APPENDIX C
Open Pit Erosion Risk Assessment Part 1

TECHNICAL MEMORANDUM

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GIANT MINE REMEDIATION PROJECT – EROSION RISK ASSESSMENT OF OPEN PITS

The Giant Mine Remediation Project (GMRP) includes eight open pits. WSP Canada Inc. was requested by Public Services and Procurement Canada (PSPC) to complete an erosion risk assessment of the open pits located throughout the Giant Mine Project (the Site).

Although mining at the Giant Mine was primarily conducted underground, eight open pits were mined from surface during later operations. The pits are currently open excavations with exposed slopes of rock, and piles of waste rock or overburden materials in the base of the pit. The open pits are complex. The remnant steep blasted bench faces on the pit slopes create hazards to people and wildlife. Additionally, Baker Creek runs adjacent to most of the open pits; flooding of Baker Creek could result in water entering the open pits and subsequently the underground, potentially causing increased minewater elevation, potential destabilization of the underground, or loss of arsenic containment. Further, the open pits are situated above the underground mine. Underground development excavations and stopes associated with historical underground mining were intersected during subsequent mining of the open pits.

The eight open pits at the Site are shown on Figure C.1 1 and listed below:

- A1 Pit (Section 2.0)
- A2 Pit (Section 3.0)
- B1 Pit (Section 4.0)
- B2 Pit (Section 5.0)
- B3 Pit (Section 6.0)
- B4 Pit (Section 7.0)
- C1 Pit (Section 8.0), and
- Brock Pit

Brock Pit has been developed as a quarry and will continue to be used as a borrow source. Use and reclamation of Brock Pit is therefore addressed in the Borrow Design Plan. Brock Pit is not included in the Open Pit Design Plan or this Erosion Risk Assessment.

The main activities associated with the closure of the seven open pits are as follows:

- backfill existing openings to surface inside of open pits that are connected to the underground.
- backfill open pits with a combination of borrow and contaminated granular fill from the Site.
- place highly contaminated granular fill, containerized roaster wastes and contaminated granular fill into the B1 Pit
- establish drainage through contaminated granular fill to the underground.
- place engineered cover over backfilled open pits.
- recontour remnant rock highwalls above pit covers to a safe slope.
- install diversion channels to minimize runoff on pit covers where needed.
- install cover drainage outlets to the receiving environment

This erosion risk assessment addresses active-remediation conditions as well as post-closure conditions, after completion of remediation activities.

1.0 METHODS

The assessment methods follow those presented in the GMRP Erosion and Sediment Management and Monitoring Plan, Version 3.0 (Erosion and Sediment MMP; CIRNAC 2023a), including Steps 1 to 3 as presented in Sections 4.1.1 to 4.1.3 of the Erosion and Sediment MMP.

1.1 Step 1: Complete Background Information

Assemble background information for the proposed work to support the assessment of drainage and erosion potential of the area and assist with subsequent selection of mitigation measures to be implemented on and downstream of the proposed works. Background information to collect includes:

- Nearby areas sensitive to activity.
- Contaminated areas that must be managed more stringently than uncontaminated areas.
- Critical areas that are not to be disturbed, including vegetation that can be preserved near the activity.
- Nearby watercourses and riparian areas, including connectivity (e.g., direct, indirect, or not connected) from the disturbed area.
- Relevant design and geotechnical information.

Background information is presented in each section and site maps are located in Appendix C.1 of this memorandum.

1.2 Step 2: Erosion Potential Evaluation

The erosion potential evaluation involves characterizing drainage, topography (slopes) and soil types in the vicinity of the activity. When determining the potential soil erosion, the upstream catchment inflow and local runoff area within the project boundary was considered. Additionally, only the most critical slope within the project boundary was considered for areas with inconsistent grading.

1.2.1 Drainage Analysis Summary

A summary of the drainage conditions should be prepared by:

- delineating sub-basin areas in the activity area
- identifying adjacent watercourses and waterbodies
- delineating floodplains
- identifying special areas (e.g., permafrost)
- identifying preliminary erosion potential based on the erosion potential map presented in the Erosion and Sediment MMP

1.2.2 Slope Analysis Summary

The slope conditions of areas to be exposed should be assessed to estimate the potential sediment loss from a given area. Exposed areas generally include all cut and fill slopes as well as large stockpiles and non-dugout borrow sources. It may be necessary to divide a slope area by drainage breaks and/or soil type. The following parameters should be characterized:

- soil types
- permafrost
- special areas including locations of potential slope instability, seepage, or contamination

1.2.3 Site Erosion Potential Classification

In addition to soil type, permafrost, and special areas, the erosion potential classification should be summarized for the general conditions of the Site and for each distinctly separate soil/slope areas to be encountered at the construction area. Erosion potential in tonnes per hectare per year (t/ha/yr) should be estimated; values of less than 11 t/ha/yr are classified as low; values between 11 and 22 t/ha/yr are classified as moderate; and values greater than 22 t/ha/yr are classified as high. TAC (2005) provides a screening tool to classify erosion potential based on the parameters identified in Table 1.

Table 1: Erosion Potential based on Slope Length, Slope Gradient and Soil Erodibility Rating

Slope Gradient	Soil Erodibility[(a)]	Slope Length	
		< 70 m	> 70 m
< 10%	Low	Low	Low
	Medium	Low	Moderate
	High	Moderate	High
10 to 20%	Low	Low	Moderate
	Medium	Moderate	High
	High	High	High
> 20%	Low	Moderate	Moderate
	Medium	High	High
	High	High	High

(a) Bedrock areas are considered non-erodible in the Erosion and Sediment MMP.

1.3 Evaluation of Consequence

Risk is an expression of the probability that an activity will cause harm and the consequence or significance of that event. This can be a qualitative or quantitative assessment. The consequence of erosion and sedimentation (either from lack of mitigation or failure of mitigation measures) is then examined based on the following:

- **Ecological Consequences** – ecological consequences are tied to the potential for adverse effects on the natural receiving environment for runoff from the area of the activity. This will be expressed as low or high. At the Site, these adverse effects could be related to sediment release or increases in concentrations of arsenic or other contaminants. Effectively, any activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay or any other fish-bearing waterbody should receive a consequence rating of "high". Activities with runoff captured within the mine closed-circuit area, and ultimately reporting to the underground mine pool or a tailing containment area, could receive a consequence rating of "low".
- **GMRP Consequences** – schedule, cost, and timing implications resulting from the need to respond to and repair any damage caused by erosion or sediment deposition. This will be expressed as low or high.
- **Legal or Regulatory Consequences** – the deposition of sediment in receiving waterbodies and ecologically significant areas can result in legal action and fines. This will be expressed as unlikely (low) or likely (high).

If any of these risks are considered high, then the overall consequence is rated as high. Earthworks or other activities in areas that introduce a high potential for mobilization of arsenic-contaminated soils (i.e., those with arsenic concentrations that are sufficiently high to be identified for remediation activities) will automatically trigger a consequence rating of "high".

For an activity to have a low consequence rating for erosion and sedimentation there should be:

- No ecologically sensitive area, such as waterbodies, riparian, or terrestrial areas, which could be disturbed by discharges of sediment-laden water from the construction area.
- GMRP costs or schedule would not be significantly affected by an erosion or sedimentation event.
- No risk of legal or regulatory consequences.

This rating will inform the Level of Effort as presented in Section 1.4.

1.4 Level of Effort

Table 2 combines the erosion potential evaluation described in Section 1.2 with the consequence evaluation described in Section 1.3. Higher levels of efforts in erosion control are appropriate for higher levels of risk.

Selection of specific BMPs will be part of development of Construction Plans, but in general the intensity of application will depend on the risk (i.e., combination of erosion potential and consequence) associated with the activity.

- At a minimum, all activities with a potential for soil disturbance will require application of procedural BMPs.
- Apart from low erosion potential / low consequence activities, formal documentation will be required, including some application of structural (i.e., erosion control and/or sediment control) and water management BMPs.
- High consequence activities, except those with low assessed erosion potential, will require consideration of staged construction / progressive rehabilitation, to minimize the amount of exposed soil at any given time, as well as more intensive sediment control practices (e.g., detention and/or isolation measures).

Table 2: Level of Effort Required for Mitigation and Monitoring

		Level of Erosion and Sediment Control						
Site Assessment and Evaluation		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

Detailed descriptions for all levels of erosion and sediment control can be found in the Erosion and Sediment MMP, a brief summary of which includes:

- **Procedural BMPs**—These apply to all GMRP reclamation activities and include site management, scheduling, and permafrost BMPs.
- **Formal ESC Plan and structural BMPs**—A formal ESC Plan will include this risk assessment, as well as identification and instructions for application of erosion control and sediment control BMPs. The latter may be included as part of the Environmental Protection Plan for the activity.
- **Water management BMPs**—These are necessary to manage runoff from the disturbed area to downstream watercourses or other areas.

- **Staged construction and progressive rehabilitation**—These are for larger scale project areas, the scheduling BMPs in the Erosion and Sediment MMP should be considered. All activities of larger scale and longer duration are to minimize exposed soils present at any point in time.
- **More intensive sediment control BMPs**—Sediment control measures are tangible methods to be applied in or around water near the location on the Site where work is being completed. They are required when the risk assessment identifies the potential for sediment to enter nearby waterbodies. These mitigations can be temporary or permanent. Erosion and Sediment MMP identifies sediment settling and filtration options. During dry conditions, it may also be necessary to apply dust control measures to prevent mobilization by wind.
- **Visual monitoring of ESC measures**—Visual inspections should be performed on regular intervals.
- **Water quality monitoring (TSS and turbidity)**—Water quality monitoring should be considered. The general framework is that water monitoring would occur in a layered manner, with samples collected on-site near the activity, and immediately downstream of the activity before it enters Trapper Creek, Baker Creek, Baker Pond, or Yellowknife Bay. It may be sufficient to conduct visual monitoring to ensure no water is released to the environment for disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system.

Note that all in-stream work is considered as high erosion potential and high consequence, due to the risk of mobilizing fine sediments. Work in in-stream and riparian areas may require specific mitigation and monitoring procedures to avoid or mitigate impacts to fish and fish habitat and may require and review and approval from DFO.

Surface runoff will be managed per the water management strategy outlined in the Water MMP. Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

2.0 A1 PIT

A1 Pit is located west of Baker Creek between A2 Pit to the south and C1 Pit to the north, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for the A1 Pit area were completed for both active-remediation (Section 2.2) and post-closure (Section 2.3) conditions.

2.1 A1 Pit Background Data

Data and information considered in this assessment for A1 Pit are presented in Table 3. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 3: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 8
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
	Local area geotechnical information	Borehole locations and borehole logs are provided in Appendix C.2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

2.2 A1 Pit Active-Remediation

2.2.1 A1 Pit Erosion Potential Evaluation

2.2.1.1 Drainage Analysis Summary

A summary of the A1 Pit drainage analysis is provided in Table 4.

Table 4: Drainage Summary at A1 Pit

Item	Description
Sub-basin delineation	The local drainage area of A1 Pit prior to remediation is approximately 63.1 ha. This includes diversion ditches that presently convey high turbidity runoff to the underground mine pool via A1 Pit.
Adjacent watercourses and waterbodies	Baker Creek runs 30 m to the east.
Floodplain delineation	A1 Pit is separated from Baker Creek's floodplain by an access road.
Special areas	The A1 Pit boundary overlaps with 0.1 ha of contaminated soils area, with an additional 0.5 ha within the floodplain shown in in Appendix C.1; Figure C.1 8.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion potential for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to moderate (11 - 22 t/ha/yr).

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

2.2.1.2 Slope Analysis Summary

2.2.1.2.1 Soil Types

No boreholes were identified within the A1 Pit boundary; however, nine boreholes were identified within the A1 Pit catchment area; borehole logs and locations are found in Appendix C.1 and Appendix C.2. A summary of these boreholes include:

- A1-4: Silty clay (0.76 m); silty clay with trace gravel (1.68 m); clayey silt with trace gravel (1.52 m); silty clay (1.53 m); sandy silt with trace clay and gravel (1.52 m); silty clay (3.05 m) to borehole end at 10.06 m. The surficial silty clay material present has an erodibility of "medium" as per the TAC (2005) guidelines.

- A1-5: Silty clay with trace organics (0.61 m); silt (0.61 m); organics (0.30 m); silty clay with clayey silt (3.36 m) to borehole end at 4.88 m. The surficial silty clay material present has an erodibility of “medium” as per the TAC (2005) guidelines.
- A1-6: Silt to clayey silt with trace gravel (0.91 m); sand and gravel (1.83 m) to borehole end at 2.74 m. The surficial silty clay material present has an erodibility of “medium” as per the TAC (2005) guidelines.
- A1-7: Sandy silt (0.91 m); clayey silt with trace gravel (2.14 m) to borehole end at (3.05 m). The surficial sandy silt material present has an erodibility of “high” as per the TAC (2005) guidelines. The surficial sandy silt material present has an erodibility of “low” as per the TAC (2005) guidelines.
- A1-8: Silt (0.91 m); silt to clayey silt (1.53 m); silty clay (1.52 m); silty clay with trace gravel and trace organics (9.45 m); gravelly, silty clay (1.83 m) to borehole end at 15.24 m. The surficial silt material present has an erodibility of “high” as per the TAC (2005) guidelines.
- A1-9: Silt (0.61 m); silty clay (5.49 m); silty clay with trace gravel (1.82 m); silty clay to clayey silt (2.44 m); silty clay with ice crystals (4.27 m) to borehole end at 14.63 m. The surficial silty clay material present has an erodibility of “medium” as per the TAC (2005) guidelines.
- GA11-B-02: Silt and clay with some sand and trace gravel (11.73 m); peat (0.77 m); silty clay with some sand (2.13 m) to borehole end at 14.63 m. The surficial silt and clay material present has an erodibility of “high” as per the TAC (2005) guidelines.
- GA11-B-03: Clayey sandy silt (3.05 m) to borehole end at 3.05 m. The surficial clayey sandy silt material present has an erodibility of “high” as per the TAC (2005) guidelines.

No geotechnical boreholes or test pits with material size gradation data were identified within the A1 Pit boundary. It is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of “high” as per the TAC (2005) guideline.

2.2.1.2.2 Permafrost

It is possible that ground ice or ice crystals may be encountered. Construction personnel should be prepared to manage frozen soils.

2.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3,000 mg/kg. 0.58 ha of contaminated soils contained within the A1 Pit drainage area are depicted in Appendix C.1; Figure C.1 8 and are currently captured by the GMRP closed circuit system.

2.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on runoff analysis of watershed LiDAR, the flow paths shown in Appendix C.1; Figure C.1 7 and summarized in Table 5 were tested to evaluate erosion potential.

Table 5: Erosion Potential Based on Slope Length, Slope Gradient, and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A[(a)]	Flow from Ingraham Trail south to A1 Pit	786.0	80.3	10.2	10 – 20	> 70	High	High
B[(a)]	Western flow around eastern edge of A1 Pit	405.8	81.9	20.2	> 20	> 70	High	High
C[(b)]	Western flow around southern edge of A1 Pit	102.7	79.4	77.3	> 20	> 70	High	High

> = greater than; < = less than.

(a) Analysis based on lower portion of flow path.

(b) Analysis based on A1 Pit boundary to pit base.

2.2.2 A1 Pit Evaluation of Consequences

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high”. All flow paths described in Table 5 report directly to A1 Pit and are captured by the GMRP closed circuit system and have a consequence of “low.”

2.2.3 A1 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 5 and the consequence rating of “low” in Section 2.2.2, Table 6 highlights the active-remediation mitigation and monitoring practices required for A1 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 6: A1 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

2.3 A1 Pit Post-Closure

The local drainage area of A1 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 9 and will be approximately 9.5 ha. Upper watershed non-contact water will be diverted around the A1 Pit cover where physically applicable. Once runoff is deemed suitable for direct release drainage from the A1 Pit cover will be directed to the east through the A1 Pit spillway towards Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 10.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

3.0 A2 PIT

A2 Pit is located west of Baker Creek, south of A1 Pit and west of the old Townsite and Marina, as shown in Appendix C.1; Figure C.1 11. Erosion Risk Assessments for A2 Pit were completed for both active-remediation (Section 3.2) and post-closure (Section 3.3) conditions.

3.1 Background Data

Data and information considered in this assessment for A2 Pit are presented in Table 7. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 7: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 12
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

3.2 A2 Pit Active-Remediation

3.2.1 A2 Pit Erosion Potential Evaluation

3.2.1.1 Drainage Analysis Summary

A summary of data available at the Site is provided in Table 8.

Table 8: Drainage Summary at the Site

Item	Description
Sub-basin delineation	The local drainage area of A2 Pit is approximately 20.1 ha.
Adjacent watercourses and waterbodies	Baker Creek runs within 25 metres of A2 Pit and Yellowknife Bay is located 220 m to the east. The A2 Pit diversion channel conveys runoff from undisturbed areas around the northeast boundary of A2 Pit.
Floodplain delineation	Immediately north of A2 Pit, Baker Creek Reach 1 flows through a channelized area between A2 Pit and Old Ingraham Trail.
Special areas	The local area around A2 Pit contains 1.9 ha of contaminated soils.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to severe (>33 t/ha/yr). Areas of severe erosion potential are located along short, steep slopes adjacent to A2 Pit.

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

3.2.1.2 Slope Analysis Summary

3.2.1.2.1 Soil Types

No geotechnical boreholes or test pits with material size gradation data were identified for the assessment area. On that basis, it is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of “high” as per the TAC (2005) guideline.

3.2.1.2.2 Permafrost

Based on the disturbed nature of the area and observations, it is possible that ground ice or ice crystals may be encountered, but this is not natural permafrost. Construction personnel should be prepared to manage frozen soils.

3.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3000 mg/kg. 1.9 ha of contaminated soils contained within the A2 Pit drainage area are depicted in Appendix C.1; Figure C.1 12 and are currently captured by the GMRP closed circuit system.

3.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on LiDAR watershed and runoff analysis, the flow paths shown in Appendix C.1; Figure C.1 11 and summarized in Table 9 were tested to evaluate erosion potential.

Table 9: Erosion Potential based on Slope Length, Slope Gradient and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A[a]	A2 Pit access road	125.2	40.1	15.98	10 – 20	> 70	High	High
B[a]	Flow from outcrop to Highway 4	158.0	55.6	35.19	> 20	> 70	High	High

< = Less than, > = Greater than.

(a) Analysis based on lower portion of Flow Path.

3.2.2 A2 Pit Consequence Evaluation

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” All flow paths described in Table 9 have a consequence of “low” as it is captured within A2 Pit and the mine’s closed-circuit system have a consequence of “low.”

3.2.3 A2 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 9 and the consequence rating of “low” in Section 3.2.2, Table 10 highlights the active-remediation mitigation and monitoring practices required for A2 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 10: A2 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[c]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[c]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[c]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

3.3 A2 Pit Post-Closure

The local drainage area of A2 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 13 and will be approximately 4.3 ha. Upper watershed non-contact water will be diverted around the A2 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the A2 Pit cover will be directed to the north through the A2 Pit spillway towards Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 14.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

4.0 B1 PIT

B1 Pit is located east of Baker Creek, north of the central mine facilities, and west of the Central Pond tailings containment area, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for the B1 Pit area were completed for both active-remediation (Section 4.2) and post-closure (Section 4.3) conditions.

4.1 B1 Pit Background Data

Data and information considered in this assessment for B1 Pit are presented in Table 11. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 11: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 16
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

4.2 B1 Pit Active-Remediation

4.2.1 B1 Pit Erosion Potential Evaluation

4.2.1.1 Drainage Analysis Summary

A summary of the B1 Pit drainage analysis is provided in Table 12.

Table 12: Drainage Summary at B1 Pit

Item	Description
Sub-basin delineation	The local drainage area of B1 Pit prior to remediation is approximately 9.1 ha.
Adjacent watercourses and waterbodies	Baker Creek runs 40 m to the west.
Floodplain delineation	B1 Pit is separated from Baker Creek's floodplain by an access road.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion potential for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to moderate (11 - 22 t/ha/yr).

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

4.2.1.2 Slope Analysis Summary

4.2.1.2.1 Soil Types

No geotechnical boreholes or test pits with material size gradation data were identified for the assessment area. On that basis, it is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of "high" as per the TAC (2005) guideline.

4.2.1.2.2 Permafrost

It is possible that ground ice or ice crystals may be encountered. Construction personnel should be prepared to manage frozen soils.

4.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3,000 mg/kg.

4.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on runoff analysis of watershed LiDAR, the flow paths shown in Appendix C.1; Figure C.1 15 and summarized in Table 13 were tested to evaluate erosion potential.

Table 13: Erosion Potential Based on Slope Length, Slope Gradient, and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A[(a)]	Flow along access road from bedrock outcrop	201.9	31.9	15.80	10 – 20	> 70	High	High
B[(a)]	Flow along access road	99.6	36.5	39.33	> 20	> 70	High	High

> = greater than; < = less than.

(a) Analysis based on lower portion of Flow Path.

4.2.2 B1 Pit Evaluation of Consequences

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” All flow paths described in Table 13 report directly to B1 Pit and are captured by the GMRP closed circuit system and have a consequence of “low.”

4.2.3 B1 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 13 and the consequence rating of “low” in Section 4.2.2, Table 14 highlights the active-remediation mitigation and monitoring practices required for B1 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 14: B1 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

4.3 B1 Pit Post-Closure

The local drainage area of B1 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 17 and will be approximately 3.9 ha. Upper watershed non-contact water will be diverted around the B1 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the B1 Pit cover will be conveyed to Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 18.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

5.0 B2 PIT

B2 Pit is located west of Baker Creek between B1 Pit to the northeast, and Brock Pit to the west, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for the B2 Pit area were completed for both active-remediation (Section 5.2) and post-closure (Section 5.3) conditions.

5.1 B2 Pit Background Data

Data and information considered in this assessment for B2 Pit are presented in Table 15. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 15: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 X
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

5.2 B2 Pit Active-Remediation

5.2.1 B2 Pit Erosion Potential Evaluation

5.2.1.1 Drainage Analysis Summary

A summary of the B2 Pit drainage analysis is provided in Table 16.

Table 16: Drainage Summary at B2 Pit

Item	Description
Sub-basin delineation	The local drainage area of B2 Pit prior to remediation is approximately 3.5 ha.
Adjacent watercourses and waterbodies	Baker Creek runs 30 m to the north; the reach of Baker Creek to the east is separated by an elevated bedrock outcrop.
Floodplain delineation	B2 Pit is separated from Baker Creek's floodplain by a constructed berm to the north, and bedrock outcrop to the east.
Special areas	The local area around B2 Pit contains 0.04 ha of contaminated soils.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion potential for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to moderate (11 - 22 t/ha/yr).

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

5.2.1.2 Slope Analysis Summary

5.2.1.2.1 Soil Types

No geotechnical boreholes or test pits with material size gradation data were identified for the assessment area. On that basis, it is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of “high” as per the TAC (2005) guideline.

5.2.1.2.2 Permafrost

It is possible that ground ice or ice crystals may be encountered. Construction personnel should be prepared to manage frozen soils.

5.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 4,500 mg/kg. 0.04 ha of contaminated soils contained within the B2 Pit drainage area are depicted in Appendix C.1; Figure C.1 20 and are currently captured by the GMRP closed circuit system.

5.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on runoff analysis of watershed LiDAR, the flow paths shown in Appendix C.1; Figure C.1 19 and summarized in Table 17 were tested to evaluate erosion potential.

Table 17: Erosion Potential Based on Slope Length, Slope Gradient, and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A	Flow from constructed berm into B2 Pit	110.8	22.0	19.88	10 – 20	> 70	High	High
B	Flow along access road into B2 Pit	173.7	21.5	12.40	10 – 20	> 70	High	High

> = greater than; < = less than.

5.2.2 B2 Pit Evaluation of Consequences

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” All flow paths described in Table 17 report directly to B2 Pit and are captured by the GMRP closed circuit system and have a consequence of “low.”

5.2.3 B2 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 17 and the consequence rating of “low” in Section 5.2.2, Table 18 highlights the active-remediation mitigation and monitoring practices required for B2 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 18: B2 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

5.3 B2 Pit Post-Closure

The local drainage area of B2 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 21 and will be approximately 4.4 ha. Upper watershed non-contact water will be diverted around the B2 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the B2 Pit cover will be directed to the north through the B2 Pit spillway towards Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 22.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

6.0 B3 PIT

B3 Pit is located between the Polishing Pond to the east and Trapper Creek / Baker Pond to the west, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for the B3 Pit area were completed for both active-remediation (Section 6.2) and post-closure (Section 6.3) conditions.

6.1 B3 Pit Background Data

Data and information considered in this assessment for B3 Pit are presented in Table 19. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 19: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 24
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

MMP = Management and Monitoring Plan.

6.2 B3 Pit Active-Remediation

6.2.1 B3 Pit Erosion Potential Evaluation

6.2.1.1 Drainage Analysis Summary

A summary of the B3 Pit drainage analysis is provided in Table 20.

Table 20: Drainage Summary at B3 Pit

Item	Description
Sub-basin delineation	The local drainage area of B3 Pit prior to remediation is approximately 5.0 ha.
Adjacent watercourses and waterbodies	Lower Trapper Creek and Baker Pond are located 200 metres southwest of B3 Pit and the Polishing Pond is located immediately to the east.
Floodplain delineation	B3 Pit is located adjacent to Baker Pond and is separated from the pond's floodplain by site access roads.
Special areas	The local area around B3 Pit contains 0.6 ha of contaminated soils.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to severe (>33 t/ha/yr). Areas of severe erosion potential are located along short, steep slopes adjacent to B3 Pit.

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

6.2.1.2 Slope Analysis Summary

6.2.1.2.1 Soil Types

No geotechnical boreholes or test pits with material size gradation data were identified for the assessment area. On that basis, it is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of “high” as per the TAC (2005) guideline.

6.2.1.2.2 Permafrost

It is possible that ground ice or ice crystals may be encountered. Construction personnel should be prepared to manage frozen soils.

6.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3,000 mg/kg. 0.6 ha of contaminated soils contained within the B3 Pit drainage area are depicted in Appendix C.1; Figure C.1 24 and are currently captured by the GMRP closed circuit system.

6.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on runoff analysis of watershed LiDAR, the flow paths shown in Appendix C.1; Figure C.1 23 and summarized in Table 21 were tested to evaluate erosion potential.

Table 21: Erosion Potential Based on Slope Length, Slope Gradient, and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A	Flow from outcrop into B3 Pit	326.5	45.1	13.82	10 – 20	> 70	High	High

> = greater than; < = less than.

6.2.2 B3 Pit Evaluation of Consequences

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” The flow path described in Table 21 reports directly to B3 Pit and are captured by the GMRP closed circuit system and have a consequence of “low.”

6.2.3 B3 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 21 and the consequence rating of “low” in Section 6.2.2, Table 22 highlights the active-remediation mitigation and monitoring practices required for B3 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 22: B3 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

6.3 B3 Pit Post-Closure

The local drainage area of B3 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 25 and will be approximately 2.6 ha. Upper watershed non-contact water will be diverted around the B3 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the B3 Pit cover will be directed to the southwest towards the North Pond Spillway and Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 26.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

7.0 B4 PIT

B4 Pit is located north of Highway 4 between the Northwest Pond to the north and Trapper Creek to the southwest, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for the B4 Pit area were completed for both active-remediation (Section 7.2) and post-closure (Section 7.3) conditions.

7.1 B4 Pit Background Data

Data and information considered in this assessment for B4 Pit are presented in Table 23. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 23: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

7.2 B4 Pit Active-Remediation

7.2.1 B4 Pit Erosion Potential Evaluation

7.2.1.1 Drainage Analysis Summary

A summary of the B4 Pit drainage analysis is provided in Table 24.

Table 24: Drainage Summary at B4 Pit

Item	Description
Sub-basin delineation	The local drainage area of B4 Pit prior to remediation is approximately 3.0 ha.
Adjacent watercourses and waterbodies	Trapper Creek runs 100 m to the west and the Northwest Pond is located 130 m to the north.
Floodplain delineation	B4 Pit is separated from Trapper Creek's floodplain by elevated terrain and the Northwest Pond by a constructed dam.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion potential for the existing ground surface is estimated to be range from very low (<6 t/ha/yr) to severe (>33 t/ha/yr). Areas of severe erosion potential are located along the open pit's eastern edge, adjacent to an access road.

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

7.2.1.2 Slope Analysis Summary

7.2.1.2.1 Soil Types

No geotechnical boreholes or test pits with material size gradation data were identified for the assessment area. On that basis, it is conservatively assumed that the soil erodibility corresponds to the most erodible materials encountered on site (silty clay, with a RUSLE k-value of 0.105) and soils subject to disturbance are assigned a qualitative erodibility rating of "high" as per the TAC (2005) guideline.

7.2.1.2.2 Permafrost

It is possible that ground ice or ice crystals may be encountered. Construction personnel should be prepared to manage frozen soils.

7.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3,000 mg/kg.

7.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on runoff analysis of watershed LiDAR, the flow paths shown in Appendix C.1; Figure C.1 27 and summarized in Table 25 were tested to evaluate erosion potential.

Table 25: Erosion Potential Based on Slope Length, Slope Gradient, and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A	Flow from the Northwest Pond dam to B4 Pit	150.0	21.1	14.04	10 – 20	> 70	High	High

> = greater than; < = less than.

7.2.2 B4 Pit Evaluation of Consequences

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” All flow paths described in Table 25 report directly to B4 Pit and are captured by the GMRP closed circuit system and have a consequence of “low.”

7.2.3 B4 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 25 and the consequence rating of “low” in Section 7.2.2, Table 26 highlights the active-remediation mitigation and monitoring practices required for B4 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 26: B4 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

7.3 B4 Pit Post-Closure

The local drainage area of B4 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 29 and will be approximately 1.1 ha. Upper watershed non-contact water will be diverted around the B4 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the B4 Pit cover will be directed towards Trapper Creek to the south. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 30.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

8.0 C1 PIT

The C1 Pit is located south of the central mine facilities, between Baker Creek and Old Ingraham Trail, as shown in Appendix C.1; Figure C.1 1. Erosion Risk Assessments for C1 Pit were completed for both active-remediation (Section 8.2) and post-closure (Section 8.3) conditions.

8.1 Background Data

Data and information considered in this assessment for C1 Pit are presented in Table 27. Excerpts presenting relevant data from these data sources and design drawings are provided in Appendices C.1 and C.2 of this memorandum, and Appendix D of the Open Pit Design Plan.

Table 27: Data Considered in Erosion Assessment

Item	Data Source	Additional Data Reference
Land cover	Layout of Open Pits and Associated Underground Features	Appendix C.1; Figure C.1 1
Topography	Existing Site topography map	Appendix C.1; Figure C.1 4
	Closure Site topography map	Open Pit Design Plan Appendix D
Sensitive areas	Existing Site soil chemistry map	Appendix C.1; Figure C.1 3
	Contaminated soils at the Site	Appendix C.1; Figure C.1 32
Drainage	Existing Site drainage map	Appendix C.1; Figure C.1 5
Soil type	Existing Site terrain map	Appendix C.1; Figure C.1 2
	Local area geotechnical information	Borehole locations and borehole logs are provided in Appendix C.2
Erosion potential	Existing Site preliminary erosion potential map	Appendix C.1; Figure C.1 6

8.2 C1 Pit Active-Remediation

8.2.1 C1 Pit Erosion Potential Evaluation

8.2.1.1 Drainage Analysis Summary

A summary of data available at the Site is provided in Table 28.

Table 28: Drainage Summary at the Site

Item	Description
Sub-basin delineation	The local drainage area of C1 Pit is approximately 5.1 ha.
Adjacent watercourses and waterbodies	Baker Creek runs within 10 metres to the west of C1 Pit. During future remediation, Baker Creek will be diverted around the north and east sides of C1 Pit.
Floodplain delineation	C1 Pit is located adjacent to Baker Creek and is separated from the creek's floodplain by a constructed berm.
Special areas	The local area around C1 Pit contains 1.9 ha of contaminated soils.
Preliminary erosion potential	Appendix C.1; Figure C.1 6 shows the preliminary erosion for the existing ground surface is estimated to be very low (<6 t/ha/yr).

> = greater than; < = less than; t/ha/yr = tonnes per hectare per year.

8.2.1.2 Slope Analysis Summary

8.2.1.2.1 Soil Types

No boreholes were identified within the C1 Pit boundary; however, eight boreholes were identified within the pit's catchment area; borehole logs and locations are found in Appendix C.2. A summary of these boreholes include:

- GA10-15: Sand and gravel to borehole end at 2.10 m. The surficial sand and gravel material present has an erodibility of "low" as per the TAC (2004) guidelines.
- GA10-16: Clayey gravel with some sand (1.30 m); clayey silt with sand (0.30 m) to borehole end at 1.60 m. The surficial clayey gravel material present has an erodibility of "low" as per the TAC (2004) guidelines.
- GA10-17: Sand and gravel with little clay to borehole end at 0.80 m. The surficial sand and gravel material present has an erodibility of "low" as per the TAC (2004) guidelines.
- GA-B-15: Clayey silt and sand (0.98 m); gravelly silty sand with some clay (1.76 m); peat (0.31 m); silt and clay with trace sand (1.06 m); clayey silt with some sand (0.77 m); silty clay with trace sand (2.89 m); silt and clay with some sand (3.66 m); clayey silt with some trace sand and some trace gravel (2.23 m) to borehole end at 13.66 m. The surficial clayey silt material present has an erodibility of "medium" as per the TAC (2004) guidelines.
- C1-BH21-23: Silty gravel with gravel and sand (1.20 m); silty clay with trace to some sand, trace gravel (2.61 m); organic silt (0.76 m); clayey silt (0.40 m) to bedrock at borehole end at 7.62 m. The surficial silty gravel material present has an erodibility of "high" as per the TAC (2004) guidelines.

- C1-BH21-24: Silty sand and gravel (0.91 m); silty clay with some sand to sandy, some gravel, and trace coarse sand (3.05 m); organic silt (0.31 m); silty clay with trade gravel and silt pockets (4.11 m); silt (2.29 m); silty sand (0.46 m) to bedrock at borehole end at 12.19 m. The surficial silty sand and gravel material present has an erodibility of “high” as per the TAC (2004) guidelines.
- C1-BH21-26: Sandy gravel with fine to coarse gravel, fine to coarse sand, and trace fines (0.76 m); silty clay, trace sand, and some fine gravel (1.22 m); gravel and sand with fine to coarse gravel, fine to coarse sand, and trace fines (0.76 m); peat (0.16 m); silty clay to clay with trace sand, trace fine gravel, and trace rootlets (2.59 m); silty clay and clayey silt with trace fine to medium sand, and trace fine gravel (1.06 m); sandy silt to silty sand with trace plastic fines (0.46 m) to bedrock at borehole end at 7.92 m. The surficial sandy gravel material present has an erodibility of “low” as per the TAC (2004) guidelines.
- C1-BH21-27: Silty sand and gravel with fine to coarse sand, fine to coarse gravel, trace plastic fines, and cobbles (1.52 m); silt with trace to some medium sand, trace fine gravel, organics, and trace rootlets (0.16 m); silty clay with trace to some fine to medium sand, and trace fine to coarse gravel (3.65 m); clayey silt with trace fine to medium sand (1.68 m) to bedrock at borehole end at 7.01 m. The surficial silty sand and gravel material present has an erodibility of “high” as per the TAC (2004) guidelines.

8.2.1.2.2 Permafrost

Based on the disturbed nature of the area and observations, it is possible that ground ice or ice crystals may be encountered, but this is not natural permafrost. Construction personnel should be prepared to manage frozen soils.

8.2.1.2.3 Special Areas

Much of the area depicted in Appendix C.1 3 is silent on soil arsenic concentrations, due to the location within an anthropogenically disturbed area. However, undisturbed areas indicate a soil arsenic concentration between 0 mg/kg and 3000 mg/kg. 1.9 ha of contaminated soils contained within the C1 Pit drainage area are depicted in Appendix C.1; Figure C.1 20 and are currently captured by the GMRP closed circuit system.

8.2.1.3 Site Erosion Potential Classification

Erosion potential is evaluated based on the factors presented in Table 1, including slope gradient, soil erodibility and slope length. Based on LiDAR watershed and runoff analysis, the flow paths shown in Appendix C.1; Figure C.1 31 and summarized in Table 29 were tested to evaluate erosion potential.

Table 29: Erosion Potential based on Slope Length, Slope Gradient and Soil Erodibility Rating

Flow Path	Description	Length (m)	Drop (m)	Gradient (%)	Gradient Bin	Length Bin	Soil Erodibility	Erosion Potential
A	Flow south from Highway 4	194.0	20.3	10.44	10 – 20	> 70	Low	Moderate
B[(a)]	Northern flow into the C1 Pit	52.0	27.5	52.90	> 20	< 70	High	High

< = Less than, > = Greater than.

(a) Analysis based on lower portion of Flow Path.

8.2.2 C1 Pit Consequence Evaluation

The Erosion and Sediment MMP indicates that any earthworks or other activities with a potential for runoff to report directly or indirectly to Baker Creek, Yellowknife Bay, or any fish-bearing waterbody should receive a consequence of “high.” All flow paths described in Table 29 have a consequence of “low” as it is captured within C1 Pit and the mine’s closed-circuit system have a consequence of “low.”

8.2.3 C1 Pit Recommended Level of Effort

Based on the highest erosion potential of “high” in Table 29 and the consequence rating of “low” in Section 8.2.2, Table 30 highlights the active-remediation mitigation and monitoring practices required for C1 Pit; refer to Section 1.4 and the Erosion and Sediment MMP for more detailed descriptions of required and recommended activities.

Table 30: C1 Pit Level of Effort Required for Mitigation and Monitoring during Active-Remediation

Site Assessment and Evaluation		Level of Erosion and Sediment Control						
		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural BMPs	Formal ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Visually Monitor ESC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required[(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]
High	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required	Required	Required	Required[(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

ESC = Erosion and Sediment Control; BMP = best management practice; TSS = total suspended solids.

8.3 C1 Pit Post-Closure

The local drainage area of C1 Pit once remediation is complete is depicted in Appendix C.1; Figure C.1 33 and will be approximately 4.8 ha. Upper watershed non-contact water will be diverted around the C1 Pit cover where physically applicable. Once runoff is deemed suitable for direct release, drainage from the C1 Pit cover will be conveyed southwest towards Baker Creek. Example flow paths in post-closure are depicted in Appendix C.1; Figure C.1 34.

Surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the

case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

9.0 SUMMARY

9.1 Active-Remediation

This erosion risk assessment examined 7 disturbance areas comprising open pit areas for active-remediation conditions:

- All 7 areas were evaluated as having high erosion potential combined with a low consequence receiving environment, including:
  - A1 Pit
  - A2 Pit
  - B1 Pit
  - B2 Pit
  - B3 Pit
  - B4 Pit
  - C1 Pit

Required and recommended components of activity-specific erosion and sediment control plans for each of these areas were identified, based on the framework presented in Table 2, and outlined in the preceding sections, and are summarized in Table 31.

Table 31: Level of Effort Required for Active-Remediation Mitigation and Monitoring

		Level of Erosion and Sediment Control						
Site Assessment and Evaluation		Level A	Level B	Level C	Level D	Level E	Monitoring	
Assessed Erosion Potential	Assessment of Consequence	Procedural Best Management Practices	Formal ESC Plan and Structural Best Management Practices	Water Management Best Management Practices	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control Best Management Practices	Visually Monitor E+SC Measures	Monitor Water Quality (TSS and Turbidity)
Low	Low	Required	(a)	(a)	-	-	Required	-
	High	Required	Required	Required	-	(b)	Required	Required [(c)]
Moderate	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required [(a)]	Required [(a)]	Required	Required [(c)]
High (7 areas)	Low	Required	Required	Required	(b)	(b)	Required	(b)
	High	Required	Required	Required	Required [(a)]	Required [(a)]	Required	Required [(c)]

(a) Recommended for activities with larger disturbance footprint or duration; may not be required for routine maintenance or activities with minimal disturbance.

(b) Should be considered depending on duration and seasonal considerations.

(c) For disturbance areas where water management practices ensure that all runoff is collected and conveyed to the mine water management system, it may be sufficient to conduct visual monitoring to ensure no water is released to the environment.

9.2 Post-Closure

In post-closure surface runoff will be managed per the water management strategy outlined in the Water MMP (CIRNAC 2023b). Specific criteria for surface runoff in new or altered diversions (post-construction criteria, Category 3) or from pit covers (water off engineered covers; Category 4) will be used to determine when water is suitable to release directly to Baker Creek or Yellowknife Bay without further long-term collection, testing or treatment. The rationale of this approach is to reduce long-term maintenance and improve the resiliency of the site, so that even in the case of a failure of perpetual care, the site's drainage system will remain functional and will not have an adverse impact on the environment.

10.0 CLOSURE

The reader is referred to the Study Limitations, which follows the text and forms an integral part of this memorandum.

We trust that the information contained within meets the Project needs. Please contact the undersigned should you have any questions.

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WSP Canada Inc.
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PERMIT NUMBER: P407
NT/NU Association of Professional Engineers and Geoscientists

Appendices: Appendix C1: ESMMP and Site Maps
Appendix C2: Borehole Maps and Logs

https://127gc.sharepoint.com/sites/ext_spac-pspc_giant/reference library/0 - regulatory submissions (mmp, dp, cp)/design plans/5 - open pits/appendices/app c erosion_assessment/18102211-740-tm-rev1-46304-open pits erosion potential assessment 24apr24.docx

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CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada). 2023. Giant Mine Remediation Project, Erosion and Sediment Management and Monitoring Plan, Ver 3.0. September 2023.

CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada). 2023. Giant Mine Remediation Project, Water Management and Monitoring Plan, Ver 4.0. August 2023.

TAC (Transportation Association of Canada). 2005. National Guide to Erosion and Sediment Control on Roadway Projects.

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