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DIAVIK WATER LICENCE AMENDMENT – PROGRESSIVE RECLAMATION – RE-ESTABLISHING NATURAL DRAINAGES: PLAIN LANGUAGE BRIEFING AND TECHNICAL REVIEW COMMENTS

Technical Memorandum # 367-23-01

Prepared for:

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PLAIN LANGUAGE SUMMARY

The Environmental Monitoring Advisory Board (EMAB) requested a technical review of sections of the Diavik Diamond Mines (2012) Inc. (DDMI; "Diavik") Water Licence Amendment – Progressive Reclamation – Re-establishing Natural Drainages submission package (dated November 24, 2022). This review focused on the aquatic environment and aquatic life related to the Licence Amendment Application – specifically, as it relates to the proposed pond breaching.

This document is a revised version of the initial Technical Review Document (NSC 2023) submitted to EMAB prior to the Technical Sessions held March 6-10, 2023, and incorporates responses provided by Diavik on v. 1.0, discussions at the Technical Sessions, additional comments identified based on review of additional documents, and responses to Information Requests.

Comments presented herein include those relevant to the Licence Amendment Application. Other aspects of the FCRP, including but not limited to the North Inlet and the pit lakes, were outside of the scope of this review.

Key comments and recommendations from this review are summarized below.

POST-CLOSURE MONITORING

- **Runoff Monitoring: Sampling Methods**: Diavik proposed to sample water at the "Mixing Zone Boundaries (MZB)" in Lac de Gras, downstream of site runoff. The proposed sites would be located either at a point 100 m from shore or farther from shore until water depth reaches 5 m. Water would be collected using a sampling device from the upper 1 m of the water column.
  - **Recommendation 1:** Sample at 100 m distance from shore in all mixing zones (or closer if full mixing occurs closer to shore); change the sampling method if needed to sample shallower water depths.
  - **Recommendation 2:** Collect water samples across the water column at the MZB stations if water is not fully mixed.
  - **Recommendation 3:** Conduct a plume survey in each mixing zone.
- **Runoff Monitoring: Monitoring Flow and Verifying Dilution**: Diavik has proposed that monitoring of flow from ponds post-breaching will be limited to presence/absence observations when the runoff is being sampled for chemistry or toxicity. This is inadequate to understand runoff inputs and for interpretation of monitoring results.
  - o **Recommendation**: Recommend regular monitoring of runoff discharge (e.g., daily).
- **Runoff Monitoring: Discontinuation of SNP Stations**: It is proposed to drop a Surveillance Network Program (SNP) station if runoff cannot be sampled in two back-to-back years. The

drainages are relatively small and flow may range from little flow in dry years to more flow in wet years.

- **Recommendation**: A decision on whether to drop a monitoring station needs to consider whether wet and dry conditions were captured in the monitoring. If the period of monitoring does not capture relatively high flow conditions, the station should remain active.

- **Runoff Monitoring: Sampling Frequency**: It is proposed to decrease runoff monitoring frequency from weekly to monthly or quarterly after 1 year of monitoring. This frequency may be inadequate to properly measure runoff quantity or quality**.**
  - **Recommendation 1**: Recommend a minimum of two years of weekly monitoring of SNP runoff sites. Any reductions in sampling frequency thereafter should be based on the results of the monitoring, including flow and water quality conditions.
  - **Recommendation 2:** Identify the approach that will be taken to trigger sampling of the streams subject to infrequent/intermittent flows, including the time required to mobilize and complete toxicity/water quality sampling once flow is detected.
- **Runoff Monitoring: Sites:** It is proposed that runoff will be sampled for chemistry and toxicity at the breach locations. Monitoring of the streams should also be conducted near the mouths to determine if and how water quality changes along the length of the stream and prior to discharging to the lake.
  - **Recommendation:** Recommend sampling runoff for water quality analysis at an additional site near the stream mouths to assess changes in water quality conditions for a minimum of one year.
- **Runoff and MZB Monitoring: Freshet:** It is expected that due to safety considerations, sampling of the MZB SNP stations will not be possible early in the spring when runoff begins to flow but the lake is still ice-covered. An alternate sampling plan should be developed that can feasibly and safely be implemented in these instances.
  - **Recommendation 1:** Develop an alternate sampling plan for scenarios in which the MZB stations cannot be sampled for safety reasons. Recommend sampling the mouth of the runoff stream (if sampling these sites regularly is not required) and/or the nearshore area of the lake as feasible.
  - **Recommendation 2:** Estimate concentrations using predicted dilution factors at the SNP MZB stations in the event the sites cannot be sampled for safety reasons.
- **Runoff Monitoring: Low Flow:** Stream flow may be too low at the pond breach sites to allow for collection of water samples for chemistry and/or toxicity testing during some periods.
  - **Recommendation:** Identify alternate sampling sites in runoff streams and/or the nearshore area of the lake if sampling at the proposed runoff SNP stations is not possible (e.g., flow or depth is too low).

- **Mixing Zone Monitoring: Chlorophyll *a***: The proposed water quality program for the mixing zones does not include chlorophyll *a* (an indicator of the amount of algae in water). Chlorophyll *a* should be included to monitor for effects related to nutrients. This is particularly relevant since a key nutrient (phosphorus) is predicted to increase post-closure.
  - **Recommendation**: Add chlorophyll *a* to the list of water quality parameters to be monitored at the SNP Mixing Zone stations.
- **Surface Water Action Level Framework (SWALF): Nutrients and Eutrophication**: The proposed surface water action level framework includes triggers and associated actions based on (1) measures of sub-lethal toxicity of runoff; and (2) comparison of the runoff quality to Aquatic Effects Monitoring Program (AEMP) benchmarks. There is no trigger relating to water quality at the mixing zone boundary stations. The proposed framework does not properly incorporate triggers and actions relating to nutrients and the potential for increases in algae in the lake.
  - **Recommendation 1**: Revise the surface water action level framework to include appropriate triggers for phosphorus and chlorophyll *a*.
  - **Recommendation 2**: Add a trigger/response/action level for chlorophyll *a* in the mixing zone.
- **Surface Water Action Level Framework: Implementation**: The structure of the SWALF means there may be long lag times between a trigger being exceeded and implementation of an action (estimated to be on the order or 3-5 weeks depending on the trigger). These time delays may create practical issues associated with implementing actions either effectively or at all.
  - **Recommendation**: Describe what the response and actions will be if an action is triggered but the runoff is no longer flowing, the quality and/or quantity of runoff changes notably, and/or if actions can no longer be implemented due to lack of flow or safety considerations.
- **Surface Water Action Level Framework: Application**: It is unclear how results of monitoring at the mixing zone boundary fit into the proposed action level framework. Specifically, there are no triggers in the framework relating to surface water quality in the mixing zone.
  - **Recommendation**: Describe how water quality conditions in the mixing zone will be incorporated into the SWALF and clarify what the actions would be if AEMP benchmarks are not met at the MZB sites.
- **Surface Water Action Level Framework: Proposed Revisions**: Diavik proposed some options for modifications to the SWALF, which includes the addition of triggers associated with monitoring conducted under the AEMP. Some of the details of these proposed changes are unclear.
  - **Recommendation 1**: Apply the Action Level 2 trigger to individual water quality, plankton, fish, and benthic invertebrate sampling stations and not to the overall average of all sites in the Nearfield area.

- **Recommendation 2**: Describe how Farfield data will be incorporated in the assessment.

- **Recommendation 3**: Provide a rationale for the proposed critical effects sizes (i.e., magnitude of effect on aquatic life that would trigger an action).

- **Recommendation 4:** Define "effects threshold" for water quality and if not defined, explain when and how it will be defined. Describe how the trigger will be assessed if there is no effects threshold.

- **Recommendation 5**: Clarify if the water quality trigger proposed for the Midfield area would apply to individual stations or to all stations combined.

AQUATIC EFFECTS MONITORING PROGRAM

- **Monitoring and Schedule**: Diavik has clarified that fish sampling at the new sampling areas around East Island will not be done until 2025. Other aquatic environment components would be sampled in 2023 or 2024 at new sites where schedule permits. Diavik noted that only winter water quality would be sampled prior to breaching Ponds 2 and 7.

  - **Recommendation**: Two years of pre-closure sampling at the new areas/sites is recommended. At a minimum, one round of monitoring for all components (water quality and plankton (winter and summer), sediment quality, benthic invertebrates, fish, and metals in fish) should be done before ponds are breached.

- **New Sampling Areas**: The Closure and Post-Closure AEMP Design Plan proposes to add new sites to address specific effects of the closure – including breaching of collection ponds. The water quality modeling predicts the greatest effects on water quality in runoff and Lac de Gras in the bay that will receive runoff from C3 (hereafter referred to as the "C3 bay"). No sampling sites have been included for this area.

  - **Recommendation**: Sample all components in the C3 bay and collect a minimum of one year of pre-closure monitoring data to facilitate pre- vs. post-closure comparisons.

SITE WATER QUALITY MODEL

- **Model Inputs: Baseline Water Quality Data**: The site water quality model used to predict effects of site runoff used a constant and "average" (median) background water quality condition for runoff based on sampling done at 8 streams in 1996 (none of which are on East Island). No details are provided and there is no discussion of this dataset in the submission (e.g., were conditions highly variable). This information is important to understand as it is a major input to the modeling that was done.

  - **Recommendation 1**: Provide a table showing the loading (amount of each substance predicted to be released into the runoff) for each source in each of the drainages.

  - **Recommendation 2**: Conduct modeling of site runoff water quality using higher concentrations for background water quality (e.g., maximum measured concentrations).

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT (HHERA)

- **Metals in Lake Trout**: The HHERA indicates that there are only data for mercury in Lake Trout and no other metals. There are existing datasets for metals other than mercury.
    - **Recommendation**: Verify that the conclusions of the HHERA would not change with the use of actual Lake Trout metals data.
- **Metals in Slimy Sculpin**: The HHERA used existing data for metals in Slimy Sculpin from the period of 2007-2019. Issues with two years (2007 and 2016) of this dataset have been identified. It would be prudent to assess whether any conclusions of the risk assessment would change with exclusion of these data.
    - **Recommendation**: Verify conclusions of the HHERA would not be affected by removal of the 2007 and 2016 slimy sculpin metals datasets.
- **Mercury in Lake Trout**: It is unclear what data were used for mercury in Lake Trout in the HHERA. The sample size presented in the HHERA does not align with the Lake Trout mercury dataset provided by Diavik previously.
    - **Recommendation**: Verify and clarify what specific mercury in Lake Trout datasets were used to define summary statistics to support the HHERA. Data sets should exclude replicate samples and analyses (e.g., 2008 dataset). Verify that the conclusions of the HHERA would not change with use of a corrected dataset (if applicable).

TABLE OF CONTENTS

1.0 BACKGROUND AND SCOPE OF WORK....1

2.0 KEY COMMENTS....3

2.1 APPENDIX VI-1: CLOSURE AND POST-CLOSURE MONITORING....4
2.1.1 Runoff Monitoring: Sampling Methods....4
2.1.2 Runoff Monitoring: Discharge Monitoring and Model Verification....4
2.1.3 Runoff Monitoring: Discontinuation of SNP Stations....5
2.1.4 Runoff Monitoring: Sampling Frequency....6
2.1.5 Runoff Monitoring: Sites....6
2.1.6 Runoff and MZB Monitoring: Freshet....6
2.1.7 Runoff Monitoring: Low Flow....7
2.1.8 Mixing Zone Monitoring: Chlorophyll *a*....7
2.1.9 Surface Water Action Level Framework: Nutrients and Eutrophication....7
2.1.10 Surface Water Action Level Framework: Implementation....8
2.1.11 Surface Water Action Level Framework: Application....9
2.1.12 Surface Water Action Level Framework: Proposed Revisions....9

2.2 APPENDIX VI-2: AQUATIC EFFECTS MONITORING PROGRAM DESIGN PLAN....11
2.2.1 Pre-Closure Monitoring and Schedule....11
2.2.2 NF Sampling Areas....12

2.3 APPENDIX X-20: SITE WATER QUALITY MODEL....13
2.3.1 Runoff Modeling: Background Water Quality and Project Effects....13

2.4 APPENDIX X-25: HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT....14
2.4.1 Metals in Lake Trout....14
2.4.2 Slimy Sculpin Metals Data....14
2.4.3 Mercury in Lake Trout....15

3.0 REFERENCES....16

1.0 BACKGROUND AND SCOPE OF WORK

Diavik Diamond Mines (2012) Inc. (DDMI; Diavik) submitted an Application to the Wek'èezhìi Land and Water Board (WLWB) to Amend Water Licence W2015L2-0001 "to enable authorization to re-establish island pre-development runoff conditions through sequential, and where practical, progressive decommissioning of the water management system (i.e., collection ponds)." (DDMI 2022a). The Application submission (submitted November 24, 2022) included a number of documents – many of which were submitted as part of the Final Closure and Reclamation Plan (FCRP) v. 1.0 submitted to the WLWB on October 13, 2022.

The Environmental Monitoring Advisory Board (EMAB) requested that North/South Consultants (NSC) undertake a technical review of portions of the Water Licence Amendment Application Package that pertain to aquatic effects monitoring as follows:

- Appendix A: Water Licence Amendment Application;
- Appendix D: Conformity Tables Between Proposed Schedule 8 Condition 3 and Supporting Materials;
- Appendix E: FCRP Main Body (sections relevant to the aquatic monitoring program only);
- Appendix VI-1: Closure and Post-Closure Monitoring Version 3.1; and
- Appendix VI-2: Closure and Post-Closure AEMP Design Plan Version 1.0.

A technical review was completed and submitted to EMAB prior to the Technical Sessions held March 6-10, 2023 (NSC 2023 v. 1.0).

DDMI submitted Version 1.0 of its Final Closure and Reclamation Plan (FCRP) on October 13, 2022. The WLWB completed their conformity check with the Water Licence and distributed the FCRP for review on December 23, 2022. Several files were re-posted after December 23, including Appendix X-19 to X-23 (January 16, 2023). Following completion of the Licence Amendment Application Review, EMAB requested that NSC undertake a technical review of portions of the FCRP that pertain to the aquatic environment, including the documents noted above, as well as:

- Appendix V: Detailed Tabulation of Closure Objectives and Criteria (sections relevant to the aquatic environment only);
- Appendix X-20: DDMI Closure Feasibility Study Site Water Quality Model, 1:100 Dry Year Scenario, and Climate Change Considerations (sections relevant to the aquatic environment only);
- Appendix X-21: Hydrodynamic and Water Quality Modelling of Pit Lakes and Lac de Gras;

- Appendix X-22: Rationale for Assessed Runoff Mixing Zones During Post-Closure;
- Appendix X-25: Human Health and Ecological Risk Assessment (aquatic environment only); and
- Appendix X-27: Surveillance Network Program Data (aquatic environment only).

This document is a revised version of the initial Technical Review Document (NSC 2023a) submitted to EMAB prior to the Technical Sessions and incorporates responses provided by Diavik on previous comments, discussions at the Technical Sessions, additional comments identified based on review of the documents noted above, and responses to Information Requests (IRs) from the Technical Sessions.

The review was restricted to consideration of the aquatic environment as it relates to aquatic life and excluded considerations relating to humans or wildlife. Comments presented herein include those relevant to the Licence Amendment Application. Other aspects of the FCRP, including but not limited to those related to the North Inlet and the pit lakes, were outside of the scope of this review.

Section 2 provides a discussion of key review comments and recommendations for consideration by EMAB.

2.0 KEY COMMENTS

Comments described in Sections 2.1 through 2.4 refer to the following general subjects:

Appendix VI-1: Closure and Post-Closure Monitoring

- Runoff Monitoring: Sampling Methods;
- Runoff Monitoring: Discharge Monitoring and Model Verification;
- Runoff Monitoring: Discontinuation of Surveillance Network Program (SNP) Stations;
- Runoff Monitoring: Sampling Frequency;
- Runoff Monitoring: Sites;
- Runoff and Mixing Zone Boundary (MZB) Monitoring: Freshet;
- Runoff Monitoring: Low Flow;
- Mixing Zone Monitoring: Chlorophyll *a*;
- Surface Water Action Level Framework: Nutrients and Eutrophication;
- Surface Water Action Level Framework: Implementation;
- Surface Water Action Level Framework: Application; and
- Surface Water Action Level Framework: Proposed Revisions;

Appendix VI-2: AEMP Design Plan

- Pre-Closure Monitoring and Schedule; and
- Nearfield (NF) Sampling Areas.

Appendix X-20: Site Water Quality Model

- Runoff Modeling: Background Water Quality Data and Project Effects.

Appendix X-25: Human Health and Ecological Risk Assessment (HHERA)

- Metals in Lake Trout;
- Metals in Slimy Sculpin; and
- Mercury in Lake Trout.

2.1 APPENDIX VI-1: CLOSURE AND POST-CLOSURE MONITORING

2.1.1 Runoff Monitoring: Sampling Methods

Sampling at the Mixing Zone Boundary (MZB) is proposed to be at fixed locations – either 100 m from shore or farther offshore to the 5 m depth contour. Diavik clarified at the Technical Sessions that the proposed sampling at the 5 m depth contour is due to logistical constraints (i.e., assumed 2 m ice thickness, sampling 2 m off the bottom and using a 1 m Kemmerer). Diavik also clarified at the Technical Sessions that the MZB sites are expected to be fully mixed but that *in situ* depth profile measurements will be collected.

It is our understanding that the MZB SNP stations would not be sampled under ice either because runoff will not be flowing, and therefore sampling is not required, or because conditions on the lake would be unsafe for sampling when runoff is flowing but ice remains on the lake. Assuming this is correct, then the presence of ice (and therefore the need to account for 2 m of ice depth) is not applicable to the selection of the precise location (i.e., minimum 5 m depth).

Other sampling methods (i.e., other than a 1 m vertical Kemmerer water sampler) could also be used for sampling these sites including but not limited to grab sampling (directly filling sample bottles) or use of a horizontal sampler or a peristaltic pump. These methods would allow for sampling of shallower depths.

In addition, if sites are not fully mixed it would be more appropriate to collect a depth-integrated sample for chemistry and toxicity testing, rather than sampling the upper 1 m of the water column as proposed.

It would be most appropriate to locate all MZB SNP stations at the 100 m distance from shore as proposed, or closer to shore if the full mixing is achieved closer than 100 m from shore, rather than applying a minimum water depth. A plume survey would assist with delineating the dimensions of the plume and identifying the location of full mixing.

Recommendation 1: Sample at 100 m distance from shore in all mixing zones (or closer if full mixing occurs closer to shore); change the sampling method if needed to sample shallower water depths.

Recommendation 2: Collect depth-integrated samples at the MZB stations rather than only a portion of the water column in the event that a site is not fully mixed.

Recommendation 3: Conduct a plume survey in each mixing zone to establish the size, dimensions, and location of full mixing. Review the proposed MZB sampling site locations based on the results of the plume survey and move stations as required and appropriate.

2.1.2 Runoff Monitoring: Discharge Monitoring and Model Verification

NSC previously submitted a technical comment in a review of the Diavik Licence Amendment Application - Progressive Reclamation – Re-Establishing Natural Drainages (NSC 2023) seeking clarification of what monitoring is proposed with respect to site runoff discharge. It was noted that Appendix VI-1 does not clearly indicate whether runoff discharge will be monitored at all sites post-breaching of the ponds or what methods would be employed - specifically measurement frequency.

DDMI responded: "Post-decommissioning surface runoff flow (discharge) will be monitored through presence/absence observations at the time of planned sampling."

Clarification was provided by Diavik at the Technical Sessions that model validation would consist of verification of the predicted dilution factors at the MZB. Diavik noted this would involve comparing the concentrations from the runoff and MZB "plus background". It is our understanding that there is no "background" water quality sampling planned in the lake to be used for this purpose.

Recommendation 1: It is recommended that discharge of surface runoff be monitored regularly (e.g., daily discharge) if/as feasible to: (A) provide a means to monitor the overall flow conditions encountered each year (i.e., hydrograph, periods of flow, volume of runoff); (B) document the range of discharge conditions to assist with interpretation of monitoring results (e.g., was toxicity testing sampling or mixing zone sampling conducted during a relatively high or low discharge); and (C) to facilitate verification of modeling results, including verification of dilution, and allow for calculation of loadings from site runoff.

Recommendation 2: Model validation of dilution factors should compare water quality in the runoff directly to the water quality at the MZB (i.e., background conditions should not be added to the MZB measurements).

2.1.3 Runoff Monitoring: Discontinuation of SNP Stations

Appendix VI-1 indicates that a proposal will be submitted to make an SNP station inactive in the event surface and runoff monitoring of a current SNP station establishes that flow is "unable to be successfully sampled for two consecutive monitoring years."

There may be considerable variability in inter-annual flow/discharge and two years may be insufficient to capture a range of high and low flow conditions. For example, the first two years may be atypically dry which would lead to inactivation of the SNP site based on the proposed approach. It would be more appropriate to consider the specific hydrological conditions encountered during the initial monitoring years (i.e., dry or wet years) relative to the estimated range of flow conditions for each stream when determining if a station could be deactivated.

Recommendation: A decision to deactivate an SNP station should consider the hydrological conditions/climatological conditions encountered during initial monitoring relative to the range of flow conditions for each stream. If the period of monitoring did not capture relatively high flow conditions, the station should remain active.

2.1.4 Runoff Monitoring: Sampling Frequency

The appendices indicate a reduction of monitoring frequency for runoff from weekly for 1 year to monthly (quarterly for toxicity) and ultimately twice per year thereafter. This reduced sampling frequency may not be adequate to effectively characterize discharge and water quality in the drainages given that inter-annual variability may be considerable. In addition, site runoff is likely to be highly variable within the open-water season and quarterly sampling may be inadequate to fully characterize these source waters; sampling needs to capture periods of intermittent flow, which may be highly variable in time and for brief periods (i.e., days). More frequent sampling (weekly or biweekly sampling) may be required to capture a range of flow and water quality conditions for more than a 1-year period.

Recommendation 1: Recommend a minimum of two years of weekly monitoring of SNP runoff sites; reductions in sampling frequency thereafter should be based on the results of the monitoring, including consideration of hydrological conditions encountered during the initial monitoring (i.e., wet or dry years/ range of flow conditions encountered during initial monitoring years) and variability of water quality conditions.

Recommendation 2: Identify the approach that will be taken to trigger sampling of the streams subject to infrequent/intermittent flows, including the time required to mobilize and complete toxicity/water quality sampling once flow is detected.

2.1.5 Runoff Monitoring: Sites

It is proposed that runoff will be sampled for chemistry and toxicity at the breach locations. Monitoring of the streams should also be conducted near the mouths to determine if and how water quality changes along the length of the stream and prior to discharging to the lake.

Recommendation: Recommend sampling runoff for water quality analysis at an additional site near the stream mouths to assess changes in water quality conditions for a minimum of one year.

2.1.6 Runoff and MZB Monitoring: Freshet

It is expected that due to safety considerations, sampling of the MZB SNP stations will not be feasible early in the spring when runoff begins to flow but the lake is still ice-covered. In the absence of the ability to monitor the mixing zone in these instances, an alternate sampling plan should be developed that can feasibly and safely be implemented. Sampling the runoff stream at the mouth (point of entry to the lake) as recommended in Section 2.1.5 (or an alternate site as/if needed) and/or in the nearshore area of the lake if safe/feasible is recommended.

Recommendation 1: Develop an alternate sampling plan for scenarios in which the MZB stations cannot be sampled for safety reasons. Recommend sampling the mouth of the runoff stream (if regular sampling of these sites is not required) and/or the nearshore area of the lake as feasible.

Recommendation 2: Estimate concentrations using predicted dilution factors at the SNP MZB stations in the event the sites cannot be sampled for safety reasons.

2.1.7 Runoff Monitoring: Low Flow

It has been noted that due to the nature of the drainages and flow conditions, that runoff flow may be inadequate to facilitate collection of water samples for chemistry and/or toxicity testing during some periods. Though this constraint may apply to the entirety of some/all of the drainages, sampling should be attempted at alternate locations farther downstream in the event sampling cannot be completed at the proposed runoff SNP stations. If sampling cannot be completed at any site in the stream(s), sampling should be conducted in the nearshore of the lake near the point of entry of the runoff.

Recommendation: Identify alternate sampling sites in runoff streams downstream of the breach locations to be sampled in the event of practical constraints on sampling at the proposed runoff SNP stations. Identify alternate sampling sites in the nearshore of the lake in the event that runoff cannot be sampled at any location in the runoff streams.

2.1.8 Mixing Zone Monitoring: Chlorophyll *a*

The water quality parameters that will be monitored at the mixing zone stations do not include chlorophyll *a*. This parameter should be included to monitor for effects related to potential nutrient enrichment. This is particularly relevant as water quality modeling indicated total phosphorus (TP) is one of the parameters that is predicted to increase post-closure. It is also noted in Appendix VI-2 (p. 17) that biological uptake will reduce concentrations in the lake, particularly during the open-water season; a measure of algal abundance is needed to account for the effect of nutrients released in runoff.

Recommendation: Add chlorophyll *a* to the list of water quality parameters to be monitored at the SNP Mixing Zone stations.

2.1.9 Surface Water Action Level Framework: Nutrients and Eutrophication

The surface water action level framework (SWALF) Action Level AL1A - Runoff monitoring triggers for the aquatic environment (SW2) are: (1) runoff > AEMP benchmarks for aquatic life; or, (2) runoff exhibits sublethal toxicity. The only trigger in the framework with respect to SW2 for the mixing zone monitoring is sublethal toxicity; there are no triggers for the MZB based on water quality for SW2.

The proposed framework is not appropriate for application to nutrients and the eutrophication pathway. Two key issues are:

- the trigger of 10 x the AEMP benchmark (in runoff) for TP would be 7.5 µg/L x 10 = 75 µg/L and for chlorophyll *a* would be 4.5 µg/L x 10 = 45 µg/L. These triggers are too high/insensitive and represent eutrophic/hypereutrophic conditions. Triggers for TP and chlorophyll *a* need to be identified that are adequately sensitive; and

- the framework needs to explicitly consider chemistry at the MZB for the nutrient enrichment pathway - specifically, the program should monitor for effects on chlorophyll *a* in the lake proper and the framework should include a trigger for chlorophyll *a* at the MZB.

It is acknowledged that the loading of phosphorus to Lac de Gras is expected to decrease post-closure. However, nutrient inputs from pond drainages would occur over a shorter period (open-water season) than those from operation (i.e., from the North Inlet Water Treatment Plant [NIWTP]) and the receiving environments differ in terms of mixing and habitat conditions such as water depth. Therefore, effects of site runoff on nutrients in the mixing zones may be expected to differ from those observed near the NIWTP.

Recommendation 1: Revise the surface water action level framework to include appropriate triggers for TP and chlorophyll *a*.

Recommendation 2: Add a trigger/response/action level for chlorophyll *a* in the mixing zone.

2.1.10 Surface Water Action Level Framework: Implementation

The surface water action level framework identifies several assessment steps with an associated action. For aquatic life, these are:

- Action Level AL1A:
  - Trigger - runoff 10 × AEMP benchmarks for aquatic life;
  - Action - sub-lethal toxicity testing of runoff at 12.5% dilution;
- Action Level AL2A:
  - Trigger - sublethal toxicity observed in runoff at 12.5% dilution;
  - Action - sublethal toxicity testing of undiluted surface water from the mixing zone boundary (MZB);
- Action Level AL3A:
  - Trigger - sublethal toxicity observed at MZB;
  - Action - re-establish temporary water collection; conduct a special effects study on the extent of effects in Lac de Gras; toxicity identification evaluation; and, identification of mitigations.

The process is conceptually logical; however, in practice may be problematic to implement in some cases due to time lags associated with sampling, laboratory analysis, and subsequent implementation of actions (estimated to be on the order or 3-5 weeks depending on the trigger).

Time lags between initial runoff sampling and subsequent implementation of Action Level AL2A sampling (MZB sampling) could result in issues associated with changes in runoff quantity and/or quality between the sampling events. Time lags on the order of several or more weeks may also result in a scenario in which runoff to Lac de Gras ceases prior to implementation of MZB sampling and/or where sampling conditions become unsafe for sampling.

Recommendation: Describe what the response and actions will be in the event that action AL1A (runoff toxicity) or AL2A is triggered (i.e., MZB sampling) but the runoff is no longer flowing, the quality and/or quantity of runoff changes notably, and/or if actions can no longer be implemented due to lack of flow or safety considerations.

2.1.11 Surface Water Action Level Framework: Application

The text indicates that "If SNP source water samples collected from the pond breach location did not meet closure criteria, or if concentrations at the edge of the mixing zone exceeded AEMP effects benchmarks then sampling would continue, and the surface water action level framework would be applied (see Section 3.1.4.4 and Figure 3-3)."

The surface water action level framework appears to apply criteria (AL 0/1) of 10X AEMP benchmarks and these appear to apply specifically to the runoff and not the mixing zone. It is unclear how these two actions interconnect as the framework does not apply the criterion of conditions being below AEMP benchmarks at the MZB.

Further, the framework does not include direct assessment of water quality conditions and comparisons to AEMP benchmarks in the mixing zone. Therefore, the framework lacks a mechanism to invoke an action in the event that water quality conditions are above benchmarks but rather relies entirely on results of toxicity testing of the mixing zone – which would only be tested in the event that site runoff exhibits toxicity.

Recommendation: Describe how water quality monitoring results in the mixing zone will be incorporated into the SWALF and clarify what the actions would be in the event that AEMP benchmarks are not met at the MZB.

2.1.12 Surface Water Action Level Framework: Proposed Revisions

Diavik has proposed some options for modifications to the SWALF in their response to Information Requests (DDMI 2023; Attachment B). For aquatic life, proposed changes include the addition of two chemistry parameters to Action Level 2 (total suspended solids [TSS] and pH) and addition of triggers from the AEMP to the SWALF. We support the inclusion of triggers and actions for the AEMP and integration within the SWALF. However, we offer the following comments/questions:

- Action Level 2 - Fish:
    - It is unclear what is meant practically by the “Nearfield mean” (NF). Only two sampling areas for fish are proposed for the nearfield area adjacent to drainages

where collection pond breaches will occur; the third is proposed in the area adjacent to the North Inlet. An "effect" may be observed in one of the NF areas but not the others and applying a mean for all areas may mask this effect.

  - How will Farfield (FF; i.e., matched "reference areas") data collected concurrently with the NF data be utilized in the proposed framework?

  - What is the rationale for the proposed critical effect size (CES) of 1.5x the reference condition? Metal and Diamond Mining Effluent Regulations (MDMER) specify CESs for fish metrics of 10% (condition) to 25% (all other metrics).

- <u>Action Level 2 - Invertebrates and Plankton</u>:

  - As above, it is unclear what is meant practically by the "Nearfield mean". Would the mean be calculated from all NF sites collectively or would this apply to specific areas adjacent to collection pond breaches independently?

  - As above, what is the rationale for the proposed CES of 50% lower than the reference condition for invertebrates and plankton? MDMER specify CESs for benthic invertebrates of 2 x standard deviation (SD).

- <u>Action Level 2 - Water Quality</u>:

  - An Action Level 2 trigger for water quality is defined as "a Nearfield station greater than the normal range plus 50% of the effects threshold." It is unclear what is meant by the "effects threshold". If the effects thresholds have not been defined for water quality, how will this trigger be assessed? Assuming they have not been defined, what trigger would be applied to cause an effects threshold to be defined?

- <u>Action Level 3 - All</u>:

  - It is unclear if the water quality trigger proposed for the Midfield area would apply to individual stations or to all stations combined;

  - Since water quality will be monitored annually and benthic invertebrates and fish on a three-year rotation, it is unclear if the proposed water quality trigger would apply to any year or only the year(s) in which the biological sampling was conducted;

  - The term reference conditions (RC) and NR (assuming this is normal range) are used in the revised SWALF. Can Diavik clarify if these are referring to the same data?

<u>Recommendation 1</u>: Clarify what is meant by the nearfield mean for the fish component (Action Level 2 trigger). Recommend assessing this trigger for each individual NF area against the reference condition. Include a description of how FF data will be incorporated in the assessment.

<u>Recommendation 2</u>: Clarify what is meant by the nearfield mean for the plankton and benthic invertebrate components (Action Level 2 trigger). Recommend assessing this trigger for each individual NF area adjacent to the pond breaches against the reference condition. Include a description of how FF data will be incorporated in the assessment

<u>Recommendation 3</u>: Provide a rationale for the proposed CES of 1.5x the reference condition for fish and 50% of the reference condition for plankton and benthic invertebrates.

<u>Recommendation 4</u>: Define "effects threshold" for water quality. If the effects thresholds have not been defined for water quality, describe how the Action Levels 2 and 3 triggers will be assessed. Assuming effects thresholds have not been defined, identify what trigger would be applied to cause an effects threshold to be defined.

<u>Recommendation 5</u>: Clarify if the water quality trigger proposed for the Midfield area would apply to individual stations or to all stations combined.

2.2 APPENDIX VI-2: AQUATIC EFFECTS MONITORING PROGRAM DESIGN PLAN

2.2.1 Pre-Closure Monitoring and Schedule

The AEMP Design Plan for the Closure and Post-Closure Phases indicates sampling would start under this Design Plan in 2025 (anticipated start of closure) and that the comprehensive monitoring (including fish, invertebrates, and FF sites) would be done in 2025 and 2028 with sampling frequency to be determined thereafter. The Closure and Post-Closure AEMP Design Plan proposed to add two new sampling areas for Slimy Sculpin monitoring: (1) one area in the vicinity of the outflow from Pond 4 (referred to as NFC3); and (2) one area in the vicinity of the outflows from Ponds 1, 5, 10, and 13 (referred to as NFC-6). Additional new NF sites for other components have also been proposed.

The FCRP indicates that "subject to schedule changes based on completion of closure work within catchments, the envisioned schedule for breaching is":

- Ponds 2 and 7: 2023;
- Ponds 1 and 13: 2025;
- Ponds 4 and 5, Sump E21: 2026; and
- Ponds 3, 10, 11, and 12: 2027.

DDMI clarified that fish sampling is not planned to be undertaken prior to breaching closure drainages, the North Inlet, or the pit lakes and that the first planned sampling is in 2025. Diavik indicated that sampling will be undertaken "where schedule permits" for water quality, plankton, sediment quality, and benthic invertebrates in 2023 or 2024 but only ice-cover season sampling for water quality would be completed before breaching of Ponds 2 and 7.

All new sampling sites for all components should be sampled prior to pond breaching to provide a "baseline" data set for comparison to closure/post-closure monitoring. This is critical information as these areas have not been sampled previously. For Slimy Sculpin, past monitoring conducted under the AEMP has noted considerable variability in the data sets and confounding factors with respect to similarities in habitat between the FF (reference) areas and the NF/MF areas which has affected data interpretation. This consideration renders the need for pre-closure data collection particularly important.

Recommendation: Two years of pre-closure sampling at the new areas/sites is recommended to provide robust data for comparison. At a minimum, one round of monitoring at the new NFC should be completed for all components (water quality, plankton, sediment quality, invertebrates, fish, and metals in fish) prior to breaching of ponds. For water quality and plankton, the pre-closure sampling should include at least one summer and one winter sampling event.

2.2.2 NF Sampling Areas

The Closure and Post-Closure AEMP Design Plan proposed to add two new sampling areas for Slimy Sculpin monitoring: (1) one area in the vicinity of the outflow from Pond 4 (referred to as NFC-3); and (2) one area in the vicinity of the outflows from Ponds 1, 5, 10, and 13 (referred to as NFC-6). Additionally, it is proposed to drop one NF area in the vicinity of the A21 pit (MF3 area).

The summary of water quality modeling results indicates that the highest predicted concentrations of constituents in runoff during post-closure are associated with the PKC Facility and the E21 and A418 Pit drainages and that the PKC Facility drainage will flow to drainage C3. None of the three NF fish sampling areas are in the areas of runoff discharge from these drainages/sources and no other sampling (i.e., water quality, plankton, benthic invertebrates, and sediment quality) is proposed in the bay that will receive C3 runoff (hereafter referred to as the "C3 bay").

NSC had previously requested clarification for the rationale used to select fish sampling areas and DDMI responded that sites were selected based on habitat constraints (water depth of 18-22 m) and that this bay does not meet these criteria.

While the desire to maintain consistency in habitat attributes when selecting sites is understood (and is critical), this constraint should not preclude sampling in areas where monitoring is particularly important. Water quality sampling is generally not constrained by habitat attributes and should be completed in this area. Fish sampling is conducted in nearshore areas and is decoupled from sampling of other components – therefore fish site selection is not dependent upon water depth and substrate offshore. Sediment quality and benthic invertebrates could be affected by sampling at shallower depth and/or in areas with different. However, sampling could be undertaken in the C3 bay in shallower habitat and data could be analysed through a pre-closure vs. closure/post-closure approach (i.e., before-after approach) or potentially through alternative study designs (e.g., gradient design).

Given that the C3 bay is predicted to experience the largest impacts related to the Project post-closure, the AEMP should not only include some sampling in this area, this area should be a high priority for monitoring. It is further suggested that collection of data in the C3 bay will increase confidence/reduce uncertainty with respect to predicted effects of the Project post-closure and would provide valuable data to inform the understanding of closure impacts.

Recommendation: Sample all components in the C3 bay and collect a minimum of one year of pre-closure monitoring data to facilitate pre- vs. post-closure comparisons of conditions.

2.3 APPENDIX X-20: SITE WATER QUALITY MODEL

2.3.1 Runoff Modeling: Background Water Quality and Project Effects

The baseline (i.e., pre-Project) water quality data for streams used in the modeling is not presented in the submission (only median values are presented) and the reader is referred to Diavik (1998) for details. The Environmental Assessment Report (Diavik 1998) presents one table with minimum, maximum, and median statistics for water quality measured in eight streams. The number of samples, frequency and timing of sampling, and locations of the sampling are not provided. There is also no discussion of the occurrence of “natural” exceedances of AEMP benchmarks for these streams in this reference.

The information as provided is inadequate to: (1) understand the quantity and quality of baseline water quality data for these systems (which formed the basis of model inputs); (2) determine what if any water quality parameters exceeded AEMP benchmarks before the Project and if exceedances occurred, how frequently and by what magnitude; (3) understand the appropriateness of the use of a median for defining background water quality conditions for water quality modeling; and (4) interpret modeling results and – in particular – discriminate Project-related effects on water quality. Ultimately the information presented is insufficient to determine if modeling was appropriate and adequate and what the Project-specific effects are projected to be.

In response to a question on the baseline data used from modeling, Diavik indicated the raw data and details regarding the stream baseline water quality sampling are presented in **Golder Associates. 1996. Technical Memo #9-3. Stream/watershed water quality report.** Review of the data presented in this report indicate that none of the streams sampled in 1996 (the baseline dataset used for water quality modeling) were located on East Island. Further, the vast majority of the data were obtained in spring; only three streams were sampled in summer and fall. Lastly, total phosphorus was only measured in summer and fall at these three streams (total n = 6).

Detection limits are only provided for the summer and fall programs (not spring) and there is only one blank sample reported for the whole program (submitted with the spring program). The single field blank sample indicates potential sample contamination – including for total copper.

For the site water quality modeling, background water quality conditions for unimpacted drainages (i.e., "natural" runoff) were assigned the median concentrations from baseline studies conducted in 1996 and these values were held constant (i.e., background water quality does not vary with differing climate/flow conditions) in the modeling conducted. In addition, the modeling assumed that source loading is constant over time; this assumption is unlikely to be accurate and likely not conservative. This approach may not be adequately sensitive or appropriate. It appears that the only model input that was varied under the different climate change scenarios is flow; therefore, the model only predicts increases or decreases in runoff constituents as a direct function of flow/volume (i.e., dilution).

It is unclear what if any exceedances of water quality benchmarks and/or acute toxicity benchmarks beyond those predicted based on the median background water quality values would be predicted if a higher background water quality statistic were selected. Specifically, for those parameters that were predicted to be higher in runoff than background median concentrations but lower than AEMP benchmarks, would use of a different statistic for background water quality conditions result in runoff concentration exceeding AEMP benchmarks?

Inclusion of loading data used for all source inputs would assist with determining what drainages may be more affected by the background water quality source term (e.g., a table identifying loads from each source, including background water quality).

Recommendation 1: Provide a table(s) of source term loads used in runoff modeling to assist with identifying what source terms are the most significant in each drainage.

Recommendation 2: Conduct runoff modeling using a more conservative background water quality source term (e.g., maximum or 95th percentile) and compare to predictions based on the median baseline water quality values.

2.4 APPENDIX X-25: HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

2.4.1 Metals in Lake Trout

The HHERA indicates that the only COPC with measurements for Lake Trout is mercury. There are data available for other metals in Lake Trout. For example, Lake Trout muscle was analysed for a suite of metals in 2015 (Golder 2017) and 2018 (Golder 2019) as part of the Traditional Knowledge Study.

Recommendation: Verify that the conclusions of the HHERA would not change with the use of actual Lake Trout metals data.

2.4.2 Slimy Sculpin Metals Data

Appendix C indicates that summary statistics for metals in Slimy Sculpin were calculated using near-field and mid-field data collected from 2007 to 2019. DDMI recently noted that the 2007 Slimy Sculpin metals dataset is anomalous as the laboratory analysis method differed from other years. This observation would warrant exclusion of the 2007 dataset, though it is noted that the 2007 data are believed to be "biased high" and therefore their inclusion may err on the side of being conservative in the HHERA.

The 2016 data are also considered to be problematic due to inadvertent exclusion of sculpin livers in the analysis of metals in sculpin carcasses; in this case the dataset is expected to be biased on the low side.

Table C-39 presents the Reference Condition concentrations for Slimy Sculpin metals. These values may also be affected by inclusion of these two datasets. Additionally, derivation of Bioaccumulation Factors (BAF) presented in the HHERA may be affected as they reportedly include metals measured in Slimy Sculpin over the period of 2007-2019.

While exclusion of the 2007 and 2016 datasets from the HHERA may have little to no effect on the risk assessment conclusions, it would be prudent to assess whether any conclusions of the RA would change with exclusion of these data.

Recommendation: Verify conclusions of the HHERA would not be affected by removal of the 2007 and 2016 slimy sculpin metals datasets.

2.4.3 Mercury in Lake Trout

It is unclear what data were used for mercury in Lake Trout in the HHERA. Table C-38: Summary Statistics for Small-Bodied and Large-Bodied Fish Tissue Concentrations Used in the ARA, WRA and HHRA for Post-Closure Conditions indicates that the Lake Trout mercury summary statistics were derived from a sample size of 250, however the text (p. 54) indicates that monitoring data from 2008-2018 were used. Based on Lake Trout mercury data provided to NSC by DDMI previously, this sample size appears to be in error and appears to include data prior to 2008 and possibly multiple measurements made on the same fish in 2008 and/or duplicate samples.

Could the specific dataset used for this task be clarified? For the 2008 data for which there are three sets of measurements, which dataset was used?

Recommendation: Verify and clarify what specific mercury in Lake Trout datasets were used to define summary statistics to support the HHERA. Data sets should exclude replicate samples and analyses (e.g., 2008 dataset). Verify that the conclusions of the HHERA would not change with use of a corrected dataset (if applicable).

3.0 REFERENCES

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Golder. 2023. Appendix X-21: Hydrodynamic and Water Quality Modelling of Pit Lakes and Lac de Gras. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, January 2023.

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Golder. 2022d. Appendix X-22: Rationale for Assessed Runoff Mixing Zones During Post-Closure. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, July 2022.

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Golder. 2022f. AEMP Reference Conditions Report Version 2.1. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, December 2022.

Golder. 2022g. Diavik Diamond Mines (2012) Inc. 2017 to 2019 Aquatic Effects Re-Evaluation Report v. 1.0 Addendum. Submitted to Wek'eezhii Land and Water Board, April 2022.

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