

John McCullum
Executive Director
Environmental Monitoring Advisory Board
5006 Franklin Ave
Yellowknife, NT
X1A 2P9

Arcadis Canada Inc.
121 Granton Drive
Suite 12
Richmond Hill
Ontario L4B 3N4
Phone: 905 764 9380
Fax: 905 764 9386
www.arcadis.com

Date: March 27, 2023

Our Ref: 30165643

Subject: Draft Review of Relevant parts of the HHERA and Appendix V & VI-1
for the Water License Amendment

Dear John,

Diavik Diamond Mines (2012) Inc. (DDMI) submitted an application to amend its type A Water License (W2015L2-0001) to the Wek'èezhii Land and Water Board (WLWB) in December 2022. The purpose of the application is to enable authorization to re-establish island pre-development runoff conditions as part of their progressive reclamation strategy through sequential progressive decommissioning of the water management system.

Under DDMI's current Water License, the WLWB is unable to authorize the re-establishing of natural drainages with associated discharge.

Scope of Work

Arcadis Canada Inc. (Arcadis) has been asked to provide a high-level review of the Human Health and Ecological Risk Assessment (HHERA) report (Appendix X-25) as well as relevant parts of the Water License (WL) Amendment Application (Appendix V, Appendix VI-1 and Appendix X-25) as it pertains to potential effects on aquatic, terrestrial and human health. Arcadis will identify any significant concerns, deficiencies or uncertainties with a focus on potential effects of runoff quality on aquatic, terrestrial and human health.

Arcadis' comments take into consideration DDMI responses to our previous comments as well as information that was provided during the workshop in March 2023. In addition, recent changes proposed by DDMI on March 22, 2023, as responses to Requests for Information were also reviewed.

Some of Arcadis' comments have been addressed by DDMI, however, a number of responses by DDMI do not address previously raised concerns. These concerns, as well as new concerns based on information provided in the Technical Workshops and/or the responses to the Request for Information are summarized below.

Background

DDMI is planning to undertake progressive reclamation at the Diavik Mine. The Final Closure and Reclamation Plan (FCRP) was submitted to WLWB on October 13, 2022. To complete closure as planned, an amendment to the current WL is required as the current license does not include the re-establishment of island pre-development runoff conditions through sequential decommissioning of the water management system (i.e., drainage control and collection system). Currently, the only authorized discharge is from the water treatment plant. DDMI intends to demonstrate in the WL application that: i) waste will not be released that will adversely affect the environment

and that additional and/or revised Effluent Quality Criteria (EQC) are not required. Instead, DDMI has proposed a Surface Water Action Level Framework to demonstrate how closure criteria for the site wide SW1 and SW2 will be met.

Effluent/Seepage as Waste

DDMI intended to demonstrate that the effluent and seepage water that they wish to discharge to Lac de Gras would not be considered a waste as it would not impair the use of Lac De Gras. Based on the presentation provided by the WLWB in the technical session on March 6, 2023 and on the definition of waste provided in Section 1 of the *Waters Act* and Section 51 of the Mackenzie Valley Resource Management Act (MVRMA), Arcadis is of the opinion that DDMI was **not** successful in claiming that the discharge would not be considered a waste. The definition of waste that would apply to the closure plan for mine is

- a) *any substance that, if added to water, would degrade or alter or form part of a process of degradation or alteration of the quality of the water to an extent that is detrimental to its use by people or by any animal, fish or plant, or*
- b) *water that contains a substance in such a quantity or concentration, or that has been so treated, processed or changed, by heat or other means, that it would, if added to other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water to the extent described in paragraph (a), ...*

It appears that DDMI is interpreting the “other water” to mean Lac de Gras as an entire waterbody or at an undefined distance, and not the water receiving the discharge (catchment areas). As per the GNWT-ENR response to Information Request #4, they are unaware of any water license issued by the land and water boards of the Mackenzie Valley that has interpreted the “other water” in such a way.

Given that water quality within the discharge areas could be above the Aquatic Effects Monitoring Program (AEMP) benchmarks and is not expected to be safe for consumption, it suggests that the water quality could be altered for its safe use by people, wildlife and/or aquatic life. DDMI has indicated that there are zones where chronic effects to certain organisms could occur within the mixing zones.

Although much of the data used to support closure are based on predictions, the available information suggests that the discharge to Lac de Gras would be defined as a waste.

It is interesting to note that in DDMI’s response to Information Request #4 Attachment B it is stated that the SWALF approach may be more appropriate for the regulation of a non-waste water discharge.

Appendix V Detailed Tabulation of Closure Objectives and Criteria.

Appendix V provides the detailed tabulation of closure objectives and criteria, as well as a history of revisions to those criteria. DDMI has revised the chemical closure criteria for human health for surface runoff and seepage water quality. Previously the closure criteria were based on Health Canada drinking water guidelines, DDMI have now proposed using British Columbia (BC) Recreational Use Guidelines or to adjust the BC Drinking water guidelines by a factor of 20 to account for incidental ingestion. There are a few clarifications required with this approach as follows:

- It is not clear how protection of Lac de Gras as a drinking water source has been incorporated into the closure criteria. It is noted that drinking water of Lac De Gras water has been assessed in the Risk Assessment and in Appendix L. However, the protection of Lac de Gras water quality for the purposes of a potable water supply are currently not considered in the closure criteria.

DDMI has also removed the closure criteria based on the AEMP benchmarks from Appendix V, although areas of the submission still refer to them in this appendix.

A spot check of Table 2 and Table 3 criteria was completed, and no discrepancies were identified.

Appendix VI-1 FCRP V1.0 Closure and Post-Closure Monitoring

DDMI has proposed two different types of monitoring as follows: i) performance monitoring which will monitor the performance of the mine site and each of the closure management areas against closure criteria and ii) Environmental Effects Monitoring, which will evaluate the combined environmental effects from all areas of the mine site on terrestrial and aquatic ecosystems.

Performance monitoring programs include monitoring for geotechnical stability, dust, hydrology, seepage, runoff and water quality, soil quality, vegetation, aesthetics and wildlife safety and use. The environmental effects monitoring programs include the Aquatic Effects Monitoring Program (AEMP), Wildlife Management and Monitoring Program (WMMP) and the Vegetation and Lichen Monitoring Program (VLMP).

Arcadis has reviewed and provided comments on only the closure criteria that could influence human health, aquatic life or terrestrial receptors (wildlife) with respect to the amendments to the WL. Specifically, the restoration of pre-mining drainage and the allowed discharge of untreated runoff and seepage water to Lac de Gras.

Surface Water Action Level Framework

DDMI has removed the use of AEMP benchmarks as the criteria to measure Closure Objectives that are related to keeping surface water safe for humans, wildlife and aquatic life and has instead proposed the Surface Water Action Level Framework (SWALF) to demonstrate compliance with the following Closure Objectives:

- SW1- Surface runoff and seepage water quality that is safe for humans and wildlife; and
- SW2- Surface runoff and seepage water quality that will not cause adverse effects on aquatic life or water uses in Lac de Gras or the Coppermine River.

Since the submission of the WL amendment application, technical workshops were held and requests for information were made. DDMI has, in a response to the request for information (IR #4), proposed potential amendments to the SWALF. The proposed changes to the SWALF will be referred to as the *proposed amended* SWALF to distinguish between the SWALF contained in the WL amendment application and the FCRP. In the proposed amended SWALF, DDMI has separated human health, wildlife and aquatic life into separate SWALFs. This separation adds some additional clarity to the process and should be encouraged to be incorporated in the final SWALF, if it is to proceed.

For SW1-1 (protection of human health) DDMI has removed the reliance on Health Canada (HC) Drinking Water Guidelines (DWG) and replaced them with Recreational Water Use Guidelines. Recreational use guidelines are drinking water guidelines adjusted by a factor of 20 to account for reduced level of exposure in recreational activities relative to consuming potable water. Comments pertaining to these have been provided under Appendix V. If an exceedance of the criteria is identified, then a risk assessment is triggered. If the risk assessment still identifies a potential for unacceptable risk, then mitigation measures are proposed. **The only concern with this approach is the potential timeline from when a risk assessment is triggered to where mitigation measures are implemented.** This process can take years to complete and implement, and in Arcadis' opinion, there should be interim mitigation measures proposed to reduce the potential risk until such time the risk assessment is completed, and mitigation measures are identified and implemented.

In the proposed amended SWALF, DDMI has proposed to include an early warning trigger, that when 80% of the SW1-1 criteria is reached, then the risk assessment would be triggered. These are positive proposed changes that should be included in the SWALF, if the SWALF is to proceed. Arcadis also suggests that the investigation of cause should be triggered when 80% of the SW1-1 is reached and that monitoring for the AEMP benchmarks or drinking water guidelines within Lac de Gras should be added to the SW1-1.

Similar comments for the proposed amended SWALF for wildlife are made. The addition of an early warning trigger to the SW1-2 criteria and the commencement of a risk assessment at this early trigger are positive changes that addressed some of our concerns regarding the timeframe for action within the original SWALF proposed. The SWALF for wildlife indicates that if the SW1-2 criteria are exceeded at the monitoring location that water quality at the mixing zone boundary should be sampled to ensure compliance with the SW1-2. It is not clear why water quality in close proximity to the shoreline, where terrestrial wildlife would consume water, would also not be monitored.

Our greatest concerns pertain to the protection of aquatic life. For SW2 (protection of aquatic life), the previous version of the FCRP relied on the use of AEMP benchmarks and aquatic life benchmarks, together with the absence of acute toxicity to rainbow trout and to *Daphnia magna* as criteria to evaluate whether the SW2 Closure Objective was met. Significant changes to the approach to determine whether the SW2 Closure Objective is met have been proposed in this version. The SWALF is illustrated in Figure 3-3 of Appendix VI-1 and is described in Section 3.1.4.4 of the same appendix.

Different Action Levels (AL) have been defined based on the interpretation of monitoring and/or toxicity results that are collected during the various monitoring programs. Action Level 1 (AL1) is triggered if the water quality data for surface runoff and seepage water is equal to or greater than 10X AEMP benchmarks for aquatic life. In previous versions, the closure objectives were not met if the water quality data exceeded the AEMP. **The basis for 10X the AEMP was not provided in this section, but in the initial responses to comments, DDMI indicated it was based on the anticipated dilution within the catchment areas.**

If there is an exceedance of 10X AEMP then a sub-chronic toxicity test is completed. Essentially, surface water or seep water would be collected, and a standardized toxicity test (Environment Canada's EPS 1/RM/21) consisting of serially diluted samples will be completed for *C. dubia*. DDMI considers *C. dubia* to be sufficiently sensitive to predict whether chronic effects to aquatic life would occur. It appears that DDMI is applying the IC25 in the 12.5% dilution test unit as the threshold to determine whether toxicity would likely be present at the mixing zone boundary. The IC25 is defined as the concentration at which 25% of the test organisms will have a reduction in whatever endpoint is being measured. This is normally a reduction in growth or reproduction, but other endpoints are measured as well. In the case of test method EPS 1/RM/21, the endpoint is survival and reproduction.

According to DDMI's SWALF, if there is no toxicity at the 12.5% dilution, then no further action is required, and monitoring continues as scheduled. If there is toxicity, then this triggers the Action Response 2, where a sample will be collected at the mixing zone boundary and toxicity testing will be completed. **Section 3.1.4.4 does not indicate whether the toxicity testing methods and endpoints would be the same toxicity test completed at the first stage. Based on preliminary responses to comments DDMI is proposing the *C. dubia* standardized toxicity test method.** Typically, at the end of the regulated mixing zone, there should be no difference in water quality from the portions of the lake not influenced by mine activity. As such, chronic toxicity endpoints to various receptors should be assessed at full strength of lake water and there should be no chronic

toxicity. It appears that DDMI intends to test one species with a high threshold effect concentration (EC_{50}) to trigger further action.

If there is no toxicity at the mixing zone boundary, then the SWALF indicates that the criteria should be revised as appropriate. It is unclear what this means or what the implications are. However, criteria should be set prior to closure. If DDMI does not feel that the AEMP benchmarks are appropriate, then they should propose site-specific criteria that are, prior to site closure. If there is toxicity, then Action Level 3A is triggered. It should be noted that DDMI's threshold of toxicity has been set at this stage to a level where more than 50% of the organisms can be adversely impacted before it is considered a toxicity impairment. A 50% effect level will likely result in ecosystem impairment and the Closure Objective of no impairment to aquatic life will likely not be met. **It is Arcadis' opinion that this threshold should not be higher than an EC/IC 25 for chronic endpoints to more than one species.**

If there is toxicity impairment (at the 50% effect level) and "practical" mitigation measures are not identified, then DDMI is suggesting an Environmental Trade Off Study be completed. It is not clear what this entails and whether consideration of factors other than economics (such as traditional use) will be considered.

With respect to the use of the Surface Water Action Level Framework to measure compliance with Closure Objective SW2, Arcadis offers the following opinions:

- The basis for the use of 10X AEMP as a criterion needs to be provided. Since dose response curves are not often linear, 10X AEMP could be lethal to organisms. It is not clear that 10X AEMP will provide adequate protection or triggers for aquatic life.
- Chronic toxicity tests should be used at the end of the mixing zone for multiple species.
- An IC50 to indicate toxicity impairment is not appropriate to trigger further action. Anything above an IC25 will need to have robust scientific rationale to support its use that population level effects will not result.
- It is not clear what considerations will go into the Environmental Trade off study and whose interests will be represented in this study. The Closure Goals that "land and water that is physically and chemically stable and safe for people, wildlife and aquatic life" and "land and water that allows for traditional use" may not be met if the Environmental Trade Off Study indicates that natural drainage is the path to be followed.

The proposed amendments to the SWALF do not address any of the concerns identified in the original proposal, but the inclusion of additional potential criteria does not, in our opinion, improve the SWALF. We offer the following high-level comments regarding the proposed amendments to the SWALF – Aquatic Life:

- An early warning trigger should be considered,
- Investigation of cause should be triggered earlier in the framework (i.e., as soon as the early warning trigger is exceeded),
- The trigger of having AEMP monitoring results in near field to be 1.5X or a difference of 50% from the reference conditions is not reasonable and there is no explanation why these critical effects are triggered at a difference from reference conditions that is so much higher than that what is required in the AEMP programs. For example, critical effects size in the AEMP program for fish are 10% to 25% difference depending on the endpoint.
- All proposed additions of AEMP measurements should be removed from the SWALF and the criteria of meeting AEMP benchmarks and the absence of chronic toxicity to more than one species should be

added to the mixing zone boundary. Otherwise, failure to meet their closure objectives of no adverse effects to aquatic life could occur.

Appendix X-25 Human and Ecological Risk Assessment

The HHERA assessed the potential for risk to receptors considering post-closure conditions (relying on predicted concentrations 10 years post-closure). Reference conditions (representing “natural” regional concentrations not influenced by the mine) were used to understand the portion of the risk estimate derived from mine activities. Based on the information provided, it is not clear whether these reference locations are unimpacted areas. Arcadis briefly reviewed the reference locations used for surface water in the risk assessment. Based on a preliminary comparison of reference concentrations to pre-mining surface water quality data, it is not clear that the reference data is representative of unimpacted water quality. Concerns remain regarding the suitability of relying on the reference conditions data. Since DDMI uses the reference location to interpret the potential contribution of mining activities to exposure and to risk (and likely to justify whether mitigation measures are required) the selection of suitable reference locations is extremely important.

The human health risk assessment (HHRA) assessed risks to Indigenous populations and recreational users of the site (such as hikers and hunters). The HHRA considered the use of the land for camping, hunting and gathering food and the use of water for canoeing and fishing, as a source of drinking water and for bathing/swimming.

The HHRA concluded that the risks to people from post-closure mine contributions are negligible, except for the risks posed by exposure to arsenic and uranium in sediment located along the rocky shoreline. However, DDMI concluded that if people were wearing shoes, then the risk to uranium would be negligible and that the concentrations of arsenic are within natural variation at the Site and in the wider region. Therefore, it was concluded that the risk contribution from the mine was negligible.

Interpretation of toxicity appears to be based on LC50 which would be concentrations by which 50 percent of organisms are adversely affected, i.e., 50 % of organisms are killed. This does not provide adequate protection to aquatic life to meet their closure objectives of no adverse effect to aquatic life.

Based on our review of the information with respect to the WL amendment application, we offer the following comments:

- For a number of the parameters, the measured concentrations at the reference locations were higher than the predicted concentrations at various discharge points 10 years after post closure. Arcadis has not reviewed the predictive models and have not reviewed the reference location rationale or sampling. However, one would not expect to have concentrations of parameters lower than unimpacted reference locations for the following reasons:
 - Some movement of impacts would have been expected over the life of the mine, therefore a baseline of impacts similar to reference conditions or higher would be expected.
 - Redirecting surface water run-off from areas of the mine that have been impacted would be expected to have some impacts identified in the run-off. At the very least, we would expect the concentrations to be similar to reference locations, if not a little bit higher. Some of the concentrations were significantly lower. This could be the case but could also represent concerns with the predictive modeling or concerns with the selection of reference locations.
 - Concern remains with reference locations some of which appear to be impacted by mining activities. In addition, some of the reference locations reportedly have excessive dust depositions making these reference locations questionable. DDMI should provide comparison of water quality

from current reference locations relied upon in the RA to pre-mining water quality to identify whether the reference locations relied upon in the RA are representative of unimpacted conditions.

- Furthermore, Arcadis does not agree on the approach taken with regards to risk from reference locations. It is not appropriate to deduct risk from reference locations from risk from mine locations to determine risk. An unacceptable risk should not be identified only if the difference in the risk from the mine is greater than the acceptable risk threshold. This would not be representative of the potential risks to human and ecological receptors. It is not clear if the predictive modelling accounted for cumulative loading of metals to the environment. All metals that enter the receiving waters will either partition to sediment, remain in surface water or be taken up and accumulated in biota.
- DDMI has evaluated human health risks using a tiered approach considering exposure based on post-closure predicted concentrations and reference concentrations. It appears that DDMI is only considering a risk unacceptable if the risk from the predicted post-closure concentrations minus the risk from the reference concentration is greater than the risk threshold of an HQ 0.2 or an ILCR 1×10^{-6} . This approach requires further justification. If an unacceptable risk is predicted based on post-closure concentrations, then the risk is unacceptable and requires consideration or management. In areas where reference concentrations are naturally elevated then it is common to manage risks to background/reference levels. But the incremental risk from the site does not need to exceed the risk threshold of 0.2 of 1×10^{-6} which is suggested. As a result, unacceptable risks are predicted for some parameters, in addition to uranium and arsenic which was indicated by DDMI.
- DDMI has reduced the consideration of sediment impacts to PHC F3 in the closure criteria. However, the HHRA identifies potential risks to human health from sediment impacts of uranium and arsenic. Sediment monitoring, especially in future discharge areas should be added to the closure plan as closure criteria to meet Closure Objectives.
- There are general concerns with the mixing zones and the mixing under low flow/low currents as well as ice cover. As this may affect deposition into sediments, Arcadis is of the opinion that sediment impacts should be monitored.
- In addition, the interpretation of risk by DDMI for HQs above 1 is flawed as it appears the assumption was made that risk from HQ increases in linear fashion when in fact the magnitude of risk associated with HQs is dependent on concentration - response relationships. This could potentially greatly underestimate risk.
- It is acknowledged by DDMI that uncertainty remains with the BLM and Windward models in that predicted concentrations e.g., of copper are lower than concentration in natural conditions of Lac de Gras which seems unrealistic. Arcadis did not review the models, however, this seems to underestimate the input and end concentrations in Lac de Gras which potentially underestimates risk.

John McCullum
EMAB
March 27, 2023

Conclusions

A number of concerns regarding the protection of aquatic life, wildlife and humans have been raised during the review of Appendix V of the FCRP, Appendix VI-1 and Appendix X-25 of the WL Amendment application. Arcadis is of the opinion that the approval of the WL Amendment as proposed is not appropriate at this time until concerns noted above are addressed.

Sincerely,
Arcadis Canada Inc.

DRAFT

DRAFT

Barbara Hard, Ph.D., R.P.Bio, QP_{RA}
Senior Biologist/Risk Assessor

Jennifer Kirk, Ph.D., QP_{RA}
Senior Biologist/Risk Assessor

Enclosures:

Tables: Excel Template