Contouring esker area and placement of erosion protection in drainage paths			X					
Chemicals	Decontaminate: oil, fuel and glycol systems			X					
	Drum paints, solvents, chemicals, glycols, and hazardous materials for shipment to off-site disposal			X					
	Remove ashes from burn pit and bury in landfill(s) > 2m below final grade – to be carried out under existing approved licence/permit		X	X					
	Burn waste oil – to be carried out under existing approved licence/permit		X	X					
	Consume most of diesel fuel for closure operations		X	X					
	Burn excess fuel at end of closure activities – to be carried out under existing approved licence/permit			X					
	Empty and purge fuel tanks and dispose in accordance with the Canadian Environmental Protection Act Regulation			X					
	Excavation of hydrocarbon contaminated soils, consolidate into containers and bury in open crown pillars			X					
	Bioremediate soil currently in landfarm; use remediated soil for reclamation – to be carried out under existing approved management plan licence/permit	X	X	X					
Machinery and Mobile Equipment	Drain fluid from equipment to be left on-site and dispose equipment in landfill(s)			X					
	Drain fluid from equipment used for long-term maintenance (e.g., excavators)[c] and dispose equipment in landfill(s) or off-site								X
Landfill	Place wastes into existing landfill(s) – to be carried out under existing approved management plan		X	X					
	Use waste rock to infill voids and create a stable contoured surface which drains freely			X					
	Cover contoured landfill(s) with 1 m of esker material			X					
Site Roads	Scarify all-weather roads; remove culverts			X					
Water Management Facilities	Treat water inventory with lime and release to lower water level – to be carried out under existing approved licence/permit			X					
	Construction of spillways in Dam 1A and J Dam; place geotextile and rip rap to 2 m depth						X		
	Excavation of spillways on Upper and Lower Sewage Lakes			X					
Mob/Demob	Mobilize Winter Ice Road maintenance equipment	X							
	Operate Winter Ice Road for salvage removal		X		X				

a) The waste rock from the perimeter of the Mill Site Area (shown in Figure 10) will be removed and disposed into the open crown pillars, shafts, landfill(s) or the central waste rock area. Waste rock which will stay on place will be contoured to drain freely and then capped with 1.0 m of esker material.
b) Refer to text for levels of As, CN, or $PbNO_3$ requiring disposal in shafts or crown pillars, rather than covering in place.
c) Assumed 5 years after closure; however Closure schedule depends on monitoring results. Activities will occur until contact water quality satisfies water licence criteria for direct discharge to the environment.

4.3.2.1 Acid Rock Drainage and Metal Leaching

Project Description

The related studies describing the potential of ARD are identified in Section 2.1.8.

The results of the recent ARD/ML investigation (Golder 2017a), indicated that approximately 67% of the waste rock can be classified as PAG. The PAG samples were not found to be concentrated in one particular area; rather PAG samples were distributed throughout the waste rock deposits around the Site. In addition, much of the sulphur present was in the form of sulphate rather than sulphide, indicating that oxidation of the waste rock was well advanced. The updated Phase I and II ESA recommended evaluation of options for dealing with the acid generation and metal leaching potential of waste rock.

Reclamation Objectives and Closure Criteria

The approved plan for the reclamation of the TCA includes covering all exposed tailings with a 1.0 m layer of esker material. This layer will prevent any contact between the tailings and the surface environment and the saturated zone at the cover/tailings interface will provide an effective barrier to oxidation.

Given the advanced state of oxidation of the waste rock, the main objective of the reclamation should be to limit the contact between the waste rock and surface runoff (as opposed to limiting oxygen flux to the waste rock).

Closure and Reclamation Options

The reclamation plan for the TCA has been approved and, as discussed in Section 3.3.1, most of the exposed tailings have already been covered as part of post-operational activities. Placement of the 1.0 m thick esker material cover will be completed over the remaining area. More details of the tailings cover are provided in Section 4.3.2.8.

In principle, the objective of limiting the contact between waste rock and surface runoff can be achieved by relocating some of the waste rock into the open crown pillar voids, the shafts or the landfill. The space available in these locations is insufficient to hold the estimate 1,000,000 m^3 of waste rock, so the remainder of the waste rock will be left in place, contoured to shed water and covered with a 1.0 m layer of esker material. More details of the activities for the closure of the waste rock are provided in Section 4.3.2.7.

During the regulatory review process, ECCC requested clarification on ARD/ML (ECCC TC No. 6). LMI confirmed:

- LMI predictions are based on the CGCM3/T47 model using the IPCC SRES A1B scenario. The model was accessed via the ECCC website. The prediction is for the 100 years between 2000 and 2100
- The objective of the cover is to isolate the waste rock from surface exposure and to reduce the contact between the waste rock and surface water. It is recognized that the 1.0 m thick cover will thaw by late summer. At the time of the spring freshet, the cover will still be frozen, and it will be practically impermeable. The runoff from the freshet will simply run off over the surface of the cover. In the spring and early summer, the top of the cover will be thawed, but the base will still be frozen. Water which infiltrates into the cover will flow through the cover itself without contacting the waste rock. In the late summer, the cover will be completely thawed, and some of the infiltration will penetrate through the cover into the waste rock. The effect of climate warming will be to increase the thaw depth and to shorten the time required for the thaw to fully penetrate through the cover.

- The annual amount of infiltration through the cover and into the waste rock was predicted using a coupled thermal model and transient groundwater flow model. To bracket the results, the model was run for the current climate and for a year 2100 climate warming scenario. The results are presented in a Technical Memorandum in Appendix H-6.
- Water quality modeling was undertaken to predict the impacts that the seeps that will emerge from the toe of the covered waste rock will have on the adjacent surface water receivers. The results are presented in a Technical Memorandum in Appendix H-5. This water quality prediction was used as an input to the Human Health and Ecological Risk Assessment (HHERA) study discussed above (Golder, 2019c). For additional information related to the HHERA, refer to Section 6.2.
- The results of the HHERA for the closure scenario and associated pathways indicated that the remediation and risk management measures outlined in the FCRP were considered sufficient to address potential risks to human and ecological receptors. However, the HHERA concluded that there could remain a moderate risk to aquatic life from low pH in Boot Lake and Unnamed Lake (also known as East Lake). It was recognized that the water quality model was conservative and that the closure measures would result in an improvement relative to the current water quality; however, it was recommended that water quality monitoring be undertaken in Boot Lake, Unnamed Lake and Lower Sewage Lake. LMI may propose additional reasonable and practical adaptive management strategies (i.e., applicable monitoring (FCRP, Tables 18 and 19) and/or additional remediation measures) may be implemented. .

Further, during the TM/PHC held in June 2019, LMI committed to go through records and provide historical data analysis regarding the ARD potential of tailings dams and roadways, etc., and to indicate whether, based on the historical information, the additional study is required. (TM/PHC Commitment No.3). It was concluded in Technical Memorandum regarding Waste Rock Information from Lupin Mine Tailings Containment Area (Stantec, 2019c) that based on historical information there was no need to proceed to the geochemical modeling proposed in Commitment No,4). For additional information refer to the Technical Memorandum provided in Appendix H-7.

4.3.2.2 Revegetation

Listing and Assessment of Possible Reclamation Activities

The areas at the Lupin Mine site which are candidates for revegetation enhancements are limited in type (covered tailings, covered waste rock, abandoned roadways etc.), most being raised above the surrounding terrain, windswept and dry. The lack of suitable growth medium and unavailable soil amendments for post use reclamation make it much more difficult. The esker deposit is the major material type that would be used in restoration activities and it lacks the organic/nutrient content that the surrounding vegetation has established. Nonetheless, the tailings cells that were covered by esker material in 1988 and 1995 have both started to re-vegetate on their own.

The procedure of scarifying reclaimed surfaces, (as was carried out successfully on Cell 1A, the old airstrip, and the East Zone crown pillar cover), will be continued in order to provide a microclimate for natural plant growth. Providing a rough surface enhances seed entrapment, moisture retention and wind protection.

A potential alternative to natural re-establishment and alien species use is the practice of native sod transplanting. This procedure would involve the transplanting of blocks of soil to the restoration area which contain both the plant species and associated microflora. These ‘sod islands’ would provide a nuclei that plants and microorganisms could emigrate from. Many plant species produce rhizomes, suckers or shoots that are responsible for

propagation. This is especially true in harsh, northern conditions where seed production may be minimal due to the short (and variable) growing season, lack of moisture and other constraints.

Sod transplanting may be a viable method of revegetation; however, in an area with minimal growth medium in combination with a shallow active surface layer, the placement of sod for the restoration of one site does not justify the removal of sod from another established area.

For areas that have been restored with the use of esker material, the most practicable technology available is to provide the most suitable substrate by surface preparation to promote natural revegetation. This includes addition of heavy (large grain sized quarry material), surface scarification and contouring to provide proper drainage patterns to avoid erosion and ponding of water.

4.3.2.3 Contaminated Soils

Project Description

The primary contaminants of concern at the Site are arsenic (as a component of the solid phase waste rock/ore as arsenopyrite mineralization) and petroleum hydrocarbons (PHCs). Secondary contaminants have been identified (i.e., lead nitrate, cyanide); however, they are localized and coincide with the primary contaminants. The following paragraphs provide further discussion of the two primary sources of contaminated soils at the Site.

Approximately 1,000,000 m^3 of waste rock was historically placed on surface at the Site for the development of roadways, laydown yards, and building foundations (URS 2005). Historical analysis of waste rock identified elevated arsenic concentrations (i.e., median concentration of 1,140 mg/kg) exceeding the applicable criteria (Morrow 2006). The deposition/blending of this arsenic rich waste rock with surficial soils has resulted in shallow arsenic impairment (i.e., arsenic impacted material) across the developed portions of the Site. Historical analysis has also confirmed that arsenic concentrations are naturally elevated at the Site. Background arsenic concentrations in soil range from 9 mg/kg to 189 mg/kg (Morrow 2006). Based on this dataset, a background total arsenic concentration was established at 179 mg/kg (Morrow 2006). Recent investigations have identified approximately 418,000 m^3 of arsenic impacted material exceeding the background concentration at developed portions of the Site (Golder 2017a). A sub-set of this volume (approximately 16,300 m^3) has been classified as heavily arsenic impacted (i.e., arsenic concentrations greater than 4,000 mg/kg). This heavily arsenic impacted shallow (i.e., less than 2.0 m thick) material is a result of placement of waste rock on mine site pad and potentially the unintentional distribution of crushed ore on Site as part of road construction.

Approximately 35,200 m^3 of PHC impacted soil has been identified at 13 historical maintenance, fueling, and fuel storage locations across the Site (Golder 2017a). Multiple above ground storage tanks were used in historical operations for fuelling vehicles and machinery, heating buildings, and fuel storage. Historical spills have resulted in PHC impacts to surficial soils. Areas of PHC impacted surficial soils have been identified based upon historical investigations, including reviews of mine records relating to spills and storage.

Reclamation Objectives and Closure Criteria

The primary goal of the closure and reclamation of contaminated soils is to minimize the release of contaminants from the Site to the surrounding environment. Based on this goal, the following objectives have been identified:

- Manage contaminated soils in-situ or relocate them to final disposal locations in order to reduce unacceptable risk to humans and terrestrial ecosystems.

- Impacts to humans, environment, and wildlife within risk managed areas are minimized.
- Human and wildlife exposure to soil contaminant concentrations above criteria for the designated land use is minimized.

A summary of the measurable criteria to meet these objectives are presented below.

- Contaminated materials will either be ex-situ remediated or risk managed in-place with an engineered cover to reduce human health and ecological risks. Verification sampling will be completed to confirm that the appropriate soil remediation criteria are met for the areas that will be ex-situ remediated. The engineered cover will be designed to reduce human health and ecological risks. Design specifications will be verified in the field.
- For the risk managed areas, the engineered cover will consist of a minimum of 1.0 m of esker material to minimize the impact to humans, environment, and wildlife. Technical specifications for the engineered cover (i.e., acceptable gradations and compaction) will be established prior to placement. CIRNAC TC No. 13 requested additional detail on the cover specification. LMI confirmed that the only available source of material for the cover on the waste rock is the existing esker borrow pit which is currently being used as the source for the cover on the TCA. The specification for the cover on the waste rock will follow the typical gradation limits of the esker material: 25 to 50% gravel size, 47 to 68% sand size and 2 to 6% silt sized (Holubec 2005). Golder (2004) provides additional data on the characterization of the esker materials (i.e., geochemistry and grain size).
- Contaminated soils will be either ex-situ remediated or risk managed in place to comply with industrial land use criteria specified within the Nunavut Environmental *Guideline for Contaminated Site Remediation* (GN, 2009). The engineered cover is designed to reduce human and wildlife exposure to soil contaminants left in place above the applicable criteria.

Post-Closure Reclamation Options

Various remedial options are available to address the shallow soil quality impairment at the Site. Options were selected based on: (i) feasibility to remediate or risk manage these areas; and (ii) experience and review of recent studies/case studies. The potential remedial options were combined/segregated into four “general response actions” which included: risk management – administrative controls; risk management – engineered controls; in-situ remediation; and ex-situ remediation. A summary of the potential remedial options for each of the four general response actions is provided in Table 15.

Table 15: Potential Remedial Alternatives

General Response Action	Remedial Options	Process Description
Risk Management – Administrative Controls	Administrative Measures	Restricting potential receptors or controlling potential exposure pathways through administrative measures (e.g., signage). Requires long term monitoring and restricted land use.
	Land Use Management Restrictions	Land use restrictions may be imposed to restrict specific types of development and activities. Land use zoning restrictions are typically intended allow management of the land in an efficient manner and/or to protect future land users from potential environment and safety hazards. The restrictions are typically legislated by government.

Table 15: Potential Remedial Alternatives

General Response Action	Remedial Options	Process Description
Risk Management – Administrative Controls	Public Awareness	This control typically involves the use of public information sessions, schools, and/or libraries to provide information to local communities and the public concerning potential hazards.
Risk Management - Engineered Controls	Physical Barriers	The construction of physical barriers or fences is a commonly used measure to restrict public access and thereby potentially reduce risk to the public.
	Engineered Cover	Engineered covers typically involve the placement of a coarse-grained material to prevent public and wildlife direct soil contact.
	Vegetated Engineered Cover	Similar to Engineered Cover, complete with topsoil and seed. Vegetative barriers may be used to minimize potential exposure and stabilize contaminants. Revegetation using native plants will promote “self-healing” by initiating and enhancing natural processes such as biological degradation and soil development.
In-situ Remediation	In Situ Treatment - Stabilization	Reduce the mobility of the contaminant in the soil through addition of chemical agents or adsorptive additives.
	In situ Treatment - Phytoremediation	Encourage plant growth for stabilization and removal of metals from soil.
Ex-situ Remediation	Landfarming	Excavated soils are typically placed in a lined cell and treated through mixing (i.e., aeration) and/or the addition of soil amendments to promote microbial degradation of contaminants (i.e., PHCs).
	Excavation of Contaminated Soil using Specialized Techniques	Removal of contaminated soil using specialized excavation techniques, including small scale equipment, dental excavation, and/or hand excavation.
	Excavation of Contaminated Soil using Conventional Techniques	Removal of contaminated soil using conventional excavation techniques, including backhoes, haul trucks, and/or dozers.

Northern Considerations

The work season is typically restricted to three or four months. As a result, potential remedial options which require a significant timeframe to implement were not considered as they were deemed impractical.

The remote location of the Site limits the remedial options. As discussed in Section 1.2, the Site is located approximately 400 km north of Yellowknife, NWT and can only be accessed by aircraft or winter roads. Potential remedial options requiring off-Site disposal of contaminated soils were deemed impractical.

Listing and Assessment of Possible Reclamation Activities

The deposition/blending of arsenic rich waste rock with surficial soils has resulted in shallow arsenic impairment (i.e., arsenic impacted material) across the developed portions of the Site. Previous interim closure and reclamation plans have committed to remediate the Site to industrial land use standards. The remedial options for the Site were restricted to either conventional soil removal (i.e., ex-situ remediation) or risk management (i.e., engineered covers) other options (i.e., administrative controls, physical barriers, and in-situ remediation) were not considered practical. As discussed in Section 4.3.2.12, a small pilot landfarm has been constructed on-site and it is currently being used to remediate about 500 m^3 of hydrocarbon contaminated soils that were excavated from the STF in 2017.

Selection of Preferred Reclamation Activities

Contaminated soils at the Site are typically shallow (i.e., less than 2.0 m thick); however they are laterally extensive (approximately 275,000 m^2). As a result, it was recognized that due to the significant volume of contaminated soils at the Site (approximately 450,000 m^3), completing ex-situ remediation of all contaminated soils is impractical. In addition, as discussed in Section 2.3.2, a substantial coarse-grained borrow source is available at the Fingers Lake esker located approximately 10 km south of the mine. This esker material is a well graded gravelly sand, composed of 59% sand, 38% gravel, and 3% silt on average (Holubec 2005) and has been historically used for closure activities at the TCA. Given these factors, it was determined that a combination of remedial options will be implemented based on contaminant type and concentration. The remedial options selected for the Site include ex-situ remediation using conventional techniques (i.e., excavators, haul trucks, and dozers), and risk management with a coarse-grained engineered cover. The capacity of the existing landfarm is too small to remediate the estimated 35,200 m^3 of PHC contaminated soils in a realistic time frame. It is also impractical to construct enough additional landfarm capacity to bioremediate the PHC soils within the planned 2 to 3 year closure period. For this reason, PHC contaminated soil will be excavated and moved into the open crown pillar voids for isolation.

Synthesis of Preferred Activities into a Reclamation Plan

Approximately 418,000 m^3 of arsenic impacted material, exceeding the background concentration, has been identified at developed portions of the Site (Golder 2017a). A sub-set of this volume (approximately 16,300 m^3) has been classified as heavily arsenic impacted (i.e., arsenic concentrations greater than 4,000 mg/kg). Heavily arsenic impacted shallow material is located adjacent to the transfer/screen house, conveyors, and crushing building portions of the mill complex. This is likely the result of placement of waste rock on mine site pad in the mill area and potentially the unintentional distribution on Site as road surface materials. The heavily arsenic impacted shallow material will be ex-situ remediated using conventional techniques (i.e., excavators, haul trucks, and dozers) and will be excavated and disposed of within the shafts or open crown pillars for isolation. The areas of remaining arsenic impacted shallow materials will be regraded to support surface water management (i.e. positive drainage), and then covered with coarse-grained borrow material from the Fingers Lake esker. The regrading of excavated depressions will be achieved by bringing in waste rock from the perimeter areas. LMI confirmed in response to CIRNAC No. 14 that areas of excavation within the central area will be brought up to the final grade by filling with waste rock (unclassified as to PAG or NPAG status), graded to a dome shape, and covered with 1.0 m of esker material. The cover is intended to reduce infiltration, thus mitigating the volume and quality of seeps from the domed area.

The arsenic impacted shallow material will be left in place and managed using a risk-based approach in accordance with the Nunavut *Guideline for Contaminated Site Remediation* (GN, 2009). An HHERA (Golder, 2019c) was undertaken to confirm the remediation strategy is sufficient to address any human or ecological risks identified. Refer to Section 6.2 for additional information. The heavily arsenic impacted soils will be risk managed with the placement of a coarse-grained engineered cover. The engineered cover will consist of approximately 1.0 m of coarse-grained borrow material from the Fingers Lake esker and will be graded to support positive drainage.

Approximately 35,200 m^3 of PHC impacted soil has been identified at 13 historical maintenance, fueling, and fuel storage locations across the Site (Golder 2017a). These locations include: the STF and Powerhouse, the Mill and Office Emergency Tanks, the Main Tank Farm Loaders, the Main Tank Farm Bedding Sand, the Emergency Powerhouse, the South Burn Pit, the Landfill, the RTL Shop, the North Burn Pit, the Incinerator, Cold Storage #1, the Former Airstrip Fuelling Area, and the former Ball Field. This material will be ex-situ remediated using conventional techniques (i.e., excavators, haul trucks, and dozers) and disposed of in the shafts or open crown pillars. The areas that have been excavated will be regraded to ensure drainage and then covered with 1.0 m of coarse-grained borrow material from the Fingers Lake esker.

As discussed in Section 3.3.2, a landfarm cell was constructed in 2016 to treat PHC impacted soil from the STF. The landfarm cell was constructed at the south end of the former Paste Backfill Building footprint. The PHC impacted soil currently in the landfarm cell (about 500 m^3) will be disposed of into the mine shafts or open crown pillar.

Management and Accountability Structure

As part of the remedial activities, a quality assurance/quality control (QA/QC) program will be implemented. The purpose of the QA/QC program will be to verify that the remedial activities are implemented as planned. The scope of the QA/QC program will be developed prior to implementing the remedial activities; however, it is anticipated that it will generally include the following tasks:

- Monitoring remedial excavations and collecting confirmatory soil samples from the limits of the excavations
- Monitoring the disposal of PHC impacted soil in the shafts or open crown pillars
- Monitoring the disposal of heavily arsenic impacted material in the shafts or open crown pillars
- Monitoring the regrading of the excavated areas
- Monitoring the placement and grading of the engineered cover over the arsenic impacted soil that is left in place
- Documenting the results of the remedial works, along with the QA/QC program, in a report.

During the regulatory review process CIRNAC requested clarification regarding QA/QC program to be implemented (CIRNAC TC No. 15).

LMI confirmed:

- The HHERA was executed in the summer of 2019, which resulted in the establishment of site-specific standards. Works will be completed in accordance with CCME (Canadian Council of Ministers of the Environment) Canadian Environmental Quality Guidelines (CCME, 2014); which provides soil quality criteria for contaminated sites. The soil screening and laboratory analytical results will be compared with the Government of Nunavut's Environmental Guideline for Contaminated Site Remediation (Government of Nunavut, 2009) Tier 1 guidelines for coarse-grained surface soil and industrial land use. PHC soil clean-up work will target the following contaminants of concern (CoC), identified in the Lupin Phase I & II ESA Update Report (Golder, 2017a): benzene, toluene, ethylbenzene, xylene(s) (BTEX) and petroleum hydrocarbon (PHC) fractions F1 through F4.
- LMI will use a combination of field screening and confirmatory lab analysis techniques to ensure that the PHC soil remediation program meets Nunavut guidelines (Government Nunavut, 2009). The soil remediation with be completed by returning to areas of known exceedances to the guidelines and commencing excavation activities. At each excavation, soil samples will be collected and field-screened for combustible headspace vapors (CHVs) and volatile headspace vapors (VHVs). Field screening results will establish the excavation limits of the various PHC soil clean-up areas, and once the excavation limits have been reached, soil samples

will be submitted to an accredited laboratory for analysis of BTEX and PHC F1-F4 for a confirmation of field screening results. Duplicate samples will also be collected as part of the QA/QC process. Field screening methods, in addition to methods for the determination the number of confirmatory samples required, will follow guidelines outlined in CCME Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 1 Guidance Manual. (CCME, 2016)

- All mine rock (except that in the airstrip and roads to be kept in service) will be removed or covered. No attempt will be made to segregate PAG and NAG mine rock, therefore no further classification testing is required. The QA/QC program for mine rock removal will be visual inspection to confirm it has been removed or covered. With respect to the management of the waste rock, the QA/QC will be directed at ensuring the thickness, material and grading of the cover. LMI has not classified waste rock as PAG or NPAG but rather intends to consolidate and cover all waste rock at the mine/mill site. Refer to the CIRNAC TC 13 for additional information regarding specifications of the esker material cover.
- QA/QC measures will be further detailed in the Post-Closure Monitoring Plan due one year following approval the licence.

Uncertainties and Information Needs

The actual volume of contaminated material/soils requiring remediation and/or risk management is uncertain. It is possible that additional contaminated material/soils will be encountered as remedial works are completed. However, a contingency allowance has been developed within the disposal strategy in order to accommodate additional materials. In addition, as previously discussed, an HHERA was undertaken, which may result in modification to the area of arsenic impacted soil to be risk managed. Finally, the heavily arsenic impacted shallow material will be disposed of within the shafts or open crown pillars. Refer to Section 6.2 for additional information related to the HHERA final report (Golder 2019c).

Monitoring, Maintenance, and Reporting Program

The purpose of post-closure monitoring is to verify the attainment of closure objectives and criteria. Contaminated soils will require limited post-closure monitoring activities. Post-closure monitoring activities associated with the landfarm are discussed in Section 4.3.2.12. The following post-closure monitoring activities will be completed related to contaminated soils:

- **Engineered Cover Monitoring:** An engineered cover will be placed over portions of the Site in order to risk manage arsenic impacted material/soils. In order to confirm that the cover does not deteriorate over time, regular maintenance and monitoring will be required. Annual visual inspections will be completed and documented and maintenance activities will be undertaken if and as needed (e.g., regrading or the placement of additional granular material to repair erosion).

- **Groundwater and Seepage Water Monitoring:** Annual monitoring of seepage water sample network, will be completed and documented to confirm the remedial objectives have been achieved.
- LMI confirmed, in response to CIRNAC TC No. 17, that LMI will examine for, monitor and sample significant seeps from the domed covered waste rock area. LMI will work cooperatively with CIRNAC, ECCC, and interested parties, to define post closure monitoring program.
- LMI proposes to submit within one year of approval of the renewed/amended licence a Post Closure Monitoring Plan as required by the Water Licence 2AM-LUP2032, Part J, Item 13 and Schedule J that incorporates, where appropriate, regulatory review comments, ongoing field work, HHERA results, and any other direction from the NWB.
- For additional information related to the Monitoring and incorporation of HHERA, refer to Section 5.0 and Section 6.2 respectively.

Contingency Program

Should the post-closure monitoring identify a significant deficiency with the engineered cover, a more robust engineered cover could be implemented. This work may include the localized placement of erosion protection over geotextile to minimize erosion/deterioration of cover materials. In addition, should the groundwater and seepage water monitoring program identify that the remedial objectives were not being achieved, additional ex-situ remedial excavation would likely be required. LMI confirmed that the results of the HHERA for the closure scenario and associated pathways indicated that the remediation and risk management measures outlined in the FCRP with respect to contaminated soils were considered sufficient to address potential risks to human and ecological receptors. LMI may propose additional reasonable and practical adaptive management strategies (i.e., applicable monitoring (FCRP, Table 18)) and/or additional remediation measures may be implemented in response to CIRNAC TC No. 18.

Costs

An estimate of the costs associated with the closure and reclamation of contaminated soils was previously presented in the Closure Cost Update provided in October 2017 (Golder 2017b). The current plan for dealing with contaminated soils will have the effect of reducing the costs, due to several factors:

- It is no longer planned to construct additional landfarm cells to bioremediate PHC contaminated soils; rather the excavated soils will be disposed of in open crown pillars for isolation; and
- The costs of disposing of excavated PHC contaminated soils into the open crown pillars will be less than managing them in landfarm cells.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.4 Underground Workings

Reclamation Objectives and Closure Criteria

The reclamation objectives for the underground workings include the following:

- Backfilling underground and surface expression voids with materials including waste rock resulting from mining operations, contaminated soils (as discussed in Section 4.3.2.3) and hydrocarbon contaminated soils that are unable to be treated by ex-situ remediation with landfarming.

- To collapse or fill any remaining crown pillar voids to reduce the risk of geotechnical instability following permanent closure.
- To ensure that all openings to surface (i.e., the shaft, ventilation raises and the ramp portal) are backfilled or sealed off to prevent access to underground.
- To place a final cover over the crown pillar and sealed areas.
- To grade the areas over the crown pillars and sealed areas to avoid ponding and to conform with surrounding landforms.

The permanent closure criteria will be met when all underground access points and related surface voids and expressions are filled and graded for geotechnical stability and long-term safety for humans and wildlife.

Post-Closure Reclamation Options

Waste-rock from surface will be placed above the backfilled surface voids to form a free draining surface which is graded to conform to surrounding landforms. Additional fill will be placed to account for potential post-closure subsidence. Finally, a 1 m layer of esker material will be placed on top of the waste rock surface to form the final cover. Post-closure geotechnical monitoring will include observations on landform stability and drainage and, if required, recommendations will be made for repairs.

Northern Considerations

The northern climate will result in a limited work season and the inability to execute materials handling and underground disposal work year-round. If required, dewatering activities will be staged to align with the work to be completed per work season.

As discussed in Section 1.2, the Site is located approximately 400 km north of Yellowknife, NWT and can only be accessed by aircraft or winter roads. Post-closure monitoring and the ability to perform repairs will additionally be impacted by the seasonality of the site access and work season.

Listing and Assessment of Possible Reclamation Activities

Two options were considered for underground disposal of site waste materials and equipment, heavily arsenic impacted material and hydrocarbon contaminated soils that are unable to be treated by ex-situ remediation with landfarming. These include:

- **Ramp Access Disposal:** Disposal of materials in the underground workings by re-accessing the underground workings through the ramp. This would involve working through the historically noted ramp ice plug. This approach would involve examining and stabilizing the underground workings for safety, dewatering the required areas for disposal, rehabilitating the ventilation system and using site equipment to haul materials underground.
- **Surface Access Disposal:** Re-access the underground workings from surface through open stopes, open shafts and collapsed crown pillars. All surface expressions of the underground workings and collapsed crown pillars would be filled to surface, crowned and capped with materials to account for subsidence and to facilitate post-closure surface water drainage.

Selection of Preferred Reclamation Activities

In late 2005 - early 2006, Kinross applied to dispose of contaminated soils in the open stope in the West Zone portion of the Lupin orebody, as shown on Figure 12. Plan explanations (Kinross, 2006b) and responses to information requests (Kinross, 2006a) were submitted in August 2006. The open stope to the West Zone 87 Level varies in width between 2.0 and 4.0 m. The stope is open to the surface in two locations, and three additional surface pits approximately 7.0 m deep were developed in the West Zone crown pillar (approximately 17 to 20 m thick). This plan projected dumping into the two openings, developing three drop raises in the longest surface pit to access the open portion of the stope, and then filling the remaining pits. The plan projected 44,750 m^3 of contaminated material could be stored in these areas with voids projected in the upper level of the open stope due to angle of repose of the stored material.

For the FCRP, it is proposed to modify the previous plan for the West Zone disposal as shown on Figure 14. The modified plan would address the void areas and increase the storage capacity. Instead of developing additional drop raises in the remaining crown pillar for disposal, the new plan would be to blast down the remaining crown pillar, creating an open slope trench approximately 260 m in length and approximately 72 m deep. The bank volume of the remaining crown pillar is approximately 9,250 m^3. Assuming a 20% swell of this material, the West Zone open stope would have approximately 11,100 m^3 of crown material collapsed into the void. Using the projected material volumes from the 2006 Kinross underground storage plan, an average stope width of 3.5 m is projected. The new void combining stope areas 2, 3, 4, and 5 (from the 2006 Kinross plan) is projected to contain approximately 66,266 m^3, plus the volume in Area 1 (open to the 27 Level) of approximately 4,000 m^3 when filled to the surface, minus the 11,100m^3 of crown pillar swelled material, for a projected total area of 59,166 m^3 for the disposal of contaminated soil, waste rock and building materials. This updated plan provides 14,400 m^3 of additional storage, removes the large void areas under the remaining crown pillar, and effectively stabilizes the West Zone crown pillar.

Additional openings available for material storage include the mine haulage hoist shaft, fresh air raise, and the exhaust raise. The mine description from historic reports includes these three shafts. The hoisting shaft being 3.4 m by 3.4 m developed to a depth of 1,210 m. The fresh air raise being a 3.0 m diameter raised from the 890 Level to the surface from a ventilation drift in most of the upper haulage levels. This fresh air raise is projected to have 630 m available for disposal material. The exhaust raise being 3.4 m by 3.4 m developed in raises from the 890 Level to the surface from a ventilation drift in most of the upper haulage levels. The exhaust raise is mostly vertical from the 87 Level to the surface and angled in the range of 64° to 77° in the levels from the 650 level to the 87 Level, where availability for material disposal is likely from the surface for approximately 595 m down to the 650 Level. The extent of internal shaft support structures is not detailed for a more accurate estimation of potential storage capacity, so a conservative projection is estimated to be 80% of the shaft volume. The projected outer wall volume of the shaft and raises accessible from surface is approximately 19,873 m^3; projecting an 80% storage factor conservatively lowers the shaft and raise storage of soils and building materials to 15,900 m^3.

The combined underground disposal for the West Zone stope, the haulage shaft, the fresh air raise, and exhaust raise totals approximately 75,066 m^3 of underground storage volume.

Requirements to collapse the West Zone crown pillar include the pumping of water contained in the crown pillar surface pits. Pits 2, 4, and 5 are projected to contain approximately 5,250 m^3 of water. The quality of this water will be sampled, and then it will either be returned to the mine void via the main haulage shaft or exhaust shaft, or

pumped to the Upper Sewage Lake as per water licence conditions. Discharge to the environment as a contingency if water quality meets acceptable discharge criteria may be considered.

Explosives required to collapse the West Zone crown pillar were projected based on a 2.56 specific gravity (SG) ore body crown pillar and a powder factor of 0.44 (kg/tonne) to determine the kilograms (kg) of explosives required. Approximately 9,260 m^3 of West Zone crown pillar volume was estimated from the 2006 Kinross underground storage plan and the back calculation of stope width based on the area of the projected backfill volumes. The projected explosives required are approximately 10,400 kg to collapse the West Zone crown pillar.

Capping material required to cover the West Zone newly opened and backfilled stope will require approximately 3,300 m^3 of waste rock fill to prepare a 1.5 m thick mound over the backfill material in the stope with 3:1 side slopes. The waste rock fill will be covered with an additional 1.0 m of esker, requiring approximately 6,200 m^3. The final cover will be graded to a minimum of 2% slope to shed runoff, to avoid ponding and to conform to the surrounding landforms

Synthesis of Preferred Activities into a Reclamation Plan

The remaining West Zone crown pillar will be collapsed to provide additional disposal capacity and to prevent future post-closure stability problems. The main haulage shaft, fresh air raise, and the exhaust raise will be completely backfilled to prevent access. Site materials and equipment, waste rock, and hydrocarbon contaminated soils will be disposed of in these areas.

To prevent future access to people and wildlife, a 10 m long plug of rock fill will be placed in the adit and portal area. The areas above the shaft and raises, and all remaining surface expressions of the underground workings, (including the portal area depression if additional backfill material is needed), will be backfilled to above grade with waste-rock from surface and then capped with esker material.

Mobile equipment from the former mining operation was left underground. Any hazardous materials (e.g., batteries, fuel, lubricants etc.) were removed from the mine for disposal when the mine entered care and maintenance in 2006.

Management and Accountability Structure

As part of the underground disposal activities, a QA/QC program will be implemented. The purpose of the QA/QC program will be to verify that the disposal activities are implemented as planned. The scope of the QA/QC program will be developed prior to implementing the underground disposal activities; however, it is anticipated that it will generally include the following tasks:

- Monitoring the disposal of the PHC impacted soil and contaminated soil (Refer to Section 4.3.2.3) into the underground workings
- Monitoring the placement and grading of the waste rock to form the mounds over the backfilled crown pillar or surface openings
- Monitoring the placement and grading of the engineered cover over backfilled areas
- Documenting the results of the remedial works, along with the QA/QC program, in a report

Uncertainties and Information Needs

The current water levels within the West Zone pits and the chemistry of the water is not known at this time. It is therefore not known if the water could be displaced to surface. The water levels and chemistry will be confirmed once crews are on-site to execute FCRP activities to confirm the water management plan. The water levels within the open shafts will additionally be measured relative to the levels in the areas to be dewatered, to confirm that the water can be transferred to the underground workings.

The actual volume of waste rock, contaminated soils requiring underground disposal and the volume of building and site waste materials is uncertain and will require field confirmation. However, a contingency allowance has been developed within the various disposal strategies, including underground, in order to accommodate additional materials. In addition, estimates for swell, compaction and void space have resulted in an assumed fill factor of 80% when placing materials underground.

Underground disposal capacity volume estimates are based on historical mine plans and Lupin Mines reports that have not been independently verified. These reports indicate that lower portions of the stopes have likely accumulated bridged material; however it is uncertain at what depth and volume. Disposal volume uncertainties have been factored into the disposal plans.

Monitoring, Maintenance, and Reporting Program

Geotechnical visual inspections will continue for a period of 3 years to ensure that the caps and fill materials remain in satisfactory condition and continue to effectively shed water.

Contingency Program

Mine water will be managed so that it is not displaced to surface and allowed to runoff overland. If necessary, the crown pillar depression will be pumped down sufficiently before waste materials are placed. This would involve pumping water out of the crown pillar to be transferred into one of the shafts.

During the regulatory review process, CIRNAC requested clarification on contingency programs related to underground workings.

LMI confirmed:

- Runoff water ponds each spring in several of the perched crown pillar slots and it will be necessary to remove this water before blasting and backfilling begins. This water will be pumped into the shaft and LMI will measure the depth of the water in the shaft in the summer of 2019 to confirm its assumed capacity for this relatively small volume of water (compared to the expanse of the underground workings and stabilized groundwater level). If required, this water will be pumped to the sewage lagoon, as currently licensed, or discharged to the environment. Consistent with Part E, Item 12 of the previous water licence 2AM-LUP1520, which states the Licensee shall discharge all minewater to the Tailings Containment Area or to the Sewage Lakes Disposal Facilities, unless otherwise approved by the Board in writing. (CIRNAC TC No.19)
- It was observed in 2019 that the water level in the shaft was more than 50 m below the water level in Contwoyto Lake and that the shaft was not ice plugged. Further evidence of this is that each summer, steam is noted rising out of the portal and LMI personnel were underground in the portal in 2013 and found no evidence of ice close to surface. (CIRNAC TC No.19)

Costs

An estimate of the costs associated with the closure and reclamation of underground workings was previously presented in the Closure Cost Update provided in October 2017 (Golder 2017b). The current plan for the underground workings will result in changes to the previous cost estimate as follows:

- Rather than constructing concrete caps in the shaft and raises as previously proposed, these openings will now be backfilled to above grade with waste rock and then covered with 1.0 m of esker material. This will reduce the costs.
- The previous cost estimate did not allow for the blasting down of the crown pillars. The costs will increase to cover the drilling and blasting of West Zone crown pillar rock. The blasting volume is estimated to be about 9,250 m^3. This will increase the costs.
- It may, as a contingency, become necessary to pump water out of the crown pillars prior to placing waste. This could involve costs for pumping the water into the shaft.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.5 Borrow/Quarry

Project Description

The various borrow and quarry facilities are described in Section 2.3.2. The Finger Lakes esker borrow area is the largest area that has been disturbed by borrowing activities, and this area will increase in size due to its future use for the implementation of closure measures. The other borrow areas within the TCA area are small and they have been inactive for a number of years. The two existing bedrock quarry areas are small and inactive and there are no plans to use these areas further during closure implementation.

Typical gradation limits of the esker material are as follows: 25 to 50% gravel size, 47 to 68% sand size and 2 to 6% silt sized (Holubec 2005). Golder (2004) provides additional data on the characterization of the esker materials (i.e., geochemistry and grain size). (CIRNAC TC No.13)

Reclamation Objectives and Closure Criteria

The objectives for reclamation of the borrow and quarry areas are: to establish physical stability, to remove hazards to wildlife, and to encourage the eventual restoration of natural habitat.

Northern Considerations

Ponding in borrow areas should be avoided because it could result in degradation of the permafrost in the underlying soils. Near vertical slopes in bedrock quarries could present a hazard to caribou, so these slopes should be flattened. Considerations regarding revegetation are discussed in Section 4.3.2.2.

Listing and Assessment of Possible Reclamation Activities

The reclamation activities for borrow areas and quarries are a matter of implementing standard good practice (i.e., *Northern Land Use Guidelines for Pits and Quarries)* (INAC, 2009*)*. Section 4.3.2.2 discusses the possible approaches to revegetation in the harsh barren lands environment.

Synthesis of Preferred Activities into a Reclamation Plan

After completion of restoration plans at the mine and tailings impoundment, the final contour of the esker borrow areas will be regraded to be compatible with the natural topography and to control potential erosion through sloping. The bases of the borrow areas will be graded so that they do not pond water. The surfaces will be 'roughed' with dozer cleats or otherwise scarified to enhance the natural re-establishment of indigenous vegetation.

For the small bedrock quarries, excavators will be used to make the backslopes gentler. This will involve mechanically pulling down loose rock off the backslopes and arranging it in the bottom of the quarries. Because these areas are bedrock outcrops, there will be no need to encourage revegetation.

Management and Accountability Structure

Earthworks contractors who are using the borrow areas, for example to complete the gravel covers in the TCA and mill areas, will be required to regrade the borrow area at the end of their contract. This requirement will be written into the project specifications, and compliance will be verified as part of the contract completion inspection.

Monitoring, Maintenance, and Reporting Program

It is possible that and concentrated surface runoff could result in localized erosion of the regraded surface in the borrow areas. As part of post-closure site inspections, the former borrow areas will be inspected. Observations will be included in the general inspection report.

Contingency Program

If, during post-closure inspections, minor erosion features are observed, these will be repaired, for example by back blading with a dozer. If more severe or persistent erosion features are noted, then appropriate repairs will be implemented, such as redirection of runoff by constructing berms and swales, localized placement of rip rap, etc.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) did not include any specific allowance for the reclamation of borrow and quarry areas. A cost allowance for this work will be added in a future estimate. These costs are expected to be small because, as discussed above, contractors using the borrow areas will be required to regrade the pits at the end of their usage.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.6 Open (Crown Pillar) Mine Workings

The discussion of Open Mine Workings has been integrated into Section 4.3.2.4.

4.3.2.7 Waste Rock

Project Description

As discussed in Section 2.3.3, about 1,000,000 m^3 of waste rock was brought up from underground during mining and most of this rock was used for construction of pads around the mine and mill area. Mine operations did not produce any stockpiles of overburden or unprocessed low grade ore.

The geochemical characterization of the waste rock is discussed in Section 2.2.2. Geochemical testing to date indicates that approximately 67% of the combined (2006 and 2017) waste rock dataset are classified as PAG. The PAG samples were not concentrated in one area; rather, the PAG samples were distributed throughout the site. In addition, much of the sulphur present in the waste rock was in the form of sulphate rather than sulphide, indicating that oxidation of the waste rock was well advanced.

At the TM/PHC, LMI committed to provide a preliminary design level explanation of waste rock storage “Dome” design (including typical cross section, seepage topography, geochemistry, and stormwater drainage estimates) (TM Commitment No.5). Refer to the Technical Memorandum in Appendix H-8 regarding Conceptual Design for the Waste Rock “Dome” at Lupin Mine for response to TM/PHC Commitment No.5. (Golder, 2019d).

For additional information related to Geochemical source term and load model for seepage from the waste rock storage “Dome” refer to Appendix H-5 and Coupled Thermal Seepage Modelling for Performance Evaluation of the Esker Cover for the Waste Rock “Dome” at Lupin Mine (Golder 2019b) refer to Appendix H-6.

For additional information related to geochemistry and ARD/ML potential refer to Sections 2.1.8 and Section 4.3.2.1, respectively.

Objectives Reclamation Objectives and Closure Criteria

Given the advanced state of oxidation of the waste rock, the main objective of the reclamation should be to limit the contact between the waste rock and surface runoff (as opposed to limiting oxygen flux to the waste rock)**.**

Northern Considerations

Given the deep permafrost conditions at the Site, materials (including waste rock) that are placed into the mine workings through the shafts or open crown pillars can be expected to freeze back. Once they are frozen, there will be little or no interaction with surface water or groundwater.

Waste rock that is left in place, and waste rock that is placed in the landfill(s) will remain frozen for most of the year. By the end of each summer, the thaw depth will extend through the 1.0 m thick esker cover. Nonetheless, most of the surface runoff will occur around the time of the spring freshet, while the cover is still at least partially frozen. With grading for positive drainage, the amount of infiltration through the cover will be small.

Listing and Assessment of Possible Reclamation Activities

The objective of limiting the contact between waste rock and surface runoff can be achieved by relocating the waste rock into the shafts or open crown pillar voids. Such backfilling would not only isolate the waste rock, but it would also serve to infill and stabilize the crown pillars and open stopes.

The space that can be made available in the crown pillar voids is however insufficient to accommodate the estimated 1,000,000 m^3 of waste rock. The realistic options for the remainder of the waste rock are as follows:

- To relocate it to the landfill(s) where it would later be covered by 1.0 m of esker material; or
- To leave it in place, where it would be contoured to shed water and covered with a 1.0 m layer of esker material.

Selection of Preferred Reclamation Activities

There is not sufficient space available in the shafts and open crown pillars to accommodate all of the remaining waste rock. An adequate degree of isolation can be achieved by covering the waste rock in place or placing it into the landfill(s) and covering it there.

Synthesis of Preferred Activities into a Reclamation Plan

The waste rock pads that are on surface in the mine and mill area will be remediated as follows:

- As shown on Figure 10 the waste rock will be removed from some areas (generally around the perimeter of the mine mill area). The waste rock will be excavated, transported and then some of the excavated waste rock will be disposed of into the shafts, open crown pillars or the landfill. The remainder of the excavated waste rock will be relocated into the central area and used the grade the surface of the waste rock that is being left in place. Waste rock placed into the landfill(s) will be covered by at least 1.0 m of esker material. The 1.0 m esker material cover will also be placed on top of any waste rock that is used to infill tops of the open crown pillars, and also on top of any rock that is left in place in the central areas. Waste rock which is not removed will be left in place, general in the central areas. The surface of the waste rock will be contoured to drain freely and then it will be capped with 1.0 m cover of esker material.

The general intention is to remove the waste rock from the perimeter areas where it is thin (i.e., typically 1.0 m or less) and to leave thicker deposits in place. In some cases, it may be expedient to consolidate “islands” of thicker waste rock into the central covered area.

Section 4.3.2.3, includes a provision to excavate an estimated 16,300 m^3 of material which has been classified as heavily arsenic impacted (i.e., arsenic concentrations greater than 4,000 mg/kg).and to dispose of it into the shafts or open crown pillars. These impacted areas will generally occur within the central waste rock area, and will likely involve soil and waste rock that are inter-mixed. In such a case, the two activities (i.e. contaminated soil cleanup and waste rock management) will be integrated. Once the excavation is completed, the area will be brought up to the desired final grade by relocating and regrading local waste rock. Then the regraded area will be capped with a total of 1.0 m esker material cover.

Management and Accountability Structure

Engineering drawings and specifications will be prepared to control the waste rock management activities. The contractor will be required to comply with these.

Uncertainties and Information Needs

The best estimate for the volume of waste rock is about 1,000,000 m^3; however this is uncertain. The in place density and final volume of the waste rock in the open crown pillars is also uncertain. These uncertainties in the mass balance can be dealt with by designing flexibility into the final grading plan for the Site.

Monitoring, Maintenance, and Reporting Program

A QA/QC program will be implemented to verify that the relocation, regrading and covering of the waste rock are implemented as planned. The scope of the QA/QC program will be developed prior to implementing the remedial activities; however, it is anticipated that it will generally include the following tasks:

- Monitoring the complete removal of waste rock from the applicable areas
- Monitoring the placement of waste rock into the shafts, open crown pillars or landfill(s) to the correct grade
- Monitoring the final grading of the waste rock that is left in place to ensure proper drainage
- Monitoring the placement of the esker material cover with respect to thickness, gradation and compaction

Contingency Program

The area for waste rock removal shown on Figure 10 is only an estimate. The actual boundary will be established in the field based on the actual thicknesses of waste rock that are encountered. Similarly, the actual volume of waste rock is uncertain. This can be accommodated by adjusting the final grading plan for the waste rock left in place, while still providing for positive drainage.

LMI confirmed, in response to CIRNAC TC No. 22, the cover will be a dome which will be contoured to shed water. The preliminary estimate of the covered area is 30 ha. The waste rock is from underground and it is relatively fine grained. It is expected to have a relatively closed surface after final grading, so the loss of fines from the cover into the rock will be minor. In any case, LMI proposes a minimum 1.0 m cover thickness after placement of waste rock, so any loss of fines will be inherently corrected during construction.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for relocation of waste rock, for grading material that is left in place and for capping with esker material. These allowances are consistent with the approach described in this FCRP.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.8 Tailings Impoundment and Containment Systems

Project Description

As described in Sections 3.2.1 and 3.3.1, the tailings from Lupin ore processing operations were deposited within a number of cells in the Lupin TCA. In accordance with the approved TCA 2004 Final Abandonment and Restoration Plan (Final TCA ARP) (Kinross 2005), as of the end of the 2017 construction season, a 1.0 m esker material cover had been completed over approximately 1,311,500 m^2 of the exposed tailings. As of the end of 2017, there remains approximately 123,500 m^2 of exposed tailings in Cell 5 and 86,000 m^2 in Cell 3. LMI intends to complete the placement of the cover by the end of the summer of 2019 as part of the approved Care and Maintenance activities.

Several other actions are required to complete the permanent closure of the TCA. These include the permanent closure Water Management actions described in Section 4.3.2.13, treating and releasing water to permanently lower the water levels in Pond 1, Pond 2 and Cell 4, removing siphons and culverts, completing tailings cover in accordance with approved plan, where necessary repairing and maintaining existing dams, and constructing permanent open channel spillways through Dam 1A and J Dam to re-establish natural drainage through the TCA

watershed. It is possible that lowering the water levels may expose small beaches of tailings below the former water level. The newly exposed areas will be examined and if any tailings are exposed, they will either be covered in place with a 1.0 m esker material cover, or they will be picked up and transported to another location in the TCA which will eventually be covered. The geotechnical stability of all dams will continue to be accessed and where required, for example on the downstream side of Dam 4, minor grading, rip-rap placement and backfilling may occur in response to recommendations provided by the TCA engineer of record. While the closure water elevations have been designed to remain above placed tailings (Kinross 2005), additional volumes of esker cover will be available to account for any minor topographic highs or residual exposed tailings. A study conducted to assess the presence of recent windblown tailings adjacent to the TCA detected no deposition of tailings material on surface (SRK 2015), however if any are identified, they will be similarly covered with esker materials.

LMI clarified, in response to CIRNAC TC No. 23, that whether the exposed tailings will be relocated or covered with esker materials will be determined by the location, thickness, and lateral extent of the exposed tailings, and operational challenges. If esker cover is deemed practical, the esker will be placed at a sufficient thickness and assessed on a case by case basis with the objective to minimizing impact to the environment.

At the TM/PHC, LMI committed to provide a decision matrix/tree that determines how exposed tailings will be handled on a case by case basis when lowering the water level in the TCA (TM/PHC Commitment No. 8). Refer to the Technical Memorandum in Appendix H-10 regarding Exposed Contaminants at Closure Water Levels for response to TM/PHC Commitment No.8. (Stantec, 2019d).

For additional information regarding water management systems at the TCA (i.e., spillways, etc.) refer to Section 4.3.2.13.

Post-Closure Reclamation Options

The closure options for the TCA have already been identified and considered. The initial Lupin Mine TCA Abandonment and Restoration plan, submitted in 2004, contemplated encapsulating the tailings within permafrost upon closure of the mine. The subsequent and currently approved Final TCA ARP (Kinross 2005) modified the tailings ARD mitigation strategy to encapsulation beneath a partially saturated granular cover. The detailed rationale for the selection is presented in a report titled Closure Plan for Lupin Tailings Containment Area, completed by Igor Holubec Consulting (Holubec 2005); included as Appendix 2 in the Final TCA ARP.

Following technical review with stakeholders LMI provided responses and the final TCA ARP was approved by the Board on August 19, 2015 on issuance of the Water Licence. (Refer to Part I, Item 1, b).

Synthesis of Preferred Activities into a Reclamation Plan

The key features of the Final TCA ARP partially saturated granular cover design are summarized below:

- A basal saturated layer of esker material that inhibits oxidation of the underlying tailings by limiting the oxygen flux through the saturated zone.
- A surface layer that restricts the rate of evaporation of the saturated esker and tailings materials.

The details of the many investigations in support of the saturated zone cover design are contained in the Final TCA ARP (Kinross 2005) and Closure Plan for Lupin Tailings Containment Area (Holubec 2005) reports.

The initial tailings cover program started in 1988. As summarized in Sections 3.2.1 and 3.3.1, much of the reclamation of the TCA has already been completed as Progressive Reclamation or Post-Operational activities.

TCA activities for permanent closure that still need to be completed include:

- Removal of the tailings pipeline and disposal in the landfill
- Examine the emergency dump pond area to see if any tailings are still present. If so, remove the tailings and transport them to the TCA in an area to be covered
- Complete the covering of the remaining exposed tailings with the 1.0 m esker material cover
- Inspect to see if any small areas of tailings are exposed when the water levels are lowered. If so, either cover the tailings in place or move them to locations which will eventually be covered
- Demolish the treatment plant and dispose of the debris in the landfill
- Install additional instrumentation to complete the permanent monitoring system

Management and Accountability Structure

As part of the TCA closure activities, a QA/QC program will be implemented. The purpose of the QA/QC program will be to verify that the Final TCA ARP closure activities are implemented as planned. The scope of the QA/QC program will be developed prior to implementing the TCA closure activities; however, it is anticipated that it will generally include the following tasks:

- Monitoring the performance of the tailings cover using the existing instrumentation together with new instruments to be installed in 2018
- Continued implementation of Care and Maintenance QA/QC procedures to ensure the cover is constructed according to the Final TCA ARP, which includes construction spot checks and survey controls
- Inspection and monitoring of the existing instruments to ensure the tailings dams are performing according to the Final TCA ARP
- Monitoring of TCA contained water prior to discharge to the environment.

Monitoring, Maintenance, and Reporting Program

LMI collected data during mine operations to monitor the tailings cover performance. The collected data included ground temperatures, water levels within the cover, water quality within the cover, slopes of the tailings surfaces, thicknesses of tailings deposition, moisture contents of the cover materials, and particle size analyses of the tailings and cover materials. During the Care and Maintenance period, TCA monitoring activities, as described in Section 3.2.1, were carried out appropriate to the resources and time available on-site.

The thermistors are currently being monitored in the summer months during maintenance activities and during the annual TCA geotechnical dam safety inspections; current to 2017.

As outlined in Section 5.0, Phase 1 Active Closure Period monitoring will include installation of new thermistors and soil moisture and temperature probes in 2018 and TCA monitoring will be carried out for a period of 2.5 years, as follows:

- All thermistors will be read monthly

- Discharge water quality monitoring will be in accordance with water licence requirements
- As observed during the most recent annual dam safety inspection (Norwest 2017a), the thermistors indicate that the frozen cores of the dams are intact and performing in a satisfactory condition. Groundwater seepage is not anticipated under permafrost conditions. LMI will complete a one-time geophysical survey along selected dams to confirm the lateral condition of the frozen cores. The existing thermistors could be paired with soil moisture sensors (discussed below), which would indicate any potential seepage to the environment;
- Soil moisture sensors will be installed in the tailings cover to provide additional monitoring of the saturation level and groundwater quality above the permafrost within the cover. The sensors will measure volumetric water content, ground temperature, pH, and electrical conductivity. Multiple sensors will be installed in a string at different depths and paired with data loggers for daily measurement collection. Porewater samples will be collected during initial installation to correlate key water quality parameters with the collected data. The sensor will allow the determination of the depth of the saturation zone and the porewater water quality (i.e., pH and conductivity) above the permafrost within the cover. Qualified personnel will review the soil sensor data to monitor the cover performance; and
- The existing groundwater monitoring pipes will be evaluated to determine their existing condition and their performance in 2018. If these pipes are in satisfactory condition, groundwater sampling and quality monitoring will be carried out monthly during site activities. However, if the pipes are deemed in non-satisfactory condition, they will be decommissioned.

During the regulatory review process, ECCC and CIRNAC requested LMI consider and/or requested clarification on:

- conducting field investigations during the Closure Phase to obtain updated data on the behavior and effectiveness of the saturated cover design. (ECCC TC No. 2)
- the stability and potential for seepage for perimeter dams given the likelihood of the frozen cores thawing due to climate change; potential changes to the physical configuration of the dams in the future as a result of climate change; and a report of the survey of the frozen cores of the dams be provided to the Board, and that it include discussion of any implications at closure. (ECCC TC No.3)
- the Post-Closure monitoring activities and duration and recommended monitoring of the TCA cover and water be done over a period sufficient to demonstrate physical and chemical stability for the long term. (ECCC TC No. 4)
- Level of thermal monitoring units to be installed to address future monitoring requirements for both the TCA and waste rock areas. (CIRNAC TC No. 33)

In response, LMI acknowledged and agreed with the historical record of significant work on site completed to evaluate cover performance and further confirmed:

- There is site monitoring in progress with thermistors and moisture meters in place (see Table 20 and Figure 5). During the active closure phase LMI has installed (in 2018) moisture meters and will excavate a test pit in Cell 1 to conduct a visual inspection of the cover and evaluate its performance. Transducers will also be installed within existing standpipes to collect data on water level variations within the cover for performance evaluation. (ECCC TC No. 2)

- The geotechnical engineer of record has recommended that this invasive investigation (i.e., a test pit) be done at a minimum to limit disturbance to the existing cover and minimize cross contamination from tailings excavation. (ECCC TC No. 2)
- The full list of TCA installed thermistors, including past and future monitoring frequencies, are included in Table 20: Existing and Future Instrumentation Monitoring. This table includes their locations, which are also shown in Figure 5 TCA. (CIRNAC TC No. 33)
- Thermistors have been monitored since 1988 and the site's geotechnical engineer of record has confirmed that existing thermistors installed within the TCA are sufficient. During the active closure phase (2018) LMI has installed moisture meters and will excavate a test pit in Cell 1 to conduct a visual inspection of the cover and evaluate its performance. Transducers will also be installed within existing standpipes to collect data on water level variations within the cover for continued performance evaluation. The geotechnical engineer of record has recommended that this invasive investigation (i.e., a test pit) be done at a minimum to limit disturbance to the existing cover and minimize cross contamination from tailings excavation. An instrumentation system will also be proposed for the cover of the waste rock. (CIRNAC TC No. 33)
- For additional information on duration of permanent monitoring and timing refer to Section 5.0 (ECCC TC No.4)

Further, with respect to perimeter dams, LMI confirmed:

- The dam stability will be assessed individually as needed depending the final closure configuration and reinforced as directed by the geotechnical engineer of record. Once the pond levels are lowered to the closure level, the majority of the external dams will no longer be considered as a dam structures as they will no longer holdback water or tailings. These will then be considered as overland structure and their stability is not a concern. (CIRNAC TC No. 23)
- Based on historical record for the dams; the dams are constructed from compacted granular material hence the relative ice content within the dams is expected to be low and therefore the physical deformation of the dams due to climate change is deemed insignificant. As majority of the perimeter dams will not be water-retaining structure at closure due to pond drawdowns, the climate change impact on potential seepage is also deemed negligible. (ECCC TC No. 3)
- LMI is currently investigating options for conducting a one-time survey to potentially assess the condition of the frozen core within a dam as reference. There are uncertainties on accuracy on detecting the froze core within the compacted dam material. Details will be discussed with specialized vendors on appropriate method(s). Consistent with recommendations made under ECCC 2 response, the geotechnical engineer of record recommends drilling into frozen core should only be considered as last resort due to the considerable risk on degrading the core of the dams. (ECCC TC No. 3)

At the TM/PHC, LMI committed to:

- One-time inspection (test pit) to "ground truth" the status of the cover nearby one of the installed standpipes (note: water quality data will be collected from all standpipes and presented in the context of historical water quality data from the standpipe information). (TM/PHC Commitment No. 10). Refer to the Technical

Memorandum in Appendix H-9 regarding Cover Data from Lupin Mine Tailings Containment Area for response to TM/PHC Commitment No.10. (Stantec, 2019e).

- One-time geophysical survey conducted along two selected dams to confirm the condition of frozen cores. (TM/PHC Commitment No. 11). Refer to Technical Memorandum in Appendix H-11 regarding Geophysical Survey Lupin Mine Tailings Containment Area Dams for response to TM/PHC Commitment No. 11 (Stantec, 2019f); and
- Risk assessment of the two dams selected under TM/PHC Commitment No. 11, based on the results of the thermal modelling (refer to Appendix H-6), and representing both perimeter and internal dam types (TM/PHC Commitment No. 12). Refer to Technical Memorandum in Appendix H-12 regarding Risk Assessment on Two Dams in the Lupin Tailings Containment Area for response to TM/PHC Commitment No. 12 (Stantec, 2019g);

For additional information related to climate change modelling refer to Section 2.1.2.

Uncertainties and Information Needs

As shown on Figure 5, there are a number of areas within Cells 1, 2, 3 and 5 which are labelled as “Tundra”. It is understood that there are no tailings in these areas of exposed tundra; therefore it is not necessary to construct the cover over them. While the closure water elevations have been designed to remain above placed tailings (Kinross 2005), it is possible that lowering the water level in Cell 4 may expose small beaches of tailings or topographic highs. No tailings have been placed in Pond 1 or Pone 2, however all tundra and newly exposed areas will be examined and if any tailings are exposed, they will either be covered in place with a 1.0 m esker material cover, or they will be picked up and transported to another location in the TCA which will eventually be covered.

A study conducted to assess the presence of recent windblown tailings adjacent to the TCA detected no deposition of tailings material on surface (SRK 2015), however if any are identified, they will be similarly covered with esker materials.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for all of the closure measures listed above, except for the cleanup of the emergency dump pond, should this be found to be necessary. These allowances are consistent with the approach described in this FCRP.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.9 Buildings and Equipment

Reclamation Objectives and Closure Criteria

The goal of specific restoration practices is to minimize, or preferably eliminate degradation of disturbed areas and to initiate, encourage and accelerate the natural recovery. All buildings (except as required for ongoing monitoring) will be demolished and the Site will be regraded to resemble the regional terrain.

Post-Closure Reclamation Options

There is equipment in the mill that could, in principle, be re-used at another mine site. Also, there are materials, such as steel, copper and stainless steel that potentially have value as scrap. LMI will support salvage of equipment and recovery of scrap wherever it is economical to do so. Unfortunately, because the Site is so remote,

these opportunities are expected to be limited. Equipment and materials that cannot be economically removed from the Site will be disposed of on-site.

Listing and Assessment of Possible Reclamation Activities

Demolition of the buildings on-site will produce a substantial volume of non-hazardous solid waste. Because of the long winter road access, it would not be feasible to haul this waste material to off-site disposal in Yellowknife, so it must be disposed of on-site. The options for onsite disposal are to deposit the waste into the shafts or open crown pillars or to deposit it into the existing landfill. To provide sufficient capacity, both options will be used together. An esker material cap will be constructed over the landfill(s) and also over the backfilled crown pillars.

Synthesis of Preferred Activities into a Reclamation Plan

Mobile Equipment

Mobile equipment associated with the underground mining activities were previously drained of fluids and left underground. All hazardous waste was removed from the underground workings before the portal was barricaded and locked. The mobile equipment will be left underground.

There is an existing fleet of surface mobile equipment, including: pickup trucks, busses, haul trucks, excavators and dozers. This equipment has been maintained for ongoing use in care and maintenance and it will continue be used to support the active closure measures. Additional mobile equipment will be brought from Ulu Mine to add to this fleet. After active closure is completed, a small subset of this equipment fleet, (possibly just a single excavator, haul truck, and dozer), will be left on-site in case repairs are necessary in the future. All other mobile equipment will be demobilized over the winter road where it is economical to do so. Equipment that cannot be economically demobilized, will be drained of fluids and then disposed of into the shafts, open crown pillars or into the landfill.

Hazardous Building Materials

Golder (2017c) completed a survey of ACM in the buildings on-site. The survey included obtaining and testing 299 samples. ACM was identified in 46 of the samples taken from a number of buildings, mostly in vinyl flooring, duct mastic, window caulking and fire stop. ACM will be removed by a HazMat crew before general demolition proceeds and it will be buried safety in the landfill. Disposal of waste asbestos is specifically permitted under the Waste Management Plan (LMI, 2016b).

As discussed in Section 2.2.1, it was noted that additional common hazardous building materials are likely present. An intrusive hazardous building materials assessment will be completed prior to any demolition activities to properly identify and quantify potentially hidden and additional potential hazardous building materials. These materials will be removed by a HazMat crew before general demolition proceeds. Materials, (such as fluorescent light tubes, ozone depleting substances, etc.), which are not permitted to be disposed in the landfill(s) will be shipped off site for disposal.

Refer to Section 2.1.7 for additional information regarding asbestos disposal.

Mill Complex

The existing buildings and equipment are described in Sections 2.3.5 and 2.3.7.

Following cessation of operations, the mill portion of the complex was given a complete wash down with the intent of gold recovery (visible gold that settles within the system) and removal of any residual contaminants (from

chemical use) to the tailings impoundment. The crusher area was normally washed down on a regular schedule while operating, and a wash down will also be completed prior to demolition.

All equipment and internal components inside the mill will be dismantled and removed from the building. These will either be transported off-site for use at other facilities or sold as scrap where possible. Non-hazardous materials with no practical value as salvage or scrap will either be deposited into a shaft or an open crown pillar or buried in the landfill. The metal frame structure will be dismantled and sold as scrap where possible. Below grade concrete foundations will remain in place. The floor slabs will be punched with a hoe ram and then covered with esker material and contoured to provide positive drainage. All concrete footwalls which interfere with final grading of the soil surface cover will be collapsed.

Paste Backfill Building

Equipment from the former paste plant has already removed for resale or scrap. The steel frame structure has been removed. The residual waste cement has been disposed within the mine workings. The concrete floors and footwalls were left in place and were used in the construction of the landfarm.

Administration/Warehouse

These areas will have all salvageable/hazardous materials removed prior to dismantling. Demolition will take place in a similar fashion to the mill building and all materials that cannot be salvaged or sold as scrap will be disposed of into the open crown pillars or into the landfill.

Power House

The powerhouse facility is now redundant. The emergency power house will remain to provide power requirements during later stages of reclamation. The camp generators located adjacent to the 600 wing of the accommodation buildings will provide sufficient power generation during final closure. An emergency back-up generator for the camp generator is in place during care and maintenance.

Power distribution throughout the site is both above and below ground. Above ground power lines would all be removed for salvage or disposal. Transformers containing low level PCBs were transported off site in 1994. No other oil containing PCB material is known to be present at Lupin.

Maintenance and Shops

All outbuildings will be evacuated, inspected for hazardous materials and dismantled for salvage or disposal. These include the: carpentry shop, surface storage garages, mobile maintenance shop, and warm and cold storage shops.

Explosives Magazine

The explosives storage magazine consists of a steel frame/metal clad building. During care and maintenance ANFO was removed from the Site. The numerous Sea-Containers used for the storage of stick powder and other blasting products have also been removed from the Site. The former explosives storage magazine will be dismantled.

A new temporary explosives magazine will be set up on-site to support the crown pillar blasting. After that work is completed, any residual blasting products will be removed from site and the new magazine will be cleaned up and dismantled.

Any debris will be disposed of in the shafts, in the open crown pillars or in the landfill.

Accommodation Facilities

The steel frame buildings will be dismantled and the debris will be disposed of in the shafts, open crown pillars or in the landfill.

Arsenic Treatment Facility

The steel frame/metal clad building will be removed from the TCA and disposed of within the surface landfill(s) located at the mine site. All remaining components will be rewashed and salvaged, if economical, or disposed of in the surface landfill.

Fuel Storage

The amount of usable fuel that is required to complete closure is currently available at site in the Main Tank Farm. Any fuel that remains on-site after the completion of closure will be burned. The empty tanks will then be withdrawn from service and disposed of in accordance with the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (2008) under the Canadian Environmental Protection Act.*

As described in Section 2.4.7.8 In 2017, about 500 m^3 of PHC contaminated soil associated with it was placed into the landfarm where it is currently undergoing bioremediation. The treatment comprises volatilization through aeration and bioremediation with nutrient amendments of nitrogen and phosphorus. The Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils (Government of Canada, 2006) will be consulted during the bioremediation process.

The Main Tank Farm area will be stripped of any fuel laden sand to be deposited into the shafts or open crown pillars.

The underlying geomembrane liner material will either be disposed of into the open crown pillars or utilized below a soil cover disposed in the landfill. Foundation material will be surveyed for hydrocarbon contamination. The remainder of the Site would be graded to conform to the surrounding natural topography and to provide positive drainage.

As discussed in Section 2.1.7, approximately 35,200 m^3 of hydrocarbon impacted soil was identified at 13 locations across the Site. These areas comprise historical maintenance, fueling, and fuel storage areas. The development of site-specific soil quality remediation objectives for petroleum hydrocarbons, such as those approved for by the NWB at the Nanisivik Mine in 2015, will be considered (Hemmera 2015). All impacted areas will be remediated according to the Nunavut *Environmental Guideline for Contaminated Site Remediation* (GN, 2009).

In addition to impacted material located within fuel storage areas, any on-site areas identified as impacted during abandonment and restoration (i.e., visible staining due to petroleum spillage) will be remediated according to these same contaminated site remediation guidelines.

Where the results of spills or incidents pose an immediate or ongoing risk to the environment, LMI will employ the *Spill Contingency Plan* and clean up or remediate soils or other species in a timely manner, prior to final reclamation.

Chemical Storage

During operations, the mine site carried an inventory of chemicals which include; cyanide, lime, lead nitrate, zinc dust, flocculants and ferric sulphate in major quantities, together with miscellaneous refinery reagents in much lesser quantities. Except for lime, (which is still used for water treatment), all of these chemicals have since been removed from the site.

The environmental site assessments (Morrow 2006; Golder 2017a) have delineated areas of chemical contamination of soils related to chemical storage and use. Section 4.3.2.3 describes the methods proposed to deal with this contamination.

Tailings Lines

The tailings line has been flushed thoroughly with clean water and then partially dismantled, but left in place. If salvageable, the pipe will be sold and shipped off-site with equipment back haul. If salvage is not viable, the piping will be disposed of in the landfill.

The tailings line foundation will be generally left intact with the exception of areas where drainage is controlled by culverts. The removal of culverts and the backsloping of the openings will ensure that minimal erosion takes place and proper drainage is achieved. Any other areas of water pooling along the tailings lines during spring melt will be opened up to provide unlimited drainage. The management of PAG material in the tailings line foundation and elevated metal concentrations in the adjacent soil will be as described in Section 4.3.2.3.

Management and Accountability Structure

An intrusive survey of hazardous materials will be carried out. Materials that are identified, together with ACM, will be removed for safe disposal by a qualified HazMat contractor.

The demolition of buildings will be carried out by a qualified demolition contractor. LMI will hire an independent supervisor to oversee the demolition process and to verify the proper disposal of the demolition waste.

Uncertainties and Information Needs

The quantities of ACM and other hazardous materials discussed in Section 2.1.7 are estimates only based on the results of the Phase I and Phase II environmental site assessments. The actual quantities will vary. The post-demolition volume of the demolition debris is not known, and it will vary depending on the extent of salvage and scrap removal.

Monitoring, Maintenance, and Reporting Program

The LMI appointed supervisor will oversee the actions of the Hazmat and demolition contractors. He will also document the quantities and disposition of the waste materials. He will also verify that the final granular cover surface meets specifications in terms of: grading, minimum thickness and gradation. The results will be documented in annual Reclamation Completion Reports.

Contingency Program

If the quantity of non-hazardous materials and demolition debris exceeds predicted volumes, the existing solid waste landfill will be extended and/or raised to accommodate the actual volumes, or a Demolition Landfill will be constructed.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for all of the closure measures listed above. These allowances are consistent with the approach described in this FCRP.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.10 Transportation and Infrastructure Support

Reclamation Objectives and Closure Criteria

The main objectives will be to restore the drainage pattern that existed prior to mining activities and to encourage the natural revegetation of transportation and infrastructure components.

Listing and Assessment of Possible Reclamation Activities

It would be possible to remove all fill materials that were placed for the construction of roadways. However, this would make it difficult to access the TCA and the esker borrow area if emergency repairs became necessary at some time in the future. Also, permafrost will have aggraded up into the roadway fills. Removing the roadway fills could result in degradation of the underlying tundra landform.

Synthesis of Preferred Activities into a Reclamation Plan

A considerable amount of roadway exists at the mine with the largest portion being the access to the explosives magazine and the access road to the Fingers Lake esker. The roadways were constructed in part with mine development waste rock. The management of PAG material in the roadways is described in Section 2.1.8. The ESA conducted in 2005 indicated that the median arsenic concentration in the roadways was 136 mg/kg and that the background concentration for the Lupin area was 179 mg/kg (Morrow 2006). Based on the preceding, the site roads will be reclaimed without a soil cover. In order to gain a better understanding of the ecological implications of this reclamation strategy, a risk assessment will be conducted to evaluate the likelihood of adverse ecological/environmental effects occurring based on future use of the property. The risk assessment will be completed during final reclamation and closure planning. Site-specific soil quality remediation objectives for metals would be derived from the ecological risk assessment.

Roadways that are currently active will be generally left intact so that construction equipment could access the TCA and the esker borrow area should emergency repairs become necessary in the future. Future access notwithstanding, culverts will be removed and the resulting openings will be backsloped to ensure that minimal erosion takes place and proper drainage is achieved. Any other areas of water pooling along the roads during spring melt would be opened up to provide unlimited drainage.

The roadways are probably the third most prominent feature change (next to the TCA and Mine Site) at the mine and will remain clearly visible for an indefinite period of time. In order to promote natural growth of vegetation, the road surfaces would be scarified to provide microclimate sites for seed deposition.

The main airstrip will not be removed; however access roads will be cut and backsloped to allow uninhibited drainage along its parallel. All ancillary equipment including signs, marker lights, strobes (associated wiring) and weather station/traffic control building will be dismantled and removed. The major components consisting of the radio beacon VOR (VHF Omni Range) and tower (Non-direction Beacon) will be removed unless other arrangements are made through the appropriate governmental agency.

Freshwater Supply

Upon closure the building, electronics, pumps and approximately 1.5 km of six inch insulated pipeline will be removed and salvaged where possible. The docks, and pumphouse will be removed, however the breakwater and causeway will be left in place due to the increased disturbance that the lake would incur during removal and because of its potential for post-closure use. Non-salvageable materials would be disposed of either into the open crown pillars or in the landfill(s).

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for all of the closure measures discussed above. This includes a provision for a final treatment of 1.786 Mm^3 of pond water.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.11 Landfills and Other Waste Disposal Areas

Project Description

The waste management facilities used at the Site are described in Section 2.3.6, the facilities include: a landfill, an incinerator, two burn pits, a waste oil storage, and a boneyard. There is also a landfarm onsite. The proposed reclamation for the landfarm is provided in Section 4.3.2.12.

The sewage facilities are described in Section 2.3.7.6.

The proposed reclamation for the waste oil storage is provided in Section 4.3.2.9.

For additional information related to asbestos disposal refer to Section 2.1.7.

Reclamation Objectives and Closure Criteria

The objectives for the reclamation of the landfill(s) and other waste disposal areas are: to control erosion, to remove hazards to wildlife, and to encourage the eventual restoration of natural habitat.

The landfill(s) will be covered with inert esker material and graded to promote positive drainage of surface runoff, to prevent water ponding on the surface, to provide erosion control around the perimeter and to prevent future human or animal contact with the covered wastes. If ashes from burned material are encountered elsewhere on the Site, the ashes will be transported and disposed of at the landfill(s) and covered as described.

Listing and Assessment of Possible Reclamation Activities

The reclamation activities for landfill(s) and other waste disposal areas are a matter of implementing standard good practice. Section 4.3.2.2 discusses the possible approaches to revegetation in the harsh barren lands environment.

Synthesis of Preferred Activities into a Reclamation Plan

Sewage Facility

Upon closure of the sewage facilities, the steel pipeline will be flushed with clean water, dismantled and disposed of within the open crown pillars or in the surface landfill(s). The dam structure between the Upper Sewage Lake and the Lower Sewage Lakes will be breached at the culvert location (lowest natural location) and backfilled with rip-rap to provide erosion control. Backslopes in the dam cut will be graded to reduce erosion at the water level. The invert of the spillway will be set so that a small residual pond will remain in the former Upper Sewage Lake in

order to reduce the possible transport of suspended solids. Natural revegetation of the former sewage lakes will be encouraged. A spillway will be constructed in the dam at the Lower Sewage Lake consistent with the spillway constructed for Upper Sewage Lake described above.

Incinerator

The incinerator will continue to be used to incinerate combustible, inert solids during closure and reclamation in accordance with the *Waste Management Plan (Solid and Hazardous)*. Ash from the burning operations will be placed in drums as per current practices and buried in the landfill. The incinerator will be dismantled for salvage or disposed of with other scrap metal. The concrete block building will be dismantled and disposed of on-site.

The burned material (ashes) in the landfill(s) will be covered with 2 m of ash free non-hazardous waste material and finally capped with 1 m of inert esker material. If ashes from burned material are encountered elsewhere on the site, the ashes will be placed in drums, transported and disposed of at the landfill(s) and covered as described.

Landfill(s)

The volume of waste generated by closure, especially building rubble, will exceed the volume that can be disposed of in the landfill with its current footprint. The landfill footprint will therefore be expanded. The landfill will be utilized for waste disposal until closure is near completion. At that time, waste rock will be used to infill any voids in the waste and then more waste rock will be placed on top of the waste to form a stable final surface contour, which is graded to promote positive drainage of surface runoff, to prevent water ponding on the surface, to provide erosion control around the perimeter and to prevent future human or animal contact with the covered wastes. The waste rock cover already placed over the closed areas of the landfill will also be capped with 1 m of inert esker material as some of the waste rock material could be PAG.

With the aim of confining the demolition debris to the smallest practical area which can accommodate the anticipated quantity, while not impacting a presently undisturbed area, a new landfill (Demolition Landfill) is proposed to be constructed within the west end of the Upper Sewage Lagoon. This site is located in a natural basin, is readily accessible, and can be easily monitored. Present water level in the lagoon would be drawn down upon closure through the syphon located at the dike at the east end of the pond, with that water reporting to the Lower Sewage Lagoon. The present sewage capacity of the upper pond is no longer necessary following the cessation of mining and milling operations (and associated personnel in camp), due to the reduced number of people that would be residing in camp for the closure and reclamation activities.

After the water level has been lowered in the upper lagoon, initial deposition of debris would take place from the west end. The advantage of this option is that the sewage lagoon is already a disturbed area, having received waste for the past 24 years. Also, it can be accessed directly from the main haul road to the TCA, thus minimizing disturbance to the surrounding tundra. All non-hazardous demolition debris would be deposited down slope in 2-metre high lifts, compacted by dozers. Additional lifts of debris will then be placed on top, as required. The final lift will be covered by 1.0 metres of esker material, packed and contoured so that water will not pool on the surface.

The burn pits and boneyard areas will be regraded to promote positive drainage of surface runoff.

Management and Accountability Structure

Engineering drawings and technical specifications will be prepared for the final grading of the landfill(s) and for the construction of the landfill covers.

Monitoring, Maintenance, and Reporting Program

As part of post-closure site inspections, the reclaimed areas will be inspected. Observations will be included in the general inspection report.

The landfill(s) do not require a full-time attendant. A landfill inspector will be appointed to undertake periodic inspections of the landfill operations to identify deposition sequencing based on volumes of waste, verify compliance with the *Landfill Management Plan*, including observations of unsuitable materials and corrective actions, wildlife sign, evidence of erosion, ponding or unusual landfill settlement, and adequacy of safety measures.

It is expected that the volume of leachate from the landfill(s) after closure will be small because the grading of the landfill(s) and the use of the esker cover will reduce infiltration. This is particularly so because much of the runoff will occur during the freshet while the bottom part of the granular cover is still frozen. Monitoring requirements for seepage from the landfill(s) are described in the *Liquid Waste Management Plan.*

Contingency Program

If, during post-closure inspections, minor erosion features are observed at the regraded areas and/or landfill covers, these will be repaired, for example by back blading with a dozer. If more severe erosion features are noted, then appropriate repairs will be implemented, such as redirection of runoff by constructing berms and swales, localized placement of rip rap, etc.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for all of the closure measures listed above. These allowances are consistent with the approach described in this FCRP. The current cost estimate includes a lump sum allowance for the operation and capping of the landfill. The next cost estimate will include a more detailed estimate of the landfill(s) closure cost taking into account its increased footprint.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.12 Landfarm

Reclamation Objectives and Closure Criteria

As described in Section 2.3.6, LMI submitted as-built documentation of the pilot landfarm design and operational procedures to the NWB in the summer of 2017, as part of the licence modification requirements. The objective of the pilot landfarm facility is to provide a contained facilities to utilize biological treatment and volatilization to remediate the PHC impacted soils which were removed from the STF in 2017. A secondary objective is to create soil for site maintenance and closure soil cover. The closure criteria for the landfarm treated soil will be met when the soil is sampled and analyzed as compliant with the treatment objectives outlined in the Lupin Water Licence.

Northern Considerations

The harsh climate at the site limits the period of time each year that the bioremediation process is effective. Monitoring is in place to determine when bioremediation will be completed.

Selection of Preferred Reclamation Activities

As discussed in Section 4.3.2.3, the pilot landfarm is currently being used to bioremediate about 500 m^3 of PHC contaminated soil from the STF. The capacity of the existing landfarm is too small to remediate the estimated 35,200 m^3 of PHC contaminated soils in a realistic time frame. It is also impractical to construct enough additional landfarm capacity to bioremediate the PHC contaminated soils within the planned 2 to 3 year closure period. For this reason, PHC contaminated soil will be excavated and moved into the open crown pillar voids for isolation.

Synthesis of Preferred Activities into a Reclamation Plan

The partially remediated PHC impacted soil currently in the pilot landfarm cell will be deposited into the shafts or open crown pillar as discussed in Section 4.3.2.3.

Management and Accountability Structure

A QA/QC program was in place during the construction of the existing pilot landfarm. Norwest (2017b) provided as-built documentation for the pilot landfarm.

Monitoring, Maintenance, and Reporting Program

The general operational procedures after placement of the PHC impacted soil within the landfarm include aeration, moisture content adjustment as necessary, application of fertilizer as necessary, and monitoring. The treated soil will be sampled and analyzed for compliance with the treatment objectives outlined in the Lupin Water Licence. Additional details regarding operation of the landfarm facility and leakage detection pipe are included in the Norwest document titled “As-built Document for the Pilot Landfarm at Lupin Mine”, submitted to the NWB in November 2017.

It is expected that the PHC contaminated soil currently undergoing treatment in the pilot landfarm will meet objectives within about two years. At that time, the treated soil will be removed and used for site remediation. Specifically, it may be used for site regrading or for localized capping. The landfarm cell will then be demolished, hoe rammed and capped in the same manner as the other foundations on-site (Section 4.3.2.9).

Contingency Program

If the soils the pilot landfarm do not meet the treatment objectives within two to three years, the soils will be removed and deposited into the open crown pillars.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included a provision to treat 32,500 m^3 of PHC contaminated soils in landfarms on the site. Under the FCRP, only the 500 m^3 currently in the pilot landfarm cell will be bioremediated; the remainder will be deposited into the open crown pillars. This will have the effect of reducing the closure costs.

Closure and reclamation costs are discussed further in Section 6.0.

4.3.2.13 Water Management Systems

Reclamation Objectives and Closure Criteria

The closure objectives are to re-establish passive drainage from the TCA watershed while meeting closure water quality objectives.

For additional information on water management systems, refer to: TCA Water Management in Section 2.4.4; Sewage system and lagoons in Section 2.4.7.6; and freshwater supply in Section 2.4.7.2.

Selection of Preferred Reclamation Activities

Water management in the TCA currently relies on human intervention to syphon water over J Dam and over Dam 1A. When required, treatment currently consists of adding slurried lime into Pond 2 before syphoning the water over Dam 1A. As the tailings cover is completed, there will no longer be contact between the tailings and surface runoff and acid generation will be controlled by the saturated zone near the base of the tailings cover. Once it has been documented that ongoing treatment is no longer required, water management of the TCA will be made passive by constructing engineered spillways to re-establish natural drainage through the TCA watershed.

Synthesis of Preferred Activities into a Reclamation Plan

In the TCA, the total watershed area is such that accumulation of spring meltwater takes place. Even though the climate is such that the rainfall and the lake evaporation are in near balance, the relatively the relatively large watershed results in an average annual increase in pond water elevation of approximately 0.5 m.

At final closure, two riprap spillways will be constructed, one through J Dam and one through Dam 1A, to permit passive water flow to the environment. Typical water elevations in the ponds, prior to and after annual discharge, are shown in Table 16.

Table 16: TCA Water Elevation

Facility	Before Discharge (m)	After Discharge (m)
Cell 4	486.8	485.0
Pond 1	484.6	481.0
Pond 2	483.0	480.0

Currently, a gated culvert located within the north arm of the Divider Dyke controls the flow of water between Cell 4 and Pond 1. To reduce the water level in Cell 4 to 485.0 m, the gated culvert will be removed and rip rap on geotextile will be placed in the resulting swale to protect against erosion. The natural topographic channel between these two ponds is at 485 m elevation, therefore the original gradient will be re-established when the culvert is permanently removed during closure activities.

Ponds 1 and 2 are separated by J Dam, and water is presently transferred between from Pond 1 to Pond 2 using a syphon. After the final transfer of water into Pond 2, J Dam will be breached and a spillway will be constructed at an elevation of 481.0 m to permit controlled flow of water into Pond 2. Limiting the maximum water level to this elevation will reduce the impoundment of water against Dam 3D and maintain a natural gradient for flow from the Cell 4 watershed.

The final elevation of the water in Pond 2, following the syphon discharge to the environment, will be at a maximum of 480 m elevation. After final syphon discharge, the syphons will be removed and a spillway will be constructed through Dam 1A at an elevation of 480.0 m. This would allow any runoff from the spring freshet or from seasonal rain storms to drain passively from the impoundment area and flow through its original natural drainage course via Seep Creek and eventually into Inner Sun Bay of Contwoyto Lake. As there is an elevation difference of approximately 2 m from the closure spillway and the natural ground of the tributary to Seep Creek, the spillway will be easily engineered to prevent the migration of fish species (e.g. arctic grayling) into the tailings containment area through the use of a vertical barrier. In addition, at a maximum water elevation of 480 m, no water will be impounded against the sides of Dam 1A, Dam 2, or M Dam.

Prior to construction of the two spillways, an evaluation of the water chemistry will be made to ensure that when outflow occurs, all water quality guidelines will be met. The outflow would amount to an estimated annual average water volume of approximately 250,000 m^3, with the majority of flow occurring in June and early July.

Management and Accountability Structure

Current water quality monitoring in the TCA will continue and the data will be analyzed to establish that treatment will no longer be required in the future. Only then will the two spillways be constructed.

Engineering drawings and technical specifications will be prepared for the two spillways.

Long term environmental stability with respect to water quality will ultimately determine the timing of spillway construction. The FCRP references two types of spillways:

(i) From project closure, internal dam spillways will be constructed as soon as practical and their timing will be dictated by closure water management activities and the balance between water treatment volumes and allowable discharge volumes to the environment. (CIRNAC TC No. 26)

(ii) Dam 1A spillway (referenced in Table 14 Revised), is to be constructed external to Dam 1A as shown in Figure 15 Tailings Containment Area Closure Spillways Conceptual Plan and Cross Sections. (Attachment 1, CIRNAC TC No. 26 TCA Conceptual Plan and Sections). The date of 2025 for the construction of the Dam 1A spillway in Table 14 (Revised) is an estimate only as this spillways construction timing is depended on post-closure water chemistry. The necessary equipment will be left on site to construct this spillway and a cost allowance for spillway construction is in the cost estimate. Funds will remain until the spillway is constructed. (CIRNAC TC No. 26)

QA/QC monitoring will be carried out while the spillways are constructed and the construction will be documented in an “as-built” report.

Contingency Program

If the water quality monitoring fails to establish that water treatment will no longer be required, then the construction of the spillways will be deferred and the current water management practice will be continued.

Costs

The Closure Cost Update provided in October 2017 (Golder 2017b) included provisions for all of the planned TCA water management measures discussed above.

Closure and reclamation costs are discussed further in Section 6.0.

4.4 Material Balance

Table 17 provides an estimation of the volumes of wastes that will be produced by the implementation of the final closure plan. It also provides the estimated disposition of the various waste materials into each of the following locations: the shafts and open crown pillars, the landfill and the central mass of waste rock which will be left in place and covered.

Table 17: Mass Balance for Disposal of Waste Materials

Volume Balance				
Waste		**Disposal**		
Description	**Material Volumes (m^3)**	**Storage in Shafts and Crown Pillar (m^3)**	**Disposal in Landfill(m^3)**	**Waste Rock in Central Area, Covered (m^3)**
PHC Contaminated Soils	34,700	34,700	-	-
Contaminated Soils (As, P_bNO_3, CN)	16,700	16,700	-	-
Waste Rock from Mill Laydown Area	21,700	21,700	-	-
Waste Rock from Lumber Yard & Bone Yard (assumed 1m thick)	48,727	1,966	-	-
Asbestos Containing Materials and Other HazMat	100	-	100	-
Demolition Rubble	30,000	-	30,000	-
Mobile Equipment	540	-	540	-
Waste Rock for Contouring Landfill	10,650	-	10,650	-
Esker Material for Capping Landfill	13,500	-	13,500	-
Waste Rock for Infilling Voids in Landfill	500	-	500	-
Other Waste Rock	918,423		-	965,184
Existing Scrap Materials from Laydown Areas			20,000	
Totals		**75,066**	**75,290**	**965,184**

1. Volume of waste rock in central area includes waste rock left in place as well as waste rock brought in from perimeter areas to consolidate under the cover.
2. Total waste rock volume is assumed to be 1,000,000 m^3 as reported.

In response to CIRNAC TC No. 27, LMI clarified the volume of demolition rubble is 55,290 m^3 (including 24,640 m^3 of waste rock and esker material used for infilling, contouring, and capping)

4.5 Implementation Schedule

The proposed closure schedule for the Project is presented in Table 14 updated to reflect CIRNAC TC No.28. In order to meet the proposed schedule, some of the proposed closure activities should be carried out in 2018 and mainly during the warmest months; which normally occurs from June to September. These activities are identified under the “Preparation Work” Stage in Table 14. The majority of these activities, as also identified in the table, will be carried out under existing approved management plans, the Final TCA Closure Plan, or in general the approved licences/permits. The majority of these activities, as also identified in the table, will be carried out under existing approved licences/permits.

The schedule will be updated during the execution of the closure activities but will generally follow the present outline.

5.0 MONITORING

Post-closure monitoring of the Site will be required to confirm that the reclamation measures completed return the Site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. The overall closure goal is supported by the three closure principles of Physical Stability, Chemical Stability and Future Use and Aesthetics for each component of the Project. The intent of the monitoring program is to collect sufficient information to assess the effectiveness of the remediation measures to achievement of overall closure goals and principles.

Monitoring of the site post-closure will progress in two distinct phases:

- Phase 1 – Active Closure Period
- Phase 2 – Passive Closure Period

The Active Closure Period (Phase 1) refers to the 2.5 year period during which active on-site reclamation work is completed. LMI projects the manpower presence at the Site will increase marginally during care and maintenance for active reclamation work. The increased presence of personnel on-site is anticipated for the reclamation period. Monitoring programs will be carried out by on-site personnel under the supervision and direction of Discovery Mining Services (DMS).

The Passive Closure Period (Phase 2) refers to the period of (5) years following the completion of active reclamation work. Environmental monitoring will be conducted to determine the success of the reclamation measures and confirm objectives have been achieved. Consistent with the Care and Maintenance phase, LMI does not project continuous manpower presence on-site during this Phase. Monitoring programs will be carried out during site visits under the supervision and direction of DMS.

During the regulatory review process, CIRNAC requested further rationale to explain the basis for the proposed monitoring period. (CIRNAC TC No. 29). LMI confirmed under the previous water licence 2AM-LUP1520 security amendment No. 1, the NWB engaged a third party consultant, Knight-Piésold (2016), to provide expert advice. The Knight-Piésold assessment accepted by the NWB proposed a three-year term and LMI amended their estimate accordingly.

In addition LMI committed to submit within one year of approval of the renewed/amended licence, following discussion with all stakeholders (TM/PHC Commitment No. 14), a Post Closure Monitoring Plan that incorporates, where appropriate, regulatory review comments, ongoing field work, HHERA results, and any other direction from the NWB. (CIRNAC TC No. 29). Refer to Water Licence 2AM-LUP2032 Part J, Item 13 and Schedule J, Item 1 & 2.

Further, LMI confirmed that the results of the HHERA for the closure scenario and associated pathways indicated that the remediation and risk management measures outlined in the FCRP were considered sufficient to address potential risks to human and ecological receptors. However, the HHERA concluded that there could remain a moderate risk to aquatic life from low pH in Boot Lake and Unnamed Lake (also known as East Lake). It was recognized that the water quality model was conservative and that the closure measures would result in an improvement relative to the current water quality; however, it was recommended that water quality monitoring be undertaken in Boot Lake, Unnamed Lake and Lower Sewage Lake. LMI may propose additional reasonable and practical adaptive management strategies (i.e., applicable monitoring (Tables 18 and 19) and/or additional remediation measures) may be implemented.

Tables 18 and 19 have been updated to reflect the issuance and approval of Water Licence 2AM-LUP2032, Part J, Item 1, and Table 1 and 2 of Schedule J.

Phase 1

LMI intends to continue implementation of closure measures already approved for the TCA noting LMI, as required by past and current water licences, has filed the appropriate closure and reclamation plan(s) reflective of the stages of operation at that time. Extensive engineering, monitoring and assessment work has been completed to date by LMI and its predecessors for the site to inform Final Closure. It is understood, consistent with Indian and Northern Affairs Canada Mine Site Reclamation Policy for Nunavut (INAC, 2002), implementation considerations acknowledge that “approaches to mine site reclamation need to remain to remain dynamic and evolving “best practices” should be an integral component of reclamation planning.” The geotechnical engineer of record for the Lupin mine site, after extensive historical record review and recent on-site work, including assessment of performance of TCA dams, is confident in the program put forth in the FCRP. LMI has been implementing final remediation of the TCA following NWB approval of the Final Closure Plan for the TCA at the last licence renewal under 2AM-LUP1520.

On approval of the FCRP under water licence 2AM-LUP1520 Part B, Item 13, LMI forecasts Phase 1 monitoring to begin in the summer of 2019 and conclude in 2021.

Monitoring on-site during Phase 1 will include:

a) General Monitoring

The Water Licence (2AM-LUP2032) under Part J and Schedule J, specifies the conditions applying to monitoring that is required at the site.

Water monitoring at the site will be conducted following the procedures outlined in the in the approved *Water Quality Monitoring Plan and Quality Assurance/Quality Control Plan* (LMI 2016a) per water licence 2AM-LUP2032 Part J, Item 6. Note: as required under Part J, Item 7 LMI has submitted to the NWB for review and to an accredited laboratory for approval an updated WQMP and QA/QC Plan (LMI 2020).

Water monitoring falls under General Monitoring and also included Environmental Effects Monitoring as defined in Section b) below.

Water quality monitoring stations, and frequency of monitoring are outlined in Table 18. Detailed parameters to be monitored are outlined in Table 19. Water monitoring stations are illustrated in Figure 12.

Field measurements of specific conductivity, pH, and temperature will be recorded whenever samples are collected by using a multi-meter (e.g., YSI 6-Series Multimeter). Water quality samples will be collected from specific sampling stations using a grab sampler or directly into bottles provided by an accredited analytical laboratory. Water quality samples will be analyzed by an accredited laboratory to appropriate detection limits (DLs). Samples from receiving waterbodies will be analyzed to DLs less than aquatic life guidelines while samples from on-site water may be analyzed to higher DLs. The specific limits will be provided once the analytical laboratory has been selected.

Samples will be collected following standard sampling protocol (LMI 2016a). Samples will be collected by qualified personnel using suitable sampling equipment. Water samples for laboratory analysis will be filtered and preserved (as required), and stored in a cool environment before shipping to the laboratory. Quality control samples (i.e., blanks and duplicates) will be collected at a quantity of 10% of all samples collected.

Summaries of monitoring events will be provided in as outlined in Section e) below.

b) Environmental Effects Monitoring

In accordance with the requirements of the Metal Diamond Mining Effluent Regulations, LMI was required to complete a final EEM study in 2019. In compliance with monitoring requirements of the MDMER, LMI submitted the Lupin Mine Phase 6 (Final) Environmental Effects Monitoring Study Design on 15 January 2019. The Phase 6 Study Design describes the Final EEM study as per Schedule 5, Section 18 of the MDMER. Recommendations and requirements identified by the TAP following their review of the Phase 5 EEM study design (Mandalay Resources Corporation 2016) and the Phase 5 EEM interpretative report (Golder 2017d) were incorporated into the Final study design.

The MDMER requires that the final study be conducted not sooner than six months after the final study design has been submitted; as such, the final study was implemented in August 2019. The Final Interpretative Report (Golder 2020) was submitted to ECCC in June 2020. Receipt of the Final Interpretative Report was acknowledged by ECCC on 8 June 2020; comments and review by the TAP are pending.

c) Geotechnical Verification Monitoring (Temperature/Thermistor)

As discussed in Sections 4.3.2.4 and 4.3.2.8, geotechnical verification monitoring will continue at the TCA and take place at the mine site at all locations where waste has been deposited. Table 20 outlines the TCA existing) instrumentation monitoring. Instrumentation locations are shown in Figure 5.

d) Remediated Soils Verification Sampling

Confirmatory monitoring of soil quality will be conducted in areas where contaminated soils are to be excavated as part of remediation efforts. This sampling program will be design to confirm that the soil quality remediation objectives have been achieved.

e) Reporting of Results

Reporting of Results during Phase 1 with be as directed under the current Water Licence or as required by legislation. Consistent with current requirements LMI will summarize monitoring results in the Annual Report to the Board due March 31st each year for the previous calendar year. The Annual Report to regulatory agencies would include interpretation of all data collected including: water quality, ground temperatures, geotechnical inspections and a summary any other reclamation/closure studies completed by LMI during the previous calendar year.

Phase 2

Monitoring during the Passive Closure Period will be undertaken monthly as a series of brief site inspection expected to last 3-4 days each from June to September. LMI intends for these site inspections to coincide where possible with regulatory site inspection completed by any Inspector designated under federal legislation. LMI will provide 30 days notice of each monitoring inspection event to be undertaken.

Site inspections will be conducted similarly to those undertaken during Care and Maintenance (i.e. Monthly).

LMI proposes gradually decreasing the frequency of site inspections and or specific monitoring requirements as testing results obtained confirm predictions of chemical, physical stability. If results are not as predicted, additional monitoring, and/or remediation works will be undertaken by LMI.

Any additional information produced following the submission and acceptance of this FCRP will be incorporated into the Annual Report required under the Type A Water Licence and to other regulatory agencies (i.e. ECCC, CIRNAC, and KIA).

Table 18: Water Quality Monitoring Stations (Update Per Schedule J, Table 1 of Water Licence 2AM-LUP2032)

Station	Description of station	Preparatory Work	Closure Phase		Post-Closure Phase					Parameter Group Code[see Table 19 (revised)]: Frequency of Sample Collection in a Given Year
		2019	2020	2021	2022	2023	2024	2025	2026	
			Active Stage		Passive Stage					
LUP-01	Freshwater Intake from Contwoyto Lake	Yes	Yes	Yes	Only if still active					Volume: Monthly totals Field, conventional, total metals, and biological: annually
LUP-10	Pond 2 discharge at Dam 1A	Yes	Yes	No	No	No	No	No	No	Volume: Quantity of treated effluent discharged, measured and recorded in cubic metres Field, conventional, total metals, and cyanide, no visible sheen Oil & Grease: Daily during periods of discharge Nutrients, radium: weekly during discharge Cyanide and bioassay: monthly (no less than one month intervals) commencing with the first day of decant
LUP-10a (LUP-102)	Internal station in TCA Pond 2, approximately 100 m upstream from siphon intake	Yes	if water present	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, radium, and bioassay: once prior to initiation of decant and once prior to termination of decant
LUP-11	Mine-water discharge at automatic sample in the mill	Not active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-12	Mill tailings taken at the mill	Not active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-14	Decant structure from the Sewage Lakes Disposal Facilities	Yes	Yes	Yes	Only if still active					Volume: monthly quantity of treated effluent discharged in cubic meters Field, conventional, nutrients, total metals, biological Other (biochemical oxygen demand), total phosphorus, total orthophosphorus (OPO4), total Kjeldahl nitrogen (TKN): first day of discharge and then monthly thereafter during periods of flow
LUP-15	Discharge from TCA Pond 1(east pond) not TCA Pond 2 (west pond)	Not Active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-16	TCA Pons 2 at Centre	Not Active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-17	TCA Pond 2 upstream of LUP-10	Not Active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-19	East End of Seep Creek in Dam 2 Lake	Not Active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-20	West end of Seep Creek before discharge into Unnamed Lake (also known as East Lake)	Yes	Yes	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, and radium: weekly during discharge from the TCA, commencing with the fist day of decant
LUP-21	North end of Concession Creek before discharge into Unnamed Lake (also known as East Lake)	Yes	Yes	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, and radium: weekly during discharge from the TCA, commencing with the fist day of decant
LUP-22	Inner Sun Bay near center and midway between end of peninsula and west shore	Yes	Yes	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, and radium: weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge

Table 18: Water Quality Monitoring Stations (Update Per Schedule J, Table 1 of Water Licence 2AM-LUP2032)

Station	Description of station	Preparatory Work	Closure Phase		Post-Closure Phase					Parameter Group Code[see Table 19 (revised)]: Frequency of Sample Collection in a Given Year
		2019	2020	2021	2022	2023	2024	2025	2026	
			Active Stage		Passive Stage					
LUP-24	Inner Sun Bay at mid-way point in narrows	Yes	Yes	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, and radium: weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge and when bioassay sample is collected at LUP-10 just prior to termination of decant
LUP-25	Outer Sun Bay (Total Rather than specific metals)	Yes	Yes	No	No	No	No	No	No	Field, conventional, nutrients, total metals, cyanide, and radium: weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge
LUP-26	Contwoyto Lake in bay east of water intake	Not Active	No	No	No	No	No	No	No	2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-27	Bulk Fuel Storage Facility	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Once prior to discharge and weekly during periods of discharge
LUP-28	Discharge from the Landfarm Facility	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Once prior to discharge and weekly during periods of discharge
LUP-29	Landfarm Facility Monitoring Well – Up gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-30a	Landfarm Facility Monitoring Well – Down gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-30b	Landfarm Facility Monitoring Well – Down gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-31	Seepage from the Landfill Facility	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-32	Landfill Facility Monitoring Well – Up gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-33a	Landfill Facility Monitoring Well – Down gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-34b	Landfill Facility Monitoring Well – Down gradient	Yes	Only if still active							Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-35	Seepage from the Landfill Facility	No	No	No	No	No	No	No	No	Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-36	Demolition Landfill Facility Monitoring Well – Up gradient	No	No	No	No	No	No	No	No	Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-37a	Demolition Landfill Facility Monitoring Well – Down gradient	No	No	No	No	No	No	No	No	Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-37b	Demolition Landfill Facility Monitoring Well – Down gradient	No	No	No	No	No	No	No	No	Field, conventional, nutrients, total metals, total oil and grease, and BTEX: monthly during periods of observed flow (June to September)
LUP-EL-01	Unnamed Lake (also known as East Lake) near shoreline near the potential seepage inputs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Field, conventional, total metals: twice-yearly: once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-BL-01	Boot Lake near shoreline near the potential seepage inputs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Field, conventional, total metals: twice-yearly: once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.

Table 18: Water Quality Monitoring Stations (Update Per Schedule J, Table 1 of Water Licence 2AM-LUP2032)

Station	Description of station	Preparatory Work	Closure Phase		Post-Closure Phase					Parameter Group Code[see Table 19 (revised)]: Frequency of Sample Collection in a Given Year
		2019	2020	2021	2022	2023	2024	2025	2026	
			Active Stage		Passive Stage					
LUP-LSL-01	Lower Sewage Lake near shoreline near the potential seepage inputs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Field, conventional, total metals: twice-yearly: once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-SP-01 to LUP-SP-XX[a]	Seeps from the Waste Rock Dome, locations of observed seepage or flow from the waste rock pile	Yes	-[b]	Yes	Yes	Yes	Yes	Yes	Yes	Field, conventional, total metals: twice-yearly: once in freshet and once in late open-water season.
LUP-TCA-01 to LUP-TCA-XX[a]	Seeps from the TCA, locations of observed seepage	Only if active	Only if active		Only if active					Field, conventional, total metals: twice-yearly: once in freshet and once in late open-water season.
SCP-1[c]	Seep Creek Pond EEM Station 1	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study
SCP-3[c]	Seep Creek Pond EEM Station 3	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study
SCP-5[c]	Seep Creek Pond EEM Station 5	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study
FL-1[c]	Fingers Lake EEM Station 1	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study
FL-3[c]	Fingers Lake EEM Station 3	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study
FL-5[c]	Fingers Lake EEM Station 5	No	Yes	No	No	No	No	No	No	Field (plus turbidity), conventional, total dissolved solids, total suspended solids, total organic carbon, dissolved organic carbon, major ions, nutrients (including total phosphorus), total metals, cyanide, and radium: once during final EEM study

(a) Seep sampling locations will be added to the post-closure monitoring program as new seeps are documented.

(b) Not sampled in 2020.

(c) EEM station (not included in the Water Licence).

Note: EEM = Environmental Effects Monitoring; FL = Fingers Lake; MDMER = Metal Diamond Mining Effluent Regulations; EL = East Lake; BL = Boot Lake; LSL = Lower Sewage Lake; SP = seep; SCP = Seep Creek Pond; FL = Fingers Lake; TCA = Tailings Containment Area

Table 19: Water Quality Monitoring Parameter Groups (Update as Per Schedule J, Table 2 of Water Licence 2AM-LUP2032)

Parameter Group Code	Specific parameters
Volume	Volume per day (discharged to the environment or withdrawn from the environment for use)
Field	Field measurements (pH, temperature, conductivity, dissolved oxygen[a])
Conventional	pH, total suspended solids, alkalinity, hardness
Nutrients	Total ammonia, nitrate, and nitrite
Total Metals	aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, and zinc
Cyanide	Total cyanide

Radium	Radium-226
Biological	Fecal coliforms
Bioassay	Acute toxicity tests (Rainbow Trout and *Daphnia magna*)
BTEX	Benzene, toluene, ethyl benzene, xylenes
Other	Specified by station

Note: a - only measured at receiving environment stations

Table 20: Existing and Future Instrumentation Monitoring

Station	Location	Instrument Type	Approved Final Reclamation Work	Phase 1 (Active Closure Period)	Phase 2 (Passive Closure Period)
D1A-00-01S	Dam 1A	Thermistors	Monthly from 2000 through 2006, annually in the summer from 2009 through 2019	Damaged in 2020 – attempting to repair. If possible, annually concurrent with site inspection (i.e., June – September)	If possible, annually concurrent with site inspection (i.e., June – September)
D2-00-2N	Dam 2		Monthly from 2000 through 2006, annually in the summer from 2010 through 2019	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
D3D-1	Dam 3D		Monthly from 2004 through 2006, once in the Summer of 2009 and annually in the summer from 2014 through 2019	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
D4-1	Dam 4		Monthly from 1995 through 2006, annually between 2009 and 2019	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
D4-2			Monthly from 1995 through 2006	No longer functional	No longer functional
D4-3			Monthly from 1995 through 2006, annually between 2009 and 2019	Damaged in 2020 – attempting to repair. If possible, annually concurrent with site inspection (i.e., June – September)	If possible, annually with site inspection (i.e., June – September)
D4-4			Monthly from 1995 through 2006, annually between 2009 and 2019	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
DK-3	Dam K		Monthly from 2004 through 2006, once in the Summer of 2009 and annually in the summer from 2014 through 2019	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site Annually concurrent (i.e., June – September)
TC1-3	Cell 1 Cover		Monthly from 1995 through 2006, once in the Summer of 2009 and twice in 2015	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
TC1-6			Monthly from 2003 through 2006, once in the Summer of 2015	Annually concurrent with site inspection (i.e., June – September)	Annually concurrent with site inspection (i.e., June – September)
TC1-7			Monthly from 2004 through 2006, once	Annually concurrent with site inspection	Annually concurrent with site inspection

Table 20: Existing and Future Instrumentation Monitoring

Station	Location	Instrument Type	Approved Final Reclamation Work	Phase 1 (Active Closure Period)	Phase 2 (Passive Closure Period)
			in the Summer of 2009 and thrice in summer of 2015	(i.e., June – September)	(i.e., June – September)

Table 20: Existing and Future Instrumentation Monitoring

Station	Location	Instrument Type	Approved Final Reclamation Work	Phase 1 (Active Closure Period)	Phase 2 (Passive Closure Period)
TC3-1	Cell 3 Cover		Monthly from 2004 through 2006, thrice in summer of 2015	Annually concurrent with site inspection (i.e., June – September)	Annually Concurrent with site inspection (i.e., June – September)
C1VWC	Cell 1 Cover	Soil Moisture and Temperature Probes(TEROS-12 VWC sensors)	Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Weekly throughout the closure period via datalogger (downloaded during site inspections)
C3VWC	Cell 3 Cover			Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Weekly throughout the closure period via datalogger (downloaded during site inspections)
WRD-1	Waste Rock Dome Cover	Thermistor string	To be installed in 2021		Weekly via datalogger (downloaded during site inspections)
WRD-2	Waste Rock Dome Cover	Thermistor string	To be installed in 2021		Weekly via datalogger (downloaded during site inspections)
WRD-3	Waste Rock Dome Cover	Thermistor string	To be installed in 2021		Weekly via datalogger (downloaded during site inspections)
WRD-4	Waste Rock Dome Cover	Thermistor string	To be installed in 2021		Weekly via datalogger (downloaded during site inspections)

* Instrument to be installed in summer of 2018. Location and station name are not yet confirmed.

6.0 POST REMEDIATION SITE AND ENVIRONMENTAL CONDITIONS

6.1 Post Remediation Site Conditions

Upon completion of the permanent closure and reclamation works described in Section 4.0, the physical status of the Lupin Mine site will be as shown on Figure 10 and Figure 11. The main points are as follows:

- All tailings in the TCA will be covered with 1.0 m of esker material and permanent monitoring instrumentation will be installed for the continued monitoring of site conditions.
- Water ponded in the TCA will be at long-term lowered water levels described in Section 4.3.2.13 and water will drain passively through spillways through J Dam and Dam 1A,
- The current buildings in the Mine and Mill area will have been removed.
- The mine and mill area will have been contoured to drain freely without ponding.
- All waste rock on surface will have been removed or covered with 1.0 m of esker material.
- All three mine shafts and open crown pillars will be backfilled to surface.
- The landfill(s) will be contoured to drain freely and it will be covered with 1.0 m of esker material.
- PHC contaminated soil will have been removed and disposed of into the mine workings.
- Contaminated soil (i.e. heavily arsenic impacted shallow material, or soils contaminated with lead nitrate or cyanide) will have been removed and disposed of into the mine workings.
- Borrow and quarry areas will have been remediated as described in Section 4.3.2.5.
- Roadways will have been scarified and culverts will have been removed to restore natural drainage.
- Except for a small fleet for maintenance purposes, all surface mobile equipment will have been removed or buried in the landfill.
- The PHC contaminated soil currently in the landfarm will be removed after treatment is completed and the landfarm will be demolished as descried in Section 4.3.2.12.

After closure, the former Lupin Mine site will resemble the landform that existed before mining, except that the following facilities will remain:

- The TCA will remain in the form described above.
- The airstrip will be left in place for future use.
- The breakwater on Contwoyto Lake will be left in place for future use.
- Minor facilities will be left in place to facilitate future site monitoring and maintenance should this become necessary, likely including: the guest house, a small fleet of construction equipment and a temporary equipment shed/workshop.

- While the roads to the TCA and the esker borrow area will be scarified, the road beds will be left in place to facilitate maintenance should this become necessary in the future.

6.2 Post Remediation Environment Conditions/Post Remediation Risks to Human and Environmental Health

LMI has completed an HHERA for the Lupin mine/mill site (Golder, 2019c) consistent with HHERA's completed for other Nunavut mining operations (i.e., Polaris and/or Nanisivik Mines) to develop site-specific soil quality remediation objectives. Refer to Section 4.3.2.3 for additional information on contaminated soils.

At the PHC/TM in June 2019, LMI committed (TM/PHC Commitment No. 1) to the completion of a HHERA to include geochemical, thermal, and seep modelling studies and provided the assessment to the NWB in October 2019. The HHERA was submitted and reviewed by interested parties prior to the issuance and approval of the Type A Water Licence 2AM-LUP2032.

6.2.1 Historical Ecological Risk and Environmental Site Assessments

To inform the closure and reclamation of the Site, a number of environmental investigations have been conducted at the Site since 2004, as follows:

- Golder. 2004. Ecological Risk Assessment for the Lupin Mine Tailings Containment Area. Prepared by Golder Associates Ltd. for Kinross Gold Corporation. December 2004.
- Morrow Environmental Consultants Inc. (Morrow). 2006. Phase 1 and 2 Environmental Site Assessment. Lupin Mine Site, Nunavut Territory. Prepared by Morrow Environmental Consultants Inc. for Lupin Mine Incorporated. January 11, 2006.
- Golder. 2017a. Updated Phase I and II Environmental Assessment, Lupin Mine, Nunavut. Prepared by Golder Associates Ltd. for Lupin Mine Incorporated. October 2017.

6.2.1.1 Golder (2004) Ecological Risk Assessment

In 2004, Golder (2004) conducted an ecological risk assessment (ERA) for the Lupin Mine TCA. Although the title of the report implies only an ERA was conducted, the objective of the evaluation was to assess potential human health and wildlife risks due to exposure to contaminants of concern (COCs) (metals and cyanide) after the closure of the mine, based on the closure plan for the TCA. At the time of the 2004 ERA, the closure plan for the TCA included two major features:

- Covering exposed tailings with 1 metre (m) of esker sand; and
- Leaving two water clarification ponds (Pond 1 and Pond 2) in place, constructing a spillway between Pond 2 and the receiving environment, and keeping water and sediment within Ponds 1 and 2.

Three sources of metals and cyanide were considered in the ERA:

- Settling of tailings in Ponds 1 and 2 and impacts to water and sediment in the ponds;
- Seepage from the esker-covered tailings to the surface of the esker-covered tailings; and
- Wind-blown transport of exposed tailings to the clean esker-covered tailings.

The only human health pathway considered applicable for evaluation was ingestion of caribou meat from caribou that may have been exposed to the tailings. It was concluded that there were no risks to human health via this pathway.

The ERA evaluated 12 terrestrial mammal and bird receptors and the following exposure pathways:

- Incidental ingestion of soil and ingestion of food items that have accumulated COCs from soil;
- Incidental ingestion of sediment and ingestion of food items that have accumulated COCs from sediment that had settled in Pond 1 and Pond 2; and
- Ingestion of water from Pond 1 and Pond 2.

The ERA concluded there were potential risks to individual shorebirds and waterfowl due to arsenic and cyanide exposure via water, sediment and food ingestion but that several assumptions made in the ERA may have led to an overestimation of risks. Risks to populations of shorebirds and waterfowl were considered unlikely; however, the characterization of risks to populations was uncertain.

The ERA also provided a number of conclusions with respect to the closure plan for the TCA:

- No human health or wildlife risks were expected with placement of 1 m of esker sand over the exposed tailings; and
- Risks to shorebirds and waterfowl were found with leaving Pond 1 and Pond 2 in place, constructing a spillway between Pond 2 and the receiving environment, and keeping water and sediment within Ponds 1 and 2. Further work to reduce the uncertainty in the assessment of risk to shorebirds and waterfowl was recommended to better inform the closure plan with respect to Pond 1 and Pond 2.

6.2.1.2 Morrow (2006) Phase One and Two Environmental Site Assessment

In 2005-2006, Morrow (2006) carried out a Phase One and Phase Two Environmental Site Assessment (ESA) to evaluate the environmental quality of the Lupin Gold Mine such that the mine closure plan at the time of the assessment could be finalized. For the purposes of the ESA, the Site was defined as the surface parcel/lease for land occupied by the mine and mill site only, along with the associated roads and water supply facilities at Contwoyto Lake. The ESA indicated that the TCA and associated #1 dump pond were part of a separate reclamation plan and not the subject of the assessment. Similarly, the airstrip would remain in place under a separate lease and was not part of the assessment.

The following summarizes the findings of the Phase One and Two ESA:

- The Phase One ESA identified a total of 61 areas of potential environmental concern (APECs) that had the potential for mine-related impacts (i.e., metals, hydrocarbons, glycols, cyanide, nitrogen and/or salt-based contamination).
- As part of the Phase Two ESA, the 61 APECs were investigated by drilling nine boreholes, excavating 59 test pits, and installing 19 groundwater monitoring wells.
- The results of the soil and groundwater sampling indicated that the primary COCs were arsenic and hydrocarbons (petroleum hydrocarbon [PHC] Fraction [F] 1 and PHC F2). Secondary contaminants (e.g.,

benzene, toluene ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) glycols, cyanide, nitrate and nitrite, sulphate and salinity) were localized and for the most part, coincided with primary contaminants.

- Acid rock drainage/metal leaching (ARD/ML) potential at the Site was investigated and it was concluded that localized areas of ARD exist; however, additional monitoring was necessary to evaluate the significance of the drainage.
- Neutral pH leaching of arsenic was widespread with the greatest concentrations existing at or downgradient of areas with hydrocarbon contamination, potentially as a result of changes in soil geochemistry. Although local ARD and widespread neutral pH leaching was found, the metal load was low because the Site is located on a low hill (i.e., groundwater recharge from precipitation only). As a result, it was considered unlikely that a measurable effect would exist in Contwoyto Lake.
- Arsenic concentrations in the development rock pad beneath the Site were elevated above federal criteria and background concentrations.
- Approximately 40,000 cubic metres (m^3) of hydrocarbon impacted soil, 8000 m^3 of nitrate and/or cyanide containing soil and 2000 m^3 of soil with traces of ore fines were estimated to exist on the Site.

The Phase Two ESA concluded the following:

- As per the closure plan, the hydrocarbon-impacted soil could be disposed of in the mine workings.
- Removal of the hydrocarbon-contaminated soil may result in a reduction of dissolved arsenic concentrations due to changes in the soil geochemistry.
- Continued monitoring and sampling of the Site wells and seeps should allow trends in metal concentrations to be established.
- Direct measurement of water quality discharging from the Site would provide the best indication of whether there are significant ARD/ML concerns at the Site.
- A HHERA was required to develop site-specific remediation criteria for metals and to identify an appropriate site closure strategy.

6.2.1.3 Golder (2017) Phase I and II Environmental Site Assessment Update

In 2017, Golder conducted an updated Phase I and II ESA at the Lupin Gold Mine. The updated ESA was completed in support of the development of an estimation of costs for the closure of the mine and the Water License renewal application. The overall objective of the ESA was to provide an update of the Morrow (2006) ESA and remediation quantities to be used to support the revised cost of closure estimate. For the purposes of the ESA update, the Site was defined as the surface parcel/lease of land occupied by the mine and mill site only, along with the associated roads and water supply facilities at Contwoyto Lake. The TCA was not part of the assessment.

The following summarizes the findings of the Phase I and II ESA Update:

- The release of approximately 10,000 litres (L) of oil contaminated water from the TCA in 2012 represented an APEC. However, as this release was associated with the TCA, which was not included in the

assessment, investigation of this APEC was not completed as part of the Phase II ESA update. All other activities conducted at the Site since 2006 were not considered to represent APECs for the Site. Therefore, no additional APECs were identified for the Site as part of the Phase I ESA update.

- The 61 APECs identified in 2006 were further assessed and delineated via the advancement of 45 test pits, the collection of 11 groundwater samples from existing wells and the collection of 10 surface water samples from seeps.
- The Phase II ESA update confirmed that the primary COCs at the Site were arsenic and PHCs. Secondary contaminants were identified (i.e., lead nitrate, cyanide); however, they were localized and coincided with the primary contaminants.
- Approximately 35,200 m^3 of PHC impacted soil was identified at 13 historical maintenance, fueling and fuel storage locations across the Site.
- Approximately 400 m^3 of lead nitrate and/or cyanide impacted soils was identified at three historical cyanide storage locations.
- Arsenic concentrations in the development/waste rock pad beneath the Site were elevated with respect to the applicable guideline. Approximately 16,300 m^3 of arsenic impacted “hot spots” were identified at two locations.
- The depth to groundwater was similar between the 2006 and 2017 groundwater monitoring events (near surface to approximately 2 metres below ground surface [mbgs]) and since 2006, PHC and dissolved metal concentrations in groundwater had generally decreased. No free product was observed in groundwater.
- Since 2006, PHC concentrations in seepage surface water had generally decreased, while the concentrations of total metals had generally increased in seepage surface water.
- The results of the ARD/ML investigation indicated that approximately 67 percent (%) of the combined waste rock dataset (Golder (2017a) samples, URS (2005) samples and Morrow (2006) samples) is classified as potentially acid generating (PAG). The PAG samples were not concentrated in one area but rather distributed throughout the Site.
- Direct measurement of acidic pH values in groundwater and seepage surface water confirmed that acid generation as a result of sulphide mineral oxidation was occurring after many years of waste rock exposure.
- The results of short-term leach testing confirmed that the waste rock used for development at the Site can generate acidity, sulphate and metals by dissolution of soluble oxidation products present in the rock (shake flask extraction testing) and sulphide oxidation (net acid generating leachates).
- Seepage results collected from Site contact water agreed with those of laboratory leach tests. The primary metal of concern in leachate was arsenic; other parameters exceeding the applicable criteria short-term leachates and Site seepage samples included aluminum, cadmium, cobalt, copper, iron, lead, nickel and zinc. Metals that occurred at elevated concentrations in a few leachate samples included chromium, phosphorous, selenium, uranium and silver.

- The Phase I and II ESA Update indicated that closure alternatives for the Site should take into consideration the acid generation and metal leaching potential of waste rock.
- The Phase I and II ESA Update recommended that an HHERA should be considered for the Site to develop site-specific remediation criteria and to inform the development of a closure plan.

6.2.2 Golder (2019) HHERA

To achieve permanent closure and reclamation of the Site, several measures will need to be implemented, including the remediation and/or risk management of waste rock and contaminated soils at the Site. An HHERA was identified in the FCRP as being required to develop Site-specific target levels (SSTLs) for COCs at the Site.

The primary contaminants of concern at the Site are arsenic (as a component of the solid phase waste rock/ore as arsenopyrite mineralization) and PHCs (related to historical maintenance, fueling and fuel storage at the Site). Secondary contaminants have been identified (i.e., lead nitrate, cyanide); however, they are localized and coincide with the primary contaminants.

The primary goal of the closure and reclamation of contaminated soils is to reduce the release of contaminants from the Site to the surrounding environment. Based on this goal, the following objectives have been identified in the FCRP:

- Manage contaminated soils in-situ or relocate them to final disposal locations in order to reduce unacceptable risk to human and terrestrial ecosystems;
- Impacts to humans, environment and wildlife within risk managed areas are reduced to acceptable levels; and
- Human and wildlife exposure to soil contaminant concentrations above criteria for the designated land use is reduced to acceptable levels.

The main objective of the reclamation of waste rock is to limit the contact between the waste rock and surface runoff.

Several post-closure reclamation options were considered and selection of preferred reclamation activities to address contaminated soils were described as follows:

- Heavily arsenic impacted soil (i.e., arsenic greater than 4,000 milligrams per kilogram (mg/kg)) will be ex-situ remediated using conventional techniques (i.e., excavators, haul trucks, and dozers) and will be disposed of within the shafts or into open crown pillars for isolation. Crown pillars will be backfilled with rock above surface to allow for settlement, then capped with 1.0 m of esker material. Areas of remaining arsenic impacted shallow materials will be regraded to support surface water management (i.e., positive drainage), and then covered with coarse-grained borrow material from the Fingers Lake esker.
- Low impact arsenic impacted material will be left in place. Soil exceeding the SSTLs developed by the HHERA will be risk-managed with the placement of a coarse-grained engineered cover. It is anticipated that the engineered cover will consist of approximately 1.0 m of coarse-grained borrow material from the Fingers Lake esker and will be graded to support positive drainage.

- PHC impacted material will be ex-situ remediated using conventional techniques (i.e., excavators, haul trucks, and dozers) and disposed of in the shafts or open crown pillars. The areas that have been excavated will be regraded to ensure drainage and then covered with 1.0 m of coarse-grained borrow material from the Fingers Lake esker.

The reclamation plan for waste rock present on the surface of the mine and mill area will include a combination of the following two measures:

- As shown on Figure 10, the waste rock will be removed from the perimeter of the mine mill area. The waste rock will be excavated and transported and either disposed of into the shafts, open crown pillars or the landfill, or relocated to the central area to create a “dome”. Waste rock placed in the landfill will be covered by 1.0 m of esker material. The 1.0 m of esker material cover will also be placed on top of any waste rock that is used to infill tops of the open crown pillars, and also on top of any rock that is left in place in the central areas. The objectives of the cover are to: 1) limit the surface exposure of waste rock; and 2) to reduce the amount of infiltration into waste rock in order to control the volume of ARD impacted seepage out of the toe of the dome.
- Waste rock which is not removed will be left in place, generally in the central areas. The surface of the waste rock will be contoured to drain freely and then will be capped with 1.0 m cover of esker material.

The heavily arsenic impacted material generally occurs within the central waste rock area and will likely involve soil and waste rock that are inter-mixed. In such a case, contaminated soil cleanup and waste rock management will be integrated. The waste rock that is not disposed of into the shafts, open crown pillars or the landfill will be relocated into the central area and used to grade the surface of the waste rock that is being left in place. This central pile of waste rock will be covered by at least 1.0 m of esker material.

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) completed a review of the FCRP and provided comments related to the timing of completion of submission of the HHERA. Specifically, they recommended that LMI should incorporate the findings of the HHERA into the final version of the FCRP. CIRNAC also had comments related to the waste rock management and PAG/ML and recommended that LMI include geochemical source modelling and closure water quality modelling to show that the ARD waste rock and long-term impacts to water quality will not be an issue.

The objectives of the HHERA provided herein were as follows:

- To evaluate the potential risks to human health and the environment from the contamination associated with the historical operation of the Site as a gold mine;
- If potential risks are present, to derive SSTLs for remediation and/or risk management that represent acceptable levels of risk to human health and the environment; and
- To define areas requiring remediation and/or risk management to mitigate risks to human health and the environment based upon the derived SSTLs, if applicable, and to confirm whether the measures outlined in the FCRP are sufficiently protective of human health and the environment.

For the purpose of the HHERA, the “Site” was defined as the surface parcel/lease of land occupied by the mine and mill site only, along with the associated roads and water supply facilities at Contwoyto Lake. The TCA was not part of the HHERA assessment.

The HHERA was completed in the context of returning the Site to a condition that protects the health of Nunavut residents and the environment around the mine and considers the historic use (before mine development) of the area by Inuit and wildlife. Potential risks to human health and the environment were evaluated for use of the Site following closure and reclamation of the Site based on current environmental conditions (e.g., current soil, groundwater and seepage surface water quality data prior to the implementation of the measures proposed in the FCRP (e.g., placement of the engineered cover)). This was done to focus the SSTL development on those COCs that may pose a potential risk, providing support to and the implementation of those measures outlined in the FCRP.

To address the CIRNAC comment related to the waste rock management and PAG/ML, surface water quality modeling of receiving water bodies was completed to evaluate the performance of the proposed granular esker cover of the waste rock dome with respect to limiting generation of ARD-impacted seepage from the waste rock dome (Appendix H-5). Hydrologic inputs to the water quality model were developed based on the results of thermal-seepage modelling completed by Golder (Appendix H-6). The modelling was used in the HHERA to better understand the importance of the seepage from the waste rock as a potential contaminant transport pathway. The resulting predictions of loading to surface water were evaluated in the HHERA for potential risks to human and ecological receptors.

For full details related to the HHERA refer to Golder 2019c. The full report was submitted in response to TM/PHC Commitment No.1 and link is provided in Appendix H-13.

6.2.3 HHERA Conclusions and Recommendations

A summary of the identified potential risks to human health and the environment, the proposed SSTLs for the Site, the areas requiring remediation and/or risk management based upon the derived SSTLs and the sufficiency of the FCRP to address the identified potential risks are discussed below.

6.2.3.1 Summary of Potential Risks

Potential risks to human health and the environment from the contamination associated with the historical operation of the Site as a gold mine were evaluated. The HHRA and ERA evaluated potential risks to the following receptors and COCs:

- Risks to the Site Visitor were identified for direct contact with soil and inhalation of soil particulates (arsenic and lead), and consumption of plants (arsenic);
- Risks to the Community Member were identified for consumption of plants (arsenic);
- Risks to terrestrial plants and soil invertebrates were identified for direct contact with soil (pH, PHCs F1 to F3, cyanide, arsenic and naphthalene);
- Risks to terrestrial plants were identified for direct contact with groundwater (PHC F2, aluminum, arsenic, cobalt, iron, zinc and sulphate);

- Risks to mammals and birds (arctic hare, arctic ground squirrel and willow ptarmigan) were identified for incidental ingestion of soil and consumption of food items (cyanide and arsenic); and
- Potential risks to aquatic life in Boot Lake and Unnamed Lake (also known as East Lake) from ARD-impacted seepage from the proposed esker-covered waste rock dome were expected to be moderate for pH. However, the surface water quality model used a number of conservative assumptions that may have overestimated transport of acidity to Boot Lake and Unnamed Lake, resulting in low predicted pH.

6.2.3.2 Site Specific Target Levels

Human health-based SSTLs for soil were derived based on the results of the HHERA (HHERA Section 4.5) and ecological-based SSTLs for soil, groundwater and surface water were derived based on the results of the ERA (HHERA Section 5.6). SSTLs protective of both human health and the environment were derived for the Site as the lower of the human health-based SSTL and the ecological-based SSTL for those COCs for which both were derived. If only a human health-based SSTL or an ecological-based SSTL were derived, that SSTL was adopted as the SSTL for the Site. Arsenic in soil was the only COC with both a human health-based SSTL (98 mg/kg) and an ecological-based SSTL (79 mg/kg) and the ecological-based SSTL of 79 mg/kg was selected as the SSTL for the Site. The SSTLs for the Site represent acceptable levels of risk to human health and the environment and are presented in Table 21.

Table 21: Site Specific Target Levels for the Site

COC	Health-based SSTL	Ecological-based SSTL	Overall SSTL[(a)]
Soil (mg/kg)			
PHC F1	--	210	210
PHC F2	--	150	150
PHC F3	--	300	300
Cyanide	--	1	0.9
Arsenic	98	79	79
Lead	95	--	95
Naphthalene	--	1	0.6
pH	--	4.13 to 9.0	4.13 to 9.0
Groundwater (mg/L)			
PHC F2	--	2	1.8
Aluminum	--	0	0.3
Arsenic	--	0	0.001
Cobalt	--	0	0.06
Iron	--	10	10
Zinc	--	0	0.4
Sulphate	--	128	128
pH	--	6.5 to 9.0	6.5 to 9.0

COC = contaminant of concern; PHC = petroleum hydrocarbon; SSTL = site specific target level; mg/kg = milligram per kilogram; mg/L = milligram per litre; -- = not applicable
(a) The overall SSTL for the Site was selected as the lower of the health-based SSTL and ecological-based SSTL.

As described in the FCRP and summarized in Section 6.2.2. arsenic concentrations above 4,000 mg/kg will be ex-situ remediated and will be excavated and disposed of within the shafts or into open crown pillars for isolation. Other soil exceeding the SSTL for arsenic will be risk-managed with the placement of a coarse-grained engineered cover.

6.2.3.3 Areas Requiring Remediation/Risk Management and Sufficiency of the Final Closure and Reclamation Plan

Locations where soil and groundwater concentrations are above the SSTLs for the Site and requiring remediation and/or risk management are indicated on Figures 13 and 14 of the HHERA, respectively.

The FCRP (Golder 2018) outlined the remediation and risk management measures proposed to address contaminated soil and waste rock at the Site. Based on the results of the HHERA, the measures outlined in the FCRP were evaluated as to whether they are sufficiently protective of human health and the environment:

- Risks to human and ecological receptors from several COCs (pH, PHCs F1 to F3, cyanide, arsenic, lead and naphthalene) in soil were identified. Exceedances of the SSTLs for soil (HHERA Figure 13) are located within the areas where waste rock will be removed or covered. The remediation and risk management measures outlined in the FCRP (e.g., placement of engineered cover) are considered sufficient to address these risks.
- Risks to ecological receptors (i.e., plants) from several COCs (PHC F2, aluminum, arsenic, cobalt, iron, zinc and sulphate) in groundwater were identified. Exceedances of the SSTLs for groundwater (HHERA Figure 14) are located within the areas where waste rock will be removed or covered. The remediation and risk management measures outlined in the FCRP (e.g., placement of engineered cover) is considered sufficient to address these risks.
- Moderate risks to aquatic life from low pH were identified for Boot Lake and Unnamed Lake. Surface water quality modeling of receiving water bodies was completed to evaluate the performance of the proposed granular esker cover of the waste rock dome with respect to limiting generation of ARD-impacted seepage from the waste rock dome. Based on the identified risks to aquatic life, the proposed risk management measures outlined in the FCRP (i.e., waste rock consolidation and placement of engineered cover) may not be sufficient to fully address the potential risks from low pH in these lakes. The water quality model used a number of conservative assumptions that may have overestimated the transport of acidity to Boot Lake and Unnamed Lake, resulting in low pH. Given this, water quality monitoring is recommended for Boot Lake, Unnamed Lake and Lower Sewage Lake. The results of the monitoring will be used to assess the current conditions, to provide data to evaluate the conservatism of the water quality model and to verify the conclusion of negligible risks to aquatic life from metals (cadmium, cobalt and copper). It is anticipated that the current water quality in these lakes would be improved with the implementation of the FCRP measures (waste rock consolidation and placement of engineered cover). The recommended water quality monitoring is briefly described below. A more detailed monitoring program can be developed under a separate scope of work:
    - Before implementation of the FCRP, it is recommended that one sample is collected from each water body and submitted for analysis of the following parameters: pH, hardness, dissolved oxygen, temperature, alkalinity, anions, sulphate and metals.

- After implementation of the FCRP, monitoring at a frequency of two sampling events per year (one at freshet and one late in the thawed season) for three years is recommended to confirm pH and metal concentrations in the water bodies.
- Contingent on the results of the water quality monitoring in the lakes, other measures may need to be considered.

In summary, the measures outlined in the FCRP are sufficiently protective of human health and the environment with respect to soil and groundwater; however, additional measures should be considered with respect to ARD-impacted seepage from the proposed esker-covered waste rock dome and potential reductions in pH in Boot Lake and Unnamed Lake. Water quality monitoring is recommended to assess the current conditions, provide data to evaluate the conservatism of the water quality model and to confirm the conclusion of negligible risks to aquatic life from metals.

6.2.4 Regulatory Review

During the regulatory review process, CIRNAC (TC 7; 14(ii); and 31) requested clarification regarding the HHERA and how the results would be incorporated into the FCRP.

LMI confirmed:

- LMI committed to submit within one year of approval of the renewed/amended licence a Post Closure Monitoring Plan (PCMP) that incorporates, where appropriate, regulatory review comments, ongoing field work, HHERA results, and any other direction from the NWB. (TH/PHC Commitment No. 14). The PCMP will be developed in accordance with Part J, Item 13 and Schedule J of Water Licence 2AM-LUP2032. For addition information related to Monitoring refer to Section 5.0. (CIRNAC TC No. 14 & 31).
- An Ecological Risk Assessment was completed by Golder in 2004 specifically for the Tailings Containment Area (TCA). The HHERA (Golder 2019c) incorporated information gained for the TCA and provided a consistent (where appropriate), consolidated ecological component assessment for the entire Lupin Mine Site. A Phase 1 and 2 Environmental Site Assessment (ESA) was completed for the mine site by Morrow Environmental in 2006. Arctic Response completed a hygiene assessment of the Lupin Mine site in 2012. In 2017, Golder prepared an Update to the Phase 1 and 2 ESA and completed a survey of asbestos containing materials. These previous reports provided the data on the background conditions to support the HHERA. No further site work will be required. (CIRNAC TC No. 14(ii))
- LMI incorporated closure water quality and thermal modelling into the HHERA. (CIRNAC TC No. 14(ii))
- The HHERA was a quantitative assessment to evaluate potential risks to human and ecological receptors for all relevant pathways identified in the problem formulation stage of the risk assessment. The HHERA included an exposure assessment based on the site-specific conditions and relevant information from previous site investigations (for example, the Phase 1 and 2 Environment Site Assessments). Toxicity reference data for humans and ecological receptors obtained from various sources such as Health Canada, United States Environmental Protection Agency and the provincial jurisdictions (e.g., Ontario MOECC). For ecological receptors, toxicity reference values were selected based on applicable assessment and measurement endpoints and considered chronic effects including decreased growth, survival and reproduction. The HHERA determined whether risks were unacceptable for specific contaminants and pathways, present site-specific

target levels, and specified whether risk management measures were required to mitigate risks. (CIRNAC TC No. 7 and 14(ii))

- The HHERA was conducted in accordance with Canadian Council Ministers of Environment (CCME), Federal Contaminated Sites Action Plan (FCSAP) ERA and Health Canada guidance. Historical and current data for the Site was screened against applicable CCME guidelines to identify contaminants of potential concern (COPCs). Additional guidelines from other jurisdictions (e.g., other provinces, US EPA, or other jurisdictions recommended by CCME, FCSAP or Health Canada) were used when CCME guidelines are not available and/or included for additional context, where applicable. This approach is consistent with methods used in HHERA for Nunavut Mine Sites (i.e., Nanisivik Mine and Polaris Mine). Following the finalization of the problem formulation of the risk assessment, the quantitative elements of the risk assessment were completed. (CIRNAC TC No. 14(ii))
- Following quantitative exposure assessment, toxicity assessment and risk characterization, LMI reviewed and compiled pertinent information from previous reports for Lupin Mine including: the 2004 Ecological Risk Assessment for the TCA; the 2006 Phase 1 and 2 ESA; the 2012 hygiene assessment; 2017 update to the Phase 1 and 2 ESA; and 2017 asbestos containing materials survey. This information was used to develop the conceptual site model which sets the stage for the HHERA in the problem formulation step. (CIRNAC TC No. 14(ii))
- The results of the HHERA for the closure scenario and associated pathways indicated that the remediation and risk management measured outlined in the FCRP were considered sufficient to address potential risks to human and ecological receptors. However, the HHERA concluded that there could remain a moderate risk to aquatic life from low pH in Boot Lake and Unnamed Lake. It was recognized that the water quality model was conservative and that the closure measures would result in an improvement relative to the current water quality; however it was recommended that water quality monitoring be undertaken in Boot Lake, Unnamed Lake and Lower Sewage Lake. LMI may propose additional reasonable and practical adaptive management strategies (i.e., applicable monitoring (FCRP, Tables 18 and 19) and/or additional remediation measures) may be implemented (CIRNAC TC No. 14(ii)).

7.0 FINANCIAL SECURITY

7.1 Basis of Financial Security

This Rev1 of the FCRP has been prepared based on the current site conditions and it provides the concepts and activities for the full closure and reclamation of the Site. The FCRP Rev1 Plan reflects relevant comments and recommendations provided by intervening parties and the Board during the review process for the Application for renewal/amendment.

Specially, information requests, technical comments (CIRNAC TC No. 24, 32 to 39), and commitments (LMI TM/PHC Commitment No. 2), identified throughout the regulatory review process were incorporated (where applicable) into documents provided in Appendix G, the:

- LMI Revised Estimate (Exhibit 25) dated 16 January 2020;
- Security Framework Milestones for Draft Water Licence Framework (Exhibit 26); and
- Joint Submission of LMI and CIRNAC regarding Security Reduction Framework (Exhibit 27) dated 16 January 2020

On issuance of the Type A Water Licence 2AM-LUP2032 by the NWB and subsequent approval by the Minister of CIRNAC, the basis of financial security is defined in Part C and Schedule C of the Licence.

This FCRP (Rev1) supersedes any previous ICRP, CMP or version of the FCRP(Rev0) including any cost estimates provided in appendix to these documents.

7.2 Key Project Milestones

LMI expects to submit reports that will form the basis for security refunds and will define the requests for security refund based on completion of line items provided in the most recent cost estimate, regardless of actual cost expended on the reclamation works consistent with the security framework milestone, joint submission and Type A Water licence requirements under Part C of 2AM-LUP2032. LMI believes refunds should be based on estimated values provided by LMI, given that the posting of security is based on an accepted estimate.

It is LMI's expectation that inspections to be completed by CIRNAC under the NWNSRTA will be completed on a timely basis in line with LMI reporting such that the processes for securing of refunds can be applied efficiently, thereby allowing LMI to apply the refunds to ongoing reclamation works thus completing the work on schedule, as efficiently as possible.

LMI filed its first request for security refund to CIRNAC on March 25, 2020. Operations subsequently forwarded it to the Minister on April 14, 2020. On May 12, 2020 the Minister approved a security reduction in the amount of $6,549,072. The new letter of credit (LOC) was approved by CIRNAC on June 9, 2020 in the amount of $19,558,231.

LMI's second request was submitted to CIRNAC on July 20, 2020 and LMI is currently awaiting the Minister's decision.

Refer to the security information posted to the NWB Public Registry.

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FIGURES

APPENDIX A

List of Permits, Licences, and Authorizations Required for Project

Table A-1: List of Permits, Licences, and Authorizations Required for the Project

Responsible Authority	Legislation	Authorization	Project Activity	Permitting Strategy/Timeline
Nunavut Impact Review Board	Nunavut Agreement Article 12 Nunavut Planning and Project Assessment Act (S.C. 2013, c. 14, s. 2)	Project Certificate – not applicable	Required to obtain requisite permits and approvals to proceed with Project	NIRB Screening Decision (NIRB 99WR053) issued 16 November 1999.
Kitikmeot Inuit Association	Nunavut Agreement Article 26	Inuit Impact and Benefits Agreement	Required to proceed with Project	Not Applicable – project entirely on Crown Lands
	Nunavut Agreement Article 20	Inuit Water Rights Compensation Agreement	May be required	
	Nunavut Agreement Article 6	Wildlife Compensation Agreement		
	Nunavut Agreement	Inuit Owned Lands - Commercial Land Use Lease	Access surface IOL to develop mine	
		Inuit Owned Lands - Quarry Concession Licences	Extract aggregate on IOL	
Nunavut Water Board	Nunavut Agreement Article 13 *Nunavut Waters and Nunavut Surface Rights Tribunal Act* Nunavut Waters Regulations	Type A and B Water Licences; Approval without a Licence	Required for water use and waste disposal	Type A -2AM-LUP2032 issued on 28 February 2020 and approved on 9 April 2020.
Crown Indigenous Relations and Northern Affairs Canada (CIRNAC)	*Territorial Lands Act* Canadian Mining Regulations- Territorial Land Use Regulations	Crown Land - Land lease and Water lot lease	Access surface Crown lands for the Project life	Refer to Section 1.3.2, Table 1
	Territorial Quarrying Regulations	Crown Land - Quarry Lease/Permit	Extract aggregate on Crown Land	

Table A-1: List of Permits, Licences, and Authorizations Required for the Project

Responsible Authority	Legislation	Authorization	Project Activity	Permitting Strategy/Timeline
Fisheries and Oceans Canada	*Fisheries Act* (Section 35(2))	Authorization under Paragraph 35(2)(b) of the *Fisheries Act*; required if serious harm to fish cannot be avoided. In instances in which serious harm to fish can be avoided, DFO may provide a letter of authorization in addition to compliance with Measures to Avoid Causing Harm to Fish and Fish Habitat.	Project activities directly removing or altering fish habitat: full lake dewatering, culvert installations, dam construction in watercourses, stream flow reductions and potential water and sediment quality changes.	General Application of DFO environmental protection measures No Authorization for the Project.
Environment Canada	*Fisheries Act (Section 36)* Metal Mining Effluent Regulations	Notice of Closed Mine Status	Notice to be provided; Final Study design required not less than 6 months following notice.	Notice of Closure filed 30 January 2019. ECCC confirmed closed mine status on 30 January 2022.
		Environmental Effects Monitoring	Implement EEM program	EEM Final Study design implemented August 2019. (See Sections 1.3.3 and 2.1.6)
Natural Resources Canada	*Explosives Act* and Regulations Blasting Permits Explosive Magazine Permits Radio Licensing	Licence for a Factory and Magazine	Required for construction of explosives factories and magazines and storage of explosives	
GN Culture and Heritage	Nunavut Archaeological and Palaeontological Sites Regulations (Nunavut) *Nunavut Historical Resources Act*	Archaeology Permit	Required to conduct archaeology surveys and to mitigate cultural/heritage resources	Not required at this time.
Nunavut Research Institute	*Scientist Act* (Nunavut)	Scientific Licences: Land and Water Social and Traditional Knowledge	Undertake non-biological and non-cultural heritage baseline and monitoring studies	Required for Final Study Design

Table A-1: List of Permits, Licences, and Authorizations Required for the Project

Responsible Authority	Legislation	Authorization	Project Activity	Permitting Strategy/Timeline
GN Environment	*Environmental Protection Act* (Nunavut) Spill Contingency Planning and Reporting Regulations(Nunavut)	Approval of Spill Contingency Plan		
	Environmental Protection Act (Nunavut)	Hazardous Waste Generator		Generator No. NUG10047
	Wildlife Act (Nunavut)			
GN Health and Social Services	*Public Health Act* (Nunavut) Camp Sanitation Regulations (Nunavut)	Approval of camp facilities	Construction and operation of camp, medical facilities, buildings and propane storage	
	Emergency Medical Aid Act (Nunavut)	Medical facilities approval		
GN Community and Government Services	Building Codes (Nunavut)	Building Permits	Construction and operation of camp, medical facilities, buildings and propane storage	
	Fire Prevention Act (Nunavut) Fire Prevention Regulations (Nunavut) Propane Cylinder Storage Regulations	Approval of camp facilities and propane storage		
Worker's Safety and Compensation Commission of Nunavut - Mine Health and Safety	*Explosives Use Act* (Nunavut) Explosive Use Regulations (Nunavut)	Authorization to store and use explosives	Required to store detonators in a magazine	
	Mine Health and Safety Act (Nunavut) Mine Health and Safety Regulations (Nunavut)	Authorization to store and use explosives	Required to store detonators in a magazine	
	Worker's Compensation Act (Nunavut) Workers Compensation Regulations (Nunavut)	Authorization for Activities	Required to proceed with Project activities	Letter on File

IOL = Inuit Owned Land

APPENDIX B

Type A Water Licence Concordance

1) Historical Water Licences' Closure Terms and Conditions Concordance

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	28-Feb-20	2AM-LUP2032	Part I, Item 1	The Board has approved the Final Closure and Reclamation Plan, dated July 2018.	28-Feb-20	Licence Approved by Minister 9 April 2020	
	28-Feb-20	2AM-LUP2032	Part I, Item 2	The Licensee shall, within ninety (90) days of approval of the Licence, submit to the Board for review, an updated Final Closure and Reclamation Plan, to address relevant comments and recommendations provided by intervening parties andthe Board during the review process for the Application.	Current submission dated 25 September 2020		
	28-Feb-20	2AM-LUP2032	Part I, Item 3	The Licensee shall notify the Board in writing, as soon as is practically possible, of any change in the status of the mine or activities associated with the mine. This notice shall include a summary of Plans and a Schedule for anticipated activities related to change in Phase of the Project.	No notifications given as of 25 September 2020		
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	At least three (3) years prior to final abandonment the Licensee shall submit to the Board a Final AR plan. That plan shall include, but is not limited to, the following:	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	a. Incorporation of recommendation made in the report entitled "Closure Cost Estimate and Scoping of Mine Closure Issues, Lupin Mine NWT," (Golder Associates, 1997).	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	b. An outline of methods to contain potential pore water expulsion from the TCA;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	c. Identification of sites of contaminated soils at the mine site	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	d. A summary of existing data for background levels of metals in the area, and identification of needs for verification of data or reassessment with modern detection	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	e. Description of restoration activities outlines in the "Interim" AR plan;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	f. An implementation schedule for the completion of restoration;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 3	g. A detailed monitoring program.	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	01-Jul-00	NWB1LUP0008 (Echo Bay/Kinross)	Part I, Item 6	The Licensee shall notify the Board of its intention to proceed with final abandonment of the undertaking at least (6) months prior to the planned dates of closure.	FCRP Consulation Record	Notice filed with ECCC 30 January 2020.	
NWB	19-Dec-01	NWB1LUP0008 (Echo Bay/Kinross) Amendment 1	No FCRP requirements outlined - Security				
NWB	13-Apr-07	2AM-LUP008 (Kinross/Lupin Mines) Assignment	No FCRP requirements outlined - Assignment	n/a	n/a	n/a	n/a
NWB	15-Oct-08	NWB1LUP0008 (Lupin Mines) Amendment 2	No FCRP requirements outlined - Expiry of licence	n/a	n/a	n/a	n/a
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Part I, Item 2 (C&M)	The Licensee shall, no later than thirty (30) days following approval of the Licence by the Minister, submit to the Board for approval, a Care and Maintenance Plan that shall be prepared in accordance with Schedule I, Item 2.	Mar-10	Submitted by MMG;	Care Maintenance Plan (2010 MMG)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Part I, Item 4	The Licensee shall notify the Board in writing, at least sixty (60) days prior to any intent to achieve Recognized Closed Mine Status.	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Part 1, Item 5	The Licensee shall submit to the Board for approval, a Final Abandonment, Reclamation and Closure Plan, at least two (2) years prior to the final andonment of the mine. The Final Plan shall be prepared in accordance with Schedule I, Item 2.	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Part I, Item 9	Notwithstanding the time schedule referred to in the Abandonment, Reclamatio and Closure Plan, The Licensee shall implement Progressive Reclamation, including progressive covering of the tailings and revegetation, as soon as is realistically possible.	FCRP Section 3.0 and subsection.	Summary of Progressive Reclamation of provided in Annual Reports	Annual Reports
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	Care and Maintenance Plan referred to in Part I, Item 2 shall include:	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	a. Water and wastewater management plans including measures to avoid the accumulation of run-off water, wastewater retention and release, and Sewage Disposal Facility operation;	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	b. Inspections for fuels, chemicals, all hazardous material s and spills;	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	c. Details on tailings management and monitoring;	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	d. Details on the continued storage of Petroleum products including Bulk Fuel Storage;	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	e. Details on the plans to be implemented for mitigation of exposed tailings and a schedule, including assessment of alternatives; and	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 2 (C&M)	f. Justification for not proceeding to full reclamation under Part I, Item 5	Mar-10	Submitted by MMG; Note Revised C&M Plan submitted and approved under most recent licence.	Care Maintenance Plan (2010 MMG) includes Appendixes: A Lupin Waste Management Plan B Lupin TCS Discharge Procedure C Lupin TCA Discharge Sampling Procedure D Lupin Wildlife Management Plan E Lupin Stormwater Management Plan
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	3. The Final Abandonment, Reclamation and Closure Plan referred to in Part I, Item 5 shall, in addition to Item I of Schedule I, include:	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	a. Incorporation of recommendation made in the report entitled "Closure Cost Estimate and Scoping of Mine Closure Issues, Lupin Mine NWT," (Golder Associates , 1997).	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	b. An outline of methods to contain potential pore water expulsion from the TCA;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	c. Identification of contaminated soil sites at the mine site;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	d. A summary of existing data for background levels of metals in the area, and identification of needs for verification of data or reassessment with modern detection limits;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	e. Soil Quality Remediation Objectives along with CCME Guidelines and the Government of Nunavut Environmental Guidelinefor Site Remediation	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	f. Environmental Site Assessment plans in accordance Canadian Standards Association (CSA) criteria	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	g. An evaluation of the Human Health and Ecological Risk associated with closure options; and	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	h. Description of reclamation activities outlined in the Interim Abandonment , Reclamation and Closure Plan.	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	a. Disposal information for unsold accommodation facilities;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	b. Disposal of contaminated soils;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	c. Inspections for fuel/oil spills and inspections of fuel containment facilities;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	d. Information on the geotechnical requirements, slope and the placement of rip rap along the downstream side of Dam 4;	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	e. Detailed drawings, activities, construction schedules and techniques for the breakwater and causeway; and	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 1 (excerpt as required)	f. Justification for not proceeding to full reclamation	n/a	n/a	n/a
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	i. An implementation schedule for the completion of reclamation; and	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	16-Jun-09	2AM-LUP0914(Lupin Mines)	Schedule I, Item 3	j. A detailed monitoring program	Requirement of most recent water licence	(See 2AM-LUP1520 (Lupin Mines)	(See 2AM-LUP1520 (Lupin Mines)
NWB	06-Oct-14	2AM-LUP0914(Lupin Mines) Emergency Amendment	No FCRP requiremtns - Effluent Discharge	n/a	n/a	n/a	n/a
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	The Board has approved the Plan entitled Lupin Mine Site, Nunavut, Canada, Interim Abandonment and Restoration Plan (Care and Maintenance), dated March 2013, submitted as additional information with the Application and consisting of the following:	Approved on issuance of licence Renewal/ Amendment	Submitted with Application for Renewal/Amendment filed March 2013	Interim AR Plan (IARP) (March 2016, LMI/MRC) include Appendix A - Figures
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	a. Figures;	Approved on issuance of licence Renewal/ Amendment		Interim AR Plan (IARP) (March 2016, LMI/MRC) include Appendix A - Figures
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	b. Closure Plan for Tailings Containment Area;	Approved on issuance of licence Renewal/ Amendment		Appendix B - Closure Plan for Tailings Containment Area (January 2005, Holubec)
							TCA Appendix A - Photographs
							TCA Appendix B Supporting Figures
							TCA Appendix C - Ground Tempertures
							TCA Appendix D - Dam and Earth Structures Stability Analyses
							Volume 1 - Geotechnical, Seepage, and Water Balance - Seepage and Water Quality for Reclaimed TCA (March 2006, Holubec)
							Volume II - Water Managemnet After Closure - Seepage and Water Quality for Reclaimed TCA (March 2006, Holubec)
							Volume III - Geochemistry and Water Quality - Seepage and Water Quality for Reclaimed TCA (April 2006, EcoMetrix)

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	c. Studies Related to Water Licence Requirements and in Support of Reclamation Planning;	Approved on issuance of licence Renewal/ Amendment		Appendix C - Studies Related to WL Requirements and in Support of Reclamation Planning (December 2004)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	d. Ecological Risk Assessment for Lupin Mine Tailings;	Approved on issuance of licence Renewal/ Amendment		Appendix D - Ecological Risk Assessment for the Lupin Mine Tailings Containment Area (December 2004, Golder),
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	e. Response to Technical Review Comments on Lupin TCA A&R Plan; and	Approved on issuance of licence Renewal/ Amendment		Appendix E - Response to Technical Review Comments on Lupin TCA A&R Plan
							Appendix F - Concordance Table to Technical Review Comments on 2013 IARP
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 1	f. Cycle 3 Environmental Effects Monitoring Report, Investigation of Cause Reports and Addendum.	Approved on issuance of licence Renewal/ Amendment		Appendix G - Site Characterization and Cycle 3 EEM Investigation of Cause Study Design (January, 2010, AECOM)
							Appendix G - EEM-Cycle 3 Interpretatie Report (May, 2011, AECOM)
							Appendix H - Addendum 2011 EEM interpretative Report Response to TAC (January 2013, HEMMERA)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 2	The Licensee shall, within ninety (90) days of approval of the Licence by the Minister, submit to the Board for review, an update to the plan referred to in Part I, Item 1, to address relevant comments and recommendations provided by intervening parties and the Board during the review process for the Application. Revisions to all plans should take into consideration the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2007) and the Mine Site Reclamation Policy (INAC, 2002).	Aug-17		Updated IARP (August 2017, LMI/MRC)
					18-Oct-17		Interim Closure and Reclamation Plan (October 2017, LMI/MRC)
					18-Oct-17		Updated Phase I and II ESA (October, 2017, Golder)
					18-Oct-17		Reclaim Update (October 2017, LMI/MRC)
					18-Oct-17		EEM Phase 5 Report (June 2017, Golder)
					18-Oct-17		Final Report - Closure Cost Update (October 2017, Golder)
					29-Nov-17		LMI/MRC Response to Comments
					16-Feb-18		Letter of credit LOC (September 2017)
					02-Mar-18		LMI/MRC Letter to NWB request Next Steps ICRP Review
					01-Jul-18		Approved
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	The Board has approved the Plan entitled Lupin Mine Site Nunavut, Canada Care and Maintenance Plan (Care and Maintenance), dated March 2013, which was submitted as additional information with the Application and consisting of the following:	Approved on issuance (AOI) of licence Renewal/ Amendment	Submitted with Application for Renewal/Amendment filed March 2013	Care and Maintenance Plan (March, 2016, LMI/MRC)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	a. Lupin Mine Waste Management Plan (Solid and Hazardous)	Approved on issuance (AOI) of licence Renewal/ Amendment		Waste Management Plan (Solid and Hazardous) C&M (March 2016, LMI/MRC)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	a. Incinerator Operation and Maintenance Procedure	Approved on issuance (AOI) of licence Renewal/ Amendment		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	b. Lupin Mine Liquid Waste Management Plan	Approved on issuance (AOI) of licence Renewal/ Amendment		Liquid Waste Management Plan C&M (March 2016, LMI/MRC)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	a. Water Quality Monitoring Plan Quality Assurance/ Quality Control Plan	Approved on issuance (AOI) of licence Renewal/ Amendment		Environmental Laboratory QA/QC Plan (December 1995, EBM)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	c. Lupin Mine Wildlife Management Plan; and	Approved on issuance (AOI) of licence Renewal/ Amendment		Wildlife Management Plan C&M (March 2016, LMI/MRC)

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 3	d. Lupin Mine Fuel Containment Management Strategy	Approved on issuance (AOI) of licence Renewal/ Amendment		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 4	The Licensee shall, within ninety (90) days of approval of the Licence by the Minister, update and submit to the Board for review the plan(s) referred to in Part I, Item 3 to address relevant comments and recommendations provided by intervening parties during the review process for the Application. Revisions to all plans should take into consideration applicable regulations and guidelines.	ICRP Recently Approved July 2018		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 5	The Licensee shall notify the Board in writing, at least sixty (60) days prior to, or upon initiating the process to achieve Recognized Closed Mine status.	30-Jan-20	"Recognized Closed Mine" means a recognized closed mine as defined by section (1) of the Metal Mining Effluent Regulations SOR/2002-222 dated 6 June 2002;	
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 6	The Licensee shall submit to the Board for approval, at least two (2) years prior to the final closure of the mine, a Final Abandonment, Reclamation and Closure Plan. The Plan shall be prepared in accordance with Schedule I, Item 1.	FCRP Ver0 Approved under 2AM-LUP2032 Part I, Item 1.		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 7	The Licensee shall notify the Board in writing, as soon as is practically possible, of any change in the status of the mine or activities associated with the Mine. This notice shall include a summary of Plans and a Schedule for anticipated activities related to the Care and Maintenance, the Transition Phase or the Final Closure of the Mine and associated infrastructure.	FCRP Ver0 Approved under 2AM-LUP2032 Part I, Item 1.	**"Care and Maintenance Phase"** refers to the current state, at the time of Licence issuance, of the Lupin Mine, a scenario in which the mine ceases Operations with the intent of resuming mining activities at some point in the future, as described in Indian and Northern Affairs Canada's (INAC) Mine Site Reclamation Guidelines for the Northwest Territories (2007); **"Transition Phase"** refers to the phase in which project activities including Water use may "ramp up" within specific or allowable thresholds for a predefined period of time and for the purposes of assess operational requirements but not including active mining and milling operations.	
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 8	Notwithstanding the time schedule referred to in the Interim Abandonment, Reclamation and Closure Plan, in Part I, Item 1, the Licensee shall implement Progressive Reclamation, including progressive covering of the tailings and re-vegetation where feasible, as soon as is realistically possible.	FCRP Section 3.0 and subsection. Progressive Reclamation reported annually refer to Annual Reports		Annual Reports (1999-2017)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 9	The Licensee shall submit to the Board for review, as part of any application to amend and/or renew the Licence, or to commence active reclamation of the Project site, an updated or revised version of the Environmental Site Assessment conducted for the Project in 2006.	Oct-17		Updated Phase I and II ESA (October, 2017, Golder)

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Part I, Item 10	The Licensee shall, as part of the updated Environmental Site Assessment required under Part I, Item 9, conduct a detailed rock characterization study or program to determine the total quantity (inventory) of Potentially Acid Generating (PAG) material associated with the Project site and identify any potential contamination that may be linked to such material. A written report of the results obtained and analyses conducted shall be submitted to the Board for review as part of any application to amend and/or renew the Licence, or notification to commence active reclamation of the Project site.	Oct-17		Updated Phase I and II ESA (October, 2017, Golder)
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	The Final Abandonment, Reclamation and Closure Plan referred to in Part I, Item 6 shall, be developed in accordance with the Mine Site Reclamation Guidelines for the Northwest Territories, 2007 and be consistent with the INAC Mine Site Reclamation Policy for Nunavut, 2002 as well as address the following:	FCRP submitted with Application for renewal/amendment July 2018		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	a. Disposal information for unsold accommodation facilities	FCRP Section 3.3.2 and Section 4.3.2.9		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	b. Disposal of contaminated soils;	FCRP Section 4.3.2.3		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	c. Inspections for fuel/oil spills and inspection of fuel containment facilities;	FCRP Apppendix E, Table E-2		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	d. Information on the geotechnical requirements, slope and the placement of rip rap along the downstream side of Dam 4;	FCRP Section 4.3.2.8		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	e. Detailed drawings, activities, construction schedules and techniques · for the breakwater and causeway; and	FCRP Table 14 and Section 2.4.7.2, Section 4.3.2.10		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	f. Incorporation of recommendation made in the report entitled "Closure Cost Estimate and Scoping of Mine Closure Issues, Lupin Mine NWT," (Golder Associates, 1997);	FCRP Section 7.0		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	g. An outline of methods to contain potential pore water expulsion from the TCA;	FCRP Section 4.3.2.13		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	h. Identification of contaminated soil sites at the mine site;	FCRP Section 4.3.2.3 and Phase 1 and 2 ESA already on file with NWB		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	i. A summary of existing data for background levels of metals in the area, and identification of needs for verification of data or reassessment with modern detection limits;	FCRP Section 4.3.2.3 and Phase 1 and 2 ESA already on file with NWB		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	j. Soil Quality Remediation Objectives along with CCME Guidelines and the Government of Nunavut Environmental Guideline for Site Remediation;	FCRP Section 4.3.2.3 and Phase 1 and 2 ESA already on file with NWB	HHERA completed and filed with NWB following TM/PHC Commitment No. 1	
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	k. Environmental Site Assessment plans in accordance Canadian Standards Association (CSA) criteria;	Completed; Phase 1 and 2 as well as update on file with NWB.		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	l. An evaluation of the Human Health and Ecological Risk associated with closure options;	Pending HHERA under development - FCRP Section 6.2		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	m. Description of reclamation activities outlined in the Interim Abandonment, Reclamation and Closure Plan.	FCRP Section 4.0 and subsections		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	n. An implementation schedule for the completion of reclamation; and	FCRP Table 14		
NWB	05-Oct-15	2AM-LUP1520 (Lupin Mines)	Schedule I, Item 1	o. A detailed monitoring program.	FCRP Section 5.0		
NWB	28-Mar-17	AAM-LUP1520 (Lupin Mines) - Amendment 1 - Security	No FCRP requirements outlined - Security	n/a	n/a	n/a	n/a

Agency	Issued	Licence	Part No., Item No.	Term and Conditions	Concordance	Notes	Link on NWB Public Registry
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	55	The Licensee shall remove all scrap metal, discarded machinery and parts, barrels and kegs, buildings and building material upon abandonment.	FCRP Section 4.0 and subsections. Section 4.3.2.9		
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	56	The Licensee shall undertake ongoing restoration for any land or improvements, which are no longer, required for the Licensee's operation on the land.	FCRP Section3.0 and Subsections		
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	57	The Licensee shall cap all drill holes and cut off any drill casings that remain above ground to ground level upon abandonment of the operation.	no exploration work done under current permits		
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	58	The Licensee shall complete all clean up and restoration of the lands used prior to the expiry date of the permit.	Ongoing; Schedule Table 14 with Term of Licence provided in Application		
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	61	The Licensee shall establish a monitoring program with the NWB in order to provide an on-going assessment of the tailings ponds. This monitoring program should include, but not be limited to measuring the seepage flow rate, temperature, total suspended solids, permafrost levels by thermisters and slope stability.	FCRP Section 5.0		
NIRB	16-Nov-99	NIRB 99WR053 Screening Decision	62	The Licensee shall submit to the NWB and NIRB a summary report of activities undertaken and any abandonment and restoration of the site.	Annual Report filed March 31 annually for prior calendar year; FCRP Section 3.0		
NIRB	09-Jun-14	Reconfirmed NIRB 99WR053 orginal screening decision applied to water licence renewal					

APPENDIX C

Glossary of Terms and Definitions

Glossary of Terms and Definitions

Term	Definition
Acid Base Accounting (ABA)	Acid base accounting; a static test that defines the amounts, and relative balance, of potentially acid-generating and acid-neutralizing (or base) minerals in a sample.
Active layer	The layer of ground above the permafrost which thaws and freezes annually.
Acid rock drainage (ARD)	Acidic pH rock drainage due to the oxidation of sulphide minerals that includes natural acidic drainage from rock not related to mining activity; an acidic pH is defined as a value less than 6.0.
Advanced mineral exploration	Any appurtenant undertaking in which the proponent requires a Type A or Type B water Licence in order to carry out the proposed activities.
Quarries and Granular Borrow Sites	Site from where soils and aggregates are obtained for use in earthworks construction.
Care and maintenance	The status of a mine when it undergoes a temporary closure.
Closure goal	The guiding statement that provides the vision and purpose of reclamation. Attainment of the closure goal happens when the proponent has satisfied all closure objectives. By its nature, the closure goal is a broad, high-level statement and not directly measurable.
Closure principles	The four core closure principles are 1) physical stability, 2) chemical stability, 3) no long-term active care requirements, and 4) future use (including aesthetics and values). The principles guide the selection of closure objectives.
Closure objectives	Statements that describe what the selected closure activities are aiming to achieve; they are guided by the closure principles. Closure objectives are typically specific to project components, are measurable and achievable, and allow for the development of closure criteria.
Closure options	A set of proposed alternatives for closing and reclaiming each mine component. The closure options are evaluated to determine the selected closure activity, which must be approved by the NWB.
Closure criteria	Standards that measure the success of selected closure activities in meeting closure objectives. Closure criteria may have a temporal component (e.g., a standard may need to be met for a pre-defined number of years). Closure criteria can be site-specific or adopted from territorial/federal or other standards and can be narrative statements or numerical values.
Contaminant	1) any physical, chemical, biological or radiological substance in the air, soil, or water that has an adverse effect; and 2) any chemical substance with a concentration that exceeds background levels or which is not naturally occurring in the environment.
Effluent	Contact water flows that may or may not require treatment prior to being discharged to the environment.
Engagement	The communication and outreach activities a proponent undertakes with affected communities and Aboriginal organizations/governments prior to and during the operation of a project, including closure and reclamation phases.
Environmental Site Assessment (ESA)	Phase I ESA: A review of available information to determine the likelihood of actual or potential environmental impacts. Phase II ESA: An intrusive investigation involving sampling and testing to better define the nature and scope of any environmental impacts.
Explosives	Gunpowder, blasting powder, nitroglycerine, gun-cotton, dynamite, blasting gelatine, gelignite, fulminates of mercury or of other metals, ANFO and every other substance made, manufactured or used with a view to producing an explosion.

Glossary of Terms and Definitions

Term	Definition
Humidify cell test (HCT)	A type of kinetic test in which a small sample (about 1 kg) is placed in an enclosed chamber in a laboratory, alternating cycles of moist and dry air is constantly pumped through the chamber, and once a week the sample is rinsed with water; chemical analysis of rinse water yields concentrations of elements and other parameters used to calculate reaction rates.
Kinetic test	A geochemical procedure for characterizing the chemical status of a sample through time during continued exposure to a known set of environmental conditions, such as a humidity cell.
Landfarm	Infrastructure that uses biological and physical processes to treat (remove contaminants) contaminated soil.
Land owner	The responsible authority with administrative control and ownership of a type of land classified as crown land, commissioners land or Inuit Owned Land. a. Crown land is land belonging to Her Majesty or in respect of which Government has the power of disposition. In Nunavut, this power rests with CIRNAC. b. Commissions land is land belonging to the Commissioner for the Government of Nunavut; which typically is land within an established municipality administered by a Municipal Corporation and/or the Department of Community Government and Services (CGS) c. Inuit Owned Land (IOL) are those lands vested in the Designated Inuit Organization (DIO) pursuant the Nunavut Agreement. For this Project the DIO is the Kitikmeot Inuit Association.
Land use permit	a. For Crown land a Class A Permit or Class B Permit as required by the Territorial Land Use Regulations SOR/82-217, s.1; SOR/88-169, s.2 administered by CIRNAC Lands Department. b. For IOLs- Land Use Licence I, II or III or Commercial Lease I, II, III as defined by the DIO. c. For Commissioners land - a permit or lease as required by the Municipal Land Administration Policy.
Leachate	Water or other liquid that has washed (leached) from a solid material, such as a layer of soil or water; leachate may contain contaminants.
Long-term active care	A post-closure mine site is in long-term active care when sustained monitoring and maintenance of active facilities is required (e.g., for more than 25 years). This should be avoided whenever possible.
Metal leaching (ML)	The release of a metal from its solid-phase mineral into mine site drainage; described by concentrations in static tests and by metal release rates obtained from kinetic tests.
Passive long-term care	Occasional monitoring, coupled with infrequent maintenance or repairs that takes place following reclamation in the post-closure phase of the mine site. Many mine sites require ongoing passive care, which can be an acceptable practice.
Ore	Rock that is considered economic according to the parameters used in the ore reserve estimate.
Overburden	A general term referring to soil and broken rock, lying above ore and mine rock, that can usually be removed without blasting; at mines in soft sedimentary rock like coal, overburden can be synonymous with mine rock.
Potentially acid generating (PAG)	Rock with an NP/AP ratio less than 2 as determined by static tests, as defined by MEND (2009). PAG rock can also be operationally defined based on the results of static testing such as ABA and NAG testing.
Permafrost	Bedrock or soil that maintains a temperature at or below 0º C for a continuous period of two years or more.

Glossary of Terms and Definitions

Term	Definition
Progressive reclamation	Selected closure activities that can be taken at advanced mineral exploration and mine sites before permanent closure. Progressive reclamation takes advantage of cost and operating efficiencies by using the resources available from an operation to reduce the overall reclamation costs incurred. It enhances environmental protection and shortens the timeframe for achieving the closure objectives.
Proponent	Applicant for, or a holder of, a water Licence and/or land use permit.
Reclamation	The process of returning a disturbed site to its natural state or which prepares it for other productive uses that prevents or minimizes any adverse effects on the environment or threats to human health and safety.
Reclamation research	Literature reviews, laboratory or pilot-scale tests, engineering studies, and other methods of resolving uncertainties. Proponents conduct reclamation research to answer questions pertaining to environmental risks; the design of reclamation research plans aims to provide data and information which will reduce uncertainties for closure options, selected closure activities, and/or closure criteria.
Remediation	The removal, reduction, or neutralization of substances, wastes, or hazardous material from a site in order to prevent or minimize any adverse effects on the environment and public safety now or in the future.
Risk assessment	Analysis of potential threats and options for mitigation for a given site, component, or condition. Risk assessments consider factors such as risk acceptability, public perception of risk, socio-economic impacts, benefits, and technical feasibility. It forms the basis for risk management.
Salvageable Materials	Decommissioned materials which can be sold or reused elsewhere.
Security deposit	Funds held by the Crown (CIRNAC) or land owner that can be used in the case of abandonment of an undertaking to reclaim the site or carry out any ongoing measures that may remain to be taken after the abandonment of the undertaking.
Selected closure activity	The closure and reclamation activity chosen from the closure options for each Project component.
Stakeholders	Industry, federal agencies, the territorial government, Aboriginal organizations/governments, land owners, affected communities, and other parties with an interest in the Project.
Talik	Unfrozen ground surrounded by permafrost.
Traditional Knowledge	Accumulative, collective body of knowledge, experience, and values built up by a group of people through generations of living in close contact with nature. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual, and political change.
Type A Water Licence	A Type A Water Licence is required if the use is of a type set out in column 2 of Schedule 2 and satisfies a criterion set out in column 5 in respect of an undertaking set out in column 1 of the Nunavut Water Regulations SOR/2013-69 *(Note: despite definition of Type B Water Licence item a), a Type A Licence is the appropriate Licence for a use of waters if a Type A Licence is required for another use of waters, or a deposit of waste, in respect of the same undertaking.)*
Type B water Licence	A Type B water Licence required if a. The use is of a type set out in column2 of Schedule 2 and satisfies a criterion set out in column 4 in respect of an undertaking set out in column 1, or b. The use satisfies the criterion set out in paragraph 4(1)(a) but does not satisfy one or more criterion set out in paragraphs 4(1)(b) to (d) of the Nunavut Water Regulations SOR/2013-69
Waste rock	All unprocessed rock materials that a mining operation produces.

APPENDIX D

Detailed History of Closure Plan Development

The following provides background on the closure and reclamation planning requirements for the Lupin Mine since construction/production began.

Date	Description
1983	Commercial production began and the first 'conceptual' Abandonment and Restoration Plan was submitted to DIAND to fulfill requirements of Water Licence N7L2-0925 and Land Lease No.'s 3593 and 3594. Revisions were requested clarifying certain areas of the plan.
1984	In December, the IARP was re-submitted in two parts
	Part 'A' was prepared by consultants Reid Crowther and Partners Ltd. and contained a review of current technologies for reclamation applicable to the Lupin Mine, as well as potential problems and conditions that may develop as a result of the operation.
	Part 'B' was prepared by Echo Bay Mines Ltd. and outlined the plan of action with respect to the conditional requirements outlined in the Water Licence and the Federal Land Leases
1985	The IARP was resubmitted to include revisions required under the amended Water Licence and was accepted apart from the plans for the TCA. Regulatory authorities indicated that it would be unwise to commit to a specific plan of action at that time due to advancing technology and the anticipated mine life.
1987 to 1995	Annual updates and revisions to the IARP were submitted for approval along with the results of various studies/reports undertaken during operations. A complete revision of the plan incorporating new information/changes in scope was not requested until the 1995 Water Licence renewal.
1995 to 2000	Licence renewal granted on June 1, 1995 by the NWT Water Board and a revised 'Interim' Abandonment and Restoration Plan was submitted in January 1996. Annual updates and revisions to the Plan were submitted to the Board for approval along with results of various studies completed to date. Transfer of authority to the Nunavut Water Board.
2000	Licence renewal granted on June 1, 2000 (NWB1LUP0008) by the NWB, with expiry on June 30, 2008.
2001	Approval of revised Interim Abandonment and Reclamation Plan.
2001 to 2005	Annual updates on progressive reclamation activities, and the results of various studies completed to date, were provided to the NWB.
2005 to 2006	Final Abandonment and Restoration Plan for the TCA was submitted June 2005. Response to technical comments on the TCA Plan submitted March 31, 2006. Outstanding issues were identified by regulatory authorities in April and May 2006 following a technical meeting. Due to the sale of LMI, no further revisions to the TCA Plan were made.
2006	After sale of LMI, the Site continued under care and maintenance and final reclamation activities were halted while future mining and ore processing options were explored. An annual update on progressive reclamation activities was provided to the NWB.
2007	A revised ICRP Plan was submitted December with the renewal application.
2008	Annual update on progressive reclamation activities was provided to the NWB.
2009	Licence renewal granted on February 25, 2009, as amended May 25, 2009 (2AM-LUP0914) by the NWB, with expiry on March 31, 2014. An updated ICRP Plan was submitted June 2009 along with various studies completed to date.
2010	A revised ICRP Plan was submitted March 2010 that addressed deficiencies in the 2009 Plan along with various studies completed to date.
2011	Annual update on progressive reclamation activities was provided to the NWB.
2012	Update to the ICRP Plan was submitted to the Board for approval along with results of various studies completed to date.

Date	Description
2013	Revised Plan(s) were submitted to the NWB for approval along with the results of studies completed to date in advance of the Water Licence renewal process April 2013.
2014	An application to renew the water Licence was submitted to the NWB February 28, 2014. The Plan(s) were reviewed during the Technical Meetings held on October 22 and 23.
2015	Comments were received about the Plan(s) at the Public Hearing held February 4 and 5. Licence renewal granted October 5, 2015 (2AM-LUP1520) with expiry of August 18, 2020.
2016	ICRP was updated to reflect comments and recommendations made during the renewal process as required under the renewed Water Licence.
2017	ICRP updated to address Amendment #1 requirements to update the IARP. Progressive reclamation included: construction of a landfarm in 2016 (which began operation in 2017) to remediate the satellite tank farm area, Dam M repairs, Cell 5 tailings cover, minor repairs to Cell 1 cover, repairs to the upper and lower sewage lagoon dams. Updated to include information from the updated ESA completed in 2017 and includes a copy of the Environmental Effects Monitoring Phase 5 study completed in 2017.
2018	Ongoing Care and Maintenance
2019	FCRP Ver 0 filed with application for amendment and renewal of water licence; EEM Final Study design implemented in August 2019.
2020	Notice of intent to close and achieve Recognized closed mine status under MDMER submitted 30 January 2019; Final Interpretive report submitted to ECCC in May 2020; Public hearing held in Kuglugtuk in January 2020 for amendment and renewal of Type A Water Licence. Type A Water Licence 2AM-LUP2032 issued by NWB on 28 February 2020 and approved by CIRNAC Minister on 9 April 2020. Winter road mobilization to begin active remediation in Q1 2020. Active Remediation ongoing. FCRP Rev1 filed in accordance with Part I, Item 2. Security reductions sought and obtained from CIRNAC in Q2 2020.

IARP = Interim Abandonment and Restoration Plan; NWB = Nunavut Water Board; TCA = Tailings Containment Area

APPENDIX E

Consultation Record

Stakeholder engagement activities "consultation record" conducted by LMI commenced in third quarter 2011 to the current date are summarized in Table E-1.

Table E-1: Stakeholder Consultation Record

Date	Stakeholder Group	Description
9 August 2011	Kugluktuk KIA	▪ Introduction of Elgin Mining/LMI to the KIA
16 November 2011	Yellowknife KIA	▪ Introduction of new team members to KIA ▪ Provided project update ▪ Discussed contact person for employment ▪ and training ▪ Discussed preferred method and timing of ▪ engagement activities
2011	Internal Consultation Measures	▪ Development of a Stakeholder Map, a tool for internal use by LMI to understand the various ▪ stakeholder groups and provide rationale for engagement activities; ▪ Ongoing engagement with relevant stakeholder groups; ▪ Commencement of consultation plan, strategic plan and communications plan development; ▪ Procurement of a facilitator to provide Inuit cultural awareness training to LMI management ▪ team; and ▪ Initiated working relationship with KIA employment and training coordinator.
16 January 2012	KIA Board	▪ Update on status of Lupin and Ulu mines
23 January 2012	KIA Representatives	▪ Follow up meeting update on status of Lupin and Ulu Mines at Mineral Exploration Roundup Vancouver, BC.
6 March 2012	KIA Representatives	▪ Follow up meeting update on status of Lupin and Ulu Mines at Prospectors and Developers Association of Canada, Toronto, ON.
29-31 May 2012	Kugluktuk: KIA, Elders and Community Representatives	▪ Community session to update on status of Lupin and Ulu Mines
15-20 April 2012	Nunavut Mining Symposium	▪ Presentation made at the Symposium in Iqaluit
2012	Kitikmeot Trade Show; Kugluktuk Recreation Frolics; Kugluktuk Summer Games; Kugluktuk Christmas Events; and Kugluktuk Hockey Team	▪ Community Sponsorship Engagement

Table E-1: Stakeholder Consultation Record

Date	Stakeholder Group	Description
2013	General	▪ No specific community engagement general touch base as needed with regulators. Also, commitment to engage communities if desired
22-23 October 2014	Kugluktuk: Community and Regulators	▪ A Pre-Hearing Conference, a Technical Session, and a Community Information Session to facilitate regulatory review process of NWB
4-5 February 2015	Kugluktuk: Community and Regulators	▪ Public Hearing and Community Information Session to facilitate regulatory review process of NWB
14 July 2015	KIA	▪ LMI hosted KIA on site tour of Lupin site.
6-7 October 2016	NWB, DIAND and Consultants*	▪ Site Tour Lupin Mine site.
12 June 2017 24 July 2017	DIAND	Meeting in Iqaluit to discuss ICRP, progressive reclamation and security.
6 July 2017 21 November 2017	DIAND	Teleconferences to discuss ICRP, progressive reclamation and security.
18 July 2017	KIA	Meeting in Kuglutuk to discuss ICRP, progressive reclamation and security.
5 September 2017	Government of Nunavut	Meeting in Iqaluit to discuss ICRP, progressive reclamation and security.
January 2018	DIAND and KIA	Meeting in Vancouver to discuss ICRP and FCRP as well as progressive reclamation and security.
April 2018	NWB and GN	Informal conversation on ICRP and FCRP.
13 April 2018	DIAND	Meeting in Ottawa to discuss ICRP and FCRP as well as progressive reclamation and security.
July 2018	DIAND, ARCADIS and NWB	Site visit
2019	DIAND	Bi weekly teleconferences related to FCRP and renewal/amendment application.
1 February 2019	NPC	Conformity determination
February – May 2019	CIRNAC (previously DIAND), ECCC, NWB	IR and TC various meetings
6-7 June 2019	CIRNAC, ECCC, NWB	TM/PHC and Community Session in Kugluktuk.

Table E-1: Stakeholder Consultation Record

Date	Stakeholder Group	Description
June-Dec 2019	CIRNAC, ECCC, NWB	Commitment responses following TM/PHC various meetings
16 January 2020	CIRNAC, ECCC, NWB, KIA, Community of Kugluktuk	Public Hearing Re: renewal/amendment Type A Water Licence.
30 January 2019	ECCC	Notice of Intent to obtain Recognized Closed Mine Status.
25 March 2020	CIRNAC	First request for security refund filed
May – June 2020	KIA	Response to Information Requests related to Part E of the water licence
May 2020	ECCC	Submission of Final Interpretive Report EEM
12 May 2020	CIRNAC	Minister approved first security refund
9 June 2020	CIRNAC	LOC approved by Minister
20 July 2020	CIRNAC	Second request for security refund filed

* Specific participants included: Dave Hohnstein (NWB), Ian Parsons (DIAND), Eva Paul (DIAND) (part-time), Charles Gravelle (Arcadia-NWB), Regan McIsaac (Knight Piésold- DIAND), Amber Blackwell (Knight Piésold- DIAND), Ken Bocking (Golder- LMI), Patrick Downey (LMI), Karyn Lewis (LMI), and Dave Vokey (Discovery Mining Services.

Additional engagement was undertaken to support Inspectors as provided Table E-2 below.

Table E-2: Additional Consultation Record

Date	Inspection Lead	Description
2009/2010	INAC	No Inspections
2011	DIAND	Inspection July 2011
2012	DIAND	Water Use Inspection July 2012
	Environment Canada	September 25, 2012
2013	ECCC	Three inspectors on site July 25, 2013 to inspect fuel storage and TCA.
2014	ECCC	Inspector on site September 16 to inspect fuel storage and TCA.
2014	DIAND	Water Resources Inspector on Site July 15, 2014 and August 17, 2014.
2015	ECCC	Inspector on site September 27 to obtain water samples for treated tailings discharge
2015	DIAND	Water Resources Inspector on Site July 14, 2015 and September 27, 2015. Manager of Field Operations also participated in September site visit.
2016	DIAND and ECCC	Water Resource Inspector, Land Inspector and Environment Canada were at site on June 14, 2016 to complete site inspections.
2017	DIAND	Water Resource Inspector were at site on July 10-12, 2017 and August 21, 2017 to complete site inspections.
2018	DIAND	Water Resource Inspection scheduled for 5 August 2018
2019	CIRNAC (previously DIAND)	Water Resources Inspection 9 June 2019
2020	CIRNAC	Water Resources Inspection 2 July 2020; 27 August 2020;

APPENDIX F

Environmental Studies/Reclamation Research/Engineering Studies and Design Reports

AECOM; Lupin Gold Mine Environmental Effects Monitoring – Cycle 3 Interpretative Report; Project Number 60147160; May 2011.

BGC Engineering; Dam 6 Site Investigation and Raise Design (Draft); Project No. 0256-006-01; June 2003.

BGC Engineering; 2006 Annual Geotechnical Inspection Perimeter Tailings Dams. Lupin Mine Nunavut; Project No. 0256-12-01; October 2006.

EcoMetrix Incorporated; Geochemistry and Water Quality, Volume III of Seepage and Water Quality for Reclaimed Tailings Containment Area, Lupin Operations; March 2006.

Geocon; Geotechnical Report on Proposed Plant and Residential Sites, Lupin Project, Contwoyto Lake, NWT; Report. File No. A1147; July 1980.

Golder Assoc.; Detailed Design Recommendations for Tailings Area K Dam Lupin Mine. Contwoyto Lake, NWT; File No. 892-2404; May 1990.

Golder Assoc.; Studies Related to Water Licence Requirements and in Support of Reclamation Planning (Lupin Mine); December 2004a.

Golder Assoc., Ecological Risk Assessment for Lupin Mine Tailings Containment Area; December 2004b.

Golder Assoc.; Updated Phase I and II Environmental Site Assessment, Lupin Mine, Nunavut; October 2017a.

Golder. Asbestos Materials Assessment Report – Lupin Gold Mine, Nunavut; December 8, 2017c.

Golder. Lupin Gold Mine Environmental Effects Monitoring Phase 5 Interpretative Report for Lupin Mine. Prepared for Lupin Mine Incorporated (a subsidiary of Mandalay Resources Corporation). Edmonton, AB. Golder Report No. 1650403. 2017d.

Golder.. Lupin Mine Phase 6 (Final) Environmental Effects Monitoring Program Final Interpretative Report. May 2020.

Hemmera; Addendum to the Lupin Mine 2011 EEM Interpretative Report – Response to Technical

Advisory panel and Environment Canada Comments; May 2012.

Holubec, I. and Hohnstein, D.; Partially Saturated Granular Cover for Reactive Tailings in Permafrost; paper presented at 7th International Symposium of Mining in the Arctic, Iqaluit, NU; April 2003. [Appendix C to 2004 TCA Management Report]

Holubec Consulting; Covers for Reactive Tailings Located in Permafrost Regions Review (Draft); prepared for Mine Environment Neutral Drainage (MEND) Program; May 2004

Holubec Consulting; Lupin Operation – Closure Plan for Tailings Containment Area; January 2005.

Holubec Consulting Inc.; Geotechnical, Seepage and Water Balance, Volume I of Seepage and Water Quality for Reclaimed Tailings Containment Area, Lupin Operations; March 2006a.

Holubec Consulting Inc.; Water Management After Closure, Volume II of Seepage and Water Quality for Reclaimed Tailings Containment Area, Lupin Operations; March 2006b.

Klohn Leonoff; Acid Rock Drainage Study, Lupin Mine, Northwest Territories; March 1992a.

Klohn Leonoff; Assessment of Water Chemistry and Remedial Measures for the Lupin Tailings Effluent System; July 1992b.

Klohn Leonoff; Column Leaching Study, Evaluation of ARD Control Measures; December 1993.

Klohn-Crippen; Tailings Reclamation Test Cover Program, 1994 Report of Activities; August 1995.

Kinross Gold Corporation; Supplement to Lupin Tailings Containment Area, 2005 Abandonment and Restoration; March 2006b.

Li, M.G., Aubé, B., and St-Arnaud, L.; Considerations in the Use of Shallow Water Covers for Decommissioning Reactive Tailings, Proceedings - Fourth International Conference on Acid Rock Drainage, Vancouver, B.C., Canada; May 1997.

MEND 2.21.1; Development of Laboratory Methodologies for Evaluating Effectiveness of Reactive Tailings Covers; Univ. of Waterloo and Noranda Technology Centre; March 1992.

MEND 6.1; Preventing AMD by Disposing of Reactive Tailings in Permafrost; Geocon; March 1993.

Morrow Environmental Consultants Inc., a member of the SNC-Lavalin Group; Phase 1 and 2 Environmental Site Assessment, Lupin Mine Site, Nunavut Territory; January 2006.

Reid, Crowther & Partners: RL&L Environmental; Report on Aquatic Studies Program for Echo Bay Mines Ltd; February 1985.

SRK Consulting (Canada) Inc.; Results of the 2015 Lupin Mine Windblown Tails Survey at Dam 6; December 2015.

TBT Engineering Consulting Group; 2010 Annual Geotechnical Inspection Perimeter Dams Tailing Containment Area, Lupin Mine, Nunavut; November 2010.

URS Corporation; ARD/ML Assessment of Waste Rock at Lupin Mine; February 2005.

APPENDIX G

Financial Security

G-1 LMI Revised Estimate (Exhibit 25) dated 16 January 2020;

G-2 Security Framework Milestones for Draft Water Licence Framework (Exhibit 26); and

G-3 Joint Submission of LMI and CIRNAC regarding Security Reduction Framework (Exhibit 27) dated 16 January 2020

SUMMARY OF COSTS

CAPITAL COSTS	COMPONENT NAME	COST	LAND LIABILITY	WATER LIABILITY	
OPEN PIT		$0	$0	$0	
UNDERGROUND MINE		$246,298	$0	$246,298	
TAILINGS FACILITY		$999,674	$0	$999,674	
ROCK PILE		$1,420,840	$0	$1,420,840	
BUILDINGS AND EQUIPMENT		$3,199,383	$0	$3,199,383	
CHEMICALS AND CONTAMINATED SOIL MANAGEMEN		$464,521	$0	$464,521	
CONTRACTOR INDIRECTS		$4,029,017	-	$4,029,017	
SURFACE AND GROUNDWATER MANAGEMENT		$327,480	-	$327,480	
INTERIM CARE AND MAINTENANCE		$70,567	-	$70,567	By LMI
SUBTOTAL: Capital Costs		**$10,757,780**	**$0**	**$10,757,780**	
PERCENT OF SUBTOTAL			**0%**	**100%**	Assumed all water liability

INDIRECT COSTS		COST	LAND LIABILITY	WATER LIABILITY	
MOBILIZATION/DEMOB		$10,155,346	$0	$10,155,346	
POST-CLOSURE MONITORING AND MAINTENANCE		$936,257	$0	$936,257	
ENGINEERING	4%	$430,311	$0	$430,311	
PROJECT MANAGEMENT - CONTRACTOR	3.60%	$386,926	$0	$386,926	
PROJECT MANAGEMENT - LMI	1.40%	$150,963	$0	$150,963	
HEALTH AND SAFETY PLANS/MONITORING & QA/QC	0%	$0	$0	$0	
BONDING/INSURANCE	1%	$107,578	$0	$107,578	
CONTINGENCY	5%	$537,889	$0	$537,889	Less uncertainty under firm bid.
MARKET PRICE FACTOR ADJUSTMENT	0%	$0	$0	$0	
SUBTOTAL: Indirect Costs		**$12,705,270**	**$0**	**$12,705,270**	

TOTAL COSTS	**$23,463,049**	**$0**	**$23,463,049**

Check Sums

1 **Open Pit Name:** **Pit # *1***

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
CONTROL ACCESS									
Fence		m		#N/A	$0.00	$0		$0	$0
Signs		each		#N/A	$0.00	$0		$0	$0
Berm at crest		m3		#N/A	$0.00	$0		$0	$0
Block roads		m3		#N/A	$0.00	$0		$0	$0
Other				#N/A	$0.00	$0		$0	$0
STABILITY STUDY									
Conduct stability and setback study		allow		#N/A	$0.00	$0		$0	$0
STABILIZE SLOPES									
Off-load crest, soil A		m3		#N/A	$0.00	$0		$0	$0
Off-load crest, soil B		m3		#N/A	$0.00	$0		$0	$0
Doze/trim overburden at crest		m3		#N/A	$0.00	$0		$0	$0
Drill & blast pit crest		m3		#N/A	$0.00	$0		$0	$0
Buttress slope		m3		#N/A	$0.00	$0		$0	$0
Other				#N/A	$0.00	$0		$0	$0
COVER/CONTOUR SLOPES									
Place fill, soil A		m3		#N/A	$0.00	$0		$0	$0
Place fill, soil B		m3		#N/A	$0.00	$0		$0	$0
Rip rap		m3		#N/A	$0.00	$0		$0	$0
Vegetate slopes		ha		#N/A	$0.00	$0		$0	$0
Vegetate pit floor		ha		#N/A	$0.00	$0		$0	$0
Other				#N/A	$0.00	$0		$0	$0
CONSTRUCT DIVERSION DITCHES									
Excavate ditches -soil		m3		#N/A	$0.00	$0		$0	$0
Excavate ditches -rock		m3		#N/A	$0.00	$0		$0	$0
Rip rap in channel base		m3		#N/A	$0.00	$0		$0	$0
CONSTRUCT SPILLWAY									
Excavate channel		m3		#N/A	$0.00	$0		$0	$0
Concrete		m3		#N/A	$0.00	$0		$0	$0
Rip rap		m3		#N/A	$0.00	$0		$0	$0
Other				#N/A	$0.00	$0		$0	$0
RECLAIM QUARRIES									
Contour slopes		m3		#N/A	$0.00	$0		$0	$0
Place overburden		m3		#N/A	$0.00	$0		$0	$0
Vegetate		m3		#N/A	$0.00	$0		$0	$0
FLOOD PIT-Capital									
Remove stationary equipment (sump pumps)		each		#N/A	$0.00	$0		$0	$0
Remove dewatering pipeline		m		#N/A	$0.00	$0		$0	$0
Remove power lines		each		#N/A	$0.00	$0		$0	$0
Construct diversion ditches		m3		#N/A	$0.00	$0		$0	$0
-Ditch, mat'l A		m3		#N/A	$0.00	$0		$0	$0
-Ditch, mat'l B		m3		#N/A	$0.00	$0		$0	$0
Construct embankment/dam		m3		#N/A	$0.00	$0		$0	$0
Supply/install pump station		each		#N/A	$0.00	$0		$0	$0
Supply/install piping system		m		#N/A	$0.00	$0		$0	$0
Remove pump post-closure		each		#N/A	$0.00	$0		$0	$0
Remove pipeline post-closure		m		#N/A	$0.00	$0		$0	$0
FLOOD PIT-Annual Cost									
Operate pumps (power)		m3		#N/A	$0.00	$0		$0	$0
Maintain pump/pipeline		allow		#N/A	$0.00	$0		$0	$0
Labour:fuel management, commissioning/decom		$/h		#N/A	$0.00	$0		$0	$0
Chemical addition, _____ kg/m3 of water		tonne		#N/A	$0.00	$0		$0	$0
Chemicals, purchase and shipping		tonne		#N/A	$0.00	$0		$0	$0
Passive/biological additives		$/ha		#N/A	$0.00	$0		$0	$0
Passive additives purchase and shipping		tonne		#N/A	$0.00	$0		$0	$0
Other				#N/A	$0.00	$0		$0	$0
					Annual pumping costs	$0			
Number of years of pump flooding		years							
					Total pumping costs	$0		$0	$0
					Total	$0		$0	$0
					% of Total			0%	0%

1 **Underground Mine Name** **UG Mine # 1**

ACTIVITY/MATERIAL	Notes	Unit	Qty	Code	Unit Cost	Cost	% Land	Land Cost	Water Cost	
CONTROL ACCESS										
Fence		m		#N/A	$0.00	$0		$0	$0	
Signs		each		#N/A	$0.00	$0		$0	$0	
Block roads		m3		#N/A	$0.00	$0		$0	$0	
Berm		m3		#N/A	$0.00	$0		$0	$0	
Concrete wall in portal		m3		#N/A	$0.00	$0		$0	$0	
Backfill portal #1	Plug portal with waste rock - 10 m long	m3	250	DRS	$2.06	$515		$0	$515	
Remove CMP		m2	0	BRS1L	$45.00	$0		$0	$0	Leave in place and cover
Backfill portal #2		m3		#N/A	$0.00	$0		$0	$0	
Cap raises - 5 total		m3	0	RRSS	$85,656.00	$0		$0	$0	Not necessary; will be backfilled and covered by waste rock "dome"
Cap raise #2		m3		#N/A	$0.00	$0		$0	$0	
Cap shaft #1		m3		#N/A	$0.00	$0		$0	$0	
Cap shaft #2		m3		#N/A	$0.00	$0		$0	$0	
Backfill adits	Covered in portal backfill	m3	0	#N/A	$0.00	$0		$0	$0	
Backfill open stope	Esker cap over backfilled West Zone	m3	0	SC4S	$3.98	$0		$0	$0	Included in 1.0 m cover on "dome" area
Concrete cap over open stope		m3		#N/A	$0.00	$0		$0	$0	
Crown Pillar Study		each	0	#N/A	$25,000.00	$0		$0	$0	
CROWN PILLAR BLASTING FOR STORAGE										Final FCRP now proposes to blast 9250 m3 in West Zone only.
Pump out water from crown pillars		m3	5,250	POCS	$1.57	$8,243		$0	$8,243	
West Zone		m3	9,250	#N/A	$25.68	$237,540		$0	$237,540	Cost basis: $22.84 / kg explosive @ 0.44 kg/tonne. Assumed 2.56 tonne/m3.
Central Zone		m3	0	#N/A	$0.00	$0		$0	$0	
East Zone		m3	0	#N/A	$0.00	$0		$0	$0	
Shafts		m3	0	#N/A	$0.00	$0		$0	$0	
REMOVE HAZARDOUS MATERIALS										
Remove hazardous materials, U/G labor		manhrs		#N/A	$0.00	$0		$0	$0	
Remove/decontam. stationary & elect. equip		mandays		#N/A	$0.00	$0		$0	$0	
Remove/decontam. mobile equipment		each		#N/A	$0.00	$0		$0	$0	
Remove misc. haz. mat & explosives		kg		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
INSTALL BULKHEADS										
Bulkheads to control water flow		each		#N/A	$0.00	$0		$0	$0	
Grout bulkhead		m3		#N/A	$0.00	$0		$0	$0	
FLOOD MINE										
Supply/install pump		each		#N/A	$0.00	$0		$0	$0	
Supply/install piping system		each		#N/A	$0.00	$0		$0	$0	
Operate pumps to flood workings		m3		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
INSTALL GROUNDWATER COLLECTION SYSTEM										
Excavate/install sumps		m2		#N/A	$0.00	$0		$0	$0	
Install pumping wells		m3		#N/A	$0.00	$0		$0	$0	
Install pumps/pipelines/power supply		LS		#N/A	$0.00	$0		$0	$0	
SPECIALIZED ITEMS										
Install water quality monitoring pipes		each		#N/A	$0.00	$0		$0	$0	
Install permanent pumping system		each		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
					Total	$246,298		$0	$246,298	
					% of Total			0%	100%	

1 **Tailings Impoundment Name:**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Land Cost	Water Cost	
CONTROL ACCESS								
Fence		m		#N/A	$0.00	$0	$0	
Signs		each		#N/A	$0.00	$0	$0	
Berm		m3		#N/A	$0.00	$0	$0	
Block roads		m3		#N/A	$0.00	$0	$0	
Other				#N/A	$0.00	$0	$0	
STABILIZE EMBANKMENT(S)								
Toe buttress, drainage layer		m3		#N/A	$0.00	$0	$0	
Toe buttress, bulk fill	Place coarse esker toe berm to repair wave cut on K Dam	m3	17000	SC1S	$2.74	$46,580	$46,580	
Rip rap		m3	0	RR3L	$7.00	$0	$0	
Vegetate		ha		#N/A	$0.00	$0	$0	
Raise crest		m3		#N/A	$0.00	$0	$0	
Flatten slopes	Flatten granular fill on Pond 2 side of D	m2	7500	#N/A	$2.53	$18,975	$18,975	
Other		m3		#N/A	$0.00	$0	$0	
COVER TAILINGS								
Grade/shape tailings surface		m3		SC3S	$4.01	$0	$0	
Liner bedding		m3		#N/A	$0.00	$0	$0	
Subgrade preparation - compact		m2		#N/A	$0.00	$0	$0	
Supply geotextile/geosynthetic		m2		#N/A	$0.00	$0	$0	
Install geotextile/geosynthetic		m2		#N/A	$0.00	$0	$0	
Soil cover	Cell 3 (86,000 m3)	m3	86000	SC3S	$4.01	$344,860	$344,860	Quantity updated as of 2019.
Soil cover	Cell 5 (104,500 m3)	m3	104500	SC3S	$4.01	$419,045	$419,045	
Vegetate		m2		#N/A	$0.00	$0	$0	
Cover tailings exposed in Cell 4	Place esker cover on tailings exposed at lower water level in Cell 4	m3	14000	SC3S	$4.01	$56,140	$56,140	
BURY PAG ROCK / TAILINGS								
Relocate PAG rock		m3		#N/A	$0.00	$0	$0	
Place cover over PAG rock		m3		#N/A	$0.00	$0	$0	
Raise crest of dam		m3		#N/A	$0.00	$0	$0	
Remove tailings from emergency dump ponds	Excavate and relocate to TCA Cell 5	m3	300	#N/A	$7.92	$2,376	$2,376	
STABILIZE DECANT SYSTEM								
Remove and dispose of syphons (8) from J Dam and Dam 1A		m	200	PLRL	$22.00	$4,400	$4,400	
Excavate and replace		m3		#N/A	$0.00	$0	$0	
Plug/backfill with concrete or clay		m3		#N/A	$0.00	$0	$0	
Other				#N/A	$0.00	$0	$0	
REMOVE TAILINGS DISCHARGE								
Cyclones		m3		#N/A	$0.00	$0	$0	
Pipe		m	4000	PLRS	$4.75	$19,000	$19,000	Includes both freshwater pipeline, and tailings pipeline.
Remove reclaim barge		allow		#N/A	$0.00	$0	$0	
CONSTRUCT DIVERSION DITCHES								
Excavate ditches -soil		m3		#N/A	$0.00	$0	$0	
Excavate ditches -rock		m3		#N/A	$0.00	$0	$0	
Rip rap in channel base		m3		#N/A	$0.00	$0	$0	
FLOOD TAILINGS								
Doze tailings to final contour		m3		#N/A	$0.00	$0	$0	
Raise crest of dam		m3		#N/A	$0.00	$0	$0	
Other				#N/A	$0.00	$0	$0	
UPGRADE SPILLWAYS								
Cell 4 Outlet	Remove culvert and rip rap remaining	LS	1	#N/A	$19,009.00	$19,009	$19,009	
Excavate channel, soil	Spillway on Dam 1A and Dam J	m3	12350	SB1L	$4.30	$53,105	$53,105	To be constructed later by LMI.
Concrete		m3		#N/A	$0.00	$0	$0	
Rip rap	Cover the spillway invert and channel slopes to 2 m flow depth using rip rap recovered from dam slopes.	m3	936	RR3L	$7.00	$6,552	$6,552	To be constructed later by LMI.
Geotextile	Place under spillway rip rap.	m2	2800	GSTL	$3.44	$9,632	$9,632	To be constructed later by LMI.
CONSTRUCT SEEPAGE COLLECTION POND								
Excavate seepage collection pond		m3		#N/A	$0.00	$0	$0	
Doze & spread excavated material		m3		#N/A	$0.00	$0	$0	
Vegetate spread material		ha		#N/A	$0.00	$0	$0	
Bedding layer		m3		#N/A	$0.00	$0	$0	
Supply geomembrane		m2		#N/A	$0.00	$0	$0	
Install geomembrane		m2		#N/A	$0.00	$0	$0	
Erosion protection layer		m3		#N/A	$0.00	$0	$0	
INSTALL GROUNDWATER COLLECTION SYSTEM								
Excavate/install sumps		m3		#N/A	$0.00	$0	$0	
Install pumping wells		m3		#N/A	$0.00	$0	$0	
Install pumps/pipelines/power supply		LS		#N/A	$0.00	$0	$0	
SPECIALIZED ITEMS								
Install permanent instrumentation, supply & technician		each	0	#N/A	$30,000.00	$0	$0	Completed by Stantec in summer 2019.
Install permanent instrumentation, drilling		each	0	#N/A	$30,000.00	$0	$0	Completed by Stantec in summer 2019.
TREAT SEEPAGE - see "Water Management" and "Water Treatment"								
TREAT SUPERNATANT								
Pump water (to pit, U/G)		m3		#N/A	$0.00	$0	$0	
Equipment maintenance and parts		allow		#N/A	$0.00	$0	$0	
Supply reagents		tonne		#N/A	$0.00	$0	$0	
					Annual treatment costs	$0		
Number of years of treatment	Allowed for on "Water Management" sheet because it will be a one-time treatment just prior to closure.	years						
					Total treatment costs	$0	$0	
					Total	$999,674	$999,674	
					% of Total		100%	

* for construction of passive treatment system refer to "Water Management"

1 **Rock Pile Name:**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost	
STABILIZE SLOPES										
Flatten slopes with dozer		m3		#N/A	$0.00	$0		$0	$0	
Flatten "bubble dump" areas		m3		#N/A	$0.00	$0		$0	$0	
Divert runon, ditch mat'l A		m3		#N/A	$0.00	$0		$0	$0	
Divert runon, ditch mat'l B		m3		#N/A	$0.00	$0		$0	$0	
Toe buttress, drain mat'l		m3		#N/A	$0.00	$0		$0	$0	
Toe buttress, fill mat'l A		m3		#N/A	$0.00	$0		$0	$0	
Toe buttress, fill mat'l B		m3		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
COVER ROCK PILE										
Subgrade preparation - doze surface		m3		#N/A	$0.00	$0		$0	$0	
Mine Site Soil Cover - Quadrant 1 - excavate,haul,spread&compact		m3	61,500	SC4S	$3.98	$244,770		$0	$244,770	Area per Commitment 5.
Mine Site Soil Cover -Quadrant 2 - excavate,haul,spread&compact		m3	54,500	SC4S	$3.98	$216,910		$0	$216,910	Area per Commitment 5.
Mine Site Soil Cover -Quadrant 3 - excavate,haul,spread&compact		m3	57,100	SC4S	$3.98	$227,258		$0	$227,258	Area per Commitment 5.
Mine Site Soil Cover -Quadrant 4 - excavate,haul,spread&compact		m3	57,892	SC4S	$3.98	$230,410		$0	$230,410	Area per Commitment 5.
Mine Site Soil - Shop Area - excavate,haul, spread&compact		m3	1,008	SC4S	$3.98	$4,012		$0	$4,012	Area per Commitment 5.
Rock cover - excavate,haul & spread		m3		#N/A	$0.00	$0		$0	$0	
Excavate downslope drainage channel & chute		m3		#N/A	$0.00	$0		$0	$0	
Rip rap drainage channel and chute		m3		#N/A	$0.00	$0		$0	$0	
Vegetate		ha		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
VERY LOW PERMEABILITY COVER (in addition to above)										
Liner subgrade preparation - compact		m2		#N/A	$0.00	$0		$0	$0	
Supply geomembrane		m2		#N/A	$0.00	$0		$0	$0	
Install geomembrane		m2		#N/A	$0.00	$0		$0	$0	
Protective cover - excavate,haul,spread&compact		m3		#N/A	$0.00	$0		$0	$0	
Vegetate		ha		#N/A	$0.00	$0		$0	$0	
Install infiltration/seepage instrumentation		allow		#N/A	$0.00	$0		$0	$0	
CONSTRUCT DIVERSION DITCHES										
Excavate ditches -soil		m3		#N/A	$0.00	$0		$0	$0	
Excavate ditches -rock		m3		#N/A	$0.00	$0		$0	$0	
Rip rap in channel base		m3		#N/A	$0.00	$0		$0	$0	
CONSTRUCT SEEPAGE COLLECTION POND										
Excavate seepage collection pond		m3		#N/A	$0.00	$0		$0	$0	
Doze & spread excavated material		m3		#N/A	$0.00	$0		$0	$0	
Vegetate spread material		ha		#N/A	$0.00	$0		$0	$0	
Bedding layer		m3		#N/A	$0.00	$0		$0	$0	
Supply geomembrane		m2		#N/A	$0.00	$0		$0	$0	
Install geomembrane		m2		#N/A	$0.00	$0		$0	$0	
Erosion protection layer		m3		#N/A	$0.00	$0		$0	$0	
INSTALL GROUNDWATER COLLECTION SYSTEM										
Excavate/install sumps		m3		#N/A	$0.00	$0		$0	$0	
Install pumping wells		m3		#N/A	$0.00	$0		$0	$0	
Install pumps/pipelines/power supply		allow		#N/A	$0.00	$0		$0	$0	
CONSOLIDATE ROCK INTO CENTRAL AREA										
Mine Site - Quadrant 1 Load, haul, dump or doze		m3	50,500	RR4S	$2.48	$125,240		$0	$125,240	
Mine Site - Quadrant 2 Load, haul, dump or doze		m3	43,500	RR4S	$2.48	$107,880		$0	$107,880	
Mine Site - Quadrant 3 Load, haul, dump or doze		m3	47,300	RR4S	$2.48	$117,304		$0	$117,304	
Mine Site - Quadrant 4 Load, haul, dump or doze		m3	49,700	RR4S	$2.48	$123,256		$0	$123,256	
Add lime		tonne		#N/A	$0.00	$0		$0	$0	
Contour area of rock left in place		m2	0	DRL	$1.05	$0		$0	$0	Contouring included in rock placement costs
Environmental Site Assessment		allow	0	#N/A	$200,000	$0		$0	$0	
SPECIALIZED ITEMS										
Install permanent instrumentation	Thermistor strings in rock dome area	each	10	#N/A	$2,000.00	$20,000		$0	$20,000	New item - by LMI
Install permanent instrumentation, drilling	2 hours excavator for each installation	hrs	20	exc-sL	$190.00	$3,800		$0	$3,800	New item - by LMI
TREAT ROCK PILE SEEPAGE - see "Water Management"										
HEAP LEACH SEEPAGE TREATMENT - Cyanide Detox										
Cyanide destruction water treatment pumping		m3		#N/A	$0.00	$0		$0	$0	
Reagents		tonnes		#N/A	$0.00	$0		$0	$0	
Electrician/mechanic to maintain treatment plant		allow		#N/A	$0.00	$0		$0	$0	
Equipment maintenance and parts		allow		#N/A	$0.00	$0		$0	$0	
					Annual treatment costs	$0				
Number of years of treatment		years								
					Total treatment costs	$0			$0	
HEAP LEACH SEEPAGE TREATMENT - ARD/ML										
Upgrade/modify pumping system - report to WTP		allow		#N/A	$0.00	$0			$0	
					Total	$1,420,840		$0	$1,420,840	
					% of Total			0%	100%	

0 **Chemicals/Soil Area Name:**

Note: The procedures, equipment and packaging for clean up and removal of chemicals or contaminated soils are highly dependent on the nature of the chemicals and their existing state of containment. Government guidelines should be consulted on an individual chemical basis. Any estimate made here should be considered very rough unless specific evaluations have been conducted.

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost	
HAZARDOUS MATERIALS AUDIT										
Hazardous materials audit		allow	0	#N/A	$0.00	$0		$0	$0	
BUILDING DECONTAMINATION & CONSOLIDATION OF HAZARDOUS MATERIALS										
Investigation of hazardous materials		allow	0	#N/A	$20,000.00	$0		$0	$0	Done: Arctic Response 2012 industrial hygeine assessment, Golder 2017 ACM survey
Environmental technician/coordinator		mandays		#N/A	$0.00	$0		$0	$0	
Decontaminate: oil, fuel and glycol systems		m2	8,490	#N/A	$22.80	$193,572		$0	$193,572	
Decontaminate maintenance shop		mandays		#N/A	$0.00	$0		$0	$0	
Decontaminate power plant		mandays		#N/A	$0.00	$0		$0	$0	
Decontaminate bulk fuel storage		mandays		#N/A	$0.00	$0		$0	$0	
Decontaminate ANFO plant		mandays		#N/A	$0.00	$0		$0	$0	
Decontaminate offices/warehouse/accom		mandays		#N/A	$0.00	$0		$0	$0	
Remove all asbestos containing materials	Safe disposal in landfill	m3	100	#N/A	$817.20	$81,720		$0	$81,720	
HAZARDOUS MATERIALS REMOVAL										
Waste oils	Assumed	litre	5,940	ORH	$1.20	$7,128		$0	$7,128	
Waste fuel		litre	36,113	ORL	$0.43	$15,529		$0	$15,529	Allowance to burn excess fuel brought to site. 100 drums to be left for post-closure use.
Waste batteries		kg	500	#N/A	$0.00	$0		$0	$0	In other hazardous materials below
Assay & environmental lab reagents		kg		#N/A	$0.00	$0		$0	$0	
Machine shop paints, solvents etc.		liter	5,000	ORH	$0.00	$0		$0	$0	In other hazardous materials below
Glycol		liter		#N/A	$0.00	$0		$0	$0	
Process reagents		kg		#N/A	$0.00	$0		$0	$0	
Nuclear sources		allow		#N/A	$0.00	$0		$0	$0	
Other hazardous materials	Non-ACM to Yellowknife - Assumed Qty.	kg	15,840	PCRL	$0.45	$7,128		$0	$7,128	
HAZARDOUS MATERIALS										
Transportation to disposal facility		allow		#N/A	$0.00	$0		$0	$0	
Disposal fees		allow		#N/A	$0.00	$0		$0	$0	
Non-ACM hazardous materials				#N/A	$0.00	$0		$0	$0	
CONTAMINATED SOILS										
Contam. soil investigation - Phase 1		each	0	#N/A	$0.00	$0		$0	$0	
Contam. soil investigation - Phase 2	Additional investigation of ARD drainage	each	0	CS1L	$7,500.00	$0		$0	$0	Completed July, 2019
CONTAMINATED SOIL REMOVAL										
HHERA for Removal of Contaminated Soils	Assessment on Phase 1 and 2 ESA Data	allow	0	#N/A	$20,000.00	$0		$0	$0	Completed October, 2019
Excavate and transport to onsite facility		m3	0	SC3S	$4.01	$0		$0	$0	
Construct 4 additional landfarm cells		LS	0	#N/A	$180,000.00	$0		$0	$0	Will not construct additional cells.
Excavate treated soils and move to underground		m3	500	#N/A	$2.29	$1,145		$0	$1,145	
Manage hydrocarbon remediation at facility	Type-1 heavy fuel and oil	m3	0	CSRL	$47.00	$0		$0	$0	
Load, haul and dump into crown pillar	PHC Soils	m3	34,700	#N/A	$1.95	$67,665		$0	$67,665	
Type-2	As, CN- and PbNO3 to crown pillars	m3	16,700	#N/A	$2.22	$37,074		$0	$37,074	
Type-3		m3		#N/A	$0.00	$0		$0	$0	
Lumber/boneyard contaminated soils	Excavate and move to crown pillars	m3	1,966	#N/A	$2.74	$5,387		$0	$5,387	
Waste rock from mill laydown area	Excavate and move to crown pillars	m3	21,700	#N/A	$2.22	$48,174		$0	$48,174	
Reagents/stabilizing agent		m2		#N/A	$0.00	$0		$0	$0	
Excavate and transport to offsite facility		m3		#N/A	$0.00	$0		$0	$0	
Contour decontaminated area		m3		#N/A	$0.00	$0		$0	$0	
CONTAMINATED SOIL VERY LOW PERMEABILITY COVER										
Supply geomembrane, HDPE, ES3, GCL		m2		#N/A	$0.00	$0		$0	$0	
Upper and lower bedding layers		m3		#N/A	$0.00	$0		$0	$0	
Install geomembrane, HDPE, ES3, GCL		m2		#N/A	$0.00	$0		$0	$0	
Erosion protection layer		m3		#N/A	$0.00	$0		$0	$0	
Vegetate		m2		#N/A	$0.00	$0		$0	$0	
Install infiltration/seepage instrumentation		allow		#N/A	$0.00	$0		$0	$0	
Other				#N/A	$0.00	$0		$0	$0	
OTHER										
				#N/A	$0.00	$0		$0	$0	
					Total	**$464,521**		**$0**	**$464,521**	
					% of Total			0%	100%	

1 **Building / Equip Name:** **Bldg / Equip #: 1**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	% Cost Land	Land Cost	Water Cost	
DISPOSE MOBILE EQUIPMENT									
Decontaminate and ship off-site		allow		#N/A	$0.00	$0	$0	$0	
Decontaminate and dispose on-site landfill		m3	540	#NA	$30.49	$16,465	$0	$16,465	
Other				#N/A	$0.00	$0	$0	$0	
REMOVE BUILDINGS - see note below									
Accommodation Complex 2020 - Kitchen, Recreation, 100, 200, 300, 400, 900, 1000, 1100, 1200		m2	4,451	#N/A	$28.13	$125,207	$0	$125,207	
Accommodation Complex 20221 - Offices, 500, 600, 700, 800, 1000, 300		m2	2,878	#N/A	$28.13	$80,958	$0	$80,958	
Hoist Room and Travel Ways		m2	463	#N/A	$203.30	$94,128	$0	$94,128	
Shaft House		m2	1253	#N/A	$203.30	$254,735	$0	$254,735	
Warehouse		m2	4671	#N/A	$70.72	$330,333	$0	$330,333	
Mill		m2	2864	#N/A	$208.72	$597,774	$0	$597,774	
Powerhouse		m2	1645	#N/A	$115.48	$189,965	$0	$189,965	
Headframe		m2	413	#N/A	$203.32	$83,971	$0	$83,971	
Airlock Building and Fresh air Intake		m2	366	#N/A	$29.84	$10,921	$0	$10,921	
Pastefill Plant	Pastefill plant has already been removed.	m2		#N/A	$0.00	$0	$0	$0	Landfarm slab will be punctured and then covered under the "dome".
Cold Storage 2 buildings		m2	1855	#N/A	$50.59	$93,844	$0	$93,844	
Surface Mobile Shop		m2	1008	#N/A	$50.59	$50,995	$0	$50,995	Shop will be left in place to support post-closure.
Carpenter Shop		m2	482	#N/A	$50.59	$24,384	$0	$24,384	
As Treatment Plant Building		m2	177	#N/A	$50.59	$8,954	$0	$8,954	As treatment plant will be left in place
Pumphouse		m2	74	#N/A	$124.53	$9,215	$0	$9,215	
Explosives Storage		m2	412	#N/A	$124.53	$51,306	$0	$51,306	
Fire house		m2	31	#N/A	$29.84	$925	$0	$925	
Emergency Power House		m2	117	#N/A	$29.84	$3,491	$0	$3,491	
Weather Station and Storage Buildings		m2	566	#N/A	$29.84	$16,889	$0	$16,889	
Shop		m2	379	#N/A	$29.84	$11,309	$0	$11,309	
Batch Plant		m2	118	#N/A	$29.84	$3,521	$0	$3,521	Subtotal building demolition
ATV Building		m2	172	#N/A	$29.84	$5,132	$0	$5,132	$2,047,960
Storage Facility at Laydown/Airstrip		m2		#N/A	$0.00	$0	$0	$0	Previously removed
Fuel tanks -2020 - all tanks excluding tanks 13 and 14	Main Tank Farm	m2	8,090	BRS1S	$68.49	$554,084	$0	$554,084	
Fuel tanks - 2021 - tanks 13 and 14	Main Tank Farm	m2	400	BRS1S	$68.49	$27,396	$0	$27,396	
Fuel tanks	Satellite Tank Farm	m2	989	BRS1S	$68.49	$67,737	$0	$67,737	
Fuel Tanks	Piping removal and disposal	m2	2,000	PLRS	$0.00	$0	$0	$0	Included in the above items
Freshwater intake		m2	0	BRCS	$128.00	$0	$0	$0	Included as "pumphouse" above
Reclaim pumps		m2		#N/A	$0.00	$0	$0	$0	
Flush sewage pipelines		LS	1	#N/A	$7,128.00	$7,128	$0	$7,128	
Airstrip lighting, navigation, electrician		mandays		#N/A	$0.00	$0	$0	$0	
Airstrip lighting, navigation, mechanical		mandays		#N/A	$0.00	$0	$0	$0	
Break foundation slabs	Use hoe ram to puncture slabs. Leave in place and cover.	m2	15,000	#N/A	$4.02	$60,300	$0	$60,300	
Boneyard debris and steel from tanks	Place in landfill	m3	20,000	#N/A	$9.14	$182,800	$0	$182,800	
Other		m2		#N/A	$0.00	$0	$0	$0	
LANDFILL FOR DEMOLITION WASTE									
Place rock cover	10,650 + 500 to fill voids	m3	11,150	RR4S	$3.07	$34,231	$0	$34,231	
Place soil cover		m3	13,500	SB4L	$3.95	$53,325	$0	$53,325	
Clean burn pit and incinerator	Dispose waste in on-site landfill	LS	1	#N/A	$11,880.00	$11,880	$0	$11,880	
Operation of landfill		LS	0	#N/A	$240,000.00	$0	$0	$0	Included in placement.
Load, haul and dump in landfill		m3	30,000	SB1S	$3.07	$92,100	$0	$92,100	
Vegetate		ha		#N/A	$0.00	$0	$0	$0	
GRADE AND CONTOUR PADS									
Grade/Contour Entire Mine Site Area	Covered under "Rock Pile" tab	m2	0	DRL	$1.05	$0	$0	$0	
Place 0.3 m granular fill over slabs		m3	0	SB4L	$5.50	$0	$0	$0	Covered by general 1.0 m "dome" cover.
Accommodation Complex		ha		#N/A	$0.00	$0	$0	$0	
Process Facilities		ha		#N/A	$0.00	$0	$0	$0	
Offices, Repair, Lab, Warehouse		ha		#N/A	$0.00	$0	$0	$0	
Storage Facilities		ha		#N/A	$0.00	$0	$0	$0	
Water and Wastewater Treatment Facilities		ha		#N/A	$0.00	$0	$0	$0	
U/G Heating Plant		ha		#N/A	$0.00	$0	$0	$0	
Emulsion Plant		ha		#N/A	$0.00	$0	$0	$0	
Warehouse, Shops and Other		ha		#N/A	$0.00	$0	$0	$0	
Place rock cover		m3		#N/A	$0.00	$0	$0	$0	
Vegetate		ha		#N/A	$0.00	$0	$0	$0	
Other		m3		#N/A	$0.00	$0	$0	$0	
PUNCTURE LINED SUMPS									
Puncture liner and place soil cover		m3		#N/A	$0.00	$0	$0	$0	
RECLAIM ROADS									
Remove culverts		each	22	#N/A	$199.00	$4,378	$0	$4,378	Includes culvert removal and road scarification.
Remove bridges		each		#N/A	$0.00	$0	$0	$0	
Scarify and install water breaks		ha		#N/A	$0.00	$0	$0	$0	
Scarify airstrip	Airstrip will stay in place	ha		#N/A	$0.00	$0	$0	$0	
Scarify laydown areas	Scarify roads and grade	ha	0	SCFYH	$6,030.00	$0	$0	$0	Item for culvert removal includes road scarification.
Vegetate		ha		#N/A	$0.00	$0	$0	$0	
Other	Grade and contour esker borrow area	m3	180,000	DSS	$0.22	$39,600	$0	$39,600	
SPECIALIZED ITEMS									
Dispose of misc. debris and laydown area refuse				#N/A	$0.00	$0	$0	$0	
					Total	**$3,199,383**	$0	**$3,199,383**	
					% of Total		0%	100%	

1 **Capital Expenditures and Short Term Water Treatment identified in 'Instructions' worksheet**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost	
BREACH DYKE EMBANKMENT							
Upper and Lower Sewage Lakes	Excavate spillways and place rip rap	LS	1	#N/A	$11,880.00	$11,880	
Rip rap slope protection		m3	0	RR4L	$7.60	$0	
Contour water intake area		m3		#N/A	$0.00	$0	
STABILIZE SEDIMENT PONDS/WATER MANAGEMENT PONDS							
Place soil cover		m3		#N/A	$0.00	$0	
Doze & spread excavated material		m3		#N/A	$0.00	$0	
Vegetate spread material		ha		#N/A	$0.00	$0	
Rip rap in channel base		each		#N/A	$0.00	$0	
REDIRECT RUNOFF/CONSTRUCT DIVERSION DITCHES							
Excavate ditches -soil		m3		#N/A	$0.00	$0	
Excavate ditches -rock		m3		#N/A	$0.00	$0	
Stabilize side slopes		m3		#N/A	$0.00	$0	
Rip rap in channel base		m3		#N/A	$0.00	$0	
BREACH DITCHES							
Excavate breaches		m3		#N/A	$0.00	$0	
Backfill/recontour		m3		#N/A	$0.00	$0	
Install flow dissipation		m3		#N/A	$0.00	$0	
Vegetate remainder of ditch		m2		#N/A	$0.00	$0	
DECOMISSION FRESH WATER SUPPLY							
Breach embankment	Includes on Bldgs & Equipment	m		#N/A	$0.00	$0	
Remove pump		LS	0	#N/A	$10,000.00	$0	Included under Pumphouse in B&E.
Remove pipeline		m	0	PLRS	$4.75	$0	Included under "Pipe" on tailings sheet.
WATER CONTROL IN RECLAMATION QUARRY							
Install pumping system		LS		#N/A	$0.00	$0	
Remove pumping system		LS		#N/A	$0.00	$0	
REMOVE PIPELINES							
Remove pipes		m		#N/A	$0.00	$0	
Concrete plug deep pipes		m3		#N/A	$0.00	$0	
Other				#N/A	$0.00	$0	
GROUNDWATER COLLECTION SYSTEM							
Excavate/install sumps		m3		#N/A	$0.00	$0	
Install pumping wells		m3		#N/A	$0.00	$0	
Install pumps/pipelines/power supply		LS		#N/A	$0.00	$0	
CONSTRUCT CONTAMINATED WATER STORAGE POND							
Excavate pond		m3		#N/A	$0.00	$0	
Doze & spread excavated material		m3		#N/A	$0.00	$0	
Vegetate spread material		ha		#N/A	$0.00	$0	
Bedding layer		m3		#N/A	$0.00	$0	
Supply geomembrane		m2		#N/A	$0.00	$0	
Install geomembrane		m2		#N/A	$0.00	$0	
Erosion protection layer		m3		#N/A	$0.00	$0	
CONSTRUCT PASSIVE TREATMENT SYSTEM (e.g. Constructed Wetland)							
Construct access roads		km		#N/A	$0.00	$0	
Install HDPE piping system from collection pond		m		#N/A	$0.00	$0	
Inter-cell flow structures		allow		#N/A	$0.00	$0	
Install liners		m2		#N/A	$0.00	$0	
Install growth media		m3		#N/A	$0.00	$0	
Wetland vegetation		ha		#N/A	$0.00	$0	
CONSTRUCT WATER TREATMENT PLANT							
Upgrade treatment plant	Repair existing As treatment plant	LS	1	#N/A	$35,000.00	$35,000	
Build sludge containment facility							
Treatment Materials - Soda Ash		bag	5000	#N/A	$16.250	$81,250	Unit price per bag of lime includes purchase, delivery, application and management.
Treatment Plant Operation	Lime treatment	1	LS	#N/A	$199,350	$199,350	application and management.
					Total	$327,480	

For cost of long-term/post-closure water treatment see "WATER TREATMENT" Worksheet"

1 **Post Closure Water Treatment - Identified as long term/post-closure in 'Instructions' worksheet**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost
ADDITION OF REAGENTS TO WTP						
H2O2		kg		#N/A	$0.00	$0
lime	Covered under "Water Management" tab	kg		#N/A	$0.00	$0
ferric sulphate		kg		#N/A	$0.00	$0
ferrous sulphate		kg		#N/A	$0.00	$0
flocculents		kg		#N/A	$0.00	$0
Other				#N/A	$0.00	$0
LABOUR AND SUPPLIES						
Annual fuel		litres		#N/A	$0.00	$0
Annual power		kW-h		#N/A	$0.00	$0
Electrician/mechanic to maintain treatment plant		allow		#N/A	$0.00	$0
Equipment maintenance and parts		allow		#N/A	$0.00	$0
Misc. supplies, hoses, tools		allow		#N/A	$0.00	$0
Communications		allow		#N/A	$0.00	$0
Other				#N/A	$0.00	$0
WTP WATER SAMPLING AND ANALYSES						
Sampling equipment		allow		#N/A	$0.00	$0
Analyses		allow		#N/A	$0.00	$0
Shipping to laboratory		allow		#N/A	$0.00	$0
Reporting		allow		#N/A	$0.00	$0
Other				#N/A	$0.00	$0
SITE ACCESS						
Road maintenance (incl. snow removal)		allow		#N/A	$0.00	$0
Winter road tariff		allow		#N/A	$0.00	$0
Truck rental		allow		#N/A	$0.00	$0
Air support		allow		#N/A	$0.00	$0

	Costs for one-time treatment to lower ponds is provided in "Water Management" tab		**Annual water treatment costs**		$0
Number of years of water treatment	Assumed water treatment is not required post-closure because the TCA is covered.	years		**Total**	$0

1 **Interim Care and Maintenance**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost	
INTERIM CARE & MAINTENANCE							
on-site caretaker		manmonths		#N/A	0	$0	
Spring extra personnel		manmonths	0	#N/A	13194	$0	Included in Contractor site maintenance under "Mobilization"
-electrician		manmonths		#N/A	0	$0	
-mechanic		manmonths	0	#N/A	11517	$0	Included in Contractor site maintenance under "Mobilization"
annual fuel	Available on site.	litre		#N/A	0	$0	
misc. supplies	Available on site.	allow		#N/A	0	$0	
pick-up truck	Available on site.	each		#N/A	0	$0	
small dozer	Available on site.	allow		#N/A	0	$0	
small excavator	Available on site.	allow		#N/A	0	$0	
snow machine	Available on site.	allow		#N/A	0	$0	
communications		allow	0	#N/A	25000	$0	Included in Contractor site maintenance under "Mobilization"
SNP/AEMP water sampling & reporting	From "PostClosure" sheet	each	1	#N/A	12360	$12,360	
geotechnical assessment	From "PostClosure" sheet	each	1	#N/A	22923.49	$22,923	
interim water treatment	Covered under "Water Management"			#N/A	0	$0	
Worker accommodations		mandays	8	#N/A	0.00	$0	Provided in contract with Contractor.
				Annual	Interim C&M Cost	$35,283	
Number of years of ICM		years	2		**Total**	$70,567	

1 **Post-Closure Monitoring & Maintenance:**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost
MONITORING & INSPECTIONS						
Annual geotechnical inspection		each	10	#N/A	$22,923.49	$229,235
Survey inspection		each		#N/A	$0.00	$0
Monitoring years - 10	Includes Maintenance	Year	3	LMI	$100,000.00	$300,000
Regulatory costs*		each		#N/A	$0.00	$0
Site water monitoring (AEMP and SNP)	Water sampling	each	10	#N/A	$12,360.00	$123,600
- Active closure and flooding		each		#N/A	$0.00	$0
- Post pit flooding		each		#N/A	$0.00	$0
Air Quality Monitoring Program (AQMP)	Not required	each	0	#N/A	$0.00	$0
Environmental Effects Monitoring (EEM) after 3 years		each	1	#N/A	$126,079.00	$126,079
Wildlife Effects Monitoring Program (WEMP)	Not required	each	0	#N/A	$0.00	$0
Vegetation Monitoring		each		#N/A	$0.00	$0
Other				#N/A	$0.00	$0
COVER MAINTENANCE						
Repair erosion - infill gullies		allow		#N/A	$0.00	$0
Repair erosion - upgrade diversion ditches		allow		#N/A	$0.00	$0
Remove problem vegetation		allow		#N/A	$0.00	$0
Repair animal damage		allow		#N/A	$0.00	$0
Repair/upgrade access controls		allow		#N/A	$0.00	$0
Other				#N/A	$0.00	$0
SPILLWAY MAINTENANCE						
Repair erosion		m3		#N/A	$0.00	$0
Clear spillway		each		#N/A	$0.00	$0
CWTS MAINTENANCE						
Maintain flow, restore vegetation		allow		#N/A	$0.00	$0
POST-CLOSURE WATER TREATMENT						
Annual water treatment cost, from "Water Treatment"						$0
Subtotal for first 10 years, undiscounted						$778,914
Discount rate for calculation of net present value of post-closure cost, %				3.00%		
Number of years of post-closure activity				25	years	
Net Present Value of payment stream						$936,257

One time lime treatment allowed for in "Water Management". No further treatment will be required after the cover is completed.

*Regulatory costs - annual reporting, management plans, progress reports etc.

Annual Discount 3%

	Geotechnical and Water Sampling		Monitoring and Maintenance		EEM		
Year	Cost	Discounted Cost	Every 3 years	Discounted Cost	One Time	Discounted Cost	Total Yearly
1	-	-		-		-	-
2	-	-		-		-	-
3	35,283.5	32,289.4	100,000	91,514	126,079	115,380	239,184
4	35,283.5	31,348.9		-		-	31,349
5	35,283.5	30,435.8		-		-	30,436
6	35,283.5	29,549.4	100,000	83,748		-	113,298
7	35,283.5	28,688.7		-		-	28,689
8	35,283.5	27,853.1		-		-	27,853
9	35,283.5	27,041.9	100,000	76,642		-	103,684
10	35,283.5	26,254.2		-		-	26,254
11		-		-		-	-
12		-	100,000	70,138		-	70,138
13		-		-		-	-
14		-		-		-	-
15	35,283.5	22,647.1	100,000	64,186		-	86,833
16		-		-		-	-
17		-		-		-	-
18		-	100,000	58,739		-	58,739
19		-		-		-	-
20		-		-		-	-
21		-	100,000	53,755		-	53,755
22		-		-		-	-
23		-		-		-	-
24		-	100,000	49,193		-	49,193
25	35,283.5	16,851.6		-		-	16,852
Net Present Value:		272,960.2		547,916		115,380	936,257

Costs for geotechnical and water sampling in years 1 and 2 are covered in 2 years of interim care and maintenance (see ICM sheet)

1 **Mobilization/Demobilization:**

ACTIVITY/MATERIAL	Notes	Units	Quantity	Cost Code	Unit Cost	Cost
MOBILIZE HEAVY EQUIPMENT						
Mobilize equipment fleet	Trucking costs	LS	1	#N/A	1888200.00	$1,888,200
De-mobilize equipment fleet		LS	1	#N/A	1900775.00	$1,900,775
De-mobilize salvageable equipment and materials		LS	1	#N/A	107479.00	$107,479
Labour for Mobilization	Labour	LS	1	#N/A	129046.50	$129,047
Labour for Demobilization	Labour	LS	1	#N/A	66478.50	$66,479
Equipment Fleet	Provision of equipment fleet (rental/depreciation)	LS	1	#N/A	3047802.00	$3,047,802
Demobilize - Excavator and Rock Truck	via Herc	LS	3	#N/A	20000.00	$60,000
Excavators		each	0	#N/A	150000	$0
Dump trucks		each	0	#N/A	50000	$0
Dozers		each	0	#N/A	150000	$0
Demolition shears		each	0	#N/A	300000	$0
Crane		each	0	#N/A	150000	$0
Loader		each	0	#N/A	150000	$0
Compactor		each	0	#N/A	0	$0
Light duty vehicles		each	0	#N/A	20000	$0
MOBILIZE MISC. EQUIPMENT						
Pump shipping		each		#N/A	0	$0
Pipe shipping		m		#N/A	0	$0
Minor tools and equipment	Included in mob/demob.	allow	0	#N/A	100000	$0
Truck tires		allow		#N/A	0	$0
Other				#N/A	0	$0
MOBILIZE CAMP						
Reclamation activities		allow		#N/A	0	$0
Long term reclamation activities (eg pump flooding)		allow		#N/A	0	$0
MOBILIZE WORKERS						
Reclamation activities - transport	All flights and logistics	LS	1	#N/A	1074795.00	$1,074,795
Reclamation activities - transport	Dash 7 flights	each	0	MWH	9100.00	$0
Reclamation activities - transport	Hercules flights	each	0	#N/A	20000	$0
Rotation over reclamation period	Worker rotation costs	LS	1	#N/A	491630.00	$491,630
Reclamation activities - travel time		mandays	0	ACCMH	175	$0
Long term reclamation activities (eg pump flooding) - transport		each		#N/A	0	$0
Long term reclamation activities (eg pump flooding) - travel time		each		#N/A	0	$0
Monitoring Airfare		each		#N/A	0	$0
WORKER ACCOMMODATIONS						
Reclamation activities	Camp services, communications, food, administration, mine management	LS	1	#N/A	2898640.00	$2,898,640
Long term reclamation activities (eg pump flooding)		manmonths		#N/A	0	$0
CONSTRUCTION MAINTENANCE						
Site roads and airstrip	Maintain during construction	LS	1	#N/A	$204,300	$204,300
Site equipment and facilities	Maintain during construction	LS	1	#N/A	$434,447	$434,447
MOBILIZE FUEL						
Fuel for reclamation activities	Supply and ship to site	LS	1	#N/A	$924,776	$924,776
Fuel freight - long term reclamation activities		liter		#N/A	0	$0
Fuel freight accommodations		liter		#N/A	0	$0
WINTER ROAD						
Mobilization - Construction and operation	366 km GK to site times	LS	1	#N/A	$477,997	$477,997
Demobilization - Construction and operation	366 km GK to site times	LS	1	#N/A	$477,997	$477,997
Limited winter use		km		#N/A	0	$0
Winter road tariff	Included in mob/demob.	kmtonne	0	WRUS	0.11	$0
DEMOBILIZE HEAVY EQUIPMENT						
Excavators	Rental of equipment while on site is under "Mobilize". Mob/demob is under "Winter Road"	km		#N/A	0	$0
Dump trucks		km		#N/A	0	$0
Dozers		km		#N/A	0	$0
Demolition shears		km		#N/A	0	$0
Crane		km		#N/A	0	$0
Loader		km		#N/A	0	$0
Compactor		each		#N/A	0	$0
Light duty vehicles		km		#N/A	0	$0
Other		km		#N/A	0	$0
DEMOBILIZE WORKERS						
crew travel time	Covered in rotation costs above.	LS	0	#N/A	$0	$0
crew transportation	Covered in flights and logistics above.	each	0	#N/A	0	$0
					Total	**$14,184,363**

Contractor Indirects:

$4,029,017

Unit Cost Table (for refining unit costs see "Estimator" worksheet)

Filter by unit

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	COMMENTS
Accomodation							
		ACCM	manday	100.00	175.00	362.33	Specified - Lupin.
Buildings - Decontaminate							
	Asbestos	BDA	m2	25.60	51.20		Low: removal of asbestos siding & flooring; High: removal of insulated pipes, friable asbestos
Buildings - Remove							Unit costs are based on 3m high, single storey building. Scale areas accordingly.
	Wood	BRW	m2	27.50	41.00		
	Concrete	BRC	m2	40.00	65.00	128.00	Specified: puncture concrete foundation slabs
	Steel - teardown	BRS1	m2	45.00	65.00	68.49	Specified - Lupin for Main and Satellite tank farms
	Steel - for salvage	BRS2	m2	67.00	100.00		
Concrete work							
	Small pour	CSF	m3	426.50	639.75		Low: YK; High=1.5xLow
	Large pour	CLF	m3	353.50	530.25	2,130.00	Specified: concrete crown pillar
Contaminated Soils							
	ESA Phase 1	CS1	each	7500.00			Low: small, "clean" site
	ESA Phase 1	CS2	each	50000.00			Low: small, "clean" site
	Remediate on site	CSR	m3	47.00	146.00	60.17	Low - 1 cell is complete and cost to construct 4 more cells is already allowed for.
Dozing							
	doze rock piles	DR	m3	1.05	2.40	2.48	Low cost: doze crest off dump; Specified - Lupin doze to central area
	doze overburden/soil piles	DS	m3	0.95	3.80	0.22	Specified rate - for regrading esker borrow area.
Excavate Rock; Low Spec's and QA/QC							
	drill/blast/load/short haul	RB1	m3	11.40	17.05		Low:quarry operations for bulk fill
	drill/blast/load/long haul	RB2	m3	12.05	17.80		
	RB1 + spread and compact	RB3	m3	12.05	17.80		
	RB2 + spread and compact	RB4	m3	12.50	30.75		
	Specified activity	RBS	m3				
Excavate Rock; High Spec's and QA/QC							(e.g. ditch/spillway excavation)
	drill/blast/load/short haul	RC1	m3	12.05	17.80		Low:foundation excavation;High:spillway excavation
	drill/blast/load/long haul	RC2	m3	12.70	18.40		
	RC1 + spread and compact	RC3	m3	12.70	18.40		e,g, cover construction
	RC2 + spread and compact	RC4	m3	13.50	19.20		e,g, cover construction
	Specified activity	RCS	m3			175.00	Specified-drift excavation
Excavate Rip Rap							
	drill/blast/load/short haul/place	RR1	m3	13.50	17.75	15.20	High: quarry & place rip rap in channel
	drill/blast/load/long haul/place	RR2	m3	14.20	20.65		
	source is waste dump/short haul	RR3	m3	7.00			cost includes sorting
	source is waste dump/long haul	RR4	m3	7.60		2.48	Specified - for relocating rock into central area
	Specified activity	RRS	m3			85,656.00	
Excavate Soil; Low Spec's and QA/QC							
	clear & grub	SBC	m2	3.40	5.00		
	excavate/load/short haul	SB1	m3	4.30	5.90	3.07	Specified - for relocationg rubble to landfill
	excavate/load/long haul	SB2	m3	4.60	7.30		
	SB1 + spread and compact	SB3	m3	5.10	8.90		Low: non-engineered; High:engineered
	SB2 + spread and compact	SB4	m3	5.50	11.00		Low: non-engineered; High:engineered
	Specified activity	SBS	m3	3.20	6.30		Low: rehandle waste rock dump by dozing; High:rehandle waste rock by hauling
	Tailings	SBT	m3	1.35	3.70	15.50	High:contour surface - wet or frozen; Specified:haul/place wet infill
Excavate Soil, High Spec's and QA/QC							
	excavate/load/short haul	SC1	m3	6.80	9.30	2.74	Specified - for placement of coarse esker as toe berm in TCA
	excavate/load/long haul	SC2	m3	7.10	11.75		
	SC1 + spread and compact	SC3	m3	8.90	14.20	4.01	Low: non-engineered; High:engineered; Specified - placement of TCA cover
	SC2 + spread and compact	SC4	m3	9.30	23.20	3.98	Low: non-engineered; High:engineered (e.g. complex covers, low volume dam construction); Specified - placement of Central Area Cover.
	Specified activity	SCS	m3			18.80	Backfill adit with waste rock
Fence							
		FNC	m	13.55	203.00		
Fuel and Electricity							
	Fuel cost - gas	FCG	litre	1.05	1.40		
	Fuel cost - diesel	FCD	litre	0.99	1.39		
	Fuel mobilization	FCM	litre	0.22	0.42		High: winter road usage
	Electricity	FCE	kW-h	0.17	0.19	0.49	Low and High:Yellowknife; Specified:diesel generator
Geo-Synthetics							
	geotextile	GST	m2	3.44			Supply and install
	geogrid	GSG	m2	5.75			
	liner, HDPE	GSHDPE	m2	7.95			Supply and install; large quantity
	liner, ES3	GSES3	m2	20.20			FOB Yellowknife
	geosynthetic installation	GSI	m2	3.16	14.00		Low:geotextile; High:ES3 or HDPE
	bentonite soil ammendment	GSBA	tonne	308.30	348.50		FOB Edmonton, add shipping & mixing
Grouting (/m3 of rock grouted)							
		grout	m3	236.55	286.75		High: cement, FOB Yellowknife
Labour & Equipment Rates							
	Site manager	sman	$/hr	125.00	152.00		
	Supervisor	super	$/hr	52.00	91.84		
	Registered engineer	eng	$/hr	95.00	220.00		
	Environmental coordinator	envco	$/hr	74.16	130.00		
	Evironmental technologist	envtech	$/hr	36.00			
	Electrician	elec	$/hr	74.00	95.00		
	Journeyman - various	journey	$/hr	44.00	71.79		
	Labour - skilled	lab-s	$/hr	41.00	49.60		
	Labour - unskilled	lab-us	$/hr	31.00	43.98		
	Equipment operator	oper	$/hr	41.00	65.00		
	Heavy duty mechanic	mech	$/hr	49.00	72.85		
	Water treatment plant operator	oper-wt	$/hr	41.00	59.86		
	Security / first aid	safety	$/hr	36.00	66.97		
	Administative staff	admin	$/hr	38.00	57.89		
	Equipment rates include operator and fuel						
	Loader - 4 cu.yd (3.06m3)	load-s	$/hr	175.00			
	Loader - 7 cu.yd (5.35m3)	load-l	$/hr	315.00			
	Excavator - 26.76-30.84 tonnes	exc-s	$/hr	190.00			
	Excavator - 68.95+tonnes	exc-l	$/hr	420.00			
	Grader	grad	$/hr	190.00			
	Dump truck off hwy 30-50 tonnes	truck-s	$/hr	225.00			
	Dump truck off hwy 55-75 tonnes	truck-l	$/hr	300.00			
	dozer, small	dozers	$/hr	205.00	260.00		
	dozer, large	dozerl	$/hr	490.00	565.00		
	smooth drum compactor	comp	$/hr	155.00			
	scooptram, 6 yd3 bucket	scoop	$/hr	170.00			
	flat bed truck with hiab	hiab	$/hr	155.00			
	fuel truck	ftruck	$/hr	150.00			

Unit Cost Table (for refining unit costs see "Estimator" worksheet)

	Filter by unit					
water truck	wtruck	$/hr	58.00	150.00		
Mobilize Heavy Equipment						
Road access	MHER	kmtonne	3.40	10.25		
Air access	MHEA	kmtonne	12.00			cargo rate>500lb
Mobilize Camp						
Road access	MCR	each	50000.00			refurbish existing camp
Mobilize Workers						
flight	MW	each	4500.00	9100.00		Low:e.g. 8 passenger; High: Dash 7
Oil Removal						
oil removal	OR	litre	0.43	1.20		Low:waste oil heater; High: ship offsite
PCB Removal						
Remove from site	PCBR	litre	40.20	46.90	7.21	Low: shipping, handling & disposal from Yellowknife
Pipes, small (<6in dia.)						
remove/dispose on site	PSR	m	1.00	24.00	7.84	Low: remove/dispose on site; High: remove/re-use
supply	PSS	m	6.10	11.10		Low:supply; High:supply and ship
install	PSI	m	25.00			
Pipes, large (>6in dia.)						
remove/dispose on site	PLR	m	22.00	72.00	4.75	Low: remove/dispose on site; High: remove/re-use; Specified - Lupin pipelines
supply	PLS	m	129.00	143.00		Low:supply; High:supply and ship
install	PLI	m	50.00			
Power Lines						
remove/dispose on site	POWR	m	25.50			
Process Chemicals						
Remove from site	PCR	kg	0.45	2.50		Low: shipping, handling & disposal from Yellowknife
Pumps						
Pump capital cost	PC	each	195000.00			
Pump shipping	PS	each	2500.00			
Pump operating cost	POC	m3	0.12		1.57	Specified: pumping water from flooded crown pillars
Pump maintenance	PM	allow	25000.00			
Pump sand BackFill						
	PBF	m3	85.00	300.00		
Scarify - road/mine site						
	SCFY	ha	4300	6030	2150	
Shaft, Raise & Portal Closures						
Shaft & Raises	SR	m2	645.00	2132.00		Low:pre-cast concrete slabs, little site prep. Area=shaft+>1m all around
Portals	POR	m3	18.80	250.00	1200.00	Low:unit cost code SCS;High:excavate & backfill collapsed portal;Spec: installed pressure plug
Site Inspection Report						
	RPT	each	10000.00	20000.00		
SpillWay - Clear						
	SW	each	3000.00	7000.00		
Survey/Instrumentation						
	SI	each	1800.00	3600.00		2 person crew
Treatment Plant - Construct						
Small (< 1000 m3/d)	TPS	lump sum	9000000	15000000		
Large (> 1000 m3/d)	TPL	lump sum	15000000	46000000		
Constructed Wetland	CWTS	ha	200000	300000		
Treatment Plant - Operate						
	TPO	m3	0.35	2.00	0.103	Specified - Lupin lime addition to pond to raise pH
Treatment Chemicals						
ferric sulphate	ferric	kg	1.19			
ferrous sulphate	ferrous	kg	1.32			
lime	lime	kg	0.56			
hydrogen peroxide, 35%	hperox	kg	1.50			
Sodium Metabisulfate	Nametab	kg	1.18			
Caustic soda, 50%	caustic	kg	0.74			
Sulfuric acid, 93%	sulfuric	kg	0.31			
flocculant	flocc	kg	6.00			
copper sulphate	copper	kg				
shipping	shipping	kg	0.20			
Vegetation						
Hydroseed, Flat	VHF	ha	4000.00			
Hydroseed, Sloped	VHS	ha	4500.00			
Veg. blanket/erosion mat	VB	ha	13000.00			
Tree planting	VT	ha	2600.00	6000.00		
Wetland species	VW	ha			47.72	Specified= /m3, Wetland Growth Media Substrate mixed and installed (sand, biochar and fertilizer, woodchips)
Water Sampling/Analysis/Reporting						
	WS	each	7000.00	10000.00		
Winter Road						
Construction	WRC	km	2000.00	11500.00		
Usage	WRU	kmtonne	0.29		0.11	LMI quote asuming shared use with diamond mines

Security Framework Milestones for Draft Water Licence Framework

CAPTIAL COSTS	SECURITY ESTIMATE COST		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
UNDERGROUND MINE	$	246,298	See below for each milestone
TAILINGS FACILITY	$	999,674	See below for each milestone
ROCK PILE	$	1,420,840	See below for each milestone
BUILDINGS AND EQUIPMENT	$	3,199,383	See below for each milestone
CHEMICALS AND CONTAMINATED SOIL MANAGEMENT	$	464,521	See below for each milestone
CONTRACTOR INDIRECTS	$	4,029,017	See below for each milestone
SURFACE AND GROUNDWATER MANAGEMENT	$	327,480	See below for each milestone
INTERIM CARE AND MAINTENANCE	$	70,567	See below for each milestone
SUBTOTAL: Capital Costs	**$**	**10,757,780**	

INDIRECT COSTS	SECURITY ESTIMATE COST			EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
MOB/DEMOB		$	10,155,346	See below for each milestone
POST CLOSURE MONITORING		$	963,257	See below for each milestone
ENGINEERING	4%	$	430,311	Submit new cost estimate with each reduction - percentages will reduced as shown in the new cost estimate
PROJECT MANAGEMENT - CONTRACTOR	3.62%	$	386,926	Submit new cost estimate with each reduction - percentages will reduced as shown in the new cost estimate
PROJECT MANAGEMENT - LMI	1.38%	$	150,963	Submit new cost estimate with each reduction - percentages will reduced as shown in the new cost estimate
BONDING/INSURANCE	1%	$	107,578	Submit new cost estimate with each reduction - percentages will reduced as shown in the new cost estimate
CONTINGENCY	5%	$	537,889	Submit new cost estimate with each reduction - percentages will reduced as shown in the new cost estimate
SUBTOTAL: Indirect Costs		**$**	**12,732,270**	
TOTAL COSTS		**$**	**23,490,049**	

Underground Mine

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)	EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
CONTROL ACCESS						
Backfill portal - plug portal with waste rock - 10 m long	m3	250	DRS	2.06	$ 515	Mines Inspector sign-off, Attached Mines Inspectors Letter to Monthly Report, CIRNAC Inspector on site will/can also assess
CROWN PILLAR BLASTING FOR STORAGE						
Pump out water from crown pillars	m3	5,250	POCS	1.57	$ 8,243	Photos and Engineer Verification, Engineer Verification as part of the Monthly Report, CIRNAC Inspector via email or will/can also access
West Zone - drill and blast	m3	9,250	#N/A	25.68	$ 237,540	Mines Inspector sign-off and Engineer Verification, Engineer Verification as part of the Monthly Report, CIRNAC Inspector on site will/can also assess
Total					**$ 246,298**	

Tailings Impoundment

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)	EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
STABILIZE EMBANKMENT(S)						
Toe buttress, bulk fill - place esker toe berm to repair erosion on K Dam	m3	17000	SC1S	2.74	$ 46,580	Survey and documentation , Engineer Verification, CIRNAC Inspector on site will/can also assess
Flatten granular fill on Pond 1 side of M Dam	m2	7500	#N/A	2.53	$ 18,975	Survey and documentation, Engineer Verification, CIRNAC Inspector on site will/can also assess
COVER TAILINGS						
Soil cover and outflow - Cell 3	m3	86000	SC3S	4.01	$ 344,860	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Soil Cover and outflow - Cell 5	m3	104500	SC3S	4.01	$ 419,045	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Cover tailings exposed in Cell 4	m3	14000	SC3S	4.01	$ 56,140	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
BURY PAG ROCK / TAILINGS						
Remove tailings from emergency dump ponds	m3	300	#N/A	7.92	$ 2,376	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
STABILIZE DECANT SYSTEM						
Remove and dispose of syphons (8) from J Dam and Dam 1A	m	200	PLRL	22.00	$ 4,400	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access

REMOVE TAILINGS DISCHARGE							
Tailings Pipe	m	4000	PLRS	4.75	$	19,000	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
UPGRADE SPILLWAYS							
Cell 4 Outlet	LS	1	#N/A	19,009	$	19,009	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
Excavate channel, soil - Spillway on Dam 1A and Dam J	m3	12350	SB1L	4.30	$	53,105	Design, Design and Engineer sign-off, CIRNAC Inspector via email or will/can also access
Rip rap - Cover the spillway invert and channel slopes to 2 m flow depth using rip rap recovered from dam slopes.	m3	936	RR3L	7.00	$	6,552	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
Geotextile- Place under spillway rip rap.	m2	2800	GSTL	3.44	$	9,632	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
Total					**$**	**999,674**	

Rock Pile

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
COVER ROCK PILE							
Mine Site Soil cover - Quadrant 1 excavate,haul,spread&compact	m3	61,500	SC4S	3.98	$	244,770	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Mine Site Soil cover - Quadrant 2 excavate,haul,spread&compact	m3	54,500	SC4S	3.98	$	216,910	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Mine Site Soil cover - Quadrant 3 excavate,haul,spread&compact	m3	57,100	SC4S	3.98	$	227,258	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Mine Site Soil cover - Quadrant 4 excavate,haul,spread&compact	m3	57,892	SC4S	3.98	$	230,410	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
Mine Site Soil cover - Shop Area excavate,haul,spread&compact	m3	1,008	SC4S	3.98	$	4,012	Aerial photo, survey with field engineer sign-off that depth of cover was confirmed, Engineer Sign-Off, CIRNAC Inspection on site
CONSOLIDATE ROCK INTO CENTRAL AREA							
Mine Site Quadrant 1 - Load, haul, dump or doze, erosion control	m3	50,500	RR4S	2.48	$	125,240	Confirm survey quantities. Proof of waste rock removal (visual assessment on outer edge of facility, Engineer sign-off, CIRNAC Inspection on site
Mine Site Quadrant 2 - Load, haul, dump or doze, erosion control	m3	43,500	RR4S	2.48	$	107,880	Confirm survey quantities. Proof of waste rock removal (visual assessment on outer edge of facility, Engineer sign-off, CIRNAC Inspection on site
Mine Site Quadrant 3 - Load, haul, dump or doze, erosion control	m3	47,300	RR4S	2.48	$	117,304	Confirm survey quantities. Proof of waste rock removal (visual assessment on outer edge of facility, Engineer sign-off, CIRNAC Inspection on site

Mine Site Quadrant 4 - Load, haul, dump or doze, erosion control	m3	49,700	RR4S	2.48	$	123,256	Confirm survey quantities. Proof of waste rock removal (visual assessment on outer edge of facility, Engineer sign-off, CIRNAC Inspection on site
SPECIALIZED ITEMS							
Install permanent instrumentation - Thermistor strings in rock dome area	each	10	#N/A	2,000	$	20,000	Photographs of Complete Work, Engineer Verification
Install permanent instrumentation, drilling - rock dome area	hrs	20	exc-sL	190	$	3,800	Photographs of Complete Work, Engineer Verification
Total					**$**	**1,420,840**	

Chemicals/Soil Area

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
BUILDING DECONTAMINATION & CONSOLIDATION OF HAZARDOUS MATERIALS							
Decontaminate: oil, fuel and glycol systems	m2	8,490	#N/A	22.80	$	193,572	Photographs of Completed Work and Item Inventory
Remove all asbestos containing materials - landfill or underground	m3	100	#N/A	817.20	$	81,720	Photographs of Completed Work and Item Inventory, Engineer Verification
HAZARDOUS MATERIALS REMOVAL							
Waste oils	litre	5,940	ORH	1.20	$	7,128	Manifests/Photographs, CIRNAC Inspector via email or will/can also access
Waste fuel	litre	36,113	ORL	0.43	$	15,529	Manifests/Photographs, CIRNAC Inspector via email or will/can also access
Other hazardous materials	kg	15,840	PCRL	0.45	$	7,128	Manifests/Photographs, CIRNAC Inspector via email or will/can also access
CONTAMINATED SOIL REMOVAL							
Excavate treated soils and move to underground from landfarm	m3	500	#N/A	2.29	$	1,145	Confirmation of Placement Underground, Engineer Verification, CIRNAC Inspector via email or will/can also access
Load, haul and dump into crown pillar - PHC Soils	m3	34,700	#N/A	1.95	$	67,665	Confirmation of Placement Underground, Engineer Verification, CIRNAC Inspector via email or will/can also access
Type-2 -As, CN- and PbNO3 to crown pillars	m3	16,700	#N/A	2.22	$	37,074	Confirmation of Placement Underground, Engineer Verification, CIRNAC Inspector via email or will/can also access
Lumber/boneyard contaminated soils - Excavate and move to crown pillars	m3	1,966	#N/A	2.74	$	5,387	Confirmation of Placement Underground, Engineer Verification, CIRNAC Inspector via email or will/can also access
Waste rock from mill laydown area - Excavate and move to crown pillars	m3	21,700	#N/A	2.22	$	48,174	Confirmation of Placement Underground, Engineer Verification, CIRNAC Inspector via email or will/can also access
Total					**$**	**464,521**	

Building / Equip

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)	EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
DISPOSE MOBILE EQUIPMENT						

Decontaminate and dispose in on-site landfill	m3	540	#NA	30.49	$	16,465	Photographs and Inventory, Engineer Verification, CIRNAC Inspector via email or will/can also access
REMOVE BUILDINGS							
Accommodation Complex 2020 - Kitchen, Recreation, 100, 200, 300, 400, 900, 1000, 1100, 1200	m2	4,451	#N/A	28.13	$	125,207	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Accommodation Complex 2021 - Offices 500, 600, 700, 800, 1300	m2	2,878	#N/A	28.13	$	80,958	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Hoist Room and Travel Ways	m2	463	#N/A	203.30	$	94,128	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Shaft House	m2	1253	#N/A	203.30	$	254,735	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Warehouse	m2	4671	#N/A	70.72	$	330,333	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Mill	m2	2864	#N/A	208.72	$	597,774	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Powerhouse	m2	1645	#N/A	115.48	$	189,965	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Headframe	m2	413	#N/A	203.32	$	83,971	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Airlock Building and Fresh air Intake	m2	366	#N/A	29.84	$	10,921	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Cold Storage 2 buildings	m2	1855	#N/A	50.59	$	93,844	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Surface Mobile Shop	m2	1008	#N/A	50.59	$	50,995	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Carpenter Shop	m2	482	#N/A	50.59	$	24,384	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
AS Treatment Plant Building	m2	177	#N/A	50.59	$	8,954	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Pumphouse	m2	74	#N/A	124.53	$	9,215	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Explosives Storage	m2	412	#N/A	124.53	$	51,306	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Fire house	m2	31	#N/A	29.84	$	925	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Emergency Power House	m2	117	#N/A	29.84	$	3,491	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
LMI Weather Station (Not ECCC) and Storage Buildings	m2	566	#N/A	29.84	$	16,889	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Shop	m2	379	#N/A	29.84	$	11,309	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Batch Plant	m2	118	#N/A	29.84	$	3,521	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
ATV Building	m2	172	#N/A	29.84	$	5,132	Confirm Removal was Completed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Fuel Tanks - Main Tank Farm - 2020 - All - excluding Tank 13-14	m2	8,090	BRS1S	68.49	$	554,084	Confirmation of Tanks still requiring cleaning - Photographs once they are removed, Mechanical Engineer sign-off - Engineer Verification of removal , CIRNAC Inspector via email or will/can also access

Fuel Tanks - Main Tank Farm - 2021 - Tank 13-14	m2	400	BRS1S	68.49	$	27,396	Mechanical Engineer in Nunavut sign-off for cleaning - Photographs once they are removed, Mechanical Engineer sign-off - Engineer Verification of removal , CIRNAC Inspector via email or will/can also access
Fuel Tanks - Satellite Tank Farm - already cleaned	m2	989	BRS1S	68.49	$	67,737	Photographs once they are removed, Engineer Verification, CIRNAC Inspector via email or will/can also access
Flush sewage pipelines	LS	1	#N/A	7,128	$	7,128	Confirmation, Engineer Verification, CIRNAC Inspector via email or will/can also access
Break foundation slabs - Use hoe ram to puncture slabs. Leave in place and cover.	m2	15,000	#N/A	4.02	$	60,300	Photographs of perforated/broken slabs, Engineer Verification, CIRNAC Inspector via email or will/can also access
Boneyard debris and steel from tanks	m3	20,000	#N/A	9.14	$	182,800	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
LANDFILL FOR DEMOLITION WASTE							
Place rock cover	m3	11,150	RR4S	3.07	$	34,231	Confirmation work was carried out in accordance with requirements, Engineer Verification, CIRNAC Inspector via email or will/can also access
Place soil cover	m3	13,500	SB4L	3.95	$	53,325	Confirmation work was carried out in accordance with requirements, Engineer Verification, CIRNAC Inspector via email or will/can also access
Clean burn pit and incinerator	LS	1	#N/A	11,880	$	11,880	Confirmation work was carried out in accordance with requirements, Engineer Verification, CIRNAC Inspector via email or will/can also access
Load, haul and dump in landfill	m3	30,000	SB1S	3.07	$	92,100	Confirmation work was carried out in accordance with requirements, Engineer Verification, CIRNAC Inspector via email or will/can also access
RECLAIM ROADS							
Remove culverts	each	22	#N/A	199	$	4,378	Photos and locations of where the culverts were located, Engineer Verification, CIRNAC Inspector via email or will/can also access
Other - grade and contour the esker borrow area	m3	180,000	DSS	0.22	$	39,600	Drone Survey - Final grade plan, Engineer Verification, CIRNAC Inspector via email or will/can also access
Total					**$**	**3,199,383**	

Capital Expenditures and Short Term Water Treatment identified in 'Instructions' worksheet

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
BREACH DYKE EMBANKMENT							
Upper and Lower Sewage Lagoons	LS	1	#N/A	11,880	$	11,880	Photographs , Engineer Verification, CIRNAC Inspector via email or will/can also access
CONSTRUCT WATER TREATMENT PLANT							
Upgrade treatment plant	LS	1	#N/A	35,000	$	35,000	Photographs, Engineer Verification, CIRNAC Inspector via email or will/can also access
Treatment Materials - Soda Ash	bag	5000	#N/A	16.25	$	81,250	Ice Road Manifests or other documentation, CIRNAC Inspector via email or will/can also access

Water Treatment Labour	LS	1	#N/A	199,350	$	199,350	Photographs of Work, Engineer Verification, CIRNAC Inspection on site
Total					**$**	**327,480**	

Interim Care and Maintenance

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
INTERIM CARE & MAINTENANCE							
SNP/AEMP water sampling & reporting	each	1	#N/A	12,360	$	12,360	Analysis reports filed, CIRNAC Inspector via email
Geotechnical assessment	each	1	#N/A	22,923	$	22,923	Filed with the NWB, CIRNAC Inspector via email
		Annual Interim C&M Cost			$	35,283	
Number of years of ICM	years	2		**Total**	**$**	**70,567**	

Post-Closure Monitoring & Maintenance:

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
MONITORING & INSPECTIONS							
Annual geotechnical inspection	each	10	#N/A	22,923	$	229,235	Annual basis, once work is completed at site - Filed with the NWB, CIRNAC Inspector via email
Monitoring years - 10	Year	3	LMI	100,000	$	300,000	Annual basis, once work is completed at site, CIRNAC Inspector via email
Site water monitoring (AEMP and SNP)	each	10	#N/A	12,360	$	123,600	Analysis filed, CIRNAC Inspector via email
Environmental Effects Monitoring (EEM) after 3 years	each	1	#N/A	126,079	$	126,079	Annual basis, once work is competed at site - Filed with ECCC, CIRNAC Inspector via email
Subtotal for first 10 years, undiscounted					$	778,914	
Discount rate for calculation of net present value of post-closure cost, %			3.00%				
Number of years of post-closure activity			25	years			
Net Present Value of payment stream							
Subtotal for first 10 years, undiscounted					**$**	**936,257**	

Mobilization/Demobilization

MILESTONE	Unit	Qty	Cost Code	Unit Cost	TOTAL SECURITY ALLOCATED TO MILESTONES (WHICH WAS CALCULATED TAKING INTO ACCOUNT CORRESPONDING REDUCTIONS OF POTENTIAL LIABILITY TO THE CROWN UNDER THE NWNRTA)		EVIDENCE REQUIRED TO CONFIRM COMPLETION OF MILESTONES
MOBILIZE HEAVY EQUIPMENT							
Mobilize equipment fleet	LS	1	#N/A	1,888,200	$	1,888,200	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
De-mobilize equipment fleet	LS	1	#N/A	1,900,775	$	1,900,775	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
De-mobilize salvageable equipment and materials	LS	1	#N/A	107,479	$	107,479	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
Labour for Mobilization	LS	1	#N/A	129,047	$	129,047	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
Labour for Demobilization	LS	1	#N/A	66,479	$	66,479	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
Equipment	LS	1	#N/A	3,047,802	$	3,047,802	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
Demobilize - Excavator and Rock Truck via Herc	LS	3	#N/A	20,000	$	60,000	Photographs - Inventory List, CIRNAC Inspector via email or will/can also access
MOBILIZE WORKERS							
Reclamation activities - transport	LS	1	#N/A	1,074,795	$	1,074,795	Release on completion of direct work apportioned to the total value of direct work as at March 31 2020, for example if a tenth of the direct work is released, a tenth of the indirect item is released, CIRNAC Inspector to confirm work is being carried out at site
Rotation over reclamation period	LS	1	#N/A	491,630	$	491,630	Release on completion of direct work apportioned to the total value of direct work as at March 31 2020, for example if a tenth of the direct work is released, a tenth of the indirect item is released, CIRNAC Inspector to confirm work is being carried out at site
WORKER ACCOMMODATIONS							
Reclamation activities	LS	1	#N/A	2,898,640	$	2,898,640	Release on completion of direct work apportioned to the total value of direct work as at March 31 2020, for example if a tenth of the direct work is released, a tenth of the indirect item is released, CIRNAC Inspector to confirm work is being carried out at site
CONSTRUCTION MAINTENANCE							
Site roads and airstrip	LS	1	#N/A	204,300	$	204,300	Release on completion of direct work apportioned to the total value of direct work as at March 31 2020, for example if a tenth of the direct work is released, a tenth of the indirect item is released, CIRNAC Inspector to confirm work is being carried out at site
Site equipment and facilities	LS	1	#N/A	434,447	$	434,447	Release on completion of direct work apportioned to the total value of direct work as at March 31 2020, for example if a tenth of the direct work is released, a tenth of the indirect item is released, , CIRNAC Inspector to confirm work is being carried out at site
MOBILIZE FUEL							

Fuel for reclamation activities	LS	1		924,776	$	924,776	Photographs, CIRNAC Inspector via email
WINTER ROAD							
Mobilization - Construction and operation 2020	LS	1	#N/A	477,997	$	477,997	Photographs, CIRNAC Inspector via email
Demobilization - Construction and operation 2022	LS	1	#N/A	477,997	$	477,997	Photographs, CIRNAC Inspector via email
Total					**$**	**14,184,363**	

Joint Submission of Lupin Mines Incorporated and Crown-Indigenous Relations and Northern Affairs Canada regarding Security Reduction Framework

January 16, 2020

As stated by both Lupin Mines Incorporated (LMI) and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), both parties have been working towards a joint proposal to the Nunavut Water Board (NWB or the Board) on a framework for the progressive release of security, and as a result of those discussions have reached the following mutual understandings:

- LMI is the party responsible for the reclamation and closure of the Lupin Gold Mine Project site.

- LMI has applied for the Nunavut Water Board to amend its water licence to authorize its use of waters and disposal of wastes required for the reclamation and closure of the Lupin Gold Mine Project site.

- LMI desires to obtain the progressive release of the security it furnishes to the Minister of Indian Affairs and Northern Development now Minister of Northern Affairs (the Minister) in relation to the outstanding liabilities associated with the Lupin Gold Mine Project and site, as significant progress is being achieved at the satisfaction of CIRNAC towards the full reclamation and closure of the Lupin Gold Mine Project site.

- The Government of Canada is committed to the reclamation and closure of mine sites that are no longer productive by their proponent.

- The Government of Canada will not incur any additional liability to the Crown in relation to mine developments including their full reclamation and closure.

- CIRNAC supports LMI's efforts to reclaim and close the Lupin Gold Mine Project site fully while reducing its costs of maintaining security with the Minister.

- CIRNAC is willing to consider LMI's requests for partial refunds of security pursuant to subsection 76(5) of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (the Act), as significant progress is being achieved at the satisfaction of CIRNAC and CIRNAC and LMI have identified milestones as set out in the attached towards the full reclamation and closure of the Lupin Gold Mine Site.

- LMI will conduct reclamation and closure work for Lupin Gold Mine Project site to reduce outstanding environmental impact and liability in accordance with the Act, its water licence, its approved Final Closure and Reclamation Plan, and the *Mine Site Reclamation Policy for Nunavut 2002,* and to that end has retained a third party contractor to continue the ongoing reclamation and closure work in February 2020.

In light of the above, LMI and CIRNAC support revising Part C of Water Licence as follows (for clarity, the following is intended to replace Part C of the Draft Water Licence Framework filed by LMI with the Board on November 19, 2019):

Part C Conditions Applying to Security

1. The Licensee shall at all times furnish and maintain security with the Minister in the amount set out under Part C, Item 2 in accordance with section 76 of the Act, less any amount the Minister or their delegate may return to the Licensee pursuant to subsection 76(5) of the Act.

2. The Licensee shall furnish and maintain the specified reclamation security amounts with the Minister under the Licence set in Schedule C.

3. The following Schedule C Milestone items will each be considered individual aspects of the reclamation and closure work (including both direct costs and indirect costs as defined in Schedule C), such as: Cover Rock Pile; Consolidate Rock into Central Area; Hazardous Materials Removal; Contaminated Soil Removal; etc. as these are generally categorized in Schedule C.

4. Upon the completion of one or more milestones set out in Schedule C, the Licensee may submit a request to the Minister for release of security pursuant to subsection 76(5) of the Act supported by the following evidence:

    a. Details of the reclamation and closure work completed, and (where required as per the table at Schedule 3) confirmation by an Engineer registered in Nunavut that the reclamation and closure work was completed, so as to meet the milestone; and
    b. An updated estimation of the cost of the remaining reclamation and closure work required at the site, including cost contingency for ongoing care and maintenance monitoring and project risks.

    Within 45 days of a receipt of a request for release of security from the Licensee, the Minister or their delegate will review the Licensee's request, confirm to the Licensee that it has fulfilled the requirements for release of security pursuant to subsection 76(5) of the Act, and (provided the Licensee has met the evidence requirements set out at Item 3(a) and 3(b) above) will endeavor to release the security amount attributed to that milestone to the Licensee in a timely manner.

5. For the purposes of subsection 76(5) of the Act, once evidence for work completed for a Schedule C Milestone has been evaluated by the Minister or his delegate, the Minister will be justified to exercise his discretion to reduce the amount of security held when the work has completed a portion of the planned reclamation and closure work included in the approved Final Closure and Reclamation Plan and in the reasonable opinion of the Minister addresses the potential environmental liability pertaining to that particular aspect.

6. The Licensee shall furnish and maintain such further or other amounts as may be required by the Board based on required periodic estimates of current mine reclamation liability.

7. At any time, the Licensee or the Minister may apply to change the amount of security held under the Licence. Any request to change the amount of security shall be supplemented by submission(s) that include supporting evidence to justify the request.

8. Within thirty (30) days after receiving any security released by the Minister in accordance with Part C Item 4 the Licensee shall provide written confirmation to the NWB and that the security has been received by the Licensee.

9. For greater certainty, nothing in this Part C is intended to limit the discretion of the Minister or their delegate granted under subsection 76(5) of the Act.

SCHEDULE C

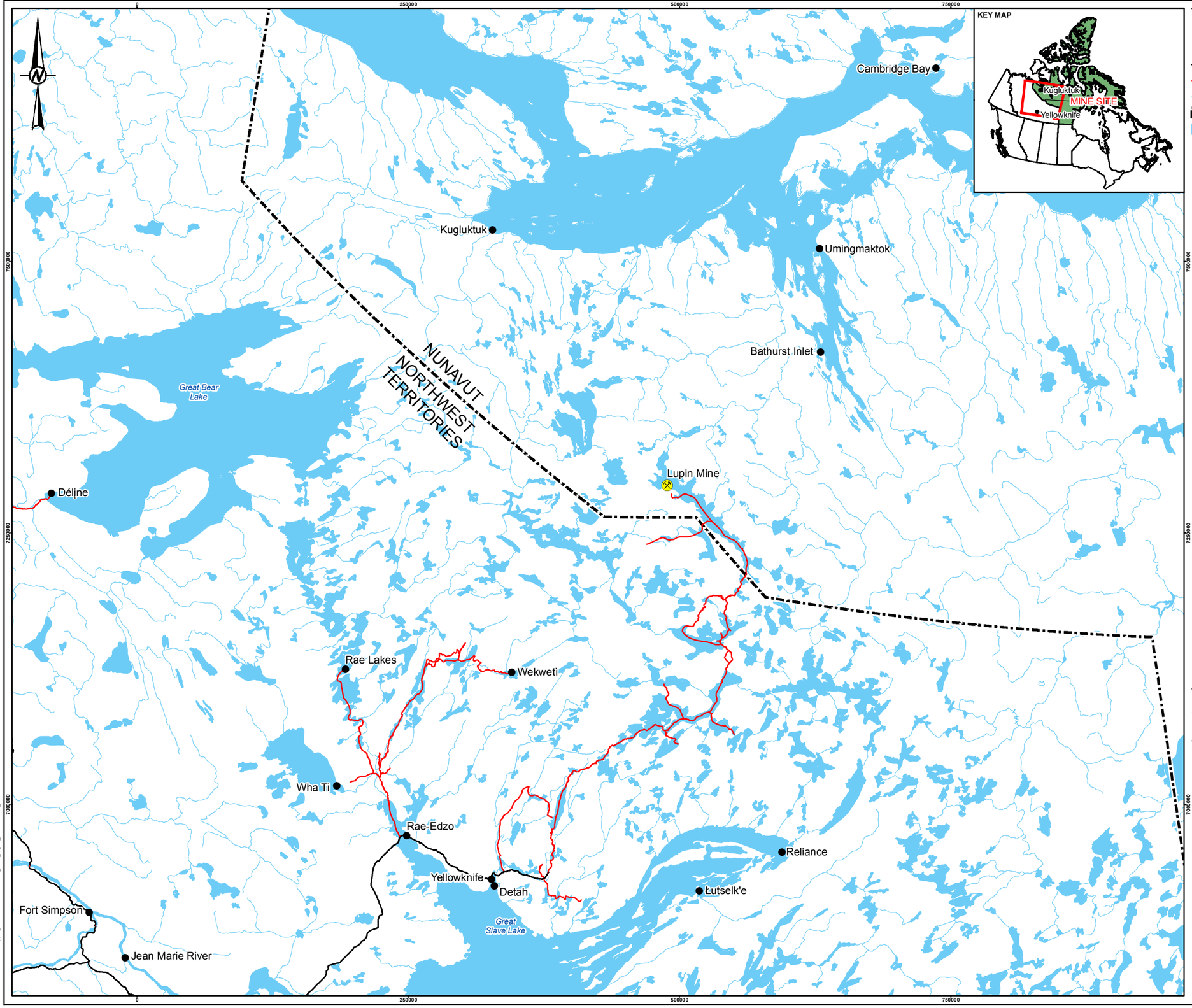
Milestone	**Total Security Allocated to Milestones (which was calculated taking into account corresponding reductions of potential liability to the Crown under the Act)**	**Evidence Required to Confirm Completion of Milestones and Support Release of Security**
[Note - To be populated per attached table, which has been agreed between CIRNAC and LMI]		
Total		

APPENDIX H

Technical Memos in Response to Information Requests, Technical Comments, Commitments from PHC/TM or Exhibits during the Application Review Process (2019)

Appendix	Description	
H-1	Public Hearing Exhibit 6 – Stantec Technical Memo dated 9 January 2020, Reference: Supporting Information to the Contingency Contaminants Management Decision Matrix. Note: Technical Memo submitted to NWB on 10 January 2020 in advance of hearing.	NWB Public Registry Document
H-2	Technical Memorandum regarding Lupin Mine Tailings Containment Area Dams Thermal Modelling Results for response to TM/PHC Commitment No.13 (Stantec, 2019a).	
H-3	Technical Memorandum regarding Geotechnical Review on the Long-Term Stability of TCA Dams for response to TM/PHC Commitment No.6. (Stantec, 2019b)	
H-4.1	APEC Drawing A053017-004 (Morrow 2006)	
H-4.2	Investigation locations Drawing A053017-005 (Morrow 2006)	
H-4.3	PCOC Tables M through U (Morrow 2006)	
H-4.4	APEC Table 6 (Golder 2017a)	
H-4.5	Current ARD (Golder 2017a)	
H-5	Closure Geochemical Source Term and Seepage Water Quality Model for Performance Evaluation of the Esker Cover for the Waste Rock “Dome” at Lupin Mine (Golder 2019a) to address Commitment No.7 from the TM/PHC.	
H-6	Coupled Thermal-Seepage Modelling for Performance Evaluation of the Esker Cover for the Waste Rock “Dome” at Lupin Mine. (Golder 2019b).	
H-7	Technical Memorandum regarding Waste Rock Information from Lupin Mine Tailings Containment Area for response to TM/PHC Commitment No.3 & 4. (Stantec, 2019c)	
H-8	Technical Memorandum regarding Conceptual Design for the Waste Rock “Dome” at Lupin Mine for response to TM/PHC Commitment No.5. (Golder, 2019b).	
H-9	Technical Memorandum regarding Cover Data from Lupin Mine Tailings Containment Area for response to TM/PHC Commitment No.10. (Stantec, 2019e).	
H-10	Technical Memorandum regarding Exposed Contaminants at Closure Water Levels for response to TM/PHC Commitment No.8. (Stantec, 2019d).	

H-11	Technical Memorandum regarding Geophysical Survey Lupin Mine Tailings Containment Area Dams for response to TM/PHC Commitment No. 11 (Stantec, 2019f);	
H-12	Technical Memorandum regarding Risk Assessment on Two Dams in the Lupin Tailings Containment Area for response to TM/PHC Commitment No. 12 (Stantec, 2019g);	
H-13	Human Health and Ecological Risk Assessment for response to TM/PHC Commitment No.1 & 7 (Golder, 2019c)	NWB public registry Document Part 1 Part 2 Part 3 Part 4



KEY MAP

LEGEND

- LUPIN MINE
- POPULATED PLACE
- HIGHWAY
- WINTER ROAD
- WATERCOURSE
- TERRITORIAL/PROVINCIAL BOUNDARY
- WATERBODY

0 75 150

1:3,500,000 KILOMETRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
LOCATION PLAN

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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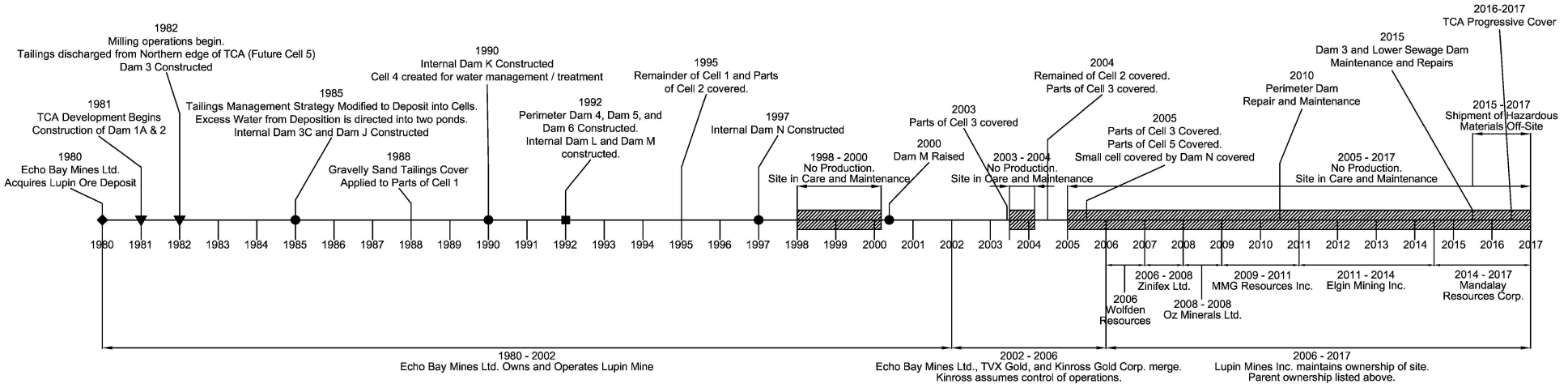

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

LUPIN MINES
INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

TITLE
SUMMARIZED PROJECT HISTORY

PROJECT NO.	CONTROL	REV.	FIGURE
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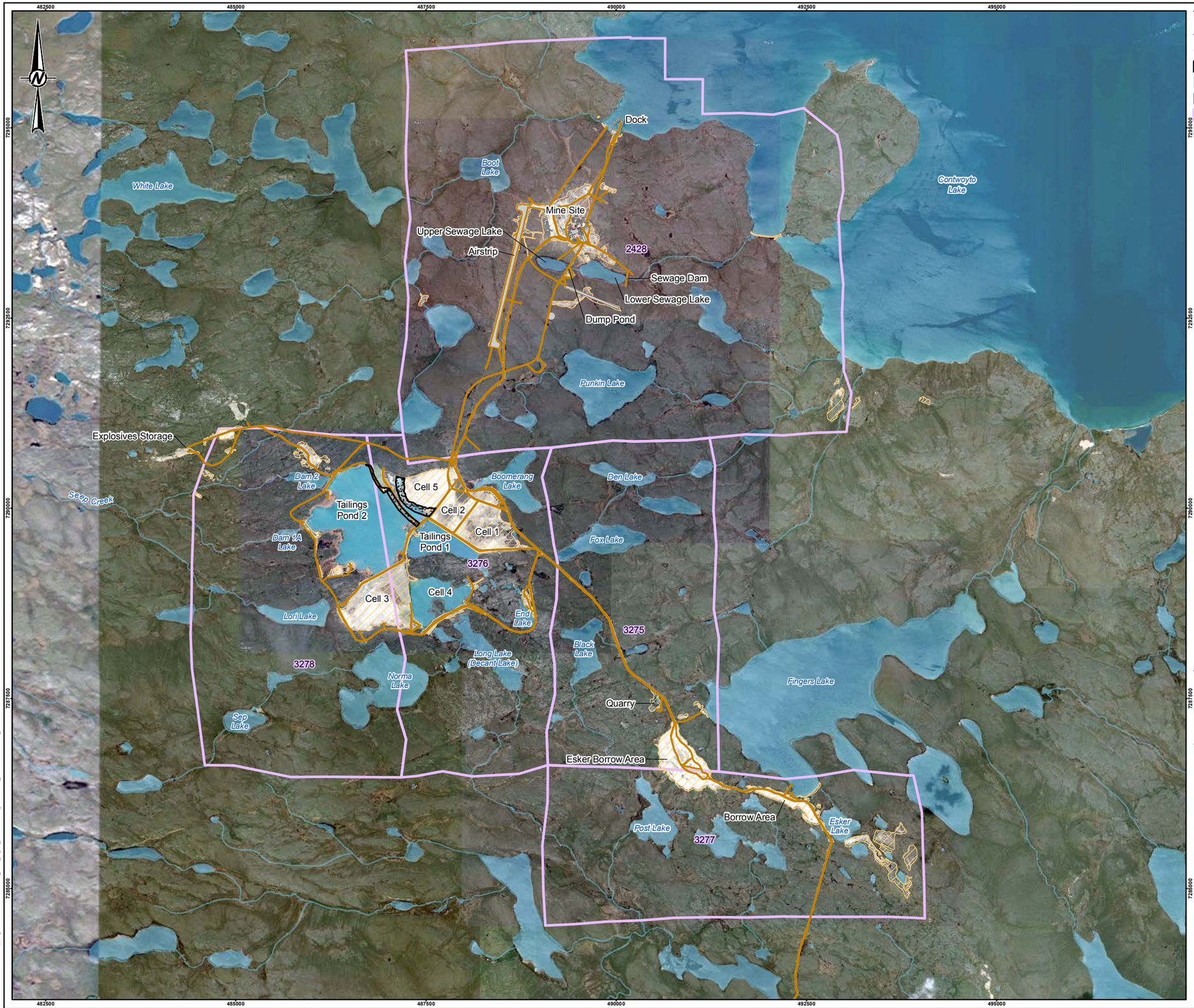

LEGEND

- ROAD
- WATERCOURSE
- APPROXIMATE 2017 RECLAMATION WORK
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- MINERAL LEASE BOUNDARY
- WATERBODY

0 2 4

1:50,000 KILOMETRES

REFERENCE(S)

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CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
GENERAL ARRANGEMENT PLAN - CURRENT CONDITIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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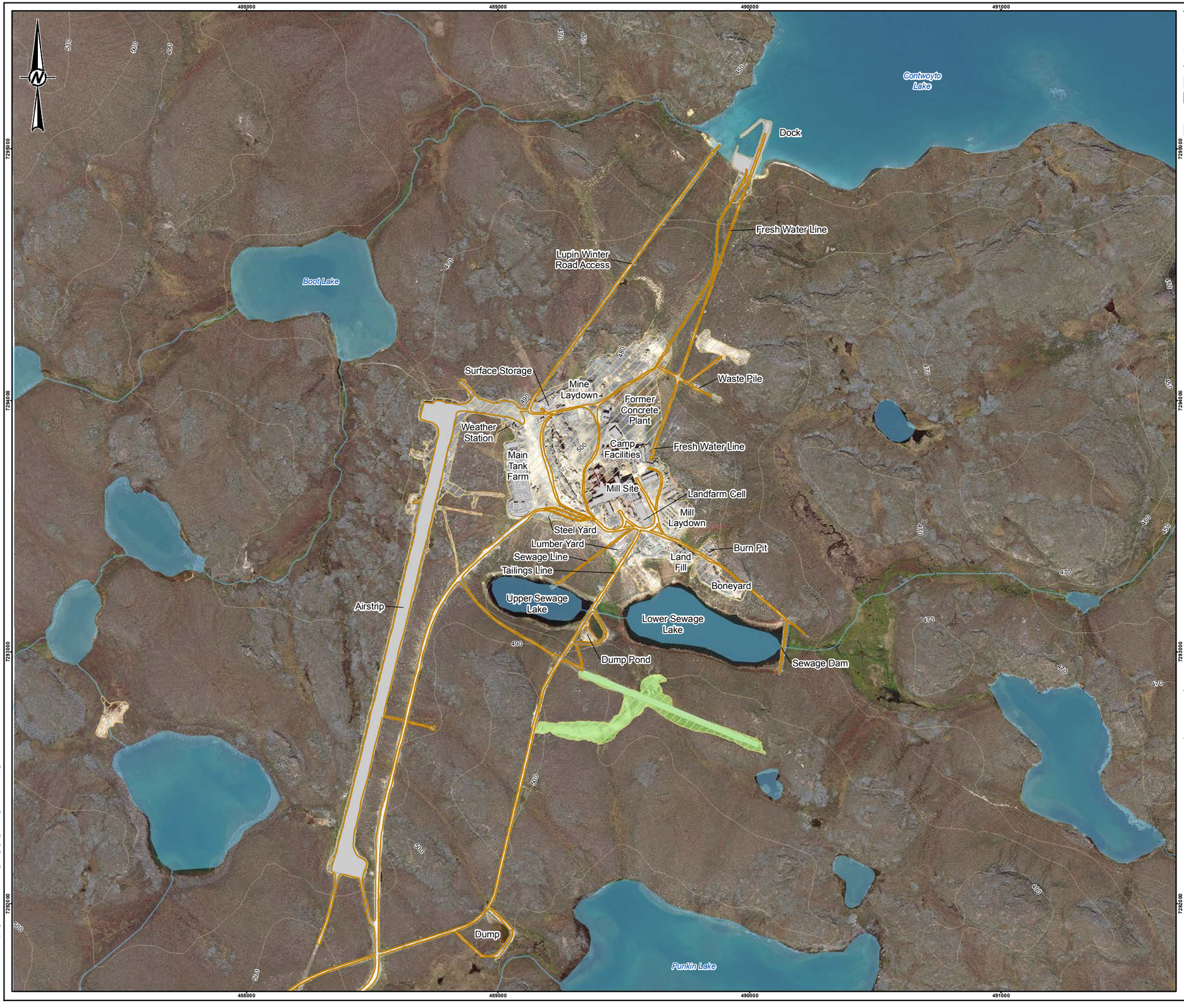

LEGEND

- CONTOUR
- WATERCOURSE
- ROAD
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- REHABILITATED DISTURBED AREA
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
MINE AND MILL SITE AREA – CURRENT CONDITIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	4

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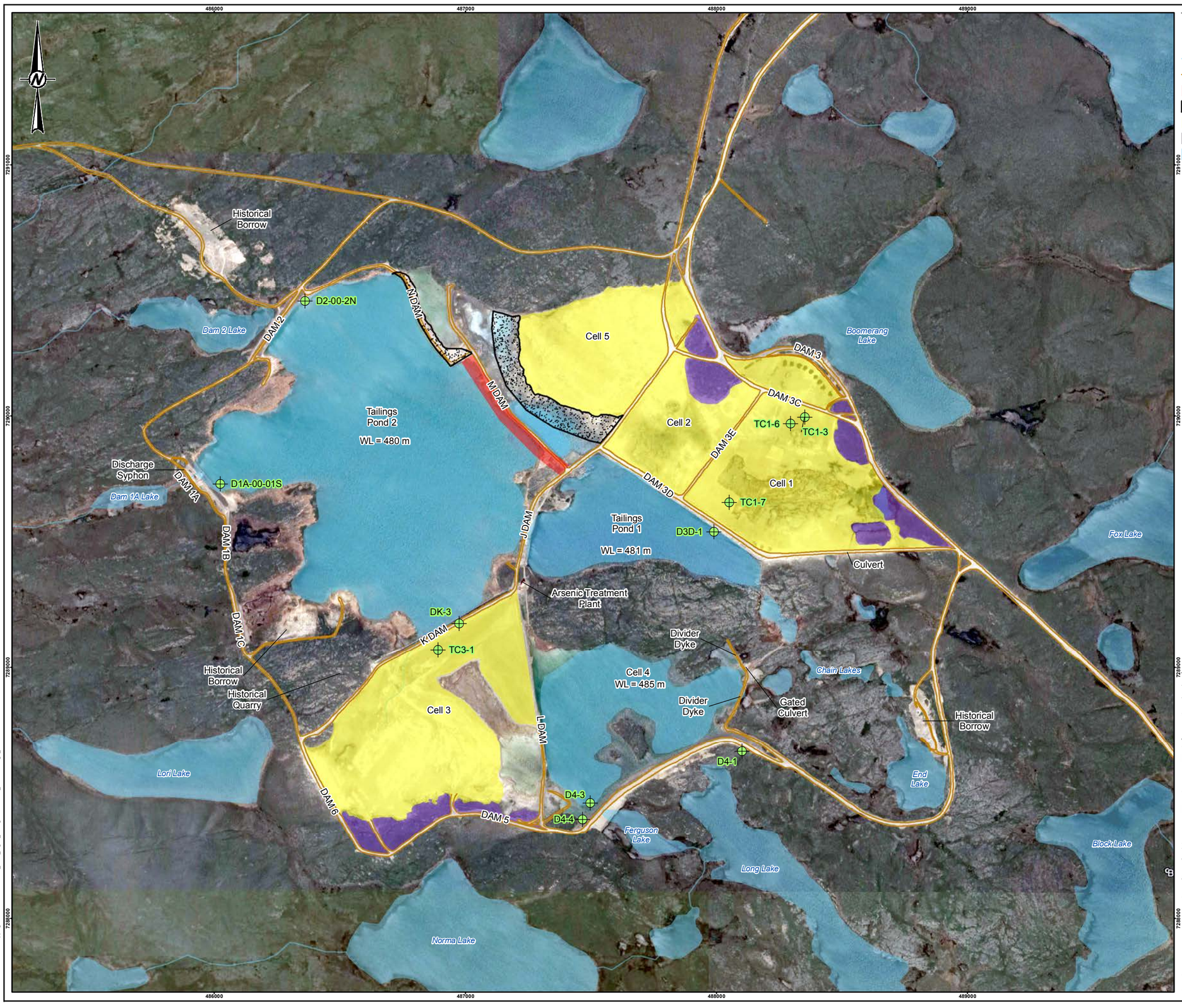

LEGEND

- ACTIVELY MONITORED THERMISTOR
- WATERCOURSE
- ROAD
- APPROXIMATE 2017 DAM REPAIR AND MAINTENANCE WORK
- APPROXIMATE 2017 RECLAMATION WORK
- PREVIOUSLY COMPLETED COVER
- TUNDRA
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

THERMISTOR LOCATIONS AND 2017 RECLAMATION WORKS OBTAINED FROM NORWEST CORP., JANUARY 26, 2018. HYDROGRAPHY AND TOPOGRAPHY DATA OBTAINED FROM GEOGRATIS © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. FOOTPRINT OBTAINED FROM CLIENT. IMAGE OBTAINED FROM GOOGLE EARTH © GOOGLE INC. USED WITH PERMISSION. GOOGLE AND GOOGLE LOGO ARE REGISTERED TRADEMARKS OF GOOGLE INC.
DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
TAILINGS CONTAINMENT AREA
APPROXIMATE 2017 WORK AREAS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-30
DESIGNED	NORWEST CORP.
PREPARED	AA
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	5

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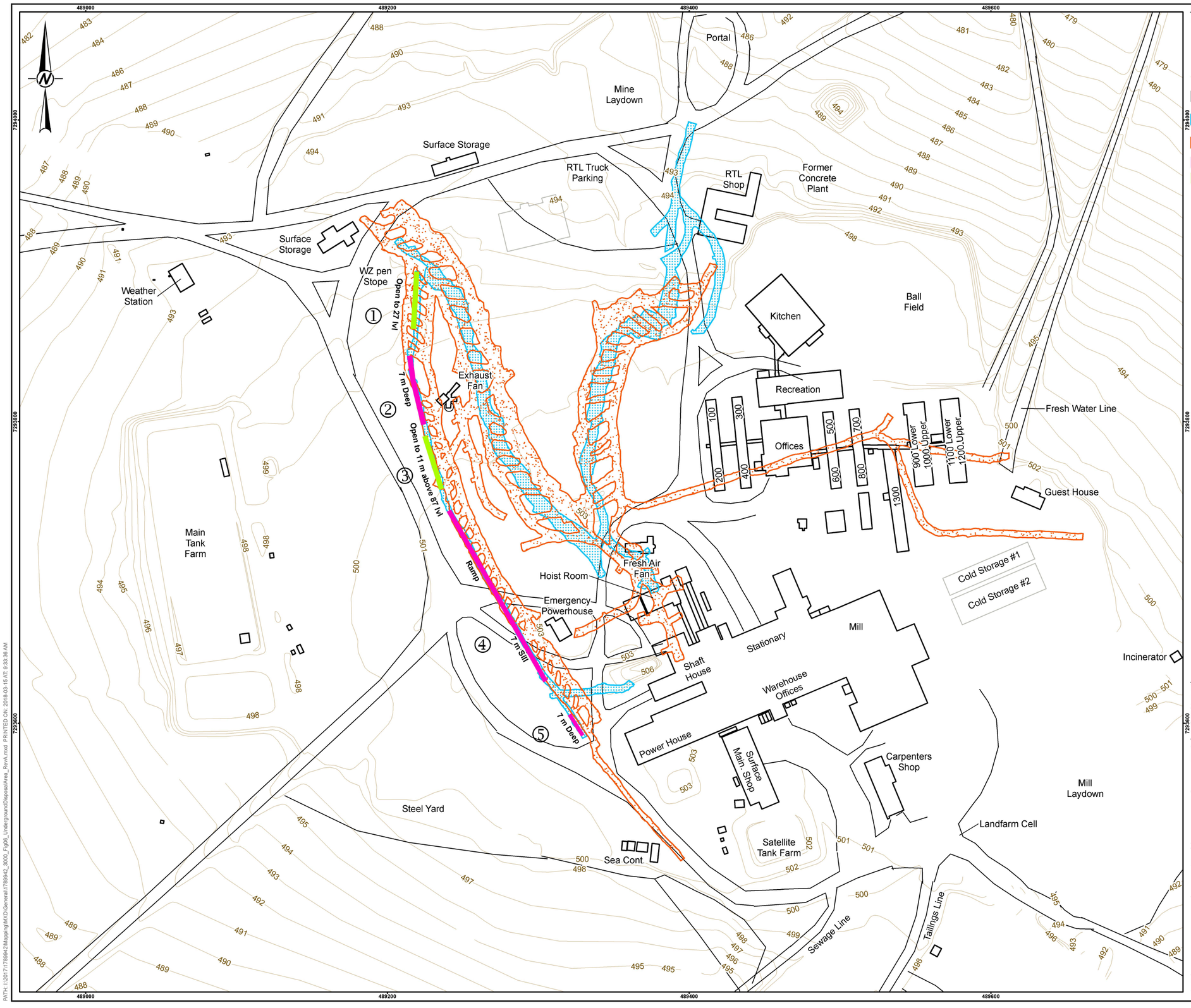

LEGEND

- ① WZ UNDERGROUND DISPOSAL KEY CROSS-SECTION LOCATION
- CONTOUR
- INFRASTUCTURE FOOTPRINT
- 27 LEVEL ORE DRIFT PROJECTION
- 87 LEVEL ACCESS DRIFT PROJECTION
- WZ CROWN PILLAR PIT
- WZ OPEN STOPE

0 50 100
1:2,500 METRES

REFERENCE(S)

UNDERGROUND DISPOSAL AND FACILITY DATA OBTAINED FROM NORWEST CORP., JANUARY 26, 2018. HYDROGRAPHY AND TOPOGRAPHY DATA OBTAINED FROM GEOGRATIS © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. FOOTPRINT OBTAINED FROM CLIENT.
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CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
UNDERGROUND MINE WORKING PLAN

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NORWEST CORP.
PREPARED	AA
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	6

LEGEND

- CONTOUR
- WINTER ROAD
- WATERCOURSE
- ROAD
- DISTURBANCE FOOTPRINT
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

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CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
LOCATION OF BORROW PITS AND QUARRIES

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	7

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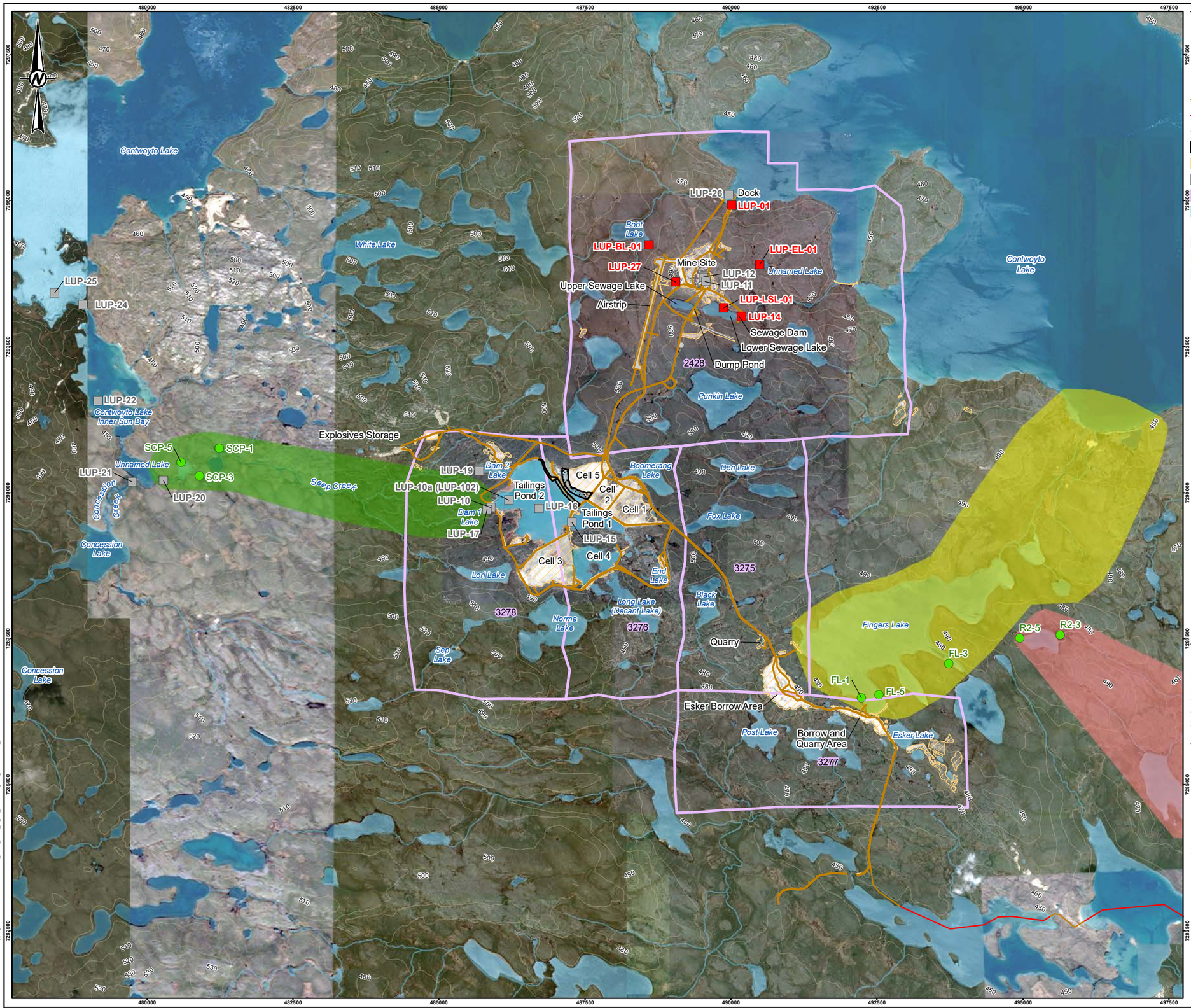

LEGEND

- EEM MONITORING LOCATION
- IARP WATER SAMPLING AND DISCHARGE LOCATION
- INACTIVE WATER SAMPLING LOCATION
- CONTOUR
- ROAD
- WINTER ROAD
- WATERCOURSE
- APPROXIMATE 2017 RECLAMATION WORK
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- MINERAL LEASE BOUNDARY
- WATERBODY

SAMPLING AREAS

- EXPOSURE AREA
- REFERENCE AREA 1
- REFERENCE AREA 2

0 2 4

1:65,000 KILOMETRES

REFERENCE(S)

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CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
MONITORING PROGRAM STATIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2020-09-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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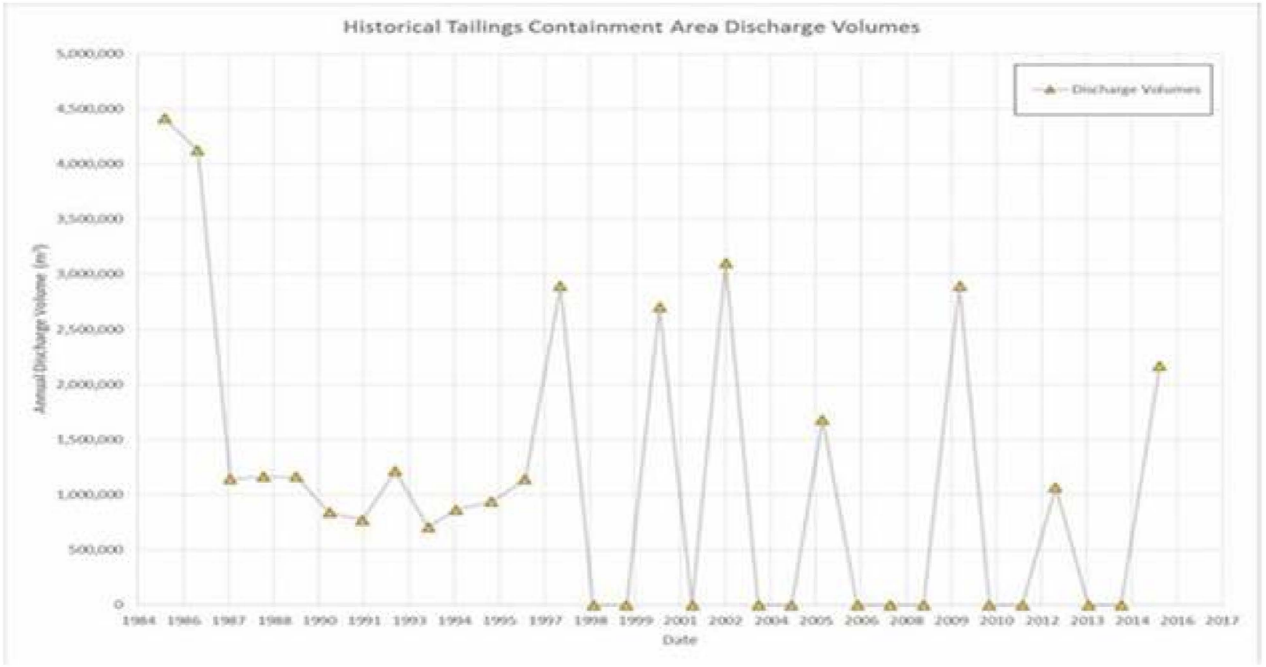

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

LUPIN MINES
INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

TITLE
HISTORICAL TCA WATER DISCHARGE TO THE ENVIRONMENT

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	9

LEGEND

- CONTOUR
- FLOW DIRECTION
- ROAD
- WATERCOURSE
- CHANNEL EXCAVATION AND CLOSURE SPILLWAY
- DEMOLITION LANDFILL
- INFRASTUCTURE FOOTPRINT
- LANDFILL
- REHABILITATED DISTURBED AREA
- WASTE ROCK COVERED
- WASTE ROCK REMOVED
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT

MANDALAY RESOURCES CORPORATION

PROJECT

LUPIN MINE CLOSURE

TITLE

MINE AND MILL SITE AREA – POST-CLOSURE

LUPIN MINES INCORPORATED

YYYY-MM-DD	2020-09-25
DESIGNED	NC
PREPARED	AA
REVIEWED	--
APPROVED	--

PROJECT NO.	CONTROL	REV.	FIGURE
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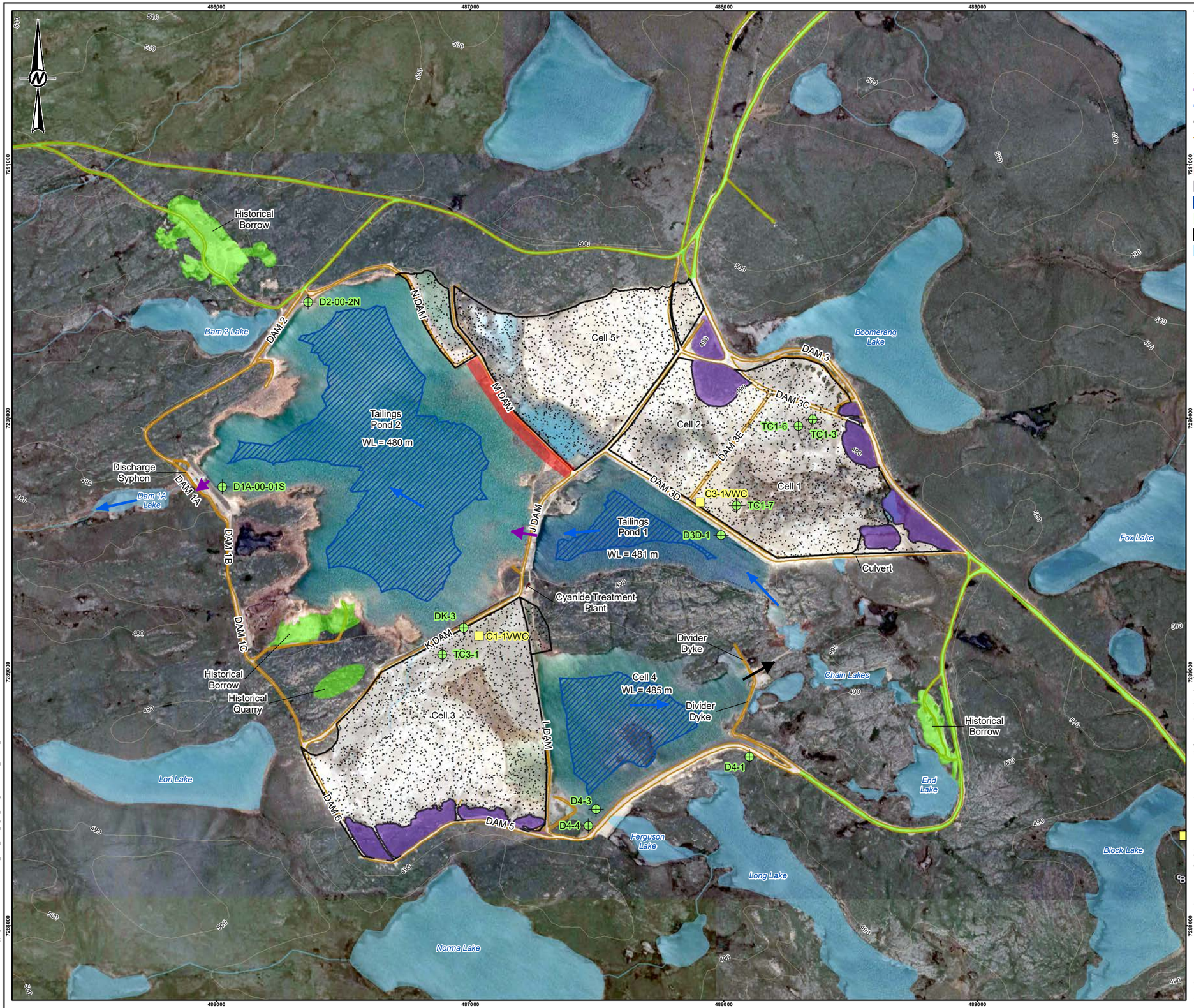


LEGEND

- ACTIVELY MONITORED SOIL MOISTURE AND TEMPERATURE PROBE
- ACTIVELY MONITORED THERMISTOR
- CONTOUR
- CLOSURE SPILLWAY
- FLOW DIRECTION
- REMOVED CULVERT
- ROAD
- WATERCOURSE
- APPROXIMATE 2017 DAM REPAIR AND MAINTENANCE WORK
- APPROXIMATE TUNDRA AREA
- APPROXIMATE WATER LEVEL OF CLOSURE (TO BE CONFIRMED)
- REHABILITATED DISTURBED AREA
- TAILINGS COVER
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

THERMISTOR LOCATIONS AND CLOSURE PLAN OBTAINED FROM NORWEST CORP., JANUARY 26, 2018. HYDROGRAPHY AND TOPOGRAPHY DATA OBTAINED FROM GEOGRATIS © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. FOOTPRINT OBTAINED FROM CLIENT. IMAGE OBTAINED FROM GOOGLE EARTH © GOOGLE INC. USED WITH PERMISSION. GOOGLE AND GOOGLE LOGO ARE REGISTERED TRADEMARKS OF GOOGLE INC. DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT

MANDALAY RESOURCES CORPORATION

PROJECT

LUPIN MINE CLOSURE

TITLE

TAILINGS CONTAINMENT AREA - POST CLOSURE

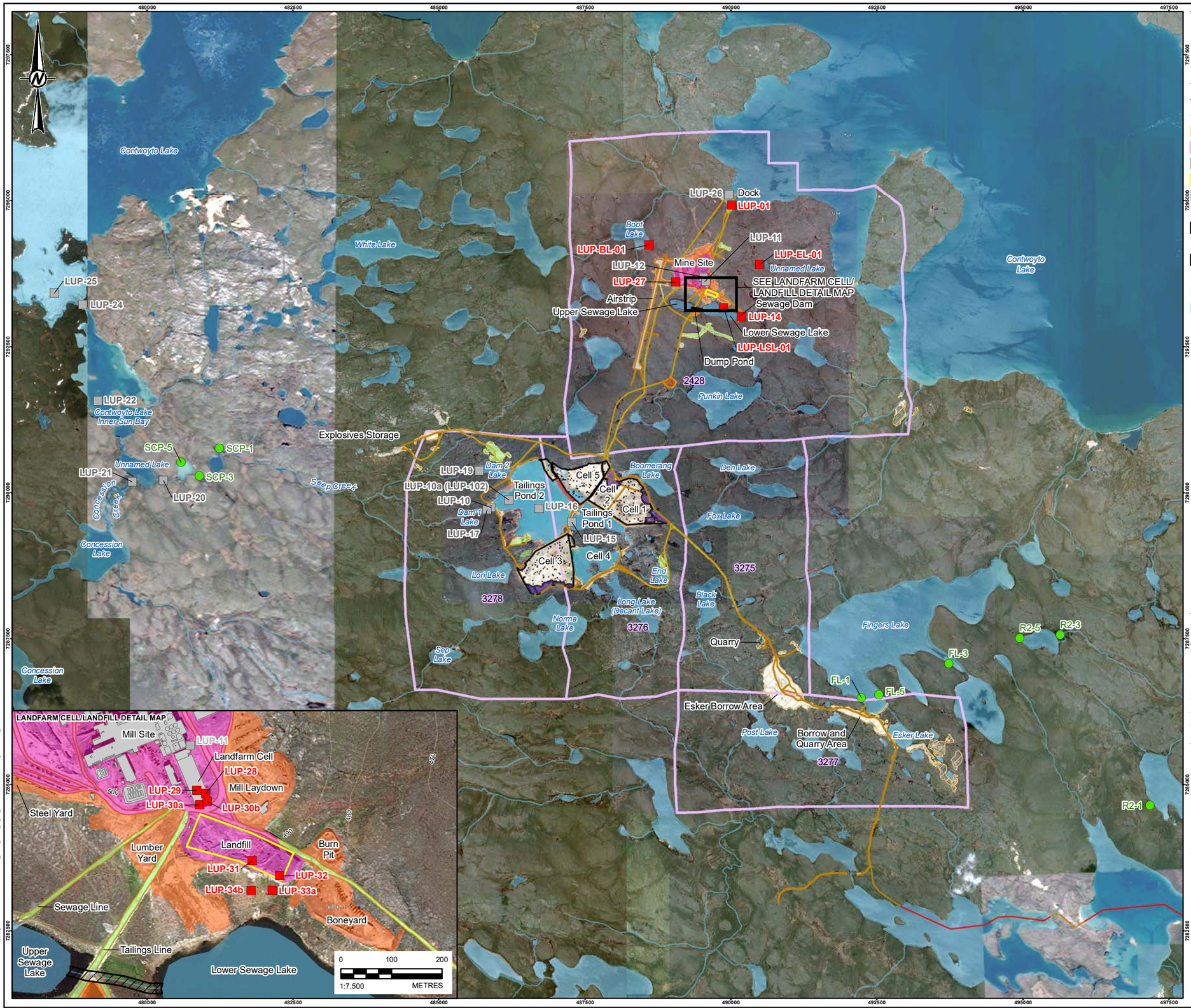
LUPIN MINES INCORPORATED

YYYY-MM-DD	2020-09-25
DESIGNED	NORWEST CORP.
PREPARED	AA
REVIEWED	--
APPROVED	--

PROJECT NO.	CONTROL	REV.	FIGURE
19136185	1000-1030	0	11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: I:\2019\19136158\Mapping\Products\General\19136158_1000_1030_Fig11_TailingsContainment_Closure_Rev0.mxd PRINTED ON: 2020-09-25 AT 2:49:53 PM



LEGEND

- EEM MONITORING LOCATION
- IARP WATER SAMPLING AND DISCHARGE LOCATION
- INACTIVE WATER SAMPLING LOCATION
- ROAD
- WINTER ROAD
- WATERCOURSE
- DISTURBANCE FOOTPRINT
- MINERAL LEASE BOUNDARY
- INFRASTUCTURE FOOTPRINT
- LANDFILL
- APPROXIMATE TUNDRA AREA
- APPROXIMATE 2017 DAM REPAIR AND MAINTENANCE WORK
- CHANNEL EXCAVATION AND CLOSURE SPILLWAY
- REHABILITATED DISTURBED AREA
- TAILINGS COVER
- WASTE ROCK COVERED
- WASTE ROCK REMOVED
- WATERBODY

0 2 4
1:65,000 KILOMETRES

NOTE(S)

LANDFARM MONITORING POINTS (LUP-28, LUP-29, LUP-30A, AND LUP-30B) AND LANDFILL MONITORING POINTS (LUP-31, LUP-32, LUP-33A, AND LUP-34B) ARE APPROXIMATE LOCATIONS.

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

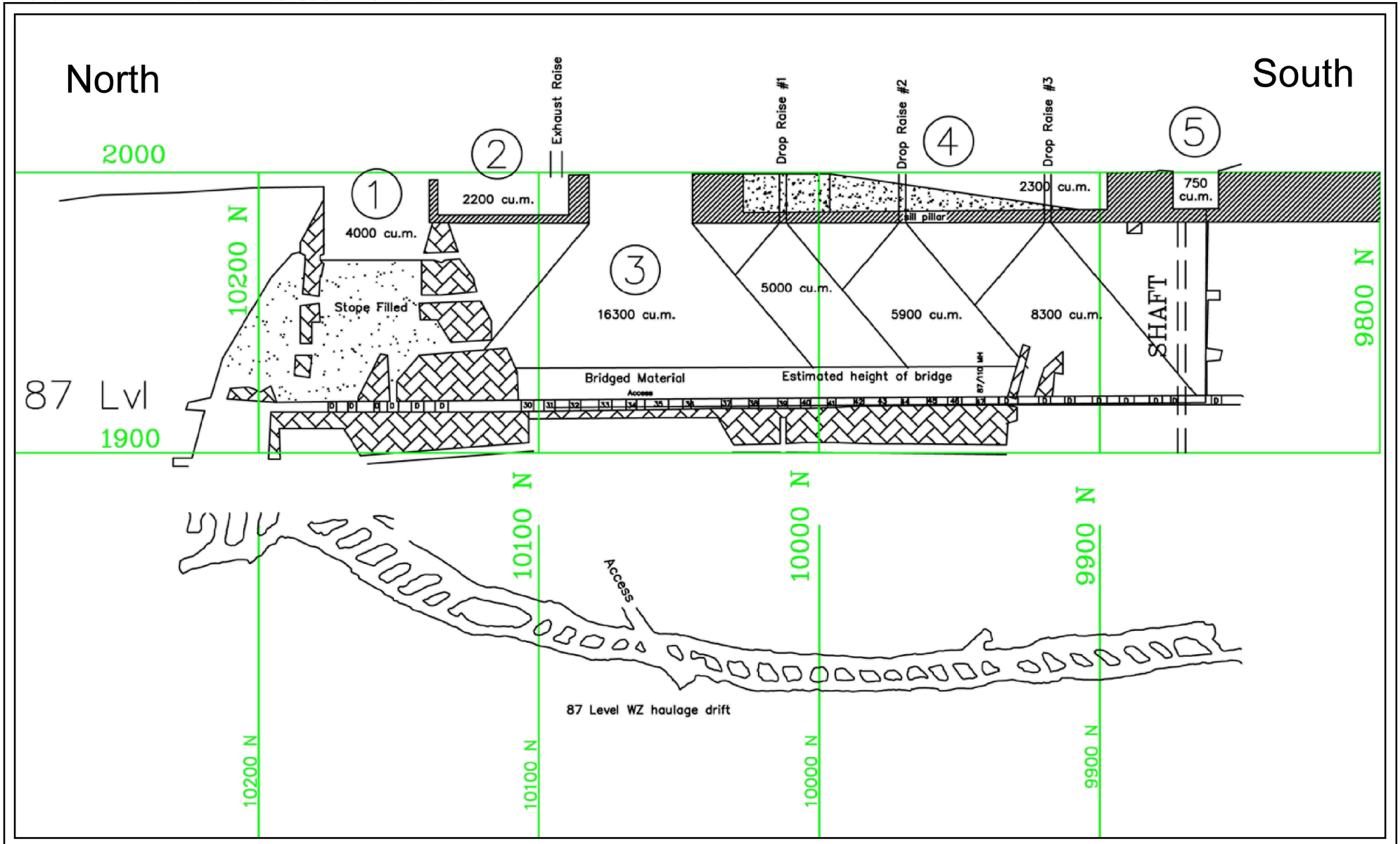
PROJECT
LUPIN MINE CLOSURE

TITLE
POST-CLOSURE MONITORING PROGRAM STATIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2020-09-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
19136185	1000-1030	0	12



CLIENT
MANDALAY RESOURCES CORPORATION

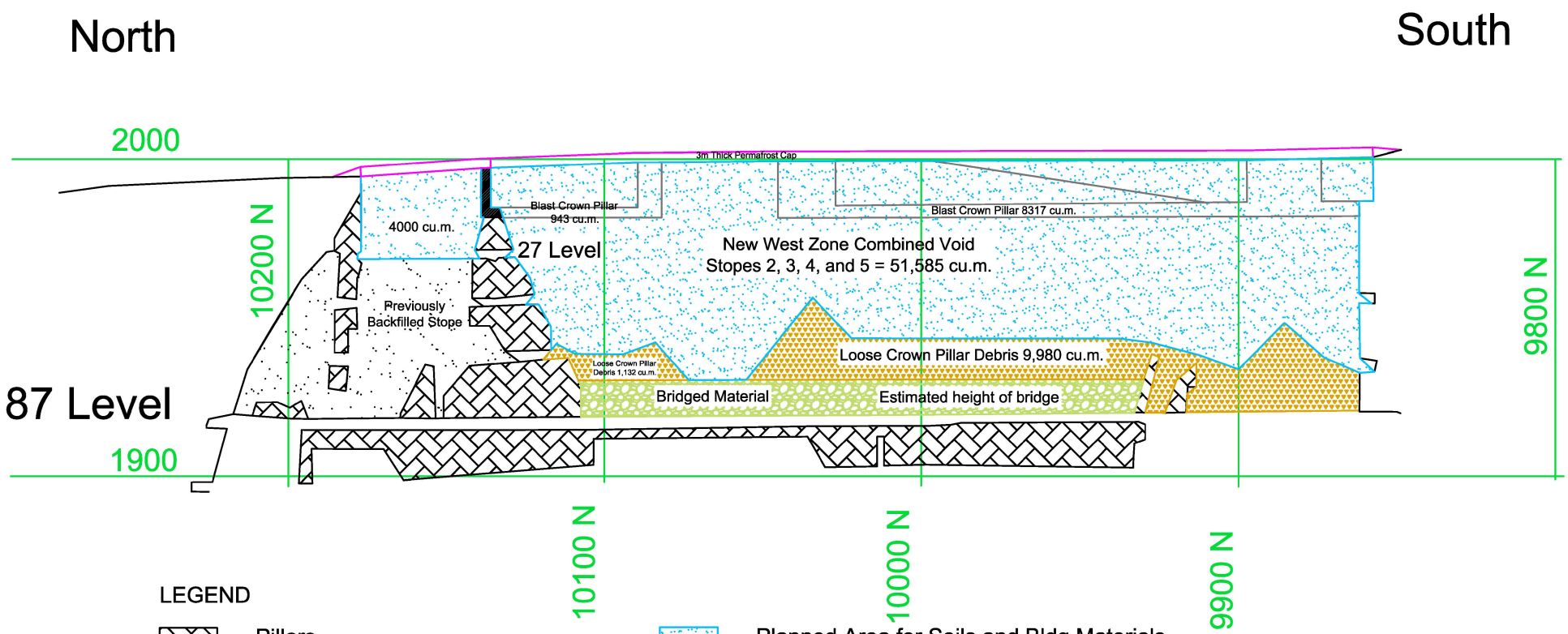
CONSULTANT
LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-03-08
DESIGNED	NORWEST CORP.
PREPARED	DBM
REVIEWED	####
APPROVED	####

PROJECT
LUPIN MINE CLOSURE

TITLE
KINROSS 2006 WEST ZONE CROWN PILLAR STOPES UNDERGROUND DISPOSAL PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	13



CLIENT
MANDALAY RESOURCES CORPORATION

CONSULTANT
LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-03-08
DESIGNED	NORWEST CORP.
PREPARED	DBM
REVIEWED	####
APPROVED	####

PROJECT
LUPIN MINE CLOSURE

TITLE
FCRP EXPANDED WEST ZONE UNDERGROUND DISPOSAL PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1789942	3000	A	14

LEGEND

THERMISTORS STATUS

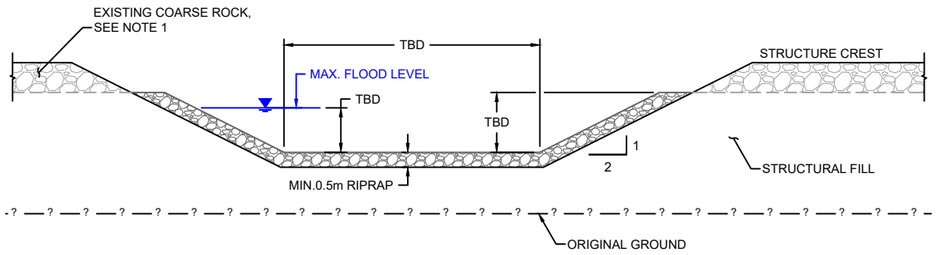
- ACTIVELY MONITORED
- MONITORED DURING DSR-NO CALIBRATION DATA
- UNLOCATED-LOCATION ESTIMATED FROM HISTORICAL MAP
- VOLUMETRIC WATER CONTENT SENSOR STRINGS

5m 0 5 10m

SCALE 1:200

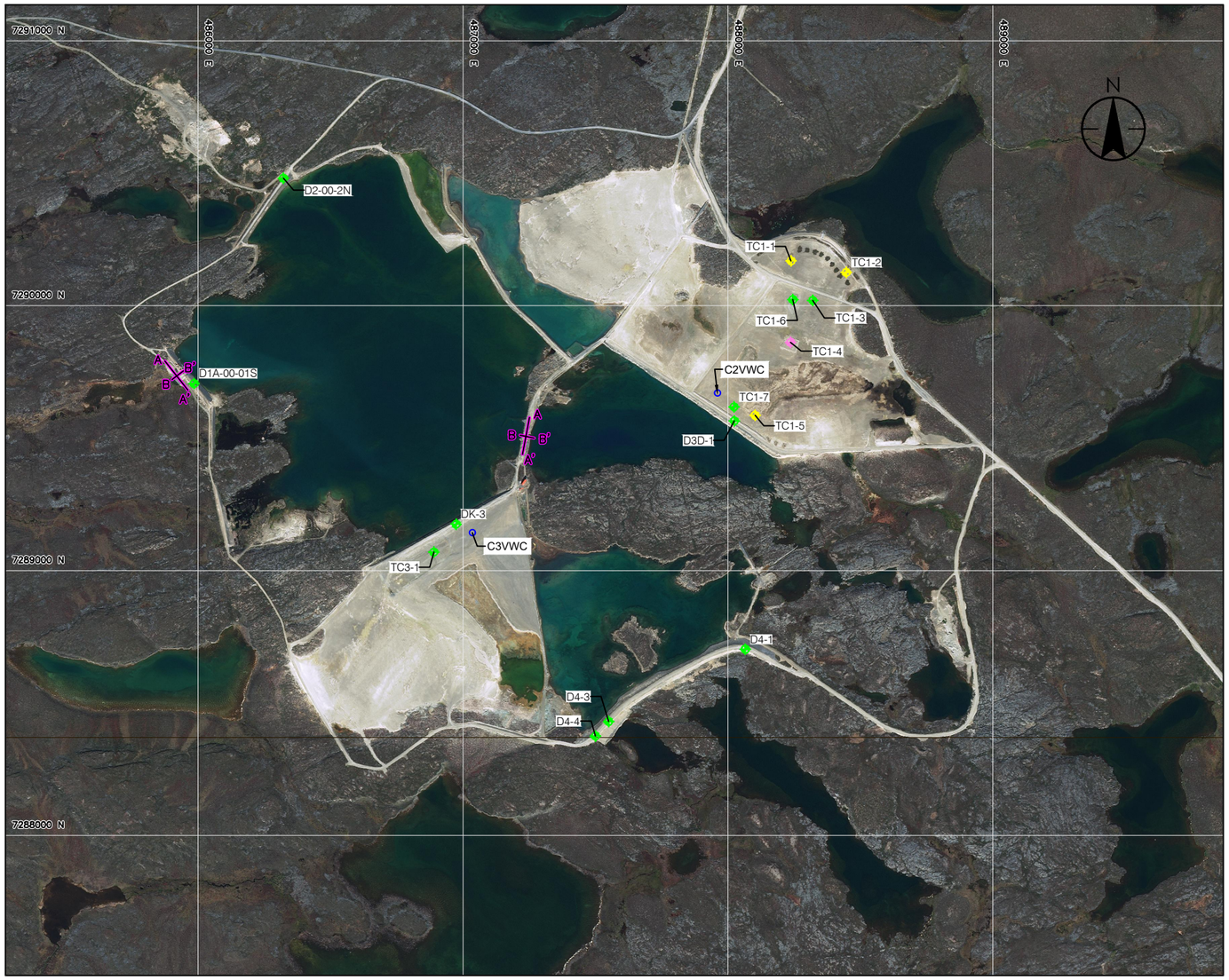
500m 0 500 1000m

SCALE 1:20,000



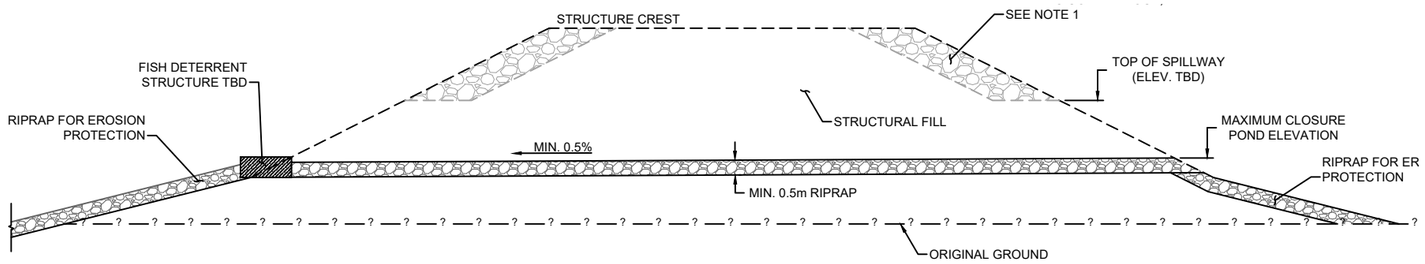
SECTION A-A'

SCALE 1:200



PLAN VIEW

SCALE 1:20,000



SECTION B-B'

SCALE 1:200

NOTES

1. COARSE ROCK ABOVE THE FLOOD LEVEL ON THE UPSTREAM AND DOWNSTREAM OF THE DAM WILL BE SALVAGE TO BE USED AS RIPRAP FOR SPILLWAY CONSTRUCTION. THE EXCAVATION WILL BE CONTOURED TO ENSURE STABILITY.

SCALES INDICATED BASED ON AN 11"x17" PLOT CONFIGURATION

LUPIN MINES INC.

FINAL CLOSURE AND RECLAMATION PLAN

SCALE:	AS SHOWN
DATE:	2020-09-16
CO-ORD. SYS.:	UTM83-12
DRW'N BY:	KM
DSG'N BY:	--
REV'D BY:	AT
APP'D BY:	SE

TAILINGS CONTAINMENT AREA CLOSURE SPILLWAYS CONCEPTUAL PLAN AND CROSS-SECTIONS

Stantec | PROJECT NO.: 129500081 | FIG. NO.: 15 | REV.: B