

# MEMORANDUM

April 16, 2023

<b>TO:</b>	Bill Slater, Slater Environmental Consulting
<b>FROM:</b>	Justin Straker
<b>RE:</b>	Review of Diavik Final Closure and Reclamation Plan
<b>COPY:</b>	Meghan Nickels, IEG

## Introduction

Per your email request of January 23, 2023, please find below the main comments and questions resulting from my review of the Diavik Final Closure and Reclamation Plan (FCRP). This memo has been revised to address follow-up questions received via email on April 10, 2023—this new content is presented at the end of the memo.

## Scope of review

My review is restricted to my areas of practice as a Professional Agrologist (BC, AB, SK, MB, ON), i.e., topics related to terrestrial ecology and mine reclamation. My review included the following list of documents—this information was primarily accessed from the Wek’èezhìi Land and Water Board’s Online Review System.<sup>1</sup> Where other sources were used, these sources are noted:

- Diavik Diamond Mines (2012) Inc. (DDMI) Final Closure and Reclamation Plan Version 1.0, December 2022 (Document #: D0007-2320-H-REP-00001);
- Diavik FCRP Appendixes I-IV—glossary, acronyms, abbreviations, units and symbols;
- Diavik FCRP Appendix V—Detailed Tabulation of Closure Objectives and Criteria;
- Diavik FCRP Appendix VI—Monitoring and Maintenance;
- Diavik FCRP Appendix VII—Expected Cost of Closure and Reclamation;
- Diavik FCRP Appendix IX—Traditional Knowledge Panel Reports and Community Engagement Summaries;

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<sup>1</sup> <https://new.onlinereviewsystem.ca/review/AF47FB08-C47F-ED11-AC20-CC60C843D8AF>

- Diavik FCRP Appendix X—Closure Design Reports, particularly Appendix X-8—Site-Wide Grading Plan, and Appendix X-9—Reclamation Closure Feasibility Design;
- Diavik Diamond Mines (2012) Inc. Closure and Reclamation Plan – V4.1, Appendix X-16—University of Alberta Final Revegetation Report (provided by Bill Slater);
- Rio Tinto Standard E16 – Biodiversity protection and natural resource management; and
- Rio Tinto – Our approach to closure.<sup>2</sup>

#### Review comments

My review is largely organized by the categories of closure objectives and associated criteria, as this provided a useful framework for addressing different topics. However, my findings are applicable to the broader scope of the FCRP, and not just to its objectives and criteria.

- **Lack of contingencies**—DDMI should be asked to explicitly identify contingency measures associated with each closure criterion, with these measures to be deployed if monitoring indicates that the closure criterion has not been met. This has not been done, as far as I can find, and its absence is a substantial shortcoming for an objectives-and-criteria framework.
- **Objective/criterion SW3**—criterion SW3-1 continues to use a “pollute-to-guidelines” approach (i.e., setting the criterion at the Government of Northwest Territories residential/parkland threshold), which is not precautionarily protective during the post-closure phase. For post-closure, it would be more appropriate to use a criterion based on reference dustfall levels (e.g., dustfall in post-closure should show no significant difference between the 12 mine-site locations and the 2 background [“C1” and “C2”] locations). It seems that the proposed criterion, which I am interpreting as  $1.75 \mu\text{g}\cdot\text{dm}^{-2}\cdot\text{day}^{-1}$ , is ~4 times higher than the upper 95<sup>th</sup> confidence interval of the geometric mean of dust deposition at reference sites from 2003 to 2021 (Appendix VI, Section 3.1.5). What is the justification for having a criterion that is substantially higher than ambient dust levels in the post-closure phase? Slater Environmental Consulting (SEC) commented on this same issue in its September 2017 review of CRP V4.0. A few other items of note:

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<sup>2</sup> Rio Tinto documents accessed on February 20, 2023 at:  
<https://www.riotinto.com/en/sustainability/environment>

In Appendix V1 Section 3.1.2, DDMI states, “Post-closure emissions of fugitive wind-blown dust from the NCRP waste rock storage area and from the PKC facility area are likely low to negligible due to the size/composition of the proposed cover materials (i.e., granitic gravels). The cover material is considered stable and will likely become dust-limited over time. (Watson et al. 2014). Any vegetation growth over time would likely further reduce the potential for wind erosion of the permanent landforms.” However, DDMI has also chosen not to actively revegetate these facilities. There is a conflict between the criterion SW3-1 and these revegetation decisions, and I suggest that DDMI adopt a reference-condition approach to the post-closure dust criterion (as discussed directly above), and reconsider revegetating the rock storage areas and PKC facility to actively lower fugitive dust emissions.

I believe it would be appropriate to amend the objective statement of SW-3 from “dust levels safe for people, vegetation, aquatic life, and wildlife” to “dust levels safe for people, vegetation, aquatic life, and wildlife, and do not contribute to a degraded air-quality environment in the post-closure phase.”

**Objective/criterion SW4**— The criterion “monitoring evidence of post-closure wildlife use of area” does not “describe the conditions when the objective has been achieved” (DDMI’s definition of a criterion), given the associated objective “dust levels do not affect palatability of vegetation to wildlife.”<sup>3</sup> As written, the criterion is not a testable statement, and must be written as such. Again, this issue was raised in SEC’s 2017 review of CRP V4.0. It would be preferable to base this criterion on a Zone-of-Influence (ZOI) analysis. Section 3.4.4.1 of the CRP states that the most recent ZOI analysis for caribou (2019) indicates that it “did not detect a ZOI.” Continued confirmation of this finding of absence of a ZOI would be a much stronger criterion. Analysis of lichen element concentrations per SEC’s Sept. 2017 review would be a good additional criterion.

**Objective SW5/criterion SW5-1**— the rationale for restricting active revegetation to infrastructure areas remains unclear. DDMI states that priority areas for active revegetation have been “established with communities and approved by WLWB.” However, in a more expansive statement in Section 5.2.9.3.5, DDMI reports

“The closure plan includes the re-establishment of partially vegetated land to the extent practical. DDMI’s primary goals in relation to re-vegetation are to increase

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<sup>3</sup> Should the current wording be taken to indicate that one caribou traversing the mine site once in the five years of monitoring proposed for the post-closure phase would verify that dust levels had not affected/were not affecting palatability of vegetation to wildlife?

vegetation growth as compared with natural recovery processes, maximize vegetation cover in re-vegetated areas, and promote soil development and sustainable vegetation growth.

DDMI engaged with Indigenous communities and the EMAB in 2019 to further discuss if and where revegetation efforts should be targeted at closure (Appendixes IX-3 and IX-5). There were many and varied views on this subject. No reviewers disagreed with the suggestion from the TK Panel of avoiding re-vegetation of areas where fuel had been stored and may have contaminated the surface material and the PKC facility to give these areas as much time as possible to heal before encouraging wildlife to these areas. Views on the benefits of revegetating the WRSAs were diverse, and no consensus was reached even after further engagement. DDMI's preferred areas for re-vegetation are shown in Figure 5-27 and include roads, the airstrip, and laydown excluding areas that have been confirmed to have petroleum hydrocarbon contamination. DDMI has not included revegetation of WRSAs. Including the large WRSAs as targeted areas for re-vegetation would likely create an unnecessary attractant to wildlife that is contrary to closure goal #5, "Final landscape that is neutral to wildlife."

This raises two issues for me as a reviewer:

1. Does the current plan of conducting active revegetation only in select infrastructure areas meet community desires for the post-mine landscape? If this is the case, then it is clearly an appropriate objective—I have technical objections to it, but these should be overridden by the expertise and objectives of local Indigenous Groups. However, it is not clear to me that this is the case. It is relatively unusual in the Canadian context (more common north of 60 degrees latitude, essentially unheard-of south of that) to accept no active revegetation with very little rationale. DDMI does not state that there are concerns related to element uptake etc. that mean that revegetation should be limited, just that they have decided that active revegetation should only occur in small "priority areas."<sup>4</sup> Appendix IX suggests that the justification to not revegetate the rock

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<sup>4</sup> Appendix IX-2, Section 3.1.1 states "The TK Panel suggested that rock piles be vegetated and provided recommendations on how best to deter wildlife from those areas until reclamation has moved toward a more natural state. However, based on feedback from the TK Panel over time, the plan has changed for these areas to the objective of a neutral presence, neither attracting nor deterring wildlife, on site while moving towards a more natural state." It is not clear what caused these changes in objectives over time. Table 3-2 of this appendix indicates that TK Panel recommendations on revegetating the rock pile(s) and PKC area were "not accepted" by DDMI.

piles and PKC facility is based on not attracting wildlife to those areas, and allowing them to heal. But there is no discussion on the risks to wildlife using those areas, particularly if rock and PK were isolated with a till cover, nor on the specific healing that needs to occur before use would be acceptable.

2. I find the statement “including the large WRSAs as targeted areas for re-vegetation would likely create an unnecessary attractant to wildlife that is contrary to closure goal #5, ‘Final landscape that is neutral to wildlife’” incongruent with the more fulsome explanation of this objective provided in Table 2-1 of the CRP:

“Final landscape that is neutral to wildlife – being neither a significant attractant nor significant deterrent relative to pre-development conditions.”

Satellite imagery of the Diavik area (Figure 1) clearly shows a vegetated landscape, with the mine being a relatively large, unvegetated area. Unless the surrounding vegetated landscape provides no habitat value to animals, I do not understand how revegetating the above-ground and non-contaminated components of the mine would be an “unnecessary” or “significant attractant...relative to pre-development conditions” (emphasis mine). Rather, that would result in a vegetated landscape similar to the pre-development landscape, and thus one that is “neutral to wildlife.” In contrast, I believe that the current plan of leaving most of the above-ground disturbance unvegetated results in a landscape that is more of a deterrent relative to pre-development conditions, in that it will provide no habitat value. The mine disturbance that will not be actively revegetated represents a long-term deletion from habitat of over 9 km<sup>2</sup>. This may be relatively small for large animals that move around and through this landscape, but more substantial for smaller animals with smaller ranges.



**Figure 1. Satellite imagery of the Diavik mine obtained from Google Earth. Imagery date is reported as 9/9/2006.**

DDMI summarizes the reclamation research completed by Dr. Anne Naeth and the University of Alberta, but very little of this work seems to be used in the reclamation plan. In particular, the lack of salvage and retention of surface soils and organics for use in reclamation and revegetation is incongruent with current practices in the mining industry, despite the obstacles to such salvage listed in Section 4.5 of the CRP. Further, it is strange that there is no reported work on use of till as a component of rooting-zone layers of reclamation cover systems, given the surplus of 1.0 Mm<sup>3</sup> of till reported in the reclamation materials balance. This till is the dominant surficial material in the area—and thus the basis for the vegetated ecosystems established in the area—and could be used to support revegetated covers on the rock piles and PKC facility.

Overall, I find the decision to not conduct active revegetation on the NRCP, SCRCP, and PKC facilities to be inconsistent with standard mining-industry practices over the period in which Diavik has been developed and operated, and not supported by the weight of presented evidence in the FCRP.

**Objective SW5/criterion SW5-3**— there appears to be no justification for what appears to be an arbitrary criterion of establishing a minimum of 10 stems/m<sup>2</sup> in areas of active revegetation. Further, the monitoring supporting the evaluation of this criterion is inadequate. Appendix VI, Section 3.1.5.2 states that “revegetation monitoring plots of 1 m by 1 m will be established at a density of 1 plot per 10 ha in mine infrastructure areas that have been contoured and seeded.” This planned monitoring intensity results in

sampling 0.001% of the actively revegetated area. Standard reclamation monitoring practices involve substantially higher sampling intensities, e.g., sampling of 0.5 to 10% of the treated area. Appendix X-9 indicates that the area of active revegetation (scarification and seeding) is 311 ha (including the airstrip). This would result in the establishment of approximately 31 revegetation monitoring plots, representing 31 m<sup>2</sup> of monitored area. The associated criterion then indicates that identification of at least 310 total stems of germinating vegetation across this sampled area will be taken as demonstrating achievement of the revegetation objective. This represents an observation of not many plants over not much sampled area, and is thin evidence on which to base an assertion of successful revegetation.

Overall, for SW5, my impression as a reviewer is that DDMI's revegetation approaches do not align with industry standard practices, and that suggested performance criteria have low thresholds.

**Objective SW9**—SW9 speaks to the objective of having topography and vegetation that “match aesthetics and natural conditions of the surrounding natural area.” Its associated criteria indicate the need for inspections by engineers, and the need to meet the vegetation criterion described above, i.e., establishment of at least 310 plants on the mine site. As discussed above, the revegetation criterion is inadequate, and would not be indicative of closure actions that have achieved the objective of matching the conditions of the surrounding natural area. In addition, the CRP V4.0 contained a criterion with respect to an evaluation of change in biodiversity across the Regional Study Area. SEC's review of that CRP noted that this criterion as stated was mathematically problematic, and asked for either a justification of or amendment to the proposed value. Instead, this criterion has been deleted. This is not a positive advancement of the FCRP closure criteria. I would prefer that the biodiversity criterion be maintained with an amended appropriate threshold, particularly by a mine operator that has historically been an industry leader in acknowledging the importance of protecting biodiversity values.

### **Response to follow-up questions**

On April 10, 2023, I received follow-up questions via email from Bill Slater. These questions, and corresponding responses, are listed below:

1. Elaborate on the assertion that the lack of active revegetation is inconsistent with standard mining industry practices (e.g., review of objective SW5 in point 1 on p. 4, and in point 2 on p. 6).

**Response:** the *Yukon Mine Site Reclamation and Closure Policy* (2006)<sup>5</sup> indicates an expectation of “the reclamation and re-vegetation of the surface disturbances wherever practicable”, and the later (2013) document *Reclamation and Closure Planning for Quartz Mining Projects – Plan Requirements and Closure Costing Guidance*<sup>6</sup> states that plans should include re-vegetation activities for all mine features, including tailings facilities and mine rock dumps. DIAND’s 2002 *Mine Site Reclamation Policy for the Northwest Territories*<sup>7</sup> echoes the Yukon’s goal of “revegetation of the site where practicable” (and includes on its cover a photo of revegetation test plots at the Ekati mine, illustrating practicable revegetation of diamond-mine facilities near Lac de Gras). The complementary *Mine Site Reclamation Guidelines For The Northwest Territories* (2007)<sup>8</sup> include the objective of re-establishing the pre-mining ground cover on all areas affected by mining activities. DDMI has not asserted that it is not practicable to revegetate the mine rock dumps, just that they are not “priority areas” for revegetation. The *Health, Safety and Reclamation Code for Mines in British Columbia*<sup>9</sup> states that the only disturbed lands exempt from revegetation requirements are facilities constructed prior to 1969, pit walls and benches constructed in rock, and steeply sloping footwalls. As an Alberta example typical of oil-sands reclamation in the northeast of the province, Syncrude Canada Limited’s *Environmental Protection and Enhancement Act Approval 00000026-03-00*<sup>10</sup> requires Syncrude to “reclaim disturbed land to a self-sustaining, locally common boreal forest ecosystem, integrated with the surrounding area, unless otherwise authorized in writing.” The only sizeable terrestrial areas exempt from this requirement would be tailings dams where alternate revegetation practices may be required for geotechnical reasons.

2. What are current industry practices/expectations in terms of percent of area revegetated, and whether rock piles and tailings areas are revegetated?

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<sup>5</sup> <https://yukon.ca/en/yukon-mine-site-reclamation-and-closure-policy>

<sup>6</sup> <https://yukon.ca/en/reclamation-and-closure-planning-quartz-mining-projects-plan-requirements-and-closure-costing>

<sup>7</sup> <https://rcaanc-cimac.gc.ca/eng/1100100036038/1547657739486>

<sup>8</sup> [https://publications.gc.ca/collections/collection\\_2014/aadnc-aandc/R74-13-2007-eng.pdf](https://publications.gc.ca/collections/collection_2014/aadnc-aandc/R74-13-2007-eng.pdf)

<sup>9</sup> <https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>

<sup>10</sup> <https://avw.alberta.ca/pdf/00000026-03-00.pdf>



**Response:** current industry practices and expectations in Canada are generally that all areas be revegetated, except for:

- areas needed for long-term or permanent infrastructure, such as water-treatment plants, water-management features, access roads, etc.;
- pit highwalls and steep footwalls; and
- pit lakes.

Sub-aerial rock piles and tailings areas are almost invariably revegetated in Canada. I checked four recent examples of reclamation plans in BC to calculate areas of revegetation as a portion of total disturbance area, and found a range of 75-87%, representing almost 13,500 ha of disturbance, and almost 11,000 ha of area planned for revegetation.<sup>11</sup> This is substantially more than the 28% of the footprint currently proposed for revegetation by DDMI. Active revegetation of the rock piles and PKC facility would bring this proportion up to 70%, which is approaching the industry ranges reported above. The 1.0 Mm<sup>3</sup> of surplus till reported in the reclamation materials balance could be used to place an approximately 20-cm-thick cover across the areas of the rock piles and PKC facility.

I know personally of two exceptions to these standard practices:

- A. The Mount Nansen mine in Yukon, where a 2019 closure plan proposed active revegetation of approximately 15% of the mine footprint. Following review and objection by the Little Salmon Carmacks First Nation, this plan was revised with a recommended objective of actively revegetating the majority of the mine site. The Mount Nansen mine was developed in an earlier era than Diavik, and was abandoned in 1999.
- B. Ontario's regulations governing mine reclamation appear to be less rigorous than those in western Canada. I know of a current operating mine in Ontario that is proposing to not actively revegetate external rock-armoured shells of tailings dams, and some steeper areas of mine rock stockpiles. However, this is an exception isolated to that jurisdiction, rather than a widespread occurrence in Canada, and even in the case, the area planned for revegetation covers 75% of the total disturbance area.

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<sup>11</sup> A publicly available report for one of these examples, the Blackwater Gold project in central BC, can be found at <https://www.blackwatergoldmine.com/resources/eac/Reclamation-and-Closure-Plan-Mines-Act-Environmental-Management-Act-Permit-Plan.pdf?v=0.959>. In this example, approximately 87% of a 2,100-ha footprint is planned for revegetation.

3. Elaborate on the assertion that revegetation monitoring approaches do not align with industry standards and that performance criteria have low thresholds (criterion SW5-3).

**Response:** it is somewhat difficult to provide this information, as most jurisdictions in Canada do not specify reclamation monitoring requirements and criteria, and these are developed by individual operators, who may not report them publicly. However, as an example, the Blackwater Reclamation Plan referenced in footnote 11 includes installation of one 100-m<sup>2</sup> permanent sample plot per 2 ha, which is equivalent to the lower end of the asserted standard range of sampling 0.5-10% of the revegetated area. This sampling intensity proposed at Blackwater results in sampling 50 times more area per total revegetated area than the monitoring program proposed by DDMI.<sup>12</sup> In addition, a criterion based on stems per unit area is odd for revegetation where seeding of grasses and forbs is the primary establishment method, as stems counts are usually used for single-stem woody plants, and abundance (estimate of cover) is usually used for grass and forb species. Finally, DDMI should have an ecological basis for its proposed revegetation performance criteria, rather than what appears to be an arbitrary criterion of 10 stems/ha – this basis was not provided in the FCRP. A standard method for developing such a basis would be use of a reference-condition approach, where a revegetation criterion would be derived from sampling adjacent, ecologically comparable non-mined (“undisturbed”) areas.

Based on the above information, I believe that an approach in alignment with standard industry practices would involve sampling a minimum of 100 m<sup>2</sup> per 2 ha, and deriving performance criteria from vegetation characteristics of adjacent reference plots sampled using similar methods and intensities, and/or to using remote-sensing approaches per footnote 12.

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<sup>12</sup> The debate on sampling intensity is becoming somewhat obsolete due to the increasing use of remote sensing for revegetation monitoring. In remote-sensing applications, it is feasible to obtain a census of the entire population of reclamation areas, rather than sampling a portion of those areas and inferring results across the non-sampled area. For instance, multi-spectral imagery could be used to derive vegetation indices for all revegetated areas and compare those results to indices derived from reference areas.

### **Closure**

Thanks you for the opportunity to contribute to this review of the Diavik FCRP. I trust the information provided in this review meets your requirements. To discuss the contents of this memo, please do not hesitate to contact me at [jstraker@iegconsulting.com](mailto:jstraker@iegconsulting.com), or at 250 701 0600.