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AQUATIC EFFECTS MONITORING PROGRAM DESIGN PLAN VERSION 5.0 – PLAIN LANGUAGE BRIEFING AND TECHNICAL REVIEW COMMENTS

Technical Memorandum # 367-18-02

Prepared for:

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1.0 BACKGROUND AND SCOPE OF WORK

Diavik Diamond Mines (2012) Inc. (DDMI) submitted the Aquatic Effects Monitoring Program (AEMP) Design Plan Version 5.0 ("Design Plan Report"; report dated March, 2018) to the Wek'eezhii Land and Water Board (WLWB) and the report was distributed on May 11, 2018.

North/South Consultants Inc. (NSC) conducted a technical review of the AEMP Design Plan Report Version 5.0 for the Environmental Monitoring Advisory Board (EMAB). As directed by EMAB in their Terms of Reference for the review, the review focused on the following:

- How well the Design Plan Report addresses EMAB recommendations since the previous re-design;
- The proposed gradient design to measure mine-related effects and compatibility with existing data;
- Ability to detect inputs/effects from other sources (i.e., Ekati Mine);
- Location and number of new far-field and mid-field stations;
- Appropriateness of proposed statistical analysis methods;
- Updates to the Biological Action Levels;
- Appropriateness of updates made to the list of variables analyzed;
- Changes to the plankton sampling schedule;
- Data handling and analyses methods; and
- Rationale for all other proposed changes to the AEMP Design Plan.

Section 2 provides a plain language briefing of the key review comments, along with recommendations for consideration by EMAB. Detailed technical review comments and recommendations are provided in Table 1, and in the Excel comments template as required for submission to the WLWB.

2.0 PLAIN LANGUAGE BRIEFING

The AEMP Design Plan Version 5.0 is well written and organized and the submission of a version with revisions identified as track changes was particularly useful for conducting a technical review.

The following sections present a plain language briefing of NSC's comments in relation to the points identified by EMAB for evaluation during the review of AEMP Design Plan Version 5.0 (Section 1.0), and any additional review comments and recommendations borne from this review. The following is organized according to the scope of work identified in Section 1.0.

2.1 INCORPORATION AND CONSIDERATION OF PREVIOUS COMMENTS AND WLWB DIRECTIVES

2.1.1 Addition of Benthic Macroinvertebrates to the Nutrient Enrichment Weight-of-Evidence (WOE) Analysis

Section 14.2.8 (page 611) of the Re-evaluation Report (Golder 2018) indicates: "In their Reasons for Decision, WLWB (2017e; Section 3.12, Part 2e) recommends that benthic macroinvertebrate density be added as a nutrient enrichment exposure endpoint of the fish population health ecosystem component, or that rationale be provided for the omission (Table 1-1). Chlorophyll *a* is currently included as a nutrient enrichment exposure endpoint for the fish population health ecosystem, which is intended to be indicative of food supply. It is assumed that an increase in the biomass of algae as measured by chlorophyll *a* provides an early indication of an enrichment-related increase in zooplankton and/or benthic invertebrate food supply for fish. Adding benthic invertebrate abundance or density would be redundant considering there is already a conservative measurement of enrichment-related food supply in the WOE [weight-of-evidence] analysis. Moreover, the benthic invertebrate community samples are collected from deep-water stations and as such the abundance or density from these samples are not representative of food supply for shallow-water, shoreline-dwelling Slimy Sculpin."

As noted in NSC (2018) comments on the 2014-2016 Re-evaluation Report, because chlorophyll *a* is measured once per year and is inherently more variable in time and space than benthic invertebrate community metrics, the latter would provide a more integrative representation of effects related to nutrient enrichment. In addition, benthic invertebrates are the primary food source for Slimy Sculpin. This comment is re-iterated here for consideration within the design plan.

Recommendation: Incorporate benthic invertebrate density in the WOE, as suggested by the WLWB.

2.1.2 Potential Addition of Dustfall and/or Snow Water Chemistry Sites

As noted in NSC (2018), reiterated here for continuity, the 2014-16 Re-evaluation Report (Section 14.2.1, page 606) provides a response to a WLWB directive: "The WLWB requested a critical review of the present sampling plan for dust, and requested DDMI consider revisions to the existing program based on the findings presented herein. Potential revisions requested by the WLWB (Table 1-1) included the following:

- Consider the implementation of additional dustfall and/or snow water chemistry monitoring sites (W2015L2-0001 update, Commitment A)..."

The response provided indicates: "The current number and location of the dustfall and snow water monitoring locations is sufficient to evaluate both the spatial and the temporal trends of dust deposition (e.g., Figure 3-10 and 3-17); nutrient deposition (Figure 3-11 to 3-14 and 3-18); and metal deposition (Figures 3-15, 3-16 and 3-19) in the vicinity of the Mine. Consequently, no additional monitoring locations are recommended at this time."

There is no rationale provided for why no additional dust monitoring sites will be added. NSC (2017) had noted in the review of the 2016 AEMP Report: "Given the relatively high dust deposition observed at sites south and southeast of the mine, it would be beneficial to add a site between the two monitoring axes (i.e., SSE in the vicinity of the water quality site MF3-3) and a dustfall monitoring station south of site Dust 10 (i.e., at or near one of the snow dust fall sites SS5-4 and SS5-5)."

Recommendation: Provide a discussion and rationale for the proposal to not add dustfall monitoring sites.

2.2 PROPOSED GRADIENT DESIGN

The proposed change in monitoring design (i.e., switch to a gradient design) appears reasonable and appropriate; this change is a response to issues identified over the years of monitoring and the observation of effluent influence extending to far-field areas.

Recommendation: N/A.

2.3 CUMULATIVE EFFECTS

Inclusion of monitoring sites at the inflow and outflow of Lac de Gras allows for an assessment of potential cumulative effects associated with the Ekati and Diavik mines. Monitoring for eutrophication indicators at these sites annually and inclusion of these results in spatial analyses in annual reports will provide for a more comprehensive analysis of upstream and downstream activities that may act cumulatively with effects from the Diavik mine.

Recommendation: N/A.

2.4 CHANGES TO FAR-FIELD STATIONS

The proposed changes to the far-field stations appears appropriate given the change in sampling design (i.e., change to a gradient design). While several stations have been omitted from the program, additional sites were added to fill in spatial gaps along the gradient axes (Section 3.4.1, page 21).

Recommendation: N/A.

2.5 PROPOSED STATISTICAL METHODS

The proposed statistical analyses appear to be appropriate and are described in detail.

Recommendation: N/A.

2.6 UPDATED BIOLOGICAL ACTION LEVELS

The report states that a Lake Trout health study will only be conducted if the small-bodied fish (i.e., Slimy Sculpin) health assessment triggers an Action Level 3 (Section 4.8.1, page 64). This has been changed from an Action Level 2 in the previous Design Plan Version 4.1 (Golder 2016a). The revision has resulted in a much higher threshold to initiate a Lake Trout health assessment. In the control-effect sampling design (Version 4.1), a significant difference in a variable indicative of a toxicological effect at the MF area relative to the FF areas was sufficient to trigger a large-bodied fish survey; under the gradient sampling design (Version 5.0), the threshold for action level 3 is an exceedance of the critical effect size (CES) **and** the normal range **and** the effect is observed in two consecutive sampling periods.

The requirement for exceeding the normal range alone is itself one action level higher than in the previous Version 4.1 AEMP design plan. Under this new action level trigger the small-bodied fish will have exceeded the critical threshold values recommended by the Environment Canada (EC) Metal Mining Environmental Effects Monitoring (EEM) Guidance Document (EC 2012) for 6 years before a large-bodied study is even defined in an AEMP Response Plan. The other major limitation with this plan is that there will be no recent or baseline data with which to compare the Lake Trout health data collected should a study be triggered, limiting the value of such a survey. There is no information provided regarding how Lake Trout health monitoring would be conducted and how the data would be analysed.

Recommendation: Review the Lake Trout health survey trigger and provide a description of a potential study design.

2.7 MODIFICATIONS TO LIST OF VARIABLES AND SAMPLING PROGRAM

2.7.1 Fish Health Endpoints

Table 3.2-1 indicates that catch-per-unit-effort (CPUE) is a measurement endpoint for the "Fish Health and Abundance" assessment. It is unclear how this endpoint factors into the Action Level evaluation as there is no reference condition (i.e., normal range) in either the Reference Condition Report Version 1.2 (Golder 2017) or Appendix 9A of the 2014-2016 Re-evaluation Report (Golder 2018).

Recommendation: Provide additional information on how CPUE/abundance is to be used in the analysis of Slimy Sculpin monitoring results.

2.7.2 Addition of Non-Lethal Fish Survey

The report indicates: “Backpack electrofishing will be used to capture Slimy Sculpin. The first fish sampling done in a given year would be a random field sampling effort at each of the study areas documenting each fish captured, before moving to the targeted lethal program” (Section 4.8.2, page 64).

Additional details regarding the non-lethal survey study design should be provided, including a description of the sampling effort, target number of individuals captured, randomization process, and number of sites.

Recommendation: Provide additional information regarding the details of the non-lethal fish sampling program field methods.

2.8 CHANGES TO THE PLANKTON SAMPLING SCHEDULE

One of the proposed changes to the study design is the change in the sampling frequency for phytoplankton. At the mid-field sites, phytoplankton would be sampled every year, as opposed to every three years. DDMI notes: “This change gives the AEMP the ability to look at potential effects on plankton in the main body of the lake on an annual basis” (page PLS-3).

We agree with this addition but would also suggest expanding the program to include annual sampling for eutrophication variables, including nutrients, chlorophyll *a*, and potentially plankton, at FF sites. As noted in previous review comments (e.g., NSC 2016, 2018), the lack of sampling at FF sites 2 out of 3 years has meant that the spatial extent of effects on eutrophication indicators has not been adequately defined in some years. For example, both TN and chlorophyll *a* spatial extent of effects extended to the edge of MF sites in 2014 (Golder 2016b).

The report also indicates: “Sampling for the plankton component of the AEMP will occur at the same locations as the sampling for other AEMP components (see Section 3.4), with the

exceptions of LDG-48 and LDS-4 which will not be sampled for plankton" (Section 4.6.2, page 58).

Since eutrophication indicators will be sampled annually at this site as noted on page 56, collection of phytoplankton samples at this site annually would be consistent with the eutrophication monitoring component of the AEMP. It is further suggested that samples could be collected and archived pending review of results from other sampling sites (i.e., NF and MF sites).

Recommendation 1: Consider increasing the frequency of FF sampling for eutrophication metrics to annual sampling and/or provide a rationale for what actions would be taken in the event that the spatial extent of effects on eutrophication metrics extended up to the MF sites in years when FF sampling is not conducted.

Recommendation 2: Collect phytoplankton samples at LDG-48 annually (samples could be archived).

2.9 DATA HANDLING AND ANALYSIS METHODS

2.9.1 Inclusion of Results from the Inflow and Outflow in Spatial Analyses of Effects

The report indicates that: "During interim years, station LDG-48, located at the outlet of Lac de Gras into the Coppermine River, and LDS-4, located in the narrows between Lac du Sauvage and Lac de Gras, will also be included in the spatial analysis" (Section 4.5.4, page 56).

As noted in Section 2.3, this addition to the program will provide valuable information on the assessment of the spatial extent of effects, notably towards the northwest axis of the lake.

Assuming the intent for defining the spatial extent of effects will include the site at the lake outflow for defining boundaries for eutrophication metrics in the NW direction, a substantive area of the lake will be defined based on the results of a single sample (i.e., LDG-48). Similar to a previous comment, it is suggested that inclusion of additional FF sites in "interim sampling years" would provide valuable information for defining spatial extents of effects for eutrophication indicators.

Recommendation: Could DDMI clarify that spatial extent of effects will include the site at the lake outflow for defining boundaries in the NW direction?

Consider sampling at additional FF sites in interim years for eutrophication metrics to assist with defining spatial extent of effects across the lake.

2.9.2 Analysis of Non-Lethal Fish Survey Data

The methodology for data analysis and statistical analysis presented in Section 4.8.4 does not specify or differentiate what data/endpoints will be calculated/analysed for each of the lethal and non-lethal fish sampling programs. According to the 2014-2016 Re-evaluation Report (Golder 2018), a randomized, non-lethal survey is intended to provide information on sculpin abundance and reproductive success (Section 14.2.2.1, page 607). However the Version 5.0 Design Plan does not include any information on how the two non-lethal metrics recommended in the Re-evaluation Report (i.e., CPUE and length-frequency histograms), are to be calculated and analysed or how they will be incorporated into the response framework (e.g., action level assessment). It is also unclear how the data will be analysed and interpreted due to the lack of reference conditions (i.e., normal ranges) for these endpoints. In addition, CPUE/abundance is not listed as a metric in Section 4.8.4 (page 68).

Recommendation: Provide a detailed description of the metrics that will be incorporated into reporting and the methods for analysing these metrics, including action levels where applicable.

2.9.3 Analysis of Fish Health Data: Stage Determination and Normal Ranges

The reference conditions (i.e., normal ranges) for fish health were updated as part of the 2014-2016 Re-evaluation Report (Appendix 9A; Golder 2018) due to a change in methods regarding the determination of stage (adult/age 1+). However, there is no methodology presented in Section 4.8 describing how sculpin will be sub-divided into the adult and “juvenile” categories indicated on page 67 or into the “young/small” categories for the length-frequency histograms described on page 68. It is unclear if the" juvenile" category differs from the Age 1+ category discussed in the 2014-2016 Re-evaluation Report (Golder 2018). If these categories differ, then the normal ranges may need to be updated again to reflect the methodology used to separate adults from juveniles rather than Age1+ as was done in Appendix 9A of the Re-evaluation Report.

Recommendation: Revise text in Section 4.8 to include methodology for stage determination. Review calculation of normal ranges for juvenile/adult categories and revise text as required.

2.9.4 WOE Analysis of Fish Health Data: Inclusion of External Abnormalities

Information on both internal and external abnormalities, including wounds, lacerations, and tumours, is being collected as part of the fish health assessment. However, this information is not incorporated into the WOE evaluation (i.e., as defined in Table 4.10-2, page 74) and parasitism has been deleted from the WOE evaluation. The report indicates (page 72) that the Standard Operating Procedures for the internal and external examinations of sculpin have been followed for all surveys; these data could be used to generate normal ranges and could be analysed for previous years and added to the WOE evaluation (i.e., a replacement for the parasitism metric that was deleted).

Recommendation: Consider adding the results of fish abnormalities to the WOE assessment to strengthen the WOE analysis.

2.9.5 Fish Health Normal Ranges

Section 5.2.4 (pages 89-90, Table 5.2-4) states that the reference conditions for fish health are contained in the Reference Conditions Report Version 1.2 (Golder 2017). However, the normal ranges were recalculated for all of the health variables as part of the 2014-2016 Re-evaluation Report (Appendix 9A; Golder 2018) due to a change in how age/stage was calculated.

Recommendation: Correct citation to reference condition if appropriate and clarify what normal ranges will be used moving forward.

2.10 RATIONALE FOR PROPOSED CHANGES

2.10.1 Fish Endpoints

As discussed in a review of the 2014-2016 Re-evaluation Report (NSC 2018), the removal of the biological variables from the endpoints and lines of evidence (Tables 4.10-1 and 4.10-2) leaves no measure of survival for fish. The rationale provided in Golder (2018) for these deletions is:

"Total length, fresh weight, and/or carcass weight should be added as endpoints to the WOE analysis instead of size at age, which cannot be determined because age data are not available for Slimy Sculpin (due to the difficulties of interpreting ages using otoliths with this species)….Survival, and Reproductive Investment – Age-1+ Abundance should both be removed from the WOE endpoints for fish population health. Neither of these endpoints can be accurately determined due to difficulties in capturing the smallest size classes (e.g., fishing gear bias), and while length-frequency and presence/absence analysis for the smallest size class may be considered as a surrogate for Age-1+ abundance, they should not be included as part of the WOE."

It would be beneficial if the two metrics recommended to be collected as part of the randomized, non-lethal survey identified in the Re-evaluation Report (i.e., abundance and length-frequency histograms; Section 14.2.2.1; Golder 2018) could be added to the WOE; however, it is recognized that this is complicated by the absence of data from previous surveys.

Recommendation: Recommend inclusion of non-lethal fish population endpoints (abundance and length-frequency histograms) in the WOE.

2.11 DETAILED TECHNICAL REVIEW COMMENTS

Detailed technical review comments and recommendations are provided in the following Table 1; these are also provided in the Excel comments template as required for submission to the WLWB.

Table 1. Technical review comments and recommendations on the AEMP Design Plan v. 5.0.

TOPIC	COMMENT	RECOMMENDATION
Study Design, Section 3.2, Assessment and Measurement Endpoints, page 19, Table 3.2-1	Table 3.2-1 (page 19) Valued Ecosystem Components and Measurement Endpoints Associated with the AEMP identifies "Maintenance of fish tissue metal concentrations that do not pose a risk to predatory fish" as an assessment endpoint and "Slimy Sculpin tissue chemistry" as the measurement endpoint. Previous AEMP reports have not included an assessment of potential risks to predatory fish associated with metals in Slimy Sculpin. While it is acknowledged this information may be lacking for a number of metals, some scientific literature is available to assist with assessing potential risks to piscivorous fish for some metals. For example, comparisons could be made to the BCMOE interim dietary guideline for selenium of 4 µg/g DW for aquatic-dependent wildlife and fish (BCMOE 2014a,b, 2018).	The assessment endpoint should either be revised to remove "predatory" or the AEMP assessment framework should be expanded to include an explicit assessment of the risks posed by metals in Slimy Sculpin to predatory fish (e.g., Lake Trout).
Study Design, Section 3.2, Assessment and Measurement Endpoints, page 19, Table 3.2-1	Fish age has been removed from the assessment and measurement endpoints for fish health and there is no longer an indicator of survival identified in Table 3.2-1.	Recommend including a measurement endpoint for survival.
Study Design, Section 3.2, Assessment and Measurement Endpoints, page 19, Table 3.2-1	Table 3.2-1 indicates that catch-per-unit-effort (CPUE) is a measurement endpoint for the "Fish Health and Abundance" assessment. It is unclear how this endpoint factors into the Action Level evaluation as there is no reference condition (i.e., normal range) in either the Reference Condition Report Version 1.2 (Golder 2017) or Appendix 9A of the 2014-2016 Re-evaluation report (Golder 2018).	Provide additional information on how CPUE/abundance is to be used in the analysis of Slimy Sculpin monitoring results.

TOPIC	COMMENT	RECOMMENDATION
Study Design, Section 3.5, Sampling Schedule, page 25 and Response Framework, Section 5.2.4, Biological Components, page 91, Table 5.2-4	The text (page 25) provides an example that states "at Action Level 1, the follow-up action for biological components is confirmation of effect"; however, this does not agree with the revised action levels presented in Table 5.2-4 (page 91), that indicates the action for Action Level 1 is no action, and Action Level 2 is to confirm effects.	Review for conformity
Description of AEMP Components, Section 4.2.2.1, Dust Deposition, Snow Cores, page 34	Section 4.2.2.1 (page 34) identifies the number of duplicate samples to be incorporated into the QA/QC program for dust monitoring. However, there is no description of the numbers and types of blank QA/QC samples for the program.	Include a description of the numbers and types (e.g., field blank, equipment blank) of blank samples included in the dust monitoring program and identify if blank samples will be prepared (where applicable; e.g., preparation of equipment blanks) at sites where duplicate samples are collected.
Description of AEMP Components, Section 4.4.4, Sediment quality, Data Analysis and Interpretation, page 54	Section 4.4.4 (page 54) indicates: "Variables with strong correlations to TOC or percent fines will be normalized to the relevant physical variable before statistical analysis." As noted in comments on the Re-evaluation Report (NSC 2018), it is agreed that normalization of data for confounding variables (fines and TOC) is appropriate and provides a means to evaluate changes in metals and nutrients independent of changes/variability in these supporting variables. However, it would also be of interest to know if absolute concentrations (i.e., raw data) also show trends over time. This would be particularly pertinent if there have been mine-related changes in either supporting variable. For example, if there is a mine-related increase in TOC concentrations, the higher TOC may also result in higher metals and/or nutrients due to the affinity of these substances to organic matter.	Please clarify if trends will also be evaluated on raw data for all of the SOIs. If this is not proposed, please provide a discussion of the rationale for excluding these analyses.

TOPIC	COMMENT	RECOMMENDATION
Description of AEMP Components, Section 4.5.4, Eutrophication Indicators, Data Analysis and Interpretation, page 56	The report indicates that: "During interim years, station LDG-48, located at the outlet of Lac de Gras into the Coppermine River, and LDS-4, located in the narrows between Lac du Sauvage and Lac de Gras, will also be included in the spatial analysis." This addition to the program will provide valuable information on the assessment of the spatial extent of effects, notably towards the northwest axis of the lake. Assuming the intent for defining the spatial extent of effects will include the site at the lake outflow for defining boundaries in the NW direction, a substantive area of the lake will be defined based on the results of a single sample (i.e., LDG-48). Similar to a previous comment, it is suggested that inclusion of additional FF sites in "interim sampling years" would provide valuable information for defining spatial extents of effects for eutrophication indicators.	Could DDMI clarify that spatial extent of effects will include the site at the lake outflow for defining boundaries in the NW direction? Consider sampling at additional FF sites in interim years for eutrophication metrics to assist with defining spatial extent of effects across the lake.
Plain Language Summary (page PLS-3) and Description of AEMP Components, Section 4.6.2, Plankton, Field Methods, page 58	One of the proposed changes to the study design is the change in the sampling frequency for phytoplankton. At the mid-field sites, phytoplankton would be sampled every year, as opposed to every three years. DDMI notes: “This change gives the AEMP the ability to look at potential effects on plankton in the main body of the lake on an annual basis" (page PLS-3). We agree with this addition but would also suggest expanding the program to include annual sampling for eutrophication variables, including nutrients, chlorophyll a, and potentially plankton, at FF sites. As noted in previous review comments (e.g., NSC 2016, 2018), the lack of sampling at FF sites 2 out of 3 years has meant that the spatial extent of effects on eutrophication indicators has not been adequately defined in some years. For example, both TN and chlorophyll a spatial extent of effects extended to the edge of MF sites in 2014 (Golder 2016a).	Consider increasing the frequency of FF sampling for eutrophication metrics to annual sampling and/or provide a rationale for what actions would be taken in the event that the spatial extent of effects on eutrophication metrics extended up to the MF sites in years when FF sampling is not conducted.

TOPIC	COMMENT	RECOMMENDATION
Description of AEMP Components, Section 4.6.2, Plankton, Field Methods, page 58	The report indicates: "Sampling for the plankton component of the AEMP will occur at the same locations as the sampling for other AEMP components (see Section 3.4), with the exceptions of LDG-48 and LDS-4 which will not be sampled for plankton." Since eutrophication indicators will be sampled annually at this site as noted on page 56, collection of phytoplankton samples at this site annually would be consistent with the eutrophication monitoring component of the AEMP. It is further suggested that samples could be collected and archived pending review of results from other sampling sites (i.e., NF and MF sites).	Collect phytoplankton samples at LDG-48 annually (samples could be archived).
Description of AEMP Components, Section 4.8.1, Fish Health, Background, page 64	The report states that a Lake Trout health study will only be conducted if the small-bodied fish (i.e., Slimy Sculpin) health assessment triggers an Action Level 3 (Section 4.8.1, page 64). This has been changed from an Action Level 2 in the previous Design Plan Version 4.1 (Golder 2016b). The revision has resulted in a much higher threshold to initiate a Lake Trout health assessment. In the control-effect sampling design (Version 4.1), a significant difference in a variable indicative of a toxicological effect at the MF area relative to the FF areas was sufficient to trigger a large-bodied fish survey; under the gradient sampling design (Version 5.0), the threshold for action level 3 is an exceedance of the critical effect size (CES) and the normal range and the effect is observed in two consecutive sampling periods. The requirement for exceeding the normal range alone is itself one action level higher than in the previous Version 4.1 AEMP design plan. Under this new action level trigger the small-bodied fish will have exceeded the critical threshold values recommended by the Environment Canada (EC) Metal Mining Environmental Effects Monitoring (EEM) Guidance Document (EC 2012) for 6 years before a large-bodied study is even defined in an AEMP Response Plan. The other major limitation with this plan is that there will be no recent or baseline data with which to compare the Lake Trout health data collected should a study be triggered, limiting the value of such a survey. There is no information provided regarding how Lake Trout health monitoring would be conducted and how the data would be analysed.	Review the Lake Trout health survey trigger and provide a description of a conceptual study design.

TOPIC	COMMENT	RECOMMENDATION
Description of AEMP Components, Section 4.8.2, Fish Health, Field Methods, page 64	The report indicates: "Backpack electrofishing will be used to capture Slimy Sculpin. The first fish sampling done in a given year would be a random field sampling effort at each of the study areas documenting each fish captured, before moving to the targeted lethal program." Additional details regarding the non-lethal survey study design should be provided, including a description of the sampling effort, target number of individuals captured, randomization process, and number of sites etc.	Please provide additional information regarding the details of the non-lethal fish sampling program field methods.
Description of AEMP Components, Section 4.9.3, Fish Tissue Chemistry, Laboratory Methods, page 69	Section 4.9.3 (page 69) indicates that "five Slimy Sculpin samples will be randomly selected after the initial analysis and sent to Flett Research Ltd.(Winnipeg, MB) for QC of the mercury results." It may be more meaningful to select five samples across a range of concentrations (obtained from the primary analysis), including minimum and maximum concentrations, rather than choosing five samples randomly. Inter-laboratory comparison results for fish mercury may vary substantively depending on the concentrations encountered.	Consider changing the approach on how to select tissue samples for QC of mercury analysis.
Description of AEMP Components, Section 4.8.4, Fish Health, Data Analysis and Interpretation, page 67-68	The methodology for data analysis and statistical analysis presented in Section 4.8.4 does not specify or differentiate what data/endpoints will be calculated/analysed for each of the lethal and non-lethal fish sampling programs. According to the 2014-2016 Re-evaluation report (Golder 2018), a randomized, non-lethal survey is intended to provide information on sculpin abundance and reproductive success (Section 14.2.2.1, page 607). However the Version 5.0 Design Plan does not include any information on how the two non-lethal metrics recommended in the Re-evaluation report (i.e., CPUE and length-frequency histograms), are to be calculated and analysed or how they will be incorporated into the response framework (e.g., action level assessment). It is also unclear how the data will be analysed and interpreted due to the lack of reference conditions (i.e., normal ranges) for these endpoints. In addition, CPUE/abundance is not listed as a metric in Section 4.8.4 (page 68).	Provide a detailed description of the metrics that will be incorporated into reporting and the methods for analysing these metrics, including action levels where applicable.

TOPIC	COMMENT	RECOMMENDATION
Description of AEMP Components, Section 4.8.4, Fish Health, Data Analysis and Interpretation, page 67-68	The reference conditions (i.e., normal ranges) for fish health were updated as part of the 2014-2016 Re-evaluation report (Appendix 9A; Golder 2018) due to a change in methods regarding the determination of stage (adult/age 1+). However, there is no methodology presented in Section 4.8 describing how sculpin will be sub-divided into the adult and "juvenile" categories indicated on page 67 or into the "young/small" categories for the length-frequency histograms described on page 68. It is unclear if the" juvenile" category differs from the Age 1+ category discussed in the 2014-2016 Re-evaluation report (Golder 2018). If these categories differ, then the normal ranges may need to be updated again to reflect the methodology used to separate adults from juveniles rather than Age1+ as was done in Appendix 9A of the Re-evaluation report.	Revise text in Section 4.8 to include methodology for stage determination. Review calculation of normal ranges for juvenile/adult categories and revise text as required.
Description of AEMP Components, Section 4.10.2., Weight-of-Evidence Framework, pages 72-80	As noted in NSC (2018), some of the weightings were not consistent across time (i.e., 2007, 2013, 2016) within the WOE evaluation presented in Appendix 10A of the 2014-2016 Re-evaluation report (Golder 2018). There is no information provided in the Design Plan Version 5.0 identifying the current weightings or how the rankings will be standardized among the sampling periods if the values have changed as part of the AEMP redesigns. There is also no discussion of whether the calculation of the WOE score is modified to account for endpoints that are missing results in a year (e.g., GSI in 2010).	Provide information on weighting factors and additional information on WOE scoring.

TOPIC	COMMENT	RECOMMENDATION
Weight-of-Evidence, Section 4.10.2.1, Lines of Evidence and Measurement Endpoints, page 73, Table 4.10-1	Section 14.2.8 (page 611) of the Re-evaluation Report (Golder 2018) indicates: "In their Reasons for Decision, WLWB (2017e; Section 3.12, Part 2e) recommends that benthic macroinvertebrate density be added as a nutrient enrichment exposure endpoint of the fish population health ecosystem component, or that rationale be provided for the omission (Table 1-1). Chlorophyll a is currently included as a nutrient enrichment exposure endpoint for the fish population health ecosystem, which is intended to be indicative of food supply. It is assumed that an increase in the biomass of algae as measured by chlorophyll a provides an early indication of an enrichment-related increase in zooplankton and/or benthic invertebrate food supply for fish. Adding benthic invertebrate abundance or density would be redundant considering there is already a conservative measurement of enrichment-related food supply in the WOE analysis. Moreover, the benthic invertebrate community samples are collected from deep-water stations and as such the abundance or density from these samples are not representative of food supply for shallow-water, shoreline-dwelling Slimy Sculpin." As noted in NSC (2018) comments on the Re-evaluation Report, because chlorophyll a is measured once per year and is inherently more variable in time and space than benthic invertebrate community metrics, the latter would provide a more integrative representation of effects related to nutrient enrichment. In addition, benthic invertebrates are the primary food source for Slimy Sculpin. This comment is re-iterated here for consideration within the design plan.	Incorporate benthic invertebrate density in the WOE, as suggested by the WLWB.
Description of AEMP Components, Section 4.10.2.1, Weight-of-Evidence, Lines of Evidence and Measurement Endpoints, page 74, Table 4.10-2	Information on both internal and external abnormalities, including wounds, lacerations, and tumours, is being collected as part of the fish health assessment. However, this information is not incorporated into the WOE evaluation (i.e., as defined in Table 4.10-2, page 74) and parasitism has been deleted from the WOE evaluation. The report indicates (page 72) that the Standard Operating Procedures for the internal and external examinations of sculpin have been followed for all surveys; these data could be used to generate normal ranges and could be analysed for previous years and added to the WOE evaluation (i.e., a replacement for the parasitism metric that was deleted).	Consider adding the results of fish abnormalities to the WOE assessment to strengthen the WOE analysis.

TOPIC	COMMENT	RECOMMENDATION
Description of AEMP Components, Section 4.10.2.1, Weight-of-Evidence, Lines of Evidence and Measurement Endpoints, pages 73-74, Tables 4.10-1 and 4.10-2	The removal of biological variables from the endpoints and lines of evidence (Tables 4.10-1 and 4.10 -2) leaves no measure of survival for fish. The rationale provided in Golder (2018) for these deletions is: "Total length, fresh weight, and/or carcass weight should be added as endpoints to the WOE analysis instead of size at age, which cannot be determined because age data are not available for Slimy Sculpin (due to the difficulties of interpreting ages using otoliths with this species)….Survival, and Reproductive Investment – Age-1+ Abundance should both be removed from the WOE endpoints for fish population health. Neither of these endpoints can be accurately determined due to difficulties in capturing the smallest size classes (e.g., fishing gear bias), and while length-frequency and presence/absence analysis for the smallest size class may be considered as a surrogate for Age-1+ abundance, they should not be included as part of the WOE." It would be beneficial if the two metrics recommended to be collected as part of the randomized, non-lethal survey identified in the Re-evaluation report (i.e., abundance and length-frequency histograms; Section 14.2.2.1; Golder 2018) could be added to the WOE; however, it is recognized that this is complicated by the absence of data from previous surveys.	Consider inclusion of non-lethal fish population endpoints (abundance and length-frequency histograms) in the WOE.
Response Framework, Section 5.2.4, Biological Components, pages 89-90, Table 5.2-4	Section 5.2.4 (pages 89-90, Table 5.2-4) states that the reference conditions for fish health are contained in the Reference Conditions Report Version 1.2 (Golder 2017). However, the normal ranges were recalculated for all of the health variables as part of the 2014-2016 Re-evaluation Report (Appendix 9A; Golder 2018) due to a change in how age/stage was calculated.	Correct citation to reference condition, if appropriate and clarify what normal ranges will be used moving forward.

3.0 SUPPORTING MATERIALS FOR REVIEW

British Columbia Ministry of Environment (BCMOE). 2014a. Ambient Water Quality Guidelines for Selenium: Technical Report Update. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, April 2014.

BCMOE. 2014b. Companion document to: Ambient Water Quality Guidelines for Selenium: Update. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, 2014.

BCMOE. 2018. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Summary Report. Water Protection & Sustainability Branch, March 2018.

Environment Canada. 2012. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. Environment Canada, Ottawa, Ontario.

Golder (Golder Associates Inc.). 2016a. Diavik Diamond Mines Inc. Aquatic Effects Monitoring Program Study Design Version 4.1. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, July 2016.

Golder. 2016b. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program 2014 Annual Report. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2016.

Golder. 2017. AEMP Reference Conditions Report Version 1.2. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, June 2017.

Golder. 2018a. Diavik Diamond Mines (2012) Inc. 2014 to 2016 Aquatic Effects Re-evaluation Report Version 1.0. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2018.

Golder. 2018b. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program Study Design Version 5.0. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2018.

North/South Consultants Inc. (NSC). 2016. Aquatic Effects Monitoring Program Design Plan Version 4.0 – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-16-04.

NSC. 2017. Aquatic Effects Monitoring Program 2016 Annual Report – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-17-01.

NSC. 2018. 2014 to 2016 Aquatic Effects Re-Evaluation Report – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-18-01.