Rio Tinto

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Ms. Violet Camsell-Blondin
Chair
Wek'èezhìi Land and Water Board
Box 32
Wekweètì, NT X0E 1W0

9 May 2017

Re: Re-Submission - Closure Plan WRSA-NCRP V1.1

Attached please find the Diavik Diamond Mines (2012) Inc. (DDMI) Final Closure Plan – Waste Rock Storage Area – North Country Rock Pile – Version 1.1. DDMI is requesting approval of the Plan under what we understand to be requirements of Part F Item 4 and Part K Item 1 of W2015L2-0001.

DDMI received Directives from the WLWB in relation to this Plan on October 25, 2016 and December 16, 2016. DDMI also received responses from the GNWT (February 17, 2017) to the WLWB Information Request (IR) of December 16, 2016. Attachment #1 is a conformance table repeating the key requirements of each Directive (including items from the GNWT IR Response) and advising how/where each has been addressed within the Plan.

In a letter dated February 17, 2017 the GNWT and their consultant submitted recommendations related to geotechnical aspects of the NCRP cover design. DDMI requested a response to each from the NCRP Engineer of Record. These recommendations and responses are included as Attachment #2.

Likely because this is a "Final" closure plan, questions have been asked about long-term monitoring and maintenance costs following completion of all closure and performance assessment activities. We understand that the activities in question are beyond the intended scope of DDMI's approved closure plans and possibly relate more to final relinquishment. Regardless, DDMI understands these concerns and has prepared Attachment #3 which provides a view on what a long-term monitoring and maintenance program might look like for the Diavik site as a whole, if it was required, and what it could cost.

Directive #14 from December 16, 2016 required DDMI to provide a letter from a professional engineer stating their professional view on whether the NCRP-WRSA re-sloping plan could be approved independent from the cover design. Attachment #4 provides this letter. DDMI agrees with the substance of this letter.

This re-submission also includes Attachment #5 and #6 that addresses additional information requested by Board Staff on May 4, 2017.

With WLWB approval of this Plan and subject to internal financial approvals, DDMI intends to commence progressive reclamation of the NCRP-WRSA in August 2017; starting with re-sloping. We respectfully request a decision from the WLWB regarding this submission by July 18, 2017.

DDMI also expects that annually, with demonstration of the progressive reclamation work completed each year, the amount of security required under Part C Item 1 will be reduced correspondingly. Quantities of re-sloped waste rock, placed till cover and placed rock cover will be provided to the end of each calendar year with the Annual Closure and Reclamation Plan Progress Report (Part K Item 4). DDMI will also submit an updated mine reclamation liability estimate (RECLAIM) with the reclamation quantities reduced by the amount of progressive rehabilitation work completed. The quantities that will be reduced are those listed in cells E5, E14 and E15 of the RECLAIM Model (Appendix VII). As this will be the first formal relinquishment of closure security for DDMI, we request that with approval of this Final Closure Plan that the WLWB either confirm the approach described above or specify a different approach.

It has been almost twenty years since DDMI first conceived of this closure approach for the waste rock storage area and more than ten years of world class research has been undertaken to verify this approach. With timely WLWB approval of this Final Closure Plan, DDMI is hopeful that this important progressive rehabilitation can commence.

Regards,

Gord Macdonald

cc Sarah Elsasser (WLWB)
Ryan Fequet (WLWB)
Patty Ewaschuk (WLWB)

Attached:

1. Final Closure Plan – Waste Rock Storage Area – North Country Rock Pile – Version 1.1.
2. Attachment #1 Conformance Table – Board Directives.
3. Attachment #2 – Engineer of Record Reply to GNWT/BCL Recommendations Feb 17, 2017.
4. Attachment #3 – Long-term Monitoring and Maintenance – Possible Scope and Cost.
5. Attachment #4 – Response to WLWB Directive #14 – Approval of Re-Slope and Cover Design.
6. Attachment #5 – Additional TetraTech information requested by Board Staff May 4, 2017.
7. Attachment #6 – Additional DDMI information requested by Board Staff May 4, 2017.

Attachment #1
Conformance Table – Board Directives

Conformance with Items from WLWB Directive October 25, 2016		
#1	To remedy this, DDMI must complete the required engagement on the WRSA Final Closure Plan, submit the record of engagement, update Section 2.4 of the Plan ("Community Engagement"), revise the Plan as necessary to reflect the results of engagement, and include a thorough description of how DDMI incorporated engagement into the Final Closure Plan. Following receipt of this information, the Board will provide a second opportunity for reviewers to comment on the WRSA Final Closure Plan so that reviewers can provide comment with the benefit of adequate engagement.	See revised Section 2.4, Appendix IX-1, and Appendix IX-2
#2	To address these issues and foster discussion, the Board is of the view that a closure criteria workshop is needed. The Board proposes to host this workshop jointly with DDMI; Board staff will be in touch with DDMI to discuss this further. DDMI can then use feedback from the workshop to revise and re-submit the closure criteria for the WRSA Final Closure Plan and to inform closure criteria for ICRP Version 4.	Workshop held in December 2016. Revised closure criteria are included in Appendix V and text in Section 5.2.3.2
Conformance with Items from WLWB Directive December 16, 2016		
1	Include a report, as an appendix, prepared by a third party with expertise in thermal modelling and thermal design	Please see Appendix XI.
1a	A statement that the research and analysis supports DDMI's WRSA cover design concept (from a thermal perspective) and that the design has been sufficiently optimized to ensure long-term thermal performance (WLWB Staff Comment #16)	Please see Section 5.2.3.3 page 53.
1b	A sensitivity analyses on the thermal modelling to address uncertainties in key inputs, including but not limited to ground temperatures (WLWB Staff Comment #21), till moisture content (WLWB-20), thickness of till and rock layers (ECCC Comment #4), and heat produced by oxidation of sulphides in the underlying Type III rock	Please see Appendix XI – Section 6.5.
1c	A more complete and up-to-date review of all thermal monitoring data from the test piles and the WRSA to verify the results of the modelling, to further understand the effects of year to year variations in climate, and ultimately determine whether any modifications to the design are warranted (WLWB Staff Comment #22). The measurements taken in the WRSA are not sufficient for understanding the effects of year to year variations in climate because there is no till layer in the WRSA. The Board understands that the absolute active layer thickness in the test piles may differ from that of the full piles, but a careful evaluation of the relative changes within the test piles could help to remove some of the	Please see Appendix XI and Attachment #5.

	uncertainty associated with the covers	
1d	Determine whether the recommendations in Section 7.5 of the thermal modelling PhD thesis (Pham 2013)5 regarding cover placement are required to ensure adequate thermal performance. The recommendations were not incorporated into the design, construction schedule, or construction specifications developed by Golder. The Board understands there are practicalities related to the A21 mine schedule, but it must be demonstrated that these limitations will not jeopardize the performance of the cover (WLWB Staff Comment #27)	The recommendations in Section 7.5 of Pham (2013) are considered through the sensitivity analysis conducted or discussed in Appendix XI - Section 6.5. Please see additional information provided in Attachment #5.
1e	Recommendations, if any, for improving the design; and	The evaluation in Appendix XI supports the current design. No improvements to the design are currently proposed by DDMI.
1f	The third party's CV.	Please see Appendix XI
2	Submit a description of how the company has addressed each of the recommendations in the third party report, or a rationale for any deviations from the third party's recommendations.	The recommendations in Appendix XI have already been included in the final design. A statement to this effect is included see Section 5.2.3.3 page 52. Please see additional information provided in Attachment #6.
3	Submit a sediment and erosion control plan for the till layer, with the following information. WLWB staff asked about the delay (approximately 2 years) after placement of the till layer and before placement of the rock layer (WLWB Staff Comments #8, 9, and 13). DDMI responded that the delay is related to the A21 mining schedule. The exposed till layer could result in significant erosion, potentially reducing the holding capacity of ditches and ponds and reduce the till layer thickness, which could decrease the thermal protection offered by the till layer. DDMI should demonstrate that it will adequately manage erosion during and after construction of the till layer. DDMI can include the sediment and erosion control plan in the appropriate section of the WRSA Final CRP, for example Section 5.2.3.3 or 5.2.3.4.	Experience with the till pile in the NCRP that is at angle of repose does not indicate that erosion is likely to be a concern to the extent described by the WLWB. Regardless, DDMI has included appropriate erosion response actions and trigger levels in Section 5.2.3.3 which are summarized from the Final Closure Design (Appendix X).
3a	Construction scheduling and erosion control measures to be employed during construction and following placement of the till to minimize erosion. For example, the till hauled from the A21 development could be used to cover the flat areas of the WRSA, but not the slopes. Instead, till could be stockpiled near the slopes of the WRSA. DDMI could move the stockpiled till onto the slopes immediately prior to rock placement. Or, DDMI could place Type I rock	DDMI has included appropriate erosion response actions and trigger levels within the Final Closure Design (Appendix X).

	immediately following placement of till on the slopes. The remaining flat areas of the WRSA could be covered later via direct haul from the A21 development	
3b	Action levels that define when DDMI should implement further contingencies to prevent further erosion of the till layer; and	DDMI has included appropriate erosion response actions and trigger levels within the Final Closure Design (Appendix X).
3c	Contingencies that DDMI can implement if action levels are reached	DDMI has included appropriate erosion response actions and trigger levels within the Final Closure Design (Appendix X).
4	Include the following information in the revised WRSA Final CRP or in the QA/QC manual required by Part F, Item 10 of the Water Licence:	
4a	A description of how DDMI will ensure that the till and rock layers are no thinner than 1.5 m and 3.0 m respectively. Under the current design, these thicknesses are necessary to ensure the cover achieves its anticipated thermal protection. As indicated by ECCC, "Given the coarse nature of these materials, it may be challenging to achieve consistent placement of the layers of till and cover rock at the desired thicknesses" (ECCC Comment #4).	Please see revised Section 5 – Quality Control and Quality Assurance Plan of the Technical Specifications (Appendix B) included with the Final Design Report (Appendix X).
4b	A statement that DDMI will implement an A21 Type I rock characterization program for rock used in cover construction. As described in the Board's September 15, 2016 directive regarding Waste Rock Management Plan Version 7, the Board intends to amend the WL Schedule for the WRMP to include a requirement that the WRMP describe a characterization program for Type I rock coming from the A21 development	DDMI has completed an A21 Type I rock characterization program that will be included in a next update to the Waste Rock Management Plan as requested by the Board. The requested statement is included in Section 5.2.3.4.
4c	A statement that DDMI will implement a verification plan (to be described in the Waste Rock Management Plan, as described in the Board's September 15, 2016 directive) prior to using Type I from the existing WRSA or other constructed structures, as described in the Board's September 15, 2016 directive to DDMI	DDMI will include a description of the verification plan for the Type I rock from A21 in the next update to the Waste Rock Management Plan. This verification plan will be implemented prior to using Type I rock from A21 to construct the cover on the NCRP-WRSA.
4d	A commitment to maintain an adequate till moisture content during placement. This moisture content must be 90%, unless DDMI can support a lower moisture content with the results of the sensitivity analysis (see requirement #1b). Board staff commented that till moisture content lower than 90% may increase the active	The design specification is a till water content that does not exceed 25 % to ensure stability (Appendix X). Thermal analysis, including sensitivity analysis has

	layer in the cover (WLWB-20). In its response, DDMI indicated that it would not be conditioning the till, has not performed a sensitivity analysis on the effects of moisture content on active layer thickness, and will not be measuring moisture content prior to placement.	confirmed the target active zone thickness can be achieved with cover constructed following the design till design water content specifications (Appendix XI). QA and QC testing requirements for till during construction are described in the Technical Specifications Table 5-2 of Appendix X.
5	Include a commitment to review the results of all ongoing research relevant to the WRSA, to determine whether the cover design should be improved. In future annual Closure and Reclamation Progress Reports (as required by Part K, Item 4), DDMI must summarize the results of ongoing research, state whether the results continue to support the design, and if not, describe how DDMI will adjust the design.	Section 5.2.3.6
6	Provide the complete set of water quality results graphed over time for the Type 1 test pile, to provide a better indication of geochemical performance, as requested by WLWB staff (WLWB Staff Comment # 14). DDMI agreed in principle to providing the data but did not submit it with their responses.	Please see Appendix V-2.
7a	A more detailed thermal monitoring plan. DDMI must outline a minimum plan that addresses the thermal monitoring program design, instrumentation, measurement frequency, and anticipated analysis of the data to evaluate thermal performance of both the Type III waste rock and cover system. DDMI should also note within the revised CRP that the company plans to enhance this program, and provide information about when the company will complete development of the enhanced program.	Appendix XI and Appendix VI-2.
7b	A rationale for the proposed monitoring time periods in Section 3.0 of Appendix VI of the WRSA Final CRP. The Board requires a more robust defence of DDMI's proposed monitoring periods to ensure they are well-founded. These time periods are closely associated with closure criteria, which should have a temporal aspect. The monitoring period also influences the closure cost estimate (ENR Comments #13, ECC Comment #5, and EMAB Comment #9). Also, in response to ENR Comment #5, DDMI indicated that "a 5 to 10 year horizon for regular monitoring of physical stability of mine closure measures is consistent with industry practice in Canadian and International	Section 3.0 of Appendix VI-2 has been revised. The number of years of post-construction monitoring required to adequately assess performance is unknown at this time and will depend upon the results obtained. The monitoring duration will be adaptively managed to be responsive to conditions as they are evaluated. DDMI has assumed 5 year of monitoring from the time the NCRP cover is complete (2023) until there is

	jurisdictions." If DDMI intends to maintain this proposed timeline, DDMI should provide references to substantiate this statement.	sufficient information to prepare an assessment report. Professional experience of the Engineer of Record suggest a typical duration would be in the range of 5-10 years, however there are no references that DDMI is aware of to support this view. It should be noted that because the NCRP cover will be placed progressively over a number of years, sections of the constructed cover could have close to 10 years of monitoring information before the Performance Assessment Report is complete.
7c	Text to explain that DDMI will replace any destroyed monitoring instruments necessary to support the monitoring program, as described in DDMI's response to WLWB Staff Comment #11.	Section 3.6 of Appendix X.
8	Provide detailed maintenance plans. Section 5.2.3.7 of the Plan includes very minimal information about post-closure maintenance for the WRSA. More detailed maintenance plans are required in a final closure plan, and are necessary to refine the closure cost estimate. For each maintenance activity, describe the proposed frequency and period over which the activity will be required, with rationale (EMAB Comment #9).	DDMI understands from discussion with EMAB that their comment primarily relates to long term monitoring and maintenance, i.e. after acceptance of both the Closure Completion Report (Part K Item 5) and the Performance Assessment Report (Part K Item 6) and beyond the expiration of any final Water License. This goes beyond the scope of what is included in DDMI's approved Closure Plans. To assist EMAB and the WLWB, DDMI has considered what could be included in a long-term monitoring and maintenance scope for the site as a whole. It would be impractical to break this down by area of the mine site. Attachment 3 provides initial concepts in this regard. DDMI looks forward to ongoing discussions around this aspect of closure planning and security relinquishment.
9	Improve the description of contingencies and associated uncertainties. WLWB staff asked whether DDMI has	Section 5.2.3.9

	identified contingencies for the WRSA, and DDMI replied that long-term water treatment is the only contingency (WLWB Staff Comment #7). The approved ICRP Version 3.2 included 5 contingencies (page 126). DDMI removed four of them in the Final WRSA Closure Plan. DDMI should return these contingencies to the list in Section 5.2.4.9 of the WRSA Final CRP, or provide a rationale for why they were removed	
10	Improve the residual effects discussion in Section 5.2.3.5	Section 5.2.3.5
10a	Compare currently predicted residual effects to those predicted during the environmental assessment and to site-specific water quality objectives for the full suite of parameters (i.e., all parameters in Table V-3 of the WRSA Final CRP and Table 7 of Appendix XIV-1 – Prediction of Seepage Quality from the North Country Rock Pile. L. Smith (2013)), as required by the C&R Guidelines (page 36). These comparisons should be presented in table format. The comparisons should include both the modelled predictions and the measured results from the test piles (See WLWB Staff Comment #6).	Appendix V-1 – Tabular Appendix V-2 - Graphical
10b	Identify and discuss any parameters predicted to exceed EA predictions and/or site-specific water quality objectives.	Section 5.2.3.5
10c	Discuss the predicted duration of the effects, as required by the C&R Guidelines (page 24)	Section 5.2.3.5
11	Photos - Include photos of the WRSA depicting what the site looked like immediately prior to closure (as required by the C&R Guidelines, page 24).	DDMI will use drone technology to provide survey and photographic records of pre-closure, closure construction and post-closure conditions. This requirement has been included in the revised design document (Appendix X). The "immediately prior to closure" survey will be conducted in August 2017 following plan approval. Conducting the drone survey at this time would not provide meaningful information due to snow cover.
12a	Revise the third paragraph on page 5 of the WRSA Final CRP (regarding segregation of rock types) as described by ENR and agreed to by DDMI (ENR Comment #2).	See page 5.
12b	Correct the references described in ECCC Comment #2, as agreed to by DDMI in its response.	Section 5.2
13	Provide additional information to enable the Board to determine the appropriate security for the WRSA:	

13a	Submit an explanation for the re-sloping cost estimate in RECLAIM, and revise if necessary. Further, the "Flatten slopes with dozer, rock pile, north" line item in RECLAIM (in the Rock Pile sheet) in DDMI's proposed estimate for the WRSA Final CRP is identical to the same line item in the approved RECLAIM estimate	Reslope volumes have been updated from 1,501,500 m^3 to 1,532,500 m^3 based on the final design. Unit costs for rock cover have been corrected to WLWB (2014) approved values of \$4.20/m^3 (NCRP) and \$6.50/m^3 (PKC).
13b	Based on the maintenance activities identified in response to Item 8 above, estimate the maintenance costs for the WRSA.	As described in response to Item 8 above, DDMI understands that EMAB's comment relates to long-term monitoring and maintenance following completion of all closure and performance assessment activities which are beyond the scope of DDMI's approved closure plans. To assist EMAB and the WLWB, DDMI has considered what could be included in a long-term monitoring and maintenance scope for the site as a whole. It would be impractical to break this down by area of the mine site. Attachment 3 provides some initial concepts in this regard and an initial estimate of typical annual costs. DDMI looks forward to ongoing discussions around this aspect of closure planning and security relinquishment.
13c	Confirm that the monitoring plan in DDMI's proposed WRSA Final CRP correlates directly with the monitoring costs in DDMI's RECLAIM estimate. For example, an aerial survey and monthly inspections are described in the monitoring plan, but it is not clear that these are accounted for in the estimate.	The tasks described in the NCRP Monitoring Plan (Appendix VI) are included within the intended scope of the RECLAIM monitoring costs. The monitoring costs in RECLAIM are site wide and not broken down to the granularity to be directly associated with a specific NCRP monitoring task.
14	Provide a letter from a professional engineer stating their professional view on whether the WRSA re-sloping plan could be approved independently from the cover design (i.e.,material types and thicknesses). In addition to the letter from a profession engineer, DDMI can comment on	Cover letter Attachment 4. DDMI agrees with the substance of this letter.

	the feasibility of Board approval of the re-sloping plan prior to approval of other aspects of the WRSA Final CRP.	
15	A conformance table that indicates how DDMI has addressed each of the requirements above	here
Conformance with items from WLWB Information Request to GNWT December 16, 2016		
IR1	GNWT Response to WLWB December 16, 2016 Information Request#1.	See response comments from the Engineer of Record included as Attachment 2 in DDMI Cover Letter.
IR2	GNWT Response to WLWB December 16, 2016 Information Request#2.	The GNWT response confirms that 10% is the appropriate contingency amount for the NCRP once this Plan is approved.

Attachment #2
Engineer of Record Reply to GNWT/BCL Recommendations Feb 17, 2017.

Attachment #2 – Engineer of Record Reply to GNWT/BCL Recommendations Feb 17, 2017.

GNWT/BCL comment	Response
• It is recommended that DDMI explain why the potential for frost heave followed by vertical settlement is not considered a credible failure mechanism?	Solifluction, which is a similar process to that described in the comment, was considered as a credible failure mode in Section 4.1.1.2 of the NCRP closure design report.
• It is recommended that monitoring be extended to minimum of 10 years following cover placement.	Monitoring will be carried out for at least 5 years following cover construction. The monitoring frequency should be adjusted based on performance, or changing conditions, or trends in observations.
• It is recommended that DDMI specify the type of aerial survey proposed, the scale of measurements possible, and whether the freeze/thaw displacements described above can be detected	Survey should be to a scale that will capture changes that may impact the performance of the cover. For a 1.5 m thick till layer and 3 m rock layer, the resolution required is on the order of 1 m. This range or better is achievable with drone flights with georeferenced photography.
• It is recommended that instrumentation also be installed to detect small scale movement and allow for a more efficient assessment of failure mechanism and rates of displacement if slope movement is detected.	Slope movements that impact the performance of the cover should be detectable from survey data (see response above), and from observations. Installing instrumentation to detect small scale movements is not considered practical due to large area of slope. I.e. a single small scale instrument would likely miss areas of movement. If the cover sloughs, which is a visible failure mode, it can be repaired.
It is recommended that physical testing, such as freeze/thaw tests, be conducted on the till under conditions which mimic the anticipated field conditions to identify the potential magnitude of cover expansion. The till should be saturated, frozen slowly (say 1 week), and confined with the equivalent of 3 m of waste rock.	DDMI disagrees with the need for laboratory testing. Larger scale testing has been carried out at site in the test piles at Diavik.
• Quality assurance/quality control in the types of materials used for cover will be very important to reduce the risk in as much as possible. The use	The technical specifications for cover construction carry requirements for QC/QA testing.

of frost susceptible materials should be avoided, particularly in areas of the pile where the risk of cover deterioration may be greatest, such as on south facing slopes.	
• At closure of the Diavik Mine, it is recommended that DDMI complete a review of the results of monitoring and research at Diavik and other mines for performance of covers to refine the scope and duration of the monitoring program for Diavik.	The closure for the NCRP has been based on testing and data collection over a number of years. As noted previously, the suggested monitoring frequency should be adjusted based on performance, or changing conditions, or trends in observations.

Attachment #3

Long-term Monitoring and Maintenance – Possible Scope and Cost

Attachment #3 – Long Term Monitoring and Maintenance

Diavik's Closure and Reclamation Plan (CRP) scope and security cost estimate cover the period of activity up to and including the closure Performance Assessment Report (Part K Item 6). Questions have been raised about the possible scope and cost of long-term monitoring and maintenance (i.e. greater than 10 years post-closure). The potential need for long-term monitoring and maintenance would not be known until the Board has reviewed the Performance Assessment Reports. Security amounts can also be revised based on the results of the Performance Assessment Report (MVLWB 2013). DDMI, with the assistance of Golder Associates, has considered what a long-term monitoring and maintenance program might look like for the Diavik site, if it was required. It is provided below for information.

Long-term Monitoring

For costing purposes, DDMI has assumed the following post-closure monitoring program:

- Geotechnical performance monitoring: This would consist of a full site inspection by a qualified geotechnical engineer, including visual inspection of structures such as the open-pit, underground, and dike areas. Provision in the budget is included a drone survey/photography of major installations, recording of instrumentation readings, and preparation of a brief geotechnical memorandum documenting results of the visit. A minimum of 4 days on site are assumed to complete the inspection, walking key areas of the site, with a one-week allowance considered for budgeting purposes.
- Wildlife monitoring: the wildlife monitoring program would be conducted by a biologist or similarly qualified professional. It is assumed that this survey can also be completed in 4 days on site. Photographs and other field information will be used to prepare an annual wildlife monitoring report.
- Water quality monitoring will be conducted in conjunction with the wildlife monitoring, and will include the collection of water samples from an assumed 10 long term on-island monitoring stations. It is assumed samples will be collected, tested for field parameters, packed, and brought back to Yellowknife for shipping to an analytical laboratory. Data from the program will be used to update a site data database, and complied into an annual report, illustrating trends for key parameters.

Annual monitoring would consist of a single site visit for the entire monitoring team and is assumed to take place during spring or summer and has a one week allowance considered for budgeting purposes. The three annual reports generated would be issued in the same calendar year. These reports would include any recommendations for future corrective actions or changes to monitoring programs.

Long-term Maintenance

The post-closure maintenance requirements may include the repair of areas where there is settlement, erosion and/or sloughing. It is anticipate that the amount of post-closure maintenance needed will be variable as a function of factors such as the wetness or dryness of the years between maintenance events. It has been assumed that maintenance will be carried out in a campaign conducted every three years.

It has been assumed that post-closure maintenance would take place in the summer, to ensure proper visibility of areas that may need maintenance, and also to assure that work can be completed with soil that is not completely frozen.

Estimated Costs

The total estimated cost is $1.70 million per three year period, or an average of roughly $560,000 year.

Of the total cost over a three-year period, 56% of the total ($1.18 million) is associated with post-closure maintenance, with equipment standby costs making up $400,000 of the total.

The annual post-closure monitoring cost is estimated to be $171,875, or $515,625 over a three year period.

A detailed breakdown of the annual monitoring cost is presented in Table 1, and the maintenance cost estimate per three year period is presented in Table 2. The post-closure monitoring and maintenance cost estimate for a typical three year period is summarized in Table 3.

Table 1. Annual Monitoring Costs.

Activity	Total ($)
Professional Fees	134,950
Equipment Rental	2,600
Transportation Costs	15,625
Camp Costs	13,200
Lab Costs	5,500
Total	**171,875**

Table 2. Maintenance Costs (assumed every three years).

Activity	Labour ($)	Equipment ($)	Direct Cost ($)	Total ($)
Equipment Mobilization and Demobilization	-	-	109,375	109,375
Crew Mobilization and Demobilization	14,200	-	34,800	49,000
Camp Costs	-	-	84,000	84,000
On-site Maintenance Work	109,925	156,350	-	266,275
Equipment Winterization	-	-	25,000	25,000
Equipment Standby	-	302,450	-	302,450
Fuel Tank	-	-	59,700	59,700
Subtotal	**124,125**	**458,775**	**312,875**	**895,800**
Indirect Costs (15%)	18,625	68,825	46,925	134,375
Subtotal	**142,750**	**527,600**	**359,825**	**1,030,175**
Mark up overhead and profit (15%)	**21,425**	**79,150**	**53,975**	**154,525**
Total	**164,175**	**606,750**	**413,800**	**1,184,700**

Table 3. Typical three year period long-term monitoring and maintenance.

Activity		Typical 3-Year Period Cost Estimate ($)
Monitoring [(a)]	Professional	404,850
	Equipment	7,800
	Direct Cost	102,975
	Subtotal	**515,625**
Maintenance	Labour	164,175
	Equipment	606,750
	Direct Cost	413,800
	Subtotal	**1,184,700**
Contingency		**$0**
	Total	**1,700,325**

Attachment #4

Response to WLWB Directive #14 – Approval of Re-Slope and Cover Design

16 February 2017

Golder Reference No. 1771864-1580-L-Rev0-1000

Diavik PO No. D03139
Diavik Work Plan No. 451

Mr. Gord Macdonald
Diavik Diamond Mines (2012) Inc.
PO Box 2498
300 - 5201 50th Avenue
Yellowknife, NT
X1A 2P8, Canada

NORTH COUNTRY ROCK PILE CLOSURE AND RECLAMATION PLAN – RE-SLOPING AND COVER DESIGN, DIAVIK MINE, NT

Dear Mr. Macdonald,

This letter provides Golder Associates Ltd. (Golder) opinion on whether re-sloping the North Country Rock Pile (NCRP) for closure could be approved independently of the closure cover design, in response to the Wek'èezhìi Land and Water Board comment No. 14 in the letter titled Waste Rock Storage Area Final Closure and Reclamation Plan dated 16 December 2016.

The NCRP is the permanent storage facility for run-of-mine waste rock generated at the Diavik Mine in the Northwest Territories. Golder prepared a design for construction of the closure of the NCRP including an assessment of the physical stability, drawings and technical specifications (Golder 2016). The cover layer thicknesses and materials were designed by others and provided by Diavik Diamond Mines (2012) Inc. (DDMI) as an input to the design presented in Golder (2016). Studies of thermal effects, geochemistry, seepage, surface water management, and environmental components of the NCRP closure design are outside the scope of the design prepared by Golder. The cover system design considers that areas of the NCRP containing waste rock with the potential for acid generation would be re-sloped from angle of repose slopes to 3 horizontal to 1 vertical slopes and covered with 1.5 m (metres) of till and 3 m of non-acid generating (Type I) waste rock. Areas of the NCRP containing waste rock that do not have the potential for acid generation would not require placement of the cover system and the side slopes would remain at angle of repose with the existing configuration of benches.

We recommend that the re-sloping of the NCRP not be completed independently of the cover design. Reasons for this include:

- Re-sloping of the NCRP is required for stability of the designed cover geometry and materials, and also to allow trafficking of equipment on-slope, and placement of cover materials on the slope. Should the design of the cover configuration change, then the design of the re-slope may fail to satisfy criteria for cover stability.

- The re-slope limits were designed considering the cover geometry and adjacent infrastructure, including the processed kimberlite containment (PKC) facility, the non-burnable waste dump, Pond 3 (Sediment Pond) and the airport road. Should the cover thickness be increased, then the footprint of the cover would increase, and may result in unforeseen impact to these infrastructures.

CLOSURE

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

ORIGINAL SIGNED & SEALED

Germán Pizarro, MEng, PEng
Geotechnical Engineer

Ben Wickland, PhD, PEng
Associate, Senior Geotechnical Engineer

GP/BEW/ls/cmm

\\golder.gds\gal\burnaby\final\2017\3 proj\1771864 ddmi_2017_surface geotech\1771864-1580-l-rev0-1000\1771864-1580-l-rev0-1000-ncrp closure reclamation 16feb_17.docx

REFERENCE

Golder (Golder Associates Ltd.). 2016. Diavik Diamond Mine North Country Rock Pile Closure Design. Report No. 1521339-1471-R-Rev1-700 Rev. 1, prepared for Diavik Diamond Mines (2012) Inc. Submitted 5 February 2016.

Attachment #5
Response to WLWB Staff May 4, 2017 request for additional information from TetraTech

May 9, 2017

ISSUED FOR USE
FILE: ENG.EARC03073-01
Via Email: Gord.Macdonald@riotinto.com

Diavik Diamond Mines (2012) Inc.
P.O. Box 498
300, 5201-50th Avenue
Yellowknife, NT, XIA 2P8
Canada

Attention: Gord Macdonald
Principal Advisor Sustainable Development

Subject: Response to the Wek'èezhìi Land and Water Board's Inquiry of Non-Conformities in DDMI's Waste Rock Storage Area (WRSA) Final Closure and Reclamation (CRP) Plan, Version 1.1

On May 4, 2017, Diavik Diamond Mines (2012) Inc. (DDMI) received a letter from the Wek'èezhìi Land and Water Board (WLVB) regarding the non-conformity items in the WRSA Final CRP with the outstanding requirements from the Board's December 16, 2016 directive. Three non-conformities are required to be clarified as per the request of the WLVB. As the third party for the thermal design of the closure cover of the WRSA at Diavik, Tetra Tech Canada Inc. (Tetra Tech) prepared the following responses regarding the first two non-conformities.

Outstanding Requirement from the Board's December 16, 2016 Directive – 1c

"Include a report, as an appendix, prepared by a third party with expertise in thermal modelling and thermal design, that includes the following: A more complete and up-to-date review of all thermal monitoring data from the test piles and the WRSA to verify the results of the modelling, to further understand the effects of year to year variations in climate, and ultimately determine whether any modifications to the design are warranted (WLWB Staff Comment #22). The measurements taken in the WRSA are not sufficient for understanding the effects of year to year variations in climate because there is no till layer in the WRSA. The Board understands that the absolute active layer thickness in the test piles may differ from that of the full piles, but a careful evaluation of the relative changes within the test piles could help to remove some of the uncertainty associated with the covers;"

Description of Non-Conformity raised by the WLVB

"The third party report does not address the thermal monitoring data from the test piles, i.e., the underlined text in the Outstanding Requirement from the Board's December 16, 2016 Directive – 1c"

Response 1c:

The thermal calibration for the full scale waste rock pile was carried out based on the ground temperature monitoring data at full scale pile and other key input parameters which are directly measured or calculated from the scaled test piles. The best available information from the scaled test piles and full pile were used for the calibration and long-term thermal performance prediction. It is not deemed necessary to calibrate the thermal model to the scaled test piles.

Considering the relatively short monitoring period (compared to long-term cover design, i.e. 100 years) and size of the scaled test piles, it is believed that the measured annual thaw depths at the scaled test piles cannot be an indicator of the long-term thermal performance of the closure cover for the full scale pile, especially under the climate change condition.

Tetra Tech Canada Inc.
14940 - 123 Avenue
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Tel 780.451.2121 Fax 780.454.5688

Outstanding Requirement from the Board's December 16, 2016 Directive – 1d

"Include a report, as an appendix, prepared by a third party with expertise in thermal modelling and thermal design, that includes the following: Determine whether the recommendations in Section 7.5 of the thermal modelling PhD thesis (Pham 2013) regarding cover placement are required to ensure adequate thermal performance. The recommendations were not incorporated into the design, construction schedule, or construction specifications developed by Golder. The Board understands there are practicalities related to the A21 mine schedule, but it must be demonstrated that these limitations will not jeopardize the performance of the cover (WLWB Staff Comment #27)"

Description of Non-Conformity raised by the WLVB

"The third party report does not address Pham's recommendations, which include a delay prior to till placement, winter placement of materials, etc. The third party should address each of Pham's recommendations, and if appropriate, DDMI should include them in the Design."

Response 1d:

The recommendations in Section 7.5 of Pham's PhD thesis are all related to the options which could increase the rate of freezeback not to the long-term closure cover thermal performance (i.e. annual thaw depth). The time required for the freezeback is not a driver of the closure cover design. The current closure cover design contains contingencies which would maintain the Type III rock in a frozen condition and retain the annual thawing front in the till layer after 100 years under the projected mean climate change scenario. The recommendation made by Pham using Type I coarse rock over the till layer would bring some benefits to the current design; however, the production of the Type I coarse rock would be an operational challenge and costly.

We trust this letter meets your present requirements. If you have any questions regarding the responses, please contact the undersigned.

Respectively submitted,
Tetra Tech Canada Inc.

REGISTERED PROFESSIONAL ENGINEER
H. XIA
LICENSEE
NT/NU
May 9, 2017

REGISTERED PROFESSIONAL ENGINEER
KEVIN W. JONES
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PERMIT TO PRACTICE
TETRA TECH CANADA INC.
Signature
Date MAY 9, 2017
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

Attachment #6

Response to WLWB Staff May 4, 2017 request for additional information from DDMI

A result of the WLWB Staff conformity check was a request for DDMI to provide additional information as follows:

> "Tetra Tech made two recommendations on page 18 of their third party report. The first of these does not appear to be addressed in DDMI's Design Report:
>
> > "It is recommended that till material to be used on the side slope of the pile should contain sufficient fine fraction which can maintain a minimum of 10% water content in the till layer for the long-term condition in order to retain the seasonal thawing front within the closure cover system after 100 years."
>
> The Design Report stipulates a maximum moisture content of till (25%) but is silent on the Tetra Tech recommendation for a minimum moisture content"

DDMI Reply:

The NCRP Closure Design (Golder 2017) is included as Appendix X to Closure Plan WRSA-NCRP V1.1. Appendix B of Golder (2017) contains the Technical Specifications for the till to be used in construction of the NCRP Cover. The following is included at page 12 of 23:

> "The Till to be placed on the re-sloped and crest surfaces of the NCRP shall be a silt, sand and gravel mixture with a maximum particle size of 1.5 m or lift thickness, with 30 to 70% passing the No. 40 sieve (0.42 mm). The maximum water content of placed till is 25%."

The Golder (2017) specification for inclusion of fines is consistent with the TetraTech recommendation. The intent of the specification is that the till should have enough fines to retain moisture. As noted by TetraTech, the inclusion of fines will enable higher long-term water content for the till. A construction material specification has been included for fines content in the till, rather than a minimum moisture content, because the initial till water content at the time of construction, which is what a construction material specification would be for, is likely not the best indicator of water retention over the long-term.

References:

Golder. 2017. *Diavik Diamond Mine North Country Rock Pile Closure Design.* Prepared for Diavik Diamond Mines (2012) Inc. March 29, 2017.

Final Closure Plan – Waste Rock Storage Area - North Country Rock Pile – Version 1.1

Diavik Diamond Mines (2012) Inc.

April 2017

Contents page

ATTACHMENTS

TABLES

1. Executive Summary

This Final Closure Plan for the North Country Rock Pile (NCRP) has been prepared as per the requirements of Diavik Diamond Mines (2012) Inc.'s Class "A" Water License WL2015L2-0001 and directives from the Wek'èezhíi Land and Water Board (WLWB).

While this document is specific to the NCRP Final Closure Plan as requested by the WLWB it will be integrated into Version 4 of the Interim Closure and Reclamation Plan (ICRP) when it is prepared in December 2016.

The North Country Rock Pile contains waste rock from the development of the A154 and A418 kimberlite pipes. Waste rock was segregated during mining to separate potentially acid generating (PAG) rock so that it could be used in construction or stored for later construction access, as described in the approved Waste Rock Management Plan.

A final closure design has been provided with this document that includes:

- Re-shaping of the pile to better fit the landscape and to provide an appropriate surface for placement of a cover;
- Construction of a thermal cover; and
- Caribou access ramps.

It is expected that this closure design will achieve the approved closure objectives. Closure criteria have been specified along with description of planned monitoring programs.

Progressive reclamation of the NCRP can begin in 2017 and can be completed before the end of mining operations currently expected to be around 2024.

2. Introduction

The Diavik Diamond Mine (the Mine) is an unincorporated joint venture established by Diavik Diamond Mines (2012) Inc. (DDMI) and Dominion Diamond Corporation (DDC) to develop a diamond mine at Lac de Gras, in the Northwest Territories (NWT) of Canada.

DDMI is a wholly owned subsidiary of Rio Tinto plc of London, England. Under the Joint Venture Agreement, DDMI has a 60 percent (%) participating interest in the Project, and DDC a 40% participating interest. DDMI has been appointed Manager and is the corporate entity responsible for conducting Project activities.

The Diavik Diamond Mine is located on East Island, a 17 square kilometre (km^2) island in Lac de Gras, NWT, approximately 300 kilometres (km) northeast of Yellowknife (64 degrees [^{o}] 31 minutes [’] North, 110^o 20’ West) (Figure 2-1). The area is remote, and major freight must be trucked over a seasonal winter road from Yellowknife. Worker access is by aircraft to the Mine's private airstrip.

The Diavik Diamond Mine involves mining of four diamond-bearing kimberlite pipes. The pipes, designated as A154North, A154South, A418 and A21, are located directly off shore of East Island (Figure 2-2). All mining, diamond recovery, support activities and infrastructure will be limited to East Island.

Overall, DDMI and DDC have a mineral claim to an area that includes portions of Lac de Gras, the East and West Islands, and portions of the mainland to the southeast and northwest. Lac de Gras is about 100 km north of the treeline in the central barren ground tundra of the NWT, at the headwaters of the Coppermine River. This river, which flows north to the Arctic Ocean east of Kugluktuk, is 520 km long and has a drainage area of approximately 50,800 km^2.

The Community of Wekweètì lies about 187 km to the west-southwest of the mine site. Łutsel K’e is 230 km to the south, Bathurst Inlet is about 275 km to the northeast, and the Lupin mine site is about 125 km to the north. The Ekati Mine is located roughly 25 km to the north (Figure 2-1).

2.1 Purpose and Scope of the Final Closure Plan - NCRP

Diavik is committed to sustainable development, fully embracing our share in that joint responsibility with all legitimate interested parties. Diavik contributes to sustainable development by seeking to maximize the resources we mine, by pursuing opportunities to enhance environmental, social and economic benefits, and by reducing adverse effects that may result from our undertakings.

Mine closure has been integral to mine design and operations. Diavik recognizes that the land and water in the mine area is being borrowed, for the purpose of diamond mining, for a relatively short period of time. Diavik will operate and close the mine site responsibly, intending to leave behind a positive community and environmental legacy.

Planning for permanent closure is an active and iterative process. The intent of the process is to develop a final plan for permanent closure. The process began in the mine design phase and continues through to closure implementation. It enables the plan to evolve as new information becomes available. However, timely closure plan decisions must also be made throughout the planning process. Some of these decisions are significant, are made early in the planning process and can affect the final closure plan. For example the decision on a location for the waste rock piles or the Processed Kimberlite Containment (PKC) is made during the mine design phase and has implications for the final closure plan. Other decisions, for example a final cover material, can be made later in the mine life and can change. Closure planning ensures that information is collected, reviews completed and decisions made as appropriate for a successful implementation.

Interim Closure and Reclamation Plans (ICRP) are documents prepared during the life of the mine that describe the current state of closure planning. The ICRP builds from an *Initial* Closure and Reclamation Plan and ultimately become the *Final* Closure and Reclamation Plan. The expectation is that each iteration of the ICRP will be a step toward the Final Plan. The most recent ICRP is Version 3.2. Version 4.0 is anticipated at the end of 2016.

This Final Closure Plan - NCRP is being prepared in advance of the Final Closure Plan for the site, to accommodate progressive closure of the North Country Rock Pile.

2.2 Closure and Reclamation Plan Goals - NCRP

Diavik's overall goal for the operation and closure of the mine site is:

> To operate and close the Diavik Mine responsibly, leaving behind a positive community and environmental legacy.

Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB/AANDC 2013) provide three main areas of focus regarding closure and reclamation goals:

- *Physical Stability* – Any mine component that would remain after closure should be constructed or modified at closure to be physically stable such that it does not erode, subside or move from its intended location under natural extreme events or disruptive forces to which it might be subject after closure. Mine site reclamation will not be successful into the long term unless all physical structures are designed such that they do not pose a hazard to humans, wildlife, or environment health and safety.
- *Chemical Stability* – Any mine component, including wastes, that remains after mine closure should be chemically stable; chemical constituents released from the mine components should not endanger public, wildlife, or environmental health and safety, should not result in the inability to achieve the water quality objectives in the receiving environment, and should not adversely affect soil or air quality into the long term.

- *Future Use and Aesthetics* – The site should be compatible with the surrounding lands once reclamation activities have been completed. The selection of reclamation objectives at a project site should consider:
    - naturally occurring bio-physical conditions, including any physical hazards of the area (pre- and post-development);
    - characteristics of the surrounding landscape pre- and post-development;
    - level of ecological productivity and diversity prior to mine development and intended level of ecological productivity and diversity for post-mine closure;
    - local community values and culturally significant attributes of the land;
    - level and scale of environmental impact; and
    - land use of surrounding areas, including the proximity to protected areas, prior to mine development and expected end land use activities for each area on site for humans and wildlife.

Closure goals, specific to the Diavik mine site, have been developed through a process involving DDMI, reviewers and WLWB staff and are listed in Table 2-1. The goals have been designed to be reasonably attainable and specific enough to develop closure objectives.

Table 2-1 Closure Goals – Diavik Mine Site

Goals
1. Land and water that is physically and chemically stable and safe for people, wildlife and aquatic life.
2. Land and water that allows for traditional use.
3. Final landscape guided by traditional knowledge.
4. Final landscape guided by pre-development conditions.
5. Final landscape that is neutral to wildlife – being neither a significant attractant nor significant deterrent relative to pre-development conditions.
6. Maximize northern business opportunities during operations and closure.
7. Develop northern capacities during operations and closure for the benefit of the north, post-closure.
8. Final site conditions that do not require a continuous presence of Mine Staff.

2.3 Closure and Reclamation Planning Team

Closure planning at Diavik is conducted by a multi-discipline, interdepartmental team that has been formally organized as a committee. The committee was established April 9, 2003, three months after production began. The committee's original focus was communicating closure plans and rationale to the operations departments, with the understanding that closure would remain a focus and that operations needed to be fully aware of the current plans. The committee also sought input on ways to improve these plans for both closure success and for operations. Participation on the committee was originally limited to operations and environment departments, and the focus was waste rock segregation and deposition plans for the PKC.

By October 2004 the committee had expanded to include company-wide representation including community affairs, human resources and finance. Currently the committee composition and areas of focus are as follows:

- *Principal Advisor, Sustainable Development* – planning, coordination, internal and external communication, documentation, review and water-related environmental aspects.
- *Superintendent, Workforce Planning* – human resources.
- *Senior Specialist, Closure and Earthworks Engineering* – PKC and general earthworks including construction design, operations planning, engineering investigations, and closure costs estimating.
- *Senior Mine Engineer* – waste rock and ore planning and management.
- *Planner, Water Management* – water management infrastructure.
- *Specialist, Mineral Waste Management* – geochemistry, processed kimberlite investigations, waste rock segregation, test piles research and hydrology.
- *Superintendent, Communities and External Relations* – community engagement, Traditional Knowledge, socio-economics, business and community opportunities.
- *Specialist, Communications* – communications plans.
- *Superintendent, Environment* – monitoring, Traditional Knowledge, wildlife access, hazardous materials, landfill, vegetation research, permits, licenses and communication with Inspector.
- *Principal Advisor, Strategic Planning* – mine planning, closure costs and finance.
- *Manager Underground Mining* – underground mining, planning, design and technical review, and coordination.

Each of the participants on the committee has access to or directly manages additional DDMI staff, expert consultants, researchers and external advisors to assist as required in closure-related activities. External teams include but are not limited to:

- University of Alberta (vegetation, fish habitat, thermal).
- University of Waterloo (geochemistry, oxygen transport, microbiology).
- University of British Columbia (hydrology, water transport).
- Golder Associates Ltd. (Golder) (closure planning, geotechnical, mine and engineering design/investigation, deposition, fish habitat, wildlife, environmental assessment, monitoring, closure cost estimates).
- AMEC Earth and Environmental (geotechnical, engineering design/investigations).
- Rio Tinto Health Safety and Environment (closure planning, communication).
- Diavik Geotechnical Review Board (geotechnical).

The committee is responsible to the Vice President of Finance.

2.4 Community Engagement

Community engagement in closure planning was initiated through general discussions about the Project in June 1995, when only a limited amount of information was available about the size of the kimberlite pipes or the assortment of infrastructure and additional engineering structures required for a future mine. The Project Concepts that formed the basis of these initial discussions with communities are shown in Figure 5-7. Diavik was made aware of several views from the communities:

- land and water are significant to the people of the north;
- potential employment and business opportunities created by the Diavik mine are important to the people of the north;
- concern for compensation from use of the land and water;
- DDMI needs to consult regularly with communities that are potentially affected;
- people are concerned about placing mining material in Lac de Gras, particularly waste;
- people of the north associate mining with chemicals and contamination of water and animals; and
- minimizing the footprint of the proposed mine site would also minimize the environmental effects.

In June 1997, a workshop was held at an exploration camp at the Diavik site to present and discuss a Project Description that had been developed with input from communities. Key design principles that were identified at the workshop and incorporated into the Project Description included:

- consolidate the mine site and locate all components on the East Island;
- locate the PKC within the central depression on the East Island and not in Lac de Gras between the two islands;
- manage water discharged to Lac de Gras; and
- consider aspects of closure in the design of the mine and associated facilities.

Community engagement then proceeded to the Environmental Assessment (EA) and Water Licensing phases. Engagement activities associated with the EA are documented in Canada (1999) and in DDMI (1999a) where closure planning continued to be discussed, including the *Initial Abandonment and Restoration Plan* (DDMI 1999b).

As the mine developed, community engagement was focused on employment, training and environmental monitoring. DDMI regularly engaged with communities through the EMAB and the Diavik Technical Committee (DTC) of the MVLWB. The DTC was involved in the review and recommendation for approval of the *Interim Abandonment and Restoration Plan* (DDMI 2001b). Although there were opportunities for community engagement through the DTC and EMAB, communities provided minimal additional closure input beyond what had been provided from 1995 to 1998.

Closure-specific community engagement was initiated in 2009 to support the development of ICRP V3.2. An on-site workshop with communities in August 2009 assisted with identifying community preferences for wildlife movement at closure. This was followed by a series of community meetings to confirm areas of focus for future engagement relating to the NCRP-WRSA, as well as to identify concerns to be addressed in the ICRP, or through closure research and further community engagement.

A Traditional Knowledge (TK) Panel (TK Panel or 'the Panel') was formed under the Environmental Monitoring Advisory Board for the Diavik Diamond Mine in 2011 and administration of the Panel then transferred to Diavik during the summer of 2013. Membership for the TK Panel is comprised of male and female Elders and youth that are selected by their community organization based on their experience, familiarity and/or interest in the land around the Lac de Gras region. DDMI views the Panel as a body to facilitate appropriate and meaningful accommodation of TK in the planning and review of mine closure options. Similarly, the Panel identifies themselves as a 'standing body' to strengthen the role of Aboriginal TK holders in closure planning. Information and recommendations shared by the Panel are reviewed at the end of each day and each session to ensure accuracy and determine what is appropriate to share publically in the report. Since the Panel was formed, closure of the NCRP-WRSA has been a strong focus for Panel discussions.

During DDMI's work with the TK Panel, both parties identified the need for a model that clearly depicted the post-closure landscape and would assist community members to visualize the site at closure. A 3-dimensional, interactive model was developed and shared with the Panel and communities during NCRP-WRSA closure design engagement sessions in 2016. The model allows the user to toggle between what the mine looks like today, and what it would look like at closure. While the interactive model cannot effectively be shared as a part of this plan, representative screen shots depicting key elements of the NCRP-WRSA closure design have been included in figures within this document to help illustrate some of the concepts discussed.

In addition to the input received by the TK Panel, DDMI met with community representatives from each of the five PA groups to review the NCRP-WRSA Closure Plan. These discussions largely focused on the closure design along with the recommendations and mitigation options previously identified by the TK Panel and DDMI. As per DDMI's Engagement Plan, Diavik staff initiated engagement with community leadership and took their direction on how best to proceed with engagement for their respective organization. Table 2-2 reflects this process and outlines the face-to-face community meetings conducted either at the mine site or in communities. A generic copy of the presentation that DDMI shared to assist with discussions is included as Appendix IX-2. An Engagement Record that aligns with the Engagement Log template in the *MVLWB's Engagement Guidelines for Applicants and Holders of Water Licenses and Land Use Permits* (2014) is also provided in Appendix IX-1 and outlines the date/time, trigger, attendees, location/ engagement type, summary of issues/recommendations raised, DDMI's response and materials provided at each meeting. DDMI followed-up in November 2016 with a letter to each of the communities requesting support to advance this progressive reclamation.

Table 2-2: Community Engagement Summary for NCRP-WRSA Closure Plan, 2016

Date (2016)	Organization	Location
29 August	Tłįchǫ Government Chiefs, Investment Corporation & Staff	Diavik site visit & tour
9 September	EMAB Board & Staff	Yellowknife
15 September	LKDFN Chief & Council, WLEC, Staff	Łutsel K'e
16 September	YKDFN staff	Diavik office
16 September	NSMA President, Board & Staff	NSMA office
21 September	KIA President & Staff	Cambridge Bay
13 October	KIA Staff, HTO, Council	Kugluktuk
14 October	Kugluktuk Hamlet	Kugluktuk
19 October	LKDFN Chief & Council, Staff	Diavik site visit & tour
3 November	YKDFN Chiefs & Staff	Dettah
17 November	YKDFN Elder's Council	N'dilo
18 November	Kwe Beh Working Group (Tłįchǫ)	Yellowknife
29 November	LKDFN Community Meeting	Łutsel K'e

Summary of Community Concerns, Recommendations and Mitigation Methods

The NCRP-WRSA is considered an eyesore for many community and TK Panel members, and their preference has always been to reduce the size of the NCRP-WRSA by putting waste rock back in to the open pits. However, community and TK Panel members have also recognized that this would be very challenging from a financial, logistical, safety and environmental perspective. Therefore, it has been deemed most important for the pile to function well in containing chemicals from entering the environment and to be safe for wildlife using this area in the future. The three main areas of concern identified by TK Panel members and community representatives in relation to the NCRP-WRSA are:

- Safe use for wildlife;
- Chemical stability and control of runoff water; and,
- Aesthetic impact on the landscape.

Section 2 of DDMI's annual closure progress reports provides a detailed summary of past TK Panel discussions. The following section summarizes TK Panel discussions and recommendations relating to closure plans for the NCRP-WRSA, in addition to feedback received during the above-noted engagements. A link to each progress report is also included below.

- 2012 Annual Progress Report - (2012 Annual Progress Report link)
- 2013 Annual Progress Report - (2013 Annual Progress Report link)

- 2014 Annual Progress Report – (2014 Annual Progress Report link)
- 2015 Annual Progress Report - (2015 Annual Progress Report link)

Wildlife Access

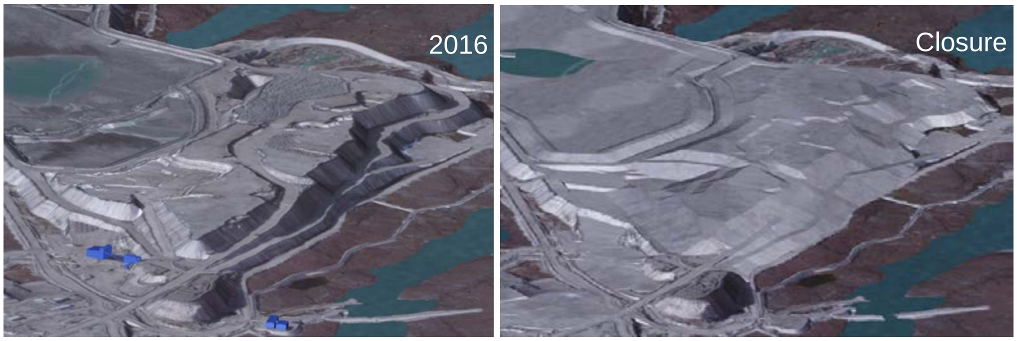
The North Country Rock Pile has always been a part of the mine plan, and the closure plan proposed during the Environmental Assessment is fundamentally the same as the final cover design discussed here. When considering the design of this feature, safe use of the pile for caribou after closure has always been a top concern for community members, as well as for the TK Panel. Many community organizations have raised concerns regarding rock size, slope angles, migration paths and cover material.

Community members have observed that caribou will ultimately go where they want, and elevated surfaces such as eskers are attractive for insect relief and the ability to spot prey. For this reason, it is preferred that safe access and egress are provided for their use, in order to help prevent injuries that could otherwise occur. Based on TK shared by Panel members and discussions with community organizations, the following considerations have been incorporated into the NCRP design to promote safe access for caribou.

Slope

The slope of the pile could be used to promote safe access or help to deter caribou from certain areas, depending on the steepness of the slope and the terrain, and Panel members provided some examples of this based on their experience on the land. The TK Panel regularly meets at the Diavik mine site in order to 'see things with their own eyes' and increase their familiarity and understanding of the site. Similarly, some community organizations have been able to visit the mine site over the years. These individuals have had an opportunity to view or walk the test pile structure that most closely resembles the slope ratio (3H:1V) and cover material that will encapsulate the NCRP-WRSA at closure. After this experience, community members are generally more comfortable with the cover design, recognizing that caribou would be able to safely climb the slopes of the pile. Panel members concluded that slopes created similar to that of the test pile would support safe travel for animals. The photos below show the covered test pile and some TK Panel members walking the slope of the pile.


Some community organizations or representatives may not have had a chance to visit the Diavik site in recent years to view the test pile or the NCRP-WRSA. The 3-D model that was created helped those who couldn't see the site first hand to visualize what the final slope of the pile would look like. An example, viewing the piles north slope, is provided below.



TK Panel members felt that it would be beneficial to have a steeper slope in the area where the NCRP-WRSA connects to the Processed Kimberlite Containment (PKC) area, as there is a strong desire to deter caribou from entering the PKC. The north slope of the NCRP-WRSA is Type III rock so it will be re-sloped to 3H:1V to enable placement of a closure cover. However the final cover slope to the PKC surface is designed to remain at a steeper 1.5H:1V slope (see Appendix X – Drawing 003 – Detail 3). This is the same angle of repose that can be seen on the pile today. DDMI expects this will assist in deterring caribou from entering the PKC, as suggested by the TK Panel. Other possible deterrent options identified by community members, such as the use of large boulders, flags or inuksuit, may be evaluated as a contingency once the cover is complete.

Elders greatly value the natural state of the environment and impacts to natural systems are considered to be negative. However, as caretakers of the land, they have also learned to recognize situations where additional impacts may be required in order to provide safety for animals. TK Panel members were pleased with the amount of natural vegetation that can still be seen at the mine site, and they originally expressed a desire to avoid future impacts to areas where natural vegetation still exists. When discussing closure plans for roads and the NCRP-WRSA, community members recognized that natural vegetation may be lost by pushing out the sides of these structures in order to ease the slope (e.g. NCRP north slope), but most saw this as an overall positive because it allowed safe passage for wildlife.

Caribou Migration and Pathways

Beginning with discussions during the Environmental Assessment for the Diavik mine, the need to create a pathway for safe passage of caribou over the rock pile during their migration has repeatedly been identified. The preference of community and TK Panel members is to align access locations with old migration routes on the north and south east sides of the island, offer multiple areas where caribou can safely move on and off the pile and keep the slope as natural as possible and similar to that of the test pile. According to Panel members and past TK studies, caribou access East Island by swimming along the channel on the north side of the island. The south side of Lac de Gras has jagged rocks where caribou could get injured. The east side of the lake is better; there is a sandbar, muskeg and rocks and its good for caribou migration.

Caribou pathways included in the NCRP-WRSA Final Closure Design align with the general recommendations of the TK Panel participants. Access areas for these pathways would be less steep than the 3H:1V slope on adjacent areas of the pile, thereby providing the easiest option for use by caribou. Similar to TK Panel recommendations, community members also commonly identified the need for a pathway over the pile that would provide a safe route for caribou. An image from the 3-D model that shows the caribou pathways on the NCRP has been shared with communities and is also included below.

Cover Materials and Barriers

TK Panel and community members have continually noted that caribou are the most important species to look after and that they must be respected. Caribou are sensitive about their feet (hooves) and knowledge passed down over generations tells that it is important to make sure that any areas where caribou travel are clean and free of debris so that their feet are well taken care of. When dumping waste rock onto the NCRP, the largest boulders inherently fall to the bottom of the slope. Community members have repeatedly noted that these are viewed as a risk to caribou health and may prevent safe access onto the pile after closure. The placement and leveling of the closure cover will largely remove this hazard and create a surface similar to that of the covered test pile, which has been recognized as acceptable and safe for caribou use. Additionally, the designated pathway access areas that align with old migration routes would be free of any such obstacles and allow for safe caribou movement on and off the pile.

Other Wildlife

Community members feel that if caribou are taken care of, other species will also be protected; hence, there has been limited discussion of other wildlife.

TK Panel members recommended that DDMI study the potential for wind and snow accumulation that could potentially impede movement on caribou ramps/pathways, as well as on the top of the NCRP, during the spring migration. Further, there was also a recommendation relating to the PKC that identified a desire to have some areas of the dam remain steep in order to encourage snow accumulation for wolverine and other denning wildlife (e.g. wolf, bear, fox, ground squirrel, etc.). The NCRP-WRSA Closure Plan provides such an area along the south face where it ties in with the PKC (see Appendix X – Drawing 003 – Detail 3). A summary of the risks and recommendations provided by community members and the TK Panel is provided in Table 2-3.

Table 2-3: Summary of Community Risks/Recommendations Relating to Caribou and Wildlife

Risks/Recommendations	**Concerned Parties**	**How Addressed in NCRP-WRSA Final Closure Design**
Support safe travel for animals; e.g. create slopes on the rock pile similar to that on the covered test pile	TK Panel LKDFN YKDFN NSMA Tłįchǫ Government	Re-shaping of the pile, final 3H:1V slope in most areas of the pile, caribou pathways, placement and levelling of cover
Create safe passageways for caribou over the rock pile and through the site following their old migration routes on the north and southeast sides; ensure that any caribou trails are clean and clear of debris; recognizing that caribou may return, provide areas of materials that are good for caribou feet so that they may pass over the reclaimed site	TK Panel LKDFN YKDFN KIA NSMA Tłįchǫ Government	Caribou pathways, pathway location determined in consultation with TK Panel and shared with communities, slope and exposure of pile should help to promote clear paths for caribou use
Create barriers between the rock pile and PKC to discourage animals from going into the PKC area; use traditional techniques (e.g. flags, trees, inuksuit) to keep caribou away from areas that are unsafe	TK Panel	Engineered cover slope of 1.5H:1V adjacent to PKC, consideration of additional deterrents would only be considered as a contingency, once the cover is complete

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Protect natural vegetation areas that exist on the Island, with the exception of future closure work that involves covering natural vegetation in order to flatten slopes for safe wildlife passage	TK Panel	Some areas of natural vegetation will be lost as the pile footprint expands in order to reduce steepness of slopes
Use fine crushed rock on passage-ways to protect the feet of the caribou	TK Panel YKDFN LKDFN Tłįchǫ Government	Placement and levelling of cover will create surface similar to covered test pile, which has been identified as safe for caribou use; placement of additional materials on caribou pathways would only be considered as a contingency, once the cover is complete
Leave some areas steep to encourage snow accumulation for wolverine and other denning wildlife (e.g. wolf, bear, fox, ground squirrel, etc.)	TK Panel	Engineered cover slope of 1.5H:1V adjacent to PKC
A limited number of large boulders (e.g. 3-4) should be placed on top of the NCRP to provide some shade for caribou, create habitat for small mammals and encourage natural re-vegetation	TK Panel	Placement of additional materials on the pile would only be considered once the cover is complete
Study the wind and snow accumulation on caribou ramps/trails as well as the top of the NCRP before finishing/ finalizing the sloping and grading of the NCRP	TK Panel	Expect winds to create some snow accumulation along the east face and promote deposition along the west side of the pile.
Ensure that TK/IQ knowledge that has been shared in the past is incorporated into future planning, specifically in relation to caribou	TK Panel	The work of the TK Panel has been very effective at capturing Traditional Knowledge and developing valuable recommendations to guide closure planning at Diavik

<u>Seepage Water and Snow Accumulation/Melt</u>

As stated earlier, one of the top concerns that TK Panel members have is chemicals seeping from the NCRP into the lake, or being ingested by wildlife drinking the water; community members echoed these concerns. The closure cover is the primary mitigation for chemical stability however the TK Panel has additional recommendations related to water that are included in the NCRP Final Closure Design.

The TK Panel prefers that the NCRP be designed to prevent water from pooling on top of the rock pile. Based on their observations on the land, once a small pool of water forms in an area, it gets bigger and becomes a pond or lake that attracts animals. Because the Panel is concerned with the quality of water within or flowing from the pile, there is concern for the health of caribou and other wildlife if they were to drink this water. DDMI also prefers not to have water pooling on the surface of the pile. The top and slopes of the NCRP are designed at a gradient intended to prevent a significant volume of standing water.

Additionally, Panel members recognize that snow cover conditions also need to be considered in the NCRP design. Prevailing winter winds (which the TK Panel identifies as being from the northeast) should result in a smooth snow cover on top of the pile, and snow would drop down and collect on the leeward side of the pile. It was noted that a means to capture runoff from melting snow during freshet would need to be considered for this area. This recommendation aligns with additional water management guidance from the Panel, as outlined in the following section.

The Panel recognizes the healing power of nature, and prefers that seepage and runoff water from the NCRP travels through seepage ponds and wetlands for as long a distance as possible prior to entering Lac de Gras. Based on Elder's experience on the land, they know that eskers have cold water flowing out of them, because of the permafrost within the esker. Panel members expect the same thing to occur at the NCRP as the permafrost builds up within the pile over the years and seasonal thaw zones release water to the environment. The Panel recommended having a 'moat' around the rock pile as a way of being able to contain and monitor the water that is coming out, and off of the pile. A series of engineered ponds (Pond1, Pond 2 and Pond 3) currently surround the NCRP. They will remain as NCRP collection ponds until it can be confirmed that NCRP runoff/seepage is of adequate quality to be released to Lac de Gras. At this time the concept would be to construct outlets in the ponds such that they would still function as settling ponds but then would naturally drain to Lac de Gras. The final closure designs for Ponds 1-3 is not included in the NCRP Final Closure Design (see Exclude Areas below). TK Panel and community recommendations relating to NCRP water and seepage management and quality are included in Table 2-4.

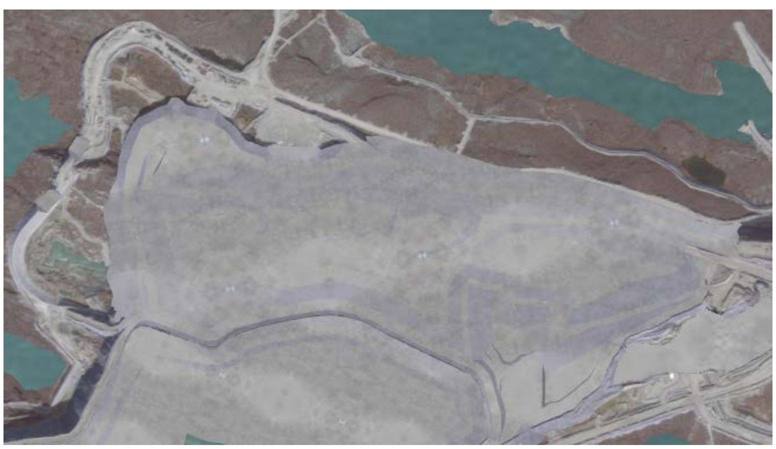


Table 2-4: Summary of Community Risks/Recommendations Relating to Water/Seepage

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Ensure a gradual slope on the top of the NCRP so that there is a slight dome down the centre	TK Panel LKDFN	Design and re-shaping of the pile, placement and levelling of the cover

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Focus water quality monitoring on the NCRP; monitor and test the seepage water regularly	TK Panel NSMA	Regular inspections and monitoring of seepage is planned (refer to Section 5.2.3.7)
Have a 'moat' around the rock pile as a way of being able to contain and monitor the water that is coming out of the pile; channel water flow to prevent contaminants from reaching Lac de Gras.	TK Panel	Areas currently referred to as Ponds 1, 2 and 3 will remain as settling ponds to capture NCRP runoff, with outlet streams that allow for natural drainage and filtration en route to Lac de Gras
Do not allow water to pool on top of the rock pile	TK Panel	Design and re-shaping of the pile, placement and levelling of the cover to include a slight dome down the centre
Keep the rock pile height as low as possible while ensuring that contaminants within the Type II and III rock areas are contained	TK Panel YKDFN NSMA	Current pile height would not be lowered; a 1.5 m till layer and 3 m rock layer will be added to pile; volumes are sufficient to contain Type II and III materials
Experiment with different types of wetlands for filtering water that collects at the base of the rock pile	TK Panel	Final closure designs for Ponds 1-3 is not included in the NCRP Final Closure Design (see Exclude Areas below)
Ensure long term scientific monitoring of NCRP to determine if it remains frozen and stable	TK Panel YKDFN NSMA KIA	Long-term monitoring to include visual inspections/surveys as well as thermal and stability monitoring
Seasonality of monitoring must be taken into consideration when planning for post-closure monitoring; monitor water more in late May and early June as these are critical times (i.e. melt)	TK Panel	Regular inspections and monitoring of seepage is planned, and includes more frequent events during freshet (refer to Section 5.2.3.7)
Sample the water frequently and watch for wildlife using the water (drinking). If wildlife avoid water, there could be a concern about the water quality.	TK Panel	Regular inspections and monitoring of seepage is planned (refer to Section 5.2.3.7)
How to incorporate results from test piles seepage research and NCRP current performance into design and/or determination of water quality criteria for NCRP?	YKDFN LKDFN NSMA	Research data have been incorporated into models as a way to scale predictions accordingly for expected performance of the NCRP; closure water quality criteria were derived from these results

Visual/Aesthetic

Traditional stewardship means leaving things as natural as possible. A principal consideration for the form of the NCRP at closure was to imitate the effects of glaciers and prevailing winds on the surrounding landscape and create a pile that mimics the shape of an esker, as much as possible. TK Panel members identified the following requirements that would meet that vision:

- a flat top with berms removed and rounded edges so that caribou can walk safely with fewer places for predators to hide;
- sloping the sides so they are less steep (similar to the covered test pile) and have varying levels of steepness around the pile;
- remove big boulders at the bottom of the pile as wildlife will likely get injured trying to walk over them; and
- the most gradual slope on the north side, as this will be the area for wildlife and people to access the top.

With the exception of the PKC tie-in zone, all of the slopes planned for the NCRP at closure are 3H:1V, similar to the test pile. However, in keeping with Panel recommendations, the north side of the pile will be pushed out past the current airport road and will have some bench areas along the slope that would serve to simulate varying levels of steepness and reduce the effort required for an animal to climb the slope. The berms on top of the NCRP will be removed, as will those around the edge of the pile, so that the edges appear to be rounded with a relatively flat top.

TK Panel members desire to see the land returned to a state that resembles how it looked prior to development is a primary factor guiding their recommendations. Other communities have identified similar concerns, noting that the existence of the pile eliminates what was once useful habitat. A summary of recommendations relating to visual/aesthetic considerations for the NCRP is provided in Table 2-5. While it is acknowledged that the mine site area will never be the same again, efforts to reclaim an area in a way that resembles natural features is preferred. The Panel also recommended using nearby hills as a reference for the material to be used to cover the rock pile. It is not practical to simulate the natural environment on the NCRP. The final design is to use available mine materials, thereby reducing further impacts to the environment during reclamation. Similar materials and methods used to cover the test pile will be utilized for the NCRP and Panel and community members seem satisfied with the look of the test pile.

Table 2-5: Summary of Community Risks/Recommendations Relating to Aesthetics

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Simulate an esker when considering the final shape of the rock pile; this includes: flat top with berms removed and rounded edges so that caribou can walk safely with fewer places for predators to hide, sloping the sides so they are less steep (similar to the test pile) and have varying levels of steepness, remove big boulders at the bottom of the pile as wildlife will likely get injured trying to walk over them, most gradual slope on north side as this will be the area for wildlife and people to access the top	TK Panel Tłįchǫ Government	Design and re-shaping of the pile, final 3H:1V slope in most areas of the pile, caribou pathways, placement and levelling of cover
Cap the rock pile with the best materials for biodiversity based on TK and science, using nearby hills as a reference	TK Panel	Material availability is an important aspect of closure planning; Diavik's preference is to use materials available at the mine site, without having to disturb other areas; mine rock and till will be the materials available in greatest supply and these are currently being considered for use in capping the rock pile
NCRP eliminates previously useful habitat for wildlife and/or traditional use	YKDFN	Development and closure design concepts for the NCRP were discussed and approved during the Environmental Assessment

Other

In addition to the three key areas of concern that were identified by community members - safe use for wildlife, chemical stability/control of runoff water and aesthetic impact on the landscape - there were some additional concerns and recommendations that were discussed. The TK Panel and some community organizations were interested in the re-vegetation plans for the NCRP-WRSA. Respect for the land includes respecting natural systems and processes. Community members recognize that things grow slowly in the north, but that over time the area should heal. They also know that humans do not control nature; however, some Panel members believe that where nature has been disrupted, some steps may need to be taken to help with healing and create conditions to allow re-growth. The Panel recommended that the area around the ponds at the base of the NCRP be considered for re-vegetation, while allowing the remainder of the pile to re-vegetate naturally. They recommended considering the use of native shrubs such as dwarf birch and willow. Other community organizations asked about the Panel's recommendations and one community noted a particular interest in passively or actively re-vegetating the whole pile; they considered the pile to be effectively useless to caribou, were it to be left without vegetation.

Reclamation plans for the NCRP cover have never included re-vegetation of the pile and the TK Panel seems to support this approach. DDMI does not plan to re-vegetate the NCRP at closure and believes that re-vegetation efforts would be more effective in other areas.

Considering and planning for climate change in relation to the design and performance of the pile was also a key concern for community members and the TK Panel. Community members want to be sure that the pile will remain chemically and physically stable despite the changing temperature and precipitation trends that have been observed, and are expected to continue in the North. Accepted climate change scenarios have been applied in the planning models and incorporated into the design and construction decisions for site infrastructure, including the long-term performance and monitoring plans of the NCRP after closure.

Community organizations were also interested in various socio-economic considerations relating to the closure plan for the NCRP and the timeline in which it is carried out. Contracting, employment and training opportunities were of primary interest. DDMI provided information on anticipated project requirements and timelines, and is encouraged by some of the developing business interests in communities, such as the provision of native seeds for re-vegetation. A summary of additional items that the TK Panel and communities considered is included in Table 2-6.

Table 2-6: Summary of Community Risks/Recommendations for Miscellaneous Items

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Some re-vegetation should be planned for the rock pile.	TK Panel Tłįchǫ Government KIA YKDFN LKDFN	The current closure plan does not account for re-vegetation on the rock pile; re-vegetation priorities for DDMI are still plant site, laydowns and roads
Re-vegetate the base of the NCRP around the ponds; consider use of good, black soil from the tundra or other eskers in the area; plant native shrubs such as dwarf birch and willow in the soil near the bottom and allow the remainder to re-vegetate naturally	TK Panel	Final closure designs for Ponds 1-3 is not included in the NCRP Final Closure Design (see Exclude Areas below); harvesting soils from outside the mine footprint is not being considered
Closure plans for the NCRP should include passive or active re-vegetation	YKDFN	The current closure plan does not account for re-vegetation on the rock pile; re-vegetation priorities for DDMI remain as plant site, laydowns and roads
Plan for climate change hundreds of years into the future	TK Panel YKDFN KIA	Accepted climate change scenarios have been incorporated in to the planning models that guide design and construction decisions for site infrastructure; this includes planning for long-term performance after closure

Risks/Recommendations	Concerned Parties	How Addressed in NCRP-WRSA Final Closure Design
Contracting/employment/training opportunities and timeline of work required to close pile	Tłįchǫ Government KIA LKDFN	DDMI provided project timeline to guide as outlined in Section 8.
Burying materials in the open pits instead of in the NCRP	LKDFN	DDMI noted that buried materials in the approved inert landfill within the NCRP would not be removed; additional materials could be considered for disposal in the open pits or underground at closure

2.5 Closure Plan Requirements

2.5.1 Guidelines and Regulations

This Plan is intended to generally conform with the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* (MVLWB/AANDC 2013) specifically pages 24/25. Exceptions are noted with rationale.

This Plan follows other regulatory guidelines, the principles of which are described in:

- Indian and Northern Affairs Canada (INAC) *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007a); and
- Indian and Northern Affairs Canada *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002).

This Plan is also subject to several Federal and Territorial Acts and Regulations which are listed in Table 2-7.

Table 2-7 Relevant Federal and Territorial Acts and Regulations

Federal Acts and Regulations	Territorial Acts and Regulations
Arctic Waters Pollution Prevention Act and Regulations	*Commissioner's Lands Act* and Regulations
Canadian Environmental Assessment Act and Regulations	*Environmental Protection Act* and Regulations
Canadian Environmental Protection Act and Regulations	*Environmental Rights Act* and Regulations
Fisheries Act and Regulations	*Mine Health and Safety Act* and Regulations
Mackenzie Valley Resource Management Act and Regulations	*Science Act* and Regulations
Navigable Water Protection Act and Regulations	
Northwest Territories Waters Act and Regulations	
Territorial Lands Act and Regulations	
Transportation of Dangerous Goods Act and Regulations	

2.5.2 Permits and Authorizations

The Diavik Diamond Mine received ministerial approval under the *Canadian Environmental Assessment Act* on November 1999 based on a Comprehensive Study Report (Canada 1999). On March 3, 2000, DDMI signed an Environmental Agreement with parties including the Federal Government, the Government of the Northwest Territories, and First Nations.

2.5.2.1 Comprehensive Study Report Conclusions

Initial plans for closure were considered in the Environmental Assessment for the Project as documented in DDMI (1998d) and Canada (1999). These initial plans for closure are summarized in Section 5 if ICRP V3.2 as are conclusions, relevant to closure from Canada (1999) that DDMI understood to be for consideration in the regulatory phase (Land Leases, Water License, Fisheries Authorization).

Where follow-up programs with environmental aspects are not within the jurisdiction of a specific permit, license or authorization, Canada (1999) determined that it would be included in an environmental agreement. On March 8, 2000 an Environmental Agreement was established. Article XV – Security and Enforcement – of the Environmental Agreement specifies the terms and conditions regarding financial securities held by the INAC Minister for the performance by DDMI of its reclamation and abandonment obligations under the Water License, Land Lease and any other obligations for which the INAC Minister is responsible. All other environmental aspects of closure are specifically included in the terms and conditions of the regulatory instruments listed in Table 2-8 and described below.

On March 31, 2000, the Federal Government issued DDMI 30-year land leases for the mine site (all expire March 29, 2030) under the *Territorial Lands Act*. In August 2000, a Class "A" Water Licence (successfully renewed in 2007 and expires November 2015) was granted under the *Mackenzie Valley Resource Management Act*, various fisheries authorizations were granted under the *Fisheries Act*, and a Navigable Waters Permit (expires August 2030) was issued under the *Navigable Water Protection Act*. Energy, Mines, and Resources Canada issued an Explosives Permit (renewed annually with no expiry) in December 1999.

A summary of all potential permits required and existing authorizations held by jurisdiction for closure are listed in Table 2-8.

Table 2-8 List of Permits and Authorizations

List of Existing Permits, Authorizations and Agreements	Responsible Authority
Water Licence W2015L2-0001	Wek'èezhìi Land and Water Board
Fisheries Authorization	Fisheries and Oceans Canada
Navigable Waters Permit	Transportation Canada
Explosives Permit	Natural Resources Canada
Land Lease	Indian and Northern Affairs Canada

2.5.2.2 Water Licence Requirements

The water license for the Diavik Diamond Mine (Class "A" Water Licence W2015L2-0001) sets out several conditions with respect to DDMI's right to alter, divert or otherwise use water for the purpose of mining. Specifically, Part K: Conditions Applying to Closure and Reclamation specifies that:

a) DDMI shall implement the implement the **Closure and Reclamation Plan** as approved by the Board and endeavour to carry out Progressive Reclamation as soon as is reasonably practicable; and

b) DDMI shall submit a Final Closure and Reclamation Plan to the Board for approval three (3) years prior to the expiry date of this Licence or a minimum of twenty-four (24) months prior to the end of commercial operations, whichever occurs first.

Part F, Item 4 of Water License W2015L2-0001 also requires that :

- At least forty-five (45) days prior to the start of Construction of any Dams, dikes, or structures intended to contain, withhold, divert or retain water or Wastes, the Licensee shall submit to the Board for approval, design drawings stamped by a Geotechnical Engineer.

DDMI submitted design drawings for the North Country Rock Final Closure Design on January 21, 2016.

2.5.2.3 Fisheries and Oceans Canada Authorization Requirements

The Diavik Diamond Mine is subject to the Authorization for Works or Undertakings Affecting Fish Habitat File No SC98001 ("Fisheries Authorization") issued by Fisheries and Oceans Canada (DFO 2000). The Fisheries Authorization outlines reporting requirements and approvals, compensation requirements for the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat, and requirements for compensation plans. DDMI must also produce monitoring plans to determine the effectiveness of all fish habitat enhancement and development efforts. There are no fish habitat enhancement or development efforts directly related to this NCRP Closure Design

2.5.2.4 Land Lease Requirements

The Diavik Diamond Mine operates under a set of five Land Leases covering the mine footprint area on the East Island. Conditions specified within the Land Lease relevant to closure include:

- Submission of a plan of restoration within 2 years of commencement of the lease with the objective of restoring the land as near as possible to its original state, including the removal of all buildings and structures, or such alternative objectives as may be approved by the Minister.
- The plan of restoration should be based on new information and technology as well as regulatory requirements so that the Project will be abandoned incrementally, in a manner consistent with sustainable development.
- Undertake ongoing restoration during the term of the lease in accordance with the approved plan of restoration.
- Requirements for security deposits.
- Dispose of all combustible garbage and debris by burning in an incinerator and all non-combustible garbage and debris by removal to an authorized dump site. Shall not deposit any waste materials in any body of water or the bed or banks thereof which will in the opinion of the Minister impair the quality of the waters or the natural environment.

2.5.2.5 Navigable Waters Permit Requirements

The Navigable Waters Permit (DFO Canadian Coast Guard 2000) does not contain requirements for closure of the NCRP.

2.5.2.6 Explosives Permit Requirements

The Explosives Permit does not contain requirements for closure of the NCRP.

3. Project Environment

Section 3 of ICRP V3.2 provides descriptions and references for the pre-disturbance environment of the mine site area. More detailed description of the baseline conditions can be found in the *Integrated Environmental and Socio-Economic Baseline Report* (DDMI 1998a.

Any existing or pre-disturbance information that has been used directly in the design of the NCRP Closure that is different from or in addition to Section 3 of ICRP V3.2; is appropriately referenced.

4. Project Description

4.1 Location and Access

The Diavik Diamond Mine is located on East Island, a 17 km^2 island in Lac de Gras, NWT, approximately 300 km northeast of Yellowknife (64º31' North, 110º 20' West) (Figure 2-1). The area is remote, and major freight is trucked over a seasonal winter road from Yellowknife. Worker access is by aircraft.

The Diavik Diamond Mine involves mining of four diamond-bearing kimberlite pipes. The pipes, designated as A154North, A154South, A418 and A21, are located directly off shore of East Island (Figure 2-2). All mining, diamond recovery, support activities and infrastructure are located on the East Island.

In total the mine site at full development was expected to have a footprint of 12.76 km^2. The mine footprint at the end of 2015 was 11 km^2.

4.2 Site History

The Diavik Diamond Mine is an unincorporated joint venture established by DDMI and DDC to develop a diamond mine at Lac de Gras, in the NWT of Canada.

Overall, DDMI and DDC have a mineral claim to an area that includes portions of Lac de Gras, the East and West islands, and portions of the mainland to the southeast and northwest. Lac de Gras is about 100 km north of the tree line in the central barren ground tundra of the NWT, at the headwaters of the Coppermine River. This river, which flows north to the Arctic Ocean east of Kugluktuk, is 520 km long and has a drainage area of approximately 50,800 km^2.

Aber Resources Ltd. began staking mineral claims in the Lac de Gras area of the Mackenzie Mining District, NWT, in November 1991. Through an option agreement dated June 1, 1992, Kennecott Canada Inc. ("Kennecott") acquired the right to earn a 60% Joint Venture interest in the Diavik claim blocks of Aber Resources Ltd. Kennecott exercised its rights under the option agreement following the discovery of the four diamond-bearing kimberlite pipes immediately off the eastern shore of East Island. The Joint Venture was consummated on March 23, 1995 with Kennecott initially appointed as Manager. Kennecott assigned its rights and interests to DDMI on November 29, 1996.

On the basis of a Feasibility Study completed in July 1999, DDMI and DDC began actively proceeding with implementation of the Project. The Diavik Diamonds Project Environmental Agreement documents were formally submitted to the Federal Government in September 1998, and in early November 1999 the Federal Minister of the Environment approved the Diavik Diamonds Project for permitting and licensing. On March 8 2000, the EA was signed and the Department of Indian Affairs and Northern Development (DIAND), now Indian and Northern Affairs Canada (INAC), issued permits to allow DDMI to begin construction activities.

The Diavik Diamond Mine started production in January 2003 producing approximately 3.8 million carats in 2003. Full production began in 2004 with a production target of 7 to 8 million carats. It is expected that the mine will produce approximately 107 million carats of diamonds over a 16 to 22 year mine life.

A historical summary of Project milestones leading to the start of production is provided in Table 4-1.

Table 4-1 Project Milestones

Date	Milestone
1991 to 1992	Aber stakes mineral claims
March 1992	Exploration begins
June 1992	Aber Resources forms joint venture with Kennecott Canada Exploration
1994 to 1995	Pipes A21, A154North, A154South and A418 discovered
February 1996	75-person exploration camp erected on-site
July 1996	5,900 metric tonne bulk sampling of A418 and A154S pipes completed
November 1996	Diavik Diamond Mines Inc. created, with head office in Yellowknife
March 1997	Bulk sample transported over the winter road to Yellowknife for processing. Approximately 21,000 carats of diamonds discovered
June 1997	Environmental baseline studies completed
September 1997	Pre-feasibility study completed
March 1998	Project description submitted to Federal Government triggering formal environmental assessment review under *Canadian Environmental Assessment Act*
September 1998	Environmental Assessment Report submitted and Comprehensive Public Involvement Plan initiated
November 1999	Federal Government approves project for permitting and licensing
September 2000	All necessary permits and licenses required to bring mine into production received
December 2000	Investor approvals to build the mine received
January 2001	Mine construction begins
October 2001	Earthworks for the A154 dike completed
July 2002	A154 dike complete and dewatering begins
December 2002	Mine infrastructure construction virtually complete
January 2003	Start of diamond production

4.3 Site Geology

The Lac de Gras RSA is located in the central part of the Slave Geological Province of the Precambrian Shield.

The surface expression of East Island is controlled by bedrock, with bedrock outcrops occurring over about 40% of the surface of the island. The bedrock geology of the island is dominated by granitic rock, with volcanic rocks such as diabase present as dikes in small proportions (Figure 3-6).

The Diavik diamond deposits occur as kimberlite pipes intruding in the granitic country rock located under Lac de Gras adjacent to East Island. Kimberlite ore is found in four pipes located under Lac de Gras just offshore of East Island; A154N and A154S (collectively identified as "A154"), A418 and A21 (Figure 2-2). The kimberlite pipes are the roots of relatively young volcanoes dated at approximately 55 million years old. The host rocks are ancient Precambrian granites and metamorphosed sedimentary rocks that are approximately 2 billion years old. Material within the kimberlite pipes comprises three broad classes: hypabyssal kimberlite, volcanic and epiclastic kimberlite and xenoliths. Volumetrically the kimberlite pipes are dominated by volcaniclastic and epiclastic material, often with a significant xenolithic component. The hypabyssal phases are volumetrically less significant, occurring as feeders to the pipes at deeper levels and as contact intrusions along the pipe margins.

Glacial till is the dominant surficial material on East Island, and overlies most of the bedrock. Glaciofluvial deposits are in the form of eskers and kames, and are most common on the north end of the island. Glaciolacustrine deposits occur mainly in lowland areas, and organic deposits typically overlie glaciolacustrine deposits near the lake shore. Shallow (less than 1 m) organic deposits typically have large stones exposed at the surface.

All of the soils that have developed on East Island are cryosols which have been influenced by varying degrees of cryoturbation. There are also numerous solifluction lobes on East Island. These lobes typically occur on slopes ranging from 10 to 25%, although they may occur on slopes as shallow as 2%.

Lake bottom sediments consist of a layer of organic-rich lake silts and clays underlain by bouldery glacial till. The organic silts and clays vary in thickness from 5 to 8 m and the underlying till may reach a thickness of between 20 m and 30 m.

4.4 Mine Plan

A mine plan describes the method and sequence for extracting the kimberlite resource from the ground. A broad range of mining methods was initially evaluated including both conventional and non-conventional methods. Non-conventional methods included jet boring, raise boring, blind drilling and dredging. Conventional methods included open-pit and underground mining methods. DDMI did not advance any non-conventional mining methods beyond the initial studies because, in general, they were experimental and found to have an unacceptably high level of technical and economic risk to be used as the basis for a comprehensive mine plan.

Three options based on conventional mining approaches were developed:

- *All underground* – Mining would advance from underground only. Declines or shafts would be developed to gain access to underground workings. A layer of kimberlite (referred to as a crown pillar, about 100 m thick) would be left in the top of the kimberlite pipe to separate the underground workings from the water of Lac de Gras. Lac de Gras would be immediately above the active mine. Water retention dikes are not a part of this alternative.

- *Underground with open pit crown pillar* – Underground mining would advance the same way as Option 1. Additionally, open-pit mining would be used to mine to a depth of 100 m. Three water retention dikes would be constructed and water removed from the open-pit areas.
- *Open pit and underground* – Open-pit mining would be used to mine the kimberlite pipes to an elevation of 190 m (A418), 130 m for A154S, 265 m for A154N and 220 m for A21. At these depths it would become economical to shift to underground mining in A154S/N and A418. Three water retention dikes would be constructed and water removed from the open-pit areas.

One of the clear advantages with Option 1 was that dike construction in Lac de Gras would not be required. Option 1 would eliminate any effects on fish habitat and water quality associated with the dikes and their construction. However, because the health and safety of workers is of primary importance to DDMI, it was determined that it would be cost prohibitive and may not be technically possible to achieve a satisfactory level of safety for an all underground alternative without a dike.

Underground mining displaces less waste rock than open-pit mining. Although both Options 2 and 3 would require storage areas on the East Island for waste rock, the storage area for Option 2 would be less than Option 3.

Communities have consistently described the importance of using resources wisely. Whereas their comments usually referred to the use of land and water, concerns were also expressed about the use of mineral resources. Communities requested that if the natural environment of the East Island is to be disturbed to recover diamonds, that DDMI maximize resource recovery and not just take the best parts. Option 3 would be the alternative that comes closest to matching this community value.

From a diamond recovery perspective, Option 3 produces the most diamonds. Based on estimated capital, operating costs and the value of diamonds produced, it was determined that the mine would not be economically viable without water retention dikes and removal of water from above the crown pillar.

With the removal of the water, the most attractive method of mining was a larger open pit followed by underground mining in the later years. From an economic perspective, Option 3 was preferred because it resulted in the lowest overall operating cost per carat recovered and was therefore the most financially robust. Option 3 was clearly the preferred option based on healthy, safety, environment, community and business considerations.

The final decision from the EA was to proceed with Option 3, a mine plan that involved water retention dikes with open-pit mining and underground mining. It was noted that mine planning is an ongoing process and that alternate mining technologies should be re-evaluated periodically, including alternative or emerging technologies to recover currently uneconomic resources (Canada 1999). The Water License and Land Leases are based on dewatering a portion of Lac de Gras for the purpose of mining the A154 North and South, A418 and A21 kimberlite pipes, as per Option 3.

The current mine plan utilizes two open pits for initial access to the A154N, A154S and A418 kimberlite pipes, and then underground mining to access the lower portions of the kimberlite pipes. A21 mining is open pit only.

4.4.1 A154 and A418 Mine Plans

The diamondiferous kimberlite pipes in the current mine plan are located near the shoreline of East Island and are surrounded by granitic country rock. The proximity of the pipes to the surface allows for economic ore extraction by open-pit mining behind water retention dikes. At greater depths the ore will be mined by underground mining methods, subject to economics. The location of these mines is shown in Figure 2-2.

4.4.2 A21 Mine Plan

DDMI determined in 2014 that the A21 kimberlite pipe could be mined economically using a dike open-pit mining method. A21 dike construction commenced in July 2015. First ore is expected early in 2018. The A21 mine is expected to remove 27 million tonnes of Type I (non-PAG) waste rock and 6 million tonnes of till to access 3.7 million tonnes of kimberlite. A separate South Country Rock and Till Storage area is being designed for the waste rock and till from A21. A pipeline has been constructed to carry up to 30,000 m^3/d of construction or operations water from A21 to the North Inlet for treatment and discharge to Lac de Gras. The location of this mine is shown in Figure 2-2

4.4.3 Waste Rock

The waste rock mined to access the A154 and A418 kimberlite ore is generally granitic in nature with small amounts of pegmatite, diabase and biotite schist lithologies. The granite, pegmatite and diabase rocks which account for approximately 80% to 90% of the total rock mass are generally non-reactive with very low sulphur levels and adequate alkalinity to neutralize any potential reaction (DDMI 2011).

Waste rock and till from the A154 and A418 open pits were placed on the north side of the island in a designated storage area. Waste rock was segregated by sulphur content (Table 4-2).

Table 4-2 Waste Rock Classification

Waste Rock Classification	Criteria (Total Sulphur in wt%)	Description
Type I	<0.04 wt%S	Predominantly granites Considered non acid-generating ("clean") waste rock suitable for construction material
Type II	0.04 wt%S to 0.08 wt%S	Granites with little biotite schist Considered intermediate or mixed rock with low acid-generating potential
Type III	>0.08 wt%S	Granites containing some amount of biotite schist Considered potentially acid-generating

Notes: wt% = percent by weight; S = sulphur; > = greater than.

A drainage collection system is in place around the waste rock and till area. Pond 1 is located on the southeast side and collects any runoff or seepage from the Type I rock and till area. Pond 3 is located on the southwest corner of the waste rock area and collects any runoff and seepage from the Type III rock placed in the south and southwest corner. Pond 2 on the northwest corner collects seepage and runoff from mixed Type I and Type II storage areas (Figure 2-2).

Type I rock is reserved for construction material including roads, laydowns, most of the PKC dams and the A21 dike. Surplus Type I rock was placed in the NCRP. Currently Type I waste rock production from the underground mine development is less than required for ongoing construction (primarily due to A21 dike requirements). Shortfalls are re-mined from the NCRP. Type III rock was placed in the NCRP in designated drainage areas (Figure 5-8) with some used for the North PKC Dam construction and a small toe buttress underwater in the A21 dike. Currently Type III rock is used for underground backfill, North PKC Dam construction or if there is a temporary surplus, stored near the crusher for future underground backfill. The volume of Type II rock produced in the open pit was very low and is dumped within the Type III rock areas. Drawing 002 Appendix X shows the extent of Type II/III rock within the NCRP.

The estimated amounts of the waste rock and till produced by the A154 and A418 open-pit and underground mines to December 2015 are given in Table 4-3A.

At the completion of open-pit mining in July 2012 the waste rock and till areas were at the maximum size. The expected maximum elevation for the waste rock pile is around 500 m (about 85 m above the level of Lac de Gras). By 2012 the area contained about 140 Mt of waste rock and 4.5 Mt of till.

After July 2012 waste rock was only be produced from the underground operations. Total waste rock production from 2016 for the remainder of the underground mine life is estimated to be less than 5 Mt, with an estimated 40% Type I and 60% Type III.

Waste rock from the A21 open pit is all Type I material. The A21 mine is expected to remove 27 million tonnes of Type I (non-PAG) waste rock and 6 million tonnes of till. Once mining commences in A21 (2018) the rock and till produced will become the preferred source for ongoing construction and reclamation. Any surplus rock and till will be stored in a South Country Rock and Till Storage Area on the south part of the island in an area that is currently in the process of being finalized.

Table 4-3B provides current estimates of operational waste rock requirements from 2016 to the end of the mine life. Waste rock produced either A21 or underground would be used depending on timing and rock type required.

Table 4-3A A154-A418 Open Pit and Underground Till and Waste Rock Production to December 2015

Year	Till (Mt)	Type I (Mt)	Type II (Mt)	Type III (Mt)	Total Tonnage (Mt)
2002	6.78	1.17	0.13	1.09	9.17
2003	5.64	6.76	2.25	10.87	25.52
2004	1.27	9.65	4.16	14.92	30.00
2005	0.00	11.88	2.33	12.90	27.11
2006	0.00	12.04	3.07	8.42	23.53
2007	4.29	10.88	2.20	5.27	22.64
2008	1.67	15.86	0.64	3.71	21.88
2009	0.00	16.26	1.11	5.99	23.36
2010	0.00	13.13	0.43	4.41	17.97
2011	0.00	4.37	0.00	4.28	9.01
2012	0.00	0.12	0.00	0.35	0.47
2013	0.00	0.14	0.00	0.25	0.39
2014	0.00	0.13	0.00	0.14	0.28
2015	0.00	0.08	0.00	0.27	0.35
Totals	**19.7**	**102.8**	**16.3**	**72.9**	**211.7**

Notes: Mt = Million tones (1 tonne = 1,000 kilograms).

Currently the largest waste rock demand in operations is for A21 dike construction followed by cemented rock fill (CRF) to fill mining voids underground. Type III rock is suitable for CRF and is a preferred long term storage location for this potential ARD/ML material. Some Type III rock is also used in the PKC dam raise along the north dam where the dam abutment merges with the Type III area of the waste rock storage area. Any future PKC dam raises that cannot be constructed with Type III rock, would be constructed with A21 waste rock. Estimated operational needs for Type I and III waste rock from the NCRP or underground production are shown in Table 4-3B and include the A21 dike and feed for general site crushed rock. PKC dam requirements have not yet been determined.

Table 4-3B Estimated Operations Waste Rock Requirements 2016-2024

Area	Type I (Mt)	Type III (Mt)
A21 Construction (Aggregate)	2.6	0.0
A21 Construction (Run-of-mine)	1.3	0.0
Crusher Feed (Site Aggregate Products)	0.9	0
Underground Cemented Rock Fill	0.0	3.3
Total	**4.8**	**3.3**

Notes: Mt = million tonnes (1 tonne = 1,000 kilograms);

Type I waste rock and till have been identified as the primary materials required for mine closure. Cover designs for the PKC and the waste rock pile require significant quantities till and Type I. Table 4-3C provides the Type I quantities estimated for the PKC (AMEC (2013) – 2013 Progress Report – Appendix IV-1) and NCRP (Appendix X - Golder (2016)). It should be noted that the closure concepts have also identified smaller volume requirements of Type I rock for closure of the infrastructure area, fish habitat and collection pond reclamation. In addition, till has been identified as a possible soil material for re-vegetation and fish habitat. These concepts are still under review and as such firm quantity estimates have not been developed and so are not included in Table 4-3C.

Table 4-3C Estimated Waste Rock and Till Requirements for Closure Covers

Area	Type I (Mt)	Till (Mt)
Closure Cover - PKC	5.8	0.0
Closure Cover – NCRP	8.1	3.5
Total	**13.9**	**3.5**

Notes: Mt = million tonnes (1 tonne = 1,000 kilograms); PKC = processed kimberlite containment.
Conversion factors: Rock = 2.04 t/m^3, Till = 1.77 t/m^3

A21 waste rock will be source for Type I rock and till for the NCRP closure. It is planned to be direct hauled from the open-pit and placed as the NCRP cover. A21 will also likely be the source for Type I rock for PKC closure, however because the PKC will be an active facility until the end of commercial production, it is not anticipated that much of the PKC cover can be placed with direct haul of A21 rock. Some re-mining will be required. A21 rock is also the preferred rock source for other closure activities discussed above but will be dependent upon timing, location and if other temporary Type I stockpiles need to be used.

Drawing 002 Appendix X shows the planned extent of the re-mine plan for the NCRP. NCRP re-mining will be largely complete by the end of 2016.

4.4.4 Processed Kimberlite Containment

The diamonds make up about one part per million of the host kimberlite rock. After this small fraction of diamonds is removed, the kimberlite that was processed during ore recovery is placed in the PKC area (Figure 2-2). Constructed in a natural valley in the centre of East Island, the PKC area is an engineered containment area surrounded by dams on all sides. The PKC was designed to hold 42.5 Mt of processed kimberlite (PK). At the completion of mining, the PKC area will be approximately 1 km long by 1.3 km wide and contain PK up to 40 m thick.

4.4.5 Water Management Facilities

Water management is the collection, storage, recycling, treatment and controlled release of water in a safe and compliant manner. The Water Management Plan (DDMI 2015) discusses the water collection system constructed around East Island. Through a system of sumps, all-weather seepage pump-back systems, piping, storage ponds and reservoirs, Diavik collects runoff water and groundwater seepage which can be used in the Processing Plant or is treated in the North Inlet Water Treatment Plant (NIWTP) before being released to Lac de Gras.

The Water Management Plan (DDMI 2015) summarizes the current water sources. Water sources are divided into two areas as shown in Figure 4-2:

- NI Subsystem; and
- PKC Subsystem.

The water inflows reporting to the NI are:

- runoff from the till storage area and the NI watershed;
- runoff from the waste rock area;
- runoff transferred from Pond 2, 3 and 13;
- groundwater inflow to the A154 pit;
- dike seepage collected at the toe of the A154 dike;
- groundwater inflow to the A418 pit;
- water transferred from the PKC via Pond 3;
- dike seepage collected at the toe of the A418 dike; and
- groundwater inflows to underground development and mining of A418/A154.

A21 construction water (dredgate and pool dewatering), groundwater inflow to the A21 pit and dike seepage collected at the toe of the A21 dike will also begin to report to the North Inlet starting in 2016.

Pit inflows, underground inflows and dike seepage are essentially continuous flows to the NI, while the other flows described above are intermittent.

The water sources reporting to the PKC pond include:

- fine PK transport water (PK Slurry);
- return seepage from Pond 4 and 5;

- pumped surface runoff from collection ponds on-site; and
- surface runoff within the PKC facility sub-catchment;

Water outflows include treated water to Lac de Gras, surface runoff, seepage and evaporation.

Freshwater is drawn from Lac de Gras. Freshwater volume requirements will reduce as reclaim water and mine water are further utilized in kimberlite processing. The following are current uses of freshwater:

- potable water;
- processing plant makeup water as required;
- fire suppression;
- dust suppression; and
- drill water for underground drilling if necessary.

The NI is located between the waste rock area and the airstrip (Figure 2-2). The NI is an inlet of Lac de Gras that has been dammed off to use as a sedimentation/equalization basin ahead of the NIWTP. The NI water storage reservoir currently has a live capacity of about 2.5 Mm^3.

The NIWTP was constructed at the northeast end of the NI to treat mine water to meet compliance requirements before discharge to the environment. The NIWTP is designed for removal of fine solids and dissolved phosphorus in cold water conditions with a proven treatment capacity of 80,000 m^3/day. The NIWTP has contingency design to reduce pH through the addition of acid if required. Major system components include coagulant and flocculent preparation equipment, and four high-capacity clarifiers.

A by-product of the water treatment process is clarifier thickener underflow or “sludge” material. Sludge is removed from the bottom of the thickeners and transported hydraulically to the NI for deposition at the bottom of the NI. To the end of 2015 the NIWTP has produced about 85,000 m^3 of sludge. Cumulatively by the end of the mine life, an additional 225,000 m^3 of sludge is expected to be produced and deposited in the NI.

Treated mine water is discharged into Lac de Gras via two submerged outfalls located 200 m offshore at a depth of 20 m. Treatment flow rates, influent and treated effluent quality values of pH, turbidity and conductivity are monitored continuously and alarmed if outside acceptable limits. Equipment faults and pH levels at points within the circuit are also monitored and alarmed. Effluent is physically tested by the operator regularly for turbidity, pH, conductivity and alkalinity. The NI water levels and inflow rates from mine areas are regularly monitored. Treatment rates are adjusted to maintain water levels within planned levels.

4.4.5.1 Collection Ponds

The Collection Pond characteristics are summarized in Table 4-4.

Table 4-4 Runoff Collection Pond Summary

Drainage Area	Pond No.	Drainage Basin Area (ha)	Total Volume (m^3)
Waste Rock and Till Area	1	86	64,280
	2	106	367,460
	3	60	1,304,240
PKC Seepage	4	15	47,610
	5	20	16,310
	7	40	230,000
Plant Site Area	10	21	15,060
	11	7	18,660
	12	20	52,590
North Site - Underground Area	13	15	123,110

Notes: ha = hectare; m^3 = cubic metre; PKC = processed kimberlite containment.

Water levels in the ponds are inspected daily during May and June. Ponds are pumped down as required during the spring freshet period. Water quality is monitored when water is present. The ponds are pumped substantially dry by October each year to provide additional storage capacity for the following spring freshet.

4.4.6 Plant Site, Accommodation Complex and Fuel Storage

The main plant site is located on East Island and includes a Processing Plant, a permanent accommodation complex, a maintenance complex, six 18-Million Litre (ML) diesel fuel storage tanks, two power plants, and the Power House (Figure 2-2). Elevated arctic corridors carry services and provide enclosed walkways that connect all major buildings.

4.4.7 Infrastructure

The Project is supported by a variety of infrastructure including:

- plant yard;
- arctic corridors, which carry services and provide enclosed walkways between major buildings;
- communication system;
- ammonium nitrate storage, explosive mixing plant and caps magazine storage;
- batch plant;
- paste plant and crusher;
- airstrip with helicopter pad and fuel storage;
- roads, which form a perimeter containment for most of the facilities;
- water pipelines;
- raw water intake and potable water treatment plant;
- sewage treatment plant with treated sewage outfall;

- hazardous wastes storage facility;
- Waste Transfer Area (WTA) and inert landfill; and
- miscellaneous administration, storage, repair shops and laydown areas.

4.5 Reclamation Materials

The predominant materials required for closure activities are Type I rock and till. The A21 mine will be the primary source of these materials as in Section 4.4.3.

Significant quantities of coarse and fine processed kimberlite will exist for possible use at closure. The availability and current closure requirements for these materials are described in Section 4.4.4 of ICRP V3.2.

By-products from the South Sewage Treatment Plant have also been identified as possible re-vegetation materials. The availability and current closure requirements for these materials are described in Section 4.4.7.6 and 4.4.5 respectively.

Lakebed sediments were identified in the 2001 ICRP as a possible reclamation material. Some lakebed sediment was dredged from the A154 and A418 dike alignments and deposited in the On-Land Sediment Storage Facility that is now Pond 3. Lakebed sediment to be dredged from the A21 dike alignment in 2016 will also be deposited in Pond 3. When Pond 3 is dewatered and decommissioned some of the lakebed material may become available, however quantities are unknown. An additional amount of lakebed sediment was excavated with the till from the top if the A154, A418 kimberlites and stored intermixed with the till in the till storage areas.

In addition to reclamation materials generated from the mining activities, surficial materials may be available for closure for closure activities. An inventory of surficial materials was completed in 1996 prior to mine development (ICRP V3.2, Appendix X-8). The most suitable surficial materials for reclamation were determined to be the organic, organic over glaciolacustrine and glaciolacustrine materials. It was initially envisaged that some of these materials could be pre-stripped from areas like the waste rock storage area and the PKC, prior to their development, and stockpiled for use in closure reclamation. A trial was conducted on the south slope of the PKC area to attempt to pre-strip reclamation materials. Progress was very slow because layers could only be stripped as the material thawed. The trial identified a significant issue with the generation of large volumes of high suspended solids melt/runoff water and the program was discontinued.

5. Requirements for Permanent Closure and Reclamation

5.1 Definition of Permanent Closure

Permanent closure is defined as the final closure of the mine site. At permanent closure there would be no foreseeable intent by DDMI to use the site for active exploration or mining, although permanent closure would not preclude renewed or future mining. Permanent closure also means that site activities will be limited to post-closure monitoring and, possibly, contingency closure actions.

Throughout this document the terms “closure” and “closure and reclamation” are used synonymously.

5.2 Permanent Closure Requirements for Specific Components and Facilities

While mining operations are expected to continue until around 2024, the North Country Rock Pile (NCRP) can be closed starting in 2017. This section presents the final plan for the permanent closure of the North Country Rock Pile. Final design drawings of the NCRP closure are included in Appendix X.

Section 5.2.1 provides an overview of the closure planning process for the site as a whole for context. Section 5.2.2 provides more detailed descriptions of the closure activities for the NCRP. This includes a history of closure planning for this area from initial mine design to the final plan, and provide a rationale for decisions and changes that have occurred over the mine life. Also included are specific closure objectives for the NCRP. For context, relevant information identified in the Northwest Territories Mine Closure Guidelines and recent Environment Canada industry standards have been summarized and appended. Uncertainties, risks, monitoring programs and linkages to research programs are also provided.

5.2.1 Overview of Current Closure Plans

Closure Management Areas

The mine site has been divided into five management areas for the purpose of closure planning:

- North Country Rock and Till Storage Area.
- Processed Kimberlite Containment (PKC) Area.
- Open Pits, Underground and Dike Area.
- North Inlet (NI) Area.
- Mine Infrastructure.

These general areas are shown in Figure 5-1. Not shown in Figure 5-1 is the South Country Rock and Till Storage Area that is to be developed for storage of surplus waste rock and till from the A21 open-pit. The final location and design for this facility is under development. Generally, it will be located between the PKC and the A21 mine area.

Closure Goals and Objectives

DDMI's overall goal is to operate and close the mine responsibly, leaving behind a positive community and environmental legacy. Regulatory guidance for closure is described in the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* (MVWLB/AANDC 2013). Four closure principles are described to guide selection of closure objectives: physical stability; chemical stability; no long-term active care and future use. DDMI's eight stated closure goals are listed in Table 5-1.

Table 5-1 DDMI Closure Goals

Closure Goals
1. Land and water that is physically and chemically stable and safe for people, wildlife and aquatic life.
2. Land and water that allows for traditional use.
3. Final landscape guided by traditional knowledge.
4. Final landscape guided by pre-development conditions.
5. Final landscape that is neutral to wildlife – being neither a significant attractant nor significant deterrent relative to pre-development conditions.
6. Maximize northern business opportunities during operations and closure.
7. Develop northern capacities during operations and closure for the benefit of the north, post-closure.
8. Final site conditions that do not require a continuous presence of Mine Staff.

For clarity it should be noted that the WLWB have specified that the INAC policy goal which states, "Returning mine site and affected areas to viable and, wherever practical, self sustaining ecosystems that are compatible with a healthy environment and with human activities" also applies to the mine site (WLWB 2010).

Closure objectives for the Diavik mine site have also been developed through a consultative process. Objectives are both site-wide, meaning they are applicable to all five closure management areas, and area-specific. The closure objectives for the site as a whole that may be applicable to the NCRP and the NCRP specific objectives are listed in Table 5-2. Together these objectives cover all applicable aspects of physical stability, chemical stability, aesthetics and future use.

Table 5-2 DDMI Closure Objectives - NCRP

Site-Wide Closure Objectives applicable to NCRP
SW1. Surface runoff and seepage water quality that is safe for humans and wildlife.
SW2. Surface runoff and seepage water quality that will not cause adverse effects on aquatic life or water uses in Lac de Gras or the Coppermine River.
SW3. Dust levels safe for people, vegetation, aquatic life and wildlife.
SW4. Dust levels do not affect palatability of vegetation to wildlife.
SW6. Ground surface designed to drain naturally follow pre-development drainage patterns.
SW7. Areas in and around the site that are undisturbed during operation of the mine should remain undisturbed during and after closure.
SW8. No increased opportunities for predation of caribou compared to pre-development conditions.
SW9. Landscape features (topography and vegetation) that match aesthetics and natural conditions of the surrounding natural area.
SW10. Safe passage and use for caribou and other wildlife.
Waste Rock and Till Area Closure Objectives
W1. Physically stable slopes to limit risk of failure that would impact the safety of people or wildlife.
W2. Rock and till pile features (shape and appearance) that match aesthetics of the surrounding natural area.
W3. Contaminated soils and waste disposal areas that cannot contaminate land and water.

Closure Planning

The closure planning framework that DDMI uses to guide the closure designs is an iterative process that requires identifying a design concept, evaluating the expected performance of the design against objectives and criteria, and then considering options to revise the design. The expected performance is assessed under existing climate and possible climate change conditions.

Information from the research plans are expected to help understand the expected performance of a specific design, refine closure objectives and criteria, and identify possible design options or alternatives. Research plans will likely be revised based on outcomes from design iterations.

The design iteration process is an internal process with important outcomes reported externally though annual Progress Reports:

- 2012 Annual Progress Report - (2012 Progress Link)
- 2013 Annual Progress Report - (2013 Progress Link)
- 2014 Annual Progress Report – (2014 Progress Link)
- 2015 Annual Progress Report - (2015 Progress Link)

Currently Approved Design Concepts

While this document is to describe the final closure plan for the NCRP, some general context around the closure plans for other areas is provided here. The following summarizes the currently approved closure design concepts for each area, including the NCRP. Some currently approved designs are under review by DDMI and a request to revise designs will likely occur as soon as sufficient information is available to support a design change. The following sections include discussions of these areas of possible design changes.

Open Pits, Underground and Dike Area

Dikes were constructed into Lac de Gras and the area behind the dikes was dewatered to allow open-pit and underground mining. At closure the underground, pit and dike areas will be flooded. When the water quality has been confirmed, small breaches will be cut into the dikes to allow fish and aquatic life from Lac de Gras to return to the area.

Waste Rock and Till Storage Area

Waste rock and till from the open-pit mining of the A154 and A418 kimberlite pipes are stored on the north side of the mine site in the North Country Rock Pile (NCRP). Waste rock has been segregated based on sulphur content to ensure than rock that is used for the construction of roads and other structures does not have the potential to generate acidic drainage. Waste rock that is permanently stored is also segregated by sulphur content. The waste rock pile has been constructed with the expectation that seepage from the area will be limited by permafrost conditions within the pile. Seepage that may occur is expected to be water that moves through the seasonal active thaw zone and exits the pile at the perimeter toe. The sulphur content of rock in the active thaw zone has been kept low by design in an effort to maintain active zone seepage of acceptable quality. Till from the till stockpile is expected to be fully utilized as a reclamation material and a till stockpile is not expected to exist post-closure.

The approved closure design concepts for the north waste rock pile includes a cover constructed with till and Type I rock for the Type II/III areas; and no cover for the Type I areas. The approved closure design concept does not include re-vegetation of the waste rock pile.

Waste rock from the A21 open-pit will be stored on the south side of the mine site. The design of the South Country Rock Pile (SCRP) is currently underway. Waste rock from the A21 pit is all Type I. Most of the A21 till and some of the A21 waste rock will be used to construct the cover for the NCRP. No cover is required or planned for the SCRP.

Processed Kimberlite Containment Area

After the diamonds have been removed the PK waste is pumped (fine fraction) and trucked (coarse fraction) to the PKC, a lined storage facility located in a central valley on the east island. Long beaches are formed from the perimeter of the facility and water is reclaimed from a central pond. The approved closure concept for the PKC includes; a minimal rock cover over the processed kimberlite to prevent erosion; a bowl-shaped final configuration; and a small water pond adjacent to an open channel spillway to direct excess water from the pond into a natural drainage pathway through a series of small ponds and streams before discharging to Lac de Gras. The PKC is not to be re-vegetated.

North Inlet Area

The NI function is water treatment equalization and settling basin. Operationally it is part of the NIWTP where mine water is treated before it is discharged to Lac de Gras. The NI was a bay in Lac de Gras and was isolated from Lac de Gras by constructing dams across the bay so the NI could be used during mining operations as part of the site water management system. At closure, the plan is to reconnect the NI with Lac de Gras.

Most recent monitoring results indicate that the sediments in the NI are not optimal for benthic invertebrates (bugs) that live on the sediment. However, it is uncertain at this time if sediment quality is likely to limit reconnecting the NI with Lac de Gras.

Mine Infrastructure and Site-Wide Closure

Buildings and infrastructure will be removed and either salvaged or buried on-site. Roads, airstrip and laydown areas may be re-contoured to remove steep sides, scarified where human and wildlife access routes are not envisaged, and areas may be targeted for re-vegetation. Natural drainage paths will be restored and landforms modified to better match the natural surroundings. Note that the footprint of the mine site will remain discernable post closure.

Research Plans

There are six active closure research plans, one plan for each of the five closure areas (waste rock and till, PKC, NI, infrastructure, and the pit, underground and dike area) and one specific to community engagement and Traditional Knowledge.

The plans describe the studies to be undertaken to support ongoing closure planning for the Diavik mine site. The studies are intended to provide information that can assist decision-making for closure options and aspects of closure designs, predict closure performance, and revise closure criteria. These research plans are nearing completion.

Results and revisions to the research plans are reported annually in the Closure and Reclamation Progress Reports listed above.

5.2.2 Closure Objectives and Criteria

The requirements for mine closure are driven by the closure goals and closure objectives, and defined by closure criteria. Closure goals are broader statements of intended outcomes (Table 5-1). Closure objectives specific to the Diavik mine site received regulatory approval with ICRP V3.2. The complete listing of objectives is included in ICRP V3.2.

Closure criteria serve both to better define the objective, and to describe the conditions when the objective has been achieved. Closure criteria specific to NCRP Closure are described in Section 5.2.3.2.

5.2.3 Permanent Closure Requirements – North Country Rock Pile

5.2.3.1 Pre-disturbance, Existing and Final Mine Site Conditions

The area used for waste rock and till storage from the A154 and A418 is shown pre-disturbance in Figure 5-6a. The image is from June 2000 and shows some initial pioneering roads and the start of the quarry for the A154 dike construction. Pre-disturbance conditions are summarized in ICRP V3.2 Section 3, along with additional references that provide more specific information. An esker and some archaeological sites were identified in this waste rock and till storage area. No other specific or unique environmental conditions were identified in this area.

Drawing 002 of Golder (2016) (Appendix X) shows the expected final extent of the NCRP prior to closure. This includes re-mining of Type I rock that will occur in 2016 for A21 dike construction. Also shown on Drawing 002 is the maximum extent of Type II/Type III rock within the NCRP area. The maximum height of the waste rock is around elevation 495 m. Quantities by rock type are included in Section 4.4.3.

As per WLWB/AANDC (2013) area photographs will be taken late in 2016, immediately prior to the initiation of NCRP closure construction activities to record what the area looked like immediately before closure.

5.2.3.2 Closure Objectives and Criteria

Closure objectives applicable to the waste rock and till area include both the site-wide objectives and the area-specific objectives. The guidance provided by WLWB/AANDC (2013), INAC (2007) and Environment Canada (2009) relevant to the waste rock area closure objectives is listed in Appendix XIII. The DDMI closure objectives for the waste rock and till area are generally consistent with both.

The proposed NCRP closure criteria are provided in Appendix V. Closure criteria are intended to be used to evaluate success in achieving the objective and can be used to determine the need for contingency closure activities (see Section 5.2.3.9). Where possible, the intent is for closure criteria to be specific and measurable. Monitoring and reporting that will be used to determine if criteria have been met are described in Section 5.2.3.7 and Appendix VI.

Physical Stability

Stability design criteria are included within the design specifications (Appendix X). Approval of the design will be deemed by DDMI as acceptance that the design meets the objectives of physical stability. The primary closure criterion for physical stability is to demonstrate that the closure design has been constructed as planned and within the specified design criteria or that deviations from the plan have been documented and signed-off by the engineer or record. Geotechnical inspections will be completed to confirm stability.

Chemical Stability

Mitigation to minimize the generation of poor quality seepage water is the largest single element of the NCRP closure design. The construction of a thermal cover is a recognized best practice for waste rock closure in permafrost environments (O'Kane, 2012). The proposed cover is the best practical mitigation option. Closure criteria have therefore been proposed to define runoff/seepage water quality that is the maximum acceptable for release to Lac de Gras (SW2 Criteria). If runoff/seepage water quality is below this level then it would be acceptable to allow it to discharge to Lac de Gras. Concentrations greater than the SW2 criteria would result in the consideration of continued active treatment as a contingency plan.

Surface runoff/seepage could also develop into surface water on the east island that could be consumed by wildlife and people. The closure criterion (SW1) is intended to define a safe water quality level for wildlife and people. The values in Table V3 are screening criteria, meaning that if levels are below those described there is not expected to be a risk to wildlife or people. However, if levels are greater than this then a detailed Risk Assessment may be required to determine acceptability or need for contingency options to prevent people or wildlife from consuming the runoff/seepage.

Future Use

Safe passage and use of the NCRP by caribou were considerations in the closure design as were landscape and use of natural materials (see also Section 2.4). As such, DDMI expects that approval of the design also indicates that acceptance that these closure objectives have been met. Closure criteria for these objectives are therefore mostly ensuring the closure construction is completed as per the design. Monitoring of wildlife use of the closed NCRP is planned (Section 5.2.3.7). Observations of wildlife use will be used to evaluate if the use criteria in Appendix V-1 – Table V1 and V2 are met.

5.2.3.3 Preferred and Alternative Closure Options

Closure planning began with the initial mine design work in 1996 to 1998, when many of the important design decisions related to closure were made. As the mine develops and more is learned about the physical, chemical and biological characteristics of the site, engineered structures and the waste rock and till being managed, closure plans also advance. Closure planning typically involves reviewing benefits and risks for possible closure options. These reviews are both internal to DDMI and external with communities, government and regulators.

The following chronology describes the closure option considerations related to waste rock and till storage, and the resultant preferred option.

Waste Rock Pile Closure Options 1996 to 1998

Sizeable volumes of waste rock are removed when mining kimberlite ore. Three options were considered when evaluating sites to store the mined waste rock:

- a typical waste rock area placed on the East Island near the open pit being mined;
- backfilling a completed open pit with waste rock from an active open pit; and
- waste rock placed in Lac de Gras by widening the dikes (e.g., top widths greater than 500 m were considered).

Water quality (geochemistry), community opinion, technical feasibility, and fish habitat were considered when evaluating the three waste rock storage alternatives.

Geochemical testing of the waste rock identified that, although most waste rock had sulphide content that was very low (less than 0.04 wt%S), some waste rock had low, but sufficiently high sulphide content (less than 0.4 wt%S) that could cause acidic drainage and metals to leach from the rock (Sala and Geochemica 1998). In practice, the two types of rock would be blended in various proportions such that overall sulphur concentrations would typically be less than 0.2 wt%S. When waste rock that contains sulphide minerals is exposed to oxygen in the atmosphere, acidic drainage and metal leaching can occur.

Option 1 has a disadvantage from a geochemical perspective because the waste rock is stockpiled on land where it is exposed to atmospheric oxygen. Any metal leaching, acidic drainage or secondary precipitates formed by the metal leaching/acid drainage could accumulate on the rock surfaces and/or in any drainage that reports from a stockpile. Potentially poor-quality drainage from a stockpile could be controlled by long-term water management measures that might include capping the country rock to reduce metal leaching and/or the continued operation of a water treatment facility.

A common and preferred method to control metal leaching from waste rock is to place material sub-aqueously (under water), where reduced oxygen levels limit the leaching reactions. This oxygen limitation was the basis for the Options 2 and 3.

In Option 2, open pits that were backfilled with waste rock would then be flooded with water from Lac de Gras. This option would provide long-term storage in an oxygen-reduced environment, therefore limiting leaching reactions. However, if the waste rock is backfilled and not immediately covered with water then metals could leach and accumulate within the open pit and form precipitates on the waste rock. When the backfilled pit eventually floods, precipitates would move into solution and potentially result in unacceptable water quality in the flooded area. This water quality issue would also be encountered if the waste rock was stored on the surface over the mine life and later re-mined and placed into a completed open pit because precipitates would also form on waste rock stored in a stockpile on land. Even if Option 2 were chosen, not all the waste rock could be backfilled, and some volume would require on-land storage. The volume of waste rock produced is 30 to 40% greater than the volume where the rock was mined due to void spaces in the blasted rock. Additionally, a completed open pit would not be available for storage during mining of the first open pit, and the final open pit could not be used for backfilling because all the waste rock would have already been removed.

With Option 3, waste rock mined after the dikes were constructed could be put into the lake allowing the material to be permanently stored in an oxygen-limited environment. Similar to Option 2, some on-land storage likely would have been required to accommodate all of the mined waste rock.

Moving mined waste rock is an appreciable component of the mining cost. Loading and hauling waste rock only once and reducing haul distances can, therefore, reduce mining costs. Of the three alternatives, Option 1 would have the greatest total haul distance, whereas Options 2 and 3 would have comparable total haul distances.

Option 2 was eliminated from further consideration on the basis of technical and economic feasibility. The full advantages of backfilling open pits can only be realized after mining is complete. From a technical and safety perspective, an open pit could not be backfilled if mining was occurring underground. Because open-pit mining of A418 and A154 was to be followed by underground mining, neither open pit would be available for backfilling.
Re-mining and hauling over 220 Mt (100 million m^3) of waste rock post-closure to a

completed open pit area at an expected to cost around $5.65 per cubic metre of waste rock (Brodie 2007) would be uneconomical.

From a community perspective, Option 3 was unfavourable because placing waste rock in Lac de Gras as an extension of the dikes was viewed as placing waste where waste did not belong. Furthermore, although the geochemical benefits of underwater storage of waste rock appears to be a generally accepted theory within the regulatory community, the question was raised regarding benefits of geochemical control versus the potential effects on fish habitat. It was unlikely that DFO's "No Net Loss" policy for fish habitat could have been achieved with Option 3. Therefore, Option 3 was not pursued.

Although the post-closure appearance of the waste rock pile was not identified as a predominant issue in the initial community and regulatory consultations, the visual appearance of the waste rock area was considered. The least visual impact would result from either Option 2 or 3. Both options would result in the smallest amount of waste rock being left in a location that could be readily seen on the East Island. For all Options, the waste rock area could be created higher with a smaller footprint, or flatter with a larger footprint.

The final decision from the EA and the basis for the Water License and Land Leases is Option 1, waste rock piles on the East Island, restricted to two areas (north for A154 and A418, and south for A21).

Waste Rock Area Closure Options

Guidance on generic options for closure of waste rock and overburden areas are provided in MVLWB/AANDC (2013) and INAC (2007a) and are included in Appendix XIII, Table 2C. These generic options are provided as context for different approaches to closure of waste rock and till areas.

Approved Closure Design – 2001

The closure design approved for the waste rock and till area is documented in the Initial Abandonment and Restoration Plan (DDMI 1999b), the 2001 *Interim Abandonment and Restoration Plan* (DDMI 2001b), the 2006 *Interim Closure and Reclamation Plan – Version 2* (DDMI 2006) and the *Country Rock and Till Storage Update Design Report* (NKSL 2001a).

The approved closure design for the waste rock and till area can be summarized as follows:

- Segregate waste rock in the pit into three types based on sulphur content and acid generating potential. Waste rock at the Diavik mine is comprised of granites, which contain very low concentrations of sulphide minerals, and biotite schist which contains low, but present sulphide concentrations. Waste rock that contains a higher proportion of biotite schist has a higher potential to leach metals and generate acidic drainage. Type I rock has the lowest sulphide content (less than 0.04 wt %S) and is considered non acid-generating, Type II rock has intermediate sulphide content (0.04 to 0.08 wt%S) and is considered to have uncertain acid-generating potential, and Type III rock has the highest sulphide content (greater than 0.08 wt%S) and is considered potentially acid generating.

- Separate the storage area by drainage basin and place the waste rock with the highest acid-generating potential (Type III) in the most secure drainage basin. Separate rock types by storage areas (i.e., drainage basins).
- Reduce the side slope angles on the pile to facilitate placement of a cover.
- The final closure design for the Type III waste rock consisted of a 1.5 m lower permeability till cover layer intended to reduce water infiltration and oxygen supply, protected by a 3 m layer of Type I rock to act as a thermal blanket. The covers were to be placed as areas of the pile reach final elevation and suitable cover materials became available. After the covers were in place and the till had frozen, the covers would inhibit the penetration of water and oxygen into the underlying Type III rock. The Type I cover would also provide erosion protection.
- Type II waste rock has a very low, but uncertain, potential to leach metals in an arctic environment. This waste rock type was planned to be placed in separate drainage basins from the Type I and Type III waste rock so that the final cover design could be confirmed from seepage observations. The proposed closure treatment for Type II consisted of covering the waste rock with 4 m of Type I to ensure the active layer was completely within the non-acid-generating (Type I) waste rock layer.
- No cover was anticipated for the Type I areas because it is considered non-acid generating.
- The waste rock storage area was designed to have a surrounding perimeter road that created ditches and collection ponds, such that all surface and seepage water could be collected and checked for water quality. Water meeting Lac de Gras discharge criteria was to be discharged to Lac de Gras during operations. Water that did not meet these criteria would be pumped to the PKC Pond or the NI.
- The waste rock and till storage area would include shallow gradient ramps at final closure to allow for caribou migration.
- The waste rock storage area will not be targeted for re-vegetation.
- A south waste rock and till storage area was included in these original closure designs for the waste rock and till mined from the A21 pit area. All waste rock from A21 was non acid generating Type I (Sala and Geochemica 1998). Note that an A21 pit is currently not planned and as such, no south waste rock and till storage area is included in closure planning.

2009 to 2014 Review

Waste rock segregations remains as the operational approach to managing the potential for poor quality seepage from the waste rock area. Waste rock is segregated into three types in the A154 and A418 pits and hauled to the waste rock area where it is placed in designated areas. Drainage basins were delineated by topography or in the case of the quarry area, excavation. The overall goal is to limit the number of basins that contain Type III rock (highest potential for generating poor quality seepage). The drainage basins in the waste rock area and the two basins where Type III rock has been placed are shown in Figure 5-8.

The closure design for the waste rock pile was dependent upon the availability of till and Type I rock from an A21 open pit. The till and Type I would be direct-hauled from the mine to the waste rock pile to be used as cover materials. When the design was proposed the specific benefits of till and rock covers to seepage water quality were unknown. The cost to place this material was limited to the incremental increase in haul distance (i.e., instead of hauling to the south waste rock and till area it would be hauled to the north waste rock and till area). On the basis of a relatively low incremental cost, DDMI made the decision to proceed with this closure design basis, concurrent with research studies to better understand the environmental benefits of a till and/or rock cover(s).

In December 2007 DDMI deferred the development of the A21 kimberlite pipe pending further engineering studies and economic evaluations so the economics of mining A21 could be improved significantly. A feasibility study and environmental review of alternative mining methods for the A21 kimberlite pipe, including methods that would not require removal and haulage of till and waste rock, are proceeding. At that time DDMI could not plan to use till or Type I rock from an A21 mine to construct a low-cost till/rock cover(s) for the Type II/III areas of the waste rock pile.

DDMI's preferred alternative in 2012 (ICRP V3.2) was to utilizes the 10-year period from 2011 (end of waste rock and till pile development) to 2022 (end of kimberlite production) to determine if there are any areas where additional closure actions may be required. Effectively to monitor the pile to see if additional mitigation was necessary. This approach was not approved by the WLWB "…until such time as an appropriate level of information is provided that supports this change" (WLWB 2010).

However in October 2014 DDMI announced plans to develop the A21 dike and open-pit and advised the WLWB in the 2014 Closure and Reclamation Progress Report of its intent to use till/rock from A21 to construct a cover on the NCRP.

DDMI initiated an extensive waste rock research project in 2004 and has reported annually on progress through the Closure and Reclamation Plan Progress Reports. This includes:

2012 Annual Progress Report - (2012 Progress Link)

- Appendix II-5 Heat Transport and the Effects of Climate Change in a Large-scale Waste Rock Pile Located in a Continuous Permafrost Region at Diavik Diamond Mine

2013 Annual Progress Report - (2013 Progress Link)

- Appendix II-3 Test Piles Annual Report 2012
- Appendix II-4 Test Piles Publications - Applied Geochemistry
    - Appendix II-4.1 The Diavik waste rock project: Persistence of contaminants from blasting agents in waste rock effluent.
    - Appendix II-4.2 The Diavik waste rock project: Implications of wind-induced gas transport.

- Appendix II-4.3 The Diavik waste rock project: Water flow through waste rock in a permafrost terrain
- Appendix II-4.4 The Diavik waste rock project: Measurement of the thermal regime of a waste-rock test pile in a permafrost environment.
- Appendix II-4.5 The Diavik waste rock project: Design, construction, and instrumentation of field-scale experimental waste-rock piles.
- Appendix II-4.6 The Diavik waste rock project: Particle size distribution and sulfur characteristics of low-sulfide waste rock.
- Appendix II-4.7 The Diavik waste rock project: Initial geochemical response from a low sulfide waste rock pile.

○ Appendix II-5 Prediction of Seepage Quality at Closure from Waste Rock Piles

2015 Annual Progress Report - (2015 Progress Link)

○ Appendix II-4 Diavik Waste Rock Research Project - 2015 Annual Report

The 2001 closure design included access ramps that would enable wildlife, particularly caribou, to travel over the pile and access the top of the pile as a possible refuge from insects. Discussions continued with communities and wildlife experts to confirm that this is the preferred approach and consider specifics of ramp location, width and surface material, advantages and disadvantages of final side slopes, impacts on overall footprint and confirmation of plans to not re-vegetate the NCRP.

In 2012 the immediate operational opportunities identified by DDMI related to waste rock were:

- Designate some of the remaining waste rock haulage to level out areas (i.e removing depressions that accumulate snow) on the top surface of the pile to minimize snow accumulation (and hence water infiltration) into the pile.
- Develop an accessible source of Type III rock near the crusher/paste plant to take advantage of opportunities to use Type III rock in underground CRF backfill. From a geochemical perspective, encapsulation of Type III rock in cement underground is a preferred long-term location compared with a surface storage location.
- Where possible use re-mining activities to construct aspects of final landforms for the waste rock area including any wildlife access ramps.

Backfilling using Type III material has been considered from the perspective impacts on mine water quality. Encapsulating Type III rock in cement and disposing of it underground is preferable to storing it on the surface where it has the potential to contribute to poor quality seepage. During operations, seepage water from backfill areas form part of the mine water that is pumped from underground, treated and discharged to Lac de Gras. Using Type III rock as part of the backfill material is not expected to affect the metals levels in the mine water (see ICRP V3.2 Appendix X-9).

These opportunities were implemented in the waste rock haulage plans for the remainder of the A154 and A418 waste rock.

Final Closure Design

The final closure design for the North Country Rock Pile generally follows the one initially proposed by DDMI in 2001. The design is presented in detail along with the final construction drawings in Appendix X. Thermal performance of the cover design is supported by test piles research and analysis (Appendix XIV) and separately by an independent evaluation (Appendix XI) that demonstrates the design has been sufficiently optimized to ensure long-term thermal performance. Recommendations from Appendix XI are already included in the final cover design. The final design includes:

- Re-sloping of the pile to better fit the landscape and to provide an appropriate surface for placement of a cover;
- Construction of a thermal cover; and
- Caribou access ramps.

Physical Stability

Golder (2016) conducted a sensitivity stability analysis to determine the maximum pile slope angle while meeting stability criteria considered to be adequately represent the NCRP closure configuration and material properties. The analysis indicated that side slopes of 1.3H:1V will meet or exceed the minimum design criteria factor of safety for slope stability for the range of foundation conditions under both static and pseudo-static conditions. The The NCRP closure design sections have 3H:1V and 1.3H:1V slopes; therefore the NCRP closure design sections satisfy the design criteria factor of safety.

The physical stability of the till layer in the cover was analysed using infinite slope analyses. Infinite slope analysis is considered a suitable assessment method due to the long slope length, and consistent slope angle and materials. Two cases were considered in the analysis:

- Case 1: Stability of the 1.5 m till layer on a 3H:1V slope before placement of the Type I capping layer (short-term condition).
- Case 2: Stability of the 1.5 m till layer on a 3H:1V slope after placement of the 3 m thick Type I capping layer (long-term condition).

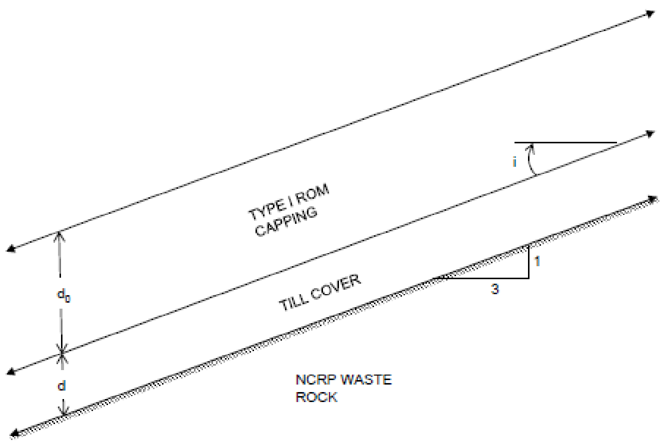
The results of analyses indicate that the design criteria for Factor of Safety are met for the final cover system configuration (Case 2: long-term condition). In the short-term when till is left without a Type I cover, freeze thaw cycles are expected to cause some minor slippage of the till layer that may require minor remediation. If the till is left exposed, the surface shall be graded to manage surface water and limit erosion. The till surface will be smoothed if erosion gullies larger than 0.3 m develop and covered with Type I ROM if erosion gullies larger than

0.5 m develop. The till layer will be rebuilt to a minimum 1.5 m thickness prior to covering with Type I ROM.

Chemical Stability

DDMI has been undertaking research on the chemical, physical, biological and thermal aspects of waste rock piles through with a team of university researches since 2004. Three test piles; Type I, Type III and a covered Type III were constructed at the mine site, instrumented and monitored. For Diavik the specific purpose was to obtain information to support final decisions regarding closure. In particular the cost/benefit of a closure cover to mitigate poor quality runoff/seepage.

Unlike conventional waste rock covers that are designed to limit infiltration, the primary purpose of the DDMI cover is to keep Type III rock frozen. Poor quality seepage is most likely generated by rainfall and snow melt that comes into contact with PAG rock that is within the annual thaw depth (active layer) of a pile. The DDMI cover is designed to keep the active zone within the cover, and the underlying Type III rock frozen. The following shows the DDMI cover design (source: Appendix X – Figure 4).



Mathematical models, supported by DDMI test pile research, were used to evaluate the thermal performance of the cover design with a till thickness of 1.5 m and a Type I run-of-mine rock thickness of 3 m. The result was that even under climate change conditions the active zone in a covered pile would be limited to 3.9 m of depth (Pham 2013), staying within the cover and retaining a frozen Type III material below. The benefit of the Diavik cover to runoff/seepage water quality was estimated by Smith (2013) also using supporting information obtained from the test piles research. In particular Smith (2013) compared estimates of seepage for the NCRP with and without the cover described above. The results show that seepage from drainage basins with an active zone completely within a 3 m cover of Type I waste rock would have a lower concentration of metals and circum-neutral pH, compared to an active zone in uncovered Type III waste rock. Smith (2013) and Pham (2013) are included in Appendix XIV. See also Section 5.2.3.5

No Long-Term Active Care

Construction of a thermal cover over the Type III rock as described in Appendix X provides the best practical option to achieve a post-closure condition that does not require long-term active maintenance. In particular in reduces the likelihood of requiring long-term active water treatment.

Future Use

Safe use for caribou has been a top concern for community members and the TK Panel. Community members have observed that caribou will ultimately go where they want, and elevated surfaces such as eskers are attractive for insect relief and the ability to spot prey. For this reason, it is preferred that safe access and pathways are provided for their use, in order to help prevent injuries that could otherwise occur. Based on TK shared by Panel members, the following considerations have been incorporated into the NCRP design to promote safe access for caribou.

<u>Slope</u>

The slope of the pile could be used to promote safe access or help to deter caribou from certain areas, depending on the steepness of the slope and the terrain, and Panel members provided some examples of this based on their experience on the land. The TK Panel regularly meets at the Diavik mine site in order to 'see things with their own eyes' and increase their familiarity and understanding of the site. As such, Panel members had an opportunity to view and walk the test pile structure that most closely resembles the slope ratio (3H:1V) and cover material that will encapsulate the NCRP at closure. After this experience, Panel members concluded that slopes created similar to that of the test pile would support safe travel for animals. The photo below shows some TK Panel members walking the slope of test pile.

TK Panel members felt that it would be beneficial to have a steeper slope in the area where the NCRP connects to the Processed Kimberlite Containment (PKC) area, as there is a strong desire to deter caribou from entering the PKC. The north slope of the NCRP is Type III rock so will be re-sloped to 3H:1V to enable placement of a closure cover. However the Final cover slope to the PKC surface is designed to remain at a steeper 1.5H:1V (see Appendix X – Drawing 003 – Detail 3). DDMI expects this will assist in deterring caribou from entering the PKC as suggested by the TK Panel.

Elders greatly value the natural state of the environment and impacts to natural systems are considered to be negative. However, as caretakers of the land, they have also learned to recognize situations where additional impacts may be required in order to provide safety for animals. TK Panel members were pleased with the amount of natural vegetation that can still be seen at the mine site, and they originally expressed a desire to avoid future impacts to areas where natural vegetation still exists. When discussing closure plans for roads and the NCRP, Panel members recognized that natural vegetation may be lost by pushing out the sides of these structures in order to ease the slope (e.g. NCRP north slope), but this was seen as an overall positive because it allowed safe passage for wildlife.

Caribou Pathway

Beginning with discussions during the Environmental Assessment for the Diavik mine, the need to create a pathway for safe passage of caribou over the rock pile has repeatedly been identified. The preference of community and TK Panel members is to align access locations with old migration routes on the north and south east sides of the island, and to keep the slope as natural as possible and similar to that of the test pile. According to Panel members and past TK studies, caribou access East Island by swimming along the channel on the north side of the island. The south side of Lac de Gras has jagged rocks where caribou could get injured. The east side of the lake is better; there is a sandbar, muskeg and rocks and its good for caribou migration. Figure 5-9 illustrates the NCRP caribou pathways included in the NCRP Final Closure Design that align with the general recommendations of the TK Panel participants.

Materials and Barriers

TK Panel members have continually noted that caribou are the most important species to look after and that they must be respected. Caribou are sensitive about their feet (hooves) and knowledge passed down over generations tells that it is important to make sure that any areas where caribou travel are clean and free of debris so that their feet are well taken care of. When dumping waste rock onto the NCRP, the largest boulders inherently fall to the bottom of the slope. These are viewed as a risk to caribou health and may prevent safe access onto the pile after closure. The placement and leveling of the cover will largely remove this hazard, and the designated pathway access areas that align with old migration routes would be free of any such obstacles and allow for safe caribou movement.

Other Wildlife

Community members feel that if caribou are taken care of, other species will also be protected hence there has been limited discussion of other wildlife. There was a recommendation relating to the PKC that identified a desire to have some areas of the dam remain steep in order to encourage snow accumulation for wolverine and other denning wildlife (e.g. wolf, bear, fox, ground squirrel, etc.). The NCRP Closure Plan provides such an area along the south face where it ties in with the PKC (see Appendix X – Drawing 003 – Detail 3).

Water

As stated earlier, one of the top concerns that TK Panel members have is chemicals seeping from the NCRP into the lake, or being ingested by wildlife drinking the water. The closure cover is the primary mitigation for chemical stability (see above) however the TK Panel has additional recommendations related to water that are included in the NCRP Final Closure Design.

The TK Panel prefers that the NCRP be designed to prevent water from pooling on top of the rock pile. Based on their observations on the land, once a small pool of water forms in an area, it gets bigger and becomes a pond or lake that attracts animals. Because the Panel is concerned with the quality of water within or flowing from the pile, there is concern for the health of caribou and other wildlife if they were to drink this water. DDMI also prefers not to have water pooling on the surface of the pile. The top and slopes of the NCRP are designed at a gradient intended to prevent a significant volume of standing water.

Additionally, Panel members recognize that snow cover conditions also need to be considered in the NCRP design. Prevailing winter winds (from the northeast) should result in a smooth snow cover on top of the pile, and snow would drop straight down and collect on the leeward side of the pile. It was noted that a means to capture runoff from melting snow during freshet would need to be considered for this area. This recommendation aligns with additional water management guidance from the Panel, as outlined in the following section.

The Panel recognizes the healing power of nature, and prefers that seepage and runoff water from the NCRP travels through seepage ponds and wetlands for as long a distance as possible prior to entering Lac de Gras. Based on Elder's experience on the land, they know that eskers have cold water flowing out of them, because of the permafrost within the esker. Panel members expect the same thing to occur at the NCRP as the permafrost builds up within the pile over the years and seasonal thaw zones release water to the environment. The Panel recommended having a 'moat' around the rock pile as a way of being able to contain and monitor the water that is coming out, and off of the pile. A series of engineered ponds (Pond1, Pond 2 and Pond 3) currently surround the NCRP. They will remain as NCRP collection ponds until it can be confirmed that NCRP runoff/seepage is of adequate quality to be released to Lac de Gras. At this time the concept would be to construct outlets in the ponds such that they would still function as settling ponds but then naturally would naturally drain to Lac de Gras. The final closure designs for Ponds 1-3 is not included in the NCRP Final Closure Design (see Exclude Areas below).

Visual

Traditional stewardship means leaving things as natural as possible. In relation to the NCRP, TK Panel members recommended that the final shape of the rock pile should simulate an esker. This includes sloping the top edges so they are rounded, sloping the sides so they are less steep (similar to the test pile) and having varying levels of steepness. They recommended that the top of the pile be flat with berms removed so that caribou can walk safely with fewer places for predators to hide. The north side should be the most gradual slope to allow safe access for wildlife and people. With the exception of the PKC tie-in zone, all of the slopes planned for the NCRP at closure are 3H:1V, similar to the test pile. However, in keeping with Panel recommendations, the north side of the pile will be pushed out past the current airport road and will have some bench areas along the slope that would serve to simulate varying levels of steepness and reduce the effort required for an animal to climb the slope. The berms on top of the NCRP will be removed, as will those around the edge of the pile, so that the edges appear to be rounded with a relatively flat top.

TK Panel members desire to see the land returned to a state that resembles how it looked prior to development is a primary factor guiding their recommendations. While it is acknowledged that the mine site area will never be the same again, efforts to reclaim an area in a way that resembles natural features is preferred. The Panel recommended using nearby hills as a reference for the material to be used to cover the rock pile. It is not practical to simulate the natural environment on the NCRP. The final design is to use available mine materials and thereby reducing further impacts to the environment during reclamation. Similar materials and methods used to cover the test pile will be utilized for the NCRP and Panel members seem satisfied with the look of the test pile.

Type III in CLR Basin

There is a small stockpile of Type III rock within the CLR basin adjacent to the crusher. This is a temporary stockpile for use in underground backfill. This full volume is expected to be used before the end of commercial production. In the event that it is not used it would be re-sloped and covered in the same way as the NCRP. A cost estimate has been included in the RECLAIM Model (Appendix VII) as proposed by DDMI (Letter to WLWB of October 13, 2016).

Excluded Area

The NCRP area includes collection Pond1, Pond 2 and Pond 3; the inert landfill and a Type III stockpile for future underground backfill. Closure designs for these areas are not included within this Final Closure Plan because these areas are still being actively used by the mine operation. The closure concepts for these areas are those described in ICRP V3.2 and will be updated in ICRP V4.

5.2.3.4 Closure Activities and Associated Engineering and Environmental Work

The general schedule of activities currently envisaged for completing closure of the NCRP is provided in Figure 5-10. This schedule is subject to change based on changes in mine planning, construction progress, results of inspections, etc. A brief description of each activity is provided below:

- *Type I re-mining* – The NCRP will have some ongoing Type I re-mining during 2016.
- *Pre-closure photography* – The NCRP will be photographed following completion of re-mining but before the star of re-sloping to document pre-closure condition.

- *Reslope* – Flattening the side-slopes to the NCRP to final design specifications (Appendix X).
- *Till cover placement* – Placement of till from A21 pre-strip to form first layer of cover as per final design specifications (Appendix X).
- *Rock cover placement* – Placement of run-of-mine (ROM) rock from A21 mining, characterized in accordance with an approved Waste Rock Management Plan and placed to form final layer of cover as per final design specifications (Appendix X).
- *Geotechnical Inspections* – Ongoing geotechnical inspections (See Section 5.2.3.7).
- *Seepage/Run-off monitoring* – Water quality sampling of seepage/runoff (if any) identified during geotechnical inspection (See Section 5.2.3.7).
- *Dust monitoring* – Ongoing site dust monitoring (See Section 5.2.3.7).
- *Wildlife monitoring* – Ongoing monitoring of wildlife use of NCRP (See Section 5.2.3.7).
- *Construction Reporting* – Yearly reporting of construction progress as per final design report (Appendix X). Request for financial security reduction based on work complete.
- *Reclamation Completion Report* – Final documentation of completed construction as per MVLWB/AANDC (2013). Request for financial security reduction based on work complete.
- *Performance Assessment Report* – Detailed comparison of NCRP conditions against closure objectives and closure criteria as per MVLWB/AANDC (2013). Request for removal of any remaining financial security for NCRP.

5.2.3.5 Residual Effects

Residual environmental effects will exist after completion of the final NCRP closure and reclamation. Potential residual effects of note include:

- a significant landscape feature (waste rock pile) that did not exist pre-development and will remain visibly different from the surrounding landscape;
- a permanent loss of the underlying vegetation and associated wildlife habitat, and some archaeological information that was covered by waste rock and till;
- an increase in the area of “human disturbed” category of Vegetation/Land Cover (VLC) type;
- localized seepage/runoff water quality and quantity that will be different from pre-development;
- some small inland waterbodies and ephemeral streams that will be permanently covered by the waste rock and till;
- a waste rock pile that may become a new attractant to caribou (e.g., for insect avoidance); and
- dust may be generated from the waste rock and till and from new rock surfaces, which would be deposited on adjacent vegetation or waterbodies.

An assessment of environmental effects at closure was conducted during the EA for the mine (DDMI 1998a). Residual effects are part of the initial assessment of the cumulative effects from all closure areas, which is summarized in Section 9 ICRP V3.2. The identified residual effects identified for the NCRP fall within the general range of effects considered in the EA.

The potential for poor quality seepage/runoff is the residual effect of greatest concern for NCRP Closure. Construction of the closure cover is expected to mitigate this risk. Estimates of runoff/seepage quality from Smith (2013) are compared graphically against closure criteria, EA Predictions and geochemical research results in Appendix V-2. Tabular results are included in Appendix V-1.

Estimated post-closure runoff/seepage water quality is not expected to result in significant adverse residual effects. Canada (1999) definition of a significant adverse effect that is specific to Diavik:

> *"The definition of a significant adverse effect is an effect that has a high probability of a permanent or long-term effect of high magnitude, within the regional area, that cannot be technically or economically mitigated. Definitions of regional effects and effect magnitudes are specific to each environmental component."* (Canada, 1999).

Runoff/seepage water quality estimates and predictions of mixing in Lac de Gras have been used to provide a preliminary screening of potential water quality effects. It should be noted that these are preliminary assessments, while based substantial research information, can only be verified with runoff/seepage and AEMP monitoring in the future. Preliminary findings of note are below with details described in Appendix V-1:

- no predicted significant adverse effects to Lac de Gras;
- runoff/seepage water quality is expected to be safe for wildlife even if wildlife is exposed directly to the runoff/seepage.
- runoff/seepage water quality is expected to be safe for human consumption after initial mixing with Lac de Gras but predicted levels of uranium in the runoff/seepage may exceed drinking water criteria and limit direct consumption of the runoff/seepage.
- potential effects to aquatic life are expected to be limited to the local assessment area (i.e. less than 1 km) with the exception of copper and silver. Current information indicates that copper and silver concentrations could exceed the AEMP benchmarks for aquatic life at the 1 km assessment boundary but not within Lac de Gras as a whole.

As noted above monitoring will be required to confirm if the predicted runoff/seepage water qualities materialize and if the runoff/seepage is as predicted, if release into Lac de Gras results in the predicted extent of water quality changes. With the exception of nitrogen compounds which are expected to be short lived in runoff/seepage, other changes in water quality that are realized would be expected to exist over the long term; that is after 2030.

5.2.3.6 Uncertainties, Risks and Research Plans

No further research is required to finalize the NCRP closure design. The Test Piles research has collected a wealth of data that will continue to be available to University researchers for many years to come. DDMI will continue to review research results of relevance to the NCRP-WRSA to determine any applicable improvements to the cover design.

There are risks that the closure design will not perform as anticipated. Monitoring programs (Section 5.2.3.7) will assess the design performance and any associated level of risk in three primary areas:

1. Risk of movement in the closure cover causing excessive cracking;
2. Runoff/seepage quality worse than closure criteria; and
3. Hazard to caribou observed along planned routes/ramps.

Section 5.2.3.9 describes the contingency plans anticipated in the event of poor quality seepage/runoff or identified caribou hazards. It is expected that excessive cracking of the closure cover would be addressed through regular maintenance (Section 5.2.3.7).

5.2.3.7 Post-Closure Monitoring, Maintenance and Reporting

DDMI currently has in place specific monitoring protocols that will be applied to NCRP post-closure monitoring. These are summarized below with detail provided in Appendix VI.

Geotechnical inspections

- geotechnical inspections including observations and measurement of settlement, erosion, surface drainage and thermal condition;

Runoff/Seepage Water Quality

- seepage quality and using a system similar to the Surveillance Network Program (SNP);

Dust and Dust Deposition

- TSP and deposition/quality measurements of any dust generated from the closed waste rock and till area; and

Wildlife

- wildlife use of the area.

Post-closure maintenance requirement are difficult to specify in advance as they will be dependent upon the outcome of geotechnical and environmental inspections. General surface maintenance activities and inspections will be coordinated for the site as a whole rather than being specific to any single closure area. For the NCRP the most likely maintenance activities will involve repair of excessive any cracking, slumping or erosion or corrections to any identified wildlife hazards.

Results of monitoring and maintenance will be documented in the NCRP Performance Assessment Report.

5.2.3.8 Post Closure Landscape

The expected view of the NCRP post-closure is currently only available as a drawing (Appendix X). DDMI is currently working on visualization images for the post-closure mine site landscape, including the NCRP. These are planned to be included in ICRP V4.

5.2.3.9 Contingency Program

Ongoing review of monitoring program results and inspections can lead to routine maintenance as described in Section 5.2.3.7. However there is the possibility that these results determine that key closure criteria are not met and contingency closure alternatives considered. Contingency plans have been developed in the case where runoff and/or seepage quality is unacceptable for either release to Lac de Gras or for exposure to wildlife/people on the East Island. The following are possible contingency actions as identified in ICRP V3.2:

- Add additional Type I material to target batter areas if inadequate seepage quality is identified (see Introduction to Appendix VIII of ICRP V3.2 for risk-based approach to determine adequacy of seepage quality). Type I rock would be re-mined from the waste rock area, collection pond dams, laydowns and/or roads.

- Add additional till cover to target batter areas if inadequate seepage quality is identified. Till would be available until at least 2025 from the north till area. A contingency reserve of till could also remain after 2025.

- Collect and treat seepage water until quality/quantity is adequate for release into Lac de Gras.

- Enhanced passive treatment of targeted seepages.

- Revised wildlife access routes including possible local re-sloping.

Continued Treatment

While clearly not desirable, if runoff/seepage water quality proves to be unacceptable for release to Lac de Gras then the contingency will be to not breach the collection system of Ponds 1-3 and continue to collect, pump and treat water using the existing water treatment facility or a modified system.

Additional Cover Material

The planned till/rock cover described in Section 5.2.3.3 is to mitigate potential poor quality seepage from Type III waste rock by maintaining a seasonal that depth that remains within the till/rock cover. If runoff/seepage proves to be unacceptable for release to Lac de Gras, adding addition till/rock cover could be an effective contingency provided the reason for the poor quality/runoff/seepage was in fact seasonal thaw that extended below the till/cover. Additional till/rock cover could also be an effective contingency if the poor quality runoff/seepage was from a Type I area of the NCRP where a till/rock cover was not previously required.

Surface Modifications

If runoff/seepage water quality is acceptable for release to Lac de Gras but the surface water stream on the East Island presents and unacceptable risk to wildlife or people, the contingency will be to bury the stream with large run-of-mine rock to eliminate or reduce the ability for wildlife/people to access this poor quality water. Cautionary signage could also be used if the risk was to people rather than wildlife.

6. Progressive Reclamation

Progressive reclamation are closure activities that are done during mine operations to advance the closure and/or decommissioning of areas or facilities that are no longer required for the current or future mining operation. These activities can be done during operations with the available resources to reduce future reclamation costs, minimize the duration of the environmental exposure and enhance environmental protection. Progressive reclamation can also reduce time for achieving reclamation objectives, and provides valuable experience on the effectiveness of measures which might be implemented during permanent closure.

North Country Rock Pile closure is considered to be progressive reclamation.

7. Temporary or Interim Closure Measures

In addition to planning for permanent closure, DDMI has prepared plans for an interim shutdown in accordance with the requirements of the Class "A" Water License and the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* (MVLWB/AANDC 2013). Please refer to Section 7.0 ICRP V3.2 (or subsequent versions) for the current approved temporary or interim closure measures applicable to the NCRP and other areas of the mine site.

8. Integrated Schedule of Activities to Permanent Closure

The integrated schedule of activities envisaged for advancing and implementing the preferred closure plan is shown in Figure 8-1. This schedule is highly uncertain and is provided to place the NCRP schedule of activities (Figure 5-10) into perspective. A refined schedule will only be possible once final designs and decommissioning plans have been completed. All schedules are subject to changes in mine plans. Market conditions could slow activities. Exploration or improved economics could extend the mine life beyond 2024. An updated schedule will be prepared with ICRP V4.

The schedule in Figure 8-1 is an updated composite of the area-specific schedules presented in Section 5.2 of ICRP V3.2. Common activities have been combined. A brief description of each activity follows:

- *Mining Activities A154/A418/A21* – The mine areas are currently expected to be active until 2024 limiting the closure activities.
- *Dump Development* – The SCRP will be an active facility starting late in 2018. It will continue to receive waste rock from A21open-pit mining through to 2023.
- *Waste Rock Re-Mining* – Waste Rock will be re-mined from the NCRP for A21 construction and underground backfill until 2016.
- *PK Deposition* – The PKC is an active facility and will be active until the last day of diamond production (currently 2024). Closure activities and associated works must remain mindful of this fact.
- *Mine Water Treatment* – The NIWTP would continue to treat mine water until the completion of underground mining in 2014 under the current mine plan.
- *Accommodation/Power/Transportation Required* – Infrastructure will be required at one level to support mining operations (currently ending 2024) and then at a lesser level for closure activities (currently ending 2030).
- *Winter Road* – It is assumed that the winter road will no longer be constructed every year after commercial production (currently 2024).
- *Engineering/Environmental Studies* – Several engineering and environmental studies need to be undertaken to confirm the preferred closure concept for each closure area, address uncertainties and reduce risks.
- *Community and Regulatory Engagement* – Continued engagement is anticipated to refine the closure plans. Final engagement is anticipated around 2029/2030 to confirm permanent closure.

- *Final Design Concepts* – Final closure design concepts will be completed and submitted for review in 2016. The designs will incorporate findings from engineering and environmental studies, research, and community and regulatory engagement.
- *Detailed Engineering* – Detailed engineering to prepare final drawings and construction specifications for closure activities would be completed as required by closure area and then two years before the final closure work begins.
- *Wildlife Access, Contouring and Cover – Waste Rock and Till* – The detailed engineering design will be used to guide the re-mining work on the waste rock area to achieve final surfaces and access routes through the area.
- *Inventory of Assets* – Detailed inventory of assets for sale/reuse, salvage and recycle would be completed three years before the final closure work begins to initiate external marketing.
- *Commercial Arrangements – Sale/Transfer of Assets* – Specific arrangements would be made for sale, reuse, salvage or recycle of equipment and materials in advance of decommissioning.
- *Complete Fish Habitat Construction* – Complete any final fish habitat construction work not completed during operations
- *Decommissioning of Collection Ponds 1, 2 and 3* – Once runoff and seepage water quality/quantity have been confirmed, decommission collection ponds including removal of any pumping/piping infrastructure.
- *PKC Outlet Preparation* – Deconstruction of a section of PKC liner and preparation of an engineered drainage outlet.
- *Placement of Final Surface and Wildlife Access - PKC* – Placement of final PKC rock surface, construction of any access routes and re-sloping of access ramps and other features.
- *Decommissioning of Surface Mine Infrastructure* – Removal of mining equipment and associated infrastructure for A418/A154 open pits and A21 mining area.
- *Decommissioning of Underground Mine Infrastructure* – Removal of mining equipment, and associated infrastructure and sealing of surface access locations for A418/A154 underground in preparation for flooding.
- *Decommissioning of Processing and Paste Plants* – Activities associated with decommissioning these facilities.
- *Decommissioning of Explosives Plant and Storage* – Activities associated with decommissioning these facilities.
- *Flood Mine Areas – Clarify Water* – Flood the open-pit and underground mine areas. Monitor clarification of A154/A418 and A21 pool areas.
- *Decommissioning of Accommodations and Other Buildings* – Activities associated with decommissioning these facilities.
- *Decommissioning of Fuel Storage and Power* – Activities associated with decommissioning these facilities.

- *Decommissioning of Collection Ponds 4, 5 and 7* – Once outlet and seepage water quality/quantity have been confirmed, decommission collection ponds.
- *Decommissioning of Dikes/Sediment Control Structures* – Excavation of breaches to re-connect Lac de Gras with mine area.
- *PKC Infrastructure Decommissioning* – Removal of reclaim barge, water and slurry pipelines, power and any associated surface infrastructure.
- *Decommissioning of Waste Transfer* – Activities associated with decommissioning this facility.
- *Decommissioning of Collection Ponds, and Pipelines 10, 11 and 12* – Activities associated with decommissioning these facilities.
- *Decommissioning of North Inlet East Dam* – Once North Inlet water and sediment quality have been confirmed and facility no longer required, decommission the east dam by excavating a breach.
- *Decommissioning of Final Camp, Airstrip and Landfill* – Activities associated with decommissioning these facilities.

9. Post-Closure Site Assessment

Residual environmental impacts of the post-closure mine site were first assessed during the Environmental Assessment (EA) for the Project (DDMI 1998a). In the 1998 EA, environmental impacts were assessed for the construction, operation, closure and post-closure phases of development (DDMI 1998a). The assessment was based the closure concepts at the time and predicted environmental changes. Specifics of the closure plan have evolved since 1998 EA (see Section 5).

Expected post-closure residual effects will become better defined over time. When the closure concepts are finalized, closure performance will be predicted and the predictions will be used to assess residual environmental impacts. After closure activities are complete actual results from performance and environmental effects monitoring will be used to assess environmental impacts.

The assessment results from the 1998 EA remain relevant as a preliminary assessment of residual environmental impacts. The development has proceeded largely as described in 1998 and with only a few exceptions (dust deposition and wildlife zone of effects), environmental conditions remain within the EA predictions. DDMI plans to use the same approach that was developed for the 1998 EA to assess residual environmental impacts at closure. These methods remain valid, relevant and a continuity in methodology from development assessment to post-closure assessment will provide helpful contrasts. The main difference in evaluating post-closure residual affects for the post-closure assessment will be that predictions of post-closure site and environmental conditions will be largely based measured environmental conditions rather than predictions. However, in some cases forecasts of environmental conditions will still be required and will be based on both measured post-closure conditions and information collected over the life of the mine operations.

Information and data collection is ongoing (see ICRP V3.2-Appendix VIII), and will be used to update predictions of environmental conditions at closure. Closure designs will also evolve from initial concepts to final design concepts. DDMI will update the residual environmental impacts when the final closure design concepts for all areas are complete. Updated residual environmental impacts for the NCRP are described in Section 5.2.4.5.

This section summarizes the approach used in the 1998 EA to assess environmental effects, as well as the results of the original assessment by key ecosystem component for the post-closure phase. Any differences based on current understanding of residual effects post-closure or changes to operational impacts as a result of environmental effects monitoring conducted to date are noted.

9.1 Assessment Approach

The 1998 EA focused on issues of ecological importance and importance to the people who would be affected by the mine development. The EA was structured to provide focused, understandable and relevant information about the type, extent and magnitude of potential environmental effects. The following general approach was used to assess potential environmental effects in the EA:

- identify important issues relevant to the assessment of the mine;
- discuss the physical, biological, socio-economic and socio-cultural environments in which the mine would be introduced;
- explain the potential effects of the mine on those environments; and
- provide an assessment of the nature and, where possible, the magnitude and severity of these potential effects.

Potential environmental effects of the mine development were originally predicted for four phases: construction, operation, closure and post-closure. The post-closure phase will be discussed here.

In conducting the *Comprehensive Study Review* for the Project the Responsible Authorities required sufficient information to determine if the proposed project would have significant adverse environmental effects. To address this information requirement, the EA described potential effects according to their magnitude, duration and geographic extent.

Potential effects on the environment were analyzed at the local, regional and cumulative scales. The size of each of these study area scales varied with the potential effect being assessed in order to capture the context necessary to best understand and quantify the potential effect. In general, the potential effects in the immediate vicinity of the mine were assessed with respect to the local scale, which was typically the East Island and adjacent water. For the regional scale the study area sizes were more varied. For example, the drainage basin of Lac de Gras (3,559 km^2) was considered to be sufficiently large to examine the potential regional effects of the mine on fish and water. However, to adequately assess potential regional effects on wildlife, a much larger area (approximately 11,500 km^2) was used.

The geographic extent is the spatial area that is affected by an activity. For the purposes of the environmental effects assessment, potential effects that were restricted to the LSAs were assessed as local in geographic extent. If an effect extended beyond the LSA, it was considered to be a regional effect. In some cases, effects have the potential to extend even farther and were considered “beyond regional.” Typically the cumulative effects were assessed using the RSA or the beyond RSA.

Magnitude describes the amount of change in a measurable parameter or variable relative to baseline conditions (e.g., 1996 conditions). The specific criteria used to determine the magnitude of an effect are related to the characteristic being investigated (e.g., fish populations, archaeological sites), the methods available to measure the effect, and the accepted practice in different scientific disciplines.

A brief description of the local, regional and cumulative study scales used, as well as the rationale for selection of the study scales is provided in Table 9-1. The criterion used to define the magnitude of each characteristic is defined in Table 9-2.

Table 9-1 Brief Descriptions of the Local, Regional and Cumulative Study Areas Used for Assessing Potential Effects in Each Discipline

Local Study Area	Regional/Cumulative Study Area	Rationale for Selection of Study Areas
Air Quality		
The East Island and adjacent waters of Lac de Gras.	An area 25 km east-west by 35 km north-south centred around East Island.	The LSA was selected as the area where ambient particulate concentrations and deposition rates would likely be the greatest. The RSA encompasses the entire area within which ambient concentrations are likely above the thresholds commonly used to define the distance from the emissions sources to locations where modelling is no longer necessary.
Vegetation and Terrain		
The East Island.	The drainage basin of Lac de Gras.	The study areas were selected because they are representative of the areas that could be affected by the proposed Project. The LSA was selected for assessing direct effects from the Project, while the RSA provides the context for understanding effects at the regional level.
Wildlife		
The East and West Islands; small islands in the east half of Lac de Gras; and the mainland along the south, east and north shores of Lac de Gras.	North to Yamba Lake; west to Destaffaney Lake; south to MacKay; and east to Glowworm and Afridi Lakes.	These study areas were selected to effectively represent and assess the diversity in patterns of use by wildlife. The LSA provides a framework for assessing effects on sedentary species with small seasonal ranges, and the RSA provides a framework for assessing effects on species that have large seasonal ranges. Migratory species which use an area seasonally are also considered using these study areas.
Fish and Water		
The East Island and the surrounding water, within 1 km of the East Island shoreline.	The drainage basin of Lac de Gras.	The LSA was selected as a framework for presenting the effects on the aquatic environment that are likely to occur in the immediate vicinity of the proposed Project (e.g., fish habitat alterations on the East Island, alterations to water quality directly adjacent to the dikes). The RSA was selected to present effects in a regional context which is most appropriate for assessing effects on fish populations in Lac de Gras and water quality in Lac de Gras as a whole.

Table 9-1 Brief Descriptions of the Local, Regional and Cumulative Study Areas Used for Assessing Potential Effects in Each Discipline (continued)

Local Study Area	Regional/Cumulative Study Area	Rationale for Selection of Study Areas
Heritage Resources		
The East Island.	The East and West Islands and adjacent mainland to the north and east.	The LSA corresponds to the area potentially affected by the footprint of the Project. The RSA corresponds to the initial baseline studies, which encompasses the widest geographic area in which the Project facilities could have been situated.
Socio-Economics		
Communities of Gameti, Wekweti, Dettah, N'dilo, Rae-Edzo, Wha Ti, and Lutsel K'e. Yellowknife was included for economic analysis.	The Western NWT; emphasis on 20 study area communities.	The LSA encompasses the communities that would likely experience changes to traditional land use and occupancy, wage-based employment and community infrastructure, as a result of the proposed Project. The RSA includes communities that may experience employment and business changes by virtue of their location and accessibility.

Table 9-2 Definitions for Magnitude and Duration

CLIMATE AND AIR QUALITY

Magnitude	Duration
Magnitude was determined by comparing to ambient air quality objectives	Duration was determined by the averaging period defined by the objectives used to determine magnitude

VEGETATION

Magnitude		Duration	
Negligible	Less than 1% changes to measurement endpoint	Short-term	Less than 1 year
Low	1% to 5% change	Mid-term	1 to 25 years
Moderate	6% to 30% change	Long-term	Greater than 25 years
High	Greater than 30% change		

WILDLIFE

Magnitude		Duration	
Low	Less than 1% change from baseline conditions	Short-term	Less than 3 years
Moderate	1% to 10% change	Mid-term	Between 3 and 30 years
High	Greater than 10% change	Long-term	Greater than 30 years

HERITAGE RESOURCES

Magnitude		Duration	
Low	Lost resource has limited scientific value with limited potential to contribute to public awareness and appreciation	Short-term	Not applicable
Moderate	Lost site has local and regional scientific interpretive values and has good potential to contribute to public awareness and appreciation	Mid-term	Not applicable
High	Lost site has regional scientific interpretive values with excellent potential to contribute to public awareness and appreciation	Long-term	Heritage resources are permanently altered

FISH AND WATER - MAGNITUDE

Sub-Section	Magnitude	
Water Quality		
Suspended Sediment	Low	Severity classes 0 (representing no effect) to less than 9 (representing short-term behavioural, feeding and physiological effects)
	High	Severity classes 9 (representing short-term behavioural, feeding and physiological effects) to 14 (representing 80 to 100% mortality)
Pore water Release; Dike Leaching; Mine Water Discharge; and East Island Runoff	Negligible	Concentration less than the drinking water and/or aquatic life guideline
	Low	Concentration exceeds the drinking water and/or the aquatic life guideline by 10% or less
	Moderate	Concentration exceeds the drinking water and/or the aquatic life guideline by 10% to 20%
	High	Concentration exceeds the drinking water and/or the aquatic life guideline by more than 20%
Sedimentation and Dust; and Air Emissions	High	Sedimentation exceeds 1 mm for any spawning and nursery habitat
Groundwater Quality	Negligible	Concentrations less than or equal to drinking water guidelines
	High	Concentrations greater than drinking water guidelines
Water Supply		
Lac de Gras Water Balance	Negligible	Less than or equal to 5% change
	Low	Greater than 5% and less than or equal to 10% change
	Moderate	Greater than 10% and less than or equal to 20% change
	High	Greater than 20% change
Groundwater Quantity	Low	Groundwater heads reduced but rock remains saturated
	High	Rock is completely dewatered and becomes unsaturated
Fish		
Angling	Low	Harvest rate below the sustainable yield
	High	Harvest rate above the sustainable yield
Blasting	Negligible	Peak particle velocity and instantaneous pressure change below threshold
	High	Peak particle velocity and instantaneous pressure change above threshold

Sub-Section	Magnitude	
Dike Closure and Dewatering	Negligible	Less than or equal to 1% change in fish populations
	Low	Greater than 1% and less than or equal to 10% change in fish populations
	Moderate	Greater than 10% and less than or equal to 20% change in fish populations
	High	Greater than 20% change in fish populations
Habitat Change	Negligible	Less than or equal to 1% loss of fish habitat
	Low	Greater than 1% and less than or equal to 10% loss of fish habitat
	Moderate	Greater than 10% and less than or equal to 20% loss of fish habitat
	High	Greater than 20% loss of fish habitat
Fish Quality	Negligible	Predicted metal concentration in fish tissue is equal to or less than the consumption threshold
	High	Predicted metal concentration in fish exceeds threshold

FISH AND WATER - DURATION

Duration	
Short-term	Less than 3 years
Mid-term	3 to 30 years
Long-term	Greater than 30 years

The regional and local study scales are visually presented in Figures 9-1 and 9-2. The RSAs are shown in Figure 9-1 and the LSAs for wildlife, vegetation and terrain, fish and water, heritage resources and air quality are shown in Figure 9-2.

The duration of potential environmental effects were broadly divided into following three classifications:

- **Short-term effects** lasting for less than three years (i.e., effects generally associated with the period of intense construction activity before the start of operations, but may also occur during other phases);
- **Mid-term effects** lasting from three to 30 years (i.e., effects generally related to mine operations and closure, and extending from the beginning of operations to the beginning of post-closure); and
- **Long-term effects** lasting longer than 30 years (i.e., effects which persist beyond closure of the mine).

The long-term effects or those that last beyond closure that are of specific interest here.

In addition to the three main effect classifications of magnitude, duration and geographic extent, additional classifications were frequently considered, including ecological context and reversibility.

Ecological context is a measure of the relative ecological importance of a component of the environment. It indicates the degree to which an affect on the component would substantially affect the functioning of the ecosystem within the local or RSA. Ecological context was occasionally used to modify the magnitude classification assigned to an effect (i.e., the magnitude of an effect may be lowered or raised in accordance with the ecological context of the environmental component being assessed). In many cases, ecological context is explicit in the selection of the resource component being addressed. For example, caribou were chosen as a wildlife species for the assessment because they are the primary herbivore in the ecosystem and important for hunting.

Reversibility is also a factor related to duration. Loss of heritage sites, for example, is not reversible because the site is not replaceable. Plant reclamation of disturbed sites is not reversible in the short-term, but natural processes would eventually result in vegetation recovery.

Because environmental effects assessments deal with predictions of future circumstances, or must predict how complex environmental systems could respond to disturbances, effects assessments vary in their level of certainty. In some cases, predictions can be made with a high degree of confidence. For example, archaeological sites within the mine footprint are highly likely to be affected. Conversely, predictions of how fish populations would respond to the effects of increased productivity can be made with less certainty. Each environmental effects report addresses issues of certainty when it is an important factor in judging the potential effects of the mine.

With information on geographic extent, magnitude and duration an effect is assigned an effect level classification, as illustrated in Figure 9-3. Effects classifications with a level designation of "IV" are all long-term duration and Level IV effects are considered post-closure residual effects. Level IV effects are further defined by geographic extent as follows:

- Level IV Local Effect;
- Level IV Regional Effect; and
- Level IV Beyond Regional Effect.

The Responsible Authorities furthered this classification system in the Comprehensive Study Report to define a "significant adverse effect". A significant adverse effect is an effect that has a high probability of a permanent or long-term effect of high magnitude, within the regional area that cannot be technically or economically mitigated (Canada 1999).

9.2 Post-Closure Effects Assessment

This section provides a summary of the effects assessment results from the 1998 EA with an emphasis on residual post-closure results. This assessment remains as a reasonable preliminary assessment of residual impacts.

Following is a summary of material presented in the Diavik Diamonds Project Environmental Effects Reports:

- Air and Climate (Cirrus 1998);
- Vegetation and Terrain (Golder 1998a);
- Wildlife (Axys Environmental Consulting and Penner and Associates 1998);
- Fish and Water (Golder 1998b); and
- Heritage Resources (Fedirchuk McCullough & Associates 1998).

These documents provide specific information.

9.2.1 Air Quality

Effects on local and regional air quality are linked to mine emissions. The environmental assessment focused on maximum periods of emissions during operations and concluded that the predicted ambient air quality would not lead to identified adverse environmental effects. Post-closure mine emission sources will be removed, which will result in improved local and regional air quality relative to operations. No long-term effects were identified.

Dust deposition is associated with potential effects to aquatic, vegetation and wildlife resources and was calculated based on information about the release of particulates into the air. The sources of the particulate material were all from mine-related activities (e.g., rock hauling, blasting, dumping, crushing) that would not exist post-closure. Some particulate would continue to be generated from wind erosion of rock surfaces but these would be substantially less than assessed for the operations phase. Dust deposition rates during operations have been measured by DDMI to be higher then predicted in the environmental assessment. Environmental impacts of dust on ecosystem components (aquatic, vegetation or wildlife) are discussed in the relevant sections below.

The mine has been designed for very efficient use of energy and energy recovery which minimizes greenhouse gas emissions. Nevertheless, mine operations emit greenhouse gases through fuel use on site and transportation of personnel and materials to the site. Emissions would primarily consist of carbon dioxide (CO_2), with much smaller amounts of methane (CH_4) and nitrous oxide (N_2O). The mine operation is a very minor emission contributor to Canada's total greenhouse gas emissions and would have no emissions post-closure.

9.2.2 Vegetation and Terrain

Disturbed vegetation recovers slowly in conditions typical of arctic environments. Even with re-vegetation efforts, effects of the mine development on vegetation are expected to remain as residual effects post-closure.

The main effect on vegetation resulting from mine development is the reduction in the aereal extent of all VLC types (Figure 9-4). The VLC and water types within the LSA directly affected by the mine development are listed in Table 9-3. Locally, the magnitude of this effect would be high. Within the RSA this direct loss of VLC from the mine development would be less than 1% and considered negligible. Additionally, because no uncommon plant species or plant communities were identified within the mine development footprint, vegetation loss would be low in the ecological context.

Table 9-3 Direct Losses to Vegetation/Land Cover Due to Development of the Diavik Diamonds Mine, Year 2018

Vegetation/Land Cover Type	Local Study Area - Baseline		Regional Study Area - Baseline		Total Disturbance (Diavik Project)		
	km^2	%	km^2	%	km^2	%loss of Vegetation Land Cover Type in LSA	% loss of Vegetation Land Cover Type in RSA
Heath Tundra	8.70	38	1,674.77	38	3.38	39	0
Heath Tundra 30 to 80% Bedrock	1.65	7	83.51	2	0.75	45	1
Heath Tundra 30 to 80% Boulders	3.84	17	530.82	12	1.70	44	0
Tussock/Hummock	2.70	12	382.12	9	1.48	55	0
Sedge Wetland	0.46	2	134.06	3	0.24	52	0
Riparian Tall Shrub	0.05	<1	3.27	<1	0.03	56	1
Birch Seep and Riparian Shoreline Shrub	0.34	1	55.88	1	0.10	28	0

Vegetation/Land Cover Type	Local Study Area - Baseline		Regional Study Area - Baseline		Total Disturbance (Diavik Project)		
	km^2	%	km^2	%	km^2	%loss of Vegetation Land Cover Type in LSA	% loss of Vegetation Land Cover Type in RSA
Boulder Complex	0.22	1	17.05	<1	0.05	23	0
Bedrock Complex	0.10	<1	4.29	<1	0.07	72	2
Shallow Water	0.98	4	172.22	4	0.46	47	0
Deep Water	3.49	15	1,304.04	30	3.12	90	0
Human Disturbance	0.06	<1	0.26	<1	0.06	100	22
Esker	0.25	1	39.95	1	0.14	55	0
Unclassified	0	0	1.08	<1	-	-	-
Total	**22.84**	**100**	**4,403.32**	**100**	**11.57**	**51**	**<1**

Notes: LSA = Local Study Area; RSA = Regional Study Area; km^2 = square kilometre; < = less than.

Localized changes in plant community composition is expected to occur outside the mine footprint in response to dust deposition and changes in drainage conditions. The effects of dust would be concentrated within 10 m of Project facilities, and mostly limited to within 50 m. Incremental losses (over losses due to the mine footprint) were calculated as being 1% and 9% for each zone of impact, respectively. Effects on vegetation due to changes in drainage were estimated to affect 10% of the LSA. The geographic extent of these changes would be restricted to the LSA, and effects would be up to a moderate magnitude. Effects on vegetation outside the mine footprint are expected to reverse in time but could last more than 25 years and therefore are classified as local residual effects post-closure.

No plant species, vegetation types or terrain type would be eliminated by the mine development. At the landscape level, the number of naturally occurring terrain units may drop, but man-made units would increase, such that a low magnitude local increase in terrain diversity would result. At the community level, the richness (number) of VLC units would decrease by 14%, which represents an effect of moderate magnitude. Introduction of disturbed types could result in an increase, although artificial, in the diversity of community types. The size and range of patches for most VLC types would decrease due to the mine footprint. These changes would have moderate to high magnitude local effects on community structure. At the species level, a reduction of some 44% of species diversity and richness units is expected at the local level. This represents a local loss of high magnitude. However, no rare or endangered species would be affected.

All changes to vegetation and/or terrain biodiversity are expected to have a local geographic extent and be long-term in duration and therefore are classified as local residual effects post-closure.

9.2.3 Wildlife

9.2.3.1 Grizzly Bear

At full mine development, existing grizzly bear habitat availability would be expected to be reduced (through reductions in habitat suitability and effectiveness) by greater than 1% within the LSA but by less than 1% within the RSA, resulting in a high local effect but a low regional effect. Effects are considered to be regional in extent because the zone of influence of sensory disturbances extends marginally beyond parts of the LSA.

At post-closure, the causes of reduced habitat effectiveness (sensory disturbance) would have been largely removed. Nevertheless, there could potentially be a holdover, regional-level effect for some time after the mining activities end due to the learned avoidance responses of individual bears. The impact extent would, therefore, continue to be classified as regional. The effects of reduced habitat suitability through direct habitat loss within the mine footprint would remain at post-closure. These effects directly affect much less than 1% of total grizzly bear habitat in the RSA, resulting in a low magnitude regional impact. Greater than 1% of the total bear habitat in the LSA are affected which is equivalent to a moderate magnitude, local impact. However, the percentage of habitat affected post-closure would be less than during full development.

9.2.3.2 Raptors

Cumulative effects to raptors at full development were anticipated to be moderate in magnitude, based on predicted impacts on areas currently providing high to very high raptor nest site potential. This assessment represents a worst-case scenario, and the actual magnitude of reduced nesting potential would likely be lower than the 1.8% loss estimated in the EA (DDMI 1998d). The magnitude of effects and overall impact rating would be reduced at post-closure because of the removal of sensory disturbances (i.e., zone of influences) and possible gains in habitat suitability from reclamation.

Based on this assessment, cumulative effects at full development would be mid-term in duration, resulting in Level III regional effects. In the worst-case scenario, assuming unsuccessful reclamation and some continuing sensory disturbance, post-closure cumulative effects would be classified as Level IV regional (i.e., moderate magnitude and long-term in duration). However, the removal of sensory disturbance and restoration of suitable nesting habitat post-closure would more reasonably be expected to reverse the direction of impacts to neutral, resulting in a post-closure assessment of no residual effects.

Reclaimed mine sites would likely provide more rugged terrain categories compared to predevelopment conditions. Steep slopes and variable aspects could result from waste rock piles and, with the implementation of proven nest site enhancement techniques at these sites (e.g., ledge creation), raptor nest site potential could potentially be improved. Reclamation could, therefore, result in an increase in area of high to very high nest site potential at post-closure, relative to predevelopment or baseline conditions.

9.2.3.3 Waterfowl

At full development, existing waterfowl staging and nesting habitat availability was expected to be reduced (through reductions in habitat suitability and effectiveness) by greater than 1% within the LSA but by less than 1% within the RSA, resulting in a high (Level IV) local effect but a low (Level I) regional effect on waterfowl. At post-closure, the causes of reduced habitat effectiveness (sensory disturbance) would have been largely removed, but physical impacts on habitat might remain even with successful reclamation. These remaining physical impacts may result in a long-term reduction in the ability of the East Island to support staging and nesting waterfowl. Thus, although the types and extent of impacts would be expected to be reduced at post-closure, the overall effects classification remains the same as at full development.

9.2.3.4 Caribou

Distribution

Long-term changes in the seasonal distribution of caribou are generally the result of long-term changes in habitat availability. Analysis of changes (direct and indirect) in caribou summer habitat availability from mine development and cumulative land use activities has been estimated at high (12.3%) and moderate (2.6%) reductions in the local and RSAs respectively, relative to 1996 baseline conditions. The area of direct habitat loss is within the original EA predictions but the measured zone of influence from monitoring studies is greater than predicted in the EA, resulting in larger habitat changes. Habitat effects would not extend beyond the RSA and would have no influence on the calving and over-wintering distributions of the Bathurst herd. Within the broad migratory corridor and summer range of the herd that encompasses the mine development, the level of measured habitat reduction shows localized shifts in habitat use but no measurable effect on broad seasonal distribution. The duration of this effect on caribou is expected to be mid-term (three to 30 years) and limited to the operations phase. With the removal of the operations stressors of noise and smell the indirect changes to habitat use are expected to be significantly reduced and only direct habitat losses will remain post-closure.

Mortality

The likelihood of injuries to caribou was projected to be very low once the mine sites are closed and post-closure landscapes are finalized. Hunting will continue to be the main source of human-caused mortality under the post-closure scenario.

Based on experiences at other mines, the likelihood of injury or direct mortality from industrial activity in the RSA is anticipated to be low under all conditions. It was assumed that hunting will remain the only significant source of human-caused mortality in the RSA and that hunting mortality will not increase as a result of mine development and operation.

Energetics

Under the post-closure scenario, the predicted paths of least resistance for fall migration returned to the predevelopment route. In the model it was assumed that movement through altered terrain in the mine sites might involve traversing or going around difficult terrain. The magnitude of effects on fall migration was predicted to be slight in the RSA. The overall energy cost of migration for individual caribou encountering the post-closure mine site resulted in an increase of less than 1%.

9.2.3.5 Carnivores

Mine-related decreases in habitat availability for both prey species and denning sites would cause a long-term reduction in the ability of the East Island to support wolves, wolverine and foxes. These decreases in habitat availability would remain post-closure. During the operations phase of the mine, most carnivores would avoid East Island. Red foxes were expected to exhibit a high degree of tolerance to mining activities and might remain as residents on less disturbed portions of East Island, assuming that an adequate prey base also remained. Wolves and wolverine were expected to be less tolerant of mining activities, and might avoid the East Island more than foxes. In either case, these localized shifts in habitat use off the East Island during operations would not represent a measurable shift in the distribution of these species within the RSA. Post-closure the predicted and observed influence of the mine area as an attractant/deterrent to carnivores would be significantly reduced/eliminated.

The mine development would not be expected to have measurable effects on the wolf and fox populations in the RSA during operations. Habitat lost to the mine and its zone of influence would represent a loss of less than 1% of the available hunting habitat in the RSA. Similarly, although at least one and possibly two fox den sites might be abandoned as a result of mining activities, comparable denning areas are widely distributed within the RSA, and the loss of East Island sites would not measurably affect regional denning potential. Direct mortalities from vehicle kills and the relocation of animals were also expected to be minimal, given the environmental management strategies adopted for the mine development. Mine-specific effects on wolves and foxes at the population level are predicted to be low and limited to the operations phase.

Due to uncertainty regarding the current status of wolverine populations and the effectiveness of mitigation, mine-specific effects on wolverines at the population level have been classified as low to moderate. Even moderate level mine-specific effects would not be expected to affect wolverine population parameters beyond regional scale (i.e., within the Slave Geological Province). These effects were also predicted to be limited to the operations phase.

The mine is not expected to contribute measurably to cumulative effects on carnivore populations during operations. Mine-related mortalities are not expected to occur post-closure.

9.2.4 Fish and Water

9.2.4.1 Water Quality

The effect on water quality in Lac de Gras from flooding and breaching the open pits at closure is classified as Level I local effect for both drinking water and the protection of aquatic life. The magnitude was predicted to be negligible to low at for the local geographic extent.

Flooding the open pits at closure is not expected to have an adverse effect on groundwater quality. As mining proceeds, the quality of groundwater improves locally due to an overall decrease in TDS. Concentrations of TDS are expected to be higher near the bottom of the pits, but lower at the sides of the pits resulting in an overall decrease in TDS in groundwater.

Treated mine water discharge during operations introduce higher levels of nutrients, particularly phosphorus from the natural groundwater, to Lac de Gras. Up to 20% of the surface area of Lac de Gras was expected to increase in trophic status during operations. This has also been confirmed by operational monitoring. Effects of increased trophic status include an increase in algal growth, and likely increases in fish growth rates, improvements in fish health. There is also the potential for an increase in the abundance of some aquatic species and a decline in the abundance of others but these effects have not been observed to date. Trophic levels are predicted to decline back to background levels post-closure when mine water discharge ceases.

Containment of runoff during operations effectively prevents any effects on water quality in Lac de Gras during operations. Post-closure, runoff from disturbed areas would be re-directed through East Island streams and lakes to Lac de Gras. Undiluted post-closure runoff water quality may locally exceed thresholds for the protection of aquatic life for total phosphorus and nine metals (copper, aluminum, cadmium, chromium, lead, mercury, nickel, silver and zinc). Therefore, post-closure runoff could have a long-term, high magnitude affect on East Island lakes which receive drainage from reclaimed areas. Aluminum, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc concentrations in post-closure runoff could adversely affect sensitive aquatic organisms in East Island waterbodies. Phosphorus levels in the post-closure runoff could substantially increase the trophic status of affected East Island lakes. However, when runoff reaches Lac de Gras, water quality in Lac de Gras is expected to remain below thresholds for aquatic life for all parameters except total phosphorus, aluminum, cadmium and chromium at the smallest assessment boundary (0.01 km^2). The magnitude of effect would be high for total phosphorus, cadmium and chromium and low for aluminum. The magnitude of the effect from cadmium would remain high at the 1 km^2 assessment boundary, but would be negligible at the 5 km^2 assessment boundary. The geographic extent would be local.

Post-closure runoff water quality is predicted to be below drinking water thresholds for all parameters and so is not expected to impact on drinking water quality on the East Island or in Lac de Gras.

The potential for these effects would be evaluated further based on actual run off monitoring information collected during operations and in advance of final closure.

9.2.4.2 Water Supply

The potential effects of changes to Lac de Gras water levels and outflows on the Coppermine River as a result of flooding the pit and dike areas are expected to be negligible and would not extend beyond closure. No measurable effect (i.e., less than 1% change) is predicted for flow in the Coppermine River downstream from the outlet of Point Lake.

9.2.4.3 Fish Mortality

An effect from angling on fish mortality was the only effect of the mine development that was identified in the EA as lasting beyond closure. Subsequent to the EA, a no fishing policy was adopted at the mine site, eliminating this potential effect.

9.2.4.4 Fish Habitat

The analysis of potential effects of mine infrastructure development on fish-bearing lakes on the East Island predicted that the permanent loss of four fish-bearing lakes on East Island would be an effect of high magnitude and mid-term duration. Habitat enhancement efforts are expected to compensate these losses by providing an overall net gain in fish habitat post-closure. At post-closure, there would be a loss of burbot and longnose sucker habitat because these species were not targeted for habitat restoration in the current mitigation plan. There is also a small reduction in rearing habitat for lake trout. However, the overall amount of habitat created for the remainder of the target management species results in a net creation of inland lake habitat.

Post-closure there is expected to be a small reduction in stream migration corridor habitat on the East Island, a habitat type that only existed under very high flow conditions.

Fish habitat losses in Lac de Gras as a result of mine development and dewatering a portion of Lac de Gras represent a maximum of 1% loss of the available habitat from baseline conditions. Post-closure, habitat enhancements would compensate for these habitat losses, resulting in a net gain in habitat. The effect on fish habitat in Lac de Gras regionally at post-closure would either be no adverse effect, indicating no net reduction or a net gain of habitat, or a negligible effect. All habitat losses at post-closure (i.e., those with negligible effects remaining) would be habitat that is not considered limiting in Lac de Gras (i.e., no post-closure effects on rearing habitat).

9.2.4.5 Fish Quality

The EA analysis determined that the metal concentrations in the flesh of fish in Lac de Gras are not expected to exceed the guidelines for safe human consumption for any fish species examined during operation or post-closure. The analysis further indicated that tainting of fish flesh as a result of the mine development would not be likely. However, post-closure runoff to two lakes on the East Island was predicted to result in elevated metals concentrations in fish flesh in those two lakes. The potential of this effect would be evaluated further based on actual runoff monitoring information collected during operations.

9.2.5 Heritage Resources

Heritage resource sites are non-renewable; as such any effects identified for the mine development would be permanent and remain post closure as residual effects. Effects on heritage resources include loss of artifacts and features, artifact distributions, and loss of site location and site context. These effects would occur at the site, local and regional level of archaeological data. At the 57 sites that fall within the footprint of the mine, the effect of the mine development is a loss of these aspects of heritage resource either through disturbance or burial. Although these adverse effects would be offset by mitigative studies, the physical location of the sites and context would still be lost.

Potential effects on heritage resources can also be positive in that the results of site inventories add to the regional database and contribute to our understanding of past lifestyles and landscape use. This is the case for 138 of the identified sites.

The magnitude of effects on individual sites was classified based primarily on the potential scientific interpretive value and the potential contribution to public awareness and appreciation of heritage resources. Specifically, the magnitude of effect on heritage resources was classified as low if the heritage resources potentially lost are associated with limited scientific interpretive value and with limited potential to contribute to public awareness and appreciation. Effects on heritage resources were classified as moderate if the loss is associated with local and regional scientific interpretive values and with good potential to contribute to public awareness and appreciation. The magnitude of an effect on heritage resources was classified as high if the loss of the heritage resources is associated with regional scientific interpretive values with excellent potential to contribute to public awareness and appreciation.

The magnitude of effect at the local level, for the 57 sites within the mine footprint, would be high. However, with the completion of mitigative studies, loss of data would be offset by information gained. Although at the local level, effects would occur at a high number of precontact quarries, the magnitude of effect would not be high when viewed from the context of regional level of data. Given the nature of heritage resources, the confidence placed in the likelihood of the predicted effects occurring is high.

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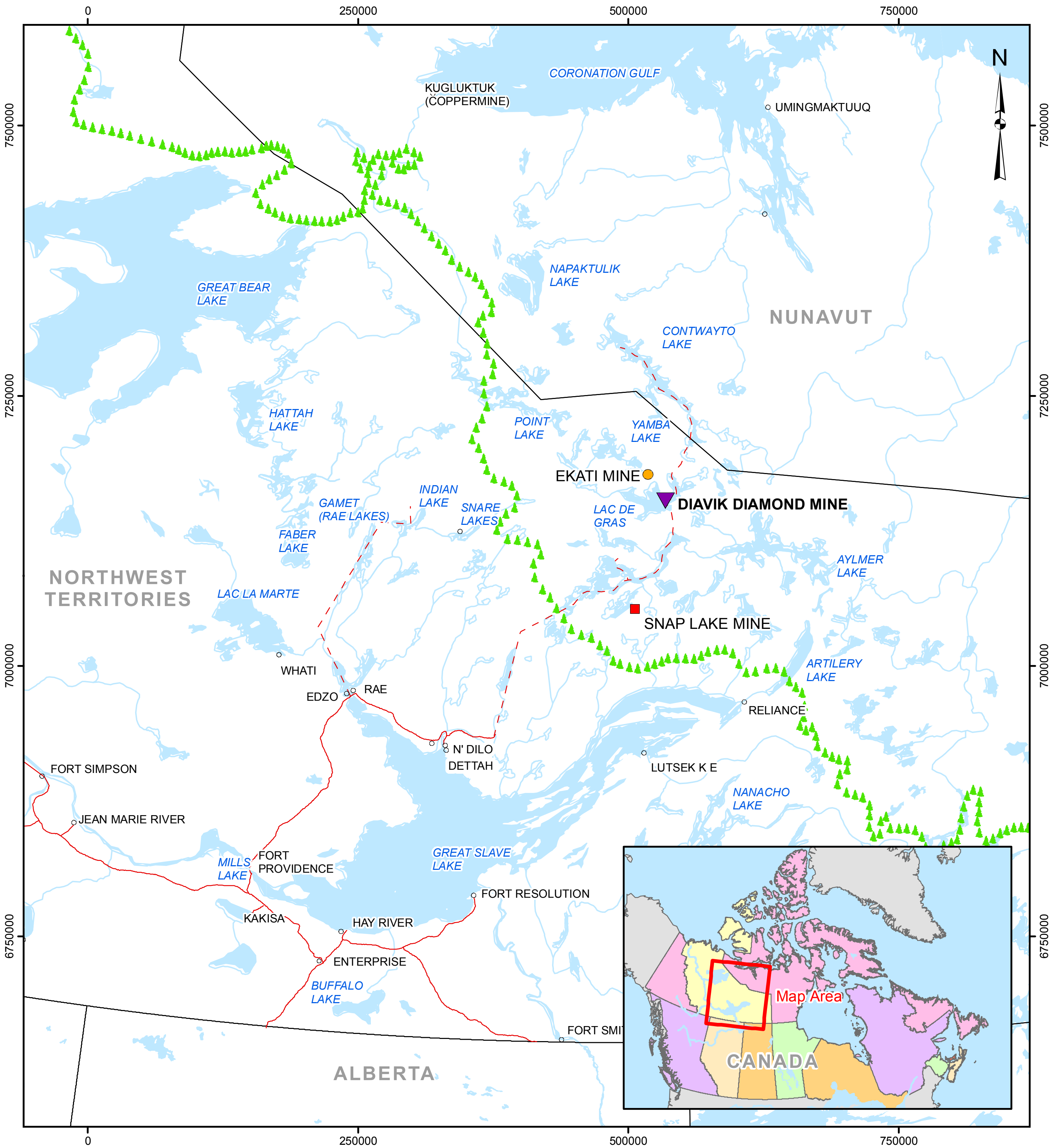
FIGURE ANNEX



LEGEND

- COMMUNITY
- DIAVIK DIAMOND MINE
- EKATI MINE
- SNAP LAKE MINE
- ALL WEATHER ROADS
- TREELINE
- WATERCOURSE
- WINTER ROADS
- PROVINCIAL BOUNDARY
- WATERBODY

REFERENCE

Projection: UTM Zone 12 Datum: NAD 83

150 0 150

SCALE 1:5,000,000 KILOMETRES

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

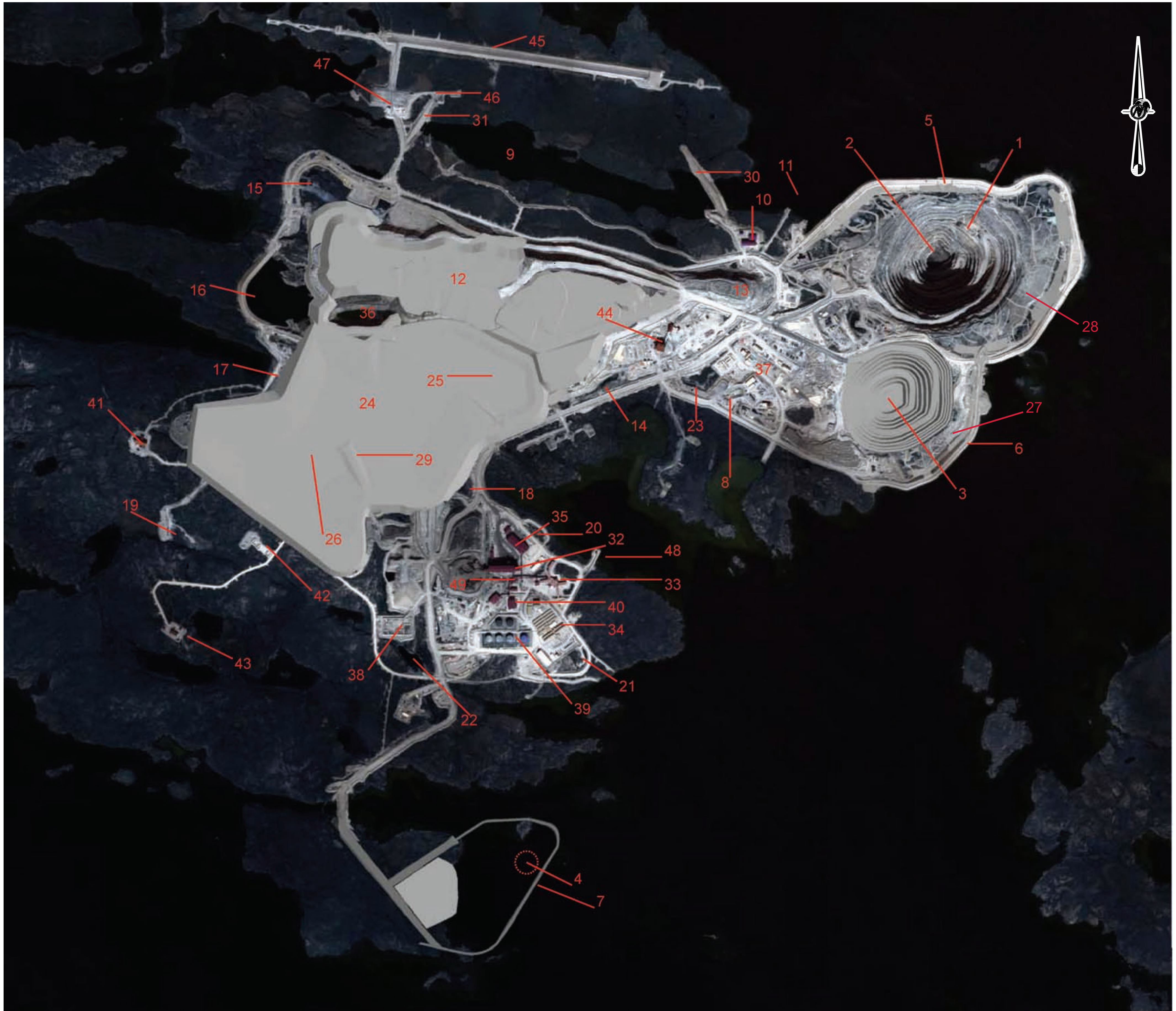
TITLE

LOCATION OF DIAVIK DIAMOND MINE

DIAVIK DIAMOND MINES INC.

PROJECT No. 09-1328-0021			SCALE AS SHOWN	REV. 0
DESIGN	TD	18 Nov. 2009		
GIS	CW	24 Nov. 2009		
CHECK	TD	24 Nov. 2009	FIGURE: 2-1	
REVIEW	GM	24 Nov. 2009		

I:\2009\09-1328\09-1328-0021\Mapping\MXD\2009AEMPUpdate\09-1328-0021 Fig 2-1 Location of Diavik Diamond Mine.mxd



LEGEND

1	A154N Kimberlite
2	A154S Kimberlite
3	A418 Kimberlite
4	A21 Kimberlite
5	A154 Dike
6	A418 Dike
7	Sediment Control Structure
8	Underground Portal
9	North Inlet
10	North Inlet Water Treatment Plant
11	Submerged Discharge Line
12	Wasterock Area
13	Till Area
14	Pond 1
15	Pond 2
16	Pond 3
17	Pond 4
18	Pond 5
19	Pond 7
20	Pond 10
21	Pond 11
22	Pond 12
23	Pond 13
24	Processed Kimberlite Containment Area
25	Coarse Processed Kimberlite Area
26	Fine Processed Kimberlite Araea
27	A418 Fish Habitat
28	A154 Fish Habitat
29	South Barge Access Road
30	North Inlet East Dam
31	North Inlet West Dam
32	Process Plant
33	Accomodation Complex
34	South Camp
35	Maintenance Complex
36	Inert Landfill
37	North Construction Area
38	Waste Transfer Area
39	Fuel Storage
40	Power Plants
41	Amminium Nitrate Storage
42	Caps/Explosives Storage
43	Emulsion Plant
44	Paste Plant and Crusher
45	Airstrip
46	Helipad
47	Terminal Building
48	Raw Water Intake
49	Sewage Treatment Plant

REFERENCE

IMAGE PROVIDED BY DDMI.

500 0 500

SCALE METRES

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

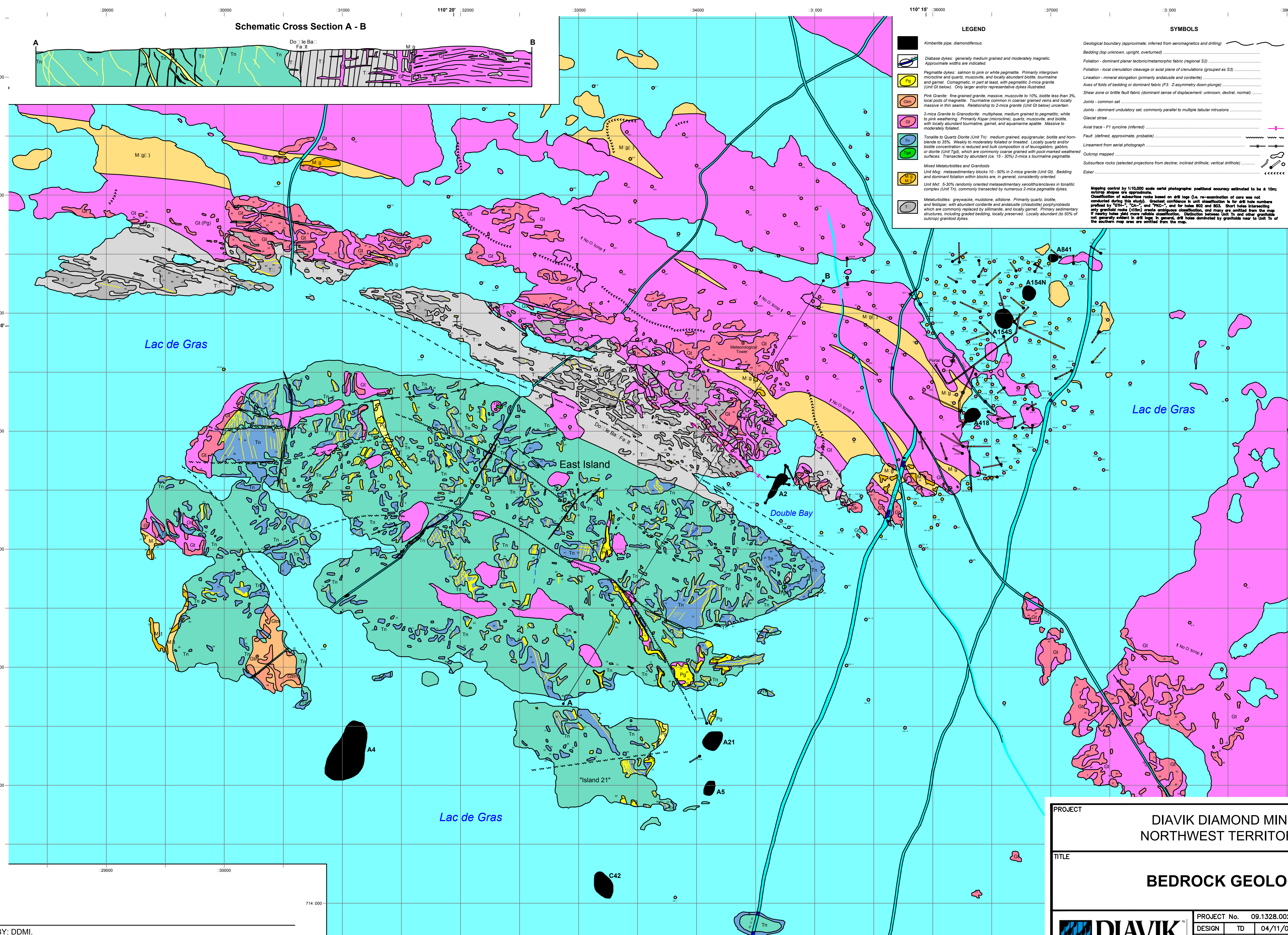
TITLE

SITE MAP

DIAVIK DIAMOND MINES INC.

PROJECT		09.1328.0021	FILE No.	0913280021C001
DESIGN	TD	04/11/09	SCALE AS SHOWN	REV. 0
CADD	TRE	26/11/09		
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE: 2-2



REFERENCE

BASE PLAN PROVIDED BY: DDMI.
TITLED: BEDROCK GEOLOGY OF EAST ISLAND, LAC DE GRAS.
DATED: JULY, 199□

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

BEDROCK GEOLOGY

DIAVIK DIAMOND MINES INC.

PROJECT No.	09.1328.0021	FILE No.	0913280021C005
DESIGN	TD	04/11/09	SCALE N.T.S.	REV. 0
CADD	JEF	17/11/09	
CHECK	TD	13/12/10	FIGURE 3-6
REVIEW	GM	13/12/10	

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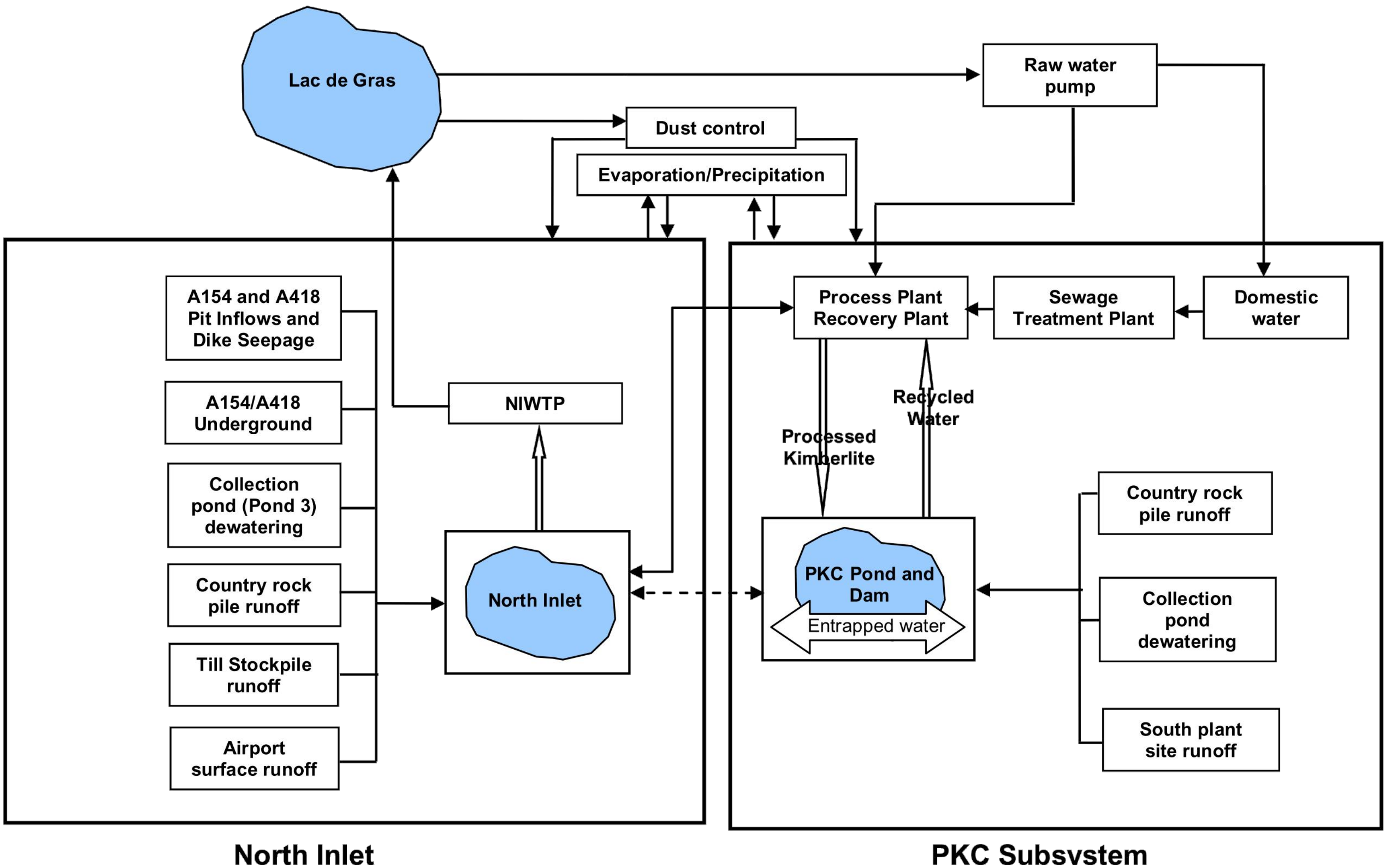


SCHEMATIC ONLY, NOT TO SCALE

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

CONCEPTUAL WATER MANAGEMENT SYSTEM

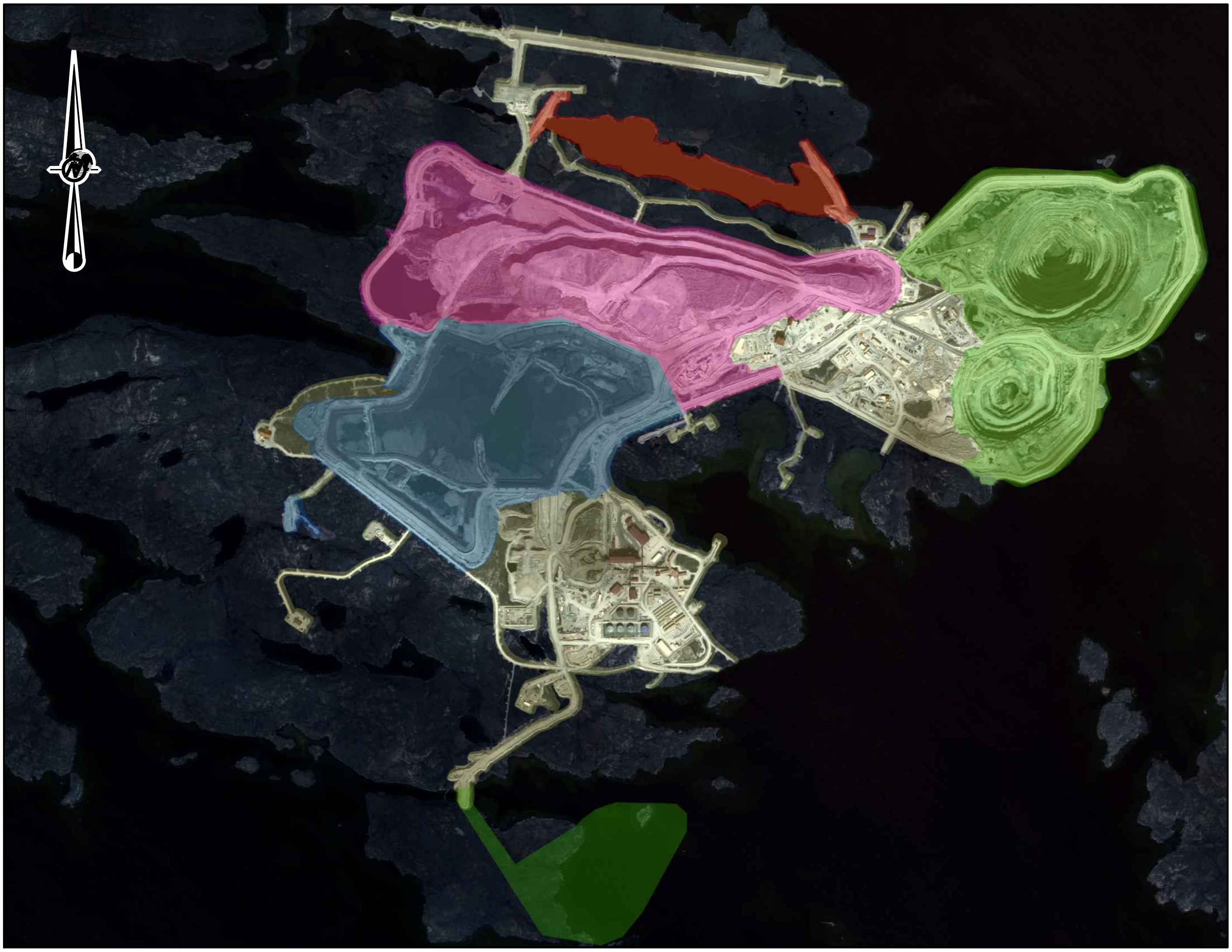
DIAVIK DIAMOND MINES INC.

PROJECT No. 06-1328-0021			FILE No.	0913280021C019
DESIGN	TD	30/10/09	SCALE N.T.S.	REV. 0
CADD	TRE	26/11/09		
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE 4-2

NOTES

SOUTH COUNTRY ROCK PILE PONDS NOT INCLUDED.



LEGEND

- MINE INFRASTRUCTURE AREAS
- NORTH INLET AREA
- OPEN PIT, UNDERGROUND AND DIKE AREAS
- PKC AREA
- WASTEROCK AND TILL AREA

1 0 1

SCALE (APPROX.) KILOMETRES

SOURCE

IMAGE PROVIDED BY DDMI

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

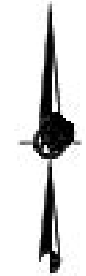
TITLE

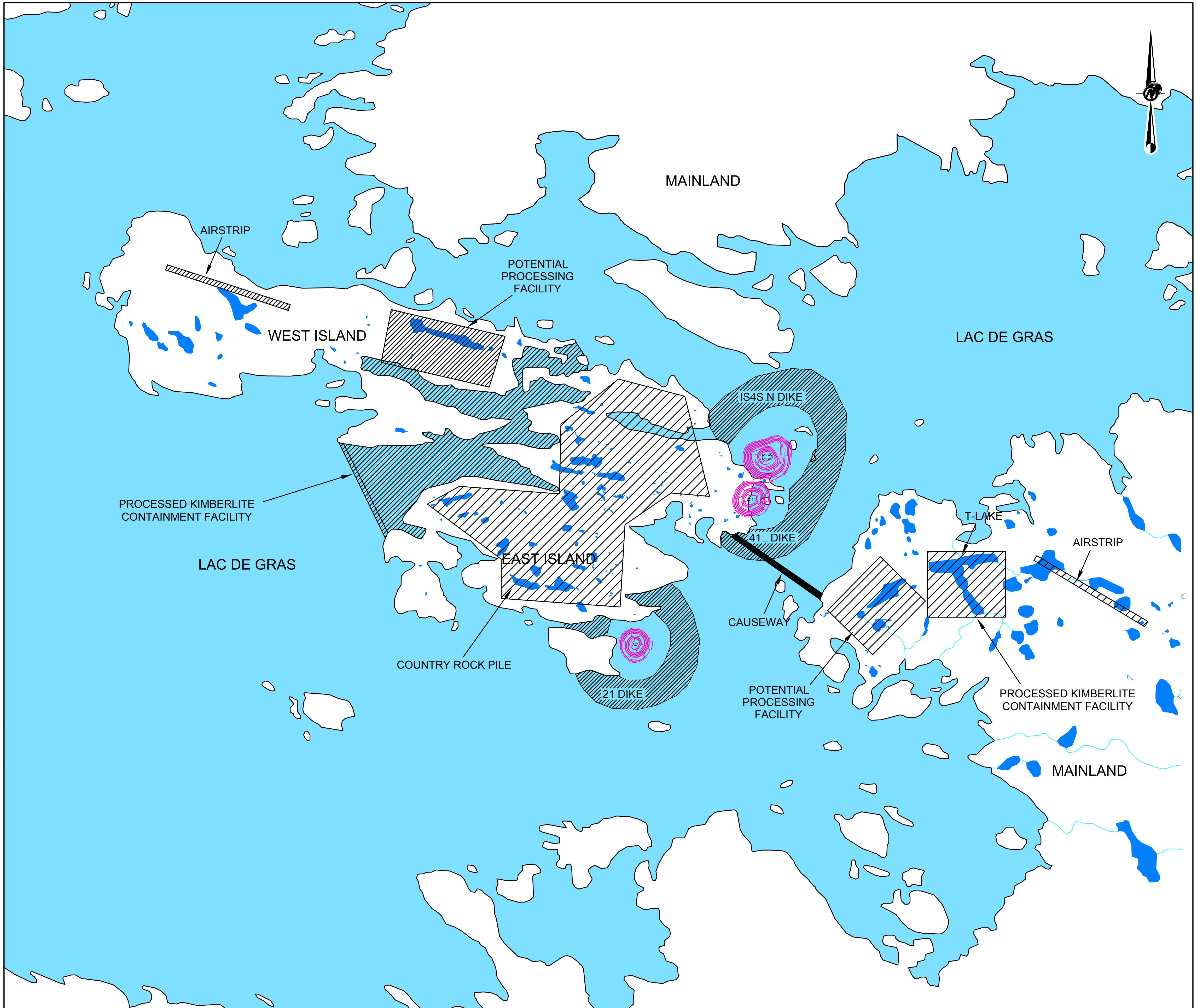
AREA DESIGNATIONS FOR CLOSURE PLANNING

DIAVIK DIAMOND MINES INC.

PROJECT		09.1321.0028	FILE No.	0913280021C020
DESIGN	TD	28/10/09	SCALE AS SHOWN	REV. 0
CADD	JEF	13/11/09		
CHECK	TD	13/12/10	**FIGURE: 5-1**	
REVIEW	GM	13/12/10		

FIGURE 5-6a
PRE-DEVELOPMENT
(2000)





LEGEND

- LAC DE GRAS OPTION
- T-LAKE OPTION

REFERENCE

NATIONAL TOPOGRAPHICAL DATA BASE SETS 76C AND 76D, FIRST EDITION.

1.5 0 1.5
SCALE KILOMETRES

PROJECT

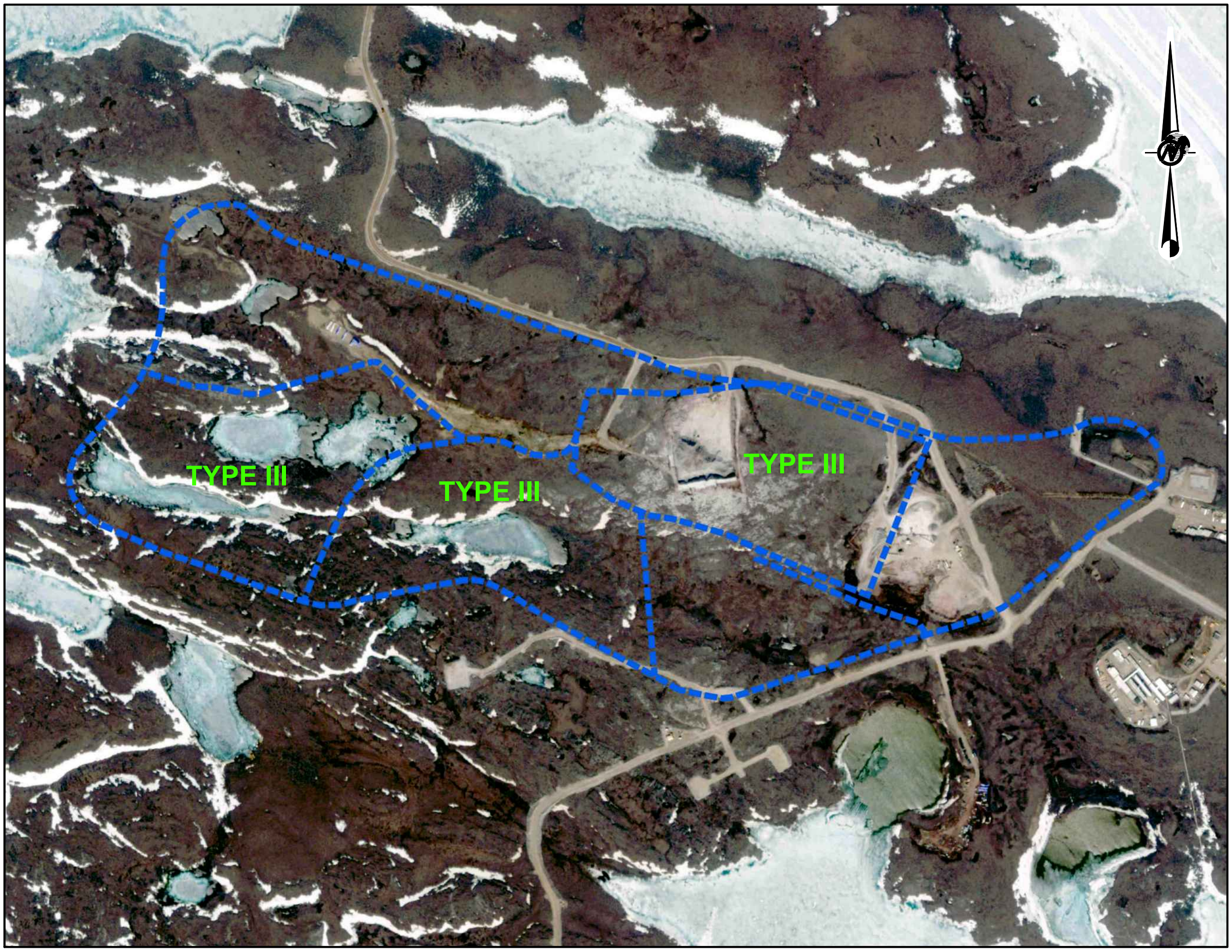
DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

PROCESSED KIMBERLITE CONTAINMENT AND WASTE ROCK ORIGINAL SITING OPTIONS

DIAVIK DIAMOND MINES INC.

PROJECT		09.1328.0021	FILE No.	0913280021C026
DESIGN	TD	04/11/09	SCALE AS SHOWN	REV. 0
CADD	RML	12/11/09		
CHECK	TD	13/12/10	FIGURE: 5-7	
REVIEW	GM	13/12/10		



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SCALE (APPROX.) KILOMETRES

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

WASTE ROCK TILL AREA DRAINAGE BASINS

DIAVIK DIAMOND MINES INC.

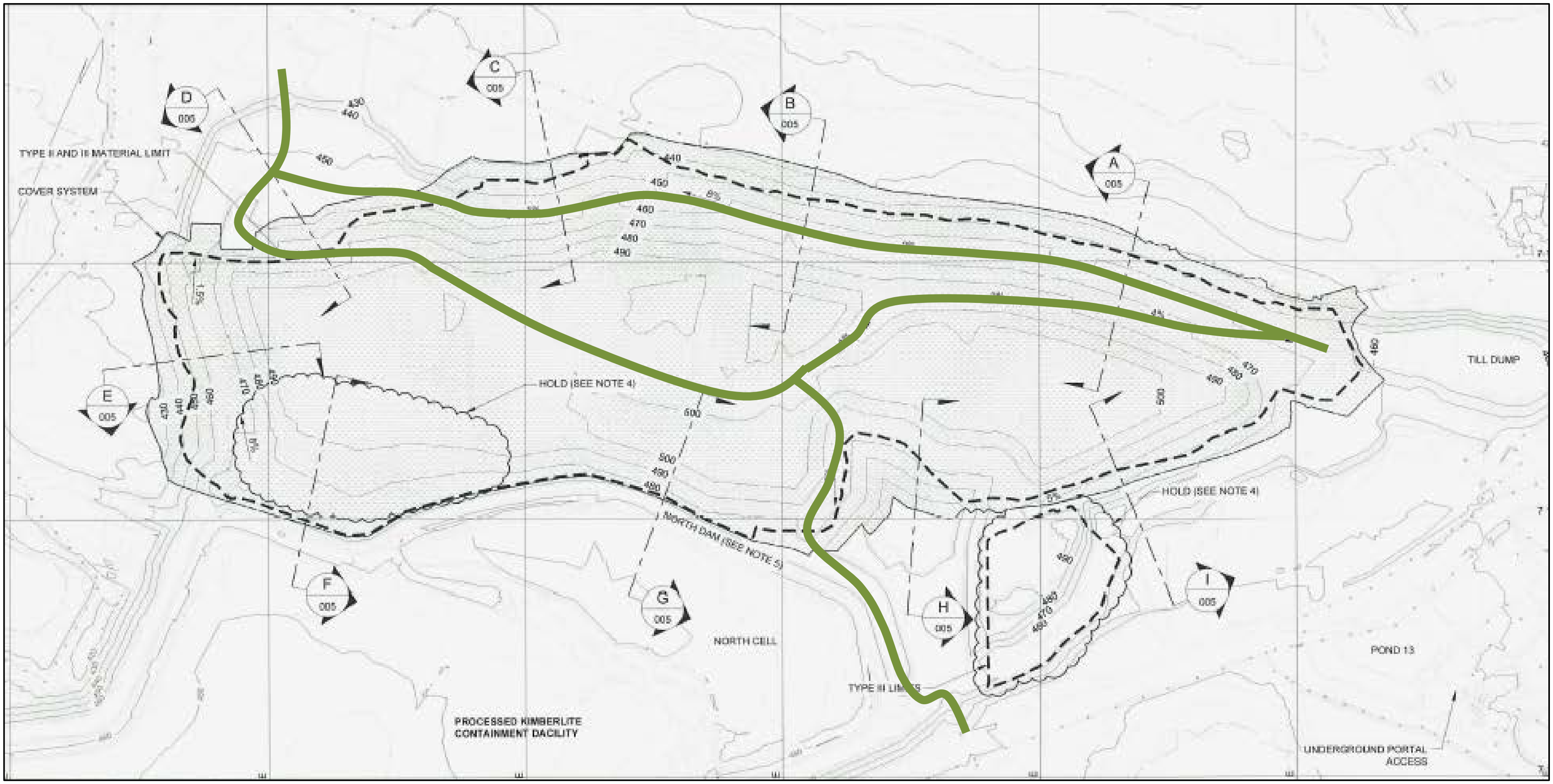
PROJECT		09.1328.0021	FILE No.	0913280021C027
DESIGN	TD	28/10/09	SCALE AS SHOWN	REV. 0
CADD	TRE	25/11/09		
CHECK	TD	13/12/10	FIGURE: 5-8	
REVIEW	GM	13/12/10		

SOURCE

IMAGE PROVIDED BY DDMI

L:\2009\1328 YKnife\09-1328-0021\11000\Report C 11100\Fig 5-8 0913280021C027 Waste Rock and Till Area - Drainage Basins.dwg Dec 15, 2010 - 10:02am

Figure 5-9. Caribou pathways through North Country Rock Pile closure landscape.



Activity	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Type 1 re-mining	■														
Pre-closure photography	■														
Reslope		■	■												
Till cover placement			■	■											
Rock cover placement						■	■								
Geotechnical inspections	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seepage/Run-off monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Dust monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Wildlife Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Construction reporting		■	■	■		■	■								
Reclamation Completion Report								■							
Performance Assessment Report										■					

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

CLOSURE ACTIVITY SCHEDULE
WASTE ROCK AND TILL AREA

DIAVIK DIAMOND MINES INC.

PROJECT No.	09.1328.0021		FILE No.	0913280021C029
DESIGN	TD	25/11/09	SCALE N.T.S.	REV. 0
CADD	JEF	03/12/10		
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE 5-10

Activity	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Underground A418/A154	■	■	■	■	■	■	■	■	■						
Open-pit Mining - A21			■	■	■	■	■	■							
Dump Development - SCRP			■	■	■	■	■	■							
Re-Mining NCRP	■														
PK Deposition	■	■	■	■	■	■	■	■	■						
Mine Water Treatment	■	■	■	■	■	■	■	■	■						
Accomodation/Power/Transportation Required	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Winter Road	■	■	■	■	■	■	■	■	■	■	■			■	■
Engineering/Environmental Studies	■		■	■	■			■							
Community & Regulator Engagement	■	■	■	■	■	■	■	■	■		■			■	■
Final Design Concepts/Decomissioning Plan	■														
Detailed Engineering	■					■	■								
Wildlife Access, Contouring, Cover - Wasterock and Till		■	■	■	■	■	■		■						
Inventory of Assets							■	■							
Commercial Arrangements - Sale/Transfer of Assets								■	■						
Complete Fish Habitat Construction								■	■						
Decomission Collection Ponds 1,2,3								■	■						
PKC Outlet Preparation									■						
Placement of Final Surface and Wildlife Access - PKC									■	■					
Decomission Surface Mine Infrstructure									■						
Decommision Underground										■					
Decomission Process and Paste Plants										■					
Decomission Explosives Plant and Storage										■					
Flood Mine Areas - Clarify Water									■	■	■	■			
Decomission Accomodation and Other Buildings										■					
Decomission Fuel Storage and Power										■					
Decomission Collection Ponds 4,5,6,7											■				
Decomission Dikes/Sediment Control Structure												■			
PKC Infrastructure Decomissioning										■					
Decomission Waste Transfer														■	
Decomission Roads, Plantsite, Laydown												■	■		
Decomission Collection Ponds & Pipelipeline 10,11,12,13													■	■	
Decommision North Inlet East Dam															■
Decomission Final Camp, Airstrip and Landfill														■	■

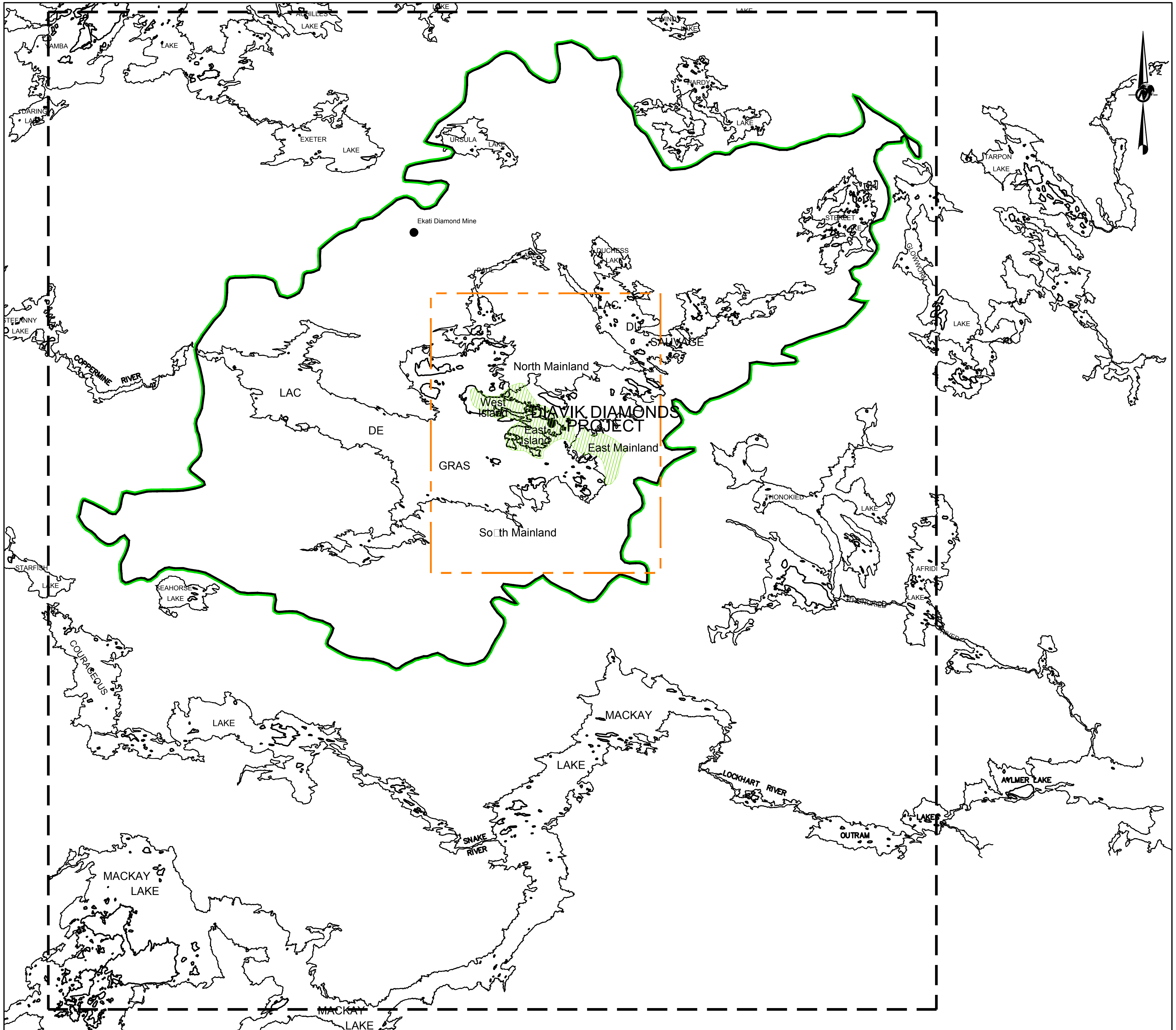
PROJECT
DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE
INTEGRATED SCHEDULE OF ACTIVITIES PERMANENT CLOSURE

DIAVIK DIAMOND MINES INC.

PROJECT No.		09.1328.0021	FILE No.	0913280021C042
DESIGN	TD	25/11/09	SCALE N.T.S.	REV. 0
CADD	JEF	25/11/09		
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE 8-1



LEGEND

- WILDLIFE
- VEGETATION AND TERRAIN
- FISH AND WATER
- HERITAGE RESOURCES
- AIR QUALITY

REFERENCE

NATIONAL TOPOGRAPHICAL DATABASE
SETS 76C, 76D, 7□M and 7□N
FROM GEOMATICS CANADA

10 0 10
SCALE KILOMETRES

PROJECT
DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

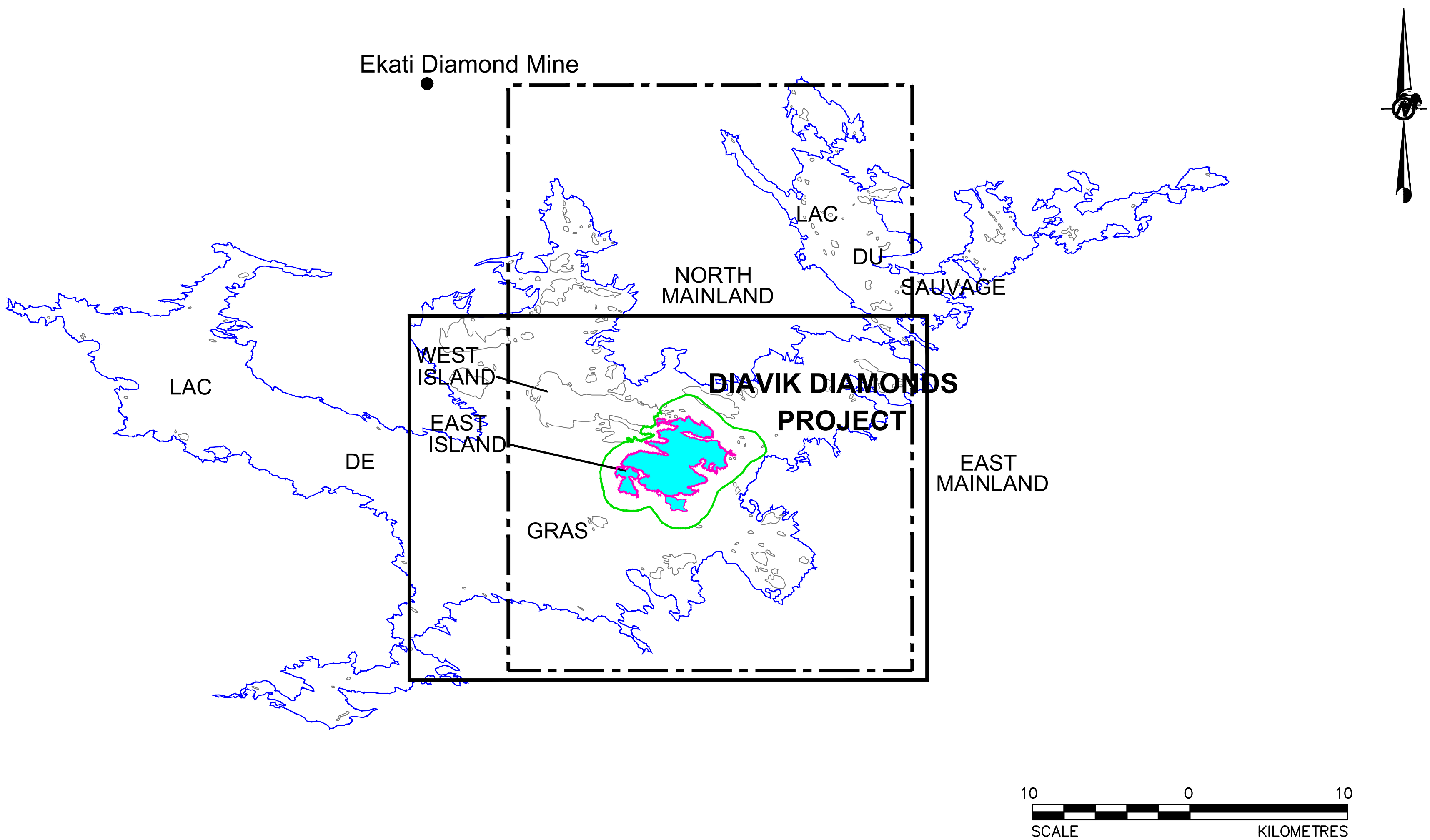
TITLE
REGIONAL / CUMMULATIVE STUDY AREAS

DIAVIK DIAMOND MINES INC.

PROJECT		09.1328.0021	FILE No.	0913280021C043
DESIGN	TD	04/11/09	SCALE AS SHOWN	REV. 0
CADD	TRE	26/11/09		
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE: 9-1

L:\2009\1328 YKnife\09-1328-0021\11000\Report C 11100\Fig 9-2 0913280021C044 Local Study Area.dwg Dec 15, 2010 – 10:04am



LEGEND

- HERITAGE RESOURCES
- AIR QUALITY
- WILDLIFE LOCAL
- FISH AND WATER
- VEGETATION AND TERRAIN

REFERENCE

NATIONAL TOPOGRAPHICAL DATA BASE SETS 76C AND 76D, FIRST EDITION
SOURCE: Fedirch□k McC□llo□gh □ Associates Ltd.., 199□

PROJECT
DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE
LOCAL STUDY AREA

DIAVIK DIAMOND MINES INC.

PROJECT		09.1328.0021	FILE No.	0913280021C044
DESIGN	TD	11/11/09	SCALE AS SHOWN	REV. 0
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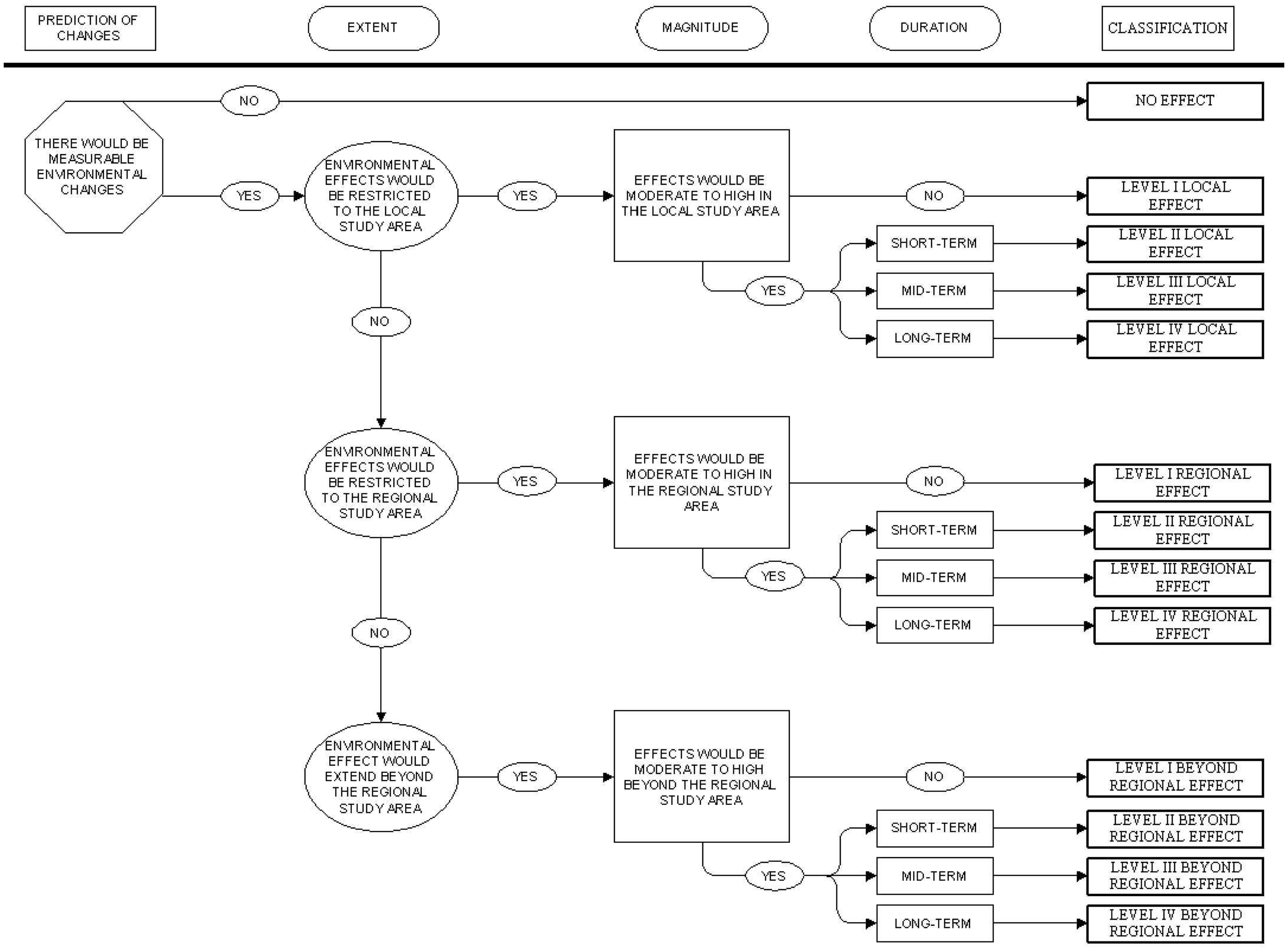
CHECK	TD	13/12/10		
REVIEW	GM	13/12/10		

FIGURE: 9-2



SCHEMATIC ONLY, NOT TO SCALE

NOTES:

1. AN EFFECT MAY BE CLASSIFIED FOR MORE THAN ONE STUDY AREA (E.G., A REGIONAL EFFECT MAY ALSO BE CLASSIFIED AS A LOCAL EFFECT).
2. EFFECT CLASSIFICATIONS ARE RANKED FROM I TO IV WITH LEVEL I BEING THE LOWEST EFFECT LEVEL AND LEVEL IV BEING THE HIGHEST EFFECT LEVEL.
3. ONLY ADVERSE EFFECTS ARE CLASSIFIED.

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

EFFECTS CLASSIFICATION FLOW CHART

DIAVIK DIAMOND MINES INC.

PROJECT No.		09.1328.0021	FILE No.	0913280021C045
DESIGN	TD	04/11/09	SCALE N.T.S.	REV. 0
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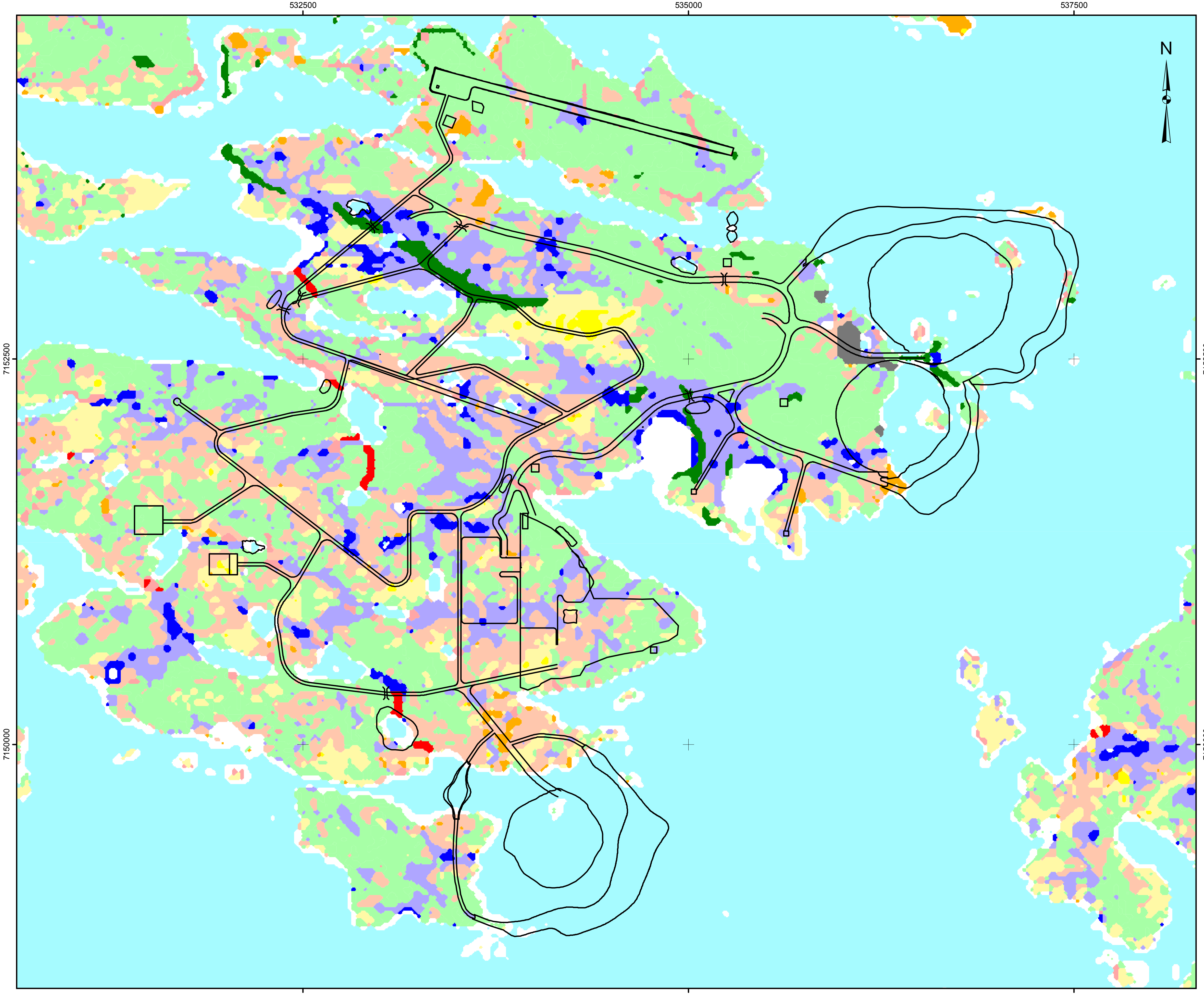
CHECK	TD	13/12/10	FIGURE 9-3	
REVIEW	GM	13/12/10		



LEGEND

DIAVIK FOOTPRINT

LAND COVER CLASSIFICATION

- HEATH TUNDRA
- HEATH TUNDRA 30-80% BEDROCK
- HEATH TUNDRA 30-80% BOULDERS
- TUSSOCK/HUMMOCK
- SEDGE WETLAND
- RIPARIAN TALL SHRUB
- BIRCH SEEP AND RIPARIAN SHORELINE SHRUB
- BOULDER COMPLEX (<80% ROCK)
- BEDROCK COMPLEX (<80% ROCK)
- SHALLOW WATER
- DEEP WATER
- HUMAN DISTURBANCE
- ESKER

REFERENCE

Projection: UTM Zone 12 Datum: NAD 83

1 0 1
SCALE 1:25,000 KILOMETRES

PROJECT

DIAVIK DIAMOND MINES
NORTHWEST TERRITORIES

TITLE

VEGETATION LAND COVER WITHIN THE LOCAL STUDY AREA AND MAXIMUM MINE OPERATION (YEAR 2018)

DIAVIK DIAMOND MINES INC.

PROJECT No. 09-1328-0021			SCALE AS SHOWN	REV. 0
DESIGN	TD	20 Nov. 2009	**FIGURE: 9-4**	
GIS	CW	20 Nov. 2009		
CHECK	TD	24 Nov. 2009		
REVIEW	GM	24 Nov. 2009		

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