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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.

It should be noted that given the short review duration and the extensive information provided in the submission that these comments are preliminary in nature, and that additional comments upon further review will likely be forthcoming.

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.

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.
- It is not clear why DDMI relied on BC drinking water guidelines to adjust for incidental ingestion and not Health Canada's. An evaluation of the differences will be forthcoming in the next review.
- It is not clear why, when BC has Recreational Use Guidelines available (i.e., for nitrate and nitrite) that DDMI chose to still adjust the drinking water guideline as opposed to adopting the guideline.

DDMI has also removed the closure criteria based on the Aquatic Effects Monitoring Program (AEMP) 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 other than for nitrite and nitrate as indicated above.

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 comment 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 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 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.

For SW1 DDMI has removed the reliance on Health Canada (HC) Drinking Water Guidelines (DWG) and replaced them with British Columbia's (BC) Recreational Water Use Guidelines, if available. 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.

For SW2 (protection of aquatic life), 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 Surface Water Action Level Framework 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 or if toxicity is identified at the 12.5% dilution for a sub-chronic toxicity test. 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, and it is unclear whether the application of 10 times the AEMP is supported.**

If any parameter is detected at concentrations greater than 10X the AEMP, then sublethal toxicity testing at 12.5% dilution (which corresponds to an eight times dilution) would be conducted. To illustrate what is meant by a 12.5% dilution or an eight times dilution, we offer the following fictitious explanation. A parameter is dissolved in a liquid with a volume of 1L and has a concentration of 30 mg/L. If we took half of that original sample, placed it in a new container and filled the volume back up to 1L, then we would have a concentration of 15 mg/L, and it would represent a dilution of 50% or a two times dilution. If we were then to take half of that sample and place it in another container with a total volume of 1L, we would then have a concentration of 7.5 mg/L, and it would represent a 25% dilution, or a 4 times dilution. Taking half of that sample, and putting it in a total volume of 1L, we would then have a concentration of 3.75 mg/L, representing a 12.5% dilution or an 8 times dilution. Taking serial dilutions of a sample is standard practice, but typically all concentrations are assessed for toxicity so that an understanding of the dose-response curve can be obtained.

Essentially, surface water or seep water would be collected, diluted serially to represent 12.5% of the original sample and toxicity testing for sub-chronic endpoints to one test species (deemed as the most-sensitive sub-lethal toxicity test) will be conducted. **It is not clear why the 12.5% (or 8 times) dilution factor was chosen, and Section 3.1.4.4 does not indicate what toxicity test or species will be conducted (nor does it reference another section where this information is provided).** Appendix VI-1 Section 3.1.4.3 does indicate that this will use *Ceriodaphnia dubia*, and Attachment 2 of the same appendix specifies the Environmental Canada standardized test method (EPS 1/RM/21). Given the uncertainty of the use of 12.5% dilution and being unsuccessful in tracking down the rationale for that dilution, **it is not clear whether this approach will provide adequate protection to aquatic life.** It appears that DDMI is applying the IC25 in the 12.5% dilution test unit as the threshold to determine whether toxicity is present or not. 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 Surface Water Action Level Framework, 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 Action Level 2 (AL2) 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, or whether they would be applying chronic toxicity testing methods and endpoints.** 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, it is not clear if this is DDMI's intention.

If there is no toxicity at the mixing zone boundary, then the Surface Water Action Framework indicates that the criteria should be revised as appropriate. It is unclear what this means or what the implications are. 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. Assuming that the toxicity endpoints are now chronic endpoints (and even if they were sub-chronic endpoints), 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:

- Additional clarification and/or rationale to some of the assumptions/approaches must be explained and provided (for example, test organisms, endpoints etc.).
- 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. It is not clear that this is proposed.
- 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.

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 actually unimpacted areas. Arcadis does not have the AEMP Reference Conditions report (Golder, July 2019) to review and evaluate the suitability of the reference locations. Figure B-1 in Appendix X-25 shows some run-off impacts from the mine in the general area where the reference locations were chosen. 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.

The Ecological Risk Assessment (ERA) makes use of short-term benchmarks. However, these benchmarks were developed by CCME for the estimation of severe effects (such as lethality) from spill events, transient and infrequent releases of non persistent contaminants. These guidelines only protect a specified fraction of individuals from severe effects for a short duration exposure period. The DDI statement that short-term benchmarks are no effect benchmarks is incorrect. The use of short-term benchmarks is not considered appropriate.

Uncertainties pertaining to toxicity testing and lack of transparency, e.g., why some toxicity tests were completed in some locations and not in others make the interpretation of the data presented difficult.

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.

There also appears to be a high level of uncertainties with the models used to predict concentrations and the interpretation of HQs using LC50 as benchmarks.

Although the risk assessment has not been reviewed in its entirety at this point, there are a few “big-picture” concerns identified to date.

- 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.
- 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 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.
- 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 a number of parameters in addition to uranium and arsenic which was indicated by DDMI.

Conclusions

The cursory review of Appendix V of the FCRP, Appendix VI-1 and Appendix X-25 of the WL Amendment identified a number of major concerns with the protection of aquatic life and human health. Arcadis is of the opinion that the approval of the WL Amendment is not appropriate at this time until concerns noted above are addressed.

Sincerely,
Arcadis Canada Inc.

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Enclosures:

Tables: Excel Template