GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE 6 August 2021 **Reference No.** 20446521-007-TM-Rev0-6000

TO Karyn Lewis
Lupin Mines Inc.

CC

FROM Ken Bocking, Dionne Filiatrault **EMAIL kbocking@golder.com**

LMI RESPONSE TO CIRNAC'S COMMENTS ON THE DOME DESIGN ISSUED FOR CONSTRUCTION DRAWINGS FOR WATER LICENCE NO. 2AM-LUP2032 – LUPIN MINE PROJECT

1.0 DOCUMENT PURPOSE/SCOPE

On June 25, 2021, Lupin Mines Inc. (LMI) provided to the NWB in accordance with requirement of water licence 2AM-LUP2032 Part G, Item 1, the following Rev 1 – Issued for Construction Dome design drawings:

- 19136158-0002-CM-0001 "Proposed Waste Rock Dome"; and
- 19136158-0002-CM-0002 "Proposed Waste Rock Dome Sections and Details".

LMI also provided Drawing 19136158-0003-1_Rev D "Proposed Waste Rock Removal and Placement".

The drawings were reviewed by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), who provided comments in a letter dated July 28, 2021.

This document provides LMI's response to CIRNAC's comments in the letter of July 28, 2021. For easy reference, the LMI responses are provided in a tabular format with reference numbers or letters that correspond to CIRNAC's comments.

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2.0 PART 1 - REPLY TO LMI'S SPECIFIC RESPONSES TO CIRNAC COMMENTS ON DOME DESIGN

Table 1: Part 1

#	Original CIRNAC Comment	LMI Previous Response	Current Comment / Status	LMI Response
a	Lack of detailed grading information on the top of "dome" – LMI in response, states that the grading details are provided in issued for construction drawing 19136158-0002-CM-0001_Rev 1.	"As indicated in Note 7, the final elevation of the top surface will be varied to suit the actual volume of waste rock that is imported from elsewhere on the mill site; however, the design slopes of the surface will not be changed."	CIRNAC concerns were addressed.	Resolved.
b	Lack of design information on storm / freshet flows – LMI in response stated that the chutes were designed to accommodate discharge flows in excess of 1 m^3/s. CIRNAC requests the design calculations for the design flow along with confirmation that the esker material on the dome cover can withstand the movement of this amount of water as it migrates to the surface water management chutes. Also, the design should identify the preferred surface water flow patterns that will be established on the top of the dome so as to confirm if reinforced swales (i.e., boulder or riprap lined channels) are required to move water to the respective chutes.		CIRNAC concerns have not been addressed to date.	Refer to 20446152-005-TM, "Supplemental Information on the Design of the Dome and the Landfill", which is attached to the minutes of the meeting of July 22. The memo demonstrates that the design flow of 1 m^3/sec. considerably exceeds the flow corresponding to a 100 year return storm of 5 minutes duration (0.39 m^3/sec.). At the design flow of 1.0 m^3/sec, the calculated flow depths and velocities are 0.129 m and 2.56 m/sec in the chute section and 0.312 m and 0.99 m/sec. exiting the stilling basin. Design charts indicate that 10 kg class rip rap is adequate for these velocities. Arrows have been added to Rev 2 of Dwg. 19136158-002-CM-001 (attached).

Table 1: Part 1

#	Original CIRNAC Comment	LMI Previous Response	Current Comment / Status	LMI Response
c	Lack of protection against rill erosion on the long (30 to >100 m) 10% slopes - LMI repeated earlier statements that only direct precipitation and meltwater on slopes will runoff and that the esker material will tend to exhibit “self-armouring”. No technical information was provided on sheet runoff for maximum storm or freshet, calculations velocities and erosion potential or factor of safety with respect to erosion mitigation. No consideration or discussion of energy dissipating features on long slopes.		CIRNAC is still concerned over the long-term erosion potential of the slopes, particularly if the perimeter berm is compromised over time, and requests the information outlined in the previous paragraph.	It is recognized that erosion rilling could occur if concentrated runoff was to spill over from the top surface onto the sideslopes and that is why berms have been included around the perimeter of the top surface, so that runoff from the top surface will be intercepted and directed into one of the erosion protected chutes. No erosion protection will be placed on the sideslopes. The sideslopes are not expected to erode from the sheet runoff that will result from snow melting or direct rainfall on the sideslopes themselves. This is based on observations of the performance of slopes on dams constructed with well graded sand and gravel. One such slope stood up well over the course of about 15 years of annual inspections, notwithstanding the fact that it was much steeper at 2:1 (H:V).
d	Lack of runoff channels from discharge chutes – LMI’s response indicates that due to setting on top of the hill, runoff from chutes will naturally drain away from the toe of the waste rock cover slopes.	Note 11 has been added to Drawing (Dwg) 19136158-0002-CM-0001_Rev 1 directing the Contractor to “construct berms or ditches as necessary to direct flow from drainage chutes away from the toe of the dome fill”.	CIRNAC concerns were addressed.	Resolved

Table 1: Part 1

#	Original CIRNAC Comment	LMI Previous Response	Current Comment / Status	LMI Response
e	Potential for toe erosion from discharge chute runoff flows – LMI stated that the stilling basin will safely dissipate the flow energy and that flow exiting the basins will be low-velocity sub-critical flow over existing natural ground expected to be bedrock or glacial till. No technical information on the stilling basin design was provided to support the statement regarding exit velocities.	Note 11 has been added to Dwg 19136158-0002-CM-0001_Rev 1 directing the Contractor to "construct berms or ditches as necessary to direct flow from drainage chutes away from the toe of the dome fill" which suggests that outflow from stilling basins may need to be managed through berms or ditches. The drawing note needs to also address the site conditions and grading requirements in the areas between the stilling basins, (i.e., need to confirm positive surface water flow away from the toe of the dome embankment).	CIRNAC recommends that LMI provide technical information on the stilling basin design to support the statement regarding exit velocities and update Note 11 on Dwg 19136158-0002-CM-0001_Rev 1 to address the site conditions and grading requirements in the areas between the stilling basins. CIRNAC concerns have not been addressed to date.	At the design flow of 1.0 m^3/sec, the calculated flow depth and velocity exiting the stilling basin are 0.312 m and 0.99 m/sec. Design charts from the British Columbia Design Manual indicate that rip rap is not required for this velocity. Note 11 has been modified on Dwg 19136158-0002-CM-0001_Rev 2 (attached) to read, "Construct ditches or berms as necessary to direct flow from drainage chutes and general runoff away from the dome fill." As documented in the minutes of the meeting of July 22, a Golder geotechnical engineer will be on site later in the summer to verify that adequate drainage is achieved by "field fitting" to the original ground surface adjacent to the toe of the dome.
f	Lack of specific notes addressing construction constraints that need to be addressed before cover placement	LMI added two notes to drawing 19136158-0002-CM-0001_Rev 1: o Note 1: "The subgrade under the dome is to be prepared in accordance with the water licence and final closure and reclamation plan (FCRP) before imported waste rock or cover materials are placed." o Note 2: "The following materials shall be removed from the existing subgrade before imported waste rock is placed: Demolition waste, petroleum hydrocarbon contaminated soils, Arsenic "Hot Spots", Soil or Rock materials impacted with Cyanide or Lead Nitrate and any hazardous waste."	Note 1 is a broad and undefined statement with no guidance on what is intended in the dome design package related to this note. Without additional guidance on what is needed/expected, LMI, the contractor, CIRNAC and others may all have different interpretations for what is required. LMI should provide clear guidance to the contractor to ensure what needs to be done is carried out and can be verified as having been done either before waste rock relocation or cover.	Note 1 has been modified on Dwg 19136158-0002-CM-0001_Rev 2 (attached) to add the statement, "Engineer's approval of cleanup is required before waste rock or cover materials are placed." As described in the minutes of the meeting of July 22, cleanup activities are under full time inspection and testing by a Golder field crew who are monitoring the contaminated soil excavations and are completing filed screening using either a RKI Eagle (PHC soil) or XRF (metal soils). Upon reaching anticipated final extents, confirmatory soil samples are sent offsite for lab analysis. The QA/QC program for soils is included in

Table 1: Part 1

#	Original CIRNAC Comment	LMI Previous Response	Current Comment / Status	LMI Response
			CIRNAC concerns have not been addressed to date. Note 2 is appropriate and provides applicable guidance and expectations for the actions to be undertaken and how it will be managed and approved in the field. CIRNAC finds the term “imported waste rock” unclear. The word “imported” suggests that waste rock is coming from elsewhere on the site. As we understand it, waste rock at the mill site will be consolidated and reshaped into the “dome mound”. LMI should confirm, whether or not there is now an expectation to “import” waste rock from other parts of the site. CIRNAC suggest that the note be revised to remove the word “imported”, if the waste rock is not coming elsewhere from the site.	Appendix C of the Post-Closure Monitoring Plan (PCMP) document. No waste rock is being imported from elsewhere on the site, only from the tan coloured areas around the mill that are shown on Figure 10 in the approved FCRP. For clarity, the word “imported” has been deleted from the notes in Rev 2 of both of the dome drawings.
g	Failure to show where materials to be removed prior to cover placement are located	LMI indicated that the locations of contaminated materials are shown on Dwg 19136158-0005-CM-0001_Rev D.	CIRNAC concerns were addressed.	Resolved
h	Failure to show locations of shaft, crown pillar area that will be buried under the dome	LMI in response states that locations of shafts, crown pillar area buried under the dome have been added to Dwg 19136158-0002-CM- 0001_Rev 1.	CIRNAC concerns were addressed.	Resolved

3.0 PART 2 - COMMENTS ON DOME DESIGN ISSUED FOR CONSTRUCTION DRAWINGS

Table 2: i. Drawing 19136158-0002-CM-0001_Rev 1 Proposed Waste Rock Dome

#	Issue	Concern	Recommendation	LMI Response
a	Concrete Foundations	Various mill facility foundations and slabs will be left in place, buried in waste rock and covered. The Dwg does not provide any information on the locations slabs and foundations that will be buried within the dome.	CIRNAC recommends that LMI add the outlines of all slabs and foundations that will be buried within the dome to the site Dwg and where applicable to the sections.	Outlines of the building foundation slabs have been added to Dwg 19136158-0002-CM- 0001_Rev 2 (attached).
b	Length of Embankment	The embankment between E 489 100 to E 489 375 and N 7 293 800 to N 7 293 975 is greater than 100m in length with no identified breaks or energy dissipating structures to slow down any sheet flow during high intensity rainfall events. The concern is that the esker material on site has a significant fine-grained component and as such may be susceptibleto the migration of fines over time.	CIRNAC recommends that LMIreview the design to confirm that esker material will not migrate during high intensity rainfall events and provide written confirmation that fine grained materials will be washed out of the embankment cover esker material.	The sideslopes are not expected to erode from the sheet runoff that will result from snow melting or rainfall on the sideslopes themselves. This is based on observations of the performance of slopes on dams constructed with well graded sand and gravel. One such slope stood up well over the course of about 15 years of annual inspections, notwithstanding the fact that it was much steeper at 2:1 (H:V).
c	West Zone Crown PillarCover and Note 4	Note 4 states that the crown pillar and shafts are to be filled before waste rock is placed on top. However,in section 4.3.2.4 of the FCRP, page 4-15, it is statedthat capping material will be required over the newly opened and filled West Zone that will consist of a 1.5 m thick mound over the backfill material with 3:1 sideslopes and that this capping material will be covered with 1m esker materials graded at 2% slopes to shedwater and conform to the surrounding land form. There is nothing on the Drawings 1 or 2 or the notes that identifies the need for this additional cap over thecrown pillar. It is our understanding that the cap overthe crown pillar was planned to allow for consolidation of the underlying fill materials without creation of a sinkhole in the dome cap and cover.	CIRNAC recommends that LMI revise the Dwg and notes to ensure that the additional capping materials are placed as appropriate prior to placement of the cover.	The capping over the backfilled West Zone crown pillar will be integrated into the overall dome landform. It is expected that most of the settlement of the backfill in the crown pillar will occur before the dome is brought to its final grade. The following sentence has been added to Note 4 of Dwg 19136158-0002-CM- 0001_Rev 2 (attached), “Place an additional ridge of waste rock to allow for settlement if so directed by the Engineer.”

Table 2: i. Drawing 19136158-0002-CM-0001_Rev 1 Proposed Waste Rock Dome

#	Issue	Concern	Recommendation	LMI Response
d	Stilling Basins	The stilling basins should be set at grade surface andnot cut into the ground beneath the toe of the embankment as this could lead to ponding and potential freezing of water in the basin thus reducing the effectiveness of the basins during the freshet or other periods of high surface water runoff. Furthermore, additional detail is required to confirm positive drainage of water from the stilling basins away from the toe of the dome embankment.	CIRNAC recommends that LMI amend the stilling basing design to provide additional detail in order to confirm a positive drainage of water from the stilling basins away from the toe of the dome embankment.	The recessing of the stilling basins into the original ground is based on similar designs used successfully at other northern sites. The reverse slope at the end of the stilling basin is more effective at containing the hydraulic jump within the stilling basin as opposed to a stilling basin built on top of original ground. Note 11 has been modified on Dwg 19136158-0002-CM-0001_Rev 2 (attached) to read, “Construct ditches or berms as necessary to direct flow from drainage chutes and general runoff away from the dome fill.”
e	Drainage at the Toe of the Embankment	It is unclear how the contractor is to understand final grading at the toe of the dome embankment and how to ensure surface water is directed away from the embankment toe, particularly in areas where initial grading work is required to remove undesirable materials. Furthermore, consideration should be given to sizing the material at the toe of the dome embankment so as to ensure that surface water flow at the toe does not result in riling or loss of fines from the esker material being placed as part of the waste rock cover.	CIRNAC recommends that LMIprovide additional drawing notes to provide guidance to the contractor as well as to theprogram stakeholders on how surface water will be directed away from the toe of the dome embankment. Consideration should be given to placing coarser material or armouringat the toe of the dome embankment.	The original ground surface adjacent to the toe of the dome is currently obscured by existing waste rock. As discussed above, a Golder geotechnical engineer will be on site later in the summer to verify that adequate drainage is achieved by “field fitting” to the original ground surface adjacent to the toe of the dome. Note 11 has been modified on Dwg 19136158-0002-CM-0001_Rev 2 (attached) to read, “Construct ditches or berms as necessary to direct flow from drainage chutes and general runoff away from the dome fill.”

Table 3: ii. Drawing 19136158-0002-CM-0002 Rev 1 Proposed Waste Rock Dome Sections and Details

#	Issue	Concern	Recommendation	LMI Response
a	Berm Construction	In the "Typical Detail of Perimeter Berm", the berm is shown as comprised of "esker" material. In the "Drainage Chute Typical Profile", the perimeter berm is shown as "10kg Erosion Protection" material. From the drawing it is not clear what materials willbe used to construct the berm. It will be helpful to show if there is a transition fromesker to "10kg Erosion Protection" material at the top of the chutes.	CIRNAC recommends that LMI clarify berm construction materials.	The perimeter berm is to be constructed of Zone 1 esker material. The intention is that a 350 mm thick layer of Zone 2 erosion protection on geotextile be placed at the bevelled end of the perimeter berm at the entrance to each of the chutes. Refer to Dwg 19136158-0002-CM-0001_Rev 2 (attached) for definition of material zonation.
b	Drainage Chute TypicalProfile – Stilling Basins	The typical section shows the stilling basin below the original ground level. Given that LMI has indicated that drainage chutes will discharge on native surfaces that are either rock or glacial till, it isunclear if this detail will apply if the native surface isrock. Does LMI intend to construct the basins into rock,and if not, what will be done in this situation?	CIRNAC recommends that LMI clarify the design of the stilling basins if native rock is found atthe toe of the chute discharge location.	It would not be necessary to construct/excavate a stilling basin into a bedrock outcrop. Note 10 has been added to Dwg 19136158-0002-CM-0001_Rev 2 (attached) to clarify this. It reads, "The stilling basin shall be deleted if the chute ends on a bedrock outcrop." As a field fit, berms of Zone 2 erosion protection would be extended to laterally contain the hydraulic jump over the bedrock surface.
c	Drainage Chute Typical Profile, Section Entrance toDrainage Chute – Non- woven Geotextile	These typical sections show the presence of non- woven geotextile in the esker cover beneath the erosion protection layer. LMI did not provide any dimensions with respect to depth of esker materialsover the non-woven geotextile fabric, nor are any details provided on anchoring the non-woven geotextile fabric. Normally we would expect that non-woven geotextile be anchored at the top and the sides down the chutes. It should not daylight atsurface as indicated on the drawing details.	CIRNAC recommends that details and/or notes should be provided to ensure that the non-woven geotextile is placed, covered, and anchored as appropriate.	The non-woven geotextile is to be placed on top of the esker material to act as a filter between the esker and the overlying Zone 2 erosion protection. (On the drawing, the geotextile line is shown slightly below the interface for visibility only.) There is no need to anchor the geotextile. The friction between the geotextile and the esker material is adequate to resist any movement for the profile and sideslope angles. Any geotextile that daylights above surface is redundant.

Table 3: ii. Drawing 19136158-0002-CM-0002 Rev 1 Proposed Waste Rock Dome Sections and Details

#	Issue	Concern	Recommendation	LMI Response
d	Esker Cover at Toe of Rock Dome Slope	The “Typical Detail of Edge of Waste Rock Dome”shows 1 m esker cover material extending to the “original ground” surface. No armouring or stabilizing elements are included for the toe of thecover, nor are there any notes with respect to subsoil requirements/conditions at the “original ground” prior to placement of the cover materials.	CIRNAC recommends that LMI Provide: □ Notes on any requirements necessary prior to placing materials on original ground along the toe of the dome slopes. □ Technical assessment supporting that the toe of slope does not require some form of toe stabilization to mitigate long term erosion potential along the toe.	It is necessary to prevent any concentrated flow along the toe of the dome cover. To this end, note 11 has been modified on Dwg 19136158-0002-CM-0001_Rev 2 (attached) to read, “Construct ditches or berms as necessary to direct flow from drainage chutes and general runoff away from the dome fill.”

Table 4: iii. Drawing 19136158-0005-CM-0001 Rev D titled Proposed Waste Rock Removal and Placement

#	Issue	Concern	Recommendation	
a	Contaminated Soil to be Excavated	In the Technical Memorandum it is stated that thisdrawing shows the locations of Contaminated Soils to be excavated. The drawing actually just shows the locations of test pits with exceedances,no inferred excavation boundaries or depths are provided. Furthermore, the nature of the impact should also be identified so as to help program stakeholders understand the nature of the remedial work that may be required at the previously identified areasof impact. For example, areas of petroleum hydrocarbon impact are expected to be minimal, however metal impacted areas may be more challenging to define in the field during the courseof the rehabilitation works. Known areas of arsenic hot spots as well as areas with elevated cyanide or lead nitrate should be identified along with any other hazardous materials so the inspectors and/or other program stakeholders willunderstand where these issues exist in three- dimensional space (i.e., area and depth interval).	CIRNAC recommends that LMI provide the inferred boundaries and depths of the contaminated soils to be excavated.	Table 29 in the Golder 2017 Environmental Site Assessment Update provides approximate estimated dimensions of the contaminated areas. The actual boundaries of contamination are not known in advance and cannot be shown on the drawing. The actual lateral extent and depth of contamination is being determined during cleanup activities following a written protocol of field screening and laboratory confirmation testing. (Refer to response to Table 1, Part 1 Item f for details). The QA/QC program for soils is included in Appendix C of the Post-Closure Monitoring Plan (PCMP) document. The nature of the contamination is summarized on Table 29 from Golder (2017) (also excerpt attached) and detailed test results are appended to the two ESAs (Morrow, 2006 and Golder 2017).
b	Area Cleared for Waste RockRemoval	Drawing 3 shows black outlined areas that are designated as “Area Cleared for Waste Rock Removal”. There is no definition of what that actual means. CIRNAC presumes that it means no other works are necessary before starting waste rock removal from these areas. It is not clear how other areas in orange, where waste rock is to be removed, are to be considered if no test pit exceedances have been noted, nor how and on what basis, these areas will be cleared forwaste rock removal.	CIRNAC recommends that LMI to provide more details on the order and schedule of construction activities related to the removal of materials from area cleared for waste rock removal, placement of contaminated materials underground and debris as approved underground, filling of surface openings (shafts, vents, portal, waste rock excavation and relocation, cover placement planned for 2021).	The black outlined areas A, B, C and D on Drawing 19136158-0003-1_Rev D are areas where no contamination was found in either of the two ESAs. The boundaries have been defined by layout points. The Contractor has been allowed to remove rock from these areas for use in the landfill for access or sideslope formation. Permission to remove rock from these areas is documented in writing in Field Communications FC-GOL-003, 007 and 008.

Table 4: iii. Drawing 19136158-0005-CM-0001 Rev D titled Proposed Waste Rock Removal and Placement

#	Issue	Concern	Recommendation	
c	Portal Area and Landfill AreaMounds at Closure	Drawing 3 shows three separate mounds remaining after the closure works have been completed (the dome, the portal, and the landfill).To date LMI have only provided information on the proposed dome and dome cover and details for the mill site proper but no such information for either the Portal Area or the Landfill Area	CIRNAC recommends that LMI provide plans and sections of the Portal Area and Landfill Areas for review.	Drawings for the landfill were provided as attachments to the minutes of the meeting of July 22. A drawing for the portal area will be provided when available.
d	Crown Pillar and Mine Openings	Crown pillar and mine openings are shown on the drawing 3 but not identified or labeled.	CIRNAC recommends that LMI add labels and notes as appropriate to identify surface openings.	Label for the crown pillar and the mine openings will be added to a future revision of Drawing 19136158-0003-1. (In the meantime, these are currently shown on Dwg 19136158-0002-CM-0001_Rev 1.)
e	Drawing Notes	Note 3 requires more detail to clarify that the final design for the closure of the portal opening will be done based on a topographic survey of the area once any demolition works are completed. Note 5 should clarify where the demolition debris from the removal of the surface main shop is to be placed and how the capping work is to be done. The concrete pad underlying the structure will need to be punctured to accommodate surface water drainage through the pad (given this area is outside the footprint of the dome structure it is inferred that the breaking of the main shop pad would be done later post-completion of the dome structure). The location of the crown pillar (as defined by the bold black and purple/pink lines should be defined in the legend.		A separate drawing for the portal area will be provided when available. Like all demolition debris, the debris from the machine shop is to be placed in the landfill and then capped as per Dwg 19136158-0001-CM-0002_Rev 1. All parties recognize that an opening needs to be left to receive this debris and rock and esker will be stockpiled for final capping. Note 7 applies to the machine shop as well as all other slabs outside of the purple area. As documented by FC-GOL-009, the punctured slabs are then to be covered with 0.3 m of esker material.

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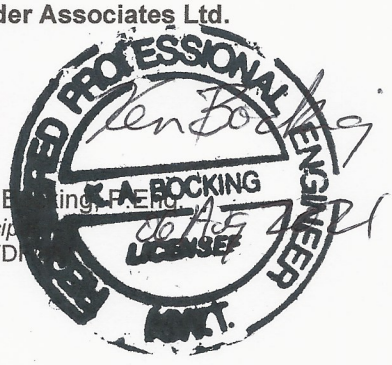

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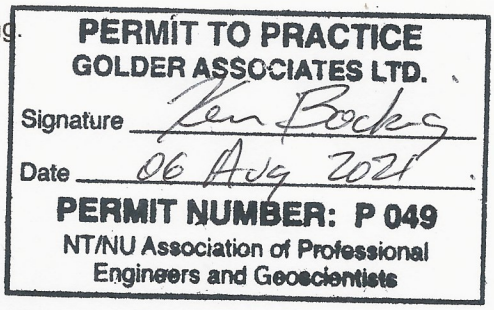


Attachments: Table 29 of 2017 ESA Update
Dwgs. 19136158-0002-CM-0001 and 0002_Rev 2

References:

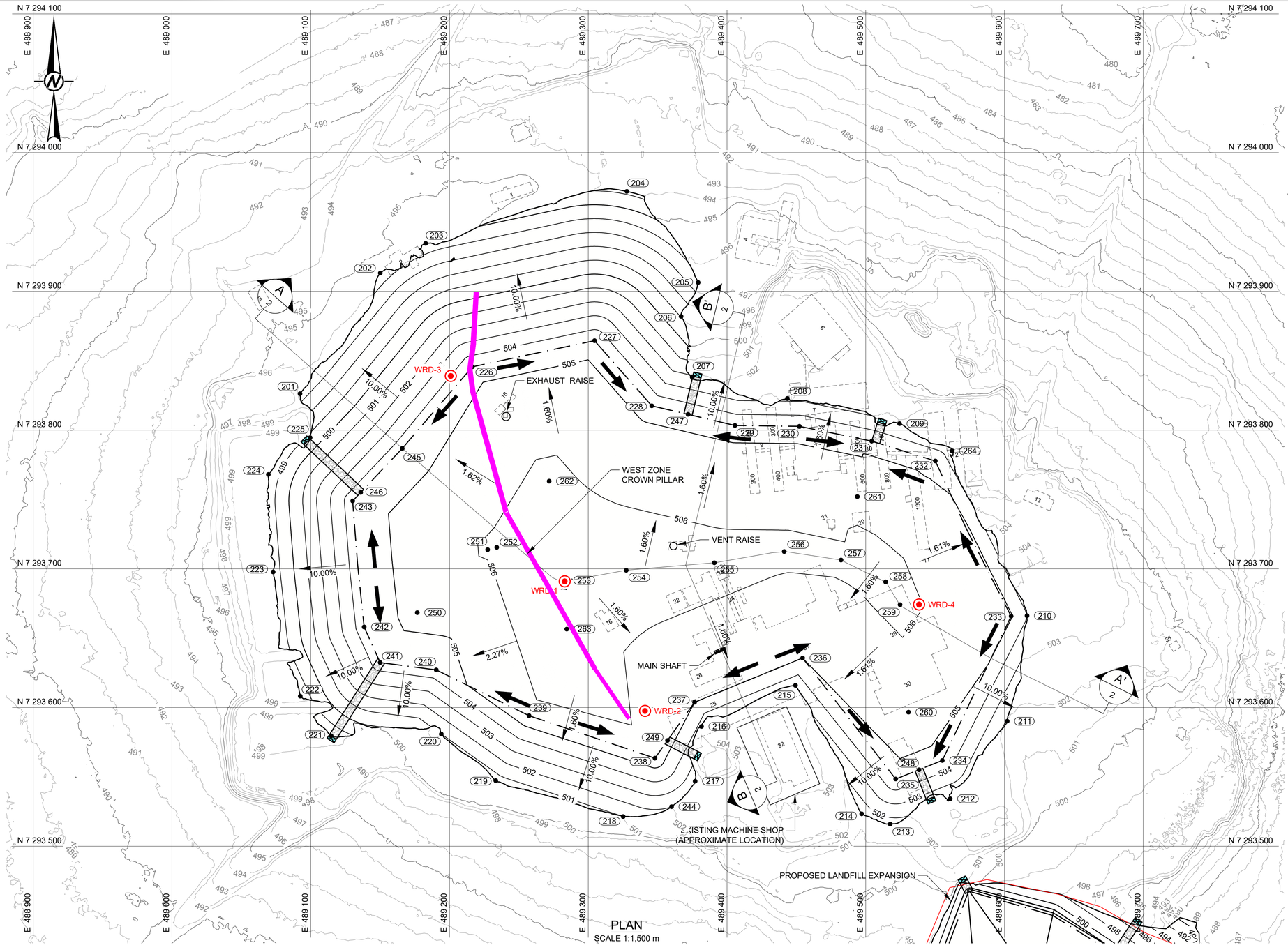
Golder 2017. Updated Phase 1 and II Environmental Site Assessment, Nunavut. October 2017.

Morrow 2016. Phase 1 and 2 Environmental Site Assessment. Volumes 1 and 2. Prepared for Kinross Gold Corp. January 11, 2006.

https://golderassociates.sharepoint.com/sites/138836/project files/6 deliverables/01 working/20446521-007-tm-reva-6000-response to cirnac dome design comments/20446521-007-tm-rev0-6000-responses to cirnac on dome design 06aug_21 .docx

Table 29: Impacted Soil Volume Estimates

Area	General Area	2006 Morrow Volume Estimates				2017 Golder Volume Estimates			
		Approximate Length (m)	Approximate Width (m)	Average Thickness (m)	Approximate Volume (m^3)	Approximate Length (m)	Approximate Width (m)	Average Thickness (m)	Approximate Volume (m^3)
1	STF and Powerhouse	150	50	1.3	9,800	30	25	1.5	1,125
						60	45	2.0	5,400
						20	20	2.0	800
						60	10	0.5	300
2	Mill and Office Emergency Tanks	200	75	1.3	19,500	20	20	2.0	800
						20	20	2.0	800
						20	20	2.0	800
						50	50	2.0	5,000
						20	20	2.0	800
3	MTF Loaders	25	50	1.3	1,600	25	50	1.3	1,600
4	MTF Bedding Sand	120	50	0.3	1,800	120	50	0.3	1,800
5	Emergency Powerhouse	25	25	1.3	800	25	25	1.3	800
6	South Burn Pit	50	25	1.3	1,600	45	50	2.0	4,500
						15	10	1.5	225
7	Landfill	Too large to excavate – to be managed in place.							
8	RTL Shop	50	25	1.3	1,600	60	80	1.5	7,200
9	North Burn Pit	25	25	1.3	800	25	25	1.3	800
10	Incinerator	2	25	1.3	800	2	25	1.3	800
11	Cold Storage #1	25	25	1.3	800	25	25	1.3	800
12	Former Airstrip Fuelling Area	25	25	1.3	800	25	25	1.3	800
13	Former Ball Field	-	-	-	-	5	5	2	50
		2006 Total Estimated PHC Volume (m^3)			**40,000**	**2017 Total Estimated PHC Volume (m^3)**			**35,200**
14		Lead Nitrate and/or Cyanide			800	Recovery Plant (soil beneath cyanide storage tanks)			200
						South Burn Pit			To be remediated with PHC impacts above.
						Cyanide Storage Area			200
		2006 Total Estimated Lead Nitrate and/or Cyanide Volume			**800**	**2017 Total Estimated Lead Nitrate and/or Cyanide Volume**			**400**
15		**2006 Arsenic "hotspots" Volume**			**2,000**	**2017 Arsenic "hotspots"**			**16,300**



PLAN
SCALE 1:1,500 m

LEGEND

- EXISTING GROUND SURFACE CONTOUR (1 m INTERVAL)
- PROPOSED WASTE ROCK COVER CONTOUR (2 m INTERVAL)
- PERIMETER BERM
- DRAINAGE CHUTE
- STILLING BASIN
- PROPOSED WASTE ROCK COVER LAYOUT POINT
- PROPOSED THERMISTOR STRING
- SLAB FROM FORMER BUILDING
- DRAINAGE DIRECTION ALONG PERIMETER BERM

NOTE(S)

1. THE SUBGRADE UNDER THE DOME AREA IS TO BE PREPARED IN ACCORDANCE WITH THE WATER LICENCE AND WITH THE FINAL CLOSURE AND RECLAMATION PLAN (FCRP). ENGINEER'S APPROVAL OF CLEANUP IS REQUIRED BEFORE WASTE ROCK OR COVER MATERIALS ARE PLACED.
2. THE FOLLOWING MATERIALS SHALL BE REMOVED FROM THE EXISTING SUBGRADE BEFORE WASTE ROCK IS PLACED: DEMOLITION WASTE, PETROLEUM HYDROCARBON CONTAMINATED SOILS, ARSENIC "HOT SPOTS", SOIL OR ROCK MATERIALS IMPACTED WITH CYANIDE OR LEAD NITRATE AND ANY HAZARDOUS WASTE.
3. FLOOR SLABS LEFT IN PLACE IN THE SUBGRADE SHALL BE PUNCTURED WITH A HOE RAM BEFORE WASTE ROCK AND/OR COVER MATERIALS ARE PLACED ON TOP.
4. THE CROWN PILLAR OPENINGS AND MINE SHAFTS ARE TO BE FILLED BEFORE WASTE ROCK IS PLACED ON TOP. PLACE A RIDGE OF ADDITIONAL WASTE ROCK TO ALLOW FOR SETTLEMENT IF SO DIRECTED BY THE ENGINEER.
5. NO WASTE ROCK SHALL BE PLACED ON THE PREPARED SUBGRADE UNTIL THE SUBGRADE PREPARATION HAS BEEN APPROVED BY THE ENGINEER.
6. WASTE ROCK OR ESKER COVER MATERIALS SHALL NOT BE PLACED ON TOP OF SNOW OR ICE.
7. THE DESIGN SURFACE SHOWN PROVIDES CAPACITY FOR ABOUT 269,000 m^3 OF WASTE ROCK. IF LESS CAPACITY IS REQUIRED, A LOWER TOP SURFACE ELEVATION SHALL BE USED WHILE MAINTAINING THE GRADES AND DRAINAGE PATTERN SHOWN.
8. TOPOGRAPHY BEYOND THE TOE OF WASTE ROCK DOME IS EXISTING TOPOGRAPHY BEFORE RELOCATION OF WASTE ROCK. WHERE WASTE ROCK IS PRESENT, THE COVER IS TO BE EXTENDED AT THE DESIGN SLOPE TO INTERSECT ORIGINAL GROUND.
9. EXISTING MACHINE SHOP TO BE LEFT IN PLACE TO SUPPORT CLOSURE CONSTRUCTION.
10. CO-ORDINATES OF SETOUT POINTS ARE PROVIDED IN FILE 'SETOUT_POINTS_FOR_ PROPOSED_WASTE_ROCK_DOME_REVC.csv.
11. CONSTRUCT DITCHES OR BERMS AS NECESSARY TO DIRECT FLOW FROM DRAINAGE CHUTES AND GENERAL RUNOFF AWAY FROM TOE OF DOME FILL,

REFERENCE(S)

1. EXISTING GROUND SURFACE TOPOGRAPHY FROM STANTEC, SURVEYED AUGUST 23 TO 25, 2019.
2. COORDINATES ARE IN METRES TO UTM NAD83, NRCS ZONE 12N.
3. FOR PLAN VIEW OF EXPANDED LANDFILL REFER TO DRAWING 19136158-0001-1.
4. UNDERGROUND WORKINGS INFORMATION PROVIDED BY CLIENT FILENAME 180125 draft_Figure 6 Surface Projection of Underground Mine Workings.DWG

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Date 05 Aug 2021
PERMIT NUMBER: P 049
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0 50 100
1:1,500 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2021-08-05	ISSUED FOR CONSTRUCTION	DB	TDR	KAB	KAB
1	2021-06-18	ISSUED FOR CONSTRUCTION	DB	TDR	KAB	KAB
0	2021-05-18	ISSUED FOR CONSTRUCTION	DB	TDR	KAB	KAB
C	2021-05-03	ISSUED FOR REVIEW	DB	TDR	KAB	KAB
B	2020-06-19	ISSUED FOR REVIEW	DB	MR	KAB	KAB
A	2020-06-08	ISSUED FOR REVIEW	DB	MR	KAB	KAB

SEAL

CLIENT
LUPIN MINES INCORPORATED

CONSULTANT
GOLDER
MEMBER OF WSP
GOLDER ASSOCIATES LTD.
6925 CENTURY AVENUE, SUITE #100
MISSISSAUGA, ONTARIO, L5N 7K2
CANADA
[+1] (905) 567-4444
www.golder.com

PROJECT
WASTE ROCK DOME DESIGN
LUPIN MINE CLOSURE
NUNAVUT, CANADA

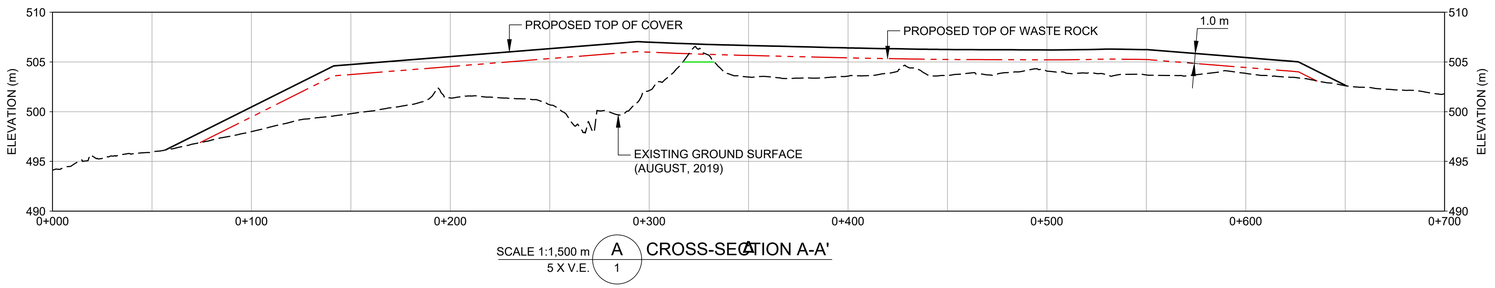
TITLE
PROPOSED WASTE ROCK DOME

PROJECT NO.	CONTROL	REV.	DRAWING
19136158	0002	2	1 of 2 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

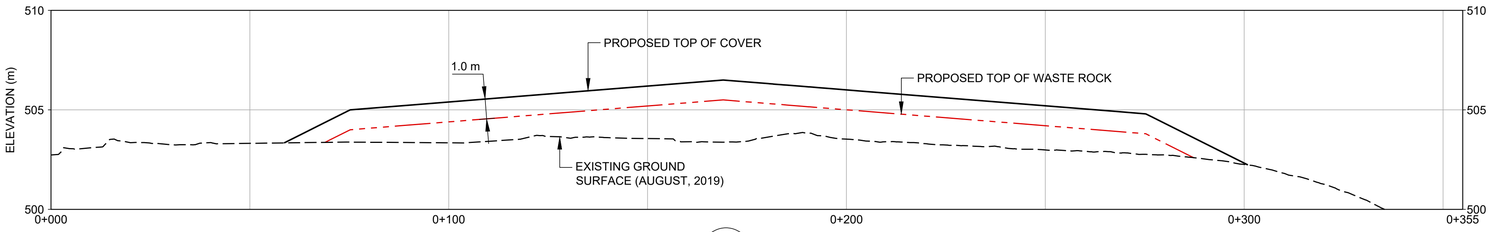
0 25 mm

Path: \\golder.gds\complexdata\office\mississauga\SIM\Clients\Mandalay_Resources\Lupin_Mine\99_PROJ\19136158_Regulatory_Support\40_PROD\0002_Waste_Rock_Dome_Design\ | File Name: 19136158-0002-CM-0001.dwg | Last Edited By: trose Date: 2021-08-06 Time:9:28:46 AM | Printed By: trose Date: 2021-08-06 Time:9:38:11 AM



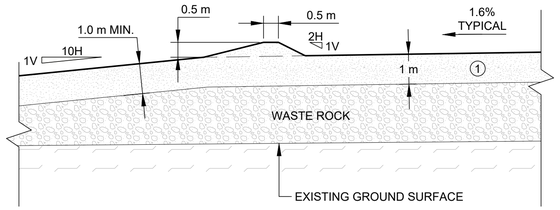
SCALE 1:1,500 m
5 X V.E.

A 1 CROSS-SECTION A-A'



SCALE 1:750 m
5 X V.E.

B 1 CROSS-SECTION B-B'



TYPICAL DETAIL OF PERIMETER BERM
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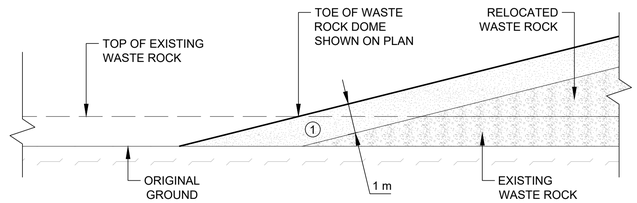
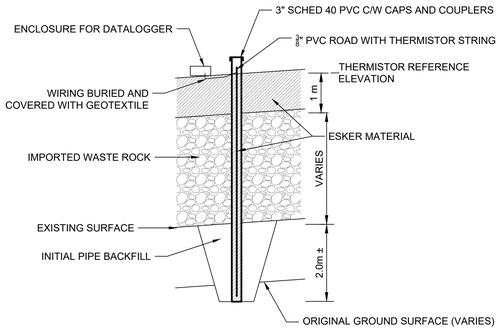
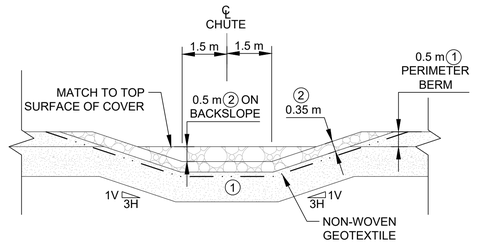


TYPICAL DETAIL OF EDGE OF WASTE ROCK DOME
N.T.S.



TYPICAL DETAIL OF THEMISTOR STRING INSTALLATION
N.T.S.



SECTION OF ENTRANCE TO DRAINAGE CHUTE
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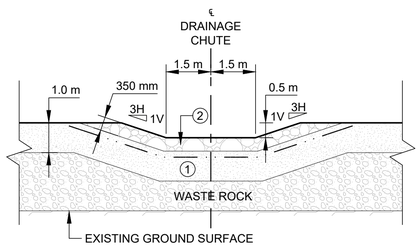
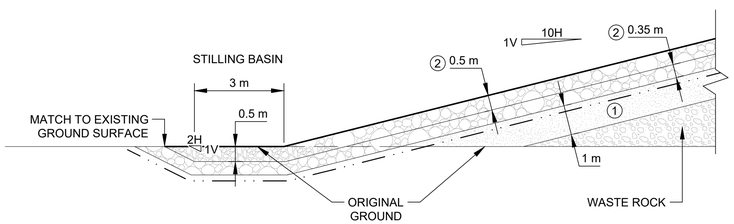
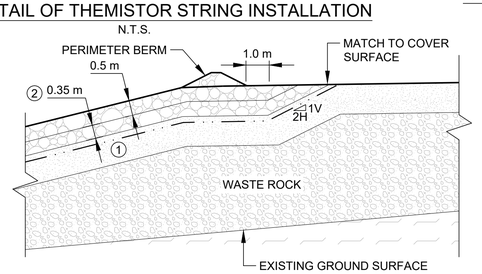


DRAINAGE CHUTE TYPICAL CROSS-SECTION
N.T.S.



DRAINAGE CHUTE TYPICAL PROFILE
N.T.S.



LEGEND

- PROPOSED TOP OF COVER IN SECTION
- PROPOSED TOP OF WASTE ROCK IN SECTION
- PROPOSED BASE REGRADE
- EXISTING GROUND SURFACE (AUGUST, 2019)

MATERIAL ZONATION

- 1 — ESKER SAND AND GRAVEL
- 2 — 10 kg EROSION PROTECTION
- NON-WOVEN GEOTEXTILE

NOTES

1. REFER TO DRAWING 1 FOR LOCATIONS OF CROSS-SECTIONS, PERIMETER BERMS, DRAINAGE CHUTES, STILLING BASINS AND INSTRUMENTATION.
2. GEOTEXTILE TO BE NON-WOVEN NEEDLE-PUNCHED MINIMUM 350 g/m^2.
3. 10 kg EROSION PROTECTION TO HAVE D_{50} OF 190 mm MINIMUM AND MAXIMUM SIZE 350 mm.

INSTRUMENTATION NOTES

1. THE REFERENCE LEVEL FOR EACH THERMISTOR STRING SHALL BE THE FINAL FINISHED GRADE OF THE ESKER COVER. THIS GRADE MAY VARY FROM THE CURRENT DESIGN ELEVATION DUE TO VARIATIONS IN THE AMOUNT OF WASTE ROCK RELOCATED; THEREFORE THE THERMSITOR STRINGS SHALL BE INSTALLED IN THE TUBES ONLY AFTER THE COVER GRADE IS FINALIZED.
2. PITS UP TO 2-M DEEP SHALL BE EXCAVATED INTO THE EXISTING GROUND SURFACE (EXISTING WASTE ROCK OR SOIL) AT ALL FOUR LOCATIONS.
3. A 2-M LONG 3" PVC PIPE SHALL BE PLACED UPRIGHT IN THE CENTER OF THE PIT, WITH EXISTING GROUND MATERIAL PLACED AROUND THE PIPE TO SUPPORT IT. ONCE THE PIPE IS STABLE AND IN AN UPRIGHT POSITION, THE PIT SHALL BE BACKFILLED USING EXISTING GROUND MATERIAL UNTIL ABOUT 0.3 M OF PIPE LENGTH IS LEFT STICKING OUT.
4. 1-M LONG 3" PVC EXTENSION SEGMENTS SHALL BE ATTACHED PROGRESSIVELY TO THE PIPE DURING PLACEMENT OF IMPORTED WASTE ROCK DOME UNTIL THE FINAL GRADE OF THE DOME IS REACHED. PLACEMENT OF WASTE ROCK SURROUNDING THE PIPE SHALL BE CONDUCTED CAREFULLY TO PREVENT DAMAGE OR BENDING OF THE PVC PIPE.
5. PRIOR TO PLACEMENT OF THE 1-M THICK ESKER COVER, ADDITIONAL PVC PIPE EXTENSION SEGMENTS SHALL BE ATTACHED WITH AT LEAST 1 M OF PIPE LEFT ABOVE THE COVER SURFACE.
6. ALL THERMISTOR STRINGS SHALL BE CALIBRATED AGAINST AMBIENT TEMPERATURE BEFORE THE STRINGS ARE LOWERED INTO THE PVC PIPE.
7. EACH STRING SHALL BE ATTACHED TO A 3/8" PVC ROD ENSURING THAT THE CABLE IS STRAIGHT AND BEAD SPACINGS ARE AS PER DESIGN. THE ROD WITH THE ATTACHED STRING SHALL THEN BE LOWERED INTO THE 3" PVC PIPE ENSURING THAT THE UPPERMOST BEAD IS 0.25 M BELOW THE SURFACE OF THE COVER.
8. THE PVC PIPE SHALL THEN BE BACKFILLED TO THE LEVEL OF THE TOP OF COVER USING A 1" MINUS ESKER COVER MATERIAL. THE TOP OF THE PVC PIPE SHALL BE CAPPED TO PREVENT INGRESS OF WATER OR SNOW.
9. INSTALL A ROBUST STANDARD ENCLOSURE TO HOUSE THE BATTERY AND DATALOGGER ADJACENT TO THE PVC PIPES AT EACH MONITORING LOCATION. WIRING CONNECTING THE PVC PIPE AND THE ENCLOSURE SHALL BE BURIED IN THE ESKER COVER AND COVERED WITH GEOTEXTILE TO REDUCE THE RISK OF CABLES BEING DAMAGED BY WILDLIFE.
10. THE STILLING BASIN SHALL BE DELETED IF THE CHUTE ENDS ON A BEDROCK OUTCROP.
11. CONSTRUCT DITCHES OR BERMS AS NECESSARY TO DIRECT FLOW FROM DRAINAGE CHUTES OR GENERAL RUNOFF AWAY FROM TOE OF DOME COVER.

REFERENCE(S)

1. EXISTING GROUND TOPOGRAPHY FROM STANTEC, SURVEYED AUGUST 23 TO 25, 2019.

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Date 05 Aug 2021
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0 20 40
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0 25 50
1:750 METRES

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PROJECT
WASTE ROCK DOME DESIGN
LUPIN MINE CLOSURE
NUNAVUT, CANADA

TITLE
PROPOSED WASTE ROCK DOME SECTIONS AND DETAILS

PROJECT NO.	CONTROL	REV.		DRAWING
19136158	0002	2	2 of 2	2

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0 25 mm

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